SERVICING

Caution: Do not touch any part of the circuit while the power supply is connected to the instrument. When the oscillograph is switched off, two minutes, at least, must be allowed to elapse before touching any part of the wiring. Some tags of the CRT holder and terminals on the side panels carry very high potentials. Contact with such points is dangerous.

REMOVING THE INSTRUMENT CASE AND BOTTOM COVER

Switch off the oscillograph. Disconnect the instrument cable lead from the mains supply.

Remove the four screws at the rear of the instrument. Raise the instrument case at the rear and withdraw it from the instrument.

If the bottom cover hampers adjustments, remove it, complete with feet and raising member, by taking out the eight 4 B.A. screws which hold it to the instrument.

+ve 200 V STABILIZED SUPPLY

Before making adjustments to controls, check the +ve 200 V stabilized supply. If necessary, set the voltage correctly by adjustment of RV28 which is located on the top of the chassis, at the rear, and on the left-hand side.

A1 AMPLIFIER

Bias Adjustment

If a valve is changed in the amplifier, reset the bias so that the current in V1 and V2 is 10 mA each, and the current in V3 is 41 mA. To do this, put the A1 VOLTS RANGE switch to the 150 mV position and short the A1 input terminal to earth, reducing the possibility of stray coupling from the meter leads causing instability.

Adjust the pre-set potentiometers, RV1, RV2 and RV3, so that the voltage drop across the anode load of the associated valve is as given below:

Control	Voltage Drop	Across Resistors
RV1	100 V	R11
RV2	12 V	R16
RV3	80 V	R22 and R23 in series

Note: Pre-set control, RV1, is nearest the front panel and RV3 is towards the rear. Clockwise rotation of the potentiometers increases the voltage drop. If valves are being changed, it is good practice to set the associated control fully counter-clockwise before switching on.

Attenuator Compensation

N.B. A square-wave generator with a fast rise-time and up to 300 V output, 50 c/s to 50 kc/s, is necessary for this adjustment.

Put the A1 VOLTS RANGE switch in the 50 V position.

Inject a square wave of 20 to 30 V and adjust the time-base controls to give a stationary picture of 10 to 20 cycles of the square wave.

Using an insulated trimming tool, adjust C5, on the A1 Volts Range assembly, to give optimum response, that is, neither undershoot nor overshoot.

Put the A1 VOLTS RANGE switch to the 500 mV position. Reduce the input signal to give a deflection of 2 to 3 cm.

Adjust C7, mounted on the underside of the A1 amplifier chassis, for optimum response. Check that there is optimum response in all attenuator positions, readjusting C5 or C7 as necessary.

N.B. Allowance must be made for the instrument case, which affects these adjustments. Alternatively, a sheet of metal about 12 in. square, with holes to allow access to the trimmer capacitors, can be placed in position as a dummy case whilst the adjustments are being made.

Return the A1 VOLTS RANGE switch to the 50 V position.

Switch off and disconnect the mains supply from the instrument. Remove the bottom cover of the instrument as described on page 25.

Position the instrument securely on its left side and switch on again.

Inject the signal into the X30 attenuator terminal, keeping the signal lead well clear of the normal A1 input terminal.

Taking precautions to avoid contact with the E.H.T. smoothing capacitors in the centre of the chassis, use an insulated trimming tool and adjust the trimmer, C68, which can be reached through the hole in the screening can on the back of the A1 input terminals, to give the best average response.

Switch off and disconnect the instrument cable lead from the mains supply. Put the bottom cover in position and screw it to the instrument.

Place the oscillograph in its normal operating position and switch on again.

Voltage Calibration

Put the A1 VOLTS RANGE switch to the 150 mV position. Adjust the cursor of the A1 VOLTS scale so that the amount of over-travel is equal at each end of the scale.

Apply a peak-to-peak voltage of 100 mV, of frequency within the mid-band of the amplifier and of accurately known voltage, to the A1 input terminal.

Measure the amplitude of the applied voltage as described on page 5 but setting the cursor to 20 instead of zero. If the measurement on the cursor reads higher than 120 mV (100 + 20), turn RV12, the fourth potentiometer from the front on the bottom left-hand side, in a clockwise direction and repeat the measurement. Continue this sequence until the reading is correct.

Check that accuracy is maintained on other ranges using appropriate levels of input signal.

Note: Errors outside those expected within the tolerance limits indicate faulty components or switch contacts in the attenuator network. On the 50 mV range, gross errors indicate faults in the feedback network, R26 and R27.

A2 AMPLIFIER

Gain Control

To adjust the gain of the A2 amplifier so that it is equal to that of the A1 amplifier:

put the A1 VOLTS RANGE switch in the 5 V position;

turn the A2 VOLTS RANGE switch fully clockwise to the 5 V+ ↑ position;

feed identical signals (2 V to 3 V, 50 c/s to 50 kc/s) into the A1 and A2 amplifiers;

adjust the A2 Gain control (RV4), located nearest the front panel under the chassis on the left-hand side, to make the amplitudes of the two displays equal.

Note: When the range is changed, small variations, caused by component tolerances, may be noticed. If desired, this adjustment can be made on the range most used.

Gain Equality

When the gain has been adjusted as given above, turn the A2 VOLTS RANGE switch to the 5+ ↓ position. If the gain is different, adjust RV5, which is the centre pre-set control, to restore it to the same value as that given by the 5+ ↑ position.

Attenuator Compensation

Put the A2 VOLTS RANGE switch to the 500 V+ ↑ position.

Apply to the input terminal, a suitable square wave from a generator as used for the attenuator compensation in the A1 amplifier. Using an insulated trimming tool, adjust trimmer capacitor, C15 on the A2 VOLTS RANGE switch, for optimum response.

Turn the A2 VOLTS RANGE switch to the 15 V+ ↑ position. Reduce the input signal appropriately and adjust the trimmer, C17 in front of V5 on the top of the chassis, to give optimum response.

Put the A2 VOLTS RANGE switch in the 15 V+↓ position and adjust the trimmer, C78 behind V4 on the top of the chassis, in a similar manner.

Check on all other positions of the attenuator that the optimum adjustment has been found on all ranges.

Note: Errors outside those expected within the tolerance limits indicate faulty components in the attenuator network.

Voltage Calibration

Put the A2 VOLTS RANGE switch to the 5 V position. Adjust the cursor of the A2 VOLTS scale so that the amount of over-travel is equal at each end of the scale.

Apply a peak-to-peak voltage of 3 V, obtained from an a.c. source of frequency within the mid-band of the amplifier and of accurately known voltage, to the A2 input terminal.

Measure the amplitude of the applied voltage as described on page 6 but setting the cursor to 1 instead of zero. If the measurement of the cursor reads higher than 4 (1 + 3), turn RV6, the second potentiometer from the front at the bottom left-hand side of the chassis, in a clockwise direction and repeat the measurement. Continue the sequence until the reading is correct.

TIME-BASE

X Amplifier Compensation

Set RV19, the centre potentiometer of three located half-way up the time-base assembly, to its mid-point of travel.

