

COMMUNICATIONS RECEIVERS

TYPES 8RO 501/00 AND/50

8RO 501/01 AND/51

soos
n

MANUAL

DB-R923e

2nd EDITION



N.V. PHILIPS' TELECOMMUNICATIE INDUSTRIE

HILVERSUM - NEDERLAND

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INTRODUCTION

The type 8RO 501 communications receivers are designed for the reception of A1, A2 and A3 signals in the 200 kc/s (1500 m) to 31.2 Mc/s (9.6 m) range (version /00 and /50) or 225 kc/s (1330 m) to 31.2 Mc/s (9.6 m) range (versions /01 and /51).

The above mentioned frequency range is divided into six overlapping sub-ranges. Versions /00 and /01 are supplied complete with cabinet. Versions /50 and /51 come without cabinet and can be built into standard 19-in. cabinets.

A3b or F1 signals respectively can be received if the communications receivers are used in conjunction with special adapters (types 8RY 507 and 8RY 504). Whilst F6-signals can be received when a 8RY 504 and a 8RY 505 adapter are used together. The circuit of the communications receiver is such that it can be used in a type 8RO 300 dual diversity telegraphy installation or a type 8RO 300 I.S.B. receiving installation, without any special measures having to be taken. It operates as a double superheterodyne receiver in all sub-ranges with the exception of the (1.1-6.24) Mc/s sub-range in which it operates as a single superheterodyne. 1.1 - 2.44 ? R.3.

The receiver has a single knob for tuning, both for coarse tuning (with motor) and for vernier tuning. The tuning mechanism can be locked in position after tuning. Two tuning dials are employed, i.e. a frequency dial and a vernier dial with an overall effective length of approx. 9 metres. The frequency dial can be tested with a built-in 500 kc/s crystal oscillator.

The bandwidth can be adjusted in six steps. At the first three positions of the bandwidth switch a crystal filter is switched into circuit.

Pulse-shaped interfering voltages can be suppressed by means of the noise limiter. The time constant of the Automatic Volume Control circuit can be varied in 3 steps.

A transmit-receive switch is used in simplex operation.

The receiver is blocked if this switch is at the "transmit" position; in this position of the switch an external transmitting relay may be energized by the relevant power supply unit.

A 5 Ω loudspeaker or a 600 Ω line and headphones (4000 Ω) may be connected to the receiver.

The receiver has to be connected to a 90, 110, 125, 145, 200, 220 or 245 V ($\pm 10\%$), 40-60 c/s ($\pm 5\%$) mains.

It can be made suitable for any of the above voltages (with the exception of 90 V A.C.) by means of a mains voltage adapter.

TECHNICAL SUMMERY

Sub-ranges 8RO 501/00 and /50

1. 200-480 kc/s (1500-625 m)
2. 470-1128 kc/s (640-265 m)
3. 1.1-2.64 Mc/s (273-114 m)
4. 2.6-6.24 Mc/s (116-48 m)
5. 6.0-14.4 Mc/s (50-20.8 m)
6. 13.0-31.2 Mc/s (23- 9.6 m)

Sub-ranges 8RO 501/01 and /51

1. 225-540 kc/s (1330-555 m)
2. 470-1128 kc/s (640-265 m)
3. 1.1-2.64 Mc/s (273-114 m)
4. 2.6-6.24 Mc/s (116-48 m)
5. 6.0-14.4 Mc/s (50-20.8 m)
6. 13.0-31.2 Mc/s (23- 9.6 m)

Circuit

For sub-ranges 1, 2, 5 and 6 : double superheterodyne with intermediate frequencies of 2455 and 455 kc/s

For sub ranges 3 and 4 : single superheterodyne with an intermediate frequency of 455 kc/s.

Impedance of the aerial input

In sub-ranges 1 to 3 (200 or 225 kc/s to 2.64 Mc/s) matched to a dummy load in accordance with CCIR standards.

In sub-ranges 4 to 6 (2.6-31.2 Mc/s) 75 Ω unbalanced (a balanced input can be provided on special request).

Tuning

Motorized coarse tuning on a linear frequency dial; vernier tuning on a vernier dial by means of the tuning control, with 100 scale divisions and additional half scale divisions. 28 turns of the vernier dial for each frequency range.

Reading accuracy of dial

Better than 0.3% of the frequency indicated for sub-ranges 3 to 6.

Backlash of the vernier control

Max. 0.5 scale division of the vernier dial.

Frequency tolerance

Frequency drift due to:

- a. the warming-up of the receiver is less than 300 c/s per Mc/s for frequencies above 6 Mc/s (measured three minutes after the receiver has been switched on);
- b. the ambient temperature is less than $+ 20 \cdot 10^{-6}$ per degree. Centigrade for frequencies above 6 Mc/s;
- c. mains voltage fluctuations of 5% is less than 600 c/s at 25 Mc/s within one minute.

Sensitivity

The aerial E.M.F. for a signal-to-noise ratio of 10 dB is:

- max. 10 μ V in range 1 (200-480 kc/s or 225-540 kc/s);
- max. 5 μ V in ranges 2 and 3 (470 kc/s - 2.64 Mc/s);
- max. 1.6 μ V in ranges 4 and 5 (2.6 - 14.4 Mc/s);
- max. 2 μ V in range 6 (13.0-31.2 Mc/s).

The above values are measured for a 30% modulated (with 400 c/s) input signal at a receiver bandwidth of 6 kc/s.

Selectivity

a. R.F. amplifier

For aerial frequencies of 200 or 225 kc/s to 1.8 Mc/s (sub-ranges 1 to 3) flat within 3.5 dB for a bandwidth of 10 kc/s
For aerial frequencies of 1.8 to 31.2 Mc/s (sub-ranges 3 to 6) flat within 2 dB for a bandwidth of 16 kc/s.

b. I.F. amplifier

The bandwidth is adjustable to:

| | at -6 dB | at -60 dB less than |
|----|----------------------|---------------------|
| 1. | 200 \pm 40 c/s | 5.5 kc/s |
| 2. | 900 \pm 200 c/s | 6.5 kc/s |
| 3. | 2000 \pm 300 c/s | 7.5 kc/s |
| 4. | 3000 \pm 400 c/s | 9 kc/s |
| 5. | 6000 \pm 1000 c/s | 13 kc/s |
| 6. | 10000 \pm 1500 c/s | 25 kc/s |

A crystal filter is switched into circuit at positions 1, 2 and 3.

Measured at the I.F. adapter terminals the bandwidth is:

for connection of an I.S.B. adapter: 16 kc/s within 1.5 dB
with the bandwidth switch set to the "10 kc/s" position

for connection of an F1-adapter: 6 kc/s within 3 dB with the bandwidth switch set to the "6 kc/s" position.

A.V.C.

If the input signal is increased from 3 μ V to 100 mV in sub-ranges 1 and 2 or from 1 μ V to 100 mV in sub-ranges 3 to 6, the output signal will not increase by more than 6 dB.
The A.V.C. switch has the following positions:

1. manual operation
2. time constant 50 msec.
3. time constant 500 msec.
4. time constant 5 sec.

Blocking

Less than -3 dB at:

a desired signal of:

10 μ V
100 μ V
1 μ V

by an unwanted signal of

15 μ V
50 μ V
250 μ V

for 10 kc/s frequency spacing.

Image rejection

The image frequencies of the first mixer stage are suppressed more than 80 dB for aerial frequencies up to 28 Mc/s. The image frequencies of the second mixer stage are suppressed more than 120 dB.

Suppression of I.F. signals

Better than 100 dB

Stray radiation of the oscillator

The radiation of the 1st oscillator, 2nd oscillator (2 Mc/s) and the B.F.O. to the aerial input terminated with a dummy load is less than 50 μ V.

Reception facilities

| | | |
|-----|--|---|
| A1 | - continuous-wave telegraphy | |
| A2 | - modulated continuous-wave telegraphy | |
| A3 | - telephony | |
| A3a | - S.S.B. signals | } only with the help of special adapters |
| A3b | - I.S.B. signals | |
| F1 | - frequency-shift signals | |
| F6 | - twinplex | |

Cross modulation

Less than 3% (-30 dB) at

a desired signal of:

10 μ V
100 μ V
1 μ V

by a 30% modulated unwanted
signal of:

3 mV
10 mV
20 mV

for 10 kc/s frequency spacing.

B.F.O. frequency

This frequency may be varied for not less than ± 3 kc/s with respect to the centre frequency of 455 kc/s; its drift is not more than approx. 100 c/s for mains voltage fluctuations of $\pm 10\%$ and changes in temperature in the range of $+10$ to $+45^\circ\text{C}$.

Output voltage I.F. adapter "455 kc/s"

approx. 400 μ V with the bandwidth switch at the "¹⁰/₁₆ kc/s" position;
approx. 700 μ V with the bandwidth switch at the "6 kc/s" position;
for an aerial E.M.F. of 1 μ V (A.V.C. inoperative) in sub-range 3 to 6 (1.1 - 31.2 Mc/s).
The capacitive load may vary between 0 and 100 pF.
The noise voltage has been left out of consideration.

Noise limiter

This is a series limiter for A2 and A3-signals which operate on the carrier.

A.F. output impedances

5 ohms (unbalanced) or
600 ohms (unbalanced or balanced)

Output power

Max. 2.5 W at the 5-ohm output terminals at 5% distortion.
Max. 20 mW at the 600-ohm output terminals at 3% distortion and a modulation frequency of 400 c/s.
This output power is obtained with an aerial E.M.F. of as little as 3 μ V in sub-ranges 1 and 2 or 1 μ V in sub-ranges 3 to 6 for an A1 signal or an 80% modulated A3-signal.

A.F. frequency response

Flat within ± 3 dB between 150 c/s and 10 kc/s, relative to 400 c/s.

A.F. hum voltage

5 ohm output: less than -58 dB relative to maximum output
600-ohm output: less than -52 dB relative to maximum output power.

Noise and modulation hum level

Max. -42 dB relative to a 30% modulated R.F. signal which is stronger than 1 mV.

Power supply

90, 110, 125, 145, 200, 220 or 245 V ($\pm 10\%$), 40-60 c/s ($\pm 5\%$).
All these voltages (except 90 V) can be selected by means of a voltage adapter.

Power consumption

Approx. 65W (the tuning motor requires an additional 17W (approx.).

Ambient temperature

-10 to +45°C

Tube and diode complement

| <u>Philips type</u> | <u>U.S.A. type</u> | <u>Number used</u> | <u>Function</u> |
|----------------------|--------------------|--------------------|------------------------|
| EF 85 | 6BY7 | 2 | R.F. amplifiers |
| | | 1 | I.F. amplifier |
| ECH 81 | 6AJ8 | 1 | Calibration oscillator |
| E99F | 7694, 6662, 6BJ6 | 2 | Mixer tubes |
| (EAA91) 5726 (E91AA) | 5726 (6AL5) | 1 | BFO and detector |
| EL 84 | 6BQ5 | 2 | I.F. amplifiers |
| | | 1 | A.F. amplifier |
| OA 2 | OA 2, A2WA, 6626 | 1 | A.V.C. and detector |
| BY 100 | - | 1 | A.F. power amplifier |
| OA 202 | - | 4 | Stabilizer |
| | | 1 | H.T. rectifiers |
| | | 2 | Noise limiter |
| | | 1 | A.V.C. |
| | | | L.T. rectifier |

Dimensions

Without cabinet: Height
(8RO 501/50) 266 mm
(8RO 501/51) Width 483 mm
Depth required 390 mm
Actual depth (knobs included) 420 mm

Cabinet included: Height
(8RO 501/00) 327 mm
(8RO 501/01) Width 527 mm
Depth (knobs included) 468 mm

Weight

approx. 32 kg (incl. cabinet)

EXPLANATION OF THE CIRCUIT DIAGRAM

The circuit diagrams (diagram 9) contains as much information as possible. A few particulars are given below.

1. The R.F. amplifier

Tuning capacitor C10 is a four-gang capacitor. The tuning coils for the various sub-ranges are:


- | | |
|--------------------|--------------------|
| 1. L3a - L6a - L9a | 4. L2b - L5b - L8b |
| 2. L3b - L6b - L9b | 5. L1a - L4a - L7a |
| 3. L2a - L5a - L8a | 6. L1b - L4b - L7b |

The coils are selected with switch SK1 "RANGE". The upper sections of the switch select the required coil and the lower sections short circuit the coils not used, if so required. For sub-ranges 1 and 2 tube B2 is switched out of circuit, the second and third stages being circuited as a bandpass filter to obtain the required bandwidth. The gain of the two tubes is controlled by the A.V.C.-voltage (see under 7 "The A.V.C. circuit").


The aerial input is unbalanced, but it may be made balanced for ranges 4 to 6. The aerial circuit can be readjusted by means of C9 "ANT.ADJ.".

2. The first mixer stage

The triode section of B3 is circuited as an oscillator or an amplifier, depending on the position of SK2 "R.F. OSC." (see Fig. 1), with this switch set to the:

" " position (as depicted in the diagram) the "R.F. OSC." socket is connected to the oscillator circuit via C63, so that the oscillator can drive the first mixer stage of another receiver for diversity reception, via an amplifier (e.g. the amplifier in the type 8RY 518 diversity switch unit).

"NORMAL" position, the triode is circuited as an oscillator. The "R.F. OSC." socket is earthed and C62 is used instead of cable capacitance.

" " position, the triode is circuited as an amplifier. In this case the oscillator signal has to be applied to the "R.F. OSC." socket. The signal may be derived from an external crystal oscillator (8RG 505 or 8RY 518) or from another receiver via an amplifier (8RY 518). If crystal control is employed, the triode section may be operated as a doubler or a tripler. The front end of switch section SK2 is used for switching on crystal oscillator (type 8RG 505) which may be connected to octal socket.

The oscillator tuning coils for the various sub-ranges are:

- | | |
|---------|---------|
| 1. L12a | 4. L11b |
| 2. L12b | 5. L10a |
| 3. L11a | 6. L10b |

Test point MP1 is used for testing the I.F. amplifier without

removing the bottom panel. The oscillator voltage is measured at test point MP2.

If B3 has had to be replaced, the difference in tube capacitance may be compensated for by means of C51, so that not all oscillator circuits have to be realigned.

