

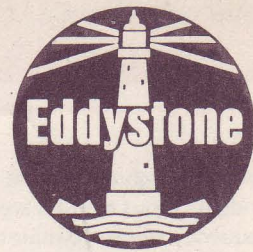
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High-Stability Communication Receiver

EC958

General Description The Eddystone Model EC958 is a professional class, solid-state communication receiver covering the band 10kHz–30MHz in ten ranges, with provision for high-stability operation at frequencies above 1.6MHz. Reception facilities cover CW, MCW, AM (DSB) and SSB in A3A, A3H and A3J modes. FSK (F1) capability can also be arranged by fitting an optional module. Operation can be from any standard 50Hz AC mains supply or from a low-voltage DC source using an external DC/AC converter.

Basic circuit configuration is governed by the tuning range in use, single- or double-conversion being employed at frequencies up to 1.6MHz. At higher frequencies, triple-conversion is used, the additional intermediate frequency providing an incremental tuning facility which is absent on the lower frequencies. Circuit arrangements permit continuous tuning over any selected range in the high-frequency band, or high-stability operation with incremental coverage in steps of 100kHz. In the latter mode, frequencies are readable to within 200Hz and the 1st Oscillator is locked to harmonics derived from an oven-controlled Master Oscillator having a long-term stability of the order 1 part in 10^7 . High-stability working at frequencies below 1.6MHz is possible by using an external synthesizer.

The signal frequency section of the receiver employs FET's in the RF Amplifier and Mixer stages, resulting in excellent two-signal

Solid state (incorporating FET's and IC's)

Frequency coverage: 10kHz to 30MHz

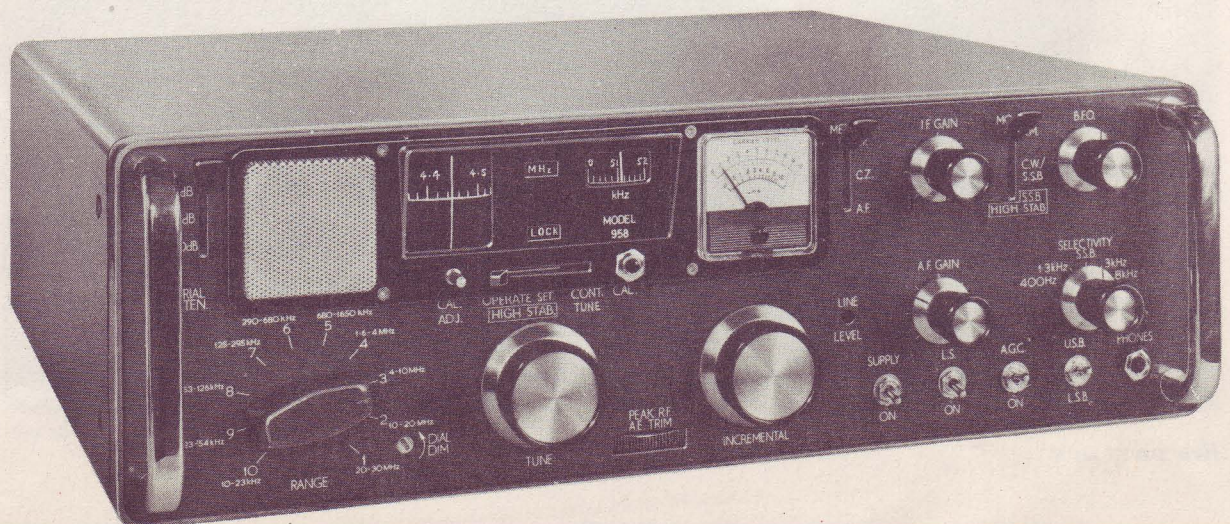
Continuous tuning or 100kHz step tuning above 1.6MHz

