OSCILLOSCOPE TYPE 13A

TECHNICAL HANDBOOK - OPERATOR'S INSTRUCTIONS

CAPABILITIES

1. This instrument is a double-beam oscilloscope designed to display waveforms of frequency 2c/s to 10Mc/s and pulses from 1 microsecond to several milliseconds duration on a linear time scale. The C.R.T. Y-plate deflection sensitivity is 30 volts per centimetre, approximately. Two amplifiers are incorporated and may be used to amplify the Y1 and Y2 inputs independently or may be switched in cascade to the Y1 plate only. Brief data on the gain and bandwidth in the various switch positions is given in Table 1. (For more complete information refer to Tels Y 052 Fig 2.) A Y2 attenuator giving ratios up to 1 to 16 is also fitted. The socket marked 50c/s supplies a waveform nominally 50 volts peak-to-peak for calibration of Y-plate deflection sensitivity.

Amplifier	Gain	Frequency limits at 3db down
A1	27	80c/s to 2Mc/s
A2	27	80c/s to 550kc/s
2A1	750	80c/s to 550kc/s
2A1 HF	60	9c/s to 5.5Mc/s
X1	30	80c/s to 400kc/s

Table 1 - Amplifier performance

PRELIMINARY

Check that the mains input voltage tapping is correctly set before switching on the instrument.

2. Remove the front cover, viewing hood and graticule, stand the instrument face downwards, release the two holding nuts at rear and remove the case. The two mains transformers are at the rear on the lower chassis; the primary tappings must be wired for the appropriate mains voltage according to Fig 2.

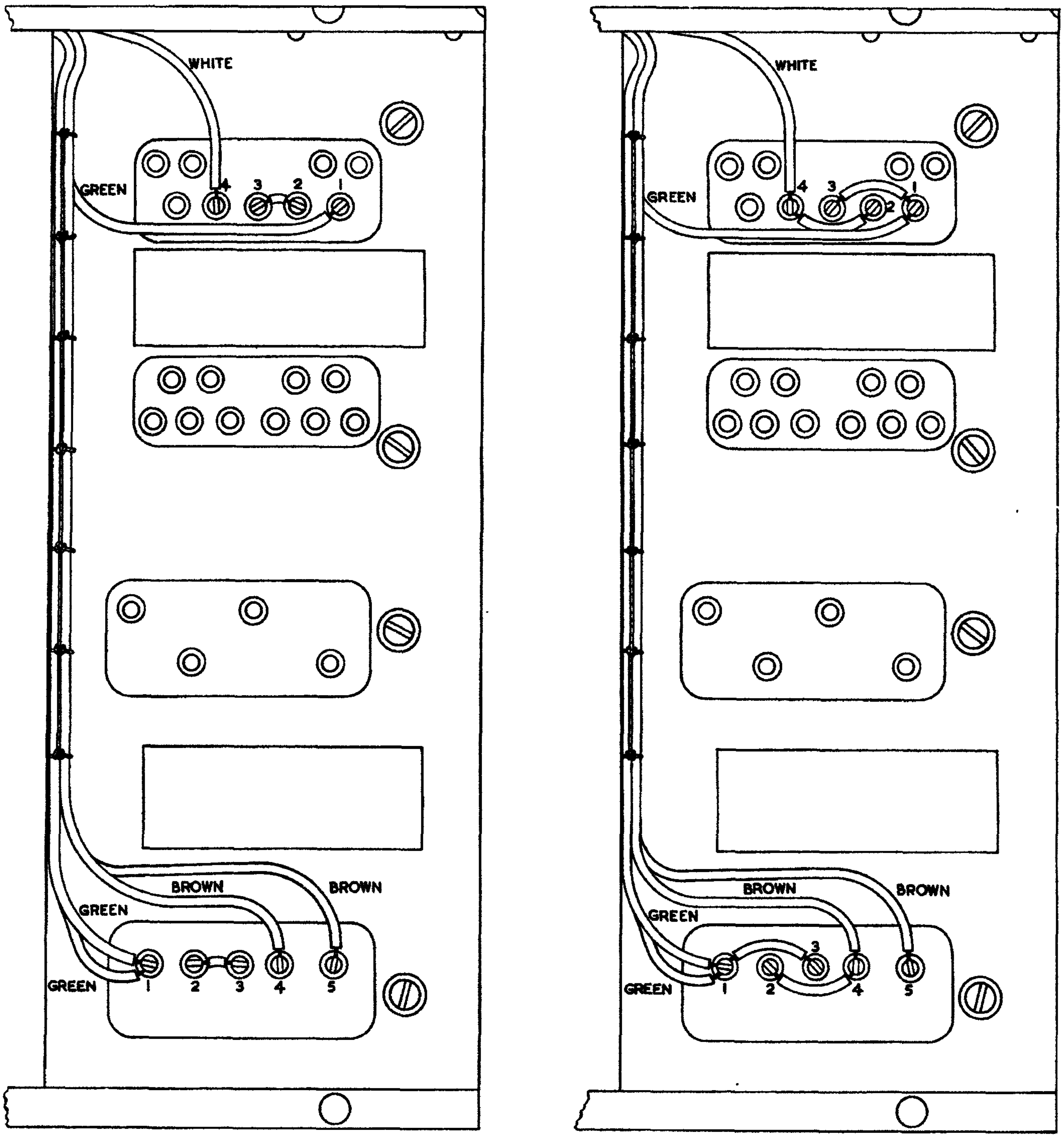
3. Ensure that all valves are firmly in their holders and the retainers and top cap connections are in place. Refit the case before connecting to the mains.

Fuses

4. Check that the fuses on the front panel are intact and of the correct value for the mains voltage setting. For 230 volt connection use 2A fuses and for 115 volt connection use 3A fuses. Spare fuses are stowed below the C.R.T. connecting board and are accessible through the rear door.

Fit a suitable three-pin plug to the mains connector. The mains lead core is colour coded:-

Red - phase
Blue - neutral
Green - earth



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CONNECTION FOR 230V OPERATION

CONNECTION FOR 115V OPERATION

Fig 2 - Mains transformer connections

Switching on

5. Connect to the mains and set POWER switch to L.T. Allow one minute for valve and C.R.T. heaters to reach working temperature. Switch POWER switch to H.T.

6. If the instrument has not been in use for a considerable time, at least 30 minutes at L.T. must be allowed for the instrument to dry out before switching to H.T.

Earthing connections

7. The oscilloscope EARTH terminal and socket are internally connected to its chassis and case. The chassis is also connected to earth via the third pin of the mains plug.

8. If the oscilloscope earth terminal is connected to the chassis of the instrument under test, all input voltages will be referred to oscilloscope chassis earth. Where the waveform to be displayed must be measured relative to a potential other than earth it is necessary to employ a blocking capacitor in the earth connecting lead or an isolating transformer.

CONTROLS

(Figs 1, 101 - Tables 2, 3, 4)

9. All the controls are on the front panel of the instrument (Fig 1) and are listed in Table 2. The block diagram (Fig 101) shows diagrammatically the time-base and input circuit switching and should be studied in conjunction with Tables 3 and 4.

Table 2 - Controls

Control	Description	Function
AMPLITUDE	Potentiometer	Controls the length of the time-base trace
TRIG SYNC	6-position switch	Selects the source of the time-base synchronising voltage
SYNC AMP	Potentiometer	Controls the amplitude of the synchronising signal fed to the time-base circuits
CAL MARKERS	3-position switch	Connects (a) Position 2, 1 μsecond and (b) Position 3, 10 μsecond marker pips which are displayed on both traces
POWER	3-position switch	Switches on mains to (a) Position 2, L.T. transformer (b) Position 3, H.T. transformer

Table 2 (contd)

Control	Description	Function
BRILLIANCE	Potentiometer	Controls the brightness of the traces on the C.R.T.
FOCUS	Potentiometer	Controls the focus of the traces
X SHIFT	Potentiometer	Controls horizontal position of both C.R.T. traces
Y1 SHIFT	-	Controls the vertical position of the Y1 trace
Y2 SHIFT	-	Controls the vertical position of the Y2 trace
Y PLATE SELECTOR	5-position switch	Determines the type of connection made from the front panel sockets to the Y-plates. See Table 3
A1 GAIN A2 GAIN	Potentiometer -	Controls the gain of the A1 amplifier Controls the gain of the A2 amplifier
Y2 ATTEN	5-position switch	Controls the attenuation of the signal to the Y2 plate only
PROBE SELECTOR	6-position switch	Connects the probe socket to the plates. See Table 4
VELOCITY RANGE	7-position switch	(a) Determines whether the internal or an external time-base is in use. (b) Gives a coarse control of internal time-base speed
FINE VELOCITY	Potentiometer	Gives a fine control of internal time-base speed
FLY BACK	Potentiometer	Gives an extra fine control of internal time-base speed

Y-Plate deflection controls

Check that the Y2 ATTEN control is in the '÷ 1' position.

10. Set the Y PLATE SELECTOR switch to the positions shewn in column 1 of Table 3 for use with the front panel sockets shown in column 4. The amplitude of the trace displayed is then controlled as indicated in column 6. Set AMPLITUDE control fully clockwise.

(1)	(2)	(3)	(4)	(5)	(6)
		Connections made			
Y-plate selector switch setting	SYNC selector setting	To deflector plate	From front panel socket	Via	Controlled by
D.C.	Y1	Y1	Y1	Direct	-
	Y2	Y2	Y2	Direct	Y2 ATTEN
A.C.	Y1	Y1	Y1	Blocking capacitor 500V d.c. Wkg	-
	Y2	Y2	Y2	Blocking capacitor 500V d.c. Wkg	Y2 ATTEN
A1 A2	Y1	Y1	A1	A1 amplifier	A1 GAIN
	Y2	Y2	A2	A2 amplifier	A2 GAIN
A1	Y1	Y1	A1	A1 and A2 amplifiers in cascade	A1 GAIN and A2 GAIN
	Y2	Y2	Y2	Blocking capacitor	Y2 ATTEN
A1 HF	Y1	Y1	A1	A1 and A2 amplifiers in cascade with improved H.F. response	A1 GAIN
	Y2	Y2	Y2	Blocking capacitor	Y2 ATTEN

Table 3 - Y plate selector switch settings

11. The Y2 ATTENUATOR switch may be used to reduce the amplitude of signals fed direct or via a blocking capacitor to the Y2 plates. This is not a precision attenuator and must not be used for measuring purposes; it also introduces distortion at the higher audio and video frequencies. For a complete specification of the Y2 attenuator characteristics refer to Tels Y 054 paras 16 to 20.

12. The shift networks are connected in all positions of the Y PLATE SELECTOR but their impedance is high. When, therefore, the D.C. position is in use the Y-SHIFT controls will be inoperative unless the external source of work voltage also has a high impedance.

13. When one trace only is required the other may be moved off the screen by use of the appropriate shift control. To avoid defocussing of the wanted trace, the Y2 trace should be moved upward or the Y1 trace downward.

THE CATHODE FOLLOWER PROBE

14. The probe has a high input impedance and should be used where it is necessary to minimize the effect on the circuit being tested of connecting the oscilloscope. The nominal input resistance is over 5MΩ with a shunt capacitance less than 5pF. The probe connector plugs into the PROBE socket on the front panel. Distortion of wave traces may result from using switch settings other than those listed in Table 4.

PROBE SELECTOR setting	Y-plate selector switch setting	Probe output connected to	Controlled by	Remarks
Y1 Y2 level	As required (See remarks column)	Beam splitter plate	-	Produces equal and opposite deflection of both beams. Other signals may be superimposed by connecting according to Table 3. External sync connection required
Y1	D.C. or A.C.	Y1 plate	-	A d.c. blocking capacitor may be inserted, if re-required between probe tip and circuit under test. Set sync selector to Y1
Y2	D.C. or A.C.	Y2 plate	Y2 ATTEN	A d.c. blocking capacitor may be inserted, if required between probe tip and circuit under test. Set sync selector to Y2
A1	A1 A2	Y1	A1 GAIN	Set Y PLATE SELECTOR for required amplification
	2 A1	Y1	A1 GAIN and A2 GAIN	
	2 A1 H.F.	Y1	A1 GAIN	Set SYNC SELECTOR to Y1
A2	A1 A2	Y2	A2 GAIN	Set SYNC SELECTOR to Y2

Table 4 - Probe selector switch settings

FUNCTION OF X DEFLECTION AND TIME-BASE CONTROLS

15. These controls are down the left of the front panel with the exception of the X-SHIFT. Since they are applied simultaneously to both beams, they always bear the

correct time relation to each other. The horizontal sweep may be produced by:-

(a) An external signal direct, or amplified approximately 30 times

(b) A linear time-base synchronised with the input waveform

(c) A single stroke linear time-base triggered by the input signal

EXTERNAL SWEEP

16. To apply an external sweep, connect the input to the X1 socket on the front panel and set the VELOCITY RANGE switch to X TIMES 1 or X TIMES 30 according to the gain required to produce adequate horizontal deflection.

LINEAR TIME-BASE

17. The linear time-base controls are marked VELOCITY RANGE, FINE VELOCITY, AMPLITUDE and FLYBACK. The last named control affects the time of the flyback and is used as an extra fine control of the repetition frequency.

18. The SYNC AMP control adjusts the amplitude of the synchronising signals selected by the TRIG SYNC switch. At Y2, Y1 and 50c/s the sync signal is derived internally, whilst at EXT a synchronising signal must be fed into the SYNC socket. To ensure adequate synchronising of the time-base it is essential that the TRIG-SYNC switch is set to pick up the signal from the Y-plate in use, or the SYNC socket as appropriate.

Single-stroke time-base

19. With the TRIG-SYNC switch at +ve or -ve the time-base becomes a single-stroke circuit triggered by a positive or a negative wavefront as required. This facility is intended for the display of short pulses or transients. A signal amplitude of about 30 volts is necessary for triggering and a delay occurs between the trigger pulse and the commencement of the trace. This delay is about 1/4 microsecond for negative triggering and 1 microsecond for positive.

DIRECT CONNECTION TO CATHODE RAY TUBE

NOTE:- Safety precaution. Switch off oscilloscope and wait 10 seconds before touching any connections on rear panel.

20. A door at the rear of the cabinet gives access to the C.R.T. connections. When connecting direct to a deflector plate a d.c. path to chassis earth not greater than 5 megohms must be provided.

21. For brightness modulation the modulating waveform must be connected to the GRID via a blocking capacitor rated at not less than 1200 volts d.c. A 3.3 megohm earth leak resistor (R75) is fitted behind the terminal panel and no additional resistor should be connected.

22. Alternatively brightness modulation may be applied to the cathode via a blocking capacitor rated at not less than 1200 volts d.c. In this case, the cathode circuit must be completed by connecting a 100kΩ resistor between the cathode and negative E.H.T. line. Access to the negative E.H.T. line is most easily obtained

at the BRILLIANCE control (rear of front panel) at the junction of R71 and R74.

CALIBRATION MARKERS

23. To measure the time duration of pulses or other waveforms, turn the CAL MARKERS switch to 1μSEC or 10μSEC when marker pulses of the selected time spacing will be superimposed on existing waveforms. Since the marker pulses are fed on to the splitter plate, between the two Y plates, they appear on both beams and do not interfere with signals connected to the Y-plates.

