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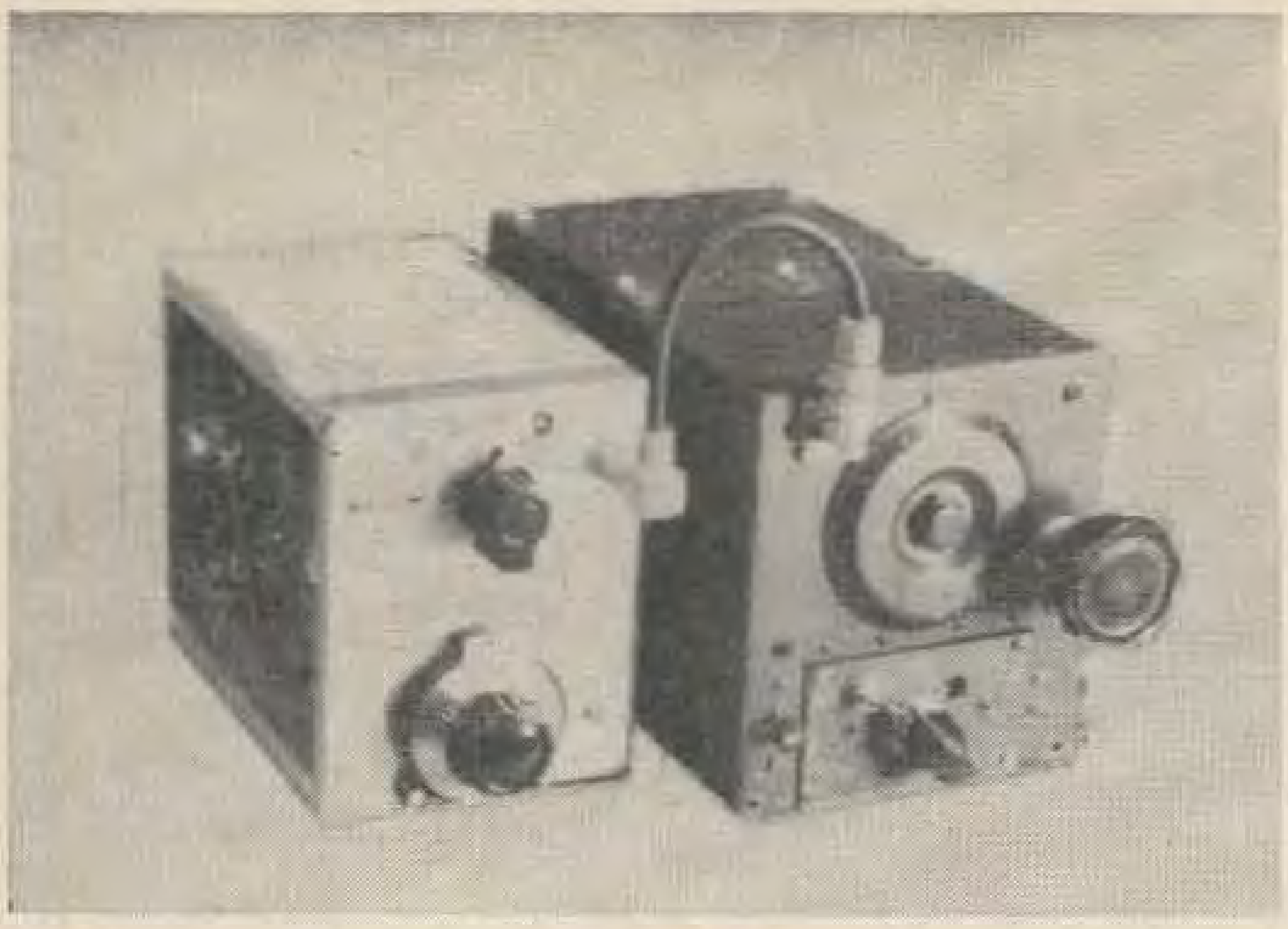
The Converter Converter



W1OOP's Converter Converter and modified BC command set.

Here's an intermediate converter for use between a UHF converter and a receiver tuning the broadcast band. It uses an inexpensive field effect transistor as a mixer for simplicity and excellent resistance to overloading.

A few weeks back I picked up the BC-band version of a command set at one of the local auctions. Now this is one of the nicer (and rarer) of the ARC-5 or 274-N series. It tunes 0.52 to 1.52 something or others (as this is about 23 years old, I guess they are megacycles) with divisions every ten kHz and about thirty turns of the knob to go the range. The intermediate frequency is 239 kHz and it has the same sort of variable-coupling cans that are used in the BC453, so sharpness is easily obtained.

