B.R. 300

HANDBOOK FOR A.P.63993 ADAPTOR UNIT (TRANSMITTER) FOR ATTACHMENT TO RECEIVER B28

1955

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ANY SUGGESTIONS FOR AMENDMENTS OR ADDITIONS TO THIS BOOK SHOULD BE SUBMITTED TO THE CAPTAIN SUPERINTENDENT, A.S.R.E., THROUGH THE USUAL CHANNELS

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RADIO EQUIPMENT DEPARTMENT . ADMIRALTY
NOVEMBER, 1955 . (R.E.952/55)

HANDBOOK FOR

A.P.63993 ADAPTOR UNIT

(TRANSMITTER)

FOR ATTACHMENT TO RECEIVER B28

CONTENTS

GENERAL VIEW OF EQUIPMENT

INTRODUCTION

1. The Adaptor Unit is a low power (8-10 Watts) crystal controlled transmitter designed to be fitted inside Receiver B28 and from which it obtains its power supplies. The frequency coverage ranges from 2 to 12 Mc/s and special precautions are taken in the circuit design to eliminate harmonics which would cause television interference. Only C.W. transmission is provided, the keying being carried out in the master oscillator and power amplifier cathodes. Normally, a separate transmitting aerial will be required but a common aerial may be used by fitting a changeover switch. A send-receive switch is mounted on the front panel of the B28 and the right hand dial lamp is rewired to serve as a tuning indicator for the power amplifier.

INSTALLATION IN RECEIVER B28

2. The following procedure should be carried out when fitting the Adaptor Unit in the receiver. An illustration of the unit as fitted is shown in the Frontispiece. Reference should also be made to the Handbook for the B28, B.R.1430.

(1) Remove the output valve V9 from B28 receiver. (The receiver A.F. output will henceforth be taken from the preceding valve by the connection made in (13) below.)

(2) Drill four holes (No. 27 drill) in the lid of the receiver so that the transmitter chassis may be mounted underneath by means of 4 BA nuts and bolts. In position, the front of the Unit is to be $2\frac{1}{2}$" in. from the edge of the lid and the right hand side of the Unit $1\frac{1}{2}$" in. from the right hand edge of the lid.

(3) Drill one hole 13/16 in. dia. $4\frac{3}{4}$ in. directly above the B.F.O. control on the receiver front panel. Mount Send-Receive switch with the red spot uppermost.

(4) Drill one hole $\frac{1}{2}$ in. dia. in the right hand side of the receiver cabinet, 2 in. from the top and $1\frac{1}{2}$ in. from the rear edge. Drill three further holes (No. 32 drill) for mounting aerial stand-off insulator with 6 BA nuts and bolts.

(5) Prepare end of co-axial cable to expose $\frac{1}{2}$ in. of copper braid, $\frac{1}{2}$ in. of dielectric and finally $\frac{1}{2}$ in. of conductor.

(6) Clamp cable by braided portion beneath cable clamp provided. Solder cable to wire extending from insulator. Trim connection.

(7) Remove connection to right hand dial lamp. Tape up and tuck away. Remove dial lamp holder, wrap three turns of black insulating tape around dial lamp support and replace the holder. (Both connections are now insulated from the chassis.) Insert 60 mA dial lamp provided.

(8) Connect yellow lead to one terminal of lamp holder.

(9) Connect white lead to pin 2 of V9 (6.3V A.C.).

(10) Connect black lead to the earth tag point on the receiver chassis alongside the aerial trimmer capacitor C38.

(11) Remove all connections to and between phone jacks, tape up leads individually and stow away.

(12) Take green lead through spigot hole of V9 holder to lower phone jack tip connector tag. Solder outer tag to earth point of jack sheath.

(13) Connect screened lead from pin 5 of V9 valveholder (screen to pin 7) to tip of upper phone jack (screen to jack sheath). Connect outer tag to jack sheath.

(14) Connect remaining dial lamp tag to tip connector of lower phone jack, passing lead through spigot hole of V9.