Note: The next page is Page 1001

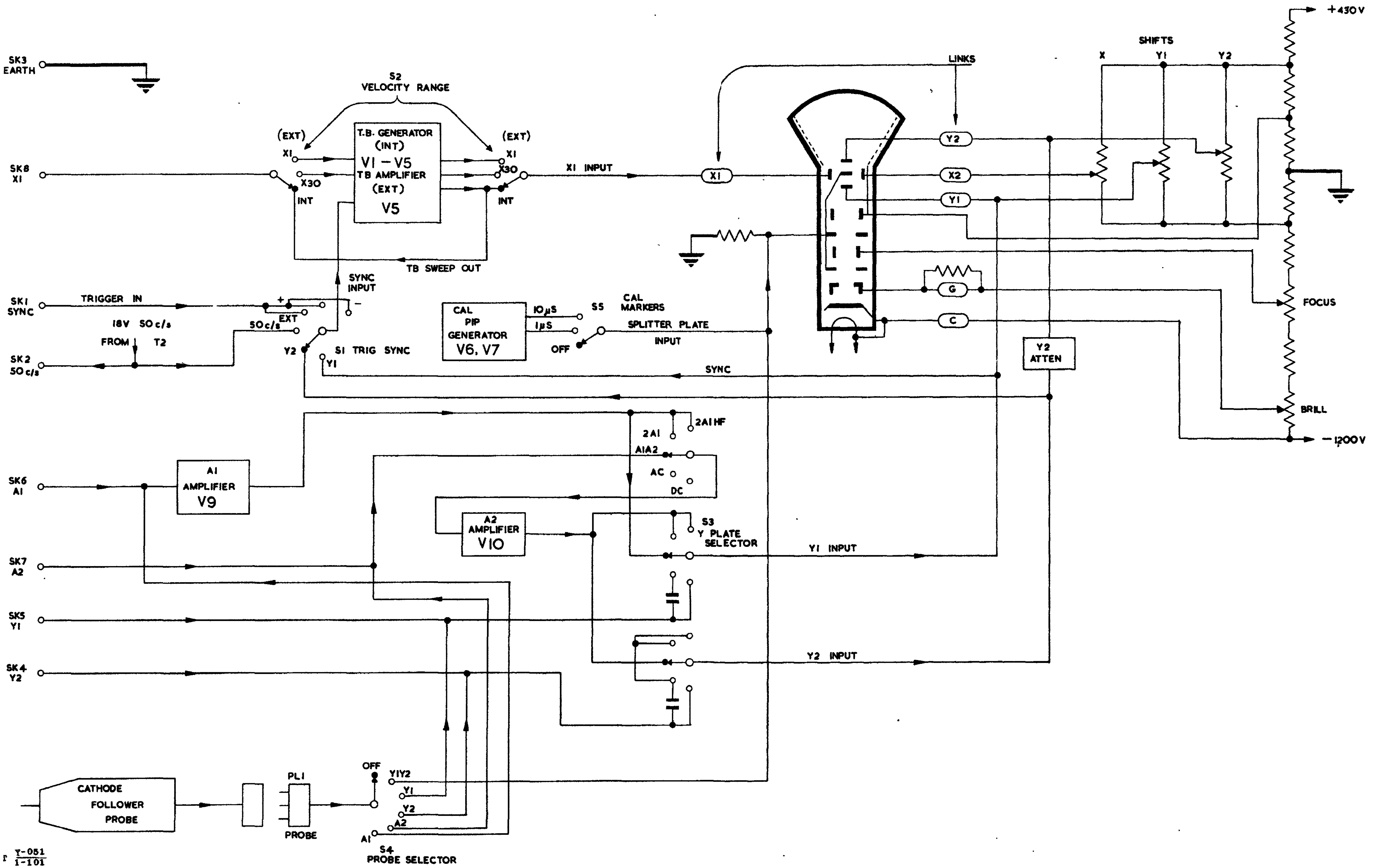

Fig 101 - Block diagram

END

OSCILLOSCOPE, TYPE 13A

TECHNICAL HANDBOOK - TECHNICAL DESCRIPTION

Erratum

Note: This page 0 will be filed immediately in front of page 1, Issue 1, dated 3 Jan 56.

1. The following amendment will be made to the Regulation.

2. Page 1004, Fig 1005, nomenclature of S6,

Reading in a clockwise direction the figures should read:-

÷ 16, ÷ 8, ÷ 4, ÷ 2, ÷ 1. ✓ Burn 3-6-65

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OSCILLOSCOPE, TYPE 13A

TECHNICAL HANDBOOK - TECHNICAL DESCRIPTION

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BRIEF TECHNICAL DESCRIPTION

Introduction

1. The Oscilloscope, type 13A is a portable general purpose double-beam cathode-ray instrument incorporating a linear time-base, deflection amplifiers and attenuator, time marker circuit and built-in power supplies.

The instrument is intended for the visual display of electrical voltage waveforms and of any cyclic function which may be represented by a voltage. It is suitable for use in tropical climates. The oscilloscope is housed in a ventilated sheet steel case. All controls and input sockets are situated on the front panel; a door at the rear of the case gives direct access to the C.R.T. base connections. A removable front cover protects the controls and tube face when not in use; this cover contains stowing clips for all leads and the cathode-follower probe.

Power requirements

2. The instrument is designed to operate from 115V or 230V 50c/s A.C. supply; its power consumption is 160 watts.

Electrical

3. The time-base is linear and when free-running, can operate at recurrence frequencies from 2c/s to 750kc/s; the sweep velocity being sufficiently high to permit investigation of waveforms having recurring frequencies up to 10Mc/s. The time-base may be synchronised with the waveform. Calibration markers at intervals of one or ten microseconds may be superimposed on both traces.

4. The time-base sawtooth waveform is available externally for the operation of a wobbulator or any similar purpose. External deflection may be applied to the X1 plate direct or through the amplifier giving a fixed gain of x30. The time-base will also operate as a single-stroke circuit triggered by either +ve or -ve wavefronts; it is then suitable for monitoring pulses or transient waveforms from one microsecond to several milliseconds duration.

5. The input to the Y deflector plates of the C.R.T. may be direct (d.c. or a.c. connection) or amplified by the separate Y1 and Y2 amplifiers having gains of up to x27, subject to falling-off at the high video frequencies. Typical amplifier characteristic curves are shewn in Fig 2. The amplifiers may also be switched in cascade to the Y1 plate, giving a gain up to x750. For improved response the cascade connected amplifiers are HF compensated in the 2A1 HF position when a gain up to x60 is available; in this condition waveforms containing frequency components up to 10Mc/s may be displayed with fair accuracy.

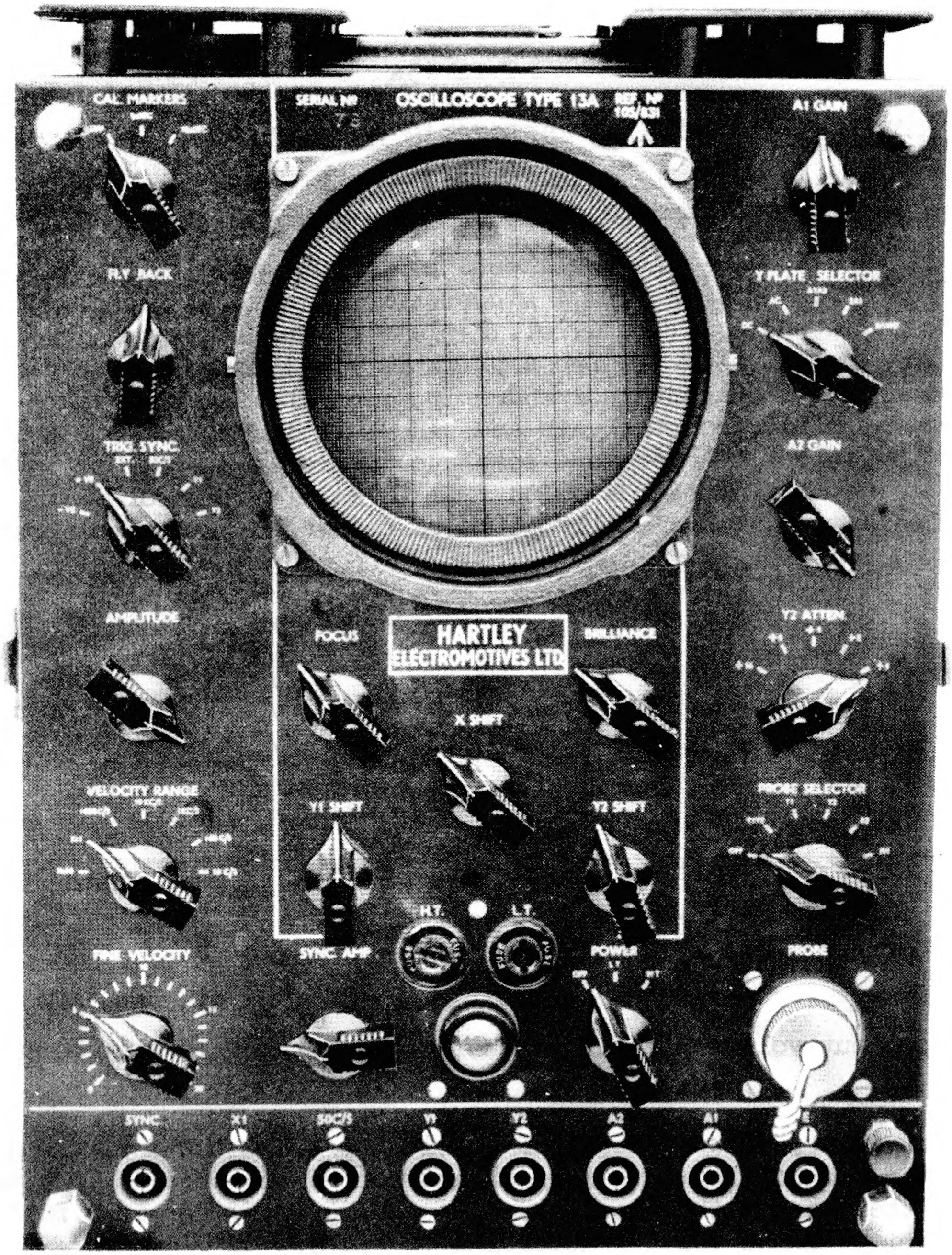

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Fig 1 - Oscilloscope 13A - Front Panel

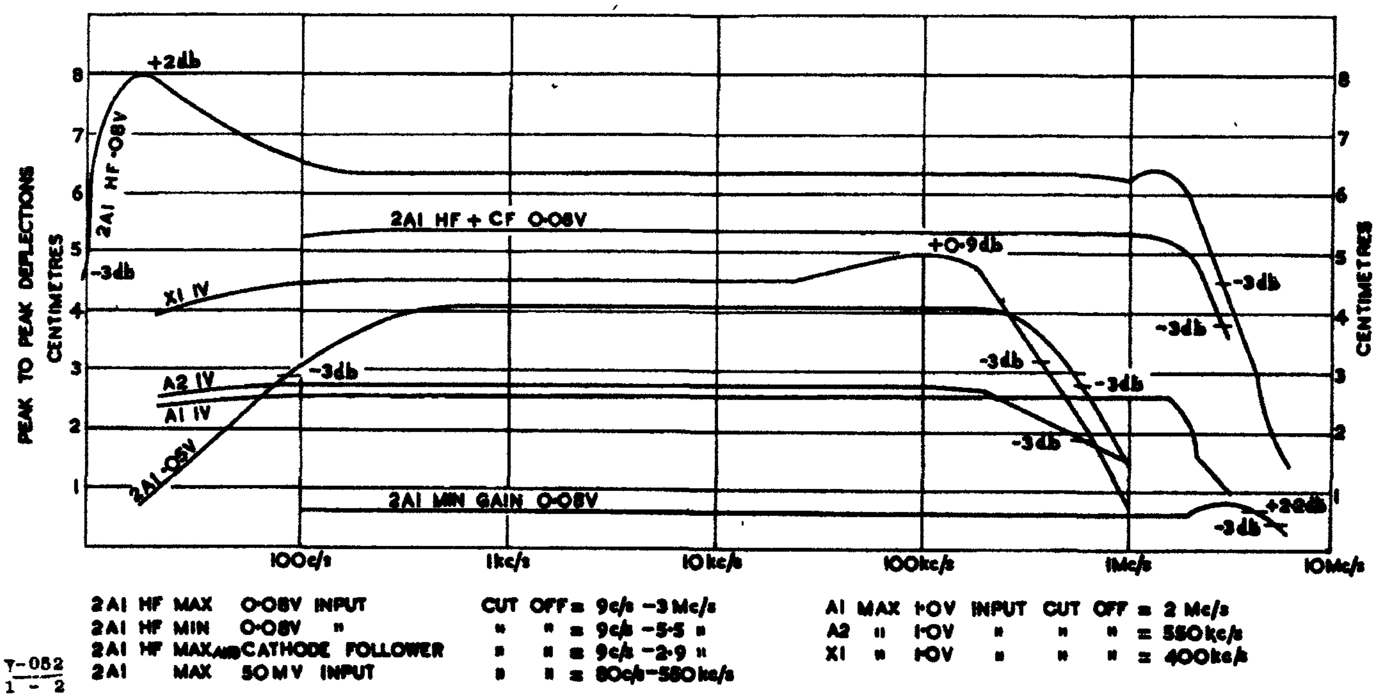

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Fig 2 - Frequency response of Y Amplifiers

6. For investigation of large waveforms a switched attenuator is included in the circuit to the Y2 plate. The attenuator does not have a good H.F. response.

7. A cathode-follower probe having a good H.F. response is provided for making connection to radio-frequency and high impedance circuits.

TECHNICAL DESCRIPTION

Power unit
(Fig 1001)

8. The mains input is to the 3-pole plug at the rear of the oscilloscope. Separate transformers, T1 and T2, are used for H.T. and L.T. supplies. The L.T. transformer may be switched on independently of the H.T., this allows the valve heaters to be switched on for a warming up period before use. T2 also supplies a 50V peak-to-peak 50c/s sine wave for Y calibration. Each transformer is separately protected by cartridge fuses situated on the front panel. Details of the connections to be altered when changing from 230V to 115V mains supply are given in Tels Y 051. A red pilot lamp on the front panel indicates that power is applied to T2.

9. The H.T. power pack is of conventional design consisting of the full-wave rectifier valve, V8 (CV378) and the two-stage LC ripple filter. The H.T. voltage

during normal operation is approximately +430V to the amplifier unit; this is reduced to +380V for the time-base by the decoupling resistor, R26. The E.H.T. power pack supplies -1200V to the C.R.T. network from the half-wave rectifier valve, V11 (CV1120) and an RC ripple filter comprising R79, C56, C57.

Cathode Ray Tube Circuit

10. The C.R.T. is operated with its final anode and deflector plates at about earth potential and with a large negative voltage applied to the cathode and grid. This, the normal practice in cathode ray oscilloscopes, simplifies connection to the deflector plates and minimises hand capacity effects on the screen.

11. The appropriate potentials for the tube electrodes are obtained from the resistor chain, R56 to R62, R71 and R77, connected between the +430V and -1200V lines. The mostnegative electrode is the grid, the potential of which is controlled by the BRILLIANCE potentiometer, R77. The FOCUS control, R62, varies the voltage of the second anode. Shift voltages, both positive and negative, are obtained from R73, R69 and R63 for X shift, Y1 shift and Y2 shift respectively.

