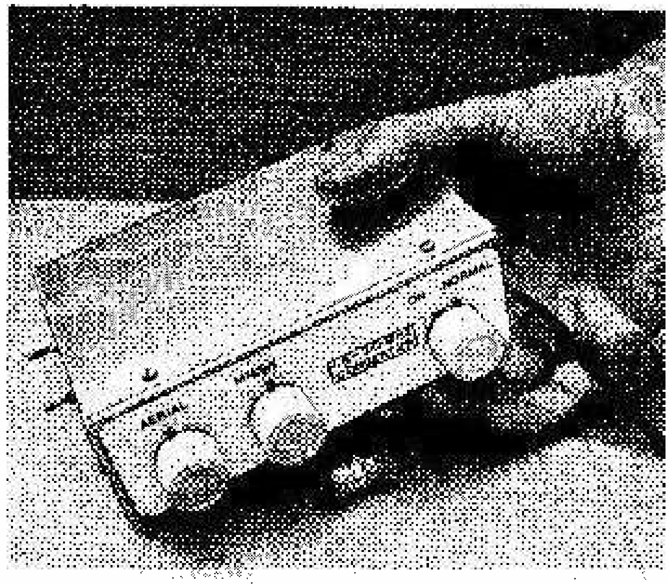
top band CONVERTER



F.G. RAYER G3OGR

THIS converter may be used with a valve or transistor receiver, bringing the 1800kHz to 2000kHz amateur "Top Band" range into the 600kHz to 800kHz section of the receiver's medium wave band. Actual frequency coverage extends somewhat outside the 1·8-2·0MHz range.

Conversion is by means of an oscillator working at about 2·6MHz, the oscillator being h.f. of the signal frequency. As an example; to receive a signal on 1800kHz, the converter output is 2600−1800, or 800kHz, while to receive a signal on 2000kHz, the converter output is 2600—2000kHz, or 600 kHz. The receiver thus functions as a tunable i.f. amplifier, covering 1800-2000kHz when tuned from 800-600kHz. It will be noted that the new frequency range is inverted, the high frequency end of this band coming towards the low frequency end of the receiver's medium wave range.

Circuit

This is shown in Fig.1. When the 3-pole switch is in the "off" position S1A and S1C take the aerial connection directly to the receiver, which then works in the usual manner. When the switch is "on" S1B connects the 9V battery supply and signals pass through the converter.

Tr1, an OC170, is the r.f. amplifier, the aerial circuit being peaked up by the panel trimmer VC1. Output from this stage passes to L2, trimmed by VC2, which

