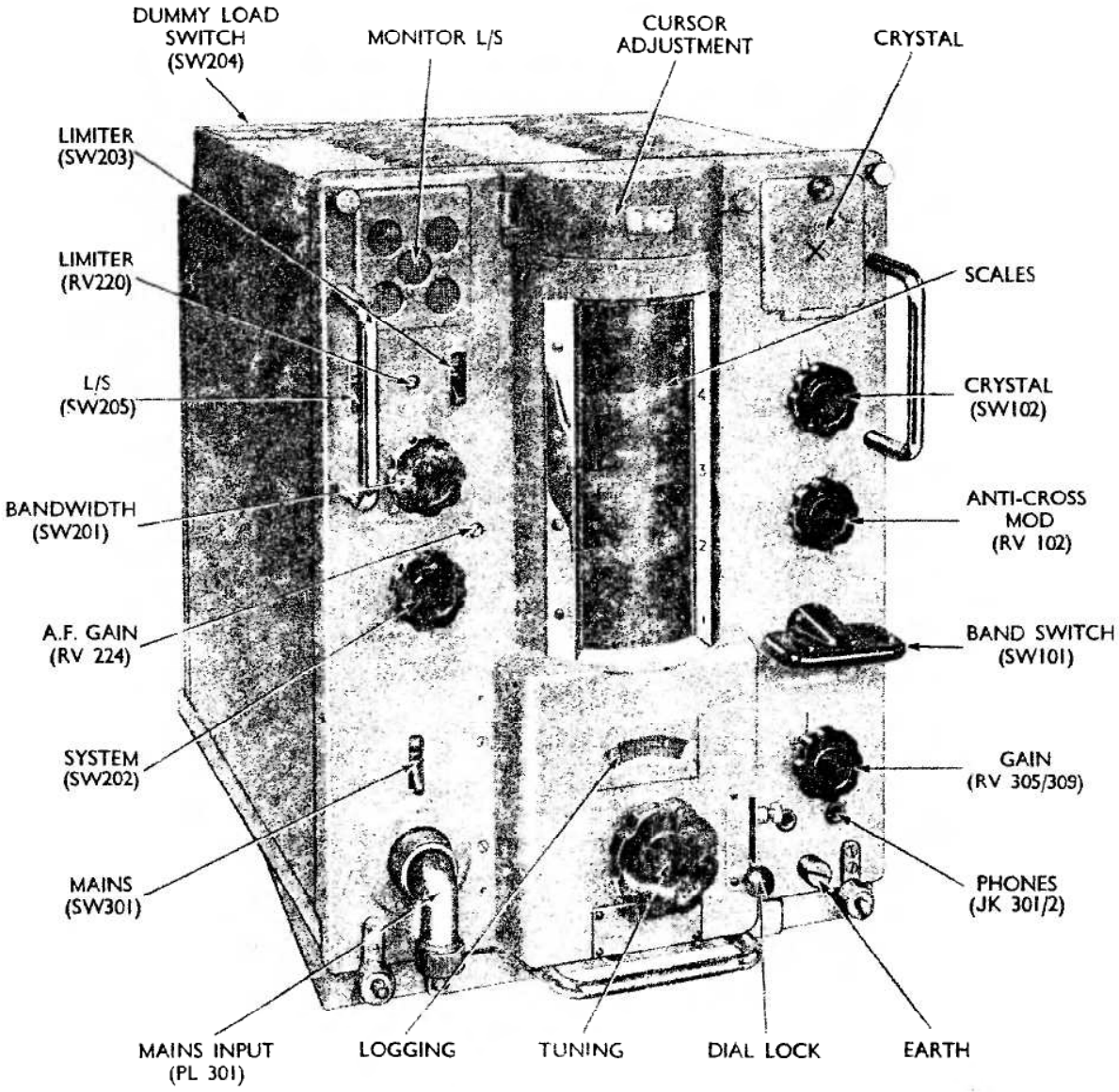

RECEIVER B.40
PATTERN 57140/A

RECEIVER B40

The receiver B40 is a conventional communications receiver for the reception of Voice, CW and FSK signals in the frequency range 650 kc/s to 30 Mc/s. There are five versions of this receiver, identified by the pattern numbers 57140, 57140A, 57140B, 57140C and 57140D. These are customarily referred to as B40, B40A, B40B, B40C and B40D. The main differences between the five versions are as follows:-

B40 Original version.

B40A Physical changes in the layout, mechanical changes to facilitate maintenance, and the substitution of improved components in certain cases.

B40B Re-designed tuning drive, the addition of a crystal filter in the IF circuits, note filter deleted, A.G.C. switch fitted, System switch modified, mains transformer replaced, improved h.t. smoothing incorporated, and a wave-band indicator fitted.

B40C Modifications in the RF assembly to adapt the receiver for Common Aerial Working.

B40D This receiver is fitted with preferred valves, which has made necessary some changes in the component values of the associated circuits. The b.f.o and local oscillator circuits are modified to adapt the receiver for FSK reception. There are two extra b.f.o. pitch positions for wide-band FSK operation, thus the SYSTEM switch in this pattern has seven positions. The l.o. circuit is modified to incorporate a fine tuning control (OSC TRIM), which is fitted to the front panel. This trimmer gives a fine adjustment to the local oscillator tuning, to compensate for transmitter frequency drift.

The instrument is of unit construction, consisting of:- RF Unit, IF Unit, AF and Power Unit. These three units, each with their own controls, are inter-connected and mounted on the framework which fits into the receiver case. The tuning drive mechanism, and front panel are also mounted separately on this framework.

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This collection of notes is mainly based on the official handbook, with some additions and amendments. P.R.G.

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DETAILED CIRCUIT DESCRIPTION

Circuit References

1. The circuit references quoted in this chapter, refer particularly to the pattern or patterns of the receiver described, as the references are not necessarily the same for the same component in different pattern circuit diagrams; this is especially the case with the B40D.

