Eddystone

TRANSISTORISED VHF RECEIVER MODEL 990R

EDDYSTONE RADIO LTD.
ALVECHURCH ROAD
BIRMINGHAM 31

EDDYSTONE VHF RECEIVER

MODEL 990R

The EDDYSTONE Model 990R is a fully transistorised single-conversion superhet for CW, AM and FM reception in the VHF band 27-240 MHz. It is suitable for use over the temperature range 0-50°C and can be supplied with a matching panoramic display unit when visual signal analysis is an additional requirement. Operating voltage can be either 12V DC or any standard AC supply.

Advanced circuit techniques are employed throughout, performance is of a high order and the design will be found suited to many varied applications including normal communications work, interference checking and noise measurement. Field use is facilitated by the ability to operate direct from low-voltage supplies with low current drain.

The complete tuning range is covered in four switched bands which give adequate bandspread even at the higher frequencies. Local oscillator arrangements permit operation with crystal control (up to eight switched channels), external frequency control or normal continuous tuning. Selectable bandwidths of 30 kHz and 200 kHz are provided, using a crystal filter in the narrow position. Alternative crystal filters are available to order when other bandwidths are required.

Two separate outputs are available from the 10.7 MHz intermediate frequency channel. The first is a low-level wide-band output (also usable as IF Input) and is mainly intended for driving the companion Panoramic Display Unit (Model EP17R) via an external IF Converter. Bandwidth at this output is of the order 1 MHz at the higher frequencies in the tuning range. The other output is taken from the final stage in the IF Channel, bandwidth being determined by the setting of the panel selectivity switch. Video output is available on both AM and FM.

Audio facilities include outputs for external speaker, telephones and remote lines, the latter being restricted to permit direct connection to Post Office circuits. A separate level control is used for the line amplifier which is totally independent of the local monitor channel. Frequency response is maintained within 6dB up to 10 kHz and a built-in monitor speaker is fitted for convenience in rack-mounted installations.

Other standard features include an internal crystal calibrator (modulated 10 MHz markers), a tuning meter and a carrier-controlled muting system. Panel controls comprise Tuning (gear-drive, flywheel-loaded with a ratio of approximately 100:1), Range Switch, System Switch (NORMAL - CRYSTAL - EXT OSC), and a combined Mode/Supply Switch. Separate switches are provided for Selectivity, AGC, Muting, Calibrator and Monitor Speaker; a mechanical cursor shift is fitted for correcting scale errors when calibrating. Pre-set Line Level, Meter Zero and Muting controls are located at the rear of the set together with a miniature toggle switch for closing down the front-end converter when using the IF Input facility.

The receiver is equally suited to bench or rack-mounting and though weighing less than 20 lb is extremely robust constructionally. Printed wiring techniques are employed for most parts of the circuit, using high-grade components throughout. Internal layout is arranged for easy access in the event of servicing being necessary. External appearance is in keeping with modern trends and finish is to the highest standard.

Sole Manufacturers:- EDDYSTONE RADIO LIMITED, ALVECHURCH ROAD, BIRMINGHAM 31, ENGLAND.

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T E C H N I C A L   D A T A

GENERAL

Frequency Coverage.

27-240 MHz in four ranges.

Range 1 . . 130 - 240 MHz (Nominal).
Range 2 . . 75 - 130 MHz (Nominal).
Range 3 . . 46 - 76 MHz (Nominal).
Range 4 . . 27 - 46 MHz (Nominal).

Intermediate Frequency.

10.7 MHz.

Power Supply.

Single-phase AC mains 100/130 and 200/260V (40-60 Hz) or 12V DC.

Transistor Complement. (NB: Equivalent types may be used where necessary)

Ref	Type	Manufacturer	Circuit Function
TR1	AF239	Siemens	RF Amplifier.
TR2	AF239	Siemens	Mixer.
TR3	AF239	Siemens	Local Oscillator 1. (VFO)
TR4	GM290	Texas	Frequency Multiplier.
TR5	GM290	Texas	Local Oscillator 2. (CRYSTAL)
TR6	GM290	Texas	Crystal Oscillator Isolator.
TR7	GM290	Texas	External Oscillator Isolator.
TR8	GM378	Texas	Crystal Calibrator.
TR9	GET880	Mullard	Tone Modulator.
TR10	GM290	Texas	IF Pre-amplifier.
TR11	GM290	Texas	Narrow Filter Input Switch.
TR12	GM378	Texas	Narrow Filter Output Switch.
TR13	GM290	Texas	Wide Filter Input Switch.
TR14	GM378	Texas	Wide Filter Output Switch.
TR15	GM378	Texas	IF Amplifier.
TR16	GM378	Texas	IF Amplifier.
TR17	C111	Fairchild	IF Amplifier.
TR18	GM290	Texas	Emitter Follower 1. (IF OUTPUT)
TR18A	GM290	Texas	Emitter Follower 2. (FM ISOLATOR)
TR19	GM290	Texas	FM Limiter Driver.
TR20	GM290	Texas	FM Limiter.
TR21	ASY29	Mullard	RF AGC Amplifier.
TR22	ASY29	Mullard	IF AGC Amplifier.
TR23	GM378	Texas	Beat Frequency Oscillator.
TR24	GM378	Texas }	CW Detector.
TR25	GM378	Texas }	
TR26	GET880	Mullard	1st Noise Amplifier.
TR27	GET880	Mullard	2nd Noise Amplifier.
TR28	2N3704	Texas }	Relay Trigger (Muting).
TR29	2N3704	Texas }	
TR30	GM378	Texas	Video Amplifier (1).
TR31	GM378	Texas	Video Amplifier (2).
TR32	GET880	Mullard	AF Amplifier. } 600Ω Channel.
TR33	OC72	Mullard	AF Output. }
TR34	GET880	Mullard	AF Amplifier. } 3Ω Channel.
TR35	AC127	Mullard	AF Amplifier. }
TR36	AC128	Mullard	AF Driver. }
TR37	AC127	Mullard }	Complementary }
TR38	AC128	Mullard }	AF Output. }

ACY44 and 2S512 may be used in lieu of GET880 and C111 respectively.

Other Semiconductor Devices (etc.)

Ref	Type	Manufacturer	Circuit Function
D1	BAX16	Mullard	Overload Protection Diode.
D2	OA47	Mullard	Response Correction Diode.
D3	OA47	Mullard	AM Detector.
D4/5	OA79	Mullard	FM Discriminator.
D6	BZY88*	Mullard	RF AGC Delay. *C6V8
D7	OA47	Mullard	RF AGC Rectifier.
D8	OA47	Mullard	IF AGC Rectifier.
D9/10	OA202	Mullard	Noise Rectifier.
D11	OAZ228	Mullard	10V Supply Regulator.
D12	DD006	Lucas	Reverse Polarity Protection.
D13	OAZ230	Mullard	12V Supply Regulator.
D14	M160T	G.E.C.	Supply Rectifier.

Input and Output Impedances.

Aerial Input . .	75Ω unbalanced (BNC).	
Ext Osc Input . .	Low-impedance (BNC).	
IF Output 1* . .	Low-impedance (BNC).	
IF Output 2** . .	Low-impedance (BNC).	
Video Output . .	1000Ω (BNC).	
Audio Output . .	Loudspeaker :	3Ω.
	Lines :	600Ω.
	Headset :	Low-Z.

* wide band.
** narrow band

IF Output 1 also usable as 10.7 MHz Input.

TYPICAL PERFORMANCE

Noise Factor.

Of the order 10dB.

Sensitivity.

5µV for 10dB s/n ratio with 50mW output in AM mode with selectivity at NARROW posn (30 kHz filter).

Spurious Response.

50dB down.

Deviation.

Up to 75 kHz.

Calibration Accuracy.

Within 1%. Crystal-controlled markers are available at 10 MHz intervals.

Frequency Stability.

1 part in 10^5 per °C change in ambient temperature. Of the order 1 part in 10^6 per °C with crystal control.

IF Bandwidth.

30 kHz (crystal filter) and 200 kHz.

AGC Characteristic.

The audio output level does not change by more than 10dB for an increase in input of 80dB above 10µV.

Audio Output.

The 3Ω loudspeaker output provides a maximum output power of 500mW at 10% distortion.

Line output is restricted to 10mW.

Audio Response.

Level within 6dB from 200 Hz to 10 kHz.

IF Output.

An output of the order 50mV is available from the IF Output 2 socket. This is suitable for driving the EP17R Panoramic Display Unit for bandwidths up to 200 kHz. IF Output 1 provides a low-level output at greater bandwidth on the higher frequency ranges.

Video Output and Response.

Output is of the order 1 volt p-p into a 1000Ω load. Video response is 6dB down at 20 Hz and 100 kHz with external loading of 250pF.

IF Converter Type 959. (See Appendix "D")

Output at 5.2 MHz is substantially the same as the input drive from the 990R receiver. The converter is crystal-controlled and has a fixed bandwidth of 1 MHz.

C I R C U I T   D E S C R I P T I O N

THE RF SECTION

General.

This portion of the receiver employs a high-gain RF Amplifier (TR1), a low-noise Mixer (TR2) and a comprehensive Local Oscillator system utilising a total of five transistors (TR3-TR7). An associated circuit is the Crystal Calibrator which uses two transistors (TR8 & TR9).

The whole Section is sub-divided into three parts; TR1-TR4 being housed in the RF Tuner Unit and TR5-TR7 in a separate screened enclosure. TR8 and TR9 are located in a further screened housing mounted on top of the RF Tuner Unit.

The five stages in the Local Oscillator system provide for continuous tuning over the whole coverage, spot frequency working on up to eight switch-selected crystal-controlled channels, or (semi-) continuous coverage using external synthesised drive when high-stability operation with flexibility of frequency selection is a requirement. The method of oscillator control is selected by the SYSTEM SWITCH (S3A-D) which also serves as "crystal-selector". Local Oscillator injection is always higher than the received signal frequency (10.7 MHz i.f.).

The RF and Mixer Stages. (TR1 & TR2)

Both the RF Stage (TR1) and the Mixer Stage (TR2) employ AF239 germanium mesa transistors. TR1 is operated as a grounded-base amplifier with manual or automatic gain control selected by one section of the MANUAL/AGC SWITCH (S6A). Gain control is not applied to the Mixer Stage but is applied to the IF Pre-amplifier TR10 which follows the Mixer. Control is from the same line as the RF Stage, a separate circuit being used for the later IF Stages.

Aerial input is taken via S1B to low-impedance taps on the input circuits L1-L4. D1 (BAX16 silicon diode) is wired directly across the input to provide some measure of protection for TR1 when using the receiver in close proximity to a high-power transmitter. The emitter of TR1 is fed via S1D and C10 from separate low-impedance windings on the input tuned circuits. All unselected main windings are shorted to ground by S1C which also connects the aerial section of the 4-gang tuning capacitor to the selected circuit. Separate trimming capacitors are provided for all circuits, those for Range 1 being directly across the tuning capacitor and therefore in circuit on all ranges.

Coupling to the Mixer Stage (TR2) is by a tuned bandpass circuit with low-impedance link coupling between primary and secondary. The collector of TR1 is matched to the primary by tapping down the appropriate coils (L5-L8), while separate coupling windings are provided on L10-L12 to match the base of the Mixer Stage. Unused circuits are shorted as on the input stage and the two sections of the tuning capacitor (C13 & C23) are switched from range to range by S1F and S1G.

Oscillator injection is to the emitter of TR2 via C45, regardless of the oscillator arrangements in use. A two-stage low-pass filter is included in the IF feed to T1 which has a low-impedance secondary for connection to the IF Pre-amplifier. Connection is to SK5, the primary of T1 being tuned to 10.7 MHz by the trimmer C30.

S2 provides a means of disabling the Mixer Stage to prevent noise and signal break-through when using SK10 as an IF input connection.

S1A switches a set of four indicator lamps (ILP1-4) to show which range is in use. The lamps are situated at the left-hand end of the appropriate range marking on the scale plate. All RANGE SWITCH wafers have five positions but are fitted with a mechanical stop to prevent selection of the fifth position.

Local Oscillator Circuits. (TR3-TR7)

Germanium epitaxial mesa transistors (GM290) are used for all stages except TR3 which employs a further AF239. TR3 & TR4 are located in the RF Tuner Unit.

TR3 is the normal Local Oscillator for continuous tuning and is tuned by the fourth section of the tuning gang (C40). Output voltage is developed across the earth return inductance from the tuned circuits which is marked "Z" on the circuit diagram. TR3 is functional with the SYSTEM SWITCH S3 at "NORMAL" and is disabled in the other positions by removal of the emitter supply voltage. Base voltage is retained at all times.

The remaining transistor located in the RF Tuner Unit is TR4. Its function is to facilitate connection to the normal oscillator tuned circuits (via the isolating resistor R17) from the alternative oscillator input at SK6. Operating conditions are such that TR4 will function as a frequency multiplier when required, multiplication by factors of two or three being possible with normal drive levels. Oscillator circuits L13-L16 offer some measure of protection against spurious drive signals especially when using the receiver with external synthesised drive.

TR4 is switched by interrupting the emitter supply at S3 when this is set to the "NORMAL" position. Base voltage is retained as on TR3.

The miniature socket SK6 located on the RF Tuner Unit is fed via PL3 which terminates a short coaxial lead from TR6 and TR7 in the separate Crystal Oscillator Unit. Both these transistors are used as emitter followers and serve to isolate the separate feeds from the internal crystal oscillator and the external oscillator drive source.

The Crystal Oscillator (TR5) employs a series-mode circuit with output taken from the collector via C56. Up to eight crystals can be fitted at any one time, separate tuned circuits being provided to permit accurate alignment of the oscillator circuit to suit the crystal in use. The tuned circuits are adjusted when installing the crystals and allow slight pulling of the crystal to bring the appropriate signal channel into the centre of the i.f. passband. All circuits are identical and have values to suit crystals in the basic range 37-88 MHz.

Actual crystal frequencies are calculated from (fs + 10.7), 1/2(fs + 10.7) or 1/3(fs + 10.7) MHz depending on the part of the overall range in which the selected signal frequency falls. Detailed information on calculation of crystal frequencies for specific signal channels will be found on page 22 in the Section on "Operation".

Oscillator drive from the Crystal Oscillator is applied to the base of TR6 which provides a low-impedance output to feed the alternative oscillator socket SK6 via PL3.

External oscillator drive is introduced to the Crystal Oscillator Unit via SK7 which is linked to a BNC socket at the rear of the set by a short length of coaxial cable terminating in PL4. Input level should be of the order 500mV, isolation being provided by the other emitter follower TR7 which feeds SK6 via PL3 and C60.

Switching of TR5, TR6 and TR7 is by S3C & S3D. Base and emitter supplies are removed from TR5 except when S3 is set to one of the eight "CRYSTAL" positions. Base voltage remains on the two emitter followers (TR6 & TR7) except at "NORMAL" when all supplies are removed from the Crystal Oscillator Unit. The emitter voltages for TR6 and TR7 are applied only in the appropriate positions, i.e. to TR6 at "CRYSTAL" and to TR7 at "EXT (OSC)".

Crystal Calibrator. (TR8 & TR9)

The crystal-controlled calibration oscillator (TR8 : GM378) and its associated Tone Oscillator/Modulator (TR9 : GET880) provide crystal check-points at 10 MHz intervals throughout the tuning range of the receiver. Injection is to the primary of the interstage coupling between RF Amplifier and Mixer by a small probe attached to SK4. This is fed from the Calibrator via a short length of coaxial cable terminating in PL5.

The Calibrator is brought into operation by means of S4 which completes the +10V supply via R37 to both TR8 & TR9. Correction for scale errors is carried out mechanically with an adjuster which provides limited lateral movement of the cursor independently of the TUNING CONTROL.

Calibration checks can be carried out in any position of the MODE SWITCH, greatest accuracy being obtained either at "CW" where the receiver can be tuned to zero-beat with the Beat Oscillator crystal, or at "FM" where the centre-zero tuning meter can be used to advantage. Checks should be made with the SELECTIVITY SWITCH at "NARROW".

THE IF SECTION

General.

The standard intermediate frequency of 10.7 MHz is employed in the IF Section which provides detection facilities for AM, FM, CW and video reception. Two IF bandwidths are available selected by a panel control.

Associated circuitry, including the AGC system, muting circuits and video amplifiers will be considered in this Section.

IF Pre-amplifier and Filter Unit. (TR10-TR14)

IF output from the Mixer Stage is fed via PL7 and a short length of coaxial cable to the base of the IF Pre-amplifier (TR10 : GM290) which is one of five transistors located in the IF Pre-amplifier/Filter Unit at the rear of the RF Tuner Unit. The four remaining transistors (TR11-TR14) are operated in the emitter follower configuration and serve as switches to select input and output of the two IF Filters. Only three of the five transistors in this unit will be functional at any time.

The IF Pre-amplifier utilises the common emitter configuration with its base tied to the RF Amplifier manual/auto gain control line via FC5. Signal output is taken via C77 and C83 to feed both the input switches in parallel from a tap on T2.

TR11 (GM290) and TR12 (GM378) switch the input and output respectively of the crystal filter used in the "NARROW" selectivity position. Overall bandwidth is 30 kHz at 6dB down. C78 and C79 allow accurate matching to the input and output of the crystal filter.

An L/C filter comprising T3, T4 and T5 is used in the other leg, input being switched by TR13 (GM290) and output by TR14 (GM378). Bandwidth on this channel is 200 kHz (SELECTIVITY SWITCH at "WIDE").

Selection of the appropriate input and output "switch" is by S5A and S5B, the former removing base and emitter voltage from the input switch on the inoperative channel, the latter removing base and emitter voltage from the output switch.

The +10V supply is also applied via S5B and R47 to D2 (OA47) in the "WIDE" position to damp the crystal filter and suppress minor distortion of the 200 kHz response which would otherwise occur due to stray coupling through TR12. C80 completes the diode circuit for i.f. voltages.

Provision is made in the form of SK10 for direct connection to the input of the IF Pre-amp (TR10) when it is desired to use the 10.7 MHz IF Stages to amplify an externally derived signal at this frequency. An external converter with IF O/P at 10.7 MHz could easily be connected at this point to extend the tuning coverage of the receiver proper. S2 allows the normal RF Tuner Unit to be shut down to prevent noise and signal breakthrough from the main channel.

SK10 can also be used to extract a low-level output at 10.7 MHz for connection to external ancillary equipment (panoramic display etc.). Bandwidth is of the order 1 MHz at the higher frequencies in the tuning range.

Main IF Board.

Output from the IF Pre-amp/Filter Unit is taken via a short coaxial cable to the large printed board which carries the greater part of the IF circuitry. Separate branches are provided for AM and FM, the AM branch also feeding a product detector for CW reception. This particular circuit is in a screened housing, as also are the two emitter followers TR18 and TR18A.

AM Stages and IF Output. (TR15-TR18)

Three stages of amplification are provided in the form of TR15 (GM378), TR16 (GM378) and TR17 (2S512), the latter being an n-p-n silicon epitaxial planar transistor.

TR15 and TR16 operate with manual or automatic gain control dependent on the setting of the MANUAL/AGC SWITCH S6. The control line is separate from that which feeds the RF and IF Pre-amp Stages; it is switched by S6B.

All three IF Stages operate in grounded-emitter mode, inter-stage coupling in each case being single-tuned circuits (T6 & T7) tapped to feed the base of the following stage. A tuned-secondary transformer (T8) is used to feed the AM/Video Detector D3 (OA47). This stage has a wide frequency response and its output is tapped down the diode load to increase the dynamic range of the following stage. R79/C119 form a normal IF filter feeding the "AM" position of the MODE SWITCH wafer S7B.

A tap on the secondary of T8 is used to drive the emitter follower TR18 (GM290) which provides a low-impedance 10.7 MHz output at SK11 (BNC socket). Output level is of the order 25mV across 75Ω for an aerial input of 10μV. Bandwidth is determined by the setting of the panel SELECTIVITY SWITCH being either 30 kHz or 200 kHz overall. The IF output is available continuously regardless of the MODE SWITCH setting.

CW Detector Unit. (TR23-TR25)

IF signal is taken from the collector of the final IF Amplifier (TR17) to feed the CW Detector via R76/C159.

