

THE

RADIO CONSTRUCTOR

Vol. 24 No. 9

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17½p (3/6)



TRANSMITTER

★ 40, 80 and 160 Metres

★ 10 watts CW

★ 7 watts Phone

Special
IN THIS ISSUE

*D. C. and AUDIO LCR BRIDGE
'Trio' 9R-59DE MODIFICATIONS - 2*

TRI-BAND RANGER

PART 1

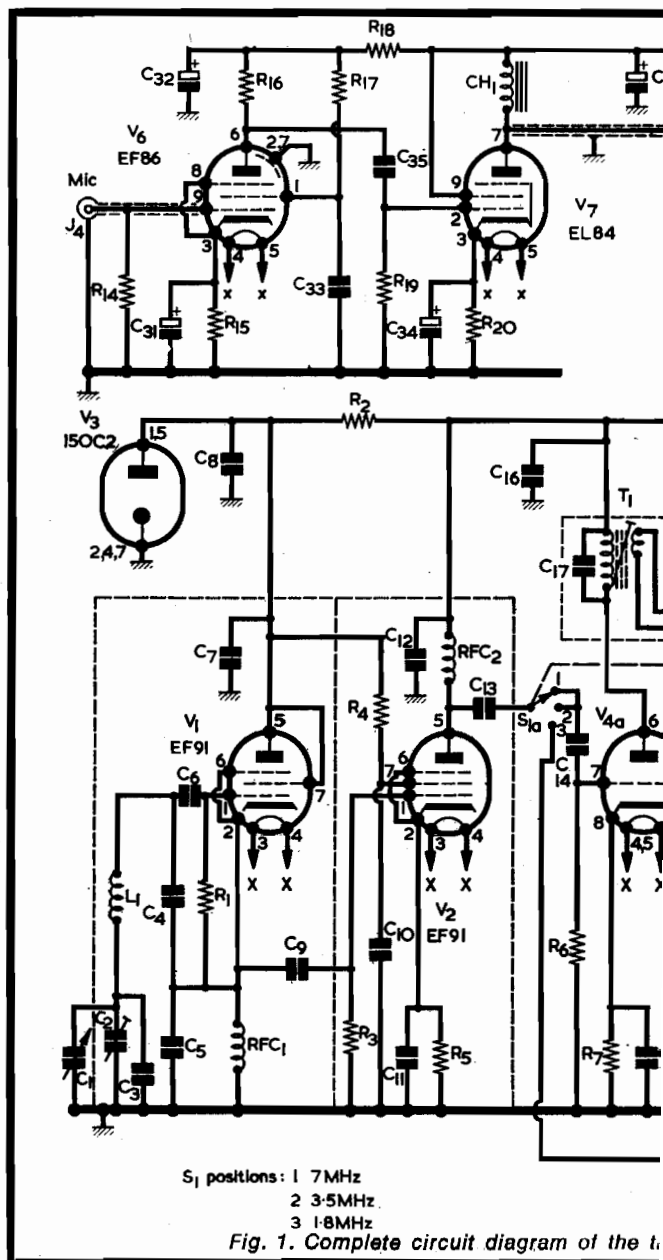
by

DAVID M. PRATT (G3KEP)

Covering the 40, 80 and 160 metre bands, this transmitter offers c.w. and phone at power inputs of 10 and 7 watts respectively. It has its own mains supply, but provision is made for powering from an external supply. Further advantages are simplicity of operation, small size and the ability to match into wide range of aerials. This article describes the circuit and its functioning; constructional details will be given in the concluding article, to be published next month. The transmitter must not, of course, be operated without the appropriate Post Office licence

SOME TIME AGO THE WRITER DESIGNED A MINIATURE receiver for the low frequency bands*, the main purpose of which was that it could be lent to young people with a view to their subsequently obtaining a transmitting licence. So successful was the performance of the receiver, and so handy was its size, that a suggestion was made that a matching transmitter be designed.

