# INSTRUCTION MANUAL

FOR

# SAILOR

## TYPE 46T

MANUFACTURERS:

A/S S. P. RADIO

AALBORG - DENMARK

# Index

# A. Specifications of SAILOR type 46 T

**I. General Description:**

SAILOR type 46 T is a waterproof transistorized marine receiver operated from built-in batteries or from the vessel's power supply.
The receiver is designed for broadcast and telegraphy reception, and for taking bearings on Consol and other radio beacons. When provided with a D.F. Aerial the receiver is capable of taking bearings on four bands and incorporates a sensing device.
The instrument on the front panel functions as a tuning indicator, ensuring easy and correct frequency tuning. The instrument provides visual indication of a bearing minimum and also serves as a voltage indicator of the built-in dry batteries.
For receiving telegraphy and for taking bearings on Consolan stations the receiver is provided with a beat oscillator (BFO).
For the purpose of improved reception an A.F. filter limiting the band width to 850—1150 c/s can be switched into the circuit.

**II. Technical Specification**

1. Transistor and diode complement:

| | |
|---|---|
| T 1 | R.F. amplifier |
| T 2 | Mixer |
| T 3 | 1st I.F. amplier |
| T 4 | 2nd I.F. amplier |
| D 1 | Detector |
| T 5 | AGC amplifier |
| D 2 & D 3 | AGC delay diode |
| D 4 | Antiblocking diode |
| T 6 | B.F.O |
| T 7 | 1st A.F. amplifier |
| T 8 | Driver |
| T 9 & T 10 | Push-pull output |
| D 5 | Voltage stabilizer |
| D 6 | Voltage stabilizer |

2. Frequency ranges:
   LW 150— 285 kc/s Beacon
   NW 255— 425 kc/s Beacon
   MW 525—1600 kc/s Broadcast
   SW 1600—4000 kc/s Marine

3. Intermediate frequency:
   470 kc/s.

4. A.G.C.
   An increase in input of 70 dB does not change output more than 6 dB.
5. Sensitivity:
   For all ranges better than 5 mmV.
6. Signal/noise ratio:
   10 dB signal/noise ratio (modulation 30 % - 400 c/s)
   270 kc/s - 20 mmV, 1000 kc/s - 15 mmV, 2800 kc/s - 10 mmV.
7. Image rejection:
   Better than 60 dB.
8. Selectivity:
   6 dB band width: ± 3 kc/s.
9. A.F. response:
   6 dB from 100 c/s to 2500 c/s.
   With filter: 6 dB band width 300 c/s.
10. Output:
    1.8 Watts with less than 10 % distortion.
11. Power supply:
    External D.C. supply voltage of 12 V, 24 V or 32 V can be used when the voltage adapter is connected in the appropriate position. Current consumption approx. 0.3 Amp.
    Internal battery-box with six 1.5-Volt dry cells, for instance EVER READY size D Standard Flashlight Battery, a standard type available all over the world.
    Normal current consumption approx. 0.04 Amp.
12. Cabinet:
    All-welded steel cabinet rust-proofed and lacquered.
    All knobs and other exterior parts are of bright chromium-plated brass.
13. Receiver dimensions (see appendix).
14. Schematic diagram (see appendix).

## B. Installation of SAILOR type 46T

**I. HI. IMP. Aerial:**

Connect the Hi. Imp. Aerial to socket marked HI. IMP. Aerial. For aerial, use a 15-50 feet long wire placed as high and as free as possible. For the down lead a coaxial cable of good quality should be used. It is most important that the down-lead is as short as possible and that it is not laid near other electric cables. All joints must be soldered.

**II. D.F. Aerial:**

Connect D.F. Aerial to socket marked D.F. Aerial. The transfer impedance is 1 kOhm. The D.F. Aerial should be mounted as high and as clear as possible. On wooden vessels, direction finding can be performed to leeward, whereas on vessels of iron it will only be possible to perform direction finding in the open air and at heights above the deckhouses.

If stay, masts, etc. can form closed circuits, insulators must be inserted at suitable places so that these closed circuits are cut off. If there are other aerials on board, they must be made so that they can be cut out, but NOT be earthed.

Both Hi. Imp. Aerial and D.F. Aerial are used for sensing. By means of the SENSE control, which is accressible behind the plastic stopper immediately below the Aerial Switch, the most distinct meter deflection can, during the installation of the receiver, be adjusted in the following way: Tune the receiver to a radio beacon of medium strength, as described in Chapter C, passage IV, and tune the D.F. Aerial, as described in Chapter E, 90° anti-clockwise from the signal minimum of the direction finder. Then turn the Aerial switch of the receiver from D.F. to Sense, and adjust the Sense control so that the indication of the meter will increase somewhat. Then the direction finder is instead turned 90° clockwise from the signal minimum of the direction finder, and when switching from D.F. to Sense the meter indication will now decrease. This procedure must be repeated a couple of times, and the Sense control must be finely adjusted at the same time so that the most distinct deflection difference is obtained on the meter.

**III. LOUDSPEAKER and HEADPHONE**

Connect Loudspeaker and/or Headphone to the sockets marked SPEAKER and PHONE. The transfer impedance is 3.2 Ohm. If headphones with higher impedance are used, they must be shunted by means of a resistance os suitable value for matching.

## IV. EXT. POWER SUPPLY:

Connect external power supply and earth wires to the TERMINAL BLOCK located under the rubber cover. Connect with correct polarity. The receiver can be adjusted for line voltages of 12, 24 and 32 volts D.C. Change-over is made by moving the voltage adapter plug inside the receiver. This plug is accessible when the battery box is removed from the receiver. The current consumption of the receiver is abt. 0.3 Amp.

The receiver is equipped with two 0.5 Amp. fuses that are eccessible when the areial connector box is dimounted.

Before the receiver is connected, ignition systems, dynamos, and electric motors on board must be effectively suppressed. This is of vital importance in order to obtain full advantage of the receiver.

