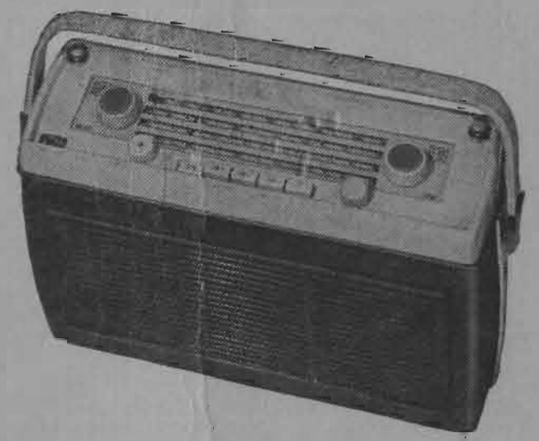
beolit 609 fm
export II

6001

SERVICE MANUAL



PRINTED IN DENMARK

A/S BANG & OLUFSEN PRODUKTIONSSELSKAB

STRUER

COPENHAGEN

ODENSE

Service Department at Struer: Telephone 970 , 51122 Room 311, 312 and 313
Spare Part's Department at Struer: Telephone 970 , 51122 Room 315 and 316
Service Department at Copenhagen: Telephone Hilda 1991 , Hilda 797
Spare Part's Department at Copenhagen: Telephone Hilda 1991 , Hilda 797
The Department at Odense: Telephone 99 , 129931

TECHNICAL DATA

AM aerials: Ferrite aerial for STD and SW 1. Telescoping whip for SW 2. Jack for external aerial. Ferrite aerial may be cut out on STD and SW 1 by means of push-button.

FM aerial: Telescoping dipole. Jack for external aerial.

Batteries: Six tubular flashlight cells. American standard: Type D.

Wave bands: STD: 445 — 188 m 550 — 1600 kc/s
SW 1: 125 — 47.5 m 2.4 — 6.3 Mc/s
SW 2: 48.5 — 18.8 m 6.2 — 16 Mc/s
FM: 88 — 108 Mc/s

External speaker connection: By means of jack plug which cuts out the built-in speaker when inserted. Impedance of external speaker should be 3.5 ohms.

Battery drain: Low volume: 27 mA.
50 mW output power: 65 mA. Max. output: 250 mA.

Tape recorder connection: By means of jack plug. Impedance: 20 k ohms.

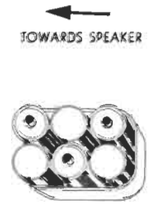
Dimensions: 325 mm wide, 248 mm high, 108 mm deep.
12 3/4" wide, 9 3/4" high, 4 1/4" deep.

Radicator: Moving-coil meter which does double duty as battery-voltage indicator and tuning indicator (magic eye).

Output power: 1 watt.

Weight: 3.68 kg (7.9 lbs).

Battery Replacement



Remove the bottom plate. Detach the battery container cover (to do this, first turn the locking device clear of the locking nuts). The batteries may now be taken out. See sketch for proper polarization. Battery voltage is checked at point F; see diagram on p. 2. All cells should be replaced at the same time.

PARTS LIST (large components and units)

FM aerial: 20223

Bottom plate: 508 C 110, seven colours: *green, blue, yellow, light grey, dark grey, red, black.*

