

The StationPro Master Station Controller

Control all your equipment interconnections from one spot in an elegant way.

James C. Garland, W8ZR

A half century ago, a well-equipped amateur station consisted of a single transceiver (or receiver/transmitter pair) and possibly a linear amplifier. In those days, the operator merely plugged a key and microphone into the radio's front panel, screwed a coax feed line into a rear jack, hooked up a speaker and amplifier relay control, tucked the wires neatly away behind the desk, and sat down to operate. Easy.

Now fast forward to the 21st century. That area behind the station operating desk has become a no ham's land of computer cables, wall warts, amplifier control wiring, audio processing cables, RTTY and packet cables, and a morass of coax feed lines. And if you have more than one rig in your station, and more than one linear amplifier, then the snarl of cables and wires can be daunting. Switching over to your "backup" transceiver or amplifier is a time-consuming challenge, likely complicated by incompatible microphone, data, audio and control connectors. Wouldn't it be great if you could just throw a toggle switch and have all this switching — RF, data, microphone, key, audio and others — taken care of automatically?

Enter the StationPro, a build-it-yourself master station controller that integrates the switching and control functions of even the most complex amateur stations. Now by just flipping a switch you can mix and match transceivers, amplifiers and microphones, in any combination. Furthermore, the StationPro

simplifies behind the table clutter, reducing the time spent crouched behind your operating desk, flashlight in hand, trying to make sense out of the rat's nest.

There are two versions of the StationPro (Figure 1). The "basic" version, *SP-I* for short, controls two transceivers (or transmitter/receiver pairs) and two linear amplifiers. The *SP-II* is the microprocessor based deluxe version. The *SP-II* can control up to three transceivers and three linear amplifiers and has

an LCD readout and additional convenience features. In addition, up to three *SP-II*s can be networked together, allowing nine rigs to be controlled. That ought to be enough even for over the top vintage radio collectors (such as yours truly). Here, we'll focus on the *SP-I* and refer readers to the QST-In-Depth Web site (www.arrl.org/qst-in-depth) and the author's Web site (www.w8zr.net/stationpro/) for the details on the deluxe *SP-II*. Briefly, here is what both versions can do for you:



Figure 1 — The StationPro comes in two versions. The SP-I (top) handles the switching for two transceivers and linear amplifiers, while the deluxe SP-II version accommodates up to three transceivers and amplifiers.

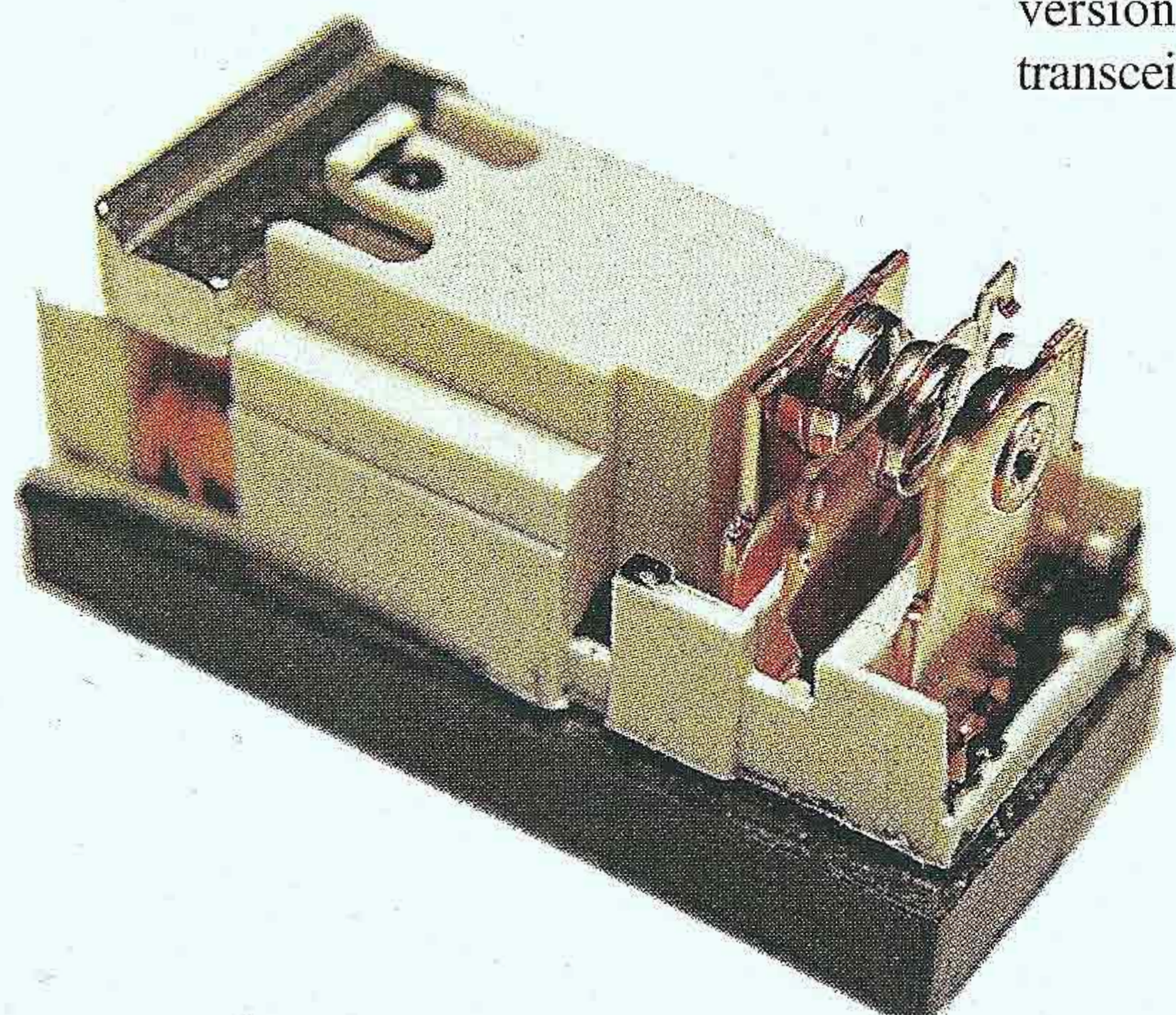


Figure 2 — This miniature Tyco/Schrack RTB14012F power relay, shown with the cover removed, easily handles the amateur legal power limit, has excellent RF properties and costs about \$2. The StationPro uses 10 of these relays to switch all RF circuits.



Figure 3 — The RF relay enclosure mounts behind the station desk and handles all the RF switching for the StationPro.

■ Route all the RF switching (up through the 6 meter band) to and from your transceivers and linear amplifiers. The StationPro's RF relays (Figure 2) are conservatively rated at the amateur legal power limit, with a substantial safety margin.

■ Transfer key or paddle, microphones (two can be selected, even having different pinouts), speakers, RTTY or packet, computer, linear amplifier relay and ALC, line in and out, footswitch (or PTT) — up to 24 separate control lines, including several spares and user configurable lines.

