COMMUNICATIONS RECEIVERS

TYPES 8RO 501/00 AND/50

8RO 501/01 AND/51

MANUAL
DB-R923e
2nd EDITION

N.V. PHILIPS' TELECOMMUNICATIE INDUSTRIE

HILVERSUM - NEDERLAND

CONTENTS

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 [illegible]0 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 (± 10%), 40-60 c/s (± 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			Sub-ranges 8RO 501/01 and /51		
1.	200-480 kc/s	(1500-625 m)	1.	225-540 kc/s	(1330-555 m)
2.	470-1128 kc/s	(640-265 m)	2.	470-1128 kc/s	(640-265 m)
3.	1.1-2.64 Mc/s	(273-114 m)	3.	1.1-2.64 Mc/s	(273-114 m)
4.	2.6-6.24 Mc/s	(116-48 m)	4.	2.6-6.24 Mc/s	(116-48 m)
5.	6.0-14.4 Mc/s	(50-20.8 m)	5.	6.0-14.4 Mc/s	(50-20.8 m)
6.	13.0-31.2 Mc/s	(23- 9.6 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 $\pm$ 20.10^{-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 µV in range 1 (200-480 kc/s or 225-540 kc/s);
max. 5 µV in ranges 2 and 3 (470 kc/s - 2.64 Mc/s);
max. 1.6 µV in ranges 4 and 5 (2.6 - 14.4 Mc/s);
max. 2 µV 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 ± 40 c/s	5.5 kc/s
2.	900 ± 200 c/s	6.5 kc/s
3.	2000 ± 300 c/s	7.5 kc/s
4.	3000 ± 400 c/s	9 kc/s
5.	6000 + 1000 c/s	13 kc/s
6.	10000 + 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 " 10/16 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 µV to 100 mV in sub ranges 1 and 2 or from 1 µV 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:	by an unwanted signal of
10 µV	15 µV
100 µV	50 µV
1 µV	250 µV

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 µV.

Reception facilities

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

Cross modulation

Less than 3% (-30 dB) at

a desired signal of:	by a 30% modulated unwanted signal of:
10 µV	3 mV
100 µV	10 mV
1 µV	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 ± 10% and changes in temperature in the range of +10 to +45°C.

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

approx. 400 µV with the bandwidth switch at the "$\frac{10}{16}$ kc/s" position;
approx. 700 µV with the bandwidth switch at the "6 kc/s" posi tion;
for an aerial E.M.F. of 1 µV (A.V.C. inoperative) in sub-rang 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 µV in sub-ranges 1 and 2 or 1 µV in sub-ranges 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 outpu power.

Noise and modulation hum level

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

Power supply

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

Power consumption

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

Ambient temperature

-10 to +45°C

Tube and diode complement

Philips type	U.S.A. type	Number used	Function
EF 85	6BY7	2	R.F. amplifiers
		1	I.F. amplifier
		1	Calibration oscillator
ECH 81	6AJ8	2	Mixer tubes
		1	BFO and detector
E99F	7694, 6662, 6BJ6	2	I.F. amplifiers
		1	A.F. amplifier
(EAA91) 5726 (E91AA)	5726 (6AL5)	1	A.V.C. and detector
EL 84	6BQ5	1	A.F. power amplifier
OA 2	OA 2, OA2WA, 6626	1	Stabilizer
BY 100	-	4	H.T. rectifiers
OA 202	-	1	Noise limiter
		2	A.V.C.
		1	L.T. rectifier

Dimensions

Without cabinet: (8RO 501/50) (8RO 501/51)	Height	266 mm
	Width	483 mm
	Depth required	390 mm
	Actual depth (knobs included)	420 mm
Cabinet included: (8RO 501/00) (8RO 501/01)	Height	327 mm
	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 coil: 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 sec tions 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 fc ranges 4 to 6. The aerial circuit can be readjusted by means c 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 tha 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 t 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 crys tal oscillator (8RG 505 or 8RY 518) or from another receiver via an amplifier (8RY 518). If crystal control is employed, t 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 t 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 withou

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 "2 kc/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 µV 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 take to terminal "AF 0" via the B.F.O. switch.
If the A.F. signal is taken from this terminal (for, say, a e 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 MΩ resistor. A low-capacita 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 wa 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, s that the I.F. response is not changed.

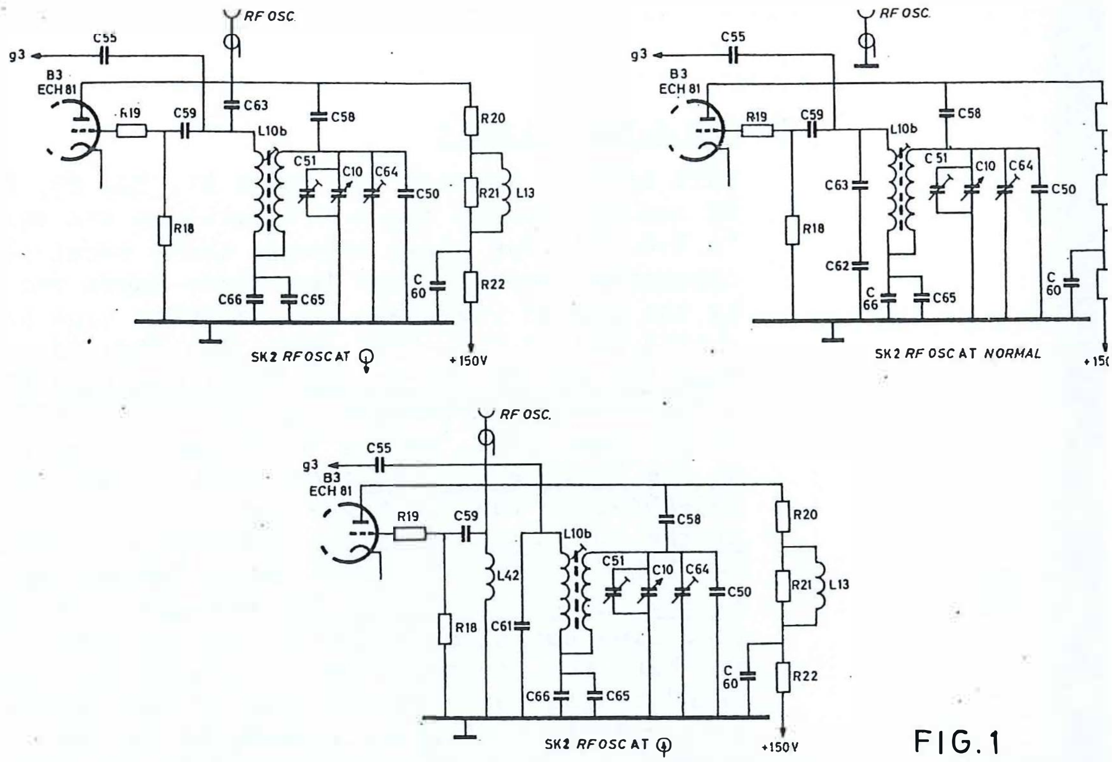

RF OSC.
C55
g3
B3
ECH 81
R19
C59
C63
C58
L10b
C51
C10
C64
C50
R20
R21
L13
R18
C66
C65
C 60
R22
SK2 RF OSC AT
+150V
C62
SK2 RF OSC AT NORMAL
L42
C61

FIG. 1

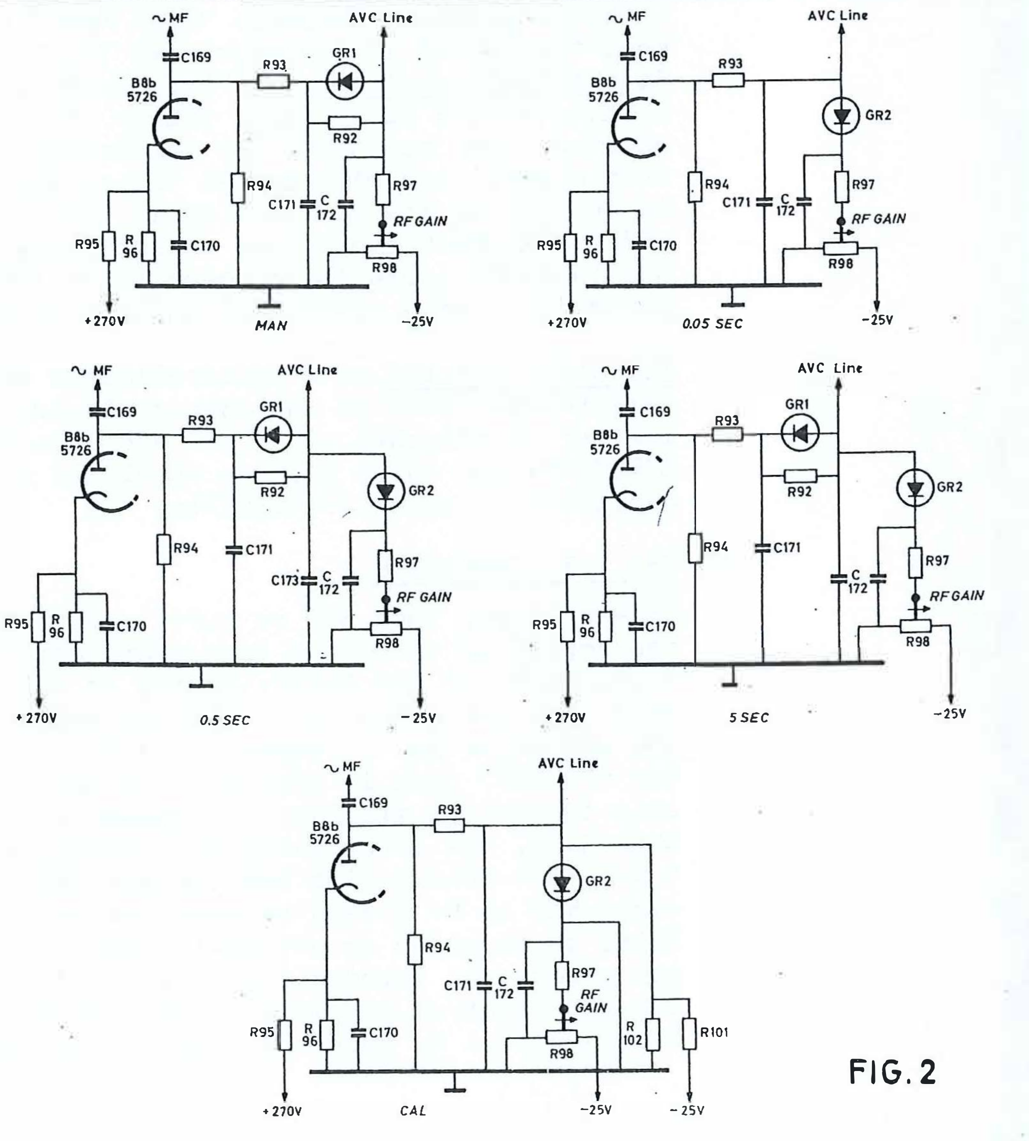

~ MF
AVC Line
C169
B8b
5726
R93
GR1
GR2
R92
R94
C171
C 172
C173
R97
RF GAIN
R95
R 96
C170
R98
+270V
-25V
MAN
0.05 SEC
0.5 SEC
5 SEC
CAL
R 102
R101

