THREE BAND SHORT WAVE PRESELECTOR

By A. P. Roberts

Covering 1.65 to 32.5MHz in three switched bands, this preselector provides an extra tuned amplifier stage for insertion between the aerial and a short wave receiver

THERE ARE MANY RELATIVELY SIMPLE AND INEXPENSIVE short wave receivers in use at present, and most of these are capable of a fair performance. They do have limitations, however, and if they are of t.r.f. design are liable to suffer from a lack of sensitivity due to the low level of r.f. amplification provided, as well as a lack of selectivity because of the small number of tuned circuits incorporated.

Simple superhet designs are better in both these respects but they may suffer alternatively from image, or second channel, interference due to the relatively low intermediate frequency of 455 to 470kHz which is usually employed. Normally, a superhet is designed so that the oscillator frequency is higher than the required signal frequency by the intermediate frequency. If a signal which is higher than oscillator frequency by the intermediate frequency breaks through to the mixer, this signal will also pass into the receiver i.f. amplifier. It will then be detected and reproduced by the receiver loudspeaker or headphones or, at least, produce spurious beat notes with the required signal. This interfering signal is the image or second channel signal, and it is required of the r.f. tuned circuit or circuits before the mixer that it be rejected and that the required signal only is accepted. With simpler superhets the amount of second channel rejection may not be sufficiently high to give adequate protection against image interference.

When propagation conditions are poor, then of course virtually any simple short wave receiver will benefit from an increase in gain.

The use of a tuned short wave preselector such as that described in this article can improve the adjacent channel selectivity of a t.r.f. receiver, reduce second channel interference with a superhet receiver, and increase overall gain with any receiver. Provided it is operated sensibly, it can make a worthwhile improvement to the performance of many simple short wave receivers.

PRESELECTOR DESIGN

The preselector to be described consists basically of a tuned amplifier which is inserted between the aerial and the receiver. Thus it provides additional selectivity and sensitivity for the whole receiving set-up.

The design uses two transistors, one of these being an f.e.t., and covers a range of approximately 1.65 to 32.5MHz (182 to 9.2 metres) in three switched bands. It obtains power from its own internal 9 volt battery, from which it consumes a current of 3mA. Construction is easy to carry out, and is aided by the use of commercially wound coils.

The circuit is given in Fig. 1. Here, the aerial is coupled to a normal carbon track potentiometer, VR1, which functions as a simple variable input attenuator. The signal from the slider of VR1 passes to the primary winding of L1, L2 or L3 according to the position of S1(a). The tuned winding of the selected coil is then coupled to the tuning capacitor, VC1, and the gate of TR1 via S1(b). S1(a)(b) is the range switch.

The f.e.t., TR1, operates as a grounded source amplifier, with R1 functioning as the source bias

