

CATHODE RAY OSCILLOSCOPE

MODEL 1200B



SPECIAL FEATURES

- * SMALL PHYSICAL SIZE
- * HIGH GAIN DIRECT COUPLED AMP - LIFIERS ON BOTH 'X' AND 'Y' AXIS
- * SYMMETRICAL DEFLECTION
- * INSTANTANEOUS SHIFTS
- * SWEEP EXPANSION
- * PORTABLE

THIS instrument is a high grade Cathode Ray Oscilloscope in extremely compact form incorporating features hitherto only found in more expensive instruments.

DESCRIPTION

The instrument complete with power pack is housed in an attractive metal case finished grey.

Direct coupled amplifiers are used on both 'X' and 'Y' axes. The overall frequency response is level within the limits of ± 1 dB between zero and 100,000 c.p.s. with a gain of approx. 50 times.

D.C. shift voltages are applied through the amplifiers, the shifts being instantaneous in operation.

JULY 1951

The time base consists of a gas discharge valve, the output being fed to plates through the 'X' amplifier. The 'X' amplifier gain control is used for sweep expansion; smooth expansion from zero to 8 screen diameters being obtained.

The 'Y' amplifier output, the 'Y' axis plates and the grid electrode of the C.R. Tube are brought out to sockets placed on the back of the instrument. On the same panel is an octal base from which power supplies of 6.3V.A.C. and 350 V.D.C. can be drawn. Nominally provided for use with Industrial Electronics Model 1400B Visual Alignment Signal Generator (details available on request) these power supplies are also of use for driving small experimental 'hook-ups'.

SPECIFICATION

TUBE	
TYPE	DG 7-5. Green Trace - medium persistence.
COLOUR	2¾ dia.
DEFLECTION	Blue & long persistence types available.
MODULATOR	Available through an A.C. coupling.
CONTROLS	"X" shift. "Y" shift (both instantaneous in response). Brilliance Focus. Corrected for astigmatism.
"Y" AMPLIFIER	
TYPE	A single pushpull stage giving symmetrical deflection. It is D.C. connected and is thus responsive to D.C. potentials. Impedance 1 Megohm.
INPUT	
FREQUENCY RESPONSE	Zero to 100 kc/s. flat within ± 1dB.
DEFLECTION SENSITIVITY	100 mV R.M.S./cm.
CONTROLS	Gain. Input Switch.
"X" AMPLIFIER	
	Identical to "Y" amplifier. Phase shift characteristics identical and negligible down to zero frequency in both "X" and "Y" amplifiers.
TIME BASE	
TYPE	Gas discharge Valve in linear Circuit.
SWEEP SPEEDS	5c/s. to 20 kc/s. Sweep expansion raises the effective speed to 160 kc/s. Slower Sweep Speeds than 5c/s. may be obtained by connecting a suitable condenser to the sockets provided at the back of the instrument.
CONTROLS	5 switched speed positions and an 11 to 1 variable control. Sweep expansion control.
SYNCHRONISING	The source may be selected from the "Y" amplifier, from the 50 Cycle Mains or from an external source, by means of a 3 position switch. Amplitude is controlled by a variable potentiometer.
CALIBRATION	A calibration signal of 1 Volt peak is available at a socket on the front panel.
POWER SUPPLY	200-250 Volts, 40-60 c.p.s. Consumption 40 Watts.
DIMENSIONS	7" wide. 8" high by 9" long. Weight 14 lbs.
GUARANTEE	Each instrument is fully guaranteed for 12 months excluding valves which are covered by the B.V.A. guarantees.

INDUSTRIAL ELECTRONICS
LONDON.

