Remote Controlled Antenna Relay

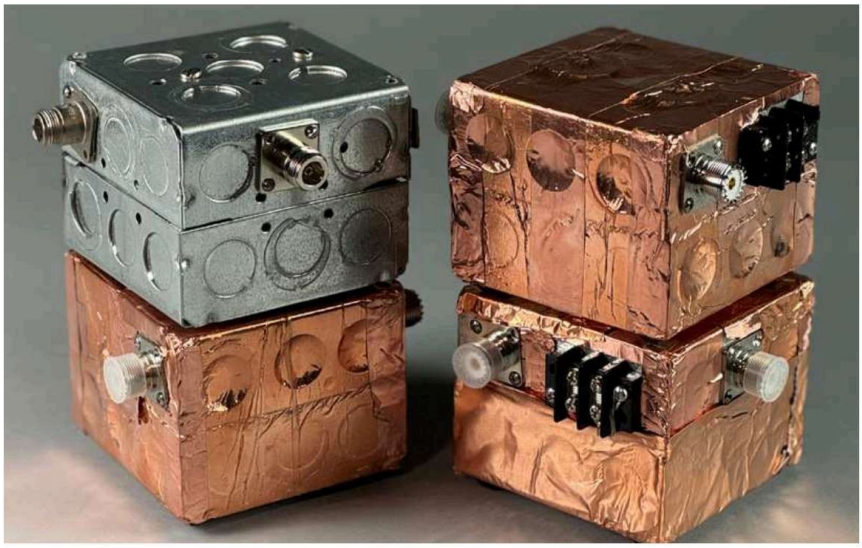
By Dennis Dugan WAØYPC

Completed Project (WAØYPC upgraded version)

Based on article in November 2Ø24 QST Magazine

A Full-Power, Inexpensive Antenna Relay

Power relays work well for antenna switching of up to 30 MHz.



An inexpensive relay for 50 Ω systems. [Sierra Harrop, W5DX, photo]

Robert J. Zavrel, W7SX

Here's a simple, inexpensive relay for 50 Ω systems (see the lead photo). I'm building a complex antenna system and need multiple relays; I also wanted acceptable performance throughout the HF bands.

Many hams now use automatic antenna tuners, which can handle modest untuned conditions, making this design usable for up to 30 MHz (and even 50 and 144 MHz, because the SWR is well within range of auto tuners for VHF). Clearly, this won't be applicable to UHF and above operations and is questionable for most systems at 2, or even 6, meters. However, it's quite satisfactory across the entire HF band.

Construction

These homebrew relay boxes were compared with the popular Dow-Key coaxial relays for "off" isolation. They had an "off" isolation of about 51 dB to 10 MHz, while my homebrew switches exhibited about 32 dB. So, for a 1 kW switching function, the Dow-Key relay will present about 10 mW to the "off" outlet, while this homebrew unit would present about 790 mW. Performing a selection from multiple antennas running high power shouldn't be a problem. However, care should be taken where the "off" switch path goes to receiver inputs or other delicate circuits, such as when the switch to select one of two transceivers to work with a single antenna is used.

I used two 1½ × 4 × 4-inch steel electrical boxes to create a 3 × 4 × 4-inch enclosure — one box is for the relay and connector mountings, and the other is used as a top (see Figure 1). These boxes are readily available in the electrical department of big-box stores. Flip the second box on top of the bottom one, widen the holes in its tabs, and drill two new holes in the top to run two 1¾- or 2-inch screws through the top box and into the threaded tabs that are already part of the bottom box.

I covered the entire assembly with sticky copper tape for additional RF shielding. The challenge was drilling holes for the female coaxial connections because punch-out holes are already present. These can become detached when attempting to drill holes for the coax connectors. You can create the holes where you want them at the size for mounting screws by drilling a small hole before carefully using a reaming bit.

