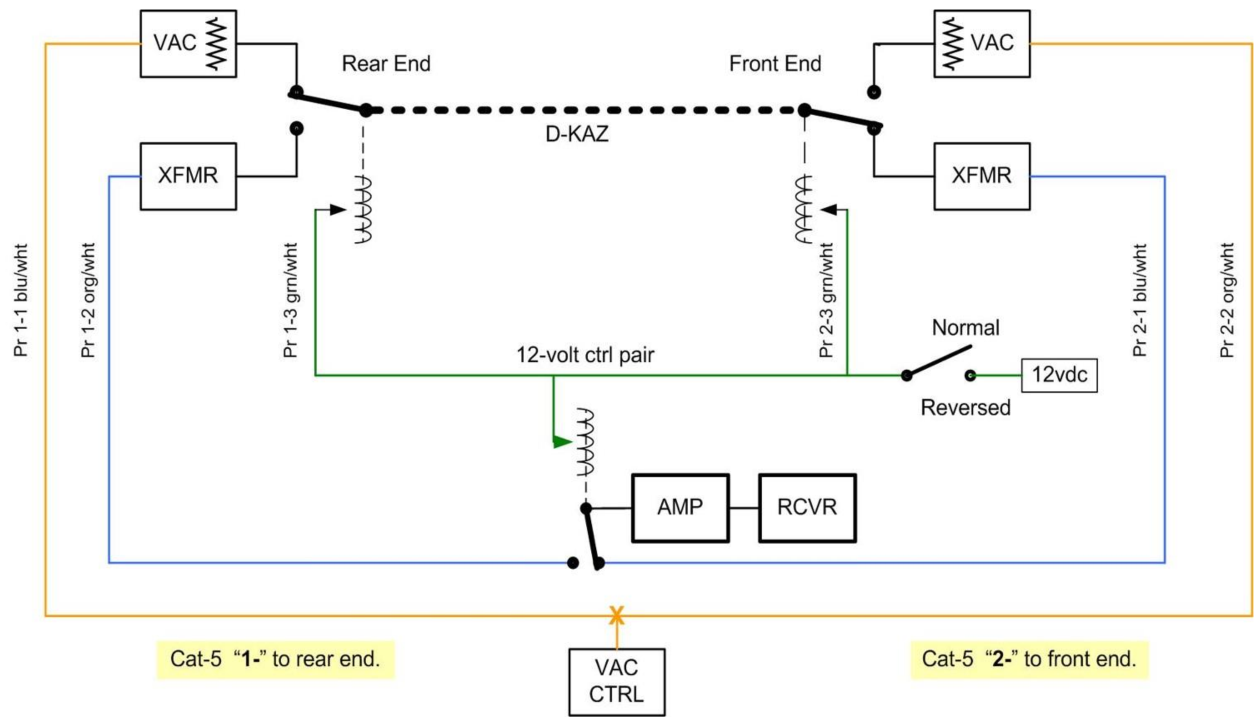
Here’s a conceptual layout of a system for **reversing any two-port antenna**. The “lead-ins” are Cat-5 cables (Category” lead-in cable is used, for its multiple pairs and its pair-to-pair isolation).

The D-KAZ *null* element is remote-controlled (shown as “VAC” for Vactrol). The signal take-off is via a 9:1 transformer that’s a fair match to the Cat-5 transmission-line. The relays are small-signal models; the controller is powered by a 12-volt SLA at the shack. (In this installation the antenna ends are less than 400 feet from the shack and there’s no appreciable relay-voltage drop through the Cat-5 cable.)



Note above that the remote-null “Vactrols” are powered in both directions, to keep the devices at operating temperatures (the “Vactrol” not in use simply ‘floats’ until it is switched in as the null).