AERIAL CIRCUITS

2.
B40/A/B

(a) A transmission line or low impedance aerial source, is connected to the primary of the first RF transformer TR101 through Pins B and C of Plug PL101. This primary has a nominal impedance of 80 ohms. These pins are not earthed, the aerial being connected via a co-axial transmission line. A high impedance aerial may be connected through Pin D of the same plug, this input feeding directly into the secondary side of TR101, which is the grid circuit of the first RF amplifier (V101), tuned by the ganged variable capacitor C112, and the associated trimmers and padders C109, C110 and C111. The RF transformer, trimmers and padders for particular ranges are contained in the turret. On ranges 1, 2, and 3, C110 and C111 are omitted. Pin A on PL101 is the earth connection.

B40C/D

(b) These patterns are designed for HF receiver common aerial working, and for this purpose, the low impedance input circuits in the turret are modified by the addition of capacitors on ranges 1, 2, and 3. This in effect converts the primary of TR101 into a pi element to form part of a filter network, when several receivers are to be worked from a common aerial. There is no provision for a high impedance aerial.

(c) If reference is made to the B40B/C circuit diagram; Notes 1 and 2 indicate which components are fitted to the different pattern receivers.

FIRST RF AMPLIFIER

3.
B40/A/B/C

(a) The signal passes to the grid of the first RF valve V101 (this is a high slope pentode, 10 mA per volt), through the coupling capacitor C102 from the tuned grid circuit.

The anode circuit of this valve consists of the parasitic stopper R105 and the primary of the second RF inter-coupling transformer TR102. When the SYSTEM switch SW202 is in the 'CAL' position, calibration signals are fed into this circuit through the capacitor C131. In this position h.t. is not applied to V101, so that aerial signals are not received; the remaining two tuned RF circuits give sufficient selectivity and amplification to receive harmonics from the b.f.o., to cover the entire range of the receiver. Pulses from an RIS outfit may be fed into the suppressor grid of V101 through Socket SK102.

(b) The ANTI-CROSS-MOD control RV102 varies the grid bias on V101. When a large RF signal, other than the tuned signal, is present at the grid of V101, the selectivity of the first RF stage may be inadequate to prevent over-loading of the valve. Demodulation takes place in the first RF valve, and the interfering signal modulates the wanted one. By varying the bias on V101, the working point on the mutual characteristic of the valve can be chosen so that demodulation does not occur, or is minimised.

B40D

(c) The circuit is similar to that of the other patterns. The replacement valve type CV4014, has been incorporated into the circuit without any component values requiring modification. An additional resistor R130 is included to limit the bias voltage developed in the cathode circuit of V101, and a crystal rectifier (MR1) is connected between the slider of the ANTI-CROSS-MOD control (RV101) and the low potential end of R130 to ensure that the grid of V101 is never driven positive by large input voltages, resulting in a flow of grid current. The effect of this grid current would be to reduce the input resistance of the valve and heavily damp the associated tuned circuit, thus reducing selectivity and increasing cross-modulation. The additional circuit MR1 and R130, prevents this condition.

SECOND RF AMPLIFIER

4.
B40/A/B/C

(a) Valve V102 is a variable mu pentode with a mutual conductance of 2 mA per volt. Its grid circuit is tuned, and comprises the secondary of transformer TR102, a section of the ganged capacitor C116, and three capacitors, C113, C114, and C115. The coupling between the primary and secondary of transformer TR102 is adjusted at

manufacture. The anode load consists of resistors R113 and R114 in parallel, these resistors are of equal value and are connected in this manner to provide the required dissipation without increasing the size of the components. The signal is parallel fed to the frequency changer grid circuit via capacitor C121 and the primary winding of the transformer TR103.

(b) Stage gain is controlled manually (RV305), or by the a.g.c. voltage. In B40/A, position 1 of the SYSTEM switch is for manual control, other positions of this switch giving automatic control. In Receivers B40B/C the a.g.c. ON/OFF switch SW206 determines the type of control.

(c) For manual control, bias is fed to the cathode resistor R115 from the manual GAIN control RV305 which is in the cathode return of V102 and the other valves that are otherwise controlled by the a.g.c. voltage. The a.g.c. voltage is fed to the grid through the resistor R112.

B40D

(d) Excepting minor changes made necessary by the change of valve, which in this case is type CV454, the electrical characteristics of the circuit in this pattern are the same as those in the other patterns. The values of certain components have been modified so that the correct valve potentials, a.g.c. characteristic, and stage gain of the valve are maintained.

FREQUENCY CHANGER AND LOCAL OSCILLATOR

5.
B40/A/B/C

(a) Signals from the previous stage are fed via TR103 to the tuned grid circuit of the frequency changer, consisting of the secondary of the transformer, a section of the ganged capacitor C125, and the three capacitors C122, C123, and C124. The valve V103 is a triode-heptode, only the heptode portion of which is in use. The local oscillator signal is fed into the injector grid (Pin 4). The anode circuit includes the tuned primary of the first IF transformer TR104; this together with the tapped secondary is mounted in the RF Unit, giving low impedance coupling to the IF Unit. The coil L201, which is tuned, becomes the input coil in the IF Unit.

(b) The local oscillator functions either:-

As a normal variable oscillator, tracking with the incoming radio frequency signal to produce the intermediate frequency signal; or crystal controlled to provide stable reception on fixed frequencies.

(i) Variable Frequency Oscillator
Crystal Switch 'OFF'

This is a conventional Hartley circuit; with both sides of the section of the ganged capacitor C135 (C126, B40D) insulated from earth. The output from the frequency changer is taken from the anode through C130 (C184, B40D). When the CRYSTAL switch is set to OFF, the crystal terminals are short-circuited to minimise the effect of the crystal on the local oscillator.

(ii) Crystal Controlled Oscillator
Crystal Switch 'ON'

When switched to this method of operation, the circuit becomes a Colpitts crystal oscillator, coupled electronically to the anode circuit; which is tuned to the required harmonic of the crystal. A table showing how these frequencies are determined is given below. The function of L101 (L106, B40D) is to provide a high impedance RF path from the cathode to earth.