MODEL	2300	1200B.	2000C.
Cathode Ray Tube	DG7/5 (Mullard) 2 $\frac{3}{4}$ in	DG7/5 (Mullard) 2 $\frac{3}{4}$ in.	DG13/2 (Mullard) 5 in.
	Alternatively, type DB7/5 (DB13/2 having a blue trace of short persistence or DP7/5 (DP13/2) having a blue trace with green afterglow of long persistence may be fitted.		
Deflection	Symmetrical on both axes in all models. Deflector plates are accessible for direct connection.		
Modulator	Accessible on all models for direct connection.		
Controls	Brightness. Focus (corrected for astigmatism). X Shift. Y Shift.		
TIME BASE Type	Hard Valve.	G.D.T.	Hard Valve.
Frequency Range	7 c.p.s. to 50 Kc/s.	5 c.p.s. to 20 Kc/s.	cycle per min. to 50 Kc/s.
No. of Ranges	5	5	6
Synchronisation.	From "Y" amplifier, internal 50 c.p.s. or external.		
Controls	Range Switch. Velocity (fine). Sync. Selector switch. Sync. Amplitude.		
HORIZONTAL DEFLECTION AMPLIFIER	A single stage of direct-coupled push-pull amplification.		
Input	Unbalanced to all models.		
Sensitivity *	70m. V.R.M. S/cm.	140m. V.R.M.S/cm.	60 V.R.M.S/cm.
Frequency Range	D.C. to 100 Kc/s. in all models.		

* Plus or minus 20%

Time Base Expansion	X5	X8	X5
Controls	Input Selector Switch. Gain T.B. Expansion (2000 only)		
VERTICAL DEFLECTION — TRIPPER	Direct - coupled push-pull amplifier in all models.		
Stages	1	1	2
Input	Unbalanced	Unbalanced	(a) Balanced or (b) Unbalanced.
Sensitivity * (max.)	50m V.R.M.S/cm.	100m V.R.M.S/cm.	10m V.R.M.S/Cm.
Frequency Range	D.C. to 3 Mc/s.	D.C. to 100 Kc/s.	D.C. to 100 kc/s
Input Resistance	High Gain $\frac{1}{2}$ M. Low " 10M.	1M	1M
Phase Shift	Negligible down to zero frequency.		
Gain Control	Continuously Var. & Stepped. Frequency compensated.	1M.Potr. non-compensated.	Continuously Var.
Controls	Input Switch (A.C. or D.C.) Gain Control.		
CALIBRATION	A signal or 1 volt peak is available at a terminal on the panel.		

* Plus or minus 20%.

OPERATING INSTRUCTIONS.

The mains supply is connected by a 3 core lead. The leads 'red' 'black' and 'green' being 'line', 'neutral' & 'earth' respectively. Instruments are despatched ready for operation on supplies of 230/250v. (240v. tapping) and 40-60 c.p.s. For operation on other voltages, nominal tapings of 200 and 220v. are provided and adjustment should be made as necessary before switching on.

TUBE CONTROLS.

The valve and C.R. Tube heaters should be allowed to reach operating temperature before adjustments are attempted. Initially, set all Gain controls to zero and both Shift controls to mid-position (pointers vertical), then advance the Brightness control until the 'spot' appears. It should now be possible to adjust the Focus control to obtain a small, well-defined 'spot'. The intensity of the stationary 'spot' should be as low as possible to avoid burning of the C.R. Tube screen, and it should be noted that care is needed in adjusting the position controls, as the 'spot' may be shifted off the screen readily by a small movement of the controls.

It will be noted that there is some interaction between the Focus and Brightness controls in instruments using the C.R. Tube Type DG7/5, and it may be found advantageous to effect final adjustment to the Focus control when a trace is visible.

The sense of the Shift controls is arranged so that clockwise rotation moves the 'spot' downwards (Y axis) and to the right (X axis), i.e. the 'spot' movement follows that of the pointer knob.

HORIZONTAL AMPLIFIER.

"X"

Since the output of the Time Base is applied to the C.R. Tube via the amplifier, no horizontal deflection will be secured until adjustments are made to render it operative. Advance the Gain control (T.B. Expansion for Model 2000C) by a small amount after setting the selector switch to T.M. The length of the Time Base deflection is determined by the setting of the "X Gain" (T.B. Expansion) control. If it is desired to use a Time Base other than the internal linear sweep, the T.B. switch should be set to "A.C" (when D.C. is present with the desired sweep voltage) or to "D.C." and the sweep length adjusted as necessary by means of the Gain control. A 50 c.p.s. (main) Time-Base may be obtained by connecting the CAL signal (1 volt peak) to the 'X' input terminal.

When applying an external signal to the 'X' amplifier of the Model 2000C, the T.B. Expansion control must be set to zero.

