624 WL

OPERATING INSTRUCTIONS

SUITCASE SET. TYPE 3. MK.I.

Set Serial No. 16069

Equipment:-

Suitcase containing:-

a) Transmitter.
b) Receiver.
c) AC. power pack set, adjustable between 100-145v., 200-245v., 40-60 cycles per sec. Spare 6L6G transmitting valve underneath.
d) Battery power pack, 6v. type with spare vibrator.
e) Assembly frame.
f) Canvas cover.
g) Instruction Manual.
h) Spares box containing:
(i) 60 ft. aerial wire. (ii) 10 ft. earth wire. (iii) 1 transmitting key. (iv) pair of phones. (v) 9 fuses (2 types) (vi) 8 bulbs (2 types) (vii) 1 - EF39 receiving valve. (viii) 1 EBC33 receiving valve. (ix) 1 ECH35 receiving valve. (x) 1 5Z4 rectifying valve. (xi) 1 screwdriver. (xii) 2 brass pins to convert mains plug to Continental fittings. (xiii) 6 Tank Coils:

L1	4.4	-	3.5	Mc/second.
L2	5.8	-	4.4	"
L3	7	-	5.8	"
L4	10	-	7	"
L5	14	-	10	"
L6	17	-	14	"

(xiv) 4 Crystals:

1.
2.
3.
4.

Total Weight - 42 lbs.

ZHWO

2M/12 2Ney

SPECIFICATIONS.

1. Power Pack AC.

size: $13\frac{1}{4}$ x $2\frac{7}{8}$ x $5\frac{3}{16}$ inches. Weight: 6 lbs.

supply: AC only, 100-145 v., 200-245 v; 40-60 c/s.

consumption: (a) Transmit 55 watts.(b) Receive 25 watts.

A spare 6L6G transmitting valve is fixed underneath.

2. Power Pack Battery Operated.

size: $13\frac{1}{4}$ x $2\frac{7}{8}$ x $5\frac{3}{16}$ inches. Weight: 8 lbs.

supply: 6 volt accumulator, automobile type of largest available ampere hour capacity; maximum drain 10 amps.

consumption: (a) Transmit 8 amperes.(b) Receive 4 amperes.

3. Transmitter.

size: $13\frac{1}{4}$ x 6 x $4\frac{7}{8}$ inches. Weight: 8 lbs.

supply: From either power pack: 400 v, 60 mA; 6.3 v, 1.8 amperes.

circuit: Single valve power oscillator, crystal controlled. Provision for frequency doubling. Plug in tank coils to cover 3.5 to 16 Mc/sec. Aerial ammeter. Send/Receive switch. Plug in transmitter key.

power output: OnAC mains: (a) the average fundamental power is 18 watts and is not less than 14 watts on any frequency.

(b) the harmonic power is 12-14 watts according to the frequency.

On batteries: (a) average fundamental power is 14 watts and not less than 12 watts on any frequency.

(b) the harmonic power is 9-12 watts according to frequency.

4. Receiver.

size:	$13\frac{1}{4}$ x 5 x $5^{3}/16$ inches. Weight: 7 lbs.
supply:	From either power pack, via transmitter connections, 250 v, 30 mA, 6.3 v, 0.9 ampere.
circuit:	4 valve seven stage reflexed superheterodyne receiver essentially designed for CW reception. 3 wave band switch selector 3.8-15.8 Mc/sec. total coverage; 50-1 slow motion vernier dial. B.F.O. switch, volume control and phone jack.
valves:	Frequency changer: Mullard ECH35 Triode hexode. IF/LF amplifier Mullard EF39 Vari-Mu Pentode. 2nd detector and B.F.O. Mullard EBC33 Double diode triode. LF amplifier. Mullard EF39 Vari-Mu Pentode.
intermediate frequency:	470 Kc/Sec. B.F.O.(fixed beat): 471 Kc/Sec.
sensitivity :	Average value 1 microvolt, for intelligible CW. signal.
selectivity:	Bandwidth 1 Kc/sec. at 0.707 peak. 6 Kc/sec at 0.1 peak.
max. output:	25 milliwatts into 4000 ohm telephones.

OPERATING INSTRUCTIONS.

Before setting up to establish communication, obtain a power supply, AC mains or battery, and an aerial and earth system.

Aerials. 60 ft. of aerial wire is provided, which, in order to obtain maximum efficiency, should be suspended as high as possible and not too close to earthed objects. Connect one end to the Red Aerial terminal on the transmitter.

Earth. A good electrical connection must be made to an existing earth tube, a main water pipe or central heating system. If these are not available, a wire of the same length as the aerial should be suspended underneath it, preferably two or three feet above the ground. The counterpoise earth should be connected to the Black Earth terminal on the transmitter.

AC Power Pack.
Ascertain whether the mains are AC or DC. This apparatus must be used on AC mains only. Ascertain the voltage by reference to electrical apparatus in use, the electric light meter or the markings on electric light bulbs. Do not connect up the power supply until ready to operate.

OPERATING INSTRUCTIONS. (cont).

To adjust the Power Pack to suit a known Voltage. The selection is made by inserting the bakelite headed screws in the appropriate holes in the power pack. Two of the screws should be either both in the 100v holes or both in the 200v; the other two screws must be one in each row, and the sum of the two added to 100v (or to 200v, according to the position of the first two scows) gives the voltage setting.

In Fig.1A. the voltage is set for 135v, and in 1B. for 205v:

FIG.1.A.

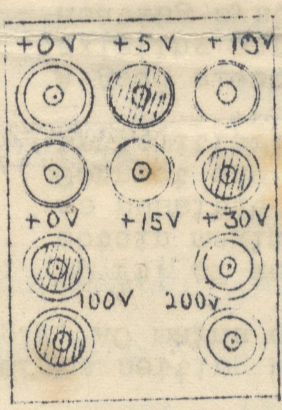
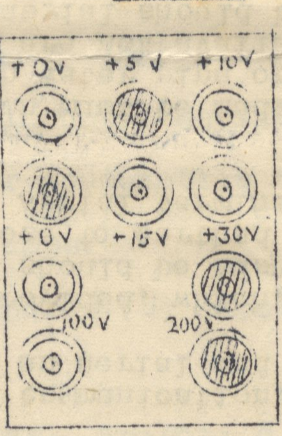


FIG.1.B.



If mains are not available or are unsuitable, a 6v. accumulator must be procured. It is essential for satisfactory working that, in view of the heavy drain on the battery - up to 8 amperes when transmitting, and 4 amperes when receiving - this should be of the automobile type, fully charged and in good condition. Two such batteries may, with advantage, be used in parallel. Batteries should not be left connected longer than is necessary and it is especially important that the transmitting key should not remain depressed for long periods.

The power to the transmitter and receiver is fed from the power pack through a five pin socket on the power pack and a five pin plug and a cable connected to the transmitter.

Battery Power Pack.