■ Control all linear amplifiers, including vintage and homebrew amplifiers, no matter whether they use positive, negative or ac relay control voltages. This flexibility means no more worries about the voltage and current limitations of your transceiver's amplifier keying circuit.

■ Provide a +12 V dc control voltage for operating a master station power relay.

Note that builders of an SP-I can upgrade to an SP-II as their station needs evolve. Upgrading merely involves replacing the front panel circuit board assembly, and plugging in a microcontroller circuit board.

StationPro Design Concepts

The StationPro's design makes use of

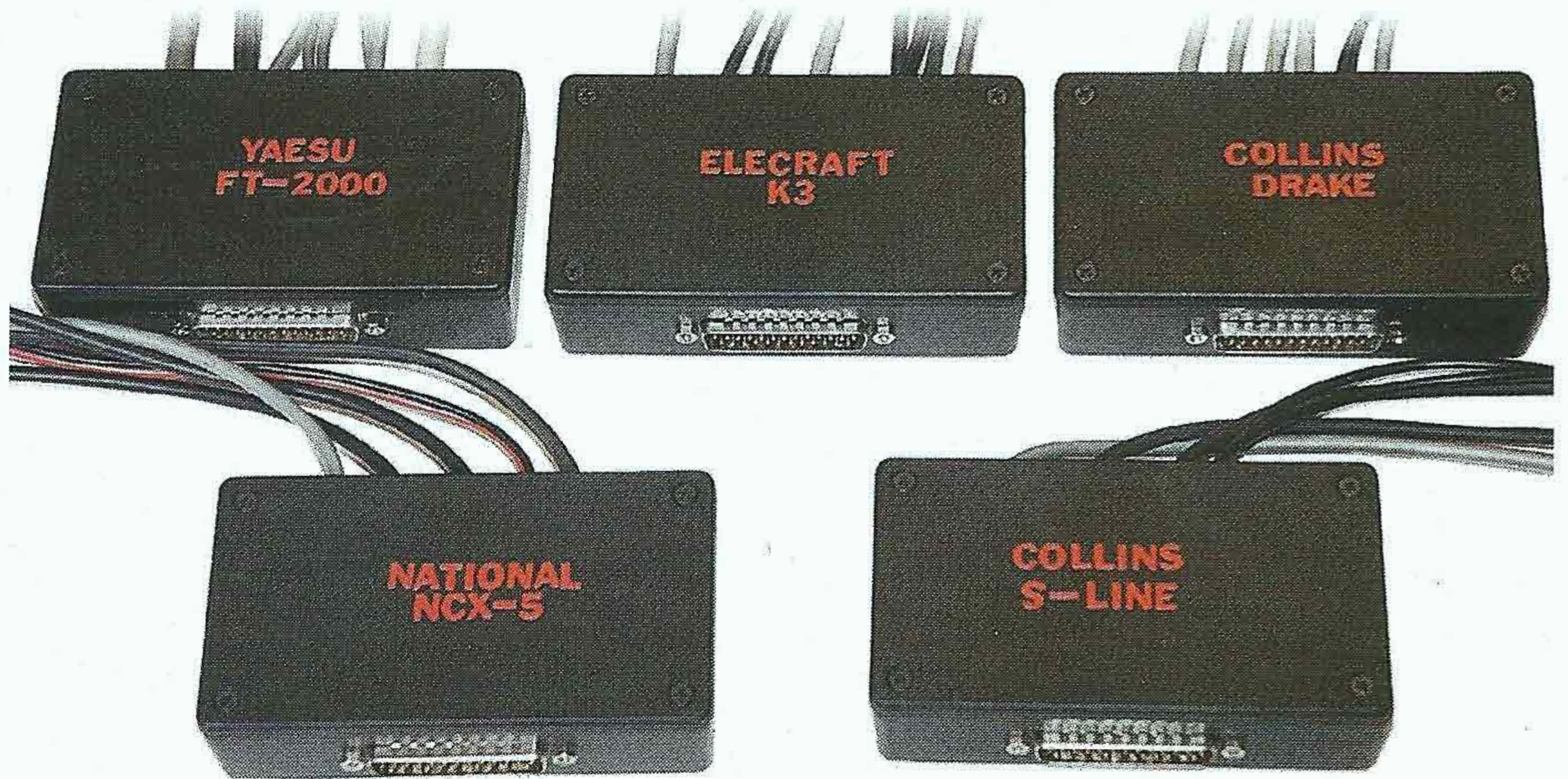


Figure 4 — Breakout pods, customized for each transceiver or exciter, interface the StationPro to the builders' rigs and minimize behind-the-desk "cable clutter."

recently developed, ultra reliable printed circuit mount relays. Two types of relays are used: small signal relays that switch audio, data and control functions and compact power relays that have excellent RF characteristics up into the VHF range. In more than 20,000 hours of 24 × 7 operation with the four StationPros in the author's station, there has not been a single relay failure.

In the StationPro, RF switching is handled by a remote relay enclosure (Figure 3) that

mounts behind the operating table and is operated by the StationPro's control unit (via an ordinary Ethernet type computer cable). Separating the RF from other control switching helps prevent unwanted RF from leaking into audio and data lines and also keeps bulky coax cables from hanging off the back of the StationPro's compact control unit.

And finally, the StationPro minimizes cable clutter by using simple breakout pods (Figure 4) to interface control cables to each trans-

