Make Your HTX-100 a Flexible IF Transceiver

By Rus Healy, NJ2L

The cost of multimode VHF/UHF transceivers is more than most of us care to spend to get on a new band. For that reason and others, transverters are a very popular way of equipping a station for the bands above 50 MHz. You still need a transceiver, but the requirements for it are considerably less than what you'd require to do the same kind of operating with everything in one box--most of the high-performance RF circuitry should be in your transverters.

So, what's the right IF radio to use? You have many choices. Most high-end MF/HF radios include provisions for easily interfacing them to transverters, but we're trying to keep costs down. Also, those radios generally aren't as portable and power-efficient as you'd like for this application. So we'll look to the lower end of the scale. Most transverters for the lower VHF/UHF bands require a 28- or 29-MHz IF, so single-band, 10-meter radios are useful for this application.

Now that the sunspot cycle is at rock bottom, it's a great time to buy 10-meter transceivers like the Radio Shack HTX-100, Uniden HR-2510 and HR-2600. People who bought them five or six years back to work the world from their cars now find little to work outside sporadic-E season, and it'll be a few more years before 10 meters is regularly hopping with worldwide DX again. I've seen a lot of these radios advertised for sale on the PacketCluster lately at very reasonable prices.

A while back, I came across an HTX-100 at the right price ($90), so I bought it. I've since gotten a second one for $100--you can see already what an improvement this is over the $250 to $500 cost of a clean, used 2-meter SSB radio! The modifications discussed here apply to more than the HTX-100, because it's a variant of the HR-2510; the two share most of their circuitry. The key difference is that the HR-2510 has CW, USB, LSB, and FM, but the HTX-100 has only CW and USB. Unless you use high-side injection (rare in transverters with 10-meter IFs) or *really* want FM in the same box, the lack of these two modes isn't a big problem. As a bonus, the HTX-100 works great with a standard Kenwood 8-pin microphone, including the up and down buttons.

The HTX-100 is a central fixture in my rover station. It required two simple, quick and cheap modifications to use with my 50, 144, 222, 432 and 1296-MHz transverters. To make it even more flexible, I've added a 2-meter transverter *inside* the HTX-100 so I can use it on the higher bands, too. In this article, I'll explain both procedures. The basic modifications--locating a source of low-level 28-MHz drive and adding a PTT output for your external transverters--are fast and easy. Adding the 2-meter transverter is a bit more ambitious, but you can pull it off if you've ever built anything as simple as a Heathkit or a transverter from a kit.

Basic Modifications

The first of the modifications requires only a few parts: a transistor, a resistor, some small coax with a connector on one end, a phono jack, and some hand tools. Also, I highly recommend getting the service manual from Tandy National Parts. (Your local Radio Shack store can give you their 800 number.) They take Visa, and for around $5 postpaid, they'll send you a copy. It will allow you to identify the parts I'll discuss here, and align or troubleshoot the radio. Here's the procedure:

1) Remove the top and bottom covers from the radio. Cut off the small semicircular tab from the rear center of the top cover. File the edge smooth. You may find it useful to unsolder the speaker wires during these modifications. It's much easier to work with the radio when the bottom cover and speaker are free of the chassis.

2) On the top side of the main board, near the rear edge (as viewed with the front panel facing you), a small piece of PC board is plugged into three sets of fingers that protrude upward from the main PC board. This jumper supplies power to the transmitter's two final amplifier stages. Remove this PC board. If you'd like the option of restoring full-power 10-meter operation, slide this board back into place so that it's only in contact with the two right-hand sets of fingers. This simple step paves the way for picking off transmit drive from the third-to-last stage.

3) Locate C74, a 560-pF ceramic disc capacitor, near the right-rear corner of the radio's main PC board. This is the interstage coupling capacitor, and it's a good place to pick off about 40 mW (+16 dBm) of transmitter power. Lift C74 from the circuit. At its output side (after Q501), on the trace side of the PC board, solder the center conductor of a piece of small coax, such as RG-188 or RG-174. This leaves the capacitor in the circuit, which provides dc blocking for the low-level output. Solder the coax shield to the PC board ground foil nearby.

4) Route the coax to the top side of the PC board (near the existing SO-239 RF connector) and out of the radio through the hole in the heat-sink casting that was formerly blocked by the small tab in the radio's top cover.