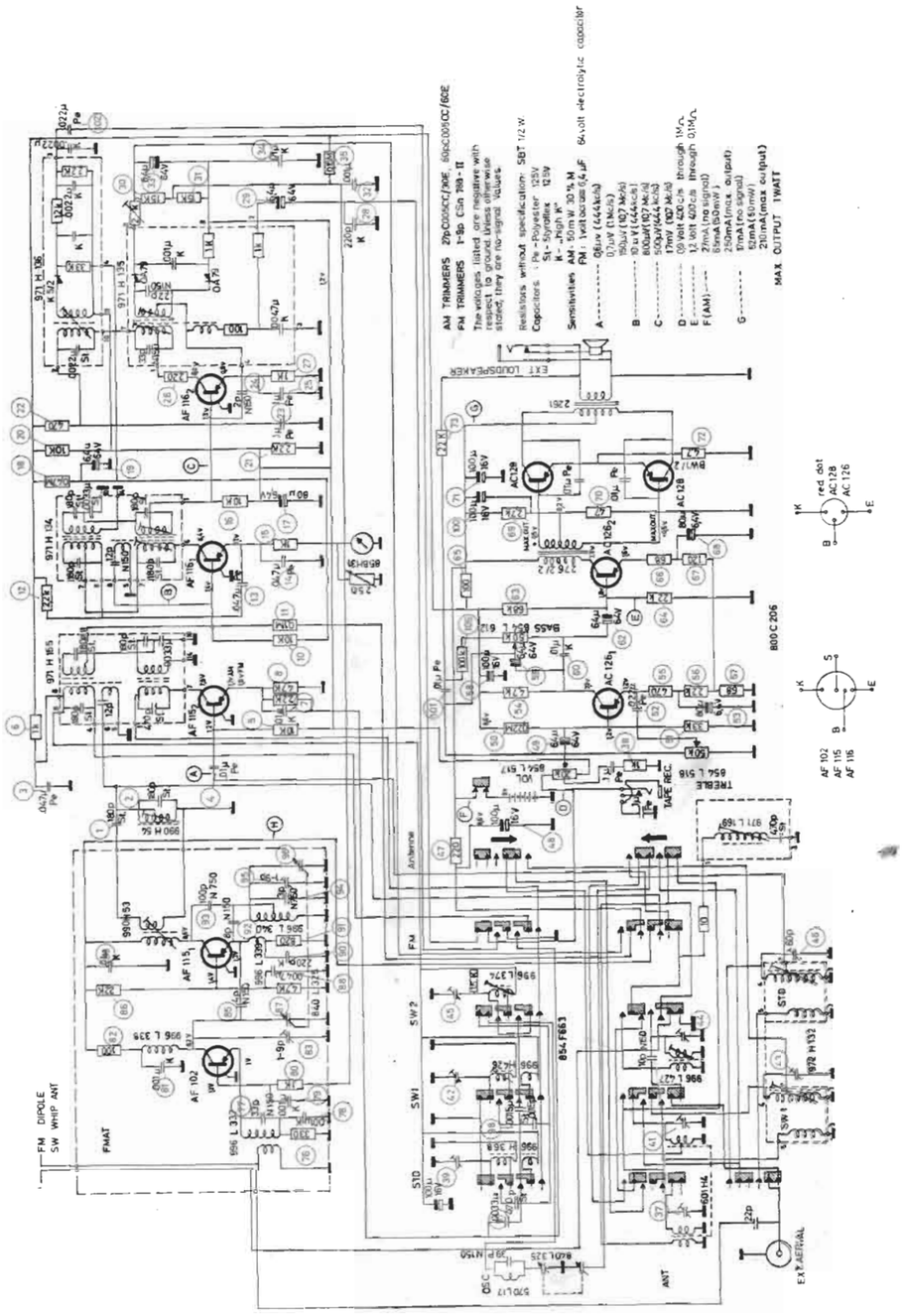
Diodes: K 5/2 (OA 79), AM detector.
2 × OA 79, FM detector.