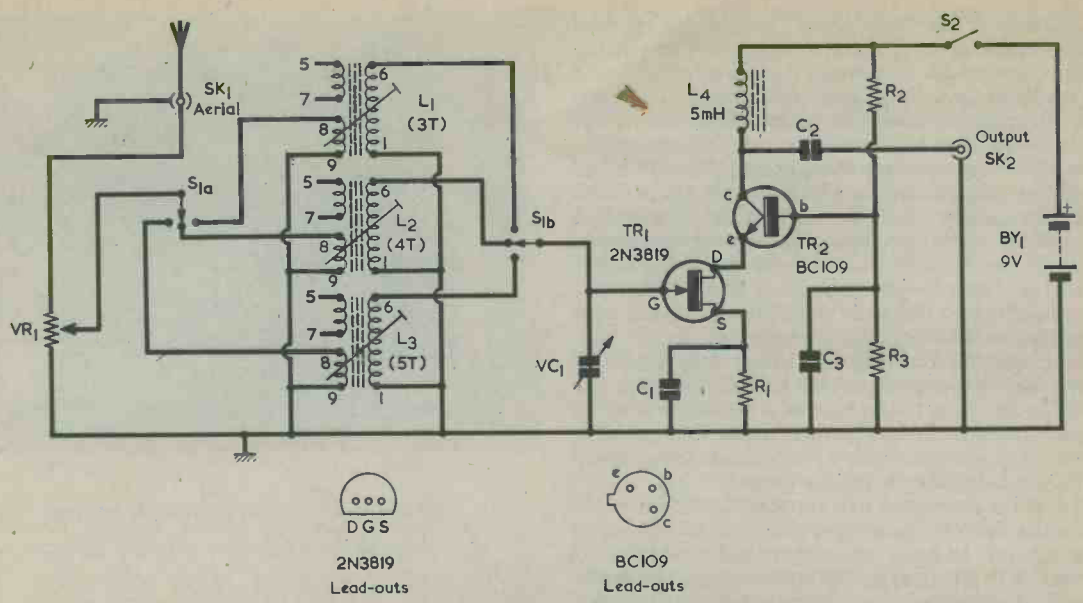


Fig. 1. The circuit of the three band short wave preselector

COMPONENTS

Resistors
(All fixed values ¼ watt 5%)

R1	470Ω
R2	39kΩ
R3	39kΩ
VR1	10kΩ potentiometer, linear

Capacitors

C1	0.01μF disc ceramic
C2	0.022μF plastic foil
C3	0.005μF disc ceramic
VC1	365pF variable, air spaced type '01' (Jackson Bros.)

Inductors

L1	Miniature Dual Purpose coil, transistor usage, Blue, Range 3T (Denco)
L2	Miniature Dual Purpose coil, transistor usage, Blue, Range 4T (Denco)
L3	Miniature Dual Purpose coil, transistor usage, Blue, Range 5T (Denco)
L4	5mH r.f. choke, type CH2 (Repanco)

Transistors

TR1	2N3819
TR2	BC109

Switches

S1(a)(b)	4 pole 3 way miniature rotary (2 poles unused)
S2	s.p.s.t. toggle

Battery

BY1	9 volt battery type PP3 (Ever Ready)

Sockets

SK1,	2 coaxial sockets

Miscellaneous

Instrument case type BV1, 8 by 5¼ by 2in. (Bi-Pak Semiconductors)
1 knob, approx. 1½ in. dia.
2 knobs, approx. 1in. dia.
3 B9A valveholders
Battery connector
Perforated s.r.b.p. board, plain, 0.1in. matrix
Aluminium sheet (for battery bracket)
4 rubber feet
Nuts, bolts, wire, etc.

resistor and C1 as a parallel r.f. bypass capacitor. The gate of TR1 is held at chassis potential for d.c. by whichever tuned winding is selected by S1(b). The drain of the f.e.t. couples into the emitter of the n.p.n. transistor, TR2.

TR2 functions in the grounded base mode, and its base is biased by R2 and R3, with C3 as the r.f. bypass capacitor. The signal current from TR1 drain flowing in the emitter of TR2 results in a voltage amplified signal appearing across the collector load, r.f. choke L4. The two transistors form a hybrid cascode amplifier.

The amplified signal at TR2 collector is fed to the output socket SK2 via the d.c. blocking capacitor, C2. This output signal is then coupled to the short wave receiver by a short length of coaxial cable, the braiding of which connects via SK2 to the preselector chassis at one end and to the receiver chassis at the other end. There is just a slight possibility that the short wave receiver in use may be an early mains-driven valve model having its chassis connected to one side of the

mains. *Because of the risk of shock, the preselector must on no account be coupled up to a short wave receiver of this type.* If the receiver is mains-driven it must have a mains transformer which gives its chassis complete isolation from the mains. The earth connection to the short wave receiver is retained, this automatically giving an earth connection to the preselector by way of the braiding of the coaxial coupling cable between them. It is necessary to use coaxial cable because this ensures that the output of the preselector is screened, whereupon there can be no undesired coupling to the aerial input, which will probably be unscreened, at socket SK1.

Power is obtained from the 9 volt battery BY1, with S2 being the on-off switch.

