A VHF/UHF/Microwave Transverter IF Switch

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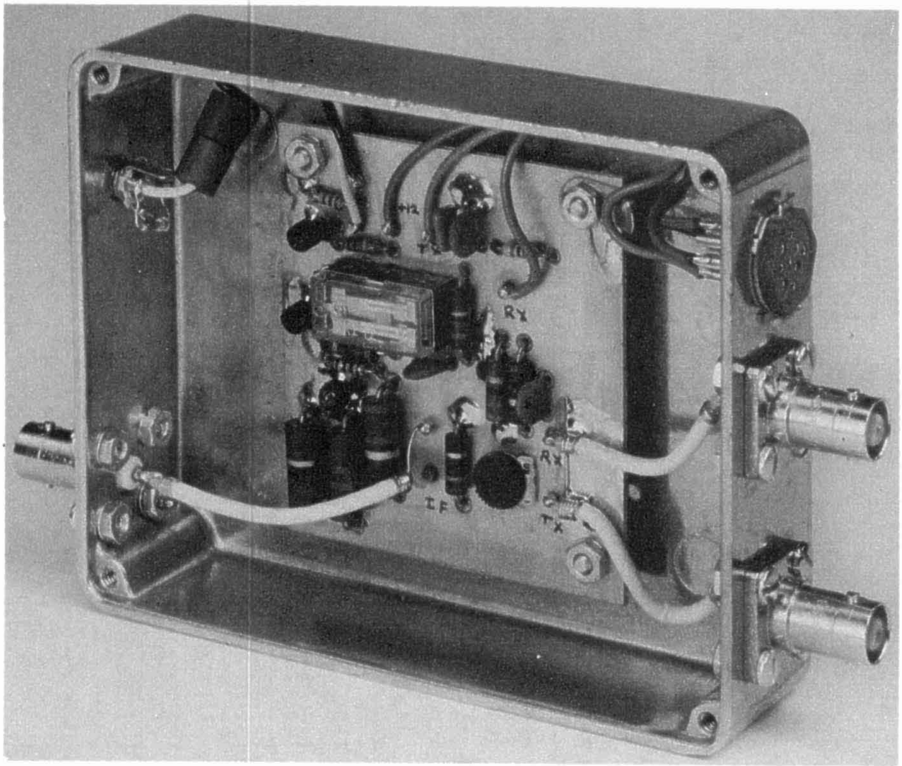

After building a VHF, UHF or microwave transverter, interfacing it with a 2-meter IF transceiver may seem trivial. The task may be more difficult than it first appears, though, because the transverter and 2-meter radio can damage each other if Murphy pays a visit.

The IF switch described here is designed to protect the transverter and transceiver while doing the necessary TR switching. See Fig 1. Using the voltage on the keying line of the IF transceiver, K1B switches the IF rig's antenna line between the transmit and receive terminals of the transverter, and K1C switches 12 V dc. An adjustable attenuator is provided on the transmitter input side of the transverter, and a protective buffer amplifier is provided on the receive side. I selected the attenuator-resistor values in the IF switch to limit the 2-W drive signal from my ICOM IC-202 144-MHz transceiver to the −4 to 0 dBm of RF drive required by my 903-MHz transverter.[1]

The buffer amplifier, U1, does not offer great noise figure (NF) or gain. Its main purpose is to protect an expensive receive converter from the IF transmitter's RF output. Keying the IF switch while transmitting at 1.5 W output from the IF rig does not damage the buffer amplifier. One buffer amp I built had a gain of 4.3 dB and an NF of 3.5 dB, and another gave 5.9 dB gain and a 3.2-dB NF. Increasing the supply voltage increases the gain and decreases the noise figure of the amplifier, but I didn't adjust U1's bias for the higher supply voltage, as this would detract from the ruggedness and reliability of the buffer amp.

Understanding the relay driver circuit requires some insight into how transceivers and transverters work. Most solid-state transceivers use pull-up resistors to provide a positive voltage that is brought to ground to put the rig in transmit. Instead of keying the rig through a current source in the keying line (as is done in my LMW 1296-MHz transverter), why not key the system with a voltage? The advantage of voltage keying is that the system can be made fail safe—the 1-MΩ resistor, Zener diode and FET input on the keying line can't damage the radio. Current-source keying must be carefully designed for compatibility with the IF rig's keying circuit to avoid damage to the rig. Voltage keying is safer than current keying for another reason: If the connection to the rig's keying line falls off, the system is left in the (sometimes safer) transmit mode. D2 protects the FET from static discharges.