Weatherproof units on each end of antenna (Cat-5 enters at bottom)

Inside antenna units

Shack control unit (Cat-5 goes to binding posts)

As used in the system above, the "Reverser" controls a D-KAZ antenna whose ports are labeled "Front" and "Rear." With the switched-directional capability of the D-KAZ we were able to *separately armchair-copy common-frequency stations from opposite sides of the antenna,* at a location near Upsala, Minnesota:

Stations heard on opposite sides of D-Kaz 140-ft. antenna

Grid Square EN25 *Copy at 4PM, 7PM, 9PM CDT 061714*

	"North" (330 deg)		"South" (150 deg)	
600	KSJB	Jamestown ND	WMT	Cedar Rapids IA
620	CKCK	Regina, SK, CA	KNMS	Sioux City IA
680	CJOB	Winnipeg, MB, CA	KFEQ	St. Joseph MO
740	KVOX	Fargo ND	WDGY	Hudson WI
790	KFGO	Fargo ND	WAYY	Eau Claire, WI
810	KBHB	Sturgis SD	WHB	Kansas City MO
860	CBKF2	Saskatoon, SK, CA--NO ID	KNUJ	New Ulm MN
880	CHQT	Edmonton, AB, CA--NO ID	WMEQ	Menominee WI
890	KQLX	Lisbon, ND	WLS	Chicago IL
910	KCJB	Minot ND	WHSM	Hayward WI
950	KWAT	Watertown ND	KTNF	St Louis Park MN
970	WDAY	Fargo ND	KQAQ	Austin MN
980	KDSJ	Deadwood SD (poor copy)	KKMS	Richfield MN
990	CBW	Winnipeg, MB, CA	KAYL	Storm Lake IA
1080	KNDK	Langdon ND	KYMN	Northfield MN
1130	KBMR	Bismarck ND	KTCN	Minneapolis MN
1170	CKGY	Alberta, SK, CA	KRUE	Waseca MN
1220	KDDR	Oakes ND	KLBB	Stillwater MN
1230	KTRF	Thief River Falls MN	KMRS	Morris MN
1280	KVXR	Moorhead MN	WWTC	Minneapolis MN
1300	KPMI	Bemidji MN	WQPM	Princeton MN
1310	KNOX	Grand Forks ND	KGLB	Glencoe MN
1340	KVBR	Brainerd MN	KWLM	Willmar MN
1350	KDIO	Ortonville MN	KCHK	New Prague MN
1360	KKBJ	Bemidji MN	KRWC	Buffalo MN
1370	KWTL	Grand Forks ND	KSUM	Fairmont MN
1450	KBMW	Breckenridge MN	KNSI	St. Cloud MN
1470	KHND	Harvey ND	KMNQ	Shakopee MN

1480	KKCQ	Fosston MN	KAUS	Austin MN
1520	KMSR	Mayville ND	KOLM	Rochester MN
1660	KQWB	Fargo ND	KUDL	Kansas City KS

Below is a related article: updates and reverser-construction information

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A few months ago (*DXM Vol 53 Nr 35*) we shared ideas on construction of a termination/reverser device for Flag antennas. Developments since that construction story was written would now suggest an update.

The engineering behind the original devices proved okay and circuitry outlined in the previous DXM article is still appropriate. However, some hardware concerns have emerged from "in-the-field' usage. They include:

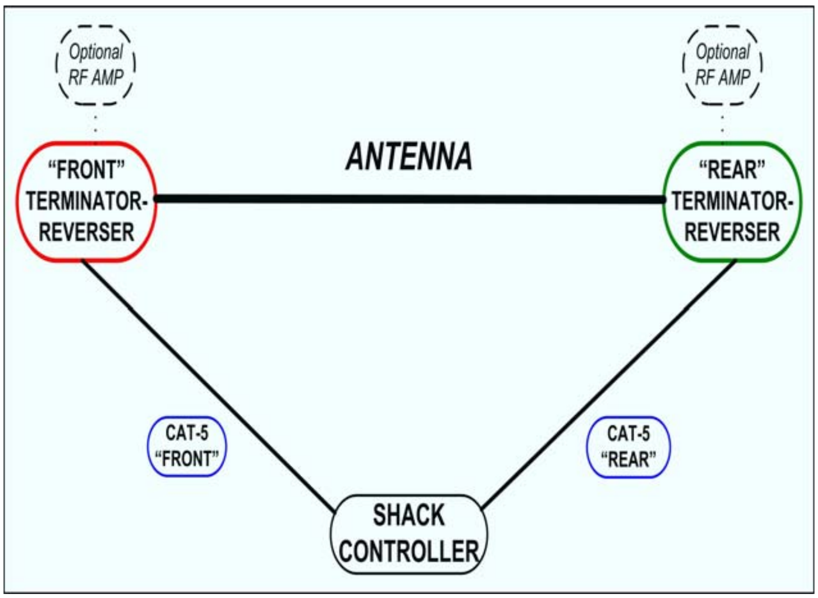
1) The scarcity of the variable (opto) resistor ("Vactrol") at a reasonable price.

