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Improved - An Antenna Switch for 2 or more Remote Operating Locations

(original published in January 2023 QST)
(See "QST In Depth" for 2023 for this article addition)

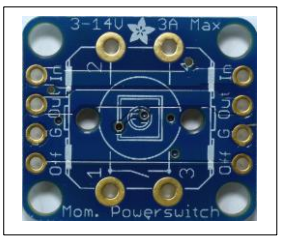
I have made some useful improvements to the antenna switch system originally published in the Hints & Hacks column in the January 2023 issue of QST that I am sure will make it easier to use and be of interest to readers. I have also included where possible, some suggestions by readers.

Impovements

The improvements made to the system can easily be added to any existing installation and are summarized as follows:

1. The original on/off control pushbuttons in the remotes were manual and were easily and often left in the "on" position, when last used (yep, by me!) There was no way of easily resetting them to "off", other than manually. These buttons have now been replaced with solid-state switch versions, which toggle on-off with each momentary push of a tactile button. They can be easily reset to "off" anytime, simply by unplugging the 12V DC power source for about 10 seconds.
2. Since CMOS devices have now been added in the switch module, as well as the power mosfet used for switching, it makes sense to add negative transient suppression diodes across each relay coil.
3. The built-in red LED on the under side of the new switch module has been repurposed by a simple "light-pipe", to indicate when the solid state switch has been toggled "ON". (note 1.)
4. A new and smaller momentary pushbutton connects to the power switch module in place of the tactile pushbutton supplied with it. (Note - if you are really clever mechanically, you might be able to use the module with its original pushbutton and still direct the module led's illumination to the top panel!)

Modification:



The 'heart of the modification is a tiny PCB module (Fig 1) called a "Momentary Power Switch" (I will refer to it as MPS). It is supplied by Adafruit and is available from Sparkfun and many other similar vendors. Its size is less than one square inch, at about 0.82" wide x 0.70" high. It comes with an unsoldered tactile pushbutton (not shown here), and is equipped with a red "ON" led on the bottom side. As received, the MPS incorporates a tiny, p-channel mosfet on the underside that is capable of directly controlling the +12 output with a load of up to 3 amperes continuous. However, in the

original design previously described in the January 2023 QST, the relays and switches were set up to operate with low-side switching to ground instead. I found that the easiest way around this was to simply add an external N-channel power mosfet.

The mosfet I used, a FQP30N06L, is indeed over-rated for this application, but it's relatively low cost, and I had a bag of them. The "on-resistance" of the FQP30N06L is only about 0.05 ohm, which means it will dissipate only a tiny amount of power in this application and so requires no external heat sink.

The schematic below (Fig 2) shows the 3 simple connections needed to the MPS and the wiring to the added N-channel power mosfet Q1.