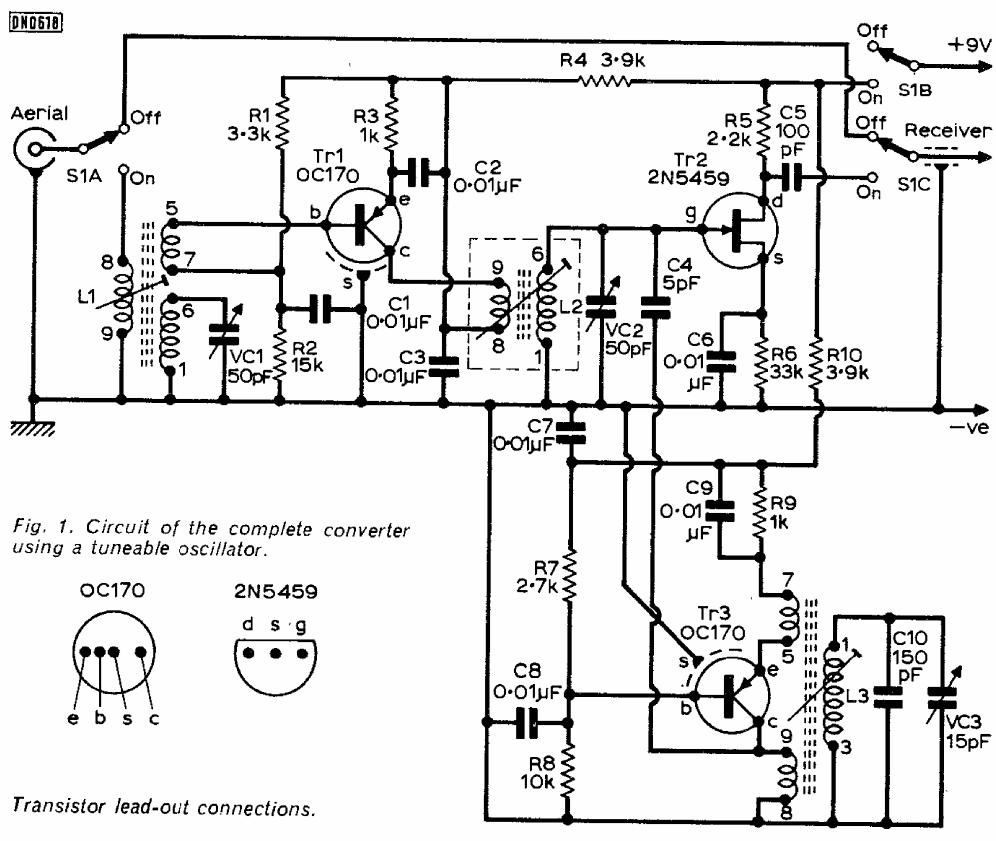


Fig. 1. Circuit of the complete converter using a tuneable oscillator.

Transistor lead-out connections.

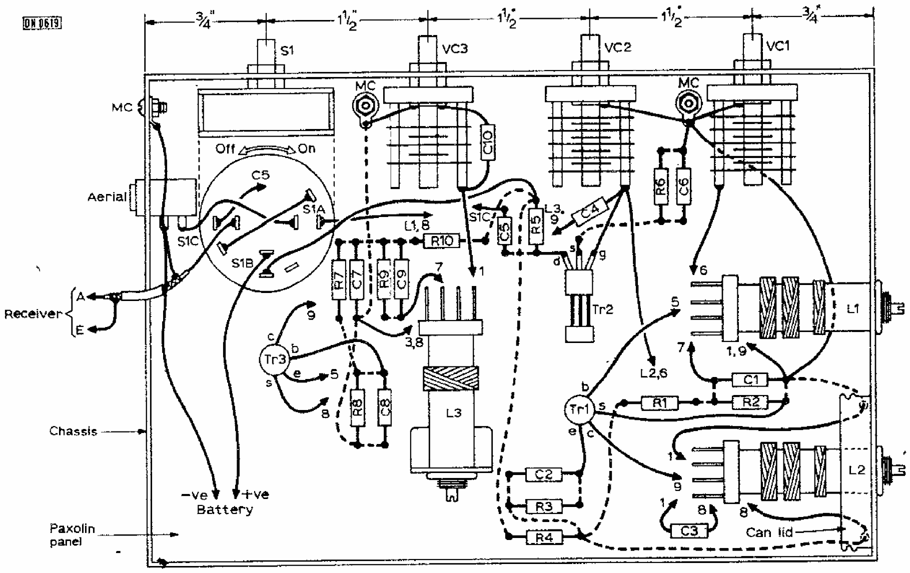


Fig. 2. Layout of the tuneable version of the converter. Tuning capacitor VC3 and associated components are not required in the crystal controlled version, shown in heading photograph.

forms the input circuit of the f.e.t. mixer Tr2, a 2N5459.

Tr3, an OC170, is the 2·6MHz oscillator, coil L3 having a fixed capacitor C10 in parallel together with the trimmer VC3. Mixer injection is via C4, while the output to the receiver is by means of a screened lead.

Crystal Control

The oscillator stage Tr3 in Fig. 1 may be replaced by a crystal controlled oscillator, as described later. In this case, VC3 and some other items here will not be required, as this part of the circuit conforms to Fig. 3.

Construction

The converter is completely screened in a 6×4×2in. aluminium box made from two 6×2in. universal chassis members, two 4×2in. members and two 6×4in. flat plates secured with self-tapping screws.

Holes for capacitors, switch and coils are punched as in Fig. 2. The can in which L2 is supplied is used as a screen by securing the lid under the bush of L2. Drill holes clear of the threaded portion of the lid, for the leads from pins 1, 6 and 8.

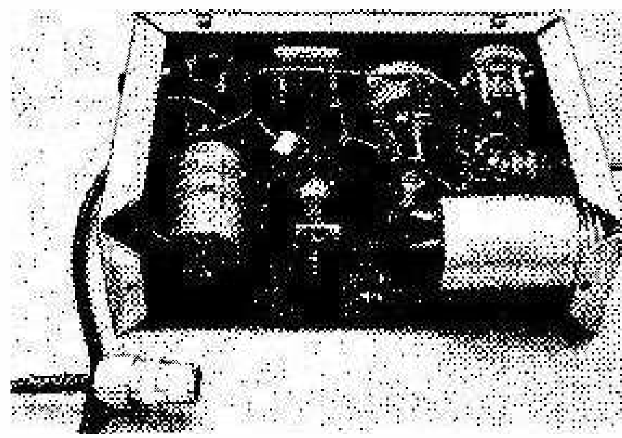
A piece of $\frac{1}{16}$in. paxolin about 5$\frac{1}{4}$in.×3$\frac{3}{4}$in. is cut and fixed inside the flanged members by countersunk 6BA bolts through the flanges and paxolin. Place washers between the flanges and paxolin, to give about $\frac{3}{16}$in. clearance for wires which will be under the paxolin. If this is not done, it will be impossible to fix the bottom 6×4in. plate in position. Secure 6BA tags under the bolts near VC1 and the switch, for earth return connections.