It will be noted that the coils each have three windings, of which only two are used. The unused windings are intended for coupling to the base of a bipolar transistor and are not required here. The f.e.t. in the TR1 position offers a very high impedance at its gate and the tuned circuit selected can couple to this directly.

All the parts employed are standard items and are readily available. VC1 is a small air-spaced single gang 365pF capacitor. In some catalogues it may be referred to as 'type OO'. S1(a)(b) can be conveniently obtained as a 4-pole 3-way miniature rotary switch, no connections being made to two of the poles.

CASE DRILLING

The preselector is housed in a ready-made instrument case measuring 8 by $5\frac{1}{4}$ by 2in. This consists of two pieces, one of which is aluminium and provides the front, rear and base, whilst the other is a vinyl covered steel top and sides. The latter is fastened to the base with self-tapping screws, which are supplied with the case.

Fig. 2 shows the drilling details for the front and rear panels.

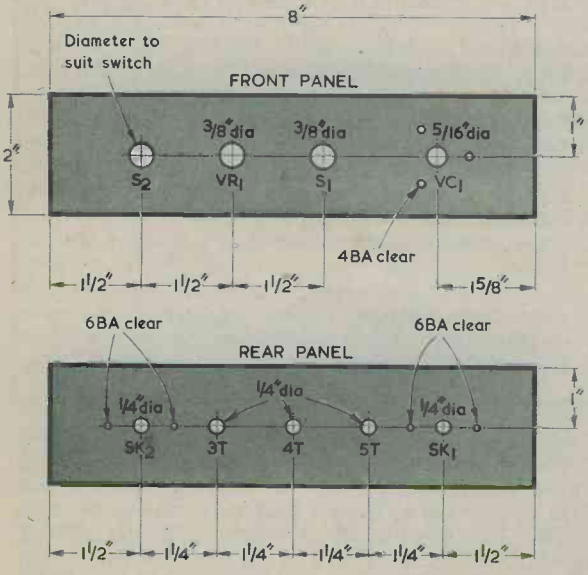
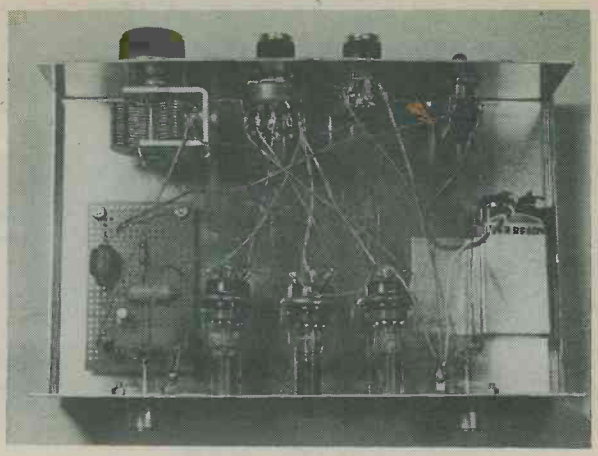


Fig. 2. Drilling details for the front and rear panels



The layout of components inside the case

Three countersunk 4BA clear holes are required in the front panel for VC1. Their positions can be marked out by pressing a piece of paper against the front plate of the capacitor and then using this as a template. When VC1 is later mounted (after all drilling has been carried out) it is held with three short countersunk 4BA bolts passing through these holes into the three tapped 4BA holes in its front panel. The bolt ends must not pass beyond the inside surface of the capacitor front plate as they may then damage the fixed or moving vanes of the capacitor. Spacing washers are required on these bolts also between the rear of the front panel and the capacitor front plate to provide spacing of $\frac{1}{8}$in. or more, thereby giving clearance for the front ball race of the capacitor.

SK1 and SK2 are standard coaxial sockets, and the 6BA clear mounting holes for these may be marked out with the aid of the sockets themselves. When these are later mounted, a solder tag is fitted under the 6BA securing nut of each which is nearer the centre of the rear panel.

