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Simple Short Wave Receiver Construction, pages 53-63 of chapter 3, referred to by the article "An Easily Built & Practical S.W.B.B. Receiver" by P. Lehman

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T.R.F. Receiver

This second t.r.f. receiver is very firmly based on the design described previously, but it has a few improvements. Firstly, it is designed for use with a long wire aerial, and accordingly it has aerial and earth sockets, with no built-in aerial of any kind. Next, it has a regeneration control so that it can be set for optimum results at any frequency within its tuning range. Finally, it has a buffer stage at the output so that it can be used with lower impedance headphones in addition to those types that are usable with the portable t.r.f. receiver.

The full circuit diagram for the second version of the t.r.f. receiver appears in Figure 3.8. Simply connecting a long aerial direct to the tuned circuit is not acceptable as it would

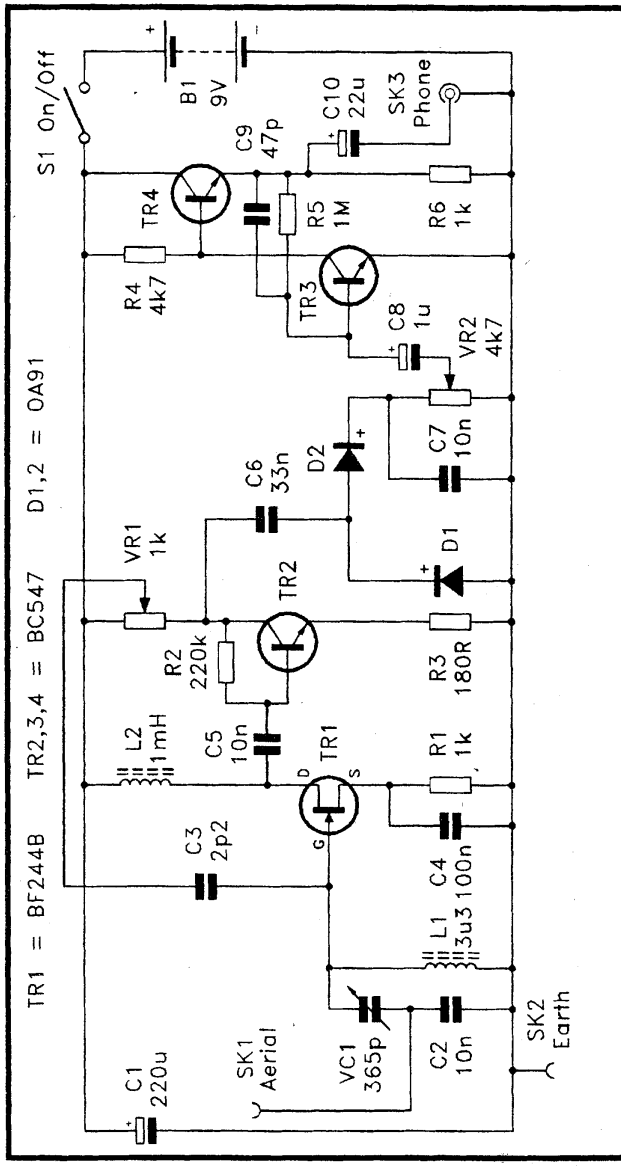

Fig.3.8 The circuit diagram for the s.w. t.r.f. receiver

excessively damp the tuned circuit and would overload the receiver. The signal could be applied to a tapping on L1, but the set has been deliberately designed to use a simple inductor in the tuned circuit. The plug-in coils that were once available for receivers of this type would not seem to be manufactured any more. Using a simple inductor overcomes problems of availability. In the unlikely event of a suitable choke for L1 being unavailable, it is not a difficult task to wind your own. The lack of any additional windings or tappings on the inductor brings with it a few design problems, but problems that are not too difficult to solve.

The aerial coupling problem is overcome by using a capacitive tapping on the tuned circuit instead of a tapping on L1 (or a low impedance coupling winding on L1). C2 has been placed in series with tuning capacitor VC1, but the high value of C2 ensures that the effective capacitance swing of VC1 is sufficient to give coverage of several bands. The aerial is connected to the junction of VC1 and C2, which effectively forms a tapping near the earth end of the tuned circuit. This method is something less than perfect, but in practice it gives perfectly acceptable results.