TIME BASE

The Time Base frequency is determined by the setting of the range switch (frequency increases with clockwise rotation) and the Fine Velocity control. The range of the latter control is approx. 12 : 1 and there is adequate overlap between adjacent settings of the range switch. Expansion of the sweep, referred to above, enables a given number of cycles to be viewed on a greatly extended base-line, so that, if the Time Base is operating near its upper frequency limit, the signal frequency may be much higher before confusion between adjacent cycles of the trace arises. Thus, if the Time Base is set for operation at 40 Kc/s, and 10 complete cycles are visible, the signal frequency is 400 Kc/s. If then the Time Base line is expanded in length X5 only 2 cycles are visible. Alternatively, the signal frequency may be increased to 2000 Kc/s and 10 complete cycles are visible.

If D.C. is present with any signal applied to the 'X' amplifier, a horizontal displacement of the trace will occur but it may be centralized, or restored to any desired position on the screen by means of the 'X' Shift control.

To use the Time-Base single stroke, insert the jack plug into the socket provided (Model 2000C). Closure of contacts connected to the plug will cause the Time-Base to stroke once at the speed determined by the settings of the range switch and velocity controls.

The lower sockets on the terminal board of the Model 1200B, are connected to the Time-Base switch "EXT" position. With the switch in this position, a 10 mfd. paper condenser connected to the sockets will give Time-Base speeds ten times slower than those obtained on the first switch position.

SYNCHRONISATION

The Time-Base may be locked to the input signal, to the 50 c.p.s. mains supply or to any external source applied to the terminal marked 'S' by means of the Sync. Selector Switch. The amplitude of the injected synchronising voltage is controlled by the SYNC. control. This control should be advanced a little and the Fine Velocity control adjusted as closely as possible to a near stationary trace, a slight increase of the Sync. voltage should then produce a satisfactory lock. Too much Sync. voltage may render it impossible to obtain a stationary trace.

The Minimum external synchronising voltage, applied to the SYNC terminal, should not be less than 0.5. volt R.M.S. in the case of Model 1200B and 0.3. volt R.M.S. in the case of Models 2300 and 2000C.

VERTICAL DEFLECTION AMPLIFIER 'Y'.

The signal is normally applied to the 'Y' input and 'E' terminals. Model 2300 has alternative input terminals. The first, designated 'H' enables the maximum gain of the amplifier to be utilised. When the signal is applied to the second, designated 'L' it is attenuated X20. In this Model no isolating condenser is fitted to the input, and a component of suitable working voltage rating must be provided externally if the signal is to be examined at any part of a circuit at an appreciable D.C. potential. Vertical displacement of the trace due to D.C. component in this, as well as other Models, may be compensated by adjustment of the 'Y' Shift control. The 'Y' gain control in Model 2300 is not frequency conscious, but the effects of the non-compensated control fitted to the Model 1200B and 2000C must be taken into consideration.

When balanced input facilities are required using Model 2000C, the signal is applied to the two 'Y' Input terminals provided. If unbalanced operation is required, one of these terminals is strapped to 'E' and the live input applied to the other.

The Frequency Responses of the amplifiers are as follows:-
Model 2300

Conditions 'D.C.' - D.C. to 100 Kc/s. (3 DB. Down)
" 'W.B.' - 20 c.p.s. to 3 Mc/s (6 DB. Down)
The sensitivity in this condition
is 500 n. V.R.M. S/cm.

Model 1200B. D.C. to 100 Kc/s. (6 DB. Down)

Model 2000C.

Unbalanced input. 10n. V.R.M. S/cm from D.C. to 100Kc/s.
(6 DB. Down)

Full screen deflection is obtained at
maximum gain with an input of 100 n .V.R.M.
S.

The input signal applied to the amplifier must be attenuated by the main control to prevent distortion due to over-loading, and additional external attenuation must be used if necessary. For Model 2300, in the 'D.C.' condition, the trace of the complete wave-form may be expanded to the limits of the screen diameter, but in the 'W.B' condition, the trace must be limited to a maximum height of 2 cm. For Model 2000C, a vertical deflection of 10 cms., which is obtained with an input of 100n V.R.M.S., may be expanded to 10 screen diameters with no visible distortion. Similarly, for the Model 1200B, a vertical deflection, extending to the limits of the screen, which will

be obtained with an input of approx. 600m. V.R.M.S., may be expanded to the point that the vertical shift control will just bring the peaks of the waveform on the screen with no visible distortion.

Some loss of high-frequency response may be experienced in the Models 1200B and 2000C, at low settings of the Gain Control. When this cannot be tolerated, the Gain control should be set to maximum and the signal attenuated externally to some value, which will provide a trace of convenient height.

