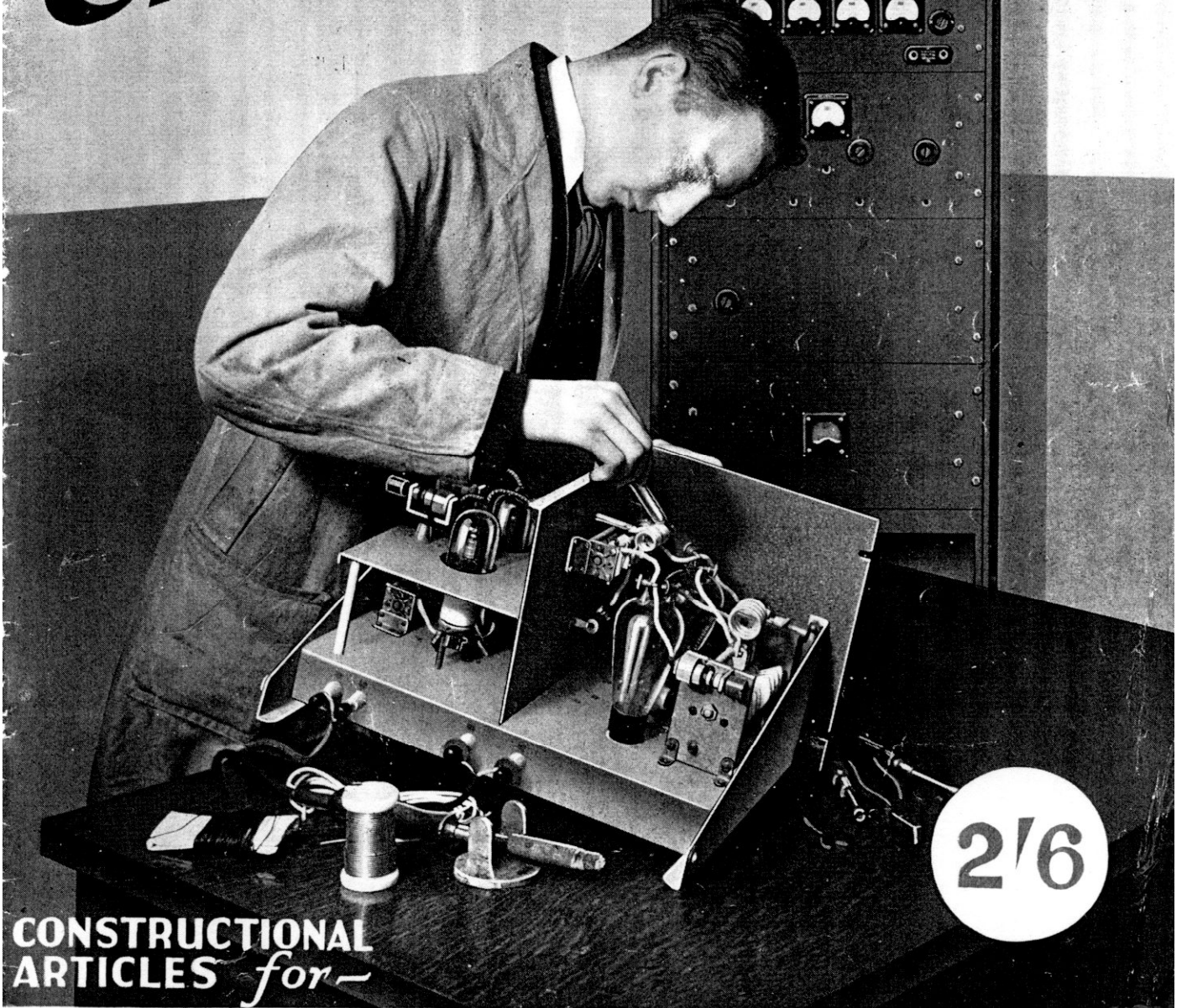


# EDDYSTONE

## Short Wave

MANUAL



2/6

CONSTRUCTIONAL  
ARTICLES *for*—

SHORT WAVE RECEIVERS AND TRANSMITTERS.

# EDDYSTONE SHORT WAVE MANUAL

No. 5

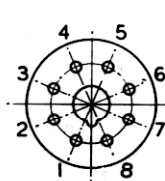
All the sets and equipment described in this Manual have been subjected to thorough tests and trials and can be relied upon to give excellent results, if built exactly to the instructions given. Should difficulties be experienced, other than from faulty construction or the substitution of different components, we shall be glad to help, but to avoid lengthy correspondence, we ask constructors to make a careful check of the equipment before writing us. Finding out the cause of one's own troubles is, moreover, not only a reason for self-satisfaction but is also highly instructive.

"Eddystone" components are available through selected Registered Retailers in most areas. In case of any difficulty, you are invited to write for the name and address of your nearest stockist.

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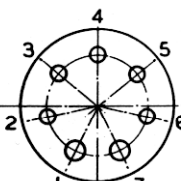
## VALVE BASE DATA



INT. OCTAL.



B 9 G.



AM. 7 PIN.

- M .. Metallising.
- S .. Shield.
- H .. Heater.
- D .. Diode.
- G1 .. Control Grid.
- G2 .. Screen Grid.
- G3 .. Suppressor Grid.
- A .. Anode.
- K .. Cathode.

### OCTAL BASED VALVES.

Valve	Pin 1	2	3	4	5	6	7	8	Top Cap
EF 36 EF 39	M	H	A	G2	G3	—	H	K	G1
L63 EC31	—	H	A	—	G1	—	H	K	—
EL35 EL37 6V6	M	H	A	G2	G1	—	H	K (G3)	—
QV04-20	H	G1	K, G3, S	G2	H.C.T.	Connect to Shield	G1	H	A
DF33	—	H	A	G2	—	—	HG3	G1	—
DAC32	—	H	A	—	D	—	H	—	G1
DL35	—	H	A	G2	G1	—	H G3	—	—

### BRITISH 9-PIN BASED VALVES.

Valve	1	2	3	4	5	6	7	8	9
EF 50	H	G2	A	G3	S	K	G1	S	H
EF 54	H	A	G2	K, S, G3	S	G1	S	S	H
EC 52	H	G1	K	A	—	—	—	—	H
QV04-7	H	A	G2	G2	S	K	G1	S	H

### AMERICAN 7-PIN BASED VALVE.

Valve	1	2	3	4	5	6	7	Top Caps.
4074A	H	—	G1	K	G1	—	H	A

# Band Spread All-Dry Four Receiver

## INTRODUCTION.

This versatile short wave receiver caters for the needs of both the general short wave listener and for the amateur who requires full bandspread facilities. To obviate the use of accumulators, it has been designed around a set of 1.4 volt valves and is capable of giving really excellent results. The receiver is easy to handle, reaction is smooth, the R.F. stage gives effective gain over the whole range of frequencies covered and the output is adequate for loud speaker use on the stronger broadcasting stations.

Eddystone plug-in high efficiency coils are used in the R.F. and detector stages and enable frequencies of from approximately 33 megacycles to 1100 kilocycles to be received, thereby including all the normal amateur bands. Stations in the broadcast band can also be received by using type 6G Coils although the tuning condensers are on the small side for this purpose. Room for the batteries is allowed for on the chassis, thus making the receiver completely self contained.

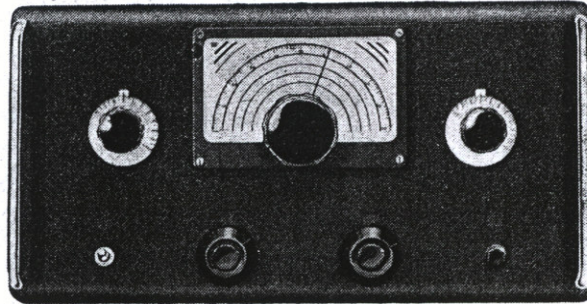
## CIRCUIT.

Fig. 1, consists of a tuned R.F. stage, followed by a detector stage which incorporates band-setting and band-spreading tuning condensers. The two larger capacity condensers are controlled by small slow motion dials and the band spreading condenser, on which the fine tuning will be done, is controlled by a Full Vision Dial Cat. No. 598. The capacity ratios are so chosen that very effective band-spreading results.

Gain control is by variation of screen potential to the R.F. valve whilst reaction is controlled by the variable potentiometer R7. The detector valve is resistance capacity coupled to a first audio stage, the latter being transformer coupled to a pentode output stage. To reduce H.T. consumption, a resistor has been inserted in the screen of the output valve but if it is intended to use the receiver with a loud speaker, this resistor R11 and its associated condenser C14 should be omitted.

## CONSTRUCTION.

The receiver is built on a Cat. No. 641 Chassis, which fits into a Cat. No. 609 metal cabinet, on the front of which are mounted the tuning dials and other controls. Two chromium plated 8" handles, fitted



to the front panel, enhance the appearance of the set and also serve to protect the dials.

The photograph of the top deck of the chassis, Fig. 2, and the one of the sub-chassis, Fig. 3, give a good idea of the layout and general construction. Details of the positions, spacing, etc., of the major components are set out in the chart, page 3, and

from this information the constructor should have no difficulty in building an exact duplicate of the receiver.

As advocated in other articles in this Manual, it would be well to start by cutting from stiff cardboard a dummy chassis top and panel, on which the positions of the components can be accurately marked out. The cardboard dummies may then be used as templates for marking out the actual chassis and cabinet front.

Two metal screens are required, one above and one below the chassis, and details of these are included in the chart. A midget insulator is required near the R.F. tuning condenser bracket and another near the detector coil (three chassis holes for each).

The positions of the tag boards, L.F. transformer, etc., beneath the chassis, are not critical but all the holes necessary for securing them should be made before everything is assembled prior to wiring up. A  $\frac{1}{4}$ " hole is required near V3 to take the screened lead to the grid top cap of this valve and another near V2 for the lead from R5 to L.T. positive.

The front panel should be carefully marked out with the positions of the holes to agree with those on the front of the chassis and the tuning condenser spindles. The bushes of the switch, potentiometers and jack pass through both the panel and the chassis and their fixing nuts, together with the metal handles, serve to hold the two parts together firmly.

The aerial socket fitted to the rear of the chassis serves for the connection of either a coaxial feeder or an open aerial. A suitable hole should be made

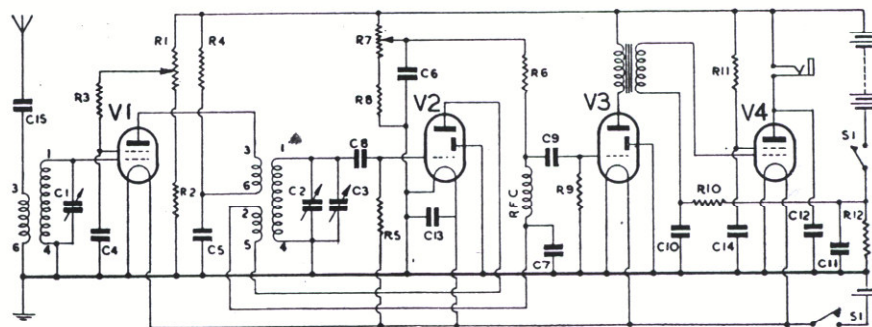


FIG. 1.

in the rear of the cabinet to allow the aerial to be connected when cabinet and chassis are assembled.

### WIRING.

The wiring throughout, except for the screened lead to  $V_3$  and possibly the battery leads, may be carried out with 20 s.w.g. tinned copper wire enclosed in insulating sleeving. All R.F. and detector circuit wiring must be kept as short as possible and this point applies very particularly to the top grid of the DAC32 detector valve. Both the grid condenser  $C_8$  and the grid leak  $R_5$  should be soldered extremely close to the top cap — otherwise static hum and other undesirable effects may be encountered.

The top cap of  $V_1$  and the stator of  $C_1$  are connected to a tag on the midget insulator, from the underside of which a wire is taken through the chassis to pin 4 of the coil base.

Similarly, the grid condenser  $C_8$  and the stators of both  $C_2$  and  $C_3$  are connected to the other midget insulator and detector coil socket. All tuning condensers are earthed with short leads from the tags provided to tags fitted under the bracket bolts.

Resistors  $R_{10}$  and  $R_{12}$  and condenser  $C_{10}$  are soldered to the group board and the associated interconnections made before the board is fixed to the rear of the chassis. The other small components are held in the wiring, 5-way tag strips being fixed on available projecting bolts, for anchoring purposes and to enable H.T. wiring, etc., to be commoned up.  $C_4$  and  $C_{12}$  are soldered directly from the appropriate valve pins to an earth tag, and condensers  $C_5$  and  $C_7$  similarly from the detector coil base.

The double pole switch connects the L.T. and H.T. batteries simultaneously. If a non self-shorting telephone jack is employed, be careful not to disconnect the telephones whilst the set is working. L.T. leads are taken up through the chassis from the switch and a chassis earthing tag and H.T. leads from the switch and the right hand tag strip to the batteries clipped to the rear of the chassis.

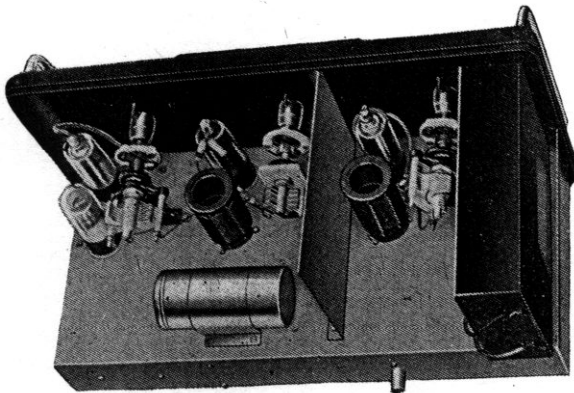


Fig. 2. Illustrating the lay-out of the receiver. Due to the addition of side brackets, it is necessary to transpose the positions of the batteries.

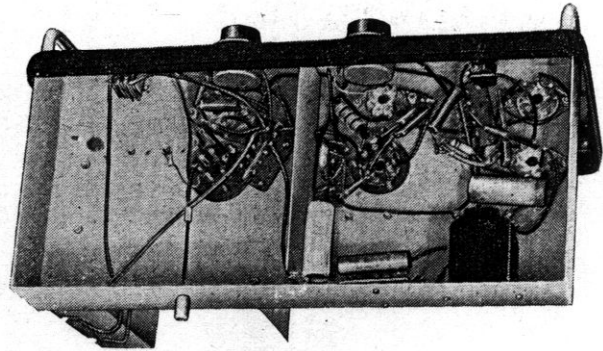


Fig. 3. Showing the mounting of components on the underside of the chassis.

### OPERATION.

Before connecting the H.T. battery, ensure that the correct voltage is shown across the filament pins (2 and 7) of any one valve, to avoid possible damage through an inadvertent error in wiring up.

On advancing the reaction control from minimum, a point will be reached at which oscillation commences, indicated by the usual slight increase in noise. The receiver is most sensitive when just oscillating — advancing the reaction control too far will cause violent oscillation. The R.F. tuning condenser should be kept in tune with the detector stage — signals will increase in strength considerably at the proper setting.

The frequency ranges, band-spread of amateur bands, etc., are set out in the table below and close agreement will be found in a receiver built to the layout and instructions given above. In the case of the 6BB coils, oscillation ceases at approximately  $28^\circ$  on the band-set dial, due to the inductance capacitance ratio becoming too low but there is still an overlap with the 6LB coil. As will be seen, the coverage is complete from approximately 35 Mc/s. to 990 Kc/s., using the six coils specified. The amount of bandspread on each amateur band is fully adequate and makes the receiver a pleasure to handle. The noise level is extremely low and weak signals can be tuned in, held and read with ease.