The Detector proper comprises TR24 and TR25 (2 x GM378), signal at IF being applied to the base of TR25 and BFO voltage to the base of TR24. The Beat Oscillator (TR23 : GM378) is crystal controlled at 10.7 MHz and delivers output to the base of TR24 from its emitter via C157.

The collectors of the two detector transistors are linked together and work into a common load (R121) from which output is taken via the filter CH21/C160 and the output capacitor C161 to the "CW" position of S7B. The +10V supply is applied to all three transistors via R124 and CH22 by S7A when set to "CW". Extensive filtering and total screening of the complete unit prevent harmonics of the 10.7 MHz oscillator appearing in the tuning range of the receiver.

FM Channel. (TR18A, TR19 & TR20)

In addition to feeding the two final amplifiers on the "AM" path, TR15 also feeds TR18A which provides isolation for the FM Stages. TR18A is wired as an emitter follower and coupled to the FM Limiter Driver Stage (TR19 : GM290) by C123A and C125. The FM Limiter (TR20 : GM290) is fed from the previous stage through a double-tuned transformer (T9) with tapped secondary to match the base impedance. Both TR19 and TR20 employ common-emitter configuration.

The Discriminator uses a pair of OA79 diodes (D4/D5) in a conventional Foster-Seeley circuit, component values etc. being chosen to preserve the overall response. Output is taken via CH18 to the "FM" position of the MODE SWITCH wafer S7B. A further output is provided via R126 to drive the Noise Amplifiers in the carrier-controlled muting circuit. The +10V supply is permanently connected to the FM Stages.

Video Amplifier. (TR30 & TR31)

Audio/video output from the "AM", "CW" and "FM" positions of S7B is fed to the base of TR30 (GM378) which serves the dual purpose of audio amplifier and emitter follower to feed the main Video Amplifier. Audio output is fed via low-pass filter C176/CH27/C177 to the Audio Section which is described later (page 10).

Video response is maintained at the emitter of TR30 which is then direct-coupled to the base of TR31 (GM378). The low frequency response in this stage is effectively boosted by applying considerable high-frequency attenuation in the form of C178. Video output is developed across R149 and connected to SK12 (BNC socket) via a short coaxial lead.

The complete video circuit is on a separate printed board mounted at the rear of the set and is operative in all positions of the MODE SWITCH, drive being derived from the selected detector via S7B.

AGC Circuits and Manual RF/IF Gain Control. (TR21 & TR22)

Separate manual gain controls and AGC circuits are provided for the RF Stage (together with the IF Pre-amp) and the IF Stages. The desired mode of operation is selected by the MANUAL/AGC SWITCH (S6) which routes the base returns of the various stages to the appropriate parts of the circuit. "Forward" AGC is employed.

In the case of manual operation, the transistors are returned to the sliders of two potentiometers (RV1 and RV3) wired directly across the 10V supply. Both potentiometers are combined in one assembly with concentric controls. Gain is reduced when the sliders move towards the <u>negative</u> end of the tracks. Both manual gain controls are switched out of circuit and are totally inoperative when using AGC.

The AGC system comprises two separate AGC Rectifiers (D7 and D8) with associated DC Amplifiers TR21 and TR22 (2 x ASY29). The diodes, which are fed from the final IF Amplifier (TR17) via C144 and C145, drive the bases of the DC Amplifiers more positive on receipt of a signal, thus causing their collector currents to increase (n-p-n transistors). Initial no-signal collector currents are set by RV5 and RV6 to produce identical control voltages on the AGC line to those obtained with the manual controls at their maximum settings. Gain of the RF AGC Amplifier is controlled by RV2.

Some measure of delay is introduced on the RF AGC line by virtue of the zener diode D6 which holds the voltage constant at low signal levels. As the signal increases in strength, voltage developed across R97 becomes greater, the zener diode loses control and the line voltage then varies in sympathy with the signal. This refinement helps maintain optimum signal/noise performance by shutting down the IF Section in advance of the earlier stages.

Meter Circuit.

A sensitive centre-zero micro-ammeter is fitted for relative carrier level measurement and is also usable as a tuning indicator. Scaling is in arbitrary divisions 0-10.

The meter operates from the IF AGC line at "CW" or "AM" and from the output of the Discriminator at "FM", switching being achieved automatically with change of mode (S7C and S7D). Series resistors (R108 and R125) prevent loading of the associated circuits and arrange the meter sensitivity to suit the available voltage. At "CW" and "AM", the meter is returned via S7D to a pre-set METER ZERO CONTROL (RV4) which allows the meter needle to be biased electrically to a normal left-hand zero against the standing "no-signal" potential across R106. In these two modes, the meter presentation is logarithmic with the MANUAL/AGC SWITCH at "AGC" and linear (up to the threshold of overload) with the switch in the "MANUAL" position. Normal centre-zero operation is employed in the "FM" mode, the meter being returned directly to earth through S7D.

Muting Circuit. (TR26-TR29)

Noise voltages at the output of the FM Discriminator (in the absence of a signal) are passed via a high-pass filter to the two-stage Noise Amplifier comprising TR26 and TR27 (2 x GET880). Circuit constants are chosen to give maximum amplification at frequencies above the speech and music range. RV7 provides a means of setting the gain of TR26/TR27, while TH1 ensures sensibly consistent performance with changes in ambient temperature.

The second of the two Noise Amplifiers feeds a voltage-doubler Noise Rectifier (D9/D10 : 2 x OA202) via a (vinkor) transformer tuned to approximately 27 kHz by C170. The output load of this stage (R135) is in series with the base return of TR28 (2N3704) which is the input stage of a Schmitt Trigger.

With the MUTING SWITCH (S8) in the "ON" position, all transistors in the muting circuit are operative and a negative voltage is produced across R135 in the absence of a received signal (i.e. under noise conditions). This puts TR28 in the "off" condition and so causes TR29 (2N3704) to conduct heavily due to the reduced voltage drop in R140. The relay RLA/2 is energised and audio output to both line and speaker cut by contacts A1 and A2 (See "Audio Section" below).

On receipt of a signal, noise voltages are removed from TR26/27, the voltage across R135 falls rapidly to zero and TR29 is tripped into the "off" condition by the increase in current through R140. RLA/2 falls out, restoring audio output and also opening the circuit across the MUTE INDICATOR terminals at the rear of the set.

THE AUDIO SECTION

General.

Audio from TR30 on the Video Board is routed to two separate gain controls (RV8 : AUDIO GAIN and RV9 : LINE LEVEL) which feed the two independent audio channels. Both amplifiers are usable simultaneously in any mode of operation and provide separate outputs for local and remote use.

Relay contacts A1 and A2 are arranged to mute both channels in the absence of a signal when the muting facility is being used. A1 short-circuits the 600Ω line output, while A2 open-circuits all local monitor outputs and closes the circuit between the two MUTE INDICATOR terminals. A remote lamp can be controlled by this circuit to indicate that the receiver is operational but in the muted condition. A separate lamp supply is required.

Low-level Audio Channel. (TR32 & TR33)

TR32 (GET880) and TR33 (OC72) form a low-level audio amplifier for connection to 600Ω line circuits. Gain adjustment is by RV9 which is a pre-set control; maximum output is limited to 10mW. The output transformer (T12) has a centre-tapped secondary and is electrostatically screened from the primary winding. Output can be arranged to suit balanced or unbalanced lines.

High-level Audio Channel. (TR34-TR38)

This amplifier employs a total of five transistors (TR34-TR38) and provides output for an external loudspeaker, an internal low-level monitor speaker and low-impedance telephones (headset). The monitor speaker can be switched off by S9 and the external speaker by insertion of the telephone plug at JK1.

The high-level audio stages operate from a +12V supply line.

POWER SUPPLY

General.

This part of the receiver is of conventional design and allows operation from any standard AC supply or 12V DC.

AC Operation.

In the case of AC working, a full-wave selenium low-voltage bridge rectifier is fed from the low-voltage secondary winding (14V) on T14. Tappings are provided on the split primary windings to allow adjustment for the local mains voltage. Zener diode D13 (OAZ230) regulates the output from the rectifier at 12V to feed the high-level audio stages, the muting circuits, and the 10V zenor diode.

DC Operation.

For DC working, the shorting plug (PL8) is removed from SK13 to isolate the 12V zener diode and the AC transformer. Connection of the external 12V supply is then by PL9, the 10V line being regulated in the normal manner by the OAZ228.

Fusing and Protection.

FS1 fuses the negative 12V supply line and is wired to be in circuit for both DC and AC operation. On AC, an additional fuse (FS2) is included in the live line to the power transformer primary. Switching is by S10A and S10B which interrupt both the AC and DC circuits in the "off" position. S10 is ganged to the MODE SWITCH S7.

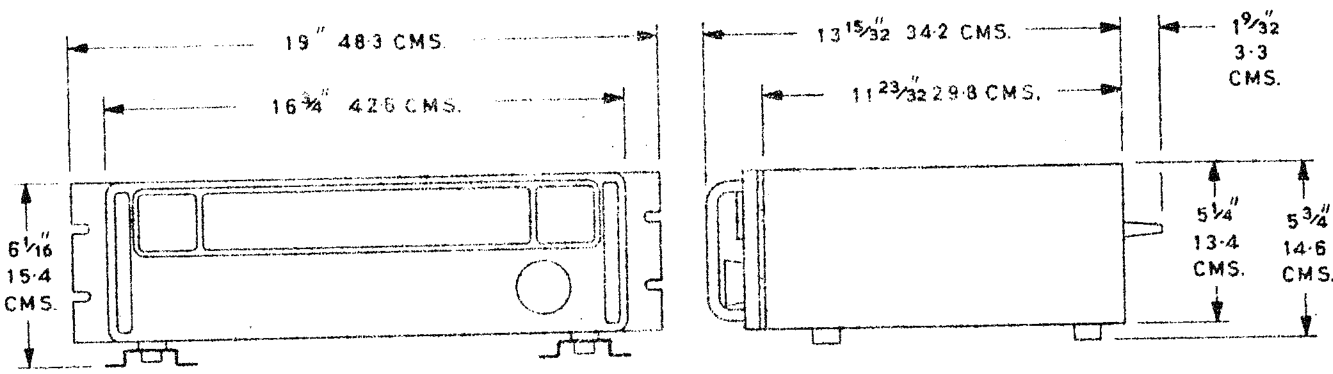
A silicon diode (D12 : DD006) is wired directly across the 12V input and serves as a protection device in the event of the supply being connected with reversed polarity. If this occurs, D12 conducts in a forward direction and draws a current which exceeds the rating of FS1. The fuse fails and isolates the receiver from the supply.

MECHANICAL CONSTRUCTION

General.

The 990R Receiver in its standard form is suitable for bench-mounting only. Rubber feet are fitted to raise the controls into a convenient operating position. Receivers are available for rack-mounting and are designated Model 990R/RM. Dimensions and fixing are arranged to suit standard 19-inch Post Office racking. Conversion kits can be supplied to allow conversion of standard receivers already in service. A shock-absorbent mounting is available if required.

Dimensions.



Weight.

Bench-mounting version	..	..	..	19½ lb. (8.8 kg.)
Rack-mounting version	..	..	..	20 lb. (9 kg.)

Internal Layout.

Printed wiring techniques are employed throughout with the exception of the Power Supply Unit which is built on a small metal sub-chassis located at the rear of the set adjacent to the IF Pre-amp./ Filter Unit in the rear right-hand corner. The various printed boards employed are as follows:-

1. RF TUNER UNIT (TR1-TR4). One main board plus four small boards carrying the coils and trimmers for the various stages.
2. CRYSTAL OSCILLATOR UNIT (TR5-TR7). One main board plus one small board carrying the coils and trimmers in the Crystal Oscillator Stage. The crystal holders are mounted on the main board and are accessible after removing the rear cover.
3. CRYSTAL CALIBRATOR UNIT (TR8 & TR9). Mounted on top of RF Tuner Unit.
4. IF PRE-AMP./FILTER UNIT (TR10-TR14). Access is through a removable cover in the right-hand side-plate.
5. MAIN IF BOARD (TR15-TR29). The two Emitter Follower Units (TR18 & TR18A) and the CW Detector/BFO Unit (TR23-TR25) are in separate screened assemblies and are mounted directly onto the main board.
6. VIDEO AMPLIFIER (TR30 & TR31).
7. LOW-LEVEL AUDIO AMPLIFIER (TR32 & TR33).
8. HIGH-LEVEL AUDIO AMPLIFIER (TR34-TR38).

(Items 6–8: Separate boards located at rear of receiver.)

Panel.

The front panel is a light-weight aluminium casting and contributes great mechanical strength to the receiver as a whole. Chromium-plated handles are fitted for convenience in handling the receiver and these also allow it to be placed "face-down" without damage to the panel controls when removing the cabinet.

Cabinet.

This is fabricated from light-gauge sheet steel and affords adequate protection for the receiver regardless of the manner in which it is mounted. Fixing points are provided in the form of hank bushes for attachment of rack-mounting brackets, rubber feet and shock-absorbent mountings.

Dial and Drive Assembly.

The tuning control drives a spring-loaded split-gear system having a reduction ratio of approximately 100:1. The drive is flywheel-loaded, substantially free from backlash and ensures a consistently high degree of re-setting accuracy when use is made of the logging scales provided. Tuning scales are over nine-inches long and are calibrated directly in frequency. A cursor adjuster allows correction for scale errors.

External Wiring.

All external wiring (with the exception of the telephone output) is taken to terminals and sockets at the rear of the set. The telephone output is brought out on the front panel and accepts a standard Post Office jack plug.

I N S T A L L A T I O N

GENERAL

Accessories.

All receivers are supplied complete with five standard BNC coaxial connectors, a 12V DC supply connector (ready-wired with shorting strap as per PL8 on circuit diagram) and a mains connector with six-feet of three-core PVC lead. Spare fuses (1A and 500mA) are retained in clips on the right-hand side-plate.

The following accessories and associated equipment are available for use with the 990R receiver:-

1. Rack-mounting conversion kit. (Comprises two rack-mounting brackets : 7093P and four 2BA x $\frac{3}{8}$" fixing screws : 40A - 246)
2. Set of four rubber mounting feet : 7132P. (For use when converting Model 990R/RM to bench-mounting)
3. Shock-absorbent mounting : LP2817. (Complete assembly for attachment to either version of the receiver)
4. Cabinet loudspeaker : Cat. No. 935.
5. Plinth loudspeaker unit : Cat. No. 906.
6. IF Converter Type 959 (959/1 for rack installation).
7. Panoramic Display Unit Model EP17R (EP17R/RM for rack installation).
8. Low-impedance telephones : Cat. No. LP2924.

Orders and enquiries relating to accessories for the 990R receiver should be sent to the "Sales & Service Dept." at our usual address.

Converting a standard 990R receiver to rack-mounting.

This is a simple operation taking only a few minutes to complete. A screwdriver is the only tool required.

1. Remove rubber mounting feet and store (with screws) for possible future use.
2. Attach rack-mounting brackets to leading edges of cabinet using the four screws supplied with the kit.

Fitting shock-absorbent mountings to the 990R receiver.

1. Place the receiver upside down and remove the rubber mounting feet. Store for possible future use.
2. Take the large neoprene washers and place these over the fixing holes in the underside of the cabinet (stepped face uppermost).
3. Lower the channel-shaped mounting brackets onto the washers, keeping the fixing flange towards the outside of the receiver and at the same time making sure that the step on the washers locates with the holes in the brackets.
4. Place the smaller neoprene washers on the inside of the channel and pass the 2BA screws with brass washers through both neoprene washers.
5. Locate screws in hank-bushes in cabinet and tighten.
6. Fix channel mounting brackets to bench top with suitable screws. Take care to bond the brackets to the bench top if this is of metal construction.

Panoramic Display Installation Type EPR30.

The 990R receiver can be supplied as a panoramic display installation which comprises the following items and is designated Model EPR30 (EPR30/RM rack-mounting).

1. 990R receiver (990R/RM).
2. EP17R Panoramic Display Unit (or EP17R/RM).
3. 959 IF Converter (or 959/1). (10.7 MHz in, 5.2 MHz out).
4. Loudspeaker Unit (bench-mounted version only).
5. Pair of tie-bars for bench-mounted installation.
6. Associated cabling and connectors.

Assembly of EPR30 Panoramic Display Installation.

1. Invert receiver and remove the four rubber feet (if fitted). Attach loudspeaker unit to underside of receiver using the four screws provided. Do not use the screws which previously held the rubber feet.
2. Connect the loudspeaker lead to the 3Ω terminals at the rear of the receiver.
3. Place receiver in a face-down position and remove the four cabinet retaining screws. Fit the two tie-bars to the receiver, omitting at this stage the top retaining screw on the left-hand bar (adjacent to aerial input socket). Fit spacing washer on the bottom left-hand screw. Set receiver down resting on its plinth speaker unit.
4. Remove the four cabinet retaining screws from the EP17R Display Unit and place it on top of the receiver. Re-fit three of the screws through the tie-bars (spacing washer on top left-hand screw). Omit screw in lower left-hand corner.
5. Slacken the two screws in the left-hand tie-bar and slide the 959 IF Converter mounting bracket between the tie-bar and the rear of the main units so that the two holes in the bracket coincide with the two centre fixing holes in the bar. Fit the two screws omitted in operations (3) and (4) above. Tighten all screws securely.
6. Connect the receiver IF Output socket to the Input socket on the 959 Converter and the IF Output socket on the IF Converter to the Input socket on the Display Unit, using the leads provided. Plug the 959 IF Converter supply connector into the 12V supply socket on the receiver after removing the existing shorting plug.
7. Make all other external connections as for normal receiver installation as described later in this Section.

Assembly of EPR30/RM Panoramic Display Installation.

1. Remove rubber feet from receiver and display unit (if fitted).
2. Mount receiver and display unit in rack with receiver in lower position.
3. Attach IF Converter Type 959/1 to rear of equipment. Refer to sheet supplied.
4. Make connections as per paras (6) and (7) for bench-mounted installation.

NB Use IF OUTPUT (1) for wide-band presentation.

MAINS VOLTAGE ADJUSTMENT

The voltage tappings on the primary side of the power transformer must be checked and changed if necessary before connecting the receiver to the supply. Tapping points are located below chassis at the rear of the set and are accessible after removing the cabinet. The transformer has two separate 130V primaries tapped as follows:-

	10V (1)	0V (2)	100V (3)	120V (4)
Rear of set	o	o	o	o
←	o	o	o	o
	10V (6)	0V (7)	100V (8)	120V (9)

DISCONNECT FROM SUPPLY BEFORE ADJUSTING TAPS.

For voltages in the range 200/260V, operate appropriate sections of secondaries in series; for voltages in the range 100/130V, operate equal sections of the primaries in parallel. Tappings (3) or (4) should be linked to (6) or (7) for series working.

The receiver leaves the factory with tappings set for 240V operation.

EXTERNAL CONNECTIONS

Mains Operation.

A suitable polarised connector and three-core mains lead are supplied with the set. The lead is colour-coded as follows:- RED : LIVE, BLACK : NEUTRAL, GREEN : EARTH. One end of the lead is left free so that the user can fit a plug of a type suitable for connection to the local supply.

When operating from AC mains, it is important to check that a shorting plug is in position at the 12V DC supply socket. Its purpose is to complete the 12V regulated positive line to the appropriate receiver circuits. The plug should be wired as PL8 on the circuit diagram at the rear of the Manual.

12V DC Operation. (NEGATIVE EARTH ONLY)

If an extended period of operation from 12V DC is envisaged, the existing shorting plug (which is used in mains operation to complete the 12V supply line) can be re-wired as shown at PL9 on the circuit diagram. On the other hand, where 12V working is for emergency operation in the event of mains failure, an additional plug should be obtained to facilitate rapid changeover. The plug is a three-way polarised female connector Bulgin Type No. P430.

Ancillary Supply.

The 12V DC supply at SK13 is available for connection to external units when the receiver is operating from AC mains supplies. Maximum available current drain is 35mA.

Note that the negative lead from the external unit must be connected to the earth terminal and not to SK13, otherwise FS1 and S10A will be short-circuited if an earth return exists between the receiver and the ancillary unit.

Aerial.

The receiver is designed for use with aerials closely matched to 75Ω and a suitable BNC connector is supplied to mate with the coaxial aerial socket at the rear of the set. Low-loss semi-air-spaced feeder cable should be employed especially when operating at frequencies towards the upper limit of the frequency coverage.