3. The second mixer stage

This stage is only used for sub-ranges 1, 2, 5 and 6. Under normal conditions the triode section of the tube is incorporated in a 2 Mc/s Colpitts oscillator circuit, in which C107 is used for temperature compensation. If a type 8RG 505 crystal oscillator is used, the 2 Mc/s oscillator must also be crystal-controlled. To do so, disconnect strip STR. A and fit a 2 Mc/s crystal (KT7). For diversity reception the oscillator (of either receiver) has to be switched out of circuit by disconnecting strip STR.B (STR.A should have been fitted). The mixer stage has to receive the required 2 Mc/s signal from the crystal oscillator in the type 8RY 518 diversity switch unit via the socket marked "2Mc/s OSC."

For sub-ranges 3 and 4, the 2nd mixer stage is switched out of circuit and the 1st mixer stage is then connected direct to the I.F. amplifier.

In this case stabilizing tube B12 is loaded by R25 instead of by R44 so as to avoid overloading it. At the same time, the -25 V voltage is applied to the "EXT. OSC." terminal in order to switch the 2 Mc/s crystal oscillator (type 8RY 518) out of circuit.

The 2nd mixer stage is screened in order to prevent whistles caused by radiation of the oscillator.

4. The I.F. amplifier

The bandwidth can be adjusted in 3 steps by changing the coupling of the bandpass filters with SK3. The crystal filter with KT1 is switched into circuit when SK3 is at one of the other three positions.

By means of C127 "CRYSTAL PHASING" a point of infinite attenuation may be put into the characteristic curve, i.e., if the capacitor is turned starting from the centre position, this point approaches the intermediate frequency of 455 kc/s. At the extreme positions of the capacitor this point is only approx. 300 c/s away from 455 kc/s, so that an interfering signal very close to the required signal can still be suppressed. With bandwidth switch SK3 set to the "0.9 kc/s" and "2kc/s" positions, C127 "CRYSTAL PHASING" must not be turned so far because the band will become unsymmetrical and, moreover, it will begin to shift. The graphs are shown in diagrams 5-7. Halfway to the I.F. amplifier, the signal is taken from L30 and applied to I.F. adapter socket "455 kc/s", to which an A3a/A3b or an F1/F6-adapter may be connected.

If the receiver is intended particularly for A3b-operation, it may be necessary to change the values of R46 in order to make the I.F. bandpass curve flat within 1 dB up to the I.F. adapter connection.

Carrier level meter ME1 measures the cathode voltage of tube B6 which is controlled by the A.V.C.-voltage. The meter has been connected between the cathode of B6 and a tapping on the cathode resistor of B7 in order to make it less dependent on variations of the power supply voltage. Potentiometer R60 and R68 serve to adjust the meter.

The calibration of the dial (0-120 dB above 1 μ V aerial E.M.F.) is a mere indication of the actual value. In sub-ranges 1 and 2 the reading of the meter will be slightly too high because one tube fewer (B2) is controlled by the A.V.C. circuit.

5. The A2-A3 detector

This detector has a conventional circuit. The A.F. signal is taken to terminal "AF 0" via the B.F.O. switch.

If the A.F. signal is taken from this terminal (for, say, a recorder), it has to be taken via a 10,000 pF capacitor. If the strip between terminals "A.F. 0" and "AF 1" has been removed, the terminal has to be earthed via a 0.27 M Ω resistor. A low-capacitance cable which must not be too long has to be used. A 135 Ω cable is to be preferred.

6. The A1 detector

The triode section serves as a beat frequency oscillator; the heptode section being used as a product detector. This circuit was chosen in order to avoid the disadvantages of the diode-injection method. The detector is switched into circuit if SK5 is at the "B.F.O." position. The A2-A3 detector is then loaded with R114, so that the I.F. response is not changed.

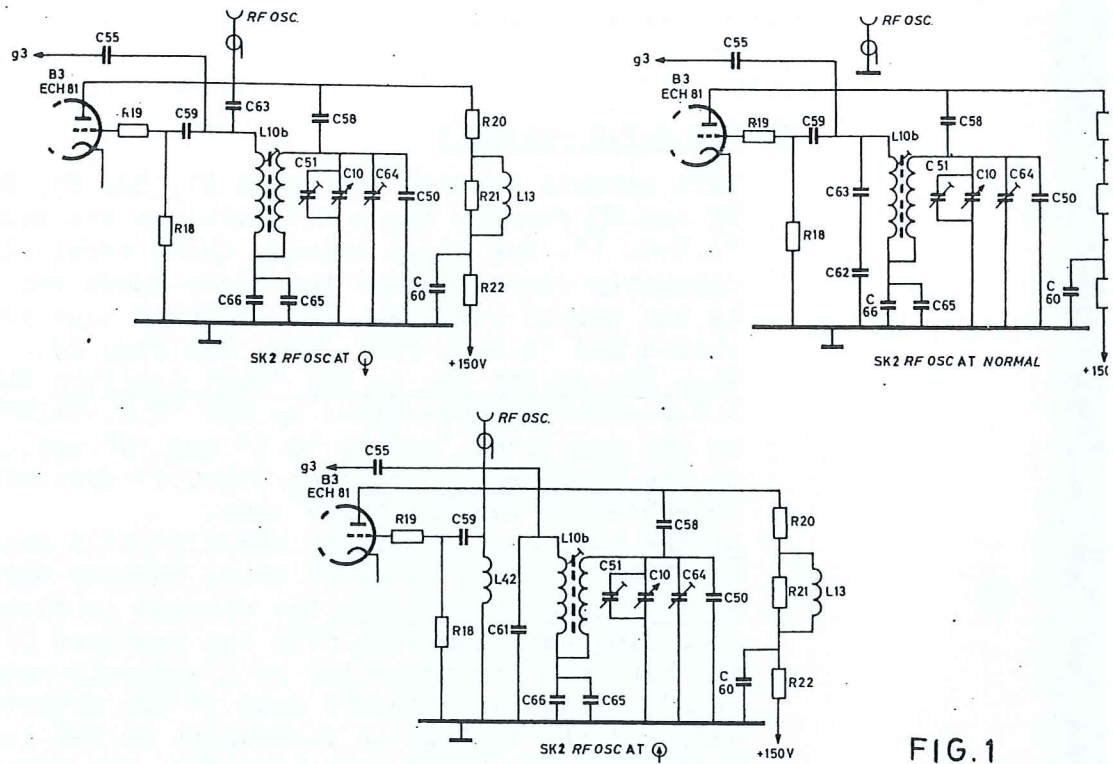


FIG. 1

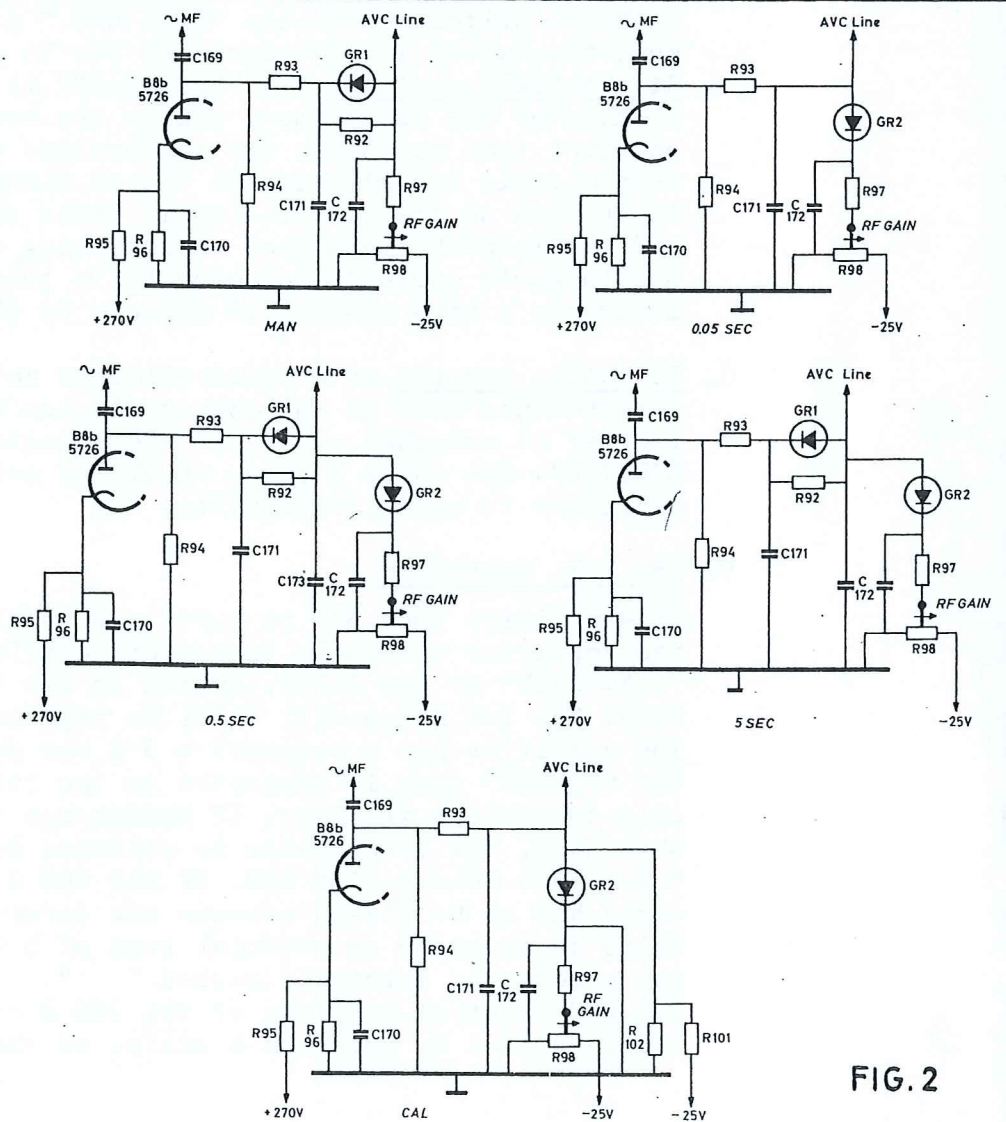


FIG. 2

7. The A.V.C.-circuit

This circuit is used for tubes B1, B2, B5, B6 and B10. Tubes B1, B2 and B5 receive the A.V.C.-voltage via terminals "A.V.C. 0" and "A.V.C. 1". The strip between these terminals may be removed for diversity operation and the above tubes can then be controlled by the second receiver. The recovery time is determined with switch SK4 "A.V.C.-CAL" (Also see Fig. 2).

With the switch set to the "MAN" position the voltage on the A.V.C.-line is determined by R98 "R.F.-GAIN" (R98 remains operative in the positions "0.05", "0.5" and "5" sec.).

At the "0.05 sec." position R93-C171 determine the charge time and R93+R94-C171 the discharge time.

At the "0.5 sec." position R93-C171/C173 determine the charge time and R92-C173 the discharge time, because GR1 is then cut off.

At the "5 sec." position the circuit is similar to that of the preceding position, but C174 has replaced C173. This position is the best for the reception of A1-signals with A.V.C., R98 "R.F. GAIN" having to be turned down to the extent that noise is not very audible during the intervals. As R98 is difficult to adjust because of the large time constant, the adjustment has to be made with the switch set to the "0.05 sec." position; after the adjustment the switch is once more set for "5 sec.".

At the "CAL" position R98 "R.F. GAIN" is inoperative because the cathode of GR2 is earthed, whilst the set is switched to the shortest time constant. The calibration oscillator is switched into circuit and B1 switched out of circuit. A bias (R101-R102) is applied to the A.V.C.-line in order to lower the noise level and to diminish the chance of receiving very strong transmitters due to earth currents and capacitive transfer. The carrier level meter has a bias reading of approx. 20 dB.

8. The noise limiter is a series-limiter and may be used to suppress interference when A2 and A3-signals are received. The noise limiter is switched on or off and adjusted by means of R77 "NOISE LIMITER". The noise limiter should be switched off if the A.F. amplifier is used individually.

9. The A.F. amplifier

Pre-amplifier tube B10 is A.V.C. controlled with the result that the amplifier cannot be turned off completely by means of R81 "A.F. GAIN" if the A.V.C.-switch is set to the "0.05 sec." position. The low notes will still be reproduced weakly.

The amplifier has 2 outputs: a 5 Ω one and a 600 Ω one.

The "PHONES" jack is connected to the latter output so as to be able to monitor the line. If headphones (4000 Ω) are plugged into this jack, the loudspeaker is switched out of circuit and the 5 Ω output loaded with R90. If the 600 Ω output is used, the strip has to be fitted between the terminal marked "5 Ω " and the third terminal or an external load of 5 Ω - 6 W should be connected across the terminals marked " ".

The 600 Ω output consists of two 300 Ω outputs which are connected in series by means of a strip, so that the midpoint can be

earthed or a phantom circuit can be used.

10. The power supply unit

The mains cord has 3 conductors; it is fitted with a double-pole plug. If so required, this plug may be replaced by a plug with 3rd-wire connection.

Tuning motor M1 is switched on by means of SK8 which is operated by the "TUNING" control.

Power supply transformer T1 may be adjusted to mains voltages of 110 to 245 V by means of a voltage adapter; the 90 V tapping, however, cannot be selected. If the receiver has to be connected to a 90 V mains, disconnect the wire from the centre terminal of the adapter and connect it to the 90 V tapping of the transformer. Lamps LA1, LA2 and LA3 are for illuminating the dials.

The receiver is protected by means of a slow-operating fuse of 1.6 A (VL1). If this fuse should happen to blow and a spare slow-operating fuse is not available, fit a normal fuse of not less than 4A.

11. The calibration oscillator

This oscillator is used to calibrate the frequency dial and the vernier dial. The crystal is incorporated in a Pierce-Colpitts circuit. C205 is used to tune to the nominal crystal frequency (= 500 kc/s).

The oscillator is switched into circuit when SK4 is set to the "CAL." position (see item 7: "At the "CAL. position", etc.). Due to the bias on the A.V.C. line, the carrier level meter has a bias reading of approx. 20 dB. Nearly all harmonics of the oscillator cause a deflection which is higher than 40 dB. When tuning to a very strong transmitter it may be that the meter reading has the same value as the reading at the calibration point. If the "ANT. ADJ." control is turned, it can be seen whether the deflection is caused by the signal from the transmitter or from the calibration oscillator; in the first case the meter deflection depends on the position of this control.