I used heavy 24 V power relays that can be purchased brand new but are also available unused from surplus outlets for less than $10. I've used these relays for antenna switching for decades. They're almost indestructible — even at full power — with one exception. I burned one once when I was trying to switch an open

Figure 1 — The two steel electrical boxes mounted one on top of the other. [Robert J. Zavrel, W7SX, photo]

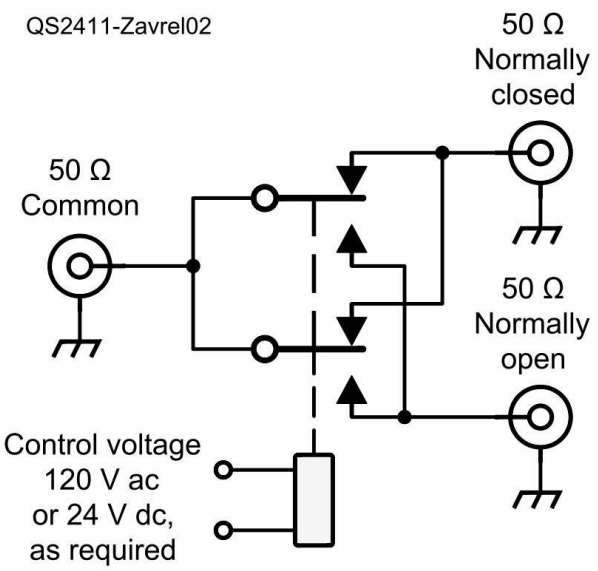


Figure 2 — Schematic of the parallel connection making an SPDT from a DPDT relay.

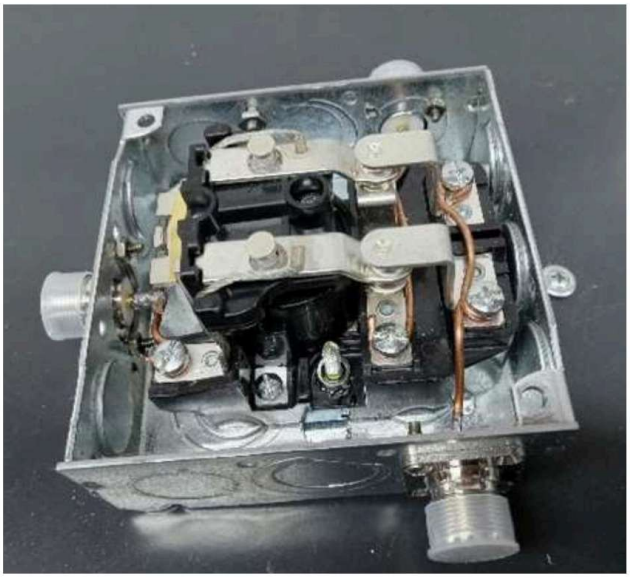


Figure 3 — Mounting of the relay and the SPDT wiring. [Robert J. Zavrel, W7SX, photo]

wire line at full power at a high-voltage point along the line. Using these relays at 50 Ω has never been a problem. Of course, clean the contacts and the plastic adjacent to the contacts to prevent arcing.

I did some rough calculations, and when I wired the two switched contacts and input contacts in parallel (see Figures 2 and 3), I got close to an impedance of 50 Ω for the completed assembly. During and after testing with a 50 Ω coaxial termination on both output connectors, I was delighted to see these input SWR results as a function of frequency:

- 1:1 SWR, 0 – 29 MHz
- 1.1:1 SWR, 29 – 37 MHz
- 1.2:1 SWR, 37 – 68 MHz
- 1.4:1 SWR, 144 MHz

Figure 3 shows how the components are mounted. The parallel connections of the common and switched terminals make one single-pole double-throw (SPDT) switch. It would also be possible to confiigure it as a double-pole double-throw (DPDT) coaxial switch, with possible small degradation of SWR. I found that #14 AWG solid bare-copper wire will handle full power.