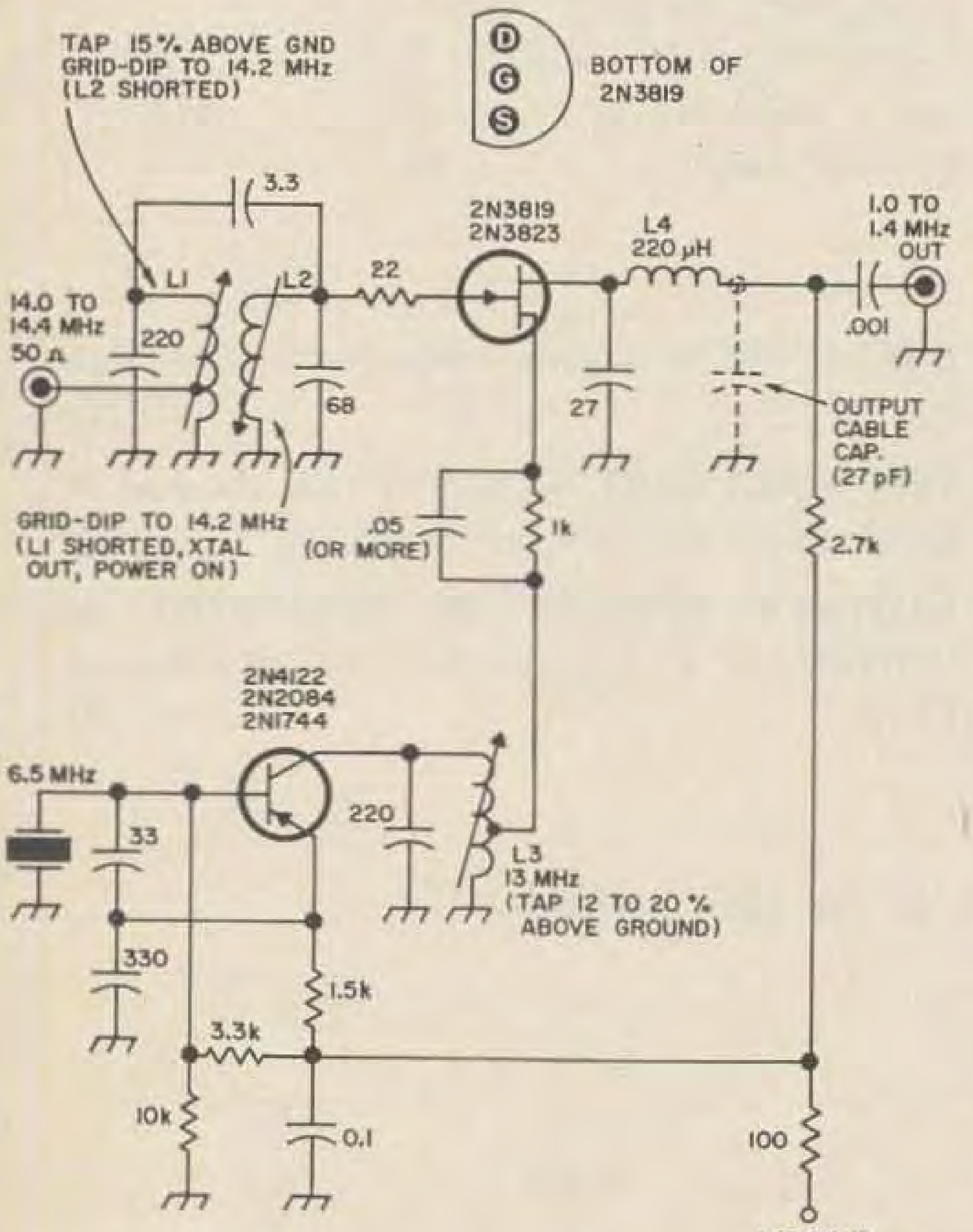


Fig. 1. Simple version of the Converter Converter by W1OOP. This is designed for covering 14.0-14.4 MHz, with 1.0-1.4 MHz output.

With such admirable selectivity and bandspread, it seemed a shame that it couldn't be used to run one or more of my UHF converters into, so as to have a permanent setup for scanning 431.95 to 432.4, for instance, while working or trying to work another band. While it is hard to get any image rejection with a second *if* of two or three hundred kilohertz, there should be no trouble in doing it with the receiver tuning 1 to 1.5 MHz. This converter was made for that purpose. My six, two and 432 converters have a nominal intermediate frequency of 14 MHz, while that for 220 tunes 16 MHz *down* for 220 *up*. By using crystals providing beating frequencies of 13 and 17 MHz the ARC-5 tunes forward on all bands, which simplifies the mental arithmetic a slew. (A slew is an archaic unit between three and ten dB.)

The oscillator uses surplus crystals at half frequency because I and Meshna had them. The mixer has an FET, since it made the whole business simpler. The 2N3819 (roughly the same as the TI-S34) can be thought of as a super-6CW4, or maybe a super-6CB6 with poor screening. It is quiet, it oscillates nicely at three hundred megohertz with only the leads to a twenty meter tank

