Technical Specification

Marine Radio Receiver Type B 312 U.

Power supply:

12-24-32-36-110-220 volts D.C.
110-220 volts A.C.
according to power pack fitted.

The built in power pack is interchangeable by a plug-and-socket connection and has for the voltages mentioned below the designation:

12 wolts D.C.:	B 380	
24 volts D.C.:	B 381	
32 volts D.C.:	B 382	
36 volts D.C.:	B 383	
110 volts D.C.:	B 384	
220 volts D.C.:	B 385	
110 volts A.C.:	B 386)	transformer re-set for
220 volts A.C.:	B 386)	appropriate voltage.

Circuit:

Superheterodyne receiver with band pass input circuit, low impedance input, 110 kc/s, intermediate frequency, variable bandwidth, beat oscillator, push pull output circuit.

Tuning range:

1.	165	- 475	kc/s
2.	465	- 1390	-
3.	1350	- 3850	-

Tuning mechanisme:

Slow motion friction drive with clock type indicating mechanisme with two pointers (slow and fast), absolutely free of backlash. Dial calibrated in kc/s, when using the vernier scale the effective length of the scale is 4500 mm on each frequency band.

Sensitivity:

50 milliwatts output for 1-3 microvolts input with a 10 db signal to noise ratio (30% modulated signal/no signal).

Selectivity:

Minimum bandwidth: nominal 1 kc/s (±0,5 kc/s):
3 db down for ±0,5 kc/s detuning
60 db down for ±3,3 kc/s detuning.

Maximum bandwidth: nominal 12 kc/s (± 6 kc/s)
3 db down for ±6 kc/s detuning.
60 db down for ±11,5 kc/s detuning.

Image ratio:

In the middle of range 1: at least 80 db
In the middle of range 2: at least 70 db
In the middle of range 3: at least 40 db

Over voltage protecting devices:

24 volts relay operated by the key disengages the loudspeaker and shorts the loudspeaker winding of the output transformer, when key is pressed.

Aerial safety lamp for protecting input circuit when working duplex telephony.

Direction finding facilities:

In connection with frame aerial type B 135 or B 278 the receiver may be used as a first class direction finder as special aerial transformers and separate sense resistors are supplied on all ranges.

Output:

Maximum output: About 6 watts, except on 110 volts D.C. mains, in which case the output is about 2 watts.

Built-in loudspeaker.

Output impedance: 3-5 ohms for extra loudspeaker (if any),
nominal: 50 ohms for headphones.

CW-reception:

Separate beat oscillator provided for. Beat note variable ±2 kc/s.

Automatic Gain control:

4 valves controlled by the A.V.C.-diode voltage giving a good output regulation for varying input. The A.V.C. may be cut out when working CW and is automatically cut out when operating the receiver as a direction finder, only manual control of R.F. and I.F. amplification being employed in this case.

Stability:

Semi-variable air dielectric trimmers are used throughout and the I.F. transformers are temperature compensated for maximum stability.

Metering:

A milliammeter and switch are provided for measuring anode current of each individual valve. Meter may be used as a good tuning indicator. Moreover the meter in connection with a built-in rectifier may be used as an output meter, giving a fine visual indicating of minimum when taking bearings. For "Consol" bearings taking output meter is indispensable.

Illumination:

The scale is illuminated by two flash light bulbs each 6 volts 0,15 amps. Switch for cutting out illumination when not wanted.

Valves:

Radio frequency amplifier	UF 85 (19 BY 7)
Oscillator and frequency changer	UCH 81 (19 D 8)
First intermediate frequency amplifier	UF 85 (19 BY 7)
Second intermediate frequency amplifier	UF 85 (19 BY 7)
Signal and A.V.C. rectifier and audio frequency amplifier	UBF 80 (17 C 8)
Beat frequency oscillator	UF 85 (19 BY 7)
Output valves	2 type UL 84 (45 B 5)
Aerial safety lamp	110 v. 15 w.
Dial bulbs	2 type 6 v. 0,15 amp.

Controls:

Tuning
Frequency range
Gain: RF/AF
Bandwidth (5 positions)
B.F.O. Pitch
Minimum sharpening/sense
Off/Direction-finding/Radio
Dial light on/off
Loudspeaker on/off
A.V.C. on/off
M.C.W., telephony/CW
Anode current/output

General construction:

Heavy aluminium chassis built integral with but electrically insulated from the metal front plate, resting in insulated side members in a metal cabinet, lacquered in grey colour and connected to earth.