Band	Signal Frequency (S) kc/s	Derivation of Crystal Freq. kc/s	Range of Crystal Frequencies
1	640 - 1650	S + 500	1140 - 2150
2	1570 - 4100	S + 500	2070 - 4600
3	3900 - 7000	S + 500	4400 - 7500
	7000 - 10000	$\frac{S + 500}{2}$	3750 - 5250
4	9500 - 14500	$\frac{S + 500}{2}$	5000 - 7500
	14500 - 18500	$\frac{S + 500}{3}$	5000 - 6333
5	17600 - 22000	$\frac{S + 500}{3}$	6033 - 7500
	22000 - 30600	$\frac{S + 500}{4}$	5625 - 7775

Note The four tuned circuits in the RF Unit have the associated components, with the exception of the ganged capacitors, located in the turret switch compartments for the individual wavebands.

B40D

(c) (i) Frequency Changer Stage

This stage is similar to other patterns. The new valve CV2128 made certain minor changes in component value necessary, to maintain the correct working levels of the valve.

(ii) Local Oscillator Circuit

A modification has been made in the local oscillator circuit to facilitate f.s.k. reception, consisting of a small variable capacitor C159, added across part of the coil L101, to give fine tuning. This capacitor is driven by a slow motion drive from a control on the front panel, marked OSC TRIM. A scale having ten divisions 5 - 0 - 5 is viewed through a window in the panel. The range of the fine tuning is approximately plus and minus 5 kc/s at 20 Mc/s, and there is a proportional decrease in this range as the frequency is reduced. The local oscillator valve is now type CV4014.

THREE STAGE IF AMPLIFIER

6
B40A/B/C

(a) This amplifier follows conventional lines, employing variable mu pentode valves V201, V202, and V203. The centre frequency is 500 kc/s. The BANDWIDTH switch SW201 changes the coupling between the primary and secondary windings of each of the transformers TR201, TR202, and also TR104 (TR116, B40D) in the RF Unit. In position 1 (WIDE) the windings are over-coupled, giving a band-width of approximately 8 kc/s. In B40/A receivers, positions 2 and 3 (NARROW and NOTE-FILTER) the coupling is loose, giving a band-width of approximately 3 kc/s.

(b) In receivers B40B/C the second position of the band-width switch is the same, but the third position switches a double crystal gating circuit into operation instead of the audio note filter. This circuit is incorporated in the grid circuit of valve V202. It consists of a 1 kc/s pass-band filter, switching in on the third position of the BAND-WIDTH switch.

(c) A.G.C. voltage can be applied to valves V201 and V202 by means of the SYSTEM switch in receivers B40/A and the A.G.C. ON/OFF switch in B40B/C/D. When switched to manual operation the a.g.c. line is earthed and the gain setting determined by the setting of the manual RF Gain control RV305.

(d) An output for the IF method of working Outfit REC is taken from the cathode resistors R235/210 of the third IF valve V203, to the co-axial socket SK202.

B40D

(e) The replacement valves in the IF Unit are all type CV131. The value of the valve cathode resistors in the first two stages has been reduced to ensure the correct biasing of the valves.

A.G.C. CIRCUIT

7.

(a) A.G.C. rectification is carried out by half of the double diode valve (V204a), fed from the primary side of the last IF transformer TR203. The cathode of this valve is biased from the potential divider R212 and R213 to give the requisite delay voltage. The load comprises two resistors R214 and R215 (R236/7 in B40B/C/D); the full a.g.c. voltage being applied to the RF and IF stages concerned. The tapping from the load applies part of the available voltage to the grid of the first audio frequency amplifier V301.

B40/A

(b) For c.w. operation, resistor R217 and capacitor C219 are short-circuited by the SYSTEM switch SW202b/c, positions 2, 3, and 4. This reduces the resistance and increases the capacity of the line, to shorten the voltage build-up and retard the decay time. As soon as the c.w. transmission commences, a.g.c. voltage is applied, and retained during the telegraphic spaces in the carrier. In switch position 5, R217 and C219 are in circuit to make equal the a.g.c. voltage build-up and decay time, for effective voice working, when the carrier is constant during transmission.

B40B/C

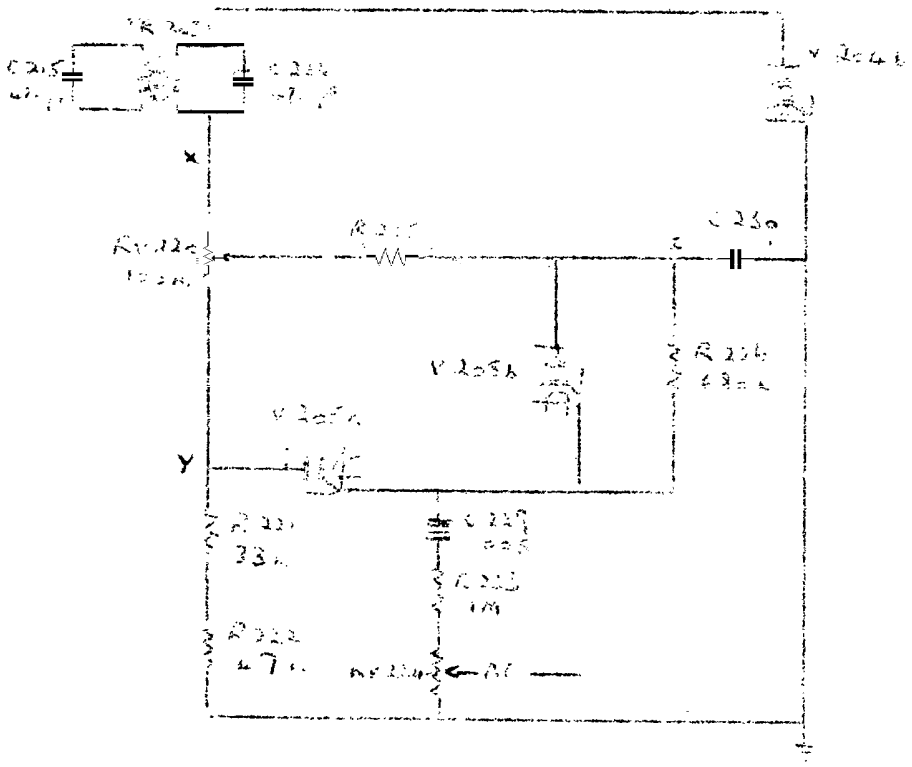
(c) The a.g.c. time-constant circuits are modified to give an 0.1 second charge and 1 second discharge for all systems of operation. R217 and C219 are deleted from these patterns.