In designing the transmitter there were two purposes in mind. Firstly, the transmitter should be suitable for use during the National Field Day of the Radio Society of Great Britain. Hence, it should be capable of a maximum d.c. input of 10 watts c.w. on three amateur bands with provision for using an external power supply. Secondly, the transmitter should be suitable for fixed station use with its own internal power supply and amplitude modu-



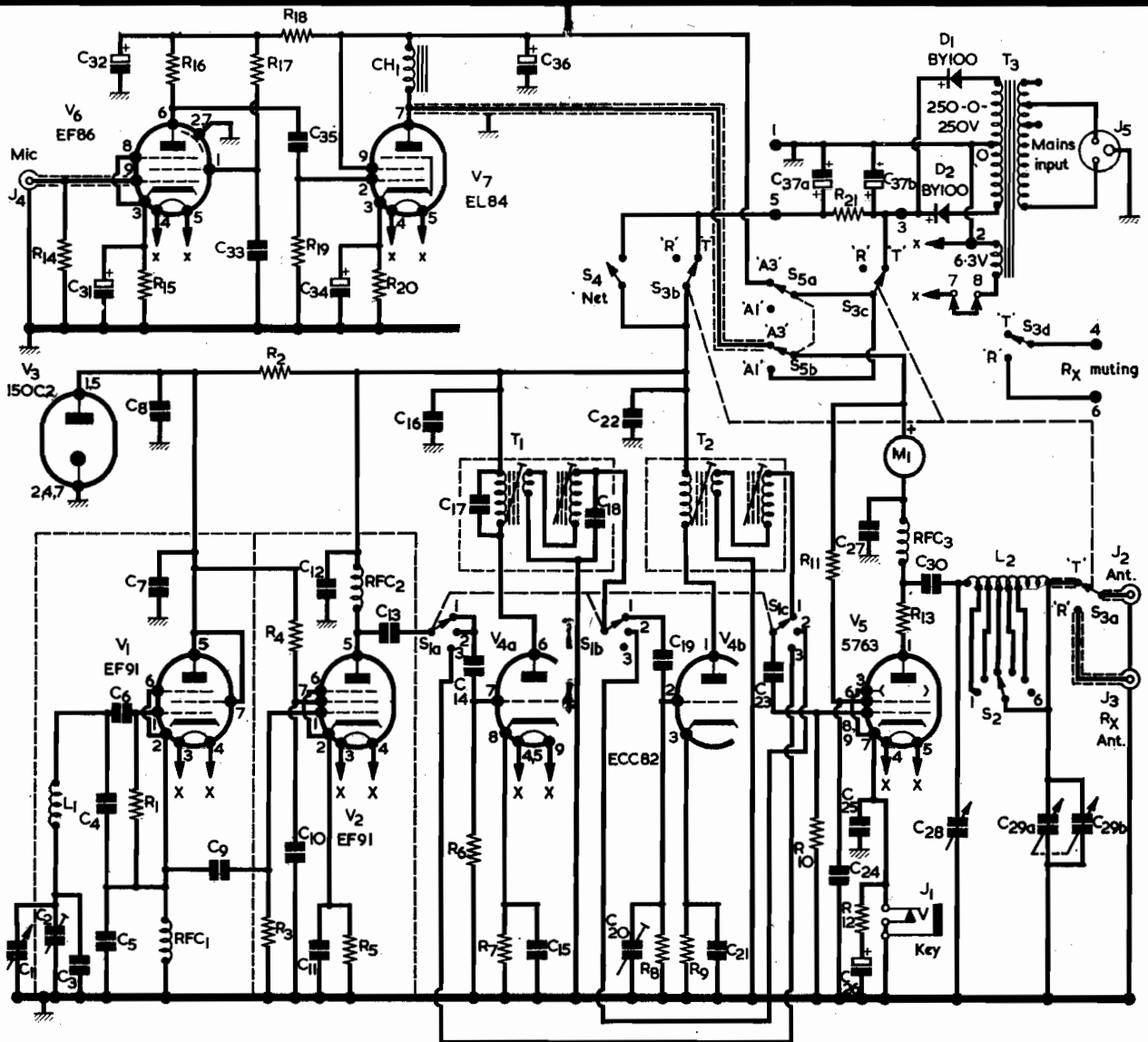
* David Noble and David M. Pratt, 'Miniature "Top-Band" Receiver', *The Radio Constructor*, July 1964.

BAND RANGER

lator. As the transmitter was to be used with many different aerial systems the method of aerial coupling used must be capable of tuning a wide range of aerial impedances.

