TECHNICAL INSTRUCTION

RS.2

F.M. Receivers

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AMENDMENT RECORD

Amendment Sheets Nos. 1 to 5 have already been issued.

Amendment Sheet No.	*Initials*	*Date*	*Amendment Sheet No.*	*Initials*	*Date*
RS.2—6		17-3-67			
RS.2—7					
RS.2—8					
RS.2—9					
RS.2—10					
RS.2—11					
RS.2—12					
RS.2—13					
RS.2—14					
RS.2—15					
RS.2—16					
RS.2—17					
RS.2—18					
RS.2—19					
RS.2—20					
RS.2—21					
RS.2—22					
RS.2—23					
RS.2—24					
RS.2—25					

Information about all issues by Technical Publications Section is available in the *List of Technical Publications* which is distributed throughout the Engineering Division at regular intervals.

CONTENTS

DIAGRAMS AT END

(Circuits unless otherwise stated)

F.M. RECEIVERS

SECTION 1

RECEIVERS HR/17 AND HR/18

INTRODUCTION

The HR/17 and HR/18 are f.m. receivers primarily intended for use at studio centres and medium-wave transmitters for monitoring nearby f.m. transmitting stations. The HR/18 differs from the HR/17 in having a carrier failure alarm which can be set to operate on weak, medium or strong signals.

These two types of receiver are now obsolescent and are being replaced by types HR/17A and HR/18A described in Section 2.

The receivers consist of a commercial f.m. tuner (Dynatron model F.M.1) mounted with a combined mains unit and a.f. amplifier on a standard 19 inch by 7 inch panel. The carrier failure alarm of the HR/18 is included in the a.f. amplifier chassis.

The receiver is preset to three frequencies in the band 88 to 95 Mc/s and any of these can be selected by a three-position switch. Output levels of 0, + 4 or + 8 dB can be delivered into a 600-ohm load for an input frequency-modulated to ±30kc/s. On the HR/17 a switch is used to select the desired output level but on the HR/18 a tag panel is used. A gain control is provided for accurate adjustment of output level.

A single receiver can operate via 70- to 100-ohm feeder from a dipole or other suitable type of aerial. Several receivers can be operated from a common aerial by use of an Aerial Coupling Unit ACU/5 described in Section 4.

GENERAL DESCRIPTION OF THE HR/17

Receiver Circuit

The complete circuit diagram of the receiver up to and including the discriminator is given in Fig. 1.

The feeder from the aerial or Aerial Coupling Unit leads to an r.f. transformer T1 which is tuned to the centre of the frequency band to be covered. This circuit is heavily damped by the input resistance of the r.f. amplifier V1 and there is negligible loss in voltage transfer from input to V1 grid even at the extremes of the band. The circuit of V1 is conventional, the anode inductor L1 being tuned to the desired frequency by one of the trimmers C7, C8 and C9 which are selected by one wafer of the station-selection switch.

V2 is an additive mixer stage, the oscillator input being injected via a 2-pF capacitor C16 into the grid circuit together with the input from the r.f. stage. Mixing occurs by virtue of the curvature of the anode current-grid voltage characteristic of V2 and the bias resistor R4 is chosen to give optimum conversion conductance.

The oscillator is one half of the double-triode V3. It has a Colpitts circuit and one of the two fundamental capacitors consists of C21 in parallel with the anode-cathode capacitance of both triodes. The other capacitor comprises the network C14, C17 to C19 and C22 to C24 in parallel with a contribution from the input capacitance of V3(a). The oscillator is tuned to the required frequencies (10·7 Mc/s below the signal frequency) by the variable trimmers C18, C23 and C24 one of which is selected by the station-selection switch.

The other half of the double triode V3 is used as a reactance valve which reduces frequency drift over a limited frequency range. Fundamentally a reactance valve consists of an amplifying stage, the grid of which is fed from the anode via an RC or RL potential divider designed to give nearly 90° phase shift at the frequency of operation. In Fig. 1 the upper arm of the potential divider is the anode-grid capacitance of V3(b) (approximately 1·5 pF) and the lower arm is required to be purely resistive. The lower arm is, however, shunted by the grid-cathode capacitance of V3(b) and this is therefore tuned out by the inductor L4 which is designed to resonate with the interelectrode capacitance at the oscillation frequency. The oscillator must, of course, operate over a band of frequencies (approximately 76·8 to 84·3 Mc/s) and the 22-ohm resistor R11 is included to make the grid-cathode circuit substantially resistive over the operating range of the oscillator.

The 10·7 Mc/s i.f. output of the mixer V2 is selected by the transformer T2 and applied to the first i.f. amplifier V4. This in turn is coupled to the 2nd i.f. amplifier V5 by the i.f. transformer T3. The grid components R17 and C37 are included to enable the second i.f. stage to operate as a limiter. Any i.f. signal at V5 grid which exceeds the grid base of this valve causes grid current which charges

C37. The polarity of this charge is such as to bias the grid of V5 negatively, causing the gain to fall and hence tending to keep the i.f. signal amplitude at V5 anode constant in spite of increases in input-signal amplitude. To obtain limiting even for small input signals the grid base of the valve is reduced by operating the valve with a low value of screen grid potential. The anode is also fed from the same source of low potential.

V5 anode circuit includes a third i.f. transformer T4 which feeds the third and final i.f. amplifier V6, also designed as a limiting stage. The grid circuit components are R21 and C43 and this valve is also operated from a low h.t. potential. The negative control-grid potential of V6 gives a measure of the amplitude of the i.f. signal at the grid and is a useful voltage to know during checking of the receiver. A 2·2-megohm resistor R23 is connected to the control grid to enable a high resistance d.c. valve voltmeter to be connected to measure the voltage at V5 grid. C42 is provided to bypass any i.f. signals. Both the screen grids and the anodes of valves V5 and V6 are fed from a 50-volt stabilised supply to reduce the effects of mains voltage variations on the audio output level from the receiver.

The second limiter stage V6 feeds the Foster-Seeley discriminator V7 via the i.f. transformer T5: The discriminator is essentially a double-diode detector so arranged that the rectified voltages across the diode loads R26 and R27 are in opposition. These two voltages are equal when the receiver is correctly tuned to an unmodulated carrier. The a.f. output appears across the two resistors R26 and R27 in series and for an unmodulated carrier input there is no a.f. output. When the carrier frequency changes with modulation the voltages developed across R26 and R27 vary so as to reproduce the a.f. signal. This signal is taken via the network R28, C51 which, together with the capacitance of the screened output lead and the input capacitance of the following amplifier, provides the required 50-microseconds de-emphasis.

Any d.c. output from the discriminator indicates by its polarity, the sign of any oscillator mistuning and, by its amplitude, the extent of such mistuning. This voltage is applied via the networks R29, C50 and R12, C29 to the grid of the reactance valve to provide a.f.c. The time constant R29, C50 is made long to attenuate audio signals in the control voltage. Resistor R12 prevents any r.f. or i.f. voltages induced in the lead to the reactance valve control grid from reaching the grid and the resistor must be mounted close to the capacitor C29 to be effective.

The cathode circuit of V17 is biased approximately 20 volts positively by the potential divider R20, R22 and decoupled by the low-reactance capacitor C41 to remove a slight hum in the a.f. output of the tuner. This positive bias appears in the a.f.c. voltage and in order that the control voltage shall fall within the grid base of V3(b) the cathode circuit of V3(b) is also returned to the junction point of the potential divider.

The two-pole socket is used for measuring the cathode current of the reactance valve V3(b); such a measurement is made by connecting a 100-μA meter built out to 10,000 ohms resistance across pins 1 and 2 of the socket. This connects the meter across the 1000-ohm cathode resistor R10 via the series resistors R9 and R14 which are decoupled by capacitors C31 and C32. The total resistance of the meter circuit is 64,000 ohms and the meter thus reads 1/65th of the cathode current, approximately 40 μA for a current of 2·5 mA.

If the receiver is accurately tuned, the d.c. output from the discriminator is zero and there is no input to the reactance valve. The cathode current of the reactance valve is thus unaffected by short-circuiting its input. If, however, the receiver is mistuned, the discriminator gives a steady positive or negative voltage output which affects the reactance-valve cathode current. A short-circuit applied to the input of the reactance valve now produces a change in cathode current. Such short-circuits can be applied by the switch SB. This is spring-loaded in the off position indicated in Fig. 1 but applies the short circuit when pressed. To check tuning, therefore, it is necessary to observe whether there is any change in meter reading when the switch is pressed. Any change indicates mistuning. Furthermore the sense and magnitude of the change in reading indicates the sense and extent of the mistuning.

Power Supply and Audio Amplifier Circuits

The circuit diagram of the power supply and audio amplifier for the HR/17 is given in Fig. 2. The audio output from the receiver is applied to the grid of triode (a) of the double-triode V8, the 33-pF capacitor C101 being part of the de-emphasis network. The output of this valve is coupled by C104 and R111 to the grid of triode (b) which is transformer-coupled to the output sockets 1 and 2, the resistor R112 being included in the secondary circuit to build out the output resistance to approximately 600 ohms. The h.t. supply for triode (a) is smoothed by R105, C102 and R106, C103.

Negative feedback is applied to triode (b) by the omission of a cathode decoupling capacitor and to both triodes by the network R103, R104, R108, R113, R114 and RV101 which returns to the cathode of the first triode a fraction of the a.f. signal from a tertiary winding on the output transformer. The resistors R103, R104 and R108 are mounted on a tag strip and the cathode of V8(a) can be connected to the required point by means of a switch, giving a choice of three output levels. (0 dB, +4 dB or +8 dB). Fine adjustment is provided by the variable resistor RV101 which controls the degree of overall feedback. The output-level control is calibrated for an r.f. input to the receiver of 30-kc/s swing but f.m. transmitters are now so adjusted that zero level input to them gives 19-kc/s swing. Thus the receiver audio output level is 4 dB less than that indicated by the output-level control.

The power supply section is conventional and includes a full-wave bridge rectifier and a π-section smoothing circuit delivering 220 volts for the anodes. A 50-volt supply for the limiter stages of the receiver is obtained from the dropping resistor R115, the voltage being stabilised by the neon V9.

Performance

The overall frequency response of the receiver is within ± 2 dB of a 50 μS de-emphasis curve (given in Fig. 3) from 40 c/s to 20 kc/s.

For an input modulated by a single frequency to a deviation of 75 kc/s, any individual harmonic distortion in the audio output is less than 1 per cent. The total harmonic distortion is less than 1·7 per cent.

Limiting begins with an input of approximately 10 μV. With an input of 31 μV the signal-noise ratio is better than 40 dB and with an input of 100 μV it is better than 55 dB.

With an input of 30 μV the automatic frequency control is effective over a frequency range of ± 150 kc/s: that is to say the control will reduce oscillator mistuning by a substantial factor provided the initial extent of mistuning does not exceed ± 150 kc/s.

Installation Procedure

The following equipment is required to instal an HR/17:

A portable test meter PTM/6 or a 100-μA meter built out to 10 kilohms resistance
A 600-ohm resistor
A test programme meter or
A high-resistance amplifier detector

Installation should be carried out in the following way:—

1. Switch on the receiver and allow it to warm up for at least 30 minutes.
2. Connect the aerial feeder to the receiver.
3. Set the station-selector switch to the required transmission.
4. Tune in the signal by adjustment of the appropriate oscillator trimmer.
5. Connect the PTM/6 or the 100-μA meter to the Painton two-pin socket.
6. Press the A.F.C. OUT FOR TUNING button and note the meter reading: this should be between 30 and 50 μA.
7. Release the A.F.C. OUT FOR TUNING button and note the meter reading. If it differs from the previous reading adjust the oscillator trimmer to give the same reading as before.
8. Check that clockwise rotation of the oscillator trimmer reduces the meter reading by at least 15 μA and that anti-clockwise rotation of the trimmer increases the meter reading by the same amount. Failure to meet this condition indicates a faulty aerial or receiver.
9. Restore the meter reading to the value obtained in test 6 by adjustment of the oscillator trimmer and disconnect the meter. The receiver is now correctly tuned. The tuning should be checked periodically.

Adjustment of a.f. Output Volume

After the receiver has been installed and tuned according to the above instructions, adjust the a.f. output of the receiver in the following manner:

1. Connect the 600-ohm resistor across the output terminals of the a.f. amplifier.
2. Connect a T.P.M. or an Amplifier-Detector across the 600-ohm resistor.
3. Set the AUDIO OUTPUT control to indicate an output level 4 dB greater than that required. For example, if zero output level is required, set the AUDIO OUTPUT control to +4 dB.
4. Check the level of audio output when the f.m. transmitter is radiating, line-up tone before

programme transmission and, if necessary, use the ADJUST ZERO LEVEL control to give exactly the required output level.

The receiver is now correctly adjusted.

The adjustment of output volume should also be checked periodically.

Maintenance

The audio-amplifier and mains unit should be fully maintained at the site but maintenance of the receiver chassis should be limited to the replacement of valves. No attempt should be made to re-align the r.f. or i.f. circuits of the receiver because this requires test equipment not normally available on site. A receiver requiring re-alignment should be returned to Equipment Department.

The extent of receiver maintenance possible on site is illustrated in the following example.

Suppose the signal-noise ratio at the output of a receiver is poor though the transmitter is known to be radiating normally. This suggests a fault in the aerial (including feeder) or in the receiver. If another aerial is available, more information can be obtained by using this in place of the normal aerial. If the signal-noise ratio is now normal, the fault lies in the aerial or feeder. If no alternative aerial is available, further information can be obtained by use of a spare receiver connected to the normal aerial. If the signal-noise ratio at the output of the spare receiver is also poor, the fault lies in the aerial. If, however, the spare receiver gives a good signal-noise ratio, the fault lies in the original receiver. If the fault is traced to the receiver and cannot be eliminated by valve changes, the receiver should be returned to Equipment Department.

GENERAL DESCRIPTION OF THE HR/18 Receiver Circuit

The complete circuit diagram of the receiver up to and including the discriminator is given in Fig. 4. It is similar to that of the HR/17 (Fig. 1) but includes three crystal diodes MR1, MR2 and MR3 which provide d.c. outputs for operating the carrier failure alarm circuit. These diodes are fed from the secondary windings of the i.f. transformers T2, T3 and T4 and i.f. signals present in the crystal outputs are attenuated by the decoupling capacitors C15, C36 and C42. The crystal outputs are connected to pins 9, 10 and 11 on the 12-pole plug PL2 and are thus conveyed to the a.f. amplifier and mains unit chassis which also incorporates the carrier alarm.

Power Supply, Audio Amplifier and Carrier Alarm Circuit

The circuit diagram for the power supply, audio amplifier and carrier alarm circuits is given in Fig. 5. The power supply and audio amplifier circuits are similar to those of the HR/17 (Fig. 2) but an additional stage V10 is included for carrier alarm purposes and the audio output level is selected by means of tags instead of a switch.

This stage is a double-triode valve with a relay A/2(2) in the common anode circuit, the common cathode circuit being biased approximately 6 volts positive by the potential divider R202, R205 across the h.t. supply. Thus in the absence of a grid input the combined anode current of V10 is too small to operate the relay. When, however, the output of the crystal diodes is applied to V10 control grids, the anode current increases (the crystal output being positive-going) to a value sufficient to energise the relay. The relay has two sets of contacts. One set (A1) constitutes a changeover switch, the connections to which are brought out to pins 3, 4 and 5 of the output socket. The second set (A2) constitutes a simple on/off switch, the connections to which are brought out to pin 6 of this socket and to earth.

The outputs of the crystal diodes in the receiver are brought into the carrier alarm circuit and are returned to earth via the resistors R206, R207 and R208. These are the diode load resistors and across each is developed a steady voltage approximately equal to the peak i.f. voltage at the grids of the i.f. amplifiers. For example the voltage across R208 is equal to the peak i.f. signal at V4 grid, that across R207 is equal to the peak i.f. signal at V5 grid and that across R206 is equal to the peak i.f. signal at V6 grid. The carrier-failure alarm circuit is actuated by a combination of two of these rectified voltages, the precise combination depending on the received signal strength. Two outputs are employed to give a good approximation to the ideal limiting characteristic, which is an input voltage-output voltage curve rising linearly for small inputs and then levelling off to a horizontal section for inputs exceeding a particular value. The characteristic obtained from any one of the crystal outputs shows the initial linear rise but tends to fall again at large input voltages. If a single crystal output were used to operate the carrier failure alarm circuit there is a danger that the fall in output would cause the alarm to operate on strong input signals. This tendency is avoided by using combinations of crystal outputs.

The adjustment of the carrier alarm voltage is carried out in the following way. One of the grids of V10 is permanently connected to R208 (associated with V4 grid) and the other grid can be connected to R206, R207 or R208 by a FIELD STRENGTH control. For a strong carrier the control is set to STRONG and connects the second grid of V10 also to R208. For a weaker carrier the control is set to MED which connects the second grid to R207 (associated with V5 grid) and for weak carriers the control is set to WEAK which connects the second grid to R206 (associated with V6 grid).

The signals from the crystals can be large enough to drive V10 into grid current and the high-value grid resistors R203 and R204 are included to limit this current to a low value which does not damp the secondary windings of the i.f. transformers unduly. To permit adjustment of the carrier alarm circuit, facilities are provided for measuring the current through the relay. The relay current passes through the 100-ohm resistor R201 and the voltage across this can be measured at pins 1 and 2 of a socket marked V10 FEED.

Adjustment of Carrier Alarm Circuit

After the receiver has been installed and tuned as described above for the HR/17 the carrier failure alarm circuit should be adjusted as follows: it is essential that the operations should be carried out in the order given.

1. Set the FIELD STRENGTH control to STRONG.
2. Connect the PTM/6 (or a 100-μA meter built out to 10 kilohms resistance) to V10 FEED.
3. Note the meter reading. If this is greater than 40 μA, this setting of the FIELD STRENGTH is satisfactory. If the meter readings is less than 40 μA set the FIELD STRENGTH control to MED.
4. Note the meter reading. If this is now greater than 40 μA, this setting of the FIELD STRENTH control is satisfactory. If the reading is still less than 40 μA, set the FIELD STRENGTH control to WEAK.
5. Disconnect the aerial or aerial feeder from the receiver and check that the alarm operates.

SECTION 2

RECEIVERS HR/17A AND HR/18A

INTRODUCTION

The HR/17A and HR/18A are f.m. receivers primarily intended for use at studio centres and medium-wave transmitting stations for monitoring transmissions from a nearby f.m. transmitter. The HR/18A differs from the HR/17A in having a carrier alarm which can be set to operate on weak, medium or strong signals.

The receivers replace the HR/17 and HR/18 described in Section 1.

The HR/17A and HR/18A consist of a commercial f.m. tuner (Dynatron model F.M.2.) mounted with a combined mains unit and a.f. amplifier on a standard 19-inch by 7-inch panel. The carrier alarm of the HR/18A is included with the a.f. amplifier. A photograph of the HR/17A is given in Fig. 2.1 and of the HR/18A in Fig. 2.2.

The receivers are pre-set to four frequencies in the band 88 to 100 Mc/s and any of these can be selected by a four-position switch. Output levels of 0, +4 or +8 dB can be delivered into a 600-ohm load for an input frequency-modulated to ± 30 kc/s, a tag panel permitting selection of the desired level. A gain control is provided for accurate adjustment of output level.

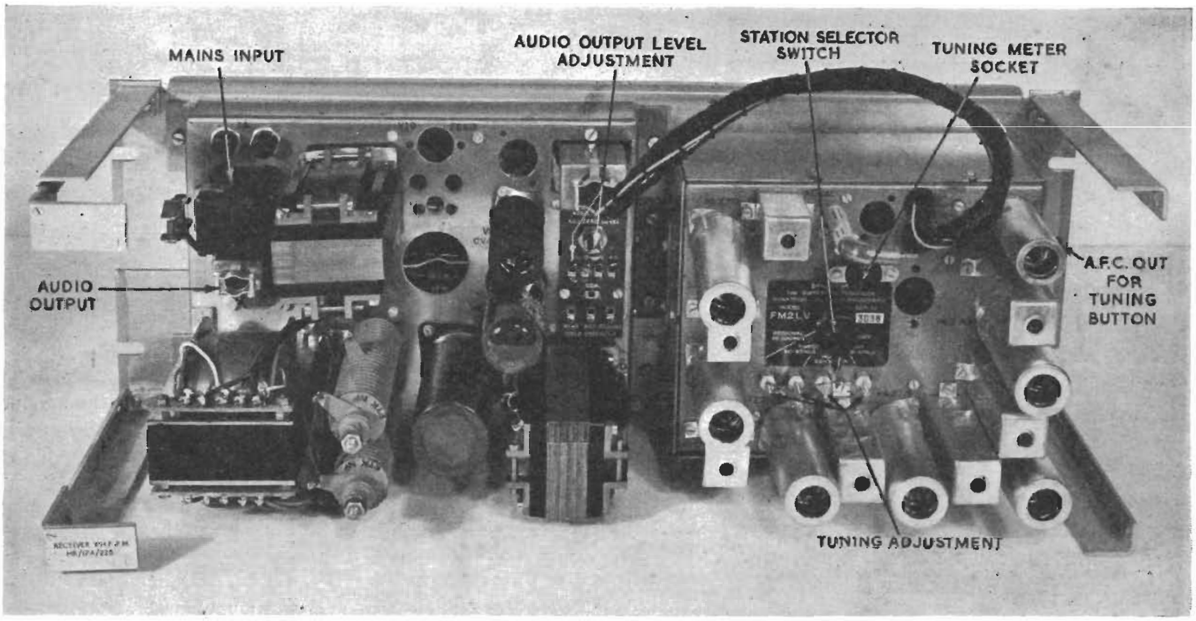


Fig. 2.1. View of HR/17A Receiver with Cover removed.

A single receiver can operate via 70- to 100-ohm feeder from a dipole or other suitable type of aerial. Several receivers can be operated from a common aerial by use of an Aerial Coupling Unit ACU/5 described in Section 4.

GENERAL DESCRIPTION OF THE HR/17A

Receiver Circuit

The complete circuit diagram of the receiver up to and including the discriminator is given in Fig. 6. This applies to receivers with serial numbers up to 200. The circuit is similar to that of the HR/17 described in Section 1 and reference should be made to that section for a detailed description of the circuit. The HR/17A does, however, differ from the HR/17 in the following respects:

1. the signal-frequency and oscillator circuits are designed to permit selection of four pre-set signals.
2. the oscillator frequency is above the signal frequency.
3. the oscillator valve operates with a smaller anode current (the decoupling resistor R7 being 39 kilohms compared with 3·9 kilohms for the HR/17). This modification was adopted to give improved frequency stability.

4. the screen potential of the mixer stage (V3) is reduced to a very low value by use of a 1·5-megohm feed resistor R5. The anode voltage is also reduced by including a 150-kilohm decoupling resistor R7. These modifications were adopted to reduce the grid base of the mixer stage to maintain a good conversion conductance with the reduced oscillator output resulting from the smaller oscillator anode current.
5. the grid-circuit time constant for the first limiter (V5) is smaller (47 pF and 47 kilohms compared with 82 pF and 470-kilohms for the HR/17): this gives improved a.m. suppression, reducing interference particularly from car ignition systems.

The circuit of receiver type F.M.2. was modified by the manufacturers after a number had been produced and the circuit diagram given in Fig. 7 applies to H/17A receivers with serial numbers from 201 onwards. The circuit differs from that given in Fig. 6 in the following respects:

1. the anode supply for the two limiters V5 and V6 is taken from the 220-volt line via 47-kilohm resistors R36 and R38. Previously these anodes were fed from the 50-volt line via a 3·3-kilohm resistor: this modification gives a further improvement in a.m. suppression.
2. the grid-circuit time constant for the second limiter (V6) is smaller (22pF and 100 kilohms compared with 500 pF and 100 kilohms): this modification was also included to improve a.m. suppression.
3. the cathode circuits of the i.f. amplifiers V4, V5 and V6 includes 33-ohm resistors R35, R37 and R39. This modification was adopted to improve the stability of the i.f. amplifier and also tend to reduce variations in input resistance and input capacitance with bias changes. The limiter stages V5 and V6 are biased back to an extent dependent on input carrier amplitude and these resistors minimise variations in i.f. passband which might otherwise accompany changes in signal strength.
4. the a.f. output of the discriminator is attenuated by 6 dB by the potential divider R31, R32: this modification was introduced to reduce the a.f. output to approximately the level available from earlier models. The level has risen by 6 dB as a result of the more efficient operation of the limiters due to modification 1 above. The use of the two 470 kilohm resistors in the potential divider together with the resistor R33 increases the output resistance of the receiver to such an extent that the 47- pF capacitor used for de-emphasis purposes in earlier models is no longer necessary.

Power Supply and Audio-amplifier Circuit

The circuit of the HR/17A power supply and audio-amplifier is similar to that of the HR/17 given in Fig. 2 but a tag panel is used instead of a switch for adjustment of audio output level and reference should be made to Section 1 of Instruction for a full description of the this circuit.

Performance

The performance of the HR/17A receiver is in general similar to that of the HR/17 (described in the previous Section) and in some respects it may be superior.

Installation Procedure and Adjustment of Output Volume

These should be carried out as for the HR/17 receiver, volume being adjusted first by means of the tag strip and subsequently, if necessary, by the AJUST ZERO LEVEL control.

Maintenance

This should be limited to the extent described on p. 1.4.

GENERAL DESCRIPTION OF THE HR/18A

The complete circuit diagram of the receiver up to and including the discriminator is given in Fig. 8. It is similar to that of the HR/17A (Fig. 6), but includes three crystal diodes MR1, MR2 and MR3 which provide the d.c. output for operating the carrier alarm circuit. These diodes are fed from the secondary windings of the i.f. transformers T2, T3 and T4 and i.f. signals present in the crystal outputs are attenuated by the decoupling capacitors C54, C55 and C56. The crystal outputs are connected to pins 9, 10 and 11 of the 12- pole plug PL2 and are thus conveyed to the a.f. amplifier and mains unit chassis which also incorporates the carrier alarm.

Fig. 8 applies to HR/18A receivers with serial numbers up to and including 200: Fig. 9 gives the circuit diagram for HR/18A receivers with serial numbers above 201. The differences between the two circuits are as described earlier (p. 2.1).

