Eddystone

COMMUNICATIONS RECEIVER MODEL 940

INSTRUCTION MANUAL

The EDDYSTONE Model 940 is a general purpose communications receiver covering the frequency band 480 kc/s to 30 Mc/s in five switched ranges. A single conversion circuit is employed and the receiver is suitable for AM, CW and SSB reception. A built-in mains pack provides for direct operation from all standard AC supplies.

Audio outputs are available for connection to an external loudspeaker, telephones and remote lines. The output stage employs a push-pull circuit and is capable of excellent quality. Circuit arrangements are such that the speaker output is automatically interrupted when telephones are in use but the line output is maintained under all conditions of operation. Audio input terminals are fitted at the rear so that the audio section of the receiver may be used alone.

Three positions of IF selectivity are provided one of which involves the use of a single crystal filter having a phasing adjustment which takes the form of a panel control.

Other features of the Model 940 include a built-in meter for measurement of relative carrier level or for use as a tuning indicator, a noise limiter for AM reception and an extremely efficient AGC system. The Local and Beat Oscillators are operated from a stabilised supply. Two RF Amplifiers are used, the first stage being a double-triode cascode arrangement. Provision is made for control of an external relay which may operate an associated transmitter from the Standby switch on the front panel.

Rugged construction and high quality components are employed throughout, the receiver is of a most convenient size, can be adapted for rack-mounting and is attractively finished with modern styling. The strong steel cabinet and chromium plated panel handles give adequate protection against rough usage. Continuous operation is possible in all areas under extreme climatic conditions.

TECHNICAL DATA

Frequency Coverage

480 kc/s to 30 Mc/s in five ranges as follows :—

Range 1	..	12·7 — 30·0 Mc/s
Range 2	..	5·4 — 12·7 Mc/s
Range 3	..	2·4 — 5·4 Mc/s
Range 4	..	1·03 — 2·4 Mc/s
Range 5	..	480 — 1030 kc/s

Intermediate Frequency

450 kc/s with crystal filter and variable selectivity.

Valve Complement

V1	ECC189	(CV5331)	1st RF Amplifier (cascode).
V2	6BA6	(CV454)	2nd RF Amplifier.
V3	6AJ8	(CV2128)	Mixer Stage.
V4	6C4	(CV133)	Local Oscillator.
V5	6BA6	(CV454)	1st IF Amplifier.
V6	6BA6	(CV454)	2nd IF Amplifier.
V7	6AL5	(CV140)	AM Detector/AGC Rectifier.
V8	6BE6	(CV453)	CW/SSB Detector.
V9	12AU7	(CV491)	Audio Amplifier/Phase Splitter.
V10	6AM5	(CV136)	Push-pull Audio Output.
V11	6AM5	(CV136)	
V12	GZ34*	(CV1377)	HT Rectifier.
V13	VR150/30	(CV216)	HT Stabiliser.
D1	2E1†	—	Noise Limiter (silicon diode).

*5Z4G (CV1863) may be fitted in this position.
† DD006 may be used as an equivalent.

Power Supply

110V or 200/240V AC (40–60 c/s).

Consumption

Approximately 80 volt-amperes.

Fusing

Live input : 1 Amp.

Input and Output Impedances

Aerial input	..	75Ω (nominal) balanced or unbalanced.
Audio input	..	0·1 MΩ (approx).
Audio outputs	..	Loudspeaker : 2·5/3Ω. Lines : 600Ω balanced or unbalanced. Telephones : Nominally 2000Ω but suitable for a wide range of impedances.

TYPICAL PERFORMANCE FIGURES

Sensitivity

3uV for a 15dB signal-to-noise ratio. (50mW output and 30% mod.).

Selectivity

The following figures are indicative of the overall bandwidths obtained in the broad ('MIN'), narrow ('MAX') and 'CRYSTAL' positions.

Position	—6dB	—20dB	—40dB
'MIN'	10 kc/s	15 kc/s	22 kc/s
'MAX'	4 kc/s	8 kc/s	12 kc/s
* 'CRYSTAL'	400 c/s	2 kc/s	3·5 kc/s

* Phased for symmetrical response.

Image Rejection

1 Mc/s	..	90dB.
8 Mc/s	..	75dB.
20 Mc/s	..	40dB.

Calibration Accuracy

0·5% on all ranges.

AGC Characteristic

The audio output level will not change by more than 9dB when the carrier level is increased by 100dB above 5uV.

Audio Output and Response

Maximum output at the 2·5 or 600Ω terminals (when used independently) is of the order 3·5 watts.

The audio response is level within 3dB over the range 100 c/s to 8 kc/s.

Distortion

Not greater than 5% at 1 watt in 2·5Ω (1000 c/s).

Hum Level

46dB below 1 watt.

CIRCUIT DESCRIPTION

The RF Section

This portion of the receiver comprises two RF Amplifiers V1 and V2, a heptode Mixer Stage V3 and a separate Local Oscillator V4.

The 1st RF Stage employs an ECC189 vari-mu double-triode in a series cascode circuit. The input is fully tuned on all ranges and provision is made for connection of balanced or unbalanced feeders of 75Ω impedance. The cascode amplifier maintains excellent signal-to-noise characteristics throughout the entire tuning range and is superior to the more conventional pentode amplifier usually found in this position.

Careful layout of the components associated with the cascode stage, inclusion of the grid stopper R2 and efficient grounding to signal frequencies of the second triode grid (pin 2 : C13 and C14) ensure stable operation at all frequencies. The HT supply is derived from the voltage divider R7/R9 while the correct bias for the second triode is obtained across R5.