(15) Connect blue terminal of Send-Receive switch to rear of H.T. plus pin on plug 173 on rear apron of receiver chassis.

(16) Locate junction of L64 and C89. Remove lead connecting this junction to H.T. plus pin of plug 173. Connect white terminal of Send-Receive switch to junction of L64 and C89.

(17) Place oscillator valve (CV.1932, CV.1933, 6J5, 6J5G or L63) in left hand valveholder and output valve (CV.509, CV.511, CV.1186, 6V6G, 6V6GT, 6F6G or KT63) in right hand valveholder.

E AERIAL SYSTEM

(a) To obtain best results it is desirable to erect the longest possible aerial, clear of surrounding objects and at the maximum convenient height. Where interference is caused to television receivers in the immediate vicinity, it will be found advantageous to erect an aerial of resonant length for the particular operating frequency in use. The correct physical length of aerial can be obtained from graphs in Fig. 3. It should be noted that, where a long earth lead is necessary, the length of this line should be taken into account when calculating aerial length as it is an essential part of the radiating system.

(b) In order to facilitate the adjustment of the transmitter for maximum output it is recommended that a current indicator be connected in the aerial system at the aerial stand-off insulator. This may be a thermocouple meter with a full scale deflection of 0.5A (A.P.7560 is suitable) but two 6.3V 0.3A lamps connected in parallel are adequate. It is desirable to short out the lamps once the transmitter has been correctly adjusted.

(c) Where random lengths of aerial are used and in particular where the transmitter is to be operated on more than one frequency with the same aerial, an additional variable capacitor in series with the aerial may be used as a means of modifying the effective electrical length.

transmitter can only be secured if a good earth is installed and it is important to ensure that this earth line is not a resonant quarter wave at the television transmitter channel frequency, i.e. Channel 1, 5.2 ft; Channel 2, 4.53 ft; Channel 3, 4.13 ft; Channel 4, 3.8 ft; Channel 5, 3.51 ft or any odd multiple of these lengths, i.e. for Channel 1, 3 x 5.2 ft = 15.6 ft. In addition, the performance and tuning facility of the transmitter at low frequencies largely depends on the availability of a good earth connection.

SETTING-UP AND OPERATING INSTRUCTIONS

5. (a) It must be emphasised that if optimum performance and maximum freedom from T.V.I. is to be secured, the tuning and operating instructions which follow should be strictly observed. The frequency range of the transmitter power amplifier (2 to 12 Mc/s) is obtained by the use of three taps on the tank inductor marked 1, 2 and 3, connection to these taps being made by a crocodile clip. The approximate frequency range of each tap is as follows:-

No tap	2 to 3.5	Mc/s
Tap 3	3 to 5	Mc/s
Tap 2	4 to 8	Mc/s
Tap 1	7 to 12	Mc/s

It will be noticed that there is an overlap between ranges and for frequencies near the limits of a range, it is necessary to select the tap which gives the optimum performance.

(b) Setting-up should be carried out in the order given.

(1) Insert the appropriate crystal. (The crystal must be for the operating frequency and not a sub-harmonic.) Plug phone jack into upper socket and key into lower socket. WARNING - A shrouded key should be used always since, when the key is 'UP', full H.T. potential appears across the terminals.

(2) Connect the aerial and the lamp indicators. Set aerial changeover switch (if fitted) to transmit. (Do not use the series aerial capacitor for the moment.)

(3) Switch on receiver and set Send-Receive switch to "RECEIVE". Allow about a minute for warming up.

(4) Set receiver operational switch to CW-MAN. Press key and tune to note on receiver at the appropriate frequency. If no note is heard, the crystal may be defective.

(5) Set both transmitter tuning dials to zero.

(6) Select the anode tap that will come within the frequency range required.

(7) Switch to "TRANSMIT" and press key.