The specification of the transmitter is as follows:

- Bands: 1.8, 3.5 and 7 MHz,
- Emission: A1 (c.w.) and A3 (a.m. d.s.b. telephony),
- Power Input: 10 watts A1; 7 watts A3,
- Power Supply: Internal mains power supply; provision for using external supply,
- Dimensions: 11½ x 5 x 7in.



S₁ positions: 1 7MHz
2 3.5MHz
3 1.8MHz

Fig. 1. Complete circuit diagram of the transmitter. T1 and T2 are wide-band couplers

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Cover Feature

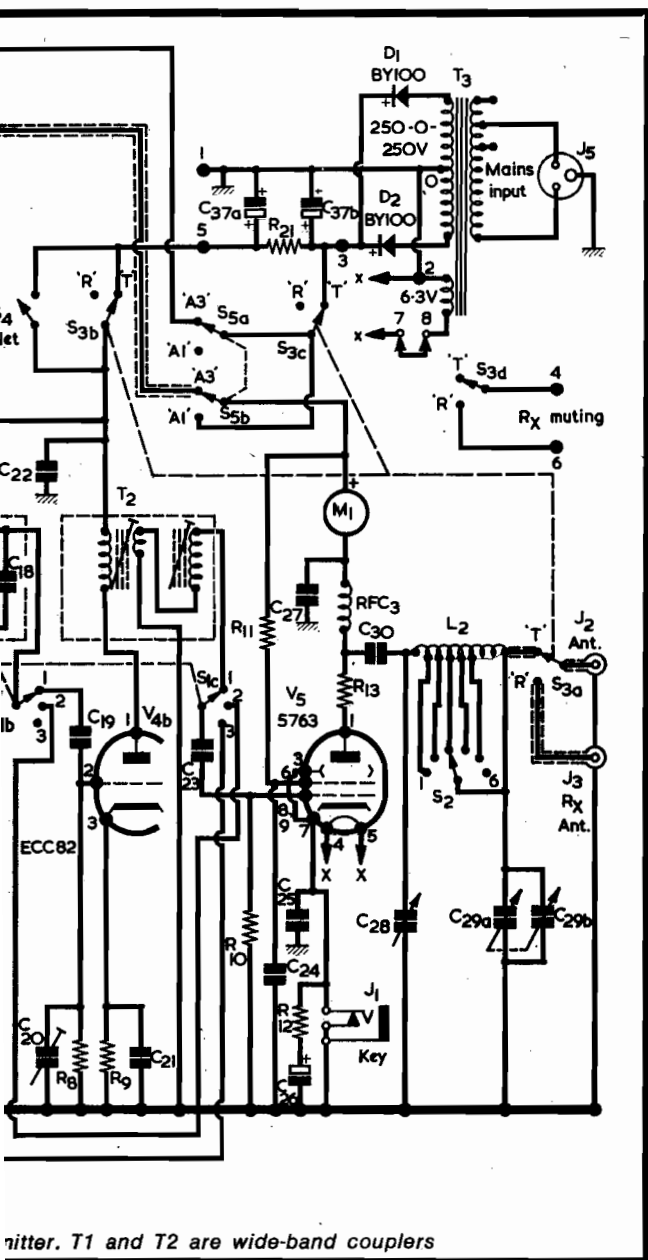
CIRCUIT

As may be seen from the circuit diagram in Fig. 1, the variable frequency oscillator comprises an EF91 (V1) operating in a Clapp oscillator circuit. This has a frequency coverage of 1.75 to 2 MHz. The anode circuit is operated at zero r.f. potential, and the output is taken from the cathode in order to limit 'pulling' due to the effect of loading of the v.f.o. circuit. V2 is an untuned buffer amplifier operating a relatively high anode voltage, thus providing sufficient output to adequately drive the subsequent stages. Voltage stabilisation of the v.f.o. and of the buffer amplifier screen voltage is achieved by a 150 volt miniature stabilizer valve, V3.

On the 1.8 MHz band the output of the buffer amplifier is switched via S1 to the control grid of the p.a. valve, V5. V4 is a double triode, each section of which is used as a frequency doubler. For 3.5 MHz operation V4(a) is used as a doubler from 1.75 MHz and its output is fed via S1(b) to the p.a., while for 7 MHz both halves of V4 are used as doublers, V4(b) providing an output of 7 MHz to the p.a. stage. The trimmer capacitor C20 is included to provide the same additional capacitance across the output from T1 as is given when T1 couples directly to the p.a. grid.