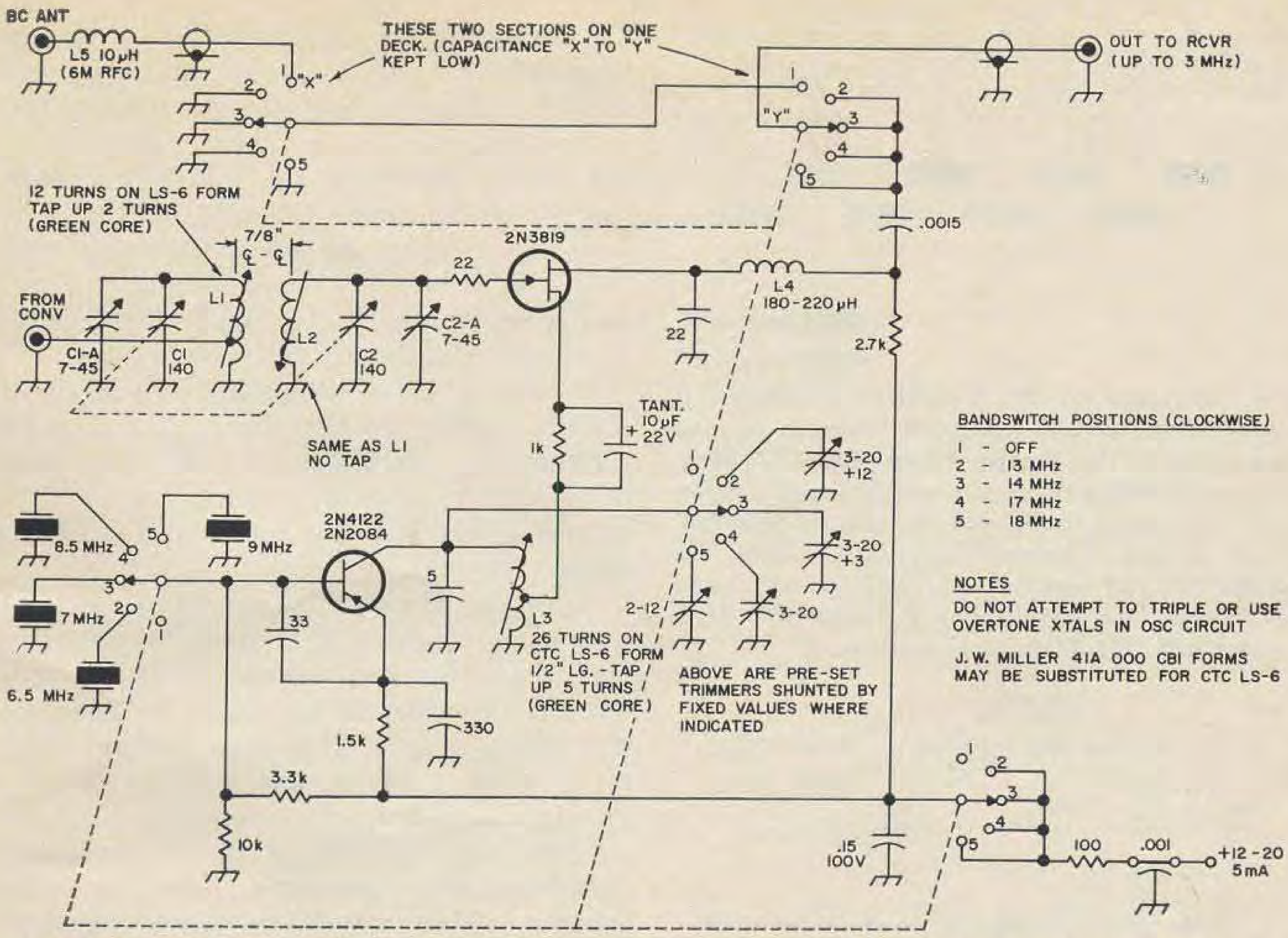


Fig. 2. More complete version of the Converter Converter, with band switching. Shield the quartz crystals if you live within 10 miles of a TV station.

circuit, and the gain, while less than overwhelming, is adequate. According to the manufacturers specifications, the currents and voltages could be almost anything, but that is no problem for the man who is making only *one* gadget, because the values can be tailored to the particular FET. Suppose we set up with a six to twelve volt battery on the drain (plate) and gate and source grounded to the negative terminal. We measure a current in the drain lead—it might be anything from 2 to 20 mA. For mixer operation, the FET should be turned all the way on only a bit of the time, and if we are trying to operate as a square-law mixer the gate voltage should swing from cutoff up to zero bias with oscillator drive, giving an average current about 40 percent of the zero-bias value, with drive, and a quiescent current 25 percent of the zero bias value. We can find the proper operating point by measuring the bias voltage required for one fourth the zero bias current, (no signal) and then setting things up so the source (cathode) resistor has that much voltage across it* when the oscillator is driving the mixer. My 2N3819 had 4.5 mA at zero bias. It also had UHF oscillations in the circuit, so I put that 22-ohm resistor in the gate lead . . . anything ten to fifty ohms would probably do.

With the second preselector tank shorted (I jammed a solder lug into C2) the current with oscillator going was 1.6 mA, but with