Lid of cabinet may be raised when 4 knurled nuts are removed. Similarly the whole receiver may be withdrawn from the cabinet when 4 other knurled nuts are turned up.

Ceramic material is used throughout in the frequency changing mechanisme.

All connections from outside to the receiver are established through plugs and sockets, one set for a co-ax cable for aerial lead in, another set for a twin lead cable for frame aerial connection and a third 10-pole plug-and socket for all other connections. Ample cable length allows for the receiver being withdrawn without breaking connections. The complete receiver is mounted on heavy shock absorbers.

Loudspeaker for bulkhead mounting supplied separately (on special order).

Weight and dimensions:

The weight is:	20 kgs.	
Height:	300 mm	+ 30 mm shock absorbers
Width:	520 mm	
Depth:	335 mm	+ knobs

Marine Receiver with Direction Finding Facilities

Type B 312 U.

Diagram:

One stage of radio frequency amplification with band pass input on all bands for satisfactory duplex telephony working, good image selectivity and minimum cross modulation, when operated near powerfull transmitters.

Low impedance input circuit for correct matching to shielded aerial lead in (co-ax cable).

Special aerial transformers on all bands for connection of frame aerial for direction finding (see below).

Frequency changer and oscillator stage with a triode-hexode valve.

Two stages of intermediate frequency amplification with 3 band filters having variable coupling giving a bandwidth variable between $\pm$0,5 kc/s and $\pm$6 kc/s (bandwidth measured at level 3 db down from maximum)

Intermediate frequency: 110 kc/s.

Diode signal rectifier and diode for automatic volume control (A.V.C.) combined with one stage of audio frequency amplification.

Beat frequency oscillator for CW reception, variable $\pm$2 kc/s by a knob in the frontplate.

Push pull pentode output stage, built in loudspeaker; output impedance 3-5 ohms for extra loudspeaker. Separate transformer winding for headphone connection.

Loud speaker may be switched in and out without effecting output to headphone or earpiece (of microphone handset).

Output: About 6 watts except on 110 volts D.C. in which case the output is about 2 watts.

Frequency range:

1:	165	- 475	kc/s
2:	465	- 1390	-
3:	1350	- 3850	-

Dial:

Friction drive with small knob on handle for quick rotating of same. Clock type indicating mechanisme with two pointers, one rotating 360° (100 divisions) the other one ten times 360° for a 180° rotation of the shaft of the tuning capacitor. The pointers are actuated through spring loaded gears from the shaft of the tuning capacitor, independent of the driving mechanisme, thus completely avoiding backlash. The dial is calibrated direct in kc/s, and besides a 100 division scale is furnished giving an effective length of the scale of about 450 cm (16 ft.) when the quick rotating pointer is used.

Stability and frequency drift:

For maximum mechanical and electrical stability trimmers in the radio frequency (including oscillator) circuits are of the midget air dielectric type. Padding capacitors and tuning capacitors in the I.F. circuits are of the protected silvered mica type combined with small ceramic capacitors with negative temperature coefficient for compensation.

Sensitivity:

If sensitivity is defined as the signal 30% modulated, which, fed to the input terminals of the receiver through a standard artificial aerial, will give an output of 50 milliwatts with a ratio of at least 10 db between the signal output and the output noise of the receiver without any signal applied, the sensitivity is: 1 microvolt on all ranges when the bandwidth is adjusted to $\pm$0,5 kc/s and 2-3 microvolts with a bandwidth of $\pm$3 kc/s.

For CW-reception the sensitivity is better than 1 microvolts on all ranges (using narrow bandwidth).

Selectivity:

For the I.F. proper the selectivity is as the following table shows:

Attenuation:

	Nominal bandwidth kc/s:				
	1 (±0,5)	1,2 (±0,6)	3 (±1,5)	6 (±3)	12 (±6)
dbs:	Detuning, plus or minus, kc/s:				
0	0	0	0	0	0
3	0,5	0,6	1,5	3,2	6,1
6	0,7	0,8	1,7	3,4	6,7
20	1,2	1,5	2,3	4,0	7,6
40	2,2	2,5	3,6	5,2	9,8
60	3,3	3,4	5,0	7,1	11,5

On range 1 (long wave) the R.F. input circuits will affect the bandwidth slightly, the final bandwidth being a little more narrow than shown above. On range 2 and 3 the R.F. circuits will not affect the selectivity worth mentioning.

