EP 14

EDDYSTONE

PANORAMIC DISPLAY UNIT

STRATTON & CO. LTD.
ALVECHURCH ROAD
BIRMINGHAM 31

EDDYSTONE MODEL EP14

PANORAMIC DISPLAY UNIT

The EDDYSTONE Model EP14 is a general-purpose mains operated panoramic display unit for use with VHF/UHF receivers having intermediate frequencies in the range 5-60 Mc/s. A maximum display width of one megacycle is available and this can be narrowed to less than 30 kc/s to facilitate detailed analysis of individual signals. Used in this manner resolution is of the order 2 kc/s at the slower sweep speeds.

A double conversion circuit is used for input frequencies in the range 6.2-60 Mc/s but with a 5.2 Mc/s input, conversion is direct to the 2nd IF since the input frequency in this case is the same as the 1st IF of the unit. The 2nd IF channel has a selective crystal filter and is provided with manual gain control to increase the flexibility of the calibrated attenuator associated with the 1st IF.

The cathode ray tube is a medium persistence type with a green trace and has an extended hood to permit direct viewing under difficult lighting conditions. It has an engraved graticule to facilitate direct measurement and the hood dimensions are such that a standard oscilloscope camera can be fitted when required. A built-in crystal oscillator can be brought into operation to give marker pips at 100 kc/s intervals for calibration of the frequency scale. Four selectable sweep speeds simplify the accurate presentation of widely differing signal displays.

In addition to its main application as a display unit, the EP14 has provision for use as a wobbulator. Oscillator output and 'Y' Amp. input sockets are provided and the unit can be used for visual alignment of amplifiers having standard IF's of 5.2 Mc/s, 5.25 Mc/s, 10.7 Mc/s, etc. Its applications as a laboratory instrument are many and varied and include frequency measurement, drift checks and use as a sensitive RF voltmeter (20μV f.s.d.).

Advanced design, rugged construction and high quality components are used throughout. The unit is intended for rack-mounting and is fitted with a blower fan to allow prolonged operation at elevated temperatures. Operation is from any standard AC mains supply.

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Sole Manufacturers:- STRATTON & CO., LTD., ALVECHURCH ROAD, BIRMINGHAM 31, ENGLAND

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TECHNICAL DATA

GENERAL

Frequency Coverage. (Panoramic Display)

Fixed input of 5.2 Mc/s (1 megacycle bandwidth) and tunable over the band 6.2-60 Mc/s in two ranges.

Range 1 .. .. 6.2-25 Mc/s. Range 2 .. .. 25-60 Mc/s.

Frequency Coverage. (Wobbulator)

Dependent on the settings of the OSCILLATOR FREQUENCY switch and the WIDTH control. With the WIDTH control at 1 megacycle sweep and the OSCILLATOR FREQUENCY switch to position '1' the fundamental output is 5.42-6.42 Mc/s. The 2nd and 3rd harmonics of this range permit coverage of the bands 10.84-12.84 Mc/s and 16.26-19.26 Mc/s.

With the OSCILLATOR FREQUENCY switch to position '2' the fundamental range is modified to become 4.8-5.6 Mc/s and the harmonics then cover 9.6-11.2 Mc/s and 14.4-16.8 Mc/s.

Intermediate Frequencies.

5.2 Mc/s and 720 kc/s. Double conversion is used in the band 6.2-60 Mc/s. A selective crystal filter is fitted in the 720 kc/s IF.

Valve Complement.

Ref	Type	Circuit Function
V1	E180F or 6688 (CV3998)	Input Amplifier (grounded-grid).
V2	ECF80 or 6BL8 (CV5215)	1st Mixer/Oscillator.
V3	EF94 or 6AU6 (CV2524)	Cathode Follower.
V4	E180F or 6688 (CV3998)	5.2 Mc/s Amplifier (grounded-grid).
V5	ECF80 or 6BL8 (CV5215)	2nd Mixer/2nd (Sweep) Oscillator.
V6	ECF80 or 6BL8 (CV5215)	Reactance Control/Oscillator Cathode Follower.
V7	EF93 or 6BA6 (CV454)	1st 720 kc/s Amplifier.
V8	EF93 or 6BA6 (CV454)	2nd 720 kc/s Amplifier.
V9	EB91 or 6AL5 (CV140)	Detector.
V10	EF94 or 6AU6 (CV2524)	Crystal Calibrator.
V11	ECF80 or 6BL8 (CV5215)	'Y' Amplifier.
V12	ECF80 or 6BL8 (CV5215)	'X' Timebase Oscillator.
V13	ECF80 or 6BL8 (CV5215)	Timebase Inverter.
V14	150C2 or OA2 (CV1832)	HT Stabiliser.
V15	108C1 or OB2 (CV1833)	HT Stabiliser.
D1	GEX13 -	Harmonic Generator.
D2	100SC2 -	Variable Capacity Diode (2nd Oscillator).
D3	DD006 -	Linearising Diode.
D4	DD058 -	Blanking Diode.
D5/6	K8/20 -	EHT Voltage Doubler.
D7/10	DD058 -	HT Rectifier.
CRT	DH7-91 or 3AFP31 (CV5302)	($2\frac{3}{4}$" diameter, medium persistence)

Input and Output Impedances.

IF Input	..	50-75Ω (nominal) unbalanced.
'Y' Amp. Input	..	0.25MΩ.
Osc. Output	..	140Ω (approx) unbalanced.

Power Supply.

Single-phase AC mains 100/125V and 200/250V (40-60 c/s). Consumption : 55VA.

Display.

Signal amplitude (20dB full scale) on the vertical axis and frequency (1 Mc/s max) on the horizontal axis.

Calibrator.

An internal calibrator provides calibration markers at 100 kc/s intervals.

Camera.

Provision is made for fitting a standard oscilloscope camera. The hood dimensions are:- length : 3.3/32" (7.86 cm.), o/s diameter : 3.3/8" (8.57 cm.) at front edge with 1 degree outward taper towards rear.

CONTROL FACILITIES

Sweep Width.

Continuously variable from less than 30 kc/s to 1 Mc/s maximum with linear scale.

Sweep Rate.

Four selectable speeds; 5, 10, 20 and 40 sweeps per sec.

Centre Frequency Shift.

300 kc/s at all sweep widths.

Attenuator.

Calibrated in 10dB steps to -60dB maximum.

PERFORMANCE

Sensitivity.

Averages 20μV for full trace deflection with the attenuator at 0dB.

Resolution.

Dependent on rate and width of sweep. 2 kc/s at narrow sweep width with timebase set to 5 c/s position.

DIMENSIONS AND WEIGHT

Dimensions.

Panel	..	standard rack mounting	..	19" x 5¼" (48.3 x 13.3 cm.)
*Depth	..	(excluding c.r.t. hood)	..	15.1/16" (38.3 cm.)
*Depth behind panel (for rack installation)			..	13¾" (34.9 cm.)

*Dimensions are given to rear of cabinet and exclude projection of plugs etc.

Weight.

36 lb. (16.3 kg.).

CIRCUIT DESCRIPTION

Input Amplifier.

This stage is operated as a broad-band grounded-grid amplifier to provide coverage of the complete range 5-60 Mc/s without the need for tuning. A triode-strapped frame-grid pentode (V1 : E180F) is used with input to the cathode via the wide-band toroidal transformer T1. Two input sockets are available (one on the front of the unit and the other at the rear). The input impedance approximates 50-75Ω throughout the range.

The bandwidth of the amplifier is preserved in the anode circuit by the two chokes CH1 and CH2 together with the resistors R3 and R4. Coupling to the 1st Mixer Stage is via C3. The input stage operates at constant gain and its operating bias is developed across the cathode resistor R5.

1st Frequency Conversion.

An ECF80 triode-pentode (V2A/B) is used as a combined Mixer/1st Oscillator on the two tunable ranges (6.2-60 Mc/s) while in the 5.2 Mc/s position the Local Oscillator is disabled and the Mixer operates as a straight amplifier.

Range switching is by S2a-S2e. S2a is arranged to introduce an unbypassed resistor (R7) in the cathode of V2A when this stage functions as an amplifier. S2b and S2c select the appropriate oscillator coils associated with V2B while the two remaining sections (S2d and S2e) reverse the connections to the c.r.t. 'X' plates to cancel the frequency inversion which occurs when changing from single to double conversion (both oscillators run on the 'high' side of the signal). In this way, the left-hand end of the trace is always made to correspond to the lowest frequency of the display. (See Note on page)

The triode portion of V2 is used as the Local Oscillator and employs a conventional tuned-grid configuration with the HT supply taken from the stabilised line (HT2). The oscillator circuits are housed in a screened unit to which connections are made via a B7G plug and socket on the underside of the unit and a miniature 6-way connector on a flying lead which carries the 'X' plate connections to S2d/e. This arrangement permits removal of the oscillator unit without the need for unsoldering connections.

The screen supply for the pentode portion (V2A) is taken via one section of the CALIBRATOR switch (S1a). When this is placed in the 'CAL' position the HT is removed from the screen to prevent signal breakthrough and so simplify initial setting up of the unit.

5.2 Mc/s Stages and Calibrator.

Output from the 1st Mixer is taken to the Cathode Follower V3 via the over-coupled transformer T2. A triode-strapped EF94 is used in this position and provides the low impedance output necessary for connection to the 5.2 Mc/s filter comprising L1-L7. The response of this filter is combined with the double-humped response of T2 and the single peak of T3 to give an overall response which is level over the range 5.2 Mc/s ± 500 kc/s and cuts off sharply outside this band.

The filter has a characteristic impedance of the order 150Ω and is terminated in a six-step attenuator providing a maximum attenuation of 60dB. The low impedance at the output from the attenuator is matched to the high impedance of the 2nd Mixer Stage by the grounded-grid amplifier V4. Like the Input Amplifier, this stage also employs a triode-strapped E180F and is coupled to the grid of the 2nd Mixer Stage via C27.

Output from the Crystal Calibrator (V10 : EF94) is introduced at the anode of the grounded-grid stage by the variable injection capacitor C23a. The Calibrator employs a 100 kc/s crystal with feedback from the screen circuit L12/C66 which is tuned to the crystal frequency. The diode D1 (GEX13) in the anode circuit distorts the output waveform and the wanted harmonics are selected by the circuits L10/C62 and L11/C64 which resonate in the 5.2 Mc/s band.

The Calibrator is brought into operation by one section of the CALIBRATOR switch (S1c) which completes the HT supply to V10 in the 'CAL' and 'CAL & SIG' positions. One of the other sections (S1a) provides gain reduction in the 'CAL' position by removing the screen voltage from V2A while the remaining section introduces R44 in the cathode circuit of V7 and V8 as described at the foot of this page.

Provision is made for setting the crystal accurately to 100 kc/s by adjustment of the pre-set capacitor C67.

2nd Frequency Conversion.

Output from the last 5.2 Mc/s stage is coupled to g1 of V5A ($\frac{1}{2}$ ECF80) which functions as the 2nd Mixer Stage. Injection from the 2nd (Sweep) Oscillator is to the same grid via C28.

