Constructional Project

HIGH PERFORMANCE REGENERATIVE RECEIVER

by RAYMOND HAIGH

Provides continuous coverage from 130kHz to 30Mhz.

Last month we explored the merits, and problems, of regenerative receivers and gave an in-depth circuit description. We also included the component listing and offered the option of-"electronic tuning."

We conclude this month with the assembly, plug-in tuning coil details, and setting-up procedure.

CONSTRUCTION

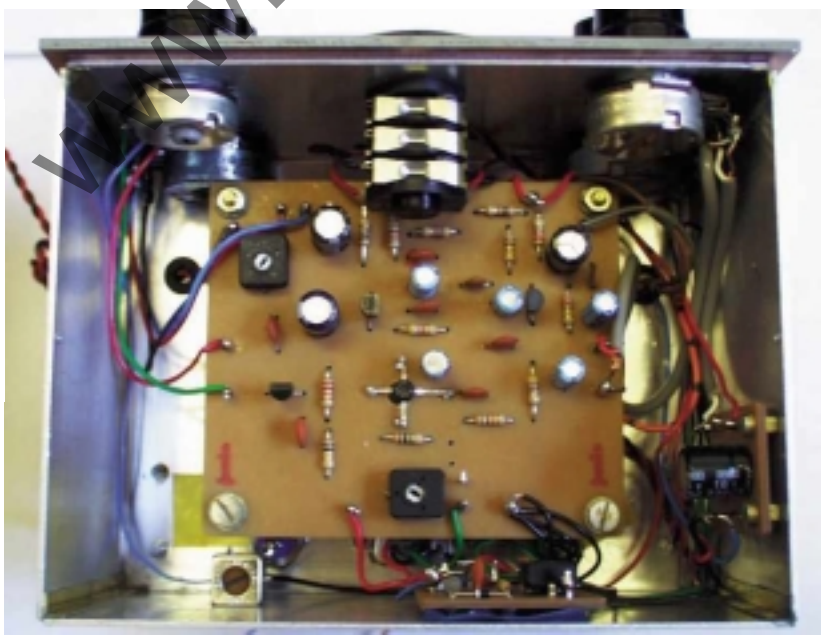
The receiver, power amplifier, and the alternative electronic tuning system are assembled on three small printed circuit boards (PCBs). This enables constructors to select what they want from the design and to use tuning components that may be to hand. Many will already have suitable audio amplifiers, and not everyone will wish to adopt electronic tuning.

The three printed circuit boards are available as a set from the *EPE Online Store* (codes 7000254, 7000255 and 7000256) at **www.epemag.com**. The topside component layout and (approximately) full-size copper track masters of the three PCBs are illustrated in Fig.4, Fig.5, and Fig.6.

Starting with the main Receiver board, mount the smallest components first, working up to the largest, but solder the semiconductors on to the board last. It is a wise precaution to clip a small heat shunt (such as a crocodile clip) to the leads of the field effect transistors (FETs) when they are being soldered.

Use solder pins, inserted through the board at the dual-gate MOSFET lead-outs, to enable it to be located on the component side. Solder pins

RF Attenuator VR1 *Headphone socket* *AF Gain VR8*



Layout and wiring of the three PCBs, headphone socket, and under-chassis controls.

Audio power amplifier PCB.

Wave trap *Electronic tuning PCB.*

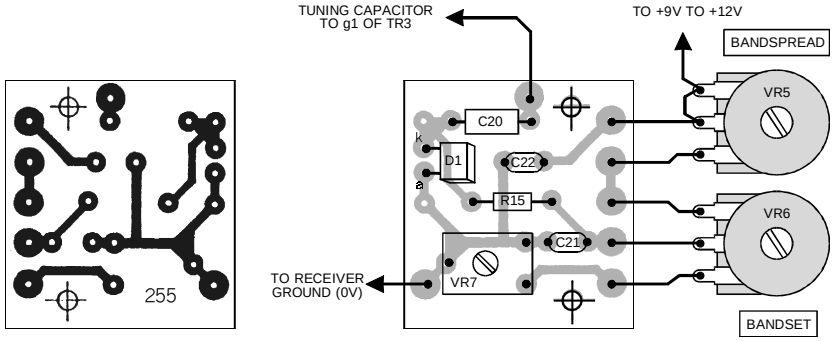


Fig.4. Printed circuit board layout for the electronic tuning system (approximately full size).