It is easier to wire the converter with only the front 6×2in. and side 4×2in. members in place. After testing, bolt on the back 6×2in. member, and fix top and bottom 6×4in. plates.

L3 is mounted on a small bracket cut from scrap metal but leads should be soldered to its pins before actually fixing it.

Wiring

Resistors and other components are fixed to the paxolin board by drilling small holes and putting the wire ends through them, Fig. 2.



General view of completed converter based on Fig. 1 and 2.

Coil pins should be scraped or cleaned with abrasive paper before soldering, since undue heating will soften the material in which the pins are moulded.

(Because of the ease with which the coils can be damaged by excessive heat applied to the pins it is suggested that constructors may wish to use a valveholder for each coil. Wire the valveholders in such a way that they can be pushed on to their respective coils, keeping the leads as short as possible.—Ed.)

When wiring L2, leave an insulated wire projecting from pin 9.

Drill a hole in the centre of the screening can and also cut off some of the threaded section, so that when the can is screwed on it does not cut into the leads from pins 6 and 8. The can is then screwed on, with the lead through the hole, the collector lead of Tr1 being soldered to the lead. Note that C3 is across pins 1 and 8, inside the can.

A 3-socket transistor holder is used for Tr2 and this can be cemented in position, or held with stout leads through the paxolin.

Check that switch connections are correct. In the "off" position the converter is not in use. With the switch "on" S1A takes the aerial to 8 on L1, S1B connects the battery positive, and S1C connects the receiver to C5.

The aerial socket fitted is a miniature item for a small jack plug, outer going to chassis, and inner to S1A. The output lead employed was small co-axial cable with the outer soldered to a tag bolted to the chassis and the inner conductor running to S1C. This was to suit associated equipment. There is adequate space for ordinary co-axial connectors or sockets, for both input and output purposes, if preferred.

An elastic band through holes in the paxolin holds the internal battery. The internal battery supply allows the converter to be connected to a car radio in a vehicle having either positive or negative earth.

Alignment

If the converter is used with a portable or table transistor receiver, run a reasonably short screened lead to the aerial input socket of the receiver, the co-axial outer conductor going to the receiver earth or chassis in the usual way. This can also be done with mains receivers where the receiver chassis is earthed and isolated from the mains. **The converter must not be used with any ac/dc type receiver having a live chassis.**

Plug in Tr2, making sure the lead-out wires are in the correct sockets. Adjust L1 and L2 so that about 15 threads of the adjusting screw protrude. L3 has about 10 threads protruding.

Tune in any Top-Band signal with the receiver tuning around 700kHz. Place VC1, VC2 and VC3 about half closed and rotate the cores of L1 and L2 for best volume. The core of L3 can be moved to alter coverage, if necessary, and then locked with a nut. It should be found that VC1 and VC2 peak up signals throughout the band; if not, adjust L1 and L2 cores for suitable coverage. In the event of a wanted Top-Band signal falling on the frequency of a medium wave signal thus causing interference, alter VC3 and re-tune the receiver. VC3 also acts as a fine tuner if the receiver is not equipped with a suitably slow tuning drive or dial.

Alternative Crystal Control

The LC oscillator tuned circuit L3 with C10 and VC3 can be replaced by a crystal controlled oscillator stage with a frequency of about 2600kHz. The circuit for this is shown in Fig. 3 and the layout in Fig. 4.

Crystal control gives much greater oscillator stability and Top Band frequency readings transferred to the receiver m.w. scale will remain unchanged, which can be useful for logging and tuning purposes. On the other hand, it is impossible to shift the m.w. tuning point in the manner previously described, in order to dodge m.w. interference. So crystal control is only suitable when the receiver is not subject to m.w. breakthrough.