Modes: CW, MCW, AM, SSB and provision for FSK

Aerial circuit overload protection

Modular construction AC mains or DC (battery) via external converter

Bench or 19-in rack-mounting



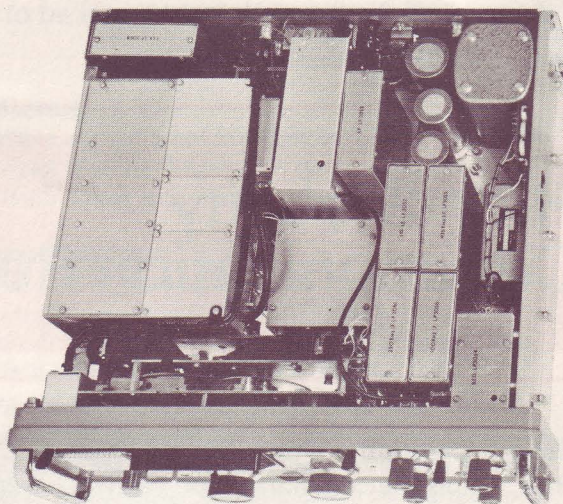
performance throughout the entire coverage. Double tuned bandpass input circuits are introduced on the higher frequency ranges to maintain a high degree of image protection through to 30MHz. Delayed AGC is permanently connected to the RF stage and a switched aerial attenuator is available for manual control of RF signal level. Adequate protection is provided against damage due to high induced voltages appearing at the aerial input.

Protection against two-signal effects is maintained at the 1st and 2nd IF's by combined use of FET's and a total of seven tuned circuits which provide adjacent channel selectivity of the order 10kHz. Tuning of the 1st IF circuits is by means of voltage variable capacitance diodes which are tracked against the high-grade variable capacitor in the Incremental Oscillator. Provision is made for correcting misalignment of the signal frequency circuits when the tunable IF is offset from its nominal value.

The conversion oscillator feeding the 3rd Signal Mixer is crystal controlled and can be switched to operate above or below the 2nd IF to provide USB/LSB selection. The same control can be used for mark/space reversal when using a receiver equipped for FSK working.

Five degrees of selectivity are provided at the final intermediate frequency (100kHz), ranging from 400Hz for narrow-band CW to 8kHz for AM reception. A multi-pole crystal filter is fitted for SSB having a bandwidth of 2.7kHz. Amplification at 100kHz is provided by four cascaded FET stages, an emitter follower being included to furnish IF output for use with ancillary equipment. Two separate AGC systems are utilized to control the RF and IF stages, the IF AGC being brought out at the rear for convenience in diversity working.

A normal diode detector is employed for AM reception and an FET product detector for CW and SSB. Carrier insertion in the latter mode can be derived from the Master Oscillator for high-stability applications above 1.6MHz. The tunable beat