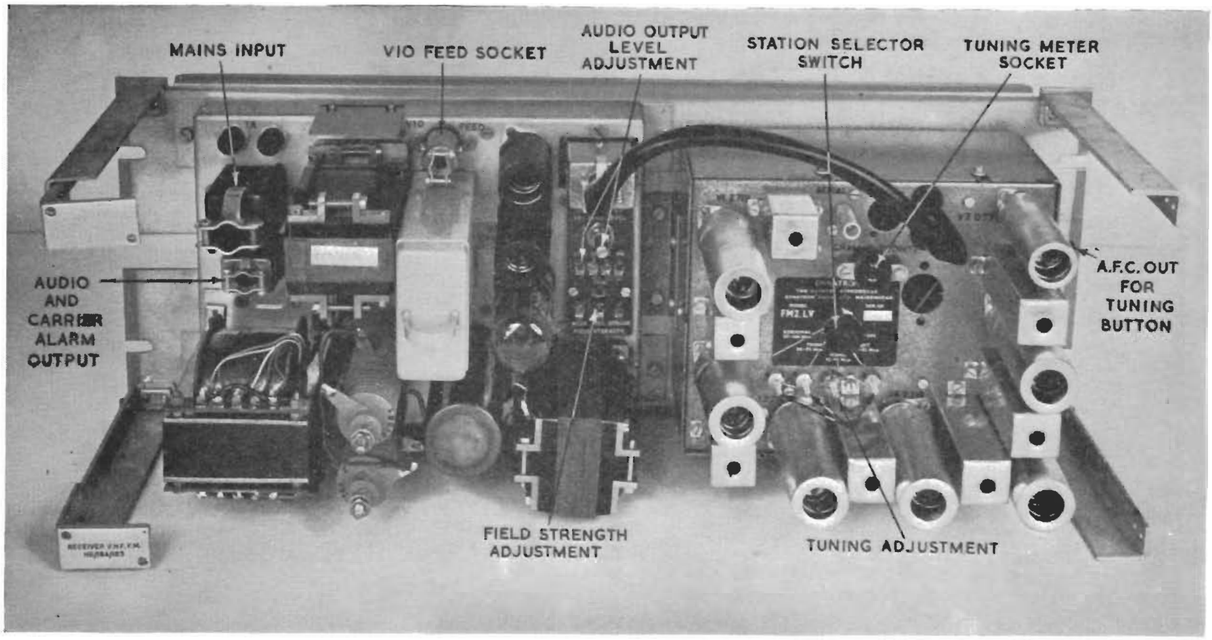


Fig. 2.2 View of HR/18A Receiver with Cover removed.

Power Supply, Audio Amplifier and Carrier Alarm Circuit

The power supply, audio amplifier and carrier alarm for the HR/18A is identical with that for the HR/18 receiver given in Fig. 5 and reference should be made to Section 1 of this Instruction for a description of the circuit.

Adjustment of Carrier Alarm Circuit

This adjustment is described on p. 1.5.

SECTION 3

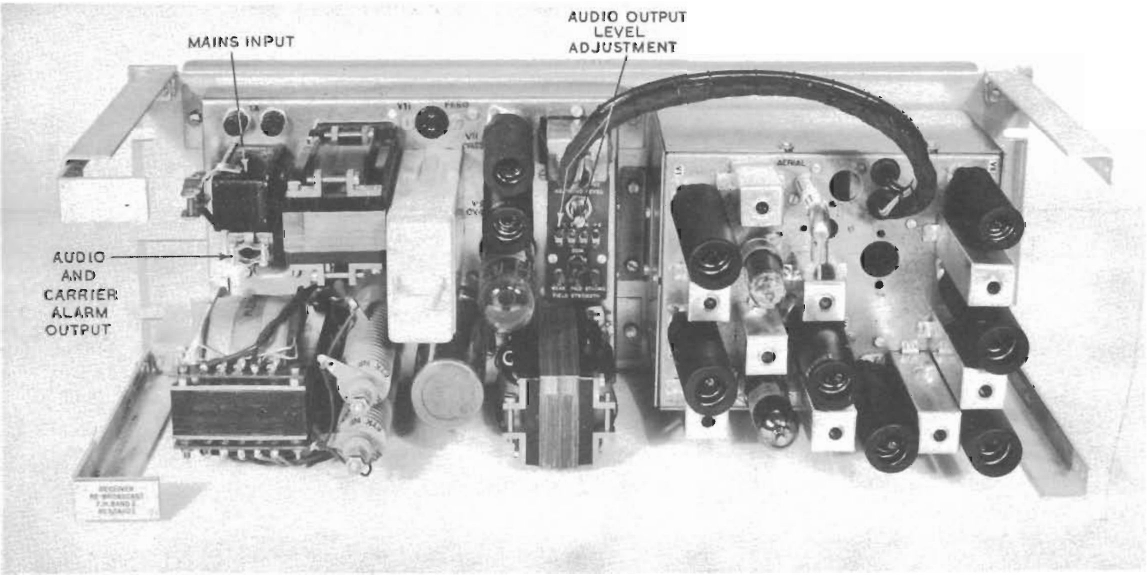
RECEIVERS RC5/1A AND RC5/1B

INTRODUCTION

The RC5/1A and RC5/1B are single-frequency crystal-controlled f.m. receivers primarily intended for use at transmitting stations for rebroadcasting. They can also be used at studio centres for monitoring transmissions from nearby f.m. transmitters. The receivers incorporate a carrier failure alarm.

The RC/1A and RC/1B receivers consist of a commercial f.m. tuner (Dynatron model F.M.2) with a modified oscillator section. The receiver is mounted together with a combined mains unit, a.f. amplifier and carrier failure alarm circuit, on a standard 19-inch by 7-inch panel.

Each receiver is tuned to a specific frequency in the band 88 to 100 Mc/s, the oscillator being crystal-controlled for good frequency stability. Any alteration of frequency requires re-alignment of the signal-frequency and oscillator circuits and this must be carried out only by Equipment Department. In the RC5/1A the oscillator frequency is below the signal frequency and in the RC5/1B it is above the signal frequency. A photograph of an RC5/1A is given in Fig. 3.1.



Output levels of 0, +4 or +8 dB can be delivered into a 600-ohm load for an input frequency-modulated to ± 30 kc/s, a tag panel permitting selection of the desired output level. A gain control is provided for accurate adjustment of output level.

A single receiver can operate via 70- to 100-ohm feeder from a dipole or other suitable aerial. Several receivers can be operated from a common aerial by use of an Aerial Coupling Unit ACU/5 described in Section 4.

GENERAL DESCRIPTION OF THE RC5/1A

Receiver Circuit

The complete circuit diagram of the receiver up to the discriminator is given in Fig. 10: this applies only to receivers with serial numbers up to 120. The circuit differs from that of the HR/18 in the following respects:

1. There is no switched signal-frequency tuning in V1 anode circuit. The receiver is intended for a

single transmission only and the anode inductor L1 of V1 is adjusted to resonate with the shunt capacitance (chiefly V1 output capacitance and V2 input capacitance) at the frequency of the transmission.

2. The double-triode oscillator and reactance-valve circuit of the HR/18 have been replaced by a circuit incorporating two pentodes V3 and V4. V3 is a frequency doubler and V4 a combined oscillator and frequency tripler, the operation of the circuit being explained in detail later.
3. The spring-loaded switch and 2-pole socket associated with the a.f.c. circuit of the HR/18 are no longer necessary and are omitted.
4. Only one crystal diode MR1 is used to supply d.c. bias to the carrier failure alarm circuit of the RC5/1A. This is taken from the grid circuit of the final limiter stage V7. Satisfactory operation of the carrier failure alarm circuit is obtained using only one crystal output because the input-output characteristic of the receiver is a better approximation to the ideal shape than for the HR/18 and HR/18A.

The oscillator circuit operates in the following manner. The control grid and screen-grid of pentode V4 are connected as a tuned-grid tuned-anode oscillator. The tuned control grid circuit contains the crystal and the tuned screen grid circuit consists of an inductor L4 which is adjusted to resonate with the screen grid-earth capacitance at the oscillator frequency. The anode circuit contains an inductor L5 which is adjusted to resonate with the 6·8-pF capacitor C22 and the anode-earth capacitance at three times the crystal frequency.

The output at V4 anode is coupled to V3 control grid by C19 and R11. The anode circuit of V3 contains an inductor L4 which is adjusted to resonate with the 10-pF capacitor C18 and the anode-earth capacitance of V3 at six times the frequency of the crystal that is twice the frequency of the input signal. The ouput of V3 is applied to the mixer (V2) control grid via the 2·2-pF capacitor C12.

The required crystal frequency can be calculated as follows. If the carrier frequency of the transmission to be received is f_c, the oscillator frequency must be (f_c — 10·7) Mc/s, the intermediate frequency of the receiver being 10·7 Mc/s. The two valves V3 and V4 give a six-fold multiplication of frequency and thus

$$\text{crystal frequency} = \frac{f_c - 10{\cdot}7}{6}\ \text{Mc/s}$$

As an example, if the carrier frequency is 93·5 Mc/s

$$\text{crystal frequency} = \frac{93{\cdot}5 - 10{\cdot}7}{6}\ \text{Mc/s}$$

$$= \frac{82{\cdot}8}{6}\ \text{Mc/s}$$

$$= 13{\cdot}8\ \text{Mc/s}$$

The i.f. amplifier and discriminator circuit is similar to that of the HR/17 and is described in Sections 1 and 2.

The circuit of receiver type F.M.2 was modified by the manufacturers after a number had been produced and the circuit diagram given in Fig. 11 applies to RC5/1A receivers with serial numbers after 120. The differences between the two circuits are as given for the HR/17A receiver with serial numbers above 200 in Section 2.

GENERAL DESCRIPTION OF THE RC5/1B Receiver Circuit

The RC5/1A receiver may in certain situations give unsatisfactory reception. For example there may be a heterodyne whistle due to second-channel interference. This can be avoided by using an RC5/1B receiver. In this type the oscillator frequency is above the signal frequency and second-channel breakthrough therefore occurs at a frequency 21·4 Mc/s higher than for the RC5/1A.

The complete circuit diagram of the RC5/1B up to the discriminator is given in Fig. 12: this applies only to receivers with serial numbers up to 120. The circuit has much in common with that of the RC5/1A but the tuning capacitances in the oscillator and frequency-multiplying stages are smaller to give higher operating frequencies. The following are the difference in component values:

1. the crystal frequency is given by

$$\text{crystal frequency} = \frac{f_c + 10{\cdot}7}{6}\ \text{Mc/s}$$

For a carrier frequency of 93·5 Mc/s

$$\text{crystal frequency} = \frac{93{\cdot}5 + 10{\cdot}7}{6}\ \text{Mc/s}$$

$$= \frac{104{\cdot}2}{6}\text{Mc/s}$$

$$= 17{\cdot}38\ \text{Mc/s}$$

2. C22 is 4·7 pF instead of 6·8 pF
3. C18 is 4·7 pF instead of 10 pF
4. C12 is 0·5 pF instead of 2.2 pF

The circuit diagram for RC5/1B receivers with serial numbers after 120 is given in Fig. 13. This differs from the circuit of Fig. 12 as explained for the HR/17A in Section 2.

Power Supply, Audio Amplifier and Carrier Alarm Circuit

The circuit of the power supply, audio amplifier and carrier failure alarm for the RC5/1A and RC5/1B receivers is similar to that for the HR/18 shown in Fig. 5 and reference should be made to Section 1 of this Instruction for full details. Only one crystal output is however used and the FIELD STRENGTH control should always be set to WEAK.

Performance

The overall frequency response of the receiver is within ± 2 dB of a 50 μS de-emphasis curve (Fig. 3) from 40 c/s to 20 kc/s.

For an input modulated by a single frequency to a deviation of 75 kc/s, any individual harmonic in the audio output is less than 1 per cent. The total harmonic distortion is less than 1·7 per cent.

Limiting begins with an input of 6 μV. For an input of 31 μV the signal noise ratio is better than 40 dB and for an input of 100 μV it is better than 55 dB.

Adjustment of A.F. Output Volume Maintenance

These are as for the HR/17 and reference should be made to Section 1 for details.

Adjustment of Carrier Alarm Circuit

Operation of the alarm circuit can be checked as follows:—

1. Set the FIELD STRENGTH control to WEAK.
2. Connect a PTM/6 (or a 100μA meter built out to 10 kilohms) to V10 FEED.
3. Note the meter reading in the presence of the carrier. This should be greater than 40μA.
4. Disconnect the aerial or aerial feeder from the receiver and check that the carrier alarm operates.

SECTION 4

AERIAL COUPLING UNIT ACU/5

Introduction

The aerial coupling unit ACU/5 enables up to four receivers to be operated from either of two aerials.

Description

The unit consists of a panel on which are mounted three co-axial plugs and four 82-ohm resistors supported on tag strips. As indicated in Fig. 4·1, the two outer plugs are connected via co-axial cable to two aerials of which one is normally a main aerial and other a reserve aerial. The centre plug is connected via the 82-ohm resistors and lengths of co-axial cable to the receivers. The centre plug can be connected to either of the two outer plugs by a U-link which thus permits rapid exchange of one aerial for the other.

Each of the co-axial cables to the receivers should have an electrical length of half a wavelength at the mid-band frequency (91·5 Mc/s). This ensures that the impedance at the tag strip end of the cable is equal to the input impedance of the receiver. If 82-ohm resistors are used, the net impedance presented across the centre plug is a reasonable match to the characteristic impedance of the aerial cable for any number of receivers up to four.

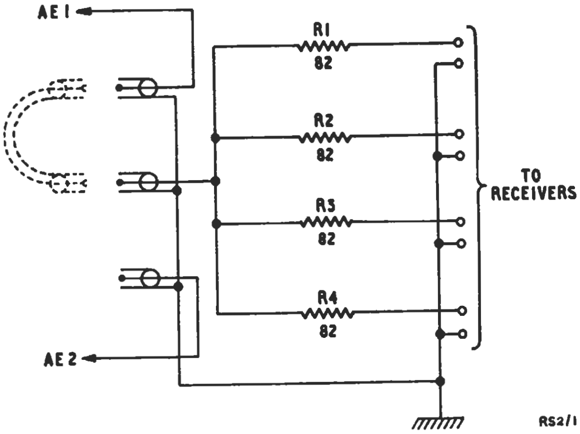


Fig. 4.1 Circuit Diagram for the Aerial Coupling Unit ACU/5

SECTION 5

F.M. RECEIVER HR/12

Introduction

This f.m. receiver is used in conjunction with the Storno transmitter Type BQP45 at outside broadcasts in order to provide a high-quality radio link between a commentator's microphone and a base point. The transmitter is carried by the commentator and the HR/12 is situated at the base point. The receiver can be pre-set to any frequency in the range 87·5 to 94·5 Mc/s; the output from the receivers is at low volume (— 70 dB approximately) so that it is suitable for feeding into OBA/9 equipment without additional attenuators. A monitor output jack is fitted which provides an output used for pre-fade listening.

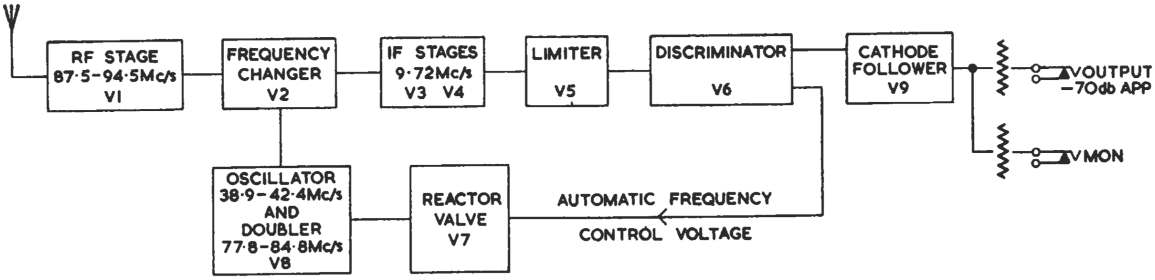


Fig. 5.1. Receiver HR/12: Block Schematic Diagram

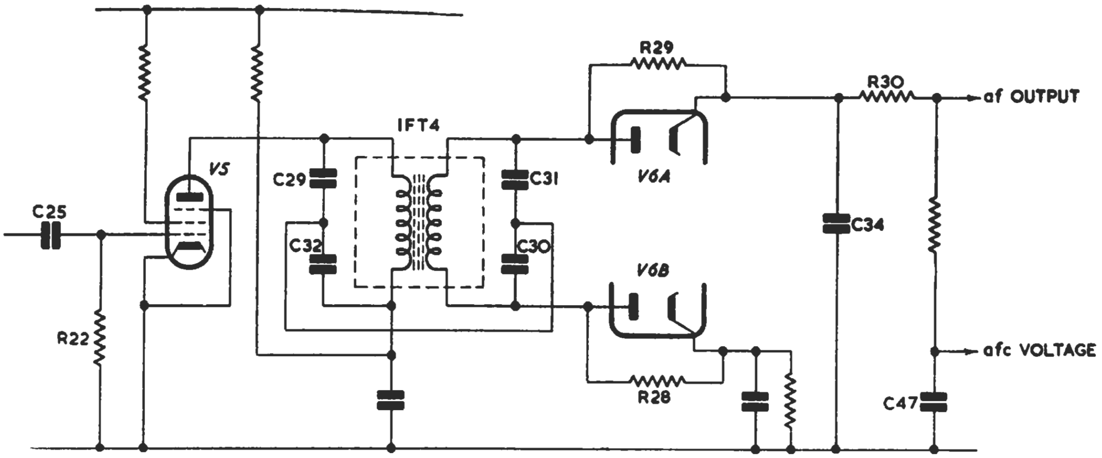


Fig. 5.2. Receiver HR/12; Simplified Circuit Diagram of Limiter and Discriminator Stages

General Description

This receiver comprises a modified r.f. chassis of an E.M.I.-type 1250 receiver, crystal-controlled calibration oscillator OS/12 and a Mains Unit MU/42. These are mounted in a case fitted with carrying handles and enclosed by a perforated cover. The mains unit supplies power to both receiver and the calibration oscillator, and works from 200-250 V 50-c/s mains or batteries. The

Circuit Description

R.F. Chassis

A circuit diagram of this unit is shown in Fig. 14 and a block schematic diagram in Fig. 5.1. The r.f. stage (V1) and oscillator-doubler stage (V8) outputs are coupled to the frequency changer V2 by π-section network; the i.f. stages (V3 and V4) are of conventional design; the i.f. frequency is 9·72 Mc/s.

A simplified diagram of the limiter and discriminator is shown in Fig. 5.2. V5, the limiter stage, is operated with a low screen potential, and is self-biased by the action of C25 and R22. With a fairly strong signal (greater than 2 V at the grid of V5) the valve is operating in Class C, and under these conditions, variations of input-signal amplitude produce only very small variations of signal amplitude in the anode circuit.

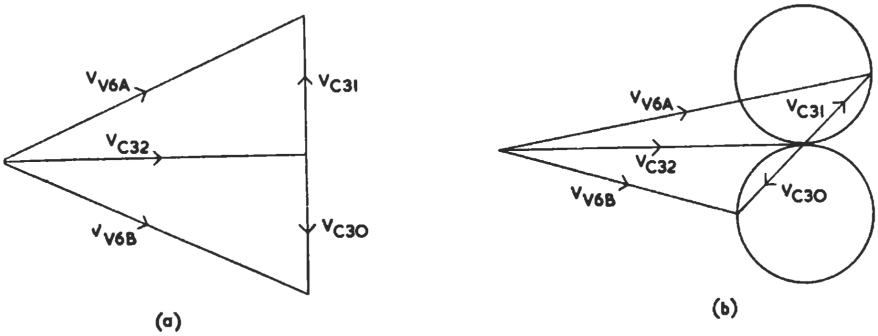


Fig. 5.3. Receiver HR/12: Discriminator Vector Diagrams

The voltages developed across capacitors C30 and C31 (referred to their junction) are equal in magnitude but 180° out-of-phase and, when the applied signal is at the frequency at which the primary and secondary of the transformer IFT4 are resonant, each is 90° out-of-phase with voltage developed across C32. This is because at resonance the voltage developed across the primary winding of the transformer is in quadrature with the voltage developed across the secondary. These relationships are shown by the vector diagram in Fig. 5.3. The voltage applied to the diode V6A is the vector sum of the voltages across C32 and C31. The voltage applied to divide V6B is similarly the vector sum of the voltages across C32 and C30. These voltages are equal in magnitude when the applied signal is at the resonant frequency of the transformer; equal and opposite voltages are then developed across R28 and R29 and there is no output signal developed across C34. When the incoming signal is not at the resonant frequency of the transformer the primary and secondary voltages are no longer in quadrature and the voltages applied to V6A and V6B are not equal in magnitude (see Fig. 5.3). There is now an output signal developed, the amplitude of which is proportional to the deviation of the signal from the transformer resonant frequency over a wide range. This is shown in Fig. 5.4. Thus when a f.m. signal is received, an a.f. output will be developed across C34, and applied to the grid of V9. R30, R40 and C74 provide de-emphasis.

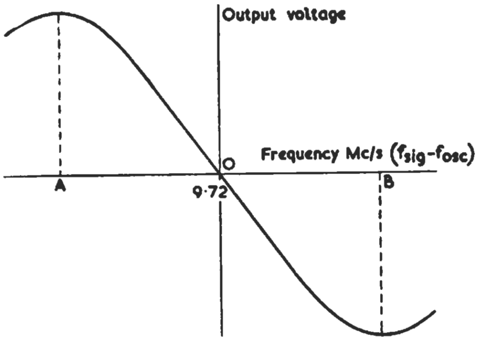


Fig. 5.4. Receiver HR/12: Discriminator Input/Output Characteristic

If the unmodulated frequency of the incoming signal, or the frequency of the receiver oscillator alters, the mean voltage developed across C34 is no longer zero, and a steady voltage is developed across C47 which is proportional to the difference of the unmodulated frequency of the signal applied to the discriminator from the resonant frequency of the transformer IFT4. This voltage is applied through R36 and R32 to the grid of the reactance valve V7 (see Fig. 5.5). V7 behaves as an inductor; its action is explained below.

The anode of V7 is coupled by C40 to the oscillatory circuit L14, C43 associated with V8, the cathode, control grid and screen grid of which form part of a Hartley shunt-fed oscillator. A portion of this oscillatory voltage is fed back by C38 and R31 to the grid of V7. The impedance from the grid of V7 to earth is predominantly capacitive (input capacitance of V7), the actual magnitude of the impedance being much less than that of R31 and R32. The voltage at the grid thus leads the voltage at the anode by approximately

90° and this voltage gives rise to an alternating component of anode current, also leading the anode voltage by approximately 90°.

When the bias applied to the valve alters, the mutual conductance also varies, altering the magnitude of the alternating component of the anode current, and thus the effective inductance of the valve. Thus when the frequency of the unmodulated i.f. signal derived from the incoming signal departs from the resonant frequency of IFT4, the local oscillator is re-tuned so as to reduce the frequency difference.

Consider the initial conditions when a signal is received. If the frequency of the unmodulated signal differs from the frequency of alignment by less than 100 kc/s (approximately), the resultant i.f. signal will fall within the working range of the discriminator, and a control voltage will be developed which will re-tune the local oscillator, so that the i.f. signal frequency will be brought nearer to the centre frequency of 9·72 Mc/s. The automatic frequency-control circuit can only reduce, and not cancel, the magnitude of the tuning error; for if the tuning error were reduced to zero, there would be no control voltage developed to re-tune the local oscillator.

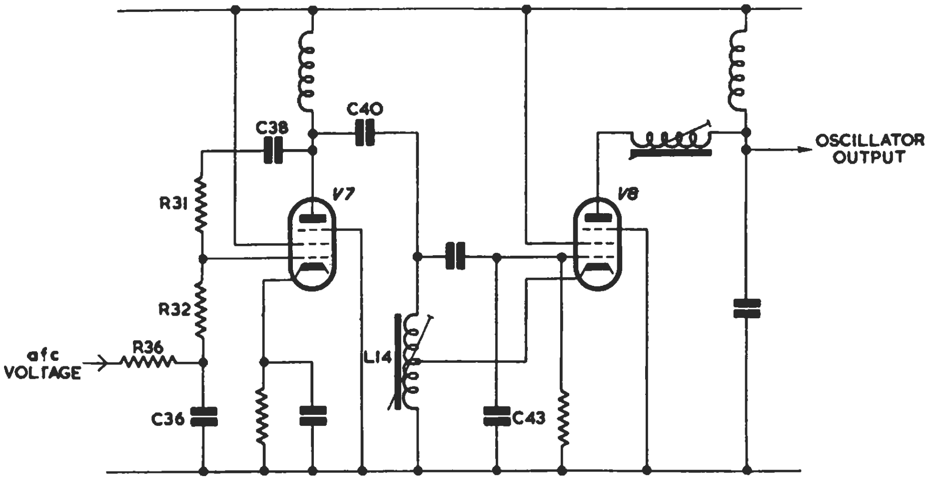


Fig. 5.5. Receiver HR/12: Simplified Circuit Diagram of Reactance Valve and Oscillator

If the signal fulfils the initial conditions (i.e., is within approximately 100 kc/s of the frequency of alignment) the automatic frequency control circuit will then compensate for frequency drift in the incoming signal or the local oscillator over a range of the order of ± 200 kc/s from the the frequency of alignment.

The maximum frequency drift which can be corrected is set by the maximum output from the discriminator; this occurs when the signal frequency at the discriminator is equal to OA or OB (Fig. 5.4) when the i.f. signal frequency is in the region of 100 kc/s off tune, and the total drift in the incoming signal and local oscillator is then about 200 kc/s. Further drift of the signal frequency, or local-oscillator frequency, increases the amount by which the i.f. signal is off tune and so reduces the control voltage, which in turn alters the oscillator frequency in a manner tending to increase the change. The receiver then goes rapidly off tune. However, before this stage is reached, distortion occurs, since the discriminator is working on the non-linear portion of the characteristic.

The local oscillator V8 is so arranged that the cathode, control grid and screen grid are coupled in a shunt-fed Hartley oscillator; the anode circuit is tuned to accept the second harmonic of the oscillator fundamental frequency.

To assist in the alignment of the receiver oscillator, and to provide a check on the degree of mis-tuning in the received signal, provision has been made for monitoring the anode current of the reactance valve V7 by means of a 0-3 mA meter. The departure of the meter reading from its quiescent value (approximately mid-scale) gives an indication of the degree of mis-tuning.

Crystal Oscillator OS/12

This oscillator is a calibration unit used in checking the alignment of the receiver unit and the unmodulated frequency of the Storno transmitter. It is mounted on a small sub-chassis in the HR/12 case, and derives its h.t. and l.t. supplies from the Mains Unit MU/42.