B40D

(d) The circuit is not changed fundamentally from the B40B/C version, excepting that the values of resistors R212, R213 and R237, are changed to alter the delay voltage and the a.g.c. voltage supplied to the first AF amplifier.

NOISE LIMITER

8.



(a) Under normal signal conditions, an alternating voltage at 500 kc/s with AF modulations superimposed is developed across the secondary of TR203 such that, when the anode of the detecting diode (V204b) is positive with respect to the cathode, the diode will conduct. RF filters remove the carrier frequency, leaving only the rectified modulation. Current will flow through the circuit RV220, R221 and R222; the point 'X' becoming negative with respect to point 'Y'.

(b) C230 will charge through R225 and due to the long time-constant of this circuit, the point 'Z' will take up a mean d.c. level with respect to earth.

(c) Since the anode of V205a is connected to point 'Y', whilst its cathode is connected via R225 and R226 to a point of relatively negative potential on RV220, the diode will conduct. It will thus present a low impedance to the AF modulation, which will be coupled by C229 to the AF GAIN control.

(d) Meanwhile the cathode of V205b is connected virtually to point 'Y' (due to the low impedance presented by V205a), whilst its anode is connected via R225 to a point of relatively low potential on RV220. The valve is therefore non-conducting.

(e) For the proper understanding of the noise-limiting action of the circuit, it should be realised that the potential at point 'Y' varies with the AF modulation. Point 'Z', however, remains at a fairly steady d.c. potential, due to the long time-constant of R225 and C230.

(f) A pulse of interference will have the effect therefore, that instantaneously, the potential at 'Z' will not change but the potentials along the chain RV220, R221, R222, will increase their negative value.

(g) When the voltage at 'Y' falls below the voltage at 'Z', V205a will cease to conduct.

(h) Thus the voltage at V205a cathode, passed to the audio circuits, is normally not limited, but sharp peaks of interference will be clipped off.

(i) If, due to the self-capacity of V205a, some of the interfering pulse passes through the valve after it has become non-conducting, it is shunted to earth via C230 and V205b, whose cathode is now negative with respect to its anode and is therefore conducting.

(j) It will be seen that RV220 can vary the potential between 'Y' and 'Z', and consequently the depth of modulation that can be passed without clipping. In this case it is a maximum of 80% with the slider of RV220 at the top, and 10% at the bottom where the points 'X', 'Y', and 'Z' are at the same potential.

BEAT FREQUENCY OSCILLATOR

9.
B40/A/B/C

(a) The circuit functions as a Hartley oscillator in the c.w. positions of the SYSTEM switch SW202, is inoperative in the R/T position, and is crystal controlled in the CAL position. In receivers B40/A, the oscillator does not function in the WIDE position of the BANDWIDTH switch SW201, as in this position the screen supply to the valve is broken. With the SYSTEM switch in the CAL position, the screen draws its h.t. supply from another source of higher potential, to increase the screen current and make the circuit oscillate so as to provide the range of harmonics required. This also makes the calibration facility independent of the position of the BANDWIDTH switch. In B40B/C the b.f.o. functions on all positions of the BANDWIDTH switch.

(b) The main tuned circuit consists of L202 and C236, and resonates 1 kc/s above the IF of 500 kc/s. The operating frequencies of the b.f.o. in the different SYSTEM switch positions are as follows:-

B40/A	1.	MANUAL	500 kc/s
	2.	LOW	499 "
	3.	HIGH	501 "
	4.	TUNE	500 "
B40B/C	1.	LOW	499 "
	2.	HIGH	501 "
	3.	TUNE	500 "

For those positions where the frquency of the tuned circuit equals the IF, a small inductance L204 is added in series with the main circuit. The larger inductance L203 reduces the resonant frequency still further to 1 kc/s below the IF for the LOW working position of the SYSTEM switch.

(c) The anode circuit of the b.f.o. oscillator valve V206 is inductively coupled to the secondary winding of the last IF transformer TR203; this is the sole function of the anode of this valve, in the oscillatory circuit the screen operates as the virtual anode. As there is only a small degree of coupling between the IF transformer windings, the b.f.o. injection has negligible effect on the a.g.c. voltage derived from the primary.

(d) With the SYSTEM switch in the R/T position, the b.f.o. valve cathode is connected to chassis through R232 via SW202n. As well as stopping the valve from oscillating, this prevents the potential of the cathode from rising too far above that of the chassis. This could happen if the cathode was left unconnected, thereby causing arcing when the switch was moved to another position, with resultant

damage to the cathode of the valve.

(e) In the CAL position the SYSTEM switch removes the short-circuit from crystal XL201, and the circuit is crystal-controlled. Although under these conditions the tuned circuit has a natural frequency of 501 kc/s, the crystal causes it to oscillate at its own frequency of 500 kc/s. The additional screen voltage to provide the strong oscillation required, is obtained through SW202h from the h.t. line, which comes through Pin 4 of PL204, as well as the normal supply coming from Pin 7. The h.t. supply to the first RF valve is open-circuited to prevent signals from the aerial coming into the receiver during calibration; this also prevents the harmonics being radiated and breaking wireless silence. The calibration signal, consisting of the fundamental 0.5 Mc/s and its associated harmonics, is passed from the coupling coil L205, through SW202m-k-j and the second RF transformer TR102, and so through the receiver. Harmonics are available up to the 60th (30 Mc/s), the fundamental being employed to beat with the signal from the IF stages at the second detector.