Variable capacitor: 840 L 325

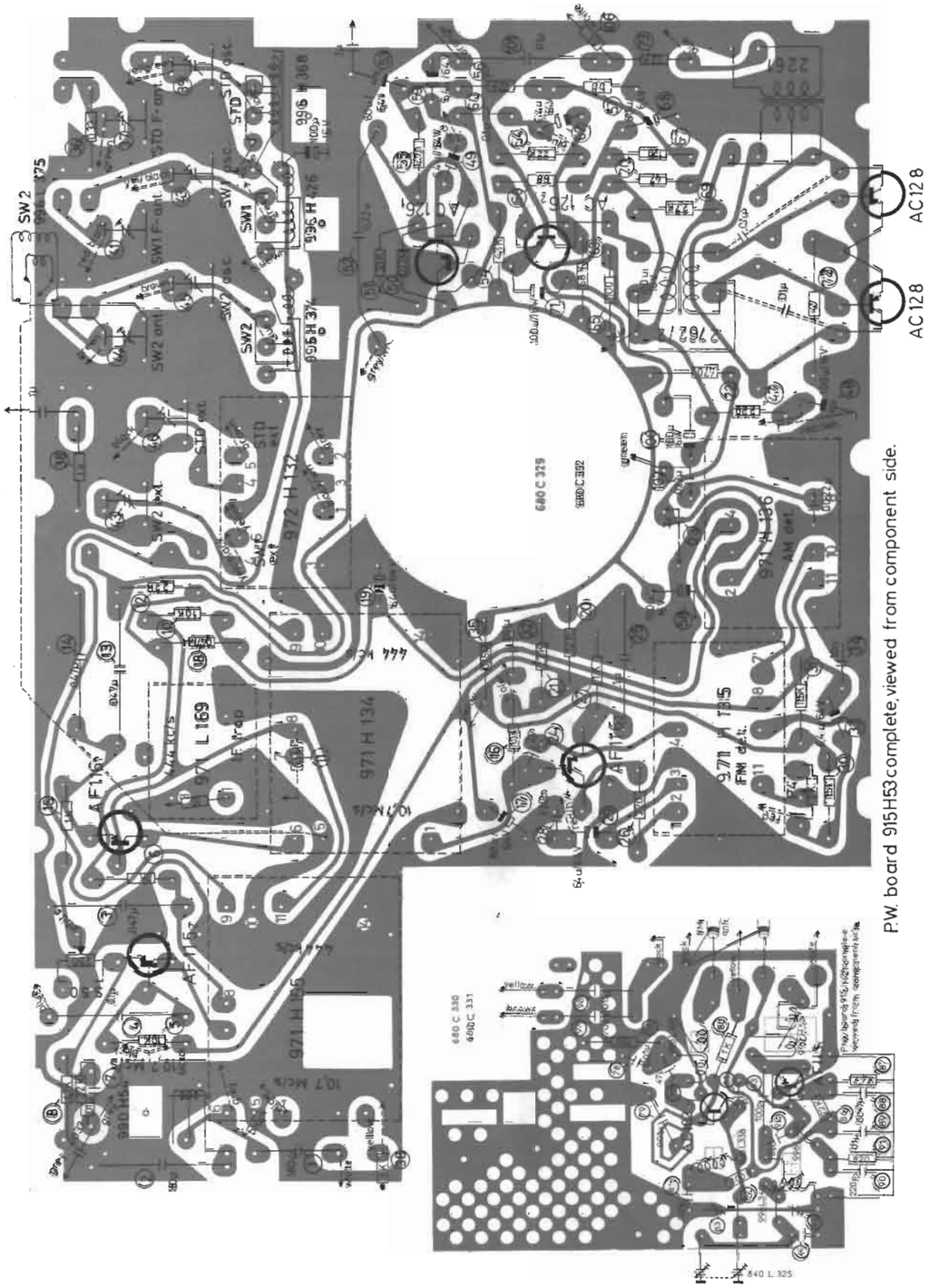
Cover (cabinet top plate): 521 C 96/840 H 383; can be supplied complete with dial glass.

Parts list is continued on page 5.

