

Low Cost Legal Limit Remote Antenna Switch for 160-2 Meters – Powered through the coax cable! by Phil Salas - AD5X

Introduction

A solution for those who need an extra coax run is a remote antenna switch. And there are two ways to power a remote antenna switch. You can use a separate control wire from your operating position. Or, you can run the relay control voltage up the center conductor of the coax cable. Putting the control voltage on the coax center conductor is the cleanest way, and in my case, the only way to do it.

Components

The isolation inductors are 100uhy JW Miller 4632 (Mouser 542-4632). These handle 400ma of current and provide a high Q such that full legal limit can be used from 160- through 2-meters. These inductors have no resonances in any of the ham bands over this range. The 0.01uf coupling capacitors should be 1KV rated. While the coupling capacitor voltage rating is not critical since there is very little voltage drop in this application, the large physical size of these capacitors makes it easy to dissipate any power dissipated due to any capacitor losses. If you operate down to 160 meters, you might want to parallel two or three of these capacitors in both the indoor and outdoor units for best performance. For the relay, I used an OMRON G2R-1-E-T130DC12 power relay. This has contacts rated at 16 amps and 240VAC and a continuous open contact voltage rating of 380VAC. However the open contact-to-contact rating is 1000VAC for 1-minute, and the contact-to-coil voltage is rated at 5000VAC for 1-minute. Even though this is a DC power relay, it will easily handle amateur legal limit amplifiers. I purchased components from both Mouser and All Electronics. Some of the parts are available from both sources as shown in the parts list of Table 1.

Indoor Unit

The indoor unit, shown in Figure 1 and Photos A & B, bridges the DC control voltage onto the coax center conductor near the operator's position in the shack. I built this circuit into a small 563-CU-3000A aluminum box. For the DC connection, I used PowerPole connectors. You can either add a SPST switch on this box to control the DC voltage, or switch the incoming 12 volts from another location. The fuse/fuseholder is not really necessary in my opinion, but I show it on the schematic should you wish to add it.

Remote Switch

The schematic of the remote switch box is shown in Figure 2 and Photos C & D. For the outdoor switch enclosure, I have had great success using those aluminum electrical outdoor boxes meant for adding external switches and outlets to your home. The most common kind has three 1/2 inch threaded holes in it - one on the back and two on the sides. You will also need a blank aluminum cover for this box. The cover comes with a weatherproof seal. The box and cover will cost you around \$4 at your local home improvement store. The box comes with two threaded hole plugs. In this application you will need to plug all three 1/2 inch holes so make sure you buy an extra hole plug. For remote mounting, I drilled a 3/8 inch hole in the back of the box and secured a 1-1/2 inch long 3/8 X 16 stainless-steel bolt to the box with a stainless-steel 3/8 lockwasher and nut. The threaded end of the bolt protrudes from the back of the box and is used to attach the relay box to any nearby supports. Stainless-steel hardware is used to prevent corrosion.

As you can see in the photos, all the components for the outdoor switch box mount on the cover. Three 5/8 inch diameter holes are punched in the cover for the SO-239 connectors. Use epoxy, hot-glue or liquid electrical tape to weatherproof the SO-239 connectors. Use stainless steel hardware to keep from having corrosion problems.

I did find that the switch worked fine up through 30 MHz, however the SWR began climbing above 30 MHz making the switch a problem at 6- and 2-meters. This was due to the inductance of the internal switch wiring and relay. I compensated with 10pf 3KV capacitors across the inputs and outputs of the switch as you can see on the schematic. A transmission line looks like a bunch of series-L shunt-C elements, where the characteristic impedance is $(L/C)^{1/2}$. So as the wiring/relay inductance increases, you need to increase the shunt-C to ground to keep the impedance at 50 ohms.

Performance

How does this switch work? Great. Measured performance is shown in Photos E & F. Note that the SWR and insertion loss are both very low on all ham bands through 2-meters. I have been using the switch with up to 1200 watts on HF and 500 watts on 6-meters. I do not have high power on 2-meters, however the performance measurements certainly show that the switch will work fine on 2-meters at high power.