Regeneration is applied from the collector of TR2 to the gate of TR1, as in the original design. The load resistance for TR2 is now the track of a potentiometer, with the feedback being taken from its wiper to the gate of TR1 via d.c. blocking capacitor C3. With the wiper of VR1 at the bottom (TR2 collector) end of the track there is full feedback. As the wiper is moved up the track, the signal level reduces, as does the amount of regeneration. With the wiper at the top end of the track there is zero feedback. Therefore, VR1 enables the negative feedback level to be set anywhere from zero to a maximum level that will cause oscillation at any setting of the tuning control.

An important factor with regenerative receivers is the accuracy with which the regeneration can be set near the point at which oscillation occurs. The easiest way of setting the correct regeneration level is often to first advance the regeneration control so that the set just breaks into oscillation, and to then back it off slightly from that point so that oscillation ceases.

Even if you try to carefully advance the regeneration control to just below the oscillation point, you will often end up misjudging it, with the set breaking into oscillation. A common problem is that of the set breaking into oscillation, and then being reluctant to stop! The regeneration control sometimes has to be backed off by a substantial amount in order to halt oscillation, and it may well have to be backed off so far that the set is operating at far from optimum performance once oscillation ceases. This makes accurate adjustment of the regeneration control very difficult indeed. Presumably this effect is due to shifts in the d.c. operating levels of the circuit as it breaks into and eventually drops out of oscillation.

Fortunately, this design seems to be largely free from this problem, and accurate adjustment of the regeneration control is reasonably easy. The precision with which the regeneration control has to be adjusted means that it is always something that has to be carried out very carefully though.

The audio stages consist of a common emitter amplifier that is essentially the same as the one in the original circuit, plus an emitter follower output stage. The latter gives a lower output impedance so that the headphones or earphone do not reduce the output level significantly due to loading effects. In this case the high frequency roll-off is provided by C9 which provides high frequency negative feedback over both audio stages.

Power is supplied by a 9 volt battery, and as the current consumption is likely to exceed 10 milliamps it is advisable to use a reasonably high capacity battery. Six HP7 cells in a plastic holder are a good choice, and will give many hours of operation.

Construction

Like the portable t.r.f. receiver, this one is based on a stripboard that has 37 holes by 20 copper strips. Construction of the board is much the same as the board for the portable receiver, and it will therefore not be described in detail. Figure 3.9 (component side) and Figure 3.10 (underside) show full details of the component layout etc. Although two of the cuts in the copper strips may seem to provide no useful