A high gain vari-mu RF pentode (6BA6) is used in the second stage of RF amplification. Like the first stage, this amplifier is also fully tuned and provides added protection against image signals and spurious responses.

Initial operating bias for V1 and V2 is developed across R4 and R16. These resistors are not directly earthed but are returned to chassis via R32 and the 10,000Ω variable resistor RV1. (R32 is normally shorted by S3b). RV1 functions as a combined RF/IF Gain control, its control range being increased by a small bleed current which is derived from the HT1 rail via R3.

A separate Local Oscillator is employed in the frequency conversion stage and as a result only the heptode portion of the 6AJ8 (V3) is used. The control grids of V1, V2 and V3 are each returned to the AGC line via R1, R12 and R20 respectively.

A tuned-anode circuit is used in the Local Oscillator Stage (V4) which employs a 6C4 triode and operates above the signal frequency on all ranges. HT is obtained from the stabilised 150V supply (HT3) and oscillator injection is taken from the control grid (pin 6) via the coupling capacitor C45 to g_1 of the heptode Mixer. A measure of temperature compensation is obtained on all ranges from the small ceramic capacitor C62 which is located on the main tuning gang.

All the tuned circuits associated with the RF Section are housed in a partitioned diecast chassis which is extremely robust and ensures a high degree of mechanical stability. All inductors except those actually in use are short circuited by the Wavechange switch to prevent absorption effects.

The IF Section

Output from the Mixer valve (V3) is taken to a two-stage IF amplifier tuned to 450 kc/s. 6BA6 vari-mu RF pentodes are used in both stages (V5 and V6), the first of which is controlled by the combined RF/IF Gain control RV1. AGC is applied to both stages via R31 and R34.

A total of seven tuned circuits are used and the amplifier features variable selectivity which is achieved by switched tertiary windings on two of the transformers (T1 and T3). In addition, a selective crystal filter can be brought into operation when the Selectivity switch is moved to the third position. The phasing capacitor (C68) associated with this filter is brought out as a panel control so that maximum benefit can be derived from the filters' variable rejection notch.

The cathode of the 1st IF Amplifier (V5), like the cathodes of the two RF Stages, is returned to chassis via R32. As mentioned previously, this resistor is normally shorted by the Standby switch (S3b). With the switch in the ' standby ' position R32 is brought into circuit and the voltage developed across it due to the cathode currents of V1, V2 and V5 (plus the bleed current through R3), is sufficient to effectively mute the receiver. A double-pole double-throw switch is used for S3 and the unused section (S3a) can be wired to operate an external relay should this facility be required. (See Installation).

Variation of the screen current of V6 due to AGC action is utilised to operate the built-in Carrier Level Meter (M1). This is wired between a tap on the screen feed (R37/R38) to V6 and the slider of a potentiometer (RV2) which forms part of a potential divider across the main HT supply. RV2 allows the voltage across the meter to be set to zero so that the meter needle can be set to the ' O ' mark on the meter scale under ' no-signal ' conditions. On receipt of a signal, AGC bias causes the screen current of V6 to fall so reducing the voltage across R37 and, by unbalancing the bridge network, causes the meter to read.

Detectors and AGC

Two separate detectors are used, a normal series diode circuit for AM and a product detector for CW and SSB.

The AM Detector employs one diode of a 6AL5 (V7B). Audio developed across the load resistor R48 is fed to the Mode switch (S6b) via the series type Noise Limiter D1. This is a small silicon diode and can be taken out of circuit by closing S5.

A mixing type detector (V8 : 6BE6) is used for CW and SSB reception and this is housed in a small screening can which is located on the power unit chassis. Like the 1st Oscillator, this stage is run from the stabilised HT supply which is applied to V8 by S6a when this is placed at CW/SSB. Signal input for the CW/SSB Detector is obtained from the secondary of T4 and is coupled in via C91.

Variation of ' pitch ' on CW signals and correct adjustment of the carrier insertion frequency on SSB signals is by C98 which provides a swing of at least 3 kc/s either side of the IF. Output is taken across the anode load R54 via the filter R56/C95/C96 and the coupling capacitor C97 to the Mode switch S6b.

The remaining half of V7 (½ 6AL5) is used as the AGC Rectifier and is fed direct from the anode of the last IF Stage via C88. The AGC is delayed by biasing the cathode of V7A from the divider R43/R44. AGC is fed to the two RF Stages V1 and V2, the Mixer V3 and both 450 kc/s IF Stages V5 and V6. AGC can be taken out of operation by S4 which earths the AGC line.

The Audio Stages

AF output from the appropriate detector is selected by S6b and routed to the AF Gain control RV3. Terminals at the rear of the set allow external audio signals to be introduced at this point. The slider of RV3 feeds the grid of V9A (½ 12AU7) which is the 1st Audio Amplifier and is resistance-capacity coupled to the Phase Splitter V9B.

Two 6AM5 pentodes are used in the Audio Output Stage. One of these (V11) is driven from the anode of V9B, the other (V10) from the cathode. Negative feedback is introduced by R63 and R66 and also by the unbypassed cathode resistor of V9B.

The output transformer has two secondary windings, one of 2·5Ω for connection to an external loudspeaker and the other of 600Ω for use when the receiver output must be transmitted over remote lines to some distant listening point. This winding is electrostatically screened from the primary and the other secondary.

Telephones are tapped into a resistive divider (R70/R71) which is fed from the anode of V10 via the blocking capacitor C107. An auxiliary contact on the jack socket breaks the loudspeaker earth return to interrupt the speaker output when telephones are in use.