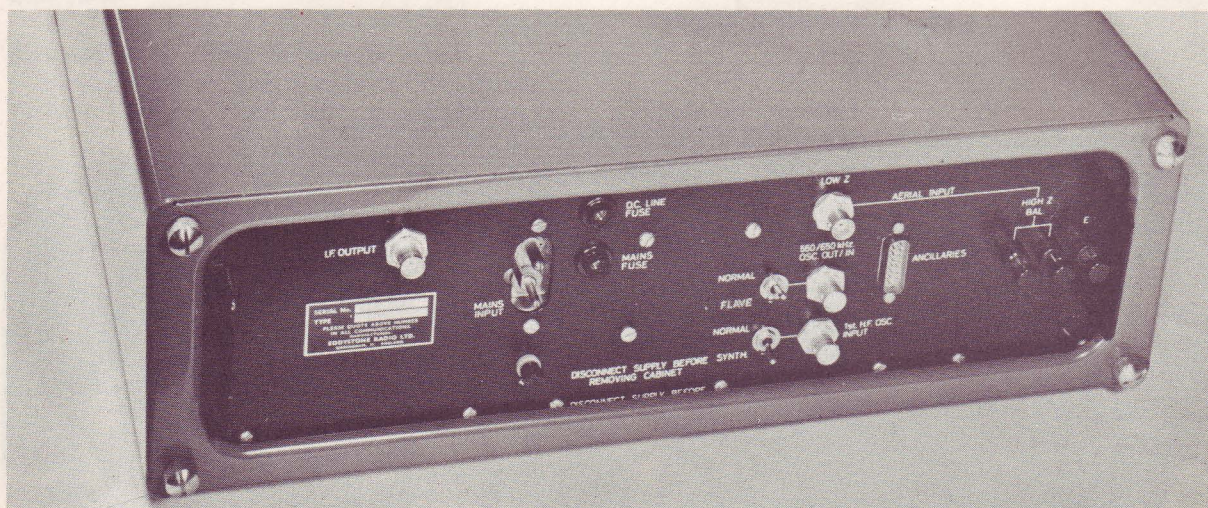


Internal view of EC958 showing modular construction

oscillator has a coverage of ± 5 kHz for CW operation and is fitted with a reduction drive for ease of adjustment.

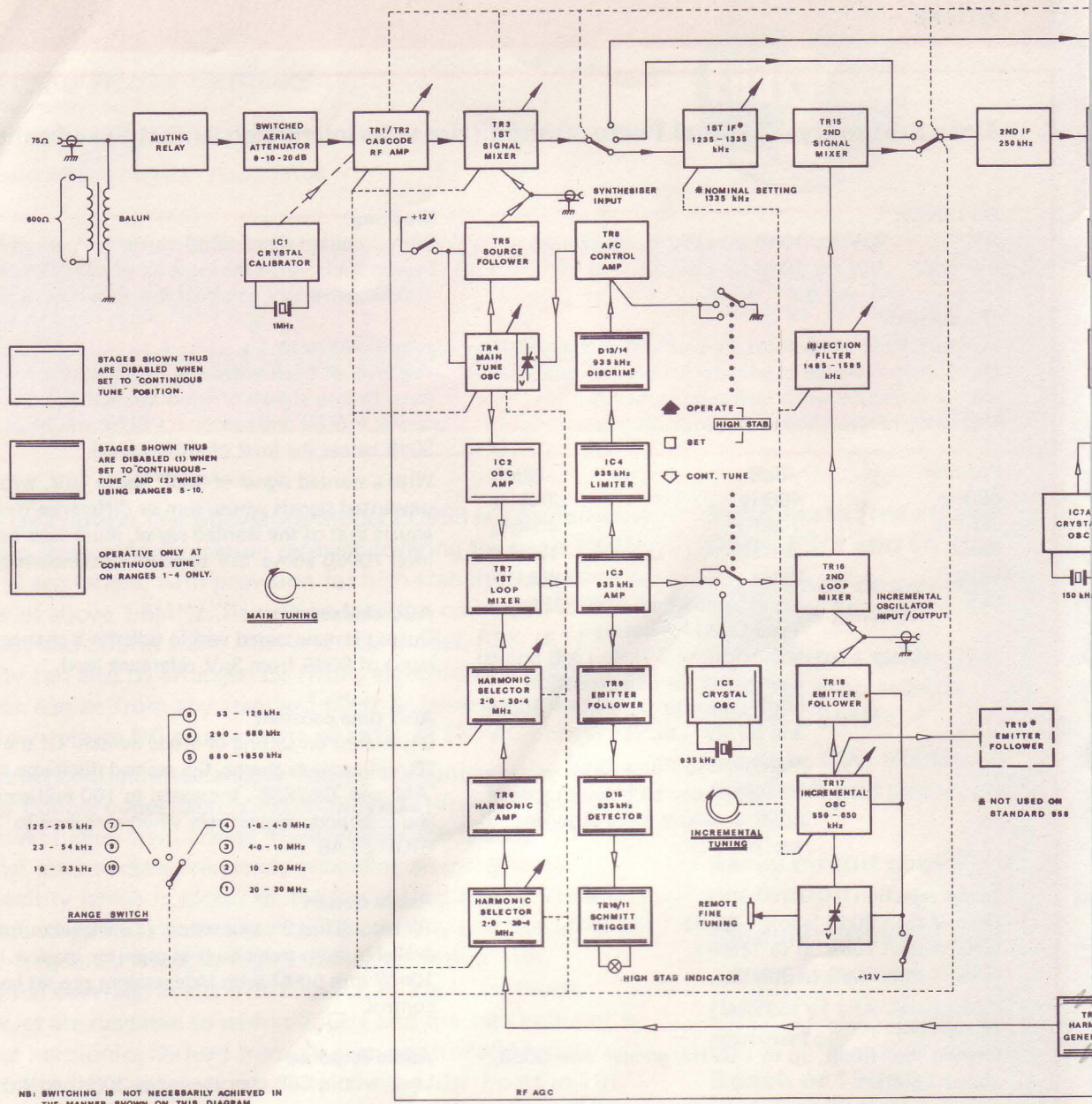
Separate audio outputs are available for loudspeaker, headset and lines, the latter being fed from a totally independent amplifier with a pre-set level control. A built-in monitor loudspeaker is provided for use where a low-level output is adequate for operational requirements. Line output can be monitored on a meter which can also be switched to serve as a carrier level indicator or centre-reading FSK monitor.