HORIZONTAL DEFLECTION CIRCUITS
(Figs 3, 4, 5, 1005)

Time-base circuit

12. The time-base circuit employs a Miller stage, V5, triggered by the flip-flop circuit, V3 and V4. The basic circuit of the Miller stage is shewn in Fig 3.

Initially, anode current is cut off by a negative bias on the suppressor grid. The anode is at H.T. potential and the control grid is at cathode potential approximately, since grid current is flowing through Rg. C is therefore charged to full H.T. potential.

13. The suppressor grid bias is lifted to cathode potential, anode current commences to flow and the anode potential falls suddenly. The control grid potential is taken negative with the anode potential, tending to reduce the anode current. The rapid fall in anode potential is arrested by the negative feedback to the control grid. The initial anode voltage drop must be less than the grid base of the valve, since the anode voltage

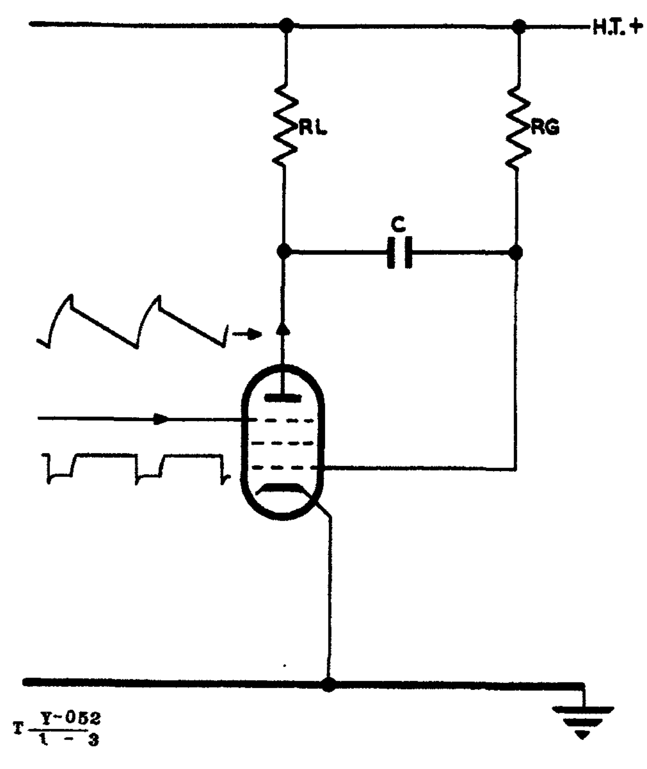

Fig 3 - Basic circuit of Miller time-base valve could not continue to fall if the anode current were cut off. The anode current is now under the control of the grid voltage and any further change in either anode or grid voltage depends on C discharging through R_g. The current through R_g is $\frac{V_{ht} - V_g}{R_g}$ and since V_g is very small compared with V_{ht}, the current is very nearly equal to $\frac{V_{ht}}{R_g}$ and is therefore almost constant. Since the grid potential is negative with respect to the cathode, no grid current can flow and the current flowing through R_g must be that through C. The voltage across C is $V_a - V_g$. If A is the stage gain, $V_c = (1 + A) V_g$ and since the current through C, $\frac{V_{ht}}{R_g}$ is almost constant, C will discharge almost linearly causing the grid potential to rise at a constant rate.

14. The rise of the grid potential is almost linear during the sweep and is accompanied by an amplified negative-going sweep at the anode. The sweep will continue linearly until the anode falls almost to cathode potential, or until the suppressor grid is once again driven negative by external control. The latter method of ending the sweep is employed in the oscilloscope, the negative bias being again applied to the suppressor grid, cutting off anode current. The anode now returns to H.T. potential and C is charged by grid current. The Miller valve is now ready to commence the next sweep.

The 'flip-flop', (multivibrator) V3, V4

15. Referring to the simplified time-base diagram Fig 4, the time-base valve, V5, is connected in the cathode load of V4. During the trace, with SW1d set at free-running, the flip-flop is in the stable condition with V3 conducting and the anode at a low potential. V4 grid is connected to V3 anode and V4 cathode is at H.T. potential at the start of the trace. V4 is thus cut off, until the sweep voltage approaches the grid potential of V4 when the valve starts to conduct and the anode potential falls. The normal flip-flop action takes place and a rapid change-over occurs to the condition where V4 conducts and V3 is cut off. The negative pulse from V4 anode is also applied to V5 suppressor to cut off the time-base valve, which returns rapidly to starting point. The flip-flop re-sets as C7 discharges through R6 and V3 grid potential rises.

Triggered time-base operation
(Figs 4, 1005)

16. With the TRIG SYNC switch in position 1 (-ve) or position 2 (+ve) the circuit is modified for triggered operation by the application of a fixed bias of -20 volts to V3 grid and V5 suppressor. Under these conditions V3 is cut off and V4 conducting. The Miller valve, V5, also conducts moderately but the time-base sweep cannot commence because V4 is effectively short-circuiting V5 anode load, R20. The time-base capacitor is charged nearly to the full H.T. potential and the circuit remains stable in this condition.

17. With the TRIG SYNC switch in the +VE position, a triggering signal applied to the SYNC socket, SK1 is differentiated by C1, R3 (time-constant 4.7μsec) to form steep fronted trigger pulses. The series diode passes only the positive pulses which are applied to V3 grid via SW1c/2 and SW1d/2 momentarily raising the grid potential so that V3 conducts. The flip-flop rapidly changes over to cut off V4 allowing V5 to begin the sweep. The trigger pulse is of short duration

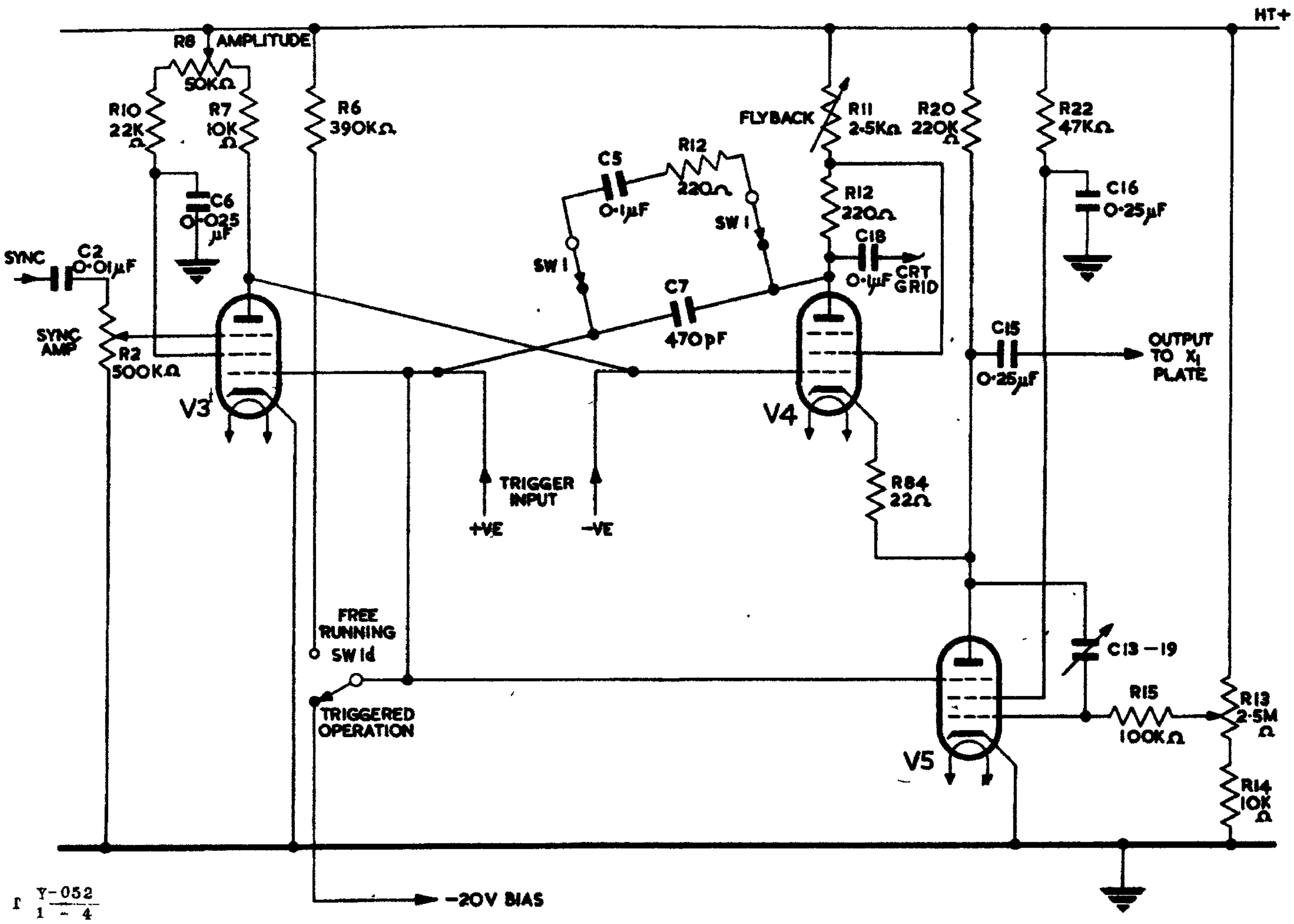

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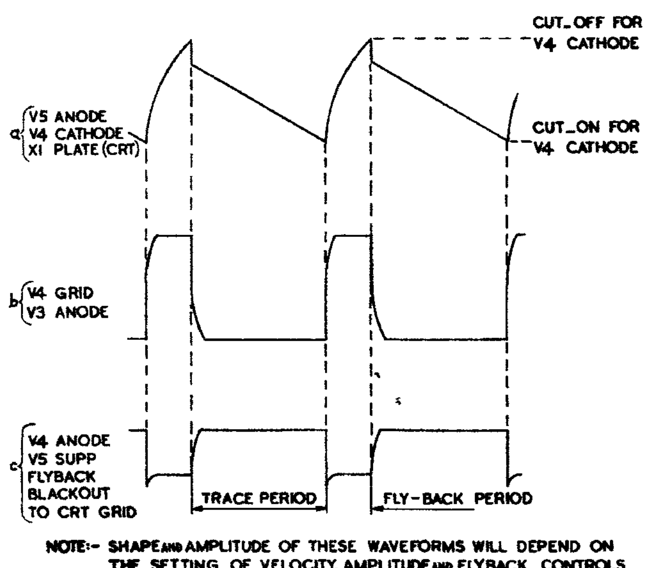
Fig 4 - Time-base circuit, simplified



NOTE:- SHAPE AND AMPLITUDE OF THESE WAVEFORMS WILL DEPEND ON THE SETTING OF VELOCITY, AMPLITUDE AND FLYBACK CONTROLS

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Fig 5 - Time-base waveforms (theoretical) and the sweep can only continue whilst V4 remains cut off; that is whilst V3 conducts. Continuation of the sweep is ensured by switching the circuit C5, R9 across C7 to increase the flip-flop delay time to more than the time of the sweep. V3 then conducts until C5 and C7 discharge. The time-base sweep is terminated when the reduction in V5 anode potential causes V4 to conduct; the flip-flop reverses and the original conditions are restored ready for the next trigger pulse.

18. With the TRIG SYNC switch in the -VE position, negative trigger pulses are passed via V2, SW1b/1 and C3, to the grid of V4 and the flip-flop operates in a similar manner since V4 anode voltage rises causing V3 to conduct as described above.

Sweep velocity control

19. This is effected by changing the time-constant of the Miller valve circuit by SW3 (VELOCITY RANGE) and R13 (FINE VELOCITY).

Control of fly-back time

20. During the fly-back, the time-base capacitor is charged through V4. R11 is made variable to enable the charging time to be altered to provide a very fine control of the repitition rate independently of sweep velocity.

Amplitude control

21. The potential of V4 grid is varied by R8 which controls the point during the sweep at which V4 starts to conduct and thus determines the sweep amplitude.

Fly-back blackout

22. The voltage waveform at V4 anode approximates to a square-wave; this is applied to the grid of the C.R.T. and alternately brightens the trace during the sweep and reduces the brightness during the fly-back.

External time-base operation
(Fig 1005)

23. In positions 3 to 7 of the VELOCITY RANGE switch the internal time-base waveform is available for external use at the X1 socket on the front panel.

24. With the VELOCITY RANGE switch in position 2 the X1 socket is connected via the 0.25µF capacitor C8 to V5 anode and thence to the X1 plate for horizontal deflection by an external waveform. V5 is biassed to cut-off.

25. For amplification of horizontal deflection signals with the VELOCITY RANGE switch in position 1 (X30) V5 is converted into a video amplifier stage with R17 (22kΩ) anode load, R16 (2.2MΩ) grid leak, the cathode bias resistor, R21 (330Ω) by-passed by C14 (0.005µF); the gain is about 30 and is fixed. Signal input is via the X1 socket.

Time calibrating circuit

26. The time marker generator consists of V6 and V7, two double-triode valves. V7A is a Hartley oscillator, the tuned circuit consisting of C19 and either L1 for 100kc/s or L2 for 1Mc/s operation corresponding to marker intervals of 10 micro-seconds and 1 micro-second respectively.

27. During the fly-back period V6B is cut off by a negative voltage from V4 anode so that V6B anode is at H.T. voltage and V6A conducts heavily, the grid being connected to V6B anode. The oscillatory circuit is thus virtually short-circuited by the valve V6A and calibration marks are not generated.

28. When the time-base sweep starts, a positive square-wave is applied to V6B grid; V6B anode voltage falls and V6A is cut off removing the damping from the LC circuit which then oscillates sinusoidally.

29. The resulting sine wave is applied to the grid of the pulse-forming amplifier, V7B, through C23. The grid biasses back, until only the positive peaks of the sine wave cause V7B to conduct, producing short negative pulses at the anode. These pulses are connected via C25 to the C.R.T. beam-splitter plate.

VERTICAL DEFLECTION INPUT CIRCUITS

30. The input circuit of the Y-plates is determined by the Y PLATE SELECTOR switch giving in succession, d.c. connection (direct to Y plates). A.C. connection (via 0.25µF capacitors); A1 A2 (one stage of amplification on each Y-plate input, independently); 2A1 (two stages of amplification in cascade to Y1 plate); and 2A1 HF (two stages in cascade with extra H.F. compensation).

Amplifiers

31. In the A1 A2 position of the Y PLATE SELECTOR switch a single stage of amplification is applied to each Y-plate. V9 is the A1 amplifier and V10 the A2 amplifier; they are conventional RC coupled video amplifiers with 3,000Ω anode loads and H.F. compensation supplied by the inductances L5, L6 and L7. The principal cathode bias resistors of 120Ω are by-passed by 500µF electrolytic capacitors, C36 and C41. The variable resistors, R38 and R48, in the cathode leads are not by-passed and function as gain controls by introducing a variable amount of degeneration.

32. In the 2A1 position V9 and V10 are connected in cascade to the Y1 plate. Both the A1 and A2 GAIN controls are operative in controlling the gain of the combination which may be varied between 8 and 750.

33. The 2A1 H.F. position connects V9 and V10 in cascade to the Y1 plate but introduces circuit changes to improve the high frequency response at the expense of the gain which is reduced to a maximum of 60. These changes are the introduction of negative feedback from V10 anode via R46 and C38 to V9 cathode and the removal of L6 to increase the frequency at which H.F. compensation takes effect. At the same time the A2 gain control is short-circuited. Fig 2 shows the frequency response of the amplifiers in terms of peak-to-peak spot deflection for a given r.m.s. input.

