

COMMUNICATIONS RECEIVER

TYPE R. 209 MK II

OPERATING MANUAL

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80, RUE DES DEUX GARES - BRUSSELS - BELGIUM

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R.209 Mk II

This receiver, an improved version of the original R.209, is a general-purpose receiver suitable for use as vehicle, manpack or fixed stations. Its solid construction renders it waterproof and almost completely air-tight. For further protection a silica-gel desicator is provided to absorb any moisture remaining in the set and it is therefore suitable for operation in extreme climates.

The R.209 is built on very sturdy lines, enabling it to withstand considerable shock and rough usage. The receiver is simple to operate and may be used with the built-in loudspeaker and with one or two pairs of 150-ohms headphones. A cover is provided to protect the loudspeaker against the ingress of moisture; this may also be used to mute it when not required.

Facilities are provided for r.t., c.w., m.c.w., and f.m. reception by rod, open wire or dipole aerials. Greatly improved stability enables carrier-shift working to be used, an i.f. output being provided for this purpose.

A 12-volt battery supply is required to operate the receiver which consumes less than 1.5 amps.

The receiver is built on the unit principle and consists of front panel and separately detachable units.

These are:-

- (a) R.F. Unit
- (b) 3 Identical I.F. Units
- (c) Discriminator
- (d) B.F.O. Unit
- (e) I.F. Chassis
- (f) A.F. Chassis
- (g) Power Supply Unit.

The three i.f. units, the discriminator unit and the b.f.o. unit are constructed as plug-in units that can be easily removed from the i.f. chassis for servicing. All the units are supported on the front panel. Tuning is facilitated by the addition of a vernier scale,



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which can be used for accurately logging stations. The tuning control can be locked.

Due to the electrical design and the rigid construction of the receiver - particularly of the r.f. unit - frequency stability is very good even when subjected to vibration, enabling the receiver to be used in a vehicle on the move.

TECHNICAL SUMMARY

Frequency Range

Range 1	12.0-20.0 Mc/s
Range 2	5.5-12.5 Mc/s
Range 3	2.3- 5.6 Mc/s
Range 4	1.0- 2.3 Mc/s

Reception

Types of reception: r.f., f.m., c.w., m.c.w., and carrier frequency shift.

Signal/Noise Ratio

At least 20 dB with 5 microvolt signal applied to the 80-ohm input.

Selectivity

4-6 kc/s at 6 dB down.
13 kc/s at 40 dB down.
Cut off slope -6 to -40 not less than 9 dB/kc/s.

Image Ratio

Better than 23 dB on Range 1
Better than 28 dB on Range 2
Better than 40 dB on Range 3
Better than 50 dB on Range 4.

I.F./A.F. Gain

Standard output (10 mW into 150 ohms) for 100 microvolts input to 1st i.f. stage.

I.F. Breakthrough

Better than 70 dB at 1.045 Mc/s.

F.M. Deviation

3.5 kc/s

Frequency Stability (Ranges 1 to 3)

- + 100 c/s per Mc/s during initial 30 minutes from switching on.
- + 200 c/s per Mc/s during 60 minutes.
- 50 c/s per Mc/s per degree C rise in ambient temperature.

At 15.54 Mc/s frequency will not change more than 5 kc/s with
- 10% change in nominal battery voltage.

Accuracy

Calibration is within $\pm 1\%$ of indicated frequency. Resetting
is better than 5 kc/s.

I.F. Output (for carrier shift working)

Up to 5V into 100k ohms on medium strength signal.

Audio Output

Sufficient to load 2 pairs of 'phones on medium signal.

Dimensions and Weight

<u>Width</u>	<u>Depth</u>	<u>Height</u>	<u>Weight</u>
12½in	9in	8½in	21 lb
31.7cm	22.8cm	21.5cm	9.5 kg

CIRCUIT DESCRIPTION

The R.209 Mk II is a high grade superheterodyne receiver using ten valves plus a voltage stabiliser as follows:-

r.f. amplifier	- V1
mixer	- V2
neon stabiliser	- V3
local oscillator	- V4
1st i.f.	- V5
2nd i.f.	- V6
3rd i.f.	- V7
2nd detector (on a.m. and c.w.)	- V8
a.f. output	- V9
a.f. output and a.v.c. delay	- V10
b.f.o.	- V11

Provision is made for low and high impedance aerials by two inputs, at 80 ohms and 1000 ohms respectively. Maximum gain is assessed as the inputs are correctly matched to the r.f. tuned circuits by the use of transformer coupling.