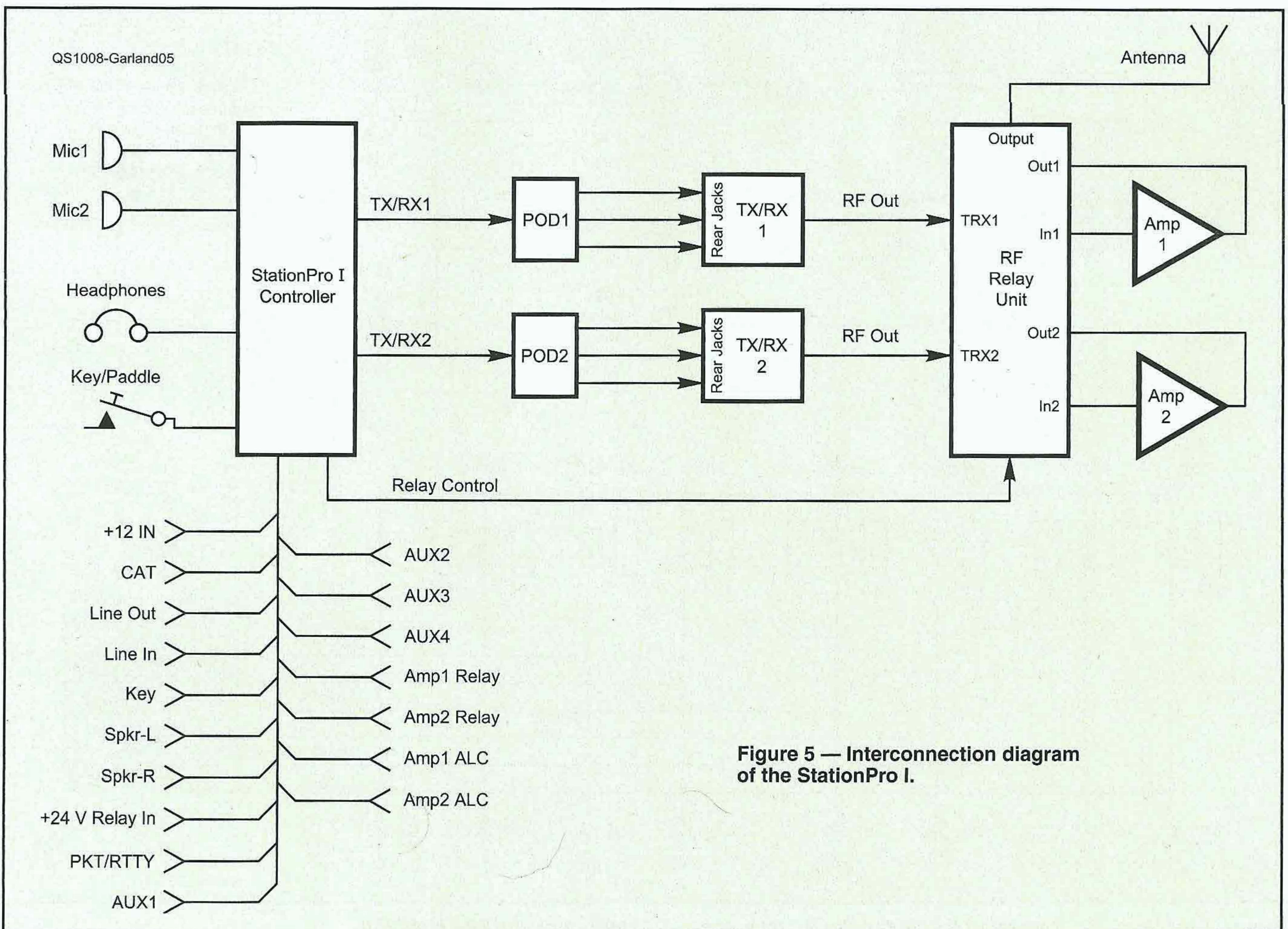


Figure 5 — Interconnection diagram of the StationPro I.

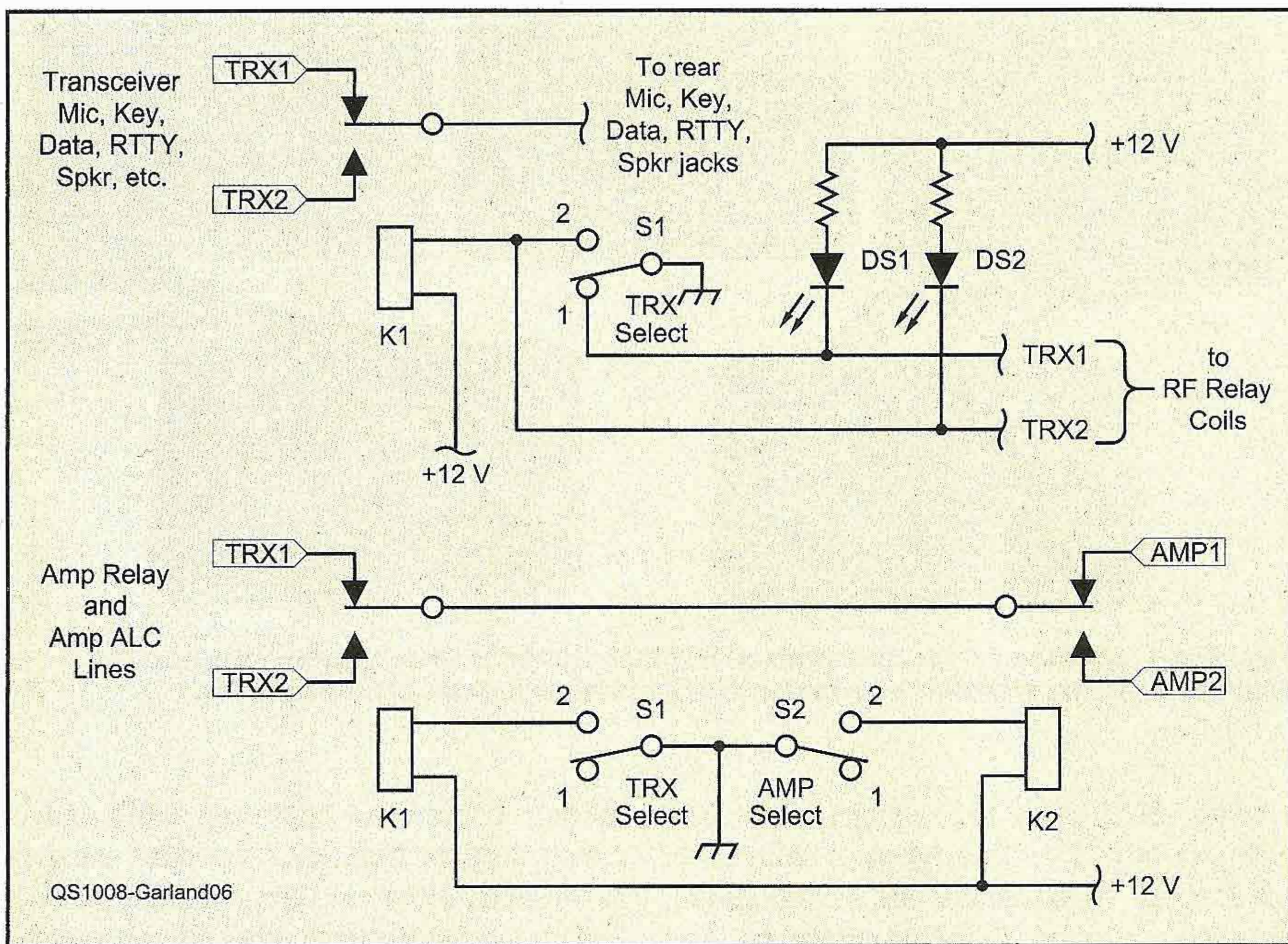


Figure 6 — Simplified diagram of the switching used in the StationPro I. Complete circuit diagrams and parts lists can be downloaded from the QST-In-Depth Web site.

ceiver. Each pod is configured by the builder during assembly to meet the requirements of a particular transceiver. The pods are connected to the StationPro control unit via a 25 conductor serial type computer cable. Short breakout cables connect each pod to the rear panel of the connected transceiver, holding behind the desk cable congestion to a minimum.