DIAGRAM FOR BEOLIT 609 FM EXPORT II

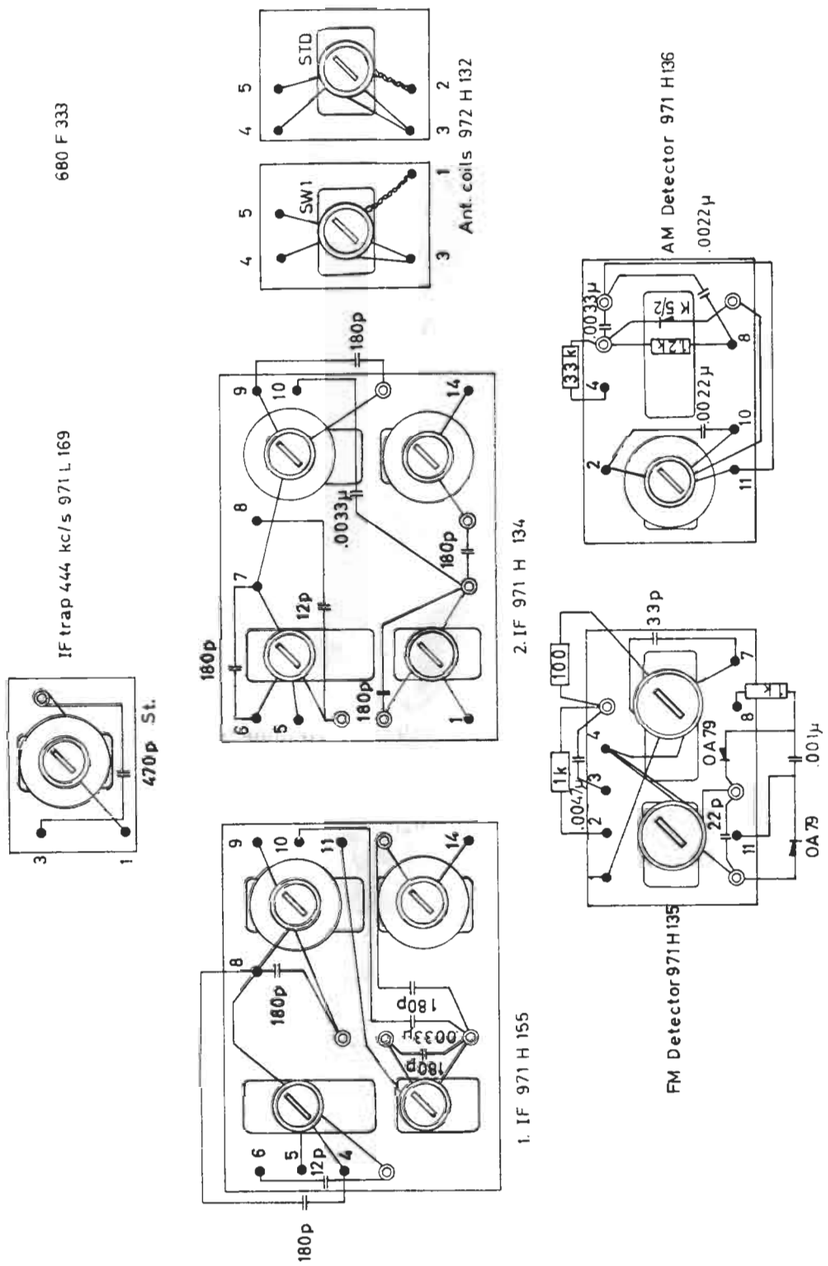


LOCATION OF COMPONENTS ON PW BOARDS



P.W. board 915H53 complete, viewed from component side.

IF TRANSFORMER WIRING DIAGRAMS



Parts list continued from page 1.

Ferrite rod:	Less coils, type BEOLIT 609	
—	Complete with coils,	601 H 4
Carrying handle:	Complete,	760 H 397
Plastic case for dry cells:	Detachable part:	760 L 371
—	Fixed part:	760 L 370
Speaker:	Oval type, 18/12 TV XS or E 570-371	
Cabinet (2 halves): seven colours:	*Green, blue, yellow, light grey, dark grey, red, black*	532 C 440
Knobs:	Bass	928 L 87
—	Treble	928 L 86
—	Tuning and volume	928 L 88
Locking ring:	For carrying handle	SL 5
Switch:	Push-button assembly	854 F 663
Potentiometers:	Bass control and on/off switch	854 L 612
—	Treble control	854 L 518
—	FM detector	2 k ohms P 4
—	Meter adjustment	250 ohms S 50
—	Volume control	854 L 517
Ornamental strips for cabinet:	1-hole	280 H 236
—	2-hole (for gramophone)	280 H 336
—	2-hole (for tape recorder)	280 H 325
PW boards:	Complete IF and AF section	915 H 75
—	Complete FM section	915 H 45
Radicator (meter):		558 H 31
Dial back plate:		535 L 420
Dial glass:	(complete with retainer springs)	840 H 70
Dial pointer:		760 L 374
Drive wheel for tuning capacitor:		312 L 39
Coils:	Oscillator STD	996 H 368
—	— SW 1	996 H 426
—	— SW 2	996 H 374
—	FM IF transformer secondary	990 H 54
Jacks:	Aerial	840 L 331
—	Gramophone/tape recorder	81/123
—	Speaker	81/123
Jack plugs:	(extra accessory) Aerial	10076
—	Gramophone and speaker	2920
Stud for carrying handle:		469 L 16
Transformers and screened coils:	STD and SW 1 aerial coils	972 H 132
—	Series-resonant wavetrap	972 H 169
—	1st IF	971 H 155
—	2nd IF	971 H 134
—	FM detector	971 H 135
—	AM detector	971 H 136