Attenuation of an image frequency signal, that means a signal having a frequency 220 kc/s higher than the frequency to which the receiver is set:

In the middle of range 1: at least 80 db
In the middle of range 2: at least 70 db
In the middle of range 3: at least 40 db

Narrow bandwidth (1 kc/s) is used when operating the receiver as a direction finder. Wide bandwidth (6-12 kc/s) is used when receiving telephony or broadcasting.

Over voltage protecting devices:

In order to protect the input circuit (aerial coil) of the receiver and to prevent signals from the ship's own transmitter from being heard in the loudspeaker a safety relay has been fitted to the receiver. The relay is fed from a 24 volt D.C. source of one of the transmitters with which the receiver is engaged. (The relay will operate for voltages ranging from 12 to 36 volts). The relay operates, when the telegraph key is pressed or, when working simplex telephony, when the push button of the microphone handset is pressed. The relay has two contacts, one shorting the receiver input terminals, the other one disengaging the loudspeaker and shorting the L. S. winding of the output transformer.

In order to protect the receiver input coil also when working duplex telephony (in which case the receiver must be kept open with carrier on) an ordinary lamp (light bulb) has been inserted in the aerial lead. The lamp will limit the current through the input coil to 0,15 amps.

When the lamp is cold (i.e. no current through the filament) the resistance of the filament is so small, that the sensitivity of the receiver practically is not affected by its presence. When hot (i.e. when current induced by the transmitting aerial flows through the lamp) the resistance of the filament is about 10 times the resistance when cold and the lamp thus will effectively protect the aerial coil of the receiver.

Notwithstanding the just mentioned muting of the receiver by the built in safety relay the loudspeaker will be cut out as soon as the pushbutton of the handset is pressed (also when working duplex) when the receiver is used in connection with telephone transmitters type A 198, A 199, A 215 and others. The earpiece of the handset is not cut out by the relay of the transmitter.

The correct connections between receiver, loudspeaker and transmitter are shown in the diagram of the receiver.

If the receiver is used without any transmitter present, terminals 5 and 6 of the terminal board belonging to the receiver should be strapped (shorted).

Control of amplification:

Two potentiometers have been fitted, one controlling R.F. and I.F. amplification, the other one A.F. amplification, giving the greatest flexibility of control.

For the sake of space saving the two potentiometers have been arranged one behind the other and their shafts brought out concentrically in the front plate. Small knob controls R.F. and I.F. amplification while big knob controls A.F. amplification.

The potentiometer of the R.F. and I.F. control is connected across a resistor in the common negativ lead of anode current supply. The moving contact of the potentiometer is through a suitable filter connected to the control grids of the R.F. and I.F. tubes. Thus a variable negativ bias is led to these tubes according to the setting of the potentiometer.

A.V.C. voltage is superposed on the manually adjusted grid bias when switch "AVC off/on" has been closed.

Yet when switch "Radio/Direction finding" is set to "D.F." the A.V.C. voltage is switched off (whatever the position of the A.V.C. switch) in order not to confuse the operation (Prescribed by the regulations of several countries).

The potentiometer of the A.F. control of amplification represents the load resistor of the signal diode rectifier, the moving contact of the potentiometer being connected to the grid of the A.F. amplifier.

Please note:

When working C.W. (beat oscillator on) best results are obtained with "A.V.C." cut off, "A.F. amplification" set to maximum and volume of the beat not adjusted by the "R.F. amplification" control knob.

Metering:

In the front plate of the receiver a milliammeter and a switch have been built in. By means of the switch the anode current of each individual valve may be checked.

With the said switch in position 1 and with the receiver working with A.V.C. the meter may be used as a tuning indicator.

With the said switch in position "output" the milliammeter may be used as an outputmeter, being fed from a semi conductor rectifier coupled to the output transformer. The outputmeter is very convenient when taking bearings and for determining "sense". Also when taking bearings by the Consol system the outputmeter may be very valuable.

Power supply:

12-24-32-36-110-220 volts D.C.,
110-220 volts A.C.

according to power pack fitted. Type of power pack for the different voltages is indicated in the specification (look this paragraph).

The current consumption on the different voltages is approximately:

12 volts D.C.:	5 amps.
24 volts D.C.:	2,5 amps.
32 volts D.C.:	2,2 amps.
36 volts D.C.:	2,0 amps.
110 volts D.C.:	0,26 amps.
220 volts D.C.:	0,22 amps.
110 volts A.C.:	0,75 amps.
220 volts A.C.:	0,37 amps.