An earthing terminal, on the rear of the chassis, will be an asset but, to be effective, the earth lead itself must be short, particularly when the receiver is being operated on the higher frequencies.

The aerial employed will, of course, depend upon local circumstances. For general use, a wire of a length between 50 and 100 feet, suspended as high and clear as possible, connected directly to the aerial socket, will prove very effective on all ranges. For restricted frequencies, e.g., any one amateur band, an aerial cut specially to the appropriate length and fed to the receiver by either low or medium impedance feeder will ensure particularly good reception on that particular frequency band, although directional effects may be noticeable.

The consumption from the batteries is very low — .25 amperes L.T. and 8.5 milliampères H.T.

PANEL OF FREQUENCIES.

Coll.	Frequency Range		Amateur Bands.			Coll.	Frequency Range		Amateur Bands.		
	Max. Mc/s.	Min. Mc/s.	Band Set Dial.	Frequency Kc/s.	Band Spread Dial.		Max. Mc/s.	Min. Mc/s.	Band Set Dial.	Frequency Kc/s.	Band Spread Dial.
6 BB	35.6	27.2 (28°)	18°	30000 28000	15° 89°	6 R	8.8	3.65	13°	7300 7000	30° 60°
6 LB	27.4	12	68°	14400 14000	15° 88°	6 W	4.65	1.92	13°	4000 3500	0° 100°
6 Y	15.85	7.05	—	—	—	6 P	2.45	.99	16°	2000 1800	10° 90°

CHART OF POSITIONS OF MAJOR COMPONENTS, DIMENSIONS, ETC.

CHASSIS (looking at front).  
 Top Chassis Screen 5" high, 7" long plus 1/2" fixing flange, mounted 6 1/2" from L.H. side, 9 1/2" from R.H. side, fixing flange on right.  
 Sub Chassis Screen 2" high, 7" long plus 1/2" flange, mounted 7 1/2" from R.H. and 8 1/2" from L.H. side.  
 Adjustable brackets all 2 1/2" from front (fixing centres). R.F. condenser bracket 2" from L.H. side, detector bracket 3" from R.H. side, Band spread bracket 1 1/2" to right of screen (i.e., dead central). All condensers 2 1/2" up from chassis top.  
 V.4 valveholder 1 1/2" from R.H. side, 3 1/2" from front.  
 V.3 valveholder 1 1/2" from R.H. side, 1 1/2" from front.  
 V.2 valveholder 5 1/2" from R.H. side, 1 1/2" from front.  
 V.1 valveholder 5 1/2" from L.H. side, 1 1/2" from front.  
 R.F. coil base 5 1/2" from L.H. side, 3 1/2" from front.  
 Det. coil base 5 1/2" from R.H. side, 3 1/2" from front.  
 (Both are fitted with pins 1 and 4 to the right).  
 Reaction control 6" from R.H. edge (3/8" dia. hole).  
 R.F. Gain Control 6" from L.H. edge (3/8" dia. hole).  
 Switch 3 1/2" to left of R.F. Control (1/4" dia. hole).  
 Jack 3 1/2" to right of Reaction Control (1/4" dia. hole).  
 Aerial Socket 5" from L.H. side.

PANEL.

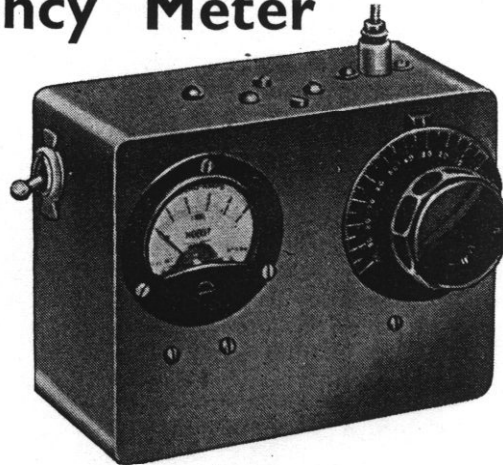
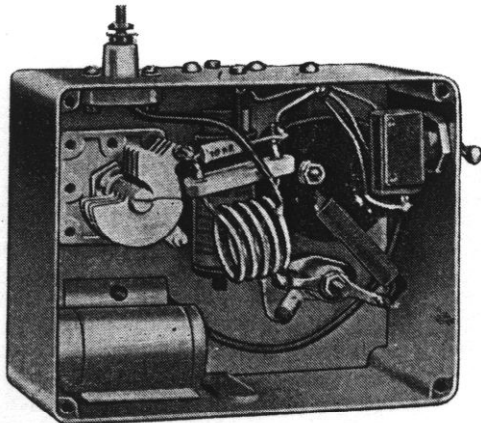
Three 1/4" holes for dial bosses, plus two 4BA. holes per dial, vertically above and below large hole and 1 1/2" apart. Holes for jack, switch and potentiometers as for chassis. Aerial socket and earth terminal holes at rear of cabinet.

LIST OF PARTS.

- |   |  |   |
|---|--|---|
| 1 General Purpose Chassis Eddystone No. 641 | 3 Adjustable Insulated Brackets .. 1007      | 2 Paper Condensers .1 mF (C10, 14).           |
| 1 General Purpose Cabinet .. 609            | 2 Midget Stand-off Insulators .. 1019        | 1 Electrolytic Condenser 8 mF (C6)            |
| 2 Metal Handles 8" .. 608                   | 1 Valve type DF 33 (V1) .. Mullard           | 1 Resistor, 1/2 watt, 5,000 ohm (R3).         |
| 2 Microdensers, 100 pF (C1, 3) .. 1130      | 2 Valves type DAC 32 (V2, 3) .. Mullard      | 2 Resistors, 1/2 watt, 1,000 ohm (R4, 12).    |
| 1 Air Dielectric Trimmer, 15 pF (C2) .. 580 | 1 Valve type DL 35 (V4) .. Mullard           | 2 Resistors, 1/2 watt, 2 megohm (R5, 9).      |
| 1 Full Vision S/M Dial .. 598               | 4 Octal Ceramic Valveholders.                | 1 Resistor, 1/2 watt, 50,000 ohm (R6).        |
| 2 Precision S/M Dials, 2" Silver .. 639     | 1 Intervalve Transformer 3-5:1 Niclet Varley | 2 Resistors, 1/2 watt, 20,000 ohm (R2, 8).    |
| 2 6-pin Coil Bases .. 964                   | 1 D.P.S.T. Toggle Switch, S.88 .. Bulgin     | 1 Resistor, 1/2 watt, 100,000 ohm (R10).      |
| 2 6-pin Coils, 6BB .. 959                   | 1 Insulated Closed Circuit Jack .. Igranic   | 1 Resistor, 1/2 watt, 10,000 ohm (R11).       |
| 2 6-pin Coils, 6LB .. 959                   | 1 Aerial Socket type L373/Skt. Belling-Lee   | 2 Potentiometers, 100,000 ohm (R1, 7).        |
| 2 6-pin Coils, 6Y .. 959                    | 1 Aerial Plug type L373/P.8 Belling-Lee      | 1 x 5-way Group Board ; 3 x 5-way Tag Strips. |
| 2 6-pin Coils, 6R .. 959                    | 3 Mica Condensers .001 mF (C4, 5, 13).       |   |
| 2 6-pin Coils, 6W .. 959                    | 2 Mica Condensers .0003 mF (C7, 12).         |   |
| 2 6-pin Coils, 6P .. 959                    | 1 Ceramic Condenser, 100 pF (C8).            |   |
| 1 R.F. Choke .. 1010                        | 1 Ceramic Condenser, 20 pF (C15).            |   |
| 2 Skirt Knobs 1 1/2" .. 2416                | 1 Paper Condensers .5 mF (C11).              |   |
| 3 Large Flexible Couplers .. 1009           | 1 Paper Condenser .01 mF (C9).               |   |

NOTE.—The stated values of resistance are not critical and the nearest preferred value, 20% tolerance, will be suitable.

V.H. Frequency Meter



INTRODUCTION.

Some method of measuring the actual operating frequency is essential when working in the five metre amateur band. The frequency meter described below fulfils this function and it also has several other uses which render it a valuable addition to any amateur station. It illustrates one use of the small diecast metal box — No. 650 — for which many other applications can be found.

Basically, the instrument is of the absorption type but with the addition of a valve and meter, which combination gives a more positive and reliable

indication than is possible with the flashlamp bulb usually employed. This latter method calls for power to light the lamp and results in very flat tuning, which drawbacks are absent in the present design.

CIRCUIT.

Referring to the complete circuit diagram shown in Fig. 1, L1, C1, and C2 form the tuned circuit, the 60 to 56 megacycle range being covered from 19 to 45 degrees of the dial. Coupling to it is accomplished by taking a lead from a point on the coil one turn from the earthy end to a midget lead-through

insulator, to the external terminal of which a short pick-up rod is fitted.

Connection to the valve is made from an approximate centre tap on the coil via a 10 pF ceramic condenser, thus keeping the tuned circuit loading low. The indicating meter, a Hobut miniature type reading up to 500 micro-amperes, is shunted across the valve with a Cat. No. 1011 choke in series.

Two versions of the meter have been tested. The one shown in the photograph, Fig. 2, utilises a type 1T4 miniature 1.4 volt filament valve (*Mullard*) used as a diode with all electrodes, other than the filament, strapped together. The use of this valve enables a small cell to be included within the box, making the instrument completely self-contained. The circuit employed is given in Fig. 1(a).

Improved results are obtainable if a television type diode (*Mullard* B.A.50) is substituted for the 1T4, but in this case, it is not possible to include a heater battery inside the box. Two terminals, one insulated, are fitted to the lid of the box for connection to an external L.T. supply which may conveniently be a 6.3 volt supply from a mains transformer indoors and three or four small dry cells in series for use outdoors. The circuit in this case becomes the one shown in Fig. 1 (b).

#### CONSTRUCTION AND WIRING.

Enclosing the instrument in the Cat. No. 650 metal box, which is complete with a close fitting flanged lid, assists in the maintenance of frequency stability and calibration and eliminates the effects of body capacity and other unwanted external influences. Because of the restricted space, the components must be located with care, otherwise the construction is straightforward.

The  $1\frac{1}{2}$ " hole for the meter is located 1" from the left hand side and  $1\frac{1}{4}$ " from the top, looking at the face of the box.

The tuning condenser requires a  $\frac{3}{8}$ " hole 1" from the right-hand side and  $1\frac{1}{4}$ " from the top. The switch is fitted to the left-hand top corner of the box, near the lid, so that it is clear of the meter terminals. Immediately below the meter is a midget insulator, to a tag on which are anchored condenser C3, one end of the RF choke and the wire to the valve anode.

The aerial insulator is mounted through the top side, 1" from both side and front, a  $\frac{1}{2}$ " hole being necessary. The small index strip for the dial should be fixed at an early stage in the construction. A small metal strap holds in place the filament cell.

When all holes in the box have been made, first fit the valve-holder in place. It is located  $2\frac{1}{4}$ " from each edge and as close to the face of the box as possible. Two  $\frac{3}{4}$ " 6 BA bolts with spacing pieces keep the valve-holder away from the metal side. Loose leads should be soldered to the valve pins (in the case of the 1T4, the G1, G2, and anode pins are commoned) for connection to the appropriate points later. The other components are then mounted, leaving the coil until the valve and meter wiring has been completed. The coil, directly across the pins of which is connected C2, is soldered to one stator of the variable condenser and to an earthing tag bolted to the side of the box. Finally, C3 and the aerial lead-through connections are completed.

#### CALIBRATION.

Before calibration, ensure that the lid is screwed down and fit a 12" length of stiff copper wire to the external terminal of the midget insulator. If assistance is available from amateurs using transmitters of known frequency, calibration can be carried out quickly. Otherwise it will be necessary to use an existing transmitter, or build a small oscillator, with which to excite a Lecher wire system. Space does not permit of a full description of this method here and the reader is referred to the "Eddy-stone" Ultra Short Wave Guide (published before the War) and to the R.S.G.B. Amateur Radio Handbook. The frequency meter itself may be employed to determine the position of the antinodes along the Lecher wires.

When a number of dial readings against frequencies have been secured, a graph should be drawn and kept for use with the instrument.

#### USING THE FREQUENCY METER.

To measure the frequency of a transmitter, the box, with its pick-up rod in position, is placed some little distance from the output tank, and the dial rotated slowly, since the tuning is quite sharp. If

*Continued on page 9*

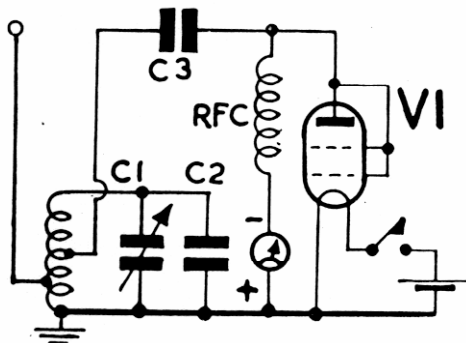


FIG. 1(a).

Circuit diagram of VHF Frequency meter employing a 1T4 1.4 volt valve.

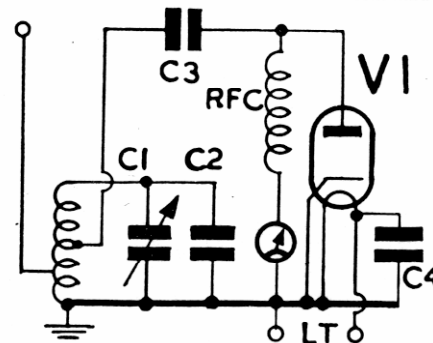


FIG. 1(b).

Circuit diagram of instrument when using a television type (6.3 v heater) diode.

# 60 Megacycle 15 Watt Transmitter

## INTRODUCTION.

Several considerations have been borne in mind when designing a transmitter for use in the 60 megacycle amateur band. Firstly, something better than the simple self-excited oscillator, with its inherently poor frequency stability and liability to frequency modulation is definitely desirable. Secondly, too elaborate a "line-up" has been avoided and the transmitter described is capable of giving good results without calling for critical adjustments.

A suitable modulator is included, together with the necessary power supply for working off A.C. mains, the whole forming a complete transmitter on one chassis.

## CIRCUITS.

The complete circuit diagram is given in Fig. 1. The radio frequency circuits, of the balanced push-pull type, are built around two type 4074A twin triode valves, which are designed for use at very high frequencies and are capable of realising high efficiency. At the same time, the power requirements, both L.T. and H.T. are economically low. The transmitter is nominally rated at 15 to 20 watts input, the R.F. output being between 10 and 12 watts.

The first 4074A valve is employed as a self-excited master oscillator in a somewhat unconventional circuit which requires only one tuning control and which, in practice, functions well. The frequency stability is good, sufficiently so in fact, to enable the use of C.W. in a particular manner, of which details are given later. The full high tension voltage is not required on the first stage and the surplus is dropped through R5. A closed circuit jack (J3) enables a meter to be plugged in to read the anode current of this stage. The master oscillator produces more R.F. voltage than is necessary to excite the power amplifier, and this factor enables the loading to be kept low, with a consequent improvement in frequency stability.