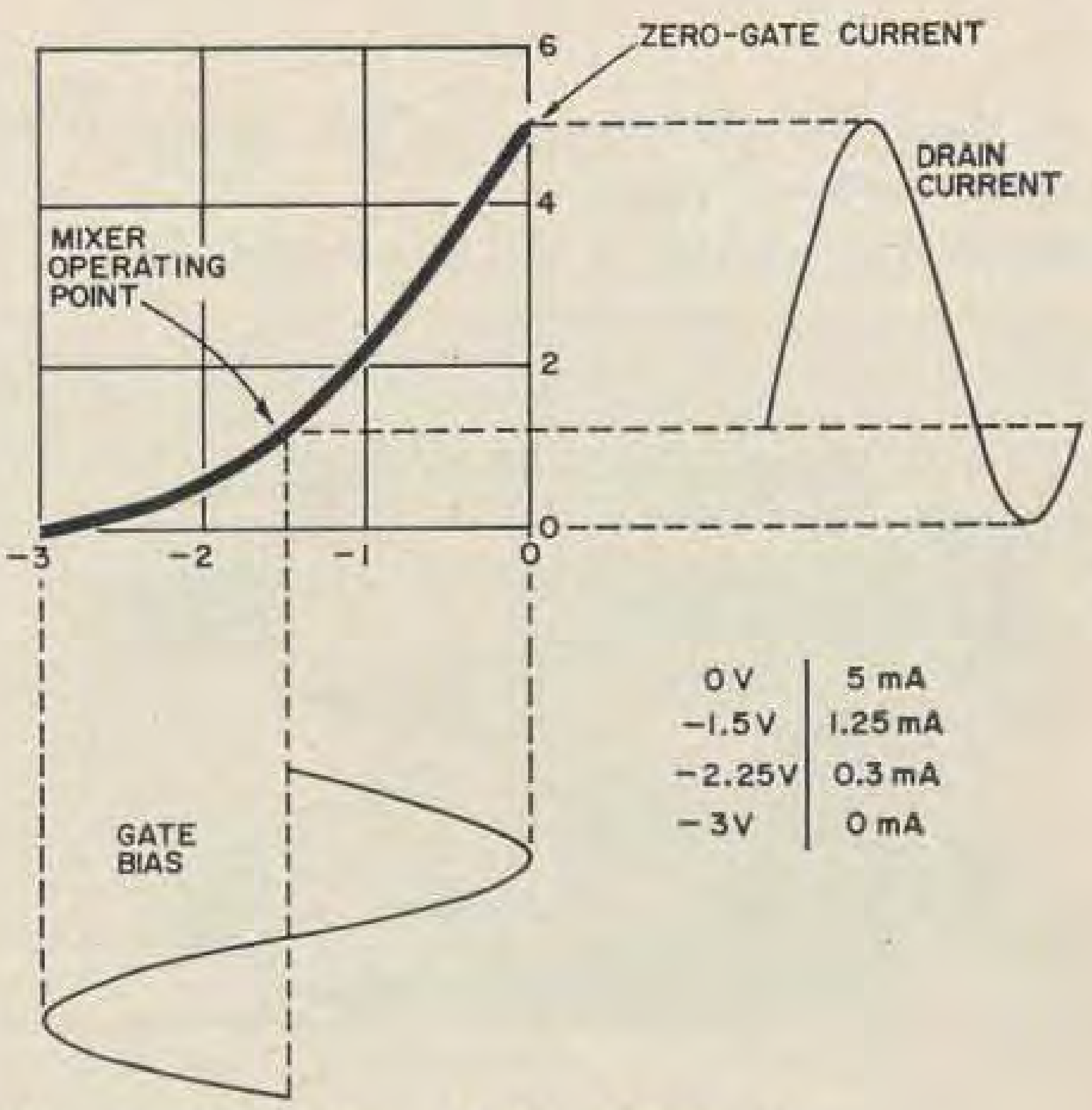


Fig. 3. Operation of the FET mixer.

*Measure through a good rf choke to avoid changing the amount of injection.