PHYSICAL DESIGN

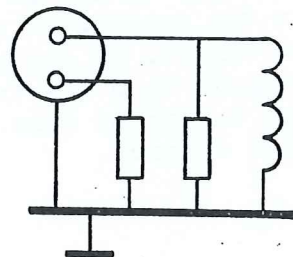
(see diagram 1)

The receiver is fitted on a chassis with a 19-in front panel. The latter contains all controls, all terminals being at the rear of the chassis.

The chassis has a perforated bottom plate. This plate has to be perforated to ensure that the receiver is sufficiently cooled. The 2nd mixer stage is screened with the help of a container; this can may be removed after the two screws at the top have been undone.

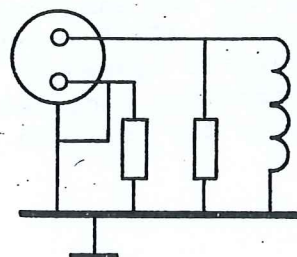
Rapid tuning is facilitated by the use of a drive motor (see diagram 8). The drive mechanism has been thoroughly tested and in normal operation it cannot possibly produce interference. The aerial input is unbalanced, because such an input is most frequently used. If so required, a balanced input may be used for ranges 4, 5 and 6, be it then that the balance is not ideal because of the wiring capacitance. If a balance input is required, replace the socket by a double-pole socket and connect terminals 1 of coils L1 and L2 and item 17 of SK1-XII to the second terminal of the socket. The above-mentioned terminals must first be disconnected from earth, however. It is recommended to earth the two terminals of the socket via a 0.33 Mohm, 1W resistor. This enables any static charges on the aerial to flow off to earth. The following circuits are used:

in ranges 1 - 2



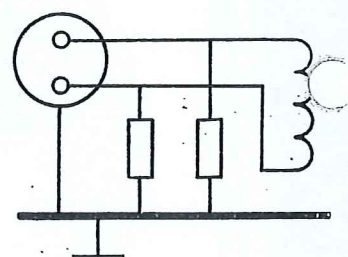
2x330 k Ω

in range 3



2x330 k Ω

in ranges 4, 5 and 6



2x330 k Ω

The knobs of trimmers C9 ("ANT. ADJ."), C189 ("BFO ADJ.") and C127 ("CRYSTAL PHASING") have been locked in the following positions:

C9 turned in completely, arrow knob "ANT. ADJ." pointing to the left

C189 turned in completely, arrow knob "BFO ADJ." pointing to the right.

The arrow knob "CRYSTAL PHASING" should point in a direction away from the rotor of the capacitor.

The cabinet in which versions /50 and /51 are housed has a

hinged lid, so that ready access can be gained to the tubes. The receiver can be taken out of the cabinet after the four screws at the left and at the right have been removed. The bottom plate of the cabinet has been perforated to ensure sufficient cooling.

FUNCTION OF THE CONTROLS

1. "BANDWIDTH" switch

The bandwidth can be adjusted in six steps by means of this switch. A crystal filter is switched into circuit for the first three steps.

2. "CRYSTAL PHASING" control

The purpose of this control is to make a signal with interference more readable by attenuating the interference. Starting from the centre position, turning the control counter-clockwise results in attenuation of the frequency lower than the input signal while turning it clockwise results in attenuation of the frequency higher than the input signal.

3. "NOISE LIMITER" control

This control is used to lower pulse-shaped interference on A2 and A3-signals.

4. "B.F.O. ADJ." control

This control is used for adjusting the pitch of A1-signals, as required.

5. "A.F. GAIN" control

This control is used to adjust the A.F. output level.

6. "R.F. GAIN" control

The R.F., I.F. and A.F.-gain is set by means of this control. With the A.V.C. switched off, the control has to be operated continually, if so required; this may be sometimes necessary.

7. "REC.-TRANSM." switch

This switch is only used in simplex traffic, with the switch set to the "REC." position, the receiver is switched on completely; with the switch set to the "TRANSM." position, the receiver is cut-off and an externally connected transmitting relay is energized.

8. "MAINS" switch

The receiver is switched on or off by means of this switch.

9. "B.F.O." switch

This switch has to be set to the "OFF" position for the reception of A2 or A3-signals. It has to be set to the "B.F.O." position for the reception of A1-signals.

10. "TUNING" control

This control knob is used for tuning in the selected sub-range. By pressing in the knob and then turning it either left or right, the tuning motor is switched on, thus permitting a rapid change-over to another frequency. The motor stops as soon as the knob is released; the same control knob can be used for vernier tuning.

There are two dials to facilitate accurate tuning: the right-hand one is the frequency dial, that in the centre being the vernier dial. Each scale division of the vernier dial represents approx. $1/2000$ part of the lowest frequency in the selected sub-range (the max. deviation is $\pm 5\%$).

Example: In sub-range 4 each scale division represents approx. $1/2000 \times 2.6 \text{ Mc/s} = 1.3 \text{ kc/s}$.

The left-hand dial is that of the carrier level meter. The dial is calibrated in dB above an aerial E.M.F. of $1 \mu\text{V}$. The receiver must always be tuned to maximum reading of this meter. After tuning is completed, the tuning mechanism can be locked into position by means of the lever above it.

11. "RANGE" switch

The required sub-range is selected by means of this switch.

NOTE: Aerials of different impedances are required for sub-ranges 1 to 3 ($0.2 - 2.64 \text{ Mc/s}$) and 4 to 6 ($2.6 - 31.2 \text{ Mc/s}$), so that a change-over from, say, sub-range 5 to sub-range 3 also necessitates a change-over to another aerial.

12. "R.F. OSC." switch

For individual use of the receiver, have this switch at the "NORMAL" position. The other positions are not used unless the switch forms part of a type 820 700 dual-diversity receiving installation, and a type 8RG 505 crystal oscillator is employed.

13. "A.V.C. CAL." switch

This switch has five positions. At the first position ("MAN") the A.V.C. is switched out of circuit. The next three positions are for time constants of 0.05, 0.5 and 5 sec. respectively. The use of these positions depends on the prevailing receiving conditions. With the switch set to the fifth position "CAL." the 500 kc/s calibration oscillator (for calibrating the frequency and vernier dials) has been switched into circuit.

14. "ANT. ADJ" control

This control is used to correct the tuning of the aerial circuit, which may have been detuned by the connection of the aerial. The aerial circuit should also be retuned whenever the receiver is tuned to another frequency.

The control can also be used to determine a calibration point if a very strong transmitter signal should happen to penetrate into the receiver when the latter is being calibrated.

15. Sockets "R.E. OSC." and "2 Mc/s OSC."

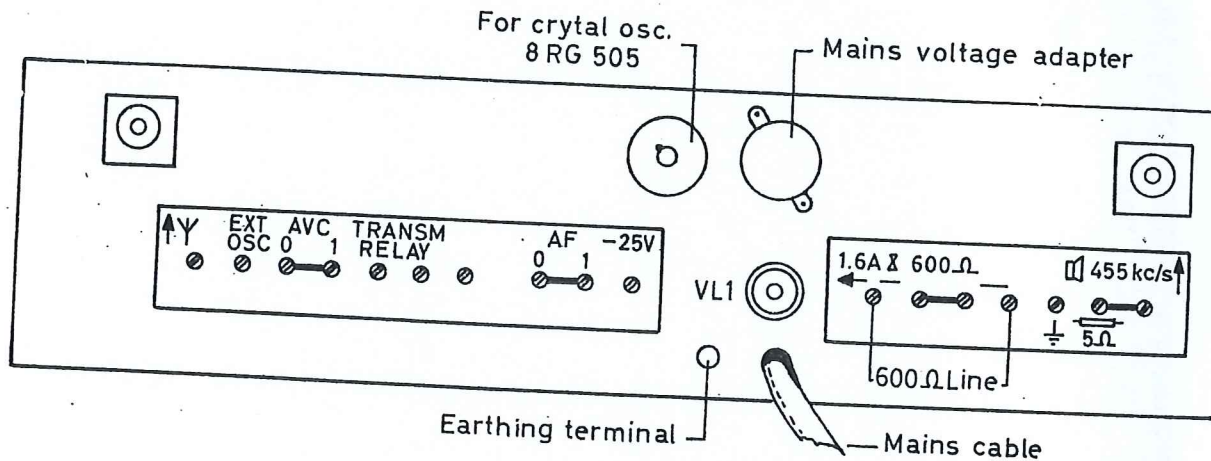
These sockets are not used unless the receiver is used in a (type 8R0 700) F1/F6 receiving installation. If a type 8RG 505 crystal oscillator is employed, only the "R.F. OSC." socket is used.



If the sockets are not used, put the separately supplied screw caps on them.

CONNECTING THE RECEIVER

The receiver is completely aligned before it leaves our works. It is ready for use as soon as it has been connected. If the receiver is used in A1/F1/F6 or A3a/A3b receiving installations, the required additional connections are given in the relevant manual.

1. Make sure that the mains voltage adapter is set for the voltage of the local mains (in the case of a 90 V mains, disconnect the wire from the central outlet of the adapter and connect it to terminal 2 of power supply transformer T1).
2. Insert the receiver into the cabinet to be used.

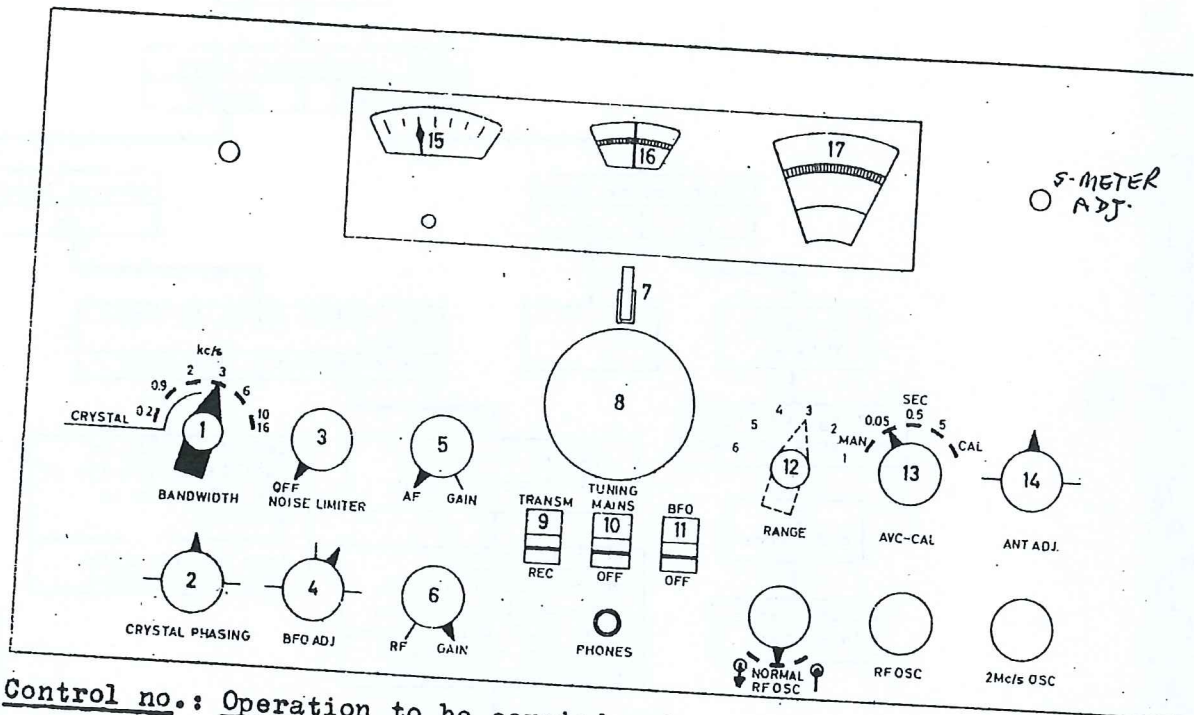


3. Make a proper earth connection to the earth terminal.
4. Connect a line to the "600 Ω" terminals or a 5-ohm loudspeaker to the terminals marked "  ". If a line is used, make sure that the right-hand strip is in position (the strip has to be removed if a loudspeaker is used). Between the "600 Ω" terminals there are two further terminals which, as a rule, have to be interconnected. The midpoint of the line can be earthed by means of these terminals; after the strip has been removed a phantom circuit may be connected to them. The line can be monitored by means of (4000-ohm) headphones plugged into the "PHONES" jack. In this case the loudspeaker is switched out of circuit.
5. If the receiver is used individually, make sure that the "A.F. 0" and "AF 1" terminals are interconnected by means of a strip.
6. Connect the aerial to the left-hand socket marked "  ". For sub-ranges 1 to 3 the input impedance has been matched to a CCIR standard dummy load. For sub-ranges 4 to 6 the input impedance is 75 Ω (unbalanced).

7. Connect the transmitting relay to be used and the associated power supply unit to the "TRANSM. RELAY" terminals.
8. Connect the receiver to the mains. A plug with 3rd-wire connection may be used, if so required.

The receiver is now ready for use.