The Oscillator employs the triode portion of V5 in a Colpitt's circuit with the coil L13 (which is wound on a ferrite core) located between the pole-pieces of the soft-iron-cored inductor L14. The magnetic field associated with L14 follows the sawtooth variations in the anode current of the Reactance Control Valve and so varies the effective permeability of the ferrite core to sweep the oscillator over the selected range. The actual coverage is determined by the setting of S4. The normal position is '1' and in this case a maximum sweep of 5.42-6.42 Mc/s obtains. Position '2' is used only when the unit is employed in wobbulator service for alignment of amplifiers in the 5.2 Mc/s band. In this case the oscillator coverage becomes 4.8-5.6 Mc/s due to the introduction of C74/C75 across the oscillator tuned circuit.

The pentode portion of V6 (ECF80) is used as the Reactance Control Valve. A pre-set variable resistor (RV3) in series with the cathode return of this stage provides a means of setting the standing anode current to such a value that the Sweep Oscillator centre-frequency (with S4 at position '1') is exactly 5.92 Mc/s. This adjustment is made during initial alignment of the unit and is carried out with the panel control RV2 at the mid-travel position. RV2 then provides the normal 'centre-frequency' function by controlling the reverse bias applied to the variable capacity diode D2 (100SC2) which is wired in parallel with the oscillator tuned circuit.

The width of the frequency sweep is controlled by RV5 which varies the amplitude of the sawtooth voltage applied to the grid of V6B. The linearity of the sweep is adjusted during alignment by the pre-set control RV4 which is in series with the Linearising Diode D3 (DD006).

The triode portion of V6 functions as a cathode follower to provide an outlet for the Sweep Oscillator when the EP14 is used as a wobbulator. Provision of an external attenuator may be necessary in cases where there is no form of gain control on the amplifier being tested. The output impedance at the 'OSC OUT' socket is of the order 140Ω and any suitable coaxial attenuator can be used.

720 kc/s Amplifiers and Detector.

Output from the 2nd Mixer Stage is coupled through T4 to a symmetrically phased crystal filter before passing to the two 720 kc/s Amplifiers V7 and V8 (2 x EF93). The cathodes of V7/V8 are returned to one section of the CALIBRATOR switch (S1b) and in normal operation ('SIG' and 'CAL & SIG') the circuit is completed by the GAIN control RV1. When the CALIBRATOR switch is moved to 'CAL', RV1 is taken out of circuit and the gain is set at a fixed level by R44. This arrangement eliminates the need for re-adjustment of the GAIN control when moving between the 'CAL & SIG' and 'CAL' positions because at low gain settings the marker pips would not be visible.

The 2nd 720 kc/s Amplifier feeds the Detector V9 which is a low impedance type employing an EB91 with both diodes strapped in parallel.

C.R.T. Circuits.

A positive-going output is developed across the Detector load resistor R49 and applied directly to the triode grid of the ECF80 (V11) which serves as the 'Y' Amplifier. SKT4 provides a means of connecting an external detector circuit to the 'Y' Amplifier when using the EP14 as a wobbulator. The input is blocked to DC by C88.

The triode portion of V11 is direct-coupled to the pentode portion, the anode of which feeds directly the Y2 plate of the c.r.t. RV6 is connected to the other 'Y' plate and provides the normal 'Y' shift function.

The focus and brilliance adjustments follow normal oscilloscope practice. and, as mentioned previously, the 'X' plates are switched by S2d/e to preserve the direction of frequency calibration. S5d introduces compensating resistors to maintain the centre frequency as the timebase frequency is changed.

Another ECF80 is used in the Timebase circuit (V12). This provides a negative-going sawtooth with an extremely fast flyback and is set to produce a full width trace on the scanning stroke by adjustment of the pre-set control RV10. The function of this 'width' control (marked 'X' WIDTH) should not be confused with that of RV5 which controls the width of the frequency spectrum shown on the display; the trace width is always the same. Flyback suppression is by a negative pulse which is developed at the anode of V12A and applied to the grid of the c.r.t. via the shaping diode D4 (DD058).

The output from the Timebase is inverted before application to the grid of the Reactance Control Valve. The positive-going sawtooth which results simplifies the linearisation arrangements in the grid circuit of V6B. The inversion is performed by V13 (ECF80) which comprises a cathode follower and direct-coupled amplifier. Capacity coupling is used to the grid of V6B to avoid complications in the biasing arrangements on this stage.

Power Supply.

The power supply section provides four separate HT and three 6.3V LT supplies. Rectification for the positive HT supplies is by four silicon diodes (D7-D10 : DD058) arranged in a conventional bi-phase half-wave circuit. Protection against voltage surges is by the limiting resistors R120 and R122 and the thermistor R121 (CZ6) which is wired in series with the centre-tap of the HT secondary winding.

The main HT rail (HT1) runs at 350V and it is from this line that the other two positive supplies are developed. HT1 supplies the 'Y' Amplifier, Timebase, Inverter and the shift networks for the c.r.t. V14 (150C2) and V15 (108C1) are series connected to provide a stabilised supply of 258V (HT2) which feeds the oscillators and V6B. The other positive supply is of 250V (HT3) to feed the remaining stages.

HT4, the negative EHT supply, is derived from the voltage doubler circuit (D5/D6 : 2 x K8/20) which is fed from one half of the HT secondary. Resistance-capacity smoothing is used (C100/C101/R119) and the output voltage is of the order -800V.

The three LT supplies are rated at 4A, 2.5A and 1A respectively. LT1 has an earthed centre-tap and feeds the heaters of V1-V10. LT2 has its centre-tap returned to the divider network R117/R118 to bring the heater/cathode voltage of V12 within the ratings for the valve. LT3 is insulated to 1000V and supplies the heater of the c.r.t.

A blower fan is provided for cooling and is operative regardless of ambient temperature. It is permanently adjusted for 110V operation and connected across one 110V section of the power transformer primary. Thus on 200/250V working the primary winding of the transformer serves as an auto transformer to give the correct working voltage. Details on adjustment of the power transformer primary taps will be found in the Section dealing with 'Installation.'

INSTALLATION

GENERAL

The EP14 is supplied complete with all valves and c.r.t. and is designed for use in a standard 19" rack. Panel height is 5¼" and the rear of the cabinet extends 13¾" behind the back edge of the panel. An additional 2¼" should be allowed for the projection of leads etc.

When installing the unit in an enclosed rack, care must be taken to avoid restricting the air flow to the blower fan which is located at the rear of the cabinet. If possible, mount the EP14 at a height that coincides with an existing ventilation area in the rear of the rack.

EXTERNAL CONNECTIONS

Mains.

The AC mains supply is connected to a socket at the rear using the connector provided with the unit. The connector is a non-reversible type and is supplied ready-wired with six feet of 3-core mains cable. One end of the lead is left free so that the user can fit a plug of a type suited to the installation. The wires are coded as follows:

Red : Live line. Black : Neutral line. Green : Earth.

The EP14 is despatched from the factory with the tappings on the power transformer set for 240V operation. The transformer has two separate primary windings (operated in series for 200/250V and in parallel for 100/125V). Taps are adjusted as shown in the Table below. A diagram showing the transformer connections appears on the next page.

Supply	Link	Input to
100V	M & H L & G	M & L
110V	M & H K & F	M & K
120V	M & H J & E	M & J
125V	M & H J & E	M & J
200V	L & H	M & G
210V	K & H	M & G
220V	J & H	M & G
230V	J & H	M & F
240V	J & H	M & E
250V	J & H	M & E

NOTE DO NOT ALTER THE CONNECTIONS TO THE FAN WHEN CHANGING TAPS ON THE POWER TRANSFORMER.

The fan is adjusted for 110V operation and connection is such that the fan operates normally regardless of the mains input voltage.

Input Sockets.

Two parallel-connected input sockets are provided, one on the front panel and the other at the rear of the unit. Connection can be to either socket and the one most convenient to the installation would obviously be employed. Standard Belling Lee L.734 plugs (provided with the unit) are used for connection.

Connection to the receiver.

The method of connecting the input to the receiver with which the unit is used will depend on the circuit arrangements involved. In many cases, the receiver will have an IF output socket so that direct connection can be made. The bandwidth available will of course be dependent on the point in the IF chain at which the output is taken. This information should be found in the Instruction Manual supplied with the receiver. If the output is taken late in the IF chain it may be better to re-wire the socket so that advantage can be taken of the greater bandwidth available at say the anode of the (1st) Mixer Stage. One convenient method of connection at this point is as follows:-

Locate the decoupling capacitor in the HT feed to the 1st IF Transformer and lift its earth connection. Fit a suitable stand-off tag and return the capacitor to earth through a resistor of say 68Ω. Output is taken from the junction between the resistor and capacitor using coaxial cable, either to the existing socket or to an additional one mounted in a suitable position. Slight re-alignment of the IF Transformer may be needed.

Another simple method is to lift the earthy side of the bypass capacitor on the cathode of the 1st IF Amplifier. The capacitor can then be used as a coupling capacitor to feed the coaxial output. Bandwidth will be slightly less than in the previous case but the connection may be more easily accessible.

If the bandwidth obtained by using either of the foregoing methods is not sufficient, greater bandwidth can be achieved by wiring a resistor in series with the HT+ side of the 1st IF Transformer primary tuning capacitor. The output is taken from between the capacitor and resistor and must be blocked to DC by a suitably rated capacitor of 0.001-0.01µF. The bandwidth will depend on the value of the resistor and this can be varied within quite wide limits to produce the desired effect.

The loss of gain produced by this last arrangement will be somewhat greater than that which results from use of the other two methods. This will not be serious in so far as the EP14 is concerned but it may possibly reduce the usefulness of the receiver in normal 'audio' applications.

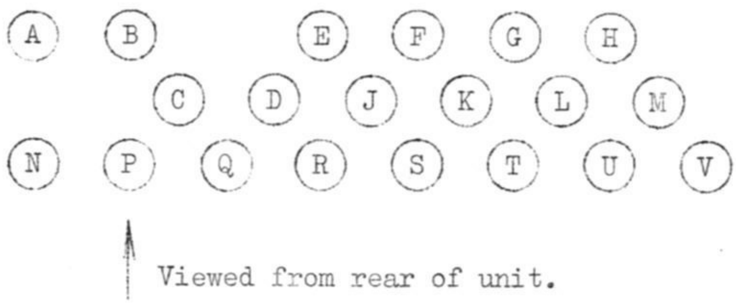
Oscillator Output and 'Y' Amplifier Input.

These two sockets are both located on the front of the unit and are used only when the EP14 is employed as a wobbulator. Connection is by Belling Lee Type L.734 plugs terminating coaxial leads. When not in use, the 'OSC OUT' socket is shorted with the special plug provided with the unit. This **reduces** direct pick-up of the oscillator signal and its harmonics by the receiver with which the unit is used.

Earth.

The terminal at the rear should be bonded to the rack in which the unit is installed.

Power Transformer Connections.



Viewed from rear of unit.