Other facilities include provision for remote tuning and the option of common oscillator control in dual-diversity working. A 1MHz crystal calibrator is provided for scale checking, and muting facilities are available when using the receiver in conjunction with an associated transmitter. The receiver can be supplied with a matching Panoramic Display Unit (Model EP961) for applications where visual signal analysis is an additional requirement.



Rear panel view

Block



Block diagram Model EC958

Mechanical Features

Rugged lightweight construction is employed throughout, with provision for rapid conversion of the basic receiver to suit standard 19-in racking. Bench-mounted receivers are normally fitted with rubber feet, but can be supplied with a matching plinth speaker or shock-absorbent mounting to suit installation requirements.

Modular techniques and unit construction are used extensively, so making the EC958 ideally suited to modern methods of servicing by substitution. Interconnections between modules and to panel functions are completed with miniature connectors to facilitate rapid removal and replacement of complete sub-assemblies.

The RF assembly is built into a diecast aluminium housing and utilizes a printed circuit coil turret for range selection. Tuning drives are flywheel-loaded and employ spring-loaded gearing throughout, with reduction ratios of 100:1 on both main and incremental controls. Scale presentation is by means of a light projection system which displays only a small range on either side of the received frequency.

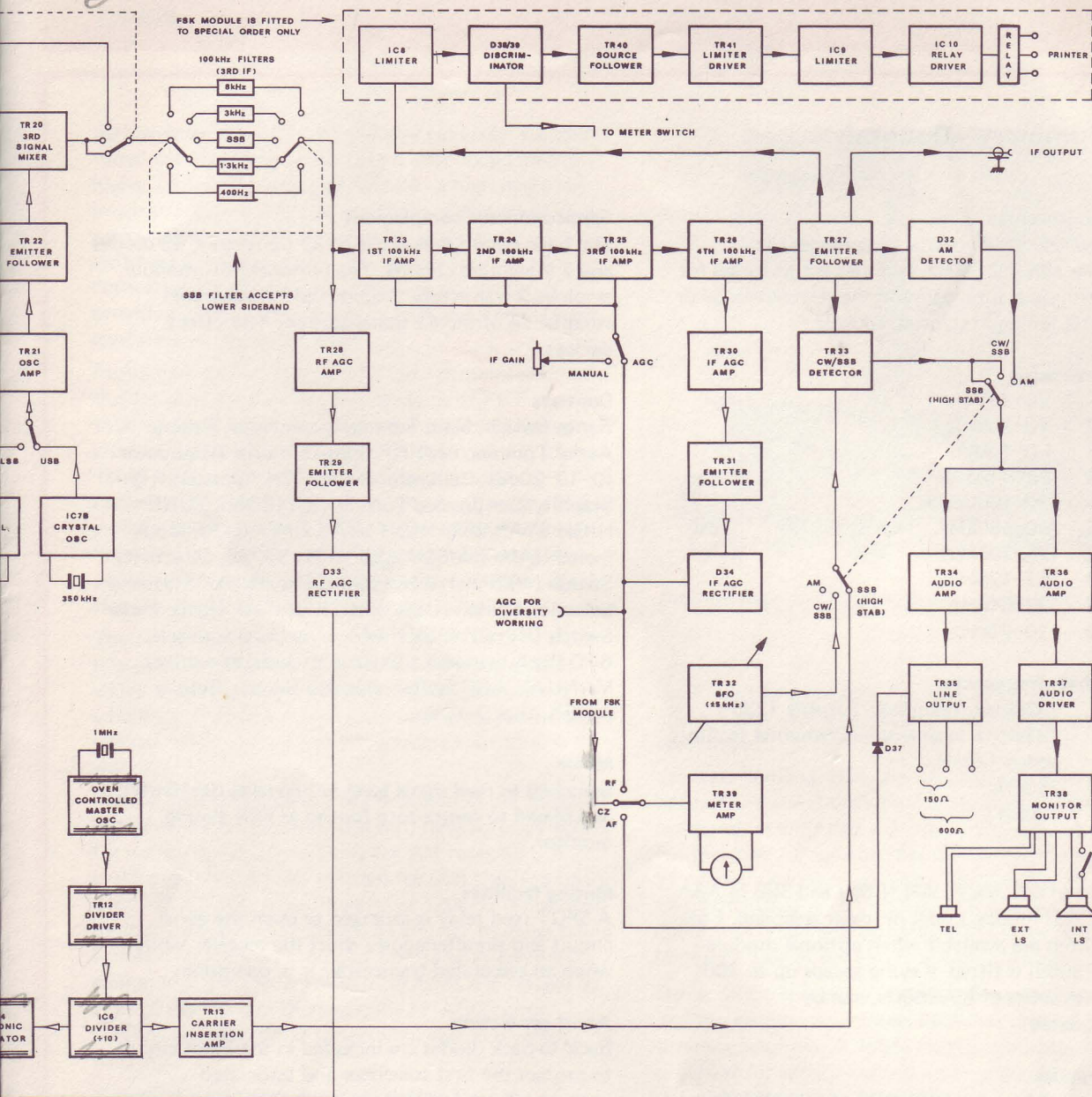
High-Stability Operation above 1.6MHz

In this mode of operation, a double-conversion drift-cancelling loop with integral AFC is utilized to eliminate frequency change due to the Main-Tune Oscillator. Overall stability is determined by the incremental oscillator which provides conversion drive for the 2nd Loop Mixer.