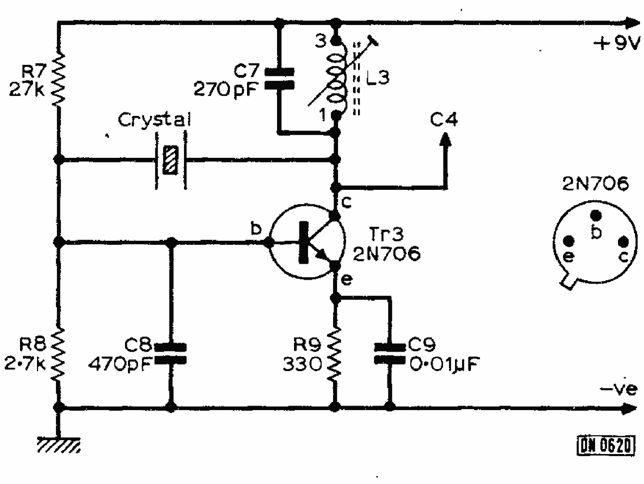


Fig. 3. Modified oscillator circuit for crystal control.

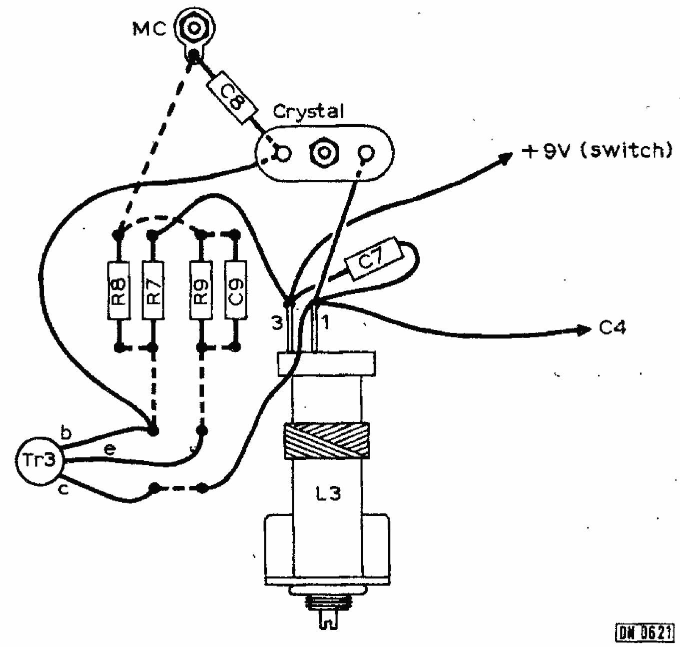


Fig. 4. Layout of components around oscillator inductor L3, when using circuit of Fig. 3.

★ components list

Resistors:
R1 3·3kΩ R5 2·2kΩ R9 1kΩ
R2 15kΩ R6 33kΩ R10 3·9kΩ
R3 1kΩ R7 2·7kΩ
R4 3·9kΩ R8 10kΩ All ¼W 10%

Capacitors:
C1 0·01μF disc ceramic C6 0·01μF disc ceramic
C2 0·01μF „ „ C7 0·01μF „ „
C3 0·01μF „ „ C8 0·01μF „ „
C4 5pF SM C9 0·01μF „ „
C5 100pF SM C10 150pF SM
VC1-2 50pF variable (Jackson C804)
VC3 15pF variable („ „)

Semiconductors:
Tr1 OC170 Tr2 2N5459 Tr3 OC170

Miscellaneous:
L1, Range 2, Blue, L2, Range 2, Yellow. L3, Range 3, Red, all miniature, transistor (Denco). Case, Universal Chassis members, 6 x 2in. flanged (2), 4 x 2in. flanged (2), 6 x 4in. flat plates (2) (Home Radio). Transistor holder, for 2N5459. 3-pole 2-way rotary switch. Screened lead, knobs, aerial socket.

Crystal Oscillator: (Fig. 3)
R7 27kΩ R8 2·7kΩ R9 330Ω
C7 270pF SM C8 470pF SM C9 0·01μF disc
Tr3 2N706 L3 See text
Crystal: 2600kHz and holder, see text

L3 can be that used for the circuit in Fig. 1, or any similar inductor which can be adjusted to about the crystal frequency by moving its core. Set the core so that the oscillator starts immediately when the converter is switched on.

Aerials

If no Top Band aerial is available a long outdoor wire will give good general results. Some 50 to 150ft of wire would do well. Bends in the run of the aerial will not matter too much, if they cannot be avoided, but the wire should not turn back on itself.

Various resonant and other aerials are used by Top-Band enthusiasts which can greatly increase signal strength. If a very short aerial is used, it should be brought to resonance by a tuner.