The r.f. amplifier (V1) is a pentode type CV131. The grid circuits are tuned by a section of the 3-gang main tuning condenser. A small variable condenser C19 across the main section is controlled by the knob labelled AE TRIMMER. The latter adjusts the different aerial capacities which may be applied to the set. The a.g.c. is applied via the resistor R60.

The mixer (V2) is a pentagrid type CV782. The grid tuned circuits are tuned by the second section of the 3-gang main tuning condenser C94B. An intermediate frequency of 460 kc/s is developed across the tuned primary of the 1st i.f. transformer, the secondary of which is connected to the grid of the 1st i.f. amplifier (V5).

As an additional precaution against frequency shift with change of current drain and subsequent change in voltage, the screen of the mixer valve is supplied from the neon stabiliser V3.

The local oscillator is a tuned grid reaction oscillator using a pentode (V4), CV785, with screen and anode strapped. The required r.f. voltage for mixing is obtained from the control grid

which is connected directly to the mixer grid. The h.t. to the local oscillator is also stabilised by means of the neon V3 whose working voltage is 68V.

The IF. section consists of three stages employing pentodes V5, V6 and V7, CV785. Each stage is constructed in unit form, housed in an aluminium can mounted on a plug-in base. The three stages are identical, each i.f. transformer consists of two pairs of cup type iron dust cores, each pair enclosing a coil former. The overall bandwidth is 5 kc/s at -6 dB. A.G.C. is applied to the first two stages only. An i.f. output is brought to a concentric plug on the front panel to enable the receiver to be connected to alternative types of detector, e.g. carrier frequency shift.

The detector is a diode pentode (V8), CV784. This stage is built into a plug-in metal unit similar to those used for the i.f. stages.

(a) For r.t. reception the h.t. is removed from the valve which then acts as a simple diode detector, using the control grid and heater. The diode load is the volume control, variable resistor VR1a. A portion of the audio voltage is tapped off by the slider of the volume control and is fed to the grid of the 1st output stage (V9).

(b) On c.w. the valve is used as above, the beat oscillator (V11) output being injected at the control grid. In this case the audio voltage is fed to the grid of the 1st output valve (V9) via a Scott type negative feedback filter.

(c) For f.m. reception the h.t. is applied to the anode of the pentode section of V8, which is used as an amplifier-limiter and the diode section becomes the discriminator diode. Limiting is achieved by reducing the anode voltage, the normal screen being used. The f.m. facility will only operate satisfactorily on strong signals.

The beat oscillator employs a diode pentode (V11) CV784 in a modified Hartley circuit, the whole being housed in a plug-in case, similar to those used for the i.f. units. The oscillator is

tuned over a range of 1.2 kc/s on each side of the i.f. by the b.f.o. control.

The anode is electron coupled to the oscillator portion. The output from the anode is applied to the diode, which rectifies part of the beat oscillator output, to supply bias to the grids of the R.F. and I.F. amplifiers when the set is working on c.w. The anode output is also fed through C88 to the grid circuit of V8.

On a.m. the a.v.c, is obtained from the detector diode load and is applied to the r.f. amplifier (V1) and the first two i.f. amplifiers (V5, V6). On c.w. part of the beat oscillator output is rectified by the diode portion of V11. A portion of this rectified voltage, depending in magnitude upon the setting of the VOLUME control is applied through the slider to the grids of V1, V5 and V6, through the a.v.c. line and to the grid of V7.

The output is obtained from two valves, V9 (pentode) and V10 (diode-pentode) in a self-drive push-pull circuit giving approximately 50 mW, feeding a 10 ohm loudspeaker and sockets for 150 ohm headphones.

A Scott type negative feedback filter is used in the output stage to peak the beat note on c.w. at an audio frequency of 950 c/s.

Crash Limiter

A separate plug-in unit is available on request comprising a fullwave rectifier and an ON/OFF switch. It is connected across the output via a 4-pin plug on the unit, which plugs in to the 4-way PHONES socket of the front panel. In the ON position it reduces sudden interference surges.

