

Building Simple Isolation Interface Devices

Mixing and matching gear may be simpler, easier, and certainly neater than you think.

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I tend to worry a lot. One of the things I used to worry about was how much work it would take to change the amplifier control device inside my fancy, expensive transceiver, should I manage to blow it up (assuming I could even get the parts). Mind you, this is a distinct possibility when using certain amplifier-transceiver combinations. The unmodified Heath SB220 series of amplifiers use a 125 (plus) volts-DC control circuit that your transceiver must switch, for example, which is considerably higher than many popular rigs like to deal with.

Most current transceivers include some kind of advisory in their instruction manuals stating, "Do not exceed xxx volts or yyy amps" in the external control circuit. To comply with such requirements and have flexibility of running any of my transceiver-amplifier combinations, I came up with a few isolation interface devices that may be useful to others. Use of such devices may or may not be necessary in all cases, but at least in my case it's one less thing I have to worry about.

Probably the best isolation device is an external relay. Use of an optical isolator is also a good choice, provided a suitable device can be found. A third, but nevertheless viable,

option is using a solid-state (transistor) switch.

This article will focus on using two of these isolation methods: the relay (specifically reed relays) and transistors (both NPN and PNP switch types). In covering these I hope to present enough useful information that you might recognize and be able to use similar techniques in a variety of ways other than these specific applications.

Relays

Using external relays has always been a standard option when connecting transceivers to amplifiers. However, I really didn't want any

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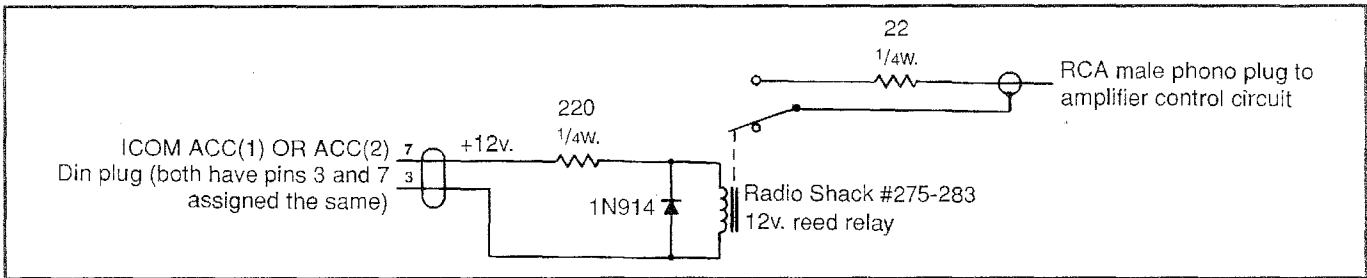


Fig. 1—ICOM 737A amplifier interface circuit using a reed relay. This circuit will work with many current ICOM transceivers.

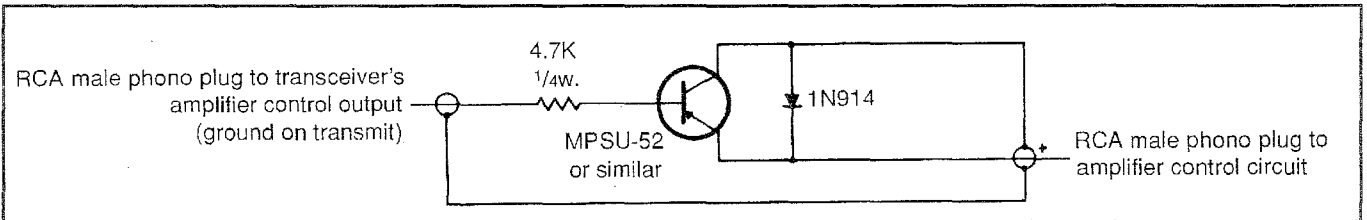


Fig. 2—Kenwood TS-50S (and similar radios) amplifier interface circuit using a PNP switch transistor.

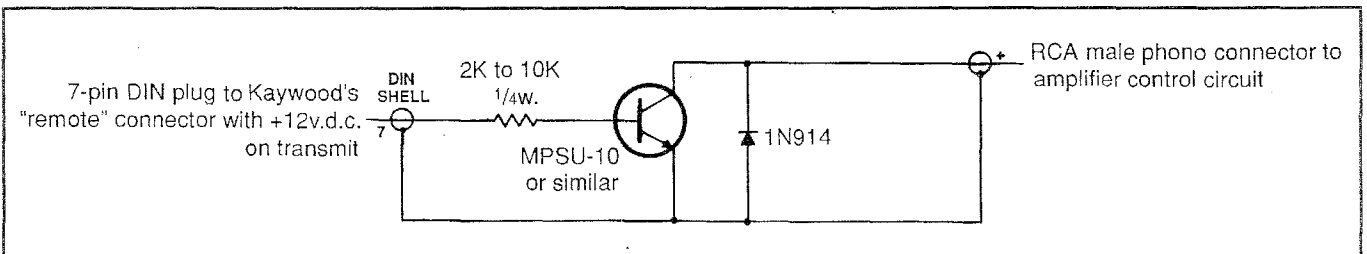


Fig. 3—Kenwood TS-440 (and similar radios) amplifier interface circuit using an NPN switch transistor.