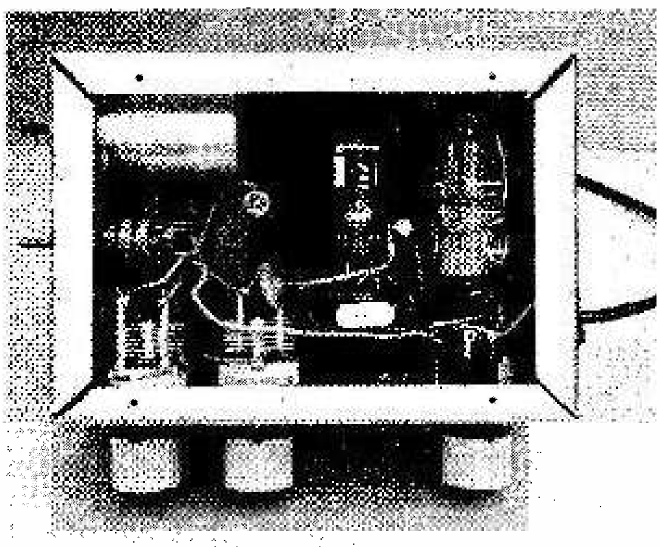
Connecting a reasonably effective earth can also greatly increase the strength of Top-Band signals.

If there is particularly troublesome interference from a m.w. transmission breaking through, this can be reduced with a wavetrap.

Tuning

With a receiver such as a car radio or older type of domestic receiver intended for use with an external aerial, there is very little pick-up of medium wave transmissions in the 600-800kHz sector when the aerial is disconnected or the converter in use. It is then only necessary to peak signals with VC1 and VC2 on the converter and tune the receiver through the 600-800kHz range.

With other receivers, and particularly portables with ferrite rod aerials, there is considerable pick-up of medium wave transmissions, so that a number of broadcast stations will be heard in the 600-800kHz range. As it is scarcely practicable to eliminate this,



Underside view of modified converter.

interference to reception in the 1·8-2·0MHz range is avoided by means of the small trimmer VC3, which allows the converter oscillator frequency to be shifted a little, so that if necessary a wanted Top Band signal can be moved off the channel occupied by a broadcast station in the m.w. range. With the aid of VC3 it was found practicable to use the converter with a portable receiver having an internal ferrite rod aerial, and provision for connecting an external aerial, and to obtain Top Band signals without m.w. broadcast interference.

VC1 and VC2 were each 50pF, but on test it was apparent that 25pF capacitors would be adequate. A pre-set, adjusted when first testing the converter, may be used instead of VC2, but with a slight falling off of results towards the extreme ends of the band. VC3 could also be omitted if the receiver does not give troublesome break-through of medium wave signals. VC1 is better retained as a panel control, to allow peaking up L1 with any aerial. ■

Electronotes..

S. GINSBERG

Calculators have been in existence for quite some time. Probably the earliest was a hand which gave a crude visual indication. The left hand fingers were worth one, going from one to five. From five to ten individual numbers were recognised by a bent finger. Once ten was reached, a finger on the other hand was raised. The abacus came with its beads enabling counting to be carried out with comparative ease. Most modern day school children have used a slide rule. These can be bought for less than £1 and offer quick means of making a calculation. Accuracy is often not very good, but is usually near enough for most practical purposes.

In this modern technological age even the slide rule is considered by many to be crude, and electronic calculators are beginning to move in. Simple machines which add, subtract, divide and multiply are readily available, some for less than £50.

Beauty of the electronic slide rule or calculator is that it is accurate and very easy to read. It is only a matter of pressing clearly labelled push buttons for the simple operations. The answer is clearly readable from illuminated digital readouts.

An electronic calculator which aroused a great deal of interest when it was launched recently, is the HP-35. This unit fits snugly into the palm of your hand, weighs only nine ounces and gives a readout from quite complex functions in less than 0·5 second. The display goes to ten digits, so accuracy is excellent. Some 30,000 transistors are employed in the m.o.s. chips which are manufactured using ion implantation. Besides adding, subtracting, multiplying and dividing, the unit also handles square roots plus a whole range of trigonometrical functions such as Sin x, Cos x, Tan x, Arc sin x, Arc cos x, and Arc tan x. Logarithmic functions include Log_{10} x, Log_e and e^x. Other functions are x^y, 1/x, data storage and positioning keys.

The calculating range covers 10^{-99} to 10^{99} which is equal to 200 decades. If any improper operations are involved, such as the square root of a negative number, a light will flash. Readouts are l.e.d's, which save power compared to other readout systems, and the unit also has a memory which will remember a figure for you and display it as and when you call it up on the readout.

Just in case you are a hardened cynic and reckon you could back your conventional slide rule against this device, try working out a square root. The HP-35 takes 110 milliseconds to do this—to ten digit accuracy too. Of course, logarithmic and exponential functions are more difficult and the HP-35 takes a full 200 milliseconds before displaying these answers.