Figure 5 shows how these various elements connect together. A key or paddle, headphones (either 1/4 inch or 3.5 mm plugs can be accommodated), and one or two microphones plug into jacks on the SP-I's front panel. For convenience, there are duplicate rear panel jacks for key, audio and PTT lines. The rear panel also has dedicated jacks for two external speakers, a computer serial interface, sound card as well as jacks for other control functions including ALC and amplifier relay control. Each transceiver connects to the control unit through a single DB-25 connector, labeled TX/RX1 and TX/RX2 in the figure. Figure 5 also shows the remote RF relay unit, which routes RF from a selected transceiver to a selected amplifier. Unselected transceiver outputs and ampli-

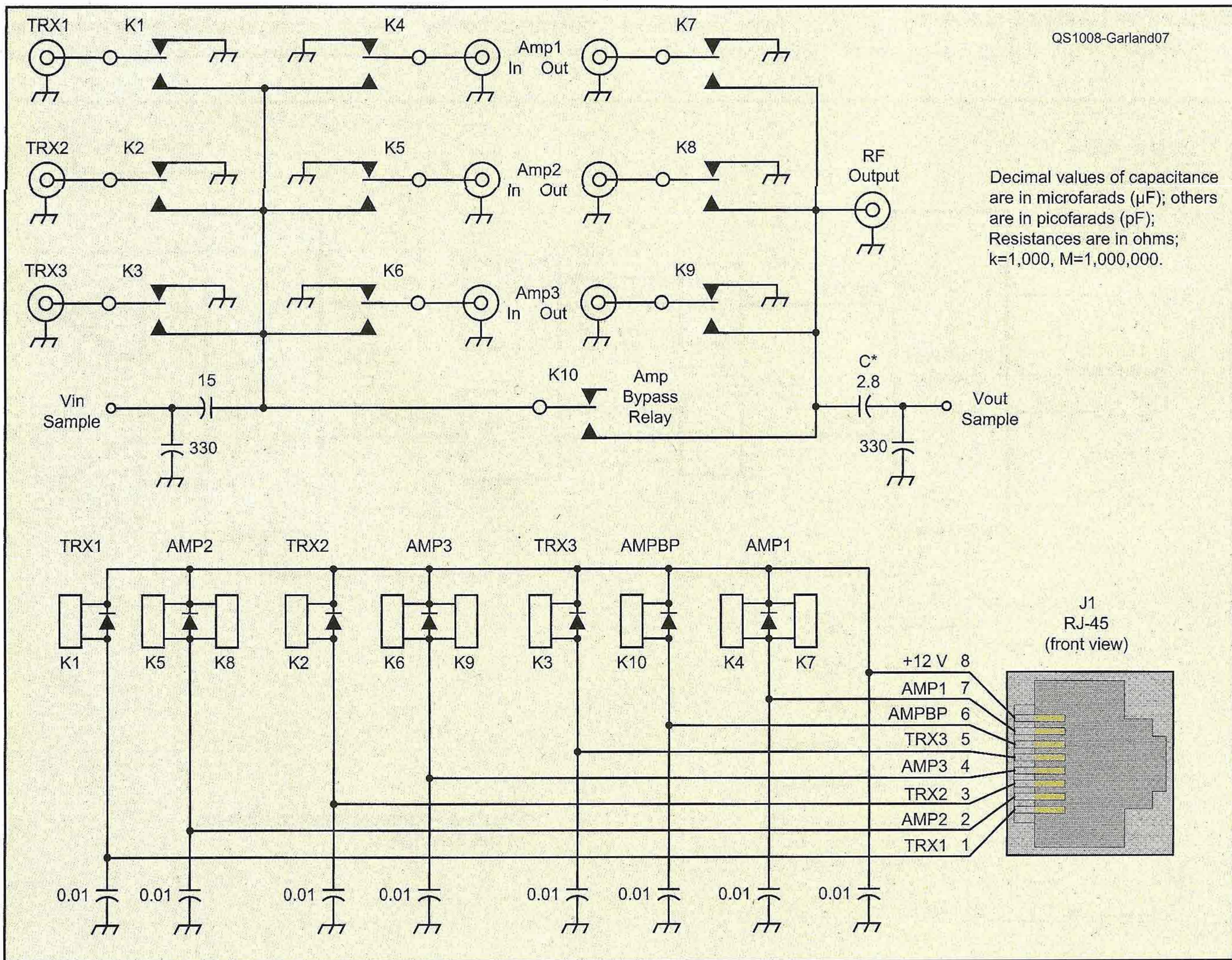


Figure 7 — Schematic diagram of the StationPro RF relay circuits, used in both the SP-I and SP-II.

fier inputs are grounded, and for barefoot operation, a relay in the RF unit bypasses all amplifiers.

Both versions of the StationPro operate on 12 V dc and draw less than 500 mA. For special applications such as VHF/UHF stations, or for amateurs who prefer to use vacuum relays for switching HF, the control unit has an auxiliary input dc power jack that can accommodate up to +30 V dc to control user supplied RF relays. If needed, this voltage is automatically routed to the builder's RF relays by the control unit.

Circuit Description

Figure 6 shows a simplified diagram of the basic switching concept used by the SP-I. Inputs from either of two transceiver/exciter, shown as TRX1 and TRX2, are switched by relay K1. This relay is actuated by S1, a front panel toggle switch labeled TRX SELECT in the diagram. This switch grounds the coil of K1 and also illuminates front panel LEDs corresponding to the selected transceiver. In actuality, K1 consists of 12 DPDT signal relays, which switch a total of 24 control lines, all dedicated to dc, audio, and data signals from each transceiver.

Most of the 24 control lines are directly routed from TRX1 or TRX2 to front and rear panel jacks on the SP-I. However, the amplifier control lines, designated AMP RELAY and AMP ALC are routed by K2 to the linear amplifier selected by switch S2, labeled AMP SELECT. The AMP RELAY line is not directly connected to the selected linear amplifier, but rather is buffered through a solid state driver circuit rated at 400 V (ac or dc) and 250 mA. During construction, the builder also has the option of replacing this driver circuit with a different circuit rated at 200 V dc (positive voltage only) and 3 A. Although it is not shown in the figure, S2 also actuates the remote RF relays for switching the selected amplifier on line. Additionally, a front panel bypass switch (not shown) deselects both amplifiers and deactivates the AMP RELAY line so that bypassed amplifiers cannot inadvertently be keyed up.

Figure 7 shows the schematic diagram of the RF relay enclosure. Nine printed circuit-mount relays, K1 through K9, route RF from a selected transceiver to a selected linear amplifier, while a 10th relay, K10, bypasses all the amplifiers. Because identical RF switching circuitry is used in both versions of the StationPro, some of the RF unit's capability is not used by the SP-I. The cost of the unused components is low, however, and having common circuitry allows an SP-I to be upgraded to an SP-II without having to replace the entire RF enclosure. The remote relay unit optionally includes RF sampling capacitors that pick off some of the RF voltage at the input and output of a selected amplifier for use by a monitor oscilloscope. The 2.8 pF pickoff capacitor,

denoted C* in the diagram, is an integral part of the circuit board pattern. All of the RF relays mount on a compact double sided printed circuit board (Figure 8), measuring 4.2 × 6.75 inches. The use of wide traces, careful layout and ground planes on the board ensure good port-to-port isolation and negligible insertion loss and VSWR up through the 6 meter band.

Construction Details

Although the StationPro is a sophisticated piece of equipment, amateurs who have prior experience with electronics kits or homebrew construction projects should have no difficulty duplicating it. Nearly all the circuitry is housed on double sided printed circuit boards, thus minimizing tedious point-to-point wiring. Prepunched and silk-screened enclosures are also available for builders.