Construction

Fig 2 shows the PC board for the IF switch. The component side is a ground plane. After drilling the holes for the component leads, use a 1/8-inch drill to remove the foil from the holes on the component side of the board. Drill a hole through the PC board at the center of U1's mounting location to provide clearance for the body of the device, and to allow one of the ground leads of the MMIC to pass through the board. One of the MMIC's two ground leads is bent and passed through a hole in the PC board under the MMIC, so that it can be soldered to the ground-plane side of the board. (The other ground lead is soldered to the circuit ground on the trace side of the board.) Soldering one ground lead to each side of the board provides good performance: wrap-around foils aren't necessary. Fig 3 shows component placement on the PC board.

I used carbon-composition resistors at R1-R3 in my first prototype IF switch. In another unit, metal-oxide resistors worked just as well at 2 meters (the input return loss at J1 is more than 20 dB). The ferrite beads on the keying line may not be needed; they are there to prevent RFI problems.

Testing

A power meter that can accurately measure power levels of −15 dBm, and that can handle accidental-overload power levels equal to the full output of your IF transceiver, is ideal for testing the IF switch. The maximum amount of power present at the receive side of the switch is −15 dBm. The power to the transmit converter is adjustable (by means of R7) between 0 and −15 dBm (for 1.5 W of drive). This represents attenuation that's adjustable from 32 to 47 dB.

If you are wondering why I didn't just use a TR sequencer to switch the IF rig and the transverter, consider the wear that CW operation can have on those expensive microwave relays! (Using my ICOM IC-202 as an IF rig, I have to flip a TR switch during CW operation anyway!)

[1]Resistor values for 50-Ω attenuators are given on p 25-44 of *The 1988 ARRL Handbook.*