Set C46, the upper trimmer capacitor of two mounted on the vertical support under the right-hand end of the time-base chassis, to its mid-point of travel.

N.B. This adjustment is not final and is repeated during the adjustment of time-base velocity.

Adjust the time-base to free-run. Turn the TIME-BASE FREQUENCY control fully counter-clockwise. Adjust the X AMP control so that the length of the trace is about 8 cm.

Feed a high-frequency signal of about 2·5 Mc/s to the A1 amplifier and synchronize the trace.

Adjust the trimmer, C64 which is below C46, to give the best linearity of trace. If necessary, use the X AMP control to maintain a trace of suitable length.

Repeat this adjustment on the other time-base range positions, up to 300 μsec, changing the frequency of the input as required and readjusting C64 as necessary until the optimum linearity on the last four range positions is obtained.

Time-base Velocity

Use a standard 0·5 μF capacitor to replace the capacitor fitted in the 100 msec range of the time-base circuit. If a standard capacitor is not available, adjust the time-base by trial and error.

Apply a 50 c/s signal of suitable amplitude, from a source of known frequency better than ±1 per cent, to the A1 amplifier.

Put the TIME RANGE switch to 100 msec and turn the TIME-BASE FREQUENCY control fully counter-clockwise.

Synchronize the display and adjust the SET TB (LOW SPEED) control, RV19, so that 5 cycles exactly are displayed on the trace.

Change the input frequency to 500 c/s and 5 kc/s in turn and check that the displays for the four ranges, 100 msec, 30 msec, 10 msec, 3 msec are in accordance with the Table given below.

Time Range	Frequency	Cycles Displayed
100 msec	50 c/s	5
30 msec	500 c/s	15
10 msec	500 c/s	5
3 msec	5 kc/s	15
1 msec	5 kc/s	5
300 μsec	50 kc/s	15
100 μsec	50 kc/s	5
30 μsec	500 kc/s	15
10 μsec	500 kc/s	5

Change the input frequency to 500 kc/s and put the TIME RANGE switch to 10 μsec.

Using an insulated trimming tool, adjust the trimmer capacitor, C46, so that 5 cycles exactly are displayed on the trace. Carry out again the procedure for X amplifier compensation, omitting the initial two steps (see page 28).

Re-check the time-base velocity against the table given above, obtaining optimum results by slight adjustment of RV19 at the low-frequency end and similar adjustment of C46 at the high-frequency end.

Time Scale Calibration

Feed a suitable signal of convenient amplitude and known frequency, for example, 1 kc/s, into the A1 amplifier. Put the TIME RANGE switch to the 5 msec position.

Set the TIME SCALE cursor to 1 and rotate the centre knob so that the start of the second cycle of the display is coincident with the centre line of the graticule.

Measure the time interval to the start of the fifth cycle (see page 8). If the reading of the cursor is greater than 4, turn the SET TIME CAL control, RV23, located at the right-hand end of the group of three potentiometers, in a clockwise direction to obtain the correct reading.

Conversely, if the reading is less than 4, turn the SET TIME CAL control in a counter-clockwise direction to obtain the correct reading.

Check the reading on all ranges and, if necessary, average out error by readjusting the SET TIME CAL control.

Trigger/Free Run Control

Put the TRIGGER/FREE RUN control to its central position. Adjust RV27, the potentiometer on the left of the group of three, until the time-base is on the verge of free-running.

Check on all time ranges and positions of the TIME-BASE FREQUENCY control, that it is possible to set the time-base either in the trigger or free-run condition as desired. If necessary, readjust RV27.

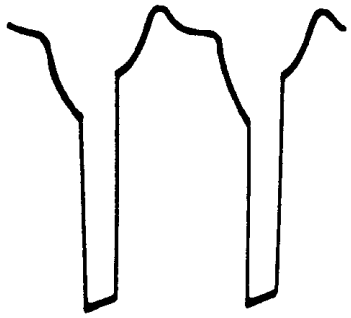
Setting RV30

Warning: The pre-set potentiometer RV30, which controls the voltage at the screen grid of V6B, is mounted just below V6 on tags 20 and 21 of the tag strip. The outer case of this control is slotted and functions as the control knob. In order to avoid contact with neighbouring high-voltage points when setting RV30, an insulated screwdriver must be inserted in the slot to rotate the outer case.

Connect the TEST WAVE terminal to the TRIGGER OR SYNC terminal. Connect the lead, coloured black-brown from the Sync Selector switch to tag strip, from the anode of V7A to the A2 INPUT terminal. Use the A1 SHIFT control to remove the Y1 trace from the display.

Set the A2 Volts Range switch to 15 V⏚, the Sync Selector switch to EXT. DIRECT + and the TRIGGER OR SYNC control to mid-position of travel (spot at 12 o'clock). Set TRIGGER/FREE RUN control to FREE RUN and the Time Range switch to 100 msec. Adjust the TIME-BASE FREQUENCY control to obtain a stationary pattern.

Set RV30 fully clockwise. Turn RV30 counter-clockwise until the bottom portion of the trace begins to square off as shown in the illustration below. Ensure that a similar waveform is obtainable with the Sync Selector switch positioned at EXT. DIRECT −.



Note: If the desired result is unobtainable. replace V6 which may be outside the tolerance limits.

HUM BALANCE

Place an earthed screen over the A1 Input terminals to prevent stray pick-up. Put the A1 VOLTS RANGE switch to the 50 mV position.

Reduce the brightness of the trace from its normal operating level to ensure optimum focus and adjust the time-base to free-run at its lowest speed.

Adjust the HUM BALANCE control, RV25, to give minimum deflection of the trace.

SETTING THE BRIGHTNESS CONTROL

Caution: An insulated screwdriver which will withstand at least 2 kV is required for the adjustment. The spindle of RV29 carries a high potential which is dangerous.

If the CRT is replaced, display any convenient signal on the CRT and turn the BRIGHTNESS control fully clockwise. Use an insulated screwdriver (insulation at least 2 kV) and obtain the brightest trace, consistent with freedom from defocusing, by resetting RV29 which is on the right-hand side towards the top and rear of the instrument.

BEAM EQUALIZER MAGNET

Caution: Safety measures must be taken to prevent inadvertent contact with the base of the cathode-ray tube (−ve 2 kV with respect to earth) when making the adjustment.

Rotate and slide the beam-equalizing magnet until the two traces are of equal brightness and also at maximum brightness simultaneously.

Note: It is also possible, if a particular known pair of signals are involved, to increase the brightness of the trace with maximum velocity, at the expense of the other trace, so that the apparent brightness of the two signals is the same.

VOLTAGE READINGS

A table of voltage readings is included to assist in servicing. Some variation of the figures must be expected because of component tolerances, and allowance must be made correspondingly. Readings were taken employing an Avometer Model 8, the highest range compatible with reading accuracy being used in each instance.

The asterisk against some of the readings indicates that high impedance gave misleading results and that the readings were taken either at the bottom end of the grid leaks or, if this was not possible, are corrected for the current drawn by the meter. For convenience, these readings are entered in the table as though they were taken actually on the valve pins indicated.