Primary 1 : E(+10)/F(0)/G(10)/H(110).
Primary 2 : J(+10)/K(0)/L(10)/M(110).
HT Sec. : Q(350)/R(0)/S(350).
LT1 : N/P(CT)/C.
LT2 : T/U(CT)/V.
LT3 : A/B.
Screen : D.

OPERATION

CONTROL FUNCTIONS

Tuning.

This control tunes the oscillator associated with the 1st Mixer Stage and is adjusted to heterodyne the input frequency to the 1st IF of the display unit (5.2 Mc/s). Calibration, which is directly in terms of input frequency appears in a window to the left of the control. A reduction drive with a 6:1 reverse vernier provides for 'fine' adjustment. The tuning scale is printed in two colours (Range 1 : green, Range 2 : red) and an overlap is provided between ranges.

The control is non-functional when the BANDSWITCH is set to 5.2 Mc/s since in this case the oscillator concerned is disabled and the unit operates with single conversion.

Bandswitch.

Selects the appropriate oscillator coil on the two tunable ranges (6.2 - 25 Mc/s and 25 - 60 Mc/s). In the 5.2 Mc/s position it disables the oscillator and modifies the circuit of the 1st Mixer Stage such that this operates as a straight amplifier. A further function performed by this control is reversal of the 'X' plate connections to cancel the frequency inversion that occurs when changing from single to double conversion. Thus the left-hand end of the trace is always the lowest frequency. (See Note on page 11)

Oscillator Frequency Switch.

For normal operation, this control is always set to Position '1'. Position '2' is used only when the unit is employed as a wobbulator. Its function is to modify the coverage of the 2nd (Sweep) Oscillator to provide for alignment of 5.2 Mc/s amplifiers. It may also be found convenient to use the alternative range when aligning an amplifier on a frequency towards the low end of the normal swept range. Use of Position '2' in this case will bring the wanted response closer to the centre of the tube thus allowing greater freedom in use of the WIDTH control to give a larger display.

Calibrator Switch.

The CALIBRATOR switch has three positions as follows:

SIG	Calibrator 'off', normal display.
CAL & SIG	Calibrator 'on', normal display.
CAL	Calibrator 'on', no signal display.

Calibration markers appear as 'pips' at 100 kc/s intervals across the trace and are usable at all sweep widths greater than 100 kc/s. The amplitude of the pips is affected by the setting of the GAIN control when in the 'CAL & SIG' position. The GAIN control is inoperative in the 'CAL' position.

Width.

Provides adjustment of the width of the spectrum being viewed by controlling the excursion made by the 2nd (Sweep) Oscillator during each cycle of the timebase output. The control provides a maximum sweep width of 1 megacycle for checking station congestion, activity etc. and a minimum width of less than 30 kc/s when observation of a single signal is called for. The sweep width in terms of frequency can be checked at any time by switching on the internal calibrator.

Centre Frequency.

Permits 'fine' adjustment of the centre frequency independently of the external receiver and input tuning. An overall movement of approximately 300 kc/s is available by adjustment of this control which varies the bias to a capacity diode connected across the 2nd Oscillator tuned circuit.

Gain Control.

This controls the overall gain of the unit by variation of the bias on the two 720 kc/s Amplifiers. The range of adjustment provided can be supplemented by altering the setting of the ATTENUATOR if this is found necessary.

The main function of the GAIN control is to initially set the display amplitude against the crossed lines on the tube graticule so that comparative measurements can be made by use of the ATTENUATOR.

It should be noted that the GAIN control varies the amplitude of both the signal display and the calibration markers when the CALIBRATOR switch is at 'CAL & SIG'.

Attenuator.

Provides up to 60dB signal attenuation in 10dB steps to facilitate direct measurements on the signal display. The relative levels of a number of signals can be compared rapidly by setting one signal to a convenient reference level and adjusting the ATTENUATOR to give the same display amplitude on the other signals. The difference in level can be deduced immediately from the ATTENUATOR readings.

When examining a single signal, adjustment of the GAIN control will allow the display to be set to occupy the full height of the graticule (corresponding to 20dB) with the ATTENUATOR at the lowest level achievable in relation to the strength of the signal. In the case of strong signals for example the attenuation can be increased to -60dB so that it is possible to view the response at a maximum of 80dB down.

The ATTENUATOR occurs prior to the point in the circuit at which the calibration markers are injected. Thus adjustment of the ATTENUATOR does not affect the height of the markers which remain at the height determined by the setting of the GAIN control.

Timebase Frequency.

This control provides four selectable sweep speeds of 5, 10, 20 and 40 c/s. In general, the lower speeds will be used when examining relatively narrow bands of frequencies (narrow sweep width). The higher speeds have some advantage in reducing the trace flicker when viewing with a greater sweep width. An exception to this rule is that when using the unit as a wobbulator, a low speed should be used to examine any steep-sided response.

If, at 'switch-on', the timebase fails to operate, move the TIMEBASE FREQUENCY switch to the adjacent position and back again. The oscillator will now function and it should be noted that the effect is normal and is not a fault condition.

Brilliance, Focus, 'X' and 'Y' Shifts.

These controls have the normal functions associated with oscilloscope use. The 'X' and 'Y' SHIFTS are effectively pre-set controls and although provided with a screwdriver slot, can be adjusted by hand.

Always operate the unit with the brilliance at the lowest convenient level.

Mains.

Normal supply switch. Completes mains to unit and blower motor.

INITIAL ADJUSTMENTS

Panoramic Display.

1. Switch on by moving the MAINS switch dolly to the right. An indication that the unit is operative is given by illumination of the tuning dial. The fan will also be heard working. Allow a short period for warm-up.

2. Set the BRILLIANCE and FOCUS controls. The BRILLIANCE should be set at the lowest convenient intensity in relation to the ambient lighting.

3. Set the 'Y' SHIFT to position the trace coincident with the bottom horizontal line on the graticule.

4. Set the OSC FREQ switch to position '1', the TIMEBASE FREQ to 10 c/s, the ATTENUATOR to OdB and the GAIN control near maximum.

5. Adjust the 'X' SHIFT by proceeding as follows:-

   (a) Move the CALIBRATOR switch to 'CAL & SIG' and set the calibrator display at a convenient level by adjustment of the GAIN control.

   (b) Set the WIDTH control to 'MIN'.

   (c) Adjust the CENTRE FREQUENCY control to approximately mid travel such that one 100 kc/s marker is displayed in the centre of the c.r.t. screen.

   (d) Slowly increase the WIDTH setting while observing the marker at the centre of the trace. Other markers will appear as the width increases but these should be ignored, attention being concentrated on the one in (c) above. If this remains in the middle of the display as the WIDTH control is moved towards the 'MAX' position, adjustment of the 'X' SHIFT will not be required. On the other hand, if the marker does wander away from centre , adjust the 'X' SHIFT slightly and repeat the check.

   It must be emphasised that when carrying out the checks above, the WIDTH control must be turned very slowly to avoid hysteresis effects in the reactor since these will cause the marker to ride off-screen as the WIDTH is returned to the 'MIN' position. If this should occur, set the WIDTH control to 'MIN' and bring the marker back on screen by adjustment of the CENTRE FREQUENCY control before proceeding with the check.

6. Next set the BANDSWITCH and TUNING to suit the required input frequency. The tuning scale is calibrated directly in terms of input frequency and the sweep direction is such that the right-hand end of the trace corresponds to the highest display frequency when a 'direct' input is used.

   The term 'direct' is used here to signify a signal from a transmitter or generator applied directly to the unit at some frequency within its tuning range. An 'indirect' input is one derived from the intermediate frequency channel of a receiver and in this case the direction of frequency calibration on the trace is dependent on the number of frequency conversions in the receiver and whether these occur with the appropriate oscillator on the 'high' or 'low' side of the signal. Inversion will always occur when the oscillator is on the 'high' side.

   When using a single conversion receiver with its oscillator 'high', the right-hand end of the trace will therefore correspond to the lowest display frequency. On the other hand, a double conversion receiver with both oscillators running 'high' will produce the lowest frequency at the left-hand end of the scale because its 2nd Oscillator inverts the 'inverted signal' at the 1st IF and therefore gives a correct reproduction of the aerial input spectrum.

A double conversion receiver with its 1st Oscillator 'high' and its 2nd Oscillator 'low' will give a frequency scale which increases from right to left on the c.r.t. trace.

Reversal of the trace direction occurs automatically when the EP14 BANDSWITCH is moved from the 5.2 Mc/s position to Ranges 1 and 2. This is due to the internal 'X' plate switching and provides a convenient means of presenting a 'left-to-right' frequency calibration when viewing the 5.2 Mc/s output of a single conversion receiver with its oscillator on the 'high' side. Range 2 should be used with the TUNING set to the high frequency end of the range so that although the 1st Mixer functions as a converter its IF outputs are well outside the passband of the 5.2 Mc/s IF. Thus the stage will operate effectively as a normal amplifier for 5.2 Mc/s and the only detectable change apart from reversal of the frequency scale will be a slight increase in the amplitude of the signal display.

When using Ranges 1 and 2, it is possible (on frequencies above 17 Mc/s) to set the EP14 tuning scale to a frequency 10.4 Mc/s below the actual setting required for the input frequency which is being used. This procedure places the 1st Oscillator (EP14) on the 'low' side of the signal, thus providing a means of reversing the trace direction when handling an indirect input on the two tunable ranges.

It must be appreciated that the dial calibration is intended only as a guide for use in initial adjustment and that final adjustment is carried out as described in para 7 below.

7. When used with a direct input, the unit will normally be tuned to produce the required display at the centre of the screen. The frequency of the input will usually be known and any measurements will usually be taken relative to the centre frequency rather than in terms of the actual frequencies involved. In the case of an indirect input however, it is usually necessary to identify the centre frequency of the display as some specific channel (usually a 100 kc/s point).

A fairly accurate method of identifying the centre frequency is to set the CENTRE FREQUENCY control to mid-travel and then adjust the WIDTH control for a 1 Mc/s sweep (11 x 100 kc/s markers with the outside two coincident with the outer vertical lines on the graticule). It is now possible to pick out the middle marker which should correspond to the centre frequency (5.2 Mc/s) of the EP14 1st IF. In practice it will be found that it is possible to pick either of the two adjacent markers as the centre frequency so that for greatest possible accuracy of adjustment an external marker signal should be used. In some cases it is possible to confirm the selected marker by reference to an easily identifiable signal though this does call for some accuracy in the dial calibration of the receiver with which the unit is used.

If the receiver has a built-in crystal calibrator, this will simplify the procedure since it is then only necessary to tune to any convenient check point (the actual frequency is of no importance) by monitoring the audio output of the receiver and then identify the marker pip on the trace. Both the CENTRE FREQUENCY and WIDTH controls should be set initially to mid-travel though the latter can be narrowed to allow greater accuracy in adjustment once the marker has been correctly identified. The centering adjustment is best made with the TUNING control (EP14) when using Ranges 1 and 2 since this leaves the CENTRE FREQUENCY control at its mid-setting which may prove more convenient during subsequent operation. With 5.2 Mc/s inputs the TUNING control is inoperative and in this case the centering adjustment must be made with the CENTRE FREQUENCY control.

