

Front view of 40673 converter. The bandswitch and the front-end tuning control are below, while the regeneration control is above. No separate front-panel is provided since the converter shares the front-panel of the complete solid-state receiver. The converter chassis forms part of the 3-in-one chassis of the complete receiver.

## A DELUXE 40673 CONVERTER

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**T**HIS article describes a deluxe all-band converter using the recently-introduced dual insulated-gate field-effect transistor RCA 40673. The converter uses a toroidal antenna coil and three FET's: a 3N128 as the Q-multiplier, a 2N3819 as the crystal oscillator and a 40673 as the mixer.

With its low noise-figure, high transconductance, wide dynamic range and immunity from cross-modulation, the 40673 offers really "hot" performance as a combined r.f. amplifier and mixer. The power gain is as high as 40 db at 30 mc, dropping to 12 db at 400 mc, while the noise figure is better than 3 db at 30 mc. In keeping with the recent trend in h.f. receiver design, the r.f. stage can be dispensed with, without any discernible deterioration in the noise figure.

Both the insulated gates of the 40673 offer extremely high input impedance. The gate No. 1, known as the signal gate, offers a low input capacitance of 6 mmf and a high forward transconductance of 12,000  $\mu$ mhos, while the very low drain-to-gate feedback capacitance of 0.02 mmf assures stable operation without neutralization. The signal gate is operated at a slightly negative bias of about 0.5 volt with reference to the source.

The gate No. 2, known as the control gate, is operated at a positive bias of about 4 volts with reference to the source. In r.f. amplifier

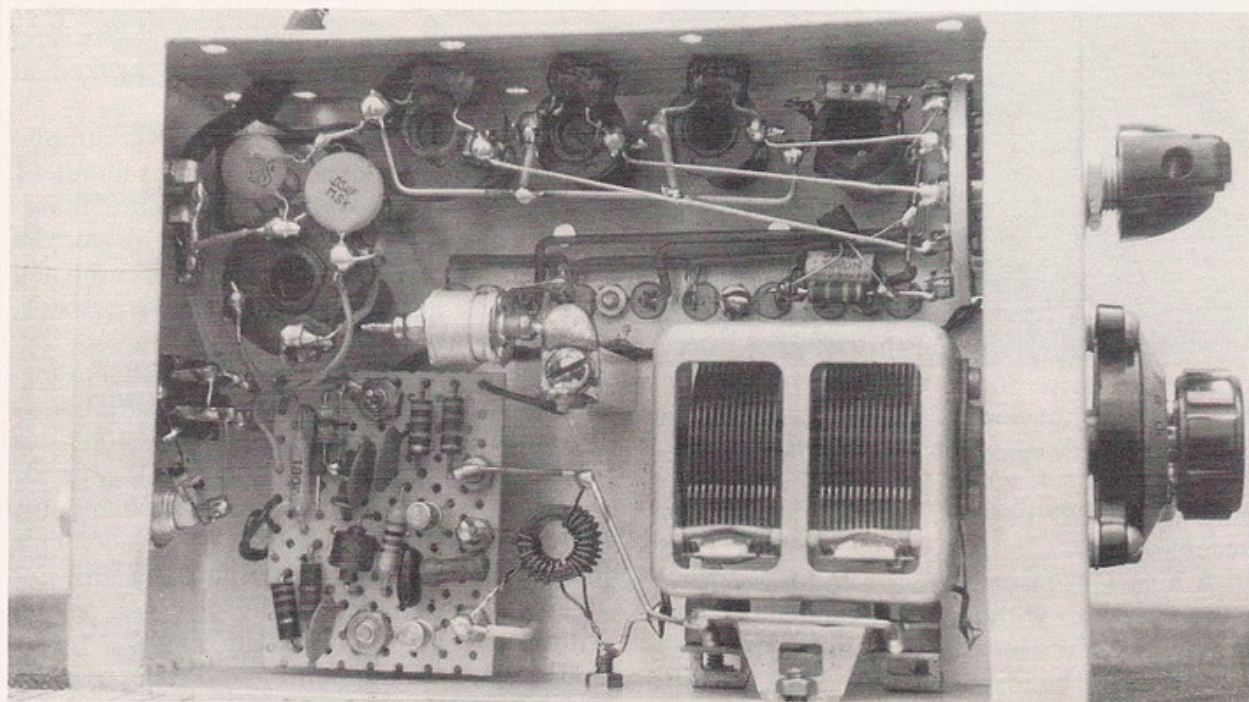
applications, excellent a.g.c. action is obtained by applying a negative a.g.c. voltage to the positively biased control gate. In mixer applications, the control gate carries the oscillator injection with practically no feedthrough to the antenna.