Power Supplies

The h.t. unit employs a built-in vibrator pack driven by a 12 volt secondary battery. A selenium type bridge rectifier with extensive filtering and smoothing gives a d.c. output of 22 mA

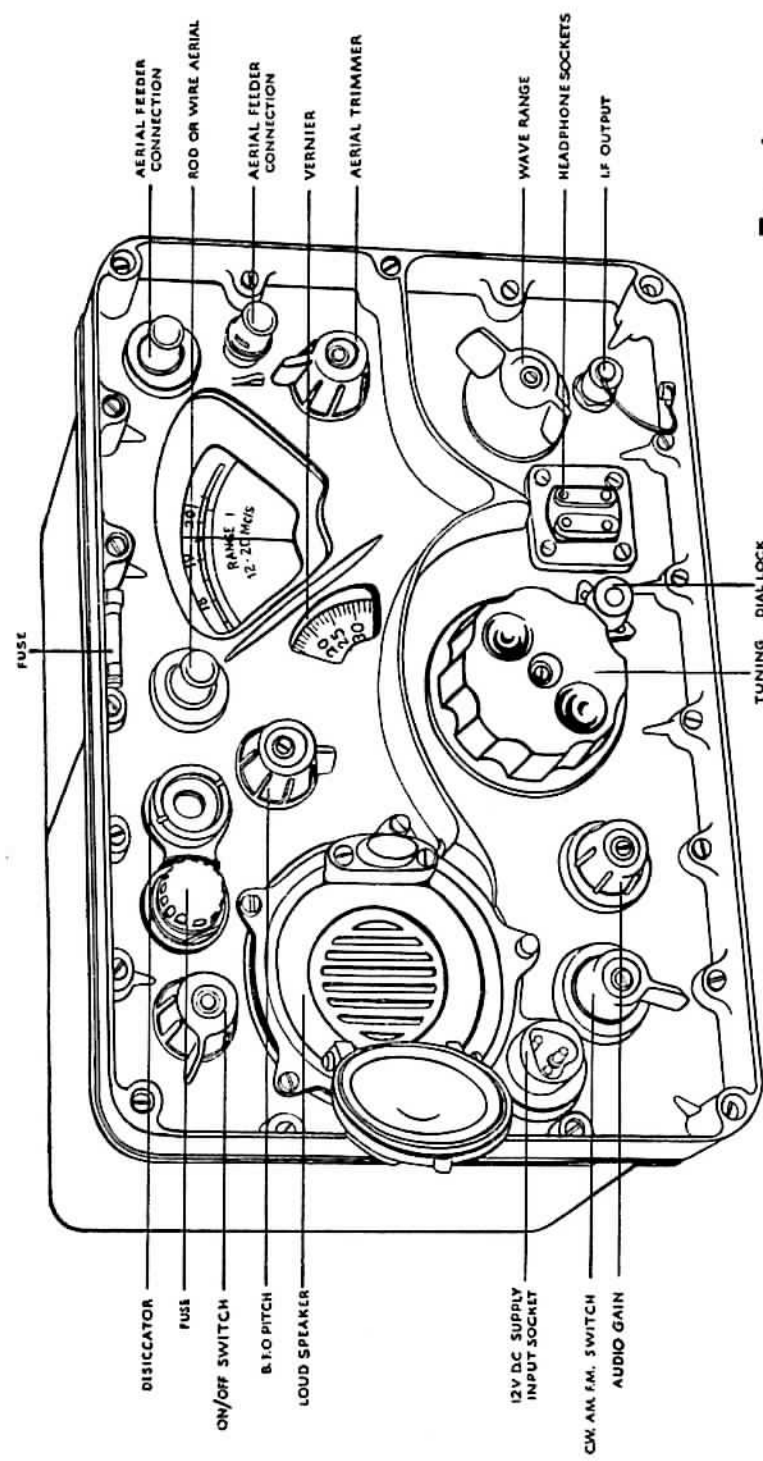


Fig. 1

at 95 volts and 14 mA at 70 volts. Battery consumption is approximately 1.5 amps.

The heater current of 650 mA is taken direct from the 12 volt supply. 200 ohm dropping resistors are used for the directly heated valves on the r.f. chassis (V2 and V4), the indirectly heated valve (V1) uses a 30 ohm resistor. All other valves use 220 ohm dropping resistors. Heater voltage is nominally 1.4 volts except for V1 (CV131) which requires 6.3 volts.

INSTALLATION

Before proceeding to operate the receiver make a general mechanical inspection to see that it appears to be in sound condition and that switches and control knobs work normally.

If installed in a special mounting for use as a man-pack, vehicle or ground station, ensure that the receiver is held securely in its mounting.