The Power Supply

This portion of the receiver is of conventional design and employs an indirectly heated full wave rectifier (GZ34 or 5Z4G) for HT. In addition to the main HT supply (HT1), two other supplies are provided as follows :—

HT2 : HT supply for V9.

HT3 : Stabilised HT supply for V4 and V8.

A double pole switch is used for mains supply switching and the live line is fused at 1 Amp by the standard type cartridge fuse FS1.

INSTALLATION

Unless otherwise specified, the Model 940 is supplied complete with all valves in a form suitable only for surface-mounting. A rack mounting version (940/RM) is available to special order but standard Models can be modified for rack-mounting (19″ rack width) by fitting rack-mounting brackets and a special cabinet. The latter has cut-outs along the two vertical leading edges to give clearance for the mounting brackets which are attached to the rear of the panel. The ¼″ BSF spacing washers located between the panel and side-plates are removed when the brackets are fitted. Cabinets and mounting brackets can be supplied to order; quote D3377/2 for the cabinet and 5912P for the mounting brackets of which two are required.

All external connections with the exception of the telephone output are located at the rear of the cabinet and this point should be borne in mind when selecting the most suitable position for mounting the receiver.

Mains Input Connections and Voltage Adjustment

The AC mains supply is connected to the polarised socket at the rear using the mains connector provided with the receiver. The lead is left free at one end so that the user can fit a plug of a type suitable for connection to the local mains supply. The individual wires are colour-coded as follows :—

RED : live line. BLACK : neutral line. GREEN : earth.

It is important to check that the mains transformer is adjusted to suit the local mains voltage before making connection to the supply. A small three-way two-pin voltage selector plug is provided for this purpose on the side of the mains transformer. When the receiver leaves the factory the selector is set in the 230V position which is suitable for AC mains voltages in the range 220–240V. For operation from other supplies the selector should be set as follows :—

110V : 110V position.

200/220V : 200V position.

Aerial Input

Two aerial terminals labelled ' A1 ' and ' A2 ' are provided in the centre aperture at the rear of the cabinet. When the aerial feeder to be connected is coaxial (unbalanced) the ' A2 ' terminal should be linked to the earth terminal ' E ' which is adjacent to it. The inner conductor of the cable is connected to the ' A1 ' terminal and the outer to ' A2.' Random single wire aerials should also be connected to ' A1 ' with the link in position as described above.

When using balanced feeders remove the link between ' A2 ' and ' E ' and attach the feeder to ' A1 ' and ' A2.'

Earthing

Although the receiver is earthed by virtue of the supply earth it may be desirable to attach a more direct earth especially if a high level of local noise is experienced on the lower frequencies.

The earth lead should be of heavy gauge, as short as conveniently possible and should be soldered to the earthing point to ensure a good connection. A specially designed earthing clip may be used if this is more convenient but under no circumstances should reliance be placed on a twisted connection. The earth lead should be connected to terminal ' E ' adjacent to the two aerial connections.

Loudspeaker

Two spring-loaded quick-release terminals labelled 2·5Ω and located in the left-hand aperture at the rear allow connection of an external loudspeaker. Any good 2·5/3Ω unit can be used. Suitable speaker units in the EDDYSTONE range are the Cat. Nos. 906 and 935, full details of which are available on request.

Line Output (600Ω)

Connection to this output is made directly at the output transformer to three solder tags which are clearly marked 600Ω. The middle terminal is labelled ' CT ' (centre-tap) and must be connected to the receiver chassis when a balanced output is required ; otherwise make no connection to this terminal.

The output is taken from the two outer terminals. To make connection, remove the cabinet (four screws at rear), pass lead through left-hand aperture and through hole above the 2·5Ω terminals. Either tie a knot in the cable or fit a suitable cable clamp six inches from the end of the cable to prevent damage should the cable be pulled accidentally.

Now pass the lead through the hole in the chassis at the rear of the transformer and make soldered connections to the tags provided.

Telephones

This output is suitable for use with telephones of almost any impedance. Connection is made with a standard jack plug at the socket on the left-hand side of the panel. Insertion of the plug immediately interrupts the loudspeaker output but not the line output.

External Relay

If the receiver is used in conjunction with an associated transmitter it may be desirable to control the latter from the Standby switch on the receiver. One section of this switch is available for this purpose and leads can be connected to the appropriate tags (the two furthest from the lower edge of the panel on the unwired side of the switch). These tags are shorted when the switch is at ' standby.'

The lead can be passed through the hole used for the 600Ω output above and for neatness can be laced to the existing cable form.

OPERATION

When the receiver has been installed in accordance with the instructions given above, it can be brought into operation by moving the Mains switch to the ' ON ' position. An indication that the mains supply is completed to the receiver is given by illumination of the tuning scales. The receiver will become operative after the normal valve warming-up period provided the Standby switch is at ' ON.' This control is arranged to mute the receiver by desensitising three of the amplifying stages. It will be found most useful when the receiver is used in conjunction with an associated transmitter since the transmitter can be controlled by the same switch if so desired. When the switch is set to ' STANDBY ' all HT supplies are retained so that drift during standby periods is kept within the smallest possible limits. The receiver functions normally immediately the switch is moved to the down position.

While the receiver is warming-up, select the appropriate range and tune approximately to the required frequency. The range numbering around the Wavechange control is repeated at the left-hand end of the tuning scales and all calibration is in megacycles except on the lowest frequency range (Range 5) where frequencies are indicated directly in kilocycles.