10.
B40D

(a) The circuit is modified to give two extra b.f.o. pitch positions for FSK WIDE operation, to obtain an audio beat note of 2550 c/s above (HIGH) or below (LOW), the intermediate frequency.

(b) This is achieved by an arrangement of pre-set variable capacitors, selected by the SYSTEM switch. The first four positions of the SYSTEM switch give four different b.f.o. pitch frequencies, the fifth is the TUNE position. The fundamental operation of the circuit remains unchanged. The NARROW f.s.k. positions give an audio beat frequency (1000 c/s) above and below the IF. This was previously obtained by the pitch coils L203 and L204, which are deleted from this receiver. The NARROW FSK positions also provide a 1000 c/s note for the reception of c.w. The operating frequencies of the b.f.o. in the different SYSTEM switch positions are as below:-

1.	FSK WIDE - LOW	497.45 kc/s
2.	FSK WIDE - HIGH	502.55 "
3.	FSK NARROW - LOW	499.0 "
4.	FSK NARROW - HIGH	501.0 "
5.	TUNE	500.0 "

(c) The R/T and CAL circuits in this pattern are selected on positions 6 and 7 of the SYSTEM switch.

(d) Valve V206 is the new type CV131. No component modifications result from this change.

11. The calibrator crystals for the B40B/C/D receivers are specially processed, and though similar to the type 'A' crystals fitted to the other patterns, are not interchangeable with them. For identification, crystals for B40B/C/D are marked 'Pattern 67864 Crystal 500 kc/s'.

FIRST AF AMPLIFIER

12.

(a) The valve V301 is a variable mu pentode, with a.g.c. voltage tapped from the a.g.c. load network applied to its grid. The audio signal comes from the main AF GAIN control RV224. B40/A receivers have the anode circuit of the valve arranged to function with two alternative loads, switched by the BANDWIDTH switch SW201d in the IF Unit, through PL204 and SK301. In the WIDE and NARROW positions of this switch, the anode load is R302. In the NOTE FILTER position it becomes a tuned circuit consisting of L301 and C302. This circuit resonates at 1000 c/s and only signals of about this frequency develop appreciable voltages across the load, to be passed to the output valve. The pass-band of this circuit is about 200 c/s.

(b) The above facility is not included in the B40B/C/D receivers, as the third position of the BANDWIDTH switch brings into circuit the crystal band-pass filter associated with the IF circuits, instead of the note filter. This last-mentioned component is deleted from these receivers, so that the anode load of V301 consists only of the load resistor R302.

(c) In the B40D the valve is replaced by the later type CV454. Minor changes have been made in component values to maintain the electrical characteristics of the stage.

OUTPUT CIRCUITS

13.

(a) Output Stage

The receiver has a single valve output stage employing a power pentode valve V302. This delivers a maximum audio frequency power of 2.5 watts to the output lines. The full output power is normally used to feed an external loudspeaker. Operating the DUMMY LOAD switch SW204 to the ON position, connects a 620 ohms resistor across this output and disconnects the loudspeaker line. The output transformer TR301 has a resistor R313 connected across its primary to reduce peak voltage, this prevents flash-over should the remote loudspeaker become inadvertently disconnected. In B40D the valve is replaced by a new type CV2136. This has resulted in minor changes to the cathode circuit components.

(b) Output Lines

The three audio outputs are fed from the secondaries of transformer TR301, through socket and plug connectors from the AF and Power Unit, to the output plug in the IF Unit. The output plug (PL203 in B40, PL202 in B40D) is a Mark 4 sealed type and provides a six-way outlet at the rear of the IF Unit.

The three output channels are:-

-A- A 2.5 watt loudspeaker line, incorporating a switch SW204 (DUMMY LOAD). When this switch is placed in the "External LS OFF" position, i.e. the switch toggle towards the front of the receiver, a compensating resistor R234 is connected to earth across the output. (Pins A and B).

-B- An output derived from a separate winding of the transformer, normally employed to provide up to 35 mW into a ship's control system. (Pins C and D).

-C- The subsidiary headphone and monitor loudspeaker line extension, with a nominal power rating of 14 mW. RV309 gives further audio gain control when the a.g.c. is operative. This control is part of the two-gang GAIN control RV305/309. The operation of RV309 is determined by the SYSTEM switch (SW202g) in B40/A receivers, and by the a.g.c. switch (SW206d) in the later patterns. (Pins E and F).

All these outputs have a nominal impedance of 600 ohms, so that it is necessary for the external reproducers to be matched to this impedance. The output level for all lines is governed by the setting of the AF GAIN control RV224.

GAIN CIRCUITS

14. (a) The receiver can be operated with a.g.c. ON or OFF depending upon the setting of the control switches. "Manual" control of AF gain is provided at all times, but the RF gain is either manually or automatically controlled. The means by which the a.g.c. is switched, differs between the B40/A receivers and the later patterns. On the former, a.g.c. is provided on positions 2 to 6 of the SYSTEM switch and is disconnected in position 1, where RF gain is manually controlled. In B40B/C/D receivers, a.g.c. is controlled simply by the a.g.c. ON/OFF switch, manual control being provided in the OFF position.

(b) Electrically, the circuit is the same in all patterns of the receiver, the switch names representing the only difference.

(c) With a.g.c. operation selected, RF gain is controlled by the a.g.c. voltage. The headphones and monitor loudspeaker output line level is adjusted under these conditions by RV309, which is the a.f. section of the ganged GAIN control, switched by SW202g/206d. The RF/IF section of the GAIN control (RV305) is short-circuited by SW202e/206c and automatic control voltage fed to the grids of the relevant valves.