Y2 attenuator

34. In normal use Y2 ATTEN switch S6 is left in position 5, marked ÷ 1.

Large amplitude waveforms may be attenuated by a factor of 2, 4, 8 or 16 selected by SW6 which alters the tapping point on the resistance chain, R64 - 68. At high frequencies the stray capacitance across the resistors would tend to assume control, so the capacitors, C48 - 50, have been included to offset this. The attenuator steps however, are not accurate, especially above 100kc/s.

35. The bottom of the attenuator is returned to the slider of the Y2 shift potentiometer and is decoupled by C51. The setting of the shift potentiometer therefore affects the accuracy of the attenuation steps on d.c. and very low frequencies, especially in the 8 and 16 positions.

Cathode-follower probe

36. The cathode-follower probe supplied as an accessory with the oscilloscope comprises a miniature pentode, V12, (CV 136) arranged in a cathode-follower circuit in a compact assembly at the end of a 3 foot connecting cable. It is used for investigating circuits where operating conditions would be affected if a Y-plate or Y-amplifier and the input leads were directly connected. The input capacitance of the cathode-follower is less than 5pF and the input resistance better than 5MΩ, compared with 80pF and 3.3MΩ for direct Y-plate connection.

37. THE PROBE SELECTOR switch, SW4, switches the input from the cathode-follower probe to either Y-plate or to either amplifier; but in position 2 the input is connected to the C.R.T. splitter-plate to give equal and opposite deflections on both traces.

Note: The next page is page 1001

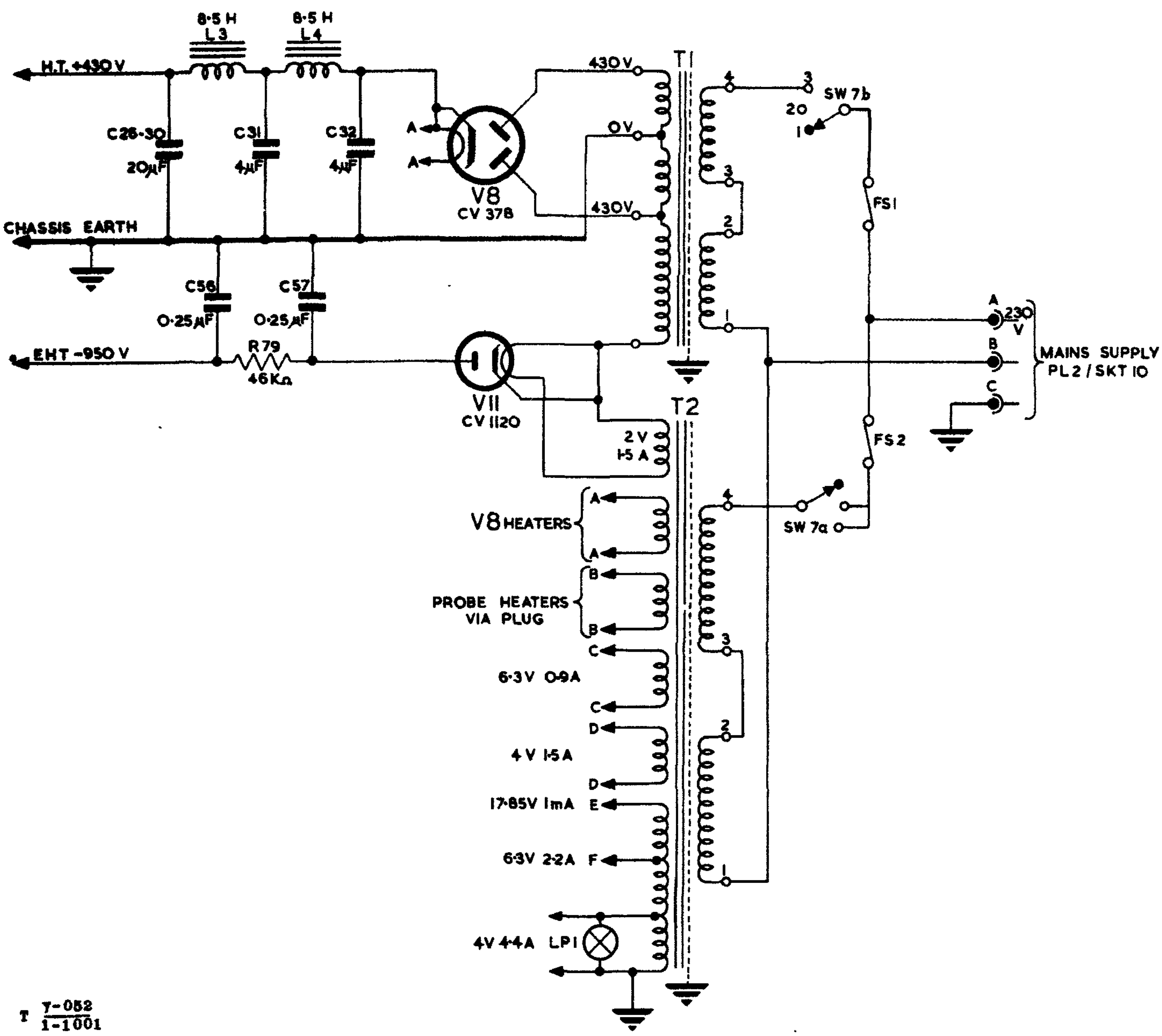

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Fig 1001 - Power supply, circuit diagram