Transformers and screened coils:	AF driver	0 5 PS 2762/2
—	AF output	1 S 2261
Transistors:	AF 102 FM-RF	
—	AF 115_1 FM mixer	
—	AF 115_2 1st FM-IF / AM mixer	
—	AF 116_1 2nd FM-IF / 1st AM-IF	
—	AF 116_2 3rd FM-IF / 2nd AM-IF	
—	AC 126 AF amplifier	
—	AC 126 driver for output stage	
—	2×AC 128 output amplifier	

NOTES:

DESCRIPTION

The BEOLIT 609 FM is a combined AM/FM receiver. Except for the ferrite aerial and the push-button switch it is built on PW boards.

The ferrite aerial is composed of two different ferrite materials. The STD ferrite-aerial coil is located on the longer ferrite rod, the SW 1 aerial coil being placed at the opposite end of the rod, which consists of a material that is especially suited for this wave-range. The left-hand section of the FM dipole serves as aerial on SW 2 and when used in this manner should be pulled out to its full length (but should not be turned down horizontal). An external aerial may be used on all bands, and the external aerial jack is common to FM and AM. On STD and SW 1, the ferrite aerial may be cut out by means of the aerial push-button. This push-button also cuts in aerial coils for use with an external aerial. These aerial coils are housed in screen cans. An external aerial is used when the receiver is operated under adverse conditions, for instance in a motor-car or in a ferro-concrete building. The built-in FM aerial is a telescoping dipole. Where reception is poor, an improvement will be obtained by pulling out the aerials, starting with the right-hand one. In some cases satisfactory reception will result with only two or three sections of the right-hand aerial pulled out. Where reception is very poor, and for long-distance reception, both aerials should be pulled out to full length and laid down in the horizontal plane, whereafter the receiver should be rotated slowly back and forth until best reception is obtained (maximum radicator reading). If there is not enough room so that the aerials can be laid down flat they may be left at an angle of 45 degrees.

The FM tuner is built on a separate PW board mounted on the tuning capacitor. This board also carries the padding capacitors for the AM bands. The aerial signal is applied, via the input coil, to the emitter of AF 102, which operates as an RF amplifier. AF 115_1 operates as a self-excited mixer. Output from the AF 102 is applied to the emitter of AF 115_1, which also connects to the tuned oscillator coil via a capacitance. The collector of AF 115_1 connects to the primary of the first intermediate-frequency transformer. The primary of this transformer is mounted on the tuner PW board, the secondary being placed on the large PW board. Coupling between the two coils is taken care of by a link and a capacitor. AF 115_2 operates as a self-excited mixer and FM intermediate-frequency amplifier. By means of the switch, the base may be connected to, respectively, the FM tuner and the AM aerial coils. The 444-kc/s series-resonant circuit is connected to the same base. A 0.01 μF capacitor connects the emitter to a tap on the tuned oscillator coil. This capacitor is connected to chassis ("earth") potential when the switch is in the FM position. The collector connects to the first AM intermediate-frequency transformer and, through it and the oscillator reaction coil, to the second FM IF transformer. The oscillator reaction coils are inactivated when the switch is in the FM position. AF 116_1 and AF 116_2 are IF amplifiers.

The radicator is inserted in the emitter circuit of AF 116_2. The radicator is a moving-coil meter which reads the AF 116_2 emitter current. When no station is being received — and, consequently, the AVC is not functioning — the emitter current will be a measure of the battery voltage. Therefore, to check the condition of the battery the

receiver controls should be set so that no station is being received (the easiest way of doing this is to depress the STD and SW 1 push-buttons at the same time, thereby disabling the oscillator). The radicator pointer, which has its position of rest at the extreme right-hand end of the scale when the receiver is switched off, should now come to rest in the green scale section if the battery is O.K. The higher the battery voltage, the farther to the left the pointer will go.