The insulated copper earth cable should have a cross sectional area of at least 2.5 $mm^2$ and be connected to the hull (in vessels of iron) or to keel bolt, engine frame or a metal sheet — 10 sq. feet at least — mounted on the outside of the hull below the water line (in vessels of wood). The earth wire must be as short os possible.

A good earth connection reduces noise to a minimum and a more distinct signal minimum when direction finding can be achieved.

## V. INT. POWER SUPPLY:

The internal batteries are placed behind the cover marked BATTERY-BOX. When replacing batteries, six 1.5-V cells, EVER READY SIZE D Standard Flashlight Battery or a similar type must be used.

Place batteries correctly (see drawing on the cover) and assemble the battery-box correctly (see colored spots on the ends).

In the position "Test Batt" of power supply switch, battery voltage is indicated on meter. Batteries should be replaced when below 7 Volts.

Warning: Remove dead batteries from battery box.

## C. Application of SAILOR type 46T

**I. Reception of General Broadcasting:**

1. Turn the POWER switch to the appropriate position.
2. Switch the receiver on.
3. Place the AERIAL switch on HI. IMP.
4. Turn the BAND switch to the required frequency range. Most broadcasting stations are to be found on the MW and LW bands.
5. Set the SENSITIVITY control at maximum. When receiving from very powerful stations, however, it may be necessary to reduce the sensitivity somewhat in order to avoid overdriving the receiver and consequent distortion. The meter indication should never exceed 9.
6. Adjust the VOLUME control for the desired signal strength.
7. Tune to the wanted station with the TUNING knob. Fine Tuning for maximum indication on the meter. For scale illumination, push in TUNING knob.
8. Turn the TONE switch to the required position. Fro broadcest reception the positions HIGH, MED., and LOW are used.

**II. Reception of Telephony and Telegraphy:**

1. Turn the POWER switch to the appropriate position.
2. Switch the receiver on.
3. Place the AERIAL switch on HI. IMP.
4. Turn the BAND switch to the required frequency range. Most communication stations are found on the SW band.
5. Use the SENSITIVITY control together with the VOLUME control for regulating the sound intensity. With careful manipulation of these controls noiseless reception can be achieved. When receiving telegraphy, the VOLUME control will generally be set near maximum, and the sound intensity is regulated by using the SENSITIVITY only.
6. Tune to the wanted station with the TUNING knob. Fine tuning for maximum meter indication. For scale illumination, push in TUNING knob.
7. Turn the TONE switch to the required position. For telephony the positions HIGH, MED., LOW, or FILTER are used.
   When receiving telegraphy the positions LOW or FILTER are used in the range WITH B.F.O. When using the B.F.O. the SENSITIVITY must be readjusted for a suitable meter reading.

**III. Reception of Consolan Signals:**

The receiver must be adjusted for the reception of telegraphy as mentioned under II. (For further instrutcions please see Chapter D).

**IV: Reception of General Circular Radio Beacons:**

1. Turn the POWER switch to the appropriate position.
2. Switch the receiver on.
3. Place the AERIAL switch to HI. IMP.
4. Turn the BAND switch to the required frequency range. Radio beacons are found on NW, but bearings can be taken on stations in all bands.
5. Tune to the wanted station with the TUNING knob. Fine Tuning for maximum meter indication. For scale illumination, push in TUNING knob.
6. Turn the AERIAL switch to D.F.
7. Adjust SENSITIVITY control so that the meter is not reading beyond full scale.
8. Set the TONE switch to the FILTER position. Sometimes better reception is gained with B.F.O.
9. Adjust the direction finder finely (as described in Chapter E) for maximum meter indication.
10. Turn the D.F. Aerial until bearing null is found. Bearing null is indicated by minimum signal on the phone or speaker, or by minimum meter indication. If the meter drops to zero at the null, advance SENSITIVITY slightly for suitable meter reading.
11. When sensing relative bearings (described in Chapter E) adjust SENSITIVITY control for a suitable meter reading after the direction finder has been turned 90° anti-clockwise from signal minimum. Turn the AERIAL switch to SENSE. If the meter reading increases, the bearing found is correct. If it decreases then the bearing is 180° reciprocal.

## D. Reception of CONSOL Beacons

**I. Description of the CONSOL direction finding system:**

The following should be taken only as an introduction to the CONSOL direction finding system. For more information on the subject reference should be made to the publications issued by various government departments.

When using the CONSOL direction finding system it is possible, when the approximate position is known, to find the exact position by plotting bearings of two CONSOL radio beacons using S. P. SAILOR type 46 T.