The oscillograph was set up as for normal working with an input of 225 V a.c. and the voltage range selector at 216 V–234 V. The time-base was adjusted so that it was just free-running on the 30 msec range with the Time-base Frequency control fully counter-clockwise and the X Amp control adjusted to give a trace 8 cm long (traces centred on the screen). No signal was injected and the Sync Selector control was set at Y1, direct, −ve normal position. All pre-set controls were adjusted correctly and the Brightness and Focus controls were set to give normal brightness for operating and optimum focus.

In general, all readings are relative to earth and are positive unless stated otherwise. The symbol ↑ indicates that the readings are taken between the heater pins of the valves and are a.c. readings.

Caution: Standard safety measures must be taken when measuring points at high potential relative to earth.

Valve Type	Valve	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9	T/C
M8083	1	G1* −1·1 V	K 0·1 V	H 6·3 V ↑	H	A 100 V	G3 0·1 V	G2 200 V	—	—	—
M8083	2	G1* −1·3 V	K 0 V	H 6·3 V ↑	H	A 188 V	G3 0	G2 200 V	—	—	—
EL822	3	Ic —	G1* −4 V	K 0·1 V	H 6·3 V ↑	H	Ic —	A 260 V	G2 200 V	G3 0·1 V	—
M8083	4	G1* 49·5 V	K 54 V	H 6·3 V ↑	H	A 220 V	G3 54 V	G2 330 V	—	—	—
M8083	5	G1* 49·5 V	K 54 V	H 6·3 V ↑	H	A 220 V	G3 54 V	G2 330 V	—	—	—
ECF80	6	AT 136 V	G1 −0·3	* G2 52 V	H 6·3 V ↑	H	A 125 V	G3-K 0	KT 56 V	GT 53·5 V	—
6BQ7A	7	A2 200 V	G2 107 V	K2 125 V	H 6·3 V ↑	H	A1 195 V	G1 125 V	K1 125 V	S —	—
6BQ7A	8	A2 200 V	G2 −23 V	K2 13·5 V	H 6·3 V ↑	H	A1 51 V	G1 13·5 V	K1 13·5 V	S —	—
ECF80	9	AT 200 V	G1 −45 V	G2 200 V	H 6·3 V ↑	H	A1 228 V	G3-K −42 V	KT 150 V	GT 146 V	—
EB91	10	K1 150 V	A2 0	H 6·3 V ↑	H	K2 0	S —	A1 150 V	—	—	—
6F33	11	G1 −5·5 V	H 0	H 6·3 V ↑	H	A 70 V	G3 0	G2 170 V	—	—	—
ECF80	12	AT 200 V	G1 −43 V	G2 200 V	H 6·3 V ↑	H	A 230 V	G3-K −40 V	KT 78 V	GT 70 V	—
CC3L	13	A 206 V	K 144 V	—	—	—	—	—	—	—	—

* Dependent on the setting of RV30

Valve Type	Valve	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9	T/C
CC3L	14	A 144 V	K 90 V	—	—	—	—	—	—	—	—
CC3L	15	A 90 V	K 35 V	—	—	—	—	—	—	—	—
CC3L	16	A 205 V	K 148 V	—	—	—	—	—	—	—	—
CC3L	17	A 148 V	K 90 V	—	—	—	—	—	—	—	—
CC3L	18	A 90	K 32 V	—	—	—	—	—	—	—	—
EL81	19	Ic —	G1 185 V	K 200 V	H 6·3 V ↑	H	Ic	Ic	G2 350 V	G3 200 V	A 350 V
EF91	20	G1 −1 V	K 0	H 6·3 V ↑	H	A 185 V	G3 0	C2 61 V	—	—	—
150C4	21	A 0	K −147 V	Ic —	K −147 V	A 0	Ic —	K −147 V	—	—	—
EZ81	22	A2 325 V a.c.	Ic	K 365 V	H 6·3 V ↑	H	Ic	A1 325 V a.c.	Ic —	Ic —	—
EB91	23	K1 −1960 V	A2 −2000 V	H 6·3 V	H	K2 −1960 V	1S —	A1 −1960 V	—	—	—
CR93D	24	G1 −1960 V X1 32 V	K† −1940 V X2 35 V	H 6·3 V Y1 0	H Y2 0	A2 −1450 V A4 350 V or 2000 V	S —	A1 0			

† Depends on the setting of RV29

C63	− ve 420 V	F1	0·6 A a.c.
C62	− ve 290 V	F2	0·6 A a.c.
C28	− ve 2320 V	F3	130 mA
C26	− ve 2070 V	F4	71 mA
C66	− ve 2510 V		