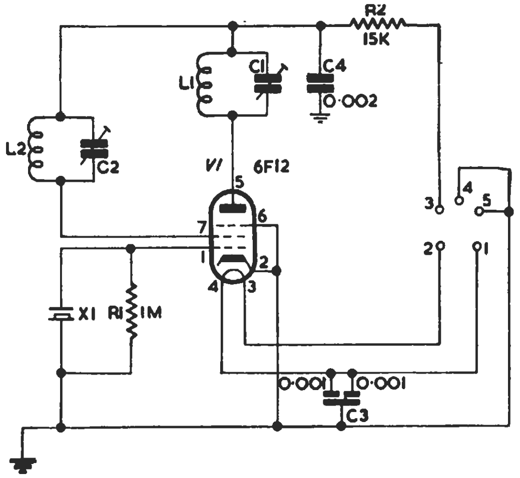


Fig. 5.6. OS/12; Circuit Diagram (Socket Connections Viewed from Back of Pins)

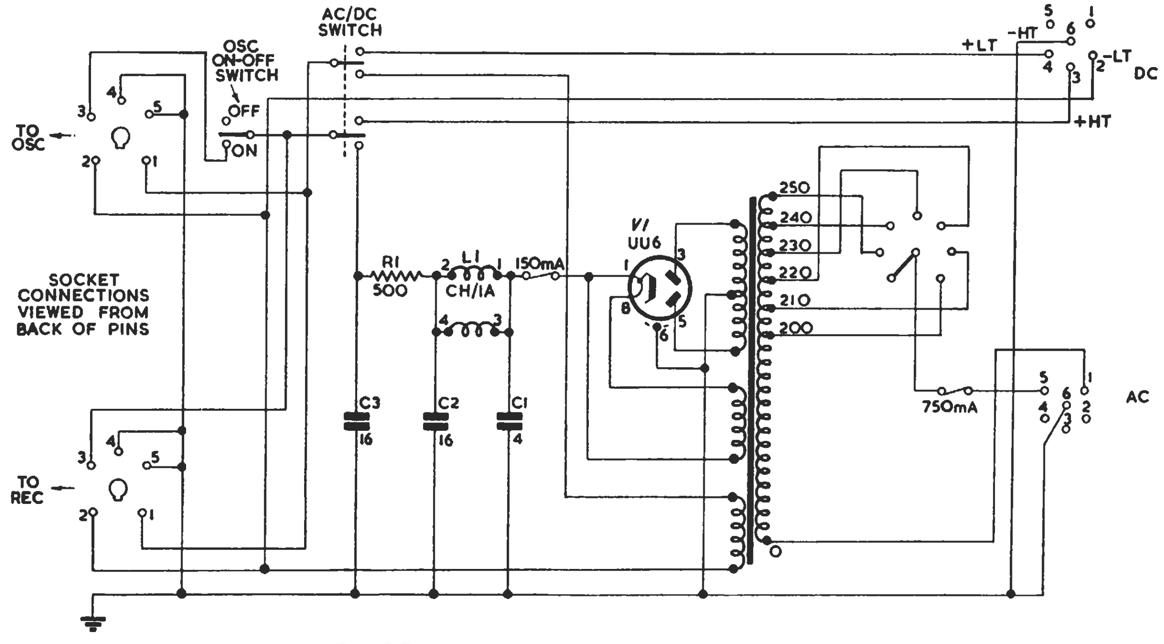


Fig. 5.7. Mains Unit MU/42: Circuit Diagram

A circuit diagram of the oscillator is shown in Fig. 5.6. The tuned circuit L2, C2 is resonant at the fundamental frequency of the crystal X1, whilst the tuned circuit L1, C1 is resonant at the fifth harmonic; the crystal is chosen so that the anode circuit is resonant at the operating frequency of the Storno transmitter. There are no connections between the oscillator and the receiver; if the receiver is correctly aligned, and has no aerial connected, there is sufficient fortuitious pick-up to suppress the receiver noise. The receiver tuning may be checked by observing the anode current of V7, by means of the meter. (See Fig. 14.) The departure of its reading from the quiescent value gives an indication of the degree of mis-tuning.

Mains Unit MU/42

This mains unit supplies h.t. and l.t. for the receiver unit and the calibration oscillator OS/12 from 200-250 volt 50-c/s mains or from 250-volt h.t. and 6-volt l.t. batteris. It is of conventional design, its circuit diagram being given in Fig. 5.7. A switch is included in the h.t. lead to the calibration oscillator, so that this latter unit may be switched to a standby condition when not in use. The mains and battery inputs are applied through 6-point plugs and sockets.

A diagram of the face panel of the unit is shown in Fig. 5.8.

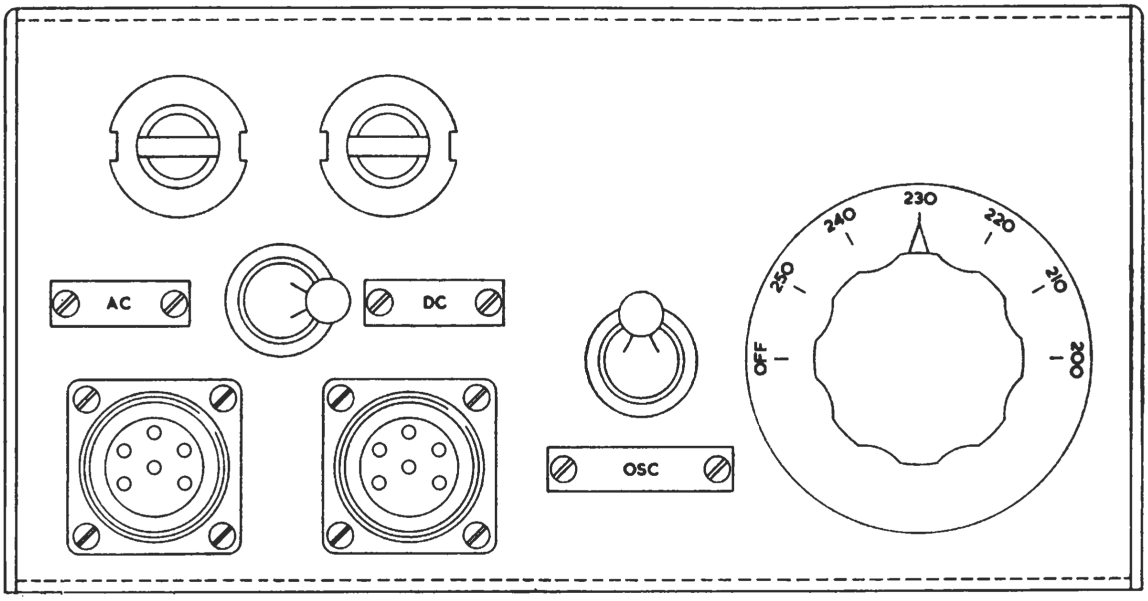


Fig. 5.8. Mains Unit MU/42: Front Panel

Operating Instructions

1. Check that the a.c./d.c. switch on the front panel of the MU/42 is at the correct position.
2. If the equipment is operating from a.c. mains, set the mains-adjusting switch on the MU/42 to the tapping nearest to the measured mains voltage.
3. Switch on the HR/12 and allow a period of at least 10 minutes for it to warm up.

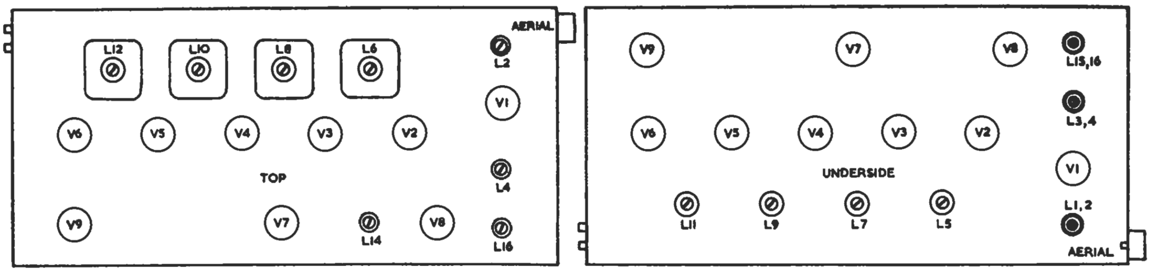


Fig. 5.9. HR/12 Component Layout

4. Check that the HR/12 is tuned to the correct frequency in the following manner:
   4.1. Disconnect the aerial at the aerial socket and insert the test-meter plug in the socket on the chassis. Note the meter reading with no input signal present. It should be in the region of 1·0 to 1·5 mA. This is the quiescent value of the anode current of V7.
   4.2. Switch on the calibrating oscillator OS/12· If the HR/12 is correctly aligned, the test-meter reading should not change and the receiver noise should be muted. No physical connection between the oscillator and receiver is necessary as there is adequate fortuitous pickup.

   If the HR/12 is slightly off-tune there will be a deflection of the meter but the receiver noise will still be suppressed when the oscillator is switched on. If the receiver HR/12 is considerably off-tune, there will be no appreciable meter deflection and no noise suppression when the oscillator is switched on. In either case the receiver must be retuned. This is achieved by adjustment of L14 (HR/12 oscillator frequency). The position of L14 core is shown in Fig. 5.9.

4.3. To retune the HR/12, adjust L14 core, with the OS/12 on, to give the quiescent value of meter reading noted in 4.1.

There are a number of settings of L14 which give the required value of anode current but the correct setting can be identified by noting how the meter reading varies when L14 is adjusted. At the correct setting, rotation of L14 core in one direction (e.g. clockwise) causes the meter reading to rise above the quiescent value and rotation of the core in the reverse direction (i.e. anti-clockwise) causes the meter reading to fall below the quiescent value. When the correct setting of L14 has been identified, set L14 accurately to give the quiescent reading.

4.4. Switch off the OS/12 and re-connect the aerial.

With the Storno transmitter switched on, check that the meter still gives the quiescent reading and that rotation of L14 core gives meter deflections above and below the quiescent value as under 4.3.

If the meter reading alters when the Storno transmitter is switched on this suggests that the transmitter frequency is not equal to that of the OS/12 and adjustment of the transmitter is required.

Alignment

Equipment required includes a signal generator covering range 9-10 Mc/s, and a valve voltmeter of very high input impedance, or d.c. meters reading 0-2 mA and 0-10 mA (see Alternative Alignment Procedure). The positions of the major components in the receiver are shown in Fig. 5.9.

(a) *I.F. Alignment*

(1) Connect the valve voltmeter to test point ' A ' (—) and chassis (+). Remove V8.
(2) Inject an unmodulated signal at 9·72 Mc/s, via a 0·001-μF capacitor, between the grid (pin 1) of V3 and chassis.
(3) Adjust cores of L10, L9, L8, L7 in that order for maximum output.
(4) Inject an unmodulated signal at 9·72 Mc/s, via a 0·001-μF capacitor, between the grid (pin 1) of V2 and chassis.
(5) Adjust cores of L6, L5 in that order for maximum output.
(6) Repeat operations 2 to 5, until no further improvement is obtained. Replace V8.

Note: It is advisable to adjust discriminator circuit after carrying out i.f. alignment, without changing generator frequency.

(b) *Discriminator Alignment*

(1) Connect the voltmeter to test point ' B ' (—) and chassis (+). Remove V7 and V8.
(2) Inject an umodulated signal at 9·72 Mc/s, via a 0·001-μF capacitor, into the grid (pin 1) of V2 and chassis. Adjust generator output to 10 mV.
(3) Adjust core of L11 for maximum output.
(4) Connect valve voltmeter to junction of R32 and R36 (—) and chassis (+).
(5) Adjust core of L12 for zero output.
(6) Repeat twice operations 1 to 5. If the discriminator is aligned correctly, an increase in the injected signal frequency from the signal generator will produce positive a.f.c. correcting voltage, shown by a reading below zero on the valve voltmeter.
(7) Replace V7 and V8.

(c) *Oscillator and R.F. Alignment*

(1) Short-circuit C36 (grid circuit of V7).
(2) Connect the voltmeter to test point ' A ' (—) and chassis (+).
(3) Inject a signal at the operating frequency at the aerial socket, or switch on the oscillator OS/12.
(4) Fully unscrew core of L14.
(5) Screw in core of L14 for maximum output (screw in to the second tuning point).
(6) Adjust cores of L4, L16, L2 in that order for maximum output.
(7) Repeat operations (5) and (6) until no further improvement can be obtained.
(8) Remove a.f.c. shorting link from C36.

Alternative Alignment Procedure

The alignment above requires the use of a high input impedance valve voltmeter, but the following instructions enable alignment to be carried out without this instrument, when necessary.

(a) *I.F. Alignment*

(1) Remove V7 and V8.
(2) Connect a 0-2 mA d.c. meter across R25 (anode circuit of V5).

(3) Inject a C.W. signal of 9·72 Mc/s through a 0·001-μF capacitor into grid of V3 and chassis.
(4) Adjust signal input until meter reads 1·8 mA.
(5) Adjust cores of L10, 9, 8 and 7 for minimum meter reading keeping signal input adjusted so that meter never reads less than 1·7 mA.
(6) Inject a C.W. signal of 9·72 Mc/s through a 0·001-μF capacitor into grid of V2 and chassis. (Connect to chassis at V2 suppressor to avoid instability.)
(7) Adjust signal input until meter reads 1·8 mA.
(8) Adjust cores of L10, 9, 8, 7, 6 and 5 in that order for minimum meter reading, keeping signal input adjusted so that meter never reads less than 1·7 mA.
(9) Replace V7 and V8.

(b) *Discriminator Alignment*

(1) With V7 and V8 removed, connect a 0-10 mA d.c. meter in the anode circuit of V9.
(2) Fully unscrew core of L12.
(2) Inject a strong signal of 9·72 Mc/s through a 0·001-μF capacitor, into grid of V2 and chassis. (Connect to chassis at V2 suppressor to avoid instability.)
(4) Adjust core of L11 for minimum meter reading.
(5) Short grid of V5 to chassis and note meter reading.
(6) Remove short from V5 grid.
(7) Screw in core of L12 so that meter goes through a minimum and back up to reading obtained in operation (5).
(8) Adjust L12 very carefully so that meter reads the same with V5 grid shorted or not shorted to chassis. If the discriminator is aligned correctly, an increase in the inject signal frequency from the signal generator will produce positive a.f.c. correcting voltage, shown by an increase in the reading on the meter.
(9) Replace V7 and V8.

(c) *Oscillator and R.F. Alignment*

(1) Short-circuit C36 (grid circuit of V7).
(2) Connect a 0-2 mA d.c. meter across R25 (anode circuit of V5).
(3) Inject a signal at the operating frequency at the aerial socket, or switch on the oscillator OS/12.
(4) Fully unscrew core of L14.
(5) Screw in core of L14 for maximum ‘ dip ’ in meter. (Screw in to the second tuning point.)
(6) Adjust cores of L14, L16 and L2 in that order for minimum meter reading.
(7) Repeat operations (5) and (6) until no further improvement can be obtained.
(8) Remove shorting link from C36.

HR/12

Supply: 200-250 V, 50 c/s or 250 V and 6 V batteries.

R.F. Chassis

Impedances:

Aerial input	50 ohms
Audio output	600 ohms

Output volume — 70 dB (approximately).
Sensitivity: 100 μV at aerial terminal for limiter saturation (2 V at grid of V5).
Total current: L.T. 2·7 A, H.T. 80 mA approx.

Valves

V1-V5, V7, V8	**Z77,** 6F12, EF91
V6	**D77,** CV140, 6D2, EB91
V9	**L77**

OS/12

Total current: L.T. 0·3 A; H.T. 3-4 mA at 250 V supply.
Crystal: S.T.C. Type 4013 Gp.1, cut for 1/5 Storno transmitter frequency.

Valves

V1	**6F12,** Z77, EF91.

MU/42

Valves

V1	UU6

Fuses

750 mA Bulgin PAK3.
150 mA Bulgin PAK1.

SECTION 6

RECEIVERS RC5/2 AND RC5/3

Introduction

The RC5/2 and RC5/3 are completely transistorised f.m. receivers fitted with carrier-failure relays and intended for rebroadcasting. They may obviously be used also for quality monitoring purposes. They are both designed for operation from a.c. mains, but the RC5/3 includes facilities for automatic change-over to battery operation if the mains fail. These receiver codings do not cover either the local oscillator or the mounting bracket required. Adaptors and side brackets exist to permit the receiver to be flush-mounted or recessed on 19-inch bays. Adaptor plates can also be supplied to permit either type of mounting on 22-inch bays.

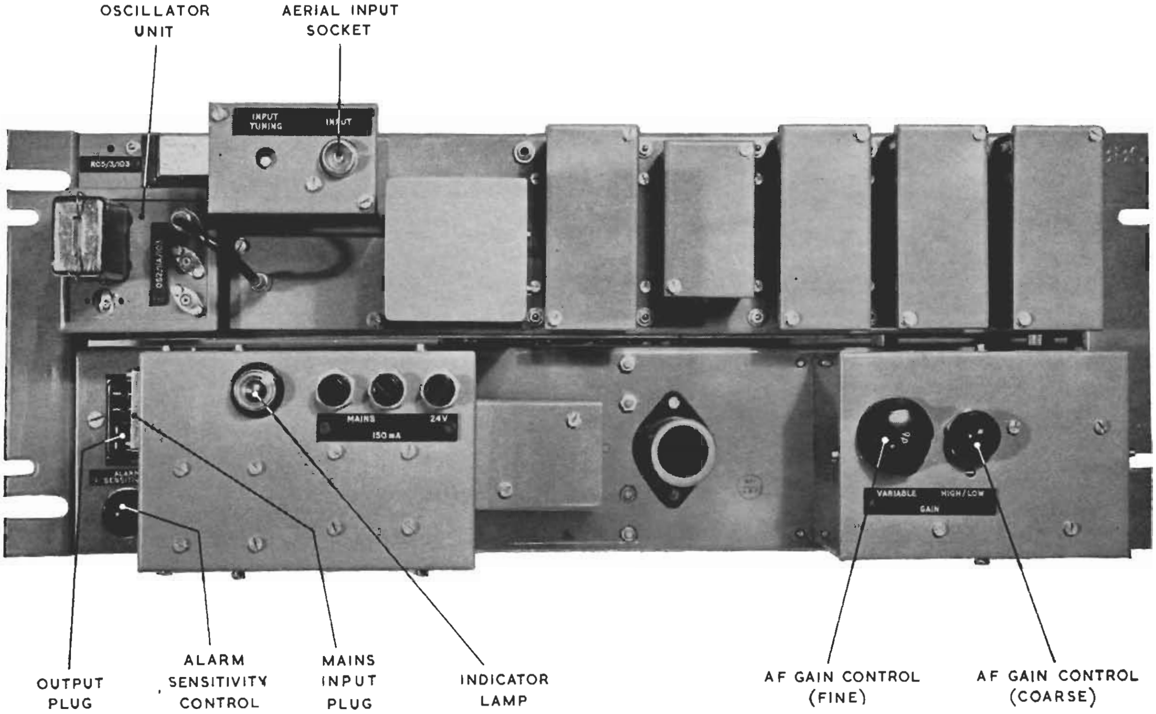


Fig. 6.1. Receiver RC5/3: General View

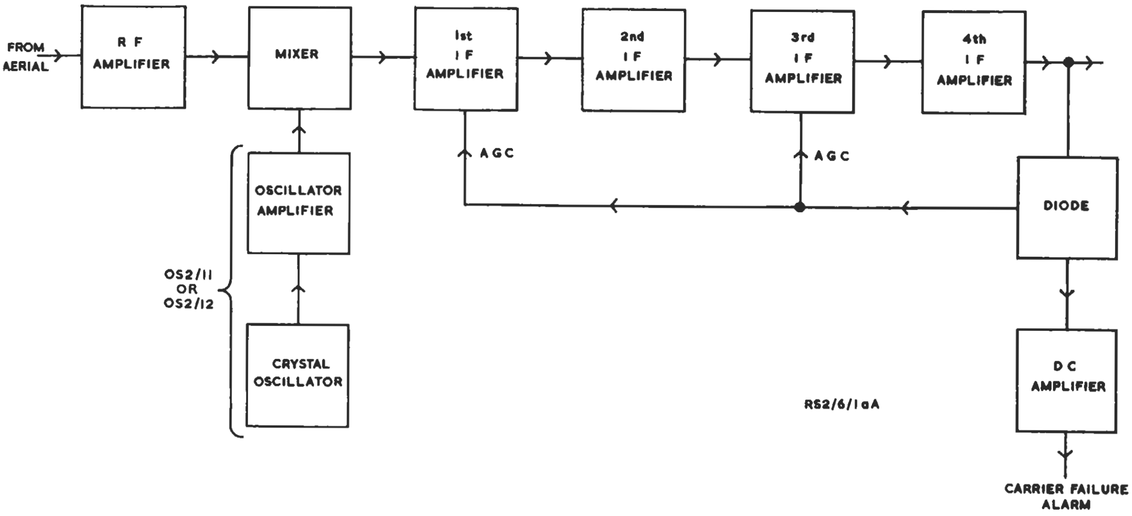
A general view of an RC5/3 receiver is given in Fig. 6.1. The receiver is constructed on two 3½-inch panels, giving a total depth of 7 inches. One panel contains the r.f. amplifier, frequency changer and i.f. amplifier and limiter and the other contains the discriminator, a.f. amplifier, carrier-failure relays and the supply. This particular division of the circuit was adopted to enable the r.f. and i.f. panel to be used in f.m. translators where the discriminator and a.f. sections are not required. The oscillator is in the form of a unit which can readily be removed from the r.f. chassis and has the general coding OS2/11 or OS2/12. Various versions of the oscillators are available, the differences depending on the frequencies covered and the output arrangements. Earlier receivers are fitted with oscillators Type OS2/11, but in future oscillator Type OS2/12E will be fitted except when a triple oscillator is required, when oscillators Type OS2/11C or D will be used.

The r.f. chassis is of silver-plated copper and all pre-set circuits are adjusted by air-dielectric trimmers. The a.f. amplifier includes two printed wiring cards.

General Description

The receiver is a superheterodyne type using the standard intermediate frequency of 10·7 Mc/s. The circuits of the mixer, i.f. stages and limiter are similar to those of a receiver developed in Research Department.*

A block diagram of the receiver is given in Fig. 6.2. As shown there is a single r.f. stage and 5 i.f. stages. The diode mixer is fed from the oscillator via an oscillator-amplifier included in the OS2/11 or OS2/12. A diode at the output of the fourth i.f. amplifier supplies a.g.c. bias to the first and third i.f. amplifiers and also operates the carrier-failure relays via a d.c. amplifier. One set of back contacts of the carrier-failure relays is generally used to short-circuit the audio output, thus muting the receiver in the event of any failure. This is effected by means of straps in the bay wiring at the back of the cable-ended socket which engages with the receiver output plug. The remaining relay contacts may be used for other purposes, such as operating carrier-failure alarms.



The discriminator feeds two stages of a.f. amplification via a sensitivity control and variable negative feedback applied to these stages gives fine control of audio output level. A phase-splitter following these stages drives a push-pull output stage incorporating negative feedback.

Circuit Description (Figs. 15 and 16)

R.F. Stage

The r.f. stage is a common-emitter amplifier using a 2N502 transistor VT1. The co-axial r.f. input and the input to the base of the transistor are tapped down the inductors L1 and L2, the position of the tapping points being chosen to give good selectivity rather than maximum power transfer to the transistor. Particular emphasis is laid on selectivity throughout the design of the receiver because it must be capable of satisfactory operation near f.m. transmitters with carrier frequencies not greatly displaced from the received frequency. The mean collector current of VT1 is stabilised by the potential divider R1 R2, which impresses a particular steady potential on the base, and by the emitter resistor R4 which determines the emitter (and hence the collector) current.

Mixer Stage

Mixing is achieved by the two diodes MR1 and MR2. These are connected between the centre-tapped windings of L4 L5 and are driven in push-pull at the oscillator frequency, the primary winding of L4 being tuned to give maximum oscillator injection. The signal frequency input to the mixer is applied to the centre point of L4 secondary winding to minimise transfer of oscillator output to the r.f. stage and thus to the aerial. This precaution is necessary because transistors readily convey signals from their output to their input circuits. The wanted difference-frequency output from the mixer is selected by the i.f. input filter.

Oscillator OS2/11

The oscillator OS2/11A shown in the circuit diagram, Fig. 16, comprises a crystal-controlled oscillator stage VT1 and an r.f. amplifier VT2

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*See Research Report T.078, 'An Experimental Transistor Receiver for V.H.F. Sound Broadcast Reception,' and R. Harvey, 'Transistor V.H.F./F.M. Receiver,' *Wireless World*, August, September and October 1960.

feeding three co-axial output sockets, only one of which is used in this receiver.

The oscillator has a tuned collector circuit L3 which is coupled by a winding on L3 to the emitter to give the positive feedback necessary for oscillation. Included in series with the coupling winding is the crystal XL1 which, in conjunction with C3, enables the frequency of oscillation to be adjusted to and maintained at the required value. The base of VT1 is effectively earthed by C1 and C5 to facilitate the application of a.g.c. and clearly therefore the emitter circuit cannot be earthed also. An undecoupled resistor R4 is hence included in series with the emitter bias components R5 C6.

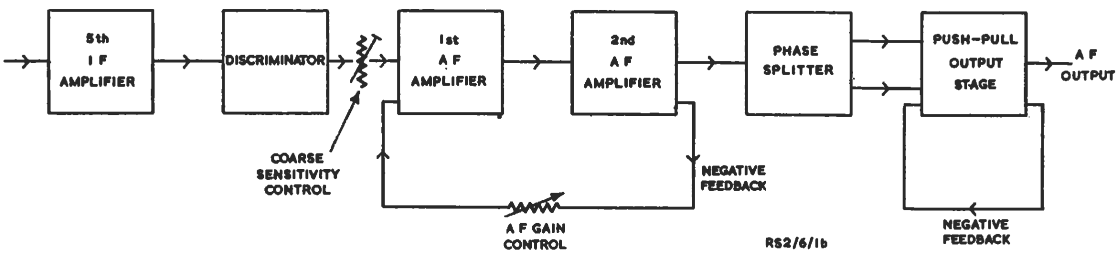


Fig. 6.2. Receivers RC5/2 and RC5/3: Block Diagram

The crystal is a type designed for good frequency stability over a wide temperature range, and although it is mounted in an oven the heater windings are not used. The oven is however heated in other applications of the oscillator, e.g., in translators.

The output amplitude of the oscillator is stabilised by an a.g.c. circuit. The r.f. signal at the collector is applied by C4 to the voltage-doubler rectifiers MR1 MR2. The rectifier output appears across the load resistor R3 and any r.f. ripple is removed by L2 and C5. The resulting smoothed output is applied as a positive-going control bias to the base of VT1, thus reducing any tendency for the oscillator output to depart from the desired amplitude.

The mean collector current of VT1 is determined by the potential divider R1 RV1 R2 which applies a voltage to the base (via R3) and the emitter resistors R4 and R5. The pre-set component RV1 is adjusted to give the desired oscillation amplitude across the crystal.

The input to the r.f. amplifier VT2 is obtained from a winding on the transformer L3, and the mean collector current is stabilised by the potential divider R6 R7 and the emitter resistor R8. The circuit includes a transformer L5 with three windings each feeding a co-axial output socket. The transformer is tuned by C10 (and the output capacitance of VT2), resonance at the oscillator frequency being secured by adjustment of the primary inductance of L5.

Four types of oscillator unit OS2/11 exist. Units designated OS2/11A and OS2/11B have single crystals oscillating respectively below and above the signal frequency with a small variable capacitor providing fine tuning. Units designated OS2/11C and OS2/11D have three crystals, all combined in a single B7G valve-type envelope, and the variable capacitor is replaced by a 3-way switch which selects the crystals to give reception of the Home, Light and Third programmes. In units coded C the crystals oscillate below the signal frequency and in units coded D above signal frequency.

Oscillator OS2/12E

The oscillator OS2/12E, shown in Fig. 17, consists of a crystal controlled oscillator stage VT1, together with two buffer stages VT2 and VT3, the latter feeding the coaxial output socket.

The oscillatory circuit is derived from a basic

Colpitts type, with collector to emitter feedback through the series resonant crystal XL1. The circuit employed allows one side of the crystal to be earthed, a practical convenience; this arrangement involves an earth at the mid point of C3 and C4, and resistor R4 is therefore included to prevent a short-circuit on C3 and to allow voltages across C3 to be fed back to VT1 base via C1. Since VT1 operates in the common base mode, R2 is necessary to enable these feedback potentials to be applied to the base. R6 and C2 are decoupling components.

The crystal operates on the fifth harmonic, being forced into the correct mode by the tank circuit comprising L1, C3 and C4. The two components C5 and C6 together form a phasing capacitor for pulling the crystal to the correct frequency.

Inductor L2 tunes out the self capacitance of the crystal. The inductor is not placed directly across the crystal, because this would invite unwanted series resonance with C5 and C6 at some point in the tuning range of the receiver, i.e., 78 to 95 Mc/s.

As in the OS2/11, the crystal is mounted in an oven, but since its stability is inherently good the heater and control circuits are not used.

The Zener diode, ZD1, stabilises the operating point of VT1 base, the biasing current being obtained via R1.

Coupling from the oscillator stage VT1 to the first buffer stage VT2 is via the small capacitor C7 to the base of VT2. This latter transistor is connected as a common-emitter amplifier of low gain with negative feedback from R10.