Setting Up

- (1) Connect the aerial lead or dipole feeder to the appropriate aerial termination on the set; the connecting lead from a vertical rod or a single horizontal wire aerial should be connected to the terminal marked "AE ROD WIRE" and the feeder from a dipole aerial should be connected to the two terminals marked "AE 80 ohms FEEDER". The lower of the two latter terminals is also used for the EARTH terminal and the earth lead should be connected to it.
- (2) Set the OFF/ON/ON and LIGHT switch (S1) to OFF.
- (3) Close the loudspeaker cover. Headphones should always be used when possible.
- (4) Insert phones plug into the PHONES socket.
- (5) The crash limiter unit, when required, is plugged into the 4-way PHONES socket and the 2 pairs of headphones plugged into the sockets on the crash limiter unit.

- (6) Set the BFO tuning knob into the central position, i.e. with the knob pointer opposite the BFO indicator on front panel.
- (7) Insert the 1.2 volt 3-point socket into the d.c. power input panel plug.

OPERATION

- (1) Set the RANGE switch (S2) to the number covering the required frequency range.
- (2) Set the FM-CW-AM system switch (S3) to the required system of operation.
- (3) Switch ON the power supply at source.
- (4) Set OFF/ON/ON and LIGHT switch to ON (or if illumination of dial is also required, to ON and LIGHT).
- (5) Turn the VOLUME control fully clockwise.
- (6) Rotate the main TUNING knob until the required dial frequency is immediately below the hairline on the window.
- (7a) Search for the required station by turning the TUNING knob slowly in both directions. Screw up the DIAL LOCK (clockwise), taking care that the dial setting is not disturbed. Finally, adjust the AE TRIMMER knob for maximum signal/noise ratio.
- (7b) If a dial resetting log for various stations has been made for the receiver, tune in any required station by turning the TUNING knob until the MAIN and VERNIER calibrated dials give the exact resetting readings of the wanted station. Screw up the DIAL LOCK. Finally, adjust AE TRIMMER knob for maximum signal/noise ratio.
- (8) Turn the VOLUME control knob anti-clockwise until the signal heard in the headphones is at required strength.
- (9) When operating on c.w., after the required station has been located, turn the main TUNING knob until the beat frequency falls to zero "silent point". Screw up the DIAL LOCK. Then adjust BFO control until the beat

frequency note rises to a convenient pitch; the circuit is designed to give a peak output at 950 c/s. Finally, adjust the AE TRIMMER knob for maximum signal/noise ratio.

- (10) If excessive static is experienced during reception, set the CRASH LIMITER switch (S4) to ON.