In the case of a receiver without a crystal calibrator, it is a simple matter to arrange a marker signal from an external signal generator or frequency meter. If this procedure is adopted, the marker signal can no doubt be arranged to fall within the portion of the spectrum which is being observed.

Use of the EP14 for Visual Alignment.

The following panel controls are non-functional when the EP14 is used in wobbulator service:-

TUNING - ATTENUATOR - GAIN

The calibrator display is available as during normal operation and the BANDSWITCH can be used to reverse the direction of the frequency calibration if this should be found necessary.

Direct visual alignment of amplifiers in the following frequency bands can be undertaken:-

OSC FREQ switch to position '1'.

5.42 - 6.42 Mc/s.	(x1)
10.84 - 12.84 Mc/s.	(x2)
16.26 - 19.26 Mc/s.	(x3)

OSC FREQ switch to position '2'.

4.8 - 5.6 Mc/s.	(x1)
9.6 - 11.2 Mc/s.	(x2)
14.4 - 16.8 Mc/s.	(x3)

It should be appreciated that this coverage is based on a sweep width of one megacycle and that in actual practice the maximum available sweep may exceed this figure by as much as 250 kc/s (at the fundamental). Slightly greater coverage is available therefore than indicated by the figures above. In addition, the CENTRE FREQUENCY control can be brought into use to give upwards of 100 kc/s greater coverage at each end of the fundamental ranges.

Greatest flexibility in operation will occur when the alignment frequency falls in the centre of the sweep range since this allows more freedom in the use of the WIDTH control in widening the actual signal display. Standard IF's of 5.2 Mc/s and 10.7 Mc/s lie in the middle of the appropriate ranges and therefore present no difficulties in this direction.

Alignment of IF amplifiers on other frequencies can be carried out provided that the receiver in which they are used is capable of being tuned to one or other of the available ranges given above.

Control over the amplitude of the display can be either with the normal amplifier gain control or by means of a coaxial attenuator in series with the oscillator output. Suitable attenuators for this purpose are the Egen Type 141 and the Belling Lee L.729 series. These units provide up to 36dB attenuation and will be found adequate for all normal applications.

An isolating resistor of the order 0.1MΩ should be wired in series with the inner conductor of the coaxial line feeding the 'Y' Amplifier input socket.

RE-ALIGNMENT

Test Equipment.

The following items of test equipment are required for re-alignment of the EP14.

1. Signal generator(s) covering 720 kc/s and the range 4-60 Mc/s. (o/p Z = 50/75Ω)
2. Multi-range testmeter having DC current ranges of 50μA and 10mA.
3. Monitor receiver.
4. Trimming tools: (a) Neosid H.S.1. hexagonal tool. (b) Insulated screwdriver. (c) Small tommy bar 5/64" diameter.

NOTE A period of at least half an hour should be allowed for the equipment to reach operating temperature before commencing alignment.

Re-alignment of the 720 kc/s Amplifiers.

This is the first stage in the alignment procedure and is carried out by introducing an unmodulated 720 kc/s signal at the grid of the 2nd Mixer Stage (V5A, pin 2). A μAmmeter (50μA f.s.d.) is connected across the 270K diode load resistor (R49) to provide an indication of output. (the negative side of the meter is earthed)

Before alignment is commenced, disable the 2nd Oscillator by earthing its grid (V5B, pin 1) and set the **GAIN** control to maximum.

Tune the generator to approximately 720 kc/s and then swing slightly to either side of this point to locate the centre frequency of the amplifier. The μAmmeter will show a sharp rise as the signal is tuned to the peak of the crystal filter and the generator should be left set to this frequency. Adjust the attenuator on the generator to give a meter reading of 30-40μA and then peak the cores in T4-T7. All cores are adjusted on their outer peak and the attenuator should be adjusted as necessary to maintain the same output reading throughout the alignment.

Adjustment of the crystal phasing capacitor (C37) may be required and is carried out as follows. First remove the short from the grid of V5B and then transfer the generator to the input socket of the unit and re-tune it to 5.2 Mc/s. Set the EP14 BANDSWITCH to the 5.2 Mc/s position and the ATTENUATOR to 0dB. Move the CENTRE FREQUENCY control to its mid-travel position and adjust the WIDTH control to obtain a suitable display of the 5.2 Mc/s signal. A scan width of the order 50 kc/s will be found most convenient. The response that appears on the face of the c.r.t. is that of the 720 kc/s amplifiers and any side lobe due to incorrect adjustment of the phasing capacitor will be seen quite clearly. The capacitor should be set to eliminate the side lobe and leave a smooth response. C37 is located on the underside of T5 and can be adjusted with a small insulated screwdriver type tool. A low sweep speed should be used while making the adjustment and any slight tendency for the response to lean can be corrected by slight re-trimming of T4/T5 while observing the display on the c.r.t.

This completes re-alignment of the 720 kc/s stages, the μAmmeter can be disconnected before proceeding.

Re-alignment of the Sweep Oscillator (V5B).

The Sweep Oscillator must be set to cover the range 5.42-6.42 Mc/s when the OSC FREQ switch is at position '1'. This step in the alignment is achieved by adjustment of the trimmer C73 and the pre-set COARSE CENTRE FREQUENCY control RV3. These adjustments are closely associated with those for the pre-set 'X' WIDTH and LINEARITY controls and the procedure given must be followed very closely. C73 is accessible on the side of the Reactor Unit and is adjusted with a small tommy bar.

First check the adjustment of the pre-set 'X' WIDTH control. This should be set such that the amount of overscan is equal to approximately 30% of the total trace width. The adjustment is not critical but should be carried out carefully in conjunction with the panel 'X' SHIFT control to allow identification of the extremeties of the trace. Ensure that the 'X' SHIFT is left in the correct position, i.e. with an equal amount of overscan at each side of the screen.

Next adjust the COARSE CENTRE FREQUENCY control RV3. To do this, break the HT feed to V6B at the 1K resistor (R67) and connect a milliameter (10mA f.s.d.) to read the combined anode and screen currents. Set the panel WIDTH control to minimum (fully clockwise) and then adjust RV3 for a meter reading of 4mA. Disconnect the meter and re-connect the resistor.

Keep the WIDTH control at minimum and inject at the input socket a 5.2 Mc/s signal from the generator, (previously checked against an external frequency standard) and adjust C73 to give a signal response at the centre of the trace. The panel control marked CENTRE FREQUENCY must be set to mid-travel when making this adjustment and a monitor receiver can be brought into operation to check that the oscillator is set on the 'high' side of the signal (i.e. sweeping across a centre frequency of 5.92 Mc/s). A short length of wire attached to the receiver aerial terminal will provide adequate pick-up of the oscillator signal.

At this stage it is convenient to check the accuracy of the 'X' SHIFT setting. If the 5.2 Mc/s signal remains in the centre of the screen when the WIDTH control is rotated towards minimum, then the 'X' SHIFT is set correctly. If the signal wanders away from centre as the WIDTH is varied then the control is set incorrectly and a correction must be made before proceeding.

Now switch to 'CAL & SIG' and increase the WIDTH setting until the display comprises the 5.2 Mc/s marker signal together with ten 100 kc/s marker pips (five to either side of the 5.2 Mc/s signal). Do not pay attention at this stage to the relative amplitudes of the crystal markers but examine closely the spacing between them. If any variation in spacing is noted, adjust the pre-set LINEARITY control RV4 to give optimum separation. It is in order to re-adjust the WIDTH control slightly if the end markers move off the screen when making this adjustment and at the same time any tendency for the 5.2 Mc/s signal to move away from centre should be corrected by adjustment of C73. It must be realised that there is a fundamental interaction between the adjustments just described and each should be repeated as necessary until the desired result is obtained.

NOTE If difficulty is experienced in obtaining good linearity, try re-setting the anode/screen current of V6B to a slightly different value in the range 3.5-4.5 mA and then repeat the adjustments described above.

Re-alignment of the 5.2 Mc/s Stages.

First check whether re-alignment is required. Set up the unit to provide a 1 Mc/s display centred on 5.2 Mc/s. Introduce at the input socket a 5.2 Mc/s signal from the generator and adjust its output to give a display with a height of about 2 cm. Now tune the generator over the range 4.7-5.7 Mc/s and check for variation in signal amplitude. If the alignment is correct the height of the display will not vary by more than 2dB from the reference level at 5.2 Mc/s. If a greater variation is observed leave the display width at 1 Mc/s and proceed as follows:-

Connect a μAmmeter (50μA f.s.d.) across the diode load resistor R49 (270K). As an alternative a valve voltmeter can be used in which case a convenient point for connection would be at the grid of the 2nd 720 kc/s Amplifier (V8, pin 1). Feed the generator into the input socket and set it first to 5.3 Mc/s. With the EP14 ATTENUATOR at 0dB and the GAIN control at maximum, adjust the generator output for a reading of 30-40μA on the meter across R49. Adjust T3 for a peak reading and then re-tune to 5.8 Mc/s. The top core (secondary) of T2 is adjusted for a peak at this frequency and then the bottom core at 4.7 Mc/s. Both cores tune on their outer peak.

Now proceed to align the 5.2 Mc/s Filter (L1-L7). Tune the generator to 6.15 Mc/s and adjust L1 and L6 for minimum output. (It will be necessary to increase the WIDTH setting and also to offset the CENTRE FREQUENCY control to permit coverage of 6.15 Mc/s. The controls should be returned to their initial settings after the adjustments have been made). Re-tune to 4.15 Mc/s and with the OSC FREQ switch to position '2', trim L2 and L7 for minimum output. Revert to position '1' and set the generator to 5.35 Mc/s. At this setting adjust L4 and L5 for maximum output. Finally, re-set to 5.7 Mc/s and align the remaining filter coil (L3) for maximum.

This completes the alignment of the 5.2 Mc/s stages and a final check can be made by observing the display while tuning the generator over the range 4.7-5.7 Mc/s.

Re-alignment of the Crystal Calibrator.

The first step in re-alignment of this stage is to peak L12 for maximum height of the crystal markers. Once this has been done, the crystal frequency must be set accurately to 100 kc/s. Position a short pick-up wire near to L10/L11 and attach it to the aerial terminal of a monitor receiver tuned to a reliable frequency standard on 5.2 Mc/s. Identify the signal from the calibrator and then adjust C67 (below chassis) for zero beat.

The relative height of the crystal markers must now be equalised. Set the unit to provide a one megacycle sweep with the CALIBRATOR switch in the 'CAL' position. Adjust L10/L11 alternately until all the markers are of the same average height.

Finally, set the overall height of the calibration display to approximately 0.5 cm by adjustment of the injection capacitor C23a (CALIBRATOR switch at 'CAL').

Re-alignment of the 1st Oscillator (V2B).