Purchasing Supplies

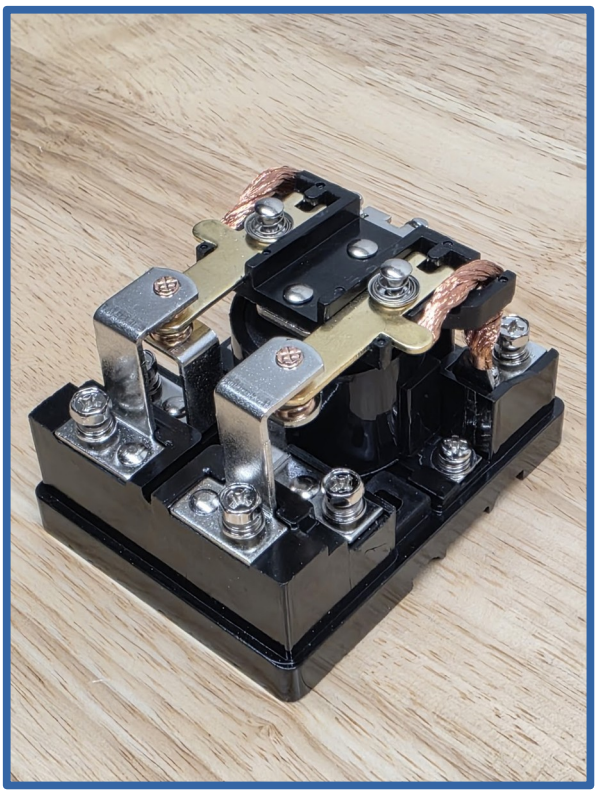
Surplus relays are available at **www.surpluscenter.com**. I found imported relays for around $20, which appear to be similar to the Tyco standard relays on Amazon with several ac and dc operating voltages (**www.amazon.com/TWTADE-JQX-62F-2Z-Electronmagnetic-Voltage-110V%EF%BC%88You/dp/B07FCJFGL9?th=1**).

Watch the ARRL Lab show you how to build one of these remote antenna switches in the digital edition of *QST* (**www.arrl.org/qst**).

Robert J. Zavrel, W7SX, was first licensed in 1965 at age 14. He achieved DXCC in 1968 and has achieved DXCC Honor Roll (using only tree-supported wire antennas), CW DXCC Honor Roll, five-band DXCC, and five-band Worked All Zones (all 200). He's a Life Senior Member of IEEE and a member of the IEEE Antennas and Propagation Society, was a member of RF Design's Editorial Review Board (1985 – 1998), is an ARRL Life Member, and has been an ARRL volunteer technical advisor since 1984. Throughout the last 45 years, Robert has authored nearly 100 technical papers (professional and amateur radio-related) and authored ARRL's *Antenna Physics: An Introduction, 2nd Edition.*

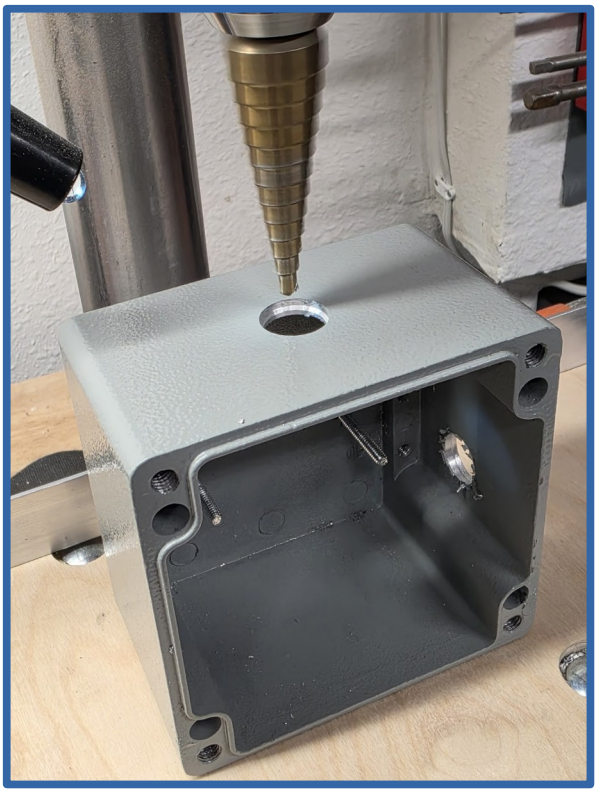
For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

Construction Details of WAØYPC Upgraded Version



High Power Relay JQX-62F-2Z, Coil Voltage AC 110V 80A, DPDT 2NO 2NC

SO-239 Bulkhead Connectors - 3Pcs Opposite corners countersunk for 6/32 x 3/8” machine screws