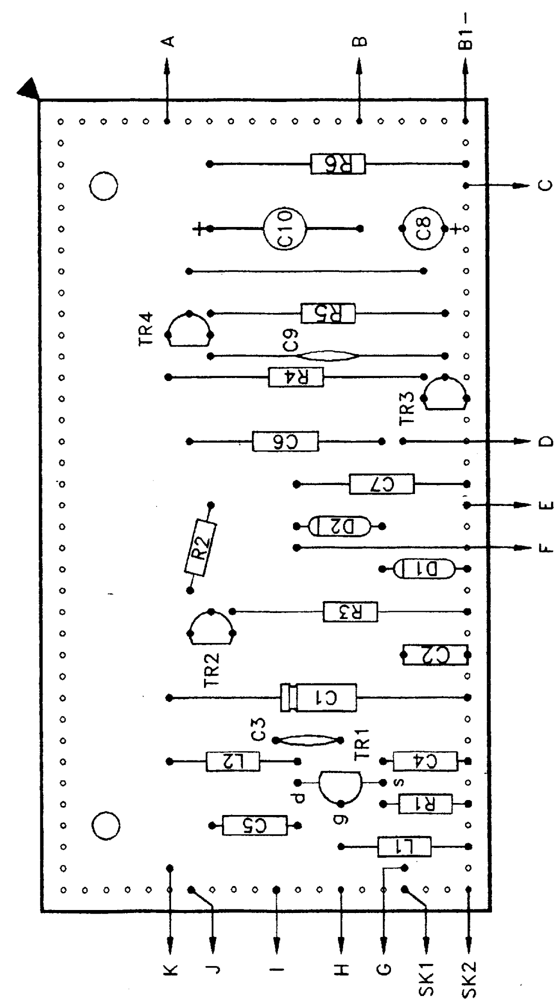

Fig.3.9 The t.r.f. receiver stripboard layout

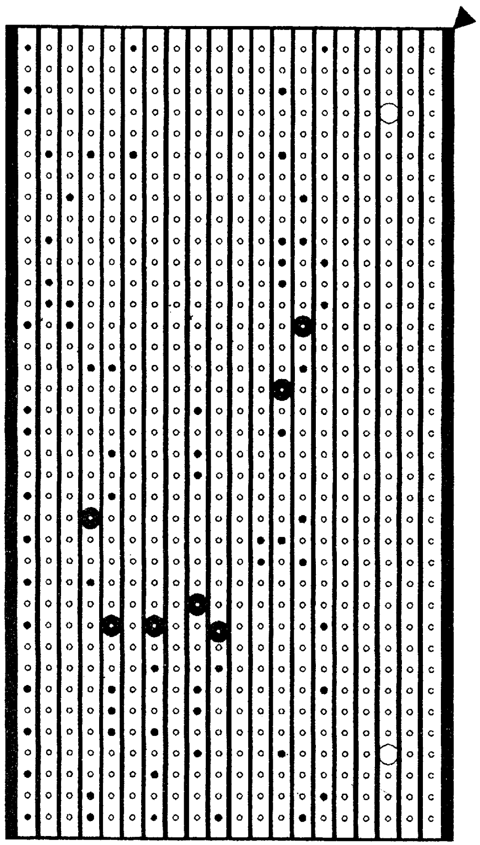

Fig.3.10 The underside of the stripboard panel

function, they are in fact needed to reduce stray coupling due to the small capacitance between the copper strips. If this is not done it is likely that problems with instability (in the form of low frequency oscillation on the output signal) will occur at certain settings of the regeneration control. It is still possible that this could happen, but only if the regeneration control is advanced well beyond the oscillation threshold.

Traditionally, simple short wave receivers are built using an aluminium chassis plus an aluminium front panel, often with no outer casing. The lack of casing was an advantage as these sets usually had band changing via plug-in coils. The absence of an outer casing meant that there was easy access to the coil holder, with no need for any opening flaps in the case to be arranged. This receiver is not primarily intended as a multi-band type having band changing, but with only a single winding and two connections to contend with, it would not be difficult to improvise simple plug-in band changing. It would just be a matter of having some form of two way socket fitted to the board in place of L1, plus some matching plugs fitted with r.f. chokes of various values.

It is worth noting that home constructed coils for a receiver of this type are easily produced. Using a coil former of about 6 millimetres in diameter fitted with a dust iron core, about 18 turns of 24 s.w.g. enamelled copper wire should give coverage of the main short wave broadcast bands. Adjusting the core enables the coverage of the receiver to be shifted upwards or downwards slightly if necessary. A home-made coil of this type is likely to work at least as well as a ready-made r.f. choke, and could well have a higher Q value, giving slightly improved results. Trying higher or lower numbers of turns enables larger shifts in the coverage to be achieved. About 40 turns of wire for instance, should provide coverage of the low frequency bands. It can be very interesting to play about with various coils to see what can be picked up.

Assuming that the set is built as a single band type, a plastic or metal box measuring about 150 by 80 by 50 millimetres or more should accommodate everything. As tuning capacitor VC1 does not have either set of plates connected to earth, my preference would be for a plastic type. This avoids having to insulate VC1 from a metal case, which might not be very