2) Concern about the contact reliability of relays used in the original devices.

3) The *hard-knock lesson* of using *solid-copper* Cat-5 for the lead-ins.

4) An interest in building any modified terminators in a weatherproof package.

BACKGROUND: Without reprinting all of the earlier discussion, we can revisit the basic concept of a remotely-controlled reversible antenna:



All three of the "nodes" will be simultaneously switch-reversed so the "Front" becomes the "Back." The "Terminator-Reversers" perform dual functions on the ends of the antenna. In mode "A" they terminate their antenna port and match it to the lead-in. In mode "B" they instead connect the antenna port to a remote-controlled variable resistance. The Shack Controller in mode "A" listens to one Cat-5 while sending Vactrol control voltage up the other. That's reversed when the antenna ends go "A" to "B."

Feedback from the earlier article included concerns about using extra-length lead-ins. We found over a summer of experimenting that there was no practical limit to lead-in length since we were using a balanced-pair lead-in (in this case Cat-5).

Now…of *course* there is a *practical* limit! We've routinely used lead-in lengths of 400 to 600 feet. Subsequent experience with Cat-5 runs over a few hundred feet does demonstrate some loss in the signal on the return path…on the order of 6 to 10 db per 1000 feet…but no degradation in Carrier-to-Noise (C/N) at the shack, as compared to the C/N right at the antenna.

Just for grins, in the longer lead-ins we also tried common-mode chokes, and they made no measurable difference. (*Disclaimer*: There were no strong MW signals present. YMMV in different environments or with *very* long lead-ins.)

PROJECT UPGRADES: Since the shack-controller section was discussed previously, we'll focus on the changes in other components to address the hardware issues above:

First: **The availability of "Vactrols"** (VTL5C4s). They're getting harder to find and their price has doubled. At Mark Connelly's suggestion we're now evaluating a device by API/Luna (see parts list below). These seem readily available, at a fraction of the Vactrol costs. **TBD:** How they hold up in the field…and whether *the resistance drifts with warm-up*, as the Vactrols have been accused of doing. (Recent measurements suggest the drift performance of the API/Lunas might be a tad better.)

Next was a concern about **using "garden-variety" switching relays** to handle the micro-current antenna signals. We've selected a relay that manufacturers call a "low-signal device." These are miniature relays whose contacts are designed to reliably switch very low currents.

"Hard knocks" with solid-copper Cat-5. The original report blathered on about the low cost of pure-copper Cat-5 and Cat-5e and paid no attention to the mechanical aspects of continuous reconnection using banana plugs. The wires broke!
We solved that by using *stranded* Cat-5 and added some insurance by hard-wiring the lead-ins to the antenna terminator units. The other end of the lead-in still uses banana plugs but the stranded wire makes them much more solid.

Stranded Category-cables cost about twice as much as single-conductor solid-copper types…but now and then you can get lucky on eBay. (I just scored a 944-foot 'construction remnant' spool of *stranded* Cat-5e for about $35.)