For battery operation a large capacity 6 volt accumulator is required. This must be connected to the set through the battery power pack. To change from mains to battery operation proceed as follows:

a) Switch off the A.C. power supply.
b) Remove the 5-pin plug from the A.C. power pack and insert it in the 5-pin socket on the battery pack.
c) Connect the spring battery clips to the accumulator terminals - Red clip to the positive (+) and Black to the negative (-)terminal.
d) The indicator lamp will light if all is correct, and a faint hum will be heard from the pack.

<u>NOTE</u>: If a rapid changeover from mains to battery operation is required, the battery leads should be removed from the spares box before beginning to operate the set, and <u>one</u> battery clip should be kept connected to the proper accumulator terminal. It should then be possible to effect the changeover so quickly that if the AC mains fail, transmission can be continued by use of the battery with only a few seconds interruption.

<u>CAUTION</u>: If the apparatus is to be used with the battery still connected up to the electrical system of a car, ascertain that it is the Negative Terminal that is earthed to the car chassis. This is usual. In certain cases, e.g. Ford cars, it is, however, the Positive Terminal which is earthed, in which case the car connections must be removed before fitting the red and black battery leads.

It is absolutely essential that the voltage of the accumulator used should not exceed 6.3 volts, since otherwise the set will be rapidly burnt out. Great care must therefore be taken if the accumulator is being charged while connected to the set.

The vibrator in use is the one adjacent to the large transformer - see photograph. If the spare vibrator is required, it must be withdrawn from its clip and inserted in place of the original, with the red spot on the vibrator next to the red spot on the chassis.

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Assuming that aerial, earth and AC mains are available, open the suitcase, unbutton and roll back the waterproof cover and take out:-

a) <u>Mains lead</u>. Fit a plug to suit the sockets in the room. Do not switch on.
b) <u>Aerial and Earth leads</u>. Connect these to the transmitter. Erect the aerial and connect the earth as previously advised.
c) <u>Key and Telephones</u>. Plug into the transmitter and the receiver. The key may be fastened to the battery power pack if desired.

<u>RECEIVER</u>.

a) Turn the Send/Receive switch to "receive" and switch on the mains supply. The red indicator lamp on the AC power pack will light, and after a few seconds a faint hum will be heard in the telephones.
b) Set the wave band switch to the desired band.
c) If CW is to be received, set the B.F.O. switch to the "on" position.
d) Consult the chart or graph relating to frequency and dial settings and move the tuning control over the setting indicated for the frequency desired, and advance the volume control towards maximum until a comfortable volume is reached.

TRANSMITTER.

a) Consult the table below and select the crystal and tank coil to operate on the frequency desired. Plug them in.

CRYSTAL	FUNDAMENTAL		HARMONIC	
	COIL	SWITCH	COIL	SWITCH
3.5 - 4.4 Mc/s	L1	1	L4	2
4.4 - 5.8 Mc/s	L2	3	L4 or 5	4
5.8 - 8 Mc/s	L3 or 4	5	L5 or 6	6

b) Set the crystal switch to the position corresponding to the crystal chosen - see the table.

The aerial meter is provided with a shorting link, seen near the aerial/earth terminals and marked "meter". With the link in position, the meter is practically short-circuited from the aerial. OPEN the link to introduce the aerial meter into the circuit.

c) Turn the right-hand (anode) tuning knob to 10 and the left-hand (aerial) tuning knob to 0.

d) Turn the Send/Receive switch to "send" and depress the key while tuning.

e) When working on a harmonic - twice crystal frequency - the crystal bulb will light, but on the fundamental - the crystal frequency - the bulb will not light until the tuning knobs are correctly adjusted.

f) The matching of the aerial is accomplished by turning the right-hand tuning knob clockwise and the left-hand tuning knob counter-clockwise until the maximum aerial current is obtained in the aerial current meter. This optimum setting only occurs for one definite position of each knob (depending upon the aerial and the frequency used), and unless the operation is carefully carried out the two knobs may never be simultaneously in their correct positions. It is, therefore, advisable to carry out the tuning slowly and systematically in the following way until the mode of operation has been thoroughly mastered.

The left-hand control can be considered as a continously variable tapping switch. For simplicity regard it as a switch with ten positions 0, 1, 2 ---, 10. Set it at 0, and rotate the right-hand knob slowly clockwise until the crystal bulb lights and a small indication appears in the aerial current meter. (When the transmitter is operating on a harmonic of the crystal frequency, the crystal bulb will be alight all the time.) Continue to turn the right-hand knob until maximum current is indicated in the aerial current meter. Note the reading.

f) Next turn the left-hand knob to position 1. The aerial current may either increase or decrease. Then turn the right-hand knob (clockwise or counter-clockwise) until maximum current is obtained. Note the reading. Continue the process with the left-hand knob turned to positions 2, 3, 4, etc. and note the maximum meter readings in each case. The correct setting is the one for which the meter reading is greatest.

The optimum setting will not in general occur with the left-hand knob at one of the marked points, but at some intermediate position. When once the above procedure has been carried out a further small adjustment of each knob can be made.

g) It is important to understand that:-
   i. a movement of either knob affects the adjustment of the other.
   ii. maximum power as indicated by meter readings is only obtained at one correct setting.

h) Do not keep the key depressed longer than is necessary.

i) The crystal current as indicated by bulb brightness should not be allowed to become unduly high. The controls can be so adjusted that this should be possible without reducing the power output (as shown by the aerial current) by more than a small amount. The "excitation control" is normally used for this purpose, but, if the bulb brightness cannot be sufficiently reduced by varying the excitation control, another method is to detune the anode slightly. This detuning should not be resorted to unless it is absolutely necessary, since it may produce bad keying and reduce the keying speed.