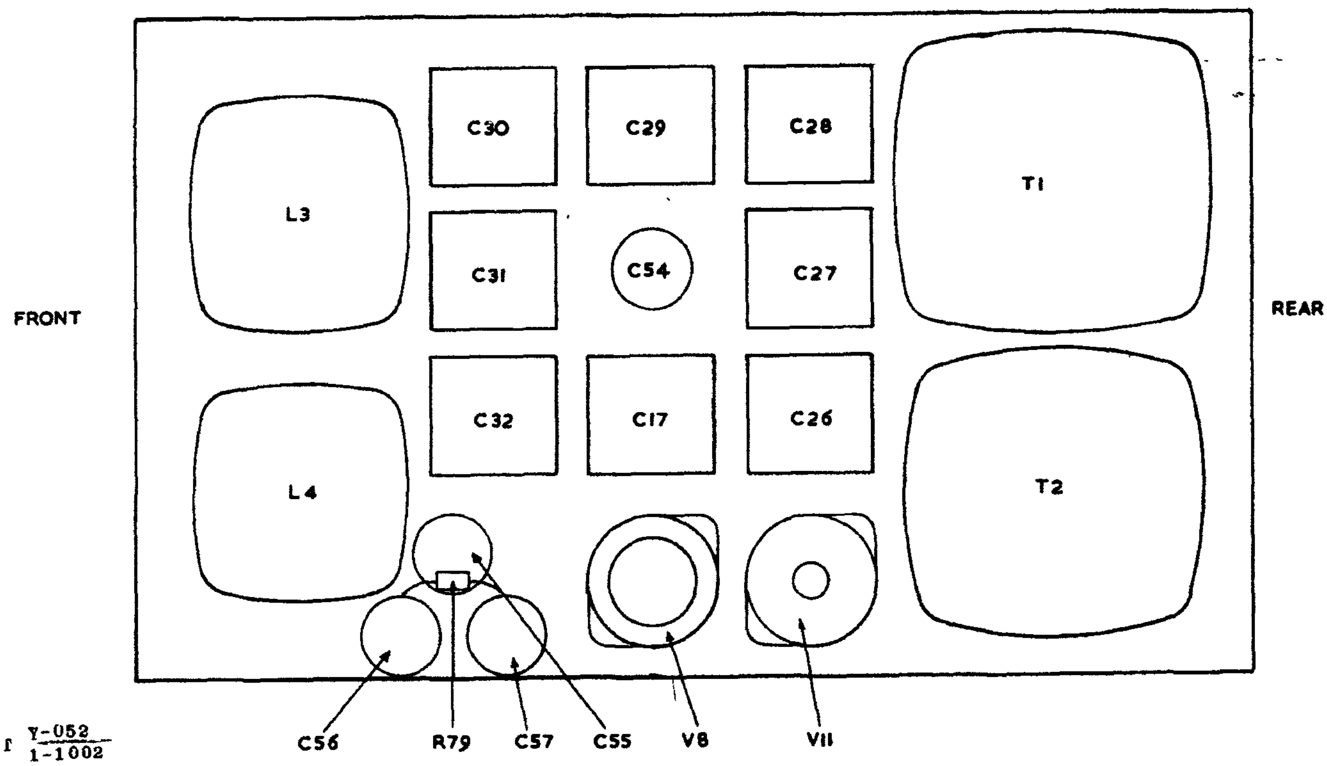


Fig 1002 - Power supply unit, component layout

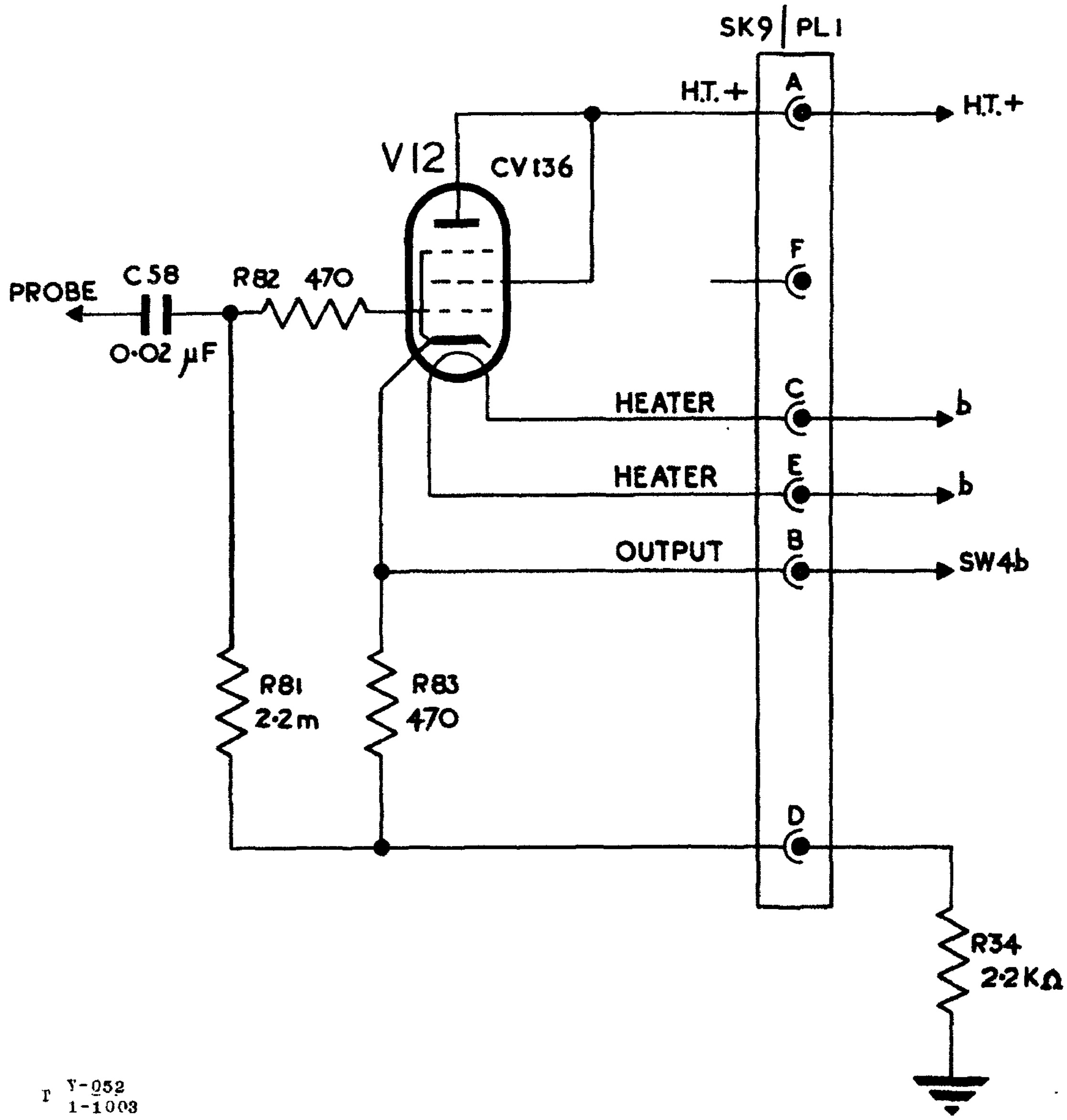


Fig 1003 - Cathode follower probe circuits

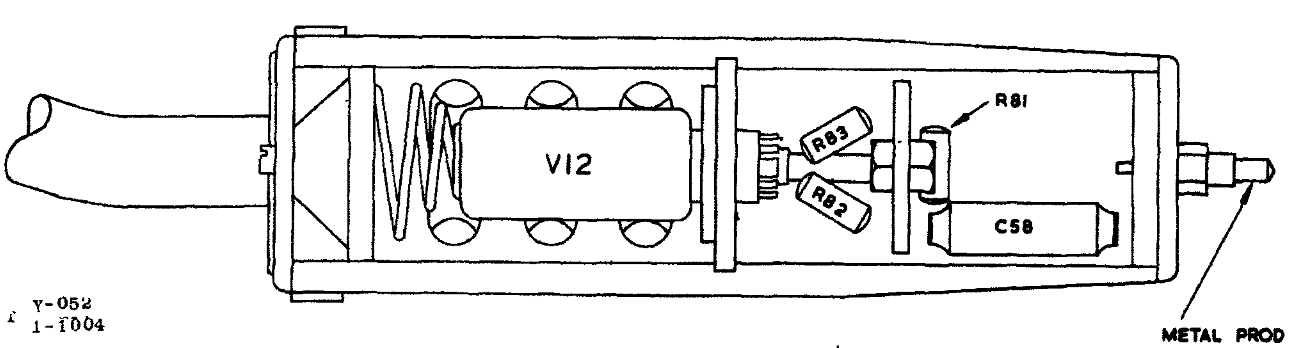


Fig 1004 - Probe assembly, component layout

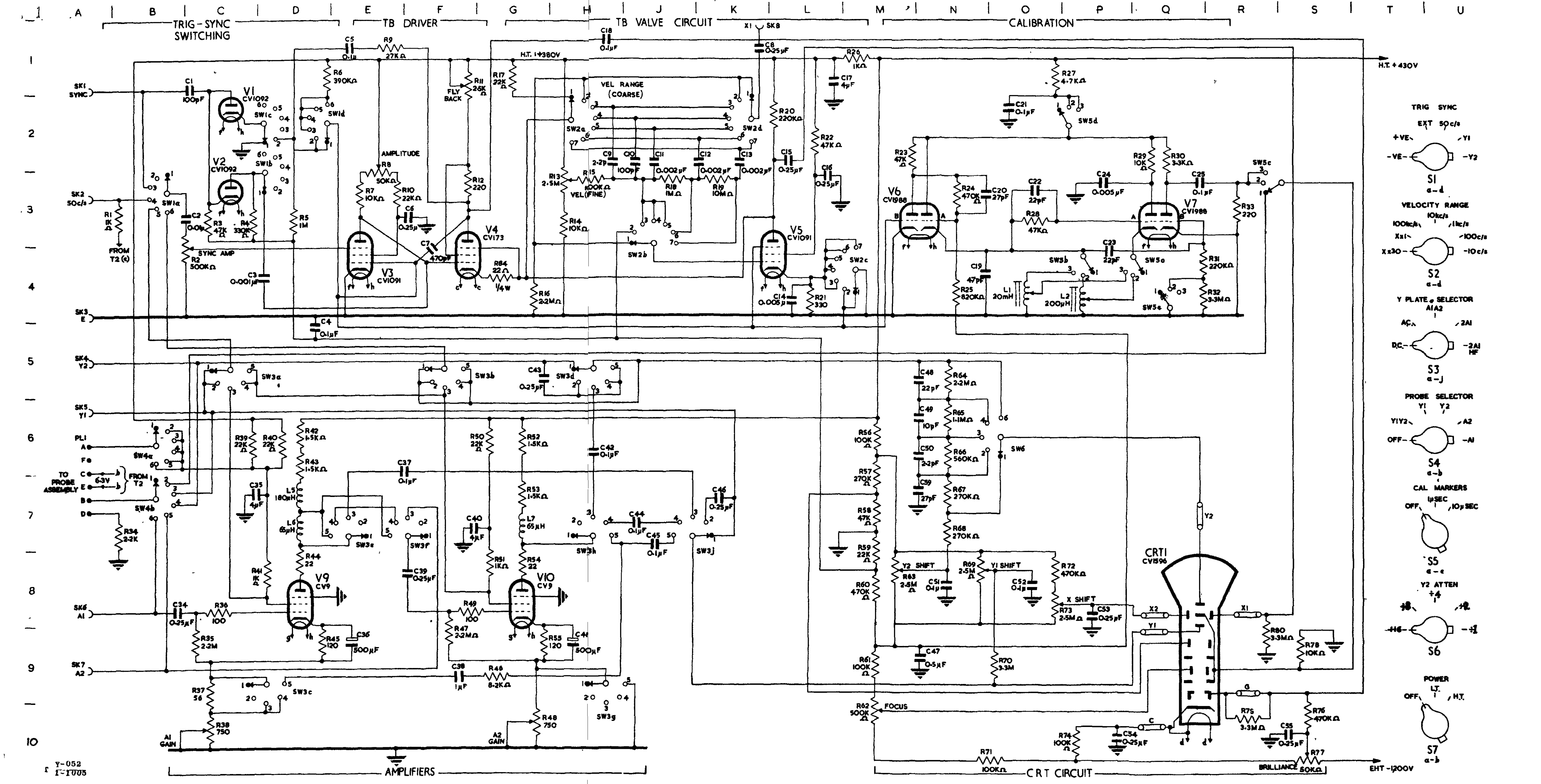


Fig 1005 - Circuit diagram

Circuit Ref	Value	Tolerance and Rating		Type	Location (Fig 1005)	Remarks
				RESISTORS		
R1	1kΩ	±20%	1/4W	composition	B3	
R2	500kΩ	±10%	1.1/2W	variable composition	B4	Sync amp
R3	47kΩ	±20%	1/4W	composition	C3	
R4	330kΩ	±20%	1/4W	composition	C3	
R5	1MΩ	±20%	1/4W	composition	D3	
R6	390kΩ	±10%	3/4W	composition	D1	
R7	10kΩ	±5%	3W	wire-wound	E3	
R8	50kΩ	±10%	3W	variable wire-wound	E2	Amplitude
R9	27kΩ	±10%	1/2W	composition	E1	
R10	22kΩ	±5%	6W	wire-wound	E3	
R11	2.5kΩ	±10%	3/4W	variable composition	F1	Flyback
R12	220Ω	±20%	1/4W	composition	F3	
R13	2.5MΩ	±10%	3/4W	variable composition	H3	Fine velocity
R14	10kΩ	±20%	1/4W	composition	H3	
R15	100kΩ	±20%	1/2W	composition	H3	
R16	2.2MΩ	±20%	1/4W	composition	G4	
R17	22kΩ	±6%	5W	wire-wound	G1	
R18	1MΩ	±20%	1/4W	composition	J3	
R19	10MΩ	±20%	1/4W	composition	K3	
R20	220kΩ	±20%	1/2W	composition	L2	
R21	330Ω	±20%	1/2W	composition	L4	
R22	47kΩ	±5%	5W	wire-wound	L2	
R23	47kΩ	±5%	5W	wire-wound	M2	
R24	70kΩ	±20%	1/4W	composition	N3	
R25	820kΩ	±10%	1/4W	composition	N4	
R26	1kΩ	±5%	3W	wire-wound	M1	
R27	4.7kΩ	±5%	6W	wire-wound	O1	
R28	47kΩ	±20%	1/4W	composition	O3	
R29	10kΩ	±5%	3W	wire-wound	Q2	
R30	3.3kΩ	±20%	1/2W	composition	Q2	
R31	220kΩ	±20%	1/4W	composition	Q4	
R32	3.3MΩ	±20%	1/4W	composition	Q4	
R33	220Ω	±20%	1/4W	composition	R3	
R34	2.2kΩ	±5%	3W	wire-wound	A7	
R35	2.2MΩ	±20%	1/4W	composition	B9	
R36	100Ω	±20%	1/4W	composition	C8	
R37	56Ω	±5%	1/2W	composition	C9	
R38	750Ω	±10%	3W	variable wire-wound	C10	A1 Gain
R39	22kΩ	±5%	6W	wire-wound	C6	
R40	22kΩ	±5%	6W	wire-wound	D6	
R41	1kΩ	±20%	1/4W	composition	D8	
R42	1.5kΩ	±10%	6W	wire-wound	D6	
R43	1.5kΩ	±10%	6W	wire-wound	D6	
R44	22Ω	±20%	1/4W	composition	D8	
R45	120Ω	±10%	1/2W	composition	D9	
R46	8.2kΩ	±5%	3W	wire-wound	G9	
R47	2.2MΩ	±20%	1/4W	composition	F9	

Table 1001 - Components (contd)

Circuit Ref	Value	Tolerance and Rating		Type	Location (Fig 1005)	Remarks
			RESISTORS			
R48	750Ω	±10%	3W	variable wire-wound	G10	A2 Gain
R49	100Ω	±10%	1/2W	composition	F8	
R50	22kΩ	±5%	6W	wire-wound	G6	
R51	1kΩ	±20%	1/4W	composition	G8	
R52	1.5kΩ	±10%	6W	wire-wound	G6	
R53	1.5kΩ	±10%	6W	wire-wound	G7	
R54	22Ω	±20%	1/4W	composition	G8	
R55	120Ω	±10%	1/2W	composition	G9	
R56	100kΩ	±20%	1/2W	composition	M6	
R57	270kΩ	±10%	1/2W	composition	M7	
R58	47kΩ	±20%	1/4W	composition	M7	
R59	22kΩ	±20%	1/4W	composition	M8	
R60	470kΩ	±20%	1/2W	composition	M8	
R61	100kΩ	±20%	1/2W	composition	M9	
R62	500kΩ	±10%	1.1/2W	variable composition	M10	Focus
R63	2.5MΩ	±10%	3/4W	variable composition	M8	Y2 Shift
R64	2.2MΩ	±5%	1/4W	composition	N5	
R65	1.1MΩ	±5%	1/2W	composition	N6	
R66	560kΩ	±5%	1/4W	composition	N6	
R67	270kΩ	±5%	1/2W	composition	N7	
R68	270kΩ	±5%	1/2W	composition	N7	
R69	2.5MΩ	±10%	3/4W	variable composition	N8	Y1 Shift
R70	3.3MΩ	±20%	1/4W	composition	O9	
R71	100kΩ	±20%	1/4W	composition	O10	
R72	470kΩ	±20%	1/4W	composition	P8	
R73	2.5MΩ	±10%	3/4W	variable composition	P8	X Shift
R74	100kΩ	±20%	1/4W	composition	P10	
R75	3.3MΩ	±20%	1/4W	composition	R10	
R76	470kΩ	±20%	1/4W	composition	S10	
R77	50kΩ	±10%	1.1/2W	variable composition	S10	Brilliance
R78	10kΩ	±20%	1/4W	composition	S9	
R79	47kΩ	±20%	1/4W	composition	Fig 1001	
R80	3.3MΩ	±20%	1/4W	composition	R9	
R81	2.2MΩ	±20%	1/4W	composition	Fig 1003	
R82	470Ω	±10%	1/2W	composition	Fig 1003	
R83	470Ω	±10%	1/2W	composition	Fig 1003	
R84	22Ω	±10%	1/2W	composition	G4	

Table 1001 - Components (contd)

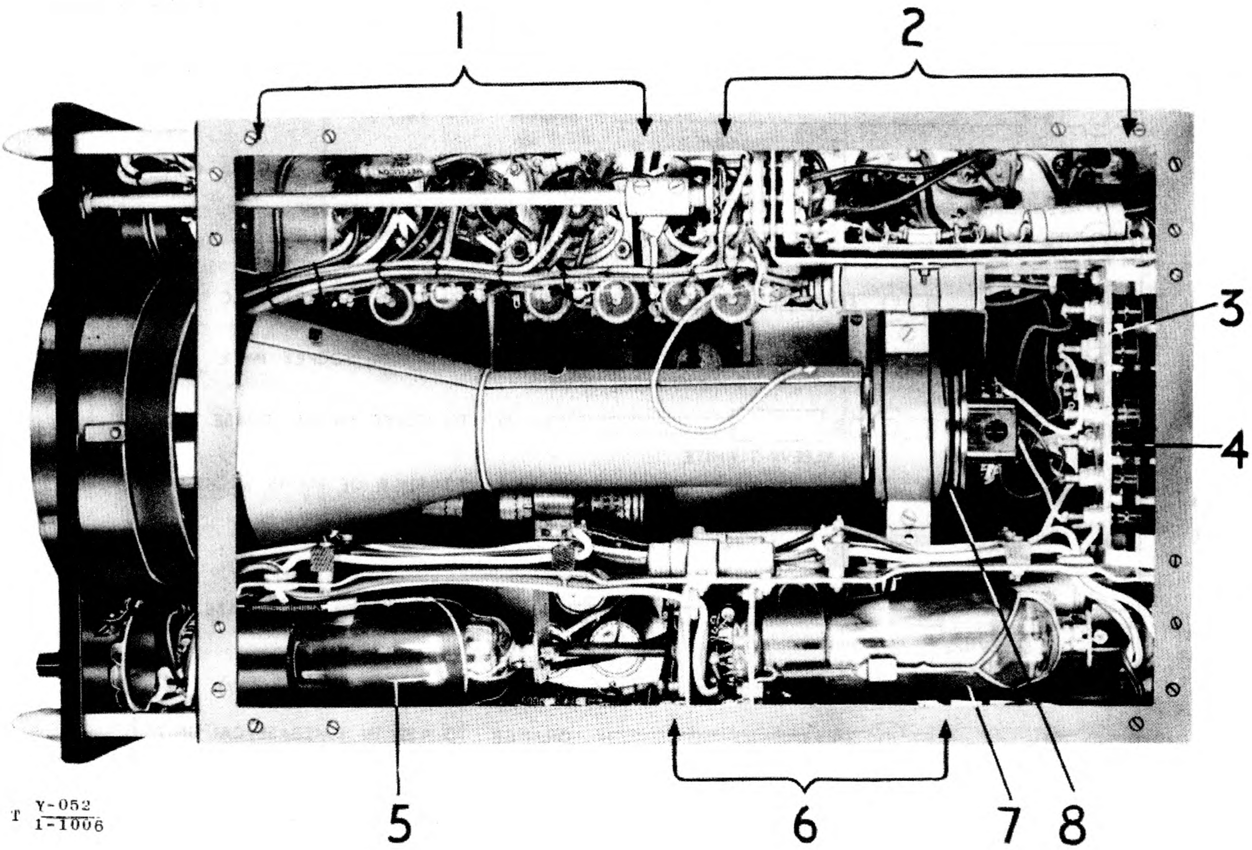
Circuit Ref	Value	Tolerance and Rating		Type	Location (Fig 1005)
CAPACITORS					
C1	100pF	±10%	500V d.c.	ceramic	C1
C2	0.01µF	±20%	1000V d.c.	paper	C3
C3	0.001µF	±20%	1000V d.c.	paper	D4
C4	0.1µF	±20%	500V d.c.	paper	D5
C5	0.1µF	±20%	500V d.c.	paper	E1
C6	0.25µF	±20%	500V d.c.	paper, tubular, wire ends	F3
C7	470pF	±10%	500V d.c.	ceramic	F4
C8	0.25µF	±20%	500V d.c.	paper, tubular, wire ends	K1
C9	2.2pF	±25%	500V d.c.	ceramic	H3
C10	100pF	±10%	500V d.c.	ceramic	J3
C11	0.002µF	±20%	1000V d.c.	paper	J3
C12	0.002µF	±20%	1000V d.c.	paper	K3
C13	0.002µF	±20%	1000V d.c.	paper	K3
C14	0.005µF	±20%	1000V d.c.	paper, tubular, wire ends	L4
C15	0.25µF	±20%	350V d.c.	paper, tubular	L3
C16	0.25µF	±20%	500V d.c.	paper, tubular, wire ends	L3
C17	4µF	±20%	600V d.c.	paper, block, type 4501	L1
C18	0.1µF	±20%	1500V d.c.	paper, block	M1
C19	47pF	±5%	500V d.c.	ceramic	N4
C20	27pF	±10%	500V d.c.	ceramic	N3
C21	0.1µF	±20%	500V d.c.	paper	O2
C22	22pF	±10%	500V d.c.	ceramic	O3
C23	22pF	±10%	500V d.c.	ceramic	P4
C24	0.005µF	±20%	1000V d.c.	paper, tubular, wire ends	P3
C25	0.1µF	±20%	500V d.c.	paper	Q3
C26	4µF	±20%	600V d.c.	paper, block, type 4501	Fig 1001
C27	4µF	±20%	600V d.c.	paper, block, type 4501	Fig 1001
C28	4µF	±20%	600V d.c.	paper, block, type 4501	Fig 1001
C29	4µF	±20%	600V d.c.	paper, block, type 4501	Fig 1001
C30	4µF	±20%	600V d.c.	paper, block, type 4501	Fig 1001
C31	4µF	±20%	600V d.c.	paper, block, type 4501	Fig 1001
C32	4µF	±20%	600V d.c.	paper, block, type 4501	Fig 1001
C33	-	-	-	-	-
C34	0.25µF	±20%	500V d.c.	paper, tubular, wire ends	B8
C35	4µF	±20%	600V d.c.	paper, block, type 4501	C7
C36	500µF	+50% -20%	12V d.c.	electrolytic, metal cased, tubular	E9
C37	0.1µF	±20%	500V d.c.	paper	E7
C38	1µF	±20%	600V d.c.	paper, block	F9
C39	0.25µF	±20%	350V d.c.	paper, tubular	F8
C40	4µF	±20%	600V d.c.	paper, block	G7
C41	500µF	+50% -20%	12V d.c.	electrolytic, metal cased, tubular	H9
C42	0.1µF	±20%	500V d.c.	paper	H6
C43	0.25µF	±20%	500V d.c.	paper, tubular, wire ends	G5

Table 1001 - Components (contd)