(8) Increase anode tuning until a dip in brilliance of the right hand receiver dial lamp occurs. Set the dial for minimum brilliance. (Note: This dial lamp serves as a tuning indicator for the power amplifier. Improved results can be obtained by connecting a 0-50 mA D.C. milliammeter (e.g. A.P.7570) in lieu of the lamp. This is not, however, an essential requirement for efficient operation of the transmitter.)

(9) Increase the aerial tuning to 1 and again restore to minimum brilliance with the anode tuning. Repeat this process, increasing aerial tuning to 2 etc. and it should be observed that the decrease in brilliance of the dial lamp is less and less pronounced as the aerial tuning is advanced. Also, the aerial lamp indicators should increase in brilliance.

(10) The optimum setting is where the aerial lamp indicators reach maximum brilliance.

Where a frequency for which there are two tapping points is used (e.g. 4500 kc/s) it may be found that increasing the aerial tuning does not cause an increase in brilliance of the aerial lamp indicators or brilliance of the right hand dial lamp.

If this is the case, switch to receive, select the alternative tap and repeat the procedure from (7).

If it is still found that the aerial tuning, when advanced, does not increase the aerial current etc. or that the dip in brilliance of the dial lamp is not pronounced and aerial current is present although the aerial tuning is at zero, then the aerial is of such a length for the operating frequency that it cannot be tuned correctly. Under these circumstances it is necessary to modify the electrical length by inserting a series variable capacitor in the aerial lead.

The procedure from (7) will then be as follows:-

(11) Set the series variable capacitor to maximum capacity. Repeat (8), (9) and (10). If the loading is still heavy, the series aerial capacitor should be decreased in gradual steps until a point is reached where advancement of the aerial tuning causes a

gradual increase in loading as indicated by a rise in aerial current and a reduction of the amount of dip in brilliance in the dial lamp as the anode tuning is rotated past the resonance point.

NOTE:- If it is found that the adjustment for maximum aerial current does not coincide with the point of minimum brilliance of the dial lamp, then either the wrong tap has been selected or the aerial series capacitor has been set incorrectly.

(c) Sample tuning figures with various aerial lengths as a result of following the foregoing procedure are shown in the table below:-

Aerial Length ft	Tap	Frequency kc/s	Anode Tuning	Aerial Tuning	Series Capacity pF	Aerial Current A
83	3	3500	2	8	200	0.38
83	0	3095	0.5	9.5	230	0.21
83	1	8160	5.5	5	150	0.35
74	3	3500	0.5	9	100	0.39
74	1	8160	6	7	Not used	0.34
62	1	8160	5	6	Not used	0.23

See Fig. 4 for calibration of a typical 500 pF variable capacitor.

The actual value of the aerial current is not important. With aerial lengths approximately to half a wavelength, little current will be delivered although such an aerial is to be preferred to a quarter wave which will give a high current reading. The transmitter should always be adjusted for maximum aerial current as shown by the indicators or ammeter.

(d) Netting

To net, press key whilst Send-Receive switch is in the "RECEIVE" position. When switching to "TRANSMIT", the receiver is muted.

ADJUSTMENT FOR TELEVISION INTERFERENCE ELIMINATION

6. (a) Frequencies which bear a direct harmonic relation to the local television transmitter frequency should be avoided wherever possible. The precautions with regard to aerial length and earth connection mentioned before should be observed if complete freedom from television interference is to be achieved. If possible, the transmitting aerial should be sited so that it is end-on to the television aerial most likely to suffer from interference.

(b) Two harmonic traps are incorporated in the transmitter circuit. L2 and C5 should be tuned to resonate at the frequency of the local sound channel and L3, C7 at the vision frequency. This may be accomplished

conveniently with the aid of a grid dip oscillator with the transmitter switched off. If, however, no grid dip oscillator is available, the circuits can be adjusted for minimum interference on a local television receiver. These adjustments should be made with the equipment switched to "RECEIVE", i.e. with only the master oscillator on. The sound and vision frequencies for the five television channels in Band 1 are as follows:-

Channel	Vision (Mc/s)	Sound (Mc/s)
1	45	41.5
2	51.75	48.25
3	56.75	53.25
4	61.75	58.25
5	66.75	63.25

MAINTENANCE

7. In the event of the transmitter failing to operate, the following procedure should be followed:-

(1) Replace the crystal with an alternative known to be serviceable.