5) Drill a 1/4-inch hole in the thin part of the back panel, near the dc power input connector. This hole will hold a phono jack for the radio's PTT output, so make sure that the hole has adequate clearance on both sides for the connector and its hardware. Also, drill carefully to avoid damaging the PC board components when the drill pops through the hole. Install a phono jack in the hole.

1. Find a point in the circuit that goes to a positive voltage on transmit. (Several points in the radio go to about +8 V during transmit, including the base of Q39.) This signal will key your transverter's PTT circuit through a transistor. Attach the circuit of Figure 1 to that point and to the new PTT jack.

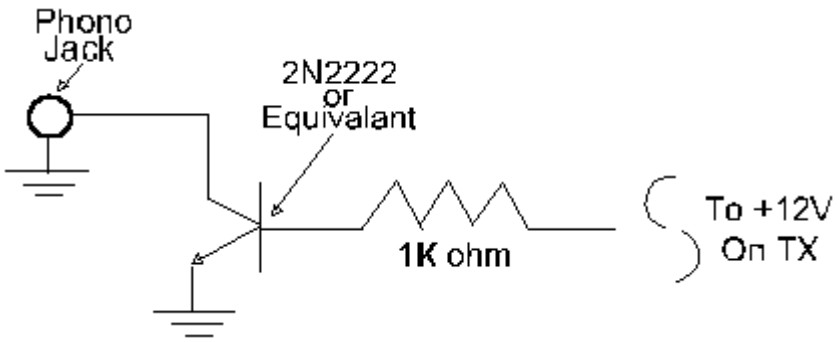

Figure 1-PTT Circuit

At this point, test the keying circuit with an ohmmeter and, if you have a low-level power meter such as an HP 431 or 432, or a spectrum analyzer, place an attenuator in line and measure the low-level transmit output from the cable you installed in steps 3 and 4. Solder the speaker leads back to the speaker and reinstall the covers. Check the radio out with your transverter. The radio's original SO-239 is now your receive input, and the new piece of coax is the transmit IF output. No power reaches the receive connector during transmit, so your receive converter isn't at risk of damage.

If you're going to use this IF radio with a transverter that has internally adjustable IF input attenuation, set the attenuation to maximum and then adjust it while monitoring output power on CW. Do not exceed the transverter's rated output power! If 40 mW is too much drive for your transverter, build a small attenuator using the circuit shown in Figure 2. An attenuator built this way has at least 20 dB of adjustment range and presents a reasonable load impedance to the transmit amplifier. As you've now seen, there's plenty of room inside the radio for this attenuator.

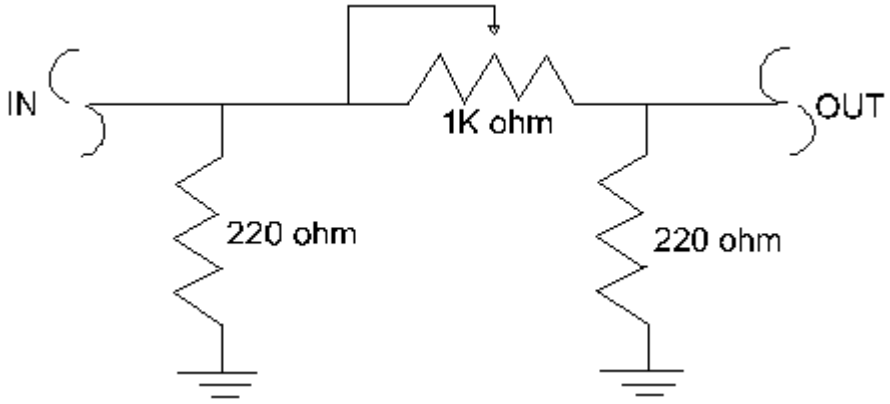

Figure 2-Attenuator (variable)

This completes the basic modifications. You can change the in-line fuse from 6 A to 2 A, since the radio now draws a maximum of less than 1 A. The radio puts out the same amount of peak power, with no adjustments, on CW and SSB.

I've had very good results using the HTX-100 modified this way. But I also wanted a 2-meter IF radio to use with my microwave transverters, and I wasn't about to plop down

the big bucks for even a used commercial multimode box. I found a slick solution in the Down East Microwave catalog. For about $109, they sell a single-board 144-MHz transverter kit (model DEM 144-28DCK) that fits inside the HTX-100. Adding it doesn't require major surgery, either. Yes, you have to remove the internal speaker to get this feature, but I think that's a pretty good trade-off!

