A LOW-COST REMOTE ANTENNA SWITCH

Getting multiple antenna feed lines into the shack is a common problem that can be easily solved with a suitable remote antenna switch. The project described here by Bill Smith, KO4NR, provides an easy and inexpensive solution. It originally appeared in April 2005 *QST*.

Relay Selection

Interesting innovations in printed circuit board (PCB) power relay design have produced a number of compact units that exhibit high dielectric strength and can carry impressive amounts of current.

Although not factory tested for RF use, the American Zettler AZ755 series PCB relays work very well in this application. (See **www.americanzettler.com** for datasheets and information.) The AZ755 is rated for 480 W switched power with a resistive load and a maximum switched current of 20 A. Despite the relay's small physical size, the dielectric strength between the contacts and coil is 5 kV RMS, with an impressive 1 kV RMS between the open contacts. This means that the relay is resistant to a flashover that could damage the coil or pit the contacts.

The AZ755 series relays are offered in a wide variety of configurations. This project uses part number AZ755-1C-12DE. This model has a 12 V dc coil, but you can use any of the available coil voltages in the series. The contact style is Form C, which is SPDT. The E suffix indicates that the relay epoxy is sealed for better protection from dirt and moisture. For relays that are not epoxy sealed, drop the E from the part number.

Circuit Design

Fig 19.81 shows the circuit, which handles up to six antennas. The common contacts of the relays (K1-K6) are connected to SO-239 connectors (J1-J6) for the antenna feed lines. The normally open (NO) contacts are all connected to the RF INPUT connector, J7. The normally closed (NC) contacts are all connected to ground so that the antennas are grounded when not in use. To select an antenna, apply 12 V dc to the appropriate ANTENNA CONTROL terminal to energize the relay and connect the ANTENNA to the RF INPUT.

C1-C6 help to keep stray RF out. In addition, D1-D6 are installed across the coils to prevent voltage spikes when the power is removed from the coil. The finished board (available from FAR Circuits) with all components mounted is shown in **Fig 19.82**.

Assembly Notes

The design is simple and assembly doesn't require special tools. In addition to the PC board and parts, you'll need a suitable enclosure to keep the board dry and pests away. The author used a plastic children's lunch box that hangs under his deck.

The most difficult part of the project is drilling the holes in the enclosure for the SO-239 connectors and getting everything to line up. You may find it easier to install the connectors in the enclosure first, and then solder them to the board. (Use the board to mark the center line and loca-