FIG. 2

7. <u>The A.V.C.-circuit</u>

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).
<u>With the switch set to the "MAN" position</u> 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.).
<u>At the "0.05 sec." position</u> R93-C171 determine the charge time and R93+R94-C171 the discharge time.
<u>At the "0.5 sec." position</u> R93-C171/C173 determine the charge time and R92-C173 the discharge time, because GR1 is then cut off.
<u>At the "5 sec." position</u> 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.".
<u>At the "CAL" position</u> 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. <u>The noise limiter</u> 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. <u>The A.F. amplifier</u>

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

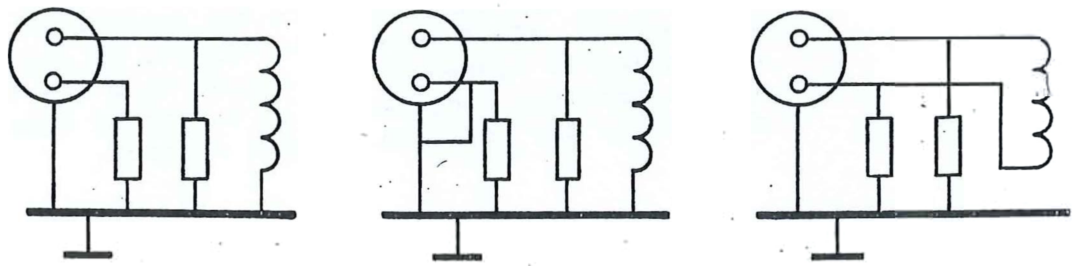
This oscillator is used to calibrate the frequency dial and the vernier dial. The crystal is incorporated in a Pierce-Colpitts circuit. C205 is used to tune to the nominal crystal frequency (= 500 kc/s).
The oscillator is switched into circuit when SK4 is set to the "CAL." position (see item 7: "At the "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 | in range 3 | in ranges 4, 5 and 6



2x330 kΩ | 2x330 kΩ | 2x330 kΩ

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 ± 5%).

Example: In sub-range 4 each scale division represents approx. 1/2000 x 2.6 Mc/s = 1.3 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 μV. 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 Mc/s) and 4 to 6 (2.6 - 31.2 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 8RG 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."

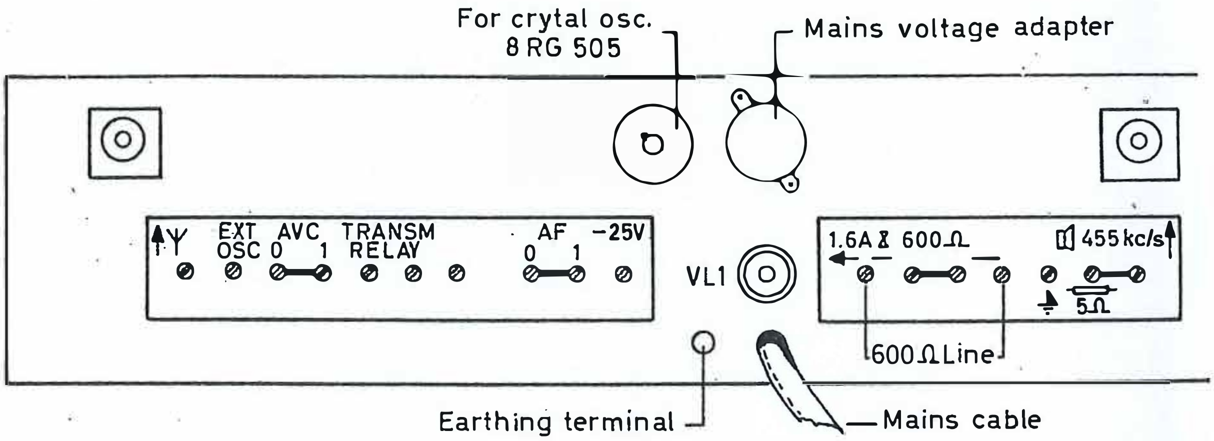
These sockets are not used unless the receiver is used in a (type 8RO 700) F1/F6 receiving installation. If a type 8RG 505 crystal oscillator is employed, only the "R.F. OSC." socket is used.
If the sockets are not used, put the separately supplied screw caps on them.

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.

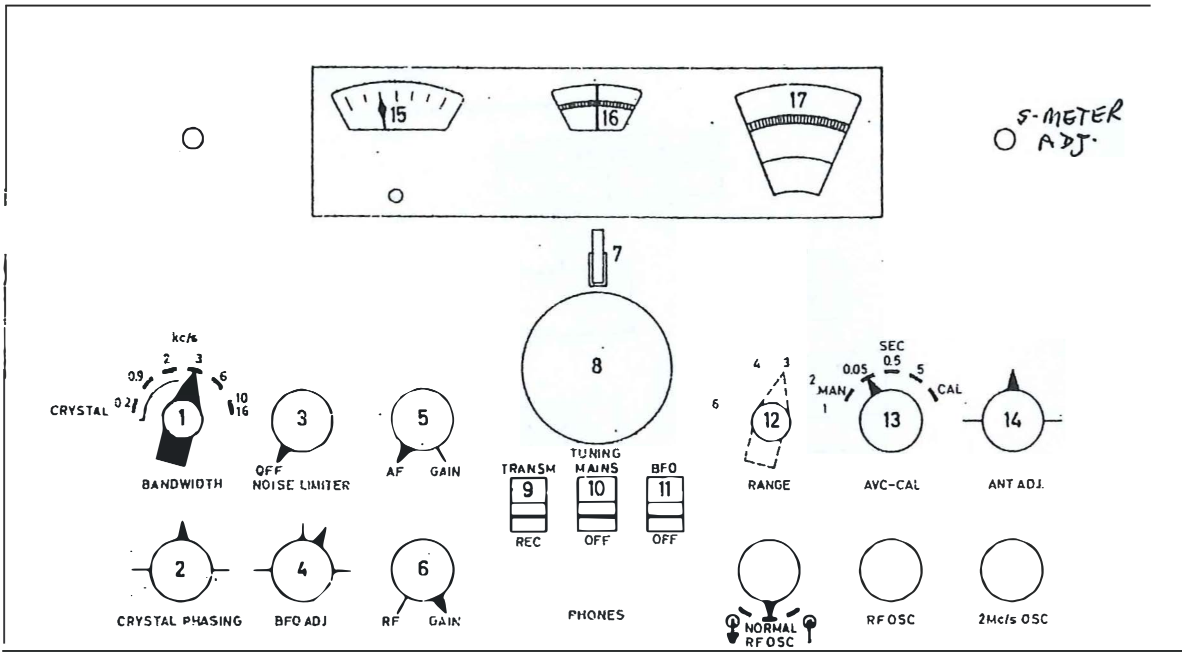
6. Connect the aerial to the left-hand socket marked " Ψ ".
   For sub-ranges 1 to 3 the input impedance has been matched to a CCIR standard dummy load.
   For sub-ranges 4 to 6 the input impedance is 75 Ω (unbalanced).

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.