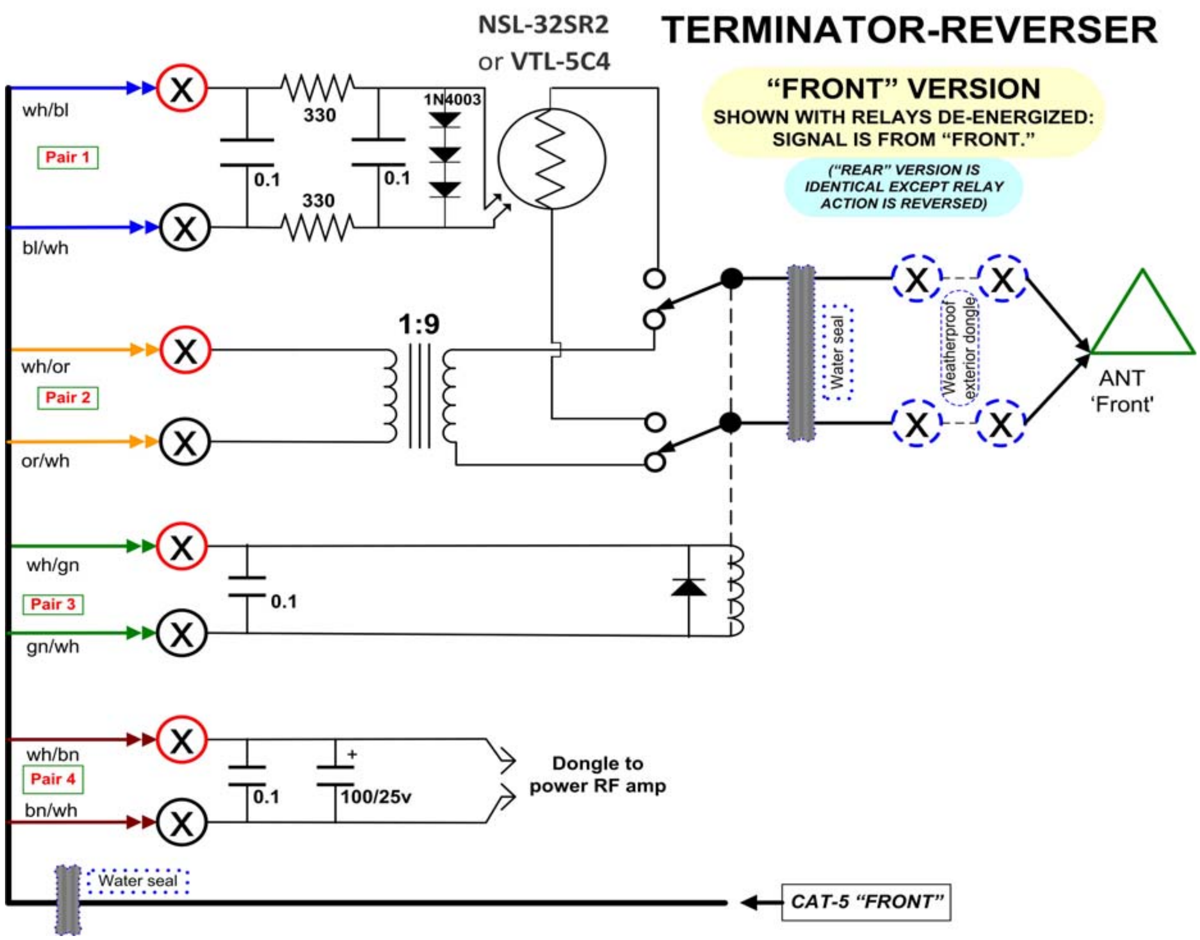
Stranded cable is mechanically superior, period. We've also done some research into the advantages of tinning these wires; the consensus seems to be that tinning any wire makes it mechanically tougher (YMMV). Finally, ferrules on the wire ends is good.

The "weather-proofing?" Addressed by paying attention and by enjoying easy parts procurement. I'm a fan of Amazon…which means we pay slightly more…in exchange for a wide parts selection and easy ordering.

A project parts list is included below.

The weatherproof enclosures are just the right size and easy to work. Wire glands as found below are popular and cheap. While the devices are not meant to be submerged, they will easily combat even torrential weather conditions.

To begin, the revised floor plan. Here's one of the two terminator-reverser modules from the original design, adding the weatherproofing and the hard-wiring of the stranded Cat-5 that replaces the banana plugs:



“Water seals” are weatherproof glands; see parts list. The only difference between “Front” and “Back” devices: relay functions are reversed.