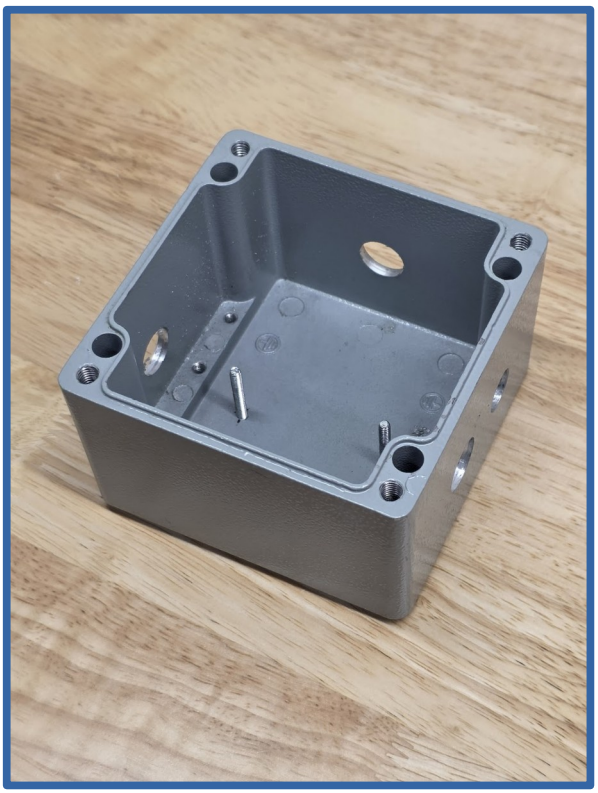


Holes for SO-239 Bulkhead Connectors and power cord/grommet are drilled with step drill.

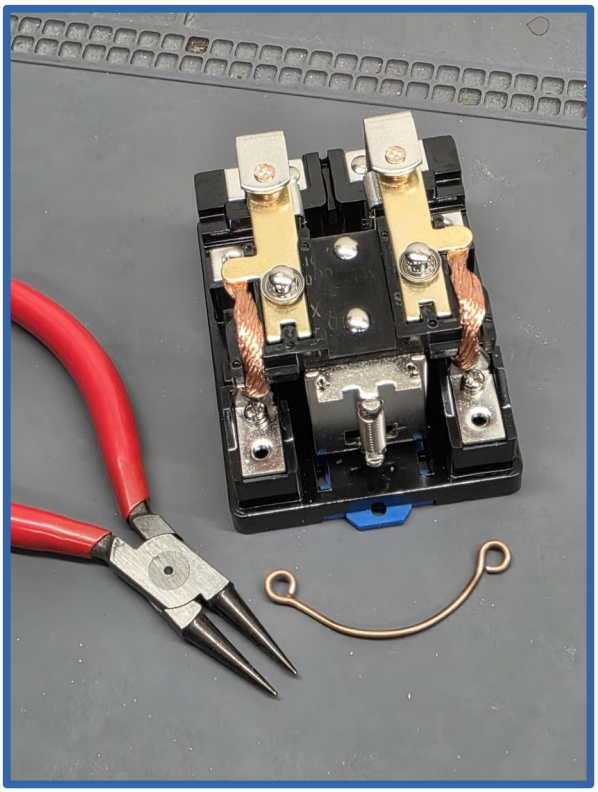
Mounting holes for SO-239 Bulkhead Connectors are drilled and tapped for 6/32 mounting screws.

Construction Details

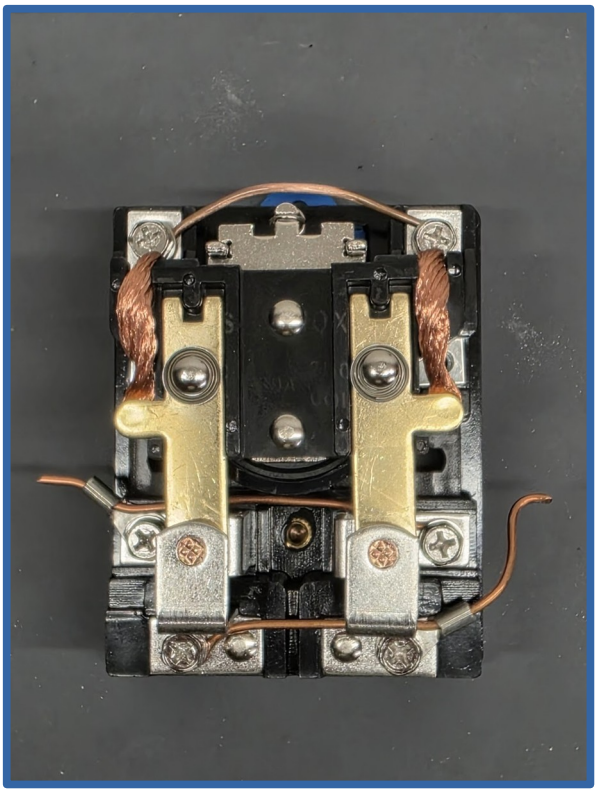
Bottom of box with 6/32 x 1” PH machine screws to mount relay. Holes are drilled and tapped for 6/32 screws.