OTHER FACILITIES

Both plates on each axis of the Cathode Ray Tube, as well as the Modulator (Grid), are connected to sockets on a terminal board, so that direct connections may be made as required. An external D.C. isolating condenser must be connected to the Modulator socket in the Model 2300. Its working voltages should be 1000 volts D.C. and a capacity of 0.01 mfd. will give a time constant of 5 milli-secs. A suitable condenser is fitted to Models 1200B and 2000C providing the same time constant.

CIRCUITRY.

The arrangement of the Cathode Ray Tube supplied in all models, is generally similar, the E.H.T. being derived from a tapping on the main H.T. winding of the mains transformer and a separate rectifier in the smaller models, and from a separate transformer and half-wave valve rectifier in the Model 2000C.

The required C.R. Tube potentials are obtained from a potential divider, which includes the Brightness and Focus potentiometers, connected across the E.H.T. supply. It will be noted on reference to the circuit diagram, that the final anode of the Tube is maintained at a fixed positive potential to earth, by means of a divider connected across the normal H.T. line. The positive voltage is adjusted to equal the voltages at the 'X' and 'Y' plates, which are directly connected to the anodes of the deflection amplifiers to eliminate undesired distortion of the Focus.

The shift control for each axis is introduced into the anode circuits of the push-pull Cathode coupled pairs of valves comprising the deflection amplifiers, and constitutes part of the anode load resistances. The displacement of the beam available by this means is symmetrical and instantaneous in operation. The range of the controls is sufficient to balance the deflection due to an applied signal of a few volts D.C., but larger components must be removed by connection of an isolating condenser to the input.

TIME BASE

The Time-Base circuit in the Model 1200B utilises a gas-discharge triode in the conventional manner, coarse range selection being achieved by switching condensers C8-C11 and fine adjustment of the repetition frequency by VR4. The Time-Base output is applied through R12 (shunted by VC2 for high frequency correction) and C3 to the 'Y' amplifier and it is rendered inoperative by S4 when this is set to 'D.C.' or 'A.C.' for operation from an external Time-Base or deflection source.

Models 2300 and 2000C both use a Miller-Transitron sweep generator, in which the synchronising voltage is applied to the suppressor grid. An additional valve V8, in providing a low resistance charging path for the condenser, materially decreases the fly-back time and constitutes a low impedance output device. The positive D.C. voltage at the Cathode output terminal of V.8, applied to the "X" amplifier through P9 (T.B. Expansion) would produce a horizontal displacement of the trace according to the setting of P9. Accordingly, this voltage is backed off by a negative voltage applied through R24, R27, P8 and R36. Single stroke working in this Model is effected by closing the screen circuit of V7 (R16, R18) which is interrupted by insertion of the jack plug in the 'S.S. Jack'.

The synchronising voltage in all models is obtained from the output of the 'Y' amplifier (signal voltage amplified), from the mains supply (INT) or from any external source at will by setting the selector switch to the desired source.

DEFLECTION AMPLIFIERS

The horizontal and vertical amplifiers in all models are basically Cathod-couples push-pull valves direct coupled between stages and to the C.R.Tube. A single stage is used in all cases other than the vertical amplifier in Model 2000C, which has two. The horizontal amplifiers require no comment, except for a variation in Model 2000C. In this Model, it is necessary to provide a backing-off voltage to compensate for a D.C. component in the time-base output. The time-base input is thus connected through P9, as already described, to the grid of V10, which would normally be connected to earth, and not through the input selector switch S5 as in other models. The horizontal axis amplifiers in general are substantially identical to the vertical amplifiers but are less sensitive.

SERVICE NOTES.

General.

Oscilloscopes are generally reliable instruments which will function for long periods with very little attention. Industrial Electronic designs are essentially lacking in critical adjustments and any faults which may occur, are likely to be minor ones, due to the premature failure of individual components, or gradual deterioration with time, temperature and humidity.

Most users will be familiar with the characteristic faults of the components which will be encountered, and will have little difficulty in tracing any defect and replacing where necessary with a part of reputable make which complies with the ratings of the original specification.

Replacement of faulty components in general may be effected with the listed values to 20% tolerance other than those which are excepted in the schedule attached to the circuit diagram. These latter parts are normally selected to the required accuracy, adjusted in value. It is advisable that the instrument should be returned to the makers in order that the performance should not depreciate by the fitting of incorrect values.