VT2 is coupled to the output transistor VT3 via C11. VT3 operates as a common-base amplifier having low input impedance and high output impedance which avoids damping the output circuit and provides good isolation of the output from the input. A π output circuit C13, L3, C15 is used to match to the load, correct matching being obtained by variation of the ratio of L3 to C13. C14 is an isolating capacitor, R17 is a damping resistor, and the choke L4 provides a low resistance path for the collector current. The normal output impedance is 75 ohms, but small variations of load can be taken up by adjustment of C13 alone. C13 is accessible externally.

I.F. Input Filter

This filter is a combination of two rejector and three acceptor tuned circuits, designed to give a bandwidth of ±150 kc/s with rejection points at ±600 kc/s. This is another measure adopted in this receiver to provide additional selectivity.

First I.F. Amplifier

The first i.f. amplifier is an OC170 transistor connected as a common-emitter amplifier. The collector supply is applied to a tapping point on the collector inductor L10 to permit neutralising via the capacitor C15. A.G.C. is applied via the decoupling components R5 C16 and an undecoupled 22-ohm resistor R65 is included in the emitter circuit to reduce variations in transistor input resistance and capacitance due to a.g.c. action.

Second I.F. Stage

The second i.f. amplifier VT3 is an OC170 common-emitter stage stabilised by the potential divider R64 R8 and the emitter resistor R9. The coupling from the previous stage includes a band-pass filter L10 L11 coupled by the small series capacitor C24. VT3 is, of course, connected across only part of L11, the position of the tapping point being chosen to give the desired working value of Q. VT3 is neutralised by the capacitor C25.

Third I.F. Stage

The third i.f. amplifier VT4 is an OC170 common-emitter stage controlled from the a.g.c. line and fed via C30 from the single-tuned i.f. inductor L12. The amplifier includes a 22-ohm emitter resistor R66 and the circuit resembles that of the first i.f. amplifier.

Fourth I.F. Stage

The fourth i.f. amplifier VT5 is an OC170 common-emitter stage fed from VT4 via a double-tuned i.f. transformer similar to that used between VT2 and VT3. VT5 is stabilised by the potential divider R15 R16 and emitter resistor R17 and is neutralised by the capacitor C40.

Fifth I.F. Stage

The fifth i.f. amplifier VT6 is an OC170 common-emitter stage stabilised by the potential divider R21 R22 and the emitter resister R23. It is fed via the capacitor C46 from a coupling winding on the i.f. tuned circuit L15.

Automatic Gain Control

Under certain conditions, when severely overloaded, transistor tuned stages can develop negative input resistances. This is avoided in the present receiver by applying a.g.c. to the first and third i.f. stages. The control voltage is obtained by rectifying the i.f. signal at the secondary winding of L15 by means of the diode MR3; this circuit has the incidental merit of reducing to some extent any amplitude-modulated component present in the i.f. signal across L15.

The a.g.c. voltage is generated across the diode load circuit R19 C47. R19 and C47 are not returned to the earth line but to a source of stabilised voltage 4·25 volts negative with respect to earth. The potential is obtained from R20 and the Zener diode ZD1, the type of diode being chosen to give the required value of stabilised voltage. Thus the potential on the a.g.c. line *C* is —4·25 volts (with respect to earth) in the absence of an input to the receiver and goes positive to an extent dependent on the magnitude of the r.f. input to the receiver. This voltage is returned to the bases of the first and third i.f. transistors, to reduce their emitter currents and their gain.

The stabilised voltage across the Zener diode ZD1 is fed to the carrier alarm circuit via *D*.

Limiter

The receiver includes a Seeley-Foster discriminator, which has no inherent a.m. rejection, and therefore a separate limiter stage is incorporated. This includes the diode MR5 which is fed from the secondary winding of inductor L16. The diode is returned to the potential divider R25 R26, which applies a reverse bias of approximately 1·5 volts. Thus the diode conducts on all signals whose peak value exceeds 1·5 volts and the input to the discriminator is effectively stabilised at this value.

Discriminator

The Seeley-Foster discriminator is fed from the limiter via a small variable capacitor C56 which provides the required high source impedance. The discriminator circuit is somewhat unconventional and indeed at first sight might be mistaken for a ratio detector. This particular arrangement was chosen to give a low output impedance suitable for transformer coupling to the a.f. amplifier. Two shunt-fed diodes MR6 and MR7 have load resistors R27, R28 and R29 so arranged that R29 carries current from both diodes in opposite directions. The a.f. output is thus developed across R29 (with a value of 15 kilohms only, although each diode has an effective load resistance exceeding 100 kilohms). R30 and C64 provide de-emphasis.

Carrier Failure Relays

The base of transistor VT14 is connected to the a.g.c. line *C* via the 100-kilohm resistor R58 and the emitter is fed via the potential divider RV1 from the —4·5 volt line *D*. RV1 is so adjusted that when the carrier is present (making *C* positive with respect to *D*) VT14 is cut off. There is then no collector current due to VT14 in the 100-kilohm resistor R71. However this resistor also supplies the base bias to VT16, an npn transistor, and with VT14 cut off the base of VT16 is at the same potential as the emitter; VT16 therefore also cuts off. This removes the current input to the base of VT17, cutting off its collector current; with no current in R59 due to VT17, the base of VT15 goes negative with respect to the emitter and VT15 conducts, causing the relays RLA and RLB to operate.

If the carrier input to the receiver disappears, the a.g.c. line *C* takes up the same potential as *D*. The emitter of VT14 is then positive with respect to its base and VT14 conducts. Its collector current, in passing through R71 causes the potential of VT16 base to go positive with respect to the emitter and VT16 conducts. Under these conditions, the low resistance of the base/emitter junction of VT16 appears across R71 and is in effect, the load for VT14. VT16 is now conducting and, as its collector current is also the base current for VT17, this transistor also conducts, the current being limited by R72. With VT17 conductive, R73 is effectively connected to ground via the base/emitter junction of VT17 and forms with R59 a potential divider across the supply. This potential divider carries VT15 base voltage towards the positive line, passing the emitter voltage which is locked to —12 volts. VT15 then cuts off, de-energising RLA and RLB. By adjustment of RV1 the relays can be set to operate for any amplitude of receiver input signal up to 1 mV. The relays will also be de-energised if for any reason the receiver fails.

The relays release as a result of VT14 taking current through R71, and the leakage current of VT14 must be so low that it cannot cause the relays to release even at the highest ambient temperatures. This is ensured by using a silicon transistor for VT14, this type having particularly low leakage currents.

A.F. Gain Stages

VT7 collector is directly coupled to VT8 base and considerable negative feedback is applied from VT8 emitter circuit to VT7 base. The d.c. component of this feedback reduces the zero-frequency gain of VT7 and VT8 to a very low value, thus stabilising the mean component of the collector currents against temperature variations.

Most of the d.c. feedback is provided by R37, R39 and R40, but these resistors are decoupled by the large capacitors C67 and C70 to prevent signal-frequency feedback. Signal-frequency feedback occurs only via the undecoupled resistor R41 and the variable attenuator AT1. The effective resistance of this network can be varied by means of AT1 to provide fine gain adjustment.

Phase Splitter Stage

The output at VT8 collector is applied via C69 to the base of VT9, the mean emitter current of which is stabilised by the potential divider R42, R43 and the emitter resistor R45. VT9 is a phase-splitter, one half of the output stage being fed from its collector circuit and the other half from the emitter circuit. A similar circuit is used in valve amplifiers to feed push-pull stages, and in such circuits equal-value anode and cathode resistors must be used to supply equal signal voltages to the two halves of the following stage. The requirements of a phase-splitter to supply a transistor push-pull stage are somewhat different; here we need to feed equal *currents* to the following stage and to obtain this each half of the push-pull stage should be fed from an equal source resistance. The source resistance for VT10 is equal to the parallel resistance of R44 (3·9 kilohms), R49 (10 kilohms) and R50 (4·7 kilohms); the output resistance of VT9 collector circuit is too large to have a significant affect on the source resistance. The source resistance for VT11 is similarly the parallel resistance of R48 (4·7 kilohms), R47 (10 kilohms) and a resistance composed of R46 and the output (emitter) resistance of VT9. For equality of source resistances it follows that R46 and VT9 output resistance should total 3·9 kilohms. VT9 has a source resistance of the order of 10 kilohms and its output resistance is approximately 300 ohms. Thus R46 should have a value of 3·9 kilohms less 300 ohms, i.e., 3·6 kilohms.

A.F. Output Stage

Each side of the push-pull output stage consists of two transistors direct-coupled in the so-called Darlington or super-alpha circuit. In this circuit arrangement the emitter of the driver transistor (e.g., VT10) is directly connected to the base of the following transistor (VT12), and the two collectors are also bonded. This is a convenient way of connecting two transistors in cascade, no coupling components being required. The combination can be regarded as a single transistor with a very high current amplification factor (approximately equal to the product of the individual amplification factors) and a high input resistance (probably of the order of 20 kilohms).

Voltage negative feedback is applied to the emitters of VT12 and VT13 by windings on the output transformer. R51 is an emitter resistor which in conjunction with the potential divider R49 R50 determines the steady current in VT10 and VT12. Similarly R47, R48 and R52 determine the steady current in VT11 and VT13.

Power Supply Circuit: RC5/2

This is conventional and includes a full-wave bridge rectifier comprising MR8 to MR11 and a π-section smoothing circuit L19 C75A C75B. The d.c. output is fed to the receiver r.f. chassis through the Zener diode ZD2. The current through the diode generates a voltage across it which is practically independent of the current, and is used to reduce variations in the r.f. chassis supply voltage with changes in load.

Power Supply Circuit: RC5/3

The power supply circuit of the RC5/3 is illustrated in Fig. 16 and differs from that of the RC5/2 in having an additional facility for automatic change-over to a battery supply in the event of a failure of the mains supply.

This facility is provided by relay RLC which is connected across the smoothed d.c. output of the mains power supply circuit. When the mains supply is available RLC is energised and contact RLC1 connects the smoothed output of the supply circuit to the receiver. If the mains supply fails RLC is de-energised and contact RLC1 connects the receiver to the 24-volt battery.

A Zener diode ZD3 and a 330-ohm resistor are included in series with the relay winding. During normal operation of the receiver from the mains the voltage across ZD3 is well above its reference voltage and the diode is of low resistance. The current in the circuit is then limited by the resistor to a value suitable for energising the relay. If the mains fail however the voltage delivered by the mains supply unit to the relay winding circuit falls. When the voltage across ZD3 reaches the reference voltage, the diode resistance becomes suddenly very high and the current in the circuit collapses abruptly, de-energising the relay and giving a more rapid change over to battery operation than if no diode were present.

Performance

The overall frequency response of the receiver is within ±2 dB of a 50-μsec de-emphasis curve (given in Fig. 3) from 40 c/s to 20 kc/s.

For an input modulated by a single frequency to a deviation of ±75 kc/s and an output of +12 dB into 600 ohms any individual harmonic distortion in the audio output is less than 0·33 per cent (−50 dB). The total harmonic distortion is less than 0·5 per cent (−46 dB).

For an input of 30 μV the signal/noise ratio is better than 40 dB, for 100 μV input it is better than 46 dB and for 1 mV input it is better than 48 dB.

Installation, and Adjustment of A.F. Output Volume

1. Set the primary tappings on the mains transformer to the local mains voltage, and power the receiver.
2. Connect the aerial feeder to the receiver.
3. Set the crystal selector switch (if any) to select the desired transmission.
4. Connect the 600-ohm input of a PPM/6 to the receiver output (pins 1 and 2 on the 8-pole plug) and adjust the two gain controls to give zero level output when the transmitter is radiating line-up tone before programme transmission. Both gain controls have approximately 10-dB range but the coarse control has only two positions (labelled *high* and *low*) and the fine control has 10 steps.

   Alternatively, a PPM/2 or a TPM/3 can be used for this measurement, provided that a 600-ohm resistor is connected across the receiver output sockets.

Adjustment of Carrier Failure Relays

Connect the output of a signal generator to the receiver input, and adjust the generator to give an unmodulated output at the carrier frequency to which the receiver is tuned. Connect an Avometer (switched to its resistance-measuring range) between tags 2 and 3 of relay RLA. Connect a second Avometer, similarly switched, between tags 2 and 3 of relay RLB. Adjust the carrier failure alarm control RV1 for minimum sensitivity and measure the receiver input at which the two relays just operate (indicated by readings on both Avometers): the input should exceed 2 mV.

Now reduce the receiver input until both relays just release; the reduction of the input should be less than 8 dB (corresponding to an input ratio of 2·5 : 1).

Set the signal generator to 1 μV output and adjust RV1 for maximum sensitivity. RLA and RLB should both operate. Adjust RV1 until both relays just release. Increase the receiver input until both relays just operate again. The signal generator should now indicate a receiver input of less than 40 μV. Check that when the receiver input is reduced by 8 dB (to 16 μV) the relays again release.

Finally set RV1 so that the relays just release with a receiver input of 40 μV. Connect an Avometer between point *Z* and chassis and confirm that operation and release of RLA and RLB does not significantly affect the Avometer reading.

Maintenance

The power supply and a.f. amplifier of the receiver should be maintained at the site but, if a fault develops elsewhere in the receiver, Equipment Department should be contacted (preferably by telephone) and a request should be made for a replacement spare receiver of the correct type and channel, it being important to ensure that the spare receiver includes the correct type of oscillator unit and is fitted with the correct type of mounting brackets. This receiver should be installed and the faulty receiver sent to Equipment Department for attention. When the original receiver is returned, the replacement spare should be sent back to Equipment Department.

S.W.A. 11/61
Revised A.I.B. 11/64

SECTION 7

RECEIVERS RC5/4, RC5/4A and RC5/5

Introduction

The RC5/4 and the RC5/4A are v.h.f. f.m. rebroadcast receivers which supersede receivers RC5/2 and RC5/3. The RC5/5 is similar but operates in the u.h.f. band. All three receivers incorporate carrier-failure detection circuits. They operate from an a.c. mains power supply but include facilities for automatic change-over to a battery supply if the mains fails.

The receivers consist of a number of plug-in units mounted in a general purpose mounting panel type PN3/23 with dimensions 18 in. by 5¼ in. The plug-in units are:

Input R.F. Unit	UN1/39 (RC5/4 and RC5/4A) UN1/57 (RC5/5)
I.F. Bandpass Filter	FL2/4
First I.F. Amplifier	UN1M/56 (RC5/4A only)
I.F. Unit	UN1/41
Discriminator and Relay Unit	UN1/52
Line Receiving Amplifier	AM7/4
Line Sending Amplifier	AM7/2
Power Supplier	PS2/9

The first four units (excepting the FL2/4) are constructed on CH1/27 chassis and the remaining three units on CH1/18C chassis; they are positioned on the PN3/23 panel from left to right in the order given. The FL2/4 is built in a copper box which is mounted on the back of the receiver. All connections are made by means of multi-way plugs and sockets.

Certain r.f. connections, including the aerial input, are brought out to B.N.C. sockets which are mounted externally and to the rear of the receiver. In addition an 8-way Painton plug, also mounted at the rear, carries a programme muting circuit, an alarm circuit, connections for an emergency battery supply and the main audio output.

General Specification

Frequency Range	85 - 97 MHz (RC5/4 and RC5/4A) 470 - 582 MHz (RC5/5) 606 - 960 MHz (RC5/5)
Minimum Input Level	100 μV (RC5/4) 30 μV (RC5/4A) 100 μV (RC5/5)
Audio Output Level (deviation ± 75 kHz)	+12 dB (reference 1 mW)
Variation of Output Level with Input Level	Less than 0·5 dB over the range: 100 μV - 10 mV (RC5/4 and RC5/5) 30 μV - 1 mV (RC5/4A)
Harmonic Distortion at 1 kHz	Better than 6 dB
Signal/noise Ratio (weighted)	
100 μV input	greater than 55 dB (RC5/4) greater than 60 dB (RC5/4A and RC5/5)
1 mV input	greater than 65 dB
A.M. Rejection (40 dB minimum)	100 μV input (RC5/4) 20 μV input (RC5/4A)
Image Rejection	Greater than 60 dB
Power Supplies	240 V a.c., 75 mA 24 V d.c., 350 mA

General Description

The receivers are of the superheterodyne type and use the standard i.f. of 10·7 MHz. A block diagram of the RC5/4A is given in Fig. 7.1; when the extra i.f. unit UN1M/56 is eliminated

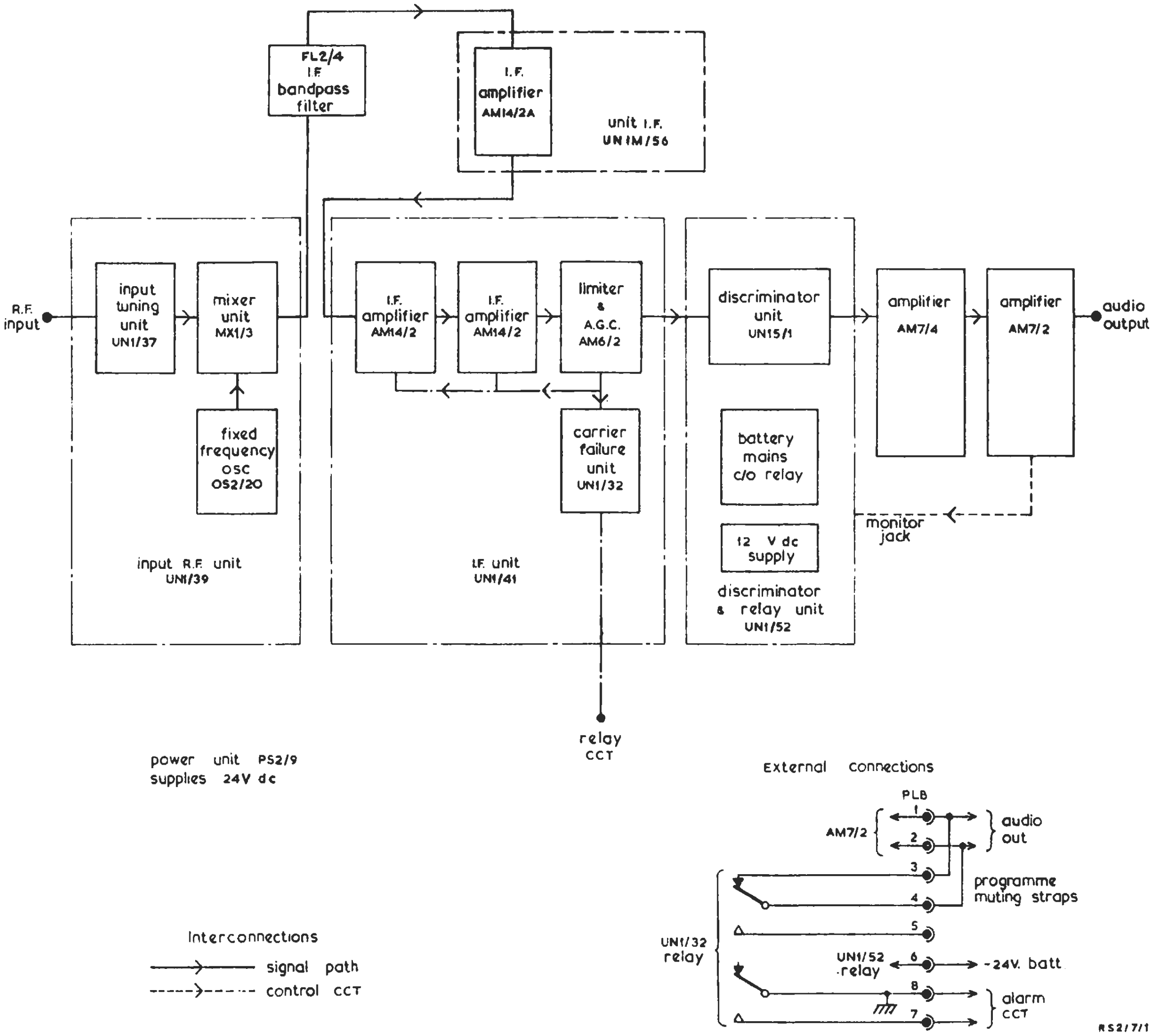


Fig. 7.1. Receiver RC/54: Block Diagram

this diagram serves also for the RC5/4. The receiver type RC5/4A is intended for use under conditions of low signal strength. The RC5/5 is essentially the same as the RC5/4 but it uses a u.h.f. input unit type UN1/57.

Note: units UN1/39 and UN1/41 are used also in the Translator EP7/5 and are described in Instruction T.12. Similar i.f. and discriminator circuits are described in Instruction RM.1 (Receiver RC4/1).

The audio amplifiers (AM7/2 and AM7/4) are described in Instruction S.10 and the power supplier (PS2/9) in Instruction G.2.

Detailed Description

R.F. Unit UN1/39 (*Figs. 18 and 19*)

This unit comprises an Input-tuning Unit UN1/37, a Mixer Unit MX1/3 and an Oscillator Unit OS2/20.

The input-tuning unit, which consists of two tuned circuits with shunt capacitance coupling, has a bandwidth of about 2 MHz at the 3-dB points. The degree of coupling depends on C3 which is adjusted during the initial line-up and should not require attention.

The mixer circuit comprises an r.f. amplifier (TR1) and a diode mixer (D1). A tuned buffer stage (TR2) provides the necessary level of oscillator drive. The i.f. is extracted by a bandpass filter (L3, L4 and the associated capacitors) which provides an output impedance of 50 ohms. The conversion gain of the mixer is 6 dB and the noise factor is 12 dB.

The crystal-controlled oscillator operates at a frequency 10·7 MHz below that of the required input frequency and produces an output voltage of 200 - 300 mV across 75 ohms. The crystal, which operates in its series-resonant mode, is mounted in a small oven but the temperature-control circuits are not used. A buffer amplifier (TR2) feeds the tuned output stage (TR3). The output tuned-circuit (L3, C14, C15 and the variable capacitor C13) is tapped, at the junction of C14 and C15, to obtain an output impedance of 75 ohms; inductor L3 is made variable so that the output impedance can be adjusted by varying the L/C ratio (i.e. the impedance) of the tuned circuit.

R.F. Unit UN1/57 (Fig. 20)

This unit operates in Bands 4 and 5 but has the same basic circuit as the UN1/39. It incorporates a series-capacitance-coupled bandpass r.f. filter and an r.f. amplifier both of which use line resonators. The local oscillator is a crystal-controlled Colpitts circuit and this is followed by a buffer amplifier, two frequency-trebler stages and a tuned output stage which also uses resonant lines. The feed to the mixer stage is at low impedance. The mixer (TR2) is a common-emitter stage and the local-oscillator output is injected at the emitter. The r.f. input signal is applied to the base of TR2 and is isolated from the biasing arrangements by L2. The mixer output, at 10·7 MHz, is fed to the i.f. circuits via an impedance-matching bandpass filter as before.

I.F. Filter FL2/4

The FL2/4 is a four-stage bandpass filter which is used to improve the rejection of unwanted signals on the skirts of the i.f. passband. It has a characteristic impedance of 50 ohms and there are no recovery regions outside the passband. The attenuation characteristic is slightly asymmetrical in that it rises more rapidly on the low-frequency side of the passband than on the high-frequency side. Details of the filter are given in Fig. 7.2.

I.F. Unit UN1/41 (Fig. 18)

The i.f. unit is assembled from a number of sub-assembly cards which include two i.f.-amplifier cards, a limiter-and-a.g.c.-circuit card and a carrier-failure-unit card; all but the last have individual screening boxes. The amplifier cards are connected together to form a.c.-coupled cascode stages and each card consists of a common-emitter stage which is aperiodically-coupled to a common-base stage with a tuned collector circuit. The two halves of each cascode stage are mounted on separate cards, and therefore in separate screening boxes, to isolate the high-impedance output circuit from the high-impedance input circuit. Thus the first cascode pair is formed by TR2 on the first amplifier card and TR1 on the second amplifier card; the second cascode pair is formed by TR2 on the second amplifier card and TR1 on the limiter-and-a.g.c. card. TR1 on the first amplifier card is used as a low-input-impedance tuned amplifier which, to some extent, matches the 50-ohm output impedance of the FL2/4. Each cascode stage provides a gain of about 30 dB with a bandwidth of 200 kHz.

In the limiter-and-a.g.c. card transistor TR1, which forms part of the second cascode stage, feeds the limiter (TR4) via capacitor C4. The limiter and TR1 in the discriminator circuit form another cascode stage which drives the discriminator transformer. The a.g.c. circuits are fed by a diode rectifier D1; the d.c. output from this, smoothed by R7 and C5, is fed to the a.g.c. amplifier (TR2 and TR3) and thence to (a) the carrier-failure circuit and (b) the i.f. amplifiers for gain-control purposes. The unsmoothed signal from the diode is a.c. coupled to the carrier-failure circuit but is not used in the RC5/4 receiver or in its variants.

The overall gain of the i.f. unit, including the limiter, is 65 dB maximum with a bandwidth of ±100 kHz. The output impedance is 50 ohms.

The Carrier Failure Unit UN1/32, the circuit of which is shown in Fig. 7.3, indicates the presence of a carrier by lighting the lamp L which is mounted on the face-plate of the UN1/41. The unit also provides two relay-contact circuits which are used to sound an alarm and to mute the receiver output. The muting circuit is completed when the receiver is plugged into position, the necessary straps being provided in the bay wiring.

When a carrier is received, the a.g.c. line is driven from −12 volts toward zero potential and so the current through TR4 in the carrier-failure unit is reduced from its no-signal value. This drives the base of TR5 positive with respect to its

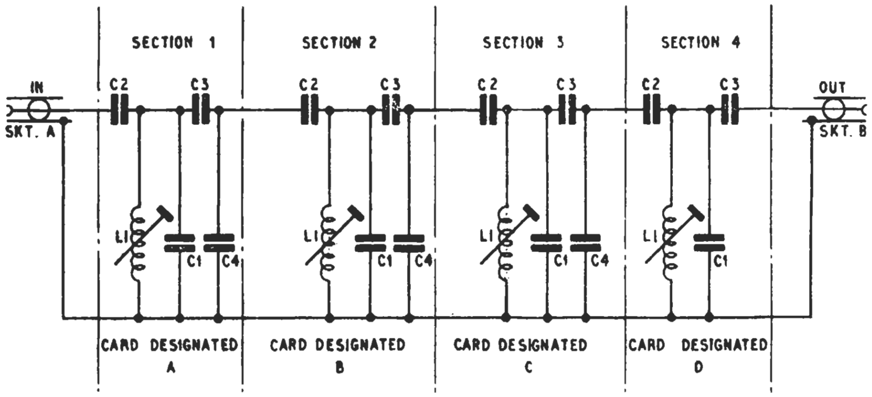


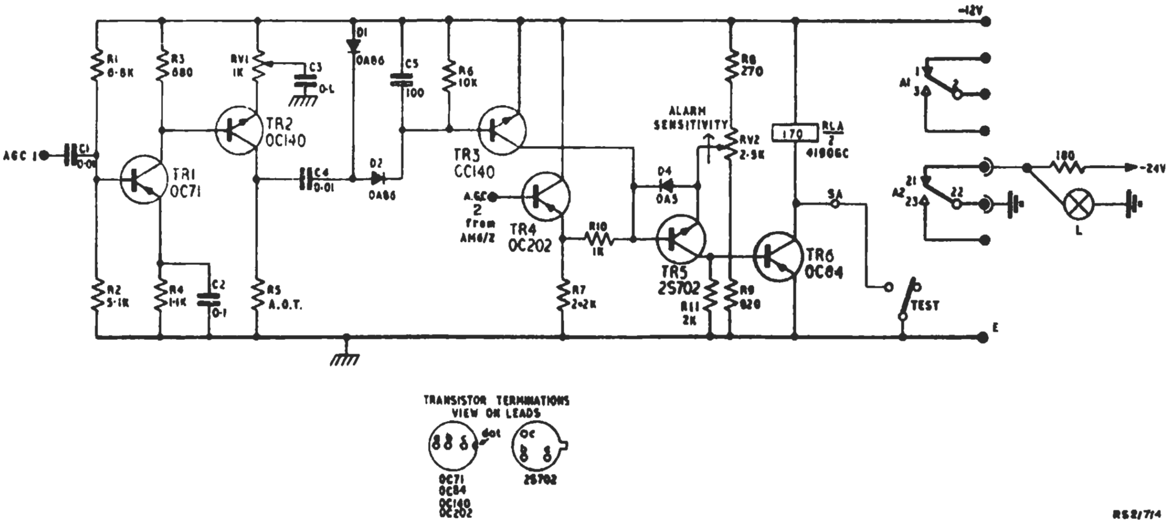
TABLE OF CAPACITORS

REF	A	B	C	D
C1	225pF	264pF	264pF	225pF
C2	52·3pF	36·3pF	30·9pF	36·3pF
C3	36·3pF	30·9pF	36·3pF	52·2pF
C4	136pF	136pF	136pF	

ALL INDUCTANCE ARE ·7µH

RS2/7/3

Fig. 7.2. I.F. Filter FL2/4: Circuit



RS2/7/4

Fig. 7.3. Carrier Failure Unit UN1/32: Circuit

emitter and so causes both TR5 and TR6 to draw current and thus operate the relay RLA. The purpose of D4 is to ensure that the reverse base-emitter rating of TR5 is not exceeded.