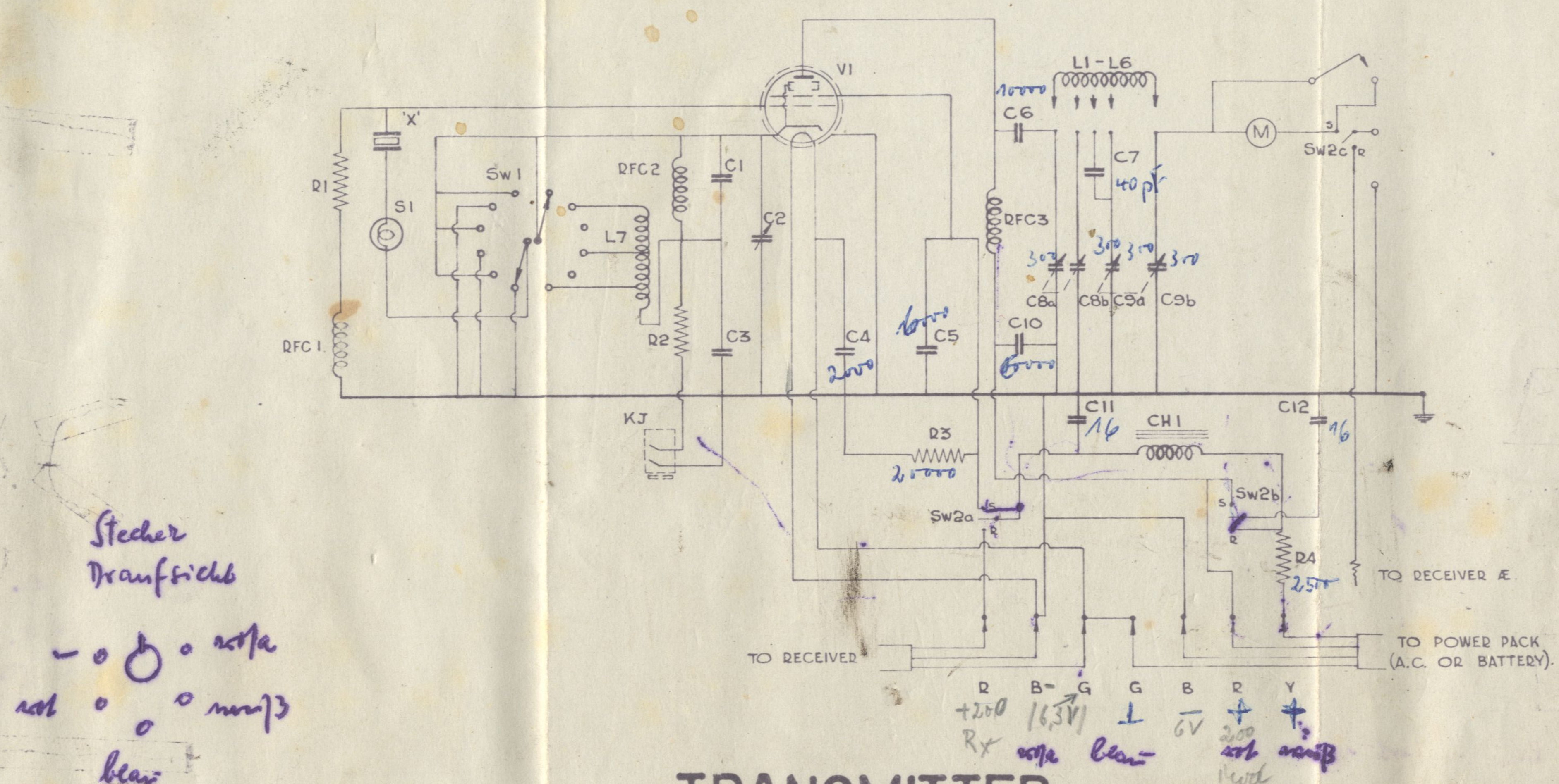
IF FOR ANY PURPOSE WHATEVER, IT IS NECESSARY TO DETUNE THE ANODE, THE ANODE KNOB SHOULD BE MOVED TO A HIGHER SETTING AND IN NO CIRCUMSTANCE TO A LOWER SETTING. THE AMOUNT OF DETUNING SHOULD IN ANY CASE BE VERY SLIGHT.

The "excitation control" is a fine adjustment of the crystal setting and should be set initially at minimum. Before proceeding to tune up the transmitter, turn the excitation control as far towards the maximum as is possible without the crystal bulb becoming unduly bright.

The excitation control is not critical unless the frequency of the crystal or its second harmonic occurs near the limiting frequencies of the tank coils. When the frequency to be tuned lies near the limiting frequencies, the excitation control should be varied during the tuning up process so as to obtain maximum aerial current. In this case a very large variation in aerial current can be caused by a small variation in the excitation control. In most other cases the main function of the excitation control is to prevent the crystal current from becoming excessive.

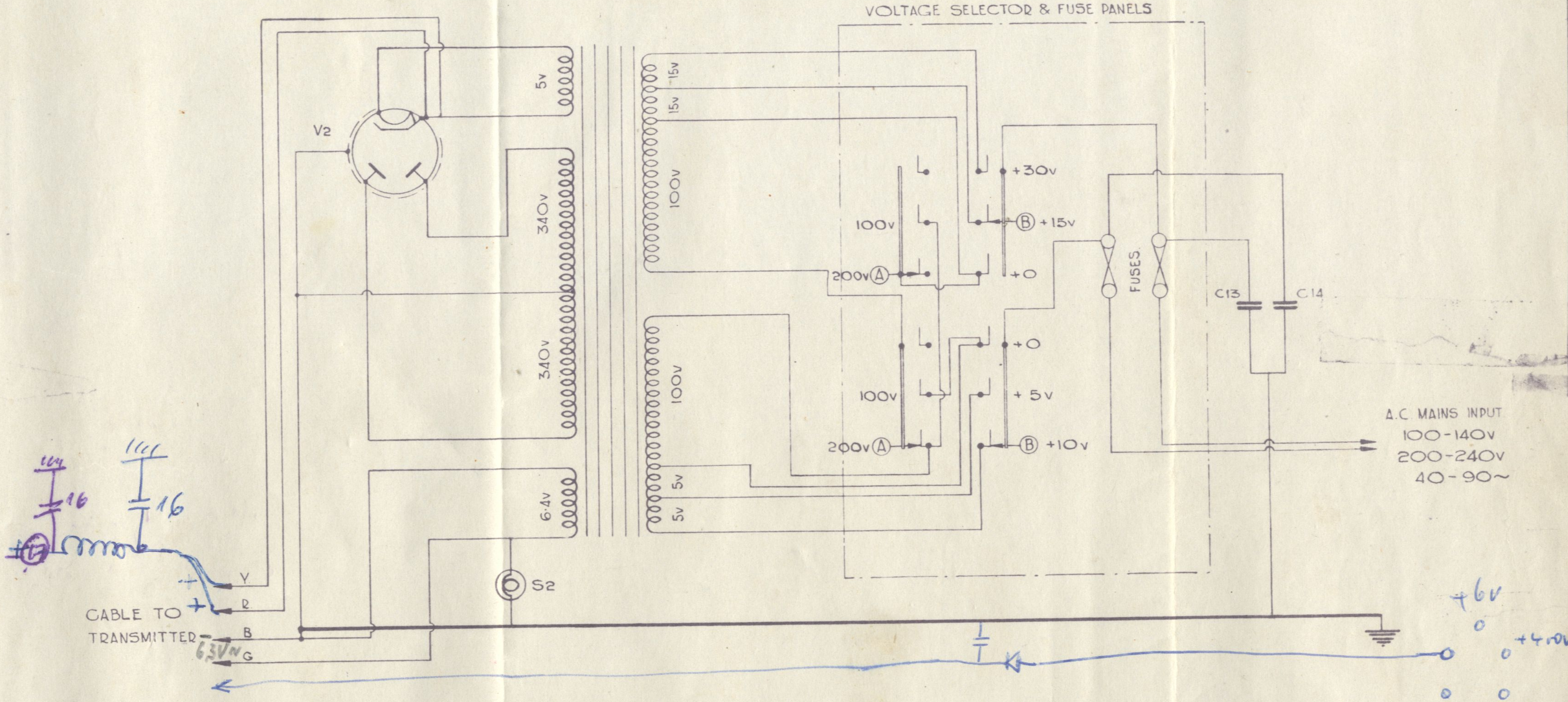
j) When transmitting, and maximum power is required, the aerial current meter should be short-circuited by closing the "Meter" link.

k) If under any particular circumstances a maximum reading is obtained with either control at 10 (or 0) then a coil of a lower (or higher) number must be chosen.