This is the final phase of the alignment procedure. Commence by introducing a 5.2 Mc/s reference signal (BANDSWITCH to 5.2 Mc/s position, CALIBRATOR switch to 'CAL & SIG') and adjust the display width to 200 kc/s centred on 5.2 Mc/s. Select Range 1 (6.2-25 Mc/s) and re-tune the generator to 7 Mc/s. Remove the cover from the 1st Oscillator Unit, tune the EP14 to 7 Mc/s and adjust the Range 1 coil (L8) to make the signal peak coincide with the centre 100 kc/s marker pip. Now re-tune the generator and display unit to 25 Mc/s and adjust C58 to bring the signal to the centre of the display. Repeat the adjustments of L8 and C58 to eliminate interaction and then select Range 2 (25-60 Mc/s). Follow the same procedure to align L9 and C59 using alignment frequencies of 25 and 60 Mc/s respectively.

Care must be taken to ensure that the oscillator is operated on the 'high' side of the signal. A simple check on this is to increase slightly the frequency of the signal from the generator. If the oscillator is on the correct side of the signal the latter will move towards the right-hand end of the trace.

INSTRUCTIONS FOR RE-STRINGING THE DRIVE CORD

In the unlikely event of the drive cord either breaking or slipping off the drive drum, replacement will be much simplified if a new length of cord is used for re-stringing. This can be made longer than the actual length required and will in consequence be easier to handle. A piece of cord some 18" (26 cm.) long will be suitable.

The complete 1st Oscillator Unit must be removed from the chassis to allow access to the drive system. Removal is quite straightforward and is carried out as follows:-

1. Remove the TUNING and BANDSWITCH knobs.
2. Unclip the dial bulb by squeezing together the two sides of the holder.
3. Unplug the 6-way connector above chassis.
4. Unplug the B7G connector below chassis.
5. Remove the two 4BA pan head screws which hold the cable clips adjacent to V5.
6. Remove the two 4BA pan head screws adjacent to the B7G connector socket.
7. The complete unit is now free and can be taken out by sliding back towards the filter unit at the rear of the chassis.
8. Remove the scale disc by slackening the two grub screws in the hub. The drive cord can now be replaced by following the instructions below:-

1. Tie one end of the cord to the tension spring and attach the latter to the hook on the drive drum.
2. Set the drum to its fully clockwise position and pass the cord through the cord slot which lies at approximately "10 o'clock".
3. Apply tension to the spring and run the cord over the top of the drum and across towards the drive spindle.
4. Wind 2½ turns round the drive spindle in a clockwise direction with the last turn towards the forward end of the spindle.
5. Make sure that tension is maintained and then pass the cord across towards the drive drum. Wind approximately 1½ turns in a clockwise direction keeping to the front of the starting end of the cord.
6. Pass the cord through the slot and tie off on spring.
7. Check the drive for free and normal operation and then re-fit the scale disc. (NB With the tuning capacitor fully meshed (fully clockwise), the red line marked radially on the scale disc should lie in a vertical position).
8. Re-fit the Oscillator Unit by reversing the procedure for removal.

INSTRUCTIONS FOR FITTING REPLACEMENT C.R.T.

1. Remove the B9G holder at the base of the original c.r.t.
2. Remove the screw which holds the base clip and take off the earth connection.
3. Remove two screws and take off the c.r.t. saddle.
4. Lift the tube clear of the unit.
5. Remove the black tape at the screen end of the tube and then slide off the mu-metal screen. (The tape prevents light entering the rear of the tube face).
6. Reverse the procedure above to fit the replacement, making sure that the foam strip is replaced round the mu-metal screen (under the saddle) and the earth tag is re-connected to the base clip. The orientation for the base is with pin 5 uppermost, (i.e. the locating lug on the centre spigot points vertically downwards). The two screws holding the saddle should be left loose to allow rotation of the tube for correct orientation while observing the trace on the screen. Once the tube has been set correctly the two screws should be securely tightened.

APPENDIX 'A'

TABLE OF VOLTAGE VALUES

The 'Table of Voltage Values' given below will prove useful in the event of the unit developing a fault which makes it necessary to carry out voltage checks. All readings are typical and were taken with a meter having a sensitivity of 20,000Ω/V and an applied mains voltage of 240V. A nominal tolerance of 10% will apply to all readings taken with a meter of the sensitivity quoted and this should be increased accordingly if readings are taken with a meter of lower sensitivity.

Readings should be taken under 'no-signal' conditions with the controls set as indicated (see Notes). All readings are positive w.r.t. chassis except where indicated.

Ref	Anode		Screen		Cathode		Note
	Pin	Reading	Pin	Reading	Pin	Reading	
V1	7	168V	9	168V	1	1.8V	
V2A	6	255V	3	130V	7	-	NOTE 1
V2B	1	45V	-	-	8	-	NOTE 2
V3	5	255V	6	255V	7	3.6V	
V4	7	234V	9	234V	1	3.7V	
V5A	6	256V	3	147V	7	-	
V5B	1	25V	-	-	8	-	
V6A	1	85V	-	-	8	2.5V	
V6B	6	196V	3	196V	7	3.9V	NOTE 3
V7	5	260V	6	145V	7	1.65V	NOTE 4
V8	5	260V	6	185V	7	6.5V	NOTE 5
V9	2/7	-	-	-	1/5	0.35V	
V10	5	4V	6	70V	7	-	NOTE 6
V11A	1	20V	-	-	8	1.25V	
V11B	6	75V	3	235V	7	25V	
V12A	1	300V	-	-	8	145V	NOTE 7
V12B	6	120V	3	11.5V	7	-	NOTE 7
V13A	1	350V	-	-	8	135V	NOTE 7
V13B	6	105V	3	105V	7	30V	NOTE 7
V14	1	150V	-	-	7	-	
V15	1	258V	-	-	7	150V	

NOTE 1. Readings taken with CALIBRATOR switch at 'SIG' position and BANDSWITCH to Range 1 (6.2-25 Mc/s). Readings in 5.2 Mc/s position are:- Anode . . 255V. Screen . . 170V. Cathode . . 2.8V.

NOTE 2. BANDSWITCH to Range 1 (6.2-25 Mc/s).

NOTE 3. WIDTH control to 'MIN', TIMEBASE FREQ to 40 c/s. Allowance should be made for the variation available with RV3.

NOTE 4. Readings taken with GAIN control at maximum and CALIBRATOR switch to 'SIG'. The cathode voltage becomes 5V when the CALIBRATOR switch is moved to 'CAL'.

NOTE 5. Readings taken with GAIN control at maximum and CALIBRATOR switch to 'SIG'. The cathode voltage becomes 10V when the CALIBRATOR switch is moved to 'CAL'.

NOTE 6. CALIBRATOR switch to 'CAL' position.

NOTE 7. TIMEBASE FREQ to 40 c/s.

C.R.T. Voltages.

The cathode ray tube voltages are as follows. Those denoted with an asterisk are negative w.r.t. chassis.

Anode 1/3	. . . .	(pin 4)	. . . .	90V.
*Anode 2	. . . .	(pin 7)	. . . .	-600V.
*Grid	. . . .	(pin 8)	. . . .	-850V.
*Cathode	. . . .	(pin 1)	. . . .	-845V.

APPENDIX 'B'

LIST OF COMPONENT VALUES, TOLERANCES AND RATINGS

Capacitors.

Ref	Value	Type	Tolerance	Wkg. V.
C1	0.047μF	Polyester	10%	400V
C2	0.01μF	Metallised Paper	20%	150V
C3	100pF	Tubular Ceramic	10%	750V
C4	6pF	Tubular Ceramic	10%	750V
C5	0.047μF	Polyester	10%	400V
C6	0.047μF	Polyester	10%	400V
C7	60pF	Tubular Ceramic	10%	750V
C8	35pF	Tubular Ceramic	10%	750V
C9	0.047μF	Polyester	10%	400V
C10	0.01μF	Metallised Paper	20%	150V
C11	0.01μF	Metallised Paper	20%	150V
C12	0.001μF	Polystyrene	5%	125V
C13	0.0018μF	Polystyrene	5%	125V
C14	0.002μF	Polystyrene	5%	125V
C15	0.0018μF	Polystyrene	5%	125V
C16	0.0022μF	Polystyrene	5%	125V
C17	0.0022μF	Polystyrene	5%	125V
C18	70pF	Polystyrene	5%	125V
C19	0.001μF	Polystyrene	5%	125V
C20	0.0018μF	Polystyrene	5%	125V
C21	0.002μF	Polystyrene	5%	125V
C22	0.0018μF	Polystyrene	5%	125V
C23	0.01μF	Metallised Paper	20%	150V
C23a	3-23pF	Air Trimmer	-	-
C24	6pF	Tubular Ceramic	10%	750V
C25	10pF	Tubular Ceramic	10%	750V
C26	0.047μF	Polyester	10%	400V
C27	100pF	Tubular Ceramic	10%	750V
C28	40pF	Tubular Ceramic	10%	750V
C29	3pF	Tubular Ceramic	0.5pF	750V
C30	0.01μF	Metallised Paper	20%	150V
C31	0.047μF	Polyester	10%	400V
C32	0.047μF	Polyester	10%	400V
C33	0.047μF	Polyester	10%	400V
C34	400pF	Silvered Mica	2%	350V
C35	800pF	Silvered Mica	2%	350V
C36	800pF	Silvered Mica	2%	350V
C37	2-12pF	Air Trimmer	-	-
C38	50pF	Tubular Ceramic	10%	750V
C39	100pF	Silvered Mica	2%	350V
C40	100pF	Tubular Ceramic	10%	750V
C41	0.047μF	Polyester	10%	400V
C42	0.047μF	Polyester	10%	400V
C43	0.047μF	Polyester	10%	400V
C44	400pF	Silvered Mica	2%	350V