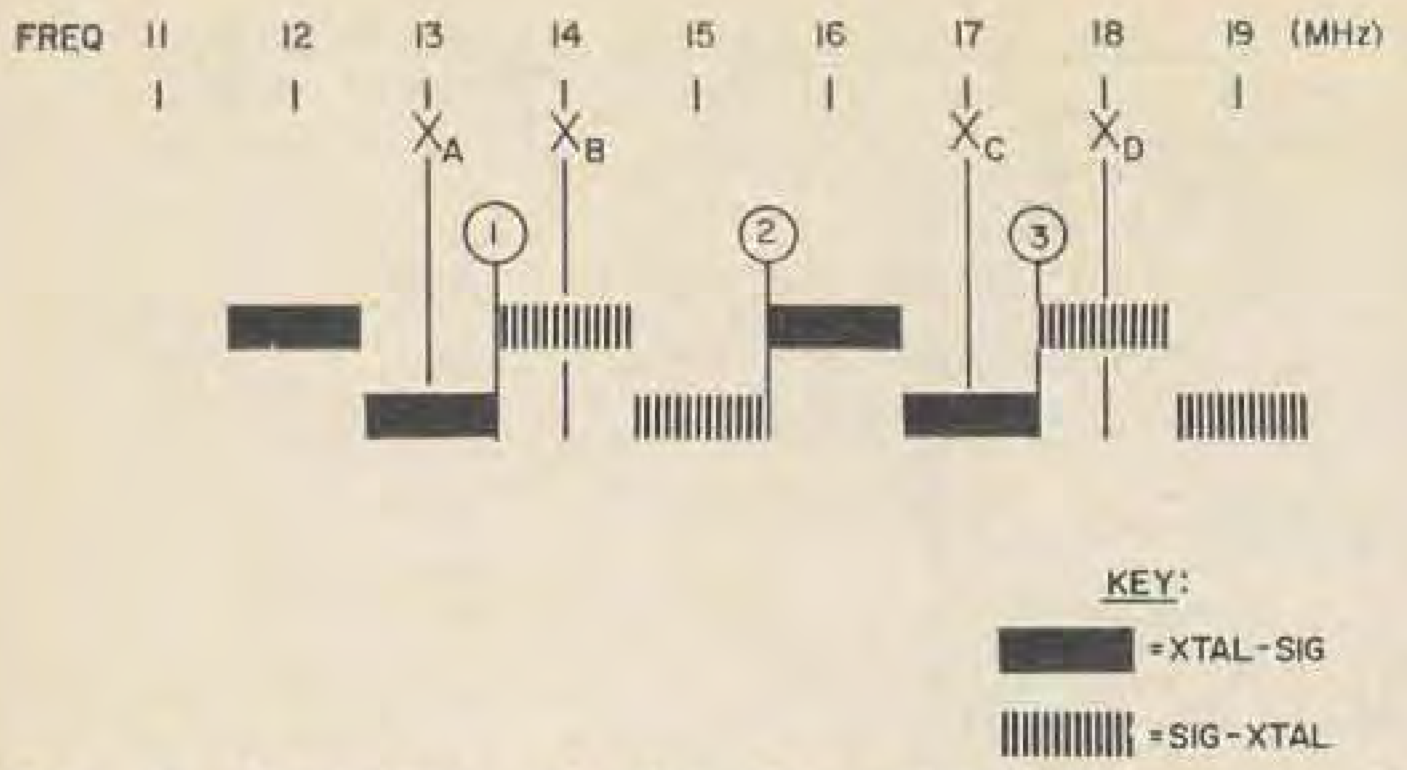


Fig. 4. Coverage of the Converter Converter. If the receiver tunes 0.50-1.50 MHz, there is no gap in coverage. If the receiver tunes 0.52-1.52 MHz, there is a 40 kHz gap at (1) and (3) and overlap at (2). Of course, if X_B and X_D are 40 kHz low, there is no gap. Coverage is 11.5-19.5 MHz. The coverage W1OOP wanted was 12-12.4, 14-14.4 and 16-15.5 MHz (the last backwards, for a 220 MHz converter with 236 MHz local oscillator.)

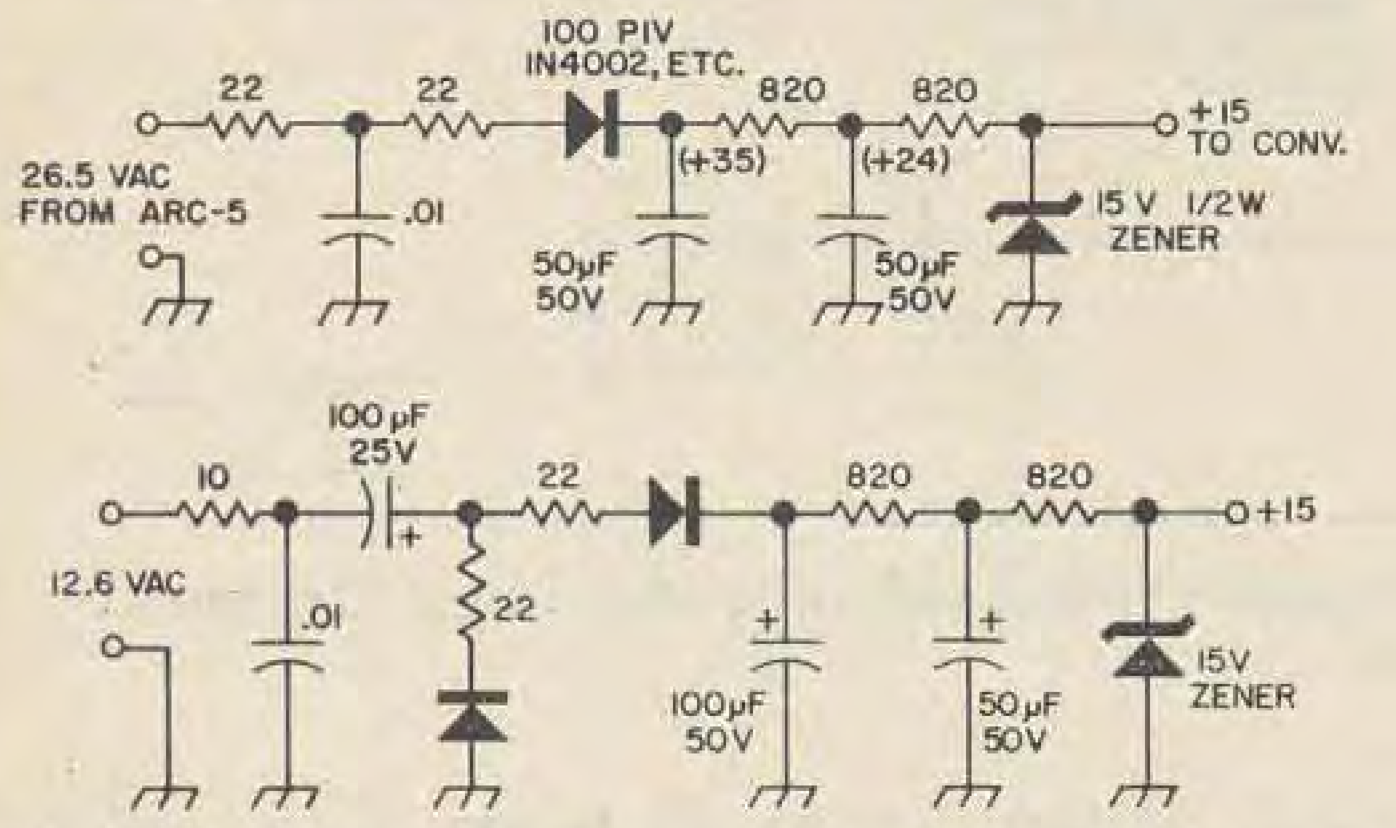


Fig. 5. Two suggested power supplies. The top one operates from 26.5 V ac from the command set and is the one W1OOP uses. The bottom one operates from 12.6 V ac and is hypothetical. In both, the 22-ohm resistors help eliminate hum modulation and hash as well as furnishing protection for the diodes.