The settings of the two gain controls will be determined by the following factors : (1) type of signal, (2) strength of signal, (3) whether or not AGC is in use. Generally speaking, AGC will be of most value when receiving AM (telephony) signals. With AGC in use, the RF Gain should be fully advanced to secure maximum AGC action and under these conditions the desired output level is obtained by adjustment of the AF Gain. For reception of CW (telegraphy) with AGC ' OFF,' the AF Gain should be well advanced and the RF Gain reduced to prevent overloading of the pre-detector stages. SSB (telephony) signals are received best with much the same combination of gain adjustments as used for CW reception.

Selection of the appropriate detector for the desired type of reception is by means of the Mode switch which has two positions labelled respectively ' AM ' and ' CW/SSB.' Except in the case of preliminary tuning of SSB signals the Mode switch should always be moved to the appropriate position before attempting to tune the desired signal. On SSB it usually proves easier to tune the signal in the ' AM ' position before proceeding to resolve it completely.

CW Reception

When tuning CW signals the Selectivity switch should be set to ' MAX.' The BFO (Pitch) control (to the right of the RF Gain) provides a total swing of some six kilocycles so that adequate variation of the beat note is available. The oscillator can be set either above or below the signal and a check should always be carried out to determine which setting gives the least adjacent channel interference. When this form of interference is particularly severe, advantage can also be taken of the built-in crystal filter which is brought into operation by moving the Selectivity switch to the ' CRYSTAL ' position. By careful adjustment of the Tuning, Crystal Phasing and BFO Pitch controls a great reduction in the interference level will be obtained together with a consequent increase in the readability of the wanted signal.

AM Reception

Preliminary tuning of AM signals can be carried out with the Selectivity switch in either the ' MIN ' or ' MAX ' positions. The strength of signal, conditions prevailing and the interference present will be deciding factors in the choice of selectivity position. The crystal filter can be introduced if interference is particularly severe but since the filter is designed primarily for selective CW reception, the quality of the received signal is bound to suffer due to attenuation of the higher audio frequencies. Impulse noise can be reduced when the Noise Limiter (NL) switch is put in the ' ON ' position. The Noise Limiter is only operative on AM since adequate noise suppression obtains on CW and SSB by virtue of the detection system which is employed.

SSB Reception

Tuning SSB signals calls for more precise adjustment of the controls than either of the foregoing modes. The Selectivity switch should be set to the ' MAX ' position for SSB reception.

Initial tuning is carried out with the Mode switch at ' AM,' AGC ' ON ' and with the RF Gain well advanced. With the controls set in this way, tune for maximum deflection on the built-in carrier level meter. It should be noted that the meter reading will be subject to large variations due to the speech on the signal and some practice is necessary to judge accurately when the signal lies correctly in the IF passband.

Now place the Mode switch in the ' SSB ' position, switch off the AGC and reduce the RF Gain setting. Without touching the tuning, swing the BFO Pitch control **very slowly** to either side of the centre setting. In one direction the signal will tend towards greater intelligibility and the BFO should be set at the point which provides the most natural sounding speech. Slight alternate adjustment of the Tuning and Pitch controls will now render the signal fully readable with reasonable quality.

If the transmitting station changes sideband or the receiver is now tuned to a station using the opposite sideband, the Pitch control must be adjusted to a similar setting on the opposite side of the centre frequency.

Carrier Level Meter

This is operative only when the AGC is ' ON.' It can be used either as an aid to accurate tuning or for comparison of carrier levels. Always set the tuning so that the meter needle is at its peak.

A pre-set control (Meter Zero) is available at the rear of the set to allow the meter needle to be adjusted to the ' O ' mark under no-signal conditions.

MAINTENANCE

Reliability in operation is a most desirable asset, a maxim which has been applied during development of the Model 940 receiver. As a result, only the most modern top grade components having adequate ratings have been employed. The valves have been chosen from a range of current types well known for their performance in receivers of this kind and the mechanical layout and construction are such that there is little possibility of damage due to rough handling.

If the receiver fails in operation, switch off immediately to avoid the possibility of damaging some expensive component. It may be that the fault is a relatively simple one and the following notes are given for guidance of an inexperienced user in checking for what to an experienced service engineer would be an obvious fault.

First and foremost ascertain that all external connections are made correctly. The loudspeaker lead may have broken or become disconnected at the receiver terminals or at the speaker unit itself. Likewise, the aerial feeder may have broken adrift causing all but the strongest signals to be lost.

When the receiver has had a chance to cool down (say five minutes), momentarily close the Mains switch and observe whether the dial lights come on or not. If the lights remain ' out ' and the mains lead to the set has been checked and found fully serviceable, the most likely cause is a burned out fuse at the mains input. This may be due to a receiver fault or may only be the breakdown of a normally fatigued fuse.

Whichever is the case, fit a replacement fuse (standard 1¼" cartridge type rated at 1 Amp) and switch on again. Allow the usual warming-up time and ascertain whether the receiver becomes operative in the normal manner. If this is the case then the trouble was most likely due to the fuse itself or possibly a violent surge in the mains supply voltage.

However, if the fuse burns out more or less immediately (i.e. lights come on for a short period and then go out), or the receiver runs for an hour or so and then fails again, the fault is a more serious one and the receiver should be taken to the nearest EDDYSTONE Agent who will rectify the trouble at a reasonable charge.

If it is necessary to take the receiver to an engineer who is not familiar with EDDYSTONE equipment, take these instructions with the set. They contain information which may enable the engineer to clear the fault more rapidly than would otherwise be the case.