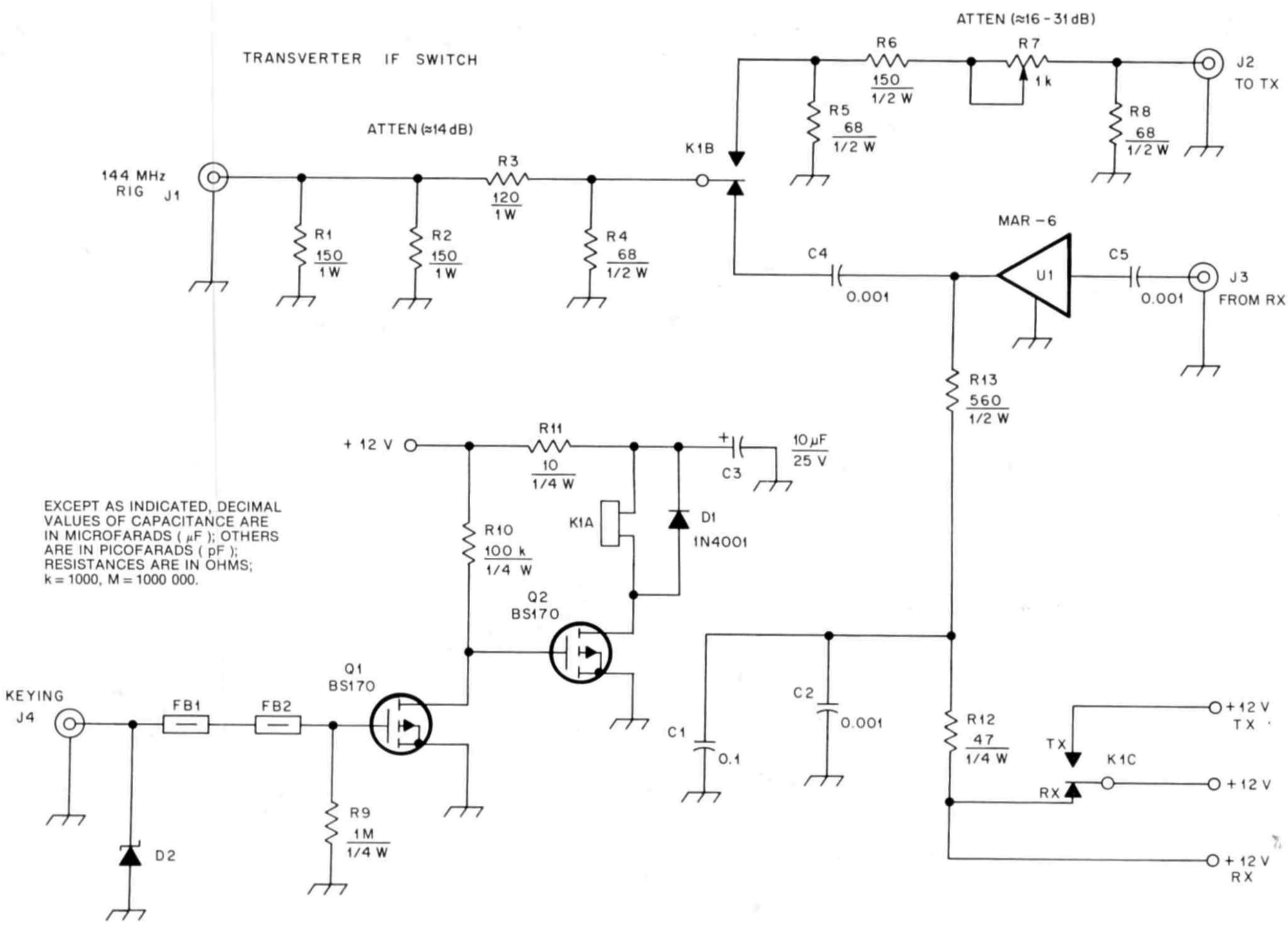

Fig 1—Schematic of the transverter IF switch. D1—1N4001 or equiv. D2—20- to 33-V, ½-W Zener diode. FB1—FB-43-801 (see text). FB2—FB-64-801 (see text). J1-J3—BNC female. K1—DPDT relay (RS 275-213). Q1, Q2—BS170 FET (available from Digi-Key, or Radio Shack® 276-2074). U1—MAR-6 or MSA 0685 MMIC.

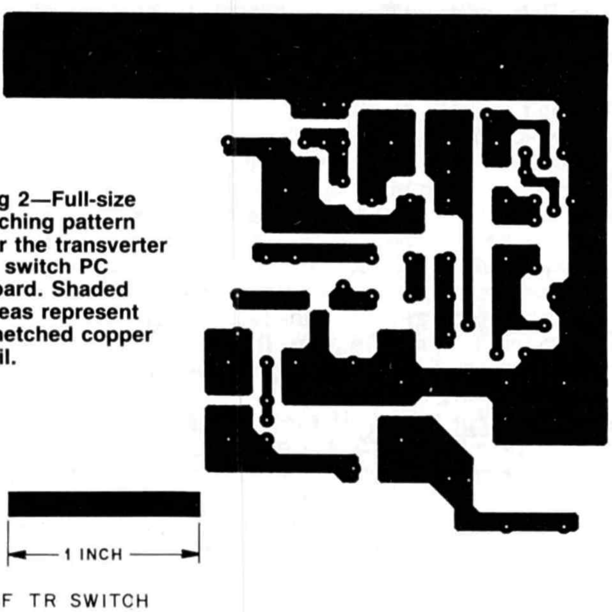

Fig 2—Full-size etching pattern for the transverter IF switch PC board. Shaded areas represent unetched copper foil.

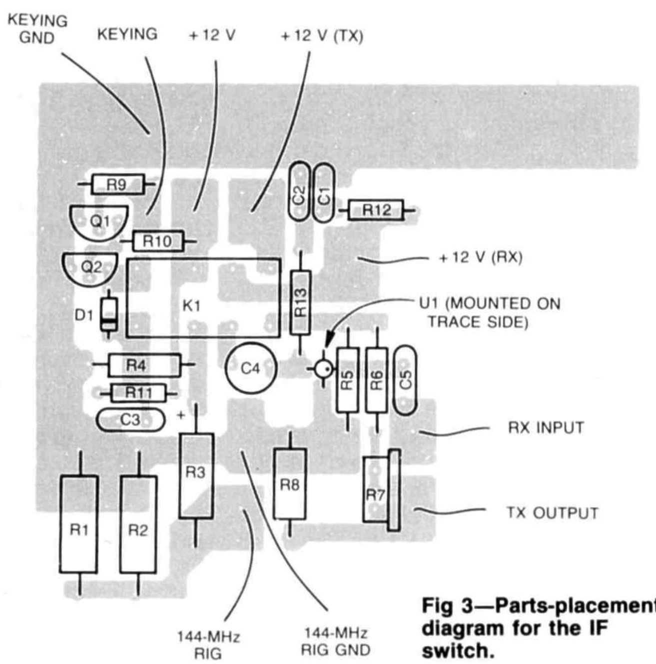

Fig 3—Parts-placement diagram for the IF switch.