Selection of the best aerial for use with the receiver will depend largely on the application for which it is to be used and must of necessity be left to the user since many diverse types are available for use in the frequency band concerned. Reference should be made to one of the many handbooks dealing specifically with VHF antenna design.

IF Input and Low-level Output (1).

BNC termination. Facilitates connection of external converter to extend coverage of the built-in tuner unit (Input frequency 10.7 MHz). All control facilities function as for normal operation with the exception of the TUNING, RANGE SWITCH and SYSTEM SWITCH. A small toggle switch at the rear of the set allows the built-in tuner to be shut down to prevent signal and noise breakthrough when using the receiver in this manner.

The same socket can also be used to extract a low-level signal at 10.7 MHz with greater bandwidth than is available at the main IF Output socket. Bandwidth is of the order 1 MHz at the higher frequencies in the tuning range and it may well be found advantageous to drive the associated panoramic display unit from this output in certain applications. Adequate drive is available for this purpose.

IF Output (2).

BNC termination. Provides output at 10.7 MHz for use with panoramic display or other ancillary units. Output is of the order 50mV and bandwidth is determined by the setting of the panel SELECTIVITY SWITCH (either 30 or 200 kHz).

Video Output.

BNC termination. Suitable for external loads of the order 1000Ω. External lead lengths should be kept to a minimum to preserve the high-frequency response which extends to 100 kHz with external loading of 250pF. A small DC potential of the order 5.5V is present at this output.

External Oscillator Input.

BNC termination. Permits connection of external oscillator drive to the Mixer Stage for high-stability working. Basic drive frequency range required is 37.7-250.7 MHz but the built-in frequency multiplier allows for multiplication by factors of two or three, so reducing the upper limit to less than 85 MHz. Drive requirement from a low-impedance source is of the order 500mV. The normal oscillator tuning circuits remain operative and discriminate against spurious drive signals in this mode of operation.

External Loudspeaker.

Two terminals are provided for connection of an external loudspeaker. The output is marked "3Ω" and suitable speakers are available in the Eddystone range. Full details are available on request.

Telephones.

The telephone output is suitable for use with low-impedance type headsets. Circuit arrangements provide for muting of the external loudspeaker on insertion of the telephone plug. The internal speaker can be cut by means of a panel switch.

Line Output.

This output is marked "600Ω" and provides a maximum of 10mW for connection to remote lines. The centre-tap (CT) can be left floating or alternatively earthed to provide a balanced output. The secondary winding is electrostatically screened from the primary.

It should be noted that this output is short-circuited (in absence of signal) by a pair of relay contacts when the muting facility is in use. Consideration should therefore be given to inclusion of a suitable pad to isolate this output when making direct connection to Post Office lines.

Mute Indicator.

One pair of contacts on the muting relay is arranged so that the circuit across the "MUTE INDICATOR" terminals will be closed when the receiver is running in the muted condition. The circuit will open (1) on receipt of a signal, (2) if the muting is switched to "off", or (3) if the receiver supply is removed.

A lamp (with external supply) can therefore be installed to indicate to a distant monitoring position that the remote receiver is operational but muted. The lamp will extinguish on receipt of a signal.

If additional signalling facilities are required, it is a simple matter to replace the lamp with a relay and use the contacts on this to control other indicators. For example, a SPDT relay could be arranged to illuminate a lamp when the circuit is quiet and to operate a call buzzer when the channel is in use.

The internal relay contact is wired such that one of the two terminals is permanently earthed and the other becomes earthed in the absence of a signal (with the MUTING SWITCH in the "ON" position).

Earth Terminal.

Bond to frame of rack when receiver is installed as a rack-mounted equipment.

OPERATION

CONTROL FUNCTIONS

Tuning.

This control is conveniently located at the right-hand side of the receiver and operates the ganged tuning capacitors in the RF Tuner Unit through a precision gear drive having a reduction ratio of the order 100:1.

Logging scales are provided on the skirt of the control knob and at the foot of the main tuning dial. Calibration on the latter runs from 0-5000 with index marks at 100-division intervals. The control knob makes one complete revolution per 100-divisions of the main scale and is marked 0-100 to permit interpolation between the main scale markings. All scaling is arbitrary and unlike the frequency scales shows an increase in reading with movement of the cursor from left to right. Tuning rate varies between 3MHz/rev. and 0.5MHz/rev. at the centres of Range 1 and Range 4 respectively.

Range Switch.

The RANGE SWITCH is situated immediately to the left of the TUNING CONTROL and must be pushed towards the panel to engage with the gear drive to the switch selector proper. The panel control is thus isolated from the remainder of the mechanism, a simple precaution which virtually eliminates any possibility of random frequency change caused by shocks inadvertently transmitted to the Tuner Unit via the switch mechanism.

Range indication is provided by a lamp display at the left-hand end of the scale plate. Clockwise rotation of the RANGE SWITCH selects a higher frequency range.

System Switch.

Selection of the desired mode of local oscillator control is handled by the SYSTEM SWITCH. Three modes of operation are possible, viz:-

1. Manual tuning using the tunable receiver oscillator ("normal" mode marked "N").
2. Fixed freq. working using the crystal controlled receiver oscillator (posns 1-8).
3. Operation with external oscillator drive for high-stability applications where flexibility in frequency adjustment is of prime importance (marked "EXT").

Note that when using modes (2) and (3) above, it is necessary to adjust the TUNING CONTROL and RANGE SWITCH to ensure that the signal frequency circuits are aligned to the correct channel. The built-in meter can be used as an aid to accurate tuning.

Mode Switch.

This control combines supply switching (on both AC and DC operation) with selection of the desired signal mode. The four positions are marked:-

"SUPPLY OFF" - "CW" - "AM" - "FM"

The supply is completed to the receiver by moving to the "CW" position and remains connected in the other two positions. Illumination of one of the range indicator lamps will show that the supply is "on".

Mode selection is accomplished by switching the audio outputs of the separate circuit branches. The supply is disconnected from the CW Detector except at "CW".

Meter switching is a further associated function performed by the MODE SWITCH. The meter is arranged to operate with centre-zero for "FM" and normal left-hand zero for "CW" and "AM" reception. A pre-set zero adjustment is provided for the two latter modes.

Selectivity Switch.

Provides "WIDE" (200 kHz) or "NARROW" (30 kHz - standard) bandwidths to suit reception mode and signal characteristics. Switching is accomplished "electronically", the panel switch merely completing power supply circuits to the appropriate switching stages. A crystal filter is used for the "NARROW" selectivity position.

NB Alternative filters can be fitted to order in the "NARROW" position only.

RF and IF Gains.

These two controls are combined in one assembly comprising two wirewound potentiometers with concentric spindle drives. The smaller control knob (with red index) is the RF GAIN. Both controls are taken out of circuit and are totally inoperative with the MANUAL/AGC SWITCH at "AGC".

AF Gain Control.

Controls the level of audio at the high-level outputs feeding telephones, internal speaker and external speaker. Adjustment of this control does not significantly affect output at the low-level line termination.

600Ω Line Level.

Provides independent adjustment of audio level at the 600Ω line output. The control is preset and is located at the rear of the receiver. Interaction between this control and the AF GAIN on the high-level channel is negligible. External line-monitoring facilities should be provided to permit accurate adjustment of this control. Maximum output is limited to 10mW.

Manual/AGC Switch.

Provides for manual or automatic control of gain in the RF and IF Stages of the receiver. The manual RF and IF controls are totally inoperative when the switch is set to "AGC". AGC will be found of greatest value during general search tuning or when monitoring a channel occupied by stations spread over a wide area, when considerable variation in strength is likely. In most other circumstances, and especially when receiving FM signals, manual control will usually be found quite satisfactory. It should be noted that the tuning meter remains operative in both positions of this switch, scaling being logarithmic at "AGC" and linear voltage at "MANUAL".

Muting Switch.

Placing the MUTING SWITCH to "ON" introduces a carrier-controlled muting circuit to suppress noise output in the absence of a received signal. This facility is primarily intended for use when the receiver is employed in a communications role and leads to considerable reduction in operator fatigue on long listening watches. All outputs are muted simultaneously and a relay circuit is available for local or remote signalling. (Refer to further information on page 21.)

Muting Gain.

This is a pre-set control at the rear of the receiver and provides a means of adjusting the muting threshold to suit the level of noise present in the absence of a signal. The control should be re-adjusted whenever the operating frequency is changed. Circuit design is such that consistent relay operation is maintained over a wide range of ambient temperature. Refer to "TUNING INSTRUCTIONS" for setting-up procedure.

Monitor Speaker Switch.

Enables the built-in monitor speaker to be cut out when not required. The external loudspeaker is not affected by operation of this control but is disconnected automatically on insertion of the telephone plug. The internal speaker and telephones can be used simultaneously if required.

Calibrator Switch.

Introduces the crystal calibrator to permit checking accuracy of the frequency scales. Modulated markers are available at 10 MHz intervals throughout the entire tuning range. Normal receiver performance and facilities are retained when the calibrator is in use.

Calibration Re-set Adjuster.

This is a mechanical adjuster which allows limited lateral movement of the cursor independently of the TUNING CONTROL. Provides a means of compensating for errors when checking the frequency scales against the crystal calibrator harmonics.

IF Input Switch.

Located at the rear of the receiver. Enables the normal front-end converter to be closed down when using the IF Input facility. This switch must be in the "UP" position for normal operation.

Meter Zero Control.

This control is operative only in the "AM" and "CW" modes. Its function is to set the meter needle to coincide with the "0" mark on the arbitrary 0-10 scale provided for comparison of carrier level. Adjustment should be made under "no-signal" conditions with the MANUAL/AGC SWITCH at "AGC".

In the "FM" mode, the meter needle rests at centre-scale and serves only as a tuning indicator, deflection from centre being a measure of the degree of off-tuning. Correct tuning on FM signals is obtained when the needle lies on the red line at the centre of the scale. Off-tuning in either direction will cause the needle to swing away from centre, returning to centre when the signal lies outside the IF passband. The needle will swing to left or right dependent on the direction of off-tuning. Deflection will be less when switched to "NARROW" selectivity.

TUNING INSTRUCTIONS

Normal Operation. (Continuous coverage)

1. Check that all necessary external connections have been made in accordance with the Section dealing with "Installation". Check that a suitable aerial system is in use and that the local AC or DC supply is available. Ensure that the IF INPUT SWITCH is in its normal position (i.e. dolly "up").
2. Switch on the receiver by moving the MODE SWITCH to "CW", "AM" or "FM" as required. An indication that the supply is completed to the receiver is given by illumination of one of the four indicator lamps at the left-hand end of the tuning scales. It should be noted that it is perfectly normal for the meter needle to swing from its normal mid-scale position towards the left-hand zero whenever "CW" or "AM" is selected. It will revert to centre-scale at "FM".
3. Check whether the meter is zero'd correctly ("AM"/"CW") and if necessary adjust the pre-set METER ZERO CONTROL at the rear of the set. The needle should lie at "0" under "no-signal" conditions with the MANUAL/AGC SWITCH at "AGC".

4. Set SYSTEM SWITCH to "N" ("Normal") for operation with internal tunable oscillator.

5. Select the appropriate range, remembering to press the RANGE SWITCH to engage the selector mechanism. Carry out a calibration check by following the procedure outlined below:-

   (a) Set controls as follows:-

MODE SWITCH	..	"FM".	RF GAIN	..	Maximum.
SELECTIVITY	..	"NARROW".	IF GAIN	..	Maximum.
MANUAL/AGC	..	"MANUAL".	AF GAIN	..	For convenient output.
MUTING	..	"OFF".			

   (b) Move CALIBRATOR SWITCH to "ON" and tune to the calibration marker at the nearest crystal check-point to the required frequency. (Check-points are available at 10 MHz intervals on all ranges - i.e. 30 & 40 MHz on Range 4; 50, 60 & 70 MHz on Range 3 etc.)

   (c) Adjust TUNING CONTROL carefully for centre-zero meter reading (see page 20) and then set CALIBRATOR SWITCH to "OFF".

   (d) Maintain present setting of TUNING CONTROL and adjust CAL RE-SET CONTROL to re-position the cursor coincident with the check-point calibration mark.

   (e) Tune to required frequency.

6. Select appropriate MODE and set bandwidth to "WIDE" or "NARROW" as required.

7. Set MANUAL/AGC SWITCH to suit signal conditions and then re-adjust all GAIN CONTROLS for required audio output (RF/IF GAINS are inoperative at "AGC").

8. Introduce muting facility if required (see below).

<u>Operation with Muting</u>.

The internal muting circuits can be used to advantage when the receiver forms part of a communications set-up. In this type of operation, the considerable reduction in operator fatigue which results from elimination of inter-station noise is a worthwhile feature of which advantage should be taken whenever possible.

The muting system is brought into operation by putting the panel MUTING SWITCH to the "ON" position and is set to suit prevailing conditions by adjustment of the pre-set MUTING GAIN CONTROL at the rear of the receiver.

The circuit is effectively a carrier-controlled system in which the receiver is silenced with a relay which is operated by a DC voltage derived from amplified noise present in the absence of a signal. The MUTING GAIN CONTROL sets the gain of the noise amplifying stages which can be adjusted to suit the level of noise prevailing on the particular frequency in use. Adjustment should be carried out as follows:-

1. With the MUTING SWITCH at "OFF" and the MUTING GAIN CONTROL fully anti-clockwise tune to the required signal and adjust all controls for optimum reception.

2. Off-tune slightly to a clear channel adjacent to the signal frequency in (1) and put the MUTING SWITCH to "ON".

3. Advance the MUTING GAIN CONTROL in a clockwise direction, stopping at the setting where the receiver becomes silenced.

4. Re-tune to the required signal frequency and ascertain that receiver un-mutes satisfactorily in the presence of a carrier.

5. Check muting performance when station ceases transmission. Receiver should silence immediately with no tendency to hang before closing. Re-adjust MUTING GAIN CONTROL if necessary.

Certain precautions must be observed when using the internal muting facility. Tuning adjustments for example should not be carried out without recourse to the built-in tuning meter, (greatest accuracy being achieved with this in the "FM" position). Accurate tuning ensures that the signal is correctly centred in the IF passband and so offers maximum protection against loss of signal due to possible drift either at the receiver or transmitter. Use of the "WIDE" selectivity position will prove advantageous in this direction if adjacent channel interference presents no problems.

Care must be taken not to change to an alternative aerial without first checking that the initial setting of the MUTING GAIN CONTROL still provides satisfactory results. Likewise, the settings of the RF and IF GAINS should not be disturbed when using "MANUAL" control, since any change in gain in this portion of the receiver will directly affect the level of noise throughout the set. The AF GAIN and LINE LEVEL controls however, can be adjusted as required with no effect on muting performance. It may be found best therefore to operate with AGC in use, even though there is no real need to do so. This obviates any possibility of inadvertent adjustment of the manual controls causing loss of signal since these are of course inoperative with the MANUAL/AGC SWITCH at "AGC".

Any large change in operating frequency should be accompanied by re-adjustment of the MUTING GAIN CONTROL to ensure reliable operation of the muting circuit. A compromise setting can usually be found such that the receiver can be tuned over the greater part of any one range with satisfactory un-muting on signals of 5μV upwards. Care should be exercised to tune slowly, making full use of the "WIDE" selectivity position as a further aid to ease of station selection. Variation in noise level from range to range is such that different settings of the MUTING GAIN CONTROL will be required on adjacent ranges. This should present little problem since it is doubtful whether the muting facility would be required in this mode of operation, its greatest value being in spot-frequency working.

Receivers fitted with non-standard filters in the "NARROW" position may suffer some degradation in muting performance. Operation will be normal in the "WIDE" position.

Crystal Controlled Working.

1. Calculate the frequency of the crystal(s) required by following the basic rules outlined below. Crystals should be Style "D" (International Style "AA") 3rd or 5th overtone (series resonance).

   (a) Crystal frequencies must fall in the range 37.7-88.0 MHz to suit the circuit constants in the crystal oscillator circuit.

   (b) The oscillator injection frequency must fall 10.7 MHz higher than the required signal frequency. Operation with the oscillator "low" is not possible.

   (c) Fundamental or harmonic operation (multiplication by factors of 2 or 3) is possible without any change in internal circuit configuration.

   (d) Signal frequencies in the band 27.0-77.3 MHz can be controlled by fundamental frequency crystals. Crystal frequency is calculated by applying the formula:-

$$f_{xtal} = f_{sig} + 10.7 \text{ MHz.}$$

   (e) Signal frequencies in the band 64.7-165.3 MHz can be controlled by fundamental crystals operating at half the required injection frequency. Frequencies in the band 102.4-240.0 MHz can be controlled by fundamental crystals operating at one third the required injection frequency. Calculate as follows:-

$$f_{xtal} = \frac{f_{sig} + 10.7}{2} \text{ MHz} \qquad f_{xtal} = \frac{f_{sig} + 10.7}{3} \text{ MHz}$$

2. Install the crystal(s) in the socket(s) situated within the Crystal Oscillator Unit which is located centrally behind the front panel. Access is by removal of the rear cover which reveals the eight crystal holders. Crystal positions are marked on the outside of the cover plate, the numbering being the same as that concentric with the panel control (1-8). Make a note of the signal frequency obtaining in each crystal position used and record this information on a small card to be kept with the receiver. Ensure that the rear cover plate is replaced securely after fitting the crystal(s).

3. Tune the pre-set crystal oscillator circuits by following the procedure outlined below:-

   (a) Connect a multi-range testmeter between the OSCILLATOR TEST POINT (FC1 :: near top of Unit at right-hand side viewed from front) and earth (negative). Set to 10V range. Reading should be of the order 8.5V.

   (b) Select each crystal position in turn and adjust the appropriate core or trimmer (see below) for a dip in meter reading. This should be of the order 1V to 1.5V with normal crystal activity. Access to trimming and core adjustments is by removal of the bottom cover from the Crystal Oscillator housing. Numbering is repeated to correspond with the crystal/panel marking.

   (c) The eight crystal oscillator tuning circuits are all identical and are arranged to cover the whole 37.7-88.0 MHz band when full use is made of both trimmer and core. There is thus no restriction on the combination of crystal/signal frequencies employed.

   When using crystals in the lower part of the range, trimming should be by means of the core (L17-L24) with the appropriate trimmer set to maximum capacity. On the higher frequencies, set the core well out and tune with the trimmer (C47-C54). Slight jockeying between trimmer and core is quite permissible and intermediate settings of the trimmer should be used at middle frequencies in the range.

   NB TRIMMERS ARE AT MAXIMUM CAPACITY WHEN THE VISIBLE SILVERED PORTION ON TOP OF THE TRIMMER IS TOWARDS THE FRONT PANEL.

   (d) Check that crystal fires readily by subjecting the receiver to several on/off switching cycles whilst observing the multi-range meter.

4. Operationally, the receiver is tuned in the normal manner but with the SYSTEM SWITCH set to the appropriate "CRYSTAL" position (1-8). The RANGE SWITCH and TUNING must be set to align the signal frequency and oscillator circuits correctly, the latter being arranged to tune the output of the frequency multiplier stage. It may be noted that crystal frequencies can be pulled slightly by careful adjustment of the appropriate crystal oscillator circuits. Advantage can be taken of this when using a receiver with non-standard filter in the "NARROW" position of selectivity. Adjust under signal conditions using built-in meter at "FM" for best accuracy.

Operation with External Oscillator.

This mode of operation is available for those occasions when high-stability working is required but with greater flexibility in frequency selection than obtains when using the internal crystal oscillator. Any synthesiser with low-impedance output capable of supplying some 500mV of drive can be used. A low-impedance isolated input with BNC socket is provided at the rear of the receiver ("EXT OSC INPUT"). The drive frequency must at all times lie 10.7 MHz higher than the required signal frequency.

External drive is therefore required throughout the band 37.7-257.7 MHz for reception of all signal frequencies 27-240 MHz. This assumes that harmonic operation using the internal frequency multiplication facility is not feasible, perhaps because of the increased spacing between the discrete synthesiser output channels which would result. If this problem does not arise, the upper frequency requirement is reduced to 83.56 MHz since multiplication by factors of 2 or 3 is available. Calculation of the required drive frequency is carried out in the same manner as when working out crystal frequencies for internal crystal control.

When using the receiver with external frequency control, the SYSTEM SWITCH must be set to "EXT", the TUNING and RANGE SWITCH being operated as for crystal control.