Ref	Value	Type	Tolerance	Wkg. V.
C45	400pF	Silvered Mica	2%	350V
C46	0.047μF	Polyester	10%	400V
C47	0.047μF	Polyester	10%	400V
C48	0.047μF	Polyester	10%	400V
C49	400pF	Silvered Mica	2%	350V
C50	400pF	Silvered Mica	2%	350V
C51	0.001μF	Tubular Ceramic	+50 -25%	750V
C52	0.001μF	Tubular Ceramic	+50 -25%	750V
C53	0.047μF	Polyester	10%	400V
C54	100pF	Tubular Ceramic	10%	750V
C55	100pF	Tubular Ceramic	10%	750V
C56	10pF	Tubular Ceramic	10%	750V
C57	13-405pF	Air Spaced Variable	-	-
C58	2-12pF	Air Trimmer	-	-
C59	2-12pF	Air Trimmer	-	-
C60	0.01μF	Tubular Ceramic	+80 -20%	250V
C61	0.01μF	Tubular Ceramic	+80 -20%	250V
C62	6pF	Tubular Ceramic	10%	750V
C63	10pF	Tubular Ceramic	10%	750V
C64	40pF	Tubular Ceramic	10%	750V
C65	0.01μF	Tubular Ceramic	+80 -20%	250V
C66	50pF	Tubular Ceramic	10%	750V
C67	3-23pF	Air Trimmer	-	-
C68	10pF	Tubular Ceramic	10%	750V
C69	0.047μF	Polyester	10%	400V
C70	50pF	Tubular Ceramic	10%	750V
C71	390pF	Polystyrene	5%	125V
C72	390pF	Polystyrene	5%	125V
C73	3.5-54pF	Air Trimmer	-	-
C74	390pF	Polystyrene	5%	125V
C75	70pF	Polystyrene	5%	125V
C76	0.002μF	Polystyrene	5%	125V
C77	0.01μF	Metallised Paper	20%	150V
C78	0.01μF	Metallised Paper	20%	150V
C79	0.047μF	Polyester	10%	400V
C80	2μF	Metallised Paper	25%	1000V
C81	2μF	Metallised Paper	25%	1000V
C82	0.01μF	Metallised Paper	20%	150V
C83	0.01μF	Metallised Paper	20%	150V
C84	0.01μF	Metallised Paper	20%	150V
C85	0.01μF	Metallised Paper	20%	150V
C86	0.01μF	Metallised Paper	20%	150V
C87	0.01μF	Metallised Paper	20%	150V
C88	2μF	Metallised Paper	25%	1000V
C89	4μF	Tubular Electrolytic	+50 -20%	350V
C90	4μF	Tubular Electrolytic	+50 -20%	350V
C91	0.1μF	Duomold	20%	500V
C92	0.05μF	Visconal *RMS	20%	600V*
C93	0.1μF	Duomold	20%	500V
C94	4μF	Tubular Electrolytic	+50 -20%	350V

Ref	Value	Type	Tolerance	Wkg. V.
C95	0.05μF	Duomold	20%	600V
C96	0.05μF	Duomold	20%	600V
C97	0.1μF	Duomold	20%	500V
C98	0.1μF	Duomold	20%	500V
C99	0.1μF	Duomold	20%	500V
C100	0.5μF	Nitrogol (dual unit)	20%	1000V
C101	0.5μF	Nitrogol	20%	1000V
C102	0.5μF	Metallised Paper	20%	1000V
C103	0.5μF	Metallised Paper	20%	150V
C104	32 + 32μF	Tubular Electrolytic	+50 -20%	350V
C105	50μF	Tubular Electrolytic	+50 -20%	450V
C106	50μF	Tubular Electrolytic	+50 -20%	450V

Resistors.

Ref	Value	Tol.	Rating
R1	2,200Ω	10%	1 watt
R2	3,300Ω	10%	1 watt
R3	820Ω	10%	½ watt
R4	10,000Ω	10%	½ watt
R5	100Ω	10%	½ watt
R6	1MΩ	10%	½ watt
R7	470Ω	10%	½ watt
R8	0.27MΩ	10%	½ watt
R9	68,000Ω	10%	½ watt
R10	2,200Ω	10%	½ watt
R11	12,000Ω	10%	½ watt
R12	12,000Ω	10%	½ watt
R13	12Ω	10%	½ watt
R14	1,000Ω	10%	½ watt
R15	330Ω	10%	½ watt
R16	150Ω	10%	½ watt
R17	220Ω	10%	½ watt
R18	150Ω	10%	½ watt
R19	220Ω	10%	½ watt
R20	220Ω	10%	½ watt
R21	150Ω	10%	½ watt
R22	150Ω	10%	½ watt
R23	220Ω	10%	½ watt
R24	220Ω	10%	½ watt
R25	150Ω	10%	½ watt
R26	150Ω	10%	½ watt
R27	100Ω	10%	½ watt
R28	220Ω	10%	½ watt
R29	3,300Ω	10%	1 watt

Ref	Value	Tol.	Rating
R30	12,000Ω	10%	½ watt
R31	12Ω	10%	½ watt
R32	390Ω	10%	½ watt
R33	1MΩ	10%	½ watt
R34	68,000Ω	10%	½ watt
R35	1,000Ω	10%	½ watt
R36	47,000Ω	10%	1 watt
R37	47,000Ω	10%	1 watt
R38	0.47MΩ	10%	½ watt
R39	330Ω	10%	½ watt
R40	0.47MΩ	10%	½ watt
R41	47,000Ω	10%	1 watt
R42	2,200Ω	10%	½ watt
R43	100Ω	10%	½ watt
R44	220Ω	10%	½ watt
R45	47,000Ω	10%	1 watt
R46	2,200Ω	10%	½ watt
R47	1,000Ω (nom.)	10%	½ watt
R48	27,000Ω	10%	½ watt
R49	0.27MΩ	10%	½ watt
R50	2,200Ω	10%	½ watt
R51	47,000Ω	10%	1 watt
R52	47,000Ω	10%	1 watt
R53	22,000Ω	10%	½ watt
R54	47Ω	10%	½ watt
R55	22Ω	10%	½ watt
R56	0.27MΩ	10%	½ watt
R57	12,000Ω	10%	½ watt
R58	22,000Ω	10%	½ watt
R59	1MΩ	10%	½ watt

Ref	Value	Tol.	Rating
R60	0.1MΩ	10%	½ watt
R61	3.3MΩ	10%	½ watt
R62	47,000Ω	10%	1 watt
R63	22,000Ω	10%	1 watt
R64	22,000Ω	10%	½ watt
R65	0.1MΩ	10%	½ watt
R66	22,000Ω	10%	½ watt
R67	1,000Ω	10%	½ watt
R68	0.1MΩ	10%	1 watt
R69	68Ω	10%	½ watt
R70	330Ω	10%	½ watt
R71	1,000Ω	10%	½ watt
R72	100Ω	10%	½ watt
R73	10,000Ω	10%	½ watt
R74	0.27MΩ	10%	½ watt
R75	100Ω	10%	½ watt
R76	1,000Ω	10%	½ watt
R77	3,300Ω	10%	½ watt
R78	0.1MΩ	10%	1 watt
R79	0.1MΩ	10%	1 watt
R80	68,000Ω	10%	½ watt
R81	0.47MΩ	10%	½ watt
R82	1MΩ	10%	½ watt
R83	10,000Ω	10%	½ watt
R84	1MΩ	10%	½ watt
R85	0.1MΩ	10%	1 watt
R86	33,000Ω	10%	1 watt
R87	0.47MΩ	10%	½ watt
*R88			
R89	0.27MΩ	10%	½ watt
	*Reference not allocated.		

Ref	Value	Tol.	Rating
R90	0.18MΩ	10%	½ watt
R91	22,000Ω	10%	½ watt
R92	0.22MΩ	10%	½ watt
R93	0.22MΩ	10%	½ watt
R94	0.1MΩ	10%	1 watt
R95	10,000Ω	10%	½ watt
R96	0.47MΩ	10%	½ watt
R97	1MΩ	10%	½ watt
R98	2.2MΩ	10%	½ watt
R99	47,000Ω	10%	1 watt
R100	0.1MΩ	10%	½ watt
R101	1MΩ	10%	½ watt
R102	3,300Ω	10%	½ watt
R103	22,000Ω	10%	½ watt
R104	2.2MΩ	10%	½ watt
R105	22,000Ω	10%	½ watt
R106	470Ω	10%	½ watt
R107	22,000Ω	10%	1 watt
R108	4,700Ω	10%	½ watt
R109	1,000Ω	10%	½ watt
R110	10,000Ω	10%	½ watt
R111	470Ω	10%	½ watt
R112	0.1MΩ	10%	1 watt
R113	47,000Ω	10%	1 watt
R114	15,000Ω	10%	½ watt
R115	2,700Ω	5%	6 watt
R116	1,100Ω	5%	12 watt
R117	0.1MΩ	10%	1 watt
R118	68,000Ω	10%	½ watt
R119	47,000Ω	10%	½ watt
R120	140Ω	5%	6 watt
R121	CZ6 Thermistor.	-	-
R122	140Ω	5%	6 watt

Potentiometers.

Ref	Value	Type
RV1	10,000Ω	Carbon
RV2	10,000Ω	Carbon
RV3	1,000Ω	Carbon
RV4	47,000Ω	Carbon
RV5	10,000Ω	Carbon

Ref	Value	Type
RV6	0.47MΩ	Carbon
RV7	0.5MΩ	Carbon
RV8	50,000Ω	Carbon
RV9	0.47MΩ	Carbon
RV10	0.47MΩ	Carbon

APPENDIX 'C'

LIST OF SPARES

The following list details all major spares for the EP14 Display Unit. Spares should be ordered by quoting the Circuit Ref. (where applicable), the written description given in the list and the Part No. in the right-hand column. The Serial No. of the unit should be stated in all communications.

All orders should be addressed to:-

Stratton & Co., Ltd., Sales and Service Dept., Alvechurch Rd., Birmingham, 31.

In cases of extreme urgency, ring PRIory 2231/4, cable 'Stratnoid', Birmingham or use Telex 33708.

Inductors.

L1-L7	Not available separately. Order complete Filter Unit	D3116
L8	Range 1 (6.2-25 Mc/s) 1st Oscillator coil	D3125
L9	Range 2 (25-60 Mc/s) 1st Oscillator coil	D3126
L10	Crystal Calibrator anode coil (1)	D3130
L11	Crystal Calibrator anode coil (2)	D3131
L12	Crystal Calibrator screen coil	D3124
L13/L14	Not available separately. Order complete Reactor Unit	D3117

Chokes and Transformers.

CH1	Ferrite-cored choke	D3128
CH2	Ferrite-cored choke	D3129
CH3	HT smoothing choke	6260P
T1	Broadband ferrite-cored input transformer	D3127
T2	1st 5.2 Mc/s IF transformer	D3118
T3	2nd 5.2 Mc/s IF transformer	D3119
T4	1st 720 kc/s IF transformer	D3120
T5	Crystal Filter output coil	D3123
T6	2nd 720 kc/s IF transformer	D3121
T7	3rd 720 kc/s IF transformer	D3122
T8	Power transformer	6407P

Crystals.

XL1	720 kc/s ± 0.05% Style 'E'	6121P
XL2	100 kc/s ± 0.005% Style 'E'	6099P

Switches.

S1	Calibrator Switch (3P-3W wafer type)	D3182
S2	Bandswitch (5P-3W wafer type)	D3183
S3	Not available separately. Order complete Attenuator	D3113
S4	Osc. Freq. Switch (2P-2W wafer type)	D3184
S5	Timebase Frequency Switch (4P-4W wafer type)	D3185
S6	Mains Switch (DPDT toggle type)	4772PA

Plugs.

Standard coaxial plug (as used for Input, Osc. Output, etc.)	6079P
Mains plug (non-reversible with earth connection) complete with 6' cable ..	D2311/1
Miniature 6-way plug (internal connector for 'X' plate switching) ..	6081P
B7G plug (internal connector for Osc. Unit)	6100/1P

Sockets.

SKT1-4	Standard coaxial sockets (as used for Input, Osc, Output, etc.) . .	6087P
SKT5	Mains socket (polarised with earth contact) . .	D2310
-	Miniature 6-way socket (for 'X' plate switching) . .	6082P
-	B7G socket (for connection to Osc. Unit) . .	6086P

Potentiometers.