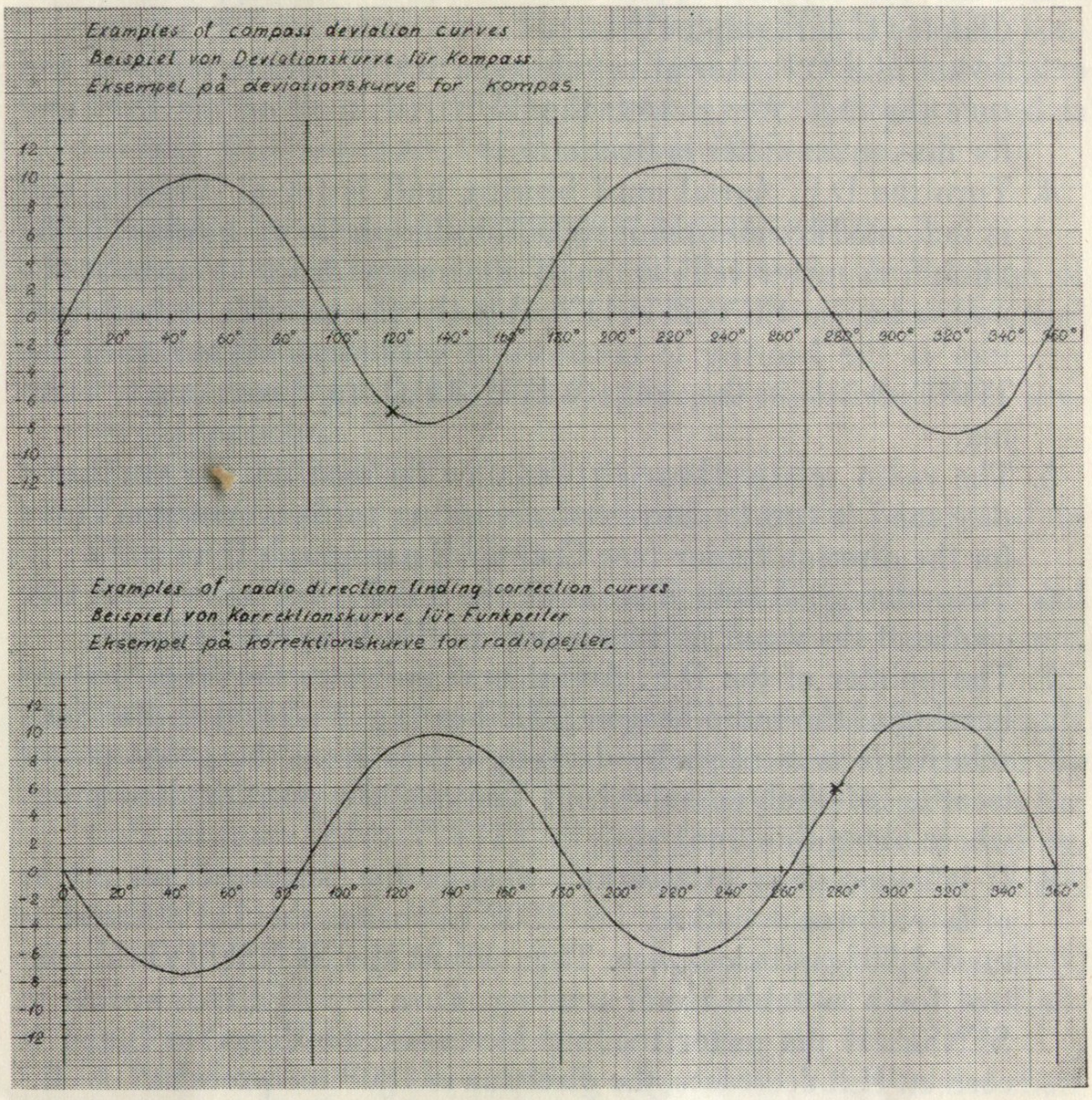
The CONSOL radio beacon consists partly of a circular radio beacon, transmitting the call sign of the beacon and a continuous signal, and partly of an omnidirectional beacon, transmitting various signals in various directions. The transmissions take place alternately as indicated in "Details of Stavanger and Bush Mills CONSOL Radio Beacons". The circular transmission is used for adjustment of the receiver to the wanted radio beacon as for a general telegraphy station, see Chapt. C, passage II.

At the end of this manual is a chart with 2 stations, "Stavanger" and "Bush Mills", which are of special interest in the North Sea and North Atlantic. For each of the two stations the moment for the commencing of the transmissions of the directional radio beacon is indicated. These consists of sectors, 60 dots are transmitted in one sector (A-sector) whereas 60 dashes are transmitted in the other sector (B-sector) during the transmission period indicated on the chart. The divisions between the sectors are indicated as "beams". Along the beam, dots and dashes are meeting in one continuous signal. The sectors are turning exactly one sector-width at a steady speed in the direction of the arrows during the period of a transmission from a directional radio beacon; thus, from the position marked X in the North Sea, you will from Stavanger CONSOL radio beacon first hear 48 dots, until the beam "S" passes by, after which you will hear 12 dashes, and the transmission is finished and will recommence with the circular transmission and so on. From Bush Mills you will first hear 28 dashes until the beam "BM" passes by, after which 32 dots will be heard. By means of quite simple diagrams, issued by various government departments, it is a simple matter to find the exact bearing of the CONSOL radio beacons, as these indicate the direction finding in degrees corresponding to the number of dots and dashes heard during the directional period of the transmission.

As the beams are not well defined, there will be several dots and

When the compass bearing of a beacon is to be determined by means of the radio direction finder, the compass course is used, as mentioned in the previous section and please note:
True course = Deviating course (read course) + variation + deviation. Variations are in the usual way taken from the chart and the deviation from the deviation table of the compass.
The local radio-direction-finder deviation is due to the influence of the metallic parts of the vessel, such as rigging, mast, hull, etc. and also the proximity of these parts in relation to the D.F. Aerial. The deviation will vary somewhat depending upon the location of the D.F. Aerial on the vessel. Therefore bearings should always be taken from the same place on the vessel, and a correction table should be made and applied to direction finder readings. A new correction table is necessary if the position of the D.F. Aerial is changed and also if there are any great changes in the location and properties of the vessels metallic parts and structure.
This correction table can be worked out by swinging the vessel near a visible radio beacon, and for every 10° swing two bearings should be taken, both relative from the diamentral plane of the vessel. First an optical bearing and then a D.F. bearing, and both sets of these bearings are recorded throughout the 360° swinging. The difference between each pair of bearings is then taken and applied to a correction chart in graph form.
An example of correcting a radio direction reading is described below on the assumption that the deviation table for the compass and the correction table for the radio direction finder have been made beforehand, and that the subsequent graph papers have been made on the basis of these tables. Coast-line deviations may arise if the radio waves from the radio beacon are to move partly over sea in order to reach the vessel, or if they leave the coast at a very acute angle. Therefore, do not use radio beacons from which such deviations are possible.
Night effect may also cause errors in direction finding, due to a mixing up of radio waves reaching the receiver along the surface of the earth, and radio waves reaching the receiver after having been reflected from the ionosphere. This effect will be found especially at night and especially during the period from one hour before to one hour after sunset and sunrise, and it shows itself in flatting out or "wandering" of minimum. Night effect varies with the seasons and geographic positions. It is minimum at the equator.
Under such circumstances you should use radio beacons that are as near the vessel as possible, and the bearings should be used with a certain reservation. If the bearing can be taken on more than one

frequency, the bearing should always be taken on the lowest frequency. This gives the most correct bearing and less trouble with fading and night effect.