Transistors TR1, TR2 and TR3 are not used in these receivers and RV1 should be set to the minimum-gain position; i.e. fully anticlockwise.

I.F. Amplifier UN1M/56

This unit provides extra gain by forming a third cascode i.f. amplifier with the input transistor of the first i.f.-amplifier card in the UN1/41. The circuit is similar to that of the i.f.-amplifier cards but the value of R7 is reduced to 270 ohms to improve the stability.

deviation of ±19 kHz, the audio output from the discriminator is −48 dB (with respect to 1 mW) or −45 dB for early models in which R5 is omitted. The output impedance is 600 ohms.

The unit also contains the arrangements for deriving the 12-volt supply, required by the r.f. and i.f. amplifiers, from either the mains or an external battery. The power-supply change-over is controlled by relay RLA which is held operated as long as power is available from the PS2/9. The 12-volt supply is obtained from the emitter follower TR1 the base of which is stabilised by two zener diodes connected in series; 6-volt zener diodes have a better temperature coefficient than 12-volt diodes.

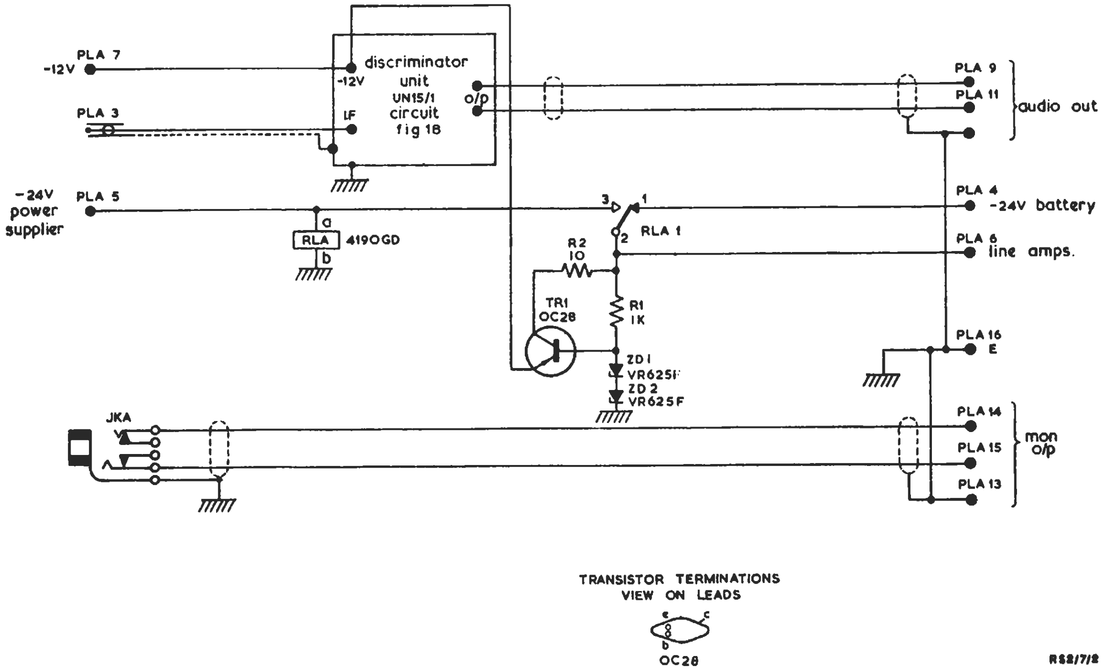


Fig. 7.4. Discriminator and Relay Unit UN1/52: Circuit

Discriminator and Relay Unit UN1/52 (Fig. 18)

The circuit of this unit is given in Fig. 7.4 but details of the Foster-Seeley discriminator are shown in Fig. 18. The diodes and their load resistors are connected so that the difference current flows in the small common resistor R18, thus providing the inverse of the conventional Foster-Seeley circuit (in which the difference voltage is applied to a large shunt resistor). At a

A monitoring jack, mounted on the front panel of this unit, is fed from the AM7/2 audio amplifier.

Maintenance

Routine maintenance on the receiver is unnecessary. Re-alignment of the receiver is not easy without sweep-frequency equipment and so, if faults occur which cannot be eliminated simply and quickly, the faulty unit should be returned to

Equipment Department.

Gain

The gain of the receiver can be checked by measuring the voltage on the a.g.c.2 line (with respect to chassis) for different levels of input signal. The figures shown in Table 1 should be obtained; higher voltages than those shown indicate a loss of gain for which the most likely cause is misalignment.

TABLE 1

	Voltage on a.g.c. line	
Input to Receiver	*Without UN1M/56*	*With UN1M/56*
0	8·3	7·8
60 μV	—	5·4
200 μV	5·4	5·0
300 μV	5·2	—
400 μV	5·1	4·5
1 mV	4·6	4·0
2 mV	4·1	3·6
20 mV	3·4	—

Discriminator and Limiter

The alignment and operation of these circuits can be checked as follows. Connect a f.m. signal generator, such as the Marconi TF 995A, to the aerial socket. Modulate the generator with a 1-kHz signal to a deviation of ±20 kHz and adjust the output level to 200 μV.

Set the gain control of the AM7/4 to give a gain of 50 dB. The receiver output, as measured on an amplifier detector, should be +15, ±3 dB.

Vary the r.f. input signal between 15 μV and 50 mV; the audio output signal should not change by more than a total of 1·5 dB.

Carrier Failure Circuit

Measure the voltage across the relay coil with the alarm sensitivity control (RV2) in both the maximum and the minimum positions. The readings should not exceed 0·2 volt and 9 volts respectively.

AIB 9/66

58/SWA/006
DC3221

RS.2

FIG.I

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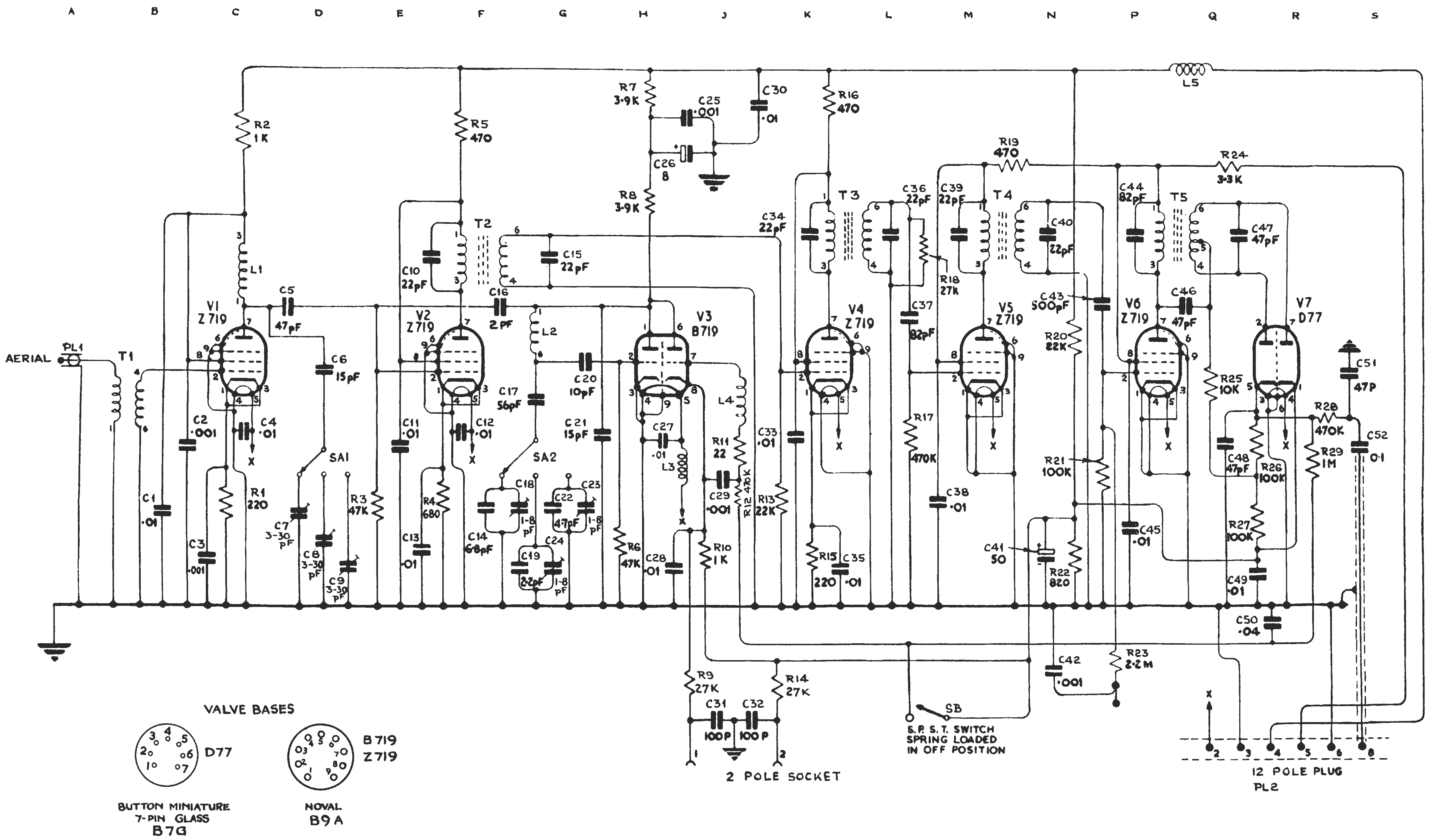


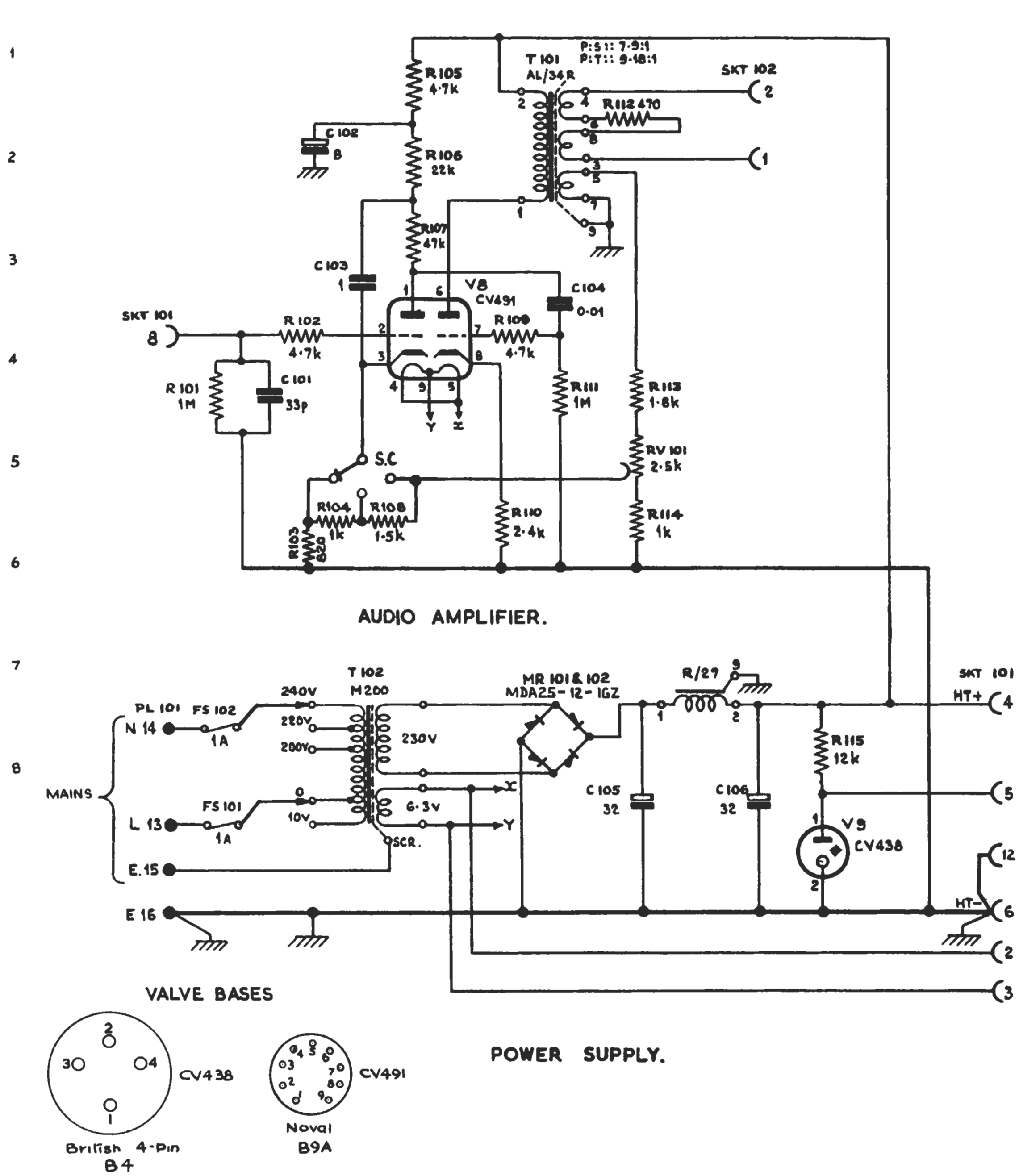
DYNATRON TUNER UNIT TYPE FM1 (MODIFIED)

HR/17 RECEIVER : CIRCUIT

58/SWA/002
EB10028

RS.2

FIG.2



COMP.	LOC.	TYPE	TOL.	COMP.	LOC.	TYPE	TOL.	COMP.	LOC.	TYPE	TOL.
C101	A4	ERIE N 750 K	±10%	R103	B6	ERIE 109	±2%	R112	E1	ERIE 9	±10%
C102	B2	T.C.C. SCE 74 PE/PVC	+50% −20%	R104	B5	ERIE 109	±2%	R113	E4	ERIE 8	±10%
C103	B3	HUNT A315	±20%	R105	C1	ERIE 9	±10%	R114	E5	ERIE 8	±10%
C104	D3	T.C.C. CP32N/PVC	±25%	R106	C2	ERIE 9	±10%	R115	G8	PAINTON P301	±5%
C105	E8	PLESSY CE 824/1	+50% −20%	R107	C3	ERIE 8	±10%	RV 101	E5	COLVERN VARIABLE	
C106	F8	PLESSY CE 824/1	+50% −20%	R108	B5	ERIE 109	±2%	MR 101 & 102	D7	ST&C MDA/25/12/1GZ	
				R109	D3	ERIE 9	±10%				
R101	A4	ERIE 9	±10%	R110	D5	ERIE 108	±2%	T101	D2	AL/34R P:S:: 7·9:1 P:T:: 9·18:1	
R102	B3	ERIE 9	±10%	R111	D4	ERIE 9	±10%	T102	B8	M 200	

HR/17 & HR/17A: AUDIO AMPLIFIER & MAINS UNIT: CIRCUIT

58/SWA/009/AP
DSKA 3964

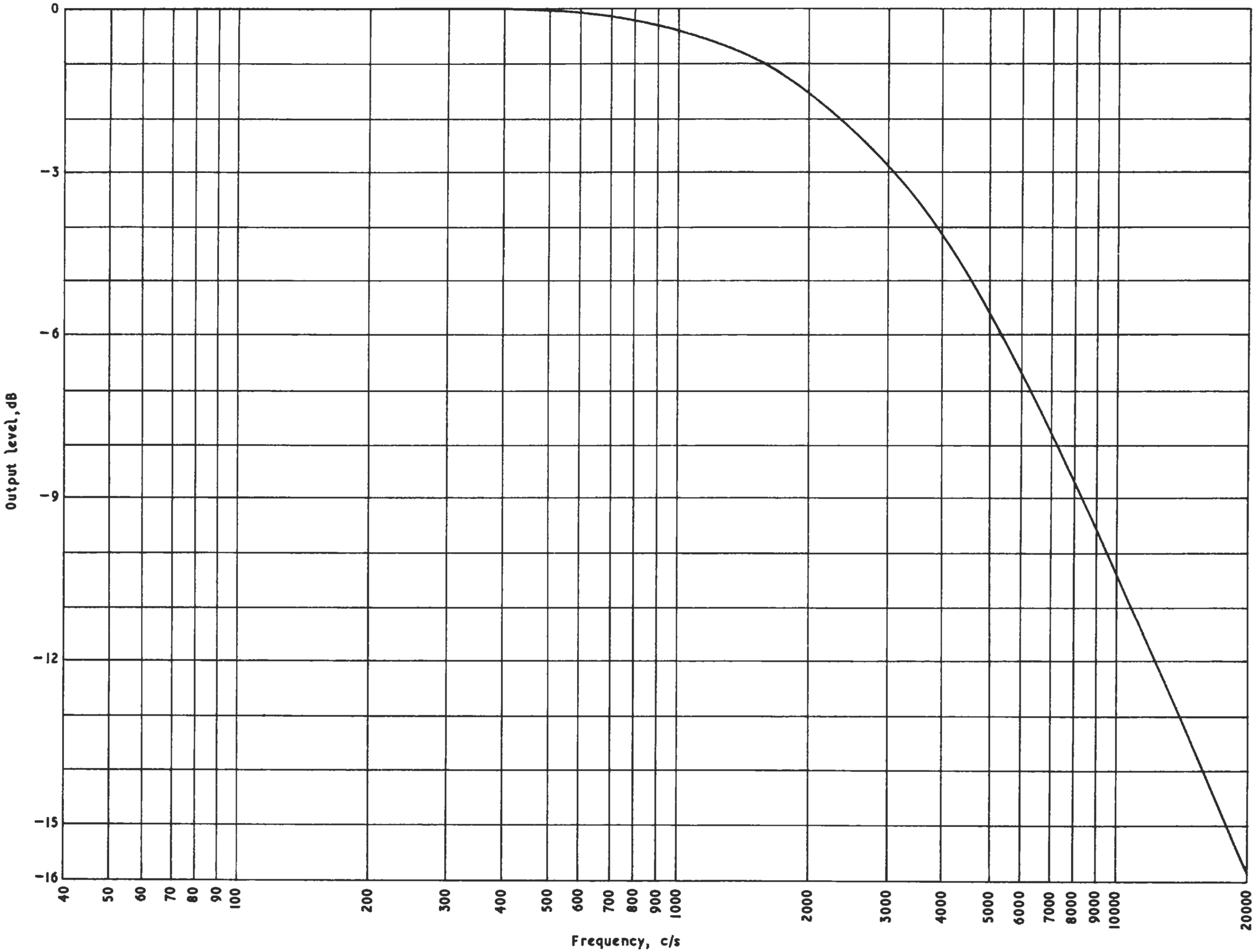


FIG 3

50 µS DE-EMPHASIS CURVE

RS2

58/SWA/003
DC3700

RS2

FIG.4

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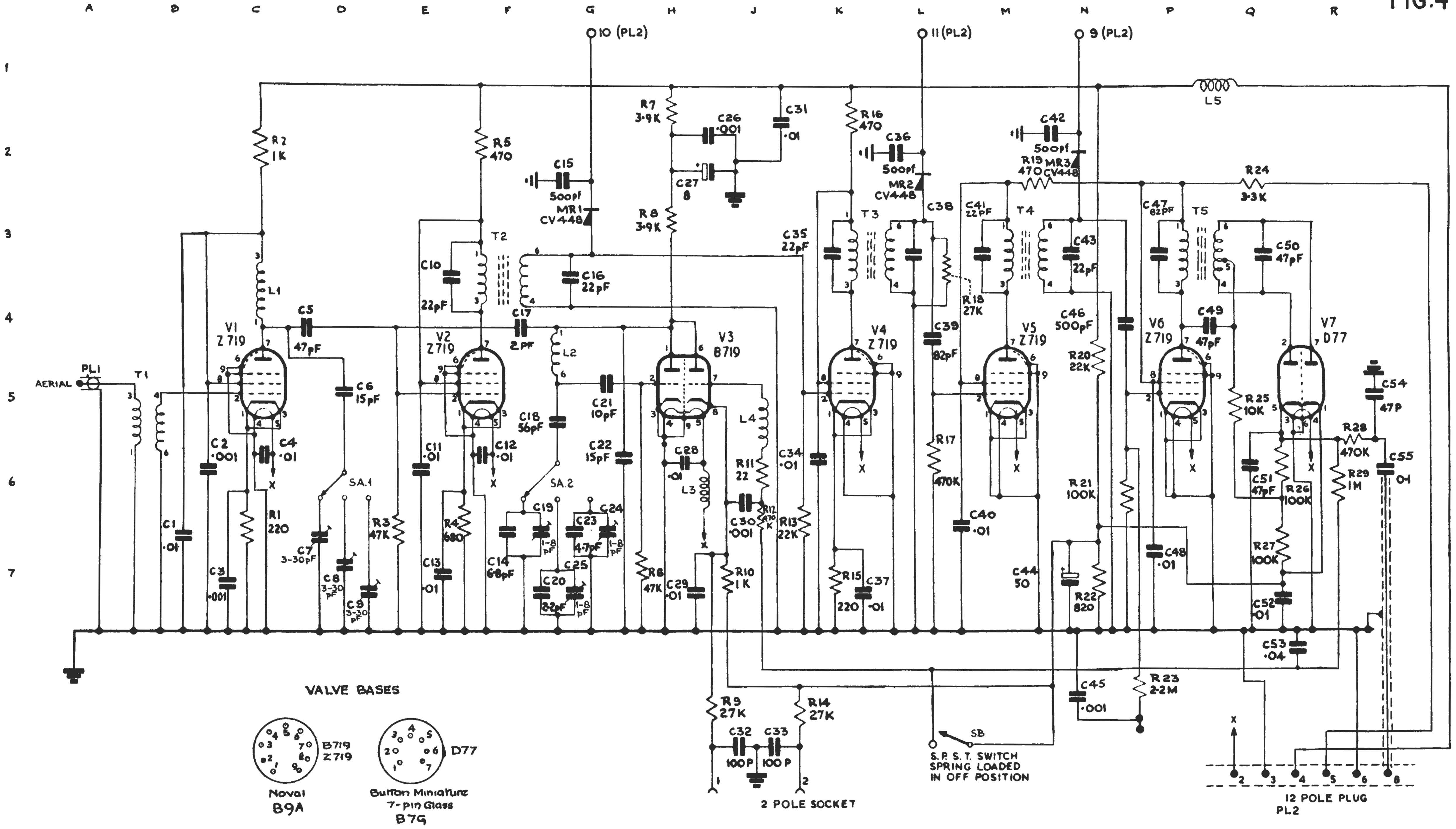
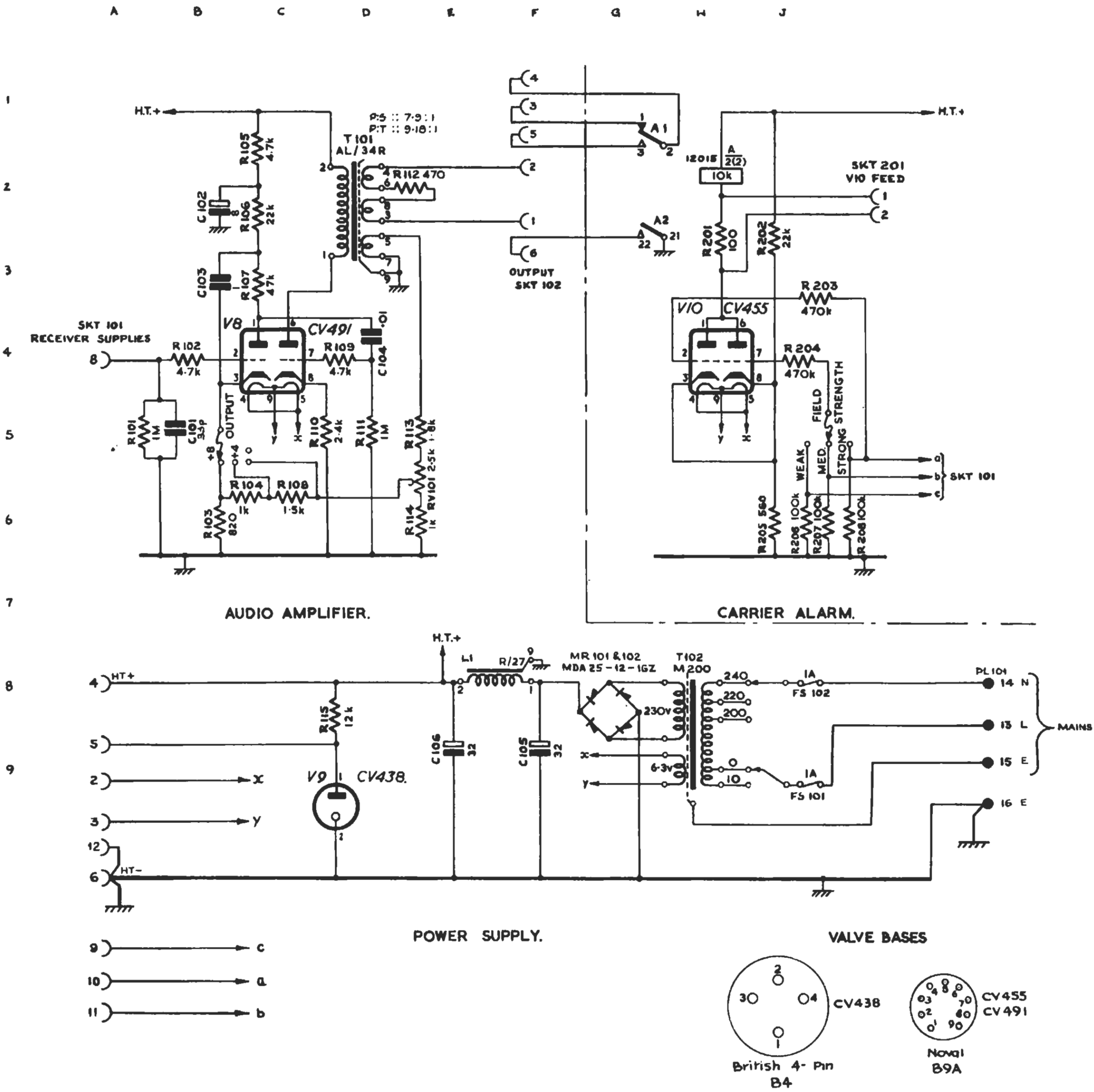