Table 1: Parts List, indoor & outdoor units. 1st part number is Mouser (www.mouser.com). Part number in parenthesis is All Electronics (www.allectronics.com).

| QTY | Description | Source | Price ea. |
|-------|----------------------|---------------------------------|--------------------|
| 1 | Omron SPDT Relay | 653- G2R-1-E-T130DC12 (RLY-543) | \$6.15 (\$2.75) |
| 3 (6) | 10pf 3KV capacitors | 75-564R30GAQ10 (5D3K) | \$0.52 (10/\$1.00) |
| 2 | 0.01uf 1KV capacitor | 581-5PR103MWMCE | \$1.02) |
| 2 | 100uhy inductor | 542-4632 | \$2.90 |
| 2 | 0.10uf capacitor | 581-SR225E104MAR (104D50) | \$0.17 (\$0.10) |
| 2 | 0.01uf capacitor | 598-M15R103K5-F (103D50) | \$0.43 (\$0.06) |
| 2 | 4.7uf capacitor | 647-UMA1C4R7MCD2 (4.7R50) | \$0.26 (\$0.08) |
| 2 | 1N4003 diode | 512-1N4003 (1N4003) | \$0.07 (10/\$1.00) |
| 5 | SO239 connector | 601-25-7350 (SO-239) | \$1.33 (\$1.00) |
| 1 | AL indoor box | 563-CU-3000A | \$5.60 |
| 1 | AL outdoor box | Lowes 71209 | \$3.35 |
| 1 | AL outdoor box cover | Lowes 72440 | \$0.61 |

Conclusion

I've described an easily built remote relay switch that will cost you no more than about \$20 including both the indoor and outdoor units (about the cost of 50 feet of RG-213!). This switch provides you with an alternative to adding additional coax cable runs when you increase your antenna farm!