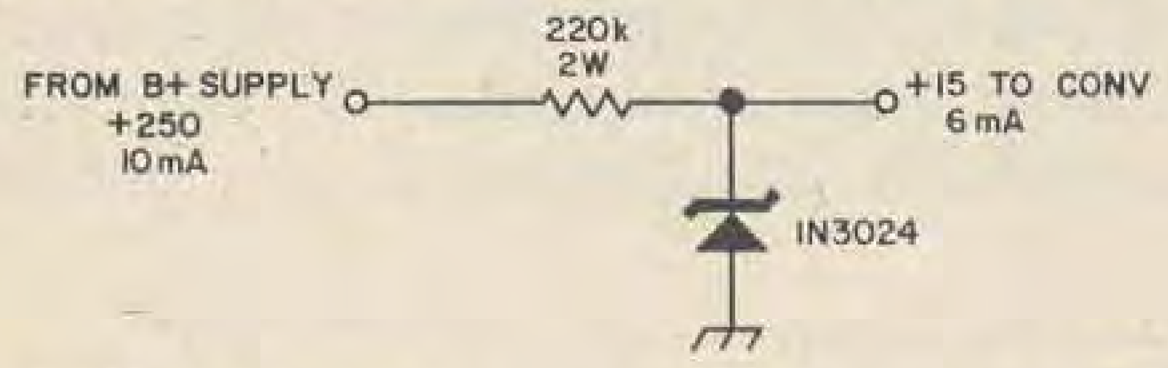
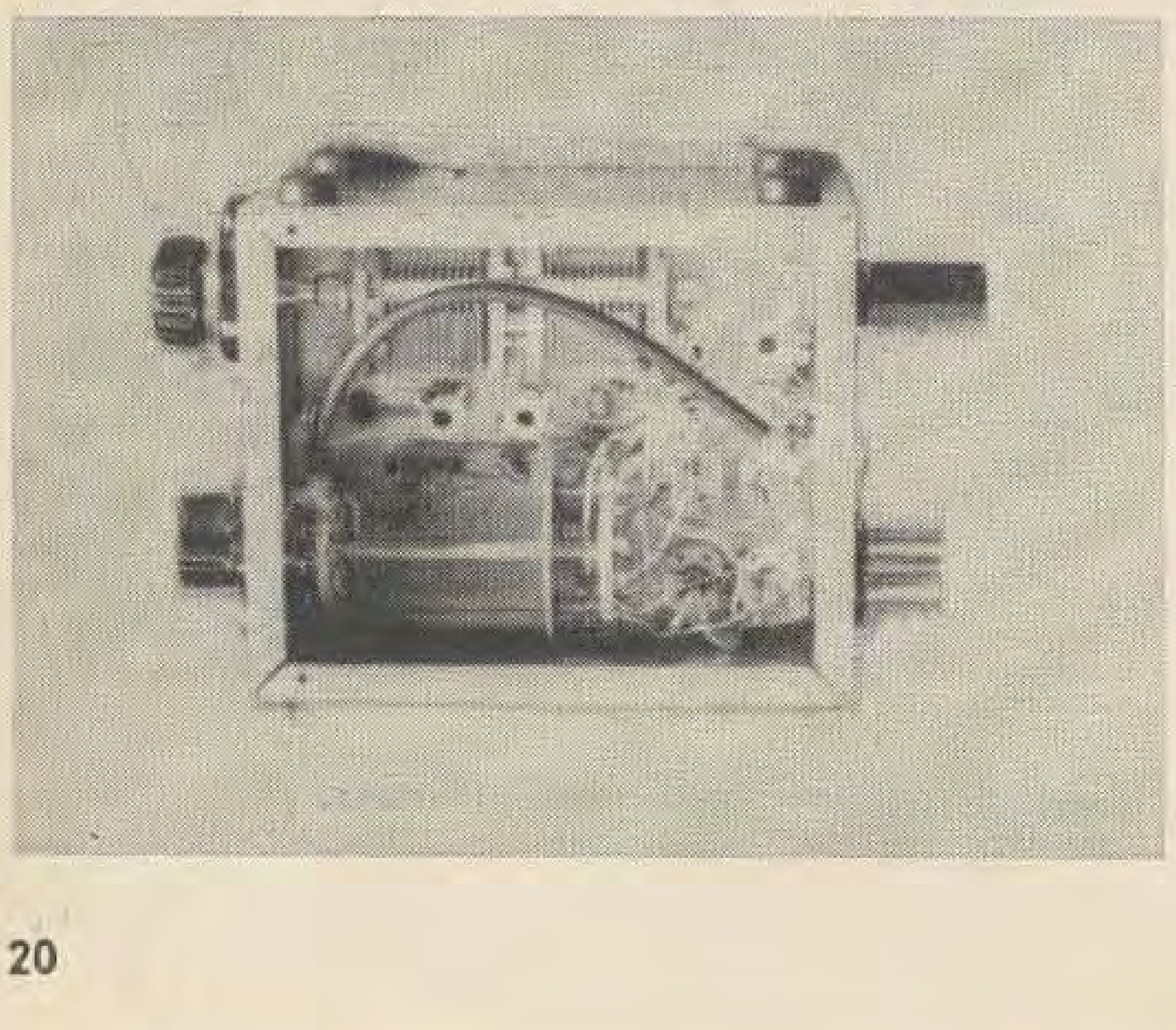


Fig. 6. You can get power for the converter from your receiver B+ supply.
Important: the resistor is 22 k, not 220 k!