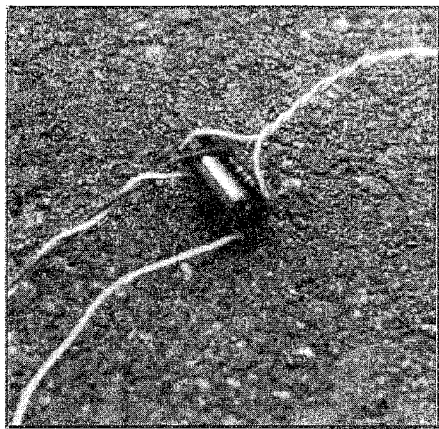


Photo 1— Reed relay mounted on "perf-board" provides building block for various interface applications.

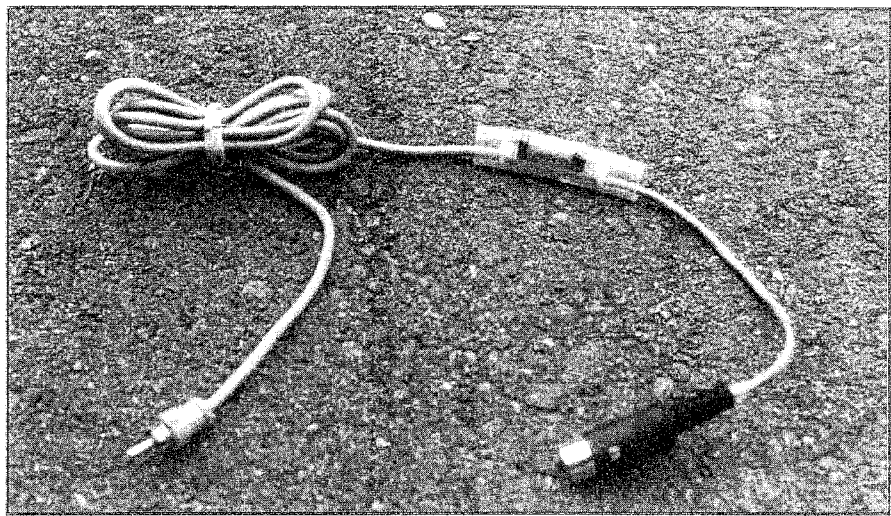


Photo 2— An "in-line" amplifier interface cable for many ICOM transceivers using a reed relay for isolation.

big, junky-looking gadget hanging off the back of my radio. Therefore, I looked into finding a suitable device that I could integrate into some kind of "in-line" cable assembly. The advantage here, at least in my mind, was that I could simply "plug it in" at each end when I wanted to use the equipment combination, then unplug it and roll it up when I was done. I also didn't want to have to remember stuff like having to connect the "red wire," say, to +12 VDC, etc. I wanted something basically "idiot proof."

Radio Shack has carried a couple of reed relays over the years—a 5 VDC @ 20 ma unit (cat. #275-232) and a 12 VDC @ 11 ma unit (cat. #275-233). Both versions have SPST contacts rated at 1A @ 125 VAC.

I've used both types in a variety of applications with few, if any, problems. The 5 volt relay does a good job at TTL levels, and I used one a while back to interface a VIC-20 to a teletype machine for RTTY operation. The 5 volt reed relay works fine at 12 volts also, if you use a 750 to 1000 ohm resistor in series with its coil. I've found the 12 volt version works quite reliably with voltages as low as 9 volts.

These relays are tubular shaped, about 1/4 inch in diameter by approximately 1 inch long, and they both have pin spacing ideal for "perf-board" mounting—in short, an ideal device for my "in-line" application. Photo 1 shows one of

these relays mounted on a piece of perf-board, ready to be connected to some application.

One specific transceiver-amplifier combination I wanted to interface was my ICOM IC-737A to either an Ameritron AL-80A or my Heath HL-2200 (the last of the SB220 series). ICOM includes a "SEND" jack on the 737A's rear panel, but includes the instruction "The specifications for the SEND relay are 16 VDC @ 2A. If this level is exceeded, a large external relay must be used." Hmm . . . Probably would work with my AL-80A, as it uses a 12 VDC control relay. But who knows what the in-rush current might be? Absolutely out of the question for the HL-2200 though.