PARTS LIST: All but the T9-1 transformer are available through Amazon; we’re providing their URLs as an example, so you can get a look at them for your own comparative shopping. (Other sources are Digikey, Newark, Mouser, Allied):
Opto-isolator: API/Luna NSL-32SR2
https://www.amazon.com/ADVANCED-PHOTONIX-NSL-32SR2-OPTOCOUPLER-RESISTOR/dp/B00LQROW82/ref=sr_1_1?ie=UTF8&qid=1480969278&sr=8-1&keywords=NSL-32SR2+OPTOCOUPLER

Opto-isolator: Excelitas VTL-5C4
https://www.amazon.com/EXCELITAS-TECH-OPTOCOUPLER-RESISTOR-2500VRMS/dp/B011NAV2F2/ref=sr_1_1?ie=UTF8&qid=1480970225&sr=8-1&keywords=Excelitas+VTL5c4

Relay: Omron G6K-2P-Y (12v dc) (You may wish a different version)
https://www.amazon.com/Low-Signal-Relays-ThruHole-NoLatch/dp/B00MEIC9UA/ref=sr_1_fkmr0_1?ie=UTF8&qid=1480969567&sr=8-1-fkmr0&keywords=Omron+G6K-2P-Y+%2812v+dc%29

Weatherproof boxes: Uxcell
https://www.amazon.com/gp/product/B00E0H7HFK/ref=oh_aui_detailpage_o02_s01?ie=UTF8&psc=1

Weatherproof cable joints (Cat-5): Uxcell
https://www.amazon.com/gp/product/B00841YDSM/ref=oh_aui_detailpage_o02_s02?ie=UTF8&psc=1

Weatherproof cable joints (ant feed): Uxcell
https://www.amazon.com/gp/product/B01072781Y/ref=oh_aui_detailpage_o02_s02?ie=UTF8&psc=1

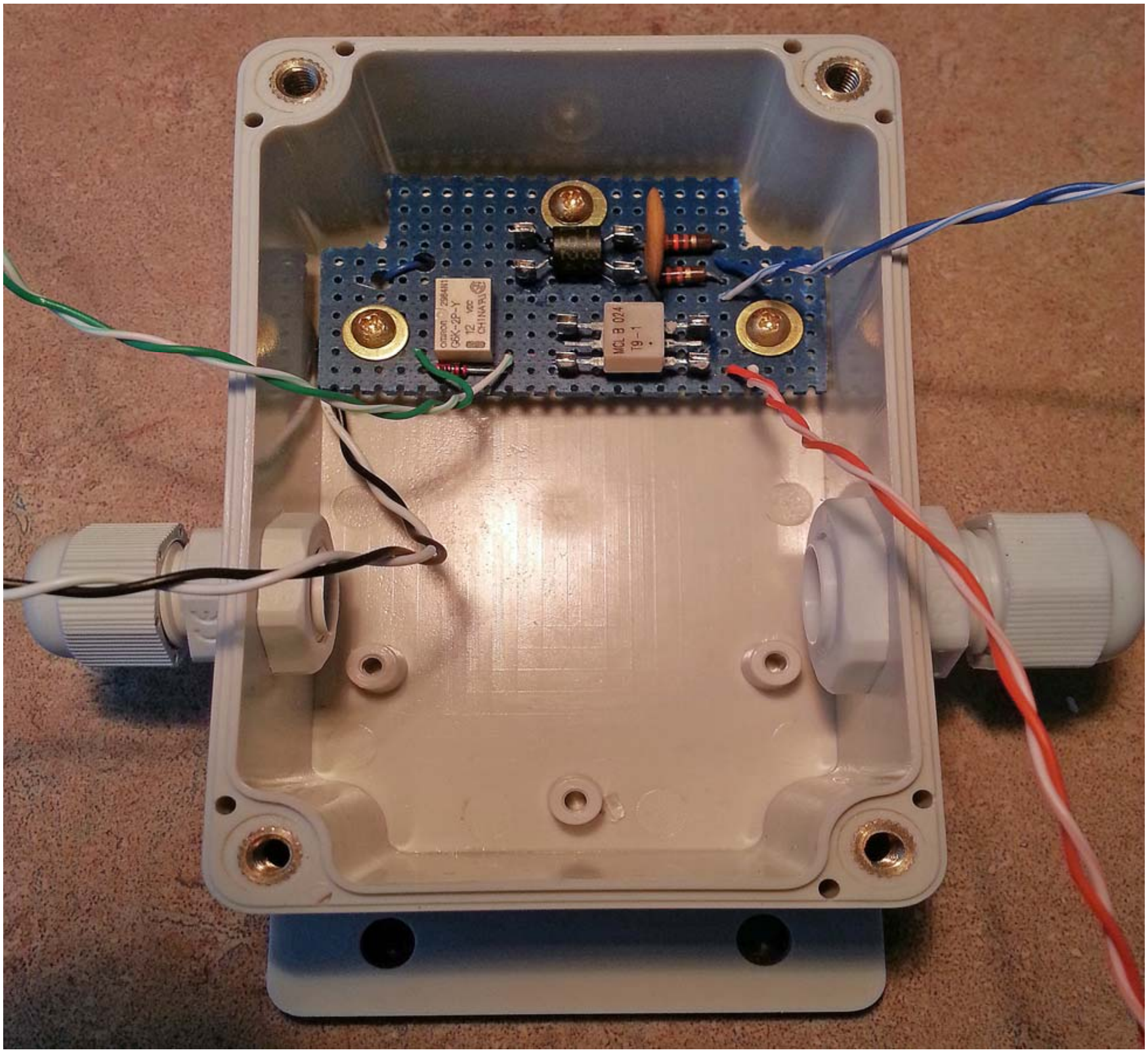
Weather-proof connector (“dongle”):
https://www.amazon.com/gp/product/B00DREUQNM/ref=oh_aui_detailpage_o03_s00?ie=UTF8&psc=1