If the pointer comes to rest between the green and the red scale sections, the dry cells will be almost spent, and if the pointer is inside the red section, the cells should be replaced. The receiver may still be able to work, but there will be a risk that the cells may give off liquid, resulting in damage to the receiver.

In the event that AF 116_1 has been replaced it will be necessary to re-adjust the radicator, due to transistor tolerances. To do this, install a set of new dry cells in the receiver and adjust the 250-ohm potentiometer for maximum radicator reading with the receiver set up for battery checking as described above.

When an incoming signal activates the AVC, the AF 116_1 emitter current will be reduced by the AVC bias voltage, and the radicator will therefore act as a tuning indicator.

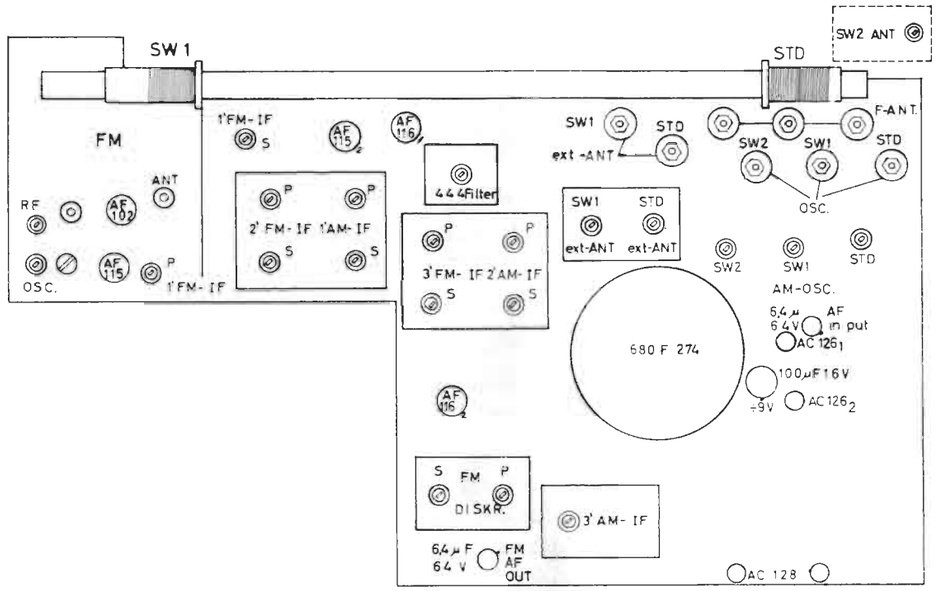
The radicator is of great importance in indoor reception of weak signals as it makes it easy to find the best placement of the receiver in the room. The radicator makes accurate direction-finding simple, and it also permits using the receiver as a rough field-strength indicator.

A type K 5/2 (OA 79) diode is used as AM signal detector and also supplies the AVC bias voltage. The entire AM detector circuit is 1.4 volts negative with respect to chassis potential, and the AVC bias moves in the positive direction — that is, towards chassis potential. The AVC bias is applied, via 33 k ohms and 6.4 μF, to the base of AF 116_1, thereby reducing the emitter current of that transistor and hence also its gain.

The FM detector is a ratio detector using two type OA 79 diodes. The series resistance of one of the diodes has been made variable to make it possible to obtain perfect balance. The FM detector also supplies the FM AVC bias voltage. The FM detector is likewise 1.4 volts negative with respect to chassis, and the AVC likewise bias moves in the positive direction towards chassis potential. The bias is applied, via 1 k ohm and 0.01 μF, to the base of AF 102 and, via 0.1 megohm, to the base of AF 116_1, thereby reducing the emitter currents of these transistors and hence also their gain. The AF signal is applied to AC 126_1 via the potentiometer. AC 126_1 is a resistance-coupled stage working into the AC 126_2 driver. The bass control is inserted between AC 126_1 and AC 126_2, the treble control being inserted in the emitter circuit of AC 126_1. Negative-feedback voltage, obtained from the output transformer secondary, is applied to the base of AC 126_2 and the emitter of AC 126_1 via 22 k ohms and 0.01 μF. An external speaker is connected by inserting a jack-plug in the external-speaker jack, whose break contacts cut out the built-in speaker. A tape recorder is connected in the same way by means of a jack-plug. The impedance of the tape recorder input circuit is approx. 20 k ohms.