Operation with EP17R Panoramic Display Unit.

Reference should be made to the Manual supplied with the Display Unit for instructions on initial adjustment etc. (see page 9 onwards). On page 11, ignore all references to the 770R (Mk.II) VHF Receiver and read instead the notes on the EPR25 Installation since these are applicable also to the EPR30 (990R + EP17R), except that the calibrator has a fundamental of 10 MHz.

It should be noted that in reading page 12 of the EP17R Manual, the lowest display frequency when using the 990R Receiver with an EP17R, occurs at the left-hand end of the trace. This is due to there being two frequency inversions, one in the receiver itself and the other in the IF Converter which provides the 5.2 MHz output to drive the Display Unit.

Interpolation can be carried out as described for the 770R Receiver provided that an external 1 MHz harmonic generator is available.

Output from the receiver to the IF Converter can be taken either from the low-level output in the collector of the Mixer Stage or from the high-level output via the emitter follower TR18. The available bandwidth is greater at the low-level output since this is taken ahead of the 10.7 MHz filters. A width of approximately 1 MHz is available at the higher frequencies in the tuning range. The setting of the panel SELECTIVITY SWITCH determines the bandwidth available at the high-level output.

MAINTENANCE

GENERAL

The 990R receiver is suitable for continuous use under arduous operating conditions and should require very little in the way of routine maintenance over quite long periods of operation. All components with the exception of the semiconductors are guaranteed by the Manufacturer for a period of one year from date of purchase. The semiconductors are covered by a separate guarantee.

As with all Eddystone receivers, the 990R can be returned to the Manufacturer at any time should major servicing become necessary. The receiver can be sent direct or via one of the many Eddystone Agents, the latter course often being the most convenient since the Agent will usually have a suitable packing case in which to return it. If there is no local Eddystone Agent and it is necessary to send direct, prior arrangements should be made before despatch. It is most important that the receiver is well protected against damage during transit and the reader is referred to the Guarantee Card for further information on this point. Always quote the Serial No. of the set in all communications.

Spares for user-servicing can be supplied and helpful advice will be freely given when necessary. Any enquiries relating to service matters should be directed to the "Sales and Service Dept." at our usual address.

The following paragraphs are devoted to minor servicing and will be found useful if it becomes necessary to replace fuses, lamps etc. Periodic cleaning of the receiver should be carried out as a matter of course, care being taken to avoid displacing any components when cleaning the interior. Full instructions for carrying out re-alignment will be found later in this Section.

Lubrication.

The gear drive and other mechanical arrangements will not normally require attention since these are treated with a permanent lubricant during initial assembly. If further lubrication is thought necessary after the receiver has been in use for a prolonged period, this can be carried out with a light mineral oil suited to the temperature conditions under which the equipment is operating. Care should be taken to use only the smallest amount of oil necessary for free and easy movement.

Replacing a faulty fuse.

Separate AC and DC fuses are provided for protection of the 990R receiver. Ratings are 1A : DC and 500mA : AC 200/260V (increased to 1A for 100/130V), the fuses being standard $1\frac{1}{4}$" x $\frac{1}{4}$" cartridge types. Circuit arrangements are such that either fuse could fail when operating from AC mains, whereas on DC only one fuse (FS1) is in circuit. In the latter case the fuse also protects the receiver in the event of the 12V supply being connected with reversed polarity. The fuseholders are at the rear and spare fuses in clips on the right-hand side-plate.

Range Indicator Lamps.

These can be changed quite easily after removal of the cabinet. Bulbs are L.E.S. type rated at 6V 50mA (Eddystone Part No. 6659P). Holders are retained in rubber grommets and can be extracted by pulling gently away from the lamp assembly.

Cleaning the scale window.

After a long period of use, especially in dusty locations, it may prove necessary to clean the inside of the scale window. To do this, take off the window escutcheon by removing the four retaining screws. The window, which is of perspex, can now be withdrawn and should be cleaned with a suitable polish containing anti-static additive.

Drive cord replacement.

In the unlikely event of the pointer drive cord breaking, replacement can easily be effected by following the instructions given below. A new cord can be obtained from Eddystone Radio Ltd. by quoting the Part No. D3631. The cord supplied is of the exact length required and is complete with end termination.

NB: Left-hand and right-hand in the instructions which follow apply when the receiver is viewed from the rear.

1. Remove the faulty drive cord.
2. Set CAL RE-SET ADJUSTER to mid-travel position.
3. Rotate TUNING CONTROL to full extreme of anti-clockwise rotation.
4. Take the knotted end of the replacement cord and slide this into the slot on the left-hand drive pulley so that the knot is trapped against the inner wall.
5. Pass the free end of the cord under the sprung jockey pulley, up and over the left-hand guide pulley and then across the scale plate towards the right-hand guide pulley. Do not attach to cursor at this stage.
6. Hold the cord in tension and rotate the TUNING CONTROL to the full extreme of its clockwise rotation so that five complete turns of cord are wound onto the left-hand drive pulley.
7. Maintain tension to prevent cord slipping and then pass the free end over the right hand guide pulley, down and under the cursor shift pulley and then across towards the right-hand drive pulley.
8. Attach the cord to the right-hand drive pulley by sliding into slot so that the eyelet is trapped against the inner wall.
9. Lift the lower run of cord so that it lies over the two inner guide pulleys which prevent it fouling the controls below.
10. Check drive for free running by rotating TUNING CONTROL to full extreme of anti-clockwise rotation.
11. Leave control at this setting, slide cursor to "O" on logging scale and attach to cord by means of three hooks on rear of carrier.
12. Check cursor for free running and CAL RE-SET ADJUSTER for normal operation. Verify scale accuracy by checking against the built-in crystal calibrator.

RE-ALIGNMENT

General.

Initial factory alignment of the receiver will hold good for a long period of time and re-alignment should only be attempted if there is a clear indication that such adjustment is in fact required. Adjustments should be made only by experienced technicians with a sound knowledge of the procedures involved and an adequate range of reliable test equipment must be available if the task is to be completed correctly.

Comprehensive instructions covering all phases of the alignment procedure are given here for the sake of completeness but in most cases it will only be found necessary to make minor adjustments to compensate for normal component ageing or replacement. The relevant instructions can be extracted as required.

All dust cores are self-locking (rubber string and silicone core-retaining compound) so that there is no need to use wax etc. after adjustment. Trimming capacitors likewise are also self-locking.

Re-alignment of the AM IF Channel.

Test Equipment — Standard Signal Generator covering 10.7 MHz with provision for amplitude modulation (30%, 400 Hz) and an output impedance of 50Ω.

Power Output Meter matched to 3Ω impedance.

Miniature insulated screwdriver type trimming tool.

Connect generator output lead to base of TR15 via the IF attenuator (R57-R59). The connection should be made in parallel with the coaxial lead to tags 1 and 2, the live generator lead being blocked with a capacitor of the order 0.001µF (tag 1 is earth).

Connect the output meter to the 3Ω terminals at the rear of the set and ensure that the external loudspeaker is disconnected. Use the internal speaker for aural monitoring whilst carrying out alignment. Set the receiver controls as follows:-

MODE SWITCH	"CW" (initial setting).
MANUAL/AGC SWITCH	"MANUAL".
RF GAIN CONTROL	Minimum.
IF GAIN CONTROL	Maximum.
AF GAIN CONTROL	Maximum.
MUTING SWITCH	"OFF".
MONITOR SPEAKER SWITCH	"ON".
IF INPUT SWITCH	"ON" (dolly down).

First tune the signal generator to 10.7 MHz by zero-beating against the crystal-controlled beat oscillator (receiver running in "CW" mode and generator modulation switched off). Setting accuracy will be within 1 kHz, so permitting accurate adjustment even in the case of a non-standard receiver fitted with a narrower crystal filter than that normally used.

Apply modulation (30%, 400 Hz) to generator, set receiver MODE SWITCH to "AM" and adjust the attenuator for a reading of approximately 50mW on the output meter. Peak the single cores in T6, T7 and T8 for maximum output, tuning in each case to the upper peak. Repeat these adjustments and then set the attenuator for a precise reading of 50mW output (external speaker disconnected). Sensitivity should be of the order 180µV. If sensitivity should appear to be low, introduce the generator at the bases of TR16 and TR17 in turn, with 0.001µF blocking as before. Check input required for 50mW output using the following figures as a guide. Allow for some variation above or below the figures quoted to cover transistor spread etc.

Generator applied at base of TR16	600µV for 50mW output.
Generator applied at base of TR17	3.6mV for 50mW output.

If sensitivity is low from TR17, check audio sensitivity on the high-level channel with a 1000 Hz signal applied across the AF GAIN CONTROL. With this control at maximum setting, an input of 1.7mV should produce an output of 500mW in 3Ω.

Re-alignment of the FM IF Channel.

Test Equipment — As for alignment of the AM IF Channel.

Connect generator and output meter as for alignment of the AM Channel; tune to 10.7 MHz by reference to receiver beat oscillator.

Locate D5 (at front left-hand side of main IF board) and short with a temporary wire strap soldered to the underside of the printed board. This allows the standard AM generator to be used for alignment. The built-in tuning meter should be ignored during the early part of the alignment procedure.

Set all controls as previously with the exception of the MODE SWITCH which should be placed at "FM". Set the top core of T10 (Discriminator) flush with the top of the can. Peak lower core in T10 and both cores in T9 for maximum reading on output meter (all cores tuned on "outer" peak).

Re-adjust attenuator for precise output reading of 100mW and note sensitivity. A figure of the order 10μV should be obtained. Stage by stage sensitivities can be measured if the overall FM sensitivity appears to be low. Typical figures are as follows:-

Generator applied at base of TR18A	50μV for 100mW output.
Generator applied at base of TR19	80μV for 100mW output.
Generator applied at base of TR20	1mV for 100mW output.

All readings taken with generator applied directly at base with series capacitor of 0.001μF in live lead.

Remove short from D5 and adjust top core of T10 to bring the needle on the built-in tuning meter to centre-scale coincident with the red indicating line. Off-tune generator by equal amounts each way from centre-frequency and ensure that meter deflections are symmetrical.

<u>Re-alignment of the IF Filters.</u>

Either filter can be aligned quite satisfactorily using the conventional signal generator and output meter technique. Crystal filter alignment however, may prove somewhat tedious by this method and use of a wobbulator is preferred if a suitable instrument is available.

Control settings for alignment of the two filters should be as for alignment of the main IF Stages, accurate centering of the generator within the passband being achieved as before by comparison with the crystal-controlled beat oscillator on 10.7 MHz. It is quite immaterial in which order the two filters are aligned.

<u>Wide IF Filter.</u>

Signal input at 10.7 MHz is applied via the IF INPUT socket, the output meter being connected to the 3Ω output as before. Access for trimming adjustment is by removal of the small cover at the rear end of the right-hand side-plate. The cores nearest to the printed board are not accessible from this side but can be adjusted through suitably positioned apertures in the inner wall of the unit (above the Filtercons).

Put the SELECTIVITY SWITCH at "WIDE" and adjust the six cores in T3, T4 and T5 for maximum reading on the output meter (all cores trimmed on "outer" peak at 10.7 MHz). It is convenient at this time to adjust also the single-tuned transformer T2 which feeds the two Filter Switches TR11 and TR13. T2 is housed in the small screening can adjacent to T3/T5 and is accessible through the side-plate.

<u>NB</u> The first 10.7 MHz circuit (T1) is adjusted later when carrying out RF alignment.

On completion of these adjustments, de-tune the generator to either side of the centre-frequency, checking the response for overall symmetry down to some 50dB. The overall bandwidth at the 6dB points should be 200 kHz.

<u>Narrow IF Filter.</u>

Change SELECTIVITY SWITCH to "NARROW" position, tune generator very slowly across passband and observe output meter carefully, noting degree of ripple. In a correctly aligned filter, ripple will not exceed 2dB and is typically 1.5dB in an average set. Ripple proportions with a maladjusted filter will rise to some 6-8dB and would therefore be very noticeable even when tuning across a normal signal.

Care must be taken not to use too high a level of input signal when checking the nose response since overload effects will tend to round off the individual peaks to present an incorrect picture of the actual shape. It is essential that a generator with slow tuning rate or preferably a separate incremental tuning control be used in this application.

Two trimming adjustments are provided for correcting the filter response, these merely adjusting the input and output terminations to provide a correct match to the filter proper. Both trimmers are accessible with the side cover removed from the right hand side-plate.

Greatest variation within the pass band will be effected by adjustment of the output (shunt) trimmer C79. The input (series) trimmer C78 produces only minor changes in the nose shape but affects very considerably the amplitude of the response and to a minor degree the skirt symmetry. In practice, C78 should be set for greatest amplitude, adjustment being quite broad and therefore permitting further minor adjustment to assist C79 in levelling out the nose response. The setting of C79 is quite critical and adjustment must be performed carefully with frequent examination of the whole nose shape. Correct skirt response with extremely rapid fall-off below about 10dB will normally be achieved automatically when the troughs in the nose response are reduced to minimum proportions.

If a sweep generator is available, this will reduce considerably the time taken to correctly align the "NARROW" filter. The swept signal should be introduced at the IF INPUT socket. Drive to the "Y" Amplifier can be taken from the AM Detector load or via the high-level IF OUTPUT using an external probe for detection of the IF signal. As with a normal generator, signal input should be kept at a fairly low level to prevent distortion of the c.r.t. display. Scanning should preferably not exceed some 10 sweeps per second with a sweep width of the order 40-50 kHz. Reduced sweep width should be used when the receiver is fitted with a narrower non-standard filter.

Overall IF sensitivity should be checked on completion of filter alignment (signal applied to IF INPUT socket, receiver mode at "AM"). Results should approximate to those given below:-

SELECTIVITY "WIDE"	. .	. .	11μV for 50mW output.
SELECTIVITY "NARROW"	. .	. .	9μV for 50mW output.

Standardisation of the Crystal Calibrator.

It is convenient at this stage in the alignment procedure to check the accuracy of the internal crystal calibrator so that it can be used in the next phase of alignment for checking the overall scale accuracy. Set the IF INPUT SWITCH to "OFF" (upper position) before proceeding.

Any close-tolerance frequency sub-standard providing 10 MHz markers from 30 MHz up can be employed to standardise the internal crystal. Connect the external standard at the aerial input and tune the receiver to the selected 10 MHz point. Select "FM" mode and adjust TUNING CONTROL very carefully for centre-reading on the tuning meter with SELECTIVITY at "NARROW". Maintain TUNING CONTROL at this setting.

Switch off the external standard and put receiver CALIBRATOR SWITCH to "ON". Adjust L25 through aperture in top of calibrator housing to bring meter needle to mid-scale position. Some care is necessary in adjusting L25 to ensure positive firing of the crystal and consistent operation of the calibrator circuit. Several on/off switching cycles should therefore be carried out whilst observing the tuning meter with receiver switched to "AM". Meter indication should be constant each time the calibrator is turned on. Frequency stability can also be checked with repeated switching, by using the "FM" mode with receiver slightly off-tuned. Constant off-centre deflection should be achieved with calibrator on.

RF Alignment. (1. Local Oscillator)

Test Equipment — Standard Signal Generator covering the range 27-240MHz with crystal scale checking facilities, provision for amplitude modulation (30%, 400Hz) and an output impedance of 75Ω.

Power Output Meter matched to 3Ω impedance.

Small insulated trimming tool with metal tip.

The overall calibration accuracy should first be checked to determine whether re-alignment of the local oscillator circuits is in fact necessary. The internal 10 MHz calibrator can be used for this purpose provided it is first standardised as described on the previous page. Control settings should be as tabulated on page 27 but with the RF GAIN at maximum, the MODE SWITCH at "FM", the IF INPUT "OFF" and the CAL RE-SET ADJUSTER at mid-travel. This latter adjustment can be made quite easily by observing cursor shift against one of the scale calibration markings.

Commence by selecting Range 1, tuning across the whole range, noting errors at each check-point without altering initial setting of CAL RE-SET. Repeat same procedure on each of the other ranges. If the error at the mid-scale marker points on Ranges 3 and 4 is greater than that at the low-frequency check-points, use an external standard to permit checking at 75 and 45 MHz respectively. Specified calibration accuracy without use of the internal calibrator and with CAL RE-SET at mid-travel is within 1% on all ranges. Re-alignment need not be attempted if errors are within this limit, i.e. 2.4 MHz at 240 MHz, 300 kHz at 30 MHz. If re-alignment of any range should be found necessary, proceed as detailed below.

Remove the top cover from the RF Tuner Unit by taking out the four screws near the corners. The cover can be removed with the Calibrator Unit in-situ provided that its supply lead and output coax are disengaged at their respective sockets. All trimming adjustments are from the top with the exception of the Range 1 trimmers (tube type). These are accessible from below without the need for removal of the underside cover.

If inspection has revealed excessive errors on Range 1, then this range must be re-aligned prior to any of the other ranges because the Range 1 trimmers are in circuit at all positions of the RANGE SWITCH. Further, for the same reason, if re-alignment of Range 1 is necessary, then re-alignment of all other trimmers (but not necessarily cores) will be required.

Normal alignment procedures apply, i.e. adjust trimmers at HF end of range and cores at LF end. Repeat adjustments several times until interaction between trimmer and core is nullified. No special procedures are required but allowance must be made for the slight de-tuning effect produced by the cover when this is replaced. A suitable dummy cover provided with alignment apertures to facilitate adjustment can be fabricated locally if desired. Alignment frequencies and relevant adjustments are listed in the Table below. Ensure that the generator frequency scale is standardised at each point.

Range	Trimmer		Core	
	Freq.	Ref.	Freq.	Ref.
1	240 MHz	C41	130 MHz	L13
2	128 MHz	C42	75 MHz	L14
3	76 MHz	C43	45 MHz	L15
4	46 MHz	C44	27 MHz	L16

The pre-set trimmer C38 (accessible through trimming aperture in underside cover of RF Unit) is adjusted during initial factory alignment to provide correct feedback phase for the transistor fitted at TR3. It is most unlikely that further adjustment of this trimmer would be required except in the event of TR3 being changed. An indication that C38 requires adjustment is that the oscillator will cease to function at certain parts of the total coverage. In general, re-adjustment to produce sustained oscillation on one range will result in correct performance on all four ranges. Nevertheless, check for correct operation at all frequencies before proceeding with alignment of the oscillator circuits.

On completion of the oscillator alignment, re-check the overall accuracy on all ranges before proceeding with re-alignment of the signal frequency circuits. The normal top cover should be replaced to permit use of the internal calibrator for this test.

RF Alignment. (2. Signal-frequency circuits)

Test Equipment As for alignment of the Local Oscillator.

As with alignment of the oscillator, alignment of the signal frequency circuits must commence at Range 1. The other ranges can be re-aligned in any order.

The generator must be accurately matched to 75Ω and is connected directly to the aerial input socket using a 75Ω BNC connector. The output meter should be fed from the 3Ω terminals as before. Alignment frequencies and adjustments are listed in the Tables which follow, trimming following normal procedures with no requirement for special techniques. Adjustments should be repeated as necessary. Control settings used in previous phases of alignment should be retained with the RF/IF GAINS at maximum and the IF INPUT SWITCH in the normal "up" position.

Range	Freq.	Aerial	Bandpass	
			Primary	Secondary
1	240 MHz	C6	C14	C24
2	127 MHz	C2	C15	C20
3	75 MHz	C3	C16	C21
4	45 MHz	C4	C17	C22
1	130 MHz	L1	L5	L9
2	75 MHz	L2	L6	L10
3	45 MHz	L3	L7	L11
4	27 MHz	L4	L8	L12

On completion of signal frequency alignment, tune the receiver carefully to a 27 MHz signal from the generator and then adjust C30 (accessible below RF Unit). This trimmer aligns the first 10.7 MHz (IF) circuit and cannot be conveniently aligned during normal IF alignment due to difficulty of access to a suitable generator input connection. Alignment of C30 on the 27 MHz signal after conversion to 10.7 MHz in TR2 is quite satisfactory.

Overall sensitivity and noise factor should now be checked at several points on each of the four ranges. Noise factor should be better than 10dB and sensitivity better than 5μV for 10dB s/n ratio (AM mode, NARROW selectivity, 30% modulation at 400 Hz and standard 50mW output at 3Ω outlet).

Adjustment of the AGC Level Controls.