Pointer Drive Cord Replacement

In the unlikely event of the drive cord either breaking or slipping out of the pulley grooves, replacement will be much simplified (even when the original cord is undamaged) if a new length is obtained. This can be made longer than the length actually required (approximately 4') and will therefore be easier to handle. Replacement will present no problems if the instructions given below are followed carefully.

NOTE : In these instructions, left and right are as viewed from the rear of the receiver.

1. Remove the cabinet after taking out the four retaining screws at the rear.
2. Take off the old drive cord by slackening the 6BA screws let into the drive pulleys.
3. Set the tuning control so that the tuning gang is fully meshed.
4. Secure one free end of the replacement cord to the 6BA screw in the left-hand drive pulley.
5. Feed the cord through the pulley slot and into the groove nearest the panel (cord leaving pulley from right to left).
6. Pass cord around jockey pulley (under then over) and across the dial between the pointer guide rods. Sufficient tension should be applied to cause the jockey pulley to take up a position one quarter of an inch from the guide rod support bracket.
7. Move the pointer to the right-hand end of the guide rods (past tuning meter) and then slide the cord up and over the retaining spring. The spring may be depressed slightly to simplify this operation.
8. Pass cord over top right-hand guide pulley, under bottom right-hand guide pulley, under meter and across towards the right-hand drive pulley.
9. Lay the cord in the groove nearest to the panel and wind three complete turns in an anti-clockwise direction. Ensure that the cord lies snugly in the pulley grooves and that the tension is maintained at the jockey pulley.
10. Press cord into pulley slot and secure to 6BA screw. (If screw is not immediately accessible, rotate tuning control to unmesh gang so that the screw comes into a more convenient position. The cord should be held firmly in line with the pulley groove whilst doing this).
11. Check that the jockey pulley is correctly tensioned and then cut off the surplus cord at the right-hand drive pulley.
12. Move gang to fully meshed position and set pointer to ' O ' on logging scale. Check drive for free and normal operation and correct vernier tracking.
13. Check the dial calibration against a suitable frequency standard.
14. Replace cabinet and fit retaining screws.

Cleaning Scale and Scale Window

1. Locate the three screws disposed vertically at each end of the rear of the scale plate. Take out the centre screw at each end and remove the small side castings at the extremities of the glass window.
2. Remove the three dial lamp holders from the rear of the scale support. These are clipped into position and are easily disengaged from the fixing slots by squeezing together the two sides of the holder.
3. Remove the four countersunk screws along the top edge of the panel and take out the long scale support.
4. The glass is now free and can be removed by lifting up and tilting back slightly.

Valve and Dial Lamp Replacement

The valves used in the Model 940 are standard types and no difficulty should be experienced in obtaining replacements. Any recognised equivalent is suitable if the type specified is not available, e.g. ECH81 can be used in lieu of 6AJ8, EB91 for 6AL5, etc.

All valves are easy of access and can be changed without difficulty. Screens or retaining clips must be replaced after fitting a new valve.

Dial lamps are rated at 6·5V @ 0·3A and are standard miniature bayonet types.

Re-alignment — General

In the unlikely event of a complete re-alignment being necessary, the following instructions should be followed in full. In the more usual case of partial alignment required to compensate for ageing components, etc. the relevant instructions can be extracted as required.

It must be stressed that alignment adjustments should not be tampered with unless there is a clear indication that alignment is in fact required. Alignment should only be carried out by fully skilled technicians equipped with suitable test instruments.

Re-alignment of the IF Transformers and BFO

Test Equipment Required.

Signal Generator covering the intermediate frequency of 450 kc/s with modulation at 400 c/s.

Output Meter matched to 2·5/3Ω.

Trimming tool (screwdriver type).

First disable the Local Oscillator by shorting out the section of the tuning gang nearest to the front panel. Set the Wave-change switch to '5,' Tuning to 700 kc/s and the RF and AF Gains at maximum. Switch off the Noise Limiter and AGC and put the Mode switch in the 'AM' position. Alignment must be carried out with the crystal filter in circuit so the Selectivity switch should be at 'CRYSTAL.' Adjust the Phasing control so that the capacitor is at its 'half-capacity' setting and check that this occurs when the index mark on the control knob is at 12 o'clock.

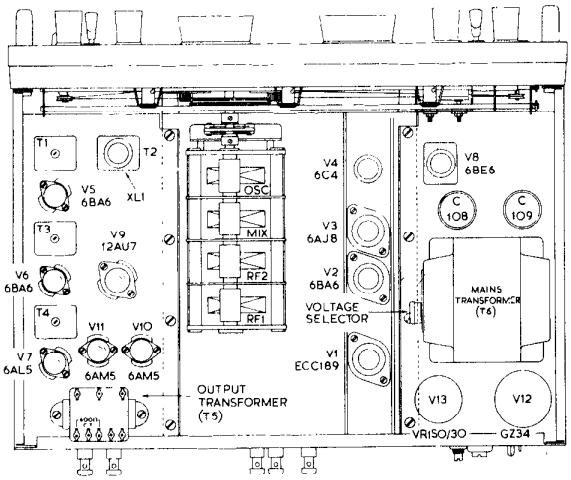
Connect the Signal Generator output lead to the stator of the Mixer section of the tuning gang (adjacent to Oscillator section) and the Output Meter and Loudspeaker to the 2·5Ω terminals at the rear. Allow 10—15 minutes for the equipment to reach operating temperature and then tune the Signal Generator to approximately 450 kc/s with modulation at a depth of 30% (400 c/s).

Now set the attenuator to a suitable level and tune the Generator for a peak reading on the Output Meter. It should be remembered that the receiver IF is in its most selective position and the tuning adjustment must be made very carefully to ensure that the output frequency is set accurately to the crystal peak. The attenuator should be adjusted to give a convenient reading on the Output Meter.