444-kc/s IF Alignment

The receiver should be tuned to a frequency near the middle of the STD band and the signal from the alignment oscillograph applied to point A (the base of AF 115_2)



through a 0.1 μF capacitor, with the iron core of the IF series-resonant wavetrap screwed all the way out. The signal is measured at the top of the potentiometer, and the circuits should be tuned for maximum response and symmetrical curve-form. The IF signal should thereafter be applied through the aerial jack and the IF series-resonant wavetrap tuned for maximum attenuation.

Alignment Points

When the tuning capacitor is at maximum capacitance, the pointer should be in line with the two indicating marks at the right-hand side of the dial.

Ferrite-aerial sensitivities as measured in a screened room with a signal from a loop aerial, at 50 mW output:

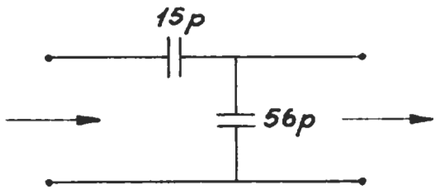
STD 656 and 1430 kc/s, sensitivity 140 and 45 μV/m
SW 1 2.8 and 6.0 Mc/s, — 28 and 35 μV/m

Sensitivities on SW 2 as measured in a screened room through external aerial jack with 33 pF in series with the signal generator and with fully telescoped whip aerial, at 50 mW output:

SW 2 7.2 and 15.3 Mc/s, sensitivity 18 and 0.9 μV.

When aligning the receiver on SW 2, a certain amount of oscillator pulling will be noticeable on the highest frequencies. Consequently, while aligning the aerial circuit

the receiver must be retuned continually in order to keep it on the alignment frequency.
When aligning the receiver on the bands on which the ferrite aerial is used, the STD band should be aligned first, followed by the SW 1 band.
When aligning the receiver on an external aerial, the signal should be applied through a dummy aerial consisting of two capacitors as shown in the sketch below.



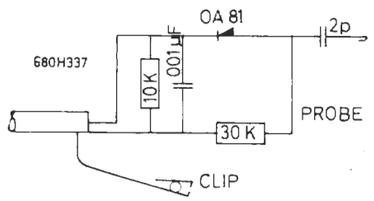
Sensitivity as measured through dummy aerial at 50 mW output:

STD:	656 and 1430 kc/s,	sensitivity	14 and 14 μV
SW 1:	2.8 and 6.0 Mc/s,	—	14 and 18 μV

The locations of coils and trimmers appear from the layout sketch on p. 9.

FM Alignment

A sweep generator should be used for aligning the 10.7 Mc/s intermediate frequency. A signal near the middle of the FM band, for instance at 96 Mc/s, should be fed into the external-aerial jack, and the oscillograph should be connected to the base of AF 116_2 (point designated C) through a probe with a built-in diode (see sketch below). The circuits should be tuned for maximum response and symmetrical curve-form. For alignment of the discriminator, the oscillograph should be connected to the top of the potentiometer without the probe, and the circuits should be tuned for symmetrical curve-form and maximum noise suppression by means of the semi-variable 2 k ohm potentiometer.
The oscillator is adjusted by means of the trimmer and the brass slug in the FM unit, after which the signal circuits are tuned for maximum response; see layout sketch on p. 9.