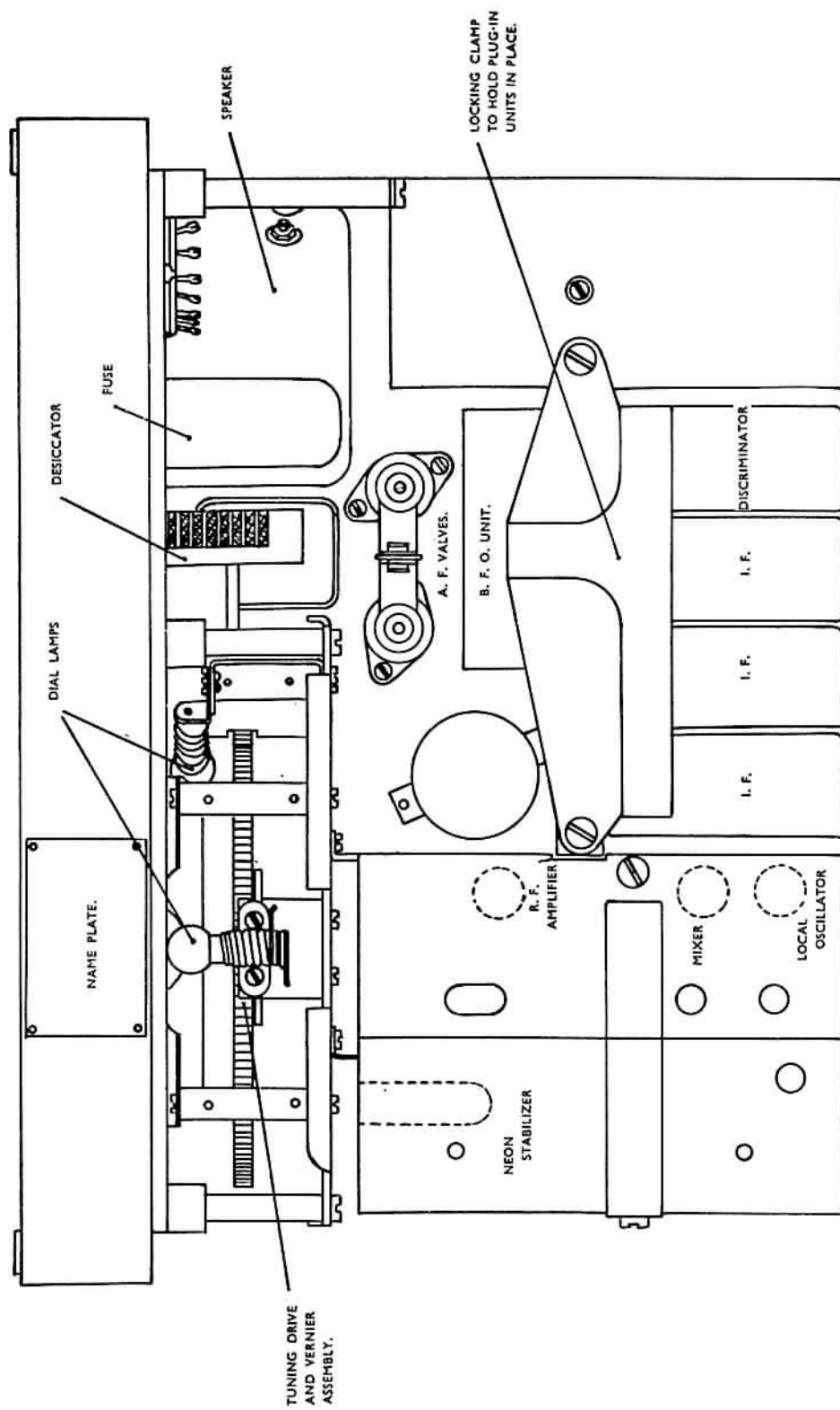
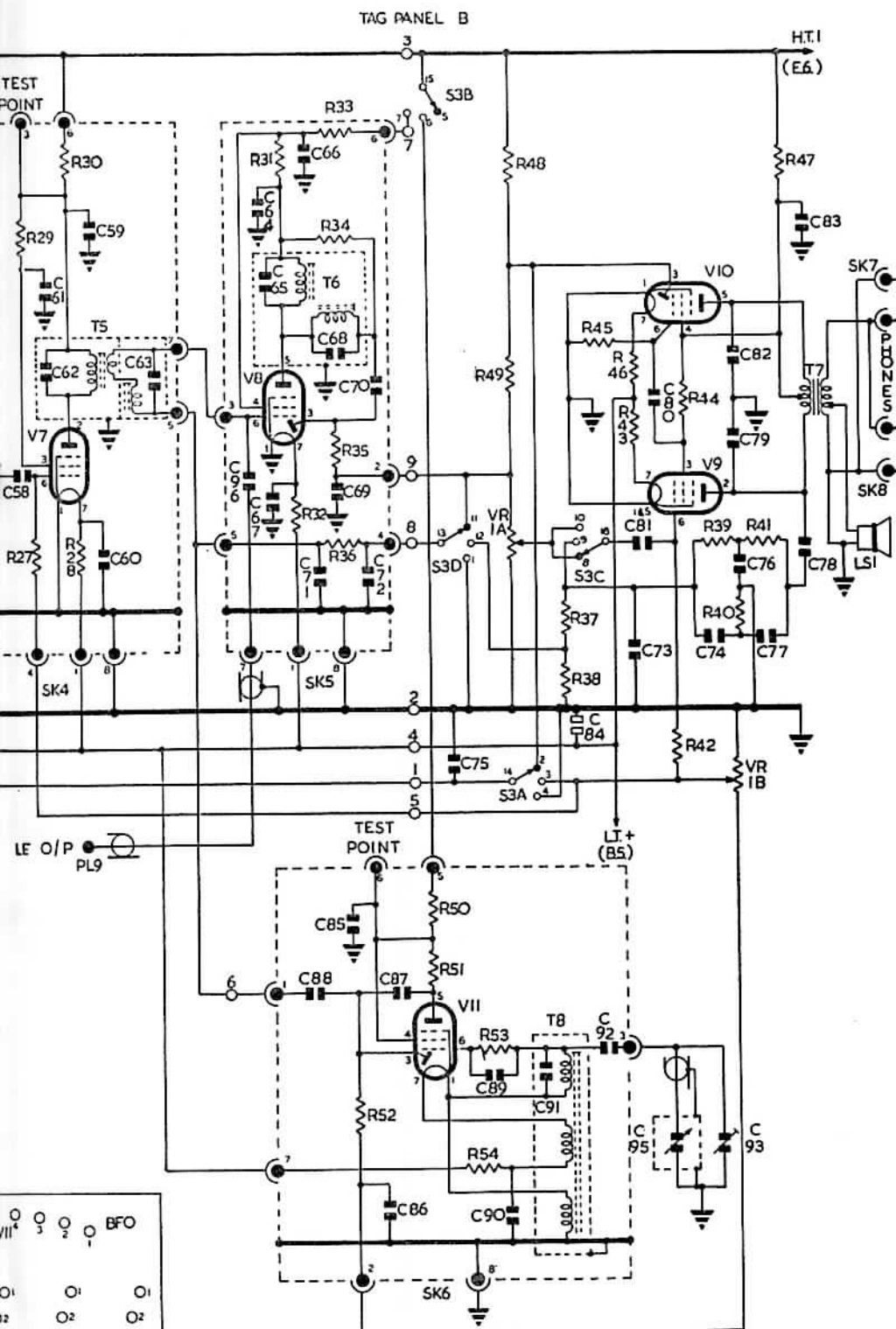