Tuning board mounted on the side of the chassis.

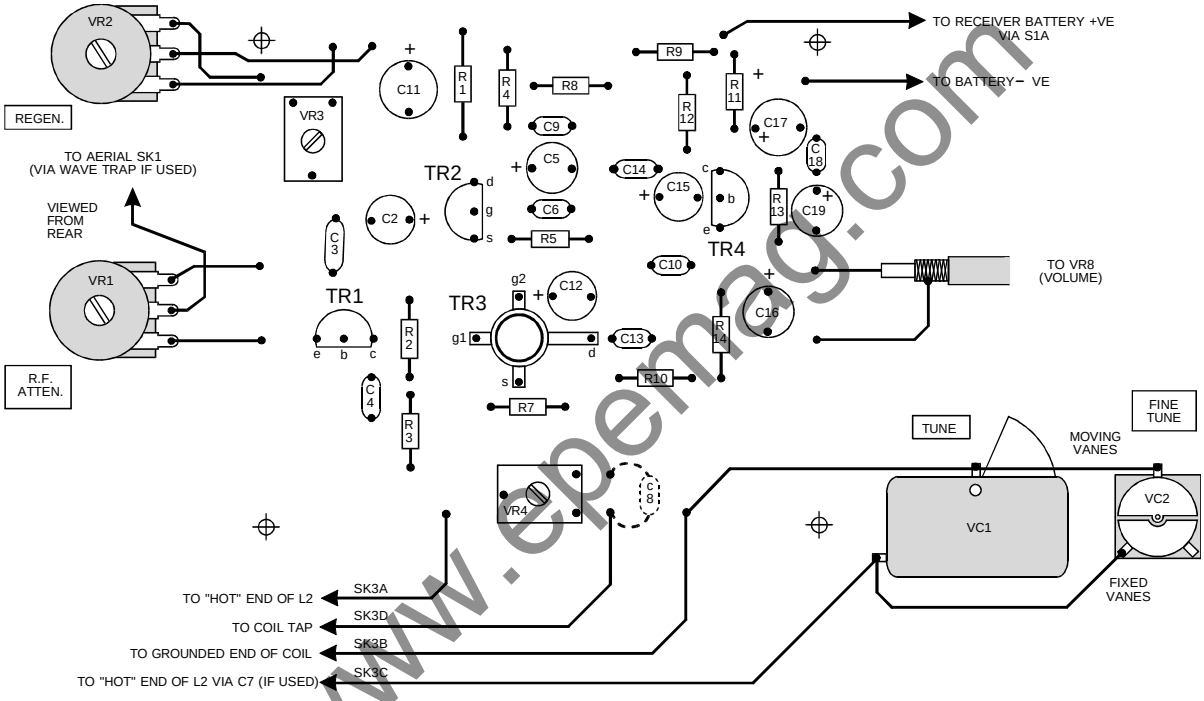


Fig.5. Main PCB layout and wiring and (below) approximately full-size copper foil master for this board.

Chassis topside layout showing D-type socket for the tuning coils.