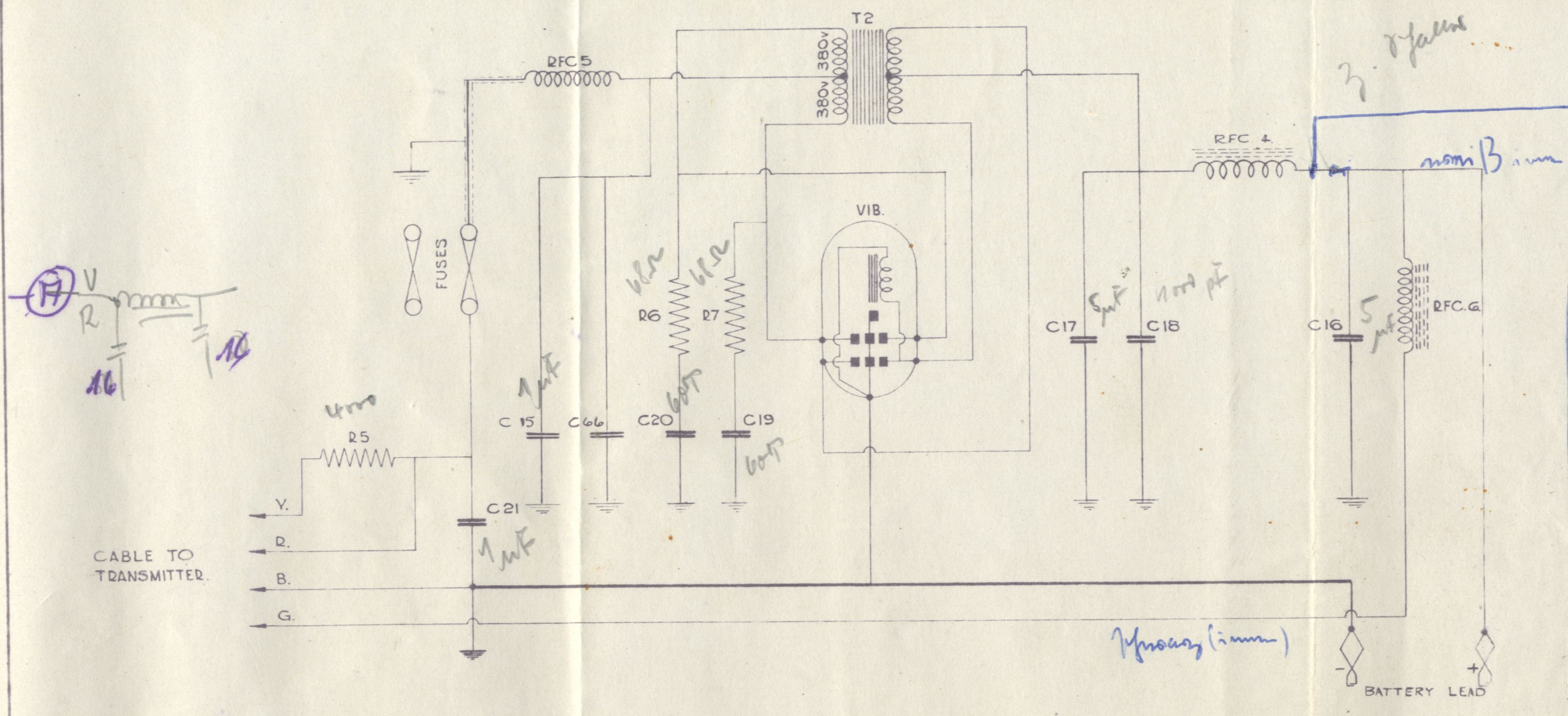
TRANSMITTER

C1	CONDENSER 50pf. CERAMIC CUP.	C8b	CONDENSER 300pf. TWIN GANG (·017" GAP).	R1	RESISTOR 30,000Ω ½w. INSULATED.	'X'	QUARTZ CRYSTAL.
C2	" 100pf. TRIMMER.	C9a	" 300pf. TWIN GANG (·017" GAP).	R2	" 200Ω 2w. UNINSULATED.	V1	VALVE 6L6G.
C3	" ·002uf. MICA 1000v TEST.	C9b	" 300pf TWIN GANG (·017" GAP).	R3	" 20,000Ω 6w. VIT. ENAM.	Sw1	SWITCH, 2POLE 6WAY.
C4	" ·002uf. MICA 1000v TEST.	C10	" ·006uf. MICA. 2200v TEST.	R4	" 2,500Ω 6w. " "	Sw2	" 3POLE 2WAY.
C5	" ·006uf. MICA 1500v TEST.	C11	" 16uf. 450v. WKG. SURGE-PROOF.	CH1	CHOKE 2·5H. MIN. @ 60MA. A.C.	M	METER. 0-350MA. (HOT-WIRE).
C6	" ·006uf. MICA 2200v TEST.	C12	" 16uf. 450v. WKG. SURGE-PROOF.	RFC1	R.F. CHOKE. EDDYSTONE 1010.	KJ	KEY JACK.
C7	" 40pf. CERAMIC DISC.	L1-L6	TANK COILS, PLUG-IN TYPE.	RFC2	" EDDYSTONE 1010.	S1	BULB 4-6v ·06A.
C8a	" 300pf. TWIN GANG (·017" GAP).	L7	CATHODE COIL.	RFC3	" EDDYSTONE 1010.		



A.C. MAINS POWER PACK.

V_2	VALVE. TUNGSRAM A.U.13.
S_2	BULB. 6v. ·1A
FUSES	2 AMPERES.
C13	CONDENSER ·006µf 600v.AC
C14	CONDENSER ·006µf 600v.AC



BATTERY POWER PACK.

						FUSE	250 m.A.
VIB.	6 VOLT, VIBRATOR. (SELF RECTIFYING).	C15	CONDENSER ·1uf. PAPER TUBULAR	C19	CONDENSER ·006uf. 600v. A.C.Wkg.	T2.	H.T. TRANSFORMER.
R5	RESISTOR, 4000Ω 6w. VITREOUS ENAM.	C16	" ·5uf. 50v. D.C.Wkg.	C20	" ·006uf. 600v. A.C.Wkg.	RFC.G	L.T. FILTER CHOKE.
R6	" 68Ω ¼w. INSULATED.	C17	" ·5uf. 50v. D.C.Wkg.	C21	" ·1uf. PAPER TUBULAR	RFC 4	L.T. FILTER CHOKE.
R7	" 68Ω ¼w. INSULATED.	C18	" 1000pf. SILVERED MICA.	C66	" ·002uf. MICA. 2200 D.C.Wkg.	RFC 5	CHOKE, MASTERADIO C12.