The two pre-set AGC LEVEL CONTROLS (RF AGC - RV5 & IF AGC - RV6) are located on the left-hand side-plate and should be set as follows:-

1. Set the RF & IF GAIN CONTROLS to maximum.
2. Set the MANUAL/AGC SWITCH to the "MANUAL" position.
3. Connect multi-range voltmeter negative lead to earth.
4. Connect multi-range voltmeter positive lead to centre tag of S6B. Note reading.
5. Set MANUAL/AGC SWITCH to "AGC". Adjust RV6 to obtain reading equal to that in (4) above.
6. Transfer multi-range meter to centre tag of S6A. Switch back to "MANUAL" and note reading.
7. Revert to "AGC" and adjust RV5 for identical reading.
8. Re-adjust RV5 slightly to ensure that the control voltage is just within the stabilisation range of the zener diode D6 which provides the RF AGC delay.
9. Check AGC characteristic at 190 MHz on Range 1 and ensure that performance is equal to or better than 10dB change in output for 80dB change in input (taken from reference level of 10µV).

If performance is not to specification, adjustment of the RF AGC AMPLIFIER GAIN RV2 will be necessary though in most cases alteration of the initial factory setting of this control is most unlikely.

RV2 is located on the main IF board and should be adjusted by small increments, checking after each adjustment what effect is produced on the overall AGC performance. Further adjustment of RV5 may be found necessary if major re-adjustment of RV2 is called for.

Low-level (600Ω) Audio Sensitivity.

With 1000 Hz signal applied across LINE LEVEL CONTROL (set to maximum), an input of 1.75mV should produce an output of 1mW in 600Ω.

APPENDIX "A"

VOLTAGE ANALYSIS

The following "Table of Voltage Values" will prove useful in the event of the receiver developing a fault which makes it necessary to carry out voltage checks. All readings are typical and were taken with a meter having a sensitivity of 20,000Ω/V. A nominal tolerance of 10% will apply to readings taken with a meter of this sensitivity and the tolerance should be increased accordingly if a meter of lower sensitivity is employed. Readings are quoted on the basis of an applied AC mains supply of 240V under no-signal conditions with the controls set as follows:-

RANGE SWITCH	Range 1.
TUNING	220 MHz.
SYSTEM SWITCH	N (Normal - manual tuning).
RF/IF GAINS	Maximum.
AF GAIN	Maximum.
LINE LEVEL	Maximum.
MODE SWITCH	AM.
METER ZERO	Set to zero meter.
MANUAL/AGC SWITCH	MANUAL.
IF INPUT SWITCH	OFF ("up" position).
CALIBRATOR SWITCH	ON.

Ref	Emitter	Base	Collector	Notes
TR1	7.4V	6.8V	2.2V	
TR2	9.55V	9.1V	0.03V	
TR3	8.7V	8.3V	0V	NOTE 1.
TR4	6.5V	6.9V	0.5V	NOTE 2.
TR5	9.6V	9.1V	0V	NOTE 3.
TR6	9.4V	8.8V	0V	NOTE 3.
TR7	9.3V	8.75V	0V	NOTE 2.
TR8	8.0V	3.3V	0V	NOTE 4.
TR9	8.75V	8.6V	0.07V	NOTE 4.
TR10	7.3V	6.8V	2.55V	
TR11	8.8V	8.5V	0V	NOTE 5.
TR12	8.9V	8.5V	0V	NOTE 5.
TR13	8.9V	8.5V	0V	NOTE 6.
TR14	8.2V	7.7V	0V	NOTE 6.
TR15	6.65V	6.1V	2.7V	
TR16	6.7V	6.1V	3.2V	
TR17	2.1V	2.75V	9.05V	
TR18	9.2V	8.9V	2.7V	NOTE 7.
TR18A	9.2V	8.9V	2.7V	NOTE 7.

Ref	Emitter	Base	Collector	Notes
TR19	7.85V	7.5V	0.23V	
TR20	7.7V	7.35V	0.55V	
TR21	0.55V	0.65V	7.0V	
TR22	0.4V	0.5V	6.8V	
TR23	8.1V	8.0V	4.95V	NOTE 8.
TR24	8.7V	8.75V	4.5V	NOTE 8.
TR25	8.1V	8.8V	4.7V	NOTE 8.
TR26	9.9V	9.4V	0.5V	NOTE 9.
TR27	9.0V	10.5V	.02V	NOTE 9.
TR28	0.05V	0.65V	0.09V	NOTE 10.
TR29	0.05V	0.09V	12.8V	NOTE 10.
TR30	7.75V	7.4V	5.5V	
TR31	8.0V	7.75V	5.6V	
TR32	9.25V	9.0V	4.2V	
TR33	9.25V	9.1V	1.0V	
TR34	10.7V	10.3V	5.0V	
TR35	6.3V	6.25V	12.4V	
TR36	12.6V	12.3V	6.1V	
TR37	6.4V	5.9V	12.4V	
TR38	5.5V	5.7V	0V	

NOTE 1. SYSTEM SWITCH to "N" (NORMAL).
NOTE 2. SYSTEM SWITCH to "EXT" (No drive applied).
NOTE 3. SYSTEM SWITCH to "CRYSTAL" (Crystal fitted and tuned).
NOTE 4. CALIBRATOR SWITCH to "ON".
NOTE 5. SELECTIVITY SWITCH to "NARROW".
NOTE 6. SELECTIVITY SWITCH to "WIDE".
NOTE 7. Accessible after removal of screening cans. Base voltage on both TR18 and TR18A can be measured on underside of printed board without need for taking off the screens.
NOTE 8. MODE SWITCH to "CW".
NOTE 9. MUTING SWITCH to "ON", MUTING GAIN fully clockwise and RF/IF GAINS at minimum settings.
NOTE 10. As (9) above but with MUTING GAIN fully anti-clockwise.

Supply Voltages.

Voltages measured across the two zener diodes should lie within the following limits:-

D11 :: 9.4 - 10.6 volts.

D13 :: 11.4 - 12.6 volts.

APPENDIX "B"

LIST OF COMPONENT VALUES, TOLERANCES AND RATINGS

Location.

In the Tables which follow, each component is allocated a reference letter which gives an indication of its approximate location. Coding is as follows:-

A RF Tuner Unit.
B Crystal Oscillator Unit.
C Calibrator Unit.
D IF Pre-amplifier/Filter Unit.
E* IF Board.
F Emitter Followers.
G BFO Unit (CW Det).
H 600Ω Audio Board.
I 3Ω Audio Board.
J Video Board.
K Panel Assembly.
L Power Unit.
M Back Plate.
N Side Plates.
O Selectivity Platform.

*Components housed in screening cans are marked E-

Capacitors.

Ref	Value	Type	Tolerance	Wkg. V.	Loc
C1	2pF	Tubular Ceramic	0.25pF	750V	A
C2	2.5-6pF	Ceramic Trimmer	-	-	A
C3	2.5-6pF	Ceramic Trimmer	-	-	A
C4	2.5-6pF	Ceramic Trimmer	-	-	A
C5	5-32pF	Air-spaced Variable	-	-	A
C6	1-6pF	Ceramic Tube Trimmer	-	-	A
C7	0.001μF	Disc Ceramic	20%	500V	A
C8	0.047μF	Polyester	20%	250V	A
C9	0.001μF	Disc Ceramic	20%	500V	A
C10	0.001μF	Disc Ceramic	20%	500V	A
C11	0.001μF	Disc Ceramic	20%	500V	A
C12	0.001μF	Disc Ceramic (leadless)	+50% -20%	500V	A
C13	5-32pF	Air-spaced Variable	-	-	A
C14	1-6pF	Ceramic Tube Trimmer	-	-	A
C15	2.5-6pF	Ceramic Trimmer	-	-	A
C16	2.5-6pF	Ceramic Trimmer	-	-	A
C17	2.5-6pF	Ceramic Trimmer	-	-	A
C18	0.001μF	Ceramic Stand-off (Tub.)	+80% -20%	500V	A
C19	2 pF	Tubular Ceramic	0.25pF	750V	A
C20	2.5-6pF	Ceramic Trimmer	-	-	A
C21	2.5-6pF	Ceramic Trimmer	-	-	A
C22	2.5-6pF	Ceramic Trimmer	-	-	A
C23	5-32pF	Air-spaced Variable	-	-	A
C24	1-6pF	Ceramic Tube Trimmer	-	-	A
C25	0.001μF	Disc Ceramic	20%	500V	A
C26	0.001μF	Disc Ceramic	20%	500V	A
C27	3pF	Tubular Ceramic	0.25pF	750V	A
C28	3pF	Tubular Ceramic	0.25pF	750V	A
C29	12pF	Tubular Ceramic	10%	750V	A
C26a	0.001μF	Tubular Ceramic	20%	750V	A

Ref	Value	Type	Tolerance	Wkg. V.	Loc
C30	4.5-20pF	Ceramic Trimmer	-	-	A
C31	0.001µF	Disc Ceramic	20%	500V	A
C32	0.001µF	Disc Ceramic	20%	500V	A
C33	0.001µF	Disc Ceramic	20%	500V	A
C34	0.001µF	Disc Ceramic	20%	500V	A
C35	0.01µF	Tubular Ceramic	20%	750V	A
C36	0.001µF	Disc Ceramic	20%	500V	A
C37	0.001µF	Disc Ceramic	20%	500V	A
C38	7-35pF	Ceramic Trimmer	-	-	A
C39	3pF	Tubular Ceramic	0.25pF	750V	A
C33a	0.047µF	Plate Ceramic	20%	30V	N
C40	5-32pF	Air-spaced Variable	-	-	A
C41	1-6pF	Ceramic Tube Trimmer	-	-	A
C42	2.5-6pF	Ceramic Trimmer	-	-	A
C43	2.5-6pF	Ceramic Trimmer	-	-	A
C44	2.5-6pF	Ceramic Trimmer	-	-	A
C45	0.001µF	Disc Ceramic	20%	500V	A
C46	0.001µF	Disc Ceramic	20%	500V	B
C47	10-60pF	Ceramic Trimmer	-	-	B
C48	10-60pF	Ceramic Trimmer	-	-	B
C49	10-60pF	Ceramic Trimmer	-	-	B
C50	10-60pF	Ceramic Trimmer	-	-	B
C51	10-60pF	Ceramic Trimmer	-	-	B
C52	10-60pF	Ceramic Trimmer	-	-	B
C53	10-60pF	Ceramic Trimmer	-	-	B
C54	10-60pF	Ceramic Trimmer	-	-	B
C55	0.001µF	Disc Ceramic	20%	500V	B
C56	0.001µF	Disc Ceramic	20%	500V	B
C57	0.001µF	Disc Ceramic	20%	500V	B
C58	0.001µF	Disc Ceramic	20%	500V	B
C59	0.001µF	Disc Ceramic	20%	500V	B
C60	0.001µF	Disc Ceramic	20%	500V	B
C61	0.001µF	Disc Ceramic	20%	500V	B
C62	0.001µF	Disc Ceramic	20%	500V	B
C63	0.001µF	Disc Ceramic	20%	500V	B
C64	25pF	Tubular Ceramic	10%	750V	C
C65	0.047µF	Plate Ceramic	+80% -20%	30V	C
C66	600pF	Polystyrene	5%	125V	C-
C67	390pF	Polystyrene	5%	125V	C-
C68	10µF	Tubular Electrolytic	+50% -10%	16V	C
C69	0.001µF	Disc Ceramic	20%	500V	C
C66a	22pF	Tubular Ceramic	5%	200V	C
C70	0.047µF	Polyester	20%	250V	C
C71	0.047µF	Polyester	20%	250V	C
C72	500uF	Tubular Electrolytic	+100% -20%	25V	O
C73	0.001µF	Disc Ceramic	20%	500V	D
C74	0.047µF	Plate Ceramic	+80% -20%	30V	D
C75	0.047µF	Plate Ceramic	+80% -20%	30V	D
C76	180pF	Silvered Mica	5%	350V	D-
C77	0.001µF	Disc Ceramic	20%	500V	D-
C78	7-35pF	Ceramic Trimmer	-	-	D
C79	7-35pF	Ceramic Trimmer	-	-	D

Ref	Value	Type	Tolerance	Wkg. V.	Loc
C80	0.0015μF	Tubular Ceramic	+50% -25%	750V	D
C81	22pF	Tubular Ceramic	5%	200V	D
C81A	0.047μF	Plate Ceramic	+80% -20%	30V	D
C82	180pF	Silvered Mica	5%	350V	D
C82A	0.047μF	Plate Ceramic	+80% -20%	30V	D
C83	0.001μF	Disc Ceramic	20%	500V	D
C84	0.047μF	Plate Ceramic	+80% -20%	30V	D
C85	180pF	Silvered Mica	5%	350V	D-
C86	6.2pF	Tubular Ceramic	5%	200V	D-
C87	180pF	Silvered Mica	5%	350V	D-
C88	6pF	Tubular Ceramic	10%	750V	D
C89	180pF	Silvered Mica	5%	350V	D-
C90	3pF	Tubular Ceramic	5%	200V	D-
C91	180pF	Silvered Mica	5%	350V	D-
C92	6pF	Tubular Ceramic	10%	750V	D
C93	180pF	Silvered Mica	5%	350V	D-
C94	1.5pF	Disc Ceramic	0.5pF	500V	D-
C95	180pF	Silvered Mica	5%	350V	D-
C96	0.047μF	Plate Ceramic	+80% -20%	30V	D
C97	0.001μF	Disc Ceramic	20%	500V	D
C98	0.047μF	Plate Ceramic	+80% -20%	30V	E
C99	10μF	Tubular Electrolytic	+50% -10%	16V	E
C100	0.047μF	Plate Ceramic	+80% -20%	30V	E
C101	0.047μF	Plate Ceramic	+80% -20%	30V	E
C102	0.047μF	Plate Ceramic	+80% -20%	30V	E
C103	180pF	Silvered Mica	5%	350V	E-
C104	0.001μF	Disc Ceramic	20%	500V	E
C105	0.001μF	Disc Ceramic	20%	500V	E-
C106	0.047μF	Plate Ceramic	+80% -20%	30V	E
C107	0.047μF	Plate Ceramic	+80% -20%	30V	E
C108	0.047μF	Plate Ceramic	+80% -20%	30V	E
C109	0.047μF	Plate Ceramic	+80% -20%	30V	E
C110	180pF	Silvered Mica	5%	350V	E-
C111	0.047μF	Plate Ceramic	+80% -20%	30V	E
C112	22pF	Tubular Ceramic	5%	200V	E-
C113	0.047μF	Plate Ceramic	+80% -20%	30V	E
C114	0.047μF	Plate Ceramic	+80% -20%	30V	E
C115	0.001μF	Disc Ceramic	20%	500V	E
C116	0.001μF	Tubular Ceramic	10%	750V	E
C117	250pF	Silvered Mica	5%	350V	E-
C118	100pF	Tubular Ceramic	10%	750V	E
C119	35pF	Tubular Ceramic	10%	750V	E
C121a	6pF	" " "	"	"	F
C120	3pF	Tubular Ceramic	0.25pF	750V	E
C121	0.047μF	Plate Ceramic	+80% -20%	30V	E
C122&A	0.001μF	Disc Ceramic	20%	500V	F
C123&A	0.001μF	Disc Ceramic	20%	500V	F
C124	0.047μF	Plate Ceramic	+80% -20%	30V	E
C125	0.001μF	Disc Ceramic	20%	500V	E
C126	0.047μF	Plate Ceramic	+80% -20%	30V	E
C127	180pF	Silvered Mica	5%	350V	E-
C128	0.047μF	Plate Ceramic	+80% -20%	30V	E
C129	180pF	Silvered Mica	5%	350V	E-
C124a	6pF	Tubular Ceramic	10%	750V	F

Ref	Value	Type	Tolerance	Wkg. V.	Loc
C130	0.047µF	Plate Ceramic	+80% -20%	30V	E
C131	0.047µF	Plate Ceramic	+80% -20%	30V	E
C132	300pF	Silvered Mica	5%	350V	E-
C133&A	0.047µF	Plate Ceramic	+80% -20%	30V	E
C134	50pF	Silvered Mica	5%	350V	E-
C135	0.003µF	~~Metallised Paper~~ ceramic	20%	250V	E
C136	0.005µF	~~Metallised Paper~~ ceramic	20%	250V	E
C137	0.047µF	Plate Ceramic	+80% -20%	30V	K
C137A	0.047µF	Plate Ceramic	+80% -20%	30V	D
C138	0.047µF	Plate Ceramic	+80% -20%	30V	E
C139	1µF	Tubular Electrolytic	+100% -20%	15V	E
C140	0.047µF	Plate Ceramic	+80% -20%	30V	E
C141	10µF	Tubular Electrolytic	+50% -10%	16V	E
C142	0.001µF	Disc Ceramic	20%	500V	E
C143	0.047µF	Plate Ceramic	+80% -20%	30V	E
C144	0.001µF	Disc Ceramic	20%	500V	E
C145	0.001µF	Disc Ceramic	20%	500V	E
C146	0.047µF	Plate Ceramic	+80% -20%	30V	E
C147	0.047µF	Plate Ceramic	+80% -20%	30V	E
C148	0.047µF	Plate Ceramic	+80% -20%	30V	E
C149	0.001µF	Disc Ceramic	20%	500V	E
C150	10µF	Tubular Electrolytic	+50% -10%	16V	E
C151	0.047µF	Plate Ceramic	+80% -20%	30V	E
C152	1µF	Tubular Electrolytic	+100% -20%	15V	E
C153	0.047µF	Plate Ceramic	+80% -20%	30V	E
C154	0.047µF	Plate Ceramic	+80% -20%	30V	G
C155	30pF	Tubular Ceramic	10%	750V	G
C156	30pF	Tubular Ceramic	10%	750V	G
C157	100pF	Tubular Ceramic	10%	750V	G
C158	10µF	Tubular Electrolytic	+50% -10%	16V	G
C159	0.001µF	Disc Ceramic	20%	500V	G
C165a	0.047µF	Plate ceramic	+80% -20%	30V	M
C160	0.01µF	Metallised Paper	20%	200V	G
C161	10µF	Tubular Electrolytic	+50% -10%	16V	G
C162	0.047µF	Plate Ceramic	+80% -20%	30V	E
C163	10µF	Tubular Electrolytic	+50% -10%	16V	K
C164	100µF	Tubular Electrolytic	+100% - 20%	15V	E
C165	0.01µF	Metallised Paper	20%	200V	E
C166	0.01µF	Metallised Paper	20%	200V	E
C167	1µF	Tubular Electrolytic	+100% -20%	15V	E
C168	0.01µF	Metallised Paper	20%	200V	E
C169	1µF	Tubular Electrolytic	+100% -20%	15V	E
C170	0.002µF	Polystyrene	5%	125V	E
C171	0.1µF	Polyester	20%	250V	E
C172	0.1µF	Polyester	20%	250V	E
C173	0.047µF	Plate Ceramic	+80% -20%	30V	E
C174	10µF	Tubular Electrolytic	+50% -10%	16V	J
C175	470pF	Polystyrene	5%	125V	J
C176	0.005µF	Metallised Paper	20%	250V	J
C177	0.002µF	Polystyrene	2%	125V	J
C178	0.002µF	Polystyrene	2%	125V	J
C179	100µF	Tubular Electrolytic	+100% -20%	15V	J
C173a	2.5µF	" " "	" "	16V	E

Ref	Value	Type	Tolerance	Wkg. V.	Loc
C180	100µF	Tubular Electrolytic	+100% -20%	15V	J
C181	60pF	Tubular Ceramic	10%	750V	J
C182	10µF	Tubular Electrolytic	+50% -10%	16V	K
C183	0.005µF	Metallised Paper	20%	250V	K
C184	0.5µF	Tubular Electrolytic	+50% -25%	50V	H
C185	100µF	Tubular Electrolytic	+100% -20%	15V	H
C186	100µF	Tubular Electrolytic	+100% -20%	15V	H
C187	10µF	Tubular Electrolytic	+50% -10%	16V	H
C188	100µF	Tubular Electrolytic	+100% -20%	15V	H
C189	0.5µF	Tubular Electrolytic	+50% -25%	50V	I
C190	100µF	Tubular Electrolytic	+100% -20%	15V	I
C191	0.5µF	Tubular Electrolytic	+50% -25%	50V	I
C192	500µF	Tubular Electrolytic	+100% -20%	12V	I
C193	200µF	Tubular Electrolytic	+100% -20%	6V	I
C194	0.001µF	Tubular Ceramic	10%	750V	I
C195	0.01µF	Metallised Paper	20%	200V	I
C196	200µF	Tubular Electrolytic	+100% -20%	6V	I
C197	500µF	Tubular Electrolytic	+100% -20%	25V	O
C198	0.001µF	Disc Ceramic	20%	500V	M
C199	6400µF	Tubular Electrolytic	+50% -10%	16V	L
C200	6400µF	Tubular Electrolytic	+50% -10%	16V	L