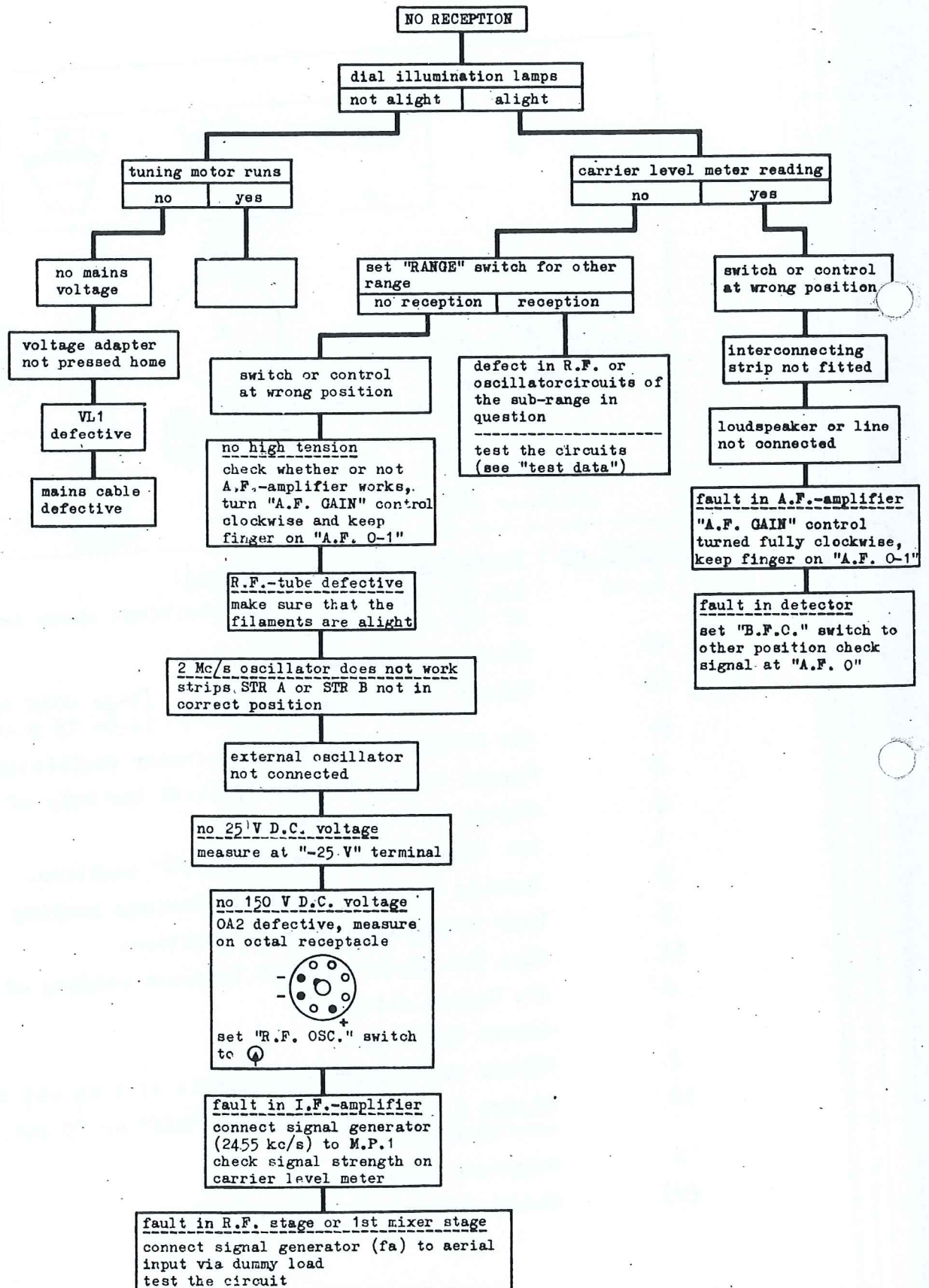
OPERATING INSTRUCTIONS



Control no.: Operation to be carried out:

- 1 to 14 Set all controls to the positions shown in the above view of the front panel.
- 10 Switch on the receiver.
- 12 Select the required sub-range (1-3: CCIR dummy load)
(4-6: 75 Ω antenna)
- 11 A1: Switch on the beat frequency oscillator.
- 8 Coarse tuning on dial 17 (with the help of the motor).
- 5 Adjust the A.F. level.
- 1 Set this knob to the "0.2 kc/s" position.
- 8 Vernier tuning on dial 16 (maximum reading of 15).
- 7 Lock tuning mechanism in position.
- 14 Tune the aerial circuit (maximum reading of 15).
- 4 A1: Adjust pitch.
- 1 Adjust bandwidth.
- 2 Filter out interfering signals if 1 is set to "CRYSTAL".
- 13 Adjust A.V.C. (A1: position "MAN" or "5 sec."; readjust 6 continually).
- 3 Suppress interference.
- (9) Change over in simplex traffic.

FAULT TRACING



INSTRUCTIONS FOR TESTING AND ALIGNING

The instructions given below do not have to be carried out prior to first operation, as the receiver is completely works-aligned. The instructions are merely given for purposes of servicing.

The following instruments are essential for proper servicing:

- R.F. standard signal generator (e.g. Philips type GM 2653)
- R.F. electronic voltmeter (e.g. Philips type GM 6016)
- Diode voltmeter (e.g. Philips type GM 6004) or
- a 50 μ Ammeter
- A.F. voltmeter (e.g. Philips type GM 6015)
- Tone generator (e.g. Philips type GM 2317)
- Oscilloscope (e.g. Philips type GM 5602)
- Frequency counter
- Damping resistors $2 \times 2200 \Omega$
- Attenuator pad.

The receiver and the test instruments must be earthed when the tests are made.

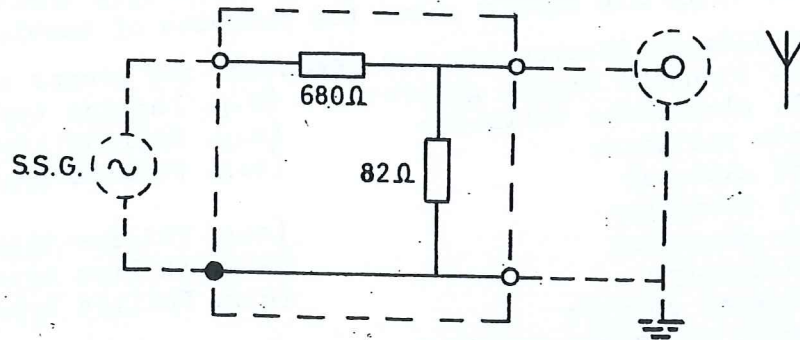
The standard signal generator must always be connected to the aerial input via a dummy load. A CCIR dummy load has to be used for sub-ranges 1 to 3; a 75Ω dummy load for sub-ranges 4 to 6 (see the diagrams below).

Philips type GM 2653 standard signal generator is equipped with the CCIR dummy load.

When the sensitivity at the aerial input is stated, the aerial E.M.F. is meant and not the terminal voltage. If the CCIR dummy load is used, the E.M.F. equals the voltage indicated by the standard signal generator; if the 75Ω dummy load is used, the E.M.F. is $1/10$ of the output voltage of the standard signal generator.

CCIR dummy load:

75-ohms dummy load:





The graphs to which reference is made are for information only. Small deviations caused by tolerances of the component parts may be encountered, but they will not have a detrimental effect on the proper operation of the receiver.

The bandpass curves, however, should show the utmost symmetry.



The test and trimming points are shown in diagram 2. During the tests and alignment, the receiver should be set up in such a way that the circuits are not affected by the radiated heat.

A. A.F. AMPLIFIER AND A1-DETECTOR (See diagram 5)

a. Testing the A.F. response

1. Remove strip "AF 0-1".
2. Set the "NOISE LIMITER" control to the "OFF" position.
3. Turn the "A.F. GAIN" control completely clockwise.
4. Connect the tone generator to terminals "A.F. 1" and the earth terminal.
5. Connect a voltmeter to the terminals marked " 5 Ω " and " " (5 Ω output). The strip should be fitted between the two outer terminals.
6. Make sure that headphones are NOT plugged into the "PHONES" jack.
7. Switch on the receiver.
8. Plot the frequency response by varying the frequency of the tone generator and keeping the output voltage at a constant level. Make a note of the voltmeter reading. At 1000 c/s the reading should be less than 3 V.
9. Disconnect the voltmeter.
10. Terminate the 600 Ω output with a 600 Ω resistor.
11. Connect the voltmeter across this resistor.
12. Repeat the instructions in item 8.
13. Disconnect the test instruments and the terminating resistor.
14. Refit the "AF 0-1" strip.

b. Testing the A1-detector and the A.F. amplifier

1. Connect the standard signal generator to the control grid of B7 and tune it to 452 kc/s (30 mV unmodulated).
2. Connect the voltmeter to the terminals marked " 5 Ω " and " ".
3. Connect the vertical deflection amplifier of the oscilloscope to the same terminals.
4. Connect the tone generator to the horizontal deflection amplifier of the oscilloscope and set the oscilloscope for an external timebase.
5. Set the "B.F.O." switch to the upper position.
6. Plot the frequency response by varying the frequency by means of the "BFO ADJ." control and determining the frequency by means of the tone generator and the oscilloscope.

B. A.V.C.-circuit

a. Testing the A.V.C. voltage at 7 Mc/s

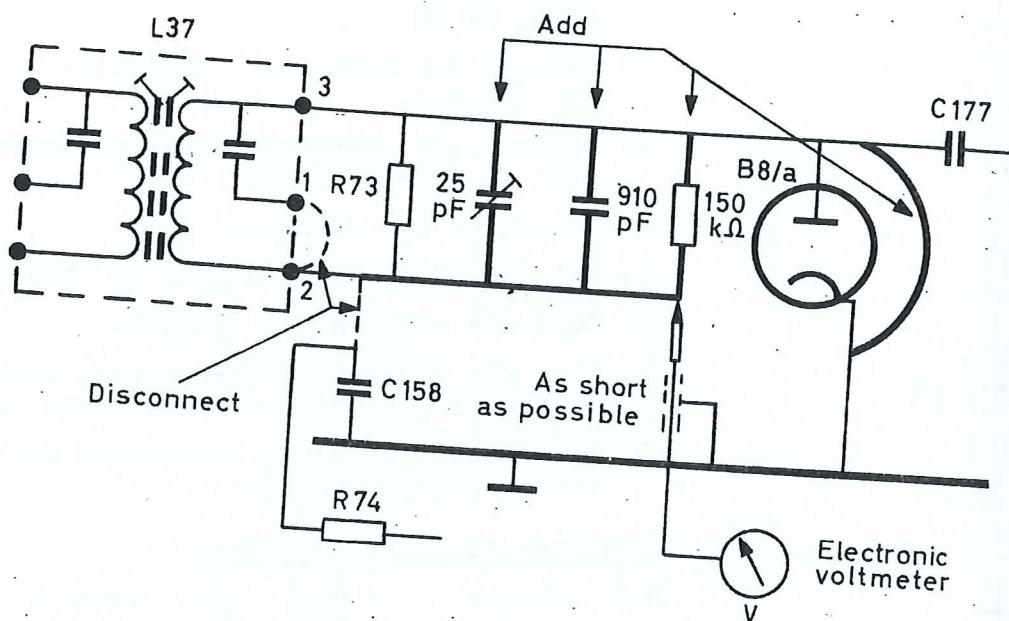
1. Connect the standard signal generator to the aerial input
2. Set the bandwidth switch for "2 kc/s".
3. Turn the "R.F. GAIN" control completely clockwise.
4. Set the "A.V.C.-CAL" control for "0.05 sec."
5. Tune the standard signal generator and the receiver to 7 Mc/s.
6. Modulate the standard signal generator with 400 c/s and adjust the depth of modulation to 70%.
7. Connect a voltmeter to the 5-ohm output.
8. Plot the A.V.C. response curve by varying the R.F. output voltage of the standard signal generator. Diagram 4 shows the A.F. output voltage (in dB) as a function of the reading of the carrier level meter.

C. I.F. amplifier

a. Testing the 2nd I.F. bandpass filter curve (see diagram 6)

1. Set the "CRYSTAL PHASING" control to the centre position (arrow pointing up).
2. Set the "R.F. OSC." control to "NORMAL".
3. Connect the "A.V.C. 0-1" terminals to earth.
4. Connect the standard signal generator (tuned to 455 kc/s and modulated with 400 c/s) to test point MP1.
5. Tune the receiver to approx. 5 Mc/s.
6. Connect the diode Voltmeter between the "A.F. 0-1" terminals and earth or remove the strip from the terminals and connect the 50 μ A meter to them.
7. Plot the bandpass filter curves up to -20 dB for the various positions of the bandwidth switch. The reading of the diode voltmeter or the current flowing through the μ Ammeter should be kept at a stable value whilst the output voltage of the standard signal generator should be varied.
If the bandpass filter curves up to -70 dB have to be measured, carry out the following additional instructions:
8. Disconnect the diode voltmeter or the μ Ammeter. If the latter is disconnected, refit the strip between terminals "A.F. 0" and "A.F. 1".
9. Remove the bottom plate from the receiver.

10. Make the following test set-up:



11. Plot the curves from -20 dB to -70 dB, again keeping the reading of the electronic voltmeter at a stable value.

12. Disconnect the test equipment, discontinue the connection between "A.V.C. 0-1" and earth and refit the bottom plate.

b. Testing the 2nd I.F. bandpass filters curves up to adapter socket "455 kc/s" (see diagram 5)

This should be done in the same way as described in item 1 to 5 and 7 of a. In this case, however, the electronic voltmeter has to be connected to adapter socket "455 kc/s" and tube B7 removed.

c. Testing the 2nd I.F. bandpass filter curves for the various positions of the "CRYSTAL PHASING" control (see diagram 7)

This should be done in the same way as described under a, the "CRYSTAL PHASING" control being set to the position shown in the graph.

d. Testing the 1st I.F. bandpass filter curve (see diagram 5)

1. Switch off the receiver.

2. Remove the screening cover from the 2 Mc/s oscillator/2nd mixer.

3. Disconnect L21-C95 from the anode of B4 (heptode section) and solder a 470 Ω resistor between terminal 2 of L21 and the anode of B4.
4. Connect the electronic voltmeter between the anode of B4 and the chassis.
5. Connect the standard signal generator to test point MP1 and tune it to 2455 kc/s.
6. Switch on the receiver.
7. Set the "R.F. OSC." switch to "NORMAL".
8. Tune the receiver to 12 Mc/s.
9. Plot the bandpass filter curve, again keeping the electronic voltmeter's reading at a constant value.
10. Disconnect the test instruments and return the receiver to the original condition.

e. Adjusting the I.F. amplifier

- Test set-up:
 - "R.F. OSC." control set to "NORMAL" and the "R.F. GAIN" control turned completely clockwise.
 - "B.F.O." switch set to "OFF".
 - "A.V.C. 0-1" terminals earthed.
 - 2 Mc/s crystal KT7 fitted. Strip STR-A must have been removed and STR-B fitted.
(If this crystal is not available a standard signal generator calibrated with a frequency counter may be used instead).
 - Electronic voltmeter (3 mV range) connected to adapter output "455 kc/s".
 - Diode voltmeter connected to the "AF 0-1" terminals and earth, or the 50 μ Ammeter connected to the "A.F. 0" and "A.F. 1" terminals.
 - Standard signal generator tuned to 455 kc/s and calibrated with a frequency counter.
Output voltage 100 mV.