RECEIVER COMPONENTS LIST

CONDENSERS

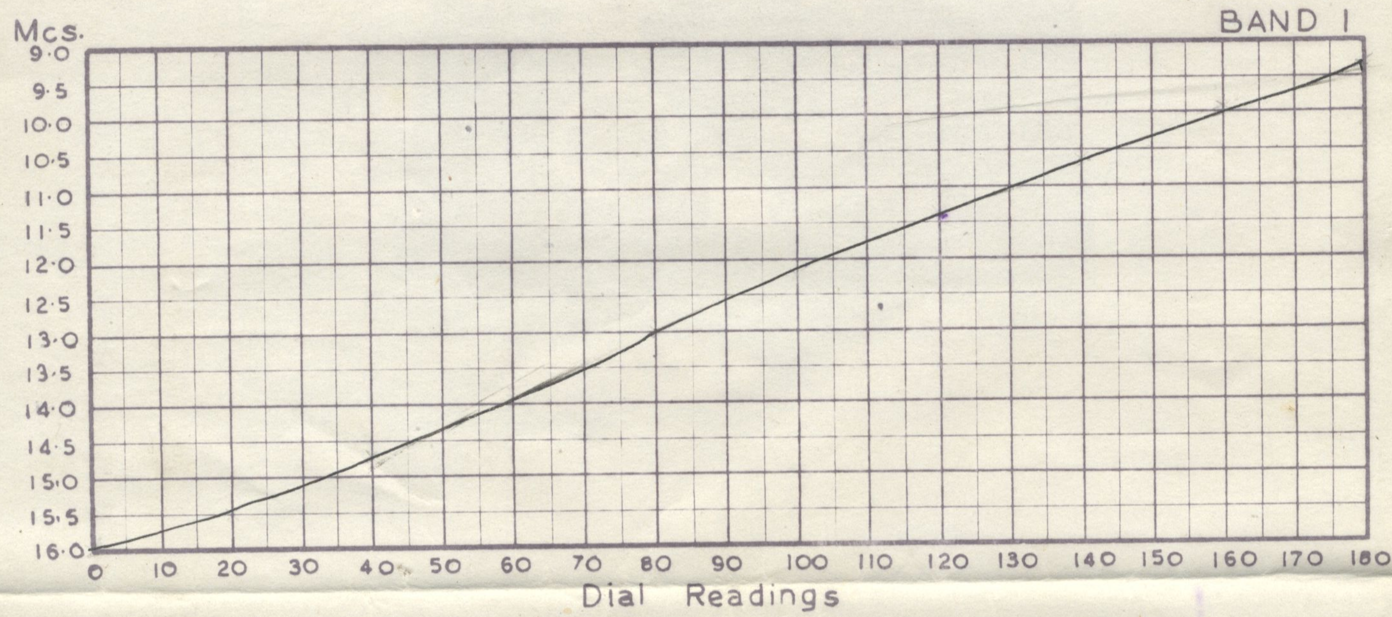
C22, C23	80µµF. 2 GANG.
C24, C25, C26	3/30µµF. TRIMMER.
C27	100µµF. TUBULAR CERAMIC.
C28	·065µF. TUBULAR PAPER.
C29	100µµF. TUBULAR CERAMIC.
C30	·065µF. TUBULAR PAPER.
C31	250µµF. MICA. WIRE ENDS.
C32	·065µF. TUBULAR PAPER.
C33, C34, C35	4/21µµF. TRIMMER.
C36	1900µµF. SILVERED MICA.
C37	1505µµF. SILVERED MICA.
C38	950µµF. SILVERED MICA.
C39	250µµF. MICA. WIRE ENDS.
C40	·1µF. TUBULAR PAPER.
C41	·065µF. TUBULAR PAPER.
C42, C43	15/45µµF. TWIN TRIMMER.
C44, C45	15/45µµF. TWIN TRIMMER.
C46, C47, C48, C49	150µµF. SILVERED MICA.
C51	100µµF. TUBULAR CERAMIC.
C52	·0065µF. TUBULAR PAPER.
C53	250µµF. MICA. WIRE ENDS.
C54	2µµF. DISC CERAMIC.
C55	100µµF. TUBULAR CERAMIC.
C56	250µµF. MICA. WIRE ENDS.
C57	150µµF. SILVERED MICA.
C58	15/45µµF. TRIMMER.
C59	·001µF. MICA. WIRE ENDS.
C60	·001µF. MICA. WIRE ENDS.
C61	100µµF. TUBULAR CERAMIC.
C62	·065µF. TUBULAR PAPER.
C63	·0065µF. TUBULAR PAPER.
C64	·065µF. TUBULAR PAPER.
C65	1µF. TUBULAR ELECTROLYTIC.

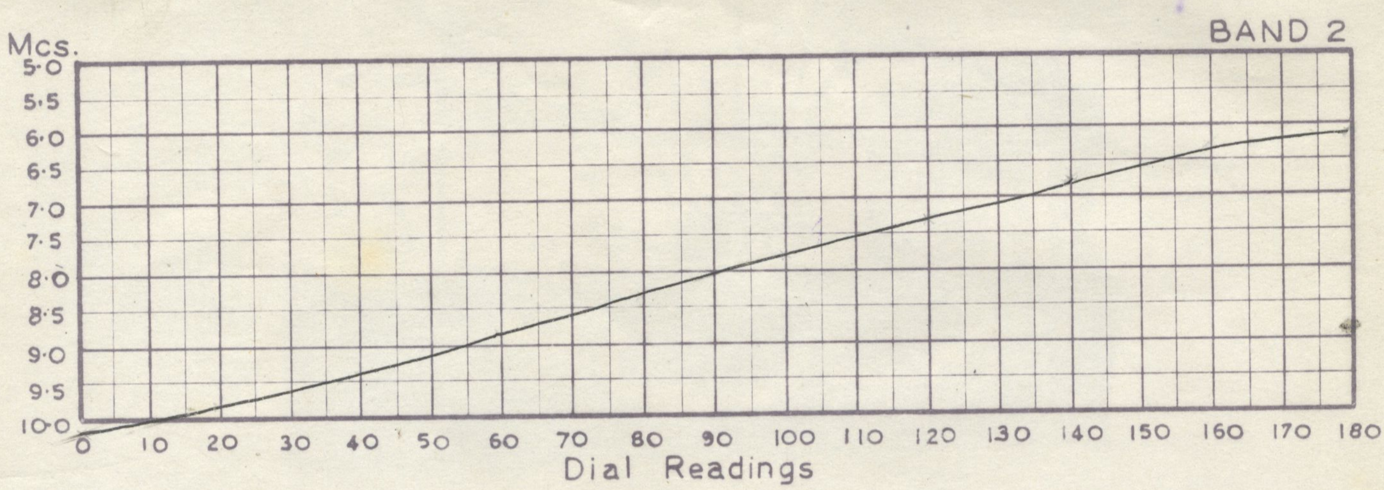
RESISTORS ETC.