Matching Transformer: (9:1) MiniCircuits T9-1
http://www.minicircuits.com/pdfs/T9-1.pdf

Diodes: 1N4003 or equivalent

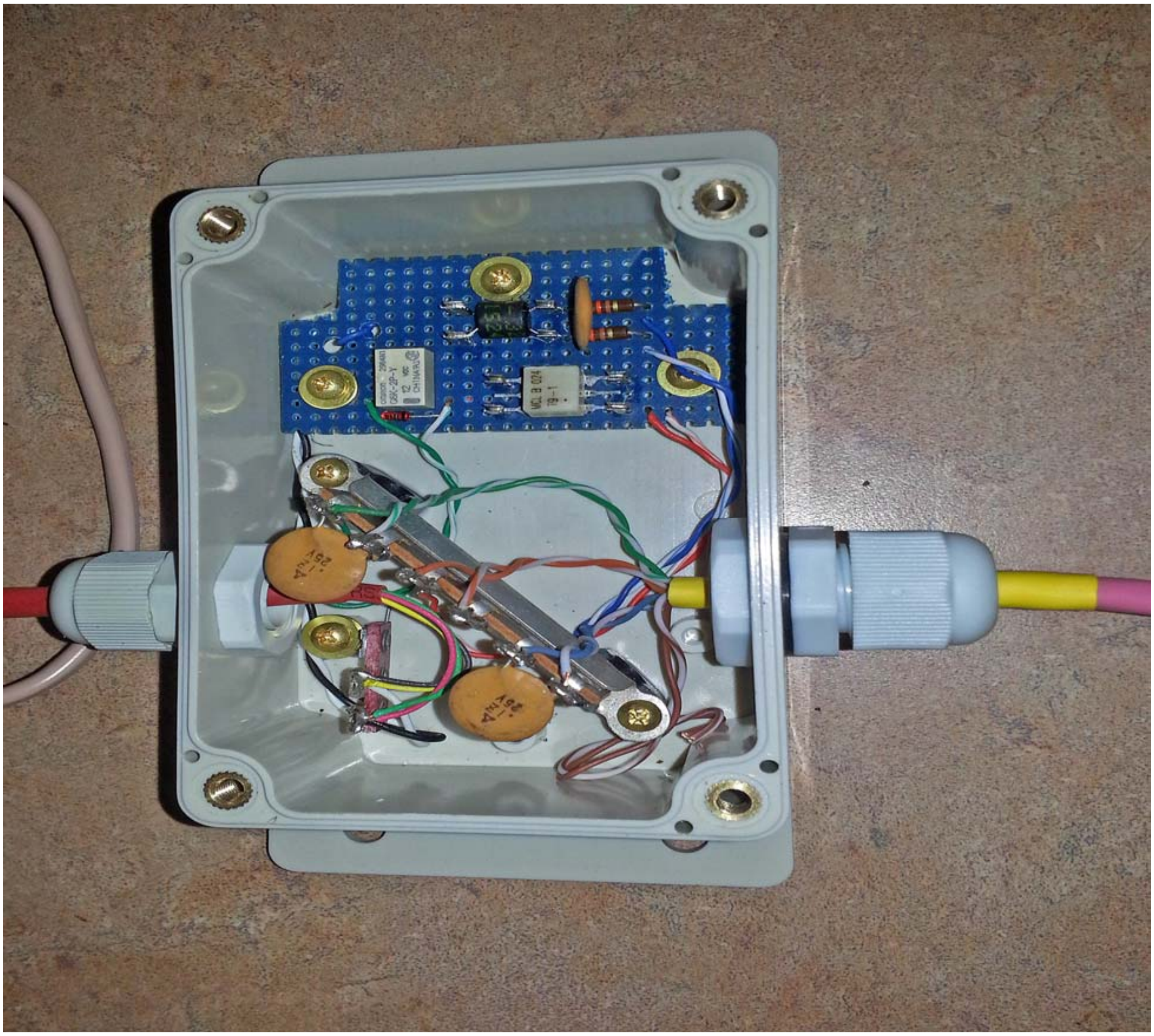
Printed circuit boards are a commodity item; even available in hobby stores.

All the parts come together in the small weather-proof box. The control stuff all mounts nicely on push-through pins on the see-through circuit board. The low-signal relay is on the left; the opto-isolator is near the back of the board and the T9-1 transformer is at the front. The use of push-pin construction makes it easy to swap parts.



This box is 3.9 x 2.7 x 2 inches and has mounting flanges top and bottom. There is no penetration of the enclosure; 6 raised “standoffs” accept #4 self-tapping screws for mounting stuff. Note the two side-mounted weather-proof glands; the one on the right will bring in the Cat-5 and the one on the left passes the cable to the antenna.