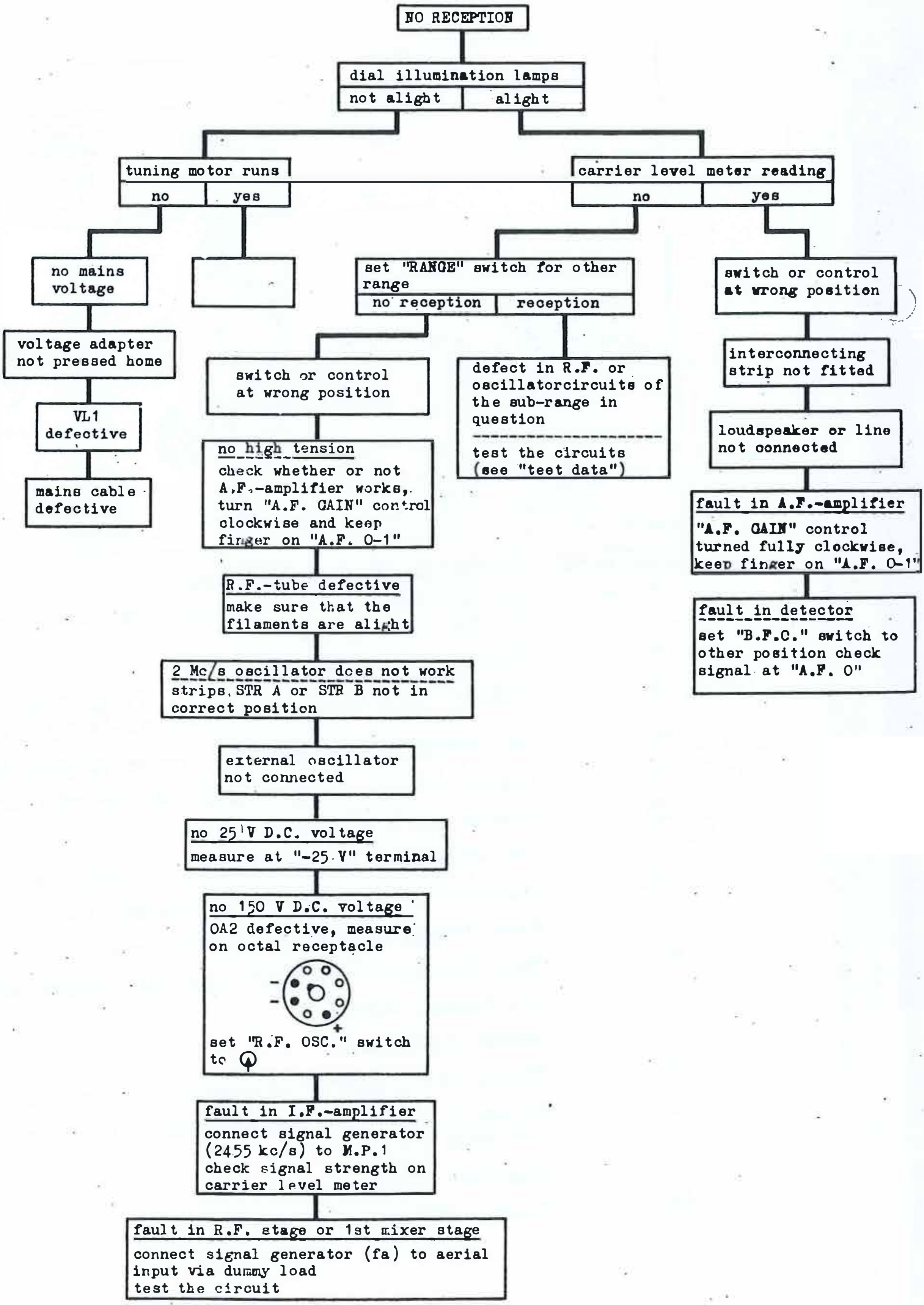
The receiver is now ready for use.

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.

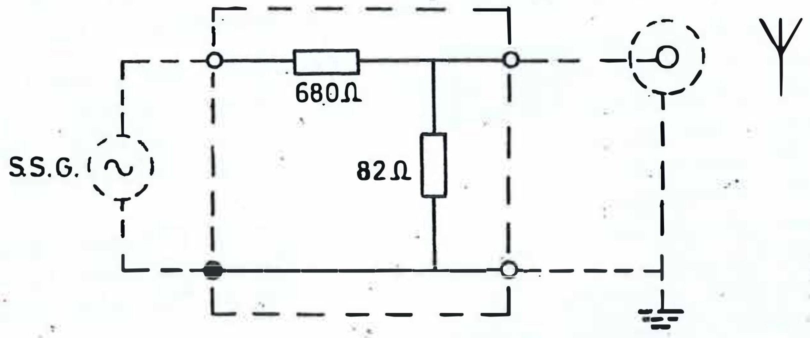
The following instruments are essential for proper servicing:
- R.F. standard signal generator (e.g. Philips type GM 2653)
- R.F. electronic voltmeter (e.g. Philips type GM 6016)
- Diode voltmeter (e.g. Philips type GM 6004) or a 50 μAmmeter
- A.F. voltmeter (e.g. Philips type GM 6015)
- Tone generator (e.g. Philips type GM 2317)
- Oscilloscope (e.g. Philips type GM 5602)
- Frequency counter
- Damping resistors 2x2200 Ω
- 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 75 Ω 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 75 Ω 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

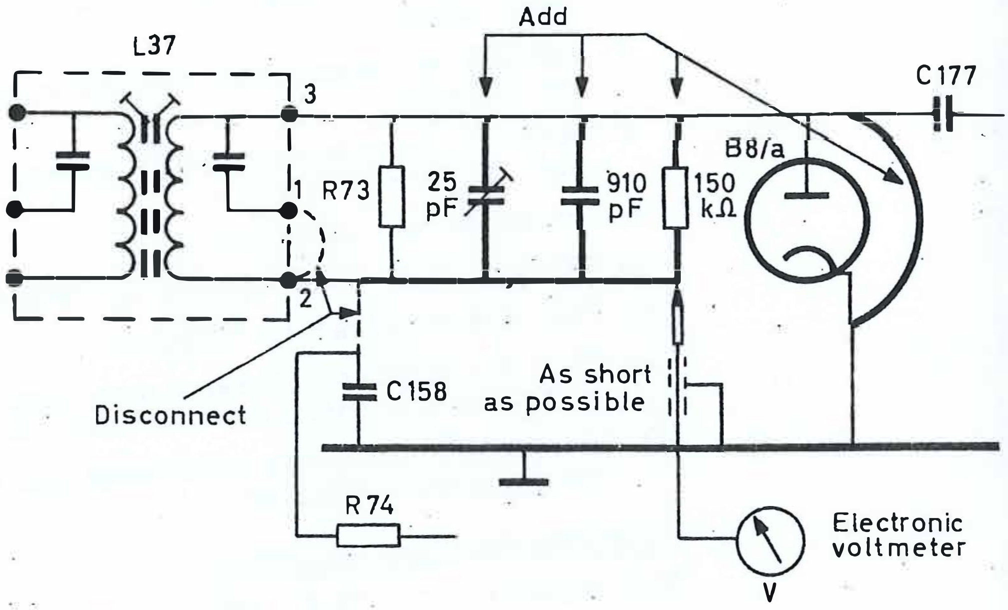
1. Connect the standard signal generator to the aerial input
2. Set the bandwidth switch for "2 kc/s".
3. Turn the "R.F. GAIN" control completely clockwise.
4. Set the "A.V.C.-CAL" control for "0.05 sec."
5. Tune the standard signal generator and the receiver to 7 Mc/s.
6. Modulate the standard signal 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 µA 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 µAmmeter 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 µAmmeter. 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. <u>Testing the 2nd I.F. bandpass filters curves up to adapter socket "455 kc/s" (see diagram 5)</u>

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

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

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. <u>Testing the 1st I.F. bandpass filter curve (see diagram 5)</u>

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.
  (Ifthis 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 μAmmeter 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 μAmmeter.

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 µAmmeter, 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 readjust, if necessary.
9. Connect the S.S.G. (455 kc/s) to test point MP1.
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. STOP.
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.

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). PHASING NOT WORK

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).

START 455 kHz IF adjust → 45. Set the bandwidth switch for "0.2 kc/s". TP 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 µV.

49. The diode voltmeter should now read approx. 1.5 V. SSOAW

50. This reading should stay within ± 2 dB for the other positions of the bandwidth switch.

2MHz osc. adjust! → 51. Set the "RANGE" switch for range 5.

52. Set the bandwidth switch for "0.2 kc/s".

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".

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 "18 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 µV 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 0-1" 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 x 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 µV 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 µV (i.e. 1 µV 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 10 mV (i.e. 100 mV from the S.S.G.).

F. <u>First oscillator and R.F. circuits</u>

a. <u>Testing the oscillator voltages at MP2</u>

(see diagram 3)

1. Connect the DC VTVM (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. <u>Testing the R.F. gain</u>

(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 sub 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. <u>Aligning the 1st oscillator and R.F. circuit</u>

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)

Tuning frequency	Tuning elements
5.8 Mc/s	C70 - C39 - 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

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

RANGE 2 (470 - 1128 kc/s

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

RANGE 1 (200 - 470 kc/s)

Tuning frequency	Tuning elements
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)

Tuning frequency	Tuning elements
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.

Tube	VK	Vg2	Va	VaH	Vat	Vg3	
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.".

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

"5 Ω" and "⏚"

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 "5 Ω" and "⏚" 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).

"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	µV	455 kc/s
Control grid B4	42	36	47	41	47	48	µV	455 kc/s
Control grid B3	32	27	35	31	35	36	µV	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 µV.
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 µV or approx. 0.25 µV.
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 "$\frac{10}{16}$ kc/s" position or approx. 670 if this switch is at the "6 kc/s" position.

PARTS LIST

Ref. no.	Technical data	Ph.-order code
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 ± 20%; 1000/600 V	OD 770 03/P2K2
C5	5.6 pF + 1 pF; 500 V	C 304 GB/M5E6
C6	3.9 pF ± 0.5 pF; 500 V	C 304 GB/L3E9
C7	3.3 pF ± 0.5 pF; 500 V	C 304 GB/L3E3
C8	100 pF ± 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 ± 10%; 65 V	C 296 AA/A100K
C12, C13	47000 pF + 20%; 630/400 V	OD 770 02/P47K
C14	27 pF ± 5%; 500 V	C 304 GH/B27E
C15	100 pF ± 5%; 500 V	C 304 GH/B100E
C16	120 pF ± 5%; 500 V	C 304 GH/B120E
C17	220 pF ± 5%; 500 V	C 304 GH/B220E
C18 (/00 and /50)	150 pF ± 5%; 500 V	C 304 GH/B150E
C18 (/01 and /51)	120 pF ± 5%; 500 V	C 304 GH/B120E
C19	1 pF ± 0.25 pF; 500 V	C 304 GH/N1E
C20	7 - 32 pF ; 150 V	NT 120 18
C21	1.5 pF ± 0.25 pF; 500 V	C 304 GH/N1E5
C25-C29	7 - 32 pF ; 150 V	NT 120 18
C30	15 pF ± 10%; 500 V	C 304 GC/A15E
C31	100 pF ± 5%; 500 V	C 304 GH/B100E
C33	56 pF ± 5%; 500 V	C 304 GH/B56E