It will be appreciated that the oscilloscope provides its own indication of the approximate location of an internal fault, whether this occurs as a random failure or arising from gradual deterioration. In a very simple case, where it may be necessary to discriminate, for example: "No horizontal deflection," it can be ascertained readily where the trouble lies in the Time-Base or the amplifier, by applying a signal from the Calibration source to the latter, to check for correct functioning.

The voltage analysis contained in the circuit diagram, provides an approximate guide to the values which will be measured, but allowance must be made if a voltmeter having a resistance other than 1000 ohms/volt is used. If checks are made at other points in the circuit, the resistance at the point of measurement will influence the current drawn by the voltmeter, and its reading must be corrected accordingly. Particular care must be exercised if measurements are made on any part of the circuit connected to the E.H.T. supply and it is preferable to use an electrostatic voltmeter for this purpose.

If it is necessary to replace an amplifier valve for any reason, the replacement should have characteristics reasonably close to those of its associate in the push-pull stage, say within 10%. Since all the amplifier valves are of the same type, it may be found possible to interchange them to find pairs which are satisfactorily matched. The loss of emission in any one amplifier valve will result in the associated shift control failing to move the 'spot' by equal displacement in either direction.

MODEL 1200B.

The location of any component may be readily ascertained from the chassis and group-board diagrams provided. When replacing components it should not be necessary to remove the group-boards from the chassis, or to disturb the wiring in any way, as most parts are easily accessible.

If the C.R.Tube controls are set up as described under "Operating Instructions" and no visible beam or trace is obtained, it is possible that the beam may be deflected outside the limits of the screen. This may be caused by the failure of a valve in either deflection amplifier. If this is the case, the beam may be displaced vertically or horizontally and rotation of the shift controls will not restore it to a normal position. To verify this the H.T. rectifier - V.7 - is removed from its holder. Since the amplifiers now draw no anode current, there should be no deflection of the beam, and it should be visible at the centre of the screen. If the beam is not visible, the cause may be failure of the E.H.T. rectifier valve - V.6 - which may be replaced for test by the type 6X5 already removed from H.T. rectifier valve-holder. Failure of E.H.T. may also be due to C5 short-circuit and a large voltage drop will appear across R.19. Failure of C6 will damage the rectifier valve and the instrument must not be left running in this condition. If the beam is visible but cannot be focussed, the E.H.T. bleeder chain comprising R.17, R23, VR7 and VR8 should be checked for continuity and resistance values. A short-circuit or leak at any point on the bleeder chain will prevent proper adjustment of the Focus and Brilliance controls.

H.T.SUPPLY.

Complete failure of the H.T. supply due to V.7 - no emission, C7 s/c or R20 o/c will be apparent as the Shift controls will be inoperative and the beam will not focus. Voltage checks may be used to trace the component at fault. It should be noted that the 3rd Anode of the C.R.Tube is maintained at approximately the same potential with respect to chassis as the anodes of the amplifier valves, and any appreciable variation will be indicated by distortion of the stationary beam. If it is necessary to replace R21 or R22, the replacement must be selected to achieve the condition described.

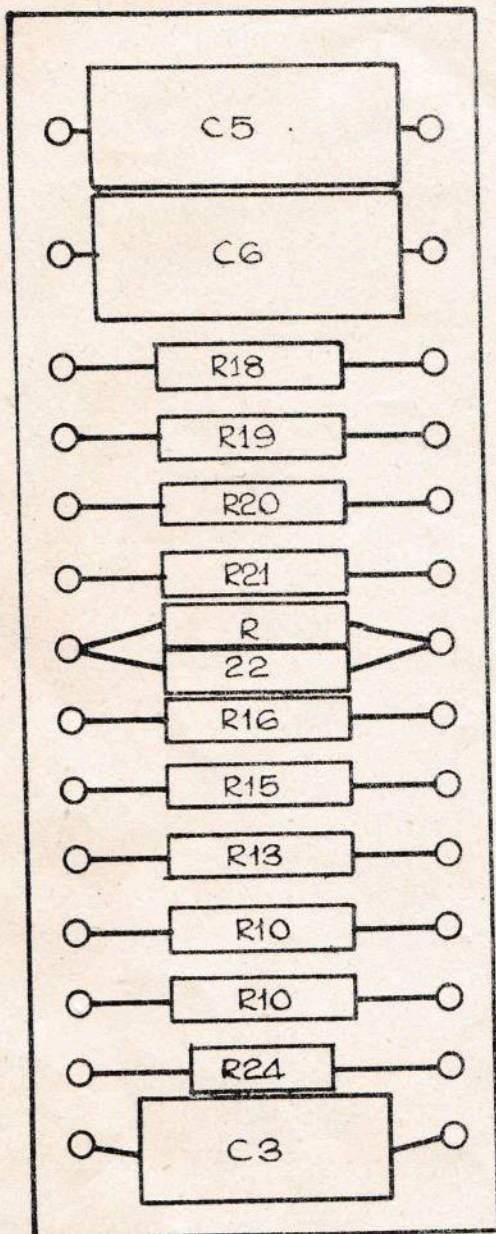
DEFLECTION AMPLIFIERS.

