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A Low Cost, Low Power Pretzel Transmitter, Good Enough to Eat

This month's project started when I decided to clean up my workbench. Seemed I had all kinds of parts laying about on the bench to build a small transmitter (and a color TV, X-ray machine and so on.) So, with pencil in one hand and a broom in the other, I started working on a schematic while the soldering iron cooked on the workbench. This is a project that just begs to be changed and modified. In fact, I'd be upset if no one modified it for their own use. The schematic is shown in Figure 1.

The project began as a transmitter for 18 MHz but, lacking a proper crystal, the transmitter ended up on 10 MHz instead. Also, I built this project on a single piece of double-sided PC board using the *ugly* construction method. If you've never tried this method before, you're in for a surprise. Normally, you use high-value resistors (1 megohm or higher) as tie points for the various connections. I didn't take this route; I used *sky wiring* instead. In sky wiring, the connections between components just tangle in the air. This does make for a few problems, the biggest of which is having the different connections short out against one another. I fixed this problem by using small pieces of pretzel here and there. I always have a fresh supply of pretzel crumbs on my workbench. And no, I have no idea what the capacitance of a length of pretzel is.

You'll also need at least two sizes of soldering irons. A large, 35 watt iron is needed for soldering to the copper foil. The copper foil is a very good heat sink and a smaller iron (15 watts or less) does not have enough umph to make a good solder joint on the copper foil. You'll still need a smaller iron, though, to make connections between the individual parts.

To keep the cost down to almost nothing, the antenna connection is simply soldered directly to the output filter. Likewise, the crystal is soldered directly to the VXO capacitor, without a socket. Be careful when soldering to the crystal—too much heat and you'll end up destroying it.

The Circuit

A VXO is used for frequency control. They're simple to build and give you an ideal method of frequency control, without the drift of a VFO. The supply voltage to the oscillator is regulated in two different ways. First, a 78LO8 regulator provides a stable +8 volts to the collector of the oscillator's transistor. Second, a red LED is used to supply 1.5 volts of bias to the base of the transistor. A red LED makes a cheap and dirty regulator (and there were plenty laying around my bench).

By adding a small amount of inductance in series with the crystal, we can expand the range of the VXO. The value is not especially critical, so don't get overly concerned with the number of turns to use and on what core. Depending on the crystal, the amount of inductance may need to be changed to get proper VXO action.

Photo A. The junk box rig on 30 meters. Note the pretzel between the buffer and the driver transistor.