Figure 9 shows how the three circuit boards making up the SP-I control unit are interconnected. The front and rear panel circuit boards plug into the main board with short ribbon cables. The 10 SO-239 (UHF) coax jacks in the remote relay unit are soldered directly to their

circuit board (Figure 10) in order to facilitate assembly and minimize lead lengths. In addition, there are two small circuit boards used in the transceiver pod breakout boxes (Figure 11). Figure 12 shows how short jumper wires on the front panel connector pins solder to mating pads on the front panel circuit board.

The printed circuit boards in the SP-I control unit fit an available 9 × 4 × 7 inch WHD Ten-Tec model BK-947 enclosure. The remote RF relay unit is housed in a custom fabricated 7.5 × 5 × 1.5 inch WHD aluminum enclosure with flanges for mounting behind an operating table. For my personal StationPros, the blank front and rear panels of the stock BK-947 enclosures were discarded and replaced by one-of-a kind custom panels having engraved lettering (www.frontpanelexpress.com). Although elegant, these prototype panels were quite pricey, and I have therefore arranged for Ten-Tec to manufacture a limited number of complete sets of punched and labeled enclosures for StationPro builders at a reasonable cost.

After bare circuit boards, components

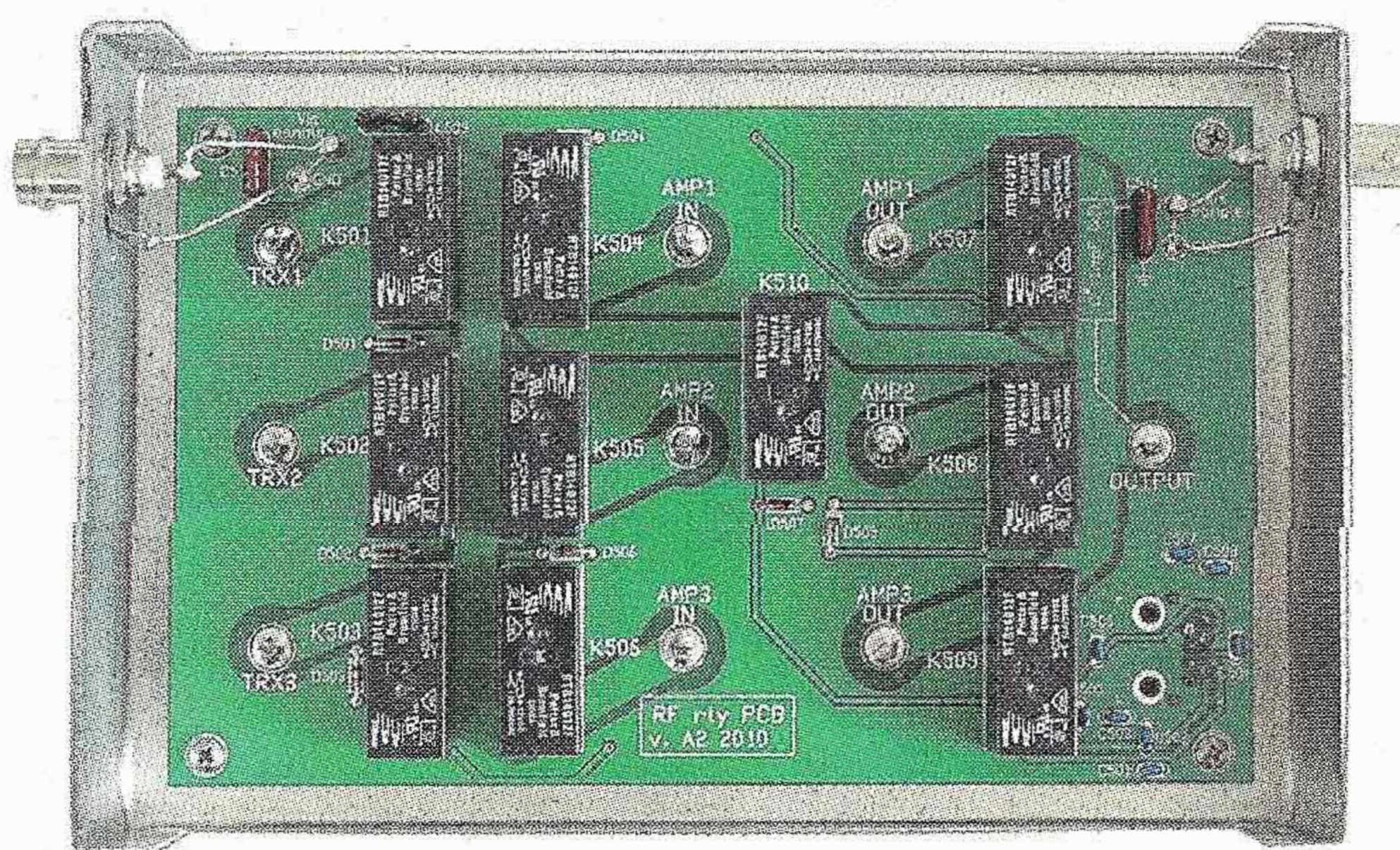


Figure 8 — All RF switching is accomplished by relays on this 4.2 × 6.75 inch printed circuit board.