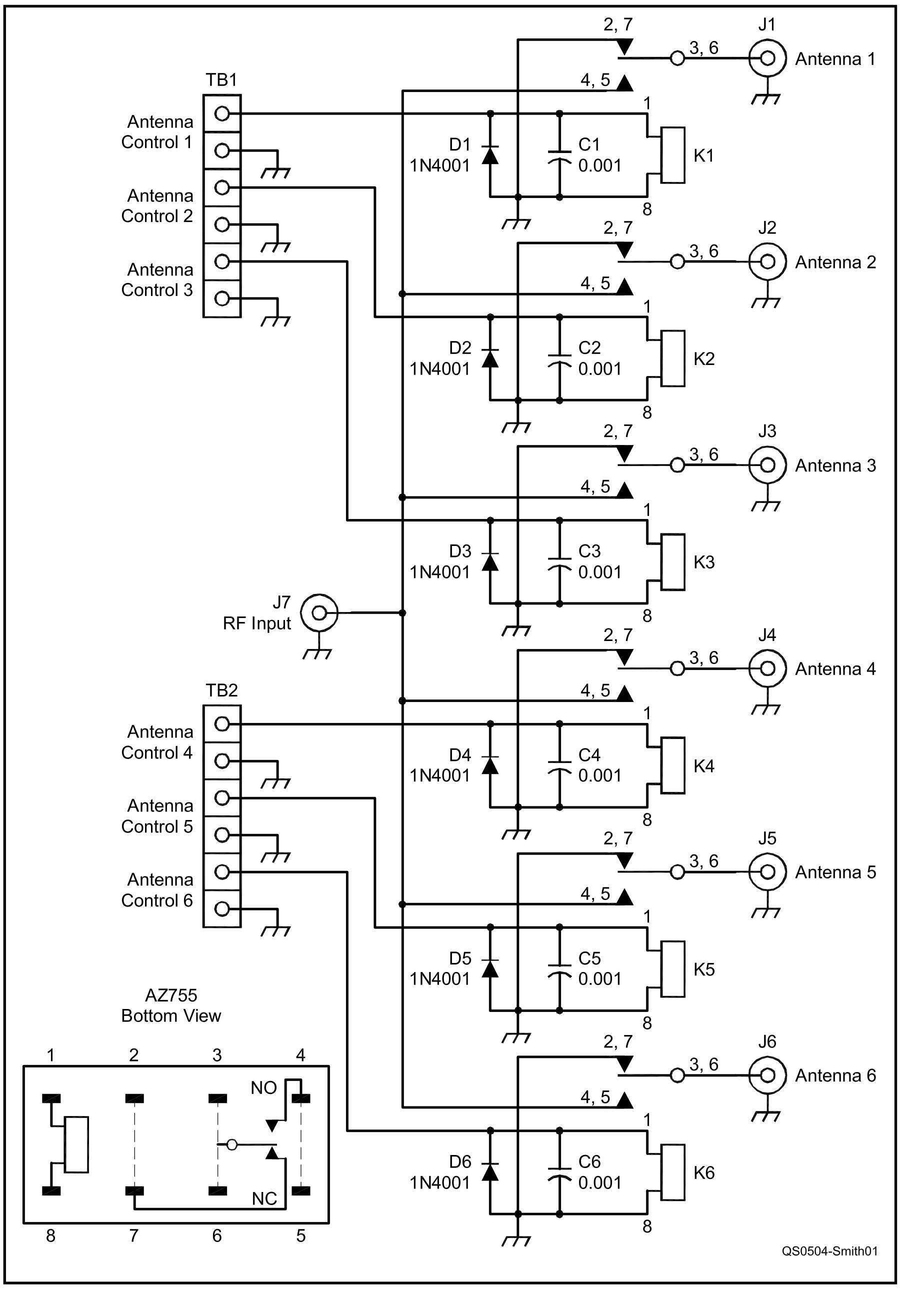

Fig 19.81 — Schematic and parts list for the remote antenna switch. Part numbers indicated with an M are available from Mouser Electronics (www.mouser.com). PC boards are available from FAR Circuits (www.farcir.net). See the *TISFind* database for more contact information.

C1-C6 — 0.001 µF, 50 V disc ceramic capacitor (M 140-50P5-102K-TB).
D1-D6 — 1N4001 diode (M 512-1N4001).
J1-J7 — SO-239A chassis mount coaxial connector with silver-plated 4-hole square flange and Teflon insulation (Amphenol 83-798 available as Mouser 523-83-798).
K1-K6 — SPDT PC board power relay with 12 V dc coil (American Zettler AZ755-1C-12DE). Available from www.relaycenter.com. See text.
TB1, TB2 — PC board terminal block with 6 contacts (M 651-1729050).

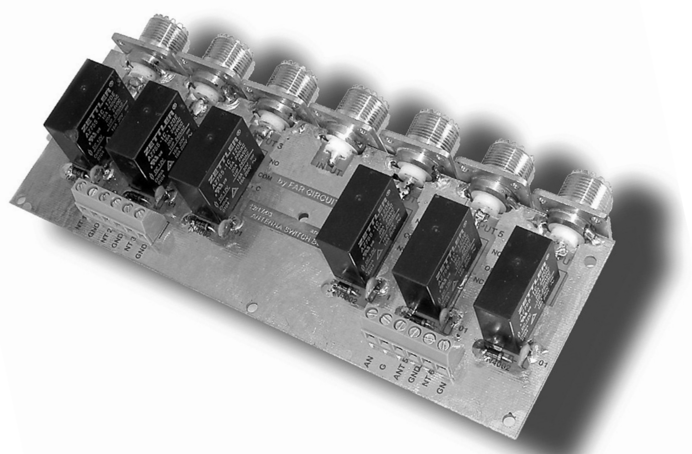

Fig 19.82 — A completed remote antenna switch. The RF INPUT connector is in the center, with three ANTENNA connectors on each side. The control cable connects to the two terminal blocks.