When it is known that a fault exists in one of the amplifiers both valves of an associated air or either axis should be removed. If one of these valves is defective, it should now be possible to obtain a visible beam or trace by manipulation of the shift controls. If both of the valves which have been removed are now placed in turn in the amplifier which is operating correctly, the faulty one may be eliminated, as it will appreciably disturb the control settings.

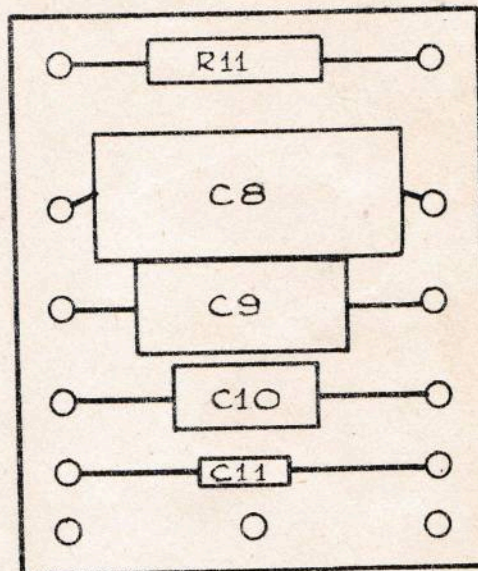
It will be readily apparent that if both of the valves initially removed are good, there will be no difference in the observed fault. Deterioration of the characteristics of any amplifier valve will be noted if the setting of the appropriate shift control departs appreciably from central. The foregoing tests must be made with no signal input to the 'Y' amplifier and the Time Base switched off.

TIME-BASE

If no horizontal deflection can be obtained when the 'X' amplifier selector switch S4 is set to 'T.B' reset the switch to 'A.C.' and connect the Cal terminal to the 'X' input. A deflection should now be obtained, indicating that the 'X' amplifier is functioning. Voltage checks at the points indicated on the circuit diagram enable it to be decided if the valve V.3 should be suspect or if any of the components R9, R10, R11, R12, R24 or VR4 are faulty. Failure of any of the condensers C8-11 will be immediately apparent on switching to the inoperative position. The trimmer condenser below the time-base valve-holder is adjusted for optimum linearity of the time-base and it should not be necessary to disturb this component.