Sensitivities

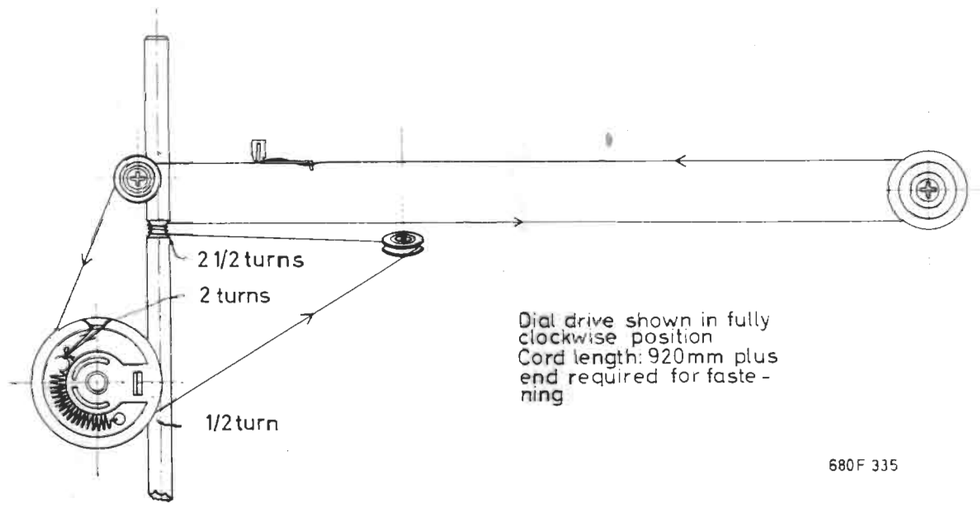
96 Mc/s: 6 μV for 1 V across 6.4 μF/64 V (No. 33 in the discriminator circuit). 26 dB signal-to-noise ratio at 4 μV.

Fault Finding

may be based on the voltages, currents, and sensitivities indicated in the circuit diagram. It should be noted, however, that RF and IF sensitivities can be measured only by means of a signal generator having low output impedance. The connection between the signal generator chassis and the chassis of the receiver should always be made before connecting the RF lead.
The best way of checking AM oscillator functioning is by means of an oscillograph connected to the emitter of AF 115_2 at which point there should be a potential of approx. 0.4 to 1.0 volt peak-to-peak. A check on the functioning of the FM oscillator may be obtained by connecting a 10 pF capacitor in series with an OA 81 diode between the emitter of AF 115_1 and chassis, with the diode connected to chassis. When the oscillator is operating, approx. 0.2 – 0.8 volt can be measured across the diode, using a vacuum-tube voltmeter.

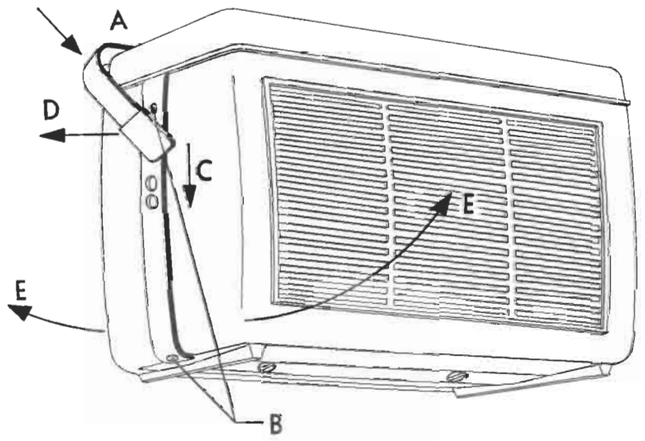
Rewiring the Tape Recorder Jack for Use as Gramophone Jack

To carry out this modification, unsolder from the tape recorder jack the orange wire which goes to the same tag as the yellow wire; thereafter connect the orange wire to the unused tag on the jack.
If a crystal pick-up is to be used with the receiver, a 100 k resistor should be connected in the pick-up jack so that it is in series with the pick-up. If the pick-up to be used is a low-impedance type, a pick-up transformer will be required. This transformer must be placed outside the receiver.



Disassembling the Receiver

1. Take off the handle by pressing lightly in the direction of the arrow A.
2. Take off the bottom piece and thereafter remove the screws marked B (at both sides).
3. Remove the side strips by sliding them in the direction of the arrow C and thereafter pulling lightly in the direction of the arrow D.
4. Remove the two halves of the cabinet by tipping them in the direction of the arrows E.
5. The top section is held to the chassis by four screws near the ends of the ferrite aerial and the two tone controls.



Dial Replacement

First proceed as described above.
Thereafter loosen the four screws holding the chassis to the top plate and unsolder the FM-aerial leads.
Remove the control knobs. Detach the chassis from the top plate. Take off the four dial-retainer springs. The dial may now be removed.
In order not to damage the cast-in studs for the retainer springs the latter must be loosened carefully by means of a screwdriver, and since the springs will presumably become too slack as a result of this procedure, new springs are supplied with each new dial.
Note that Cellutape has been affixed to the dial in the places where it is held by the springs.