(d) When the RF gain is manually controlled, RV309 is disconnected by the opening of SW202g/206d. Switch sections SW202e/206c open and RV305 becomes the operative component of the GAIN control, varying the cathode voltage of the RF and IF valves concerned, to give the desired gain adjustment. The a.g.c. lines to these valves and the first AF valve are short-circuited to earth at SW202a/206a and SW202d/206b respectively.

RECTIFIER AND STABILISING CIRCUITS

15.
B40/A/B/C

(a) The double-diode valve V303, functions as a full-wave rectifier. The smoothing circuit comprises two chokes, L302 in the positive h.t. line, and L303 (L304, B40B/C/D) in the negative h.t. return line, with smoothing capacitor C305, C307 (C315, B40B/C/D), and C308 (C314, B40B/C/D).

(b) V304 is a neon stabiliser for the supply voltage to the local oscillator valve V104. The stabiliser priming electrode is supplied from the main h.t. line through R310 To provide effective de-coupling, the stabiliser valve is earthed at the RF Unit. Resistor R312 reduces the voltag to the first RF valve, which is a separate supply.

B40D

(c) This receiver incorporates an additional rectifier valve, the two anodes of each valve being strapped together and the whole arrangement used to form a full-wave rectifier circuit, with a valve at each end of the mains transformer h.t. winding. The valves employed are the preferr type CV493 (V303 and V304). In this pattern the stabilising valve is V305, which is a replacement type CV1832. As there is no priming electrode in this new valve, R310 is not included in this pattern. With the exception of the modifications mentioned above, the circuits are similar to the other pattern receivers.

VALVE TYPES

B40/A/B/C

Circuit Reference	Stage		CV No.	Equivalent
V101	First RF		CV327	EF52
V102	Second RF		CV303	EF22
V103	Mixer		CV302	ECH22
V104	Oscillator		CV327	EF52
V201/2/3	1st, 2nd, 3rd IF		CV303	EF22
V204	Det. and AGC		CV140	EB91, 6AL5, CV4025
V205	Noise Limiter		CV140	EB91, 6AL5, CV4025
V206	BFO		CV303	EF22
V301	AF Amp		CV303	EF22
V302	Output		CV304	EL22, 7C5
		or	CV2136	6BW6, 6061
V303	Rectifier		CV346	EZ22
		or	CV1790	7Z4
V304	Stabiliser		CV287	150B3

B40D

Circuit Reference	Stage	"Preferred" CV No.	"Preferred" Equiv.	"Reliable" CV No.	"Reliable" Equiv.
V101	1st RF	CV138	EF91	CV4014	6064
V102	2nd RF	CV454	EF93	CV4009	5749
V103	Mixer			CV2128	ECH81
V104	Osc.	CV138	EF91	CV4014	6064
V201/2/3	IF Amps.	CV131	EF92	CV4015	M8161
V204	Det/AGC	CV140	6AL5	CV4007	5726
V205	N.L.	CV140	6AL5	CV4007	5726
V301	AF Amp.	CV454	EF93	CV4009	5749
V302	Output	CV2136	6BW6	CV4043	6061
V303	Rectifier	CV493	6X4	CV4005	6063
V304	"	CV493	6X4	CV4005	6063
V305	Stabiliser			CV1832	0A2

In most cases, "Preferred" valves were fitted by the manufacturer, and when replacements were necessary "Reliable types were used if available.

DISMANTLING THE RECEIVER

To Remove Receiver from its case:

1. Remove all external connections.
2. Undo the two milled headed screws at top corners of front panel.
3. Tip receiver forward onto its panel handles.
4. Lift case off.
5. Restore receiver to upright position.

To Remove AF and Power Unit:

1. Remove the GAIN knob at bottom right of panel.
2. Remove V301.
3. Unplug two plugs, PL204/5 (PL203/4, B40D), and tuck up beside shaft of SYSTEM switch, taking care that nothing protrudes to foul the choke on the AF/Power chassis as it slides back.
4. Undo two large captive screws at bottom rear and slide AF/Power chassis free.

To Remove IF Unit:

1. Remove the BANDWIDTH, SYSTEM, AF GAIN and LIMITER knobs.
2. Withdraw two plugs from AF/Power Unit and two plugs from RF Unit.
3. Undo two captive screws at rear and slide IF chassis free.

RF Unit

All components on this unit can be reached without dismantlin it from the receiver framework. The screws holding the mechanism in position are situated on the underside of the framework.

To Replace Dial Lamps:

1. Open hinged flap at top of dial.
2. Undo two screws and ease multiple dial lamp assembly upwards from inside dial drum.
   (Note - when replacing, make sure that wiring harness does not foul inside of dial drum)

To Replace Logging-scale Lamp:

1. Remove AF/Power Unit as above.
2. Undo one screw securing lampholder arm.
   (Note - when replacing, ensure that arm is securely fastened and is not fouling either the dial drum or the logging scale.

OPERATING INSTRUCTIONS

Initial Setting-Up

1. (1) Ensure that the output line is connected, if not, switch in the Dummy Load, i.e. switch toggle towards the front of the receiver.
   (2) Place the Mains Switch in the "ON" position. Until it has warmed up, there will be a tendency for the receiver to drift slightly off tune.
   (3) Limiter switch to "OFF".
   (4) Bandwidth switch to "NARROW" or "3 kc/s".
   (5) Crystal switch to "OFF".
   (6) Loudspeaker switch to "OFF". Use 'phones.
   (7) System switch to "TUNE".
   (8) Anti-Cross-Mod. control fully clockwise.
   (9) AGC switch (where fitted) to "ON".

To tune-in a required signal.

2(a) If the station has been "logged" and the precise setting on the logging scale is known, set the band switch to the appropriate waveband and adjust the tuning control to the required logging scale position, search to and fro across this setting until the required station is heard. Tune very carefully to the "dead space" of the signal, then set the System Switch to the "HIGH" or "LOW" position for the reception of c.w. signals, or to the "R/T" position for the reception of "Voice" signals.

See paragraph 3(g) for the full use of the System Switch.