DYNATRON TUNER UNIT TYPE FM1 (MODIFIED)

HR/18 RECEIVER : CIRCUIT

FIG.5

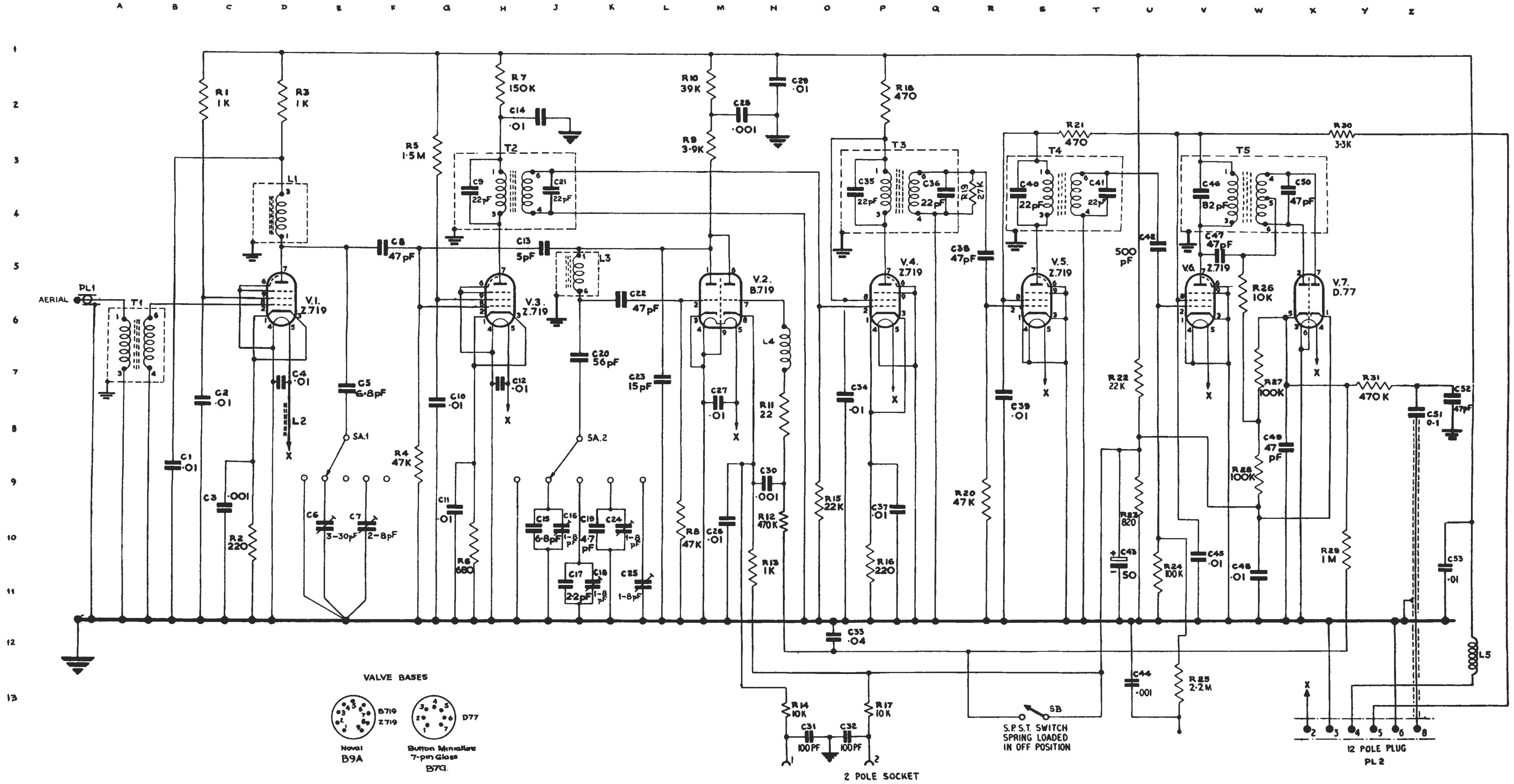


COMP.	LOC.	TYPE	TOL.	COMP.	LOC.	TYPE	TOL.	COMP.	LOC.	TYPE	TOL.
C101	A5	ERIE N750K	±10%	R101	A5	ERIE 9	±10%	R114	D6	ERIE 8	±10%
C102	B2	T.C.C. SCE 74 PE/PVC	+30% -20%	R102	A4	" "	"	R115	C8	PAINTON P301	±5%
C103	B3	HUNT A815	±20%	R103	B6	" 109	±2%	R201	H2	ERIE 109	±2%
C104	D4	T.C.C. CP32 N/PVC	±25%	R104	B6	" "	"	R202	J2	PAINTON P301	±5%
C105	F9	PLESSEY CE 824/1	+50% -20%	R105	C1	" 9	±10%	R203	J3	ERIE 9	±10%
C106	E9	" " "	"	R106	C2	" "	"	R204	J4	" "	"
				R107	C3	" 8	"	R205	J6	" 100	±2%
L1	E8	R/27		R108	C6	" 109	±2%	R206	J6	" 9	±10%
				R109	C4	" 9	±10%	R207	J6	" 9	±10%
MR101	F8	ST&C MDA/25/12/GZ		R110	C5	" 108	±2%	R208	J6	" 9	±10%
MR102		" " " " " M200		R111	D5	" 9	±10%				
				R112	D2	" "	"	T101	D2	AL/34R	
RV101	D5	COLVERN VARIABLE		R113	D5	" 8	±10%	T102	G8	" "	

HR/18 & HR/18A: AUDIO AMPLIFIER CARRIER ALARM & MAINS UNIT: CIRCUIT

58/SWA/004
EJ9447

FIG.6



DYATRON TUNER UNIT TYPE FM2 (MODIFIED)

HR/17A RECEIVER: (SERIAL NUMBERS PRIOR TO 201) CIRCUIT

58/SWA/005
EJ9978

RS 2

FIG.7
2ND ISSUE

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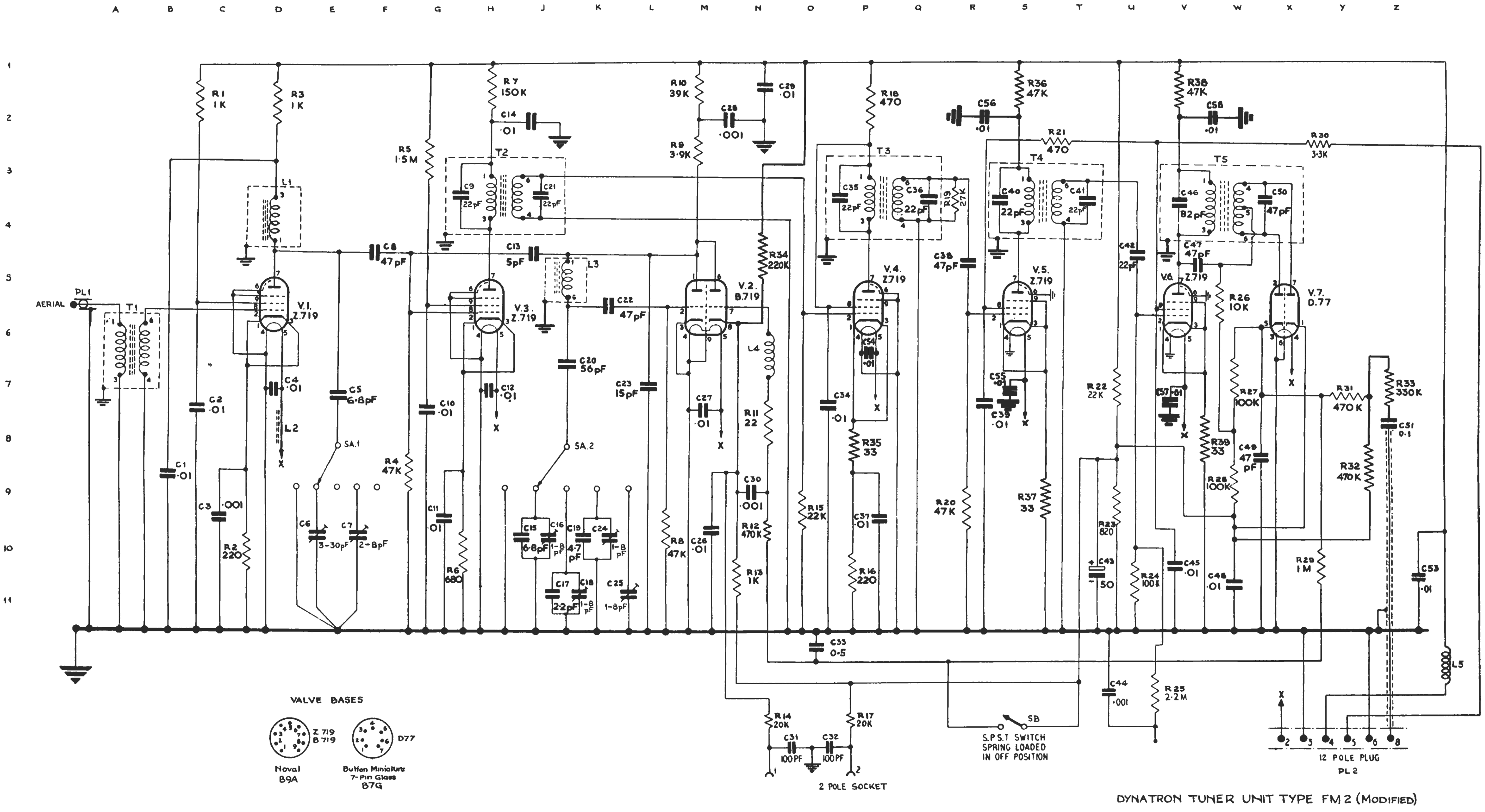


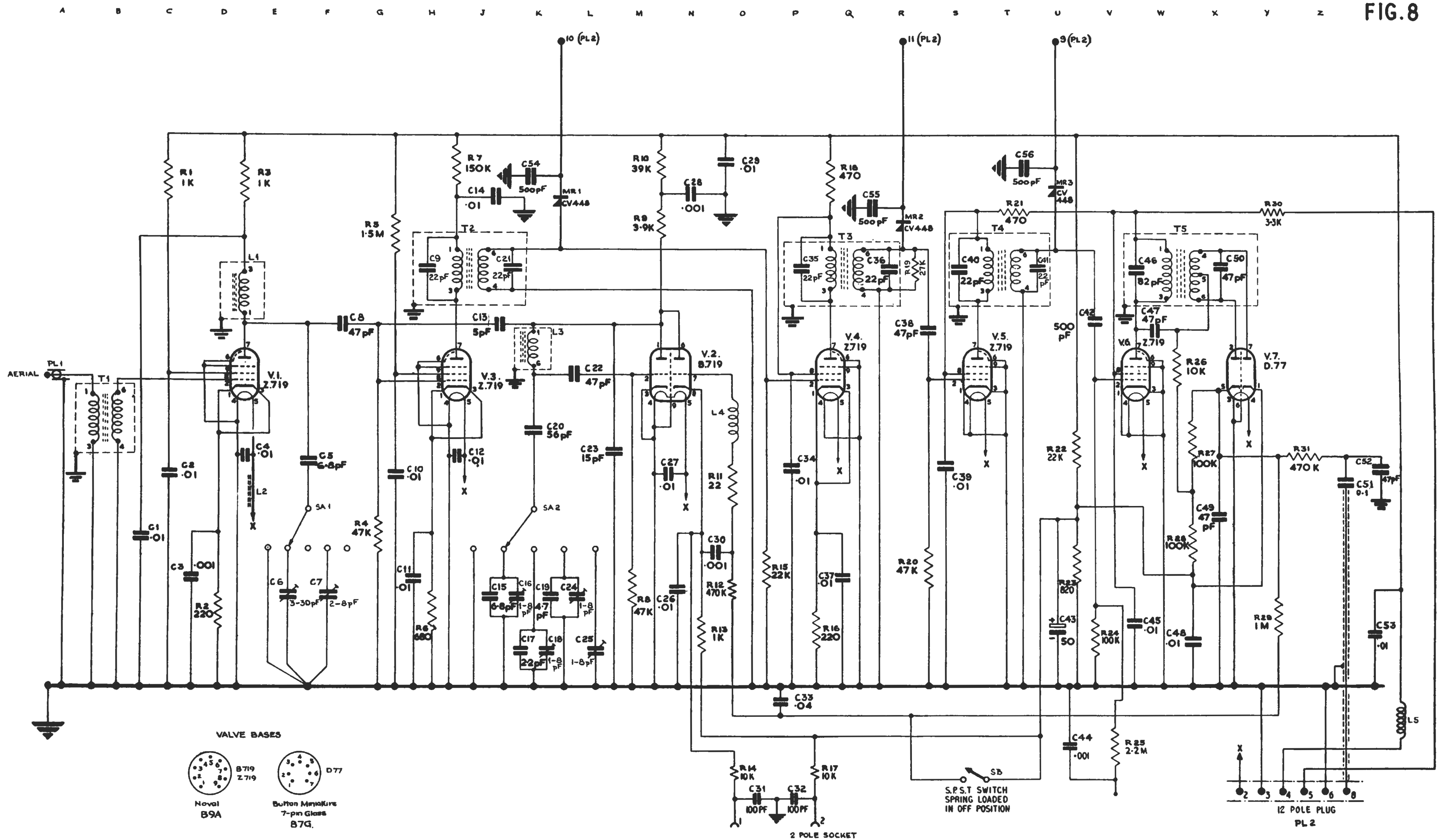
DYNATRON TUNER UNIT TYPE FM 2 (MODIFIED)

HR/17A RECEIVER: (SERIAL NUMBERS AFTER 201) CIRCUIT

58/SWA/007
EJ 9740

RS 2

FIG. 8



DYNATRON TUNER UNIT TYPE FM2 (MODIFIED)

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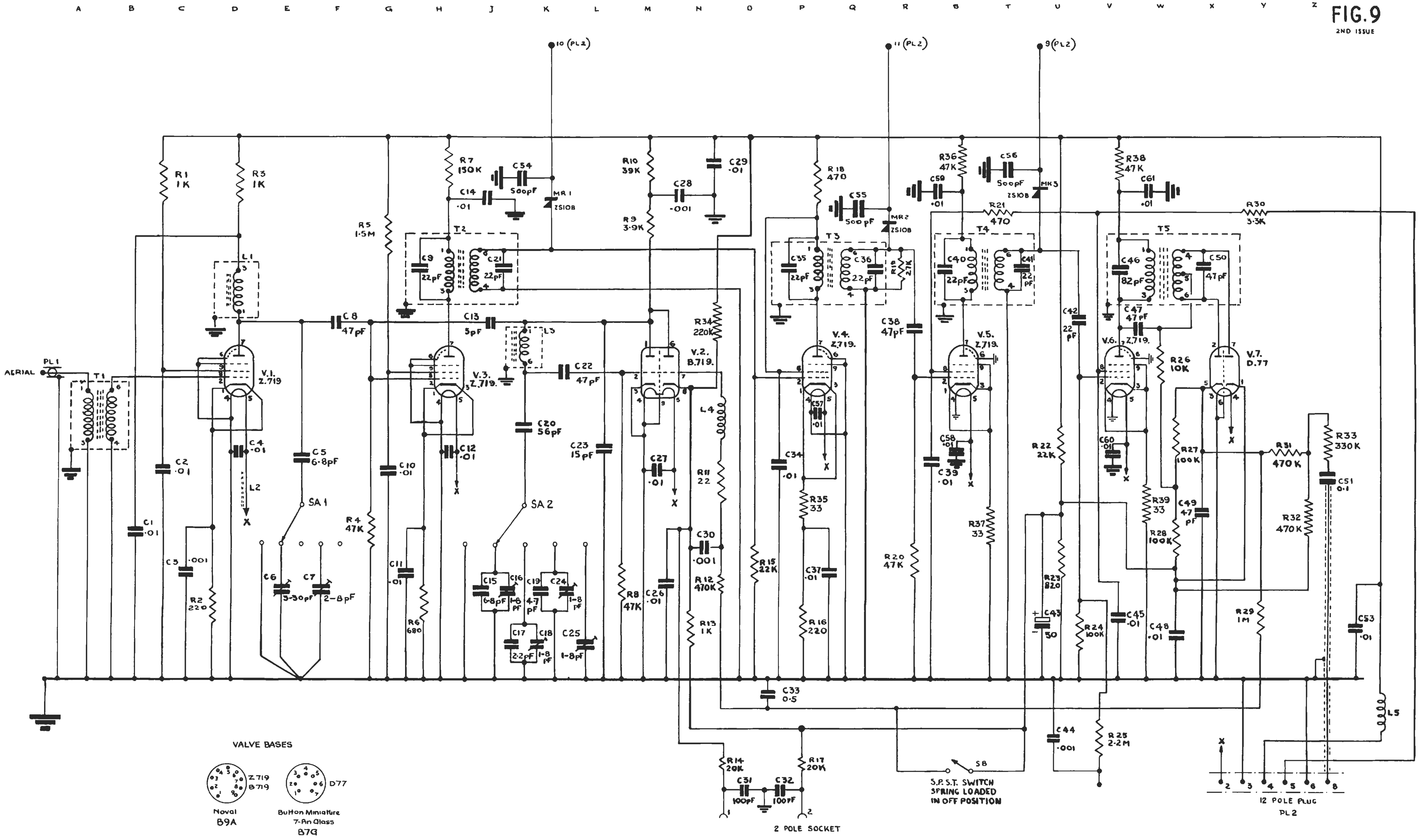
HR/18A RECEIVER: (SERIAL NUMBERS PRIOR TO 201) CIRCUIT

58/SWA/008
EJ9979

RS2

FIG.9
2ND ISSUE



DYNATRON TUNER UNIT TYPE F.M.2 (MODIFIED)

HR/18A RECEIVER: (SERIAL NUMBERS AFTER 201) CIRCUIT

58/SWA/010
ED 9718

FIG.10

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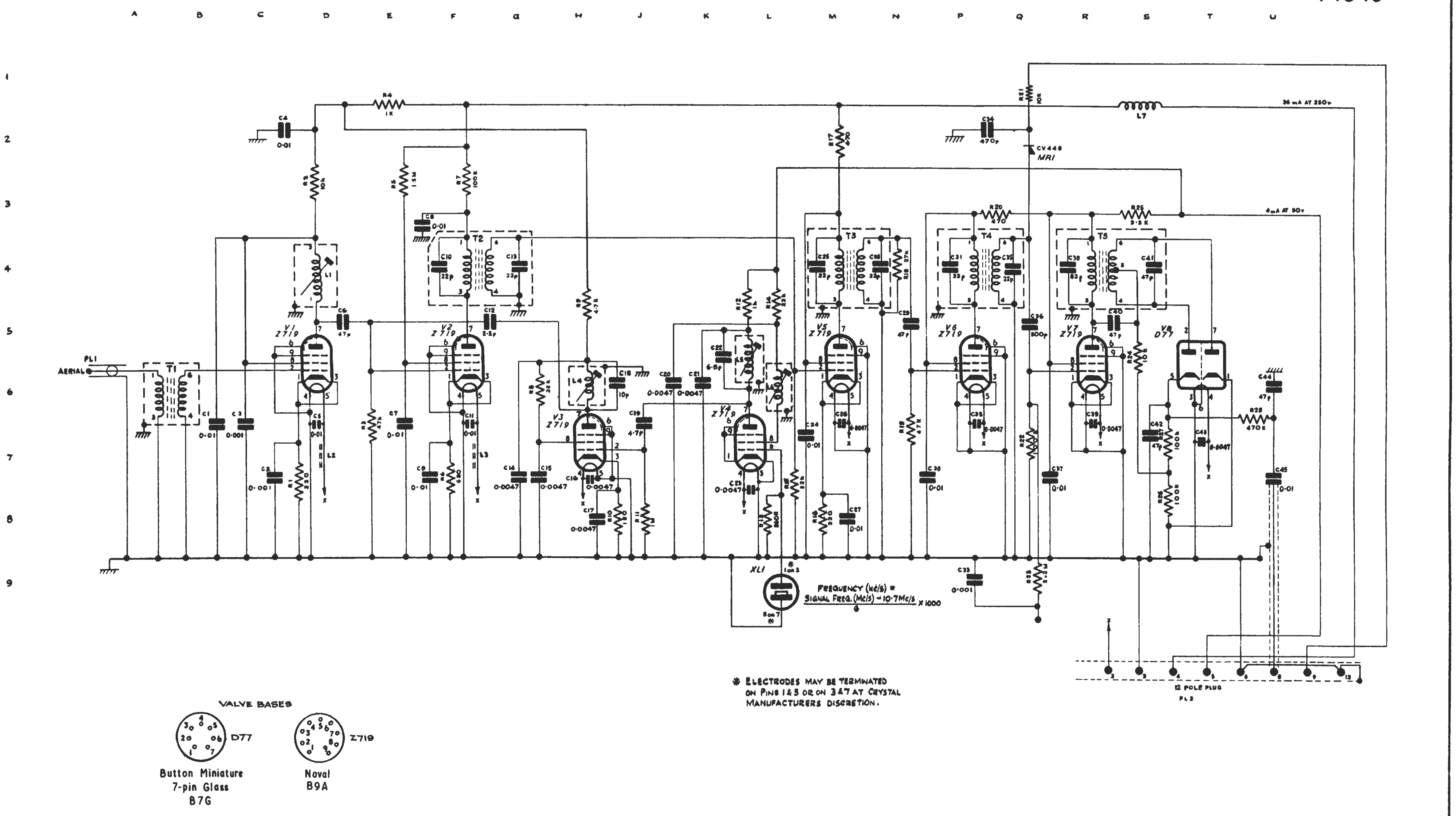
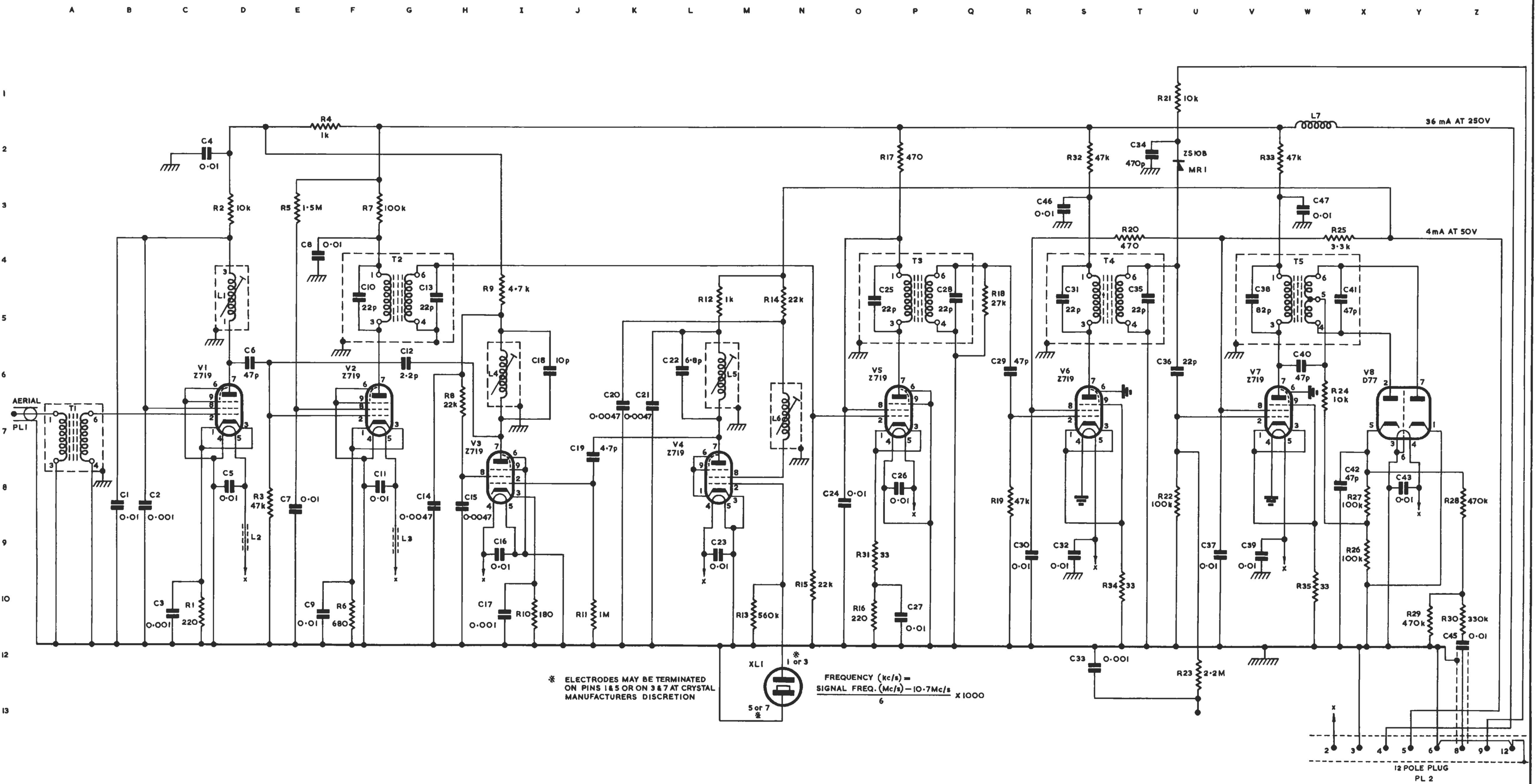


* ELECTRODES MAY BE TERMINATED ON PINS 1 & 5 OR ON 3 & 7 AT CRYSTAL MANUFACTURERS DISCRETION.