The p.a. valve V5 is a 5763, chosen for its miniature size and ideal characteristics for a transmitter with the present specification. With 250 volts h.t. the valve is capable of a 'comfortable' 10 watts d.c. input on c.w. A key jack is provided in the cathode circuit of the p.a. valve, a key click filter, R12 and C26, being incorporated to limit the click on 'break'.

The p.a. tuned circuit is a pi-tank type with a multi-tapped coil to provide a wide range of impedance matching. The variable capacitor C28 is used to resonate the p.a. circuit, while the two-gang capacitor C29 is used for aerial loading.



mitter. T1 and T2 are wide-band couplers





COMPONENTS

Resistors

(All resistors $\frac{1}{2}$ watt 10% unless otherwise stated)

R1	100k Ω
R2	5.1k Ω 8 watt 5%
R3	47k Ω
R4	22k Ω
R5	150 Ω
R6	22k Ω
R7	470 Ω
R8	22k Ω
R9	470 Ω
R10	27k Ω
R11	10k Ω 1 watt
R12	270 Ω
R13	47 Ω
R14	1M Ω
R15	2.2k Ω
R16	100k Ω
R17	1M Ω
R18	39k Ω
R19	680k Ω
R20	180 Ω 1 watt
R21	680 Ω 8 watt 5%

Capacitors

C1	75pF variable (ex-RF27 unit or Jackson Bros. Type U101)
C2	30pF miniature trimmer, air-spaced.
C3	120pF 5% silvered-mica
C4	1,000pF 5% silvered-mica
C5	1,000pF 5% silvered-mica
C6	100pF 5% silvered-mica
C7	0.1 μ F polyester film, 350V wkg
C8	10,000pF ceramic, 350V wkg
C9	100pF silvered-mica
C10	10,000pF ceramic, 350V wkg
C11	10,000pF ceramic, 350V wkg
C12	10,000pF ceramic, 350V wkg
C13	100pF 5% silvered-mica
C14	100pF 5% silvered-mica
C15	10,000pF ceramic, 350V wkg
C16	10,000pF ceramic, 350 wkg
C17	5pF 5% silvered-mica
C18	5pF 5% silvered-mica
C19	100pF 5% silvered-mica
C20	3-27pF Mullard concentric trimmer
C21	10,000pF ceramic, 350V wkg
C22	10,000 pF ceramic, 350V wkg
C23	100pF 5% silvered-mica
C24	1,000pF ceramic, 500V wkg
C25	1,000pF ceramic, 500V wkg
C26	2 μ F electrolytic, 350V wkg
C27	1,000pF ceramic, 750V wkg
C28	500pF single-gang variable (Jackson Bros. E-Gang, Cat. No. 4507)
C29	500+500pF twin-gang variable
C30	2,000pF 10% mica, 750V wkg

C31	100 μ F electrolytic, 16V wkg
C32	16 μ F electrolytic, 350V wkg
C33	0.1 μ F polyester film, 350V wkg
C34	25 μ F electrolytic, 25V wkg
C35	10,000pF polyester film, 400V wkg
C36	50 μ F electrolytic, 350V wkg
C37	16+16 μ F twin electrolytic, 450V wkg

Inductors

CH1	L.F. choke, 10H 70mA
L1	128 turns, 32 s.w.g. enam. copper wire close-wound on $\frac{1}{2}$ in. diameter Perspex rod. Former length 2 $\frac{1}{4}$ in. Winding length 1 $\frac{9}{16}$ in. Upright mounting by 6BA bolt.
L2	90 turns, 24 s.w.g. enam. copper wire close-wound on 1in. diameter Perspex tube. Winding tapped at 60, 40, 30, 20 and 10 turns from anode end. Winding length 2 $\frac{3}{16}$ in. Former length 3 $\frac{1}{4}$ in. Upright mounting by means of small bracket at base and 4BA bolt.
RFC1	2.5mH, miniature r.f. choke
RFC2	2.5mH, miniature r.f. choke
RFC3	1.5mH, 100mA, r.f. choke
T1	3.5MHz wide-band coupler (to be described in Part 2)
T2	7MHz wide-band coupler (to be described in Part 2)
T3	Mains transformer, drop-through, secondaries: 250-0-250V 100mA, 6.3V 3.5A (R.S.C. Hi-Fi Centres Ltd., Audio House, Henconner Lane, Leeds 13).