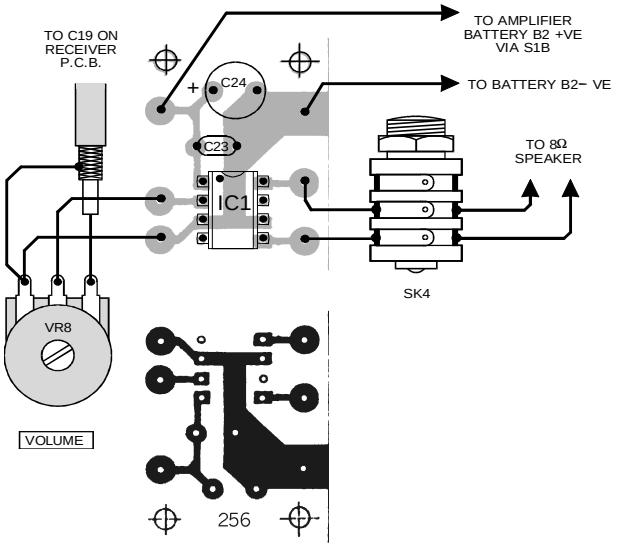
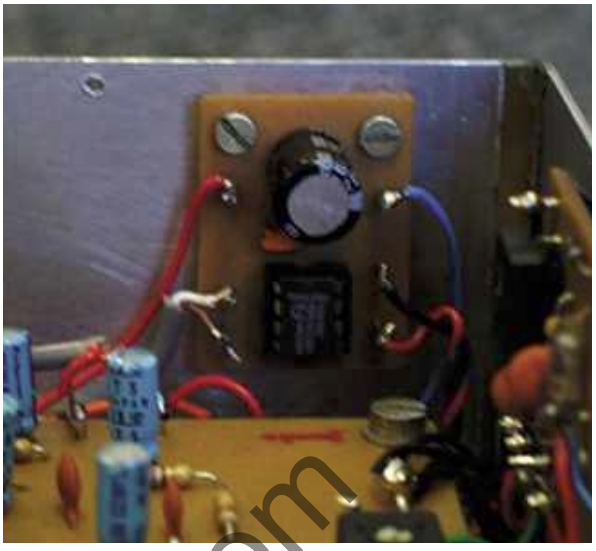


Fig.6. The audio power amplifier PCB (approximately full size).



The audio amplifier PCB mounted on the side

With care a neat construction for L2 can be achieved.

should also be inserted, just to the right of VR4, so that capacitor C8 can be temporarily soldered across preset VR4 during the setting up process.

Solder pins inserted at the PCB interwiring points will ease the task of off-board wiring. Use of an 8-pin DIL socket will facilitate the substitution and checking of IC1.

The same construction approach should be adopted for the two smaller boards.

Table 2: Tuning Ranges

TOKO Coils and a 10pF-365pF Variable Capacitor
(see Fig.7 for details of coil base wiring)

TOKO Coil	Base Wiring	C7 pF	R6 ohms	C8 pF	Min freq. MHz	Max freq. MHz
CAN1A350EK	C	--	12k	--	0.130	0.322
RWO6A7752EK	C	--	6k8	--	0.257	0.765
RWR331208NO	A	--	22k	1000	0.510	1.600
154FN8A6438EK	C	470	8k2	--	1.246	3.034
KANK3426R	A	470	12k	1000	2.143	5.100
KANK3337R	A	470	3k3	1000	4.900	11.970
MKXNAK3428R	A	220	8k2	1000	11.200	23.500
KXNK3767EK	B	47	12k	10	22.000	30.500

Notes:
(1) Adjustable cores permit wide variation in tuning range.
(2) The 470PF capacitor, C7, reduces the variable capacitor swing to 10pF-205pF: with the 220pF capacitor, the swing is 10pF-137pF; and , with a 47pF capacitor as C7, 8pF-40pF.
(3) The RW06A7752EK coil is useful for covering the I.f. end of the Medium Wave band.

BAND CHANGING

Tuning coils (L2) could be connected into circuit by means of miniature crocodile clips and short (50mm maximum) wire links. However, a much better arrangement is to wire them, together with C7, R6, and C8 (when used), to 9-pin D-type computer plugs to make up plug-in modules and to mount a matching socket on the Receiver frame (see photographs). How this can be achieved is shown in Fig.7. Also illustrated are the different methods of connecting the coil windings.

Various versions of L2 for full frequency coverage.

RECEIVER ASSEMBLY

Layout is not critical, but connections between the tuning components and the receiver PCB must be short and direct and signal input and output leads should be kept well separated.