Note: Coils a are in the upper part of the coil containers, coils b being in the lower part.

1. Connect the standard signal generator to the control grid of B7.
2. Adjust the cores of L37 to maximum reading of the diode voltmeter or the 50 μ Ammeter.
3. Test the bandpass curve for symmetry by detuning the S.S.G. by ± 3 kc/s. Readjust L37b if the curve is not symmetrical.
4. Connect the S.S.G. (455 kc/s) to the control grid of B6.
5. Set the bandwidth switch for "3 kc/s".

6. Adjust coils L36b-L36a and L31a-L31b (in that order) to maximum deflection of the diode voltmeter or 50 μ Ammeter, the coil coupled with the coil to be adjusted being damped by the pad.
7. Set the bandwidth switch for "6 kc/s".
8. Check the bandpass curve. Use the core in L31b to obtain identical peaks. If there are no pronounced peaks, test for symmetry at 452 kc/s and 458 kc/s, use L31b to read-just, if necessary.
9. Connect the S.S.G. (455 kc/s) to test point MP1. \leftarrow
10. Tune the receiver to 5 Mc/s.
11. Set the bandwidth switch for "3 kc/s".
12. Adjust coils L30b - L30a and L25a - L25b (in that order) to maximum meter reading. Use the pad to damp the coil which is coupled with the coil to be adjusted.
13. Damp coil L24 with a 2200-ohm resistor.
14. Damp coil L23 with the 2200-ohm resistor (connect this resistor across crystal-phasing capacitor C127).
15. Set the bandwidth switch for "0.2 kc/s".
16. Tune the S.S.G. to maximum meter reading.
17. Adjust coil L22 to maximum meter reading.
18. Remove the 2200-ohm resistors.
19. Replace crystal KT1 by a 4.7 pF capacitor.
20. Set the "CRYSTAL PHASING" control for minimum meter reading.
21. Turn the "CRYSTAL PHASING" control until the meter reading has increased by 20 dB.
22. Adjust coil L23 to maximum meter reading.
23. Set the bandwidth switch for "2 kc/s".
24. Repeat the instructions in items 20 and 21.
25. Adjust coil L24 to maximum meter reading.
26. Set the bandwidth switch for "0.9 kc/s".
27. Repeat the instructions in items 20 and 21.
28. Adjust capacitor C133 to maximum meter reading.
29. Set the bandwidth switch for "0.2 kc/s".
30. Repeat the instructions in items 20 and 21.
31. Adjust capacitor C134 to maximum meter reading.
32. Disconnect the 4.7 pF capacitor and refit 455 kc/s crystal KT1.

Stop

33. Check the bandwidth; it will now be approx. 600 c/s. Lower the inductance of L23 by turning out the core approx. $1\frac{1}{2}$ turns until the bandwidth is 200 c/s (see diagram 7).
34. Tune the S.S.G. to maximum meter reading.
35. Set the bandwidth switch for "0.9 kc/s".
36. Adjust capacitor C116 to maximum meter reading.
37. Repeat the instructions in item 13 to 36 (only if the receiver has got completely out of adjusted by one cause or another).
38. Set the bandwidth switch for "3 kc/s".
39. Adjust capacitor C117 until the curve is symmetrical at the -6 dB points (keep the voltmeter reading at a constant level).
40. Set the bandwidth switch for "6 kc/s".
41. Adjust capacitor C118 to identical peaks in the curve and to a curve which is symmetrical at the -6 dB points (keep the voltmeter reading at a constant level).
42. Set the bandwidth switch to " $\frac{10}{16}$ kc/s".
43. Adjust capacitor C119 until the outer peaks of the band-pass filter curve are identical (use the electronic voltmeter).
44. Check the I.F. curve with the help of the electronic voltmeter. The top should be flat within 1.5 dB (see diagram 7).
45. Set the bandwidth switch for "0.2 kc/s". *TI MP 1*
46. Tune the S.S.G. to maximum reading of the diode voltmeter.
47. Set the bandwidth switch to "3 kc/s".
48. Tune the S.S.G. to 455 kc/s and adjust the output voltage to approx. 30 μ V.
49. The diode voltmeter should now read approx. 1.5 V. *SSORW*
50. This reading should stay within ± 2 dB for the other positions of the bandwidth switch.
51. Set the "RANGE" switch for range 5. *2MHz*
52. Set the bandwidth switch for "0.2 kc/s". *osc. adjust.*
53. Tune the S.S.G. to maximum meter reading (frequency 2455 kc/s). *to MP 1*
54. Set the bandwidth switch for "0.9 kc/s".
55. Adjust the core of L21 to maximum meter reading.
56. Adjust coils L15a-L15b and L14-L14a (in that order) to maximum meter reading; use the pad to damp the coil which is coupled with the coil to be adjusted.
57. Set the bandwidth switch for " $\frac{10}{16}$ kc/s".

PHASING

NET

WORK

START

455 kHz

IF adjust

58. Check the bandpass filter curve with the electronic voltmeter. It should be flat within 1.5 dB. If necessary turn the core of L21 a little.
59. Set the bandwidth switch for "6 kc/s".
60. Check the bandpass curve. The peaks have to be nearly symmetrical. If necessary, detune coil L21 (with the bandwidth switch set for "10 kc/s"). Make sure that the curve is still flat within 1.5 dB.
61. Set the bandwidth switch for "0.2 kc/s".
62. Tune the S.S.G. to maximum meter reading.
63. Remove the 2 Mc/s crystal (KT7) and refit strip STR A.
64. Adjust the core of L18 to maximum meter reading.
65. The sensitivity should now be 30 μ V for a reading of the diode voltmeter of 1.5 V with the bandwidth switch set to the "3 kc/s" position.

D. Beat frequency oscillator

Adjustment

1. Set the "RANGE" switch for range 4.
2. Set the bandwidth switch for "0.2 kc/s".
3. Connect the S.S.G. to test point MP1.
4. Tune the S.S.G. (approx. 455 kc/s) to maximum reading of the diode voltmeter connected to the "AF O-1" terminals.
5. Switch on the beat frequency oscillator (switch marked "B.F.O.").
6. Have the arrow of the "B.F.O. ADJ." control point straight up.
7. Adjust coil L38 to zero interference with the help of the loudspeaker.
8. Test the frequency variation; it should be not less than 2×3 kc/s.

E. Carrier level meter

This adjustment cannot be made unless the receiver itself has been properly aligned.

1. Using the adjusting screw, set the meter pointer to 40 dB (the receiver being switched off). Switch on the receiver.
2. Set the bandwidth switch for "0.2 kc/s".
3. Connect the S.S.G. to the aerial socket (remember the 75 Ω dummy load).
4. Tune the receiver and the S.S.G. to approx. 7 Mc/s.
5. Turn the "A.F. GAIN" control completely clockwise.
6. Set the "A.V.C.-CAL." switch for "0.05 sec.".

7. Set the bandwidth switch for "3 kc/s".
8. Adjust the output voltage of the S.S.G. to 1 mV (i.e. 100 μ V aerial E.M.F.)
9. Remove the cap from potentiometer R68 (at the upper left of the front panel) and use the potentiometer to adjust the meter to 40 dB.
10. Adjust the output level of the S.S.G. to 10 μ V (i.e. 1 μ V aerial E.M.F.).
11. Using potentiometer R60 (at the upper right of the front panel) adjust the meter to 0 dB.
12. Repeat the instructions in items 8 to 11.
13. Make sure that the meter reads 80 dB for an aerial E.M.F. of 40 mV (i.e. 100 mV from the S.S.G.).

F. First oscillator and R.F. circuits

a. Testing the oscillator voltages at MP2

(see diagram 3)

1. Connect the ~~diode~~ ^{DC. VTUM} voltmeter (range 10 V) to test point MP2.
2. Set the "RANGE" switch for the required range, or for all the ranges in turn.
3. Plot the graph(s) by tuning the receiver to the various frequencies and reading the voltage from the voltmeter.

b. Testing the R.F. gain

(see diagram 4)

1. Discontinue the connection between the "A.V.C. 0" and "A.V.C. 1" terminals; connect "A.V.C. 1" to earth.
2. Connect the electronic voltmeter to test point MP1.
3. Connect the S.S.G. to the aerial socket (via the proper dummy load).
4. Set the "R.F. OSC." switch to "⬆" and short circuit the socket marked "R.F. OSC."
5. Readjust the trimmer of the last R.F. circuit of the set range in question and then plot the graph(s). Return the trimmer to its original position afterwards. The "R.F. OSC." switch has to be set to the "NORMAL" position, however, if an error in synchronism has to be traced.

c. Aligning the 1st oscillator and R.F. circuit

The frequency of the S.S.G. must always be calibrated with the help of a frequency counter.

Set up the receiver in such a way that the R.F. circuits are not affected by the radiated heat.

Allow the receiver to warm up for approx. 2 hours before commencing the alignment.

Range 4 (2.6 - 6.24 Mc/s)

| <u>Tuning frequency</u> | <u>Tuning elements</u> |
|-------------------------|------------------------|
| 5.8 Mc/s | C70 - C37 - C26 - C9 |
| 2.8 Mc/s | L11b - L8b - L5b - L2b |

After this the circuits have to be staggered at 2.8 Mc/s, which is done in the following way:

- Increase the tuning frequency by 9 scale divisions (i.e. 2.8 Mc/s + 11.7 kc/s);
- Readjust oscillator coil L11b to zero interference;
- Adjust coil L8b (approx. 1/3 turn clockwise);
- Decrease the tuning frequency by 18 scale divisions (i.e. 2.8 Mc/s - 11.7 kc/s);
- Readjust oscillator coil L11b;
- Adjust coil L5b (approx. 1/3 turn counter-clockwise);
- Tuning frequency 2.8 Mc/s;
- Readjust oscillator coil L11b;
- Tuning frequency 5.8 Mc/s;
- Adjust the trimmers C39 and C33.

The entire procedure has to be carried out only once.

RANGE 3 (1.1 - 2.64 Mc/s)

| <u>Tuning frequency</u> | <u>Tuning elements</u> |
|-------------------------|------------------------|
| 2.5 Mc/s | C73 - C40 - C27 - C9 |
| 1.15 Mc/s +) | L11a - L8a - L5a - L2a |

RANGE 2 (470 - 1128 kc/s)

| <u>Tuning frequency</u> | <u>Tuning elements</u> |
|-------------------------|--|
| 1050 kc/s | C76 - C45 - C28 - C9 |
| 500 kc/s +) | L12b - L9b ^o) - L6b ^o) - L3b |

RANGE 1 (200 - 470 kc/s)


| <u>Tuning frequency</u> | <u>Tuning elements</u> |
|-------------------------|--|
| 450 kc/s | C78 - C47 - C29 - C9 |
| 200 kc/s +) | L12a - L9a ^o) - L6a ^o) - L3a |

Resistors R7 and R13 should be short circuited.

RANGE 1 (225 - 540 kc/s)

| <u>Tuning frequency</u> | <u>Tuning elements</u> |
|-------------------------|--|
| 500 kc/s | C78 - C47 - C29 - C9 |
| 225 kc/s | L12a - L9a ^o) - L6a ^o) - L3a |

Resistors R7 and R13 have to be short circuited.

- +) "ANT. ADJ." control at position: 
- o) Damp the other coil during the alignment.

TEST DATA

The tests have been carried out in accordance with the C.C.I.R.-recommendations and I.E.C. publication no. 69. The values given below are average values measured on a number of receivers. Deviations may occur because of tolerance in the tubes and the other components; as a rule, they have no detrimental influence on the operation of the receiver.

A. POWER SUPPLY UNIT

The controls and switches have to be at the positions mentioned below (unless stated otherwise).

"R.F. GAIN" turned completely clockwise - "B.F.O." at the upper position - "A.V.C..CAL." at "MAN."; terminals "A.V.C. 0-1" have to be earthed.

Transformer T1, terminals 9-12 : 221 V A.C.
10-11 : 32 V A.C.
13-14 : 6.3 V A.C.

Voltage across C199 prior to L40 : +291 V

Voltage across C199 after L40 : +270 V (+276 V with "R.F. GAIN" turned counter-clockwise and "A.V.C. 0-1" earthed)

Voltage across C200 (R117) : +249 V

Voltage across C200 (R118) : +210 V

Voltage across B12 : +150 V

Voltage across C197 : -39 V

Voltage across C198 : -25 V

Current through L40 : 145 mA (110 mA with "R.F. GAIN" turned counter-clockwise and "A.V.C. -1" not earthed)

Current through R116 : 2.6 mA

Current through B12 : 17 to 19 mA

Current through R119 : 36 mA

These currents and voltages have been measured with a multi-range meter.

Hum voltage across C199 after L40: 130 mV A.C.

Hum voltage across C200 (R117) : 20 mV A.C.

Hum voltage across C200 (R118) : 20 mV A.C.

Hum voltage across C198 : 2 mV A.C.

These voltages have been measured with an electronic voltmeter.

B. TUBE OPERATING POINTS


For the measurements mentioned below, the controls and switches have to be at the following positions (unless stated otherwise):

"R.F.GAIN" completely clockwise - "A.V.C./CAL." at "MAN."
- "R.F. OSC." at "NORMAL" - "REC./TRANSM." at "REC." -
"RANGE" at "5" - "B.F.O." at the upper position, whilst the
"A.F.-0" and "A.F. - 1" terminals have to be interconnected
and the "A.V.C. 0-1" terminals earthed.