(2) Check 6.3V heater supply (normal current 1A with CV.1186 or 0.75A with CV.509 or CV.511).

(3) Check anode voltages. They should be 230V approximately. (The total H.T. current is approximately 68 mA when using output valve CV.1186 or 58 mA when using CV.509 or CV.511.)

(4) Check screen voltage of power amplifier; correct value approximately 230V.

(5) Replace valves with proved alternatives.

(6) Check that no D.C. voltage appears on either of the crystal holder pins. The presence of a D.C. voltage indicates failure of C3 which should be replaced.

(7) Ensure that C10 and C11 are not shorting to ground.

The most commonly encountered faults will be revealed by these tests. Figure 2 shows the location of the majority of the components which can be seen on the underside of the chassis.

COMPONENTS LIST

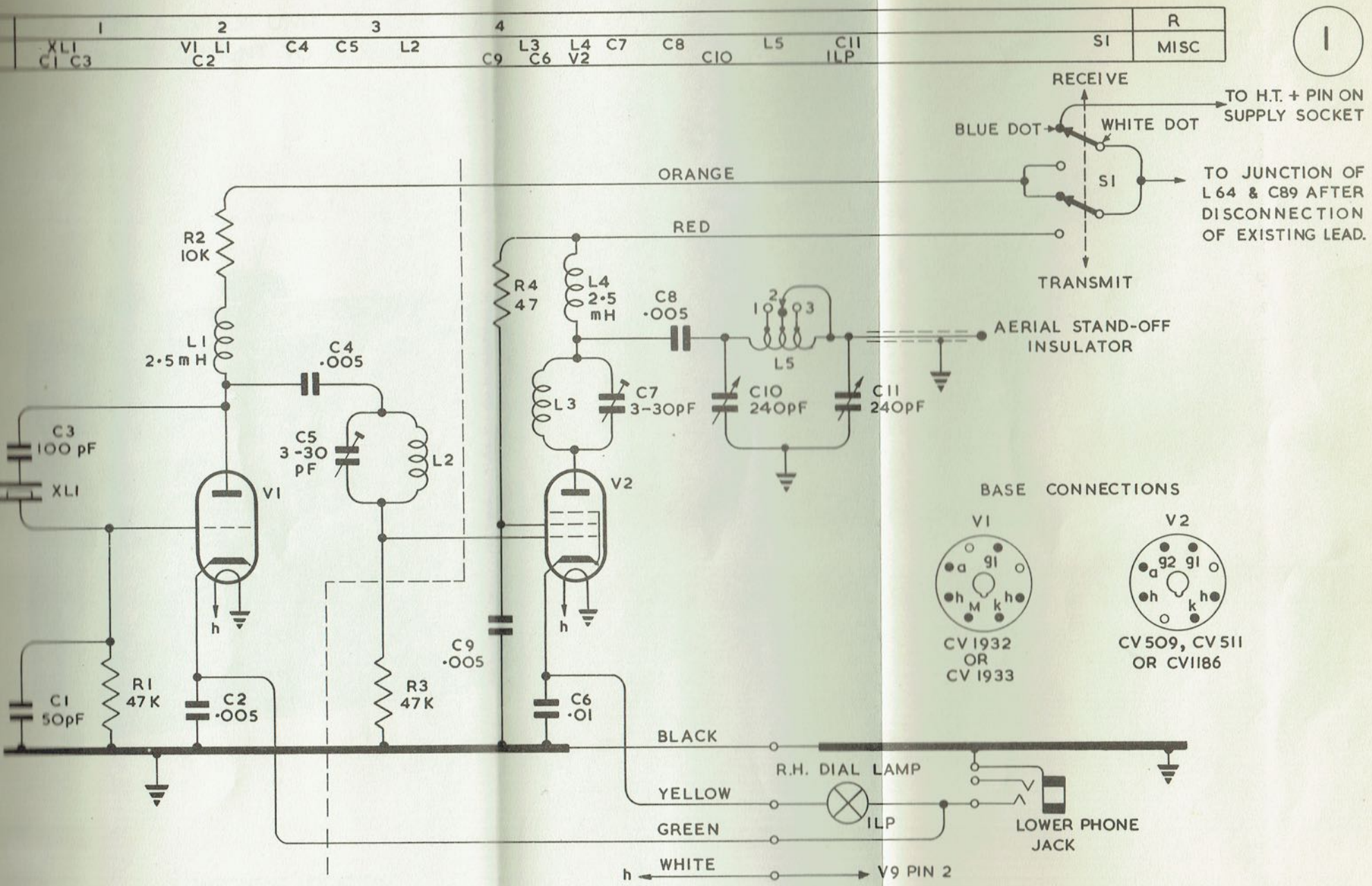
FOR

A.P.63993 ADAPTOR UNIT (TRANSMITTER) FOR ATTACHMENT TO RECEIVER B28

Circuit Reference	Description	A.P. or Joint Service Cat. No.	Value	Tolerance	Rating
RESISTORS					
R1	Composition	Z222215	47K ohms	± 10%	½W
R2	Wire wound, vitreous enamel	Z244241	10K ohms	± 5%	3W
R3	Composition	Z222215	47K ohms	± 10%	½W