Two 6BA clear holes are required in the base for the component panel shown in Fig. 4, and these may be marked out with the aid of the panel itself. The panel will take up the position, close to SK2, which is shown in the photograph of the internal layout. The photograph also illustrates a small aluminium bracket which holds the battery in place. Two suitably positioned 6BA clear holes may next be drilled for this. When the 6BA bolts are later fitted to these four holes, their heads will be below the cabinet base. Finally, four holes should be drilled near the base corners for four rubber feet.

WIRING

The drilling is now complete and the four rubber feet, VC1 and the components shown in Fig. 3 may be fitted. The spindles of VR1 and S1(a)(b) should be cut to a suitable length before they are mounted on the chassis. The three Denco coils are secured by plastic nuts which pass over threaded sections on their formers. These plastic nuts should be taken to 'finger tightness' only, as the plastic thread could otherwise be sheared. The coils should have the orientation shown in Fig. 3, i.e. pins 1 and 9 should be towards SK2.

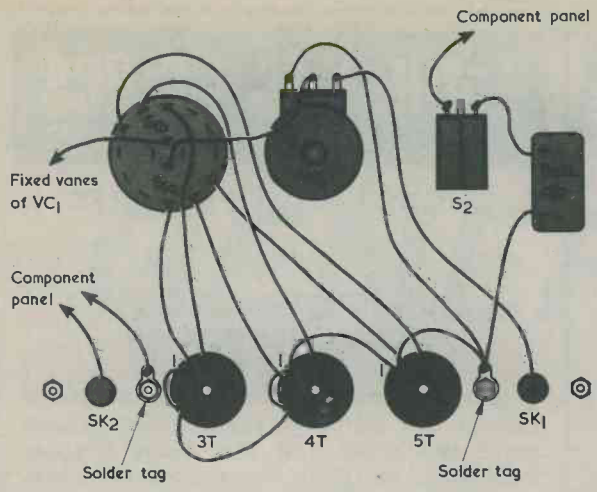


Fig. 3. Chassis wiring. For convenience, all components are drawn in a single plane

It is possible to solder leads direct to the pins of the three Denco coils, but this is liable to lead to deformation of the plastic formers due to the heat from the soldering iron. It is recommended instead that B9A valveholders be fitted over the coil pins and connections made to the valveholder tags.

Fig 3 illustrates the chassis wiring, with all the components shown in a single plane for ease of presentation. Before wiring up to switch S1(a)(b) confirm with an ohmmeter or continuity tester the three outer tags corresponding to each centre tag used. The relative positioning of the centre and outer tags may differ, with some switches, from that shown in the diagram. All wiring should be kept reasonably short. The chassis connection to VC1 moving vanes is automatically provided by its mounting to the front panel, and a wiring connection to its fixed vanes tag is all that is necessary.

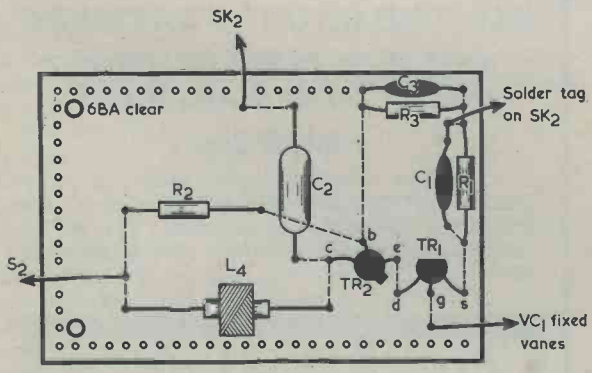


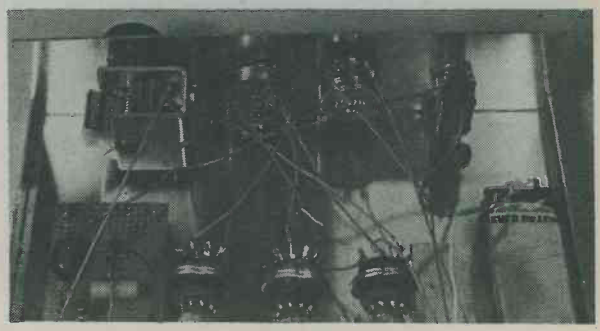
Fig. 4. Component layout and wiring on the perforated panel

COMPONENT PANEL

The two transistors and their immediate components are wired up on a plain perforated panel, of 0.1in. matrix, having 16 by 25 holes. The component layout and underside wiring on this panel are shown in Fig. 4.