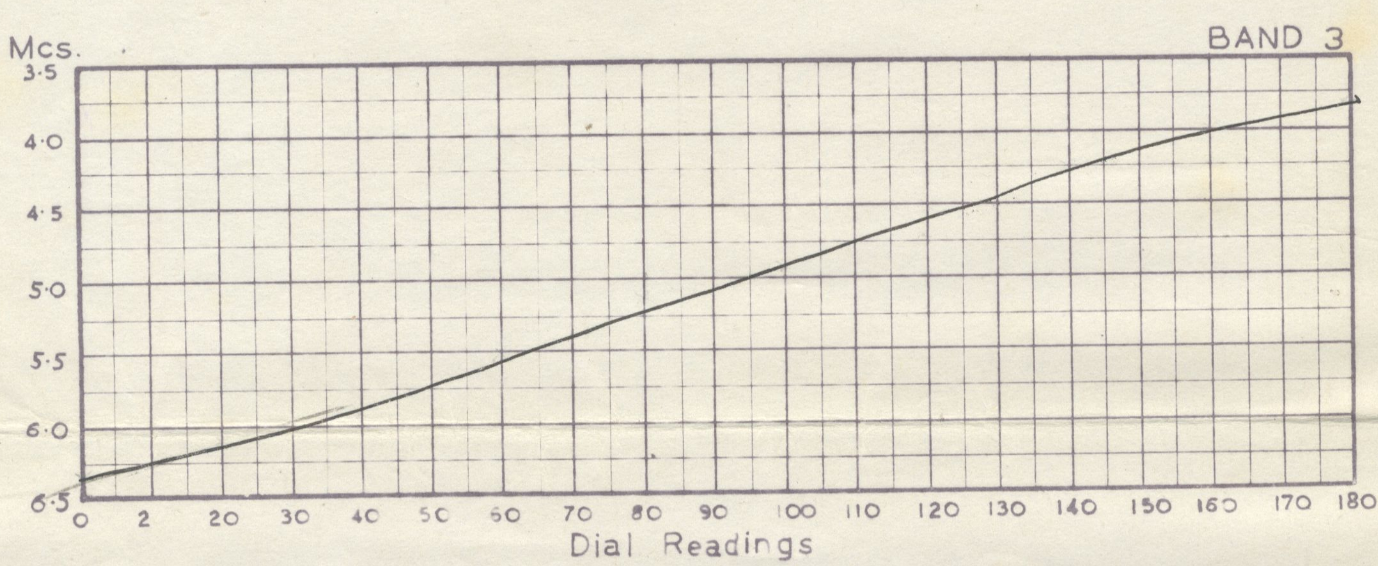
R9	1M.Ω ¼W. INSUL.
R10	200Ω ¼W. INSUL.
R11	47,000Ω ¼W. INSUL.
R12	50,000Ω ½W. INSUL.
R13	45,000Ω. 1W. UNINSUL.
R14	5000Ω ½W. INSUL.
R15	45,000Ω 1W. UNINSUL.
R16	15,000Ω 1W. UNINSUL.
R17	100,000Ω ¼W. INSUL.
R18	2M.Ω ¼W. INSUL.
R19	100,000Ω ¼W. INSUL.
R20	1M.Ω ¼W. INSUL.
R22	250,000Ω ¼W. INSUL.
R23	100,000Ω 1/10W. UNINSUL.
R24	100,000Ω ¼W. INSUL.
R25	10M.Ω ¼W. INSUL.
R26	45,000Ω 1W. UNINSUL.
R27	200,000Ω ½W. INSUL.
R28	5000Ω ½W. INSUL.
R29	270Ω ¼W. INSUL.
R30	50,000Ω ½W. INSUL
VR.1.	5000Ω WIRE-WOUND POT.
SW3	4 POLE-3 WAY SWITCH.
SW4	D.P.D.T. TOGGLE SWITCH.
V.3	ECH. 35
V.4	EF. 39
V.5	EBC. 33
V.6	EF. 39

COILS

L.8	GRID:- 32½ TURNS. NO. 30 S.W.G. D.S.C. AERIAL:- 8½ TURNS. NO. 36 S.W.G. D.S.C.
L.9	GRID:- 20½ TURNS. NO. 28 S.W.G. ENAMELLED. AERIAL:- 6½ TURNS. NO. 36 S.W.G. D.S.C.
L.10	GRID:- 13½ TURNS. No. 24 S.W.G. ENAMELLED. AERIAL:- 4½ TURNS. NO. 34 S.W.G. D.S.C.
L.11.	GRID:- 34¼ TURNS. NO. 34 S.W.G D.S.C. ANODE:- 9¾ TURNS. NO. 34 S.W.G. D.S.C.
L.12	GRID:- 21½ TURNS. NO. 28 S.W.G. ENAMELLED. ANODE:- 11¾ TURNS. NO. 34 S.W.G. D.S.C.
L.13	GRID:- 14½ TURNS. NO. 24 S.W.G. ENAMELLED. ANODE:- 5¼ TURNS. NO 32 S.W.G. D.S.C.
L.14	114 TURNS. 7/45 LITZ. S.S.C.
L.15	" " " " "
L.16	" " " " "
L.17	" " " " "
L.18	GRID:- 107 TURNS. 7/45 LITZ. S.S.C. ANODE:- 20 TURNS. 36 SWG. D.S.C.







CALIBRATION CURVES

SERIAL Nº 16069

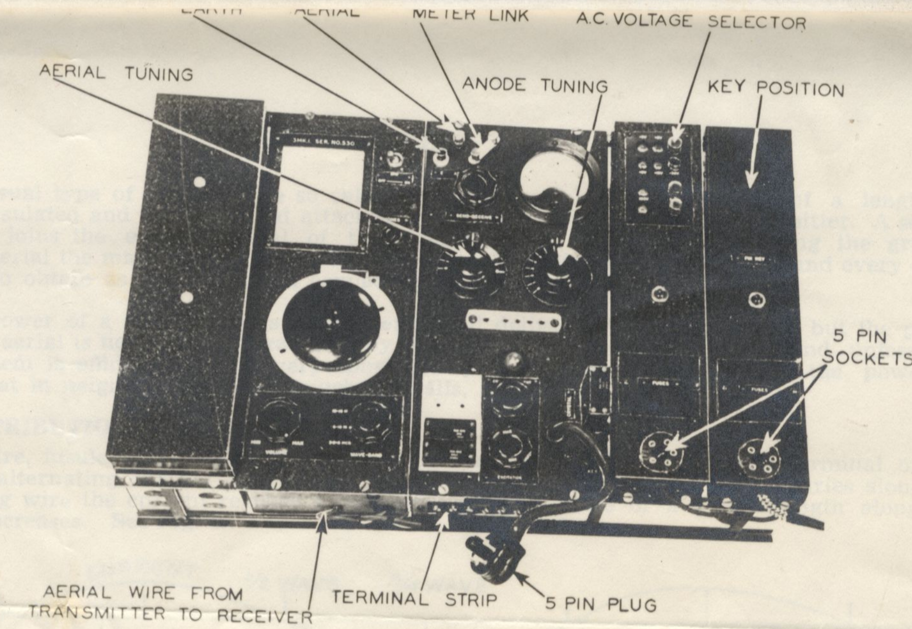
80 m 179 (3,5) – 140 (3,7)