The first loop conversion produces a loop frequency of 935kHz by heterodyning the MTO frequency with an appropriate harmonic derived from the oven-controlled Master Oscillator and its associated frequency divider/harmonic generator.

The selected harmonic will be a multiple of 100kHz falling in the range 2.0MHz to 30.4MHz, and will lie 400kHz higher than the 0.1MHz calibration mark to which the main tuning control is set. Correct adjustment of this control is indicated by illumination of a panel legend activated by a detector fed from the 935kHz amplifier.

The 935kHz drive is passed to the 2nd Loop Mixer where it mixes with the incremental oscillator frequency to provide oscillator injection for the 2nd Signal Mixer. Any change in MTO frequency will



therefore be transmitted through the system to give automatic drift correction by changing the effective 1st intermediate frequency.

Bandwidth in the 935kHz circuits is restricted to 10kHz to limit noise and spurious transfer through the loop to the 2nd Signal Mixer. An AFC system is incorporated to take control of the MTO frequency after this has been set to provide 935kHz output from the 1st Loop Mixer.

A 935kHz Crystal Oscillator drives the 2nd Loop Mixer when the receiver is in the 'continuous tune' mode. The incremental control can be used as a fine tuning adjustment when operating in this manner.

Panoramic Display Installations EPR31 and EPR31/RM

The EC958 can be supplied with a matching Panoramic Display Unit (Model EP961) to form a wide coverage display installation suitable for spectrum analysis. The complete outfit is designated 'Model EPR31' (bench-mounting) or 'Model EPR31/RM' (19-in rack-mounting). EC958 receivers already in service can be converted to Model

EPR31/RM by addition of the display unit and appropriate hardware.