## III. Example of correction of R. D.F. bearing.

| | | |
|---|---|---|
| Deviating course (indicated compass course) | | 120° |
| Magnetic deviation (according to sea chart) | — | 4° |
| Local compass deviation (acc. to compass correction curve) | — | 7° |
| True course | | 109° |
| Indicated D. F. relative bearing (radio) | | 280° |
| Radio correction (according to radio correction curve) | + | 6° |
| True radio relative bearing | | 286° |
| True course | | 109° |
| True radio relative bearing | | 286° |
| | | 395° |
| | — | 360° |
| True radio compass bearing | | 35° |

**IV. Direction Finding with General, Fixed Direction Finder.**

1. Place the movable graduated disc with FOR-mark in line with 360°.
2. Tune the receiver to the desired radio beacon (described in Chapter C paragraph IV 1-8).
3. Switch the D.F. Aerial to the same BAND as the receiver and tune the D.F. Aerial with the TUNING knob on the D.F. unit for maximum meter indication.
4. Turn the D.F. Aerial until bearing null is found. Bearing null is indicated by minimum signal on the phone or speaker, or by minimum meter indication. If the meter drops to zero at the null, advance SENSITIVITY slightly for suitable meter reading. If the bearing is taken on a very weak signal, turn the TONE switch in the range WITH B.F.O. for better meter reading.
5. The radio relative bearing can now be read on the graduated disc, and it can be corrected according to the correction curve for the diretion finder (see Chapter E paragraph II).
6. Turn the graduated disc until the FOR-mark shows the true course of the vessel at the moment of the direction finding.
7. The pointer of the D.F. Aerial now indicates the true compass bearing of the radio beacon. This bearing is plotted on the chart relative to true north by drawing a line from the geographical location of the radio beacon. The vessel's position lies somewhere along this line.
8. If it is necessary to ascertain whether the bearing is correct or of a reciprocal nature, i.e. 180° opposite, the D.F. Aerial is turned 90° anti-clockwise. Then adjust the SENSITIVITY control for a suitable meter reading. Turn the AERIAL switch to SENSE. If the meter reading increases, the direction found is correct. If it decreases, the direction is 180° reciprocal.

**V. Direction Finding with Radio Direction Finder on Direction Finding Compass.**

1. Tune the receiver to the desired radio beacons (described in Chapter C paragraph IV 1-8).
2. Switch the D.F. Aerial to the same BAND as the receiver and tune the D.F. Aerial with the TUNING knob on the D.F. unit for maximum meter indication.
3. Turn the direction finder until signal minimum is found.
4. The compass bearing can now be read from the prism of the compass directly.
5. This bearings is then plotted on the chart relative to true north

by drawing a line from the geographical location of the radio beacon. The vessel's position lies somewhere along this line.

6. If it is necessary to ascertain whether the bearing is correct or of a reciprocal nature, i.e. 180° opposite, the D.F. Aerial is turned 90° anti-clockwise. Then adjust the SENSITIVITY control for a suitable meter reading. Turn the AERIAL switch to SENSE. If the meter reading increases, the direction found is correct. If it decreases, the direction is 180° reciprocal.

**VI. Direction Finding with FERRITE-NAVIGATOR.**

1. Place the chart on an even base with North-South direction of chart exactly parallel to the stem-to-stern line of the vessel, and North of chart pointing forward.
2. Place a centre pin on the chart at the position of the radio beacon in question.
3. Place the FERRITE-NAVIGATOR on this pin.
4. Tune the receiver to the desired radio beacon (described in Chapter C paragraph IV 1-8).
5. Switch the D.F. Aerial to the same BAND as the receiver and tune the D.F. Aerial with the TUNING knob on the D.F. unit for maximum meter indication.
6. Turn the D.F. Aerial until bearing null is found. Bearing null is indicated by minimum signal on the phone or speaker, or by minimum meter indication. If the meter drops to zero at the null, advance SENSITIVITY slightly for suitable meter reading. If the bearing is taken on a very weak signal, turn the TONE switch in the range WITH B.F.O. for better meter reading.
7. The FERRITE-NAVIGATOR is now pressed against the chart, and the true course of the vessel at the moment of direction finding is set on the graduated scale by turning the ruler.
8. A line drawn along the marking edge of the ruler on the chart is the position line of the vessel.
9. If it is necessary to ascertain whether the bearing is correct or of a reciprocal nature, i.e. 180° opposite, the D.F. Aerial is turned 90° anti-clockwise. Then adjust the SENSITIVITY control for a suitable meter reading. Turn the AERIAL switch to SENSE. If the meter reading increases, the direction found is correct. If it decreases, the direction is 180° reciprocal.

# F. Service Information

## I. Alignment Procedure for SAILOR type 46T.

All adjusting points are sealed from factory, and readjustment should be made only when repairs have been done.

1. I.F. Alignment:

1.1. Connect a sweep generator to the base of the mixer (T2) and an oscilloscope to the A.F. side of the detector (D1).

1.2 Set band switch at MW and tune for highest frequency.

1.3 Adjust tuning cores of L13, L14, L15, L16, and L17 for maximum response at 470 kc/s.

2. Oscillator and R.F. Adjustment:

2.1 Connect the signal generator to the receiver (HI. IMP. AERIAL) through a dummy antenna. Connect a speaker to the receiver for listening in. Turn sensitivity control fully clockwise.