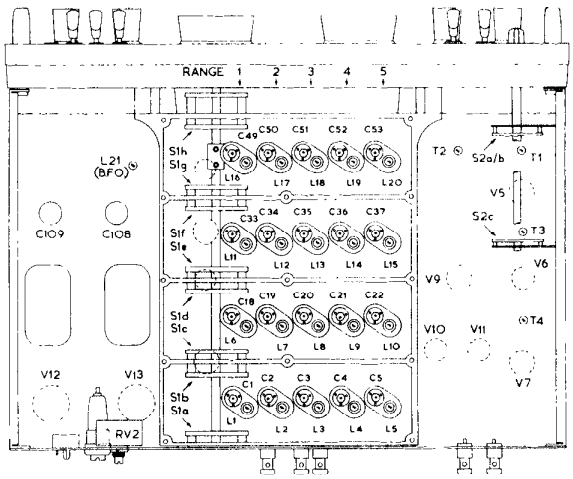
Peak the ferrite cores in T1—T4 (see Plan view for location) to obtain maximum reading on the Output Meter. It should be noted that the cores will tune in two positions : i.e. to an 'inner' and an 'outer' peak. All cores except the bottom (primary) core of T1 are set to the 'outer' peak : i.e. the one which occurs when the core is furthest from the opposite coil. The bottom core of T1 is set to the 'inner' peak while the core in the crystal filter output coil (T2) can be set to either peak.

Increase the attenuation as alignment proceeds and ensure that on completion a sensitivity of the order 7uV is obtained for an output of 50mW (IF selectivity at 'MAX'). If this figure is not achieved, stage by stage checks should be carried out with the Generator applied directly to pin 1 (grid) of V5 and V6. Typical sensitivities to be expected are (1) at grid of V5 : 220uV for 50mW output, and (2) at grid of V6 : 14mV for 50mW output. A low sensitivity in either position will most likely be due to a faulty valve (6BA6) or low gain in the audio stages. AF sensitivity is of the order 120mV for 50mW output (1,000 c/s) with the signal applied at the AF Input terminals. (All sensitivities quoted with loudspeaker disconnected).

After the amplifier has been aligned in the 'CRYSTAL' position, a check should be made on the symmetry of the response in the 'MAX' and 'MIN' positions. If the response is asymmetrical in the 'MIN' position, slight re-adjustment of the bottom (primary) core of T1 will allow correction without affecting the response in the other positions of the switch.



Plan view of Receiver



Underside view of Receiver

Once the alignment of the IF Transformers has been completed, check that the Generator is tuned to the crystal frequency and then cut the modulation. Set the receiver Mode switch to the 'CW/SSB' position and adjust the BFO Pitch control so that the capacitor is at 'half-capacity.' Check that, at this setting, the control knob index lies at 12 o'clock.

Now adjust the BFO core (L21) for zero beat and then check that the swing of the control covers at least 3 kc/s above and below the centre frequency.

This completes alignment of the receiver IF Section : the Generator and the shorting link on the forward section of the tuning gang can now be removed.

RF Alignment

Test Equipment Required.

Crystal Calibrator giving markers at 1 Mc/s and 100 kc/s intervals over the range 480 kc/s — 30 Mc/s.

Standard Signal Generator covering the range 480 kc/s — 30 Mc/s with an output impedance of 75Ω and modulation at 400 c/s.

Output Meter matched to 2·5/3Ω.

Trimming tools (screwdriver and concentric trimmer types).

The first step in re-alignment of the RF Section is a check on the accuracy of the dial calibration to ascertain whether adjustments are required in the Local Oscillator Stage. Set up the receiver for CW reception with the BFO in the centre of the IF passband. Connect the Crystal Calibrator to the aerial input terminals and check the scale accuracy at 100 kc/s intervals throughout each of the five ranges. Calibration accuracy should be within 0·5% (i.e. within 25 kc/s at 5 Mc/s, 75 kc/s at 15 Mc/s etc.). If the indications are that the calibration accuracy is outside the limits quoted, re-alignment should be carried out using normal tracking procedure. Adjustments should be made at the spot frequencies listed in the Table below. When the Signal Generator is used as the signal source for oscillator alignment it must be standardised against the Crystal Calibrator.

Range	Trimming Frequency	Trimmer	Padding Frequency	Core
1	27·0 Mc/s	C49	13·5 Mc/s	L16
2	11·5 Mc/s	C50	5·8 Mc/s	L17
3	4·8 Mc/s	C51	2·5 Mc/s	L18
4	2·2 Mc/s	C52	1·1 Mc/s	L19
5	950 kc/s	C53	500 kc/s	L20

The oscillator tracks 'high' on all ranges. On Ranges 1 and 2 there is a possibility of setting the oscillator on the low side of the signal and a check should be made to ensure that the response with minimum capacity or minimum inductance is selected. Care should be taken to balance any interaction between the trimming and padding adjustments which should be repeated at least twice to achieve the desired accuracy.

Once the scale calibration has been checked and corrected if necessary, alignment of the RF and Mixer circuits can be commenced. The Output Meter should be connected to provide a clearer indication of maximum output than is possible with the speaker alone. The receiver input impedance is 75Ω and the Signal Generator should be arranged to match this impedance when connected to the 'A1' and 'E' terminals at the rear. Modulation should be 30% at 400 c/s. Alignment adjustments are made at the following frequencies, tuning for maximum output with the appropriate trimmer or core. As with oscillator alignment each adjustment should be repeated at least twice to reduce errors due to interaction.