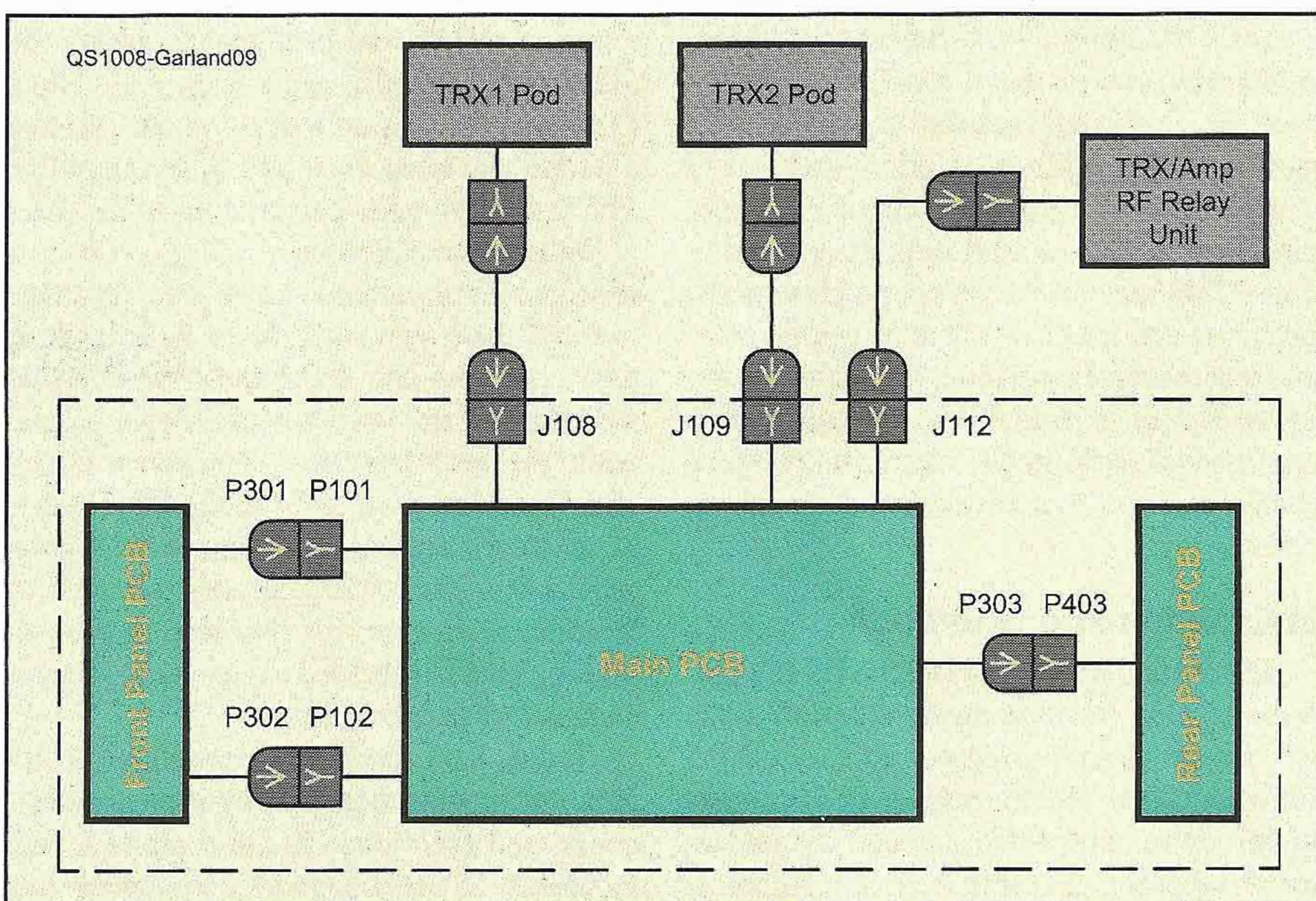


Figure 9 — All rear panel connectors on the StationPro mount directly on printed circuit boards. The use of short ribbon cables minimizes the need for tedious point-to-point wiring.

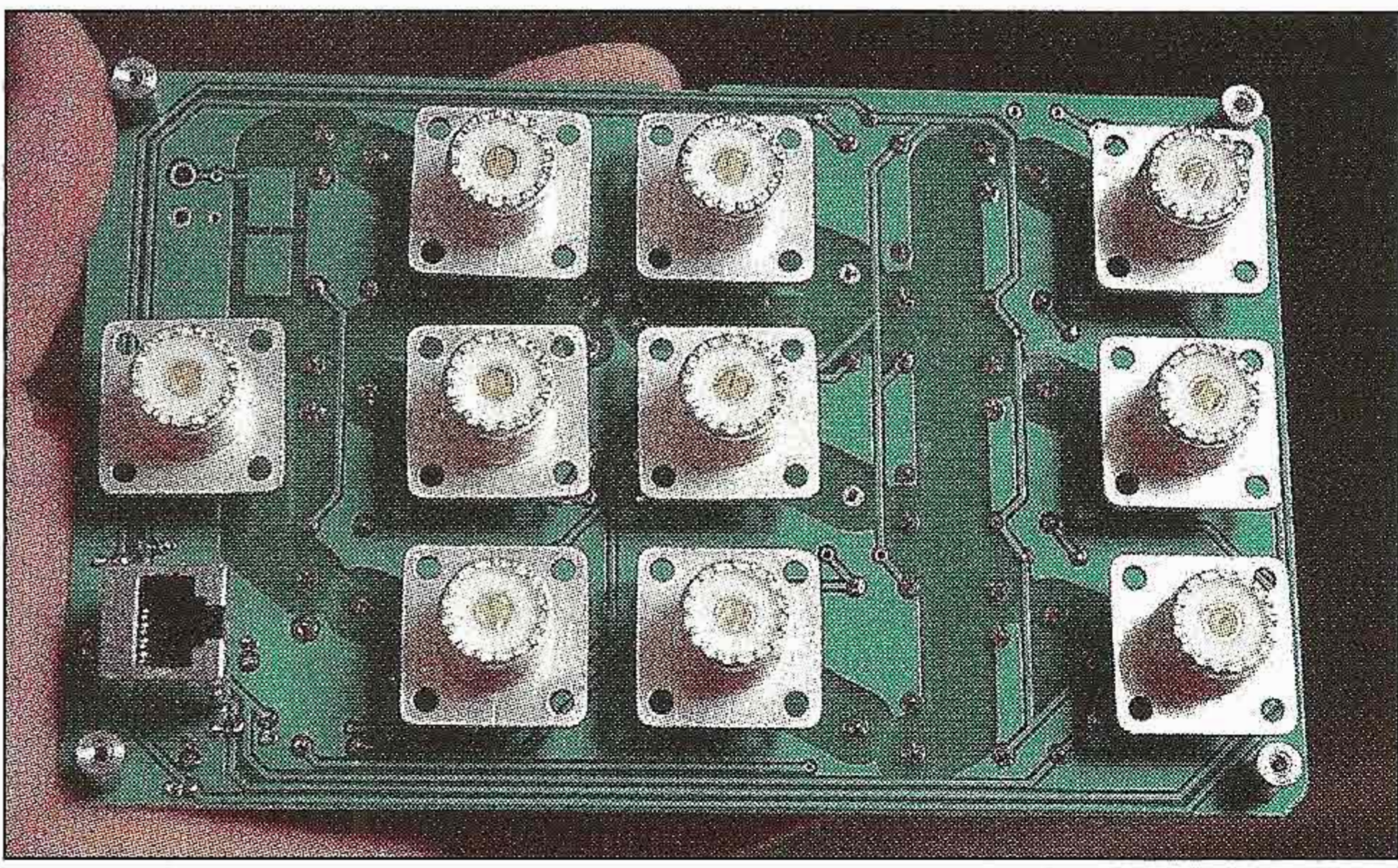


Figure 10 — The 10 SO-239 (UHF) coax connectors on the RF relay enclosure attach directly to the printed circuit board in order to minimize lead lengths. The Ethernet-type control connector is visible at the lower left of the board. The 2.8 pF high voltage RF pickoff capacitor, visible on the upper left, is an integral part of the board pattern.