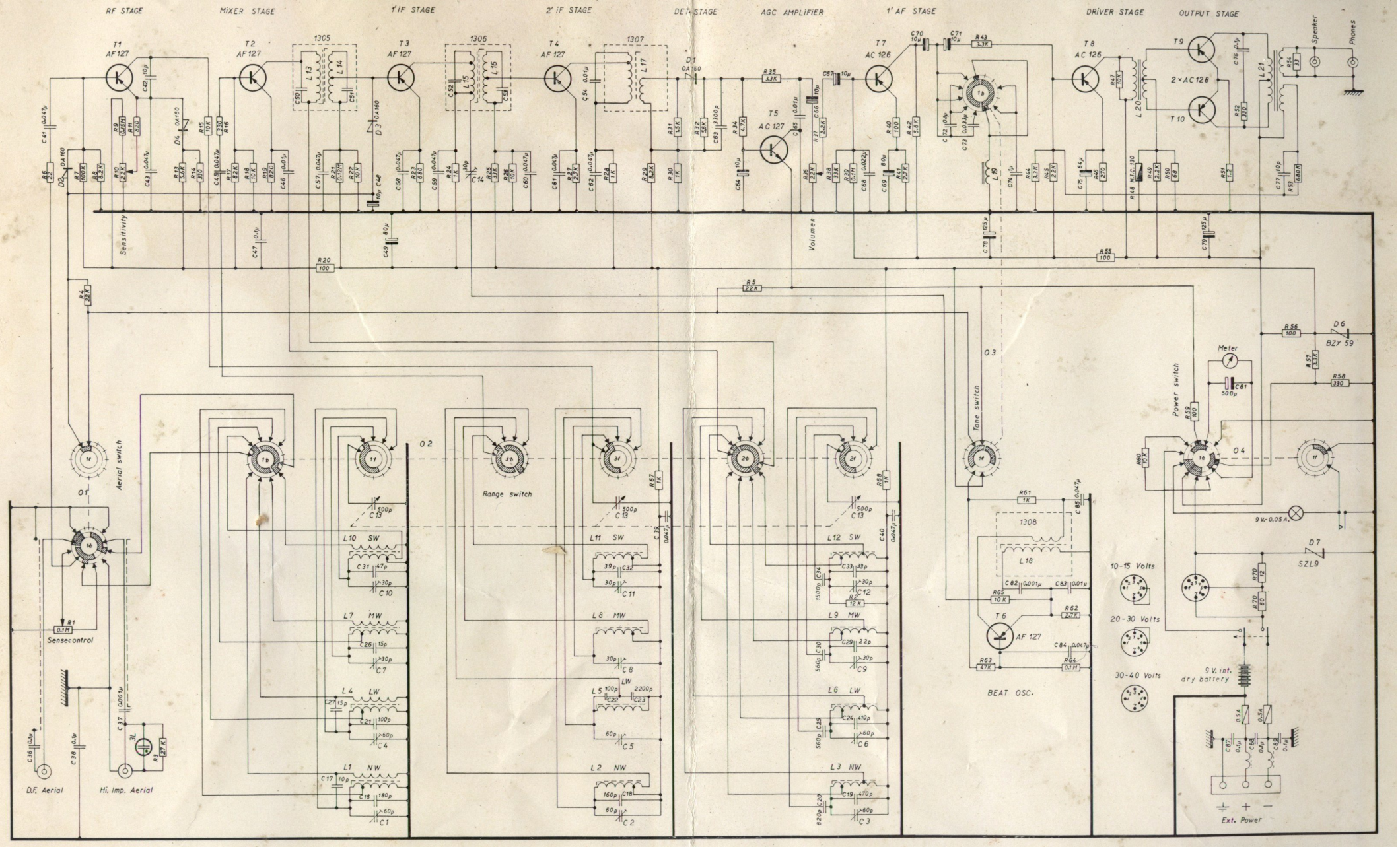
2.2 Adjust the receiver to obtain maximum meter reading. Output of the signal generator should be so low that meter reading does not exceed 5.

2.3 Adjustment to be made as follows:

| Range | Frequency | Adjusting Points |
|---|---|---|
| LW | 170 kc/s | L6 — L4 — L5 |
| | 270 kc/s | C6 — C4 — C5 |
| NW | 270 kc/s | L3 — L1 — L2 |
| | 400 kc/s | C3 — C1 — C2 |
| MW | 600 kc/s | L9 — L7 — L8 |
| | 1400 kc/s | C9 — C7 — C8 |
| SW | 1800 kc/s | L12 — L10 — L11 |
| | 3600 kc/s | C12 — C10 — C11 |