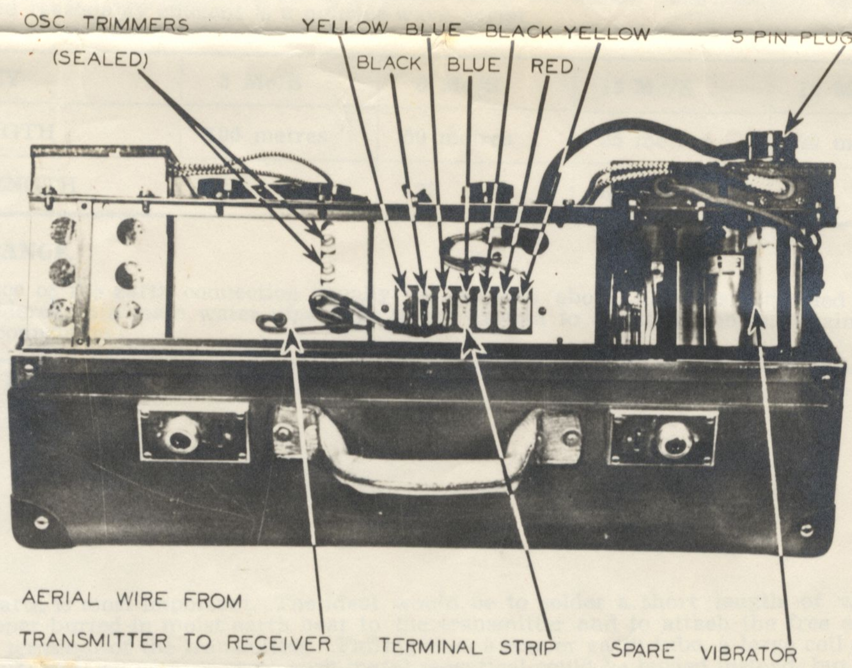
40 " 150 – 156

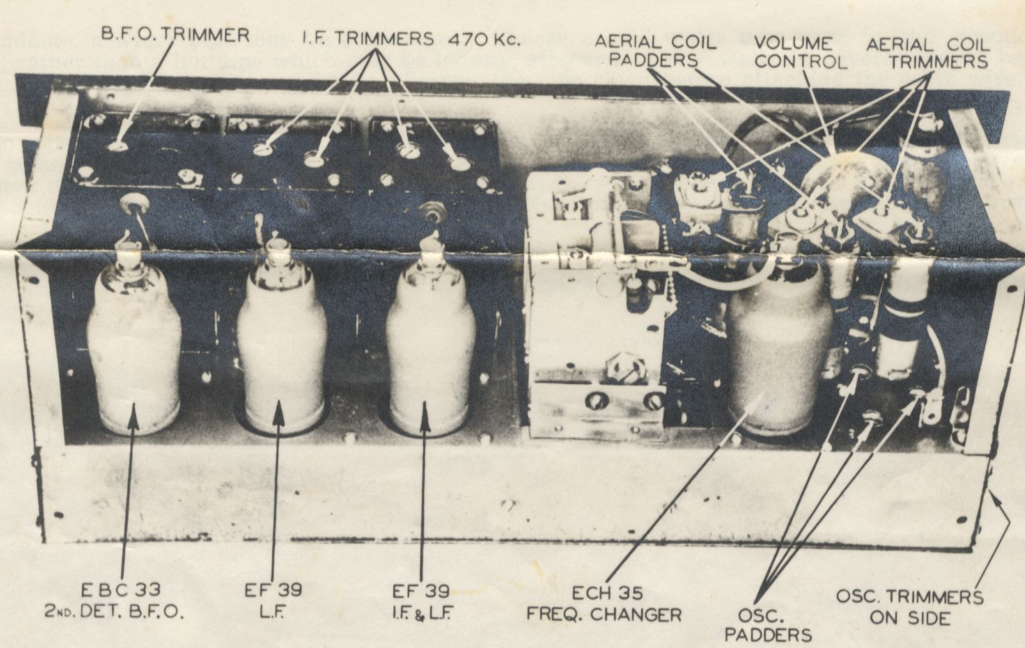
20 " 85 (14,0) – 14,3 (78)

11 MHz = 133,5

16150


AERIAL
METER LINK
A.C. VOLTAGE SELECTOR
AERIAL TUNING
ANODE TUNING
KEY POSITION
5 PIN SOCKETS
AERIAL WIRE FROM TRANSMITTER TO RECEIVER
TERMINAL STRIP
5 PIN PLUG


OSC. TRIMMERS (SEALED)
YELLOW
BLUE
BLACK
YELLOW
BLACK
BLUE
RED
5 PIN PLUG
AERIAL WIRE FROM TRANSMITTER TO RECEIVER
TERMINAL STRIP
SPARE VIBRATOR


B.F.O. TRIMMER
I.F. TRIMMERS 470 Kc.
AERIAL COIL PADDERS
VOLUME CONTROL
AERIAL COIL TRIMMERS
EBC 33 2ND. DET. B.F.O.
EF 39 I.F.
EF 39 I.F. & L.F.
ECH 35 FREQ. CHANGER
OSC. PADDERS
OSC. TRIMMERS ON SIDE

AERIALS.

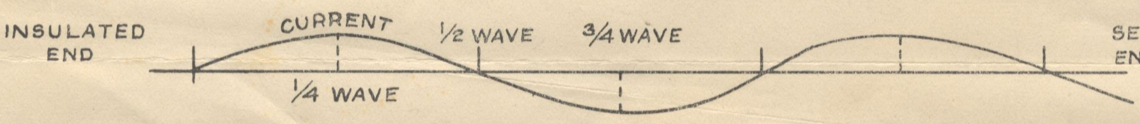
APPENDIX A.

The most usual type of aerial is the so called Marconi aerial which consists of a length of wire, one end insulated and the other end attached to the aerial terminal of the transmitter. A second length of wire joins the earth terminal of the transmitter to a conductor entering the ground. In this type of aerial the main losses are due to the resistance of the earth connection and every effort must be made to obtain as good an earth connection as possible.

The rated power of a transmitter is the power it will deliver to a suitable aerial but the power delivered to the aerial is **not** the power **radiated** by the aerial, which is always less and unless the aerial-earth system is efficient may be very considerably less. The remainder of the power is dissipated as heat in neighbouring objects such as walls, etc., and in the ground.

CURRENT DISTRIBUTION IN AERIALS.

If a long wire, insulated at one end, has the other end attached to the aerial terminal of the transmitter, an alternating current is produced in the wire, the amplitude of which varies along the wire. For a long wire the current reaches a maximum at a distance of a ¼ wavelength along the wire and then decreases. See Fig. 1.



Since the power radiated is proportional to the square of the current, it is clearly desirable to have at least one current maximum occur somewhere along the aerial. The shortest aerial which can be considered reasonably efficient is a quarter-wave aerial.

FREQUENCY	3 Mc/S	6 Mc/S	12 Mc/S	16 Mc/S
WAVE LENGTH	100 metres	50 metres	25 metres	20 metres
¼ WAVE LENGTH	25 „	12½ „	6¼ „	5 „

EARTH RESISTANCE.