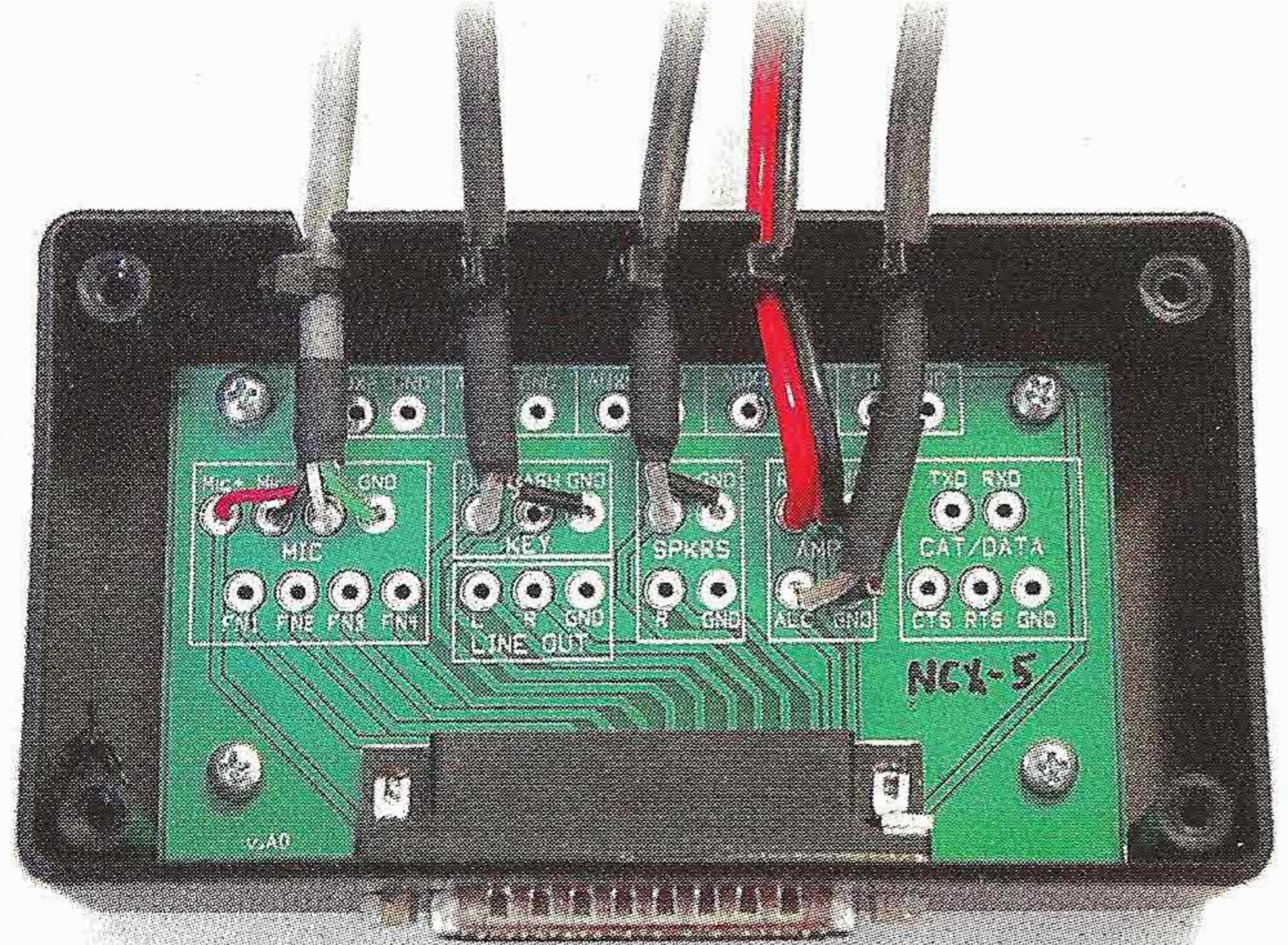


Figure 11 — Breakout pods simplify StationPro interconnections to transceivers. For vintage rigs, such as the 1960 era National NCX-5 transceiver, only a few of the available control lines are needed.

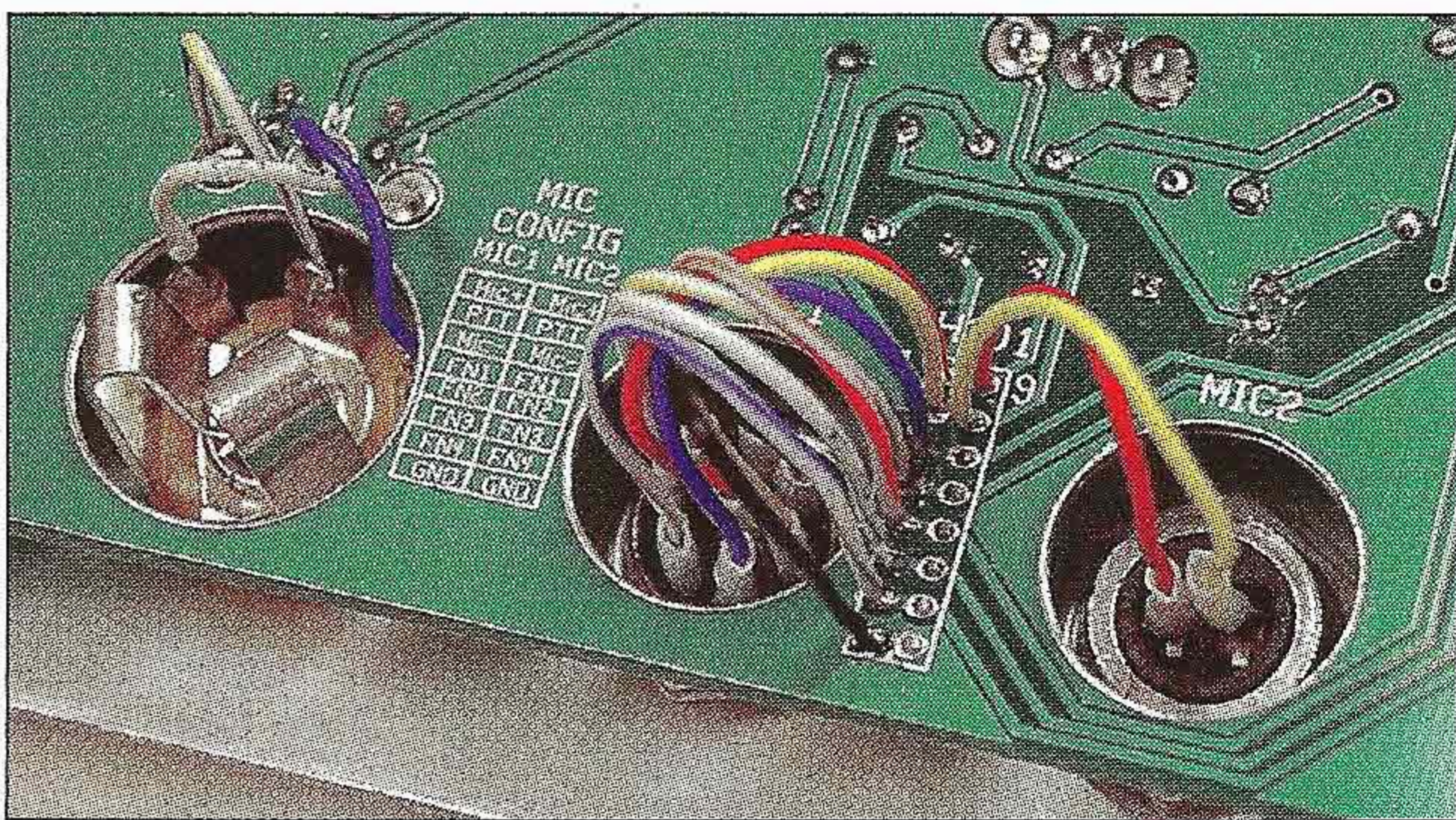


Figure 12 — To minimize laborious point-to-point wiring, short jumper wires from front panel connectors solder to mating pads on the printed circuit board.