If I wanted to use my 737A with either the Ameritron or Heath amplifier an external relay would be necessary. What I finally came up with is the cable shown in photo 2 and its circuit, shown in fig. 1. I decided to use the 12 volt reed relay due to its lower current requirement to take advantage of another scheme many ICOM radios use.

Many current ICOM transceivers have two DIN plugs on their rear panels—a 7-pin and an 8-pin. Both of these connectors provide a +12 volt source and a current sinking T/R input. And

the pins are redundant. The available current sink is limited to 10 ma, but by using a small series resistance, say 250 ohms, the 12 volt reed relay can be kept below this limit with no apparent operational difficulty.

I decided to use the 7-pin DIN plug because it will go into either rear connector on the ICOM and work the same. These connectors are called "ACC(1)" and "ACC(2)" on my 737A, by the way.

To complete the in-line relay cable design, I added a back-EMF spike suppression diode (1N914) as a precaution, and a small value resistor (22 ohms) in series with the contacts to limit the in-rush current across the relay's contacts. I also used a 220 ohm resistor in series with the relay coil to limit this circuit's current to 10 ma or less (see fig. 1).

In keeping with my "in-line cable" requirement, I built the entire assembly on a small piece of perf-board sized mainly to fit inside a piece of plastic tubing I got at a local hardware store. To give the entire cable assembly some mechanical integrity, I tied the input and output cable ends to the perf-board using small cable ties. What I ended up with is a neat, functional interconnect cable that works well. The

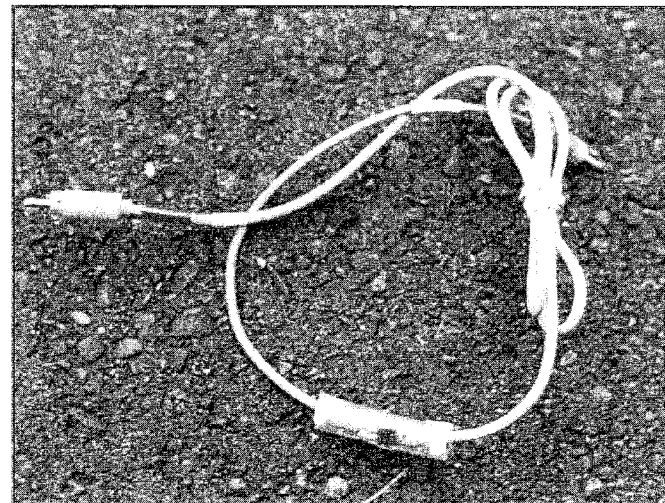
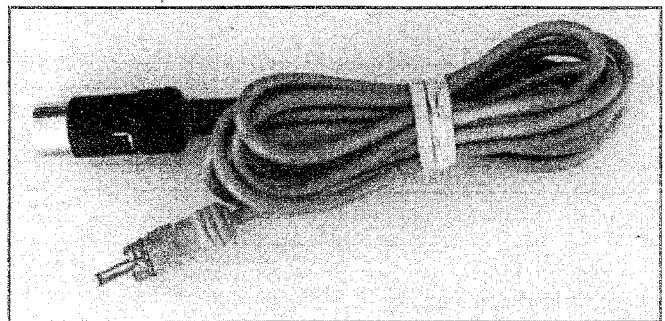


Photo 3— An "in-line" amplifier interface cable for the Kenwood TS-50S and similar radios using a PNP switch transistor for isolation.

Photo 4— Another Kenwood amplifier interface cable using a NPN transistor installed inside the DIN connector.



worst case I could expect in using something like this would probably be a welded or fried set of reed relay contacts, external to my transceiver, and the whole relay can be changed if need be for less than a couple of bucks.

PNP Transistor Switches

Some radios may present a different challenge than the ICOM. To use the circuit shown in fig. 1, you must locate a handy +12 VDC source. A somewhat different, but equally effective, approach can be the use of a switch transistor. PNP high-voltage types are generally best for use in these applications.

I used a Motorola type MPSU-52 to connect my Kenwood TS-50S to my various amplifiers, but a ECG 189 or similar type would also work okay. Photo 3 shows the cable I built for interfacing my TS-50S to my amplifiers using an "in-line" PNP switch transistor.

The reason for the change to a switching transistor in this interface application was in keeping with my single "in-line" cable requirement. Details of the circuit I used are shown in fig. 2.