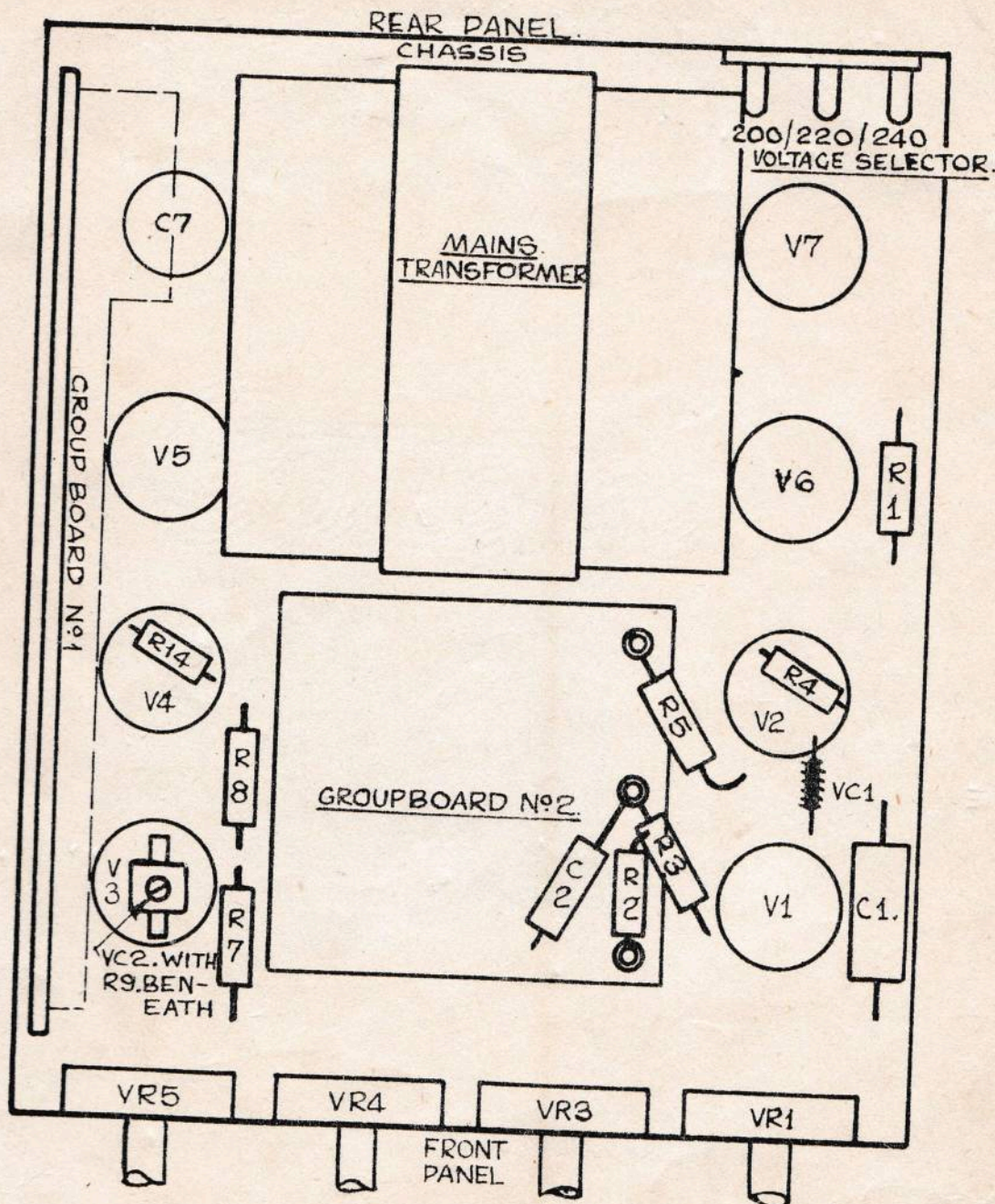


GROUP-BOARD No 1



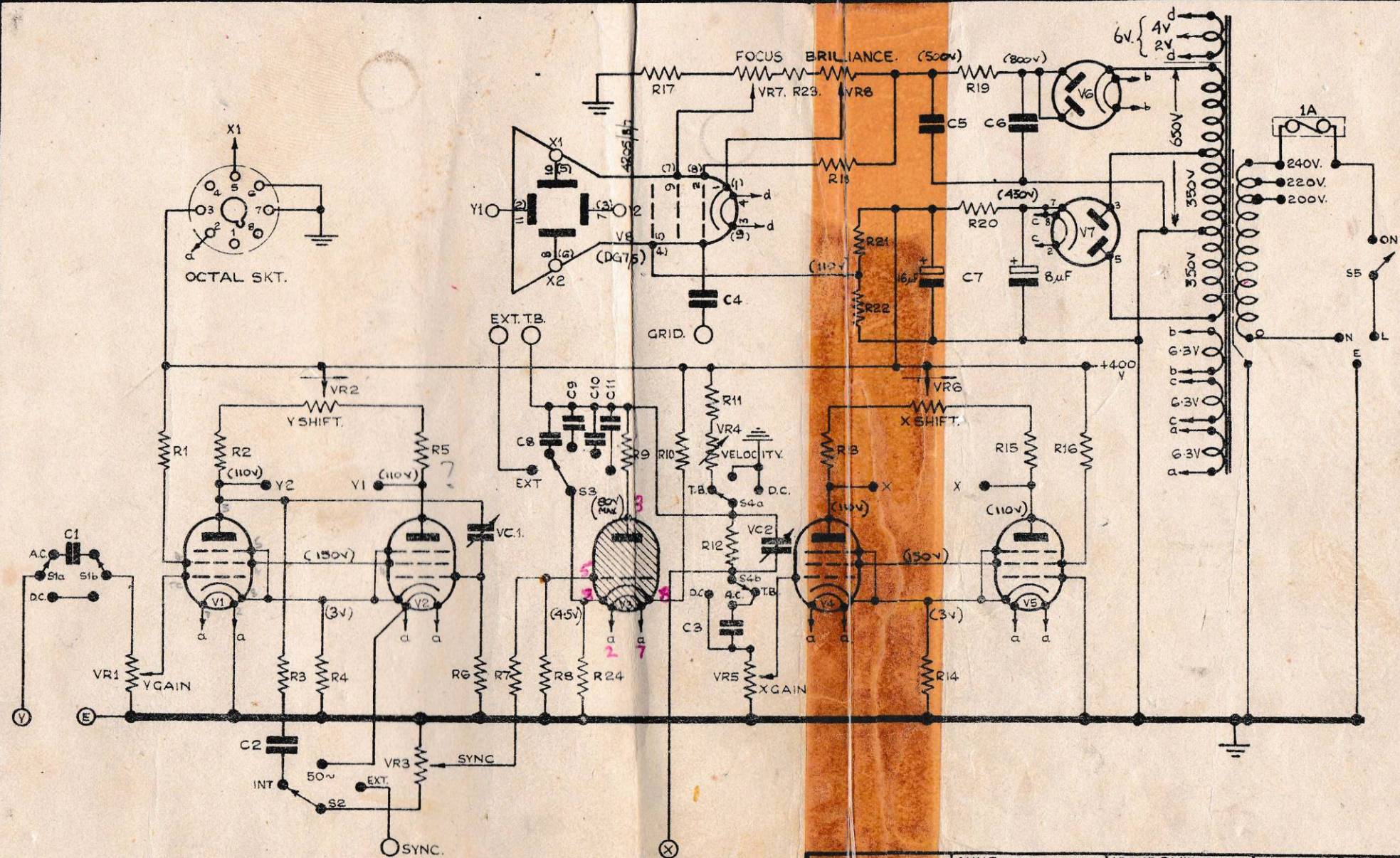
GROUP-BOARD No 2.

SKETCH SHOWS POSITION
OF COMPONENTS ON GROUP
- BOARDS.



SKETCH SHOWING POSITION OF COMPONENTS BELOW CHASSIS.

ITEM.	TYPE.
1	100 K Ω
2	22 K Ω
3	1 M Ω
4	330 Ω
5	22 K Ω
6	10 K Ω
7	1 M Ω
8	220 K Ω
9	100 Ω
10	100 K Ω
11	100 K Ω
12	1 M Ω
13	22 K Ω
14	330 Ω
15	22 K Ω
16	100 K Ω
17	1 M Ω
18	470 K Ω
19	1 M Ω
20	1.5 K Ω
21	220 K Ω
22	100 K Ω
23	220 K Ω
24	1 K Ω
25	0.1 μ F
26	1000 pF
27	0.1 μ F
28	0.01 μ F 1000V.
29	0.1 μ F
30	0.1 μ F
31	8+16 μ F
32	0.1 μ F
33	0.01 μ F
34	1000 pF
35	3-8 pF.
36	8-30 pF.
37	1 M Ω
38	100 K Ω
39	1 M Ω
40	5 M Ω +10 M Ω IN PAR
41	1 M Ω
42	100 K Ω
43	500 K Ω
44	100 K Ω
45	EF36
46	GK25
47	EF36
48	GX5GT
49	DG75 OR.
50	205/3/7.



NB: R8 ADJUST IN TEST AS NECESSARY.

DRN	CHKD:	ISSUE 2: VALVE TYPE	ISSUE 3: 4.11.53.
DATE	APPD:	R8, R19, R22, CHANGED	R18, C4 CHANGED
27.2.53.		ISSUE 1: REDRAWN	ISSUE 4: 24.11.54.
CIRCUIT.			1200B.
INDUSTRIAL ELECTRONICS, DERBY RD, EAST SHEEN, LONDON, S.W.14.			