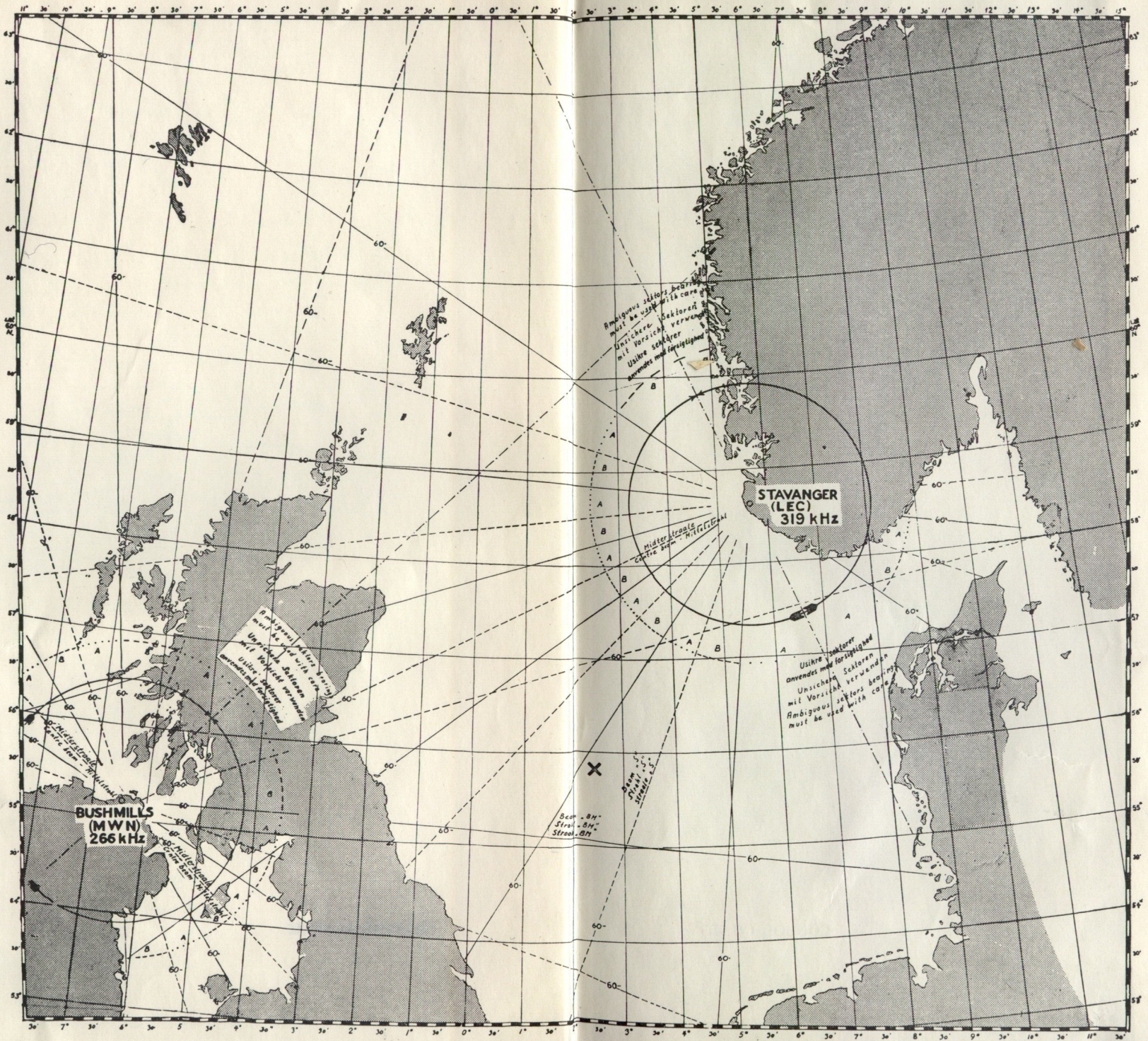
3. B.F.O. Adjustment:

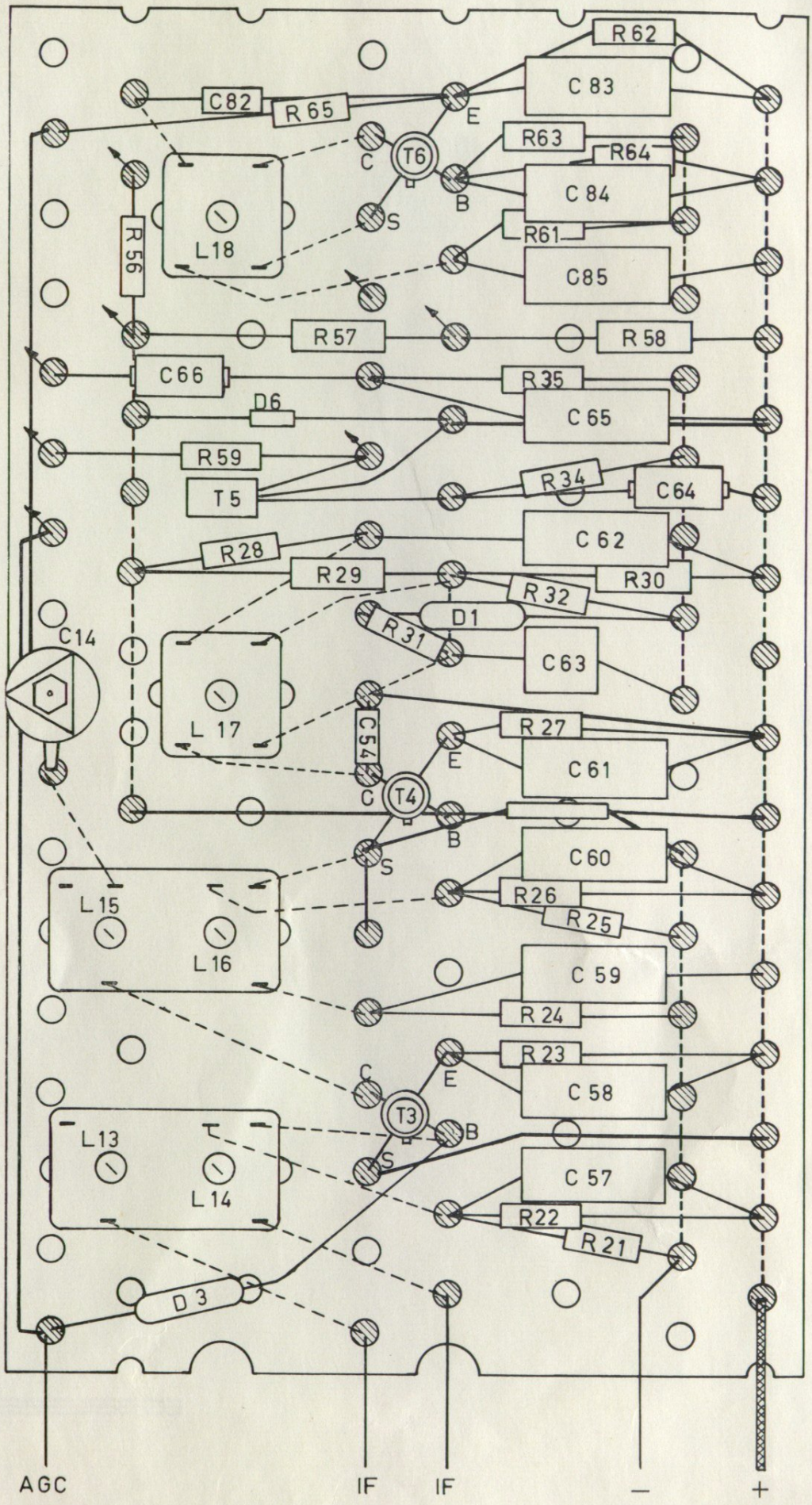
3.1 Turn tone switch fully clockwise (FILTER WITH BFO) with no signal applied to the receiver. Adjust tuning core of L18 for maximum meter reading. Adjust C14 for a meter reading of 2.5.