Note that I used the same basic construction technique—i.e., perf-board packaged inside a 1/2 inch diameter piece of plastic tubing. For those with access to clear shrink tubing, that would work also. The use of plastic tubing does allow for easy access to the circuit should the need arise though.

An advantage in using a PNP transistor is that the entire interface uses a single line and ground to and from the interface board. The transceiver doesn't have to "source" anything except a ground-on-transmit contact to work. A disadvantage in using PNP types is they're harder to find in small packages with high (200+) voltage and current ratings.

Another trade-off when using transistor switches is that the isolation isn't as good as with a relay. To protect my transceiver's relay,

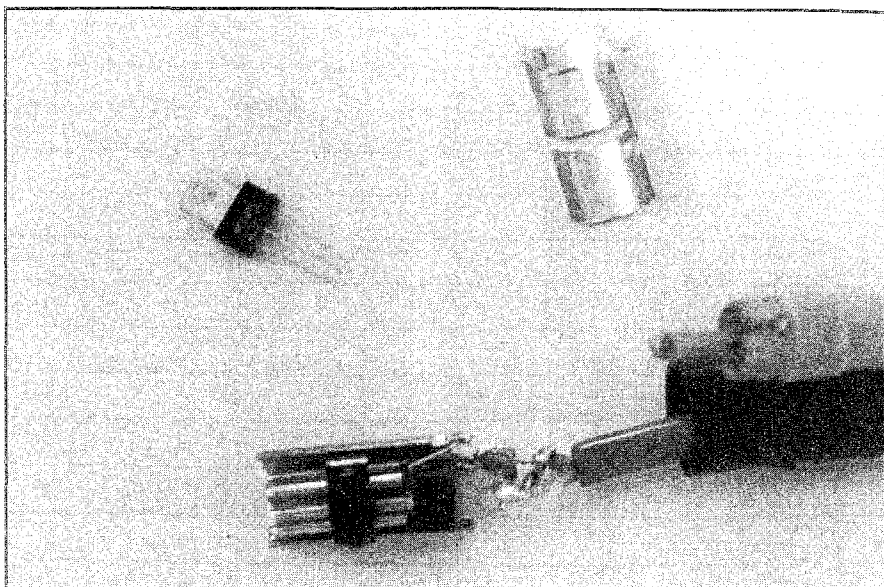


Photo 5—Installing a switch transistor inside a DIN connector's shell. This cable uses an NPN transistor for isolation and works with Kenwood TS-440's and similar radios.

I used a 4.7 K ohm base resistor. This gives a worst-case condition (assuming I'm switching a 125 volt load) of $125 \text{ V} / 4700 \text{ ohms} = \text{approximately } 27 \text{ ma}$. And that would be the case only if the transistor shorted.

The MPSU-52 transistor is rated at 80 volts emitter-collector (maximum), making its use with my Heath a little risky. Through the judicious use of suppression diodes, I've never had a problem. The worst case here most likely would be a "fried" external switch transistor.

NPN Transistor Switches

Another interface scheme I've used with sev-

eral Kenwood radios—e.g., the TS-440, 140, etc. (and would work with the 450 and 850 as well)—is an NPN switch. Photo 4 shows a cable I built for this group of Kenwood radios. I was able to install the entire switch circuit inside the DIN plug's shell. Details of this are shown in photo 5; the circuit I used is shown in fig. 3.

Using this circuit has an added advantage of being able to disable Kenwood's internal T/R relay (a jumper option), which many operators find annoying, as the relay is noisy.

This circuit is incredibly simple, using a transistor, a resistor, and a diode. I used a MPSU-10 type transistor with a 10 K ohm base current limiting resistor (which also provides radio isolation), but any value between 2K and 10K will work. Also, a Sylvania general-replacement type ECG-191 transistor or similar can also be used.

When building transistor switching circuits, be sure to include a back-EMF suppression diode if you expect to switch your amp more than once or twice. I typically use a 1N914, but its voltage rating is a little light for controlling 125 volt circuits. A 1N4002 or something similar could be substituted. Again, my 1N914s have held up fine.

Another thing to note is that I've omitted any base pull-up resistors (something like 40 K ohms or so from the base to the emitter), which is sometimes a standard practice in the design of such circuits. But again, I've never found this to be necessary.

Another note of caution: The unloaded base potential of a transistor tends to rise to near that of its emitter due to the internal base-emitter capacitance and diode action. If your rig is using some sort of open-collector switching scheme for its amplifier control circuit, you should check its maximum voltage rating and compare it to your amplifier's control voltage. If your amplifier's control voltage is much higher than your transceiver's voltage limit, you could "smoke it"—even with a 4.7 K ohm isolation resistor. It's not likely this could happen, but it is possible.

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