Linear or logarithmic signal displays are available on a 10 x 6cm screen, with a linear frequency base adjustable up to a maximum of 8kHz (determined by receiver IF selectivity). Resolution is such that two signals differing in level by 40dB can be resolved when only 200Hz apart. A separate data sheet on the EP961 is available on request.



Frontal appearance of Model EP961 Panoramic Display Unit

Data Summary—General

Frequency coverage

10kHz–30MHz in ten overlapping ranges. At frequencies above 1.6MHz, facilities are provided for either continuous tuning within the selected range or incremental tuning in steps of 100kHz.

Frequency ranges

Range 1	20–30MHz
2	10–20MHz
3	4.0–10MHz
4	1.6–4.0MHz
5	680–1650kHz
6	290–680kHz
7	125–295kHz
8	53–126kHz
9	23–54kHz
10	10–23kHz

Intermediate frequencies

1st IF:	1335kHz (nominal). Tunable 1235–1335kHz to provide incremental facility above 1.6MHz.
2nd IF:	250kHz.
3rd IF:	100kHz.

Facilities

Reception of CW, MCW, AM (DSB) and SSB in A3A, A3H and A3J modes, upper or lower sideband. FSK (F1) facilities are available when optional module (Type LP3058) is fitted. Keying speeds up to 200 bauds, with shifts of 85–850Hz, can be accommodated.

Power supplies

Single-phase AC mains 100/125V and 200/250V (40–60Hz), or low-voltage DC using external DC/AC converter.

Loading

Of the order 35W.

Input and output impedances

Aerial Input

75 Ω unbalanced throughout entire range. Additional 600 Ω input (balanced or unbalanced) available below 1.6MHz.

Synthesizer Input

Low impedance (to 1st Signal Mixer).

Incremental Oscillator (Input/Output)

Low impedance (to provide common oscillator facility for diversity working above 1.6MHz).

IF Output (100kHz)

Low impedance (to drive external ancillaries, e.g. Panoramic Display Unit Model EP961).

Audio Output

Loudspeaker: 3 Ω

Lines: 150 Ω unbalanced, 600 Ω balanced or unbalanced.

Headset: Low impedance.

Semiconductor complement

The basic circuit makes use of 39 transistors, 43 diodes and 7 integrated circuits. The optional FSK module employs 2 transistors, 3 diodes and 3 integrated circuits. 24 of the 41 transistors are field-effect devices.

Controls

Range Switch, Main Tuning, Incremental Tuning, Aerial Trimmer/Peak RF Control, Aerial Attenuator (0–10–20dB), Calibrator Switch, Cal Adjuster, High Stability/Continuous Tune Switch (CONT TUNE–HIGH STAB SET–HIGH STAB OPERATE), Mode Switch (AM–CW/SSB–SSB HIGH STAB), Selectivity Switch (400Hz–1.3kHz–SSB–3kHz–8kHz), Sideband Selection Switch (USB/LSB), IF and AF Gains, Meter Switch (RF–CZ (FSK)–AF), Line Level (pre-set), BFO Pitch (variable \pm 5kHz with reduction drive), MANUAL/AGC Switch, Speaker Switch, Supply Switch, Dial Dimmer.

Meter

Switched to read signal level or line level (0–10mW), and biased to centre-zero for use as FSK tuning monitor.

Muting facilities

A SPDT reed relay is arranged to open the aerial circuit and simultaneously short the receiver input when an associated transmitter is in operation.

Aerial protection

Back-to-back diodes are included in the input circuit to protect the first transistor and associated components against damage due to lightning, etc.

Dimensions

Panel Size

Bench-mounting: 16.75in x 5.25in (42.6 x 13.4cm)

Rack-mounting: 19in x 5.25in (48.3 x 13.4cm)

Overall Height

With standard rubber mounting feet: 5.75in (14.6cm)

With anti-vibration mounting: 6.0625in (15.4cm)

With matching plinth loudspeaker: 9in (22.8cm)

Depth

Overall, including front and rear projections: 17.656in (44.8cm)

Intrusion into rack: 15.875in (40.3cm)

On matching plinth loudspeaker: 18in (45.7cm)

Additional 1.75in clear required at rear to accommodate safe bending radius for cabling, etc.