The second 4074A valve acts as a balanced push-pull Class C power amplifier with a somewhat higher L/C ratio in its anode circuit than is employed in the master oscillator. A 0/100 milliammeter is permanently wired in the anode circuit. Neutralisation is effected by Cat. No. 481 Neutralising Condensers, mounted symmetrically in easily accessible positions.

Bias for the M.O. valve is obtained through separate resistors and for the P.A. valve through a

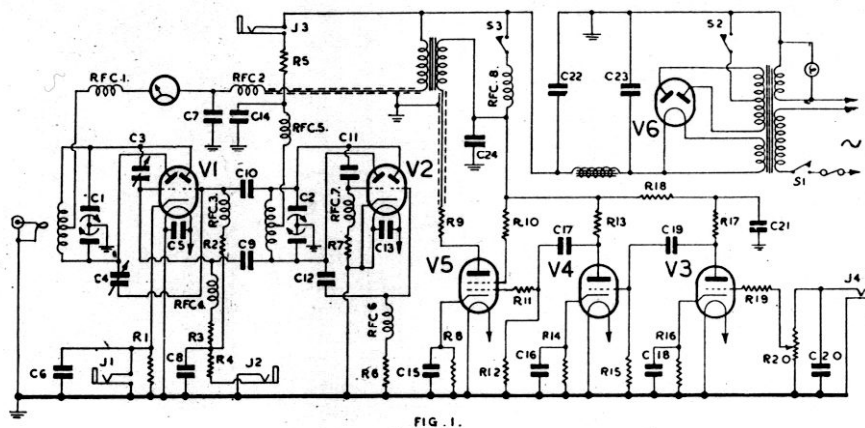


FIG. 1.

combination of resistors. Whilst not essential, a certain amount of fixed bias, obtained from a battery, is advisable on the P.A. valve and the jack (J2) may be employed for the connection of this additional bias. This jack is primarily included to enable measurement of grid current to be made, this being necessary when neutralising the transmitter. The resistor in the cathode circuit of the P.A. valve is normally shorted out when the transmitter is functioning properly but it is included for use during tuning operations and for the special method of C.W. operation.

The modulator conforms to standard practice and, as shown in Fig. 1, is intended for use with a crystal type of microphone. If a moving coil microphone is employed, a suitable coupling transformer must be included. If a carbon microphone is used, the second valve may be omitted, in which case of course, the anode of the first valve will be coupled to the grid of the output valve.

The first two stages in the modulator use triode valves, the first a medium impedance type and the second a low impedance type. The beam power output valve is capable of giving up to 8 watts audio output, which is sufficient for full modulation of a 16 watt carrier. The switch S3 cuts off H.T. to the modulator valves when C.W. is being used. The correct output load of the EL35 valve is 2,500 ohms and this is matched into the P.A. anode impedance of approximately 5000 ohms by a multi-ratio transformer.

With the modulator and R.F. stages all on one chassis, precautions are necessary to avoid R.F. getting back into the modulator. Adequate filtering is included so that no difficulty should be experienced from this trouble.

The power supply also follows normal practice. It uses the Mullard type FW4/500 rectifier since the total H.T. current consumption is in the region of 150 milliamperes. When the transmitter is in operation, all heaters are allowed to run contin-

uously and S2, which breaks the H.T. centre tap to earth, is employed as a transmit/standby control.

### GENERAL CONSTRUCTION.

The transmitter is built on a standard chassis Cat. No. 617, with a 8 $\frac{3}{4}$ " front panel and two side angle brackets, the whole forming a rigid unit of pleasing appearance. Placing the transmitter, modulator and power supply all on the one chassis means that little space is wasted but no undue constructional difficulties will be experienced if the work is carried out in proper sequence.

The photographs Figs. 2, 3 and 4, show clearly the lay-out which has been adopted, whilst the chart, page 9, gives details of the spacings between various components. It is suggested that a dummy chassis top and panel are cut out of stiff cardboard and all the components, screens, etc., laid out thereon and the positions carefully marked. The cardboard pieces may then be used as templates for marking out accurately the actual chassis and panel.

The Retailer from whom the items are purchased may be in a position to assist the constructor in the work of making the larger holes, otherwise the help of a local metalworker should be engaged. Note that the jacks and switches are fitted to the front of the chassis and  $\frac{3}{4}$ " holes to give clearance are required in the front panel. Two jacks (J2 and J3) and two switches (S1 and S2), being those which are less frequently used, are mounted at the rear of the chassis. The smoothing condensers take the form of a three-in-one block, manufactured by British Insulated Cables Ltd. This block mounts conveniently below the chassis to the rear, thereby saving top space.

### THE RADIO FREQUENCY STAGES.

Tandem construction, with the valves in a horizontal position, permits an efficient lay-out with an absence of long leads. To reproduce the excellent

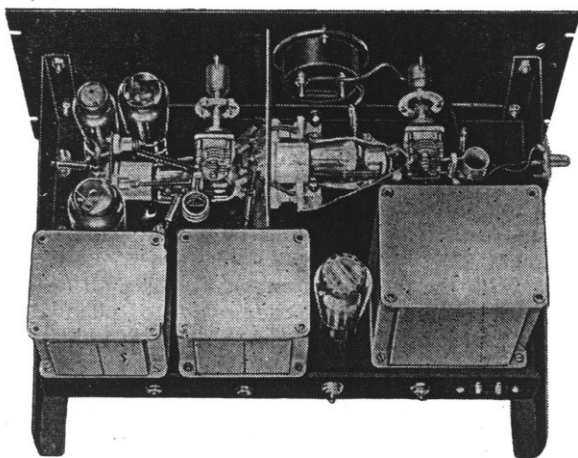


Fig. 2. Top view illustrating the lay-out of the transmitter.

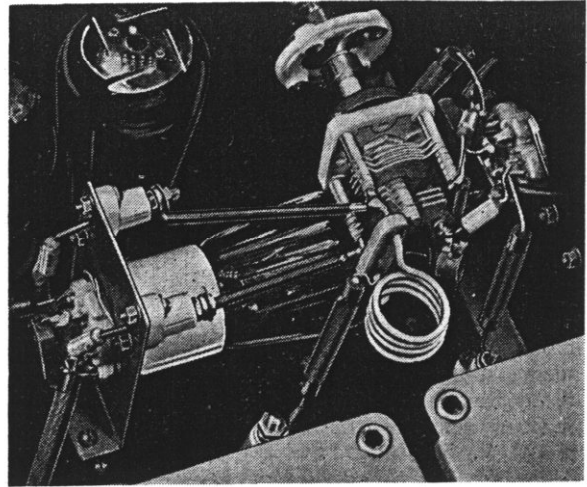


Fig. 3. Close-up view of oscillator stage.

results given by the prototype this layout should be followed closely, for which purpose a close-up view of the master oscillator stage is shown in Fig. 3.

The M.O. valveholder is fitted to its bracket with the cathode pin at the top. To each top corner of the bracket is fitted a midget stand-off insulator, employed as a lead-through to hold the grid condensers and associated wiring firmly in place. The grid R.F. chokes are similarly held rigid by two further insulators on the chassis, leads being taken from the undersides to the grid resistors. The M.O. tuning condenser is fitted to an adjustable bracket and its associated tuning coil soldered directly on the end lugs on the stator sections. One end of the anode R.F. choke is soldered to the centre of the coil, the other being taken to the top of a Cat. No. 564 red lead-through insulator. The tuning condenser rotor is connected to the cathode pin of the valve via a short piece of thick copper braid.

A 6" square brass screen holds the P.A. valveholder and the neutralising condensers, which are themselves fitted to miniature stand-off insulators. Two holes in the screen are necessary to enable the grid connections to pass through to the neutralising condensers. The P.A. tuning condenser is mounted on an adjustable bracket in a position which brings it close to the valve top caps. As before, the coil is soldered directly across the condenser and the R.F. choke from the centre of the coil is held by a midget insulator, from which a lead is taken to the meter. Another red lead-through insulator carries the H.T. supply through the chassis, an R.F. choke (RFC2) and by-pass condenser (C7) being fitted as closely as possible to this insulator to prevent stray R.F. being carried below the chassis.

As a result of keeping the wiring short, the insertion of the valves is a little difficult but this is no real disadvantage since it is unlikely that the valves will require changing over long periods. The valves should initially be fitted in their holders before the



adjustable brackets are fixed in place and should it become necessary at any time to change a valve, the nut holding the tuning condenser should be slackened off and the condenser itself gently lifted sufficiently to give clearance for the removal of the valve and the insertion of a new one.

Aerial coupling is effected by a single turn coil of 18 s.w.g. wire, enclosed in sleeving and looped around the centre of the P.A. coil. The ends of the loop are soldered to a Belling-Lee coaxial aerial socket, fitted to a brass bracket which, in turn, is mounted on the angle bracket opposite the coil.

### MODULATOR AND POWER SUPPLY.

The modulator valves are grouped together near the master oscillator and the associated components are arranged on group mounting boards fitted beneath the chassis near the appropriate valveholders. The power supply components and the modulation transformer are fitted at the rear of the chassis and mounting of them should be left to the last, to allow the chassis to be easily handled for wiring up. Details of this part of the construction are clearly shown in the photographs.

### WIRING.

To begin with, the M.O. and P.A. radio frequency stages should be wired, followed by the group boards and audio circuits and finally the power supply circuits.

The cathode, one heater and the two blank pins on the M.O. valveholder are all soldered to a tag bolted on to the brass bracket. Condenser C<sub>4</sub> is soldered directly across the heater pins and a flexible lead from the "live" heater taken through a hole in the chassis. The other components associated with this stage are then wired up.

The silver plated tuning coil, a Cat. No. 602 of four turns, is soldered to the condenser lugs nearer the M.O. valveholder and to the same lugs are soldered stiff pieces of wire from the grid lead-through insulators. Anode caps on short flexible leads are soldered to the other condenser lugs. Note that the anode connections are crossed over so that the grid condenser goes from the grid of one triode section to the anode of the other. The valve will otherwise fail to oscillate.

The P.A. stage wiring is very similar. In this case, an additional condenser is soldered across the cathode pin and earth tag, and leads through the chassis are required both for the cathode and live heater connections. The tuning condenser rotor is not earthed but is allowed to "float." The tuning coil is one of five turns. It is again necessary to cross over the connections between the anodes of the P.A. valve and the neutralising condensers.

The chart gives details of the components which are fitted to the group boards, No. 1 being the board mounted on the side of the chassis and the others numbered reading outwards from this. The small components are of course fitted to the boards

before the latter are bolted in place below the chassis, using spacing washers to prevent any possibility of short circuits occurring. The wiring of the R.F. stages can then be completed. If a suitable power supply is available (one giving between 150 and 250 volts will serve) it will be well to give the R.F. stages a preliminary test as outlined below, to ensure they are functioning correctly.

Next the audio stages may be completed. The majority of the components are already in place on the group boards but some, R<sub>9</sub>, R<sub>10</sub> and R<sub>11</sub> for example, are held in the wiring and should be connected with very short leads. The electrolytic by-pass condensers are connected between the appropriate valve pins and the nearest chassis earthing point. The lead from the underside of the red lead-through insulator to the modulation transformer should be of screened cable and likewise the lead from the modulation transformer to the anode of V<sub>5</sub>. The H.T. connections for the three modulator valves are brought to a common tag from which a by-pass condenser is connected to earth. From this tag also a lead is taken to S<sub>3</sub> via a radio frequency choke.

Tags 1 and 6 form the primary of the modulation transformer and are connected to the anode of the EL35 valve and to H.T. via the switch S<sub>3</sub>. The secondary tags, connected in series with the H.T. supply to the power amplifier, are 7 and 10. It is also necessary to connect up the following tags:— 2 to 5; 7 to 9; and 10 to 12.

The audio circuits may now be tested but, before doing so, connect a dummy load — a high wattage resistor of 5,000 ohms or near — across the modulation transformer secondary winding.

Finally, it only remains to mount and wire up the mains transformer and smoothing choke. The safety fuse fitted in series with the primary of the transformer is fixed to the rear of the chassis, between the two switches, a 1 ampere fuse being adequate.

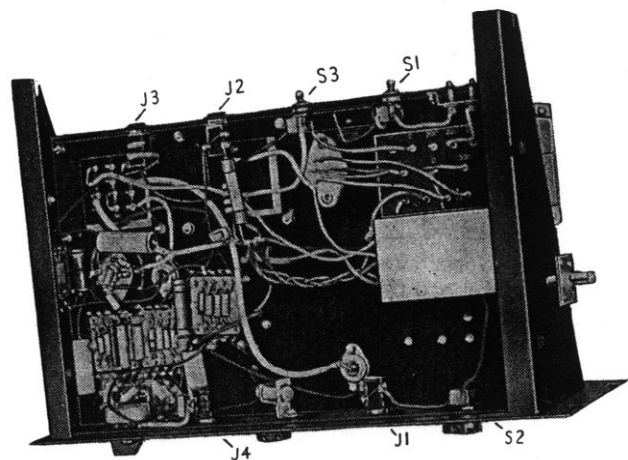


Fig. 4. Under chassis view of the transmitter.

### PRELIMINARY ADJUSTMENTS.

On the first test, H.T. should be applied only to the M.O. valve, after ensuring that the heaters of all valves are alight. A reading of approximately 40 milliamperes should be indicated on a meter plugged into J3 (at the rear) and touching a grid pin should cause this current to vary, indicating oscillation. It is doubtful whether a neon lamp will light — a good one will but a poor one will not.

On plugging a meter into J2, a current in the region of 25 mA should be shown. This is more grid current than the valve is rated for and more than is required but the reading will drop when H.T. is applied to the P.A. valve. Variation of C1 will, in all probability, cause variations in the amount of grid current, due to the final stage not being neutralised. Starting with the neutralising condensers at minimum capacity, screw them in equally, a little at a time, swinging C1 over a small range, until no change of grid current is observable. In the photograph the neutralising condensers are set at the correct adjustment and this will serve as a guide.

Before applying H.T. to the P.A. valve, remove the short circuit across R1 by inserting an unconnected plug into J1. Alternatively connect about 25 volts of negative battery bias in series with J2, either of which methods will prevent damage to the valve through the excessive anode current which may flow. Also it is not wise to run the valve without some form of artificial aerial load, which may take the form of a 24 volt 6 watt bulb connected to the aerial socket, preferably via a length of coaxial cable. With the P.A. anode circuit off resonance, a fairly high reading will be indicated on the anode meter, but on rotating C1 to bring the circuit into resonance, this current will drop considerably. The grid current will also drop and will now be in the region of 10 mA., which is the correct value. By adjusting the coupling loop, it will be found possible to light the bulb brightly and care must be taken not to burn it out. A neon lamp held near the tank coil will strike easily. On closing S3, which applies H.T. to the modulator section, and speaking into the microphone, the brilliancy of the bulb should vary, indicating modulation.

In the original transmitter, the amateur band of 58.5 to 60 megacycles covers 67 to 55 degrees of the master oscillator dial. If the lay-out has been closely followed, the amateur band will occupy a similar range in a duplicate transmitter but, before putting it "on the air" for radiation tests, it is essential to check the frequency and ensure that it is set correctly. Space does not permit a description of methods of measuring the frequency and the reader is referred to the hints given in the article on the V.H. Frequency Meter in this Manual and to Handbooks dealing at length with the subject.