Circuit Ref	Value	Tolerance and Rating	Type	Location (Fig 1005)
		CAPACITORS		
C44	0.1µF	±20% 500V d.c.	paper	J7
C45	0.1µF	±20% 500V d.c.	paper	J7
C46	0.25µF	±20% 500V d.c.	paper, tubular, wire ends	K7
C47	.5µF	±20% 350V d.c.	paper	N9
C48	22pF	±10% 500V d.c.	ceramic	N5
C49	10pF	±10% 500V d.c.	ceramic, tubular, insulated	N6
C50	2.2pF	±25% 500V d.c.	ceramic	N6
C51	0.1µF	±20% 500V d.c.	paper	N8
C52	0.1µF	±20% 500V d.c.	paper	O8
C53	0.25µF	±20% 500V d.c.	paper	P8
C54	0.25µF	±20% 1500V d.c.	paper, tubular, impregnated	Q10
C55	0.25µF	±20% 1500V d.c.	paper, tubular, impregnated	S10
C56	0.25µF	±20% 1500V d.c.	paper, tubular, impregnated	Fig 1001
C57	0.25µF	±20% 1500V d.c.	paper, tubular, impregnated	Fig 1001
C58	0.02µF	±25% 350V d.c.	paper, tubular, type 5190	Fig 1003
C59	27pF	±10% 500V d.c.	ceramic	N7
		INDUCTORS		
L1	20mH		oscillator inductor	O4
L2	200µH		oscillator, inductor	P4
L3	8.5H		smoothing choke	Fig 1001
L4	8.5H		smoothing choke	Fig 1001
L5	180µH		R.F. inductor	D7
L6	65µH		R.F. inductor	D7
L7	65µH		R.F. inductor	G7
		SWITCHES		
SW1a			Trig-sync	B3
b			Trig-sync	D3
c			Trig-sync	D2
d			Trig-sync	D2
SW2a			Velocity range	H2
b			Velocity range	J4
c			Velocity range	M4
d			Velocity range	K2
SW3a			Y plate selector	C5
b			Y plate selector	F5
c			Y plate selector	D9
d			Y plate selector	H5
e			Y plate selector	E7
f			Y plate selector	F7
g			Y plate selector	H9
h			Y plate selector	H7
j			Y plate selector	K7

Table 1001 - Components (contd)

Circuit Ref	Value	Tolerance and Rating	Type	Location (Fig 1005)
		SWITCHES		
SW4a			Probe selector	B6
b			Probe selector	B7
SW5a			Cal markers	Q4
b			Cal markers	P4
c			Cal markers	R3
d			Cal markers	P2
e			Cal markers	Q4
SW6			Y2 atten	O6
SW7a			Power	Fig 1001
b			Power	Fig 1001



1 - Timebase
2 - Calibrator
3 - CRT Connecting link panel
4 - Mains socket (under)
5 - V9
6 - Amplifier unit
7 - V10
8 - CRT base connector

Fig 1006 - Plan view of Oscilloscope

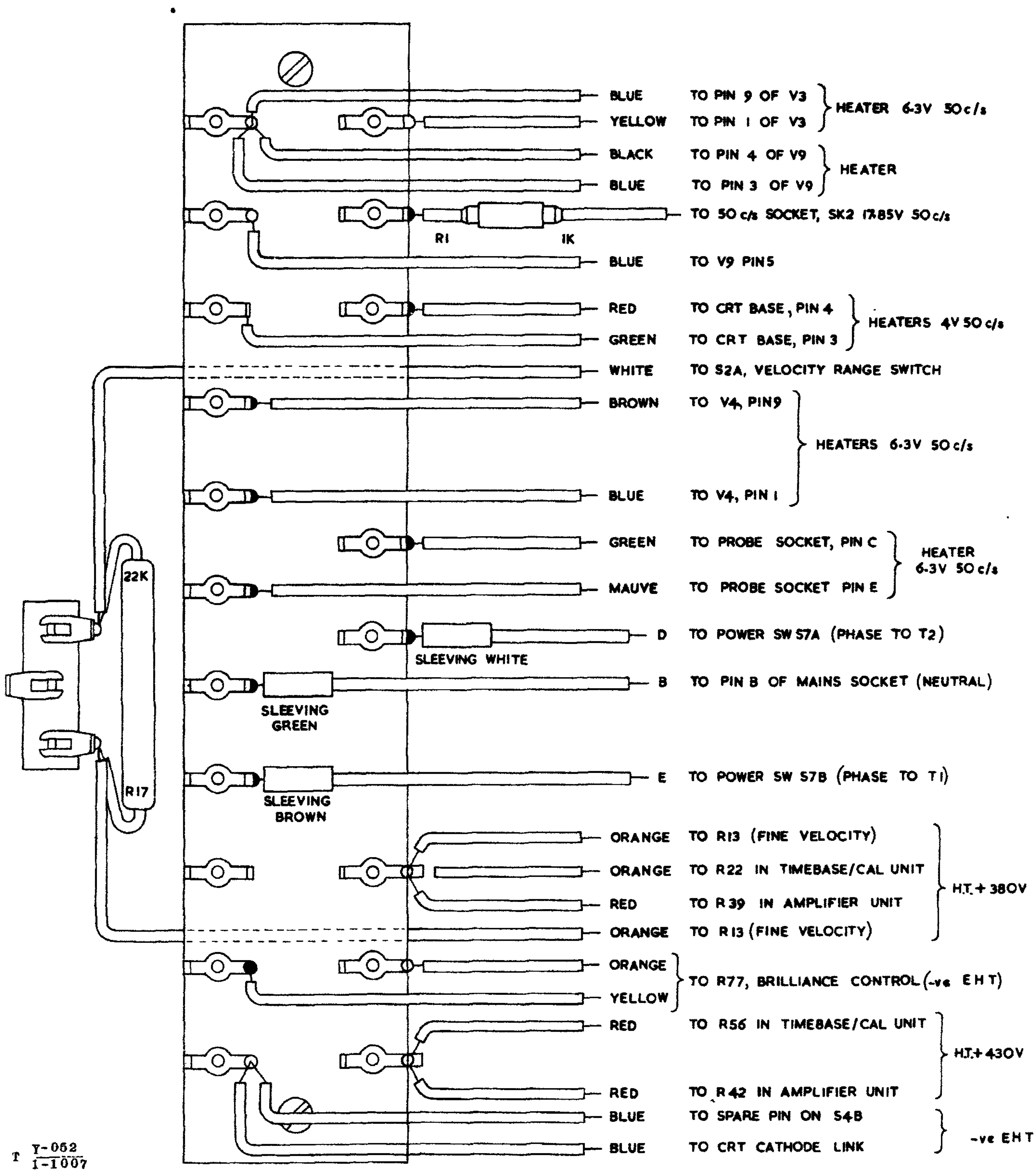


Fig 1007 - Power supply unit, connecting panel

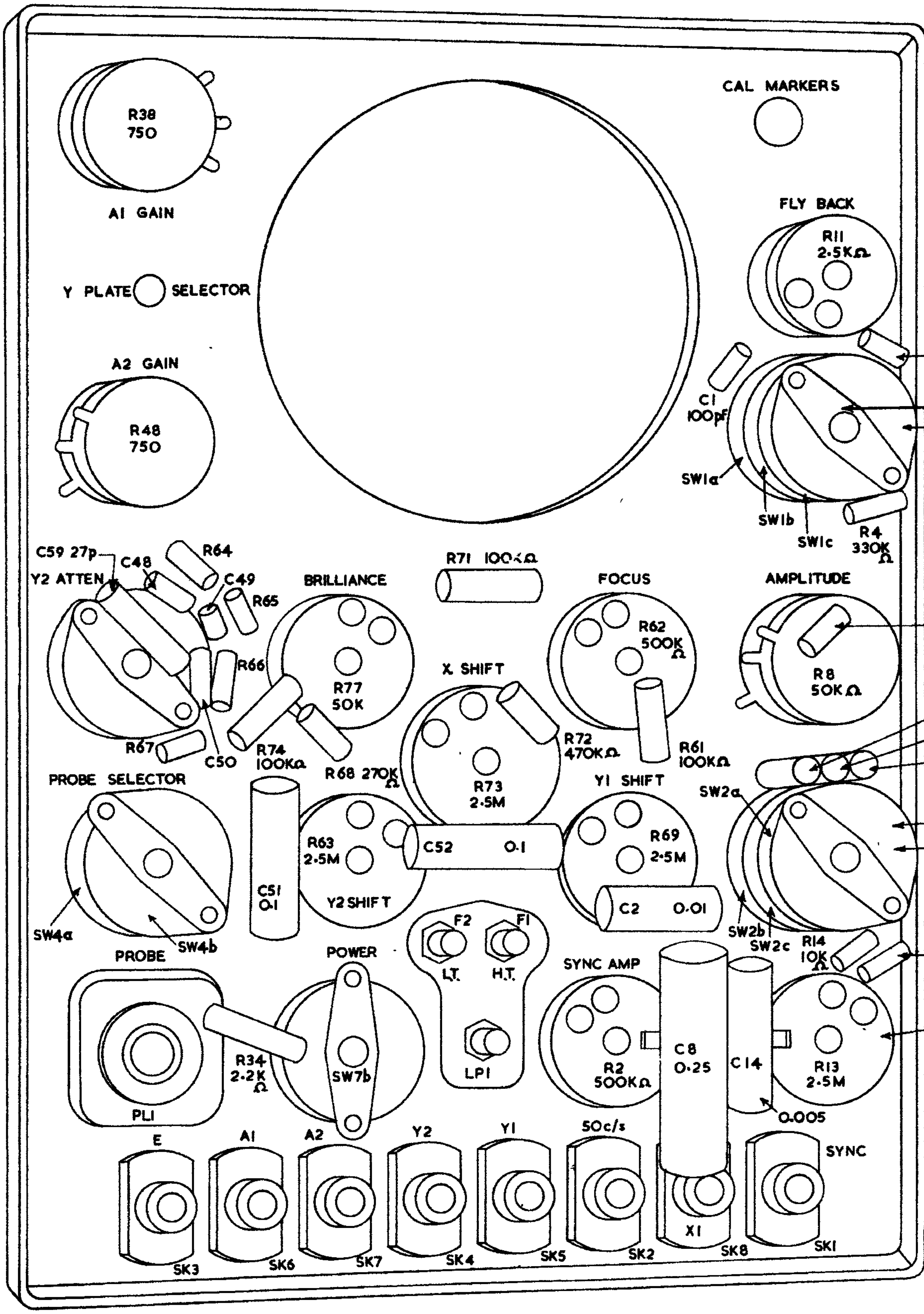


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Fig 1008 - Front panel - component layout

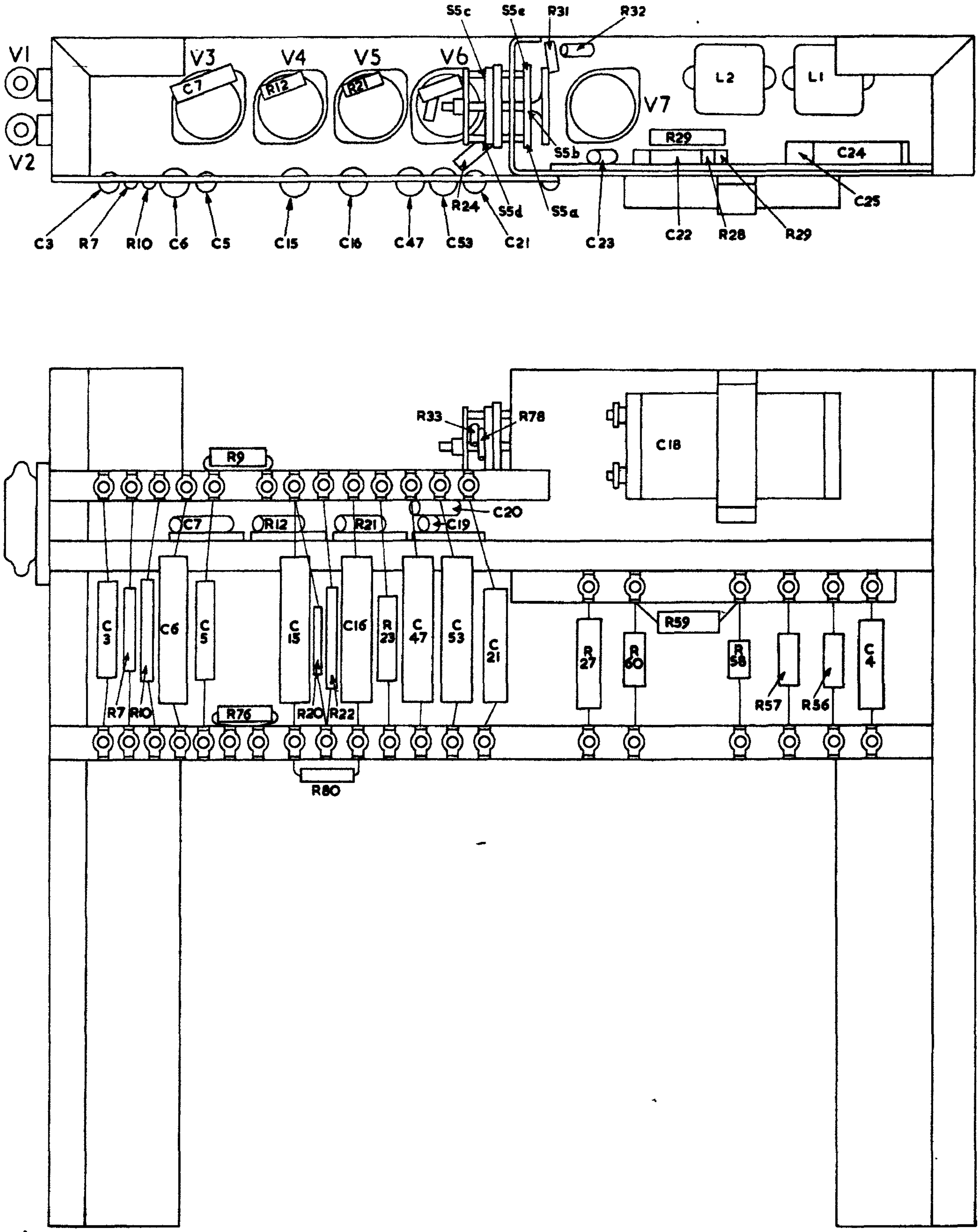

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Fig 1009 - Time-base and calibrator assembly, component layout