Valves

V1	EF91
V2	EF92
V3	150C2
V4	ECC82
V5	5763
V6	EF86
V7	EL84

Rectifiers

D1	BY100
D2	BY100

Meter

M1	0-50mA moving-coil meter (S.E.W. Type MR38P)
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Switches

S1	3-bank rotary switch, 1-pole 3-way per bank (see text)
S2	1-pole 6-way ceramic rotary switch
S3	4-pole 2-way rotary switch
S4	s.p.s.t. spring biased toggle switch
S5	d.p.d.t. toggle switch

Jack Sockets

J1	Closed-circuit jack
J2	Coaxial socket
J3	Coaxial socket
J4	Coaxial socket
J5	3-way mains input plug and socket assembly, Bulgin type P360, (Home Radio Cat. No. P360)

COMPONENTS

(Continued)

Valveholders

- 3 B9A valveholders
- 1 B9A valveholder, with skirt and screening can (for V4)
- 3 B7G valveholders
- 1 Octal valveholder

Miscellaneous

- 5 pointer knobs, Bulgin Type K424/Chr., or similar
- 5-way tagstrip, centre tag earthed
- 10-way tagboard, Bulgin Type C125 (Home Radio Cat. No. BTS34F)

Epicyclic 6:1 ball drive, Type 4511/F (Jackson Bros.)

Nylon lead-through insulators, Lektrokit Type LK2021, as required

Octal plug (with pins 7, 8 bridged)

Die-cast box, Eddystone Type 7134P (Home Radio Cat. No. E896)

Chassis, 16 s.w.g. Type 'K'; L = 10½ in., W = 4½ in., D = 1½ in. (H. L. Smith and Co. Ltd.)

Panel and Cabinet, 16 s.w.g. Type 'W'; L = 11½ in., W = 5 in., D = 7 in., with three 3 in. louvres on both sides (H. L. Smith and Co. Ltd.)

MODULATION

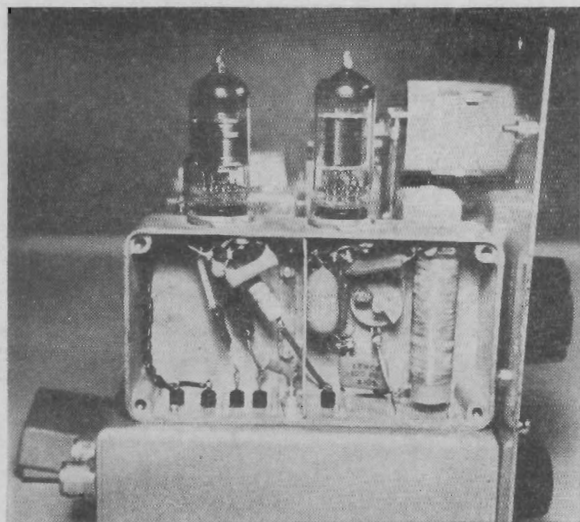
When telephony operation is desired the anode and screen-grid of the p.a. valve are switched by S5(b) to the output of the two-stage modulator, V6 and V7. The circuit operates as a Heising choke anode and screen modulator. Theoretically the circuit is not capable of 100% modulation without distortion, but with the component values specified the modulation level was found to be adequate, and the quality far superior to other types of modulation which have been tried. The circuit is designed for use with a crystal microphone which is applied via J4 to the control grid of V6. The output of this valve is then resistance-capacitance coupled to the grid of V7. The gain of the microphone amplifier stage was carefully adjusted by experiment to provide the correct amplification for the microphone used, thus obviating the need for a variable gain control. The gain of the modulator may be varied to suit different microphones by adjusting the value of R19.

POWER SUPPLY

In order that the transmitter may be self-contained for fixed station use an internal mains power supply is included. It employs a 250-0-250 volt transformer and silicon rectifiers in order to provide maximum rectified h.t. voltage. H.T. to the p.a. and modulator is taken direct from the reservoir capacitor C37(b), while a stage of smoothing, R21, C37(a), is used for the remainder of the r.f. circuit.