Range	Trimming Adjustments			
	Frequency	1st RF	2nd RF	Mixer
1	27·0 Mc/s	C1	C18	C33
2	11·5 Mc/s	C2	C19	C34
3	4·8 Mc/s	C3	C20	C35
4	2·2 Mc/s	C4	C21	C36
5	950 kc/s	C5	C22	C37

Range	Padding Adjustments (Core)			
	Frequency	1st RF	2nd RF	Mixer
1	13·5 Mc/s	L1	L6	L11
2	5·8 Mc/s	L2	L7	L12
3	2·5 Mc/s	L3	L8	L13
4	1·1 Mc/s	L4	L9	L14
5	500 kc/s	L5	L10	L15

SPARES

Spare parts should be ordered by quoting the circuit reference (where applicable) and the part number given in the list below.

Coils

L1 : D2677/1
L2 : D2680
L3 : D2683
L4 : D2686/1
L5 : D2689/1
L6 : D2678/1
L7 : D2680/1
L8 : D2684
L9 : D2687
L10 : D2690/1
L11 : D2677/2
L12 : D2681/1
L13 : D2684/1
L14 : D2687
L15 : D2690/1
L16 : D3281
L17 : D3282
L18 : D3283
L19 : D3284
L20 : D3285

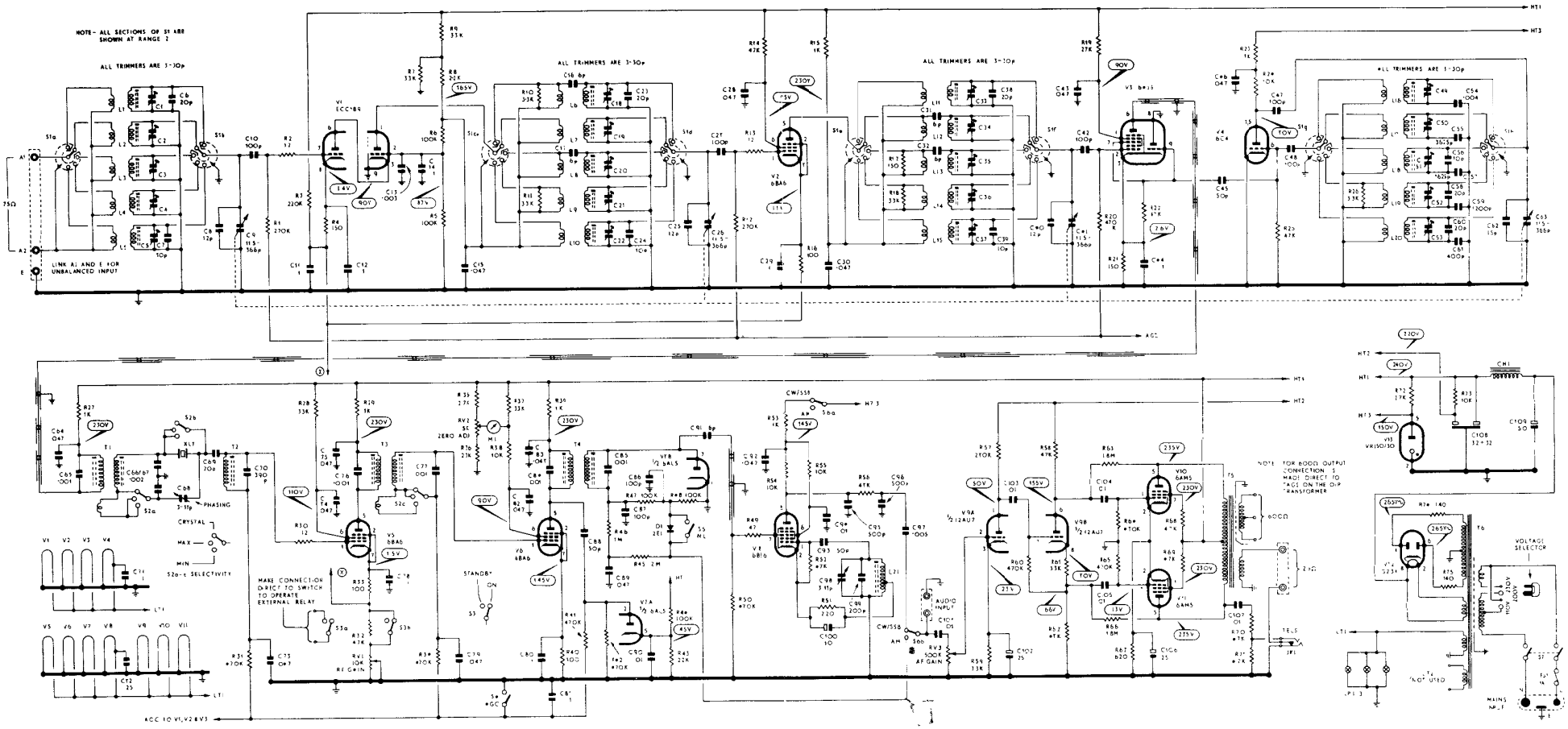
Transformers and Choke

T1 : D2901
T2 : D2892*
T3 : D2924
T4 : D2902
T5 : 6146P
T6 : 3937P
CH1 : 5863/1P

* Excludes crystal.

Miscellaneous

Crystal XL1 — Style E 450 kc/s ±·05%. : 6240P.
Glass window : 5847P.
Control knobs — small : 5816P.
Control knobs — large : 5817P.
Control knobs — chrome : 5780P.
Dial lamps : 3131P.
BFO Unit : D2891.