RV1	10,000Ω . .	5937P
RV2	10,000Ω . .	5937P
RV3	1,000Ω (pre-set) . .	6076P
RV4	47,000Ω (pre-set) . .	6488P
RV5	10,000Ω . .	5937P
RV6	0.47MΩ (pre-set) . .	6077P
RV7	0.5MΩ . .	6428/1P
RV8	50,000Ω . .	6428P
RV9	0.47MΩ (pre-set) . .	6077P
RV10	0.47MΩ (pre-set) . .	6077P

Drive Assembly.

Epicyclic reduction drive . .	6489P
Drive drum . .	6490P
Drive cord (18") . .	6491P
Scale disc . .	D3135
Cursor window . .	6395P
Escutcheon . .	D2904

Miscellaneous.

Chromium plated panel handles . .	5827P
Dial bulb . .	3131P
Dial bulb holder . .	6374P
Earth terminal . .	6371P
Fan . .	6492P
Fuseholder . .	6103P
Fuse (1.5A x $1\frac{1}{4}$") . .	6104P
Graticule . .	6390P
Knobs . .	5816P
Thermistor (CZ6) . .	6493P
Tuning capacitor (13-405pF) . .	6494P
Valve retainer (spring type) . .	5311PA
Valve screening can (B7G) . .	6126P
Valve screening can (B9A) . .	6127P

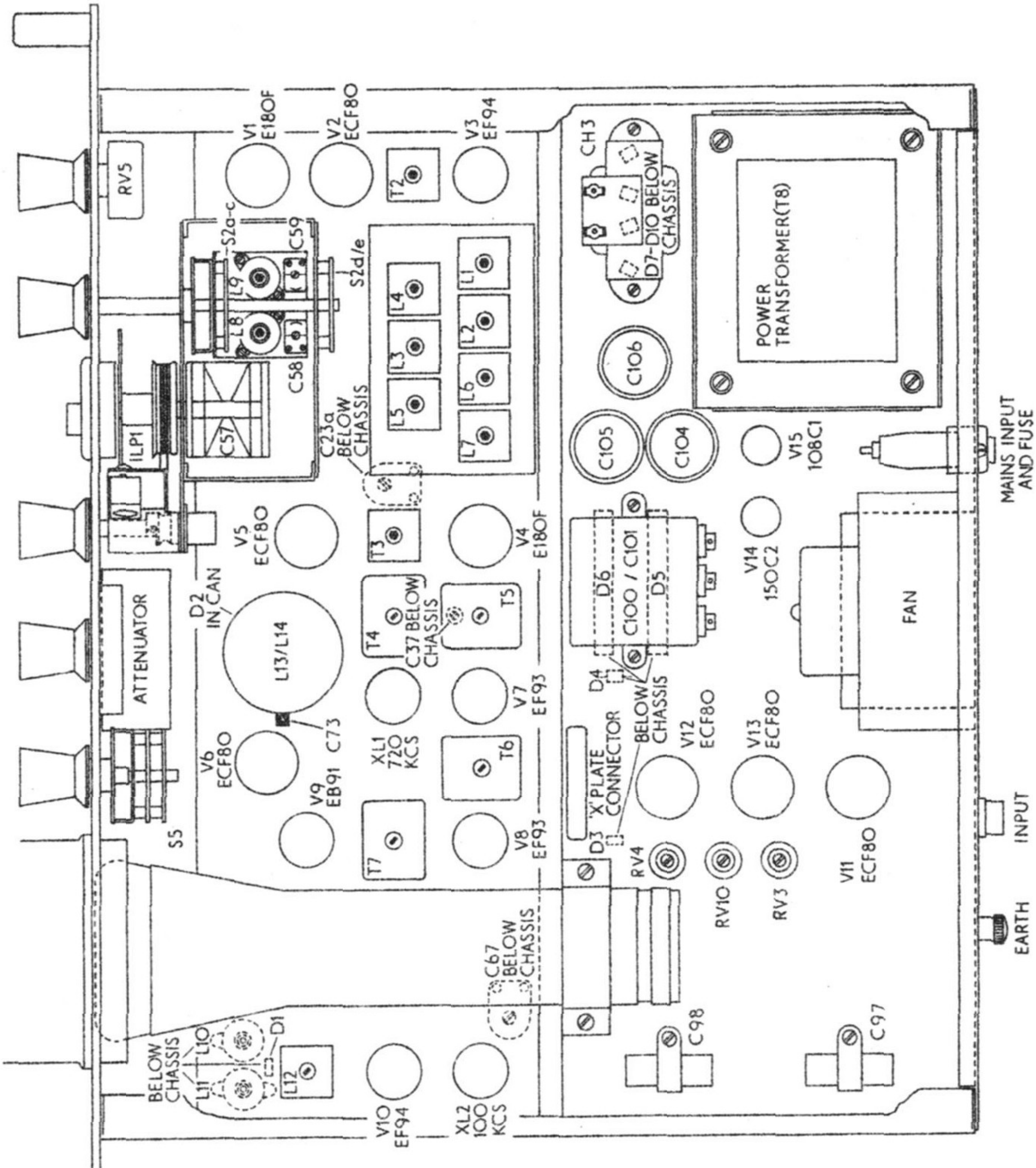
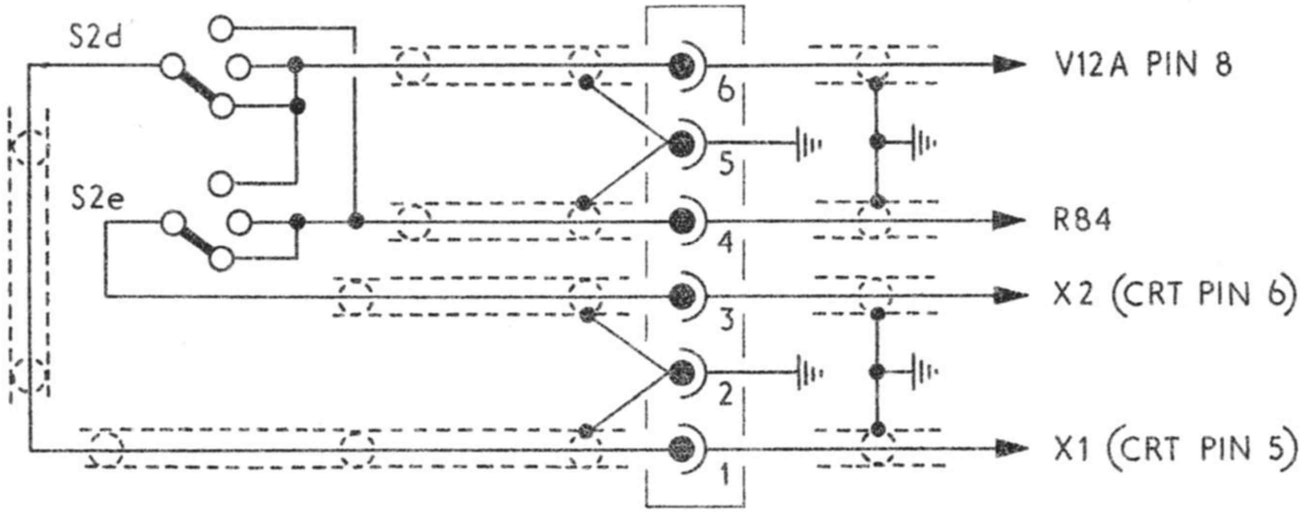


FIG 1. PLAN VIEW OF MODEL EP14.

FIG. 2. WIRING OF 'X' PLATE CONNECTOR.



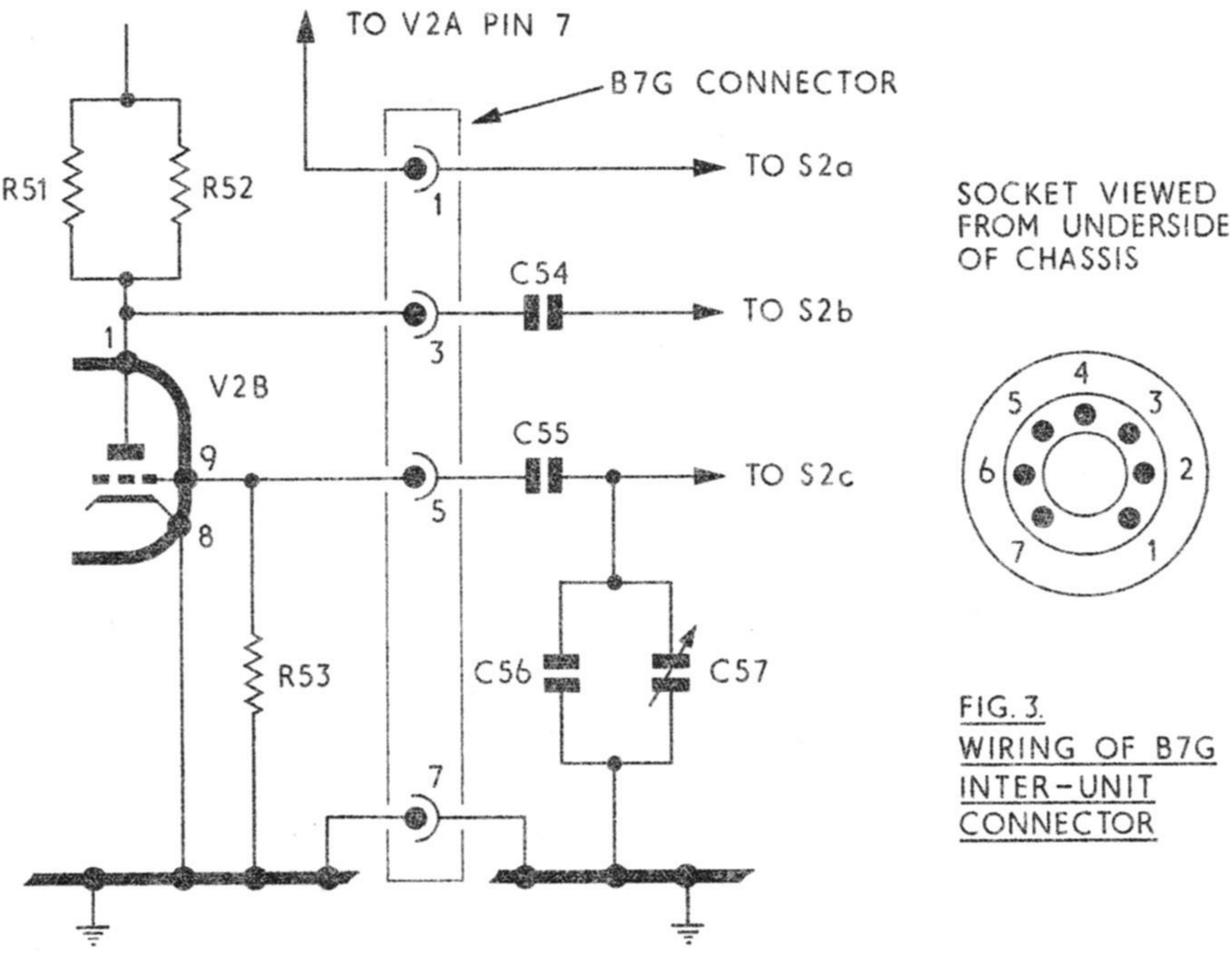


FIG. 3.
WIRING OF B7G INTER-UNIT CONNECTOR

AMENDMENT SHEET NO. 1

The following amendments should be incorporated in this Manual to cover modifications which have been made to the Crystal Calibrator. The circuit is shown correctly in the diagram supplied with the Unit.