It should be emphasised that the BY100 rectifier diodes used have a maximum peak inverse voltage rating of 800 volts. In the full-wave rectifier circuit employed here the actual peak inverse voltage of each diode is given by 2.828 times r.m.s. transformer output voltage. It is important therefore that the output from each half of the transformer secondary does not exceed 270 volts, as this will most certainly result in breakdown of the diodes and consequent damage to the mains transformer.

Various points of the power supply circuit are taken to an octal socket mounted at the rear of the transmitter. The pin connections are shown in the



Side view of the transmitter. The v.f.o. box cover has been removed to show the internal components

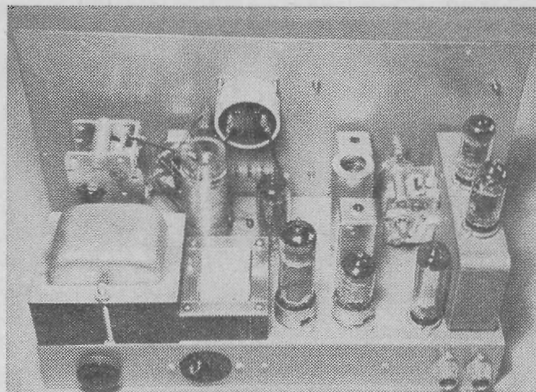
circuit diagram. An external strap between pins 7 and 8 is removed to disconnect the transformer heater winding when working from an external supply. The external heater voltage may then be applied between pins 2 and 7. External h.t. is applied to pins 1 and 3. The octal socket is also used for the muting connections to the receiver and for the measurement of voltages without the necessity of removing the unit from its cabinet.





SWITCHING

The transmitter contains five switches which provide a variety of functions. S1 is the main band switch which selects the appropriate frequency multiplier stages and feeds drive to the p.a. valve. The construction of this switch is shown in Fig. 2. The author used an N.S.F. 'Oak' switch as shown, but if this cannot be obtained a suitable alternative is a Radiospares 'Maka-Switch' assembly. 'Maka-Switch' kits are available both from Henry's Radio and from Home Radio. The 'Maka-Switch' assembly should be made up to the dimensions given in Fig. 2, and the wafers may be 1-pole 12-way or 4-pole 3-way 'break-before-make' types, with no connections made to the unused tags.



A view of the transmitter from the rear. The v.f.o. box is at the right. The p.a. output coil is upright and appears midway between the meter and the mains transformer

loading for a wide range of aerials. The main Transmit/Receive switch S3 switches h.t. to the transmitter. Aerial changeover with an output for the receiver is provided, as also is receiver muting,