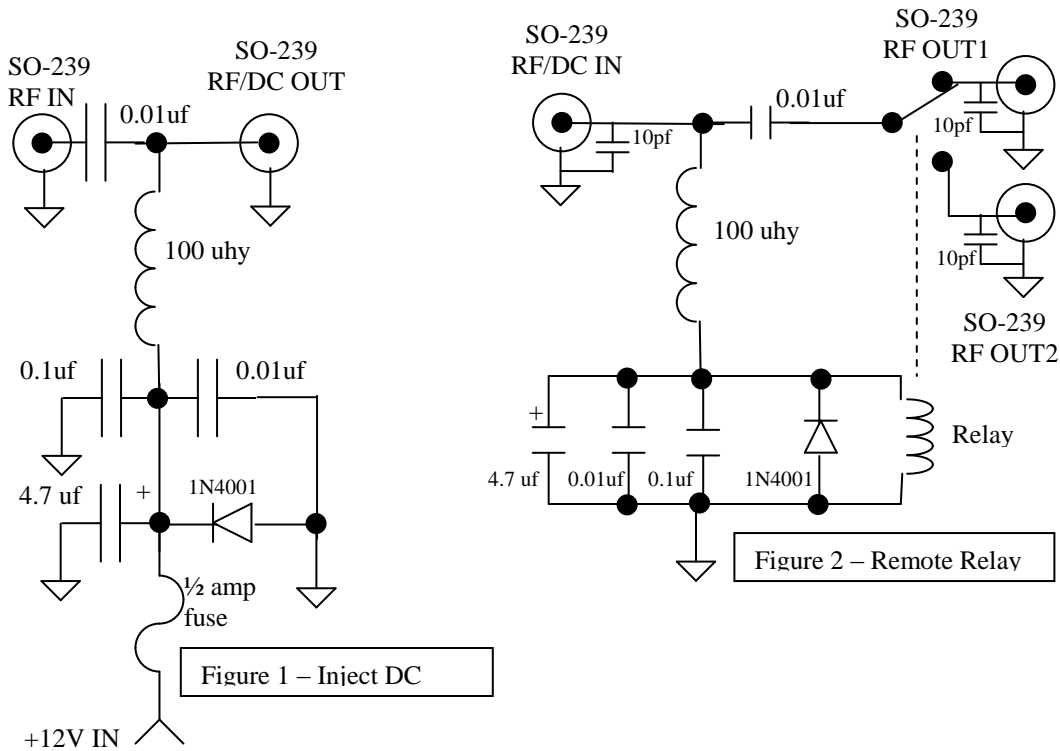




Photo A: Inside Unit – External View

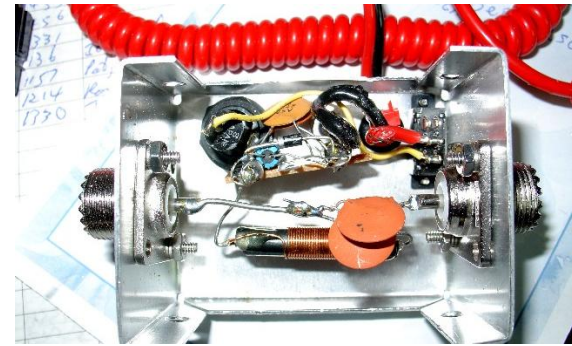


Photo B: Inside Unit – Internal View



Photo C: Outside Unit – External View

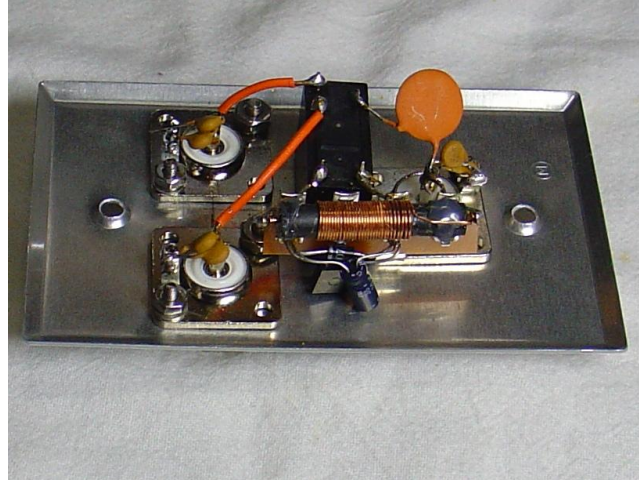