### AERIAL COUPLING.

In general, it will be found that the single turn aerial coupling loop advocated is adequate for use with coaxial feeder or with other methods of feeding the aerial. The power amplifier valve should draw

about 60 milliamperes with the aerial coupling correctly adjusted but it will be well to experiment with the degree of coupling, to secure optimum radiation. A coaxial feeder is, in any case, recommended, as it has been found that with an open aerial connected to the aerial socket on the transmitter, R.F. feedback to the modulator stages can occur, with consequent instability.

### C.W. OPERATION.

The tone of the note given by this transmitter is pure D.C. in character and quite steady. If, however, the H.T. supply to the power amplifier is keyed, the variation of H.T. voltage and of the load on the first valve naturally causes considerable changes of frequency. The system therefore adopted is to key across the resistance (R1) in the cathode of the P.A. valve, by which means only a relatively small change of frequency occurs. When keying in this manner, two separate frequencies are radiated, one of which forms a "marker" wave and is capable of being received on either a straight or a superheterodyne receiver. This system, although somewhat novel, works quite well in practice and is recommended to newly licensed amateurs, who are not permitted to use telephony for the first twelve months.

The actual value of cathode resistance necessary is governed by the total cathode current taken by the P.A. valve. The aim should be to produce the smallest change of frequency which will give adequate spacing of "marker" and "spacer" signals — say 10 kilocycles. It may therefore be necessary to wire in across the key terminals a supplementary 1,000 ohm variable resistance, of the wirewound type, and adjust it to give the proper separation, as indicated on a near-by receiver. Due to valve heating, a slight frequency creep may be evident but it is not serious, provided the transmitter has been given time to warm up before operating. No trouble has been experienced in holding and reading the signal on a very selective superheterodyne receiver. If a suitable piece of rubber is available, it will be well to place it to support the chassis and so protect the latter from external vibration.

When using this (or any other) 60 Mc/s. transmitter, it is important to remember that a four foot length of wire is near enough a quarter wavelength long at the working frequency and, because of this fact, considerable R.F. pick-up is possible on the key and microphone leads, irrespective of whether or not the leads are screened. To minimise such pick-up, the leads should be made either very short or considerably longer than four feet, at the same time keeping them as far away as possible from the aerial lead or feeder. If, in spite of these precautions, it is suspected that R.F. is reaching the modulator valves in the transmitter, mica or ceramic condensers, of a value about 100 pF., should be soldered directly across the grid and cathode pins of each valve in the modulator section. These will effectively by-pass to earth any R.F. at these points, without having any noticeable effect on the speech quality.

COMPONENTS LIST.

2 Air Dielectric Trimmers, 25 pF × 25 pF	Eddystone Cat. No.	583
2 Neutralising Condensers, 4 pF	..	481
7 R.F. Chokes, V.H.F.	..	1011
1 R.F. Choke	..	1010
2 Adjustable Mounting Brackets	..	1007
2 Slow Motion Precision Dials, 2" Silver	..	639
2 Flexible Couplers, Large Size	..	1009
9 Midget Stand off Insulators	..	1019
2 Red Lead Through Insulators	..	565
1 U.S.W. Coll, 4 turns	..	602
1 U.S.W. Coll, 5 turns	..	603
1 Instrument Knob, 1½"	..	1089
1 Chassis	..	617
1 Panel, 8½"	..	620
1 Pair Angle Brackets	..	618
1 Mains Transformer, Outputs 300-0-300 v. 150 mA	Woden	
6.3 v. 3 amp. 4 v. 3 amp.	Woden type C.S.P.12	
1 Smoothing Choke, 20 H., 150 mA	Woden type U.M.1.	
1 Modulation Transformer	Standard Telephones & Cables Ltd.	
2 Valves (V1, V2), 4074A	Mullard	
1 Valve (V6), F.W. 4/500 Rectifier	Osram	
1 Valve (V3) L.63	Mullard	
1 Valve (V4) E.C.31	Mullard	
1 Valve (V5), E.L.35	S.T.C.	
2 Valveholders, American 7-pin Ceramic		
3 Valveholders, Octal Ceramic		
1 Valveholder, British 4-pin.		
1 Smoothing Condenser Block, 3 × 8 mF, 550 v. B. I. Ltd.	Weston	
1 Milliammeter, 100 mA, Moving Coil	Rothermel	
1 Microphone, D.104, Crystal	Bulgin	
3 Switches, S.P.S.T., S.81	Belling Lee	
1 Fuse Holder and Fuse (1 amp.), L.1045/C3	Bulgin	
1 Panel Light Holder and Bulb D.19	Igranic	
4 Telephone Jacks, Insulated, Closed Circuit		
2 Electrolytic Condensers 50 uF, 12v. (C16, 18).		
1 Electrolytic Condenser 25 uF, 25 v. (C15).		
2 Ceramic Condensers, 10 pF (C9, 10).		
2 Ceramic Condensers, 40 pF (C11, 13).		
8 Mica Condensers .0003 uF (C5, 6, 7, 8, 13, 14, 20, 24).		
2 Tubular Paper Condensers, .01 uF (C17, 19).		
2 Resistors, ½ watt, 5,000 ohms (R6, 7).		
2 Resistors, ½ watt, 500 ohms (R2, 3).		
1 Resistor, ½ watt, 50,000 ohms (R18).		
1 Resistor, ½ watt, 100,000 ohms (R17).		
1 Resistor, ½ watt, 1,000 ohms (R14, 16).		
1 Resistor, ½ watt, 2,000 ohms (R15).		
2 Resistors, ½ watt, 10,000 ohms (R11, 13).		
1 Resistor, ½ watt, 1 Meg. (R15).		
1 Resistor, 1 watt, 200 ohms (R8).		
1 Resistor, ½ watt, 250,000 ohms (R11).		
1 Resistor, ½ watt, 100 ohms (R10).		
1 Resistor, ½ watt, 12 ohms (R9).		

- 1 Resistor, Variable, 2 Megohm (R20).
- 2 Resistors, 5 watt, 1,000 ohms (R1, R5).
- 1 Resistor, 1 watt, 1,000 ohms (R4).
- 1 Resistor, ½ watt, 500,000 ohms (R19).
- 4 5-way Group Boards.
- 1 Aerial Coaxial Socket, L.373/Skt. Belling Lee
- 1 Aerial Coaxial Plug, L.373/P.8 Belling Lee
- 1 Mains Connector, P.31 Bulgin

NOTE.—The resistance values given are not critical. All may be of 20% tolerance and the nearest preferred size will serve if the actual value specified is not obtainable.

CHART OF

CONSTRUCTIONAL DETAILS & DIMENSIONS.

Details of dimensions, spacings, etc., of screens and components used in the transmitter. Distances are from valveholder, etc., centres or from fixing hole centres in the case of items such as adjustable brackets, etc.

CHASSIS (looking at front).

- M.O. Valve Bracket 2" wide, 3" high plus ¼" flange. Valveholder central 1½" up. Fixed 2" from R.H. edge, centre 3½" from front.
- M.O. Condenser Adj. Bracket fixed 2½" from front, 6" from R.H. edge. Screen 6" by 6" plus ¼" flange. Fixed 8" from R.H., 9" from L.H. edge flush to panel. Valveholder central 2½" up. Midget insulators 2½" up each side of valveholder.
- P.A. Condenser Bracket (adj.) 4" from L.H. side, 2½" from front.
- Midget Insulators (M.O. grid chokes), 3" apart, ½" from R.H. edge.
- Midget Insulators (P.A. grid chokes), 3" apart, ½" right of screen.
- Red Insulators M.O., 4" from R.H. edge, 5" from front.
- P.A. 6½" from R.H. edge, 1½" from front.
- V3, V4 valveholders 1½" from front, 1½" apart.
- V5 valveholder 7½" from front, 2" from R.H. side.
- Jack holes ½" diam., switch holes ½" diam., all 3" apart, 1" up from lower edge.

Hole for Mains Connector at rear of chassis 1½" × ½".

PANEL (looking at front).

- 5" × ½" clearance holes for jacks, switches, etc., 1" up from lower edge.
- ½" holes for dials — M.O. 5" from lower edge, 7" from L.H.
- P.A. 5" from lower edge, 5" from R.H. edge.
- Meter 2½" hole, 2½" from top edge, 8½" from L.H. edge.

DETAILS OF COMPONENTS ON GROUP BOARDS.

- No. 1. R6, C14, R7, R5.
- No. 2. R14, R12, R8, C17.
- No. 3. C19, R15, R18, R17, R16.
- No. 4. R1, R13, C8, R2, R3.

The details given above represent the order in which the components are mounted, reading left to right, looking at the front of the inverted chassis.

# V.H. Frequency Meter

Continued from Page Four.

only a small, or perhaps no reading is obtained, the instrument should be moved nearer but care should be exercised to prevent damage to the microammeter.

No meter reading will be possible when measuring the frequency of a receiver but indication will be given in the manner normal to absorption type meters — that is, cessation of oscillation at resonance, or diminution of quench noise.

The meter may be used to indicate neutralisation of a power amplifier. With H.T. removed from the P.A. and the tank circuit tuned to resonance, a small reading should be obtained on the frequency meter when it is placed near and tuned to the transmitter frequency. Adjustment of the neutralising condenser, at the same time swinging the tank condenser slightly to maintain resonance, should be made, until no meter reading is obtainable.

If a transmitter with a fair amount of power is employed, the meter can be used to measure qualitatively the radiation from an aerial system and to show the effect of various degrees of aerial coupling. The polar diagram and back to forward ratio of a

beam array can be determined and the positions and lengths of director and reflector elements adjusted for optimum radiation in the desired direction.

One further application of the frequency meter is as a standing wave detector on open wire feeder lines. If, on moving the aerial rod attached to the meter along a feeder line, the meter reading fluctuates considerably at regular intervals, it is a definite indication of the existence of standing waves along the line. Further adjustments of matching, particularly at the aerial end, should make it possible to reduce the variations to a small amount — it will usually be difficult to remove them completely.

COMPONENT LIST.

1 Air Dielectric Trimmer 15 pF (C1)	Eddystone Cat. No.	580
1 Direct Drive, 2" Dial (Black)	..	595
1 U.S.W. Coll, 5 turns	..	603
1 R.F. Choke (VHF)	..	1011
1 Die-cast Metal Box with Lid	..	650
2 Midget Insulators	..	1019
1 Switch, SPST, type S.80	..	Bulgin
1 Meter 0—500 microamps	..	Hobut
2 Ceramic Condensers, 10 pF (C2, 3)	..	Erlie
1 Mica Condenser .0003 mF (C4).	..	
1 Valve 1T4 or EA 50	..	Mullard
1 Valveholder, as required.	..	
1 L.T. Cell, 1.5 volt.	..	

## Five—Ten 3-Valve Converter Unit

### INTRODUCTION.

When used in conjunction with a short-wave receiver (which may be either a T.R.F. or superheterodyne, the very high frequency converter described below enables signals on the 5 and 10 metre amateur bands to be received. The short-wave receiver may already include the 10 metre band in its coverage but it is likely that both sensitivity and selectivity may be poor at this extreme range and the use of the converter will result in a much better performance generally.

The super-regenerative type of receiver has inherently low selectivity, is unable to receive C.W. signals and is liable to cause serious interference to other receivers and its use is therefore deprecated. The converter unit suffers from none of these defects and is capable of giving excellent results with any type of shortwave receiver.

### CIRCUIT.

The converter unit has been designed and built around three modern valves, of a type which ensure really good performance at very high frequencies. As shown in the circuit diagram, Fig. 1, an EF54 (previously known as an RL7) single ended R.F. pentode is employed as a tuned R.F. amplifier. It will normally be operated at full gain but a variable resistor (R2) is included to enable gain to be reduced when strong local signals are being received. This system of gain control works quite well, even though the EF54 valve is not of the variable-mu type. The frequency changer is an EF50, with suppressor grid injection from the local oscillator, which employs an EC52 (previously RL16) triode. The tuned circuit of the latter incorporates a fixed condenser in parallel with the split-stator tuning condenser, which arrangement results in adequate spreading of the amateur bands. The R.F. and F.C. tuning condensers are ganged and controlled by a direct drive, since tuning of these stages is not critical. Conversely, the oscillator tuning is sharp and a good slow motion dial is essential.

Interchangeable coils are employed, three being required for each band. The aerial input is arranged for a coaxial feeder from a dipole aerial, although other types may be used. The intermediate frequency output, at 1.6 megacycles, is taken via a short-length of coaxial feeder to the short-wave receiver. An open wire should not be used or pick-up of unwanted signals around 1.6 Mc/s. may occur.

### CONSTRUCTION.

The converter is built on a diecast aluminium chassis and enclosed in a metal cabinet. Very com-



plete screening is essential and therefore a certain amount of metal work is unavoidable. As shown in the photograph of the top deck, Fig. 2, the oscillator section is screened off by a piece of metal which should be as thick as possible — preferably not thinner than 18SWG — and arranged to come flush with the front of the chassis. The oscillator condenser is mounted on a metal bracket, the dimensions of which, together with those of other metal parts, is given in the chart (page 12). The screen beneath the chassis measures

9" by 2" and should be bent to shape and fixed so that it screens off all components associated with the R.F. stage from those of the other two stages. Three small holes are required in this screen, for connections to H.T., L.T., and the suppressor grid of the EF50. The latter hole should be made immediately opposite the appropriate pin of the EF50 valveholder, to enable the lead to be kept separate from other wires.

The mounting of the gang condenser calls for detailed explanation. It is not desirable to use in this position a twin gang condenser with a common spindle, since coupling between the R.F. and F.C. stages will occur. Two Cat. No. 580 air dielectric trimmer condensers are therefore employed, with a medium size insulated flexible coupler. The condensers are held together by two brass rods, 2 $\frac{3}{8}$ " long and either  $\frac{3}{16}$ " or  $\frac{1}{4}$ " square, tapped 6 BA at the ends and screwed to the spare holes in the ceramic end plates. Two further tapped holes in each rod enable the assembly to be fixed to the chassis. Spacing pieces  $\frac{3}{16}$ " long are employed to hold the condensers above the chassis, with the stator plates uppermost. If tapping facilities are not available, two 3" lengths of 6 BA screwed rod may be used, with nuts and washers on both sides of the ceramic plates. Small brass feet, for mounting purposes, can then be located conveniently along the rods and held in place with 6BA nuts.

The screen between the two condensers is fixed to the rear condenser by the nut on the spindle bush, two slots being cut out to take the brass rods. The screen, which again should be of stout metal, comes flush with the chassis. It projects slightly over the edge on one side and is close against the EF50 valve on the other side. Each coil holder is fitted as close as possible to its associated condenser, leaving a small clearance between the coil and the condenser plates. The bracket holding the aerial socket is fitted on the edge of the chassis and a single

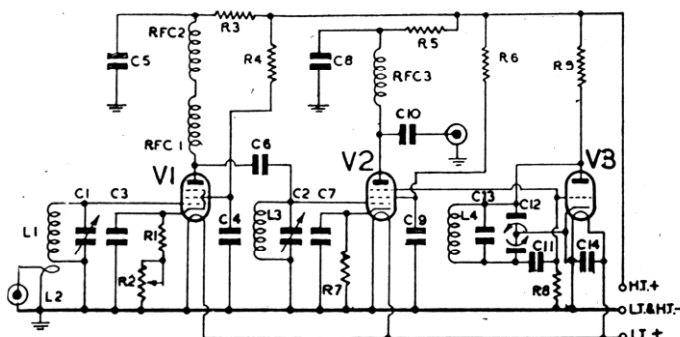


Fig. 1.

turn coupling of 18 SWG wire is arranged close to the R.F. coil.