Ref. no.	Technical data	Ph.-order code
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 µF ± 10%; 65 V	C 296 AA/A10K
C45	7 - 32 pF 150 V	NT 120 18
C46	0.01 µF ± 10%; 65 V	C 296 AA/A10K
C47	7 - 32 pF ; 150 V	NT 120 18
C48	15 pF + 10%; 500 V	C 304 GC/A15E
C50	18 pF } in series	C 305 GH/B18E
	15 pF	C 305 GH/B15E
C51	0.7 - 3.7 pF	C 004 EA/3E
C53	0.01 µF -20+50%; 250 V	C 301 BA/H10K
C54, C55	100 pF ± 5%; 500 V	C 304 GH/B100E
C56	0.01 µF -20+50%; 250 V	C 301 BA/H10K
C57	0.1 µF ± 10%; 65 V	C 296 AA/A100K
C58, C59	100 pF ± 5%; 500 V	C 304 GH/B100E
C60	0.01 µF -20+50%; 250 V	C 301 BA/H10K
C61	18 pF ± 5%; 500 V	C 304 GC/B18E
C62	68 pF ± 5%; 500 V	C 304 GB/B68E
C63	3.3 pF ± 0.5 pF; 500 V	C 304 GB/L3E3
C64	3.5 - 19.5 pF	NT 120 28
C65	510 pF ± 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 ± 1%; 500 V	48 336 01/510E
C69	1800 pF ± 1%; 500 V	48 336 01/1K8
C70	3.5 - 19.5 pF	NT 120 28
C71	1800 pF ± 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 ± 1%; 500 V	48 336 01/750E
C75	4.7 pF ± 1 pF; 500 V	C 304 GH/L4E7
C76	3.5 - 19.5 pF	NT 120 28
C77	5.6 pF ± 1 pF; 500 V	48 336 99/5E6
C78	3.5 - 19.5 pF	NT 120 28
C79	4.7 pF ± 0.5 pF; 500 V	C 304 GB/L4E7

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

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

Ref. no.	Technical data	Ph.-order code
C173	0.047 µF ± 10%; 65 V	C 296 AA/A47K
C174	0.47 µF ± 10%; 65 V	C 296 AA/A470K
C175	40 µF ; 50 V	C 435 AL/H40
C177	2.2 pF ± 0.25 pF; 500 V	C 304 GB/N2E2
C178	0.047 µF ± 20%; 630 V	OD 770 02/P47K
C179, C180	100 pF ± 5%; 500 V	C 304 GH/B100E
C185	0.01 µF -20+50%; 250 V	C 301 BA/H10K
C186	0.1 µF ± 10%; 250 V	OD 770 05/A100K
C187	1200 pF ± 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 ± 20%; 1000 V	OD 770 03/P1K
C192	4700 pF ± 20%; 1000 V	OD 770 03/P47K
C193	100 pF ± 5%; 500 V	C 304 GH/B100E
C194 (2 par.)	0.3 µF ± 10%; 400 V	49 134 11
C195, C196	0.033 µF	OD 770 03/P33K
C197, C198	100 µF ; 50 V	C 435 AL/H100
C199	2x50 µF ; 400 V	AC 5409/50+50
C200	2x12.5 µF ; 500 V	AC 5311/12.5+12.5
C201	0.01 µF -20+50%; 250 V	C 301 BA/H10K
C202, C203	4700 pF ± 20%; 1000 V	OD 770 03/P4K7
C204	10 pF ± 1 pF; 500 V	48 336 99/10E
C205	7 - 32 pF ; 150 V	C 005 BA/25E
C206	150 pF ± 5%; 500 V	48 336 05/150E
C207	0.01 µF -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

Ref. no.	Technical data	Ph.-order code
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

Ref. no.	Technical data	Ph.-order code
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 kΩ ± 5%; 0.25 W	B8 305 05B/18K
R2	10 Ω ± 5%; 0.25 W	B8 305 05B/10E
R3	1 MΩ ± 10%; 0.25 W	B8 305 13A/1M
R4	150 Ω ± 5%; 0.25 W	B8 305 05B/150E
R5	68 kΩ ± 5%; 0.5 W	B8 305 06B/68K
R6	2.2 kΩ ± 5%; 0.5 W	B8 305 06B/2K2
R7	82 Ω ± 5%; 0.25 W	B8 305 05B/82E
R8	1 MΩ ± 10%; 0.25 W	B8 305 13A/1M
R9	33 Ω ± 5%; 0.25 W	B8 305 05B/33E
R10	120 Ω ± 5%; 0.25 W	B8 305 06B/68K
R11	68 kΩ ± 5%; 0.5 W	B8 305 06B/68K
R12	2.2 kΩ ± 5%; 0.5 W	B8 305 06B/2K2
R13	82 Ω ± 5%; 0.25 W	B8 305 05B/82E
R14	470 kΩ ± 5%; 0.25 W	B8 305 13B/470K
R15	22 kΩ ± 5%; 0.5 W	B8 305 06B/22K
R16	1 MΩ ± 10%; 0.25 W	B8 305 13A/1M
R17	100 Ω ± 5%; 0.25 W	B8 305 05B/100E
R18	47 kΩ ± 5%; 0.25 W	B8 305 05B/47K
R19	100 Ω ± 5%; 0.25 W	B8 305 05B/100E
R20	10 kΩ ± 10%; 1 W	B8 305 07A/10K
R21	15 kΩ ± 5%; 0.25 W	B8 305 05B/15K
R22	1 kΩ ± 5%; 0.25 W	B8 305 05B/1K
R24	2.2 MΩ ± 10%; 0.25 W	B8 305 13A/2M2
R25	15 kΩ ± 5%; 8 W	48 766 05/15K
R26	10 kΩ ± 5%; 0.25 W	B8 305 05B/10K
R27	2.2 kΩ ± 5%; 0.25 W	B8 305 05B/2K2
R28	150 kΩ ± 5%; 0.25 W	B8 305 13B/150K
R29	1 kΩ ± 5%; 0.25 W	B8 305 05B/1K

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

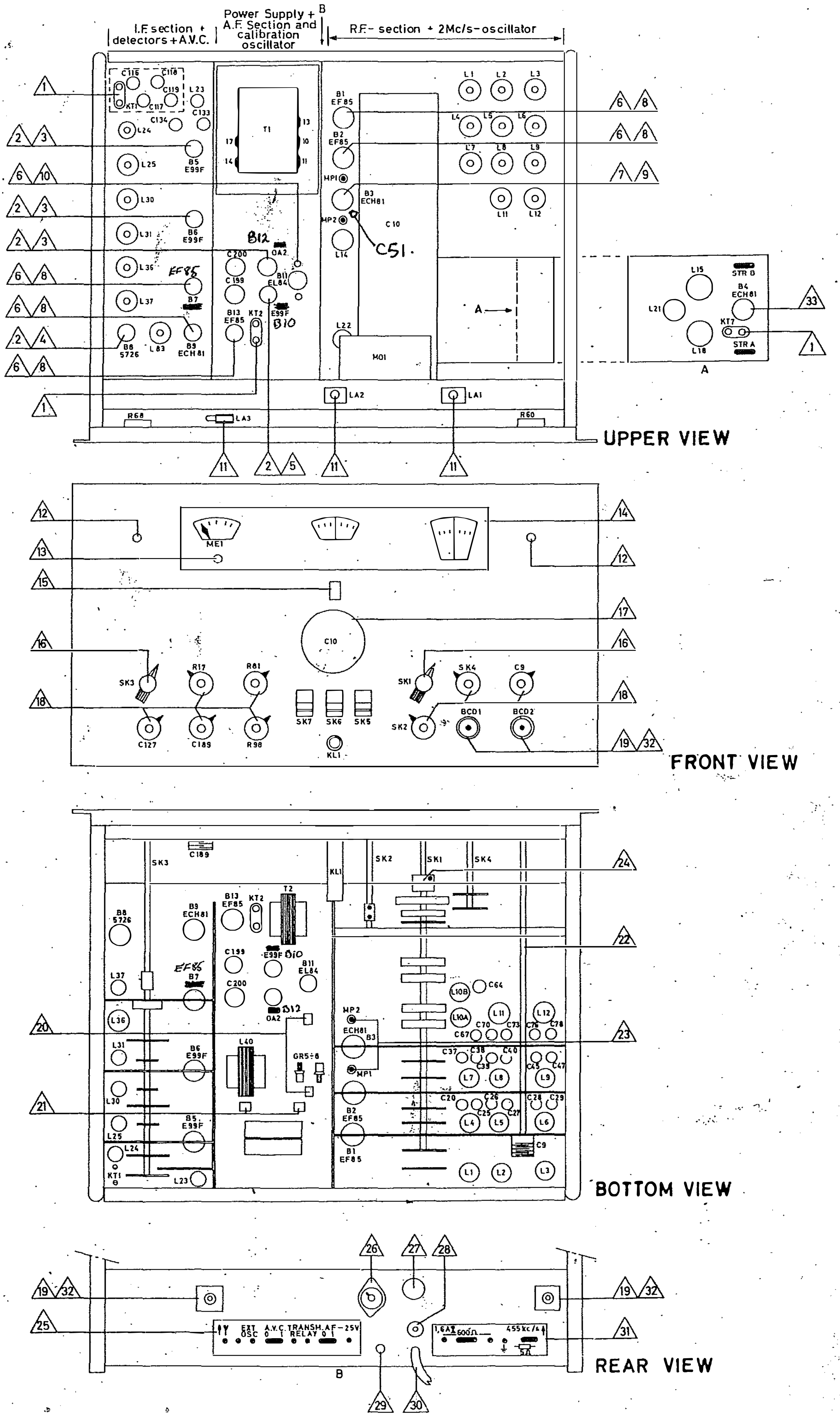
Ref. no.	Technical data	Ph.-order code
R74-R76	22 kΩ ± 5%; 0.25 W	B8 305 05B/22K
R77	200 kΩ ; 0.25 W (lin.)	NT 117 65
R78	68 kΩ ± 5%; 0.25 W	B8 305 05B/68K
R79, R80	1 MΩ ± 10%; 0.25 W	B8 305 13A/1M
R81	1 MΩ ; 0.25 W (log.)	NT 117 31
R82	1 MΩ ± 10%; 0.25 W	B8 305 13A/1M
R83	2.7 kΩ ± 5%; 0.25 W	B8 305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