Photo D: Outside Unit – Internal View

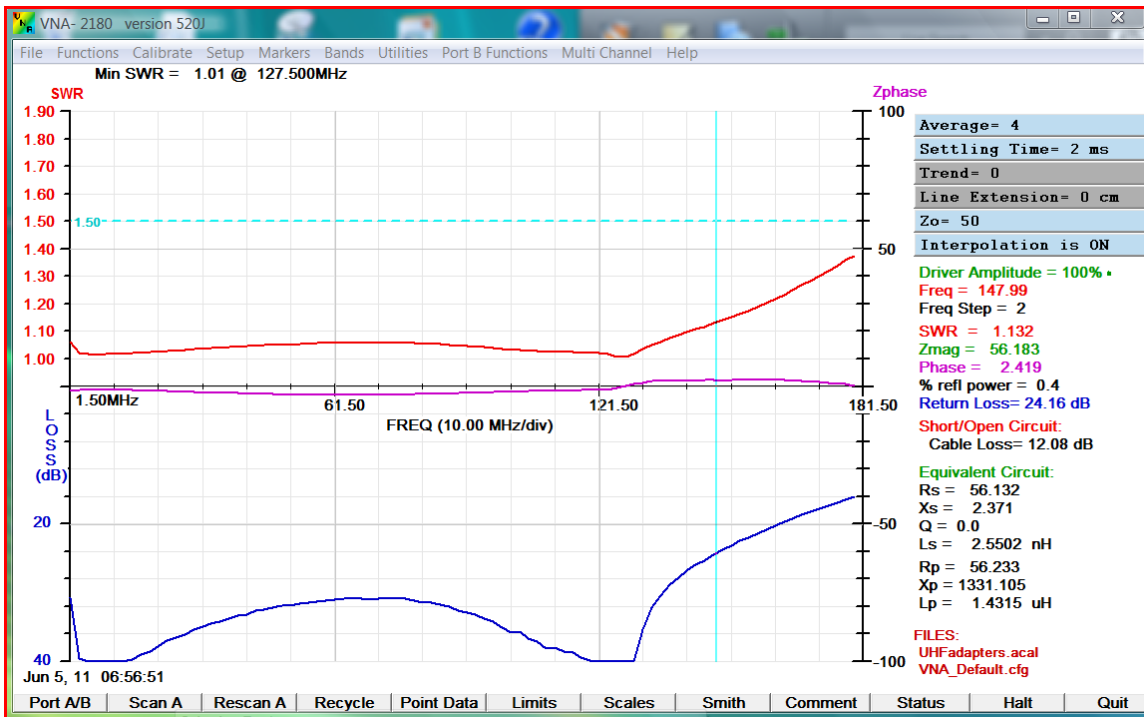


Photo E: Input SWR and Return Loss of the remote switch when terminated in a precision load.

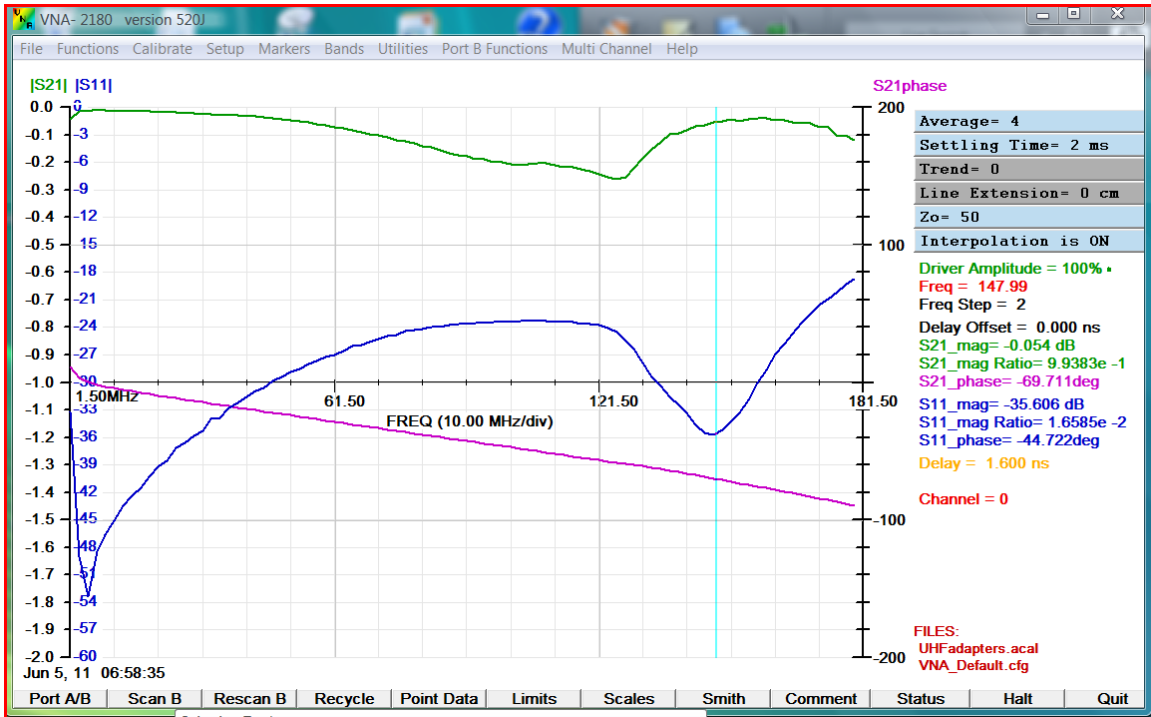


Photo F: Insertion loss of the remote switch