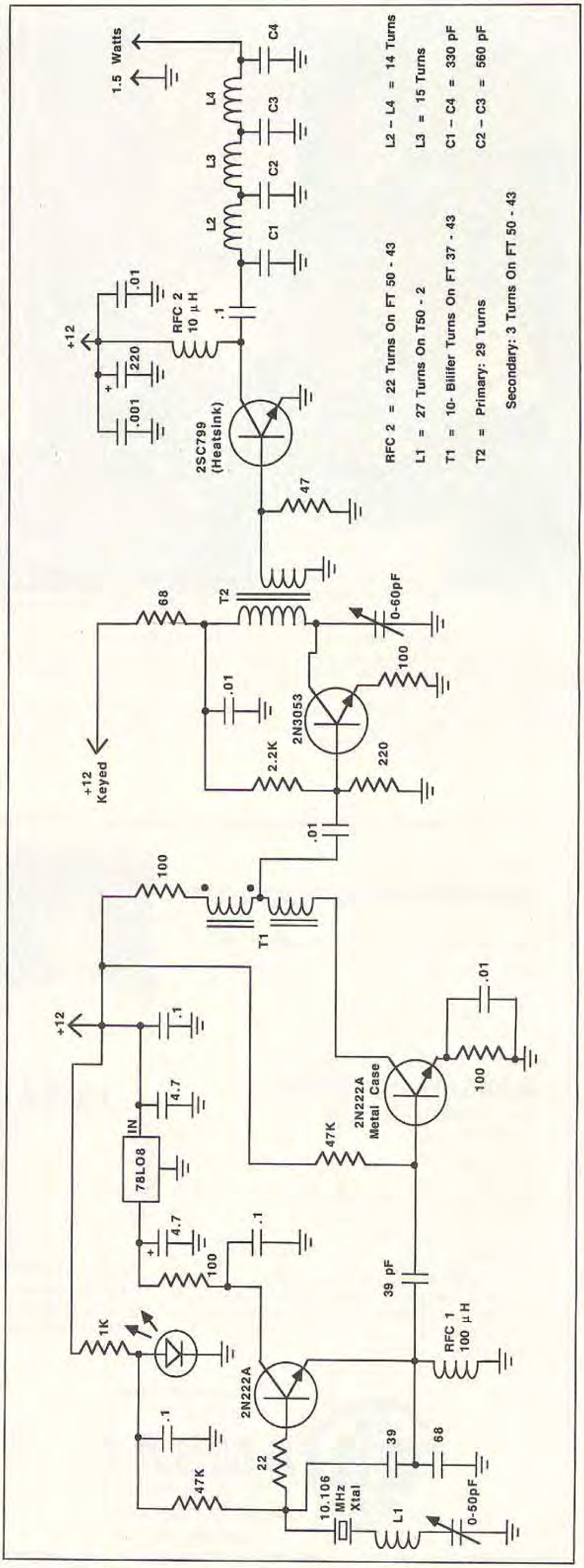

Figure 1. Schematic for the junk box 30 meter pretzel rig.

The main tuning capacitor I have listed as 50 pF on the schematic. In my version, the capacitor I used looks like it may be only 20 or 30 pF. Even with this small value, I'm able to go from 10.115 MHz to 10.122 MHz with a crystal marked 10.116 MHz. That's not too bad, as this range puts me right about in the middle of the action on the 30 meter band. Depending on the value used for your tuning capacitor, crystal and series inductors will determine the frequency swing. Some crystals will *bend* more than others, giving you greater VXO swings.

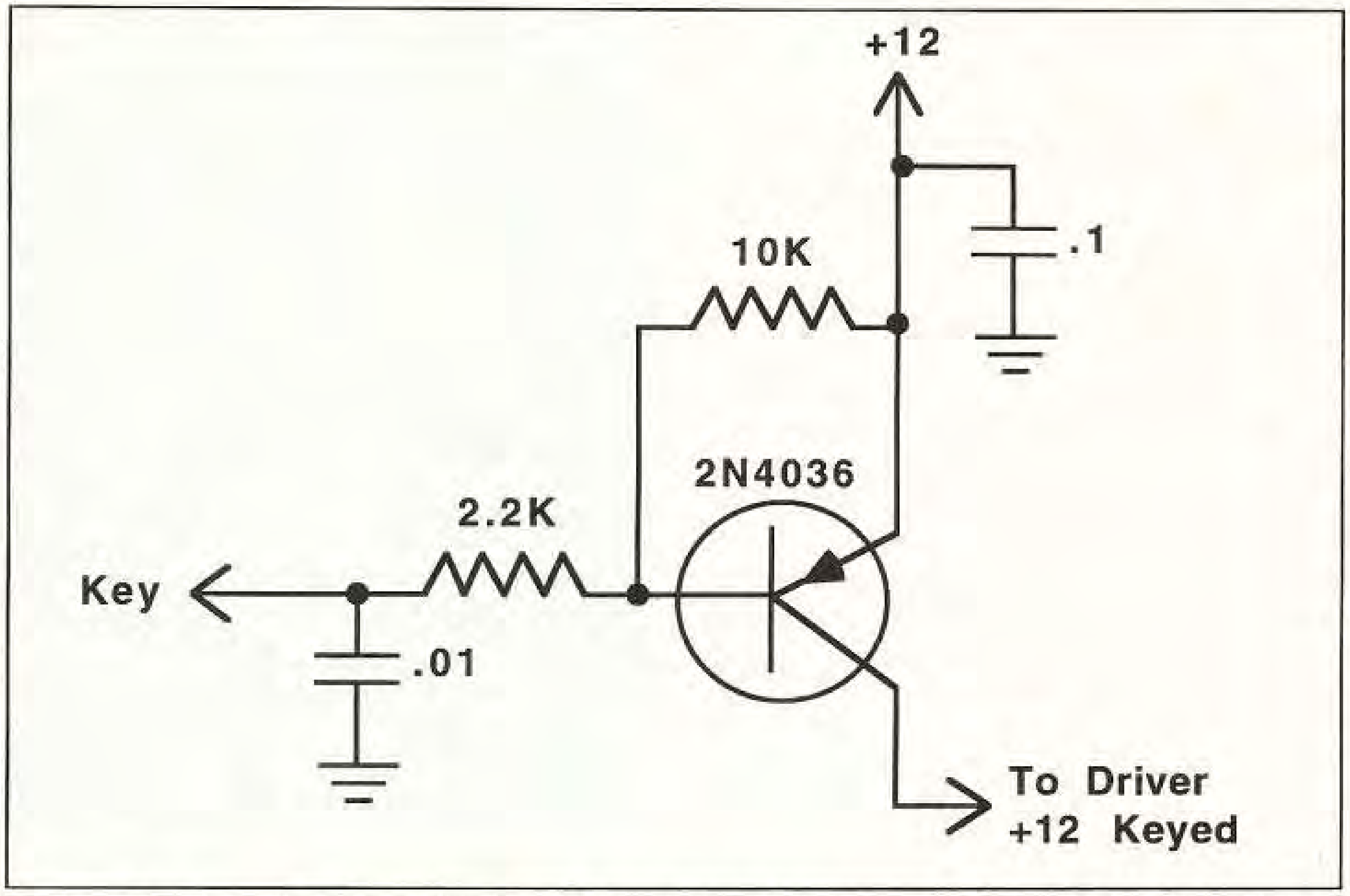

Figure 2. Schematic for an optional keying transistor and how you would interface it to the project.