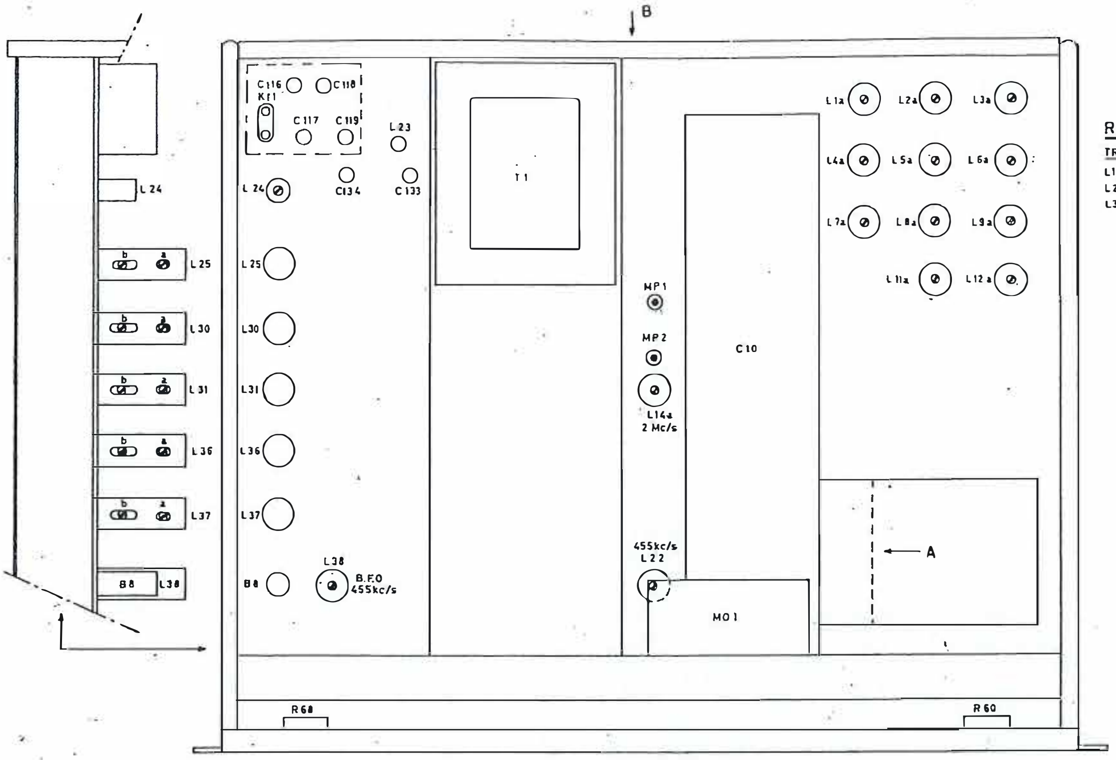
Ref. no.	Technical data	Ph.-order code
R116	4.7 kΩ + 5%; 0.25 W	B8 305 05B/4K7
R117	4.7 kΩ + 5%; 0.5 W	B8 305 06B/4K7
R118	8.2 kΩ ± 10%; 1 W	B8 305 07A/8K2
R119	3.3 kΩ + 5%; 10 W	48 767 05/3K3
R120	0.68 Ω ; 2 W	E 104 AA/AE68
R121	470 kΩ + 5%; 0.25 W	B8 305 13B/470K
R122	150 kΩ + 5%; 0.25 W	B8 305 13B/150K
R123	100 kΩ + 5%; 0.25 W	B8 305 05B/100K
R124	2.2 kΩ + 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 40
VL1	1.6 Amps delayed	08 142 33

LIST OF BREAKABLE AND EXPENDABLE COMPONENTS

(see drawing no. 1)

Pos.no.	Description	Order code
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 perspplex	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
	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

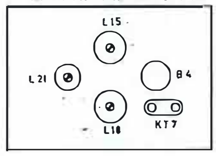

I.F. section + detectors + A.V.C.
Power Supply + A.F. Section and calibration oscillator
R.F.- section + 2Mc/s-oscillator
UPPER VIEW
FRONT VIEW
BOTTOM VIEW
REAR VIEW
EXT OSC
A.V.C. 0 1
TRANSH. RELAY
AF - 25V 0 1
455kc/s



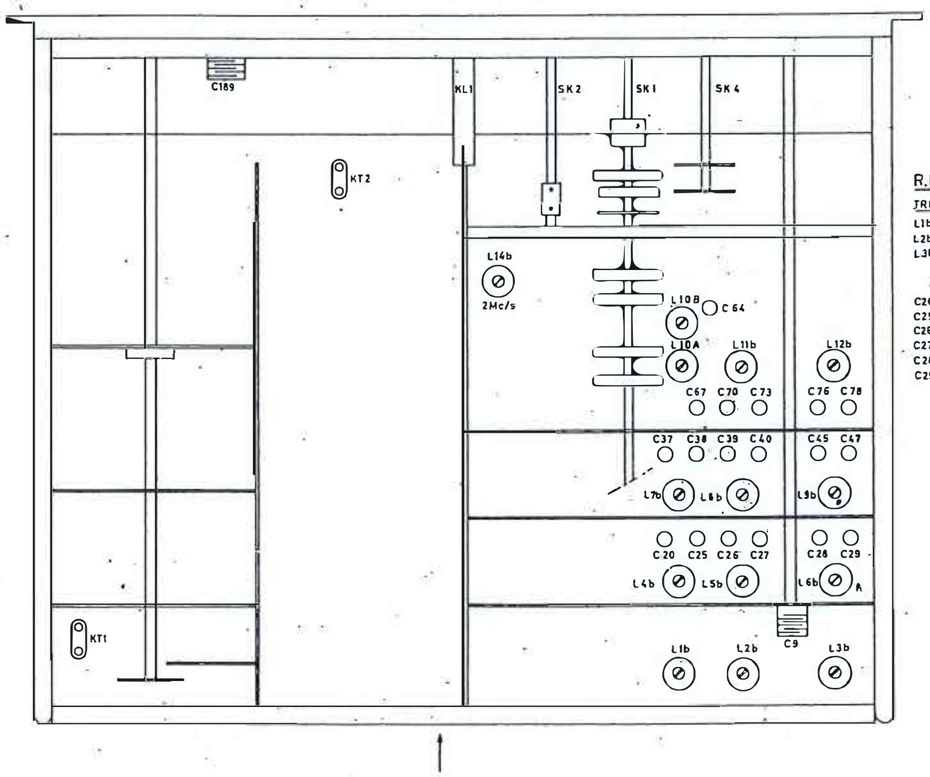
R.F. AND 1st OSC. CIRCUITS

TRIMMING POINTS	FREQUENC
L1a, L4a, L7a, L10a	6.5 Mc/s
L2a, L5a, L8a, L11a	1.15 Mc/s
L3a, L6a, L9a, L12a	200 kc/s (/
	225kc/s (/

2nd MIXER AND 2Mc/s OSCILLATOR

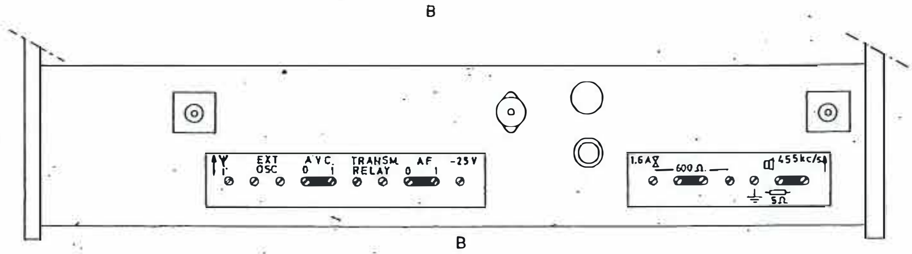


A



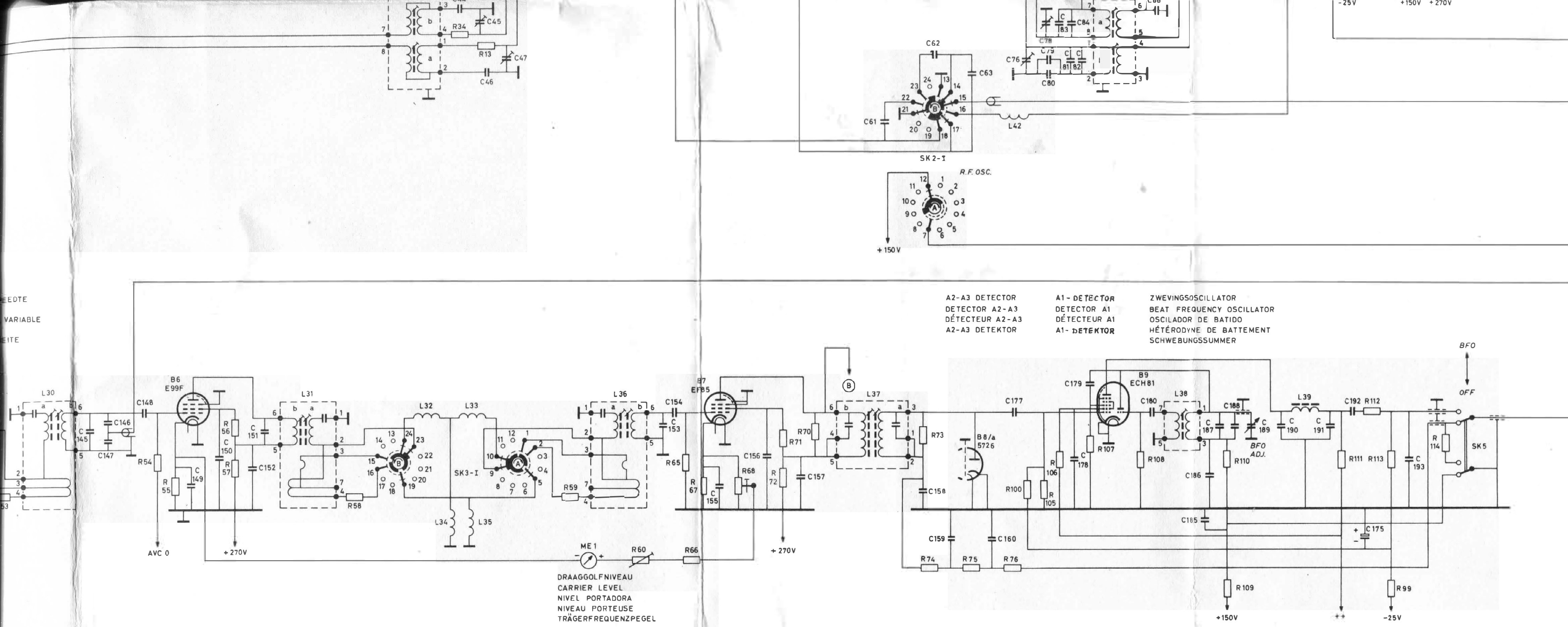
R.F. AND 1st OSC. CIRCUITS

TRIMMING POINTS	FREQUEN
L1b, L4b, L7b, L10b	14 Mc/s
L2b, L5b, L8b, L11b	2.8 Mc/s
L3b, L6b, L9b, L12b	500 kc/s
C20, C37, C64	29 Mc/s
C25, C38, C67	13.5 Mc/s
C26, C39, C70	5.8 Mc/s
C27, C40, C73	2.5 Mc/s
C28, C45, C76	1.05 Mc/s
C29, C47, C78	450 kc/s (
	500 kc/s, (