When fitting the chassis into the cabinet, it is good plan to fit short extension spindles to the flexible couplers, of a length to bring them level with the gain control spindle. A spot of paint on the end of each spindle will then leave an indication on the inside of the cabinet front of the exact point at which the appropriate holes should be drilled. A hole  $\frac{3}{8}$ " diam. is required in the side of the cabinet to give clearance to the aerial plug.

#### WIRING.

It is hardly necessary to say that in a V.H.F. unit of this type, it is imperative to keep short all R.F. wiring and particularly the wiring in the tuned circuits. Also, loops in the wiring must be avoided as far as possible — for instance, when grounding several points, separate wires should be used, each going to the same soldering tag on the chassis, rather than one wire running from component to component and thence to chassis.

To take the oscillator stage, the coil base is lifted  $\frac{5}{16}$ " above the chassis so that the soldering tags come level with the condenser lugs. Short wires through the chassis connect to the anode pin and the grid condenser. The latter is supported on a single insulated tag. R8 and C14 are soldered directly across the appropriate valve pins, and C13 directly across the upper condenser lugs.

The frequency changer wiring calls for little comment. The tag on the tuning condenser bush is soldered to the "cold" end of the coil base and to a tag fitted under the coil base fixing screw. The positions of the other components associated with this stage are clearly shown in Fig. 3.

The tag on the R.F. tuning condenser and the cold end of the coil base are both soldered to a tag bolted to the chassis. The other components are grouped closely around the valveholder, insulating tags being employed where necessary, to hold parts rigid. Two R.F. chokes in series are necessary in the anode circuit of the R.F. valve. The VHF choke (RFC1) is held between the anode valveholder pin and a single tag strip beneath RFC2 (which is visible in the photograph) and is held by another tag strip, to which R3 and C5 are also connected.

The power supply leads are brought together to a tag strip bolted to the rear of the chassis. All valve pins labelled "screen" and the tag on the centre spring grip of the V2 valveholder are soldered to a common earthing tag. In the case of V1, the screen is connected internally to the cathode and the pins marked "screen" are left alone, but the centre tag is earthed.

#### PUTTING THE CONVERTER INTO OPERATION.

The converter requires 6.3 volts 1 amp. for the valve heaters and 200/250 volts 30 mA (approx.) H.T. supply. These may be obtained from the set used with the converter (provided the mains transformer will not thereby be overloaded), from a separate mains unit or from batteries. Smoothing must be good, to prevent A.C. modulation of the oscillator.

The output socket is connected to the aerial input of the receiver, which should be tuned to 1.6 megacycles. If the receiver is a superhetrodyne the B.F.O. will be used as usual for the reception of C.W. whilst in a straight receiver, the detector stage should be just oscillating. A suitable aerial system should be connected to the aerial socket.

A low power oscillator, roughly calibrated, will be found an asset in ascertaining that the converter is working properly, particularly on the 60 Mc/s. band, where, in some localities, signals may be rare. On the 60 Mc/s. band, 3 turn coils are plugged into the R.F. and F.C. coil sockets and a 4 turn into the oscillator coil socket. The actual oscillator range, over the full dial, will be 53 to 63 Mc/s. The oscillator may therefore be used either 1.6 Mc/s. higher or lower than the signal frequency — in the latter case, the coverage will be from 51.4 to 60.5 Mc/s. and the amateur band (58.5 to 60 Mc/s.) will occupy from 60 to 48 degrees. Future possible extensions of the band are also covered.

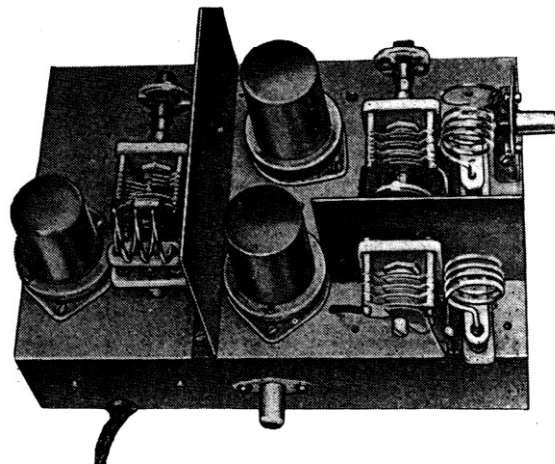


Fig. 2. The oscillator is to the left of the metal screen. Front right is the frequency changer and rear right the R.F. stage.

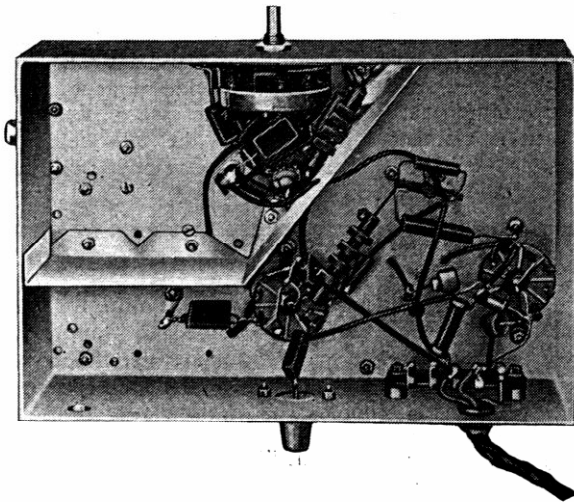


Fig. 3. Under-chassis view of the Converter. RFC2 is shown near the potentiometer and beneath it, but not visible is RFC1.

The left hand smaller dial controls the R.F. and F.C. tuning condensers and the noise level will increase at resonance. The dial reading will be 50° approx. at 60 Mc/s. Whilst not critical, the tuning of these stages must be kept in step with the oscillator or signals will be missed. The coils, condensers and stray capacities associated with the first two stages are all similar and ganging is therefore fairly good. Fine adjustment can be carried out, with the aid of a steady local signal, by opening up or closing up one of the coils, but this coil must then be marked so that it is always put back in the same coil socket.

For use on the 28 Mc/s. band, three 10 turn coils are plugged in. In this case, the oscillator covers 28 to 35 Mc/s. and is set 1.6 Mc/s. lower than the signal frequency, giving coverage of from 26.4 to 33.4 Mc/s. The band of 28 to 30 Mc/s. is covered from 78 to 44 degrees on the oscillator dial, the R.F./F.C. dial setting being in the region of 90 degrees. All settings are, of course, approximate but close

agreement will be found providing the layout shown is accurately followed.

The aerial coupling coil should be very close to the tuning coil and, on 28 Mc/s., it may be found an improvement with some aerials to use two turns instead of one.

#### CHART OF CONSTRUCTIONAL DETAILS, (Looking at Front.)

- Central Brass Screen 4" high, 5½" long, with mounting flange fitted 5" from L.H. edge, 3½" from R.H. edge.  
 Oscillator Condenser Bracket, 1½" wide, 1½" high, plus flange. Fitted 2½" from front, spindle 2½" from R.H. edge, 1½" up.  
 V3 (OSC) Valveholder 2" from rear, ¼" from R.H. edge.  
 V1 (RF) Valveholder 1½" from front, 3½" from L.H. edge.  
 V2 (FC) Valveholder 1½" from rear, 3½" from L.H. edge.  
 Condenser Screen 3" high, 3½" wide. Condenser spindle 1½" from L.H. edge, 1½" up.  
 L4 Coil Base behind C12.  
 L1 Coil Base alongside RF Section of Condenser (fixing hole ¼" from L.H. side, 2½" from front).  
 L3 Coil Base alongside FC Condenser section (¼" from L.H. side, ¼" from rear).  
 Aerial Socket Bracket 1½" long, 1" high, plus flange, fitted flush with L.H. side, centre 1½" from front edge.  
 Lower Screen 2" deep plus flange, 9" long, bent to fit.

#### COMPONENTS LIST.

	Eddystone Cat. No.	
1 Die-cast Chassis	643	
1 Metal Cabinet	644	
2 Air Dielectric Trimmers, 15 pF	580	
1 Air Dielectric Trimmers, 25 × 25 pF	583	
1 Vernier Slow Motion Dial, Silver	637	
1 Direct Drive, 2" Dial, Silver	638	
3 Flexible Insulated Couplers, Medium Size	529	
3 U.S.W. Coil Bases	606	
3 U.S.W. Coils, 10 turns	605	
2 U.S.W. Coils, 3 turns	601	
1 U.S.W. Coil, 4 turns	602	
1 VHF Choke (RFC1)	1011	
2 R.F. Chokes (RFC 2 and 3)	1010	
1 Instrument Knob 1½"	1089	
1 Valve, type EF54 (V1)	Mullard	
1 Valve, type EF50 (V2)	Mullard	
1 Valve, type EC52 (V23)	Mullard	
3 Ceramic Valveholders, 9-pin British with Locking rings.	Belling Lee.	
6 Mica Condensers, .0005 mF. (C3, 4, 5, 7, 9, 14).		
1 Mica Condenser, .001 mF. (C8).		
2 Mica Condensers, .0003 mF. (C10).		
2 Ceramic Condensers, 10 pF. (C6, 13).		
1 Ceramic Condenser, 50 pF. (C11).		
1 Resistor, ¼ watt, 220 ohm (R1).		
3 Resistor, ¼ watt, 500 ohm (R3, 5, 7).		
2 Resistor, ¼ watt, 5,000 ohm (R4, 6).		
1 Resistor, ¼ watt, 30,000 ohm (R8).		
1 Resistor, ¼ watt, 20,000 ohm (R9).		
1 Resistor, Variable, 5,000 ohm (R2).		
2 Coaxial Sockets, type L373/Skt.	Belling Lee.	
2 Coaxial Plugs, type L373/P.8	Belling Lee.	
1 × 5-way, 3 × 1-way, 1 × 3-way Tag Strips.		

#### 28 Meg. Transmitter. CHART OF POSITIONS AND DIMENSIONS. *Continued from page 20.*

##### TRANSMITTER TOP CHASSIS.

- Crystal Holder, 6" from left hand edge, 2½" from rear.  
 V1 Valveholder, 8" from left hand edge, 2½" from rear.  
 V2 Valveholder, 5" from right hand edge, 2½" from rear.  
 L3 Insulators, 1½" apart, 2½" from rear.  
 L4 Insulators, 1½" apart, 1½" from right hand edge.  
 C13 Bracket, 1½" wide, 2½" high with ½" fixing flange.  
 Mounted 2" from front. Condenser mounted 1½" up.  
 V3 Screen, 11" (overall) by 5½" high, plus ½" flange. Valveholder 1½" up, 2½" from front.  
 L5 Insulators, 3" apart, 3" from left hand edge.  
 Coaxial Socket Bracket, 3" × 1½" wide, fixed to Angle Bracket.  
 1" holes for leads to heater and G2 of V3.  
 ½" hole for leads to anode current meter.  
 ½" hole for P.A. H.T. lead through insulator.  
 ½" hole beneath Insulator for G.B. negative lead.  
 ½" holes beneath L3 Insulators.

##### TRANSMITTER UNDER-CHASSIS AND PANEL.

- Brackets for C3, C4 and C10, 2" wide, 1½" high plus ½" flange.  
 Jack mounting holes, ⅜" diam., 3" apart at rear.  
 Hole for 10-way Socket ⅜" × 1½" — centre 3½" from right hand side.  
 In front: 4 × ¼" holes for Condenser drives and panel light (see text); 1 × ⅜" hole for Jack (5 × ¼" holes in panel); 1 × 2½" hole for meter 8" from right hand side of panel, 2½" from top.

##### POWER SUPPLY CHASSIS.

- 1 × ½" hole in front left for transmitter control switch.  
 1 × ½" hole in front right for red panel light.  
 1 × ¼" hole in centre for green panel light.  
 1 hole 1½" × ¼" at rear left for mains plug.  
 1 × ¼" hole for mains switch, 3" to right of mains plug.  
 1 × ⅜" hole for modulator plug, 5" from righthand edge.  
 1 hole ⅜" × 1½", 2" from right hand edge.  
 ⅜" hole in panel (above metal rectifier) for R.21.  
 3 × ¼" holes in panel, to match items on front of chassis.

##### MODULATOR CHASSIS.

- V9 Valveholder 1½" from right hand edge, 2" from front.  
 V5 Valveholder 6½" from right hand edge, 2" from front.  
 V6 Valveholder 2½" to left of V5.  
 V7 Valveholder 1" from front, 2" from left hand edge.  
 V8 Valveholder 2½" to rear of V7.  
 1 × ¼" hole for mains switch, front left.  
 1 × ¼" hole for panel light, 3" to right of switch.  
 1 × ¼" hole for gain control, 3" to left of panel light.  
 1 × ⅜" hole for microphone jack, 3" to left of gain control.  
 4 × ¼" holes in panel to match.  
 1 × 2½" hole in panel for meter, 9" from left hand edge (of panel)  
 1 hole 1½" × ¼" at rear right for mains plug, 2½" from top.  
 1 × 1⅜" hole at rear left for output plug, 2½" from side.

## Two-Valve Pre-Selector

### INTRODUCTION.

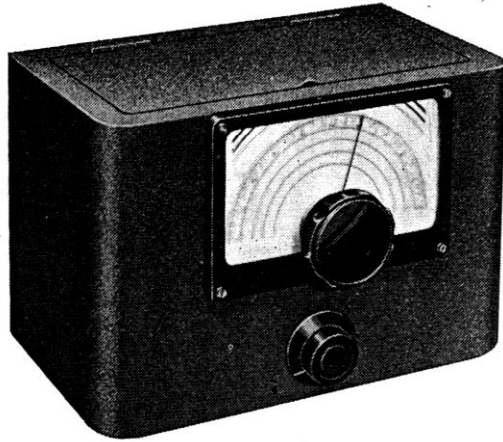
Whether used in conjunction with a straight or superheterodyne type of communications receiver, a pre-selector confers a number of advantages. In the first case, the considerable R.F. gain given by the pre-selector will enable reception of signals otherwise practically inaudible and the additional adjacent channel selectivity will be greatly improved. In the second case, using a superhet, almost if not complete freedom from image interference is an additional advantage. The pre-selector described below is designed for use with a mains operated set, from which it should be possible to draw the comparatively small power requirements. The unit may be used with a battery receiver if facilities exist for providing the H.T. and L.T. supplies, either from batteries or from a small mains power pack. Two additional tuned circuits are definitely advisable, to obtain optimum results, and therefore two valves are used in the pre-selector.

### CIRCUIT.

Fig. 1, which gives the complete circuit diagram, is practically self-explanatory. The R.F. pentode valves employed are Mullard type EF39, giving high gain with low noise level. The three types of Eddystone plug-in coils give a continuous coverage from 32 to 3.5 megacycles. The range may be extended to lower frequencies by means of additional coils, but the advantages fall off below 3 Mc/s, unless a very small or badly screened aerial is used. The tuned circuits are controlled by a single knob and the full vision dial can, if desired, be directly calibrated for each of the three ranges.

Variable gain control is fitted and at maximum gain, on some frequencies, it may be found that self-oscillation will occur. In point of fact, this feature is somewhat advantageous, as the selectivity is considerably increased when using regeneration below the point of actual oscillation. With the gain control backed off slightly, the pre-selector is quite stable. Screened leads and top connectors to the grid top caps of the valves will cure the self-oscillation but the performance on the higher frequency ranges will be affected by the losses introduced thereby.