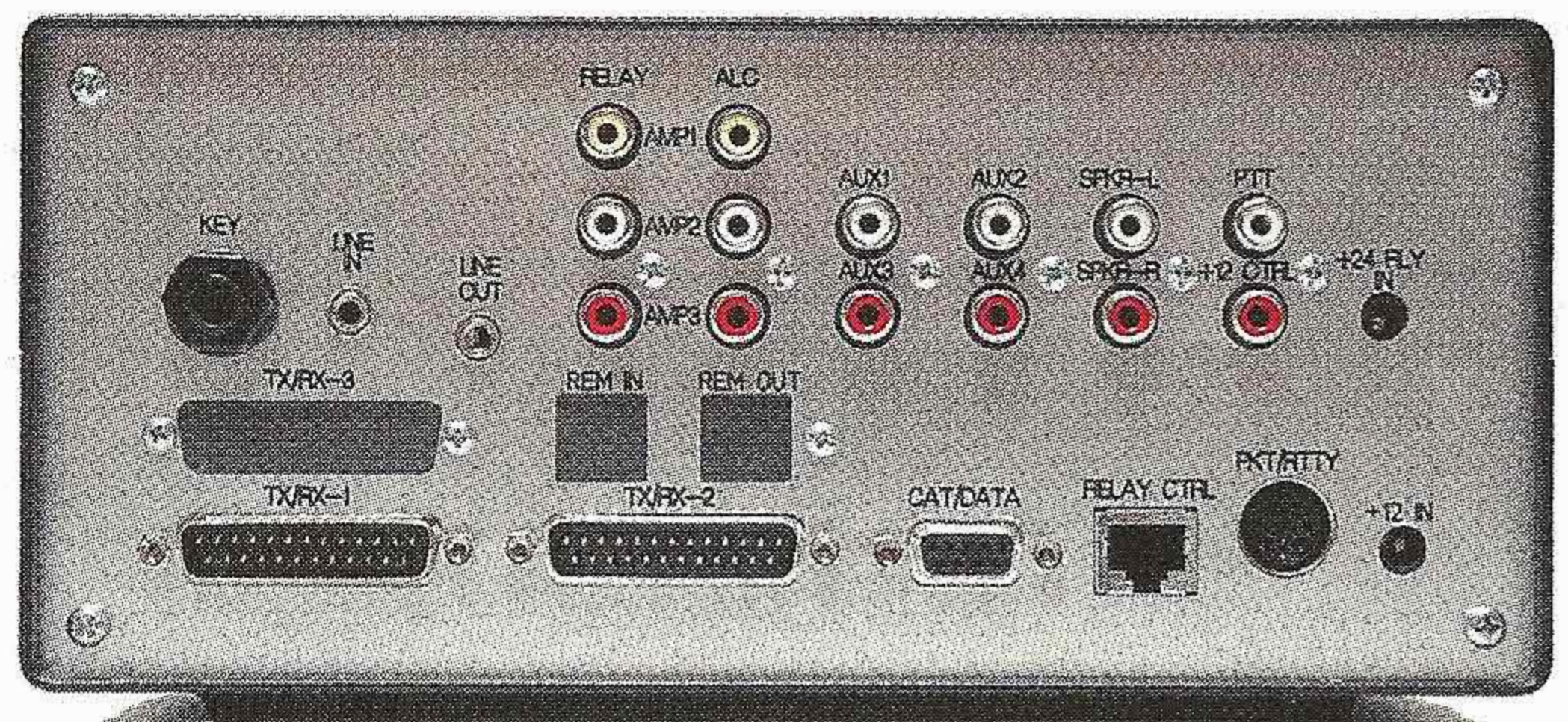


Figure 13 — Both versions of the StationPro use identical rear panels in order to facilitate upgrades. Unused cutouts on the SP-I's panel, shown here, are blanked off with a small cover plate.

and enclosures are obtained, builders should allow about 7 to 10 hours to construct an SP-I. Comprehensive step-by-step assembly instructions can be downloaded from the author's StationPro Web site at www.w8zr.net/stationpro/ or from the QST-In-Depth Web site. Both Web sites also contain detailed parts listings, additional photographs and construction hints, complete circuit diagrams, circuit descriptions and operating instructions. The sites also have information about obtaining printed circuit boards, components, and enclosures. In addition, a StationPro user group forum is available at groups.yahoo.com/group/stationpro/, where builders can exchange hints, offer advice and share experiences.

Installation and Operation

Installation of a completed SP-I is straightforward. One connects the control unit to the RF relay enclosure using an ordinary CAT 5 Ethernet cable. The transceiver pods connect to the control unit with a standard 25 conductor serial cable, available from any computer or office supply store. Coax jumpers from the transceivers and linear amplifiers connect to the mating jacks on the RF enclosure, and

the station speaker(s), computer serial cable, sound card and any control cables plug into the rear panel (Figure 13). One or two microphones plug into front panel jacks, along with a key or paddle and headphones. Using the StationPro I literally requires no instruction. One turns the unit on and selects the desired microphone, transceiver and linear amplifier. The StationPro takes care of everything else.

When I received my FCC license as a teenager, it was common practice for amateurs to build their own stations. In those bygone days, receivers and transmitters were mostly straightforward vacuum tube designs, and while the workmanship of homebrew efforts sometimes left a bit to be desired, thousands of amateurs not only experienced the great satisfaction (and significant cost-savings) of building their own rigs, but also developed lifelong interests that led to careers in science, engineering and technology.


Today, ham transceivers are highly complex instruments, designed by teams of engineers, and their innards are crammed with thousands of surface mount components that are almost too small to see. Although this march of progress has resulted in affordable rigs having extraordinarily high performance,

it has also made it harder for amateurs to realize the educational benefits and personal satisfaction of that earlier era. The StationPro, as with some of my earlier QST projects, is my effort to tempt amateurs to head back to their workbench, fire up their soldering iron, hone their skills, and enjoy the rewards of building a useful station accessory they can't just go out and buy.^{1,2}

¹J. Garland, W8ZR, "The EZ-Tuner, Part I," QST Apr 2002, pp 40-43; "Part II," QST, May 2002, pp 28-34; "Part III," QST, Jun 2002, pp 33-36.

²J. Garland, W8ZR, "A Deluxe HF Receiver Multicontroller," QST, May 2004, pp 31-38.

Photos by the author.

Jim holds an Amateur Extra Class license and is a former physics professor and university president. He is a Life Member of the ARRL and a Gold member of the ARRL Diamond Club who lives in Santa Fe, New Mexico. His Amateur Radio Web site is www.w8zr.net and he may be contacted at 102 Spur Ranch Rd, Santa Fe, NM 87540 or at w8zr@arrl.net. 

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