FIG. 2



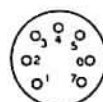
Fig. 3

WAFERS VIEWED FROM KNOB END WITH KNOB
IN COUNTERCLOCKWISE POSITION ie BAND 4



0	0	0	0	BFO
1	1	1	1	
2	2	2	2	
3	3	3	3	
4	4	4	4	
5	5	5	5	
6	6	6	6	
7	7	7	7	
8	8	8	8	
9	9	9	9	
10	10	10	10	

AM
CW
FM



UNDERSIDE VIEW OF PINS
ALL VALVES

- V1 - CV 131
- V2 - CV 782 (1R5)
- V3 - CV 284
- V4,5,6,7,9 - CV 785 (1T4)
- V8,10,11 - CV 784 (1S5)

VIEW OF SK2-6.

II.

PARTS LIST

<u>Circuit Ref</u>	<u>Code No.</u>	<u>Value</u>	<u>Tolerance</u> ⁺ -
<u>RESISTORS</u>			
R1	Z1/ZA30541 MK.79026	1 ohm	20%
R2	Z1/ZA30541 MK.79026	1 ohm	20%
R3	Z.222217 MG.77172	47k ohms	20%
R4	Z.222217 MG.77172	47k ohms	20%
R5	Z.223208 MG.77176	2.2M ohms	20%
R8	GH3105/27 ohms Z243321	27 ohms	5%
R10	Z223208 MG.77176	2.2M ohms	20%
R11	Z243362 ohms GH03165/200 ohms	200 ohms	- 0 + 5%
R12	Z222091 MG.77168	4.7k ohms	10%
R13	GH 62260/2.7k Z222058	2.7k ohms	10%
R15	GH 03165/200 ohms Z243362	200 ohms	- 0 + 5%
R16	Z221133 MG.77166	150 ohms	20%
R17	Z222196 MG.77183	33k ohms	20%

<u>Circuit Ref</u>	<u>Code N°.</u>	<u>Value</u>	<u>Tolerance</u> ⁺ -
R19	Z223208 MG.77176	2.2M ohms	20%
R20	Z243364 GH03165/220 ohms	220 ohms	5%
R21	Z222175 MG.77164	22k ohms	20%
R22	Z222070 MG.77167	3.3k ohms	20%
R23	Z223208 MG.77176	2.2M ohms	20%
R24	Z243364 GH03165/220 ohms	220 ohms	5%
R25	Z222175 MG.77164	22k ohms	20%
R26	Z222070 MG.77167	3.3k ohms	20%
R27	Z223208 MG.77176	2.2M ohms	20%
R28	Z243364 GH03165/220 ohms	220 ohms	5%
R29	Z222175 MG.77164	22k ohms	20%
R30	Z222070 MG.77167	3.3k ohms	20%
R31	Z222175 MG.77164	22k ohms	20%
R32	Z243364 GH03165/220 ohms	220 ohms	5%
R33	Z222133 MG.77169	10k ohms	20%