R4	Composition, insulated	Z221068	47 ohms	± 10%	½W
CAPACITORS					
C1	Ceramic	W3316/ Z132288	50 pF	± 10%	500V D.C. Wkg.
C2	Moulded Mica	Z124325	0.005 µF	± 20%	750V D.C. Wkg.
C3	Ceramic	Z132185	100 pF	± 5%	500V D.C. Wkg.
C4	Moulded mica	Z124325	0.005 µF	± 20%	750V. D.C. Wkg.
C5	Air dielectric trimmer	W5035/ Z167006	3-30 pF	- 0% + 15%	150V D.C. Wkg.
C6	Moulded mica	Z124378	0.01 µF	± 10%	350V D.C. Wkg.
C7	Air dielectric trimmer	W5035/ Z167006	3-30 pF	- 0% + 15%	150V D.C. Wkg.
C8	Moulded mica	Z124325	0.005 µF	± 20%	750V D.C. Wkg.
C9	Moulded mica	Z124325	0.005 µF	± 20%	750V D.C. Wkg.
CHOKES, R.F.		Special Proprietary Items			
L1	R.F. Choke		2.5 mH		
L4	R.F. Choke		2.5 mH		
VARIABLE CAPACITORS					
C10	Air dielectric		240 pF max.		
C11	Air dielectric		240 pF max.		
LAMPS					
ILP	M.E.S. 6.3V 0.06A				

COMPONENTS LIST (Cont'd.)

Circuit Reference	Description	A.P. or Joint Service Cat. No.	Value	Tolerance	Rating
	VALVES				
V1	Crystal oscillator (Commercial equivalents 6J5, 6J5G or L63)	CV.1932 or CV.1933			
V2	Power amplifier (Commercial equivalents 6V6G, 6V6GT, 6F6G or KT63)	CV.509 CV.511 or CV.1186			
	SWITCH				
S1	Toggle, 2 pole, 2 way	Z510504			