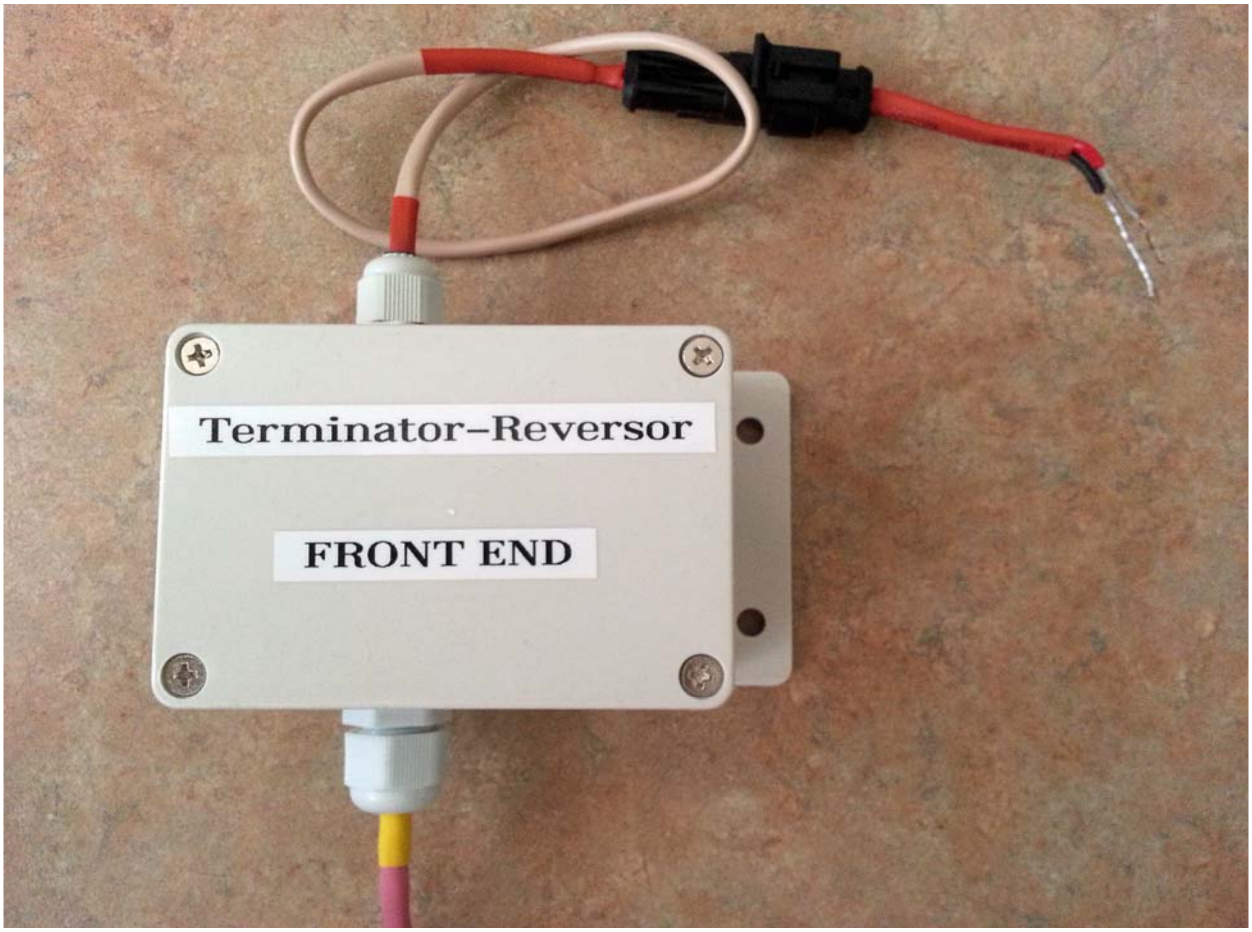
Ready for the cover:



The Cat-5 pairs are terminated on a 6-pin barrier strip that’s screwed to standoffs that are super-glued to the case (the strip mounting holes didn’t coincide with those three raised standoffs). The external wire to the antenna (keep it short!) leaves the enclosure at the lower left. Externally this is connected to a weatherproof dongle for easy disconnect from the antenna.

The fourth pair (white/brown) is available to get power to an antenna-mounted amplifier. If such external powering is to be used, there’s room for an additional gland at the bottom of the case to accommodate a power wire to the amplifier.

The finished unit with Cat-5 now entering at the bottom. Note the weatherproof plug/connector dongle at the top. The tinned leads on that dongle will be connected to the antenna via weatherproof splices.



Someday we'll learn to put labels on straight ☺

Another thread circulating among those with opinions on the subject is whether the tightly-enclosed boxes need a "weep-hole" to drain moisture. We went to Bud for answers. Their firm advice was that if you put the assembly together in a dry environment and seal it, moisture will not get into the box. They suggested that a "weep-hole" is in fact a way for moisture to <u>enter</u> the enclosure.

Before I could ask the question, they also advised that desiccants aren't necessary if the interior was dry when the cover was screwed on. But I guess if I lived near Pat Martin I'd throw in some desiccant-packages just for grins.

One-click antenna-reversing may not be your cup of tea but it’s certainly useful when DX targets surround you, or you’re chasing sunset skip. Weatherproofing of the antenna terminators makes sense for any antenna that’s left up in the elements. Rust gathering around exposed antenna terminals likely will impact those tiny signal currents.

Hope this is useful information; as usual, please feel free to sass back”

Cheers!

Mark Durenberger 12/05/16

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