Page 2. Delete 'D1' in the Table at foot of page.

Page 4. Amend the last sentence in the last paragraph to read:-

'The wanted harmonics are selected by the circuits L10/C62 and L11/C64 which resonate in the 5.2 Mc/s band.'

Page 21. Add:- 'C61a 3pF Tubular Ceramic ± 0.5pF 750V DC wkg.'

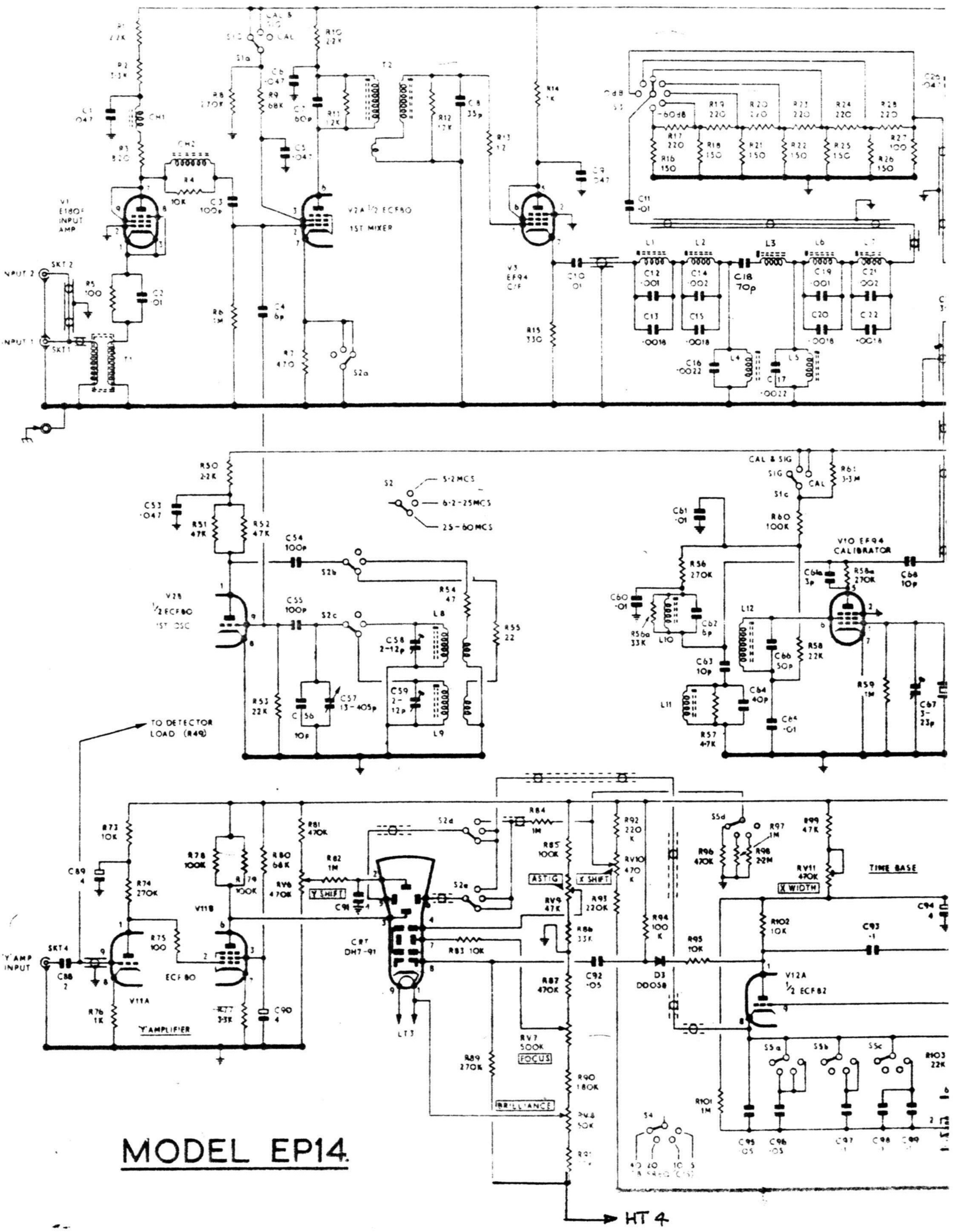
Page 22. Add:- 'R56a 33,000Ω ± 10% ½ watt.'

Amend R57 to read:- '4,700Ω ± 10% ½ watt.'

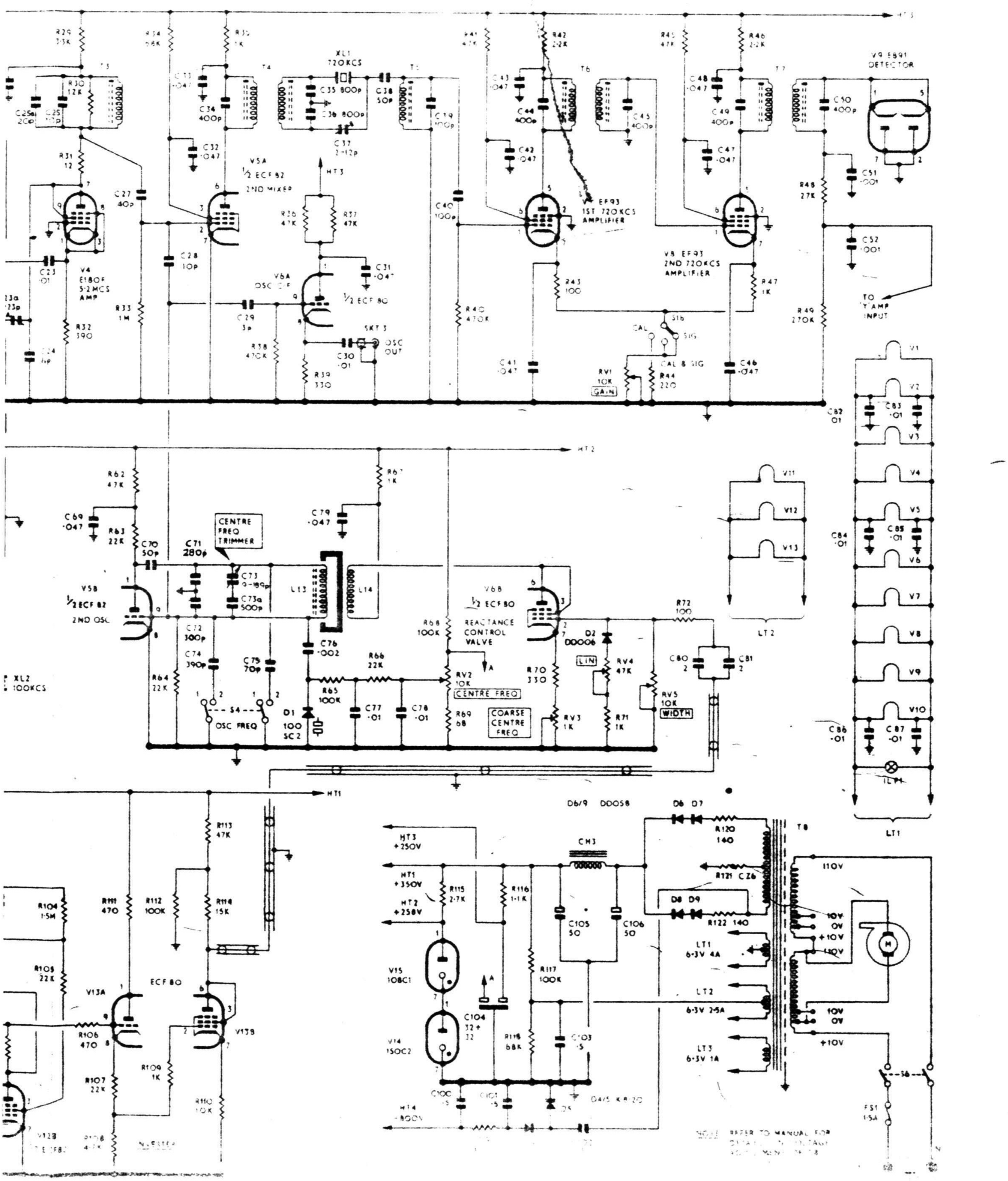
Add:- 'R58a 0.27MΩ ± 10% ½ watt.'

Mark R56a and R57 with an asterisk and add a footnote to the effect that the values given are nominal and subject to change during test.

Page 26. Delete 'D1' (near c.r.t.).


V1 E180F INPUT AMP
V2A 1/2 ECF80 1ST MIXER
V3 EF94 C/F
INPUT 2
INPUT 1
SKT 2
SKT 1
CAL & SIG
S1a
S1c
S2a
S2b
S2c
S2d
S2e
S3
0 dB
-60 dB
V2B 1/2 ECF80 1ST OSC
S2
5-2 MCS
6-2-25 MCS
25-60 MCS
V10 EF94 CALIBRATOR
TO DETECTOR LOAD (R49)
'Y' AMP INPUT
SKT 4
V11A
V11B
ECF 80
'Y' AMPLIFIER
CRT DH7-91
LT 3
Y SHIFT
ASTIG
X SHIFT
X WIDTH
FOCUS
BRILLIANCE
TIME BASE
D3 DD058
V12A 1/2 ECF82
S4
S5a
S5b
S5c
S5d
HT 4

MODEL EP14.


HT3
V9 EB91 DETECTOR
XL1 720KCS
V5A ½ ECF82 2ND MIXER
V4 E180F 5·2MCS AMP
V6A OSC ½ ECF80
V7 EF93 1ST 720KCS AMPLIFIER
V8 EF93 2ND 720KCS AMPLIFIER
TO 'Y' AMP INPUT
CAL S1b SIG
CAL & SIG
RV1 10K GAIN
SKT3 OSC OUT
HT2
CENTRE FREQ TRIMMER
V5B ½ ECF82 2ND OSC
V6B ½ ECF80
REACTANCE CONTROL VALVE
RV2 10K CENTRE FREQ
COARSE CENTRE FREQ
RV3 1K
RV4 47K LIN
RV5 10K WIDTH
S4 OSC FREQ
XL2 100KCS
LT2
LT1
HT1
D6/9 DD058
HT3 +250V
HT1 +350V
HT2 +250V
HT4 -800V
CH3
V15 108C1
V14 150C2
T8
LT1 6·3V 4A
LT2 6·3V 2·5A
LT3 6·3V 1A
110V
10V
0V
+10V
FS1 1·5A
V13A ECF80 V13B
NOTE: REFER TO MANUAL FOR DATA ON VOLTAGE ADJUSTMENT