RC5/1A RECEIVER (SERIAL NUMBERS PRIOR TO 120) : CIRCUIT

DYNATRON TUNER UNIT TYPE FM2 (MODIFIED)

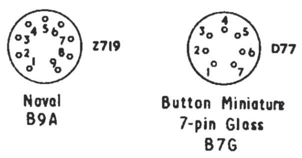
FIG.11
2ND ISSUE



✻ ELECTRODES MAY BE TERMINATED ON PINS 1&5 OR ON 3&7 AT CRYSTAL MANUFACTURERS DISCRETION

$$\text{FREQUENCY (kc/s)} = \frac{\text{SIGNAL FREQ. (Mc/s)} - 10{\cdot}7\text{Mc/s}}{6} \times 1000$$

VALVE BASES



Noval
B9A

Button Miniature
7-pin Glass
B7G

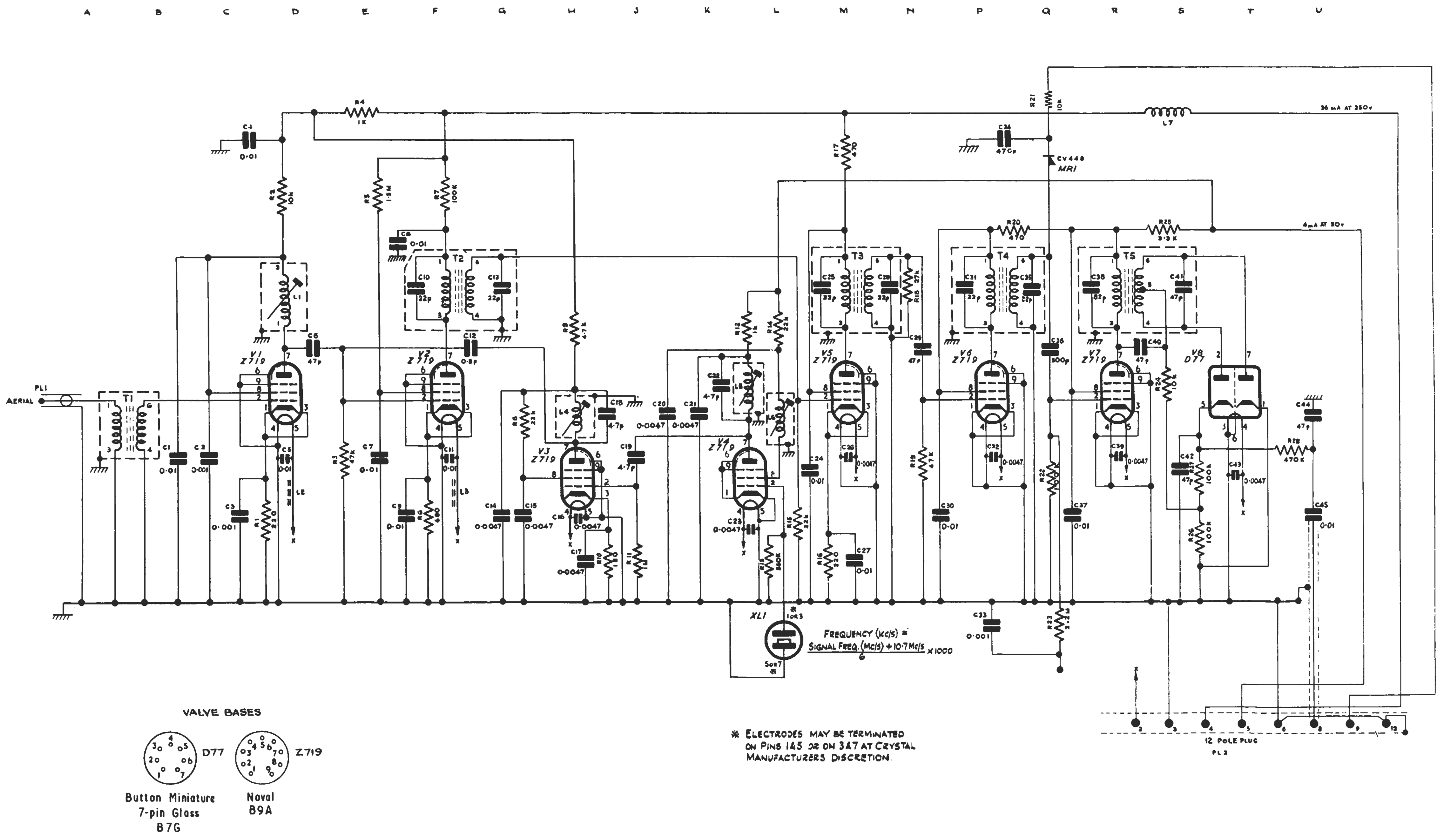
RC5/1A RECEIVER (SERIAL NUMBERS AFTER 120) : CIRCUIT

DYNATRON TUNER UNIT TYPE FM2 (MODIFIED)

58/SWA/012
DD4647

RS2

FIG.12



RC5/1B RECEIVER (SERIAL NUMBERS PRIOR TO 120): CIRCUIT

DYNATRON TUNER UNIT TYPE FM2 (MODIFIED)

58/SWA/011/AP
ED 9980
ISS 1

FIG 13

2ND ISSUE

RS.2

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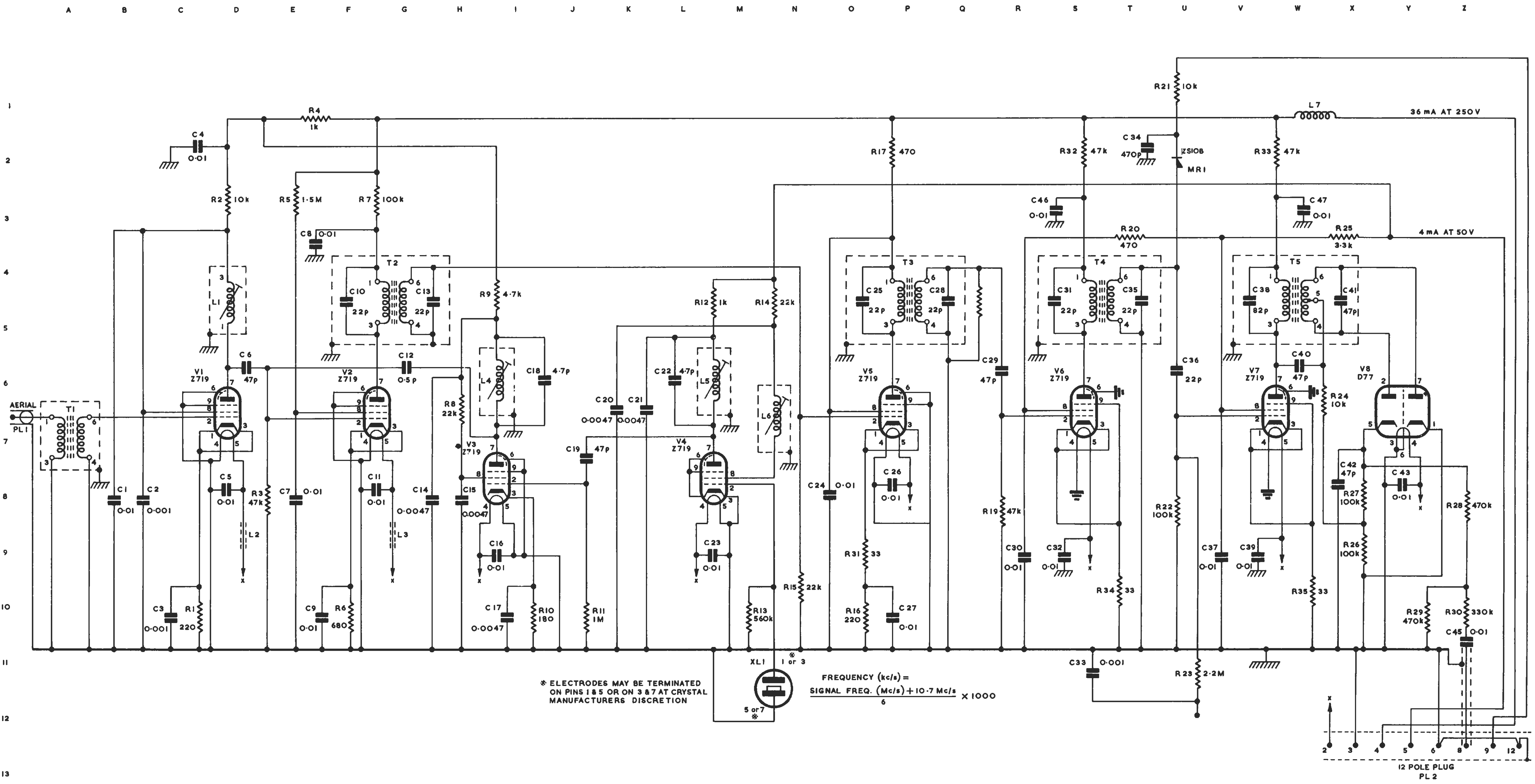
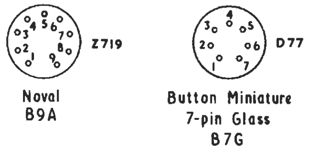


VALVE BASES



RC5/1B RECEIVER (SERIAL NUMBERS AFTER 120) : CIRCUIT

DYNATRON TUNER UNIT TYPE FM2 (MODIFIED)

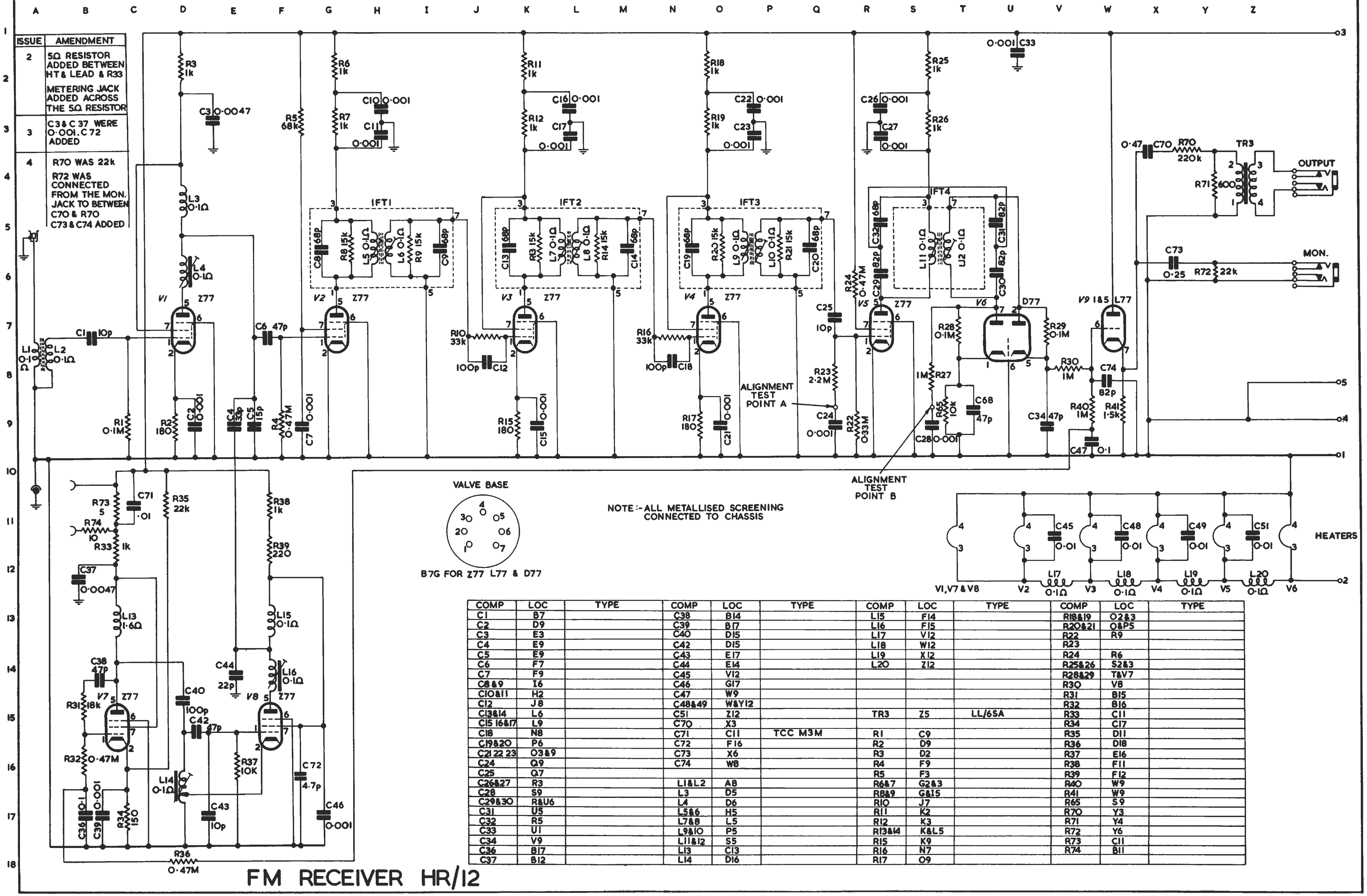
50/GGJ/006/AJP

FIG 14

4th ISSUE

RS.2

ISSUE	AMENDMENT
2	5Ω RESISTOR ADDED BETWEEN HT & LEAD & R33 METERING JACK ADDED ACROSS THE 5Ω RESISTOR
3	C3 & C 37 WERE 0·001. C 72 ADDED
4	R70 WAS 22k R72 WAS CONNECTED FROM THE MON. JACK TO BETWEEN C70 & R70 C73 & C74 ADDED



COMP	LOC	TYPE	COMP	LOC	TYPE	COMP	LOC	TYPE	COMP	LOC	TYPE
C1	B7		C38	B14		L15	F14		R18&19	O2&3	
C2	D9		C39	B17		L16	F15		R20&21	O&P5	
C3	E3		C40	D15		L17	V12		R22	R9	
C4	E9		C42	D15		L18	W12		R23		
C5	E9		C43	E17		L19	X12		R24	R6	
C6	F7		C44	E14		L20	Z12		R25&26	S2&3	
C7	F9		C45	V12					R28&29	T&V7	
C8&9	I6		C46	G17					R30	V8	
C10&11	H2		C47	W9					R31	B15	
C12	J8		C48&49	W&Y12					R32	B16	
C13&14	L6		C51	Z12		TR3	Z5	LL/6SA	R33	C11	
C15 16&17	L9		C70	X3					R34	C17	
C18	N8		C71	C11	TCC M3M	R1	C9		R35	D11	
C19&20	P6		C72	F16		R2	D9		R36	D18	
C21 22 23	O3&9		C73	X6		R3	D2		R37	E16	
C24	Q9		C74	W8		R4	F9		R38	F11	
C25	Q7					R5	F3		R39	F12	
C26&27	R3		L1&L2	A8		R6&7	G2&3		R40	W9	
C28	S9		L3	D5		R8&9	G&15		R41	W9	
C29&30	R&U6		L4	D6		R10	J7		R65	S9	
C31	U5		L5&6	H5		R11	K2		R70	Y3	
C32	R5		L7&8	L5		R12	K3		R71	Y4	
C33	U1		L9&10	P5		R13&14	K&L5		R72	Y6	
C34	V9		L11&12	S5		R15	K9		R73	C11	
C36	B17		L13	C13		R16	N7		R74	B11	
C37	B12		L14	D16		R17	O9				

FM RECEIVER HR/12

COMPONENT TABLE: FIG. 15

PAGE 1

Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
C1	A5	Oxley A7/30D		C50	AD1	Erie K7004/811	25
C2	B6	T.C.C. CTH310	+100 −0	C51	AD3	Oxley A7/30D	
C3	D7	T.C.C. CTH310	+100 −0	C52	AD3	T.C.C. SMP101 350V	20
C4	C5	Oxley A7/12·5D		C53	AE4	Erie K7004/811	25
C5	D2	T.C.C. CTH310	+100 −0	C54	AF7	Erie K7004/811	25
C6	E5	Oxley A7/12·5D		C56	A13	Wingrove & Rogers S50-01/2	
C7	J5	T.C.C. CSM20N	5				
C8	J8	Oxley A7/650		C57	A14	Mullard E7876	
C9	K4	Oxley A7/650		C58	B14	T.C.C. CSM20N	2
C10	K5	T.C.C. SMP501	2	C59	B15	T.C.C. CSM20N	2
C11	K5	Oxley A7/650		C61	D15	Mullard E7876	
C12	L4	Oxley A7/650		C62	D14	T.C.C. SMP101 350V	5
C13	L5	T.C.C. CSM20N	5	C63	D15	T.C.C. SMP101 350V	5
C14	M5	Oxley A7/650		C64	F15	T.C.C. SM3N	5
C15	N3	Erie N030AD		C65	H15	Erie K120051/K	20
C16	N7	Erie K7004/811	25	C66	J17	U.C.C. SC541/8LS	
C17	N3	Oxley A7/65D		C67	K16	U.C.C. SC541/8LS	
C18	N7	Erie K7004/811	25	C68	K12	U.C.C. SC517/8LS	
C19	P3	T.C.C. SMP401	2	C69	L13	U.C.C. SC502/8LS	
C20	P4	Erie K7004/811	25	C70	L15	U.C.C. SC596/7LS	
C21	Q5	T.C.C. SMP401	2	C71	N13	U.C.C. SC502/8LS	+100 −20
C22	Q5	Oxley A7/65D		C72	N16	Plessey CE294	+100 −20
C23	Q7	Erie K7004/811	25	C73	S14	T.C.C. CE180AAR 3V	
C24	R4	Wingrove & Rogers C32-01		C74	U14	Hunt BM19KV	20
C25	R3	Erie N030AD		C75A C75B	AE15	Plessey CE17035/1 25V	
C26	S3	Oxley A7/65D					
C27	S7	Erie K7004/811	25	C76	K4	T.C.C. SMP101 350V	10
C28	S3	T.C.C. SMP101	20	C77	L4	T.C.C. SMP101 350V	10
C29	T4	Erie K7004/811	25	C78	A14	T.C.C. SMP101 350V	2
C30	T4	Erie K7004/811	25	C79	T7	Erie K7004/811	25
C31	U3	Erie N030AD		C80	C14	Erie N750AD	10
C32	U3	Oxley A7/65D		C81	C15	Erie N750AD	
C33	U7	Erie K7004/811	25	C83	C5	Erie N030AD	
C34	V3	T.C.C. SMP401 350V	2				
C35	V4	Erie K7004/811	25				
C36	W4	Wingrove & Rogers C32-01		L1	A5	U.I.C. P1838	
C37	W5	T.C.C. SMP401 350V	2	L2	B5	U.I.C. P1838	
C38	W7	Erie K7004/811	25	L3	D5	U.I.C. P1990	
C39	W6	Oxley A7/65D		L4	F5	U.I.C. P1990	
C40	X3	Erie N030AD		L5	H5	U.I.C. P1839	
C41	Y3	Oxley A7/30D		L6	K4	U.I.C. P1840	
C42	Y7	Erie K7004/811	25	L7	K5	U.I.C. P1838	
C43	Y3	T.C.C. SMP101 350V	2	L8	L4	U.I.C. P1840	
C44	Z4	Erie K7004/811	25	L9	M5	U.I.C. P1839	
C45	Z7	Erie K7004/811	25	L10	R3	U.I.C. P1990	
C46	AB2	Erie N030AD		L11	R5	U.I.C. P1990	
C47	AB5	U.C.C. SM87S	+100 −20	L12	T3	U.I.C. P1990	
C48	AC3	Erie N030AD		L13	W3	U.I.C. P1990	
C49	AC7	Erie K7004/811	25	L14	X5	U.I.C. P1990	

COMPONENT TABLE: FIG. 15

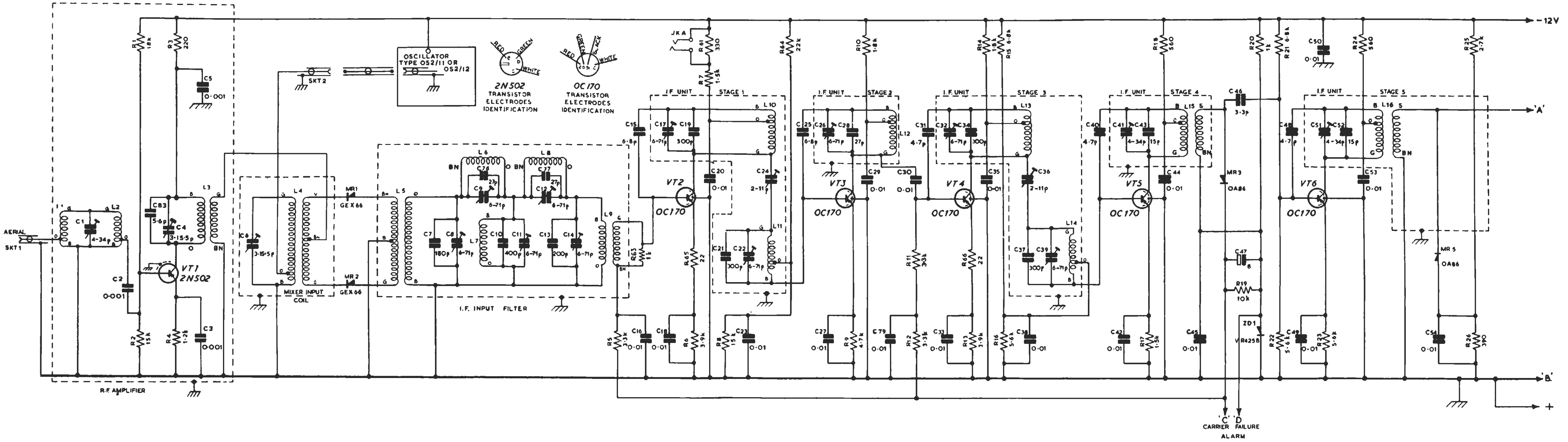
PAGE 2

Comp.	Loc.	Type	Tolerance per cent
L15	Z3	U.I.C. P1990	
L16	AE3	U.I.C. P1990	
L18	B14	EA 10764 Det 50	
L19	AE15	ED TC/2P/3	
R1	C1	Erie 16	10
R2	C7	Erie 16	10
R3	D1	Erie 16	10
R4	D7	Erie 16	10
R5	M7	Erie 16	10
R6	P7	Erie 16	10
R7	P2	Erie 16	10
R8	Q7	Erie 16	10
R9	S7	Erie 16	10
R10	S1	Erie 16	10
R11	U5	Erie 16	10
R12	U7	Erie 16	10
R13	V7	Erie 16	10
R14	V1	Erie 16	10
R15	V1	Erie 16	10
R16	V7	Erie 16	10
R17	Y7	Erie 16	10
R18	Z1	Erie 16	10
R19	AB6	Erie 16	10
R20	AC1	Erie 16	10
R21	AC1	Erie 16	10
R22	AC7	Erie 16	10
R23	AD7	Erie 16	10
R24	AE1	Erie 16	10
R25	AG1	Erie 16	10
R26	AG7	Erie 16	10
R27	E14	Erie 109	2
R28	E15	Erie 109	2
R29	F15	Erie 109	2
R30	F14	Erie 109	2
R31	H14	Erie 109	2
R32	H15	Erie 109	2
R33	J12	Erie 109	2
R34	J17	Erie 109	2
R35	K13	Erie 109	2
R36	K11	Erie 109	2
R37	K15	Erie 109	2
R38	L12	Erie 109	2
R39	L14	Erie 109	2
R40	L16	Erie 109	2
R41	L17	Erie 109	
R42	M12	Erie 109	2
R43	M17	Erie 109	2
R44	N12	Erie 109	2
R45	N17	Erie 109	2
R46	N16	Erie 109	2
R47	P13	Erie 109	2
R48	P17	Erie 109	2
R49	P12	Erie 109	2
R50	P17	Erie 109	2
R51	S14	Erie 109	2
R52	S15	Erie 109	2
R53	U15	Erie 108	2
R54	V13	Erie 109	2
R55	V15	Erie 109	2
R58	A18	Erie 109	2
R59	E17	Erie 109	2
R61	P1	Erie 16	10
R63	N5	Erie 16	10
R64	R1	Erie 16	10
R65	P5	Erie 16	10
R66	V5	Erie 16	10
R68	A18	Erie 108	2
R69	C14	Erie 16	10
R70	A19	Erie 109	2
R71	B17	Erie 109	2
R72	C18	Erie 109	2
R73	E18	Erie 109	2
RV1	A19	Colvern CLR1132/15S	10

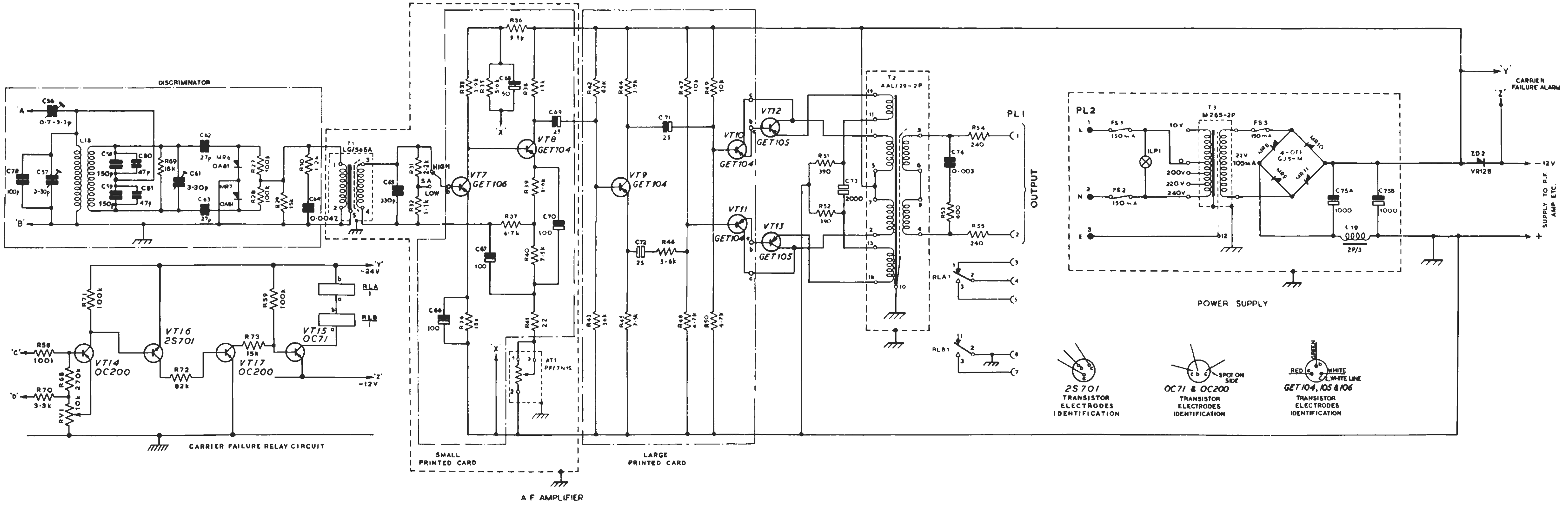
61/SWA/001/AP
EE10742
EE10777
EE10741

FIG 15 ISSUE 2 (AUG 64)