Inside of box with 6/32 x 1” machine screws for mounting relay.

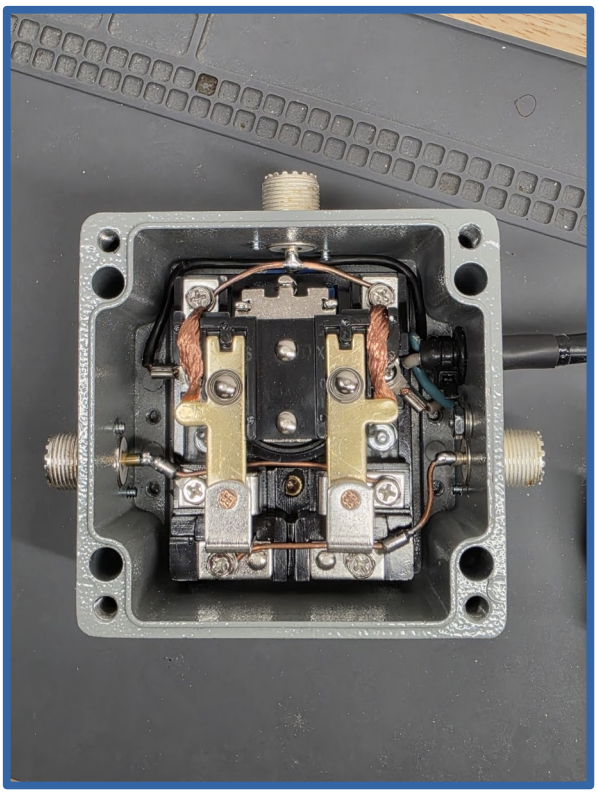


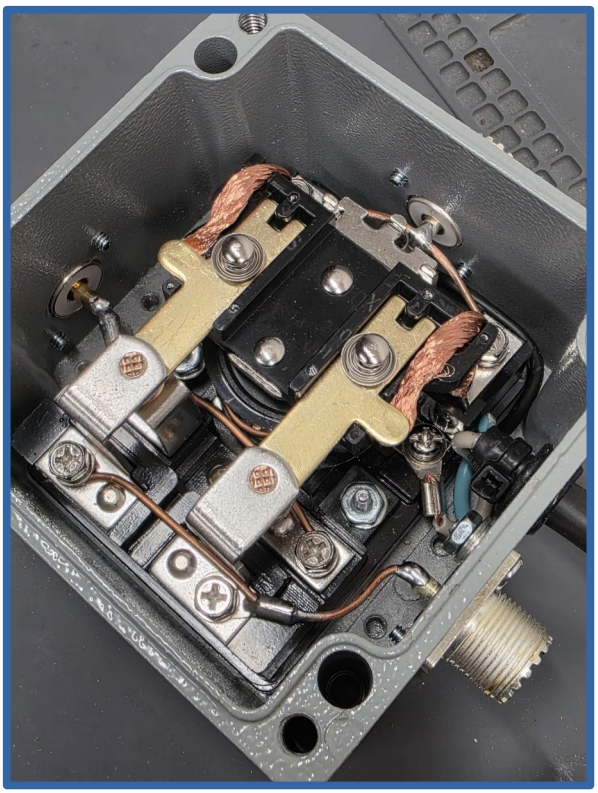
14ga Solid Copper Wire with formed ends for terminal connection