The voltages have been measured with a multi-range meter unless stated otherwise.

| <u>Tube</u> | <u>Vk</u> | <u>Vg2</u> | <u>Va</u> | <u>VaH</u> | <u>Vat</u> | <u>Vg3</u> | |
|-------------|-------------------|--------------------|------------------|-------------------|------------------|----------------------|---|
| B1 (EF85) | 1.8 | 95 | 244 | - | - | - | V |
| B2 (EF85) | 1.8 | 95 | 244 | - | - | - | V |
| B3 (ECH81) | 1.0 | 63 | - | 266 | 80 ^{a)} | 5 to 8 ^{b)} | V |
| B4 (ECH81) | 1.9 | 105 | - | 130 | 50 ^{c)} | 10 ^{d + e)} | V |
| B5 (E99F) | 1.0 | 95 | 244 | - | - | - | V |
| B6 (E99F) | 1.0 | 95 | 244 | - | - | - | V |
| B7 (EF85) | 1.8 | 95 | 244 | - | - | - | V |
| B8 (5726) | 5.5 ^{f)} | - | - | - | - | - | V |
| B9 (ECH81) | g) | 95 ^{h)} | - | 170 ^{j)} | 35 ^{c)} | 9 ^{d)} | V |
| B10(E99F) | 1.4 | 27 ^{c)} | 65 ^{c)} | - | - | - | V |
| B11(EL84) | 8.2 | 249 | 252 | - | - | - | V |
| B12(OA2) | - | - | 150 | - | - | - | V |
| B13(EF85) | - | 48 ^{d+k)} | 52 ^{c)} | - | - | - | V |

Notes:

- a. "R.F. OSC." at "  " and cable earthed.
- b. Measured with a diode voltmeter (GM 6004) connected to MP2.
- e. Measured with a diode-voltmeter (GM 6004).
- d. Measured with a diode-voltmeter (GM 6004) via a 2.2 Mohm resistor.
- e. 6 to 9 V when crystal-controlled (KT7).
- f. Terminal 5 of the tube socket.
- g. Vg1 = -2V.
- h. 105 V if "B.F.O." switch is at "OFF" position.
- j. 85 V if "B.F.O." switch is at "OFF" position.
- k. "A.V.C./CAL" switch is set to "CAL".

THE UNIVERSITY OF CHICAGO

The University of Chicago is a private research university located in Chicago, Illinois. It was founded in 1837 and is one of the oldest and most prestigious universities in the United States. The university is known for its commitment to academic excellence and its diverse student body. It has a long history of producing world-class scholars and leaders in various fields of study. The university's research output is highly influential, and it has a strong reputation for its contributions to knowledge and society. The University of Chicago is a member of the Association of American Universities and is ranked among the top universities in the world.

| Year | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 |
|---------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Enrollment | 10,000 | 10,500 | 11,000 | 11,500 | 12,000 | 12,500 |
| Faculty | 1,000 | 1,050 | 1,100 | 1,150 | 1,200 | 1,250 |
| Research | \$10,000,000 | \$11,000,000 | \$12,000,000 | \$13,000,000 | \$14,000,000 | \$15,000,000 |
| Graduates | 2,000 | 2,100 | 2,200 | 2,300 | 2,400 | 2,500 |
| International | 500 | 550 | 600 | 650 | 700 | 750 |
| Undergraduate | 1,500 | 1,550 | 1,600 | 1,650 | 1,700 | 1,750 |
| Graduate | 500 | 550 | 600 | 650 | 700 | 750 |
| Postgraduate | 100 | 110 | 120 | 130 | 140 | 150 |
| Non-degree | 100 | 110 | 120 | 130 | 140 | 150 |
| Exchange | 100 | 110 | 120 | 130 | 140 | 150 |
| Visiting | 100 | 110 | 120 | 130 | 140 | 150 |
| Transfer | 100 | 110 | 120 | 130 | 140 | 150 |
| Other | 100 | 110 | 120 | 130 | 140 | 150 |

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C. LEVELS

A.F. amplifier

"NOISE LIMITER" set to "OFF", "A.F. GAIN" control turned completely clockwise, terminals "A.V.C. 0-1" earthed and terminal "5 Ω " interconnected with the right-hand terminal.

Tone generator connected to the "AF1" terminal ("AF 0-1" terminals disconnected), "600 Ω " terminals terminated with a 600 Ω resistor. The following levels are found for an output power of 2.5 W (i.e. 3.56 V at the

" $\overline{5 \Omega}$ " and " $\frac{1}{\infty}$ "

terminals):

at the 600 Ω terminals

: 6 V A.C.

at the anode of B11 (type EL84)

: 155 V A.C.

at the control grid of B11 (type EL84)

: 6.5 V A.C.

at the "AF 1" terminal with reference to earth 0.6 V A.C. (this level is raised by approx. 14 to 16 dB for the same output level when the "R.F. GAIN" control is turned completely counter-clockwise, the "A.V.C.-CAL." switch is set to "MAN." and the "A.V.C. 0-1" terminals are not earthed).

A1 detector

"NOISE LIMITER" set to "OFF", "A.F.-GAIN" control turned completely clockwise, "B.F.O. switch" at the upper position and the "A.V.C. 0-1" terminals earthed.

Standard signal generator (tuned to 455 kc/s, unmodulated) connected to the control grid of B5 via a series-capacitor. Adjust A.F. tone to 400 c/s by means of "B.F.O. ADJ." control.

For an output voltage of 3.56 V at the " $\overline{5 \Omega}$ " and " $\frac{1}{\infty}$ " terminals the levels are:

at the control grid of B9 (ECH81) : 100 mV A.C.

at the control grid of B7 (EF85) : 25 mV A.C.

A2-A3 detector

Test set-up similar to that for the A1 detector with the following exceptions:

"B.F.O." switch set to "OFF" and the "S.S.G." 30% modulated with 400 c/s.

The level at the control grid of B7 (type EF85) is 20 mV for an AF output voltage of 1.07 V (= 30% of 3.56 V).

A.V.C.

"R.F. GAIN" control turned completely clockwise, "A.V.C.-CAL." switch set for "0.05 sec." and "A.V.C. 0-1" terminals not earthed. Standard signal generator (tuned to 455 kc/s, unmodulated) connected to the control grid of B7 via a capacitor.

The A.V.C. threshold is exceeded (i.e. the carrier level meter begins to deflect) at 30 mV on the control grid of B7.

The direct voltage on the "A.F. 0-1" terminals is -1.5 V with

reference to earth (measured with a type GM 6004 diode voltmeter). In the absence of an I.F. signal this voltage is -0.4 V.

I.F. amplifier

"B.F.O." switch set to "OFF", "R.F. OSC." switch at "NORMAL" and "A.V.C. 0-1" terminals earthed. Frequency range 5. Vernier dial set to 2000 scale divisions.

Standard signal generator (unmodulated) connected to the grid of the tube in question.

At a voltage (at the "A.F. 0-1" terminals) of -1.5 V with reference to earth (measured with a type GM 6004 diode-voltmeter), the levels are:

| Position of "BANDWIDTH" switch: | 0.2 | 0.9 | 2 | 3 | 6 | 10 | 16 | kc/s | Frequency |
|------------------------------------|-----|-----|----|-----|-----|-----|----|---------|-----------|
| Control grid B7 | - | - | - | 30 | - | - | - | mV | 455 kc/s |
| Control grid B6 | - | - | - | 2.3 | 2.8 | 1.8 | - | mV | 455 kc/s |
| Control grid B5 | - | - | - | 280 | 540 | 440 | - | μ V | 455 kc/s |
| Control grid B4 | 42 | 36 | 47 | 41 | 47 | 48 | - | μ V | 455 kc/s |
| Control grid B3 | 32 | 27 | 35 | 31 | 35 | 36 | - | μ V | 2455 kc/s |

R.F. amplifier

In ranges 1 and 2 the gain between the aerial (EMF) and test point MP1 ("AVC 0-1" terminals earthed) is approx. 50.

The A.V.C. circuit begins to operate at an input voltage of approx. 1 μ V.

In ranges 3 to 6 the gain is 100 to 200.

The A.V.C. circuit begins to operate at an input voltage of approx. 0.5 μ V or approx. 0.25 μ V.

At an average R.F. gain of 150, the gain up to adapter socket "455 kc/s" is approx. 430 if the "BANDWIDTH" switch is at the

"10 kc/s" position or approx. 670 if this switch is at the

"6 kc/s" position.

PARTS LIST

| <u>Ref. no.</u> | <u>Technical data</u> | <u>Ph.-order code</u> |
|-------------------|-------------------------------|-----------------------|
| B1, B2 | | EF 85 |
| B3, B4 | | ECH 81 |
| B5, B6 | | E99F |
| B7 | | EF 85 |
| B8 | | 5726 |
| B9 | | ECH 81 |
| B10 | | E99F |
| B11 | | EL 84 |
| B12 | | OA 2 |
| B13 | | EF 85 |
| C3 | 0.01 μF -20+50%; 250 V | C 301 BA/H10K |
| C4 | 2200 pF \pm 20%; 1000/600 V | OD 770 03/P2K2 |
| C5 | 5.6 pF \pm 1 pF; 500 V | C 304 GB/M5E6 |
| C6 | 3.9 pF \pm 0.5 pF; 500 V | C 304 GB/L3E9 |
| C7 | 3.3 pF \pm 0.5 pF; 500 V | C 304 GB/L3E3 |
| C8 | 100 pF \pm 5%; 500 V | C 304 GH/B100E |
| C9 | 8 - 48 pF ; 300 V | C 003 DA/40E |
| C10 | 4x285.6 pF ; 250 V | XB 001 45 |
| C11 | 0.1 μF \pm 10%; 65 V | C 296 AA/A100K |
| C12, C13 | 47000 pF \pm 20%; 630/400 V | OD 770 02/P47K |
| C14 | 27 pF \pm 5%; 500 V | C 304 GH/B27E |
| C15 | 100 pF \pm 5%; 500 V | C 304 GH/B100E |
| C16 | 120 pF \pm 5%; 500 V | C 304 GH/B120E |
| C17 | 220 pF \pm 5%; 500 V | C 304 GH/B220E |
| C18 (/00 and /50) | 150 pF \pm 5%; 500 V | C 304 GH/B150E |
| C18 (/01 and /51) | 120 pF \pm 5%; 500 V | C 304 GH/B120E |
| C19 | 1 pF \pm 0.25 pF; 500 V | C 304 GH/N1E |
| C20 | 7 - 32 pF ; 150 V | NT 120 18 |
| C21 | 1.5 pF \pm 0.25 pF; 500 V | C 304 GH/N1E5 |
| C25-C29 | 7 - 32 pF ; 150 V | NT 120 18 |
| C30 | 15 pF \pm 10%; 500 V | C 304 GC/A15E |
| C31 | 100 pF \pm 5%; 500 V | C 304 GH/B100E |
| C33 | 56 pF \pm 5%; 500 V | C 304 GH/B56E |

| <u>Ref. no.</u> | <u>Technical data</u> | <u>Ph.-order code</u> |
|-----------------|------------------------------|--------------------------------|
| C34-C36 | 10000 pF -20+50%; 250 V | C 301 BA/H10K |
| C37-C40 | 7 - 32 pF ; 150 V | NT 120 18 |
| C44 | 0.01 μ F \pm 10%; 65 V | C 296 AA/A10K |
| C45 | 7 - 32 pF ; 150 V | NT 120 18 |
| C46 | 0.01 μ F \pm 10%; 65 V | C 296 AA/A10K |
| C47 | 7 - 32 pF ; 150 V | NT 120 18 |
| C48 | 15 pF \pm 10%; 500 V | C 304 GC/A15E |
| C50 | 18 pF } 15 pF } in series | C 305 GH/B18E C 305 GH/B15E |
| C51 | 0.7 - 3.7 pF | C 004 EA/3E |
| C53 | 0.01 μ F -20+50%; 250 V | C 301 BA/H10K |
| C54, C55 | 100 pF \pm 5%; 500 V | C 304 GH/B100E |
| C56 | 0.01 μ F -20+50%; 250 V | C 301 BA/H10K |
| C57 | 0.1 μ F \pm 10%; 65 V | C 296 AA/A100K |
| C58, C59 | 100 pF \pm 5%; 500 V | C 304 GH/B100E |
| C60 | 0.01 μ F -20+50%; 250 V | C 301 BA/H10K |
| C61 | 18 pF \pm 5%; 500 V | C 304 GC/B18E |
| C62 | 68 pF \pm 5%; 500 V | C 304 GB/B68E |
| C63 | 3.3 pF \pm 0.5 pF; 500 V | C 304 GB/L3E3 |
| C64 | 3.5 - 19.5 pF | NT 120 28 |
| C65 | 510 pF \pm 1%; 500 V | 48 336 01/510E |
| C66 (2xpar.) | 390 pF | C 305 GH/C390E |
| C67 | 3.5 - 19.5 pF | NT 120 28 |
| C68 | 510 pF \pm 1%; 500 V | 48 336 01/510E |
| C69 | 1800 pF \pm 1%; 500 V | 48 336 01/1K8 |
| C70 | 3.5 - 19.5 pF | NT 120 28 |
| C71 | 1800 pF \pm 1%; 500 V | 48 336 01/1K8 |
| C72 (2xpar.) | 390 pF | C 305 GH/C390E |
| C73 | 3.5 - 19.5 pF | NT 120 28 |
| C74 | 750 pF \pm 1%; 500 V | 48 336 01/750E |
| C75 | 4.7 pF \pm 1 pF; 500 V | C 304 GH/L4E7 |
| C76 | 3.5 - 19.5 pF | NT 120 28 |
| C77 | 5.6 pF \pm 1 pF; 500 V | 48 336 99/5E6 |
| C78 | 3.5 - 19.5 pF | NT 120 28 |
| C79 | 4.7 pF \pm 0.5 pF; 500 V | C 304 GB/L4E7 |