For the satisfactory reception of weak, amateur, SSB transmissions (where correct tuning is extremely critical), the PCBs and tuning capacitors must be very rigidly mounted and screened in a metal box or case. The prototype is assembled in and on a small aluminum box with a piece of double-sided PCB forming a screened front panel.

The photographs show how this is done. The arrangement has proved quite satisfactory, but a heavier, diecast metal box would be preferable, if one is to hand.

Some form of reduction drive to the Bandset capacitor VC1 will make tuning easier, and dial calibrations can be marked on a piece of card stuck to the front panel.

SETTING UP

This is very much a switch-on-and-go receiver, and the setting up process only involves optimizing the feedback levels so that the Regen. control VR2 is smooth and effective over the full swing of the tuning capacitor on all coil ranges.

First, check the PCBs for any bridged tracks or poor joints. Check the orientation of the semiconductors and polarized capacitors.

Set VR3 to minimum and VR4 to maximum resistance. Connect the Medium Wave coil into circuit, wire in capacitor C8, connect an aerial, and switch on.

Turn up the RF attenuator (VR1) and AF gain (VR8), then advance regeneration control VR2. Transmissions should be picked up, loud and clear, around the dial.

With the tuning capacitor VC1 fully meshed, set preset VR4 to the highest possible resistance consistent with the Q-multiplier just oscillating when Regen. control VR2 is turned to maximum. Measure the resistance of VR4 and permanently wire a fixed resistor of the same value, R6, in series with the tapping on the coil.

Preset potentiometer VR3 determines the voltage across the regeneration control. Set it to the highest possible resistance consistent with effective regeneration being obtained on all ranges.

The optimum values of resistor R6, measured on the prototype receiver, are listed in Table 2. They may not hold good for all dual-gate MOSFETs, but they will certainly be a useful guide.

Tabulated values of swing-reducing capacitors (C7) relate to a 365pF variable capacitor. If a different component is used, they will need modifying. Indeed, if its maximum value is as low as 200pF, swing reducers will only be required on the two highest shortwave ranges.

Coil cores should be set to give continuous coverage. Varying the inductance causes slight changes in the optimum value of resistor R6, and this part of the procedure should be carried out before the resistors are selected.

OPERATION

Best results will be obtained by attenuating the RF input as much as possible and adjusting AF gain to ensure audibility.

The regeneration control VR2 should be set just short of the oscillation point when receiving broadcast transmissions. When amateur SSB signals are being tuned in, it must be advanced until the Q-multiplier stage is just oscillating. (The internally generated oscillation replaces the carrier removed at the transmitter so that the detector can render the signal intelligible in the usual way.)

If the set is reluctant to regenerate, strong signals tend to spread across the dial, or difficulty is encountered when trying to clarify SSB signals, reducing the input from the aerial will invariably cure the problem. In cases where local Medium Wave or, less likely, Long Wave transmitters swamp the receiver, a wave trap (L1/C1) will have to be fitted.

CALIBRATION

A crystal marker or signal generator can be used for calibration purposes. Alternatively, an “all-band” radio with an accurate dial (preferably digital) should prove suitable.

Take a short aerial wire from the calibrating receiver and place it close to the Q-multiplier whilst it is oscillating. This will enable the radio to pick up the radiated energy.

The two receivers can now be tuned in step whilst the dial is marked out. Even if the calibrating receiver does not have a BFO (beat frequency oscillator) to make the oscillations audible as a tone, the presence of the signal should be discernible.

Refer to Table 2 for guidance on the frequency coverage to be expected with individual coils. It is easy to be confused by harmonics whatever method of calibration is adopted.

PERFORMANCE

When correctly set up and operated, the radio is sensitive, selective, and capable of receiving broadcast and amateur transmissions from all over the world.

If a reasonable aerial is used, say 15 meters or 20 meters of wire located as high as possible and clear of earthed objects, the RF input control will have to be turned well down when listening to all but the weakest stations. An earth (a metal rod in the ground) connection can improve reception, especially at low frequencies.

The receiver has a clear, pleasant tone, and audio output is more than adequate.

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