Ref	Value	Tol.	Rating	Loc
R1	82Ω	5%	½-watt	A
R2	820Ω	5%	⅛-watt	A
R3	330Ω	5%	⅛-watt	A
R4	39Ω	5%	⅛-watt	A
R5	680Ω	5%	⅛-watt	A
R6	3,300Ω	5%	⅛-watt	A
R7	33,000Ω	5%	⅛-watt	A
R8	1,000Ω	5%	⅛-watt	A
R9	47Ω	5%	⅛-watt	A
R12a	2,200Ω	"	"	A
R10	2,700Ω	5%	⅛-watt	A
R11	22,000Ω	5%	⅛-watt	A
R12	2,200Ω	5%	⅛-watt	A
R13	6,800Ω	5%	⅛-watt	A
R14	3,300Ω	5%	¼-watt	A
R15 *	15,000Ω	5%	¼-watt	A
R16	2,200Ω	5%	¼-watt	A
R17	100Ω	5%	⅛-watt	A
R18	820Ω	5%	⅛-watt	A
R19	680Ω	5%	⅛-watt	B
R20	4,700Ω	5%	⅛-watt	B
R21	47,000Ω	5%	⅛-watt	B
R22	10,000Ω	5%	⅛-watt	B
R23	82,000Ω	5%	⅛-watt	B
R24	0.1MΩ	5%	⅛-watt	B
R25	390Ω	5%	⅛-watt	B
R26	10Ω	5%	⅛-watt	B
R27	390Ω	5%	⅛-watt	B
R28	6,800Ω	5%	⅛-watt	B
R29	47,000Ω	5%	⅛-watt	B
R30	3,300Ω	5%	⅛-watt	C
R31	47,000Ω	5%	⅛-watt	C
R32	680Ω	5%	⅛-watt	C
R33	220Ω	5%	⅛-watt	C
R34	560Ω	5%	⅛-watt	C
R35	680Ω	5%	⅛-watt	C
R36	15,000Ω	5%	⅛-watt	C
R37	100Ω	5%	⅛-watt	O
R38	470Ω	5%	⅛-watt	D
R39	820Ω	5%	⅛-watt	D
R40	2,700Ω	5%	⅛-watt	D-
R40A	100Ω	5%	⅛-watt	D-
R41	1,000Ω	5%	⅛-watt	D
R42	15,000Ω	5%	⅛-watt	D
R43	2,700Ω	5%	⅛-watt	D
R44	1,000Ω	5%	⅛-watt	D
R45	68Ω	5%	⅛-watt	D
R46*	1,000Ω	5%	⅛-watt	D
R47	10,000Ω	5%	⅛-watt	D
R48	15,000Ω	5%	⅛-watt	D
R49	2,700Ω	5%	⅛-watt	D

Ref	Value	Tol.	Rating	Loc
R50	1,000Ω	5%	⅛-watt	D
R51	2,700Ω	5%	⅛-watt	D
R52	15,000Ω	5%	⅛-watt	D
R53	470Ω	5%	⅛-watt	D
R54	15,000Ω	5%	⅛-watt	D
R55	4,700Ω	5%	⅛-watt	D
R56	1,000Ω	5%	⅛-watt	D
R57	100Ω	5%	⅛-watt	E
R58	100Ω	5%	⅛-watt	E
R59	180Ω	5%	⅛-watt	E
R60	270Ω	5%	⅛-watt	E
R61	1,000Ω	5%	⅛-watt	E
R62	100Ω	5%	⅛-watt	E
R63	1,500Ω	5%	⅛-watt	E-
R64	680Ω	5%	⅛-watt	E
R65	270Ω	5%	⅛-watt	E
R66	470Ω	5%	⅛-watt	E-
R67	1,000Ω	5%	⅛-watt	E
R68	270Ω	5%	⅛-watt	E
R69	1,500Ω	5%	⅛-watt	E-
R70	680Ω	5%	⅛-watt	E
R71	2,200Ω	5%	⅛-watt	E
R72	5,600Ω	5%	⅛-watt	E
R73	10Ω	5%	⅛-watt	E
R74	68Ω	5%	⅛-watt	E
R75	150Ω	5%	⅛-watt	E
R76	270Ω	5%	⅛-watt	E
R77	6,800Ω	5%	⅛-watt	E
R78	3,300Ω	5%	⅛-watt	E
R79	4,700Ω	5%	⅛-watt	E
R80&A	2,200Ω	5%	⅛-watt	F
R81&A	15,000Ω	5%	⅛-watt	F
R82&A	390Ω	5%	⅛-watt	F
R83&A	1,000Ω	5%	⅛-watt	F
R84	6,800Ω	5%	⅛-watt	E
R85	2,700Ω	5%	⅛-watt	E
R86	1,000Ω	5%	⅛-watt	E
R87	100Ω	5%	⅛-watt	E
R88	2,700Ω	5%	⅛-watt	E
R89	6,800Ω	5%	⅛-watt	E
R90	470Ω	5%	⅛-watt	E
R91	100Ω	5%	⅛-watt	E
R92	10,000Ω	5%	⅛-watt	E
R93	10,000Ω	5%	⅛-watt	E
R94	12,000Ω	5%	⅛-watt	K
R95	Not used	-	-	-
R96 *	10,000Ω	5%	⅛-watt	K
R97	1,500Ω	5%	⅛-watt	E
R98	22,000Ω	5%	⅛-watt	E
R99	22,000Ω	5%	⅛-watt	E

R46 *Value changed with non-standard crystal filter. 560Ω on 990R/1

* R15 and R16 may be adjusted on test.

Ref	Value	Tol.	Rating	Loc
R100	470Ω	5%	$\frac{1}{8}$-watt	E
R101	10,000Ω	5%	$\frac{1}{8}$-watt	E
R102	10,000Ω	5%	$\frac{1}{8}$-watt	E
R103	22,000Ω	5%	$\frac{1}{8}$-watt	E
R104	22,000Ω	5%	$\frac{1}{8}$-watt	E
R105	470Ω	5%	$\frac{1}{8}$-watt	E
R106	1,000Ω	5%	$\frac{1}{8}$-watt	E
R107	150Ω	5%	$\frac{1}{8}$-watt	E
R108	22,000Ω	5%	$\frac{1}{8}$-watt	K
R109	18,000Ω	5%	$\frac{1}{8}$-watt	K
R110	10,000Ω	5%	$\frac{1}{8}$-watt	K
R111	10,000Ω	5%	$\frac{1}{8}$-watt	G
R112	47,000Ω	5%	$\frac{1}{8}$-watt	G
R113	4,700Ω	5%	$\frac{1}{8}$-watt	G
R114	1,500Ω	5%	$\frac{1}{8}$-watt	G
R115	6,800Ω	5%	$\frac{1}{8}$-watt	G
R116	68,000Ω	5%	$\frac{1}{8}$-watt	G
R117	680Ω	5%	$\frac{1}{8}$-watt	G
R118	6,800Ω	5%	$\frac{1}{8}$-watt	G
R119	68,000Ω	5%	$\frac{1}{8}$-watt	G
R120	680Ω	5%	$\frac{1}{8}$-watt	G
R121	1,500Ω	5%	$\frac{1}{8}$-watt	G
R122	270Ω	5%	$\frac{1}{8}$-watt	O
R123	1,000Ω	5%	$\frac{1}{8}$-watt	O
R124	100Ω	5%	$\frac{1}{8}$-watt	E
R125	4,700Ω	5%	$\frac{1}{8}$-watt	J
R126	2,200Ω	5%	$\frac{1}{8}$-watt	E
R127	4,700Ω	5%	$\frac{1}{8}$-watt	E
R128	68,000Ω	5%	$\frac{1}{8}$-watt	E
R129	680Ω	5%	$\frac{1}{8}$-watt	E
R130	82,000Ω	5%	$\frac{1}{8}$-watt	E
R131	2,200Ω	5%	$\frac{1}{8}$-watt	E
R132	22,000Ω	5%	$\frac{1}{8}$-watt	E
R133	82,000Ω	5%	$\frac{1}{8}$-watt	E
R134	470Ω	5%	$\frac{1}{8}$-watt	E
R135	0.1MΩ	5%	$\frac{1}{8}$-watt	E
R136	68,000Ω	5%	$\frac{1}{8}$-watt	E
R137	47,000Ω	5%	$\frac{1}{8}$-watt	E
R138	100Ω	5%	$\frac{1}{8}$-watt	E
R139	22Ω	5%	$\frac{1}{8}$-watt	E
R140	33,000Ω	5%	$\frac{1}{8}$-watt	E
R141	3,300Ω	5%	$\frac{1}{8}$-watt	J
R142	2,700Ω	5%	$\frac{1}{8}$-watt	J
R143	10,000Ω	5%	$\frac{1}{8}$-watt	J
R144	2,200Ω	5%	$\frac{1}{8}$-watt	J
R145	680Ω	5%	$\frac{1}{8}$-watt	J
R146	330Ω	5%	$\frac{1}{8}$-watt	J
R147	39Ω	5%	$\frac{1}{8}$-watt	J
R148	100Ω	5%	$\frac{1}{8}$-watt	J
R149	1,500Ω	5%	$\frac{1}{8}$-watt	J

Ref	Value	Tol.	Rating	Loc
R150	4,700Ω	5%	$\frac{1}{8}$-watt	K
R151	4,700Ω	5%	$\frac{1}{8}$-watt	K
R152	82,000Ω	5%	$\frac{1}{8}$-watt	H
R153	10,000Ω	5%	$\frac{1}{8}$-watt	H
R154	1,000Ω	5%	$\frac{1}{8}$-watt	H
R155	1,000Ω	5%	$\frac{1}{8}$-watt	H
R156	5,600Ω	5%	$\frac{1}{8}$-watt	H
R157	22,000Ω	5%	$\frac{1}{8}$-watt	H
R158	2,700Ω	5%	$\frac{1}{8}$-watt	H
R159	0.1MΩ	5%	$\frac{1}{8}$-watt	H
R160	180Ω	5%	$\frac{1}{8}$-watt	H
R161	4,700Ω	5%	$\frac{1}{8}$-watt	I
R162	47,000Ω	5%	$\frac{1}{8}$-watt	I
R163	680Ω	5%	$\frac{1}{8}$-watt	I
R164	4,700Ω	5%	$\frac{1}{8}$-watt	I
R165	10Ω	5%	$\frac{1}{8}$-watt	I
R166	15,000Ω	5%	$\frac{1}{8}$-watt	I
R167	15,000Ω	5%	$\frac{1}{8}$-watt	I
R168	15,000Ω	5%	$\frac{1}{8}$-watt	I
R169	680Ω	5%	$\frac{1}{8}$-watt	I
R170	390Ω	5%	$\frac{1}{8}$-watt	I
R171	560Ω	5%	$\frac{1}{8}$-watt	I
R172	47Ω	5%	$\frac{1}{8}$-watt	I
R173	3.3Ω w.w.	5%	3-watt	I
R174	3.3Ω w.w.	5%	3-watt	I
R175	1,000Ω	5%	$\frac{1}{8}$-watt	I
R176	16Ω w.w.	5%	3-watt	I
R177	12Ω	5%	$\frac{1}{2}$-watt	K
R178	8Ω w.w.	5%	3-watt	L
R179	3.3Ω w.w.	5%	3-watt	L
R124a	4,700Ω	5%	1/8 watt	E
R125a	10,000Ω	5%	1/8 watt	K

Potentiometers.

Ref	Value	Type	Loc
RV1*	10,000Ω	Wirewound	K
RV2	560Ω	Pre-set carbon	E
RV3*	10,000Ω	Wirewound	K
RV4	1,000Ω	Pre-set carbon	M
RV5	47,000Ω	Pre-set carbon	N
RV6	47,000Ω	Pre-set carbon	N
RV7	47,000Ω	Pre-set carbon	M
RV8	5,000Ω	Carbon	K
RV9	5,600Ω	Pre-set carbon	M

*RV1 & RV3 are combined with concentric spindles.

Thermistors.

Ref	Type	Loc
TH1	VA1066S	E
TH2	VA1066S	I

Filtercons.

Ref	Value	Wkg. V.	Type	Loc
FC1	0.0015μF	200V	Erie Style 1201-052	B
FC2	0.0015μF	200V	Erie Style 1201-052	B
FC3	0.0015μF	200V	Erie Style 1201-052	B
FC4	0.0015μF	200V	Erie Style 1201-052	B
FC5	0.0015μF	200V	Erie Style 1201-052	D
FC6	0.0015μF	200V	Erie Style 1201-052	D
FC7	0.0015μF	200V	Erie Style 1201-052	D
FC8	0.0015μF	200V	Erie Style 1201-052	D
FC9	0.0015μF	200V	Erie Style 1201-052	D
FC10	0.0015μF	200V	Erie Style 1201-052	D
FC11	0.0015μF	200V	Erie Style 1201-052	G
FC12	0.0015μF	200V	Erie Style 1201-052	G

APPENDIX "C"

SPARES

The following list details all major spares for the Model 990R VHF Receiver. Spares should be ordered by quoting the Circuit Ref. (where applicable), the written description given in the list and the Part No. in the right-hand column. The Serial No. of the receiver should be stated in all communications.

All orders and enquiries should be addressed to:-

EDDYSTONE RADIO LIMITED,
SALES & SERVICE DEPT.,
ALVECHURCH ROAD,
BIRMINGHAM, 31.

Telephone :: PRIory 2231/4.
Cables :: EDDYSTONE Birmingham.
Telex :: 33708.

Ref	Description	Part No.
	INDUCTORS	
L1	Range 1 Aerial coil	D3739
L2	Range 2 Aerial coil	D3740
L3	Range 3 Aerial coil	D3741
L4	Range 4 Aerial coil	D3742
L5	Range 1 Bandpass coil (Primary)	D3743
L6	Range 2 Bandpass coil (Primary)	D3744
L7	Range 3 Bandpass coil (Primary)	D3745
L8	Range 4 Bandpass coil (Primary)	D3746
L9	Range 1 Bandpass coil (Secondary)	D3747
L10	Range 2 Bandpass coil (Secondary)	D3748
L11	Range 3 Bandpass coil (Secondary)	D3749
L12	Range 4 Bandpass coil (Secondary)	D3750
L13	Range 1 Oscillator coil	D3751
L14	Range 2 Oscillator coil	D3752
L15	Range 3 Oscillator coil	D3753
L16	Range 4 Oscillator coil	D3754
L17	Crystal Oscillator coil (1)	D3734
L18	Crystal Oscillator coil (2)	D3734
L19	Crystal Oscillator coil (3)	D3734
L20	Crystal Oscillator coil (4)	D3734
L21	Crystal Oscillator coil (5)	D3734
L22	Crystal Oscillator coil (6)	D3734
L23	Crystal Oscillator coil (7)	D3734
L24	Crystal Oscillator coil (8)	D3734
L25	Crystal Calibrator coil (complete in can with C66/67)	D3731
	L1-L24 are normally supplied pre-assembled on associated miniature printed circuit wafers, together with appropriate trimmers.	

Ref	Description	Part No.
	TRANSFORMERS	
T1	10.7 MHz IF Transformer (RF Tuner Unit)	D3757
T2	10.7 MHz IF Transformer (IF Pre-amplifier)	D3767
T3	10.7 MHz IF Transformers (Cascaded to form 200 kHz filter)	D3732
T4		D3781
T5		D3782
T6	10.7 MHz IF Transformer (Main IF)	D3717
T7	10.7 MHz IF Transformer (Main IF)	D3718
T8	AM Detector Transformer (Main IF)	D3768
T9	Limiter Driver Transformer (Main IF)	6933/1P
T10	FM Discriminator Transformer (Main IF)	6934/1P
T11	Noise Amplifier Output Transformer (Main IF)	D3719
T12	Line Output Transformer (600Ω)	7020P
T13	Loudspeaker Transformer (3Ω)	7021P
T14	Power Transformer	7022P
	CHOKES	
CH1	RF Amplifier Emitter Choke	D2854
CH2	Filter Choke (10V feed to RF Amplifier)	D3755
CH3	Low-pass Filter Choke) Mixer IF Output Filter	D3755
CH4	Low-pass Filter Choke)	D2854
CH5	Filter Choke (10V feed to Crystal Oscillator)	D2854
CH6	Anti-parasitic Choke (Crystal Isolator)	D3755
CH7	Tone Oscillator Choke	~~6763P~~ (now 100mH 56mA)
CH8	Gain Control Filter Choke (Main IF)	D3558
CH9	Gain Control Filter Choke (Main IF)	D3558
CH10 to CH17	Filter Chokes (10V feeds on Main IF Board)	D3558
CH18	Discriminator Output Filter Choke	D3558
CH19	RF AGC Choke	D3558
CH20	IF AGC Choke	D3558
CH21	CW Detector Output Filter Choke	D3558
CH22	Filter Choke (10V feed to CW Detector)	D3558
CH23	Noise Amplifier Inter-stage Choke	7341P
CH24	Noise Rectifier Output Filter Choke	6836P
CH25	Filter Choke (10V feed to Noise Amplifier)	D3558
CH26	Video Amplifier Input Choke	D2854
CH27	Video Amplifier Output Choke	D2854
	TRIMMERS	
C2 etc.	2.5-6pF Ceramic	7288P
C6 etc.	1-6pF Tubular Ceramic (Part of Tuner Assembly)	-
C30	4.5-20pF Ceramic	7289P
C38,C78	7-35pF Ceramic (also C79)	7291P
C47 etc.	10-60pF Ceramic	7290P

Ref	Description	Part No.
	CRYSTALS	
XL1	10.0 MHz ± 0.005%. Series-mode Style "J" 0-60°C.	7298P
XL2	10.7 MHz ± 0.005%. Series-mode Style "J" 0-60°C.	7299P
	CRYSTAL FILTERS	
	Standard 10.7 MHz Filter, 30 kHz bandwidth	7294P
	(990R/1) 10.7 MHz Filter, 7.5KHz bandwidth	7367P
	SWITCHES	
S1	Range Switch:- Clicker Mechanism (4-position)	7282P
	Extension Spindle (1)	7283P
	Extension Spindle (2)	7283/1P
	Coupling Hubs for (1) and (2) above	7353P
	Wafers :: S1A, S1B/D	D3818
	S1C, S1E, S1F, S1G, S1H	7286P
	S1I, S1J	7286/1P
S2	IF Input Switch (SPDT Miniature Toggle Type)	7352P
S3	System Switch:- Clicker Mechanism (10-position)	7012P
	Wafers :: S3A, S3B	6302/1P
	S3C, S3D	7014P
S4	Calibrator Switch (SPST Toggle Type)	4771PB
S5	Selectivity Switch (DPDT Toggle Type)	4772PC
S6	Manual/AGC Switch (DPDT Toggle Type)	4772PC
S7	Mode Switch (Complete Assy including DPST Supply Switch)	7234P
S8	Muting Switch (SPST Toggle Type)	4771PB
S9	Monitor Speaker Switch (SPST Toggle Type)	4771PB
S10	See S7 above.	
	POTENTIOMETERS	
RV1/3	10,000Ω + 10,000Ω Dual Unit with concentric spindles	5810P
RV2	560Ω Pre-set Carbon	6843P
RV3	Part of RV1 Assy.	-
RV4	1,000Ω Pre-set Carbon	6076P
RV5	47,000Ω Pre-set Carbon	6488P
RV6	47,000Ω Pre-set Carbon	6488P
RV7	47,000Ω Pre-set Carbon	6488P
RV8	5,000Ω Carbon (AF Gain)	6860P
RV9	5,600Ω Pre-set Carbon (Line Level)	6366P