| <u>Ref. no.</u> | <u>Technical data</u> | | <u>Ph.-order code</u> |
|-------------------|-----------------------|------------------------------|-----------------------|
| C80 | 82 | pF \pm 1 pF; 500 V | 48 336 99/82E |
| C81 | 18 | pF | C 305 GH/B18E |
| C82 | 30 | pF \pm 1 pF; 500 V | 48 336 99/30E |
| C83 (/00 and /50) | 22 | pF | C 305 GH/T22E |
| C83 (/01 and /51) | 18 | pF | C 305 GH/B18E |
| C84 (/00 and /50) | 82 | pF \pm 1 pF; 500 V | 48 336 99/82E |
| C84 (/01 and /51) | 75 | pF \pm 1 pF; 500 V | 48 336 99/75E |
| C85 | 82 | pF \pm 1 pF; 500 V | 48 336 99/82E |
| C86 (/00 and /50) | 390 | pF \pm 1%; 500 V | 48 336 01/390E |
| C86 (/01 and /51) | 470 | pF \pm 1%; 500 V | 48 336 01/470E |
| C88 | 100 | pF \pm 1%; 500 V | 48 336 01/100E |
| C89 | 120 | pF \pm 1%; 500 V | 48 336 01/120E |
| C90 | 120 | pF \pm 1%; 500 V | 48 336 01/120E |
| C91 | 0.047 | μ F \pm 20%; 630/400 V | OD 770 02/P47K |
| C92 | 100 | pF \pm 1%; 500 V | 48 336 01/100E |
| C93 | 68 | pF \pm 5%; 500 V | C 304 GH/B68E |
| C94 | 100 | pF \pm 5%; 500 V | C 304 GH/B100E |
| C95 | 240 | pF \pm 1%; 500 V | 48 336 01/240E |
| C96 | 0.01 | μ F -20+50%; 250 V | C 305 BA/H10K |
| C97 | 0.1 | μ F \pm 10%; 65 V | C 296 AA/A100K |
| C98 | 0.01 | μ F -20+50%; 250 V | C 305 BA/H10K |
| C99 | 100 | pF \pm 5%; 500 V | C 304 GH/B100E |
| C100 | 0.01 | μ F -20+50%; 250 V | C 305 BA/H10K |
| C101-C103 | 6800 | pF | C 309 AB/H6K8B |
| C104 | 30 | pF \pm 1 pF; 500 V | 48 336 99/30E |
| C105 | 56 | pF \pm 1 pF; 500 V | 48 336 99/56E |
| C106 | 160 | pF \pm 1%; 500 V | 48 336 01/160E |
| C107 | 22 | pF | C 305 GH/T22E |
| C108 | 0.01 | μ F -20+50%; 250 V | C 301 BA/H10K |
| C111 | 0.1 | μ F \pm 10%; 250 V | OD 770 00/A100K |
| C112 | 240 | pF \pm 1%; 500 V | 48 336 01/240E |
| C113-C114 | 0.01 | μ F -20+50%; 250 V | C 301 BA/H10K |
| C116-C119 | 7 - 32 | pF ; 150 V | C 005 AA/25E |
| C120 | 390 | pF \pm 1%; 500 V | 48 336 01/390E |
| C121 | 39 | pF | C 305 GH/C39E |

| <u>Ref. no.</u> | <u>Technical data</u> | <u>Ph.-order code</u> |
|-----------------|--------------------------------------|-----------------------|
| C122 | 0.01 μF -20+50%; 250 V | C 301 BA/H10K |
| C125 | 390 pF \pm 1%; 500 V | 48 336 01/390E |
| C127 | 2x10 pF | C 003 ZZ/28 |
| C128 | 3.3 pF \pm 0.5 pF; 500 V | C 304 GB/L3E3 |
| C129 | 220 pF \pm 1%; 500 V | 48 336 01/220E |
| C130 | 15 pF \pm 10%; 500 V | C 304 GC/A15E |
| C131 | 330 pF \pm 5%; 500 V | C 304 GH/B330E |
| C133, C134 | 7 - 32 pF ; 150 V | C 005 BA/25E |
| C135 | 12 pF \pm 10%; 500 V | C 304 GB/A12E |
| C137 | 0.1 μF \pm 10%; 65 V | C 296 AA/A100K |
| C138, C139 | 0.01 μF -20+50%; 250 V | C 301 BA/H10K |
| C140 | 1000 pF \pm 1%; 500 V | 48 336 01/1K |
| C145 | 750 pF \pm 1%; 500 V | 48 336 01/750E |
| C146 | 270 pF \pm 1%; 500 V | 48 336 01/270E |
| C147 | 2700 pF \pm 5%; 500 V | 48 336 05/2K7 |
| C148 | 330 pF \pm 5%; 500 V | C 304 GH/B330E |
| C149 | 0.1 μF \pm 10%; 65 V | C 296 AA/A100K |
| C150 | 0.01 μF -20+50%; 250 V | C 301 BA/H10K |
| C151 | 1000 pF \pm 1%; 500 V | 48 336 01/1K |
| C152 | 0.01 μF -20+50%; 250 V | C 301 BA/H10K |
| C153 | 1000 pF \pm 1%; 500 V | 48 336 01/1K |
| C154 | 330 pF \pm 5%; 500 V | C 304 GH/B330E |
| C155 | 0.1 μF \pm 10%; 65 V | C 296 AA/A100K |
| C156 | 0.01 μF -20+50%; 250 V | C 301 BA/H10K |
| C157 | 0.047 μF \pm 20%; 630 V | OD 770 02/P47K |
| C158-C160 | 33 pF \pm 5%; 500 V | C 304 GH/B33E |
| C163 | 0.047 μF \pm 10%; 65 V | C 296 AA/A47K |
| C164, C165 | 0.01 μF -20+50%; 250 V | C 301 BA/H10K |
| C166 | 0.047 μF \pm 20%; 630 V | OD 770 02/P47K |
| C167 | 1000 pF \pm 20%; 1000 V | OD 770 03/P1K |
| C168 | 64 μF ; 25 V | C 435 AL/F64 |
| C169 | 100 pF \pm 5%; 500 V | C 304 GH/B100E |
| C170 | 0.1 μF \pm 10%; 65 V | C 296 AA/A100K |
| C171 | 0.047 μF \pm 10%; 65 V | C 296 AA/A47K |
| C172 | 1 μF \pm 10%; 65 V | C 296 AA/A1M |

| <u>Ref. no.</u> | <u>Technical data</u> | <u>Ph.-order code</u> |
|-----------------|--|-----------------------|
| C173 | 0.047 μ F \pm 10%; 65 V | C 296 AA/A47K |
| C174 | 0.47 μ F \pm 10%; 65 V | C 296 AA/A470K |
| C175 | 40 μ F ; 50 V | C 435 AL/H40 |
| C177 | 2.2 pF \pm 0.25 pF; 500 V | C 304 GB/N2E2 |
| C178 | 0.047 μ F \pm 20%; 630 V | OD 770 02/P47K |
| C179, C180 | 100 pF \pm 5%; 500 V | C 304 GH/B100E |
| C185 | 0.01 μ F -20+50%; 250 V | C 301 BA/H10K |
| C186 | 0.1 μ F \pm 10%; 250 V | OD 770 05/A100K |
| C187 | 1200 pF \pm 1%; 500 V | 48 336 01/1K2 |
| C188 | 68 pF | C 305 GH/C68E |
| C189 | 40 pF | C 003 ZZ/15 |
| C190, C191 | 1000 pF \pm 20%; 1000 V | OD 770 03/P1K |
| C192 | 4700 pF \pm 20%; 1000 V | OD 770 03/P47K |
| C193 | 100 pF \pm 5%; 500 V | C 304 GH/B100E |
| C194 (2 par.) | 0.3 μ F \pm 10%; 400 V | 49 134 11 |
| C195, C196 | 0.033 μ F | OD 770 03/P33K |
| C197, C198 | 100 μ F ; 50 V | C 435 AL/H100 |
| C199 | 2x50 μ F ; 400 V | AC 5409/50+50 |
| C200 | 2x12.5 μ F ; 500 V | AC 5311/12.5+12.5 |
| C201 | 0.01 μ F -20+50%; 250 V | C 301 BA/H10K |
| C202, C203 | 4700 pF \pm 20%; 1000 V | OD 770 03/P4K7 |
| C204 | 10 pF \pm 1 pF; 500 V | 48 336 99/10E |
| C205 | 7 - 32 pF ; 150 V | C 005 BA/25E |
| C206 | 150 pF \pm 5%; 500 V | 48 336 05/150E |
| C207 | 0.01 μ F -20+50%; 250 V | C 301 BA/H10K |
| GR1-GR4 | | OA 202 |
| GR5-GR8 | | BY 100. |
| KT1 | 455 kc/s | OD 991 14 (455 kc/s) |
| KT2 | 500 kc/s | OD 991 27 (500 kc/s) |
| KT7 | 2000 kc/s (only if the crystal oscillator 8GR 505 is used) | OD 991 15 (2000 kc/s) |
| L1 | | NT 139 76 |
| L2 | | NT 139 77 |

| <u>Ref. no.</u> | <u>Technical data</u> | <u>Ph.-order code</u> |
|------------------|-----------------------|-----------------------|
| L3 (/00 and /50) | | NT 139 78 |
| L3 (/01 and /51) | | NT 139 73 |
| L4 | | NT 139 79 |
| L5 | | NT 139 80 |
| L6 (/00 and /50) | | NT 139 81 |
| L6 (/01 and /51) | | NT 139 74 |
| L7 | | NT 139 82 |
| L8 | | NT 139 83 |
| L9 (/00 and /50) | | NT 139 84 |
| L9 (/01 and /51) | | NT 139 75 |
| L10a | | NT 099 70 |
| L10b | | NT 099 69 |
| L11 | | NT 139 85 |
| L12 | | NT 139 86 |
| L13 | | NE 633 64 |
| L14, L15 | | NT 139 88 |
| L16, L17 | | NT 099 72 |
| L18 | | NT 139 89 |
| L21, L22 | | NT 139 90 |
| L23 | | NT 139 91 |
| L24 | | NT 139 92 |
| L25 | | NT 139 93 |
| L26, L27 | | NE 633 46 |
| L28 | | NE 099 71 |
| L29 | | NE 633 44 |
| L30 | | NT 139 94 |
| L31 | | NT 139 95 |
| L32, L33 | | NE 633 44 |
| L34 | | NT 099 71 |
| L35 | | NE 633 44 |
| L36 | | NT 139 95 |
| L37 | | NT 139 96 |
| L38 | | NT 139 97 |
| L39 | | NE 633 70 |
| L40 | | NQ 270 03 |

| <u>Ref. no.</u> | <u>Technical data</u> | | | | <u>Ph.-order code</u> |
|-----------------|-----------------------|----------------------|------|---|-----------------------|
| L42 | | | | | NE 633 48 |
| L43 | | | | | NE 633 46 |
| LA1-LA3 | 6.3 V - 0.32 A | | | | 80 45D/00 |
| ME1 | | | | | P 085 11AZ/31 |
| M1 | | | | | J.W. 41 300 |
| R1 | 18 | k Ω \pm 5% | 0.25 | W | B8 305 05B/18K |
| R2 | 10 | Ω \pm 5% | 0.25 | W | B8 305 05B/10E |
| R3 | 1 | M Ω \pm 10% | 0.25 | W | B8 305 13A/1M |
| R4 | 150 | Ω \pm 5% | 0.25 | W | B8 305 05B/150E |
| R5 | 68 | k Ω \pm 5% | 0.5 | W | B8 305 06B/68K |
| R6 | 2.2 | k Ω \pm 5% | 0.5 | W | B8 305 06B/2K2 |
| R7 | 82 | Ω \pm 5% | 0.25 | W | B8 305 05B/82E |
| R8 | 1 | M Ω \pm 10% | 0.25 | W | B8 305 13A/1M |
| R9 | 33 | Ω \pm 5% | 0.25 | W | B8 305 05B/33E |
| R10 | 120 | Ω \pm 5% | 0.25 | W | B8 305 06B/68K |
| R11 | 68 | k Ω \pm 5% | 0.5 | W | B8 305 06B/68K |
| R12 | 2.2 | k Ω \pm 5% | 0.5 | W | B8 305 06B/2K2 |
| R13 | 82 | Ω \pm 5% | 0.25 | W | B8 305 05B/82E |
| R14 | 470 | k Ω \pm 5% | 0.25 | W | B8 305 13B/470K |
| R15 | 22 | k Ω \pm 5% | 0.5 | W | B8 305 06B/22K |
| R16 | 1 | M Ω \pm 10% | 0.25 | W | B8 305 13A/1M |
| R17 | 100 | Ω \pm 5% | 0.25 | W | B8 305 05B/100E |
| R18 | 47 | k Ω \pm 5% | 0.25 | W | B8 305 05B/47K |
| R19 | 100 | Ω \pm 5% | 0.25 | W | B8 305 05B/100E |
| R20 | 10 | k Ω \pm 10% | 1 | W | B8 305 07A/10K |
| R21 | 15 | k Ω \pm 5% | 0.25 | W | B8 305 05B/15K |
| R22 | 1 | k Ω \pm 5% | 0.25 | W | B8 305 05B/1K |
| R24 | 2.2 | M Ω \pm 10% | 0.25 | W | B8 305 13A/2M2 |
| R25 | 15 | k Ω \pm 5% | 8 | W | 48 766 05/15K |
| R26 | 10 | k Ω \pm 5% | 0.25 | W | B8 305 05B/10K |
| R27 | 2.2 | k Ω \pm 5% | 0.25 | W | B8 305 05B/2K2 |
| R28 | 150 | k Ω \pm 5% | 0.25 | W | B8 305 13B/150K |
| R29 | 1 | k Ω \pm 5% | 0.25 | W | B8 305 05B/1K |

| Ref. no. | Technical data | | | | | Ph.-order code. |
|-------------------|----------------|------------|-----------|------|----------|-----------------|
| R30 | 150 | k Ω | \pm 5% | 0.25 | W | B8 305 13B/150K |
| R31 (/00 and /50) | 68 | Ω | \pm 5% | 0.25 | W | B8 305 05B/68E |
| R31 (/01 and /51) | 56 | Ω | \pm 5% | 0.25 | W | B8 305 05B/56E |
| R32 | 10 | Ω | \pm 5% | 0.25 | W | B8 305 05B/10E |
| R33, R34 | 15 | Ω | \pm 5% | 0.25 | W | B8 305 05B/15E |
| R35 | 5.6 | k Ω | \pm 5% | 0.5 | W | B8 305 06B/5K6 |
| R36 | 470 | k Ω | \pm 5% | 0.25 | W | B8 305 13B/470K |
| R37 | 180 | Ω | \pm 5% | 0.25 | W | B8 305 05B/180E |
| R38 | 100 | k Ω | \pm 5% | 0.25 | W | B8 305 05B/100K |
| R39 | 270 | k Ω | \pm 5% | 0.25 | W | B8 305 13B/270K |
| R41 | 82 | k Ω | \pm 5% | 0.25 | W | B8 305 05B/82K |
| R43 | 10 | k Ω | \pm 5% | 0.25 | W | B8 305 05B/10K |
| R44 | 2.2 | k Ω | \pm 5% | 0.25 | W | B8 305 05B/2K2 |
| R45 | 10 | k Ω | \pm 5% | 0.25 | W | B8 305 05B/10K |
| R46 | 180 | k Ω | \pm 5% | 0.25 | W | B8 305 13B/180K |
| R47 | 1 | M Ω | \pm 10% | 0.25 | W | B8 305 13A/1M |
| R48 | 82 | Ω | \pm 5% | 0.25 | W | B8 305 05B/82E |
| R49 | 47 | k Ω | \pm 10% | 1 | W | B8 305 07A/47K |
| R50 | 2.2 | k Ω | \pm 5% | 0.5 | W | B8 305 06B/2K2 |
| R51 | 3 | Ω | \pm 1% | 0.4 | W | 48 760 01/3E |
| R52, R53 | 3.9 | Ω | \pm 1% | 0.4 | W | 48 760 01/3E9 |
| R54 | 1 | M Ω | \pm 10% | 0.25 | W | B8 305 13A/1M |
| R55 | 82 | Ω | \pm 5% | 0.25 | W | B8 305 05B/82E |
| R56 | 47 | k Ω | \pm 10% | 1 | W | B8 305 07A/47K |
| R57 | 2.2 | k Ω | \pm 5% | 0.5 | W | B8 305 06B/2K2 |
| R58, R59 | 1 | Ω | \pm 1% | 0.4 | W | 48 760 01/1E |
| R60 | 5 | k Ω | | 0.25 | W (lin.) | NT 117 29 |
| R65 | 1 | M Ω | \pm 10% | 0.25 | W | B8 305 13A/1M |
| R66 | 2.2 | k Ω | \pm 5% | 0.25 | W | B8 305 05B/2K2 |
| R67 | 180 | Ω | \pm 5% | 0.25 | W | B8 305 05B/180E |
| R68 | 1 | k Ω | | 0.25 | W (lin.) | NT 117 12 |
| R70 | 68 | k Ω | \pm 5% | 0.25 | W | B8 305 05B/68K |
| R71 | 68 | k Ω | \pm 5% | 0.5 | W | B8 305 06B/68K |
| R72 | 2.2 | k Ω | \pm 5% | 0.5 | W | B8 305 06B/2K2 |
| R73 | 82 | k Ω | \pm 5% | 0.25 | W | B8 305 05B/82K |