<u>Circuit Ref</u>	<u>Code N°.</u>	<u>Value</u>	<u>Tolerance</u> ⁺ ₋
R34	Z223145 MG.77185	0.68M ohms	20%
R35	Z223103 MG.77174	0.33M ohms	20%
R36	Z222217 MG.77172	47k ohms	20%
R37	Z223124 MG.77190	0.47M 0.42M ohms	20%
R38	Z223163 MG.77175	1M ohm	10%
R39	Z223205 MG.77192	2.2M ohms	10%
R40	Z223163 MG.77175	1M ohm	10%
R41	Z223205 MG.77192	2.2M ohms	10%
R42	Z223289 MG.77177	10M ohms	10%
R43	Z243364 GH 03165/220 ohms	220 ohms	5%
R44	Z222175 MG.77164	22k ohms	20%
R45	Z222133 MG.77169	10k ohms	20%
R46	GH03165/220 ohms Z243364	220 ohms	5%
R47	Z222007 MG.77191	1k ohm	20%
R48	Z223289 MG.77177	2 x 10M ohms	10%

<u>Circuit Ref</u>	<u>Code N°.</u>	<u>Value</u>	<u>Tolerance</u> ⁺ -
R49	Z223208 MG.77192	2.2M ohms	20%
R50	Z222083 MG.77168	4.7k ohms	10%
R51	Z222196 MG.77183	33k ohms	20%
R52	Z223019 MG.77173	68k ohms	20%
R53	Z222196 MG.77183	33k ohms	20%
R54	GH 03167/220 ohms	220 ohms	5%
R55	GH 03167/18 ohms Z243312	18 ohms	10%
R56	GH 42260/220 ohms Z221151	220 ohms	10%
R57	GH 03165/3,5k ZA42929	3,5k ohms	5%
R58	GH03165/1k Z244200	1k ohm	5%
R59	GH 42270/15k Z222154	15k ohms	20%
R60	Z223208 MG.77192	2.2M ohms	20%

<u>Circuit Ref</u>	<u>Code N°.</u>	<u>Value</u>	<u>Tolerance</u> ⁺ -
<u>Capacitors</u>			
C1	MG.19883	0.01uF	20%
C2	MG.19883	0.01uf	20%
C3	MG.19883	0.01uf	20%
C4	MG.19845	0.1uf	20%
C5	MG.19846	0.5uf	20%
C6	MG.19846	0.5uf	20%
C8	MG.19846	0.5uf	20%
C9	MG.19883	0.01uF	20%
C10	MK.19893	0.01uF	10%
C11	MG.18029	8 uF	
C12	MG.18029	8uF	
C13	MG.19845	1uF	20%
C14	MG.19074	5000pF	20%
C15	MG.19893	0.01uF	10%
C16	MK.19237	400pF	1%
C18	MK.19228	470pF	20%
C19	MG.21046	25pF	
C23	MK.19228	470pF	20%
C24	2821236	3-30pF	
C25	2821236'	3-30pF	

<u>Circuit Ref</u>	<u>Code N°.</u>	<u>Value</u>	<u>Tolerance</u> ⁺ -
C26	2821236	3-30pF	
C27	2281236	3-30pF	
C28	MK.19237	400pF	1%
C29	MK.19228	470pF	20%
C30	MG.19883	0.01uF	20%
C31	MG.19845	0.1uF	20%
C32	MG.19883	0.01uF	20%
C33	MK.19247	470pF	5%
C34	MK.19247	470pF	5%
C35	MG.19845	0.1uF	20%
C36	MK.19228	470pF	20%
C37	GH38050/10pF	10pF-3000 PPM	
C38	2821236	3-30pF	
C39	2821236	3-30pF	
C40	2821236	3-30pF	
C41	2821236	3-30pF	
C42	MK.19245	150pF	5%
C43	2819508	4000pF	2%
C44	MK.19239	750pF	1%
C45	MK.19239	750pF	1%

<u>Circuit Ref</u>	<u>Code No.</u>	<u>Value</u>	<u>Tolerance</u> ⁺ ₋
C46	MK.19227	200 pF	20%
C47	MG.19883	0.01 uF	20%
C48	MG.19845	0.1 uF	20%
C49	MG.19883	0.01 uF	20%
C50	MK.19247	470 pF	5%
C51	MK.19247	470 pF	5%
C52	MK.19227	200 pF	20%
C53	MG.19883	0.01 uF	20%
C54	MG.19845	0.1 uF	20%
C55	MG.19883	0.01uF	20%
C56	MK.19247	470 pF	5%
C57	MK.19247	470 pF	5%
C58	MK.19227	200 pF	20%
C59	MG.19883	0.01 uF	20%
C60	MG.19845	0.1 uF	20%
C61	MG.19883	0.01 uF	20%
C62	MK.19247	470 pF	5%
C63	MK.19247	470 pF	5%
C64	MG.19883	0.01 uF	10%
C65	MK.19244	100 pF	5%
C66	MG.19883	0.01 uF	20%