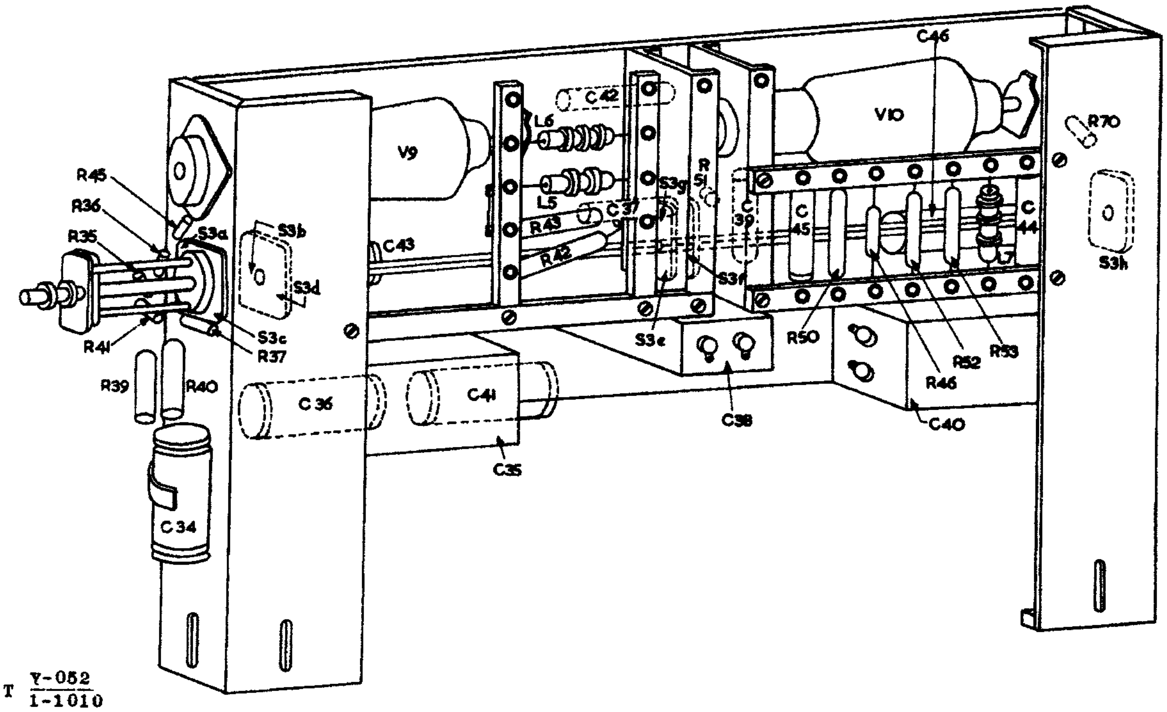

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Fig 1010 - Amplifier assembly, component layout

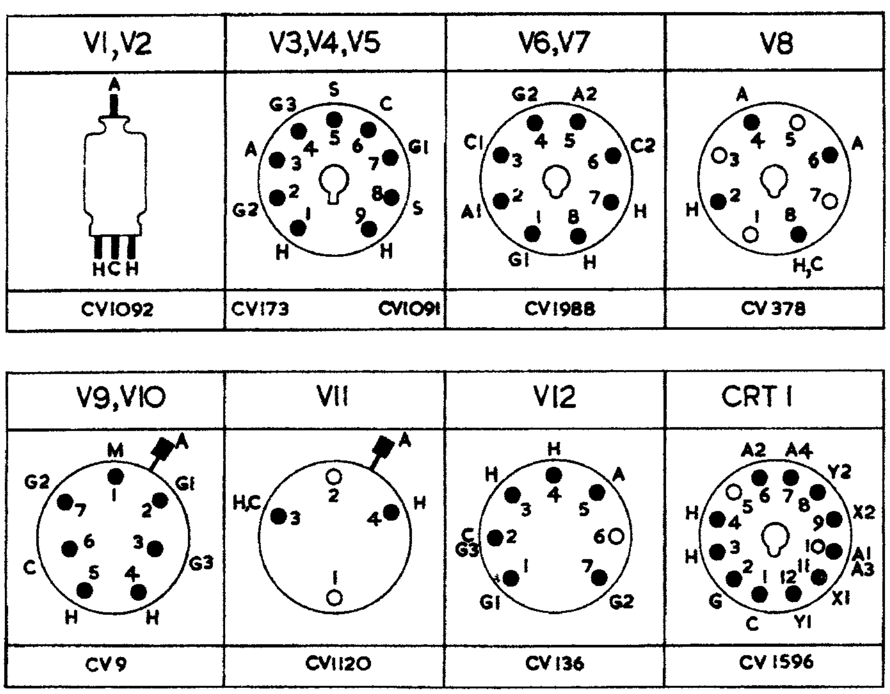

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Fig 1011 - Valve and C.R.T. base connections

Table 1002 - Valve data

Circuit Ref	Inter service type	Commercial equivalent	
V1, V2	CV1092	EA50	
V3, V5	CV1091	EF50	
V4	CV173	DDR2	
V6, V7	CV1988	6SN7GT	
V8	CV378	R231	
V9, V10	CV9	A160	
V11	CV1120	SU2150A	
V12	CV136	DDR7	

57/Maint/2819

END

OSCILLOSCOPE, TYPE 13A

TECHNICAL HANDBOOK - FIELD AND BASE REPAIRS

DISMANTLING AND RE-ASSEMBLING INSTRUCTIONS

Removal of front cover and case

1. Disconnect the mains lead from the rear of the instrument, release the two side clips and remove the front cover, viewing hood and graticule. Tilt the oscilloscope forward allowing it to stand on the front panel protecting spigots; unscrew the two slotted nuts at the rear and lift off the case.

Removal of C.R.T. and mumetal screen

2. Remove the viewing hood and graticule; remove the four No. 4 B.A. screws securing the graticule housing and remove the housing. Unsolder the red earth lead from the mumetal shield and carefully pull off the 12-pin C.R.T. base socket and allow it to hang on the wiring. Slacken off the two No. 2 B.A. screws holding the rubber lined clamp on the C.R.T. base; withdraw the tube and mumetal screen through the hole in the front panel.

Removal of power unit

3. To obtain access to the power unit for component replacement proceed as follows:-

(a) Remove covers and lay oscilloscope on its left side. (as seen from the front).

(b) Loosen the clip at the rear of the chassis which secures the screened mains leads (Uniflexmet) to the chassis.

(c) Unsolder resistor, R1 (100kΩ 1/4W) from the 50c/s socket on the front panel.

(d) Remove the sixteen No. 4 B.A. screws which hold the power unit to the corner plates of the other units.

(e) Remove the three No. 6 B.A. screws and nuts which secure the power unit screen to the amplifier chassis.

(f) Taking care not to strain the connecting leads, swing the power chassis about its front edge through approximately a right angle. The components are now readily accessible.

(g) If the complete removal of the power unit chassis is necessary, loosen the clamp securing the Uniflexmet mains leads to the front of the power unit and unsolder all the leads connecting the remainder of the oscilloscope to the power unit connecting panel. Refer to Tels Y 052 Fig 1007.

(h) To re-assemble, reverse the above procedure.

Removal of the front panel

4. It is impossible to remove the front panel as a unit; to obtain access to the front panel components first remove the power unit, C.R.T. and valves then proceed as follows:-

(a) Unscrew and remove the four front panel protecting spigots.

(b) Turn the CAL MARKERS switch to OFF, remove the forward screw of the spindle coupling and extract the extension spindle and control knob.

(c) Turn the Y-plate selector to D.C. and remove the control knob and the spindle bush fixing nut.

(d) Ease the front panel forward as far as the wiring will permit.

5. At this stage it is possible to reach the majority of the components and terminals but should it be found necessary, the front panel may be removed from the components as follows:-

(a) Remove the remainder of the control knobs and the spindle bush securing nuts, taking care to prevent the controls behind the panel from rotating and straining the wiring connections. Remove also the four No. 6 B.A. countersunk screws securing the probe socket and the three similar screws securing the fuse and indicator lamp assembly.

(b) Lift the panel clear of the control spindles. It is now attached only to the input sockets and earth terminal and may be swung round through about 90 degrees.

6. When replacing the panel care must be exercised to ensure that:-

(a) Wires are not trapped between controls and the panel, particular care is necessary in the case of the FINE VELOCITY, SYNC AMP, X SHIFT and Y1 SHIFT which have component mounting brackets secured with them.

(b) Controls are correctly oriented before tightening up the fixing nuts.

Dismantling the cathode-follower probe

7. Remove the ten No. 8 B.A. countersunk screws securing the sides of the cover to the end pieces; remove the covers.

TESTS AND ADJUSTMENTS

Adjustment of calibration marker circuit

8. A Calibrator, crystal, No. 7 and a pair of headphones are required. The crystal calibrator must have been recently adjusted according to the instructions printed on the rear of the instrument.

9. Remove the covers from the oscilloscope, connect to the mains and switch on; set VELOCITY RANGE to X TIMES 1 and CAL MARKERS to 1µSEC.

10. Connect batteries and headphones to the crystal calibrator; set FIL switch to ON, MOD switch to OFF and frequency selector switch to 1,000kc/s. Connect together the EARTH terminals of the crystal calibrator and oscilloscope and connect an insulated lead to the A terminal of the crystal calibrator. Loosely couple this lead to L1 and L2 by holding it within about an inch of the coils.

11. Listen on the phones to the audio beat note due to the crystal calibrator and cal marker oscillators. If there is an audible note then the cal marker oscillator is within 1% of 1Mc/s which is sufficiently accurate and no adjustment is required.

12. Ensure that the beat note is due to the cal marker oscillator and not some spurious signal by switching the oscilloscope POWER switch to L.T., when the note should cease. Return the switch to H.T.

13. If no note is heard carefully remove the wax to free the adjustable iron core of L2 and using a non-metallic screwdriver, rotate the core unitl a whistle is heard. Adjust to approximately zero beat and re-fix the core with molten wax.

14. Switch the crystal calibrator to 100kc/s and the oscilloscope CAL MARKER to 10μSEC. Carefully remove the wax to free the adjustable iron dust core of L1 and loosely couple the crystal calibrator by holding the A lead of the calibrator within about one inch of the coil.

15. Listen for a note in the phones and using a non-magnetic screwdriver, rotate the core of L1. A series of beats should be heard, the fundamental being very much louder than any of the harmonics. Tune L1 to approximately zero beat with the fundamental frequency and seal the core with molten wax.

Y2 attenuator tests

16. The following instruments are required:-

Voltmeter, valve, No. 2 or No. 3
Oscillator, video, No. 2 or other source providing a signal of approximately 75c/s and 100kc/s at a variable amplitude of the order of 30 volts.

17. Connect the LOW terminal of the video oscillator to the oscilloscope chassis and the HIGH terminal to the Y2 socket on the oscilloscope front panel with the Y PLATE SELECTOR set to D.C. The oscilloscope need not be connected to the mains supply.

18. Connect the valve-voltmeter earth terminal to the oscilloscope chassis and the HIGH terminal to the Y2 terminal on the C.R.T. connecting panel at the rear of the oscilloscope, leaving the Y2 link in position. Set the oscillator to 75c/s.

(a) Set the Y2 ATTENUATOR to ÷ 1 and the valve-voltmeter RANGE SELECTOR to 50V. Adjust the oscillator output to make the valve-voltmeter reading 30 volts.

(b) Switch the Y2 ATTENUATOR to ÷ 2 and record the valve-voltmeter reading.

(c) Set the valve-voltmeter RANGE MULTIPLIER to 15 volts and adjust the oscillator output to make the valve-voltmeter reading 10 volts.

(d) Switch the Y2 ATTENUATOR to ÷ 4 and record the valve-voltmeter reading.

(e) Set the valve-voltmeter RANGE MULTIPLIER to 5 volts and adjust the oscillator output to make the valve-voltmeter reading 4 volts.

(f) Switch the Y2 ATTENUATOR to ÷ 8 and record the valve-voltmeter reading.

(g) Adjust the oscillator output to make the valve-voltmeter reading 2 volts.

(h) Switch the Y2 ATTENUATOR to ÷ 16 and record the valve-voltmeter reading.

19. Disconnect the valve-voltmeter input lead from the Y2 terminal. Connect the valve-voltmeter probe HIGH and LOW terminals to the Y2 and EARTH terminals respectively at the rear of the oscilloscope using short connecting leads. Set the oscillator to 100kc/s and repeat para 18 (a) to (h).

20. The readings obtained in para 18 and para 19 should lie within the limits shown in Table 1 column 6. This represents a tolerance per step of 10% at 75c/s and 20% at 100kc/s.

(1)	(2)	(3)	(4)	(5)	(6)
Oscillator frequency	Valve-voltmeter range	Y2 ATTEN Initial setting	Valve-voltmeter Initial Reading	Y2 ATTEN switched to:	Valve-voltmeter Final Reading
75c/s	50V	÷ 1	30V	÷ 2	13.5 - 16.5V
75c/s	15V	÷ 2	10V	÷ 4	4.5 - 5.5V
75c/s	5V	÷ 4	4V	÷ 8	1.8 - 2.2V
75c/s	5V	÷ 8	2V	÷16	0.9 - 1.1V
100kc/s	50V	÷ 1	30V	÷ 2	12 - 18V
100kc/s	15V	÷ 2	10V	÷ 4	4 - 6V
100kc/s	5V	÷ 4	4V	÷ 8	1.6 - 2.4V
100kc/s	5V	÷ 8	2V	÷16	0.8 - 1.2V

Table 1 - Y2 Attenuator test data

Time-base ranges, free-running

21. By suitable adjustment of the controls the time-base repetition frequency should cover the range 2c/s to 750kc/s; the adjacent ranges should overlap. A minimum trace length of 7cm should be obtainable at all frequencies. See Table 2 for nominal ranges.

VELOCITY RANGE switch position	Frequency min	Frequency max
10c/s	2c/s	100c/s
100c/s	100c/s	800c/s
1kc/s	800c/s	5kc/s
10kc/s	5kc/s	80kc/s
100kc/s	80kc/s	750kc/s

Table 2 - Time-base ranges

Amplifier frequency response tests

22. With the gain control at maximum the figures shown in Table 3 should be obtained.

Notes: 1. This Issue 2, pages 5 and 6, supersedes Issue 1, page 5, dated 3 Jan 56 and Issue 1, page 0, dated 3 Aug 56.

2. Table 3 has been amended, the latter half of para 22 amended and re-numbered para 23, Table 4 is additional and paras 23-25 have been re-numbered to paras 24-26.

Input socket	Y-plate selector switch	Response relative to 1kc/s not worse than			
		1kc/s	50c/s	500kc/s	1Mc/s
A1	A1A2	0dB	-1dB	-	-3.5dB
A1	2A1	0dB	-6dB	-	-7dB
A1	2A1HF	0dB	-1dB	-	-1dB
A2	A1A2	0dB	-1dB	-	-7dB
X1	X30*	0dB	-1dB	-8dB	-
* Refers to velocity range switch					

Table 3 - Amplifier frequency response

23. The response when using the cathode follower probe as compared with the response without the probe at 1kc/s, input at A1 and Y-plate selector switch at 2A1HF should not exceed the figures quoted in Table 4.

Input socket	Y-plate selector switch	1kc/s	50c/s	1Mc/s
A1	2A1HF	-1.6dB	-4.6dB	-3.1dB

Table 4 - Amplifier frequency response with probe

Amplifier linearity tests

24. Set VELOCITY RANGE to X TIMES 1, FLYBACK fully clockwise and earth the A2 socket. Apply an input of 100V at 1kc/s ±5% between X1 terminal and E on the c.r.t. connecting panel at the rear of the oscilloscope. Connect a resistance attenuator so as to enable a fraction of this voltage to be applied to the amplifier under test.

(a) A1 amplifier. Switch Y PLATE SELECTOR to A1A2. Connect the attenuated input to the A1 socket and adjust the two voltages to obtain a trace on the c.r.t. screen 6 cm in length and at an angle of 45 degrees to the vertical. The trace so obtained must not deviate from a straight line by more than ±2 mm.

(b) A2 amplifier. Set A2 GAIN to maximum, A1 GAIN to minimum, connect A1 socket to earth. Connect the attenuated input to A2 socket and adjust the two voltages to obtain a 6 cm trace at 45 degrees. The trace so obtained must not deviate from a straight line by more than ±2 mm.

Hum test

25. Connect A1, A2 and Y2 sockets to E socket and also to a good earth point. Under these conditions the residual mains hum on the Y1 trace must not exceed 1 mm for any setting of the Y PLATE SELECTOR switch except 2A1. At 2A1 it must not exceed 4 mm.