Direction finding:

Used in connection with loop aerial type A 135 for indoor installation or type B 278 (water proof model) for outside installation the receiver may be used for taking bearings in the whole range 165-3850 kc/s. Individual matching transformers for each frequency band have been fitted, and minimum sharpening facilities as in the best commercial direction finders are provided, making the receiver very efficient for taking bearings, especially thanks to the very high degree of selectivity which can be obtained by proper setting of the selectivity knob.

In the 165-480 kc/s band bearings on radio beacons and broadcasting stations can be taken with an accuracy of less than 1 degree (provided that the signals are not spoiled by static or electrical interference) when the minimum sharpening knob is properly used.

Before using the direction finder for navigation, calibration for quadrantal error, originating from the ship's hull and rigging, must take place. (Notice: error depends on frequency so the calibration must only be used for frequencies in the neighbourhood of the frequency for which calibration has been made).

On the higher frequencies good bearings may be obtained but very great errors may be present, resulting from the ship's hull or rigging or (very important) from aerials connected to a transmitter tuned to the frequency on which bearings are being taken. (So: disconnect transmitting aerials when taking bearings.)

Bearings taken in the band 1350-3750 kc/s should not be used for navigating in narrow waters, but only for looking up other ships in open waters.

For sense determination each frequency band is fitted with a sense resistor which must be adjusted - according to the aerial being used. Adjusting normally takes place simultaneously with the calibration of the direction finder.

As mentioned above the meter is very valuable for sense determination.

When taking bearings to CW radio beacons and to broadcasting stations the beat oscillator must be "on" ("CW on"). Also when receiving modulated signals it may prove advantageous to operate the receiver with beat oscillator on, especially when noise or other interference is present.

If the receiver is delivered from the factory without any frame aerial, a compensating coil has been fitted to terminals Ra1-Ra2. If a frame aerial is connected later on, the said coil must be removed.

Valve complement:

Radio frequency amplifier	UF 85 (19 BY 7)
Oscillator and frequency changer	UCH 81 (19 D 8)
First intermediate frequency amplifier	UF 85 (19 BY 7)
Second intermediate frequency amplifier	UF 85 (19 BY 7)
Signal and A.V.C. rectifier and audio frequency amplifier	UBF 80(17 C 8)
Beat frequency oscillator	UF 85 (19 BY 7)
Output valves	2 type UL 84 (45 B 5)
Aerial safety lamp	110 volts 15 w.
Dial bulbs	2 type 6 v. 0,15 amp.

Controls:

Tuning (afstemning)
Frequency range (frekvensområde)
Gain R.F./A.F. (forstærkning)
Bandwidth (båndbredde)
Pitch (tonehøjde)
Minimum sharpening sense (minimum sidebestemmelse)
Off/direction finding/radio (afbrudt/pejling/radio)
Dial light on/off (skalalys ind/ud)
Loudspeaker on/off (højttaler ind/ud)
M.C.W., telephony/CW (MCW, telefoni/CW)
Anode current/output (anodestrøm/output)
A.V.C. on/off (A.V.C. ind/ud).

Mechanical construction:

A heavy aluminium chassis built integral with, but electrically insulated from, the metal front plate, resting in insulated side members in a metal cabinet lacquered in grey colour, and connected to earth, thus making the receiver shock proof and at the same time totally insulating the mains from earth.

The cabinet has a lid which may be raised when 4 knurled nuts are turned up. The whole receiver unit may be withdrawn from the cabinet when 4 other knurled nuts are truned up.

Ceramic material is used throughout in the frequency range switch. The coils are wound on non hygroscopic forms and thoroughly impregnated, trimmers are of the air dielectric type on ceramic base, capacitors have tropical finish, and all precautions have been made to make the receiver moisture proof.

All connections from outside to the receiver are established through plugs and sockets, one set for a co-ax cable for aerial input, another set for a twin lead cable for frame aerial connection and a third 10-pole plug-and socket for all other connections. For the latter purpose a cable with a plug in each end (shock proof construction) has been supplied, one plug being inserted in a socket in the chassis, the plug in the other end being inserted in a socket in a terminal board (also supplied with the receiver) screwed to the bulkhead. The cables have ample length, permitting the chassis to be withdrawn from the cabinet for inspection without breaking connections.

If the receiver chassis is housed in a cabinet common to receiver and transmitter, the 10 way connecting cable is terminated in a terminal strip inside the cabinet instead of being led to a bulkhead connecting board.

Size:

Height: 300 mm + 30 mm shock absorbers
Width: 520 mm
Depth: 335 mm + knobs

Weight: 20 kgs.

(B 312 U)

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