The panel cannot be purchased with the size shown, and it has to be cut out from a larger perforated board. After this, the two 6BA clear mounting holes are drilled out. (In practice, this process will be carried out at an early stage in construction to enable the corresponding 6BA clear holes in the cabinet base to be marked out.) The components are mounted in the positions indicated with their lead-outs bent over at right angles underneath the panel. The lead-outs are cut to length and soldered together to form the circuit. The underside wiring is represented by the broken lines in the diagram.

Four leads leave the panel to connect to S2, VC1 fixed vanes, the centre connector of SK2, and the chassis tag at this socket. Flexible insulated wires should be fitted here cut to a suitable length by putting the panel temporarily in position on the cabinet base, and then having their ends stripped for connection. The panel is next mounted by means of two ½in. 6BA bolts with two extra nuts, or spacing washers, on each to hold the panel a little way off the base. This method of mounting should be adequate to provide reliable clearance but if it is felt that additional protection against short-circuits to the underside wiring is required a piece of thin s.r.b.p. ('Paxolin') sheet having the same dimensions as the panel can be secured underneath it and directly against the cabinet base. The four insulated leads from the panel may then be soldered to the appropriate circuit points.



Connections to the coils are made by way of B9A valveholders fitted over the coil pins

There is a space for the battery on the side opposite the component panel. A small piece of aluminium sheet may be bent to form a simple bracket which will hold the battery in position, and this bracket is secured to the cabinet base at the two 6BA clear holes drilled earlier.

When wiring has been completed it should be carefully checked over. The battery may then be fitted under its bracket and connected into circuit. The preselector is then ready for use.

NOTES ON USE

The preselector is coupled to the short wave receiver by a coaxial cable in the manner described earlier. It is desirable to keep this cable as short as is reasonably possible in order to minimise losses. The aerial connects to the centre connector of SK1.

Operation of the controls is very simple. S1(a)(b) selects the desired range. In its extreme anticlockwise position it switches in the 3T coil, giving a coverage of about 1.65 to 5.5MHz (182 to 55 metres). The central position of S1(a)(b) selects the 4T coil, providing a range of approximately 5 to 15.5MHz (60 to 19.4 metres), and the fully clockwise position brings in the 5T coil, with a range of about 10.5 to 32.5MHz (28.5 to 9.2 metres). The cores of the three coils are fully screwed in, so that the ends of the threaded brass stems are flush with the ends of the formers.

VC1 is the tuning control and is adjusted to peak the wanted signal. It will need to be adjusted slightly every time the main tuning on the receiver is altered. Preselector tuning is quite sharp because of the negligible loading on its tuned circuit which results from an f.e.t. input stage. A slow motion drive for VC1 is not necessary, however, provided it is fitted with a reasonably large knob.

The rear of the preselector, showing the two coaxial sockets and the three plastic coil securing nuts

It is very important to ensure that VR1 is not advanced any further than is necessary to provide an adequate signal for the receiver. If VR1 is left in the maximum position all the time with a t.r.f. receiver the detector may be overloaded with most signals, and audio quality and even selectivity may be impaired. With a superhet, excessive signal output from the preselector can cause a substantial increase in cross-modulation, thereby causing the increased overall gain to offer little benefit. VR1 must be kept at a *low* level setting with most signals if the preselector is to give optimum performance.

The main advantage of using a unit such as this is the improvement in r.f. selectivity it offers. When propagation conditions are poor and signal strengths are very low, then it is possible to take advantage of the full additional gain afforded by the preselector. It is essential to bear these points in mind and to operate the preselector accordingly to obtain the maximum benefit from it. ■