FIELD REPAIRS

Permitted repairs

26. The following components will not be removed or replaced in field workshops:-

(a) Capacitors C19, C23

(b) Inductors L1, L2

Note: The next page is Page 1001

267/8/804
ME8/706

Table 1001 - Settings of controls for voltage testing

Control	Position of controls except where stated otherwise
POWER switch	H.T.
CAL MARKERS	OFF
FLYBACK	Centralised
TRIG SYNC	EXT
AMPLITUDE	Centralised
VELOCITY RANGE	1kc/s
FINE VELOCITY	Position 10
SYNC AMP	Anti-clockwise
Y1 SHIFT Y2 SHIFT X SHIFT	Trace centralised
FOCUS BRILLIANCE	Adjusted for clear trace
A1 GAIN A2 GAIN	Clockwise
Y PLATE SELECTOR	A1 A2
Y2 ATTEN	÷ 1
PROBE SELECTOR	OFF

Table 1002 - Voltages at test points; with mains input 115V or 230V and controls as in Table 1001

Test point	Reading	Setting of AVO 7 - range	Remarks
Heater voltages at valve pins			
V1 to V7	6.3V	a.c. 10V	±0.3V r.m.s.
V9, V10 and C.R.T.	4.0V	a.c. 10V	±0.2V r.m.s.
V11	2.0V	a.c. 10V	±0.1V r.m.s.
V8	5.0V	a.c. 10V	±0.25V r.m.s.
V12 at pins C and E of PROBE socket	6.3V	a.c. 10V	±0.3V r.m.s.
V8 pin 8 (cathode)	+475V	d.c. 1,000V	
L3, L4 junction	+450V	d.c. 1,000V	
C26	430V	d.c. 1,000V	±10%

Table 1002 (contd)

Test point	Reading	Setting of AVO 7 - range	Remarks
C17	380V	d.c. 1,000V	±10%
C57	-1200	d.c. 4,000V	±10% (use multiplier)
C56	-1000	d.c. 1,000V	±10% with BRILLIANCE control clockwise
50V 50c/s socket	17.85V	a.c. 100V	±5% r.m.s.
C.R.T. pin 6 (A2)	-250V -740V	d.c. 1,000V d.c. 1,000V	FOCUS anti-clockwise FOCUS clockwise
C.R.T. pin 7 (A4)	+40V	d.c. 1,000V	
C.R.T. link panel X2 terminal	-190V +100V	d.c. 1,000V d.c. 1,000V	X SHIFT anti-clockwise X SHIFT clockwise
C.R.T. link panel Y1 terminal	+40V -35V	d.c. 1,000V d.c. 1,000V	Y1 SHIFT anti-clockwise Y1 SHIFT clockwise
C.R.T. link panel Y2 terminal	-30V +30V	d.c. 1,000V d.c. 1,000V	Y2 SHIFT anti-clockwise Y2 SHIFT clockwise
C.R.T. link panel GRID terminal	-800V -760V	d.c. 1,000V d.c. 1,000V	BRILLIANCE anti-clockwise BRILLIANCE clockwise
C.R.T. link panel CATHODE terminal	-820V	d.c. 1,000V	
V3 pin 3 (anode)	+15V +250V	d.c. 1,000V d.c. 1,000V	AMPLITUDE clockwise AMPLITUDE anti-clockwise
V3 pin 2 (screen)	+110V	d.c. 1,000V	
V4 pin 3 (anode)	+380V	d.c. 1,000V	
V4 pin 2 (screen)	+380V	d.c. 1,000V	
V4 pin 6 (cathode)	+175V	d.c. 1,000V	
V5 pin 3 (anode)	+300V +140V	d.c. 1,000V d.c. 1,000V	AMPLITUDE anti-clockwise AMPLITUDE clockwise
V5 pin 2 (screen)	+320V	d.c. 1,000V	
V5 pin 6 (cathode)	+3V	d.c. 10V	VELOCITY RANGE set to X 30
V6 pin 2 (anode (a))	+310V	d.c. 1,000V	CAL MARKERS switch set to 10µSEC

Table 1002 (contd)

Test point	Reading	Setting of AVO 7 - range	Remarks
V6 pin 5 (anode (b))	+50V	d.c. 1,000V	
V7 pin 2 (anode (a))	+185V	d.c. 1,000V	CAL MARKERS switch set to 10μSEC
V7 pin 5 (anode (b))	+290V	d.c. 1,000V	
V9 top cap (anode)	+215V +240V	d.c. 1,000V d.c. 1,000V	A1 GAIN clockwise A1 GAIN anti-clockwise
V9 pin 7 (screen)	+300V +320V	d.c. 1,000V d.c. 1,000V	A1 GAIN clockwise A1 GAIN anti-clockwise
V9 pin 6 (cathode)	+10V +57V	d.c. 100V d.c. 100V	A1 GAIN clockwise A1 GAIN anti-clockwise
V10 top cap (anode)	+250V +280V	d.c. 1,000V d.c. 1,000V	A2 GAIN clockwise A2 GAIN anti-clockwise
V10 pin 7 (screen)	+275V +290V	d.c. 1,000V d.c. 1,000V	A2 GAIN clockwise A2 GAIN anti-clockwise
V10 pin 6 (cathode)	+10V +52V	d.c. 100V d.c. 100V	A2 GAIN clockwise A2 GAIN anti-clockwise
PROBE socket pin 1	+320V	d.c. 1,000V	PROBE SELECTOR switch set to Y1 Y2 plug withdrawn

Note: Deviations from the above test figures of the order of 10% are to be expected in practice.

57/Maint/2819

END

OSCILLOSCOPE, TYPE 13A

TECHNICAL HANDBOOK - MISCELLANEOUS INSTRUCTION

Redesignation of EMERs

Information

1. To maintain the proper sequence of EMER numbers, it is intended that:-

   (a) all future issues of EMERs on this equipment will be published in the series Tels Y 050 - Y 059 and

   (b) the current EMERs will be redesignated.

Distribution - Class 930. Code Nc. 6

<u>Action</u>

2. The following EMERs will be redesignated as shewn.

Present designation					New designation (e)
	EMER designation (a)	Pages (b)	Issue No. (c)	Date (d)	
1	✓ Tels Y 800/4	1 - 2	1	26 Nov 53	Tels Y 050

57/Maint/6670

END

OSCILLOSCOPE, TYPE 13A

TECHNICAL HANDBOOK - MISCELLANEOUS INSTRUCTION

SUB-TITLE: AMPLITUDE control - replacement of 50kΩ potentiometer (RV8)

1. Introduction

The AMPLITUDE control potentiometer, (RV8), Cat No Z1/ZA 40491 has proved unsatisfactory in service. As and when this control becomes unserviceable it is to be replaced by a potentiometer of similar ohmic value but of larger wattage dissipation and improved construction.

2. Items affected

Oscilloscope, type 13A	Z4/10S-831
AMPLITUDE control potentiometer (RV8)	Z1/ZA 40491

3. Action required by:-

(a) Units authorized to carry out field or base repairs

(i) As and when potentiometer, RV8, (Cat No Z1/ZA 40491) is found to be unserviceable, demand stores as detailed in para 4.
(ii) On receipt of stores, fit as replacement for unserviceable item.
(iii) On overhaul, examine the equipment. If potentiometer Z1/ZA 40491 is fitted as RV8, replace by the new type potentiometer, demanding stores and fitting on receipt.

4. Stores

Stores will be demanded through normal Ordnance channels quoting this Misc Instr and equipment serial number on the indent.

(a) Stores to be demanded

VAOS, Section	Part No	Designation.	Qty per eqpt
Z1	5905-99-932-5797	Resistor, variable, w.w., rotary, toroidal, 50kΩ, ±10%, 5W, linear	1

5. EMER amendments

An amendment to Tels Y 052, Table 1001 will be issued as a separate regulation.

END

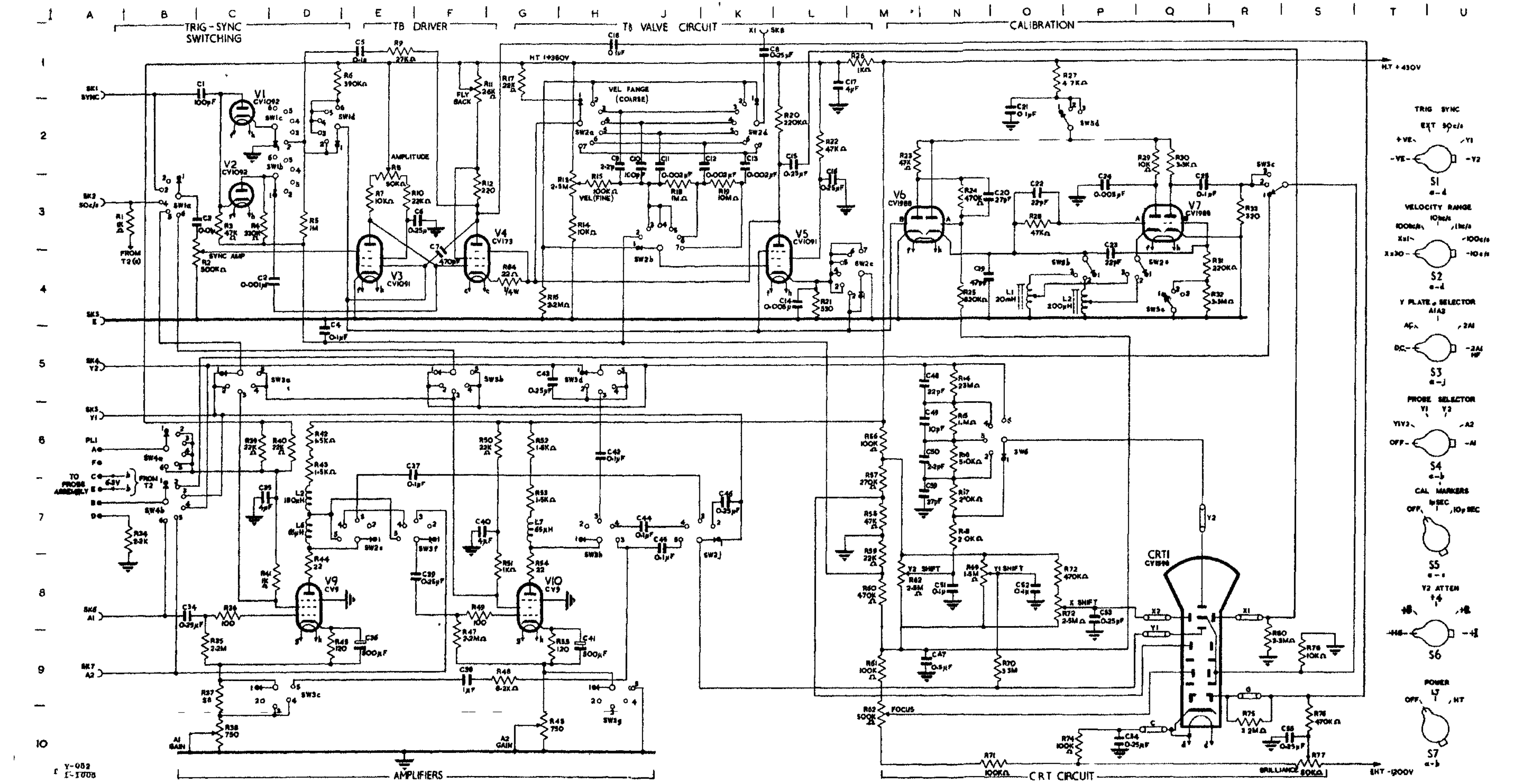

Fig 1005 - Circuit diagram

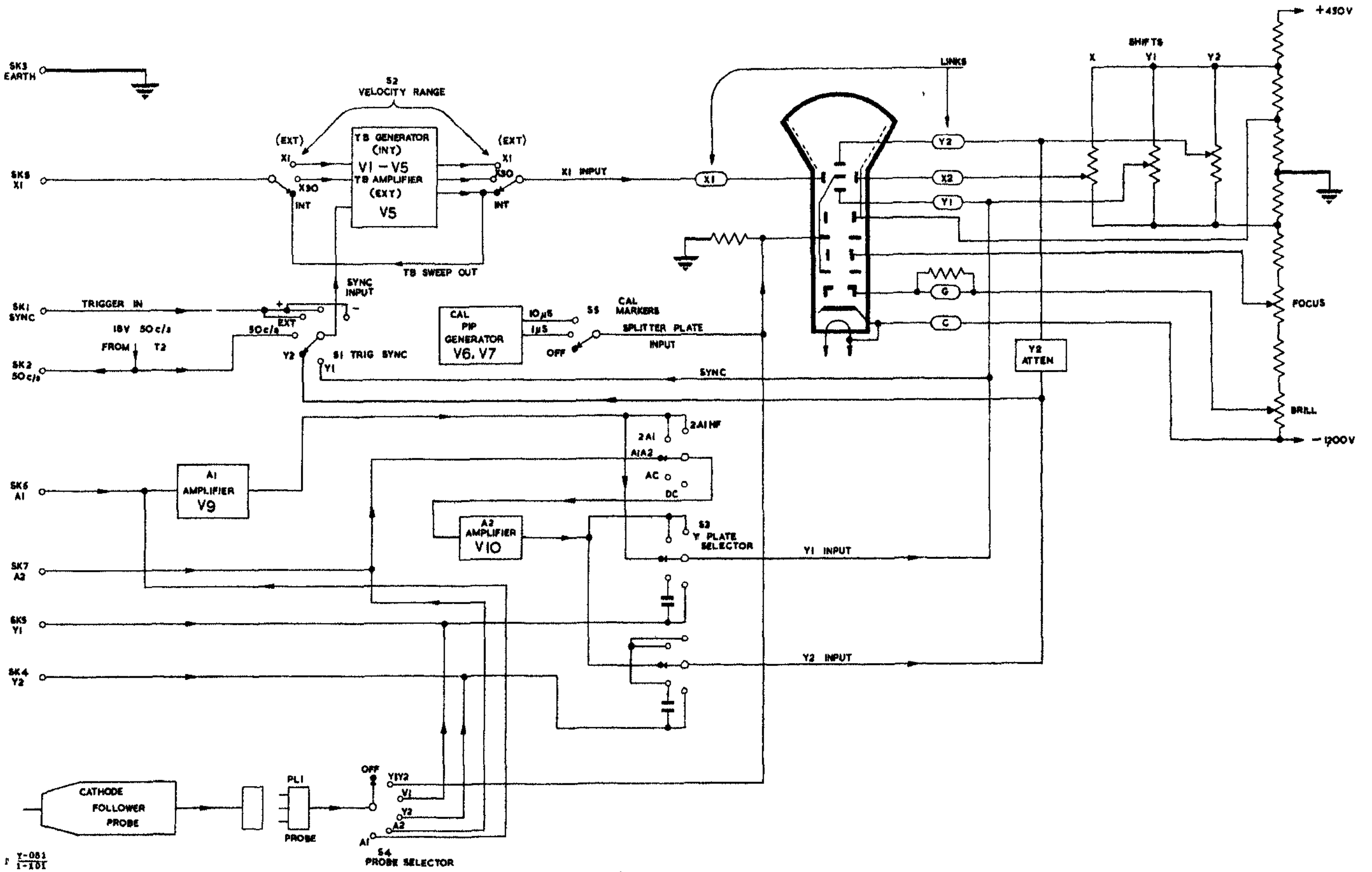

Fig 101 - Block diagram.

END