(b) If no logging scale setting for the required station is available, set the Wave-band Switch and Tuning control to the approximate tuning position. Then proceed as follows:-

   (1) Set the System Switch to "CAL".
   (2) Tune to the zero beat of the calibration mark (black spot) nearest to the required frequency.
   (3) Shift the tuning drum cursor, by means of the cursor adjustment, until the arrow in the centre lines up with the dead space.
   (4) Set the System Switch to "TUNE", and adjust the tuning control to the required frequency, search and adjust as in 2(a).
   (5) Record the logging scale reading.

(d) Adjust gain controls as follows:-
   (1) AF Gain to give a suitable level in the Remote Reception positions.
   (2) Gain Control to give adequate level in operator's 'phones.

To receive signals from a station

3. The satisfactory reception of signals, whether Morse or Voice, whether or not in the presence of interference, jamming or fading, requires an understanding of the function of the various controls provided. A detailed explanation of the use of each control provided for this purpose, and its effect upon the incoming signal is given below:-

Crystal Switch

(a) This switches in or out of circuit, a crystal whose function is to maintain the receiver accurately at a frequency determined by the crystal frequency. A pilot light shows behind a slot in the door of this compartment when the crystal switch is in the "ON" position.

Oscillator Trimming Control (B40D only)

(b) This is a fine tuning control for the local oscillator, enabling small adjustments to be made on either side of the normal setting. The scale has ten divisions marked 5 - 0 - 5, viewed through a window in the panel. This control is used for making fine tuning adjustments, particularly when receiving automatic telegraphy transmissions.

Anti-Cross-Modulation Control

(c) This control is normally in the "fully clockwise" position, and is used when cross-modulation interference is encountered. This form of interference is rare, and may be recognised by the manner in which the interfering signal "rides" on the wanted signal. It ceases when the wanted signal ceases, e.g. between morse symbols, and cannot be removed by tuning re-adjustments. It can be minimised, and possibly eliminated, by rotating the Anti-Cross-Modulation Control to the point where the interference is least.

Limiter Switch (SW203) and Limiter Control (RV220)

(d) Under conditions of severe interference, pulse or otherwise, the Limiter Switch (SW203) should be switched "ON". The amount of limitation imposed on the interference is effected by the Limiter Control (RV220). When the control is fully clockwise, limiting action is minimum. As the control is turned anti-clockwise, the amplitude of the interfering signals is reduced. The optimum position for this control is the point where interference cannot be reduced any further without undue distortion of the speech or (as in the case of morse signals) reducing the wanted signal also.

A.G.C. Switch (SW206) B40B/C/D

(e) This switch will normally be set to "ON", so that the a.g.c. cicuit is operative. Only when a very weak signal is being received should it be necessary to switch off a.g.c. When switched "ON", the a.g.c. system levels out variations of signal strength due to fading, or variations of signal strength among ships operating on the same frequency. In the case of receivers B40/A, a.g.c. is switched "ON" or "OFF" according to the position of the System Switch (SW202).

Bandwidth Switch (SW201)

(f) B40/A

(i) This is a three position switch giving two positions of IF selectivity, 8 kc/s and 3 kc/s. In the third position, the bandwidth remains at 3 kc/s, but an additional Note Filter with an effective audio bandwidth of approximately 200 c/s at 1 kc/s, is brought into circuit in the AF unit. In the WIDE position, the b.f.o. circuit is inoperative.

B40B/C/D

(ii) A similar switch to that already described for the previous two patterns, is used to provide bandwidth positions of 8 kc/s, 3 kc/s, and 1 kc/s. The third position is a 1 kc/s Crystal Filter circuit which replaces the Note Filter of the earlier patterns. The b.f.o. functions in all three positions.

System Switch (SW202)

(g) This switch permits selection of the following positions:-

CAL

(i) This is used when tuning-in a station which has not previously been logged. It permits the scale to be set accurately to the frequency in use. The receiver is tuned to the dead-space of the calibration signal nearest to the required signal frequency, and the cursor is rotated to the black spot denoting the calibration point in question.

R/T (Voice)

(ii) This position is used when receiving Voice signals.

TUNE

(iii) When tuning-in a station, this position is used. The tuning control should be adjusted to the dead-space of the required station. Subsequently the System Switch should be set to R/T for "Voice" signals, or to HIGH or LOW for morse signals.

HIGH or LOW

(iv) When receiving morse, if interference from a station working on an adjacent channel is experienced, the switch should be set either to HIGH or LOW, according to which position affords the greates freedom from interference. This is most effective on the 1 kc/s position.

MANUAL (B40/A only)

(v) The a.g.c. circuit is inoperative in this position. It should be used only when very strong interfering signals are experienced. Under these circumstances, if the a.g.c. circuits are in use, they will tend to produce such large a.g.c. voltages that reception is blocked.

It must be remembered however, that in the MANUAL position, the b.f.o. is at 500 kc/s and will produce "dead-space" tuning conditions if the wanted signal is tuned in accurately. The receiver must therefore be detuned slightly to ensure an audible note from the wanted signal.

F.S.K. Facilities (B40D only)

(vi) Two additional positions are provided on the System Switch for Frequency Shift Keying (FSK) reception. These are marked "FSK WIDE -HIGH-" and "FSK WIDE -LOW-" and are used for the reception of signals with a frequency shift of 200 - 1000 c/s. The HIGH and LOW c.w. positions remain the same (1000 c/s above and below the IF) and are also used for the FSK NARROW shift (0 - 200 c/s), so that the System Switch in this pattern has the following settings:-

Switch Position	System		
1	FSK WIDE	LOW	
2	FSK WIDE	HIGH	
3	FSK NARROW	LOW)	C.W.
4	FSK NARROW	HIGH)	
5	TUNE		
6	R/T		
7	CAL		

AF Gain Control (RV224)

(h) This control is normally set to give the required volume on the remote loudspeakers and 'phones connected to the control system. The degree of automatic control afforded by the a.g.c. system should ensure that variations in strength of incoming signals will not often require a change in the setting of the AF Gain Control.