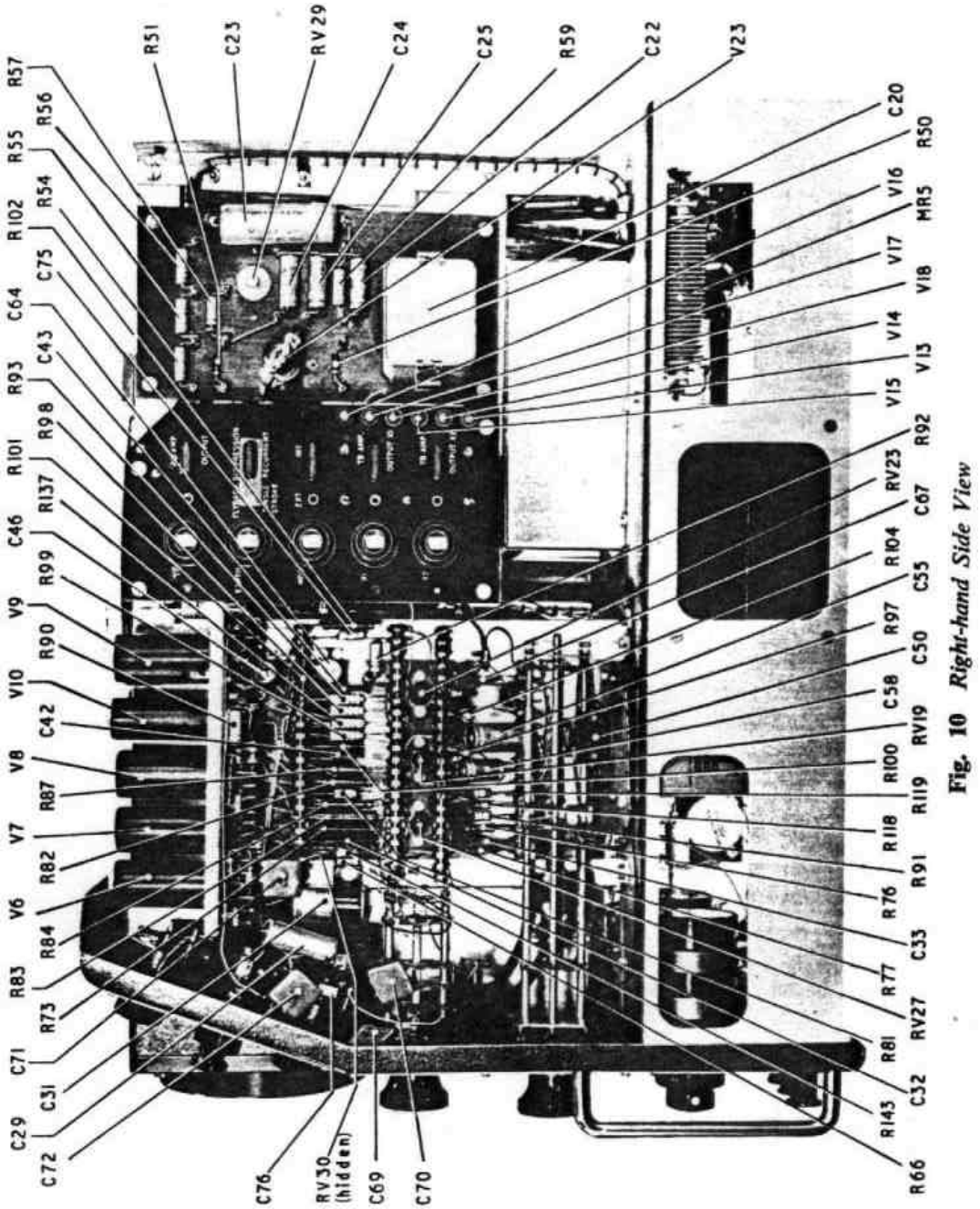


Fig. 10 *Right-hand Side View*

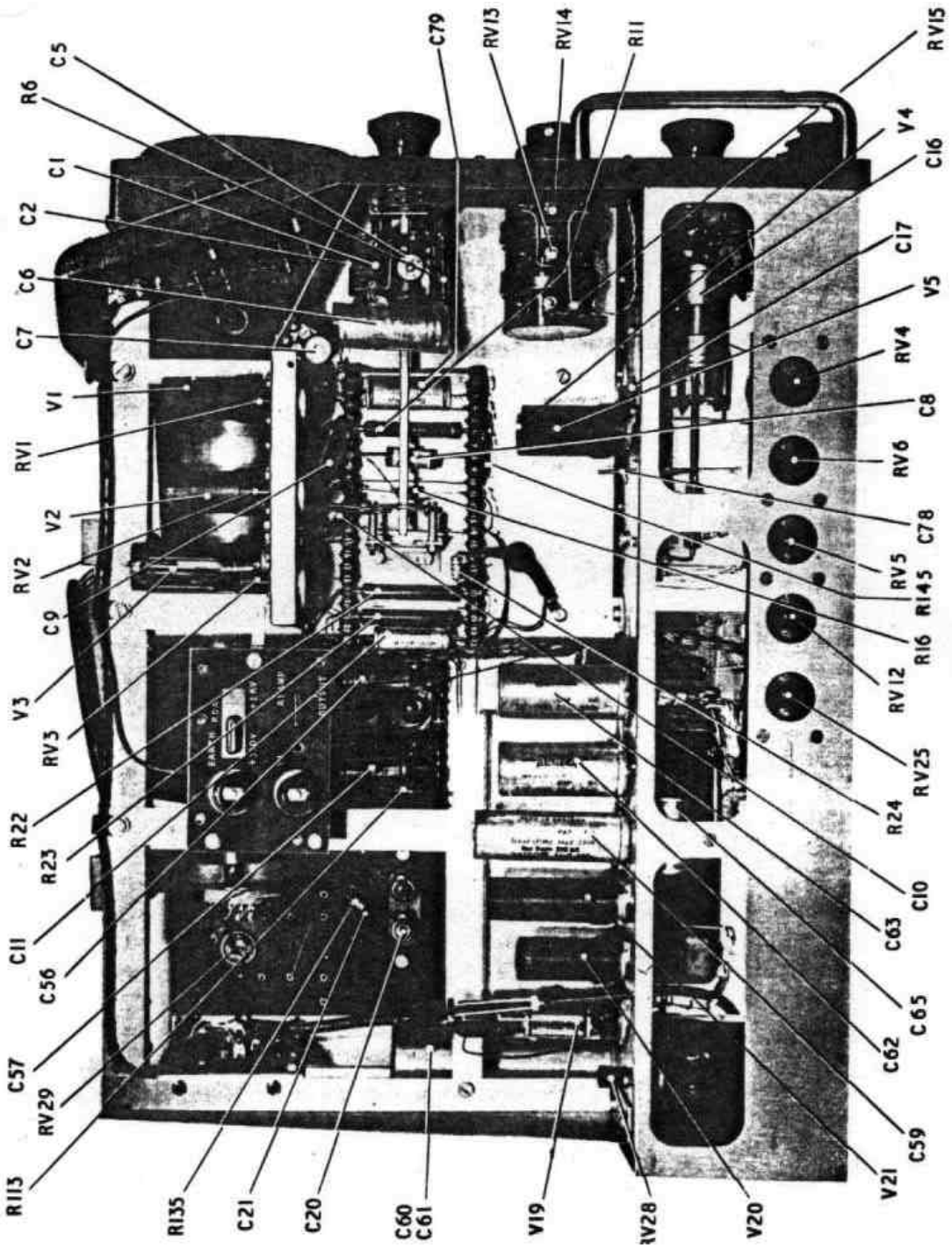


Fig. 11 *Left-hand Side View*

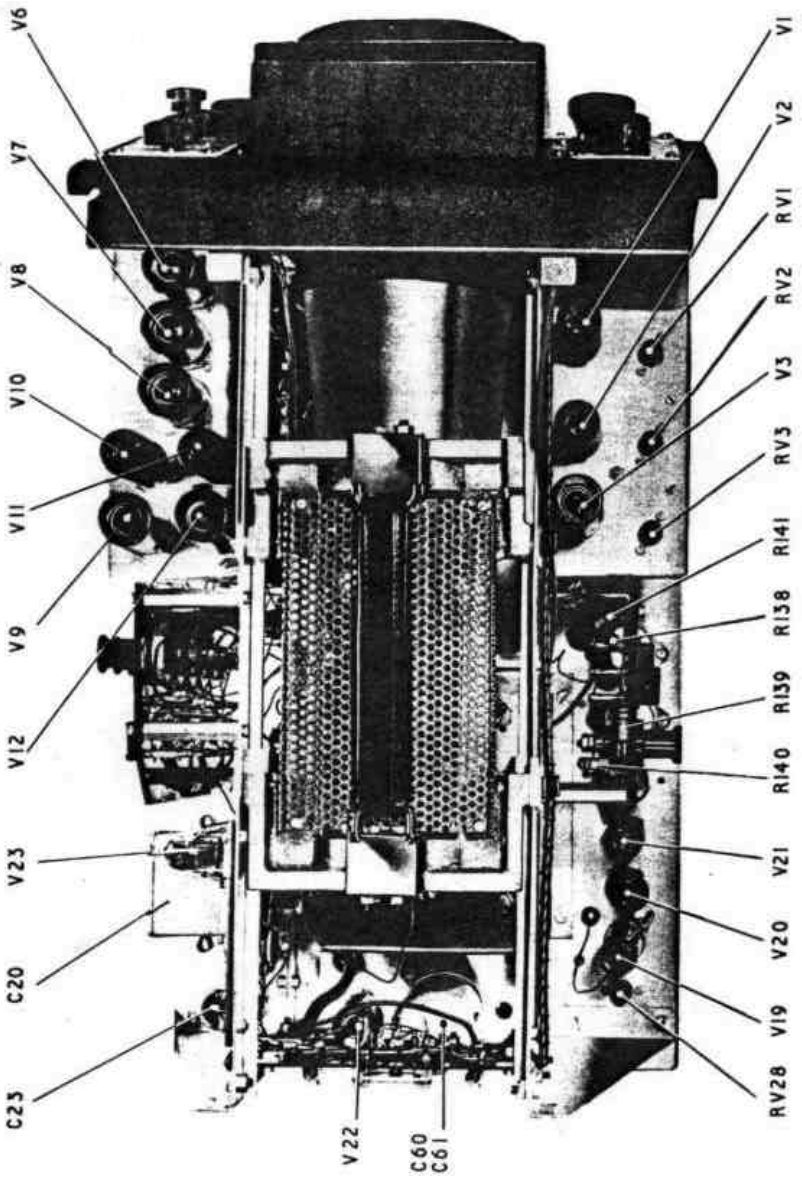


Fig. 12 *Top View*

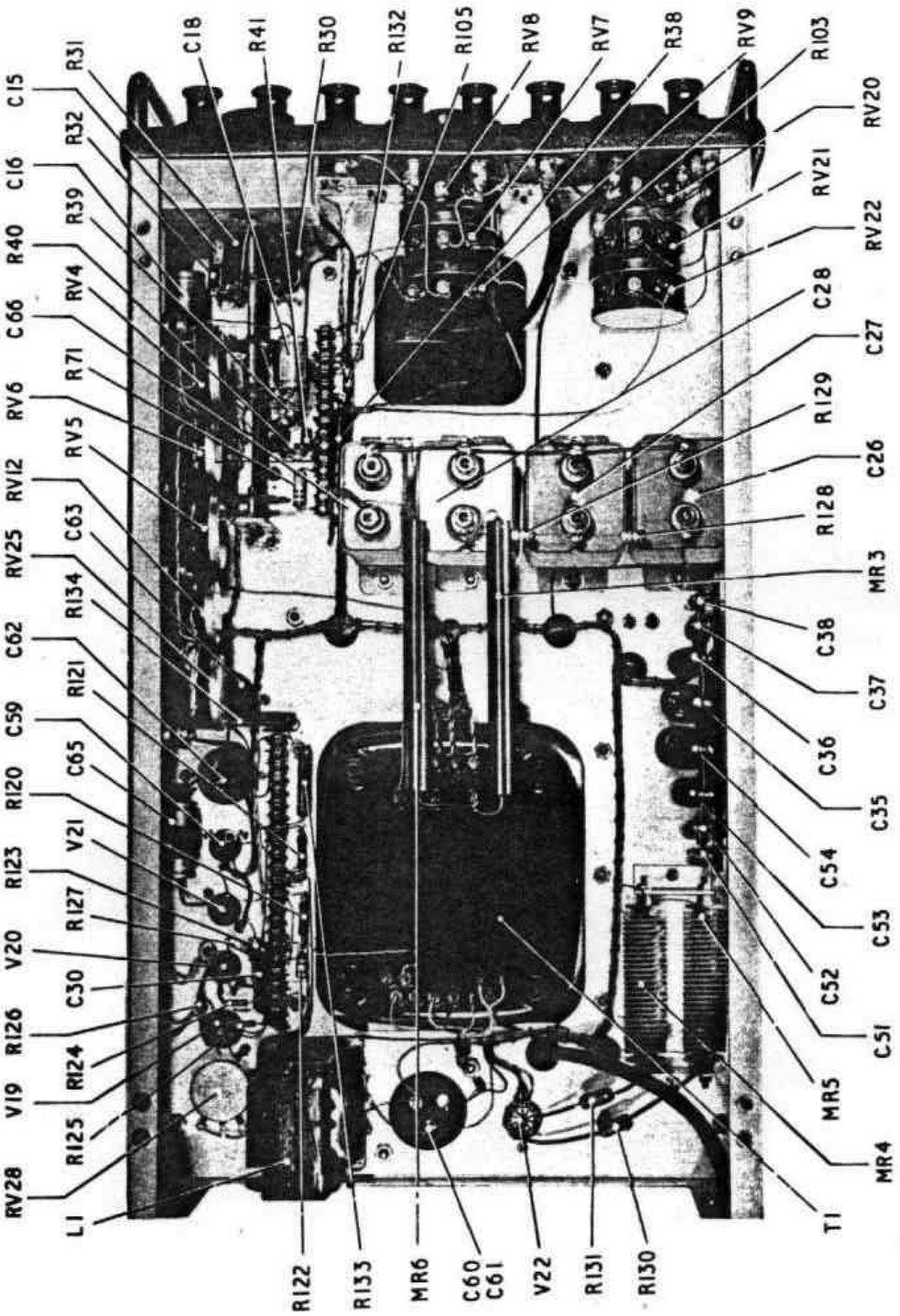


Fig. 13 *Bottom View*

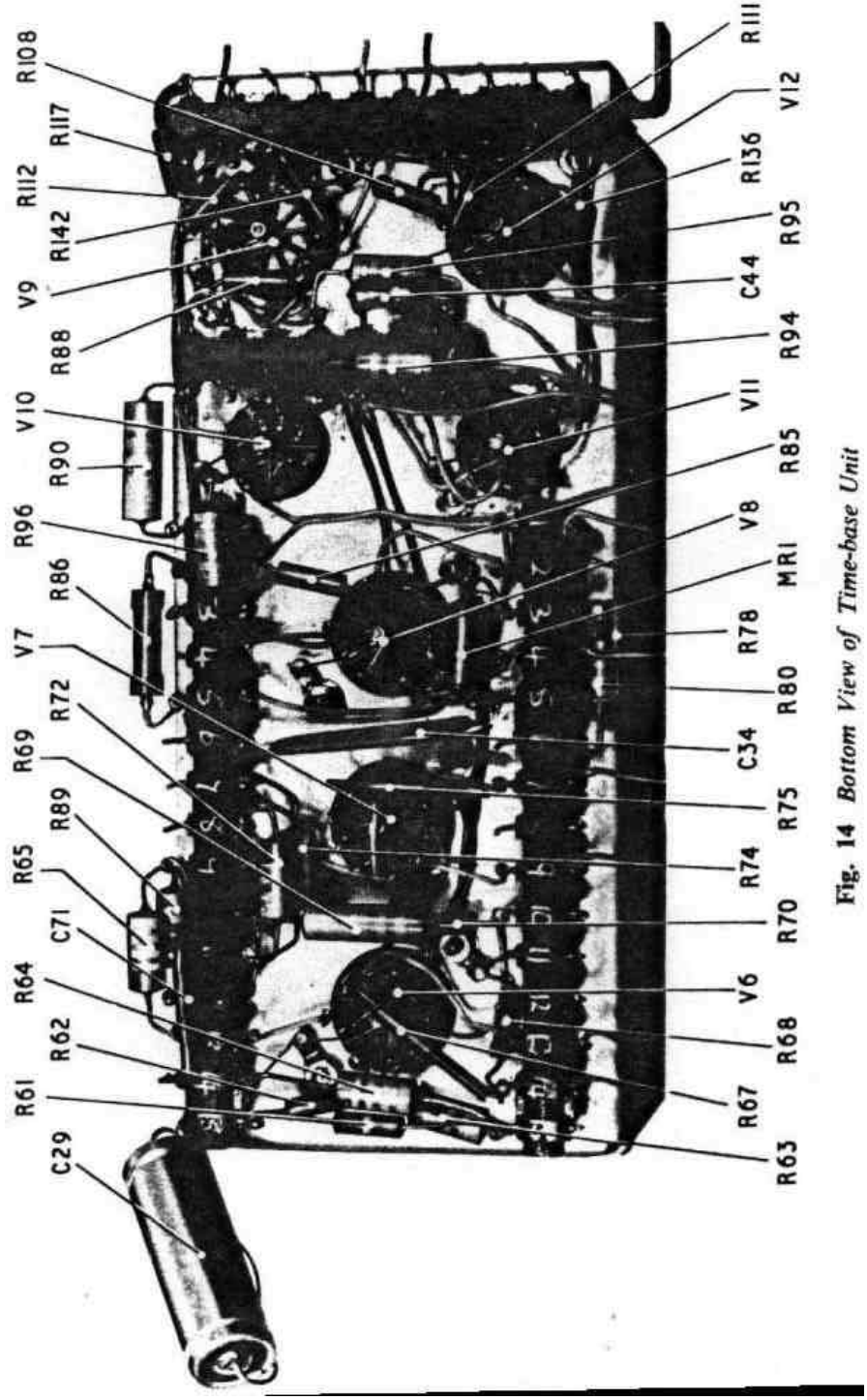


Fig. 14 *Bottom View of Time-base Unit*

CIRCUIT COMPONENTS

N.B. Orders for spare parts must include the instrument serial number which is marked on the top of the fuse panel.

Ref.	Value	Tolerance	Rating	Part Number
R1	100 Ω	±20%		DR16/10120
R2	3·03 kΩ	±2%	¼ W	ITB.3505/C21/3·03 kΩ/02
R3	10·4 kΩ	±2%	¼ W	ITB.3505/C21/10·4 kΩ/02
R4	33·3 kΩ	±2%	¼ W	ITB.3505/C21/33·3 kΩ/02
R5	150 kΩ	±2%	½ W	ITB.3500/C22/15402
R6	1 MΩ	±2%	¼ W	M132574/23
R7	430 kΩ	±2%	½ W	ITB.3500/C22/43402
R8	150 Ω	±20%		DR16/15120
R9	100 Ω	±20%		DR16/10120
R10	470 kΩ	±20%	¼ W	DRO9/47420
R11	10 kΩ	±5%	2 W	M132574/157
R12	26·6 MΩ	±2%	2 W	ITB.3505/C25/26·6 MΩ/02
R13	560 kΩ	±10%	¼ W	DRO9/56410
R14	150 Ω	±20%		DR16/15120
R15	100 Ω	±20%		DR16/10120
R16	1·2 kΩ	±5%	½ W	ITB.3500/C22/12205