From the amateur's point of view, the most welcome feature of the 40673 is the gate protection afforded by back-to-back zener diodes integrally fused between each gate and the source. These diodes are special low capacitance zeners with a zener voltage of around 10 volts. The diodes protect the gates from electrostatic charges during handling and transients during operation. To the amateur, this means a lot: There is no danger of front-end burn-out due to sluggish operation of the transmit/receive relays, barring of course a "direct hit." Also there is no necessity for the messy job of running a grounding wire around the leads before soldering, and the only precaution recommended is to ground the tip of the soldering iron along with the source terminal.

### Circuit and Construction

The converter is built inside a 6"  $\times$  4"  $\times$  2" aluminum chassis, with the conversion crystals alone occupying the top of the chassis. This converter forms part of a complete solid state double conversion receiver, now under construction. The antenna terminal is a BNC chassis connector, and a d.p.d.t. slide-switch located near the connector per-

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Bottom view of 40673 converter. The layout is worth careful study. The toroidal coil is suspended from its leads. The 2N3819 oscillator stage is wired close to the bandswitch, with the 31.5 mc crystal and tank nearby. The oscillator injector trimmer is mounted on a ceramic standoff. The output tank trimmer is partially hidden by the disc ceramics. Note the offset mounting of the vernier dial to accommodate the front-panel at a later stage.

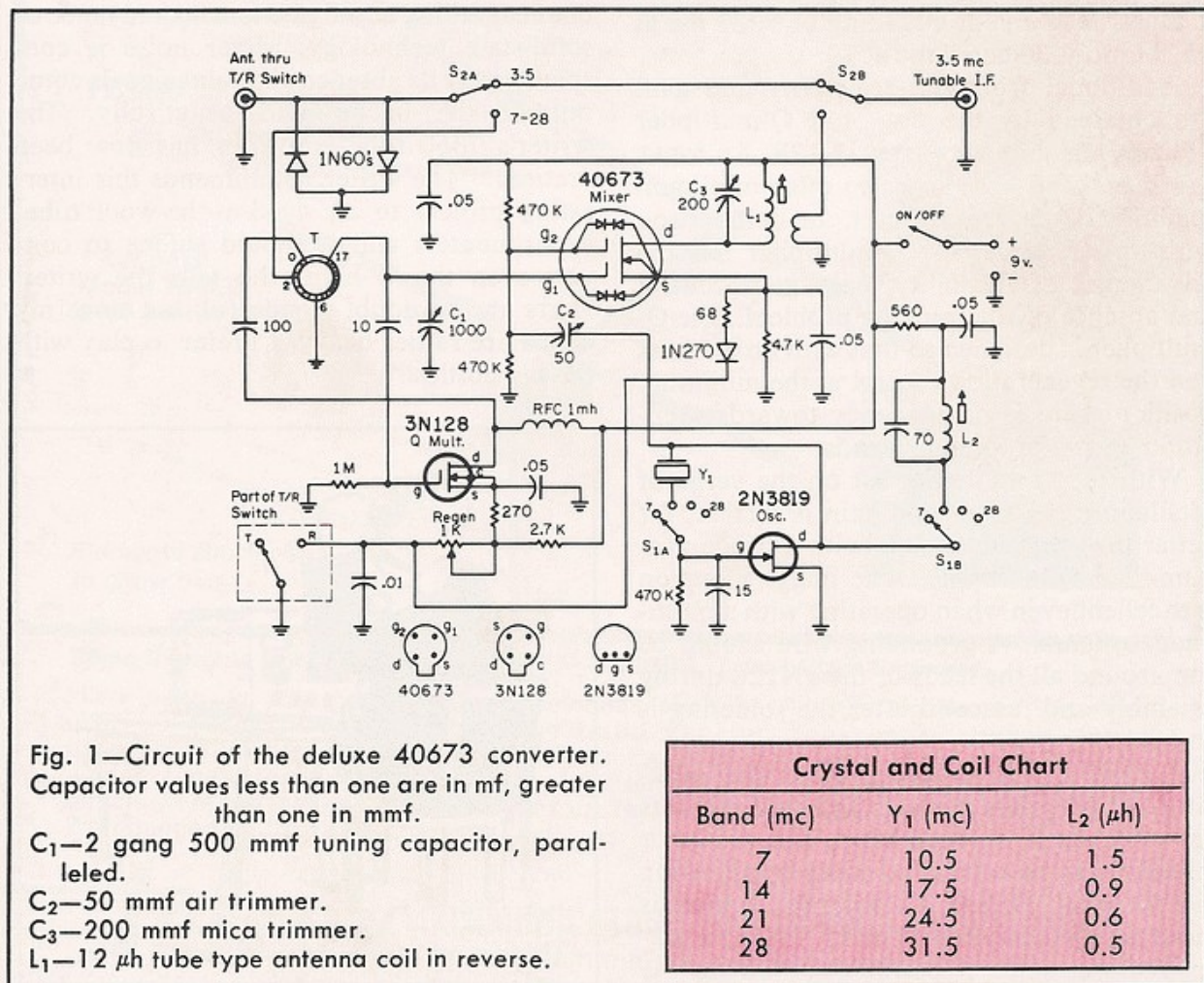
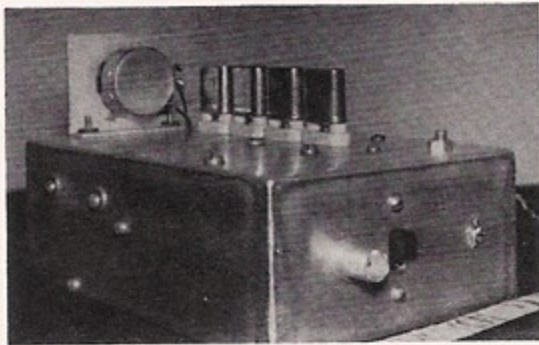