The stray capacities across each tuned circuit are approximately equal and the Eddystone coils are closely matched during manufacture. The ganging therefore holds well over the whole range and separate trimming condensers have been found unnecessary.



### CONSTRUCTION.

The pre-selector is built on a diecast chassis, which, in turn, is enclosed in a metal cabinet. The appearance of the complete unit is pleasing and matches the excellent performance.

As will be seen from Figs. 2 and 3, which are photographs above and below the chassis, the construction is fairly simple. Two metal screens are required, their dimensions, together with other constructional details, being given on page 14.

All necessary holes should be made in the chassis before any item is permanently mounted. When fitting the chassis into the cabinet, the dodge mentioned in the article on the Five-Ten Converter should be employed. It consists of, where necessary, extending the spindles and putting a blob of paint on the end of them. A clear marking is then obtained on the inside of the cabinet of the correct point at which holes should be drilled. Three holes are required at the rear of the chassis, two for the input and output sockets, and one for the power supply cable. Note that two holes are required immediately below the tuning condenser stators to enable connections from the latter to be led through to the coil bases.

### WIRING.

Wiring up is quite straightforward and Fig. 3 clearly shows the details. C<sub>4</sub>, R<sub>2</sub>, C<sub>3</sub>, and R<sub>1</sub>, are mounted on a 5-way group board, which is bolted to the side of the chassis close to the V<sub>1</sub> valveholder. Similarly, R<sub>4</sub>, C<sub>6</sub>, C<sub>7</sub>, and R<sub>7</sub>, are mounted on another group board, fitted close to the V<sub>2</sub> valveholder. The other components are held in the wiring, small mounting strips being used where necessary.

The lead between the anode of V<sub>1</sub> and the second

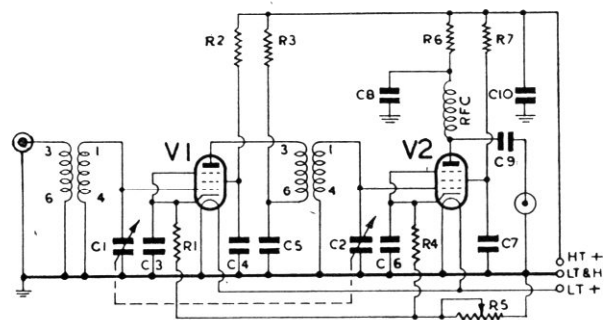


Fig. 1. Showing complete circuit diagram.

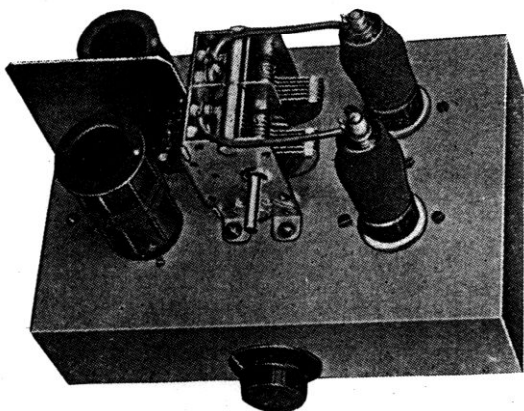


Fig. 2. The first tuned stage is to the front and the second to the rear.

coil holder should preferably consist of a short length of narrow diameter coaxial feeder, but if this is not obtainable ordinary screened wire will serve. The lead between C9 and the output socket should be another short length of similar cable.

### PUTTING THE CONVERTER INTO OPERATION.

The two EF39 valves require 6.3 volts .6 amp. for the heaters and an H.T. supply of about 250 volts, 15 milliamperes. The aerial input is transferred from the normal receiver to the left-hand aerial socket on the pre-selector and the output socket on the pre-selector connected to the receiver by means of the shortest possible length of coaxial feeder. Unscreened wire must not be employed for connecting the pre-selector to the receiver as it is liable to act as an aerial and pick up signals direct, and may also interact with the proper aerial, so causing instability.

Resonance of the pre-selector will be indicated by an increase in noise level, and, as a guide to the constructor, the following figures were obtained when calibrating the prototype model:—

Coil 6LB	..	37°	30 Mc/s	} Amateur Band
		45°	28 Mc/s	
Coil 6BB	..	0°	27 Mc/s	} Amateur Band
		100°	13 Mc/s	
		87—82°	14 Mc/s	
Coil 6R	..	0°	9 Mc/s	} Amateur Band
		100°	3.5 Mc/s	
		26—20°	7 Mc/s	

It will be noticed that a gap occurs between 9 and 13 Mc/s and listeners interested in short wave broadcasting between these two frequencies can eliminate the gap by employing two type 6Y coils.

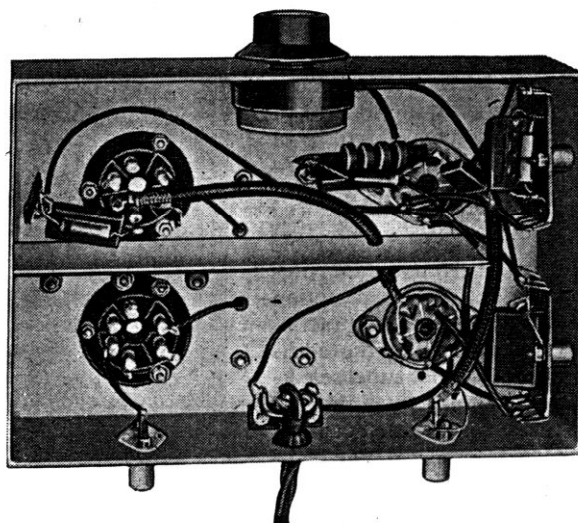


Fig. 3. View beneath the chassis of the Pre-Selector Unit.

### CONSTRUCTIONAL DETAILS & DIMENSIONS.

Tuning condenser spindle, 4½" from each edge.  
 Length of spindle projecting, reduce to ½".  
 Front condenser holes 1½" from front of chassis.  
 V1 valveholder 2" from right-hand edge and 1½" from rear.  
 V2 valveholder 2" from right-hand edge and 2" from front.  
 First coil holder 2" from left-hand edge and 1½" from rear.  
 Second coil holder 2" from left-hand edge and 2" from front.  
 Gain control central 1" up.  
 Input (aerial) socket 2" from left-hand side 1" up.  
 Output socket 2" from right-hand side 1" up.  
 Top screen 3" wide, 3½" high, plus ½" flange, mounted centrally between coils, flush with tuning condenser.  
 Lower screen 7" long, 2" deep, plus ½" flange, centrally mounted.

### COMPONENTS LIST.

1 Die Cast Chassis	..	..	Eddystone Cat. No.	643
1 Small Metal Cabinet	..	..	"	644
2 6-pin Coil Bases	..	..	"	964
2 6-pin Coils 6BB	..	..	"	959
2 6-pin Coils 6LB	..	..	"	959
2 6-pin Coils 6R	..	..	"	959
1 R.F. Choke	..	..	"	1010
2 Midget Insulators	..	..	"	1019
1 Full Vision Dial	..	..	"	598
1 Skirt Knob 1½"	..	..	"	2416P
1 Flexible Coupler	..	..	"	1009
2 Valves Type EF39 (V1, V2)	..	..	"	Mullard
2 Valveholders Octal Ceramic.	..	..	"	
1 twin gang Condenser 100 pF per section	..	..	"	Polar
2 Coaxial Sockets, type L.373/Skt.	..	..	"	Belling Lee
2 Coaxial Plugs, type L.373/P.8	..	..	"	Belling Lee
2 5-way Group Boards.	..	..	"	
1 3-way Tag strip.	..	..	"	
2 1-way Tag strips.	..	..	"	
7 Mica Condensers .001 mF (C.3, C4, C5, C6, C7, C8, C10).	..	..	"	
1 Mica Condenser .0003 mF (C9).	..	..	"	
2 Resistors ½ watt 300 ohm (R1, R4).	..	..	"	
2 Resistors ½ watt, 1,000 ohm (R3, R6).	..	..	"	
2 Resistors, ½ watt, 10,000 ohm (R2, R7).	..	..	"	
1 Variable Resistor, 10,000 ohm (R5).	..	..	"	



## 28 Megacycle C.W. & Telephony Transmitter

### INTRODUCTION.

The transmitter described below has been specifically designed to meet present-day licence conditions, particularly as they apply to the 28 to 30 Mc/s. band. At the same time, it is possible, with minor modifications, to employ the transmitter also on other high frequency bands.

Crystal control is employed and the number of valves has been reduced to the minimum. No very high voltage supply is required, yet the radio frequency output is entirely adequate for long distance communication.

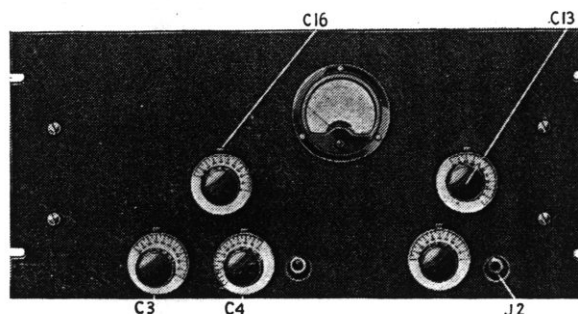
A suitable modulator and power supply are included in the design and the equipment as a whole is recommended as a thoroughly efficient and up-to-date transmitter for amateur use.

### CIRCUIT DESCRIPTION.

As will be seen from the circuit diagram, Fig. 1, the transmitter proper utilises three modern valves. The first of these (a 6V6) is employed in a triode circuit with a 7 megacycle crystal and the design is such that absolutely stable operation is assured. The R.F. voltage required to drive the second valve is low and the H.T. voltage on the 6V6 is correspondingly low — actually 150 volts. One result of this is that crystal current is small and heating negligible.

The second valve (a QV04-7) is a new type recently introduced by Mullard. It is fitted with a 9 pin glass base and the short electrode leads and general design enable exceptionally good efficiency to be achieved at the higher frequencies. In the present design, this valve operates as a frequency doubler and furnishes ample drive for the final power amplifier valve, a Mullard QV04-20. The latter is a double beam power tetrode, of similar characteristics to the American type 815. The driving power requirements are low, the overall efficiency high and neutralisation has been found unnecessary.

The modulator, which is capable of giving up to 30 watts output, follows normal practice. The first valve is a high gain microphone amplifier, enabling either a crystal or moving coil microphone to be used. The circuit as shown in Fig. 1 (b) is intended for use with a crystal microphone. If a moving coil type is employed a matching transformer will be necessary. The second valve, a medium impedance triode, is transformer coupled to the two EL37 output valves, which operate under Class AB1 conditions. A multi-ratio matching transformer is used to match the required load of the output valves (approximately 5,000 ohms.) to the impedance presented by the R.F. power amplifier stage (approximately 2,700 ohms.). The modulator has its own power supply and can therefore be switched off when not required. To secure good regulation a choke input filter



systems employed and, because of the thorough smoothing incorporated, the output is entirely free from hum.

The power supply for the transmitter provides one high tension supply, which is applied to all three stages in the transmitter, dropping resistors reducing the voltage for the first two stages. Again the filter is of the choke input type, used with a mercury vapour rectifier valve. It is desirable to have an independent supply available to provide grid bias for the power amplifier valve. This will ensure that no damage is caused to the P.A. stage, and will also avoid the use of batteries. This supply, which incorporates a metal rectifier, gives a higher maximum voltage than is required for the present transmitter, but it has been borne in mind, as with the design as a whole, that the power supply may at a later date be required for other purposes. All heaters are supplied from a separate transformer, and control of the transmitter is effected by a switch in the primary of the H.T. transformer. This switch is mounted on the panel of the power supply chassis, but, if desired, an extension lead may easily be fitted.

Inter-connection between the transmitter and its associated power supply is effected by a multi-way cable, fitted with a plug at each end. Sockets to match are fitted on the chassis. A separate 3-way lead is necessary between the modulator chassis and the power supply chassis.

### GENERAL CONSTRUCTION.

Each unit of the transmitter is built on a standard chassis, the majority of the controls being brought out to the front panels. On the transmitter chassis, three of the jacks are fitted to the rear of the chassis, the one on the front being the keying jack. If the three units are mounted in four upright channels (Cat. No. 615/642) the assembly as a whole will have a really professional appearance and occupy a minimum of space. Whilst two meters only are included in the design, the constructor may, of course, include additional meters to read the currents taken at various stages, and such meters could be accommodated in the rack on special panels which are available.

### THE R.F. STAGES.

The photograph (Fig. 2) of the upper deck of the transmitter conveys a good idea of the lay-out adopted, and, while not critical, it will be well to follow this lay-out as closely as possible, particularly in the case of the power amplifier valve, which must be well shielded to prevent instability.

The holder for the QV04-20 valve is mounted in a metal screen, which is  $4\frac{1}{2}$ " high,  $5\frac{1}{2}$ " wide and extended as shown in the photograph for another  $5\frac{1}{2}$ ". By mounting the valve horizontally in this way good screening is achieved between the input and output circuits, the anode caps are brought near the tuning condenser, and wiring in the final tuned circuit is reasonably short. The butterfly type condenser, Cat. No. 584, which is used to tune the grid circuit is fitted to a brass bracket, mounted close to the valve holder. The dimensions of this and other brackets are given later. The screen grid-by-pass condenser is screwed directly to the metal screen, close to the valveholder. Two miniature insulators, fitted with valve sockets instead of the usual 4BA screws, serve as coil holders and are mounted on the chassis to the right of the grid tuning condenser. A third insulator acts as a lead-through from the centre tap on the coil to the grid bias supply.

It is necessary to clamp around the metal ring at the base of the QV04-20 valve a metal strap, from the fixing bolt of which a connection should be made to the valveholder fixing bolt, using a very short length of copper braid for the purpose.

The tuning condensers for the other stages are all mounted below the chassis, but are controlled from the front by flexible drives. Condensers C4 and C10 are insulated from their brackets by paxolin washers, and as the rotors of these condensers are at low R.F. potential, no losses are introduced. Condenser C3 need not be insulated. Note that, whilst these condensers are centrally mounted in the brackets, the relative holes in the front of the chassis (and in the front panel) are made  $1\frac{3}{8}$ " from the lower

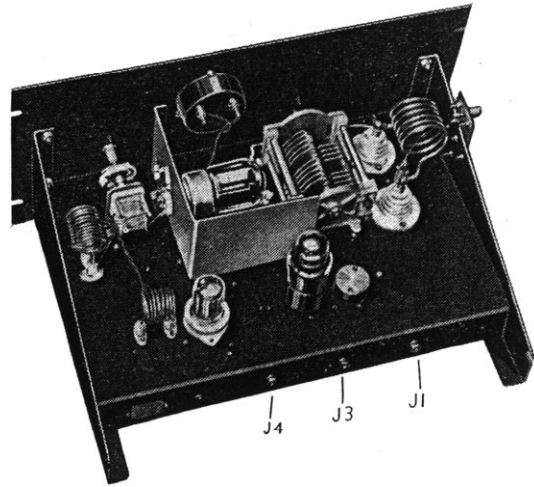


Fig. 2. View of top of the transmitter chassis.

edge, but otherwise in line with the condenser spindles, to allow easy fitting of the index strips used with the dials. The discrepancy in alignment is easily taken up by the flexible driving shafts. Fig. 3 shows the positions occupied by C3, C4, and C10 and their associated drives, which are variable in length between  $4\frac{3}{4}$ " and 6".