Ref	Description	Part No.
	PLUGS AND SOCKETS	
-	Standard BNC coaxial plug (as used for Aerial Input etc.)	6084P
-	Standard Telephone plug (to mate with JK1)	6567P
PL1	10-way free female connector	6285P
PL2	Miniature coaxial plug	7293P
PL3	Miniature coaxial plug	7293P
PL4	Miniature coaxial plug	7293P
PL5	Miniature coaxial plug	7293P
PL6	Two-pole free connector (one male, one female contact)	7245P
PL7	Miniature coaxial plug	7293P
PL8	Shorting plug for AC operation (3-way female)	D3640
PL9	12V DC Input connector (3-way female with 6' twin-lead)	D3641
-	AC Mains connector (complete with 6' of 3-core cable)	D2311/1
SK1	10-way male chassis-mounted connector	6286P
SK2	BNC coaxial socket	7225P
SK3	Miniature coaxial socket	7292P
SK4	Miniature coaxial socket	7292P
SK5	Miniature coaxial socket	7292P
SK6	Miniature coaxial socket	7292P
SK7	Miniature coaxial socket	7292P
SK8	BNC coaxial socket	7225P
SK9	Two-pole chassis-mounted (one male, one female contact)	7245P
SK10	BNC coaxial socket	7225P
SK11	BNC coaxial socket	7225P
SK12	BNC coaxial socket	7225P
SK13	12V DC Input socket (3-way shrouded male)	7130P
SK14	AC Mains input socket (3-way male, polarised with earth contact)	D2310/1
	KNOBS	
	Tuning	D3613/1
	Skirt for Tuning knob (graduated 0-100)	D3708
	RF Gain	D3723
	IF Gain	D3724
	AF Gain, System Switch, Mode Switch, Range Switch	D3614
	DRIVE MECHANISM AND ASSOCIATED ITEMS	
	Basic Drive Mechanism complete with flywheel and output gear. (Also includes w/change mounting plate)	LP3014
	Guide pulley (large)	6125P
	Guide pulley (small)	7040P
	Cal Re-set Assembly	D3644
	Cursor Assembly (cursor, carrier and steady)	D3643
	Drive cord	D3631
	Scale plate (calibrated)	7231P
	Coupler (System Switch)	7382P

Ref	Description	Part No.
	MISCELLANEOUS	
	Chromium-plated panel handles	6553P
	Tuning meter	7006P
	Finger plate	7230P
	Escutcheon	6990P
	Monitor speaker	6101P
	Monitor speaker grille	6976P
	Range indicator lamps (6V, 50mA, LES)	6659P
	LES holder	6600P
	Fuse - 1A x $1\frac{1}{4}$" x $\frac{1}{4}$" cartridge	6124P
	Fuse - $\frac{1}{2}$A x $1\frac{1}{4}$" x $\frac{1}{4}$" cartridge	6244P
	Fuseholder	6103P
	Terminals (as used for 600Ω o/p etc.)	6102P
	Perspex window	6977P
	Cover fixing screws	5446P
	Emitter Follower Unit	LP2946/1
RLA/2	Relay (DPCO/12V/200Ω)	7235P

APPENDIX "D"

IF CONVERTER TYPE 959

The IF Converter Type 959 is an ancillary unit for use with the 990R VHF Receiver when IF output is required at 5.2 MHz to drive the associated Panoramic Display Unit Type EP17R. A variant of the standard 959 Unit is available for rack-mounting (959/1).

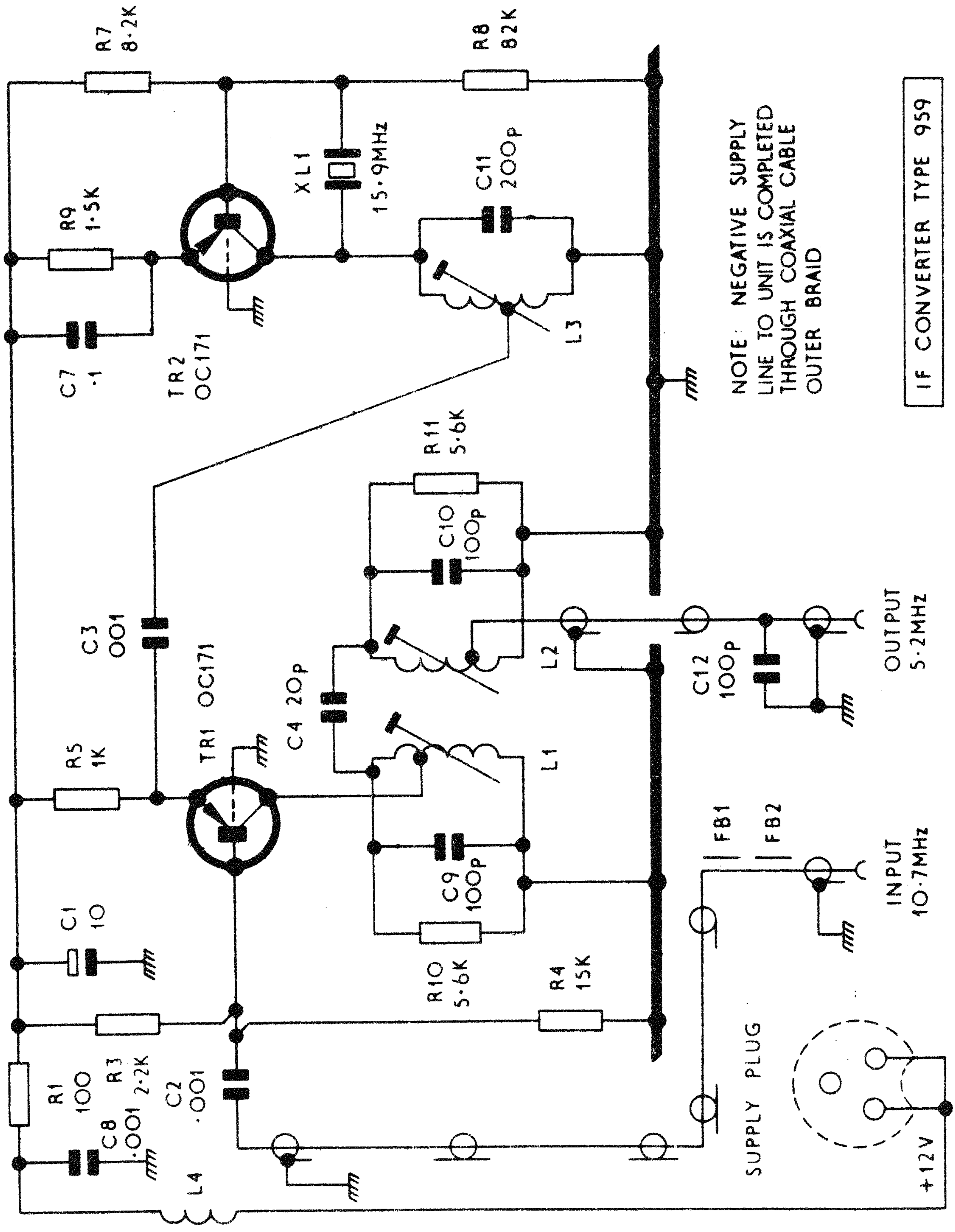
The unit employs two transistors (Mullard OC171) as Mixer (TR1) and Oscillator (TR2). The oscillator is crystal-controlled at 15.9 MHz and the unit operates as a "no-loss/no-gain" device with a bandwidth of 1 MHz. BNC coaxial sockets are fitted for input (10.7 MHz) and output (5.2 MHz) connections.

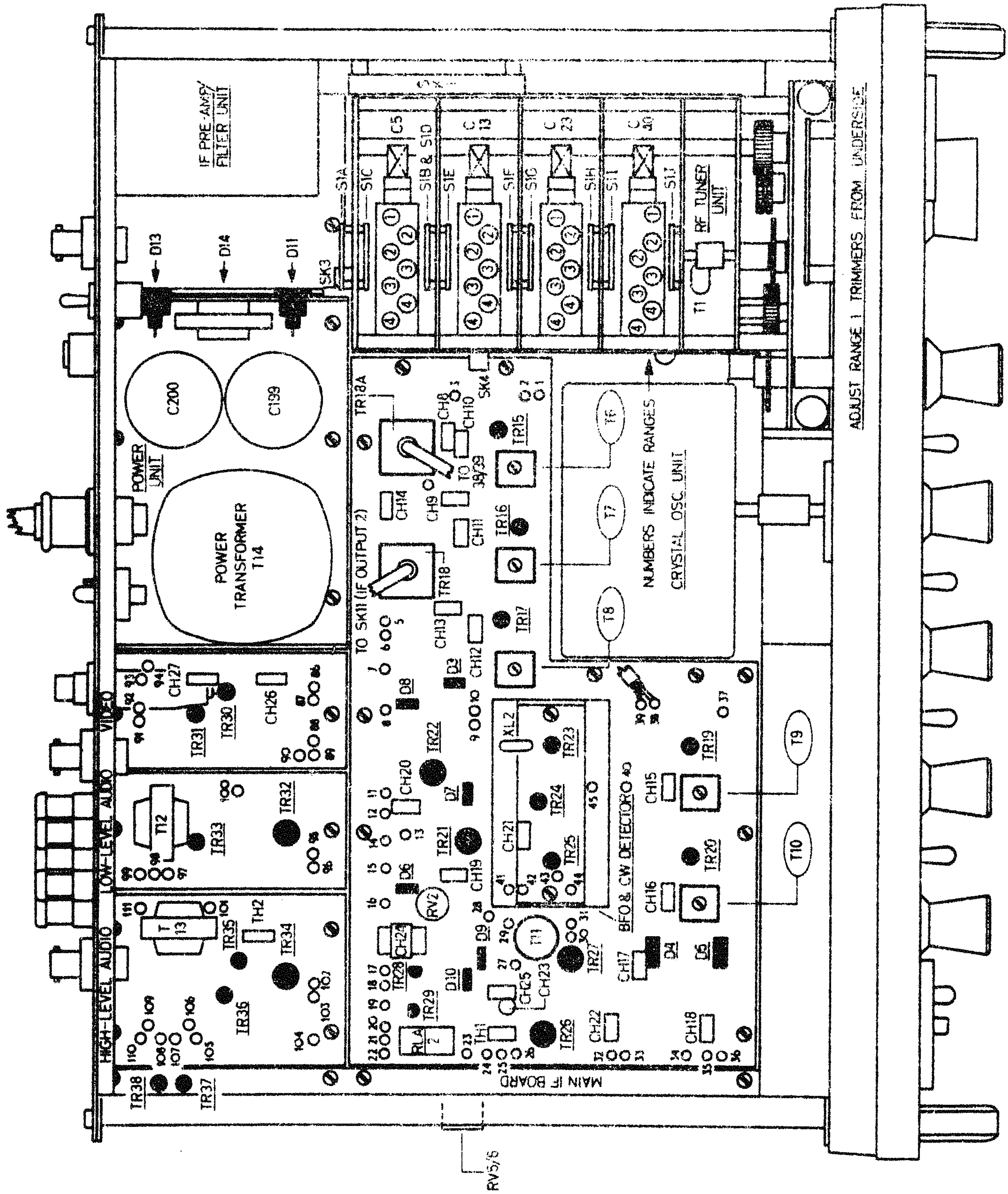
A flying lead terminates in a polarised connector to mate with the 12V DC socket at the rear of the 990R Receiver. The connector carries the +ve supply lead only and has a shorting strap to complete the receiver supply as on the normal shorting plug fitted for AC working. The -ve return is via the coaxial leads to avoid shorting out the switch S10A and the fuse FS1 in the main receiver. This would occur if the -ve line was taken via the 12V DC connector.

A circuit diagram of the converter is given on the following page. Other converters can be produced to special order for applications where IF drive is required at other specified frequencies.

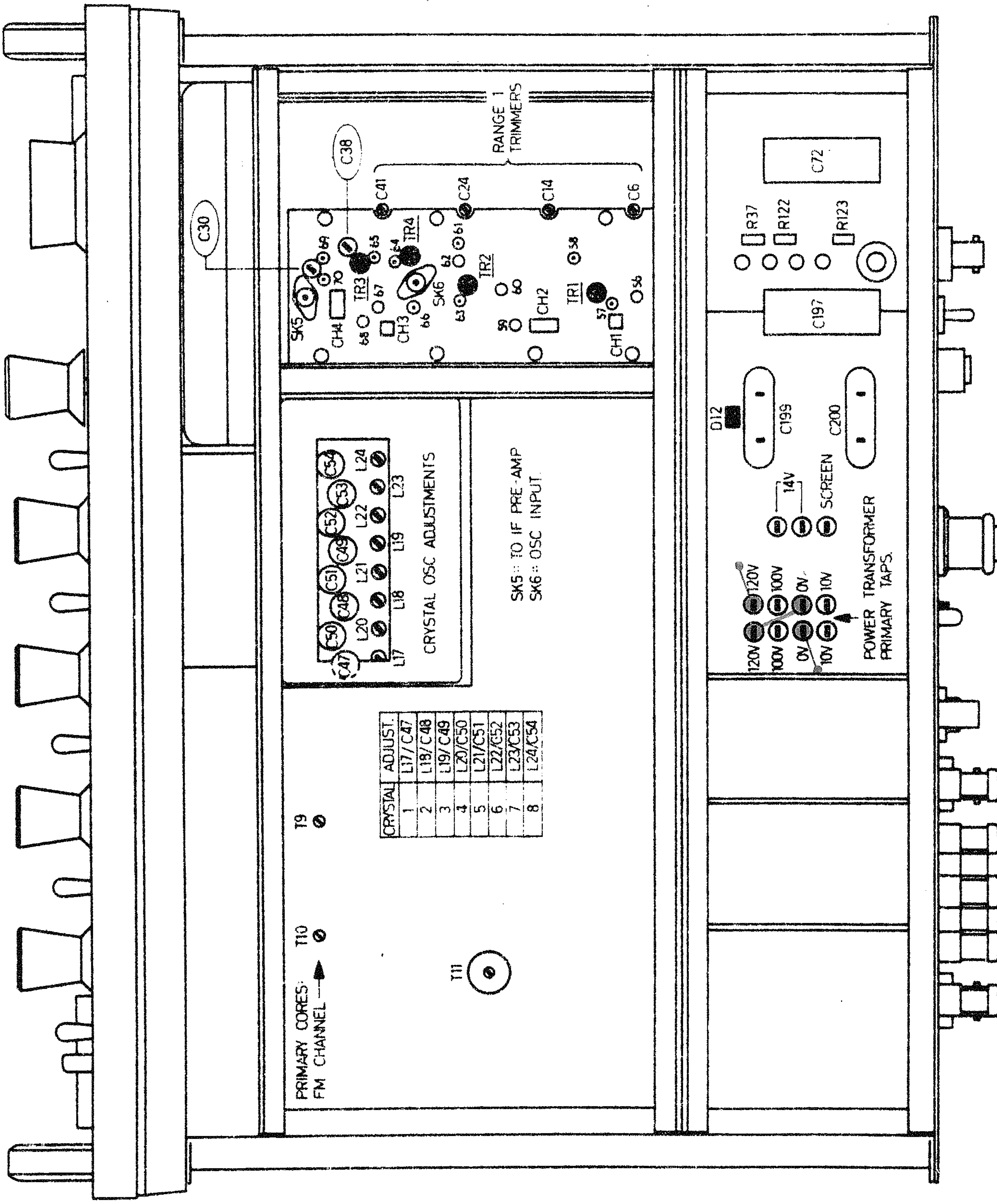
Component Values for IF Converter Type 959.

Ref	Value	Type	Tolerance	Rating
C1	10µF	Tubular Electrolytic	+50% -10%	16V
C2	0.001µF	Tubular Ceramic	20%	750V
C3	0.001µF	Tubular Ceramic	20%	750V
C4	20pF	Tubular Ceramic	10%	750V
C5	-	Reference not allocated	-	-
C6	-	Reference not allocated	-	-
C7	0.1µF	Polyester	20%	250V
C8	0.001µF	Tubular Ceramic	20%	750V
C9	100pF	Polystyrene	5%	125V
C10	100pF	Polystyrene	5%	125V
C11	200pF	Polystyrene	5%	125V
C12	100pF	Tubular Ceramic	10%	750V
R1	100Ω	Carbon	10%	½-watt
R2	-	Reference not allocated	-	-
R3	2,200Ω	Carbon	10%	½-watt
R4	15,000Ω	Carbon	10%	½-watt
R5	1,000Ω	Carbon	10%	½-watt
R6	-	Reference not allocated	-	-
R7	8,200Ω	Carbon	10%	½-watt
R8	82,000Ω	Carbon	10%	½-watt
R9	1,500Ω	Carbon	10%	½-watt
R10	5,600Ω	Carbon	5%	⅛-watt
R11	5,600Ω	Carbon	5%	⅛-watt

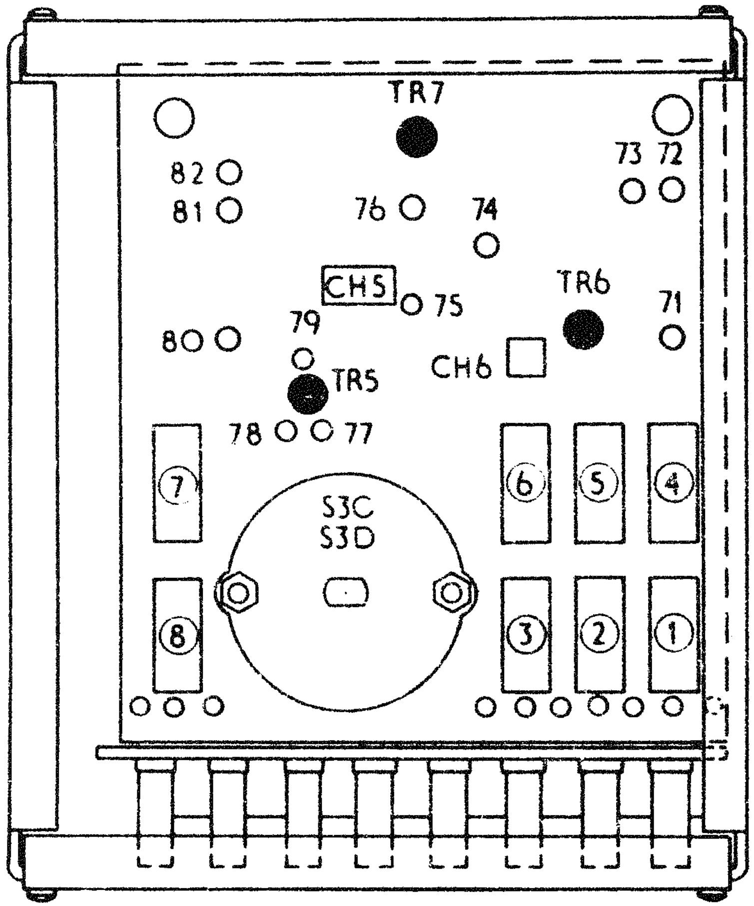

R7
8·2K
R8
82K
R9
1·5K
XL1
15·9MHz
C11
200p
C7
·1
TR2
OC171
L3
NOTE: NEGATIVE SUPPLY
LINE TO UNIT IS COMPLETED
THROUGH COAXIAL CABLE
OUTER BRAID
IF CONVERTER TYPE 959
R11
5·6K
C10
100p
C3
001
TR1 OC171
C4 20p
L2
L1
C12
100p
OUTPUT
5·2MHz
R5
1K
FB1
FB2
INPUT
10·7MHz
C1
10
C9
100p
R10
5·6K
R4
15K
R1
100
R3
2·2K
C2
·001
C8
·001
L4
SUPPLY PLUG
+12V



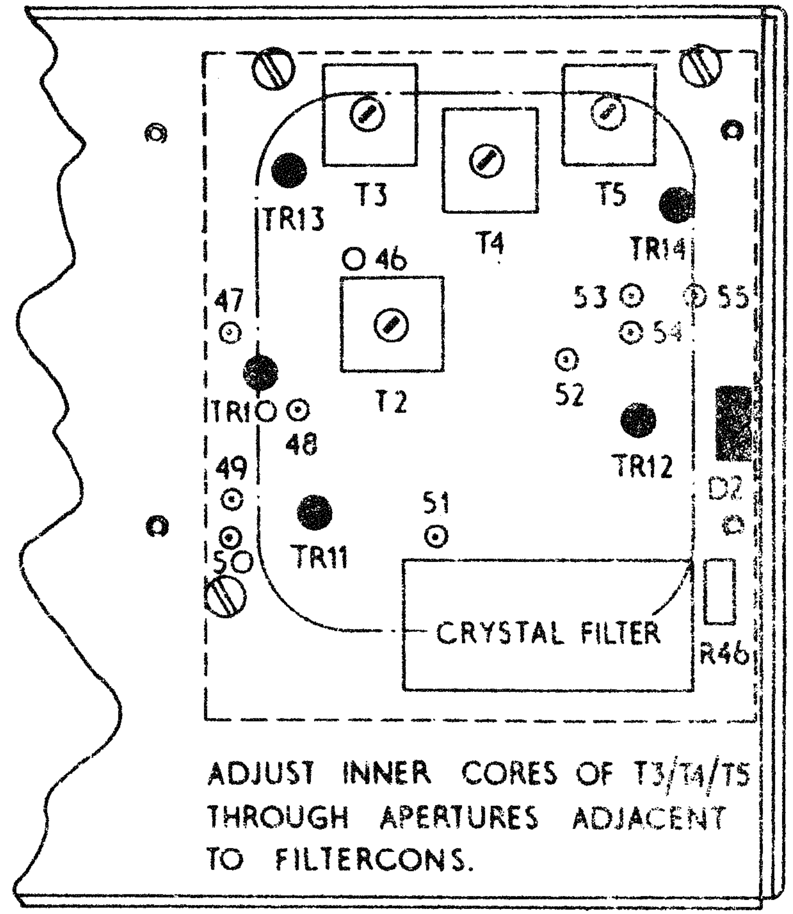
Plan View of 990R Receiver.