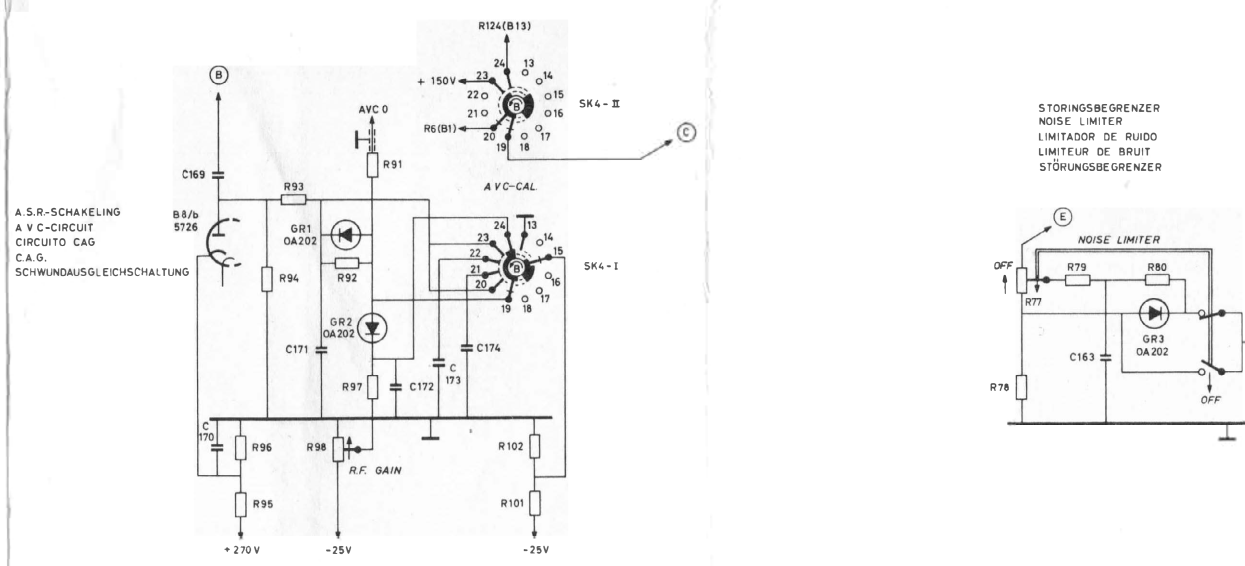


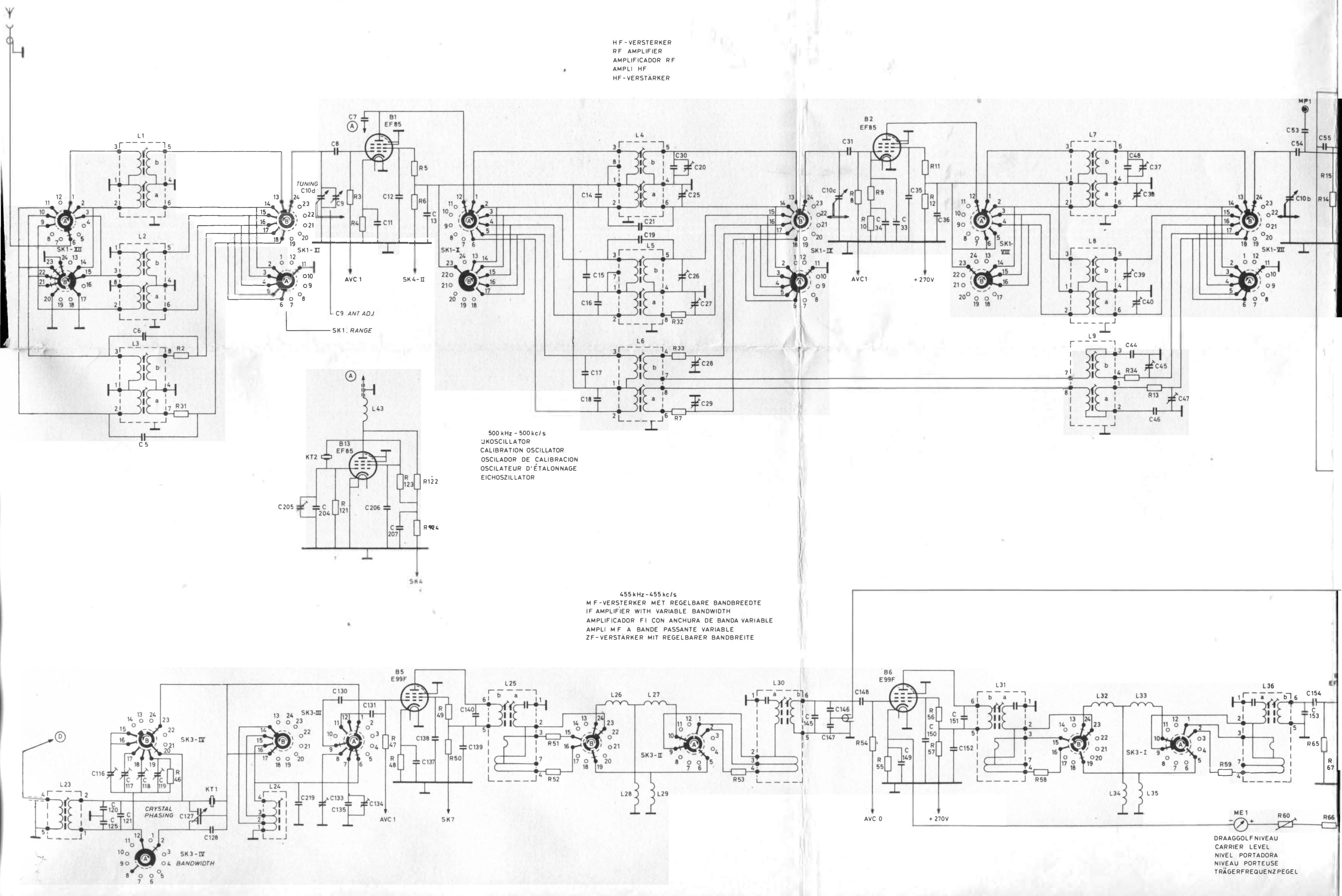
B

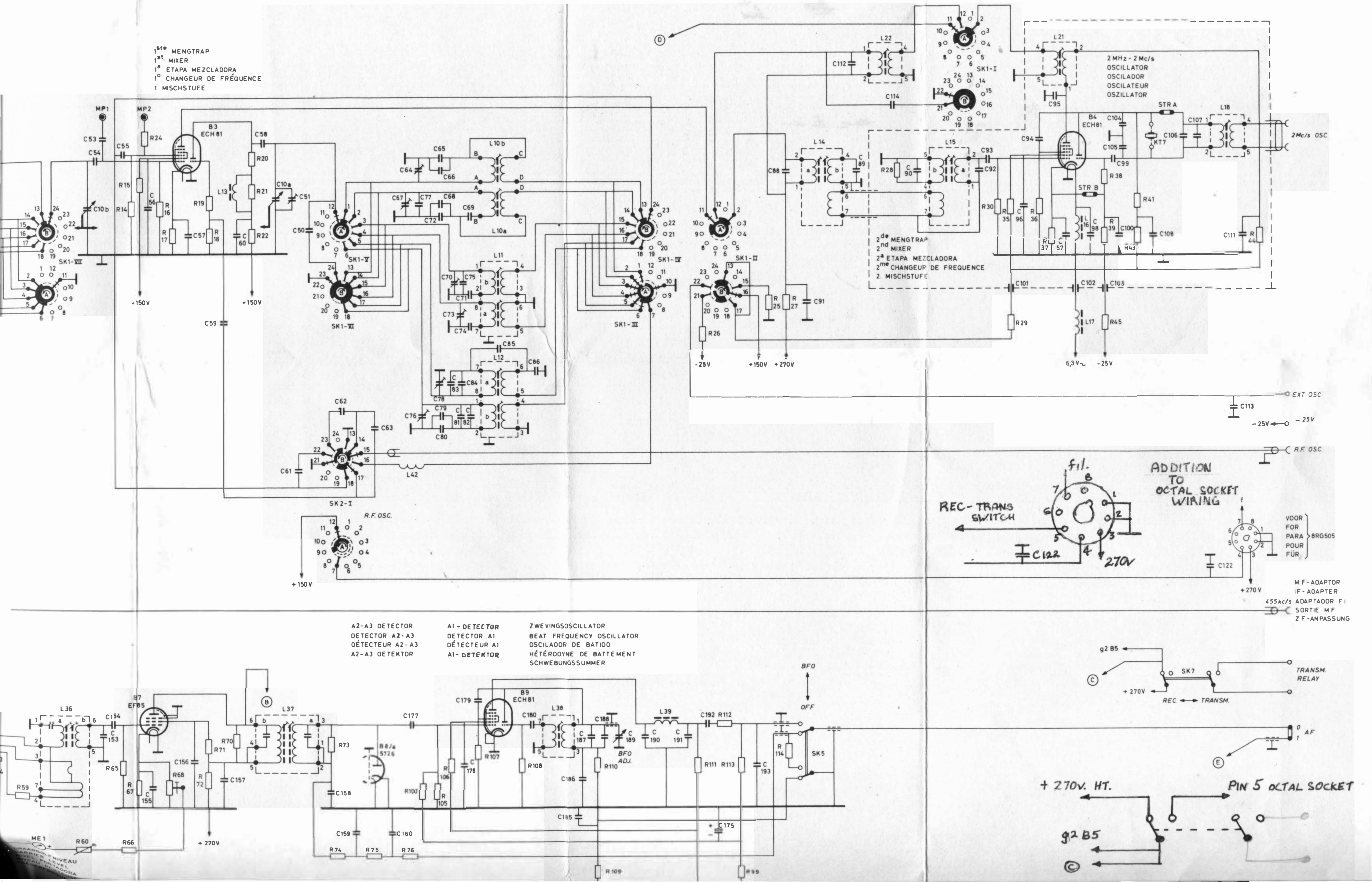
EEDTE
VARIABLE
EITE

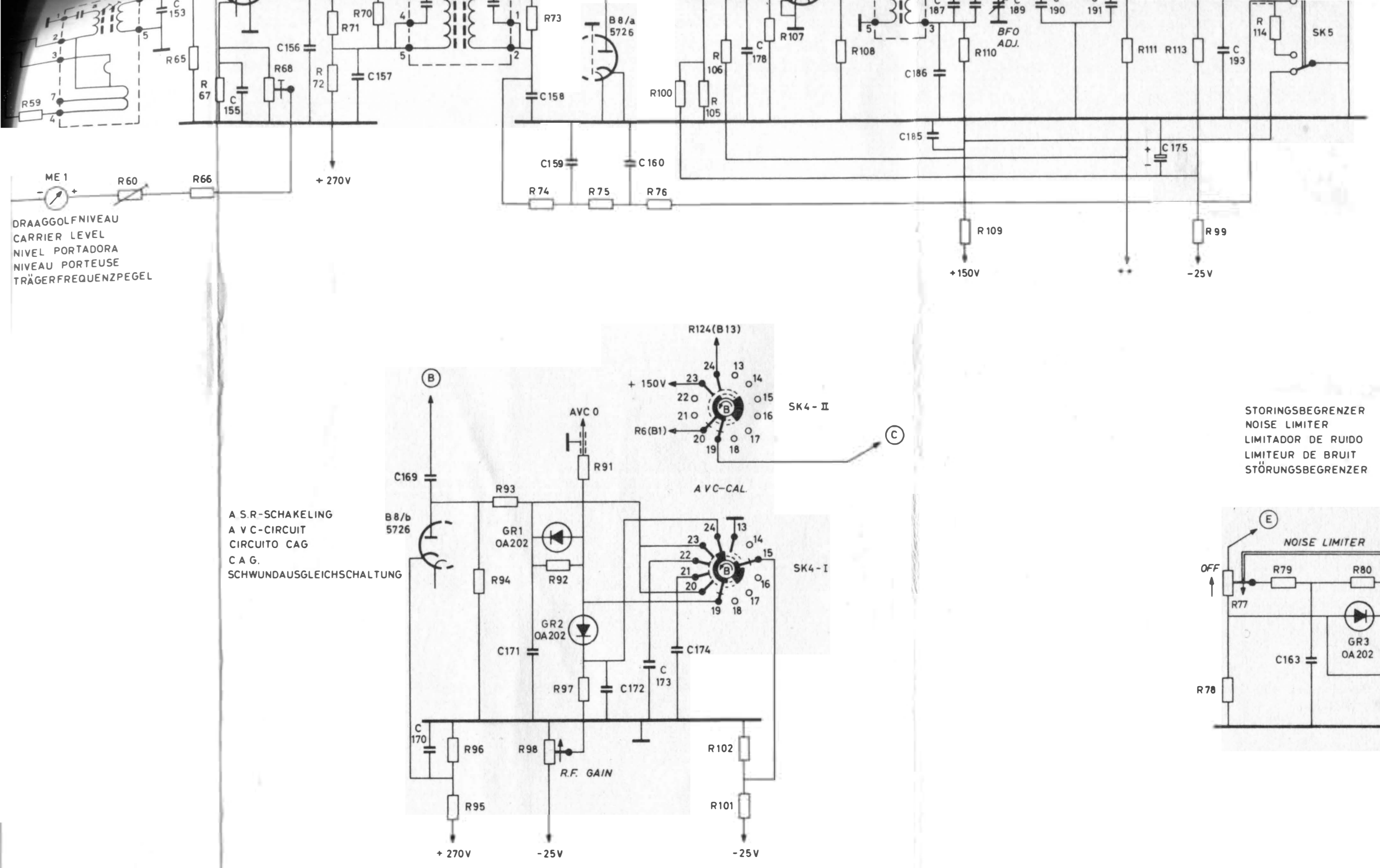


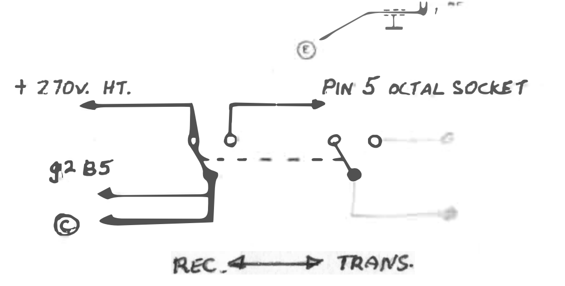
LABEL	GRAVERING	TEXTO	INSCRIPTIONS	GRAVIERUNG
GAIN	L.F-VERSTERKING	GANANCIA BF	GAIN B.F.	N.F-VERSTÄRKUNG
T ADJ.	ANT. INSTELLING	AJUSTE ANT	ANTENNE	ANTENNENEINSTELLUNG
NDWIDTH	BANDBREEDTE	ANCHO DE BANDA	LARGEUR DE BANDE	BANDBREITE
O ADJ	ZWEVINGSOSC. INST.	AJUSTE BATIDO	HÉTÉRODYNE DE BATTEMENT	EINSTELLUNG DES SCHWEBUNGSSUMMER
	IJKING	CAL.	ÉTALONNAGE	EICHUNG
STAL PHASING	BANDVERSCHUIVING DOOR EEN KRISTAL	FASE CRISTAL	SÉLECTIVITÉ QUARTZ	BANDBREITEVERSCHIEBUNG DURCH KRISTALL
OSC.	EXT. OSC.	OSC. EXT.	OSC EXT.	EXT. OSC
NS	NET	RED	SECTEUR	NETZ