C2 unshorted the current could be changed from 1 to 2.2 mA by tuning the preselector around. When working, the preselector tuned 1 MHz above the oscillator gave me 1.7 mA, while tuning to the low side dropped the current to about 1.4 mA. The big variations were when the preselector was tuned only a few hundred kilohertz either side of oscillator frequency. I judged that bias and injection were about right.

I used a 10-μF tantalum bypass on the source resistor, on the theory that it would reduce crossmodulation if any were going to take place, but any value over a 0.1μF should work. I had a lot of the small tantalums on hand.

Tuneup: The oscillator section should be got going first, as it is used in setting up the mixer bias as above. The preselector circuits then should be made to track over the range desired. If a dual 140-pF capacitor is used, the tuning range can be about two to one in frequency; for more range, use a larger capacitor. Many of the commercial ham-band-only receivers have a similar scheme. (They cannot track the preselector with the *if* tuning because sometimes they are going in different directions!) No *rf* stage is used because of the gain provided by the UHF converter ahead, but the two coils are loosely coupled by being side by side (0.875 in or 2.215 cm center to center) with windings in the same direction and the top end of each coil hot. (With this polarity, a little capacitance coupling will *add* to the inductive coupling.) The two circuits have to tune the right range (or a little bit more, but no less) and should do it together, but they don't have to track with a dial or an oscillator.

I started with the slugs all the way out and went to minimum capacitance on the gang capacitor. Then using the trimmers, I put both coils at about 20 mHz. A piece of drill rod in the coil *not* being grid-dipped keeps things simple. Dip one, shift drill rod, dip other. Then to low end (11.5 mHz) and maximum capacitance put slugs where they need to be. Then, using signals from an antenna or from the dipper, you can peak the trimmers on a signal at the high end and peak the iron slugs on a low end signal once or twice and the job is done. The preselector action should be very obvious. Write down a few dial readings so you can hit them again in a hurry.