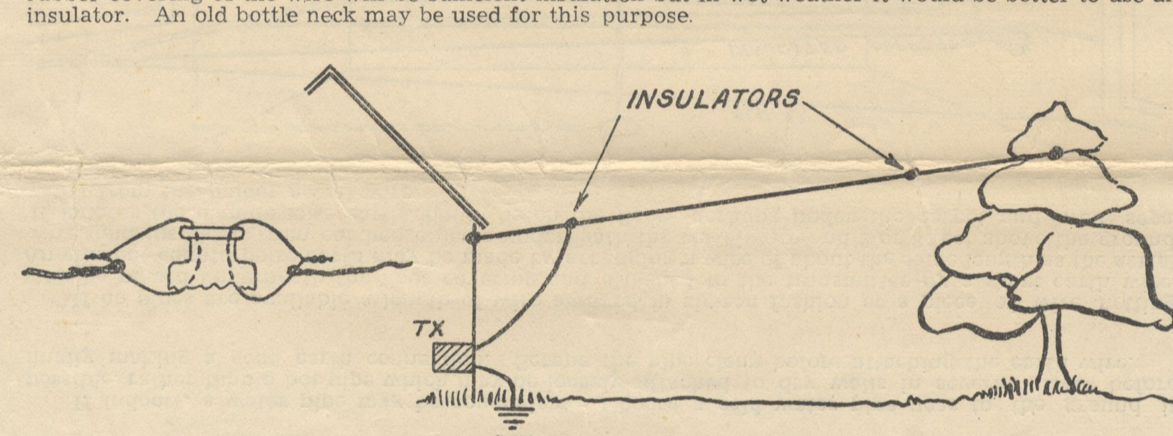
The resistance of the earth connection usually varies from about 10 ohms. obtained when the earth wire is soldered to a main water pipe near to the ground to about 100 ohms. obtained from a moderate earth connection.

Earth Resistance in ohms.		10	50	100
Radiated power as a percentage	¼ wave	80%	44%	29%
of the power in the aerial	⅛ wave	50%	16%	9%
	1/16 wave	20%	5%	2½%

The amount of power that can be afforded to be wasted when using suitcase sets is small, it is therefore never any use trying to use a shorter aerial than ⅛ wave and this only in conjunction with a very good earth.

ERECTING AN AERIAL.

It is not usually practicable to erect a vertical ¼ wave aerial although this would be very efficient, but at least this length of wire and more if possible should be erected with a long vertical or rising portion and the top bent in some way towards the horizontal as in an inverted L. The exact length of wire is not critical as the transmitter is matched to the aerial in use during the tuning operations. The whole should be left well away from earthed objects such as buildings, cliff sides, surrounding trees, etc., and the end not attached to the transmitter should be insulated. In dry weather the rubber covering of the wire will be sufficient insulation but in wet weather it would be better to use an insulator. An old bottle neck may be used for this purpose.



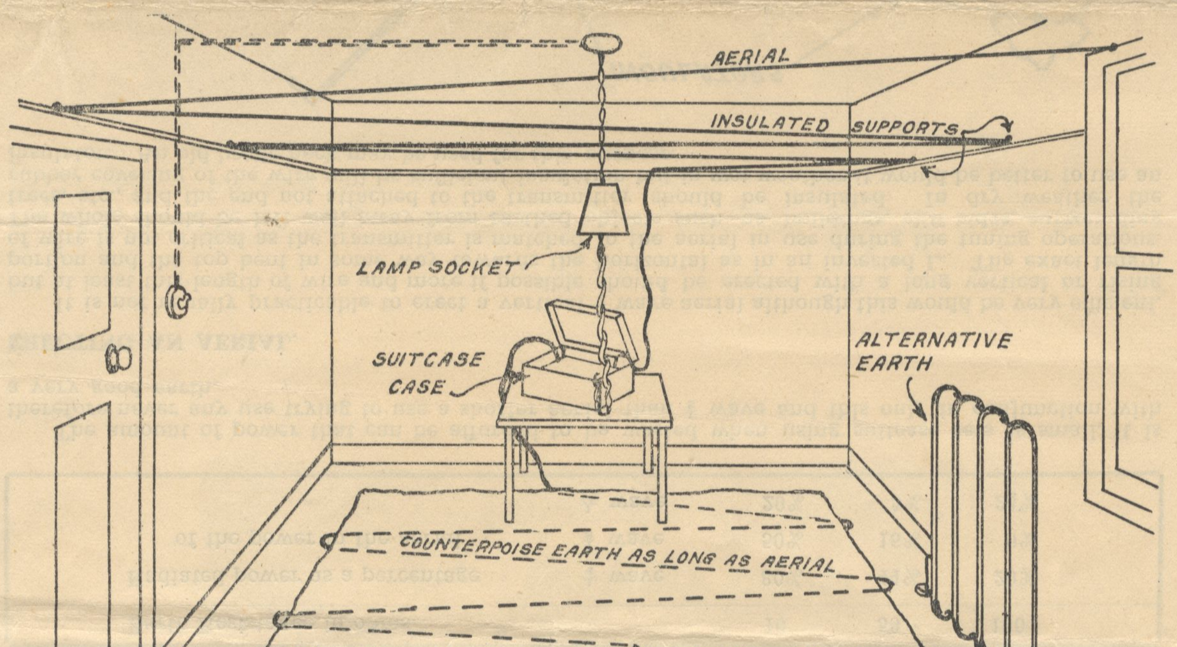
If it is impossible to use an outdoor aerial great care must be used to erect the most efficient indoor aerial possible. At least a ¼ wave length of wire should be used and this arranged high in the house —possibly in zig-zag fashion in the space amongst the rafters under the roof. Should circumstances restrict activities to one room the aerial wire should be arranged in zig-zag fashion across the room about a foot below the ceiling, spacing the wires as widely as possible, paying special attention to the fact that no part of the wire should run parallel to metal girders—electric wires, water pipes or spouting, nor should the wire be doubled back on itself at any point.

THE EARTH.

An efficient earth is most important. The ideal would be to solder a short length of wire to a large sheet of copper buried in moist earth near to the transmitter and to attach the free end of the wire to the earth terminal of the transmitter. Failing this, a copper earth tube, a large coil of barbed wire, an old oil drum well scraped, or some such metal receptical could be buried instead, but it is most important that where it is attached to the earthwire should be clean metal, a good electrical contact, preferably soldered should be made and that the ground should be moist.

If indoors, a water pipe may be convenient. Choose a cold water pipe near to the ground if possible, rather than a hot pipe which may be loosely attached to dry walls in several places before finally making a good earth connection. Scrape the pipe clean before attaching the earth wire.

If no pipes are available a length of wire arrayed in zig-zag fashion or a piece of wire netting may be placed underneath the floor covering and attached to the transmitter by a short earth wire. An efficient counterpoise earth may be made by arranging a wire of about the same length as the aerial wire, and insulated from earthed objects underneath the aerial wire and 2 or 3 feet above the ground. If indoors the counterpoise earth should be on the floor—perhaps under the carpet and well separated from the indoor aerial wire.



A POSSIBLE INSTALLATION IN A CONFINED SPACE