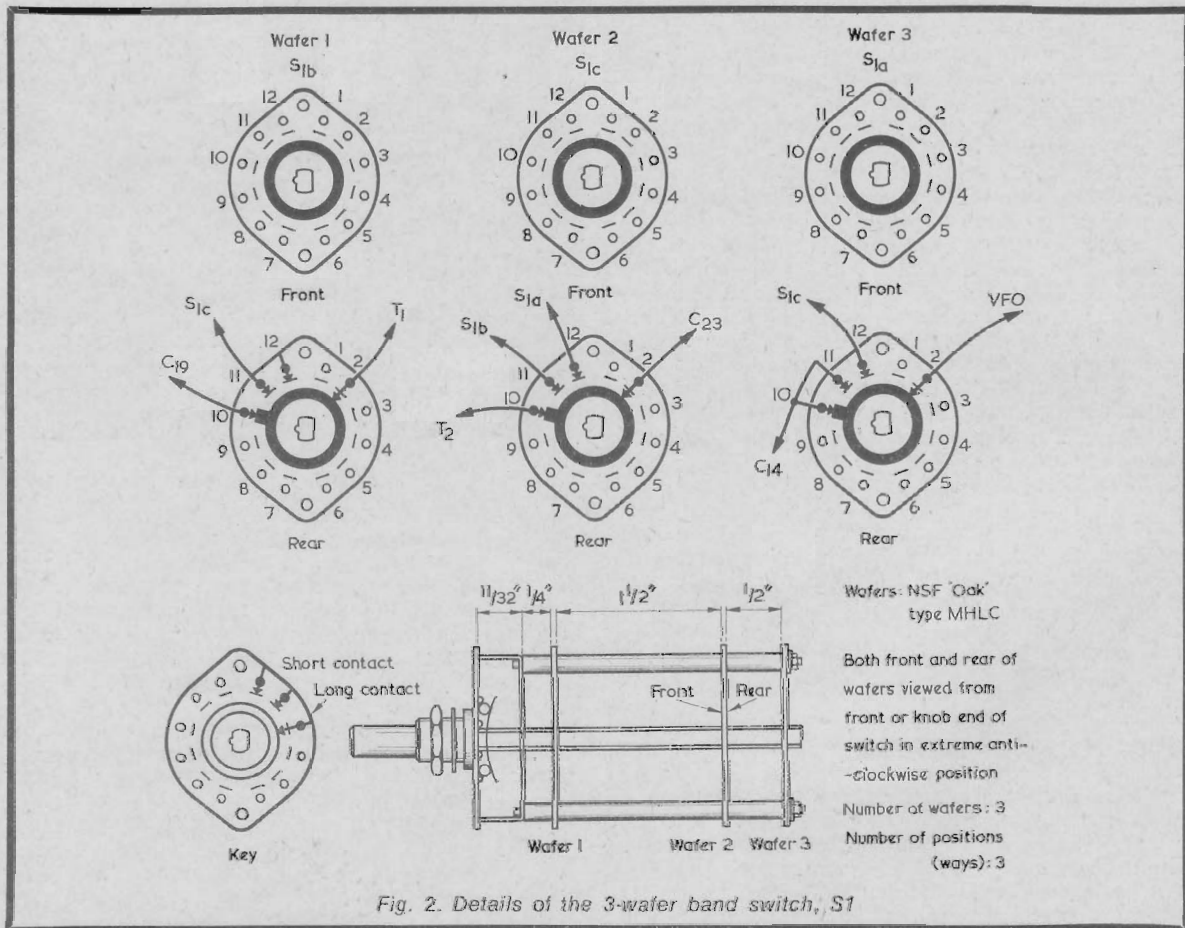
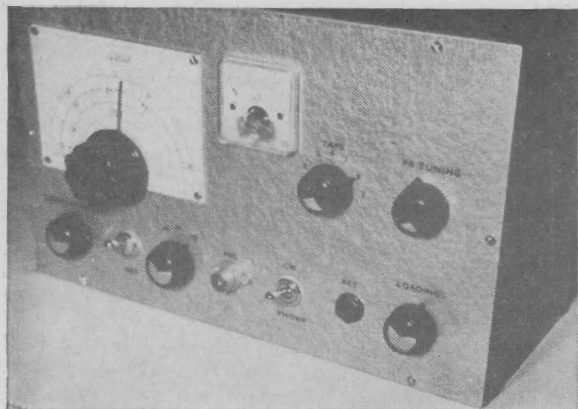


Fig. 2. Details of the 3-wafer band switch, S1

As has been mentioned earlier, the multi-position p.a. switch, S2, provides a range of tapping connections on the p.a. tank coil L2 in order to facilitate

which is taken to pins 4 and 6 of the rear octal based socket.

A provision for switching on the v.f.o. and driver



Three-quarter front view of the miniature three-band transmitter. Control layout is neat and uncluttered

stages alone for netting purposes is made using the spring biased toggle S4. S5 is the emission switch; on 'A1' the h.t. is fed direct to the p.a. valve, while in the 'A3' position h.t. is applied to the modulator, and the supply to the p.a. is switched to the anode of the modulator output valve V7.

(To be concluded)

NEW INTEGRATED POWER VOLTAGE REGULATORS

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The L005 gives an output voltage of 5V with an input voltage range of 7.5 to 20V; the L036 an output voltage of 12V with an input voltage range of 14.5 to 27V; the L037 an output voltage of 15V with an input voltage range of 18.5 to 27V.

The three devices have an output voltage within $\pm 5\%$ of nominal, and feature very low output resistance, high ripple rejection (typ. 60 dB) and extremely low temperature coefficient (0.003%/°C typ).

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