R17	470 kΩ	±20%	¼ W	DRO9/47420
R18	100 kΩ	±10%	¼ W	DRO9/10410
R19	270 kΩ	±20%	¼ W	DRO9/27420
R20	100 Ω	±20%		DR16/10120
R21	56 Ω	±20%		DR16/56020
R22	1·1 kΩ	±2%	2 W	M132574/158
R23	1·1 kΩ	±2%	2 W	M132574/158
R24	47 kΩ	±20%	¼ W	DRO9/47320
R25	10 MΩ	±10%	¼ W	DRO9/10610
R26	1·27 Ω	±5%		M132587
R27	0·53 Ω			
R28	10·2 kΩ	±2%	¼ W	M132574/5
R29	37 kΩ	±2%	¼ W	M132574/138
R30	143 kΩ	±2%	½ W	M132574/141
R31	1 MΩ	±2%	¼ W	M132574/23
R32	910 kΩ	±2%	¼ W	M132574/149
R33	150 kΩ	±5%	½ W	M132574/48
R34	150 Ω	±20%		DR16/15120
R35	1·1 MΩ	±2%	½ W	M132574/143
R36	1·1 MΩ	±2%	½ W	M132574/143
R37	51 kΩ	±5%	¼ W	M132574/139
R38	22 kΩ	±5%	1 W	M132574/155
R39	100 Ω	±20%		DR16/10120
R40	150 Ω	±20%		DR16/15120
R41	8·2 kΩ	±10%	¼ W	DRO9/82210
R42	150 Ω	±20%		DR16/15120
R43	22 kΩ	±5%	1 W	M132574/155

Ref.	Value	Tolerance	Rating	Part Number
R44	100 Ω	±20%		DR16/10120
R45	8·2 kΩ	±10%	¼ W	DRO9/82210
R46	150 Ω	±20%		DR16/15120
R47	1 MΩ	±20%		DR16/10520
R48	1 MΩ	±20%		DR16/10520
R49	1 MΩ	±20%		DR16/10520
R50	4·7 MΩ	±20%		DR16/47520
R51	4·7 MΩ	±20%		DR16/47520
R52	1 MΩ	±20%		DR16/10520