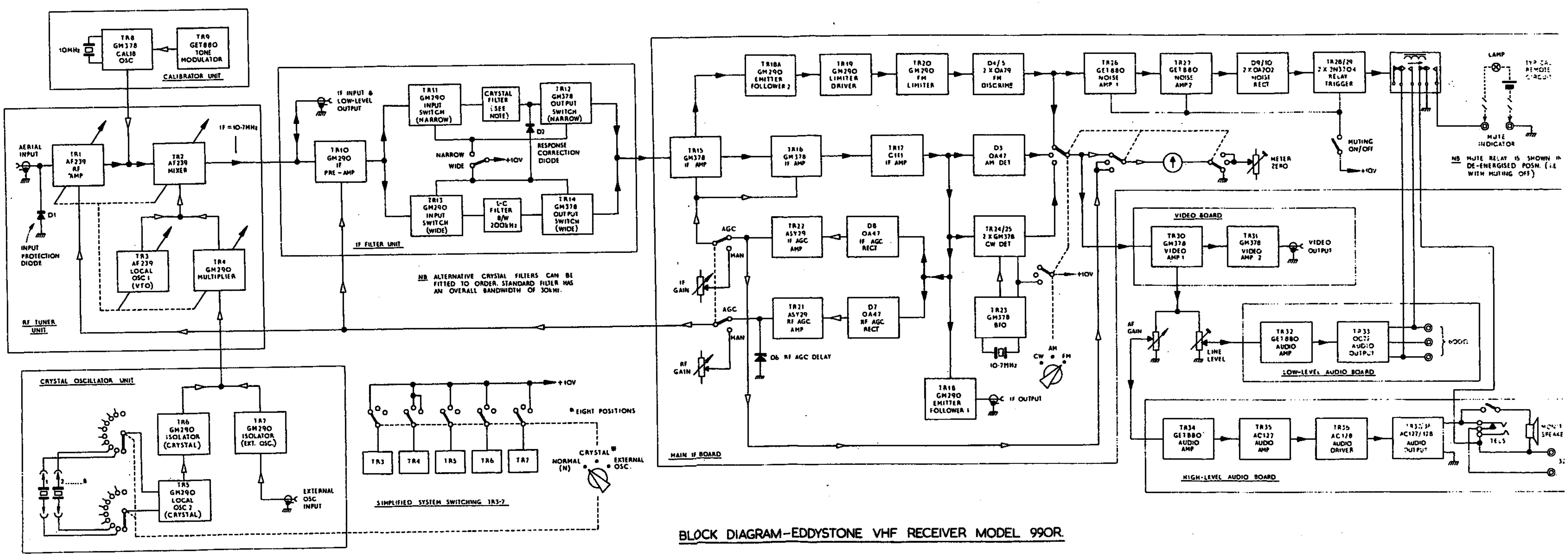
Underside View of 990R Receiver.



Internal View of Crystal Oscillator Unit.

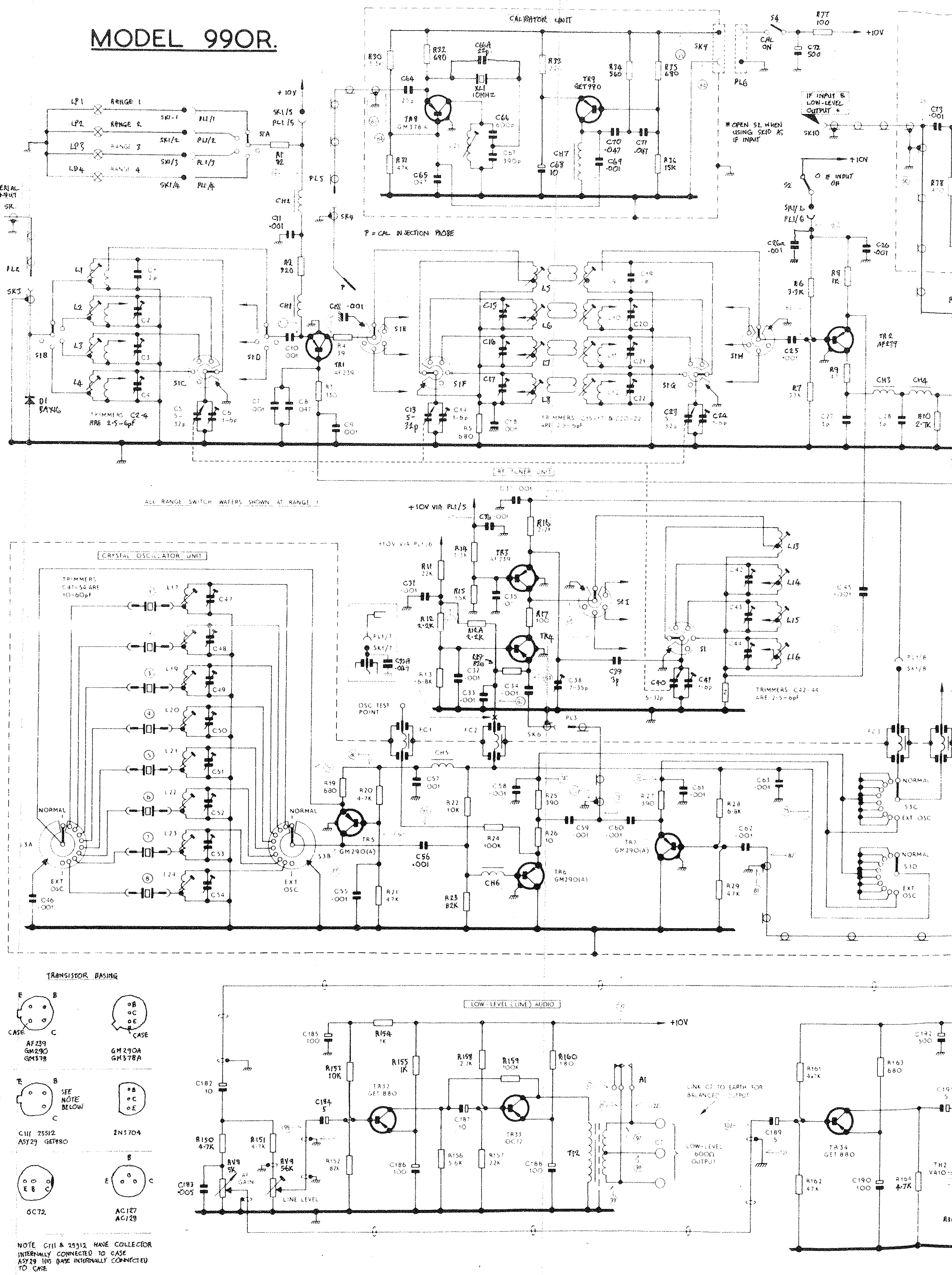


Internal View of IF Pre-Amplifier/Filter Unit.

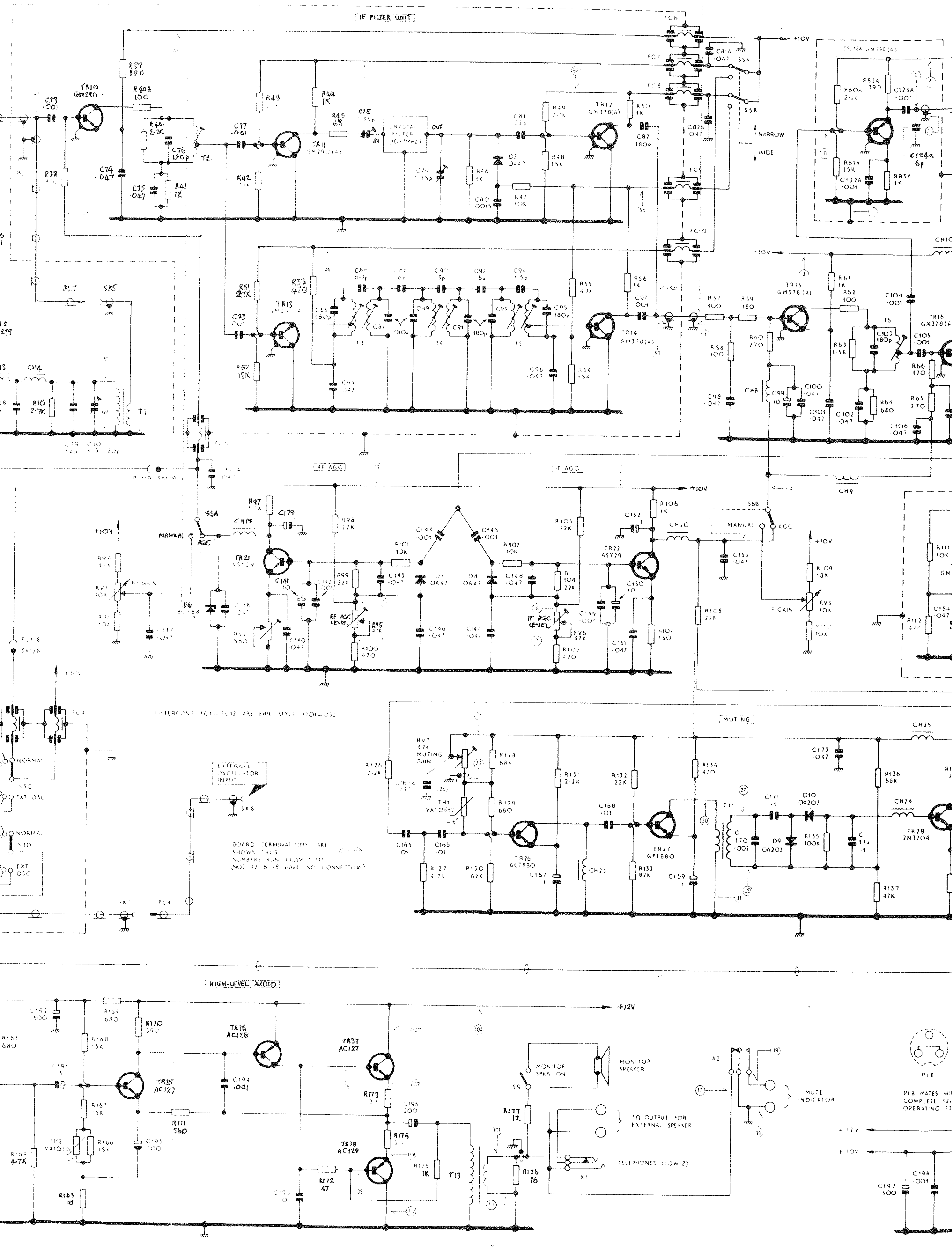


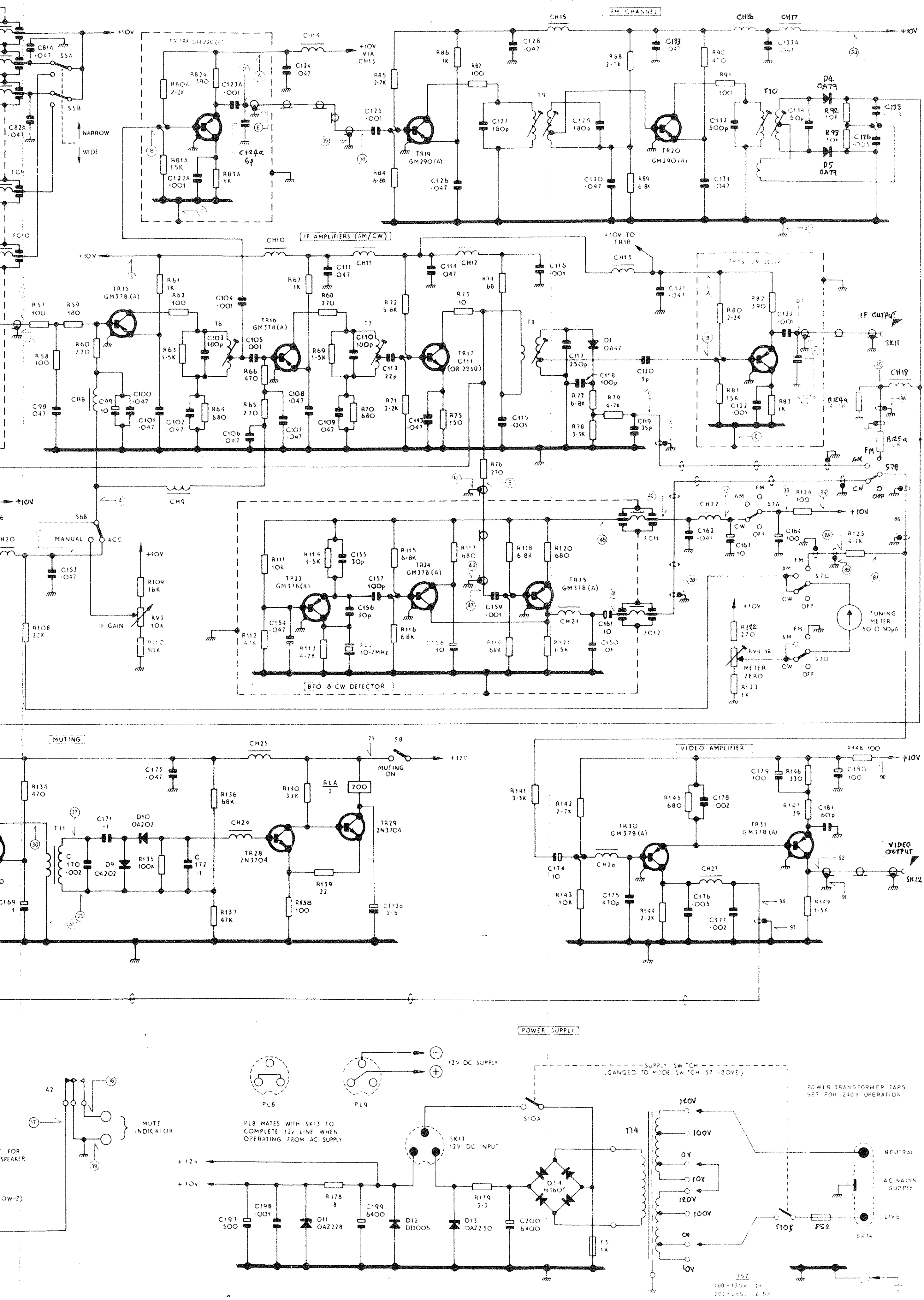
BLOCK DIAGRAM-EDDYSTONE VHF RECEIVER MODEL 990R

MODEL 99OR.



CALIBRATOR UNIT
RF TUNER UNIT
CRYSTAL OSCILLATOR UNIT
LOW-LEVEL (LINE) AUDIO
AERIAL INPUT
RANGE 1
RANGE 2
RANGE 3
RANGE 4
P = CAL INJECTION PROBE
CAL ON
IF INPUT & LOW-LEVEL OUTPUT *
* OPEN S2 WHEN USING SK10 AS IF INPUT
IF INPUT ON
ALL RANGE SWITCH WAFERS SHOWN AT RANGE 1
TRIMMERS C2-4 ARE 2·5-6pF
TRIMMERS C15-17 & C20-22 ARE 2·5-6pF
TRIMMERS C47-54 ARE 10-60pF
TRIMMERS C42-44 ARE 2·5-6pF
OSC TEST POINT
NORMAL
EXT OSC
+10V
+10V VIA PL1/5
+10V VIA PL1/6
AF GAIN
LINE LEVEL
LINK CT TO EARTH FOR BALANCED OUTPUT
LOW-LEVEL 600Ω OUTPUT
TRANSISTOR BASING
AF239 GM290 GM378
GM290A GM378A
SEE NOTE BELOW
C111 2S512 ASY29 GET880
2N3704
OC72
AC127 AC128
NOTE C111 & 2S512 HAVE COLLECTOR INTERNALLY CONNECTED TO CASE ASY29 HAS BASE INTERNALLY CONNECTED TO CASE


IF FILTER UNIT
+10V
TR10 GM290
TR11 GM290(A)
TR12 GM378(A)
TR13
TR14 GM378(A)
TR15 GM378(A)
TR16 GM378(A)
TR18A GM290(A)
CRYSTAL FILTER
NARROW
WIDE
RF AGC
IF AGC
MANUAL
AGC
RF GAIN
IF GAIN
TR21 ASY29
TR22 ASY29
RF AGC LEVEL
IF AGC LEVEL
FILTERCONS FC1-FC12 ARE ERIE STYLE 1201-052
NORMAL
EXT OSC
EXTERNAL OSCILLATOR INPUT
BOARD TERMINATIONS ARE SHOWN THUS
NUMBERS RUN FROM 1-111
(NOS 42 & 78 HAVE NO CONNECTION)
MUTING
MUTING GAIN
TR26 GET880
TR27 GET880
TR28 2N3704
HIGH-LEVEL AUDIO
+12V
TR35 AC127
TR36 AC128
TR37 AC127
TR38 AC128
MONITOR SPKR ON
MONITOR SPEAKER
3Ω OUTPUT FOR EXTERNAL SPEAKER
TELEPHONES (LOW-Z)
MUTE INDICATOR
PL8
PL8 MATES WITH
COMPLETE 12V
OPERATING FR


FM CHANNEL
IF AMPLIFIERS (AM/CW)
BFO & CW DETECTOR
MUTING
VIDEO AMPLIFIER
POWER SUPPLY
+10V
+10V VIA CH13
+10V TO TR18
+12V
NARROW
WIDE
S5A
S5B
TR18A GM290(A)
TR19 GM290(A)
TR20 GM290(A)
TR15 GM378(A)
TR16 GM378(A)
TR17 C111 (OR 2S512)
TR23 GM378(A)
TR24 GM378(A)
TR25 GM378(A)
TR28 2N3704
TR29 2N3704
TR30 GM378(A)
TR31 GM378(A)
D4 OA79
D5 OA79
D3 OA47
D9 OA202
D10 OA202
XL2 10·7MHz
IF OUTPUT
SK11
VIDEO OUTPUT
SK12
MANUAL
AGC
S6B
IF GAIN
RV3 10K
TUNING METER 50-0-50µA
METER ZERO
RV4 1K
AM
FM
CW
OFF
S7A
S7B
S7C
S7D
S8
MUTING ON
RLA 2
MUTE INDICATOR
12V DC SUPPLY
PL8
PL9
PL8 MATES WITH SK13 TO COMPLETE 12V LINE WHEN OPERATING FROM AC SUPPLY
SK13 12V DC INPUT
SUPPLY SWITCH (GANGED TO MODE SWITCH S7 ABOVE)
S10A
S10B
T14
D14 M160T
FS1 1A
FS2
POWER TRANSFORMER TAPS SET FOR 240V OPERATION
NEUTRAL
AC MAINS SUPPLY
LIVE
SK14
FS2
100-130V 1A
200-260V 0.5A