A.P. 63993 ADAPTOR UNIT (TRANSMITTER) FOR ATTACHMENT TO REC. B28. — CIRCUIT DIAGRAM

A.P.63993 ADAPTOR UNIT (TRANSMITTER) FOR ATTACHMENT TO RECEIVER B28

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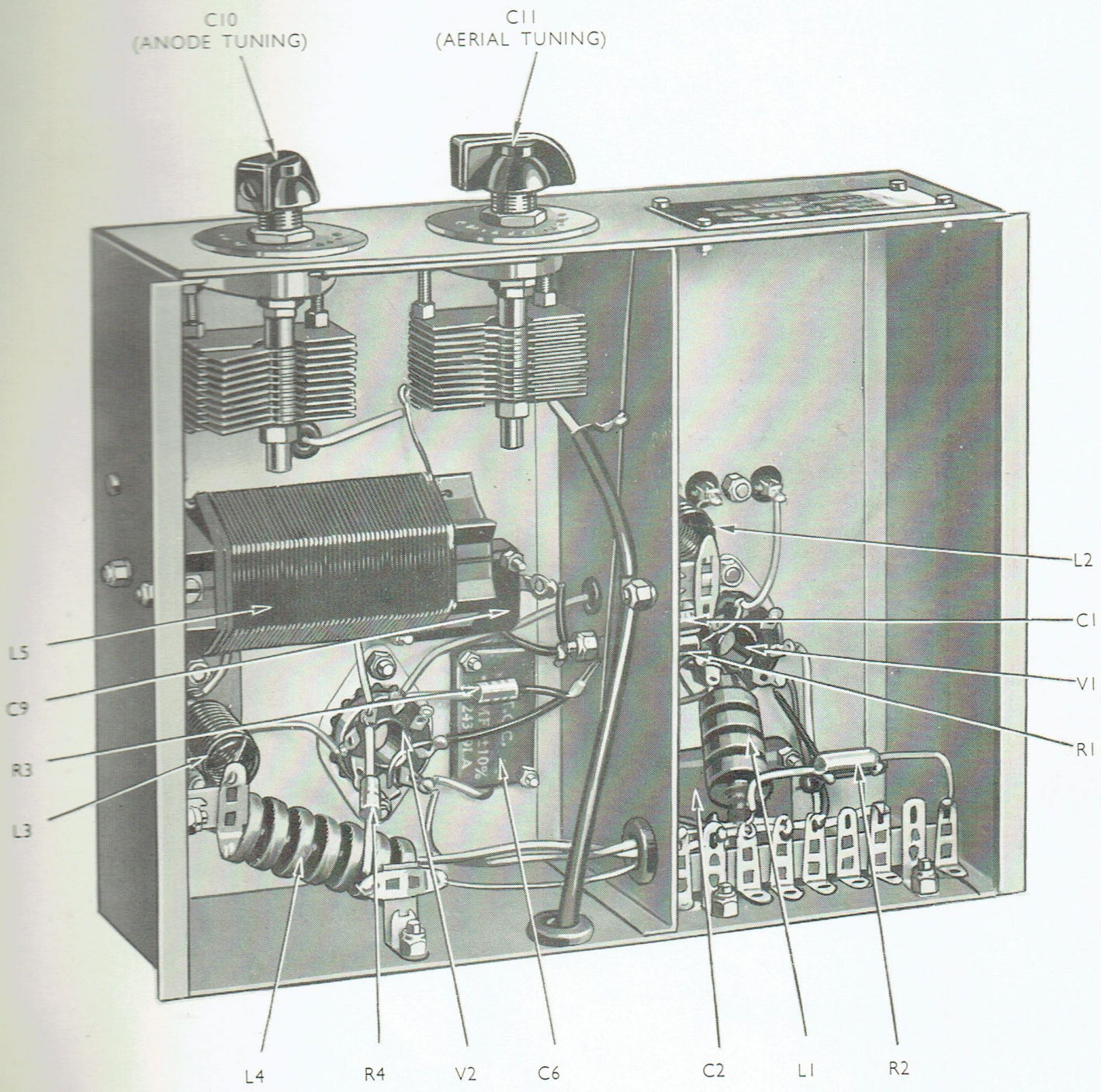
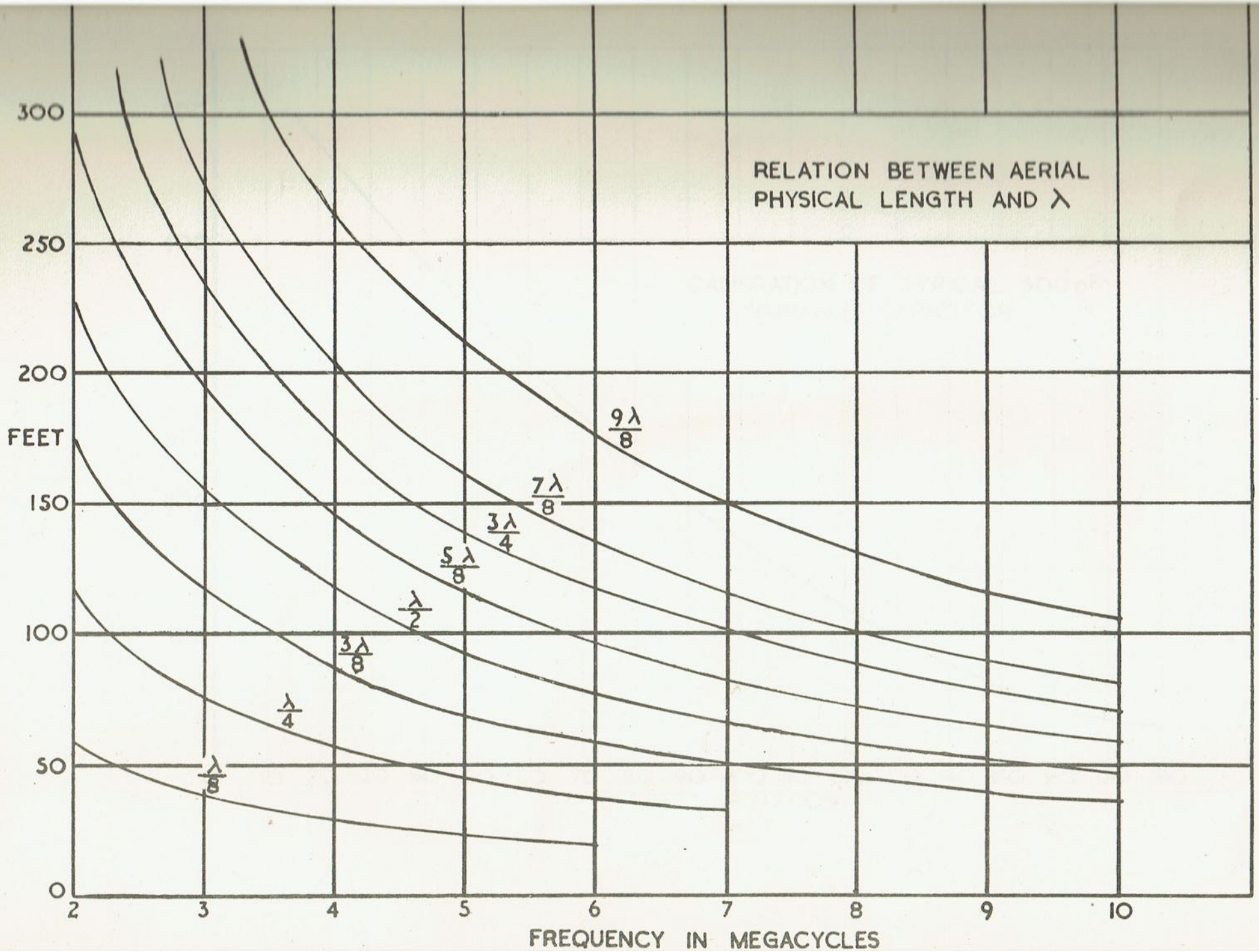
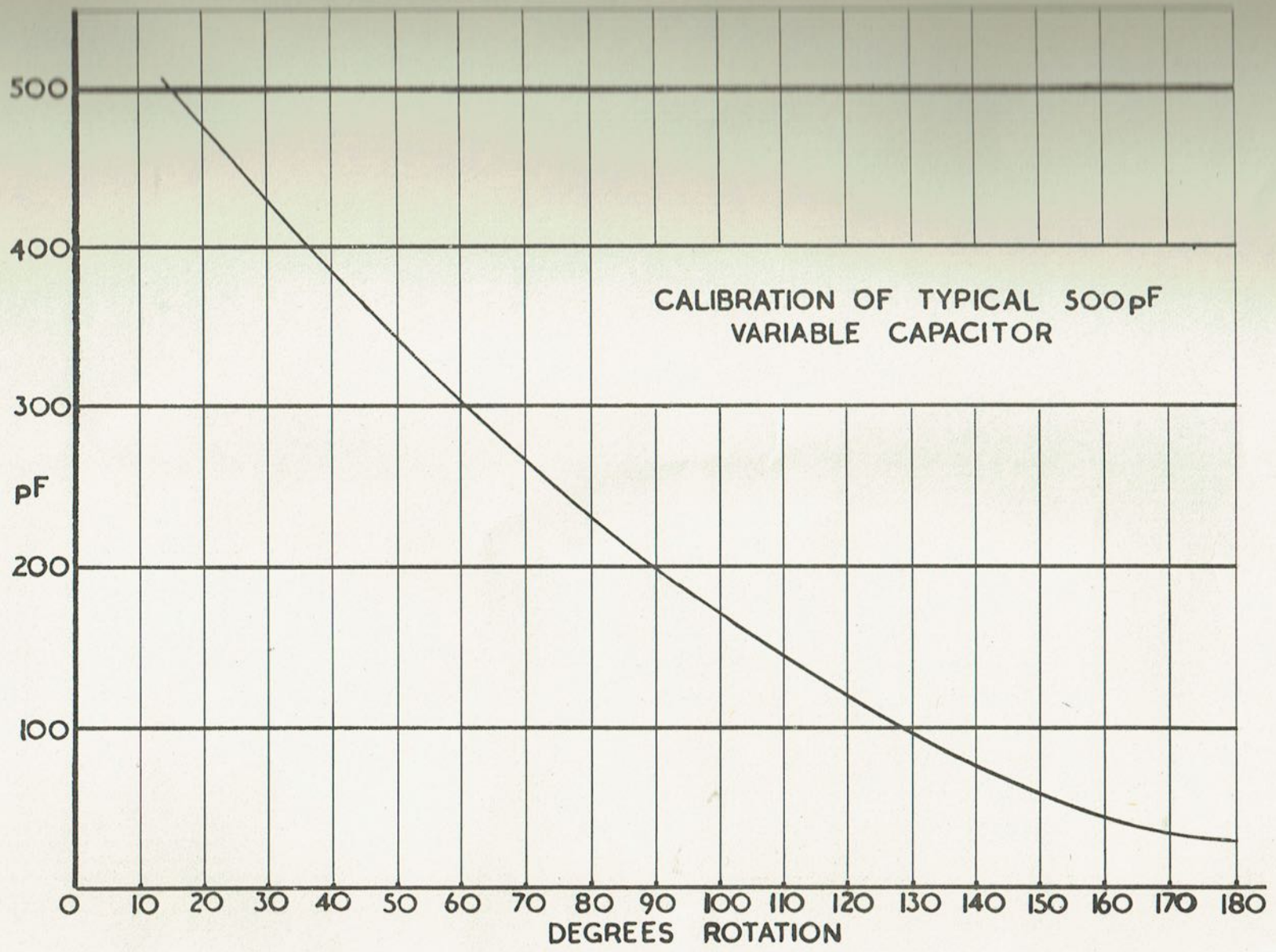



RELATION BETWEEN AERIAL
PHYSICAL LENGTH AND λ
300
250
200
FEET
150
100
50
0
2
3
4
5
6
7
8
9
10
FREQUENCY IN MEGACYCLES
9λ/8
7λ/8
3λ/4
5λ/8
λ/2
3λ/8
λ/4
λ/8


CALIBRATION OF TYPICAL 500pF
VARIABLE CAPACITOR
500
400
300
200
100
pF
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
DEGREES ROTATION