N	HAND	MANUAL	MANUEL	MANUELL
OR DRIVE: PUSH AND TU	AFSTEMMOTOR: DRUK EN DRAAI	ACCIONAMIENTO A MOTOR APRETAR Y GIRAR	ACCORD MOTORISÉ: POUSSER ET TOURNER	MOTORANTRIEB. DRÜCKEN UND DREHEN
SE LIMITER	STORINGSBEGRENZER	LIMITADOR DE RUIDO	LIMITATEUR DE BRUIT	STÖRUNGSBEGRENZER
MAL	NORMAAL	NORMAL	OSCILLATEUR INTÉRIEUR	NORMAL
	UIT	NO	ARRÊT	AUS
NES	HOOFDTELEFOON	AURICULARES	CASQUE	KOPFHÖRER
GE	GEBIED	BANDAS	SOUS-GAMMES	BEREICH
GAIN	H.F.-VERSTERKING	GANANCIA RF	GAIN H.F.	HF-VERSTÄRKUNG
OSC	H.F-OSC.	OSC. RF	OSC. H.F	HF-OSZILLATOR
	ONTVANGEN	REC.	RÉCEPTION	EMPF.
NSM	ZENDEN	TRANSM.	EMISSION	SEND
NSM RELAY	ZENDRELAIS	RELEV. TRANSM.	RELAIS D'ÉMISSION	SENDERELAIS
ING	AFSTEMMING	SINTONIA	ACCORD	ABSTIMMUNG
/s OSC.	2 MHz-OSCILLATOR	OSC. 2 Mc/s	OSC. 2MHz	2MHz-OSZILLATOR