The tuning coil L3, which is also mounted on midget insulators fitted with sockets, is above the chassis, to enable it to be link-coupled to L4. Holes are therefore required beneath the insulators to take leads through to the valve, etc. Coils L1 and L2 are fixed to the chassis with small brass angle pieces. All the by-pass condensers are screwed directly to the chassis, the other components being held in the wiring, tag strips being used where necessary. An American 5 pin valveholder is used to hold the crystal.

Condenser C16 is lifted above the chassis by a  $\frac{1}{4}$ " metal pillars, to bring the stator plates more in line with the valve top caps and with the stand-off insulators. A  $\frac{7}{16}$ " hole is required midway between the latter to take a Cat. No. 564 insulator, which carries the high tension supply through the chassis. At the rear of the chassis  $\frac{7}{16}$ " holes are required for jacks 1, 3 and 4, and also a hole  $1\frac{1}{4}$ " by  $\frac{15}{16}$ " for the 10 way socket. A hole  $\frac{3}{8}$ " diameter, fitted with a rubber grommet is required near the front of the chassis to take the leads from the milliammeter. On the front panel  $2\frac{1}{2}$ " hole is necessary to take the meter, and  $\frac{3}{4}$ " clearance holes for the panel light and the jack. The holes for the tuning condenser controls are all  $\frac{3}{8}$ " diameter, and should be fitted with metal bushes. Small holes, to give clearance to 6BA, 1" above the spindles, are necessary for fixing the dial index strips.

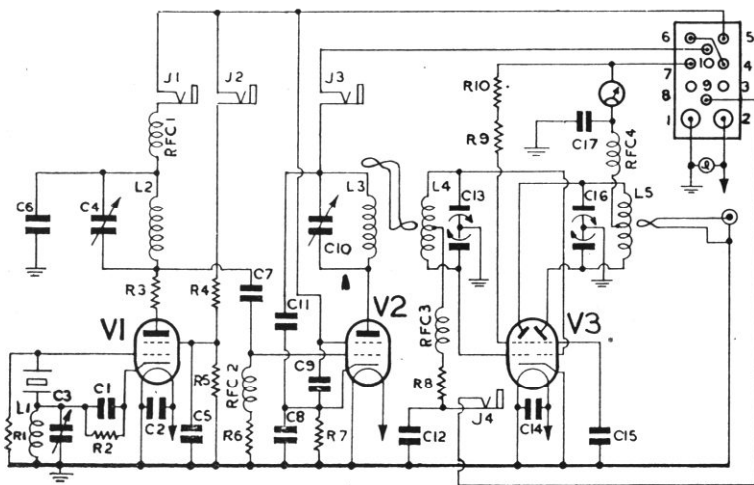


Fig. 1a. Circuit of radio frequency sections. BP583.

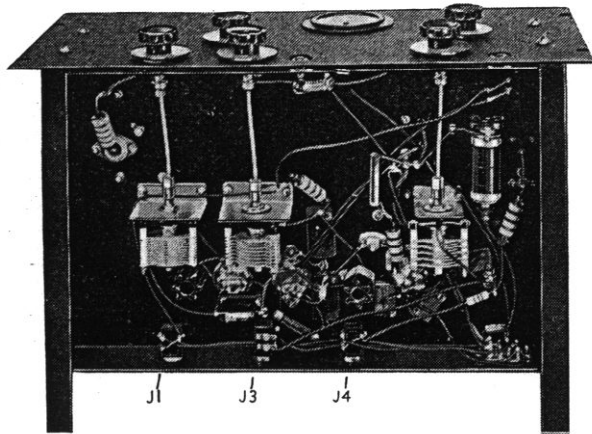


Fig. 3. Under-chassis lay-out of the 28 Mc/s. transmitter.

### TUNING COILS.

Coils L1 and L2 are wound on 1" ribbed formers, Cat. No. 646. L1 is close wound with 9 turns of 22 SWG enamelled wire and L2 has 12 turns 20 SWG wire, space one wire diameter. L3, of 8 turns, is wound with 14 SWG wire. It is self-supporting and has an outside diameter of  $1\frac{1}{4}$ ", the length being adjusted to 1", and the ends, spaced  $1\frac{1}{2}$ " apart, made to fit into the valve sockets on the stand-off insulators. L4 is similar to L3 but has 10 turns, occupying  $1\frac{1}{2}$ ". A thin flexible wire is soldered to an approximate centre tap on this coil. The link winding between L3 and L4 consists of a length of 16 SWG wire, enclosed in sleeving formed into loops at each end, with the centre portion twisted. L5 is 2" outside diameter, and has 6 turns, spaced to occupy  $1\frac{1}{2}$ ". It should preferably be made of  $\frac{3}{8}$ " silverplated copper tubing but, if unavailable, No. 10 or 12 SWG wire will serve. Output coupling to L5 is effected by a single turn of 16 SWG wire, enclosed in sleeving, soldered to a Belling-Lee coaxial socket which is mounted opposite the centre of the coil on the angle bracket.

### WIRING.

The wiring should be commenced with the sub-chassis wiring of V1. To ensure good electrical connection the tag on the rotor plates of C3 should be connected to an earthy tag fitted beneath one of the crystal holder bolts, to which also is soldered one end of L1. The resistor R3 is important and should be mounted directly on the valve pin. A value of 10 ohms is recommended, but this may be varied up to 20 ohms. A miniature insulator mounted near the V1 valveholder assists in holding securely condenser C7, and the anode wiring.

Leads are brought down through the chassis from the midget insulators holding L3 to the variable condenser and associated components. The remainder of the sub-chassis wiring is clearly illustrated in Fig. 3. The wiring may be carried out with 18 SWG tinned wire, enclosed in insulating sleeving, except in the case of heater wiring which should be of somewhat heavier gauge.

Pins 3, 5 and 6 of the QV04-20 valveholder are connected to a soldering tag, mounted under one of the valveholder fixing bolts. Pins 1 and 8 are connected together and a lead from them taken down through the chassis for connection to L.T. Another lead through the chassis carries H.T. to the screen grid (pin 4) and in series with this lead is the decoupling resistor R9, mounted very close to the valveholder. One end of C15 is connected to pin 4 of the valveholder, and one end to the earth tag.

### POWER SUPPLY.

The photographs of the power unit Figs 4 and 5 have been annotated to indicate the various components and no difficulty should be experienced in following the lay-out and construction.

All the chokes and transformers have been mounted to give sub-chassis connections, necessitating the cutting of suitable holes in the chassis. This work should preferably be entrusted to a local metal worker, but, if desired, the chokes and transformers may be mounted for above chassis connection. In the latter case the holes leading down through the chassis should be fitted with rubber grommets. The power resistors are mounted well apart to allow the heat to dissipate.

On the front of the chassis are mounted the stand-by switch, a green panel light, which is connected to the special L.T. winding provided on the grid bias transformer, and a red panel light, connected to the special L.T. winding on the high tension transformer. On the rear of the chassis, from left to right, are mounted a 2-pin mains plug, the mains on/off switch, the mains fuse, the 3-pin plug for connection to the modulator, and the 10-way socket. The metal rectifier is mounted on top of the chassis, close to its associated transformer.

On the front panel, above the metal rectifier, is fitted the variable resistance incorporated in the grid

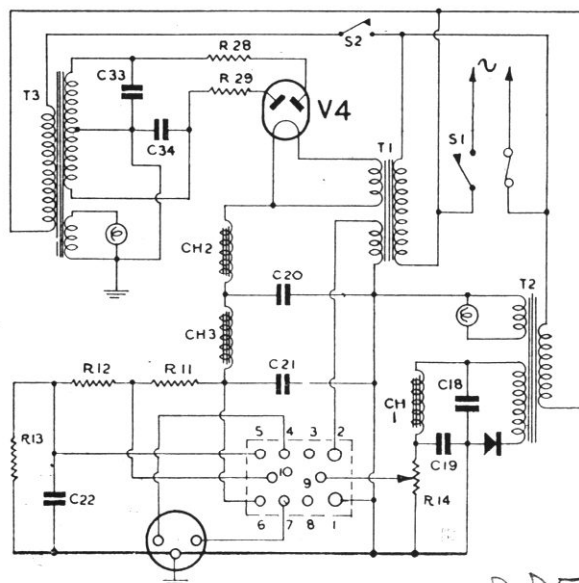


Fig. 1b. Circuit of the power supply.

B.P.584

bias supply, and three clearance holes are also required for the stand-by switch and the panel lights.

The circuit diagram of the power unit is given in Fig. 1 (b) and the actual wiring calls for little comment, other than to say that a good grade of insulated wire should be employed. Note that the third (centre) pin of the modulator plug is connected to the chassis itself, thereby automatically ensuring that the modulator chassis has a direct metallic connection to the power supply chassis. A three way interconnection cable is required, fitted with sockets at each end.

By reason of the swinging choke and of the mercury vapour rectifier valve, which has a very low internal voltage drop, the regulation of the power supply is very good. The output voltage is less than with a condenser input filter and for this reason, the H.T. transformer must be wound to deliver more voltage than is required on the anodes of the valves. With the transformer specified, the voltage on load is 380. A mercury vapour rectifier is liable to produce a form of "hash" which shows up on the carrier as modulation hum and to prevent this effect, resistors R28 and R29 and condensers C33 and C34 are included. These components should be mounted as close as possible to the valveholder. The condensers must be rated for a high working voltage.

### THE MODULATOR.

A photograph of the modulator is shown in Fig. 6, and the circuit diagram is given in Fig. 1 (c). The former indicates the lay-out, and annotations have again been made to identify the various components. Details of constructional dimensions, etc., of the valve positions, and of the items mounted on the panel are given. The meter hole, which is  $2\frac{5}{8}$ " in diameter, is made near the top of the panel, in order that the meter will be clear of any component on the chassis. Exact details of the positions occupied by the transformers and chokes are not given as these are by no means critical. On the front of the chassis, from left to right, are the mains switch, panel light, gain control, and microphone jack. On the rear are mounted the output socket, the mains fuse holder, and the mains 2-pin connector.

Wiring is quite straightforward. All the small components associated with V5 are mounted on a group board, which is fitted near the valveholder. Similarly, the components associated with V6 (R22, C27, and R23) are mounted on another group board, fitted below the smoothing condenser C30, which must be screwed down after the group board has been bolted in place.

The driver transformer is located between V6 and the output valves, thereby enabling short connections to be made. Note that half the primary winding, marked "A" and "H.T." is used, as otherwise, the transformer ratio is too low when using a single driver valve. The tags marked "GB" are connected together and to earth.

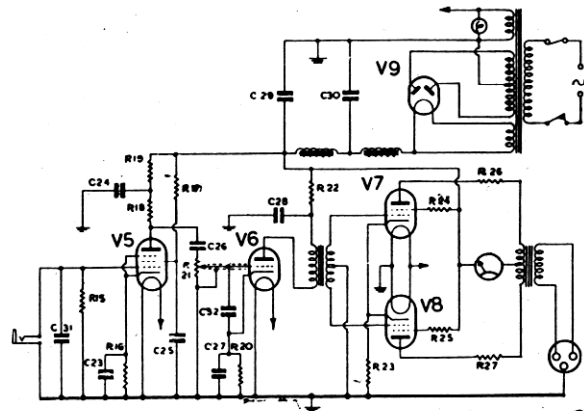


Fig. 1c. Modulator circuit.

The two anti-parasitic resistors R27 and R28 are connected directly to the anode pins on the holders of V7 and V8, the blank pins (No. 6) on these holders being employed to hold these resistors in place. Connections from these pins are then taken to tags 2 and 5 on the modulation transformer. Tags 3 and 4 on the latter, connected together, form the primary centre tap from which a connection is taken through a rubber grommet in the chassis to the panel meter. Tags 8 and 10 on the modulation transformer are connected to the output socket, the third terminal of which is grounded to the chassis. Tags 8 and 9 are connected together and also tags 10 and 11.

If difficulty is experienced in obtaining a cathode resistor of the correct value (160 ohms) for the output valves, the proper value may be made up with several separate resistors, capable of dissipating three watts in all.

A screened lead and preferably a screened top cap is required for the grid connection to V5, the grid resistor of which is soldered across the microphone jack. It will be desirable to earth the outer casing of the gain potentiometer if this has not already been done during manufacture.

Whilst the modulator is normally perfectly stable, instability will result if RF voltages from the transmitter are allowed to reach the valve grids. Whether or not trouble of this type is experienced will depend on the relative positions of transmitter, aerial, modulator, etc. Condensers C31 and C32 are fitted to the modulator to by-pass any RF reaching the grids of V5 and V6 — they consist of small .0001 mF mica or ceramic condensers, soldered directly across the appropriate valve pin in the case of V6, and across the jack terminals, in the case of V5. If rack and panel mounting is adopted, it is probable these condensers can be omitted.

Another point to watch is the length of microphone lead, pick-up on which is the chief source of RF reaching the modulator valves. Such pick-up will occur even if the lead is screened, since the screening is only effective at audio frequencies. The microphone lead should therefore be kept reasonably short and well away from the transmitter tank and aerial circuits.

### TESTING THE MODULATOR.

A dummy load is essential when testing the modulator, since without it high peak voltages will occur at the anodes of the output valves and flash-over is likely. This dummy load can be a 230 volt 40 watt lamp, connected across tags 8 and 10 of the modulation transformer. The match will not be correct but this will not matter for test purposes. The high tension voltage on load should be 350 and the reading shown on the anode current meter in the vicinity of 140 mA. On speaking into the microphone, with the gain control turned up, upward kicks of the meter needle should occur and the lamp light up.

The details of modulation transformer tapings given earlier relate to an operating *cathode* current of 140 mA through V3 (made up of 120 mA anode, 16 mA screen grid and 4 mA control grid) — in any case, on telephony, this current must not be exceeded. If the aerial load is such that a lower current flows, the impedance presented by V3 will increase and the tapings on the modulation transformer may have to be altered to secure an efficient transfer of audio power. Reference to the makers' data sheet will indicate the correct tapings to employ, in such cases.

### OPERATING THE TRANSMITTER.

#### PRELIMINARY TESTS.

When the construction and wiring has been completed, including making up the interconnecting cables, preliminary tests can be carried out, using as an artificial load an ordinary 230 volt, 40 watt lamp connected across the output socket on the transmitter. First of all, with a one ampere fuse inserted in the fuseholder on the power chassis, it should be ascertained that the valve heaters all light up and that the power unit is delivering its correct voltages, which, off load, will be in the region of 420 volts H.T. and 200 volts (max.) grid bias.

In the first tests the H.T. should be disconnected from both anodes and screen grids of the QVo4-20 valve. A milliammeter plugged into jack 1 should show about 20 mA. flowing in the anode circuit of V1 when the latter is in a non-oscillating condition. On rotating C3 from its maximum position, the current will suddenly drop to about 10 mA. C3 should be rotated a few degrees further to ensure stable crystal operation, with an indicated current of about 15 mA. On rotating C4, two dips of anode current will occur, one a large one at a small dial reading, and a second smaller one at a high dial reading. The first tuning point is the correct one and the latter, which occurs at the third harmonic of the crystal, should be ignored.

Plugging the meter into jack 3 will now indicate a current of about 40 mA. in the anode circuit of V2. On bringing C10 into resonance, this will drop to about 16 mA. The anode circuit of V2 is now operating at 28 megacycles and a neon lamp held to one end of the coil should light fairly brightly.