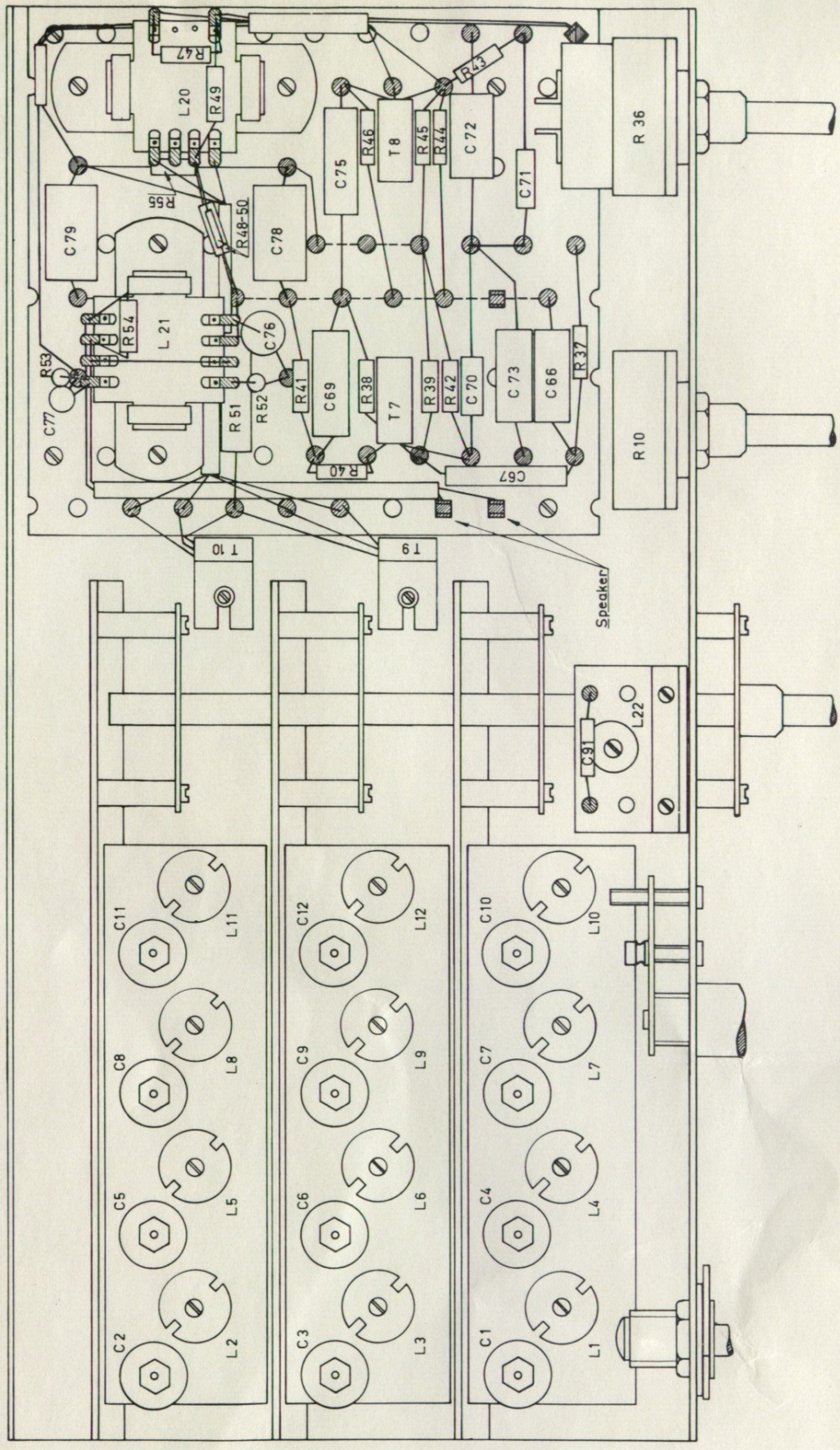

Dette diagram omfatter SAILOR 46T med bogstavet B efter apparatets nummer.
Dieses Schaltschema betrifft SAILOR 46T mit dem Buchstaben B nach der Nummer des Gerätes.
This diagram refers to SAILOR 46T with a letter B placed after the number of the receiver.

DIAGRAM SAILOR 46T
A/S S. P. RADIO
DANMARK

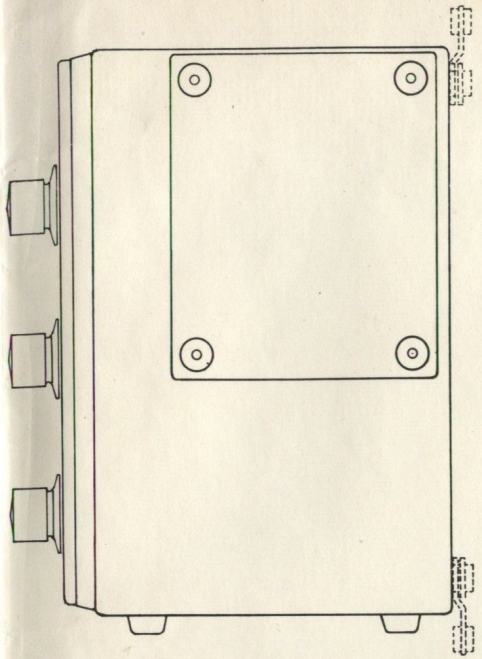

STAVANGER
(LEC)
319 kHz
BUSHMILLS
(MWN)
266 kHz
Ambiguous sectors bearings must be used with care
Usikre sektorer anvendes med forsiktighed
Unsichere Sektoren mit Vorsicht verwenden
Midterstraale
centre beam
Mittelstrahl