Fig. 1—Circuit of the deluxe 40673 converter. Capacitor values less than one are in mf, greater than one in mmf.

- C<sub>1</sub>—2 gang 500 mmf tuning capacitor, paralleled.
- C<sub>2</sub>—50 mmf air trimmer.
- C<sub>3</sub>—200 mmf mica trimmer.
- L<sub>1</sub>—12 μh tube type antenna coil in reverse.



Rear-view of converter shows the antenna connector and bypass switch for 3.5 mc reception

mits the converter to be bypassed for 3.5 mc reception.

A high-Q toroidal antenna coil tunes from 7 to 28 mc without bandswitching. The writer just did not want to take the antenna circuit to the bandswitch. The toroidal coil is suspended by its leads and spaced at least its diameter away from adjacent metal parts. The 2 gang 500 mmf tuning capacitor is provided with a vernier dial so as to permit precise peaking of the antenna tuning on each band. The vernier dial has 100 divisions and it tunes to 28 mc at a reading of 5, 21 mc at 15, 14 mc at 30 and 7 mc at 72.

Additional front-end selectivity and gain are obtained by the use of a Q-multiplier utilizing the popular IGFET 3N128. An IGFET has been used here so as to offer minimum loading to the tank circuit. In comparison with an r.f. stage, the Q-multiplier has the advantages of flexibility, easy gain control and absence of the tracking problem. The Q-multiplier is designed so that with no antenna and the regeneration control at the minimum position there is no tendency towards oscillation on any of the four bands.

With the Q-multiplier set on the verge of oscillation, the front end gain is terrific, far better than that obtainable with a triode vacuum-tube Q-multiplier. The image rejection is excellent even when operating with a multi-band antenna. A grounding wire should be run around all the leads of the 3N128 during assembly and removed after the soldering is complete.

A 2N3819 JFET is used as the crystal oscillator. Appropriate crystals and tank circuits are switched in on each band. The oscillator injection can be controlled easily by adjusting the 50 mmf Philips air trimmer, which is mounted on a ceramic standoff. This is a useful feature, since it permits optimizing the

performance of the converter with respect to conversion gain, oscillator stability and noise figure. The output tank is peaked at 3.4 mc.

With a nine volt regulated power supply, the total power consumption is just about 11 ma. In order to realize the optimum noise-figure consistent with low battery drain, the drain current of the 40673 should be adjusted to 4 ma by varying the source bias resistor, if necessary.

During transmit, the receiver antenna terminals are shorted and the Q-multiplier is disabled. Also the source of the 40673 is raised from 0.5 volt to about 1.2 volts by switching out the normal source-bias resistor and leaving a 4.7K resistor in its place. This lowers the mixer gain substantially and enables the mixer to handle a larger signal without overload, for monitoring the transmitted signal. The shunting diodes across the antenna terminals are all that is needed for adequate front-end protection, provided the transmitter has no electrolytics to discharge.

#### Summary

The performance of the converter leaves one marvelling at the phenomenal advance of solid-state technology. Mixer noise is conspicuous by its absence and faint signals come out of the background beautifully. The writer's 7360 tube converter has now been "retired." The writer recommends this interesting project to all dyed-in-the-wool tube-experimenters and it should suffice to convert even the W-ham who tells the writer, "FETs are no doubt wonderful, but since my hands are rather heavy, I prefer to play with the big bottles!" ■