The idea is pretty much the same as

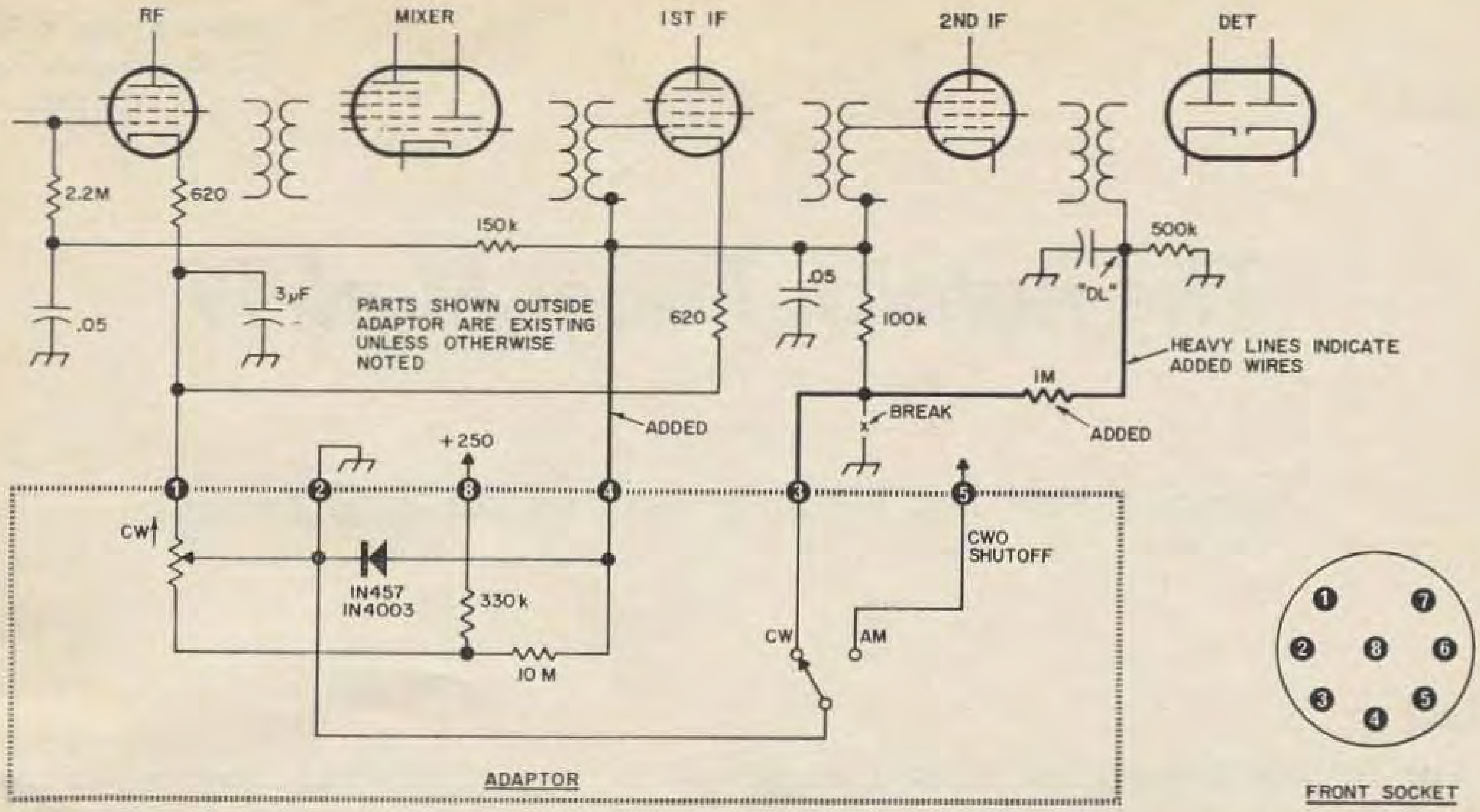


Fig. 7. Adding AGC and gain controls to the SCR-274N. The potentiometer is an Ohmite CB-2531, IRC-CTS Q14-120, Mallory U-28, RV4NAYSD253F or E. It has 25 kΩ total with about 2500 ohms to CW terminal at 50% rotation. The voltage on CCW terminal is low at low gain settings and about +15 volts with the control more than half on. This means no ACG developed until −2 volts on DL. Putting the switch in the CW position puts things back to the original 274-N status. You have to use some ACG delay or there's not enough audio. Replace the antenna connector with a BNC or phono jack for converter use.

K1Q1M's "Crystal-Controlled Front End" in the February 66 issue, except that we don't use tubes. One word of caution: although I put the crystals outside the box (in sockets) I found that there was pickup from my rather local TV stations, curable by putting a shield over them. Therefore, I suggest putting the crystals inside the box. The input is a two-stage bandpass filter, the output is a low-pass filter (cuts off a bit over 3 mHz) and there is not any excuse for hash from TV signals, nor for TVI from the oscillator, if things are laid out correctly, and the power leads filtered.

Because the power drain is only about 5 mA, the juice could be stolen from the B-supply in many cases. (Be sure the regulator diode used is dependable!) The power supplies shown will work on twelve or twenty-four-volt filament windings. Without re-adjustment, it should be ok to use with any receiver tuning either the broadcast band or up to 3 mHz, for instance the 1.5 to 3 mHz Arc-5.

Later tests show that the $1 Motorola MPF105 FET works very well in this circuit.

. . . W1OOP

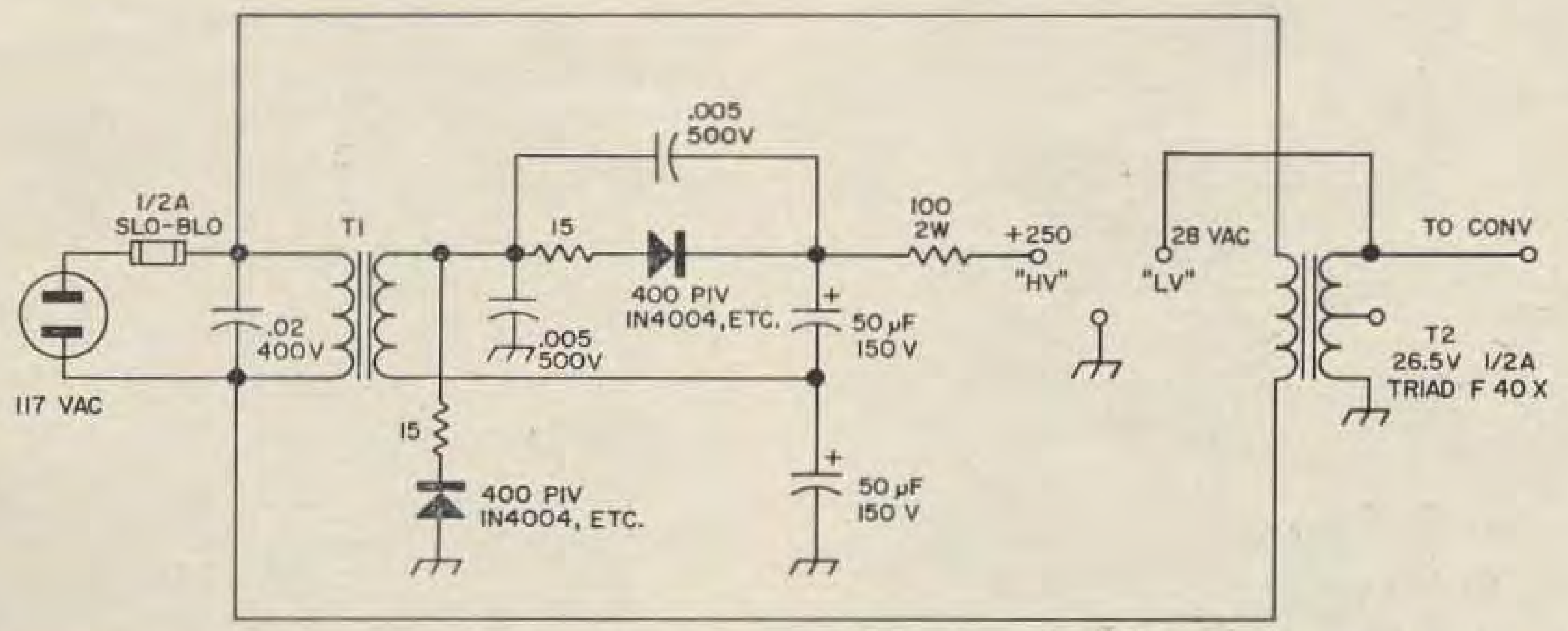


Fig. 8. Simple conversion power supply. T1 is a Lafayette isolation transformer XF or Triad N-51X (20 VA isolation transformer). Use the Triad backwards to keep B+ down. The 0.005 μF capacitors and 15 ohm (not critical) resistors reduce hash in the BC band.