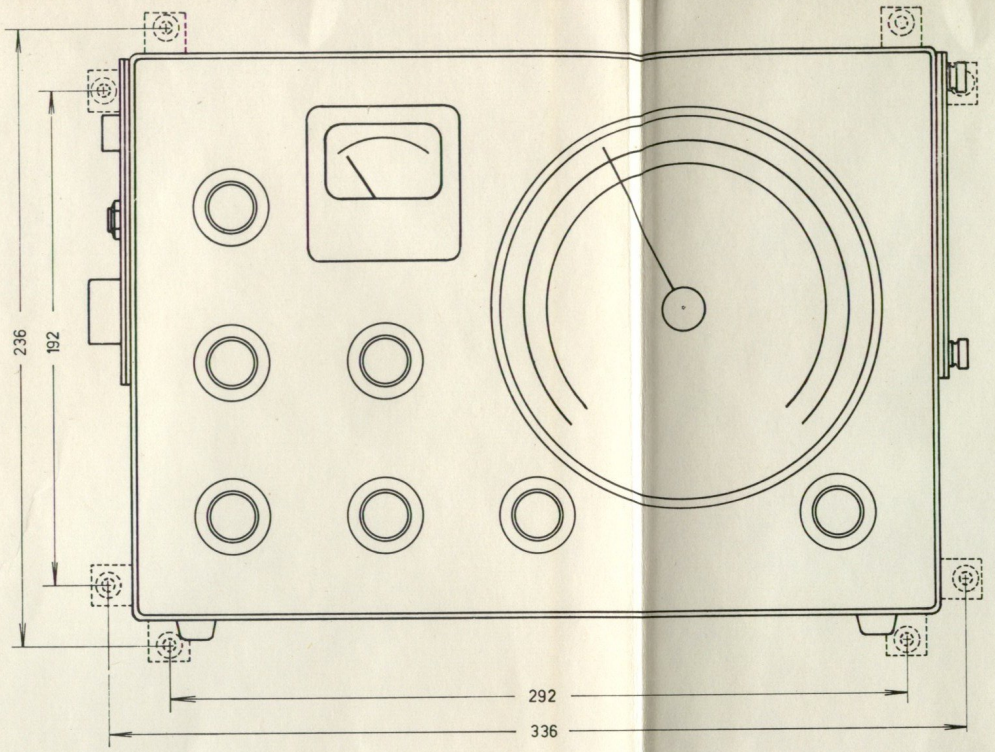


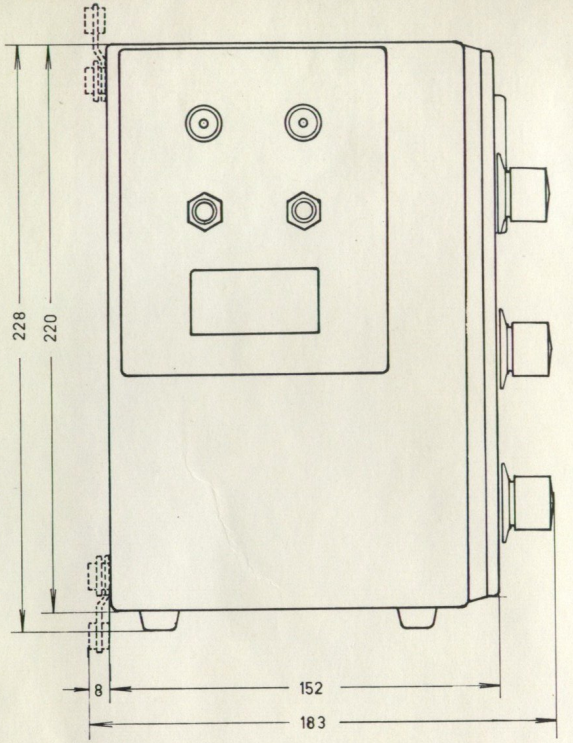

IF PANEL LAYOUT

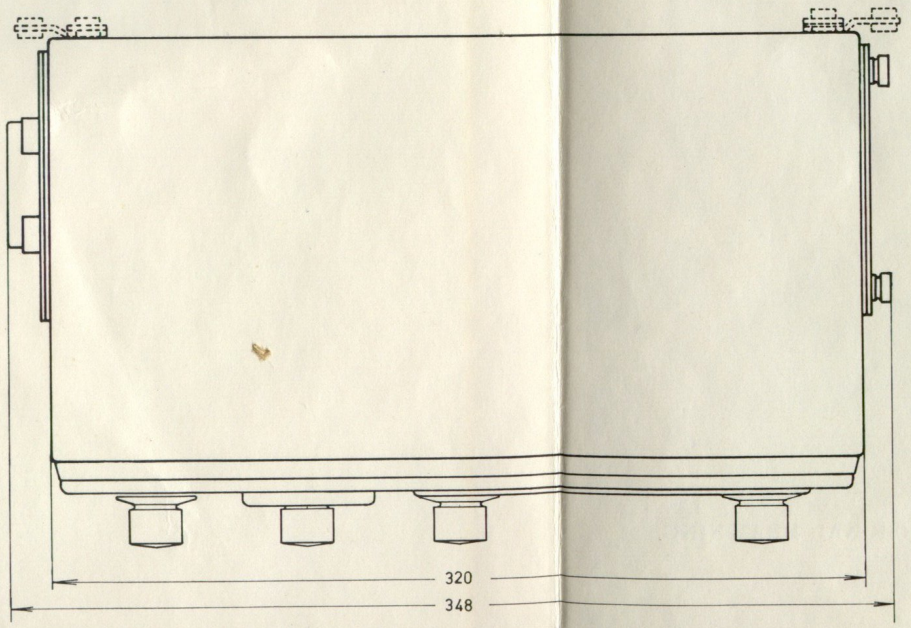



CHASSIS, BOTTOM VIEW. LF PANEL LAYOUT
(L22 and C91 are not mounted in type 46T)






Dimensions in mm
1" = 25,4 mm