R53	1 MΩ	±20%		DR16/10520
R54	330 kΩ	±10%	½ W	DRO8/33410
R55	330 kΩ	±10%	½ W	DRO8/33410
R56	330 kΩ	±10%	½ W	DRO8/33410
R57	180 kΩ	±10%	½ W	DRO8/18410
R59	2·7 kΩ	±20%	¼ W	DRO9/27220
R60	1 MΩ	±20%		DR16/10520
R61	100 kΩ	±20%		DR16/10420
R62	150 Ω	±20%		DR16/15120
R63	470 Ω	±10%	¼ W	DRO9/47110
R64	10 kΩ	±10%	¼ W	DRO9/10310
R65	10 kΩ	±10%	¼ W	DRO9/10310
R66	39 kΩ	±10%	¼ W	DRO9/39310
R67	150 Ω	±20%		DR16/15120
R68	100 kΩ	±20%		DR16/10420
R69	22 kΩ	±10%	½ W	DRO8/22310
R70	100 Ω	±20%		DR16/10120
R72	1·8 kΩ	±10%	¼ W	DRO9/18210
R73	56 kΩ	±5%	¾ W	M132574/150
R74	10 kΩ	±10%	¼ W	DRO9/10310
R75	100 Ω	±20%		DR16/10120
R76	270 kΩ	±5%	½ W	M132574/55
R77	330 kΩ	±5%	½ W	M132574/144
R78	22 kΩ	±20%		DR16/22320
R79	150 Ω	±20%		DR16/15120
R80	12 kΩ	±10%	¼ W	DRO9/12310
R81	3·3 kΩ	±10%	¼ W	DRO9/33210
R82	33 kΩ	±5%	¾ W	M132574/151
R83	3·9 kΩ	±5%	1 W	M132574/156
R84	600 Ω	±5%	¾ W	M132574/180
R85	150 Ω	±20%		DR16/15120
R86	150 kΩ	±5%	½ W	M132574/48
R87	560 kΩ	±5%	½ W	M132574/145
R88	1 MΩ	±20%		DR16/10520
R89	2·7 kΩ	±10%	¼ W	DRO9/27210
R90	330 kΩ	±10%	½ W	DRO8/33410