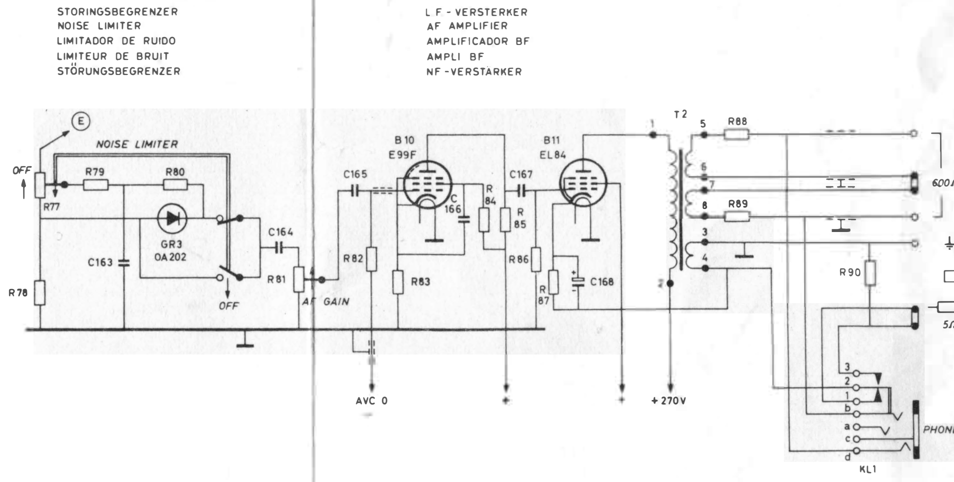

HF-VERSTERKER
RF AMPLIFIER
AMPLIFICADOR RF
AMPLI HF
HF-VERSTÄRKER
500 kHz - 500 kc/s
IJKOSCILLATOR
CALIBRATION OSCILLATOR
OSCILADOR DE CALIBRACION
OSCILATEUR D'ÉTALONNAGE
EICHOSZILLATOR
455 kHz - 455 kc/s
MF-VERSTERKER MET REGELBARE BANDBREEDTE
IF AMPLIFIER WITH VARIABLE BANDWIDTH
AMPLIFICADOR FI CON ANCHURA DE BANDA VARIABLE
AMPLI MF A BANDE PASSANTE VARIABLE
ZF-VERSTÄRKER MIT REGELBARER BANDBREITE
DRAAGGOLFNIVEAU
CARRIER LEVEL
NIVEL PORTADORA
NIVEAU PORTEUSE
TRÄGERFREQUENZPEGEL
TUNING C10d
C9 ANT ADJ
SK1. RANGE
CRYSTAL PHASING
SK3-IV BANDWIDTH
B1 EF85
B2 EF85
B13 EF85
B5 E99F
B6 E99F
AVC 1
AVC 0
SK4-II
SK4
SK7
+270V
ME1

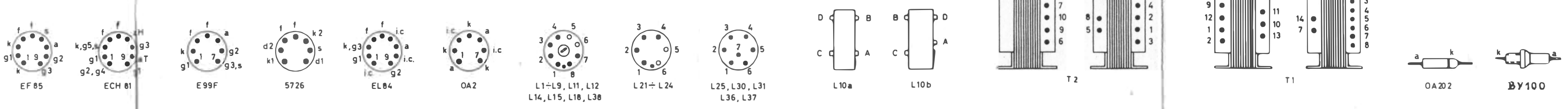

1ste MENGTRAP
1st MIXER
1a ETAPA MEZCLADORA
1o CHANGEUR DE FRÉQUENCE
1 MISCHSTUFE
B3 ECH 81
B4 ECH81
2 MHz - 2 Mc/s
OSCILLATOR
OSCILADOR
OSCILATEUR
OSZILLATOR
2de MENGTRAP
2nd MIXER
2a ETAPA MEZCLADORA
2me CHANGEUR DE FREQUENCE
2. MISCHSTUFE
2Mc/s OSC
EXT OSC
R.F. OSC
R.F. OSC.
ADDITION TO OCTAL SOCKET WIRING
REC - TRANS SWITCH
270V
VOOR
FOR
PARA
POUR
FÜR
8RG505
MF-ADAPTOR
IF-ADAPTER
ADAPTADOR FI
SORTIE MF
ZF-ANPASSUNG
455kc/s
A2-A3 DETECTOR
DETECTOR A2-A3
DÉTECTEUR A2-A3
A2-A3 DETEKTOR
A1 - DETECTOR
DETECTOR A1
DÉTECTEUR A1
A1 - DETEKTOR
ZWEVINGSOSCILLATOR
BEAT FREQUENCY OSCILLATOR
OSCILADOR DE BATIDO
HÉTÉRODYNE DE BATTEMENT
SCHWEBUNGSSUMMER
B7 EF85
B9 ECH81
BFO ADJ.
BFO
OFF
AF
TRANSM. RELAY
REC ↔ TRANSM.
+ 270V. HT.
PIN 5 OCTAL SOCKET
g2 B5
+150V
+270V
-25V
6,3V~





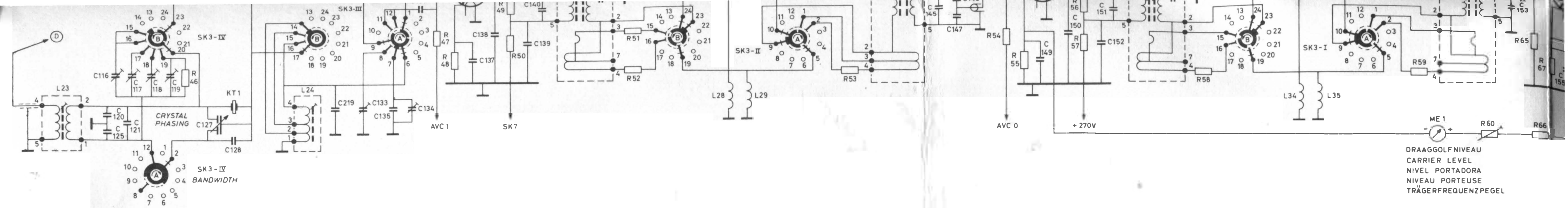
MODIFIED CONNECTIONS TO REC - TRANS. SWITCH.

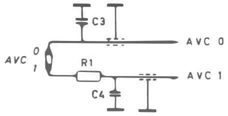




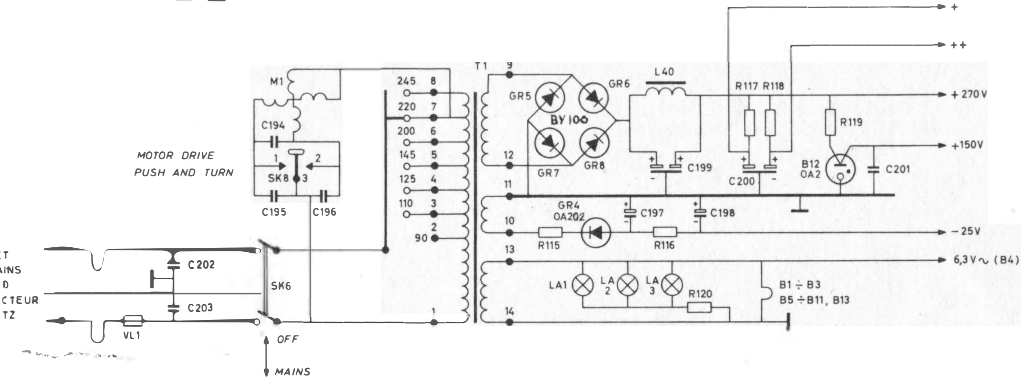
SCHEMA/DIAGRAM/ESQUEMA/SCHÉMA/SCHALTBILD
NºDB-R923u/1-9/630223 8RO501/50en/51

9





VOEDINGSGEDEELTE
POWER SUPPLY UNIT
FUENTE DE ALIMENTACION
ALIMENTATION
NETZTEIL



LABEL	GRAVERING	TEXTO	INSCRIPTIONS	GRAVIERUNG
AF GAIN	L.F-VERSTERKING	GANANCIA BF	GAIN B F.	NF-VERSTARKUNG
ANT. ADJ.	ANT. INSTELLING	AJUSTE ANT.	ANTENNE	ANTENNENEINSTELLUNG
BANDWIDTH	BANDBREEDTE	ANCHO DE BANDA	LARGEUR DE BANDE	BANDBREITE
BFO ADJ.	ZWEVINGSOSC. INST.	AJUSTE BATIDO	HÉTÉRODYNE DE BATTEMENT	EINSTELLUNG DES SCHWEBUNGSSUMMER
CAL	IJKING	CAL	ÉTALONNAGE	EICHUNG
CRYSTAL PHASING	BANDVERSCHUIVING DOOR EEN KRISTAL	FASE CRISTAL	SÉLECTIVITÉ QUARTZ	BANDBREITEVERSCHIEBUNG DURCH KRISTALL
EXT. OSC	EXT. OSC	OSC. EXT.	OSC EXT.	EXT. OSC
MAINS	NET	RED	SECTEUR	NETZ
MAN	HAND	MANUAL	MANUEL	MANUELL
MOTOR DRIVE	AFSTEMMOTOR	ACCIONAMIENTO A MOTOR	ACCORD MOTORISÉ	MOTORANTRIEB
PUSH AND TURN	DRUK EN DRAAI	APRETAR Y GIRAR	POUSSER ET TOURNER	DRÜCKEN UND DREHEN
NOISE LIMITER	STORINGSBEGRENZER	LIMITADOR DE RUIDO	LIMITATEUR DE BRUIT	STÖRUNGSBEGRENZER
NORMAL	NORMAAL	NORMAL	OSCILLATEUR INTÉRIEUR	NORMAL
OFF	UIT	NO	ARRÊT	AUS
PHONES	HOOFDTELEFOON	AURICULARES	CASQUE	KOPFHÖRER
RANGE	GEBIED	BANDAS	SOUS-GAMMES	BEREICH
RF GAIN	HF-VERSTERKING	GANANCIA RF	GAIN H F	HF-VERSTÄRKUNG
RF OSC	H F-OSC	OSC RF	OSC H F.	HF-OSZILLATOR
REC.	ONTVANGEN	REC.	RÉCEPTION	EMPF
TRANSM	ZENDEN	TRANSM	EMISSION	SEND
TRANSM RELAY	ZENDRELAIS	RELEV. TRANSM.	RELAIS D'ÉMISSION	SENDERELAIS
TUNING	AFSTEMMING	SINTONIA	ACCORD	ABSTIMMUNG
2Mc/s OSC	2MHz-OSCILLATOR	OSC 2Mc/s	OSC 2MHz	2MHz-OSZILLATOR

ALLE DRAAISCHAKELAARS ZIJN IN DE LINKER STAND GETEKEND
ALL ROTARY SWITCHES ARE SHOWN SET TO THE LEFT-HAND POSITION
TODOS LOS CONMUTADORES ROTATORIOS APARECEN DIBUJADOS EN LA POSICION IZQUIERDA
TOUS LES COMMUTATEURS ROTATIFS SONT REPRÉSENTÉS DANS LA POSITION DE GAUCHE
ALLE DREHSCHALTER SIND IN DER LINKEN STELLUNG GEZEICHNET

MOEDERCONTACT
CENTRAL OUTLET
CONTACTO PRINCIPAL
PÔLE
MUTTERKONTAKT