Weight

41.75lb (18.9kg).

Data Summary—Typical Performance (Not to be interpreted as Test Specification)

Sensitivity

AM: $3\mu\text{V}$ for 10dB s/n ratio } Bandwidth
CW/SSB: $1\mu\text{V}$ for 10dB s/n ratio } 3kHz

IF selectivity

Five selectable bandwidths are provided at the 100kHz IF. Maximum overall bandwidth is determined by the front-end circuits when operating on the low-frequency ranges. Overall IF bandwidths are:

Position	-6dB	-60dB
400Hz	400Hz	2.4kHz
1.3kHz	1.3kHz	4.5kHz
3kHz	3kHz	12kHz
8kHz	8kHz	18kHz

SSB An asymmetrical filter (GEC Type QC 1170) having a bandwidth of 2.7kHz (3dB points) is provided for SSB reception. 50dB points lie at *carrier + 300Hz* and *carrier - 6kHz*.
Marconi SSB Filter Type F2005/01 can be fitted to special order to satisfy more stringent applications.

Image rejection

Greater than 60dB below 1.6MHz
Greater than 70dB up to 18MHz
Greater than 50dB to 30MHz

IF rejection

Greater than 60dB, up to 1.6MHz; greater than 90dB, above 1.6MHz.

Frequency stability

The figures quoted are indicative of the frequency stability achieved after a 30-minute warm-up period. The 1.6-30MHz figures are quoted for high-stability working, in which mode a supply voltage change of $\pm 10\%$ does not change the tune frequency by more than 10Hz.

With constant ambient temperature

1.6MHz-30MHz	Less than 20Hz (long-term).
160kHz-1.6MHz	Less than 1 part in 10^4 in any 5-minute period.
10kHz-160kHz	Less than 50Hz in any 5-minute period.

With 5°C change in ambient temperature

1.6MHz-30MHz	Less than 20Hz.
160kHz-1.6MHz	Less than 5 parts in 10^4 .
10kHz-160kHz	Less than 150Hz.

Cross modulation

With a wanted signal 60dB above $1\mu\text{V}$, the interference produced by an unwanted signal 10kHz off-tune and of level 90dB above $1\mu\text{V}$ will be more than 30dB below standard output.

Blocking

With a wanted signal 60dB above $1\mu\text{V}$, an unwanted carrier 10kHz off-tune must be of a level exceeding 100dB above $1\mu\text{V}$ to affect the output by 3dB.

Intermodulation

The level of third-order intermodulation products given by two signals of equal strength lying at *carrier + 1kHz* and *carrier + 1.6kHz* will be at least 30dB below the level of either signal.

With a wanted signal of 30dB above $1\mu\text{V}$, two unwanted signals whose sum or difference frequency equals that of the wanted signal, must each be of a level 100dB above $1\mu\text{V}$ to produce standard output.

AGC characteristic

Output is maintained within 6dB for a change in input of 90dB from $3\mu\text{V}$ reference level.

AGC time constant

Dependent on setting of Mode Switch. Of the order 20 milliseconds charge, 0.5 second discharge at 'AM' and 'CW/SSB'. Increased to 100 milliseconds and 5 seconds respectively when switched to 'SSB HIGH-STAB'.

Audio output

1W into 3Ω at 5% distortion. (Low-level output also available from small built-in monitor speaker.)
10mW into 600Ω with independent pre-set level control.

Audio response

Level within 3dB over the range 300Hz to 4kHz.

IF output

20mV into 75Ω for $3\mu\text{V}$ carrier at aerial input.

Radiation

Typically 20pW and not greater than 400pW at any frequency.

Operational temperature rating

0-50°C.

Calibration accuracy

Calibration interval of 200Hz on incremental scale permits frequency setting to within 50Hz by interpolation.

A 1MHz crystal calibrator is incorporated for verification of scale accuracy on the HF ranges.

Remote fine tuning

100Hz above and below local tune frequency. This facility is available on ranges 1-4 only.