The oscillator runs all the time; it is not keyed. The supply voltage of the oscillator must be removed or you'll hear its signal in your receiver. If you plan on using this oscillator for a direct conversion receiver you'll need to keep it running. If you want, a second low-value capacitor may be used to couple some RF into a mixer for your receiver.

Energy from the oscillator is coupled to the buffer via a small capacitor. In my model, I found a 33 pF cap on the bench, so that is what I used. Reducing the value of this capacitor will reduce the amount of RF coupled into the buffer. The smaller the value, the less pulling of the oscillator during keying. To a lesser extent, this will affect the amount of output power, too. Don't go too low or you'll end up with a QRPp transmitter. On the other hand, don't use too much capacitance either. It will load down the oscillator and give you no more output at the antenna. Values between 20 and 100 pF should work just fine.

The buffer consists of another 2N2222 transistor. The 2N2222 I used is in the metal-case style. These seem to be a bit harder to kill and I've found you can get a bit more power out of these metal-cased units than the popular plastic jobs. A transformer decouples the RF from the collector of the buffer and a small amount is then placed at the base of the driver transistor.

The driver uses a 2N3053 transistor in the TO-5 case. This stage is tuned by the 2-40 pF trimmer on the collector of the driver. The trimmer I used seemed to be a bit too small, so another 37 pF capacitor was soldered in parallel with the trimmer. The driver is the only stage that is keyed. Keying is done by applying +12 volts to the driver. The transmitter keys very well. There are several bypass capacitors on the collector to keep RF out of the VCC line. In most cases a PNP keying transistor would be used here. I could not find one, so I keyed the rig by the "arm-strong" method—I used a clip lead! Figure 2 details a keying transistor and how you would interface it to the project. I did not use a heat sink on this driver transistor, but one wouldn't be a bad idea.

RF from the driver is coupled via the transformer's link turns to the PA transistor. A 47 ohm swamping resistor on the base of the PA transistor helps stabilize this stage. You'll need to use a heat sink on the PA transistor. The output filter is of a standard design using three toroids. Silver mica capacitors would be my capacitors of choice, but I used ceramic capacitors without any noticeable trouble.

By changing the input impedance of the filter we can get more RF out to the antenna. Normal input impedance is 50 ohms. This was exactly the case in my version. Instead of using the standard value capacitors in the first stage, I changed the input impedance of the filter. I started with 140 pF and, by adding small-value capacitors in parallel, I steadily increased output power. After I got done, I had over 3 watts of clean RF going to the antenna, and a real mess with all those capacitors soldered in parallel! Three watts is about one S-unit over the normal 1.5 watts you'll get. The values shown in the schematic will produce an output power of 1.5 watts. It's up to you to play with the output filter impedance and thus change the output power of the rig.

The transistor used in the PA is somewhat critical. Because the leads are rather long, it's best not to use a transistor with a lot of gain, especially in the UHF range. That means don't even think about using a 2N3866! I used a junk box version of a 2SC799. A transistor pulled from a junk CB would be a fine choice too.

As I mentioned earlier on, this is a project just begging to be changed and added to. The only points to worry about are the lead lengths on the PA transistor and the driver. Try to keep them as short as possible. This is especially true of the emitter lead of the PA transistor.

Remember, the case of the driver and the PA are connected internally to their collectors. Therefore, they are also connected to the VCC line. Don't allow them to contact the copper foil or you'll end up with fireworks and melted transistor leads.

Have a good time with this project. Even if you don't get it to work, it's great practice in radio theory. If nothing else, find out why something won't work. Learning is always a process of correcting mistakes.

Clear the Pretzels Off the Bench!

One of the reasons I had to clean up my workbench was to start construction of the ARK 40 transceiver. This is really a slick project, especially if you're tired of the usual VXO- or VFO-controlled NE602 transceiver. The ARK 40 will produce a hefty 5 watts output on the 40 meter band. Oh yes, the ARK 40 is a fully synthesized rig on the 40 meter band. It's simple to operate and a joy to use. You can find a complete review of the ARK 40 elsewhere in this issue of *73*.

Next month, I'll have some details about computing the values for the output filters. Until then, remember, use wits instead of watts. 73