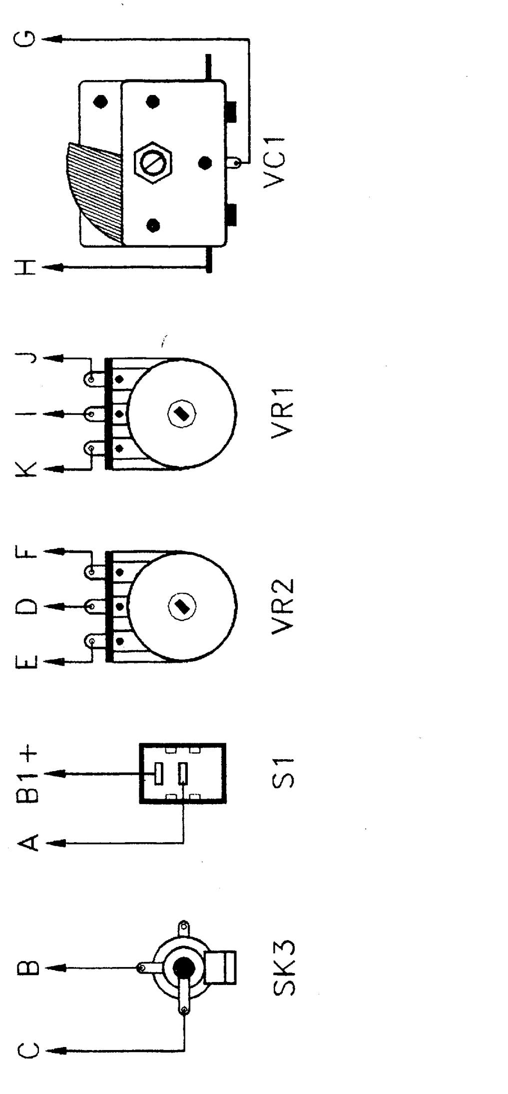

Fig.3.11 Details of the t.r.f. receiver wiring

easily accomplished. The controls and headphone socket are mounted on the front panel, but it will probably be more convenient to have the aerial and earth sockets fitted on the rear panel. Choose a layout that will enable the point to point wiring to be kept reasonably short. Details of this wiring are shown in Figure 3.11, which should be used in conjunction with Figure 3.9.

The selectivity of this receiver is quite good, and the use of some form of bandspread is strongly recommended. Tuning will be quite difficult without the aid of electrical or mechanical bandspread, but the set will just about be usable if VC1 is merely fitted with a large control knob.

In Use

This set is not designed for use with a short aerial, and at the very least an indoor aerial about eight metres long should be connected to SK1. An earth connection is not essential, but should be used where possible. The receiver is used much like any other set, but there is obviously the slight complication of the regeneration control to contend with. With this only moderately advanced you should be able to locate the broadcast bands and receive a few of the stronger transmissions. Select a band, and then advance VR1 as far as possible without the set breaking into oscillation. It should then be possible to tune a number of stations on that band at good strength, but it might be necessary to make some readjustments to VR1 in order to keep the regeneration at the optimum level. With luck, you will find that setting the regeneration control with the set tuned to the middle of a band will give good reception over the entire band, with no further adjustment of VR1 being necessary.

Components for Figure 3.8

Resistors (all 0.25 watt 5% carbon film)

R1	1k (brown, black, red, gold)
R2	220k (red, red, yellow, gold)
R3	180R (brown, grey, brown, gold)
R4	4k7 (yellow, violet, red, gold)
R5	1M (brown, black, green gold)
R6	1k (brown, black, red, gold)

Potentiometers

VR1	1k lin
VR2	4k7 log

Capacitors

C1	220µ 10V axial elect
C2	10n polyester
C3	2p2 ceramic plate
C4	100n polyester
C5	10n polyester
C6	33n polyester
C7	10n polyester
C8	1µ 63V radial elect
C9	47p ceramic plate
C10	22µ 16V radial elect
VC1	365p air spaced (Jackson type O)

Semiconductors

TR1	BF244B
TR2	BC547
TR3	BC547
TR4	BC547
D1	OA91
D2	OA91

Miscellaneous

L1	3µ3 r.f. choke
L2	1m r.f. choke
SK1	Red 4mm socket
SK2	Black 4mm socket

SK3	3.5mm jack socket
B1	9 volt (6 x HP7 in holder)
S1	s.p.s.t. sub-min toggle
	Case
	0.1 inch pitch stripboard, 37 holes by 20 strips
	Crystal earphone, high impedance headphones, or medium impedance headphones, with 3.5mm jack plug
	Battery connector
	Three control knobs
	Wire, solder, fixings, etc.