<u>Circuit Ref</u>	<u>Code N°.</u>	<u>Value</u>	<u>Tolerance</u> ⁺ -
C67	MG.19845	0.1uF	20%
C68	MK.19224	100pF	5%
C69	MG.19223	47pF	20%
C70	MK.19225 Z132289	100pF	20%
C71	MG20524	47pF	10%
C72	MK.19225	100pF	20%
C73	MK.19225	100 ⁴⁷ pF	20%
C74	MK.19242	68pF	5%
C75	MG.19845	0.1uF	20%
C76	MK.19245	150pF	5%
C77	MK.19242	68pF	5%
C78	MG.19883	0.01uF	20%
C79	MG.19075	2000pF	20%
C80	MG.19845	0.1uF	20%
C81	MK.19228	470pF	20%
C82	MG.19075	2000pF	20%
C83	MG.19845	0.1uF	20%
C84	GH35013/500uF	500uF	
C85	MG.19883	0.01uF	20%
C86	MG.19074	5000pF	20%

<u>Circuit Ref</u>	<u>Code №.</u>	<u>Value</u>	<u>Tolerance</u> ⁺ -
C87	MK.19228	470pF	20%
C88	MK.19212	15pF	10%
C89	MK.19228	470pF	20%
C90	MG.19845	0.1uF	20%
C91	MG.19247	470pF	5%
C92	MK.19203	68pF	10%
C93	2821236	3-30pF	
C94A) C94B) C94C)	MG.21045	3 x 300pF	
C95	MG.21046	25pF	
C96	MK.19200	10pF	10%
C100	GH.38108/2uF	2uF	25%
C101	GH.38108/2uF	2uF	25%
C103	MG.19845	0.1uF	20%
C105	MK.19200	10pF	10%
C106	MG.19845	0.1uF	20%
C107	MK.19200	10pF	10%
C108	MK.19200	10pF	10%
C109	GH.41650/150pF	150pF	5%
C110	MG.20528	10pF	20%
C111	GH.38050/10pF	10pF	- 3000ppm
C112	MK.19200 ZB2252	10pF	10%
C113	MK.19239	750pF	1%
C114	GH.56053/100pF ZB2300	100pF	10%

<u>Circuit Ref</u>	<u>Code N°.</u>	<u>Description</u>
<u>VALVES</u>		
V1	CV.131	Valve
V2	CV.782	Valve
V3	CV.284	Valve (Neon)
V4	CV.785	Valve
V5	CV.785	Valve
V6	CV.785	Valve
V7	CV.785	Valve
V8	CV.784	Valve
V9	CV.785	Valve
V10	CV.784	Valve
V11	CV.784	Valve
<u>MISCELLANEOUS</u>		
LP1	MG.922.20	Pilot Lamp
LP2	MG.922.20	Pilot Lamp
VB1	GW.000.28	Vibrator Type NS.12
W1	GW.001.21	Metal Rectifier
F1	GW.001.22	Fuse L.693
LS1	MK.860.41	Loudspeaker E9899
T1	GW.000.86	Vibrator Trans
T2	MG.510.52	1st. I.F. Trans
T3	MG.510.52	2nd " " "
T4	MG.510.52	3rd " " "
T5	MG.510.52	4th " " "
T6	MG.510.51	Discriminator Trans
T7	MG.510.50	Output Transformer
T8	MG.510.53	B.F.O. Tranformer

<u>Circuit Ref</u>	<u>Code N°.</u>	<u>Description</u>
L1	MG.550.46	H.F. Choke
L2	MG.550.46	H.F. Choke
L3	MG.550.46	H.F. Choke
L4	GW.000.84	L.T. Smoothing Choke
L5	GW.000.85	H.T. Smoothing Choke
L6)	MG.560.98	Coil Bank Assy (Aerial)
L7)		
L8)		
L9)		
L10	MG.550.47	H.F. Choke
L11)	GW.000.75	Coil Bank Assy (R.F.)
L12)		
L13)		
L14)		
L15	MG.550.47	H.F. Choke
L16)	GW.000.76	Coil Bank Assy (Osc)
L17)		
L18)		
L19)		
L20	GW.000.83	H.T. Smoothing Choke
VR1A	MG.803.29	Carb Pot 1mm Lin Law
VR1B		1 M ohm Log Law Ganged