The 144-28DCK transverter is simple to build. Rather than etched band-pass filters, it uses pretuned helical filters, so it's still a "no-tune" transverter. This transverter, built on a PC board about 3 by 5 inches, is just the right size to mount inside the HTX-100. It fits under the space where the speaker usually sits, and gives at least 50 mW output at 144 MHz. This is more than enough drive for most microwave transverters, including those from Down East. I use the HTX-100 with the 144-28DCK inside it with DEM transverters for 903, 2304 and 3456 MHz, and my home-brew 5760 transverter.

If you've already made the modifications described above, you've completed the starting points for adding 144-MHz capability to the HTX-100. In addition to the transverter board, you'll need an RF relay good at 144 MHz, and a small SPDT PC-mount relay from Radio Shack to switch the 28-MHz drive between the external cable you added and the 144-28DCK transverter input. In my HTX-100, I wired the 144-MHz transverter's IF output in parallel with the 28-MHz SO-239 receive input connector on the radio, since I disable the 28-MHz IF line from the other transverters when I'm using the radio on 2 meters.

Start by removing the bottom cover and the speaker. You can install the speaker in a small box and connect it to the radio's rear-panel speaker connector, if you like. With this done, there's room inside the box for the transverter.

On the back side of the radio's main PC board is a metal shield. Cover it with electrical tape to prevent shorts. Install the assembled transverter board in the radio with the helical filter toward the front of the radio. I used a couple of small pieces of double-sided foam tape to hold things in place.

Solder a short, stiff ground wire from the transverter board's ground plane to the radio board's ground foil. Now, solder a wire from the transverter's power input to the unused center pin on the radio's dc input connector. Solder another piece of wire into the male connector to allow you to turn on the transverter.

Install your SPDT 144-MHz RF switching relay in an open space near the other rear-panel connectors. (Mine uses and Omron G5Y-154P, which has a 12-V coil and sells for about $6 from Digi-Key, 800-DIGIKEY.) Route pieces of small coax from the relay to the transverter board's RF input and output pads. Don't use unshielded wires for these connections.

Connect another piece of coax to the relay's common port through the small hole in the bottom of the rear casting, in the same way as the 28-MHz transmitter-drive coax is

routed through the top of the casting. Be sure to remove the tab from the rear center of the bottom cover before reinstalling it.

Using the relay contacts provided on the transverter, connect the 144-MHz TR relay to be switched when you go between transmit and receive on 2 meters.

Install a small SPDT relay near the point where the 28-MHz drive coax connects to the PC board. (Again, double-sided foam tape works fine.) Remove that coax from the board and solder its center conductor to this relay's normally-closed contact. Connect a 0.001-microfarad capacitor between the PC board pad where the coax was formerly connected, and the relay's common terminal. Now connect a short wire or a piece of small coax between the relay's normally-open terminal and the transverter's 28-MHz transmit drive input. (If the distance is more than 1/2 inch, use coax.)

Connect this relay's coil in parallel with the transverter power on the center pin of the radio's dc input connector. With this done, 28-MHz transmit drive is applied to the transverter when it's powered up, and to the coax heading out the back panel when it's not.

That wraps up the addition of 144 MHz to your HTX-100. Power up the radio and the transverter to make sure that you can communicate on 2 meters. Set the transmit attenuator on the transverter board so that the 144-MHz RF output is no more than 10 mW. If the S meter on the HTX-100 goes upscale when you power up the transverter, reduce the receive converter output on the transverter board using the transmit-IF potentiometer on the transverter board.

Expansion

To increase the flexibility of this setup even more, I've added a 7-watt power amplifier to the radio/transverter combination so I can use it as a stand-alone 2-meter SSB rig during long trips. This amplifier is also available from Down East microwave in kit form. One caution: Although this amplifier is a great addition to the 144-28DCK, this combination doesn't meet FCC spectral purity requirements because the second harmonic isn't suppressed enough. Therefore, you should build or buy a filter to get the second harmonic under control. ICE in Indianapolis offers 2-meter band-pass filters, and Down East Microwave carries them. Fair Radio also has suitable filters from time to time.

Enjoy the newfound flexibility of your HTX-100!