RS2
SECTION 6



RECEIVERS RC5/2 & RC5/3: R F & I F AMPLIFIER CIRCUIT



RECEIVER RC5/2: DISCRIMINATOR A F AMPLIFIER & POWER SUPPLY CIRCUIT

COMPONENT TABLE: FIG. 16

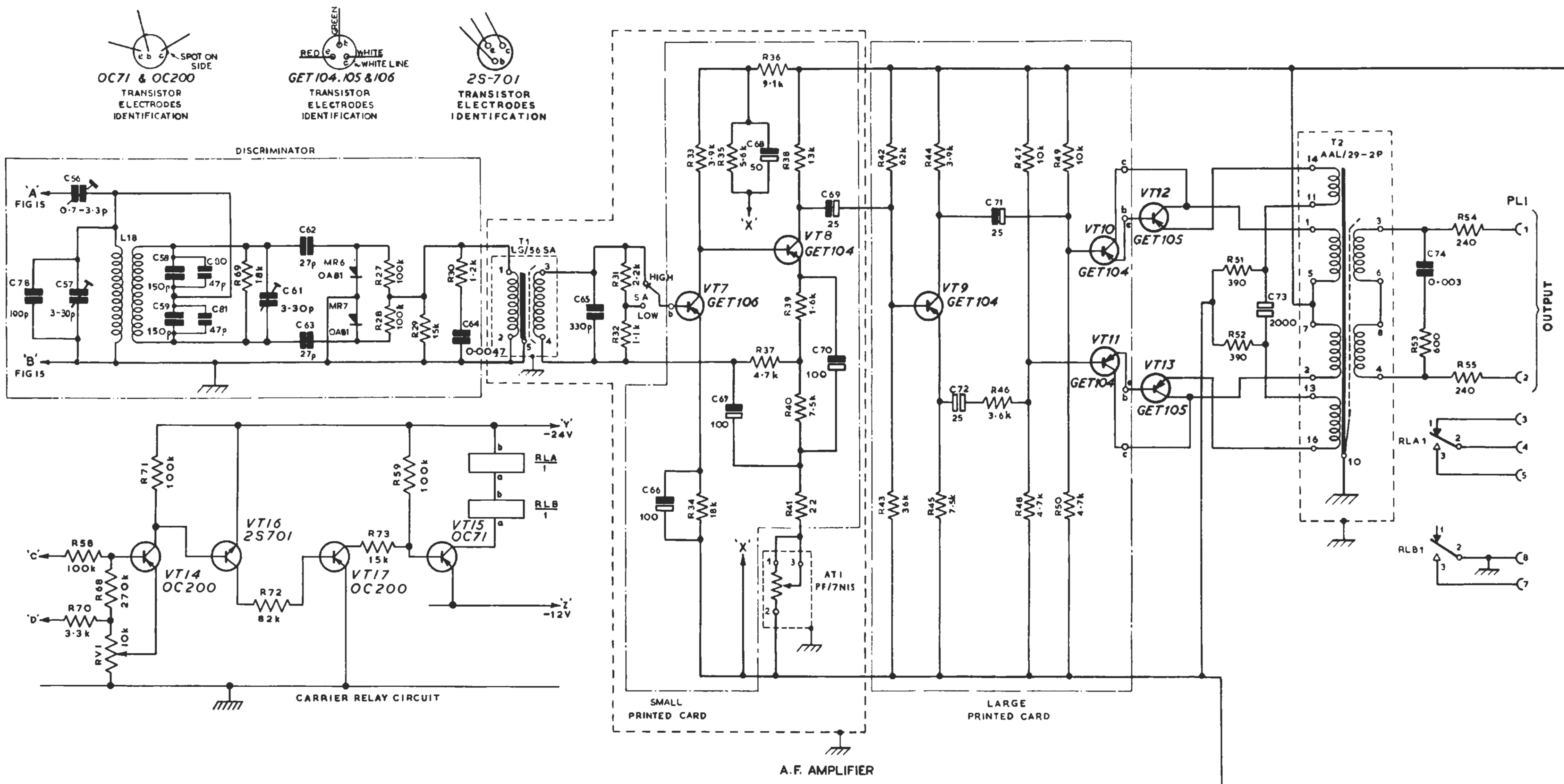
Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
C1	A17	T.C.C. CTH310	+20 −0	R1	A14	Erie 16	10
C2	A14	T.C.C. CTH310	+20 −0	R2	A17	Erie 16	10
C3	A18	Wingrove Rogers C32-01		R3	B16	Erie 16	10
C4	B14	Erie N030AD	5	R4	D17	Erie 16	10
C5	B17	T.C.C. CTH310	+20 −0	R5	D18	Erie 16	10
C6	C18	T.C.C. CTH310	+20 −0	R6	E14	Erie 16	10
C7	D15	Erie N030AD		R7	E17	Erie 16	10
C8	E18	T.C.C. CTH310	+20 −0	R8	F18	Erie 16	10
C9	F14	T.C.C. CTH310	+20 −0	R27	E4	Erie 109	2
C10	F15	Erie N030AD		R28	E5	Erie 109	2
C11	F18	T.C.C. CTH310	+20 −0	R29	F5	Erie 109	2
C12	A16	Erie N030AD	5	R30	F4	Erie 109	2
C56	A3	Wingrove Rogers S50-01/2		R31	H4	Erie 109	2
C57	A4	Mullard E7876		R32	H5	Erie 109	2
C58	B4	T.C.C. CSM20N	2	R33	J2	Erie 109	2
C59	B4	T.C.C. CSM20N	2	R34	J7	Erie 109	2
C61	C4	Mullard E7876		R35	K2	Erie 109	2
C62	D3	T.C.C. SMP101	5	R36	K1	Erie 109	2
C63	D5	T.C.C. SMP101	5	R37	K5	Erie 109	2
C64	F5	T.C.C. SM3N	5	R38	L2	Erie 109	2
C65	H4	Erie K120051/K	20	R39	L4	Erie 109	2
C66	J7	U.C.C. SC541/8LS		R40	L6	Erie 109	2
C67	K6	U.C.C. SC541/8LS		R41	L7	Erie 109	
C68	K2	U.C.C. SC517/8LS		R42	M2	Erie 109	2
C69	L3	U.C.C. SC502/8LS		R43	M7	Erie 109	2
C70	L5	U.C.C. SC596/7LS		R44	N2	Erie 109	2
C71	P3	U.C.C. SC502/8LS	+100 −20	R45	N7	Erie 109	2
C72	N6	Plessey CE294	+100 −20	R46	N6	Erie 109	2
C73	S4	T.C.C. CE180AAR		R47	P3	Erie 109	2
C74	U4	Hunt BM19KV	20	R48	P7	Erie 109	2
C75A	Y16	Plessey CE17035/1		R49	P2	Erie 109	2
C75B				R50	P7	Erie 109	2
C78	A4	T.C.C. SMP101 350V	2	R51	S4	Erie 109	2
C80	C4	Erie N750AD	10	R52	S5	Erie 109	2
C81	C4	Erie N750AD	10	R53	U5	Erie 108	2
				R54	V3	Erie 109	2
				R55	V5	Erie 109	2
				R56	Z16	Erie 9	10
L1	F13	Painton 200150		R58	A8	Erie 109	2
L2	C15	Painton 200150		R59	E7	Erie 109	2
L3	D14	EB 10818 Det 5		R68	A8	Erie 108	2
L4	E13	Painton 200150		R69	C4	Erie 16	10
L5	G15	EB 10818 Det 6		R70	A9	Erie 109	2
L6	A17	CH2/1		R71	B7	Erie 109	2
L18	A4	EA 10764 Det 50		R72	C8	Erie 109	2
L19	Y16	ED TC/2P/3		R73	E7	Erie 109	2

FIG 16
ISSUE 2
(AUG 64)

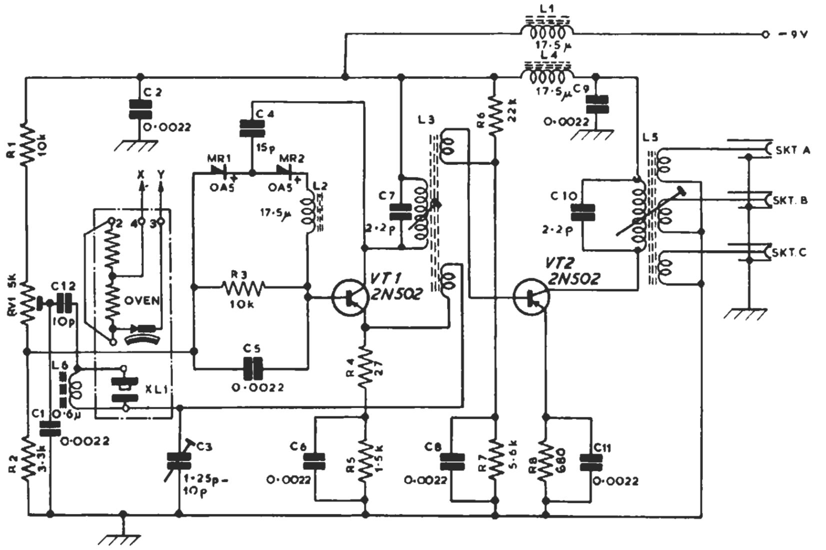
OC71 & OC200 TRANSISTOR ELECTRODES IDENTIFICATION

GET104, 105 & 106 TRANSISTOR ELECTRODES IDENTIFICATION

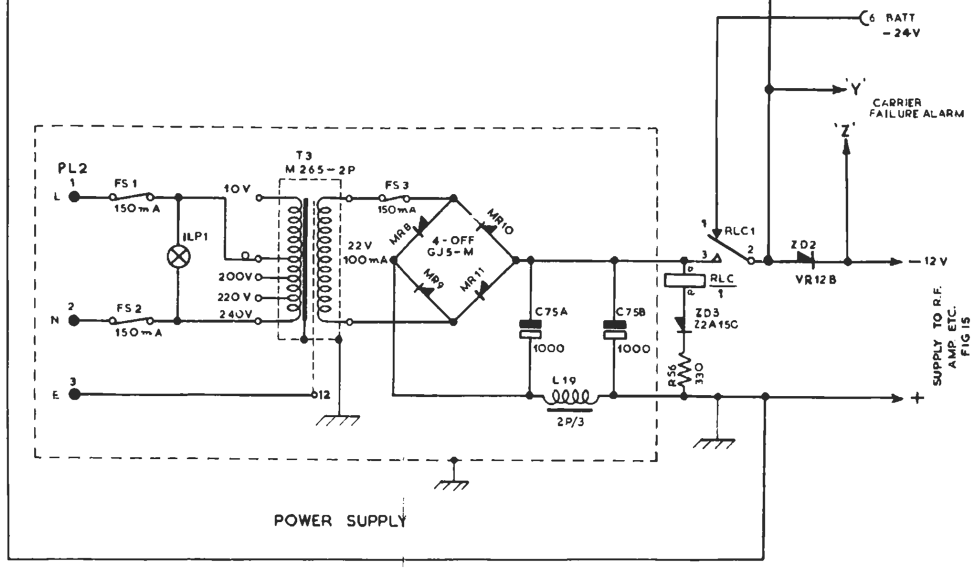
2S-701 TRANSISTOR ELECTRODES IDENTIFCATION



RECEIVER RC5/3: DISCRIMINATOR & A F AMPLIFIER CIRCUIT



OSCILLATOR OS2/11A CIRCUIT

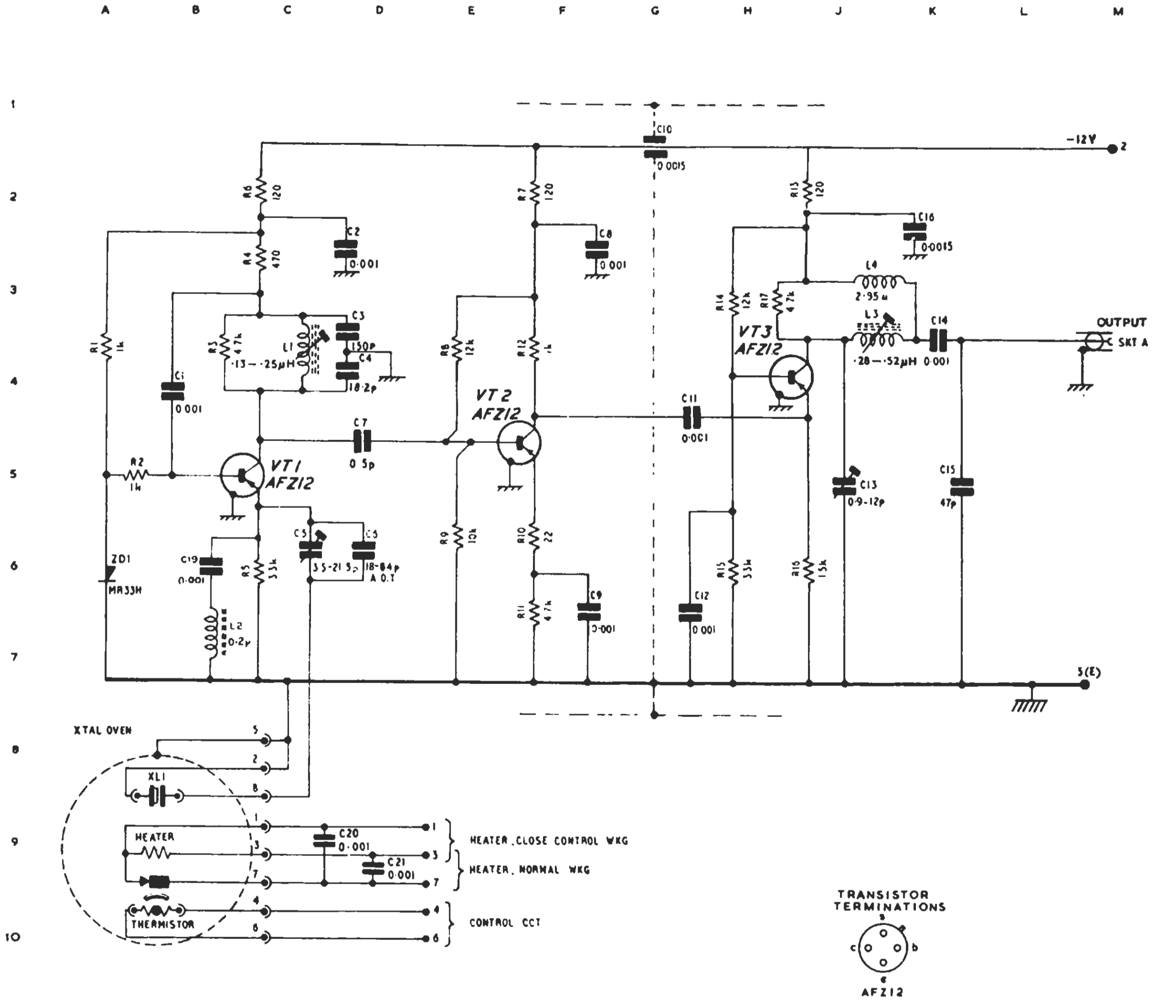


RECEIVER RC5/3: POWER SUPPLY CIRCUIT

COMPONENT TABLE: FIG. 17

Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
C1	B4	Erie K350081/831	20	L2	B7	DA10282	
C2	D2	Erie K350081/831	20	L3	J3	DA10281	
C3	D3	T.C.C. CTU425/C	2	L4	J3	Painton 200151	
C4	D3	Erie N080AD N470AD	1				
C5	C5	Oxley A7/18D					
C6	C5	Erie NP0AD NP0BD	1				
C7	D4	Erie NP0/831					
C8	F2	Erie K350081/831	20	R1	A4	Erie N1	2
C9	F6	Erie K350081/831	20	R2	A5	Erie N1	2
C10	G1	Erie K170051/362	20	R3	B3	Erie N1	2
C11	G4	Erie K350081/831	20	R4	C3	Erie N1	2
C12	G6	Erie K350081/831	20	R5	C6	Erie N1	2
C13	J5	Mullard C004EA/12E		R6	C2	Erie N1	2
C14	K4	Erie K350081/831	20	R7	F2	Erie N1	2
C15	K5	Erie N750AD	10	R8	E4	Erie N1	2
C16	J2	Erie K120051/324	20	R9	E5	Erie N1	2
				R10	F6	Erie N1	2
				R11	F7	Erie N1	2
C19	B6	Erie K350081/831	20	R12	F4	Erie N1	2
C20	C9	Erie K350081/831	20	R13	H2	Erie N1	2
C21	D9	Erie K350081/831	20	R14	H3	Erie N1	2
				R15	H6	Erie N1	2
				R16	J6	Erie N1	2
L1	C3	DA10280		R17	H3	Erie N1	2

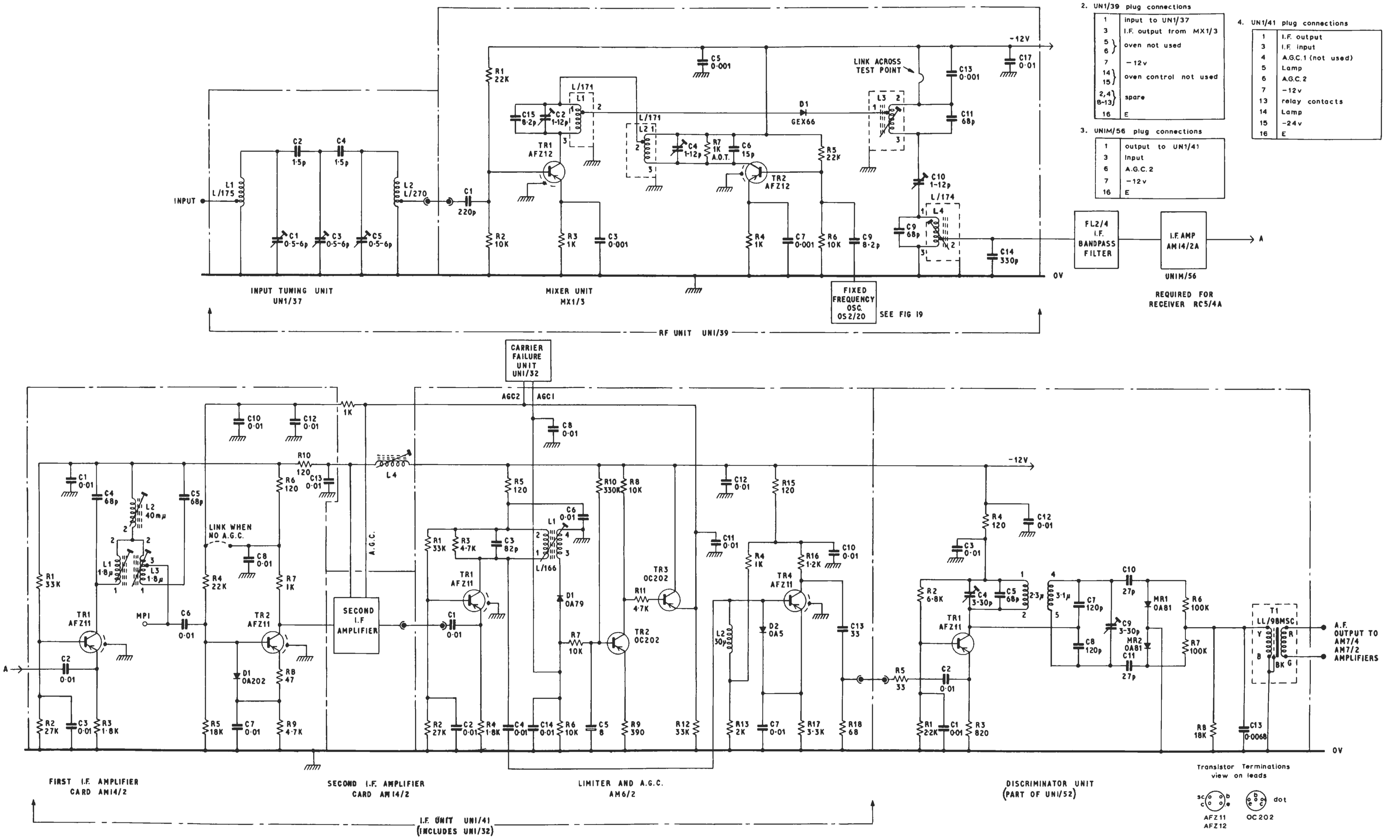
FIG 17
(AUG 64)



NOTE:- THE FREQUENCY OF THIS OSCILLATOR CAN BE SET ON TEST TO ANY VALUE BETWEEN 78 & 95 Mc/s

FIXED FREQUENCY OSCILLATOR OS2/12E: CIRCUIT

FIG 18



NOTES

1. Screening Boxes BX1/4 indicated thus ———·———·———

2. UN1/39 plug connections

1	input to UN1/37
3	I.F. output from MX1/3
5 6	oven not used
7	−12v
14 15	oven control not used
2,4 8-13	spare
16	E

3. UNIM/56 plug connections

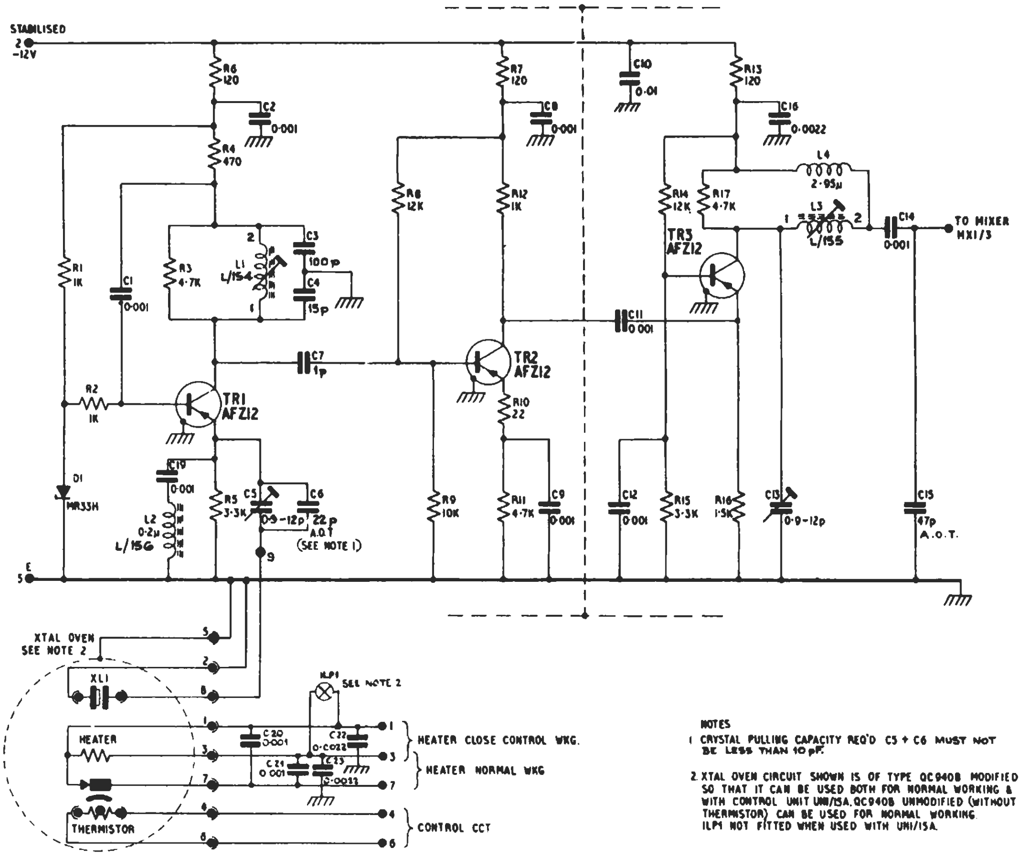
1	output to UN1/41
3	Input
6	A.G.C. 2
7	−12v
16	E

4. UN1/41 plug connections

1	I.F. output
3	I.F. input
4	A.G.C. 1 (not used)
5	Lamp
6	A.G.C. 2
7	−12v
13	relay contacts
14	Lamp
15	−24v
16	E

VHF/FM REBROADCAST RECEIVER RC5/4 AND RC5/4A : CIRCUIT

FIG 19



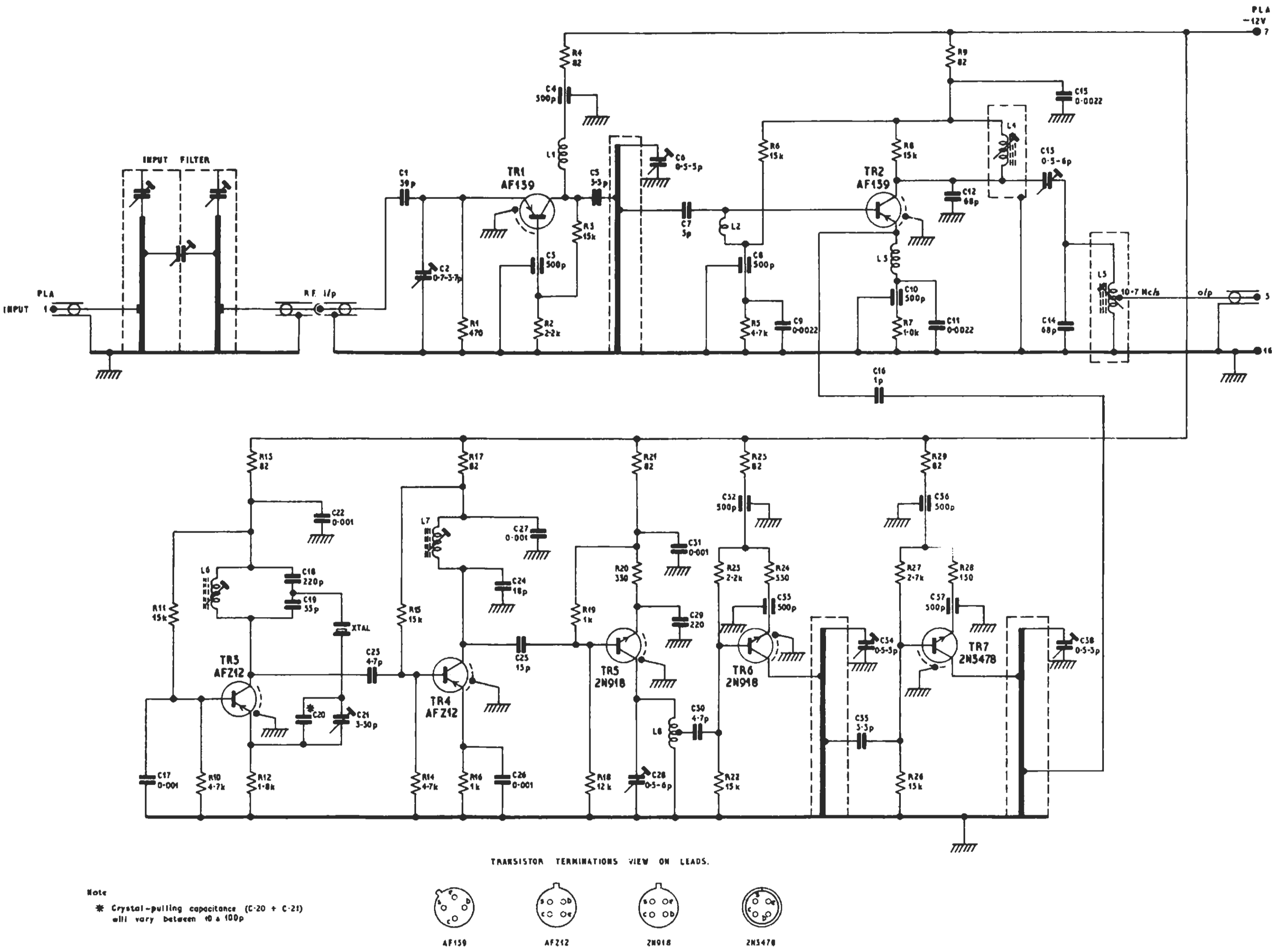
NOTES

1 CRYSTAL PULLING CAPACITY REQ'D C5 + C6 MUST NOT BE LESS THAN 10 pF.

2. XTAL OVEN CIRCUIT SHOWN IS OF TYPE QC940B MODIFIED SO THAT IT CAN BE USED BOTH FOR NORMAL WORKING & WITH CONTROL UNIT UN1/1SA. QC940B UNMODIFIED (WITHOUT THERMISTOR) CAN BE USED FOR NORMAL WORKING. ILP1 NOT FITTED WHEN USED WITH UN1/1SA.

TRANSISTOR TERMINATIONS
VIEW ON LEADS

CRYSTAL OSCILLATOR OS2/20 : CIRCUIT



Note

✱ Crystal-pulling capacitance (C·20 + C·21) will vary between 10 & 100p

BAND 4 / BAND 5 INPUT RF UNIT UN1/57 : CIRCUIT

FIG 20

ERRATA

To Editor,
Technical Instructions,
305, *St. Hilda's, Maida Vale.*

The following errors have been noted in ***Instruction***

Station........................ *Date*.................. *Signature*..................

ERRATA

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Technical Instructions,
305, *St. Hilda's, Maida Vale.*

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