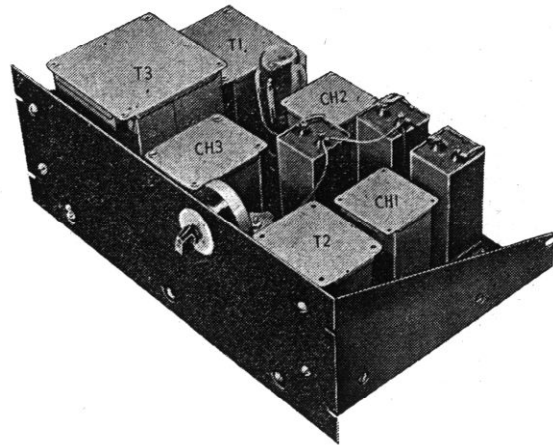


Fig. 4. Power Supply Chassis.

The next step is to insert one loop of the link coupling at the low potential end of L3 and the other loop in the centre of L4, using fairly tight coupling to commence with. The high tension supply to V3 should be re-connected and R14 adjusted to give about 60 volts bias. On tuning C13 to resonance, a meter plugged into jack 4 will indicate grid current of anything up to 12 mA. This is more than the rated grid current for V3 but it will be found to drop considerably when the anode circuit of V3 is tuned to resonance and the load connected. The anode current of V3 will rise to a comparatively high value as C13 comes into resonance and no time should be lost in adjusting C16 to a point at which this current drops to a minimum. At the same time, the lamp will light up more or less brightly, depending on the degree of coupling.

During these tuning operations, the quality of the note from the transmitter should be checked on a near-by receiver, and the stability as a whole should be found quite satisfactory. The aerial load may now be coupled to the output loop and, provided the aerial has been correctly designed, it should be found possible to load the final valve up to its full rated current of 150 mA. This value of anode current is only permissible when using C.W. and, for telephony, it must be reduced to not more than 120 mA., by easing off the aerial coupling. The grid current of V3 should now be finally checked, and, if found to be in excess of 4 mA., the link coupling between L3 and L4 should be slacked off. Slight inter-action naturally occurs between the anode circuit of V2 and the grid circuit of V3 and final adjustments will be necessary to both C10 and C13.

Keying is accomplished by breaking the H.T. supply to the screen grid of V1. As only 4 mA. flows in this circuit, keying is to all intents and purposes free from clicks but, if further suppression is thought desirable, a condenser of .1 mFd (at least 500 volts working) and a resistance of 5,000

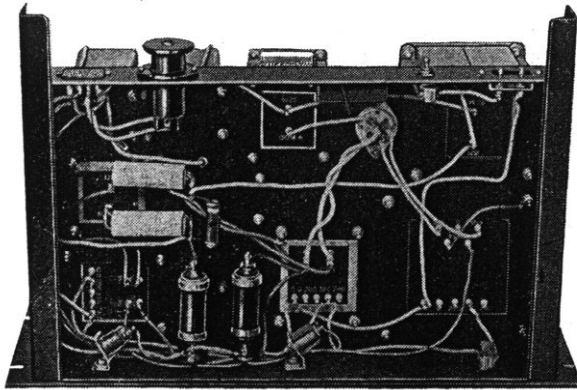


Fig. 5. Under-chassis view of Power Supply.

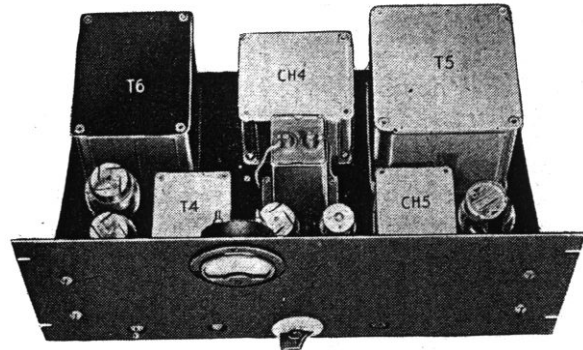


Fig. 6. The modulator used with the transmitter.

ohms., connected in series, may be placed across the key. The crystal ceases to oscillate when the key is up and break-in operation is therefore possible.

A word of warning is necessary in cases where a long wire or other type of open aerial is employed. The R.F. energy produced by this transmitter is quite considerable and if only a small amount is allowed to reach the grid circuit, instability of V<sub>3</sub> is possible, since the driving requirements of this valve are extremely low. If trouble of this type occurs, and cannot be cured by running the aerial well clear of the exciter stages, it may be necessary to include additional metal screening around the

grid circuit of V<sub>3</sub> and possibly to extend the screen around the valve. This trouble is very unlikely to occur if a coaxial fed aerial is used.

As a guide to the dial readings which may be expected, the following details are given of the readings obtained on the prototype transmitter when using a crystal with a fundamental frequency of 7011 Kc/s. :-

C<sub>3</sub> 85° : C<sub>4</sub> 27° (second dip at 80°)  
C<sub>10</sub> 53° : C<sub>13</sub> 78° : C<sub>16</sub> 50°

Under working conditions, the voltages applied to the anodes of V<sub>1</sub>, V<sub>2</sub> and V<sub>3</sub> are respectively 150, 300 and 380 volts.

## COMPONENTS LIST.

1 Transmitting Condenser, Split Stator 60 × 60 pF (C16) .. .. .	Eddystone Cat. No.	137	1 Mains Transformer, outputs 450-0450, 150 mA., 5 volts, 3 amps. (T5).	
1 Microdenser, 160 pF (V3) .. .. .	"	1131	6.3 volt, 4 amp.	
1 Microdenser, 40 pF (C4) .. .. .	"	1129	1 Mains Transformer, outputs 200 volt, 60 mA. 5 volts, 5 amps. (T2).	
1 Microdenser, 20 pF (C10) .. .. .	"	1094	2 Swinging Chokes, 5/25 Henry, 150 mA (CH 2, 5).	
1 Air Dielectric Trimmer, 34 × 34 pF (C13) .. .. .	"	584	2 Smoothing Chokes, 20 Henry, 150 mA (CH 3, 4).	
3 R.F. Chokes (RFC1, 2, 3) .. .. .	"	1010	1 Smoothing Choke, 20 Henry, 60 mA (CH 1).	
1 R.F. Choke Transmitting Type (RFC4) .. .. .	"	1022	1 Metal Rectifier, type 14A/46 .. .. .	Westinghouse
1 Flexible Coupler .. .. .	"	1009	1 Driver Transformer, type DT1 (T4) .. .. .	Woden
5 Direct Drive Dials, 2 Silver finish .. .. .	"	638	1 Modulation Transformer, Multi-match, type UM2 (T6) .. .. .	Woden
3 Flexible Driving Shafts .. .. .	"	530	2 Fuse Boxes with Clips and 1 amp. Fuses, type L.1045/103 .. .. .	Belling-Lee
2 Small Pointer Knobs and Dials .. .. .	"	425	4 Condensers, 4 mF, 750 volt working (C20, 21, 22, 30).	
2 Stand-off Insulators .. .. .	"	916	4 Electrolytic Condensers, 8 mF, 500 volt working. C18, 19 24, 28).	
1 Red Lead-through Insulator .. .. .	"	564	1 Electrolytic Condenser, 16 mF, 500 volt working (C29).	
2 Ten-way Sockets .. .. .	"	535	2 Electrolytic Condensers, 50 mF, 12 volt (C23, 27).	
2 Ten-way Plug Connectors .. .. .	"	534	4 Mica Condensers, .002 mF (C1, 2, 5, 6).	
6 Midget Insulators .. .. .	"	101	2 Mica Condensers, .0005 mF (C15, 17).	
3 Chassis — Standard .. .. .	"	617	5 Mica Condensers, .001 mF (C8, 11, 12, 14, 9).	
3 Pairs Angle Brackets .. .. .	"	618	1 Ceramic Condenser, 100 pF (C7).	
3 Panels 8½" .. .. .	"	620	1 Paper Condenser, .5 mF (C25), 350 volt working.	
2 Coll Formers, Plain, 1 diameter .. .. .	"	646	1 Paper or Mica Condenser, .01 mF (C26), 500 volt.	
1 Valve, type 6V6 (V1) .. .. .	Cossor		2 Mica or Ceramic Condensers, .0001 mF (C31, 32).	
1 Valve, type QV04/7 (V2) .. .. .	Mullard		2 Mica Condensers, .0001 mF, 1000 volt working (C33, 34).	
1 Valve, type QV04/20 (V3) .. .. .	Mullard		2 Resistors, 1 watt, 100 ohms (R24, 25).	
1 Valve, type EF36 (V5) .. .. .	Mullard		1 Resistor, 1 watt, 20,000 ohms (R6).	
1 Valve, type L63 (V6) .. .. .	Osram		2 Resistors, ½ watt, 50,000 ohms (R5, 19).	
2 Valves, type EL37 (V7, 8) .. .. .	Mullard		2 Resistors, ½ watt, 500 ohms (R7, 8).	
1 Valve, type 22V/310A (V4) .. .. .	S.T.C.		2 Resistors, ½ watt, 200 ohms (R2, 9).	
1 Valve, type 5Z3 (V9) .. .. .	Cossor		3 Resistors, ½ watt, 10 ohms (R3, 26, 27).	
6 Valveholders, Octal Ceramic.			2 Resistors, ½ watt, 1 megohm (R15, 17).	
2 Valveholders, American 4-pin.			2 Resistors, ½ watt, 1,000 ohms (R16).	
1 Valveholder, British 9-pin with Locking Ring .. .. .	Belling Lee		1 Resistor, 3 watt, 160 ohms (R23).	
1 Crystal with holder .. .. .	Q.C.C.		1 Resistor, 1 watt, 10,000 ohms (R4).	
5 Insulated Closed Circuit Jacks .. .. .	Igranic		1 Resistor, 3 watt, 1,500 ohms (R11).	
3 Panel Lights and Holders (2 Red, 1 Green).			1 Resistor, 10 watt, 4,700 ohms, type C.P.185 (R12)	Varley
3 Toggle Switches, S.P.S.T. .. .. .	Bulgin		1 Resistor, 10 watt, 10,000 ohms, type C.P.42 (R10)	Varley
2 Milliameters, Moving Coil, 200 mA .. .. .	Sangamo-Weston		1 Resistor, 10 watt, 6,800 ohms, type C.P.186 (R13)	Varley
2 5 Amp. Flush Mounting Mains Plugs P.31 .. .. .	Bulgin		1 Resistor, 1 watt, 800 ohms (R20).	
1 Coaxial Socket and Plug L.373 .. .. .	Belling Lee		1 Resistor, 3 watt, 7,500 ohms (R22).	
2 Plugs and Sockets, type P.161 or P.162 .. .. .	Bulgin		1 Variable Resistor, ½ megohm (R21).	
1 Mains Transformer, outputs 6.3, volts 4 amps., 5 volts, 3 amps. (T1).			1 Resistor, 15 watt, Variable, 5,000 ohms, P.I.V. (R14)	Reliance
1 Mains Transformer, outputs 500-0-500, 200 mA., 5 volts, 5 amps. (T3).			2 Mica or Ceramic Condensers .0001 mF (C31, 32).	
			2 Mica Condensers .0001 mF. 1000 V wkg (C33, 34).	

FOR THE CHART OF POSITIONS AND DIMENSIONS OF THE 28 MEGACYCLE TRANSMITTER,  
SEE FOOT OF PAGE 12.

# EDDYSTONE COMPONENTS PRICE LIST

July, 1946

Cat. No.	Item.	Price.		
		£	s.	d.
50	Large White Flexible Coupler		3	0
137	Split Stator Transmitting Condenser, 60 × 60 pF.	2	14	6
425	Small Pointer Knob and Dial		1	8
481	Neutralising Condenser 4 pF. max.		3	6
529	Medium size White Flexible Coupler		2	6
530	Flexible Driving Shaft		6	0
534	10 way Plug Connector		7	6
535	10 way Socket		4	6
564	Red Lead Through Insulator		1	6
580	Air Dielectric Trimmer, 15 pF.		5	6
583	" " " Split Stator, 25 × 25 pF.		7	0
584	" " " Butterfly type, 34 × 34 pF.		7	6
595	Direct Drive 2" Dial, Black		5	6
598	Full Vision Slow Motion Dial	18	6	
601	VHF. Coil 3 turns		2	3
602	" " 4 "		2	3
603	" " 5 "		2	4
605	" " 10 "		2	6
606	" " Base		1	6
608	Chromium Plated Handles, 8"		5	6
609	General Purpose Cabinet and Panel	3	5	0
615/642	Front and Rear Vertical Rack Channels	2	10	0
616	Top and Bottom Rack Frames	1	1	0
617	Standard Rack Chassis	11	0	
618	Rack Angle Brackets	10	6	
619	10½" Rack Panel	10	9	
620	8¾" " "	10	0	
621	7" " "	9	3	
622	3½" " "	7	6	
635	Chromium Plated Handles, 3"		4	9
636	Rack Top Plate	10	0	
637	S/M Vernier Dial, Silver	1	0	0
638	Direct Drive Dial 2", Silver		7	0
639	S/M Precision Dial 2", Silver	15	0	
641	General Purpose Chassis	19	6	
643	Die-Cast Chassis	10	6	
644	Metal Cabinet for Cat. No. 643	1	5	0
646	Ribbed Coil Former, 1"		1	6
650	Small Die-cast Box and Lid		5	6
916	Stand-off Insulator		1	6
959	6 pin Coil, Type 6BB		5	0
959	6 " " " 6LB		5	0
959	6 " " " 6Y		5	0
959	6 " " " 6R		5	3
959	6 " " " 6P		5	9
964	6 pin Coil Base		1	9
1007	Adjustable Insulated Bracket		2	6
1010	Radio Frequency Choke		2	6
1011	VHF Choke		1	6
1019	Miniature Stand Off Insulator			8
1022	Transmitting R.F. Choke		3	0
1089	Instrument Knob, 1¾"		1	11
1094	Low Loss Microdenser, 20 pF		6	0
1129	" " " 40 pF		6	6
1130	" " " 100 pF		7	11
1131	" " " 160 pF		8	3
2416P	Skirt Knob, 1¾"		1	6



**STRATTON & CO. LTD.  
WEST HEATH  
BIRMINGHAM 31**

**Sole Manufacturers of Eddystone Radio Products**



## ERRATA IN EDDYSTONE MANUAL NO.5

### INSIDE FRONT COVER. (Valve Base Data)

DF33 Top Cap Gr.d. Not pin 8.

DF33 Pin 1 Metalising (to be earthed)

DAC32 " " " " " "

N.B. Type EF 54 Pins 4, 5, 7, & 8, are internally connected to the Cathode, Screen and suppressor grid

### Page 2

Top Cap of V1 & Stator of C1 to Pin 1 of Coil base (not pin 4)

### Page 10

Three holes for connection to H T LT, & anode of V1, via C6 (not EF 50 suppressor grid)

### Page 11

With Oscillator frequency lower than signal, coverage will be from 51.4. to 61.4. Mc/s  
(not 60.5 Mc/s)

N.B. Due to alteration in design & consequent increase in inductance values, a 3 turn coil should be substituted for a 4 turn coil in the oscillator stage.

### Page 14

For "Putting the Converter into Operation" read "Putting the Preselector into operation"

### Page 20. Add to Components list:

- |   |          |          |               |          |
|---|----------|----------|---------------|----------|
| 1 | Resistor | 1/2 watt | 100,000 ohms. | (R18)    |
| 2 | "        | "        | 50 "          | (R28,29) |

Note, only 1 X 1000 ohms Resistor (R18) is required.