Ref.	Value	Tolerance	Rating	Part Number
R91	39 kΩ	±10%	¼ W	DRO9/39310
R92	6·8 kΩ	±10%	½ W	DRO8/68210
R93	6·8 kΩ	±10%	½ W	DRO8/68210
R94	100 kΩ	±10%	¼ W	DRO9/10410
R95	100 kΩ	±10%	¼ W	DRO9/10410
R96	470 kΩ	±10%	½ W	DRO8/47410
R97	270 kΩ	±10%	½ W	DRO8/27410
R98	33 kΩ	±10%	½ W	DRO8/33310
R99	33 kΩ	±10%	½ W	DRO8/33310
R100	100 kΩ	±20%		DR16/10420
R101	2·7 MΩ	±5%	¼ W	M132574/153
R102	470 kΩ	±5%	¼ W	M132574/154
R103	39 kΩ	±10%	¼ W	DRO9/39310
R104	39 kΩ	±10%	¼ W	DRO9/39310
R105	39 kΩ	±10%	¼ W	DRO9/39310
R106	82 kΩ	±10%	¼ W	DRO9/82310
R107	1·5 MΩ	±5%	¼ W	M132574/147
R108	150 Ω	±20%		DR16/15120
R109	51 kΩ	±5%	2 W	M132574/159
R110	30 kΩ	±5%	2 W	M132574/160
R111	150 Ω	±20%		DR16/15120
R112	150 Ω	±20%		DR16/15120
R113	30 kΩ	±5%	2 W	M132574/160
R114	51 kΩ	±5%	2 W	M132574/159
R115	82 kΩ	±10%	¼ W	DRO9/82310
R116	1·5 MΩ	±5%	¼ W	M132574/147
R117	150 Ω	±20%		DR16/15120
R118	110 kΩ	±10%	¼ W	DRO9/11410
R119	220 kΩ	±10%	¼ W	DRO9/22410
R120	500 kΩ	±2%	¼ W	M132574/140
R121	375 kΩ	±2%	¼ W	M132574/148
R122	150 kΩ	±10%	¼ W	DRO9/15410
R123	68 kΩ	±10%	¼ W	DRO9/68310
R124	150 Ω	±20%		DR16/15120
R125	150 Ω	±20%		DR16/15120
R126	150 Ω	±20%		DR16/15120
R127	180 kΩ	±10%	¼ W	DRO9/18410
R128	82 kΩ	±10%	¼ W	DRO9/82310
R129	82 kΩ	±10%	¼ W	DRO9/82310
R130	160 Ω	±10%	3 W	ITB.3501/3115/160 Ω/10
R131	160 Ω	±10%	3 W	ITB.3501/3115/160 Ω/10
R132	33 Ω	±20%	½ W	DRO8/33020
R133	5 kΩ	±10%	4·5 W	ITB.3501/3111/5 kΩ/10
R134	3 kΩ	±10%	4·5 W	ITB.3501/3111/3 kΩ/10
R135	100 kΩ	±10%	¼ W	DRO9/10410
R136	150 Ω	±20%		DR16/15120

Ref.	Value	Tolerance	Rating	Part Number
R137	33 kΩ	±10%	½ W	DRO8/33310
R138	10 MΩ	±10%	½ W	DRO8/10610
R139	10 MΩ	±10%	½ W	DRO8/10610
R140	10 MΩ	±10%	½ W	DRO8/10610
R141	6·8 MΩ	±10%	½ W	DRO8/68510
R142	150 Ω	±20%		DR16/15120
R143	18 kΩ	±10%	¼ W	DRO9/18310
R144	150 kΩ	±20%	½ W	DRO8/15420
R145	1 kΩ	±10%	¼ W	DRO9/10210
C1	3550 pF	±2%	350 V	M129619/355002
C2	1030 pF	±2%	350 V	M129619/103002
C3	323 pF	±2%	350 V	M129619/32302
C4	72 pF	±2%	350 V	M129619/7202
C5	3–12 pF		500 V	ITB.6500/3
C6	0·25 μF	±20%	500 V	M129709/6
C7	3–12 pF		500 V	ITB.6500/3
C8	50 μF		12 V	M131633/17
C9	0·1 μF	±10%	250 V	M129726/5
C10	0·1 μF	±10%	250 V	M129726/5
C11	0·1 μF	±20%	350 V	M129698/14
C12	1450 pF	±2%	350 V	M129619/145002
C13	405 pF	±2%	350 V	M129619/40502
C14	105 pF	±2%	350 V	M129619/10502
C15	5–25 pF		500 V	M128533/3
C16	0·25 μF	±20%	500 V	M129699/6
C17	2·75–15 pF		350 V	ITB.6501/4
C18	0·25 μF	±20%	150 V	M129698/2
C19	0·1 μF	±20%	350 V	M129698/14
C20	0·25 μF	±20%	2·5 kV	ITB.6037/·25/20/2500/CP10JA/I
C21	330 pF	±10%	350 V	M129619/33010
C22	0·1 μF	±20%	150 V	M129706
C23	0·1 μF	±20%	1 kV	M129701/13
C24	0·1 μF	±20%	150 V	M129706
C25	0·1 μF	±20%	150 V	M129706
C26	0·25 μF	±20%	2·5 kV	ITB.6037/·25/20/2500/CP10JA/V
C27	0·25 μF	±20%	2·5 kV	ITB.6037/·25/20/2500/CP10JA/V
C28	0·25 μF	±20%	2·5 kV	ITB.6037/·25/20/2500/CP10JA/V
C29	0·1 μF	±20%	350 V	M129698/14
C30	0·03 μF	−20%+80%	500 V	M129702/2
C31	1 μF	±20%	250 V	M129698/10
C32	0·001 μF	±5%	350 V	M129619/100005
C33	0·03 μF	−20%+80%	500 V	M129702/2
C34	560 pF	±10%	350 V	M129619/56010