Gain Control (RV305/309)

(j) (i) When the a.g.c. system is in use, this control affects only the loudness of the signal heard in the built-in loudspeaker or receiver telephones. It does not affect the level in the control system.

(ii) When the a.g.c. is inoperative, i.e. in MANUAL or A.G.C. 'OFF', the overall signal level, both local and remote, is varied by this control.

4. The function of the other controls is as follows: -

Bandswitch

(a) This is the turret switch which selects the appropriate coils for each waveband, at the same time illuminating the relevant dial scale.

Tuning Assembly

(b) Tuning facilities are situated in the centre of the receiver and consist of the tuning drum, its associated cursor adjustment and dial locking device, logging scale and flywheel tuning drive; the knob being at the lower centre of the instrument. Tuning is by means of four ganged capacitors, one in each of the two RF amplifiers, the mixer, and local oscillator circuits. The drive operates the tuning drum through a 20 : 1 reduction gear box, a 3 : 1 reduction is made in the transmission to the ganged capacitors through a chain drive. Receivers B40B/C/D employ a modified drive incorporating a further gear box between the ganged capacitors and the chain drive. A stopping device at each end of the drive travel prevents damage to the ganged capacitors.

Tuning Drum

(c) The five scales - one for each band - are positioned on the drum at a slight angle to the horizontal. As the drum rotates, the cursor rises or falls (depending on the direction of rotation) allowing two revolutions of the drum between the stops at the ends. Calibration points are indicated by a + sign.

Cursor Shift Control

(d) This is a knurled wheel behind the curved hinged cover at the top of the central part of the front panel. It is used to enable the cursor to be aligned with the calibration marks on the tuning scales.

Dial Lock

(e) Situated at the right hand side of the tuning knob, this lever controls a device for holding the tuning assembly in a particular setting. Loading springs prevent excessive pressure being placed on the locking mechanism. A thumb set screw at the side of the lever prevents it dropping under severe vibration.

Monitor Loudspeaker and Switch

(f) This is used for local loudspeaker reception. It is switched "On" or "Off" by means of the loudspeaker switch and can be used in circuit whether or not the external lines are connected. The audio output is relatively small, and care must be taken not to overload it by using excessively high settings of the gain control.

Telephone Jacks JK301/2

(g) Headphones pattern W621, impedance 600 ohms, should be inserted into these jacks. Either two or three contact jack plugs may be used.

Earthing Terminal

(h) This terminal is situated at the bottom right-hand side (as seen by the operator) of the receiver, below the 'phone jacks.

Dummy Load Switch SW 204

(j) It is essential that this switch is in the ON position, i.e. with the lever towards the front of the receiver, when the 600 ohms output line is not in use. The switch then connects a dummy load resistor of 620 ohms across this line. The switch is placed in the OFF position when a remote loudspeaker is connected in the line.

Scale Lamps Brilliance Control RV125 B40/A/B/C RV 102 B40D

(k) Part of this control is in series with the scale lamp selected by the bandswitch and adjusts the brightness of the scale lamps.

NOTE: Controls described in (j) and (k) above, are at the back of the IF and RF units.

External Connections

5. Power Supply

(a) The power supply is fed to the receiver via a Mk.4 plug and socket on the front panel.

The remainder of the external connections are made to the plugs and sockets on the bracket at the rear of the RF and IF units.

Aerial Input Plug PL101

(b) This is a four pin Mark 4 plug, situated at the rear of the RF unit. Pins B and C are used for the low impedance aerial inputs. A high impedance aerial may be connected to pin D in B40/A/B receivers only; there is no high impedance aerial input provided in B40C/D receivers. Pin A is earthed.

RIS Socket SK102 (SK101, B40D)

(c) This is a coaxial type socket (rear of the RF Unit). Outputs from RIS outfits can be applied to the receiver, through this plug.

REC Socket - SK202

(d) This is a coaxial type socket, situated at the rear of the IF unit. This IF output can be used for Outfit REC.

REB Socket - SK203

(e) This is a coaxial type socket, situated at the rear of the IF unit. This socket is the one nearest to the RF unit, and provides d.c. for use with Outfit REB.

Audio Output Plug - PL203 (PL202, B40D)

(f) This is a Mark 4 six pole sealed type plug, providing three output channels as follows: -

(i) Pins A and B deliver 2.5 watts into a 600 ohms line. This output is normally connected to a remote loudspeaker.

(ii) Pins C and D deliver 35 mW into a 600 ohms line from a separate winding on the transformer.

(iii) Pins E and F give an output of 14 mW into a 600 ohms line. They are an extension of the headphone and monitor loudspeaker circuits.

(iv) Pins A and F are earthed.

Additional Hints on Operating

Despite the official recommendation, it is not good practice to use AGC in most cases. For general searching on any mode, the AGC should be OFF, one should set the AF Gain at a convenient level and 'ride' the RF Gain (RV305) while tuning

SSB Reception

In general the technique is to have AGC 'OFF', with the AF Gain at maximum and the RF Gain as low as possible in order to avoid overmodulation distortion which can make it impossible to resolve signals. On upper sideband the point of clarity will be found on the low side of the signal and vice versa.

B40/A As the AGC and BFO are linked with the Bandwidth and System switches in these models it is not possible to set for optimum efficiency. However, satisfactory results are obtainable.
Bandwidth must be 'NARROW' to have the BFO on and without the audio note filter.
System switch to 'MANUAL' to disable the AGC.

B40B/C Bandwidth as desired.
System switch to 'HIGH' for upper sideband on 14, 21 and 28 MHz, and to 'LOW' for lower sideband on 1.8, 3.5 and 7 MHz.

B40D Bandwidth as desired.
System switch to 'CW (FSK NARROW) HIGH' for upper sideband, and to 'CW (FSK NARROW) LOW' for lower sideband.

On all models, if for some reason it is desired to have the AGC 'ON' for SSB reception, it may be found helpful to reduce the strength of incoming signals by turning down the Anti-Cross-Modulation control.