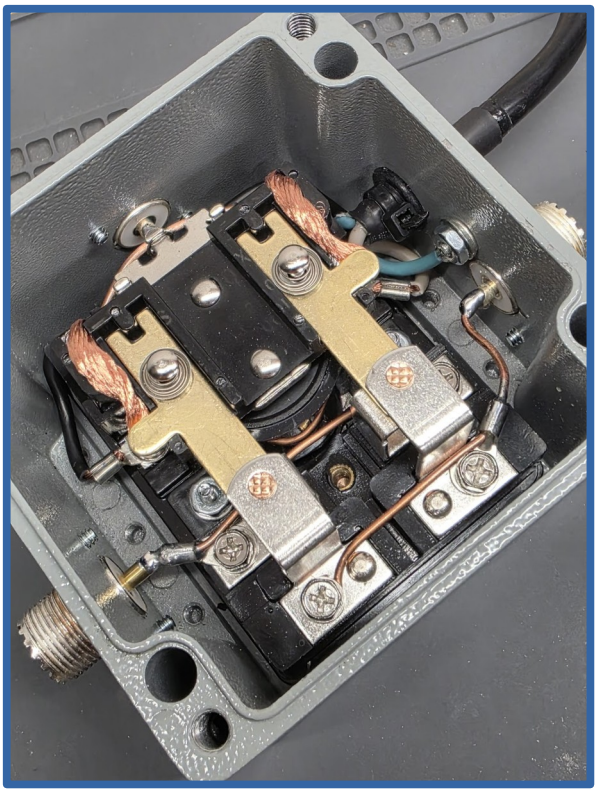
14ga Solid Copper Wire in position before soldering – Note the terminal connectors to facilitate hookup

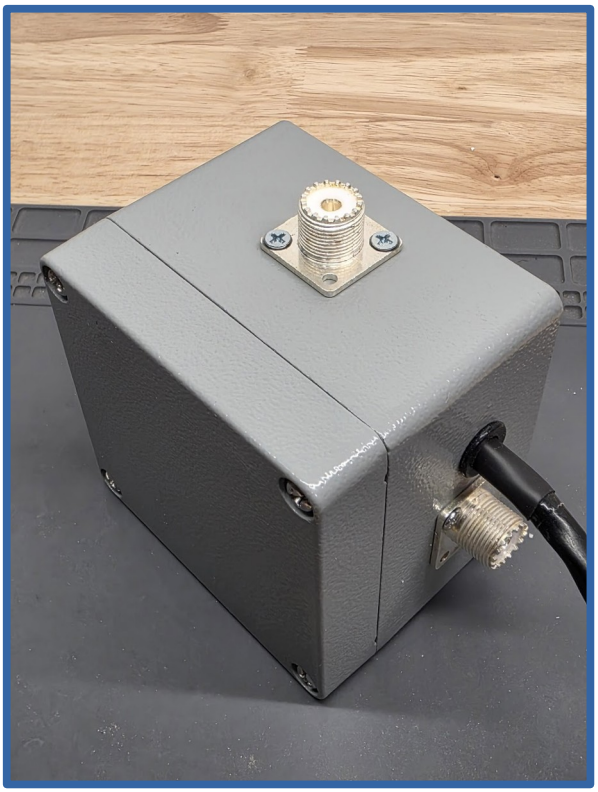
Construction Details





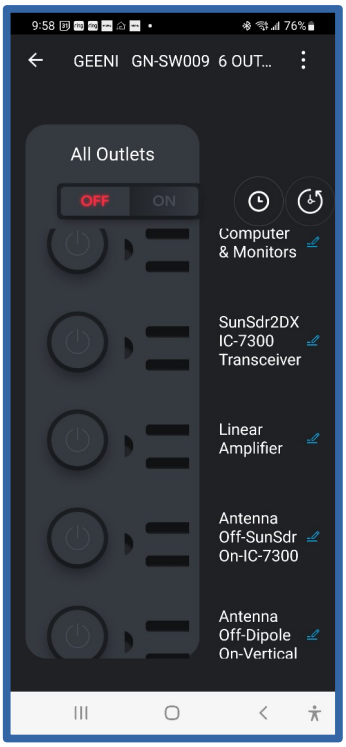
All views show Relay mounted in box with 6/32 x 1” PH machine screws and SO-239 bulkhead connectors mounted with 14 ga copper wire soldered. Power cord in place thru grommet and wired to relay and ground post.