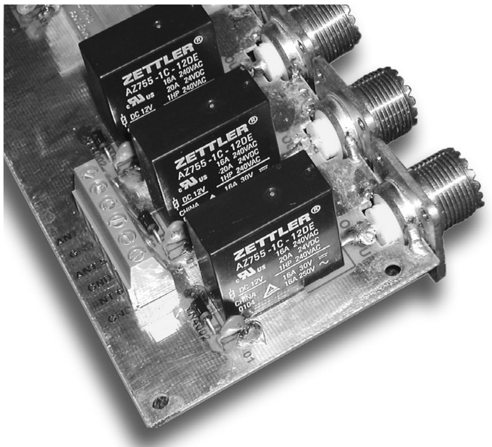

Fig 19.83 — Connector flanges are soldered to the board's ground plane top and bottom. The ground ends of D1-D6 and C1-C6 are also soldered top and bottom. The relays have two pins each for the contact connections. Solder all pins and install eyelets supplied with the FAR Circuits board to ensure good connections for the relay common and normally closed pins.

tion of the connectors on the enclosure.) After the connectors are tacked in place, remove the screws holding the SO-239s to the enclosure and remove the total assembly. This ensures a perfect fit when reassembling.

Make sure the SO-239s are all the same type and brand to ensure a uniform fit. The board was designed around the Amphenol connectors recommended in the parts list. They have silver-plated center pins and flanges, and Teflon insulation. The silver plating makes the connectors easier to solder than nickel-plated connectors, and the Teflon insulation is much less prone to melting than the plastic often found on inexpensive connectors. Other SO-239 connectors may fit with possible modification for a good fit.

Use a *hot* soldering iron when soldering the flange of the SO-239 to the board's ground plane as shown in **Fig 19.83**. Be sure to solder top and bottom.

The PC board is double-sided, and FAR Circuits supplies eyelets with the board to use in the larger holes for the common and normally closed relay pins. They provide for a better connection to the component side of the board. In addition, soldering a short length of #14 bare copper wire into the center pin of each SO-239 will give you a better connection to the circuit trace on the board. Be sure to solder the ground ends of C1-C6 and D1-D6 on both the top and bottom sides of the board.

Powering It Up

The switch is controlled with a 12-V dc power supply and small ceramic rotary switch as shown in **Fig 19.84**. The switch simply sends 12 V to energize one of the relay coils and select the desired antenna. When 12 V is removed, the normally closed relay contacts connect all feed lines to ground. Connect the PC board's ground plane to a ground rod for lightning protection and as a means of eliminating static.

The control cable can be the 8-conductor variety usually used for rotators. Long runs of wire may require large conductors to prevent unacceptable voltage drops at the relay coils, but the relays will work over a fairly wide range of coil voltages so it's not critical.

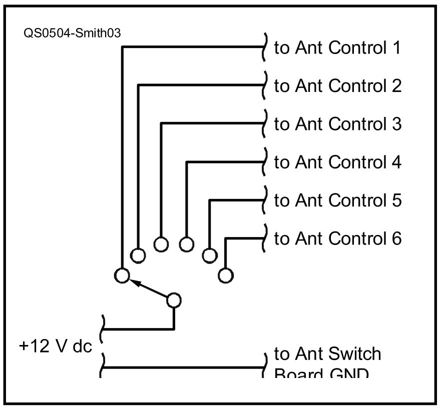

Fig 19.84 — Antennas are selected with a simple 12-V supply and rotary switch.

Testing

Initial testing should be conducted on the bench with an antenna analyzer or a transceiver (internal antenna tuner off) and power/SWR meter connected to the RF INPUT jack. Connect a 50 Ω load to one of the antenna jacks on the switch board. Apply a small of RF power. The SWR should be close to 1:1 (similar to readings without the switch in the line.

If everything looks okay, increase the power and check the SWR through the switch on all bands that you plan to use it on. Next, move the wattmeter to the switch output and verify that the power on that side is about the same as the power at the input. There should be little or no measurable loss through the switch. Repeat these tests for all of the switch positions.

If you run an amplifier, test the switch at high power. The author used the switch at 1-1.3 kW during normal intermittent operation (SSB and CW) with no problems.

Although they are not designed for RF, the relays perform well. The board exhibits low SWR, low insertion loss and good isolation over a wide frequency range. The ARRL Lab tested the completed antenna switch board. Insertion loss measured <0.1 dB for 2-50 MHz (for all ports to common). SWR measured 1.1:1 or less from 2-28 MHz, 1.2:1 or less on 50 MHz. Isolation was >60 dB for 2-28 MHz, except for the two innermost ports, which were 50 dB at 28 MHz. Worst-case isolation on 50 MHz was 45 dB.