CAPACITORS

C1–5, 18–22, 33–37, 49–53 : 3–30 pf Air Trimmer. (C49–53 may be 4–29 pf).
C6, 23, 38, 60, 69 : 20 pf Silvered Mica ± 10% 350V DC,
C7, 24, 39, 58 : 10 pf Silvered Mica ± 10% 350V DC.
C8, 25, 40 : 12 pf Tubular Ceramic±10% 350V DC,
C9, 26, 41, 63 : 4-gang Air Spaced Variable.
C10, 27, 42 : 100 pf Polystyrene±5% 125V DC.
C11, 12, 14, 29, 44, 71, 78, 80, 81 : 0·1 uF Plate Ceramic+80—20% 200V DC.
C13 : 0·003 uF Metallised Paper±20% 350V DC.
C15, 28, 30, 43, 46, 64, 73–75, 79, 82, 83, 89, 92 : 0·047 uF* Polyester±10% 400V DC.
C16, 17, 31, 32, 91 : 6 pf Tubular Ceramic±10% 350V DC.
C45, 88, 93 : 50 pf Tubular Ceramic±10% 350V DC.
C47, 48, 86, 87 : 100 pf Tubular Ceramic±10% 350V DC.
C54 : 0·007 uF Polystyrene±1% 125V DC.
C55 : 3625 pf Silvered Mica±1% 350V DC.
C56 : Reference not allocated.
C57 : 1625 pf Silvered Mica±1% 350V DC.
C59 : 1200 pf Silvered Mica±1% 350V DC.
C61 : 400 pf Silvered Mica±1% 350V DC.

*0·05 uF may be fitted as alternative.

C62 : 15 pf Tubular Ceramic±10% 350V DC.
C65, 76, 77, 84, 85 : 0·001 uF Polystyrene±5% 125V DC.
C66, 67 : 0·002 uF Polystyrene±5% 125V DC.
C68, 98 : 3–11 pf Air Spaced Variable.
C70 : 390 pf Polystyrene±5% 125V DC.
C72 : 0·25 uF Metallised Paper±20% 150V DC.
C90, 101, 103–105, 107 : 0·01 uF Tubular Ceramic±20% 350V DC.
C94 : 0·01 uF Metallised Paper±20% 150V DC.
C95, 96 : 500 pf Metallised Paper±20% 350V DC.
C97 : 0·005 uF Tubular Ceramic±20% 350V DC.
C99 : 200 pf Silvered Mica±5% 350V DC.
C100 : 10 uF Tubular Electrolytic 16V DC.
C102, 106 : 25 uF Tubular Electrolytic 25V DC.
C108 : 32 – 32 uF Tubular Electrolytic 350V DC,
C109 : 50 uF Tubular Electrolytic 450V DC.

RESISTORS

R1, 12, 57 : 0·27 MΩ±10% ½ watt.
R2, 13, 30 : 12Ω±10% ½ watt.
R3 : 0·22M Ω±10% ½ watt.
R4, 17, 21 : 150Ω±10% ½ watt
R5, 6, 44, 47, 48 : 0·1M Ω±10% ½ watt.
R7, 28, 37 : 33,000Ω±10% 1 watt.
R8 : 2,200Ω±10% ½ watt.
R9 : 3,300Ω±10% ½ watt
R10, 11, 18, 26, 59, 61 : 3,300Ω±10% ½ watt.
R14 : 47,000Ω±10% 1 watt.
R15, 23, 27, 29, 39, 53 : 1,000Ω±10% ½ watt.
R16, 33, 40 : 100Ω±10% ½ watt.
R19, 35, 36 : 27,000Ω±10% 1 watt.
R20, 31, 34, 41, 42, 50, 60, 64, 65 : 0·47M Ω±10% ½ watt,
R22, 25, 32, 52, 56, 58, 62, 70 : 47,000Ω±10% ½ watt
R24, 54, 55 : 10,000Ω±10% ½ watt.
R38, 73 : 10,000Ω±10% 1 watt.
R43 : 22,000Ω±10% ½ watt.
R45 : 2MΩ±10% ½ watt.
R46 : 1MΩ±10% ½ watt.
R49 : 47Ω±10% ½ watt.
R51 : 220Ω±10% ½ watt.
R63, 66 : 1·8M Ω±10% ½ watt.
R67 : 620Ω±10% ½ watt.
R68, 69 : 4,700Ω±10% 1 watt.
R71 : 4,700Ω±10% ½ watt.
R72 : 2,700Ω±5% 6 watt wire-wound.
R74, 75 : 140Ω±5% 6 watt wire-wound.

VOLTAGES

All voltages indicated on the circuit above were taken using a meter of 20,000Ω/V sensitivity and an applied mains voltage of 240V. A variation of −5% should be allowed and readings should be taken between the point indicated and chassis. Range switch should be at '5,' Gain controls at maximum, Mode switch to CW/SSB, Standby switch to ON and AGC OFF.

ERRATA

The following corrections apply to the circuit above:
C54 should read: 007
C56 is not fitted and should be deleted.
C58 should read: 10p.
The note above L16 should be amended to read:
ALL TRIMMERS ARE 3–30p OR 4–29p.
Transpose references V10 and V11.
Note that the following capacitors are directly earthed and not via C54, C55 etc. as shown: C49, 50, 51, 52, 58, 53 and 60.

Eddystone Radio Limited
Member of Marconi Communication Systems Limited
Alvechurch Road, Birmingham B31 3PP, England
Telephone: 021-475 2231
Cables: Eddystone Birmingham Telex: 337081

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