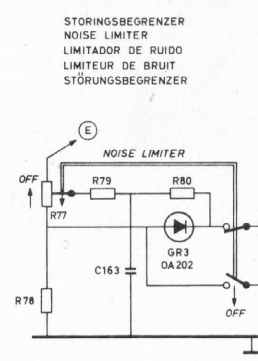
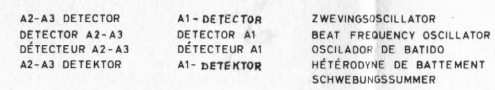
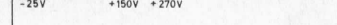
| <u>Ref. no.</u> | <u>Technical data</u> | | | <u>Ph.-order code</u> |
|-----------------|-----------------------|------------------------------|-----------|-----------------------|
| R74-R76 | 22 | k Ω \pm 5%; 0.25 W | | B8 305 05B/22K |
| R77 | 200 | k Ω ; 0.25 W (lin.) | NT 117 65 | |
| R78 | 68 | k Ω \pm 5%; 0.25 W | | B8 305 05B/68K |
| R79, R80 | 1 | M Ω \pm 10%; 0.25 W | | B8 305 13A/1M |
| R81 | 1 | M Ω ; 0.25 W (log.) | NT 117 31 | |
| R82 | 1 | M Ω \pm 10%; 0.25 W | | B8 305 13A/1M |
| R83 | 2.7 | k Ω \pm 5%; 0.25 W | | B8 305 05B/2K7 |
| R84 | 1.5 | M Ω \pm 10%; 0.25 W | | B8 305 13A/1M5 |
| R85 | 470 | k Ω \pm 5%; 0.25 W | | B8 305 13B/470K |
| R86 | 1 | M Ω \pm 10%; 0.25 W | | B8 305 13A/1M |
| R87 | 220 | Ω \pm 5%; 0.5 W | | B8 305 06B/220E |
| R88, R89 | 270 | Ω \pm 5%; 0.25 W | | B8 305 05B/270E |
| R90 | 5.1 | Ω \pm 10%; 6 W | | B8 300 31A/5E1 |
| R91 | 10 | k Ω \pm 5%; 0.25 W | | B8 305 05B/10K |
| R92 | 8.2 | M Ω \pm 10%; 0.25 W | | B8 305 13A/8M2 |
| R93, R94 | 1 | M Ω \pm 10%; 0.25 W | | B8 305 13A/1M |
| R95 | 270 | k Ω \pm 5%; 0.5 W | | B8 305 14B/270K |
| R96 | 5.6 | k Ω \pm 5%; 0.25 W | | B8 305 05B/5K6 |
| R97 | 18 | k Ω \pm 5%; 0.25 W | | B8 305 05B/18K |
| R98 | 10 | k Ω ; 0.25 W (lin.) | NT 117 30 | |
| R99 | 10 | k Ω \pm 5%; 0.25 W | | B8 305 05B/10K |
| R100 | 390 | k Ω \pm 5%; 0.25 W | | B8 305 13B/390K |
| R101 | 8.2 | M Ω \pm 10%; 0.25 W | | B8 305 13A/8M2 |
| R102 | 1.8 | M Ω \pm 10%; 0.25 W | | B8 305 13A/1M8 |
| R105 | 33 | k Ω \pm 5%; 0.25 W | | B8 305 05B/33K |
| R106 | 22 | k Ω \pm 10%; 1 W | | B8 305 07A/22K |
| R107 | 470 | k Ω \pm 5%; 0.25 W | | B8 305 13B/470K |
| R108 | 47 | k Ω \pm 5%; 0.25 W | | B8 305 05B/47K |
| R109 | 220 | k Ω \pm 5%; 0.25 W | | B8 305 13B/220K |
| R110 | 47 | k Ω \pm 5%; 0.25 W | | B8 305 05B/47K |
| R111 | 18 | k Ω \pm 10%; 1 W | | B8 305 07A/18K |
| R112 | 22 | k Ω \pm 5%; 0.25 W | | B8 305 05B/22K |
| R113 | 100 | k Ω \pm 5%; 0.25 W | | B8 305 05B/100K |
| R114 | 270 | k Ω \pm 5%; 0.25 W | | B8 305 13B/270K |
| R115 | 470 | Ω \pm 5%; 0.25 W | | B8 305 05B/470E |

| <u>Ref. no.</u> | <u>Technical data</u> | <u>Ph.-order code</u> |
|-----------------|---------------------------------|-----------------------|
| R116 | 4.7 k Ω \pm 5%; 0.25 W | B8 305 05B/4K7 |
| R117 | 4.7 k Ω \pm 5%; 0.5 W | B8 305 06B/4K7 |
| R118 | 8.2 k Ω \pm 10%; 1 W | B8 305 07A/8K2 |
| R119 | 3.3 k Ω \pm 5%; 10 W | 48 767 05/3K3 |
| R120 | 0.68 Ω ; 2 W | E 104 AA/AE68 |
| R121 | 470 k Ω \pm 5%; 0.25 W | B8 305 13B/470K |
| R122 | 150 k Ω \pm 5%; 0.25 W | B8 305 13B/150K |
| R123 | 100 k Ω \pm 5%; 0.25 W | B8 305 05B/100K |
| R124 | 2.2 k Ω \pm 5%; 0.25 W | B8 305 05B/2K2 |
| SK1 | | OD 938 50 |
| SK2 | | OD 932 06 |
| SK3 | | OD 938 51 |
| SK4 | | OD 938 13 |
| SK5-SK7 | | V3 577 16 |
| SK8 | | NT 176 07 |
| T1 | | NQ 281 09 |
| T2 | | NQ 280 4C |
| VL1 | 1.6 Amps delayed | 08 142 33 |

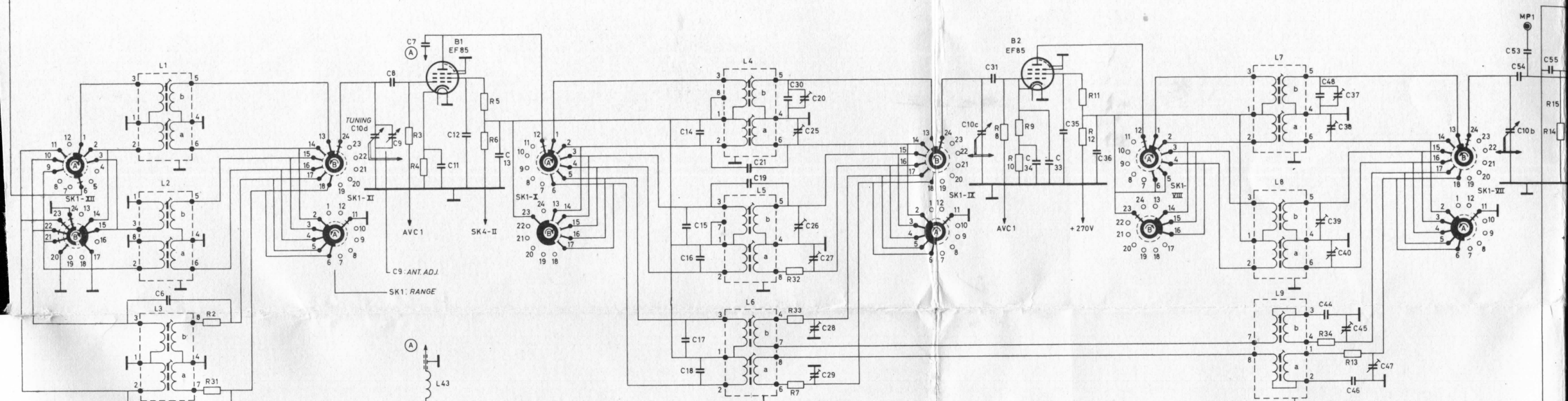
LIST OF BREAKABLE AND EXPENDABLE COMPONENTS
(see drawing no. 1)

| <u>Pos.no.</u> | <u>Description</u> | <u>Order code</u> |
|----------------|-----------------------|-------------------|
| 1 | Crystal holder | B1 925 15 |
| 2 | Tube socket | B8 700 33 |
| 3 | Screening can | B1 880 59 |
| 4 | Screening can | B1 880 58 |
| 5 | Screening can | B1 880 60 |
| 6 | Tube socket | B8 700 35 |
| 7 | Tube socket | OD 904 86 |
| 8 | Screening can | B1 880 45 |
| 9 | Screening can | NT 291 70 |
| 10 | Sprung cap. | OD 904 71 |
| 11 | Fitting | OD 916 28 |
| 12 | Sealing cap | NT 343 79 |
| 13 | Sealing cap | B1 891 50 |
| 14 | Sheet of perspex | P 556 119/977AB |
| 15 | Lever | NT 222 70 |
| 16 | Arrowed knob | F 111 CA/40x6 |
| 17 | Tuning knob | P4 076 07/02 |
| 18 | Arrowed knob | F 111 AE/22x6 |
| 19 | Socket | NT 824 14 |
| 20 | Mounting bracket | B8 708 21/02 |
| 21 | Mounting bracket | B8 708 21/00 |
| 22 | Shaft | NT 787 07 |
| 23 | Ceramic lead through | NX 095 46 |
| 24 | Coupling | NT 204 49 |
| 25 | Connecting strip | NT 352 76 |
| 26 | Octal tube socket | B1 506 15 |
| 27 | Mains voltage adapter | 08 524 54 |
| 28 | Fuse holder | B1 506 68 |
| 29 | Earthing terminal | NT 969 65 |
| 30 | Mains cable | R 613 KA/32LA8 |
| 31 | Plug | 23 685 94 |
| 32 | Connecting strip | NT 352 75 |
| 33 | Plug | NA 186 95 |
| 34 | Tube socket | B8 700 34 |

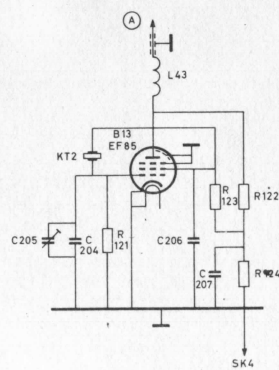




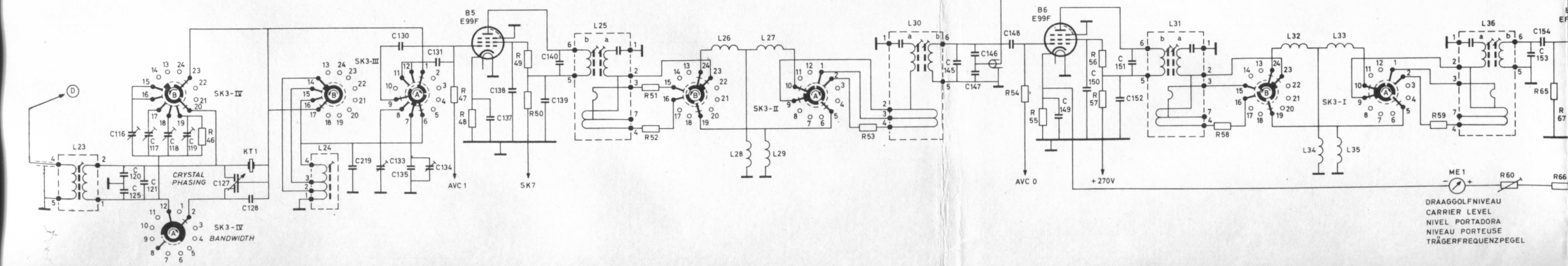
HF-VERSTERKER
RF AMPLIFIER
AMPLIFICADOR RF
AMPLI HF
HF-VERSTÄRKER



500kHz - 500kc/s
JMKOSCILLATOR
CALIBRATION OSCILLATOR
OSCILADOR DE CALIBRACION
OSCILLATEUR D'ÉTALONNAGE
EICHOSCILLATOR



455kHz - 455kc/s
M.F.-VERSTERKER MET REGELBARE BANDBREEDTE
IF AMPLIFIER WITH VARIABLE BANDWIDTH
AMPLIFICADOR FI CON ANCHURA DE BANDA VARIABLE
AMPLI M.F. A BANDE PASSANTE VARIABLE
ZF-VERSTÄRKER MIT REGELBARER BANDBREITE



DRAAGGOLF NIVEAU
CARRIER LEVEL
NIVEL PORTADORA
NIVEAU PORTEUSE
TRÄGERFREQUENZPEGEL