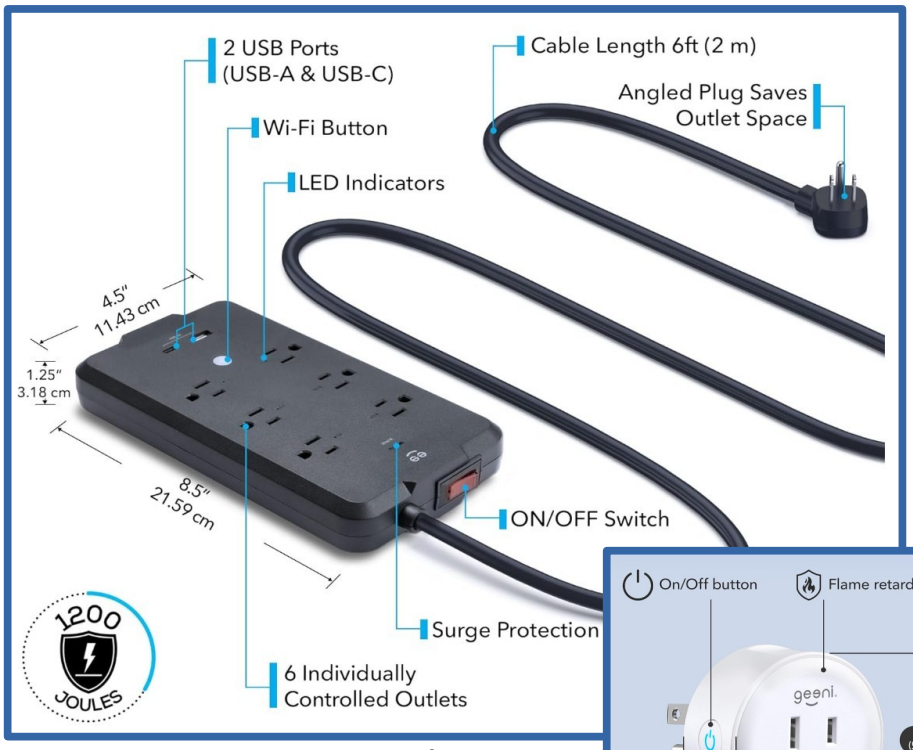


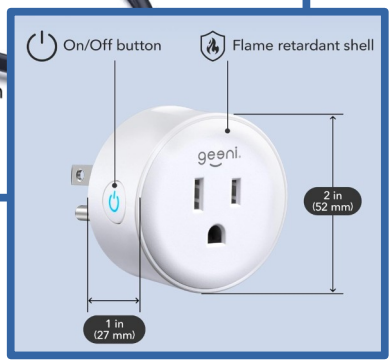


Completed Remote Controlled Antenna Relay

Parts & Needed Items







Geeni Smart Plug Power Strip, 6 Outlets and 2 USB Ports, 6 ft. Cord, Surge Protector with Voice Control, WiFi Control. Each outlet is controlled with smartphone app from any location. To the right is a single Geeni Dot Smart Plug if only one device needs to be controlled remotely.

Parts List

1 - Fielect Aluminum Enclosure Project Box - Amazon Link
1 - JQX-62F-2Z AC 110V Electromagnetic Relay - Amazon Link
Other options are available for 12v & 24v DC
1 – Pkg of 3 SO 239 Connectors 4-Hole Flange - Amazon Link
1 - Geeni Smart Plug Power Strip - Amazon Link
1 - Geeni Dot Smart Plug - Amazon Link
1 - Power Cord Pigtail 3 Prong 18AWG - Amazon Link
1 - Rubber Grommets M6 - Amazon Link

Misc

1’ - 14ga solid copper wire
5 - 6/32 x 3/8” FH machine screws
1 – 6/32 x ½” FH machine screw for ground attachment
2 - 6/32 x 1” RH machine screws
3 - 6/32 Hex nuts and washers
2 - Terminal connectors

Needed Tools

6/32 Tap
7/64” Drill bit
Step drill capable of drilling up to 5/8” holes
Misc pliers, screwdrivers, wire strippers, solder, solder iron, 5/16” wrench