Ref.	Value	Tolerance	Rating	Part Number
C35	0·5 μF	±5%	500 V	M129726/9
C36	0·15 μF	±5%	500 V	M129726/8
C37	0·05 μF	±5%	500 V	M129726/7
C38	0·015 μF	±5%	500 V	M129726/6
C39	5000 pF	±5%	350 V	M129619/500005
C40	1450 pF	±2%	350 V	M129619/145002
C41	450 pF	±5%	350 V	M129619/45005
C42	0·03 μF	−20%+80%	500 V	M129702/2
C43	390 pF	±5%	350 V	M129619/39005
C44	10 pF	±10%		M129612/8
C45	33 pF	±10%	350 V	M129619/3310
C46	5–25 pF		500 V	M128533/3
C47	100 pF	±5%	350 V	M129619/10005
C48	450 pF	±5%	350 V	M129619/45005
C49	1450 pF	±2%	350 V	M129619/145002
C50	5000 pF	±5%	350 V	M129619/500005
C51	0·015 μF	±5%	500 V	M129726/6
C52	0·05 μF	±5%	500 V	M129726/7
C53	0·15 μF	±5%	500 V	M129726/8
C54	0·5 μF	±5%	500 V	M129726/9
C55	0·25 μF	±20%	350 V	M129698/15
C56	0·1 μF	±20%	350 V	M129698/14
C57	0·1 μF	±20%	350 V	M129698/14
C58	0·25 μF	±20%	150 V	M129698/2
C59	32 μF + 32 μF		350 V	M131640/40
C60	100 μF		450 V	M131619
C61	60 μF			
C62	32 μF		450 V	M131640/52
C63	32 μF		450 V	M131640/52
C64	1·5–7 pF		500 V	M128533
C65	0·5 μF	±20%	250 V	M129698/9
C66	0·1 μF	±20%	2500 V	ITB.6037/1/20/2500/CP10GA/V
C67	0·03 μF	−20%+80%	500 V	M129702/2
C68	Trimmer			M148945 M148946
C69	0·03 μF	−20%+80%	500 V	M129702/2
C70	0·03 μF	−20%+80%	500 V	M129702/2
C71	0·03 μF	−20%+80%	500 V	M129702/2
C72	0·03 μF	−20%+80%	500 V	M129702/2
C73	0·03 μF	−20%+80%	500 V	M129702/2
C74	0·03 μF	−20%+80%	500 V	M129702/2
C75	18 pF	±10%	350 V	M129619/1810
C76	10 pF	±10%		M129612/8
C77	0·01 μF		1·5 kV	ITB.6014
C78	1·25 pF–11 pF		350 V	ITB.6501/5
C79	0·5 μF	±20%	250 V	M129698/9

Ref.	Value	Part Number
RV1	40 kΩ	M158581/2
RV2	40 kΩ	M158581/2
RV3	40 kΩ	M158581/2
RV4	1 kΩ	ISB.8000/10220
RV5	5 kΩ	M158577
RV6	40 kΩ	M158581/2
RV7	50 kΩ	M158517
RV8	50 kΩ	
RV9	50 kΩ	
RV10	250 kΩ	M158521/3
RV11	50 kΩ	M158521/12
RV12	40 kΩ	M158581/2
RV13	50 kΩ	M158517
RV14	50 kΩ	
RV15	50 kΩ	
RV16	250 kΩ	M158521/3
RV17	100 kΩ	M158606
RV18	100 kΩ	M158521
RV19	100 kΩ	M158581/3
RV20	50 kΩ	M158517
RV21	50 kΩ	
RV22	50 kΩ	
RV23	250 kΩ	M158581/4
RV24	5 kΩ	Ganged to RV17
RV25	200 Ω	M158577/3
RV26	100 kΩ	M158521
RV27	250 kΩ	M158581/4
RV28	100 kΩ	M158581/3
RV29	50 kΩ	IUB.8021/503320/75
RV30	10 kΩ	ISB.8034/3

Ref.	Description	Part Number
MR1	CG42H	ISB.9009
MR2	CG42H	ISB.9009
MR3	Z46H140X	M183537
MR4	Z11H26XE	M183538
MR5	Z11H26XE	M183538
MR6	Z46H140X	M183537
S1	3 pole, 7 way	M153631 M153632
S2	5 pole, 10 way	M153633 M153650
S3	5 pole, 12 way	M153634
S4	3 pole, 11 way	M153635
S5	double pole, double throw	ISB.4002/2

Ref.	Description	Part Number
T1	Transformer	IUB.3011
L1	Choke	IKA.30217
LP1 (Pilot Lamp)	6·3 V, 0·3 A	M201505
F1	3 A	M157503/11
F2	3 A	M157503/11
F3	750 mA	M157503/17
F4	250 mA	M157503/9

Ref.	Valve
V1	M8083
V2	M8083
V3	EL822
V4	M8083
V5	M8083
V6	ECF80
V7	6BQ7A
V8	6BQ7A
V9	ECF80
V10	EB91
V11	6F33
V12	ECF80
V13	CC3L
V14	CC3L
V15	CC3L
V16	CC3L
V17	CC3L
V18	CC3L
V19	EL81
V20	EF91
V21	150C4
V22	EZ81
V23	EB91
V24	CR93D

MECHANICAL PARTS

Description	Part Number
Knob, switch—large (maroon)	ITB.7503/2
Knob, flat with spindle hole through insert—small (maroon)	IUB.7505/16
Knob, flat with spindle hole through insert—large (maroon)	IUB.7504/4
Knob with spot, flat—small (maroon)	IUB.7505/13
Knob, with spot, flat—large (maroon)	IUB.7504/7
Knob with spot, miniature (maroon)	ITB.7511/4
Visor Adapter Plate Moulding	IVB.7524/2
Terminal	ITA.212/Maroon
Terminal	ITA.212/Black
Graticule and Pin Assembly	MC416362
Leather Carrying Handle	M199809
Rubber Feet	ISB.8508
Transparent Cursor	ISB.7516
Transparent Pointer	ISB.7517
Tube Magnet (CRT Clip)	M191519
Rubber Band for Tube Magnet	M164623
Raising Member	MC416045
Pilot Bulb Holder	M164500/2
Voltage Change Plug (black)	ISB.2503
Red Plug and Insulator Assembly	MC440320
Raising Member Channel and Retaining Clip Assembly	MC416218
P.D.A. Connector	ISB.1505

SPARES AND SERVICE

To assure the prompt despatch of spare parts, it is essential that the order includes the model number and serial number of the instrument, the description of the part(s), the part number(s) and the quantity required.

Whilst every effort is made by the Cossor Service Department to maintain an adequate supply of spares, a delay in despatch must be tolerated, usually, on those parts not expected to require replacement.

Where purchase of the instrument has been made through a Cossor Stockist or Agent, all service enquiries and orders must be routed direct to that supplier.

COSSOR INSTRUMENTS LTD.

A subsidiary of A. C. COSSOR LTD. and of RAYTHEON COMPANY U.S.A.

THE PINNACLES · ELIZABETH WAY · HARLOW · ESSEX · ENGLAND

Telephone: HARLOW 26862 Telegrams and Cables: Cossor Harlow Telex: 81228

Printed in England