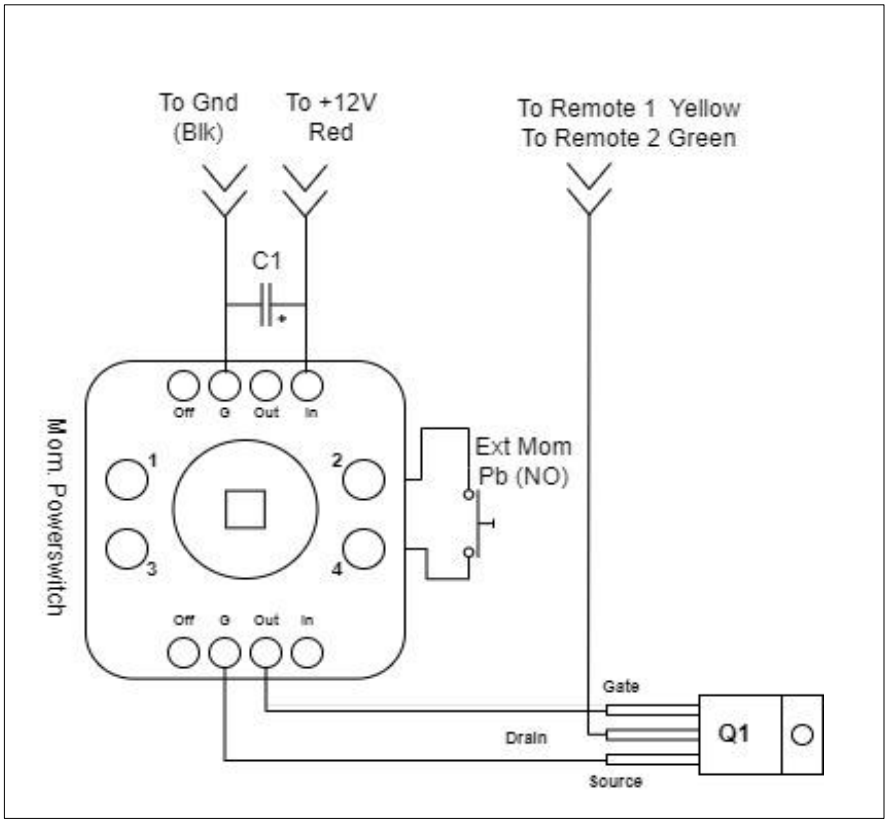
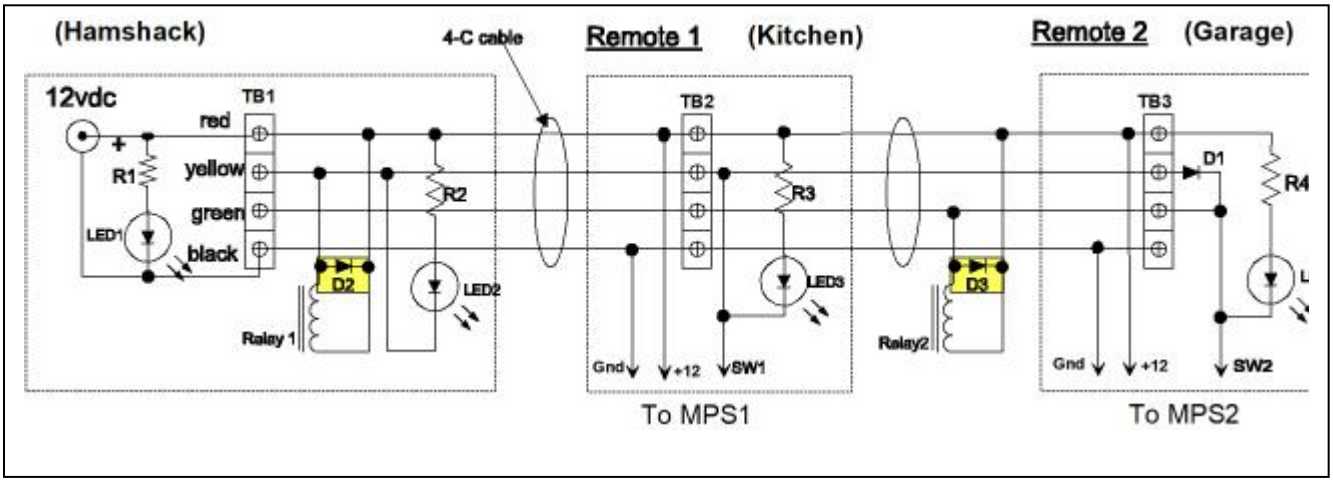


Fig 3 shows Remote #1 as an example which has been modified with the addition of the MPS, a home-made light-pipe and a new momentary pushbutton. On the topside you can see the illuminated light-pipe on the left. It is in contact with the led which is on the MPS bottom-side. The light-pipe is easy to make from 5mm acrylic rod or similar. See note 1 for guidance.

I connected the mosfet to the MPS by short flexible leads and secured the device with a plastic screw to the box sidewall as no heat-sinking is necessary.

Fig 4 below shows the modified system wiring with the added diodes and the connections to the new MPS switches. New diodes are highlighted in yellow.



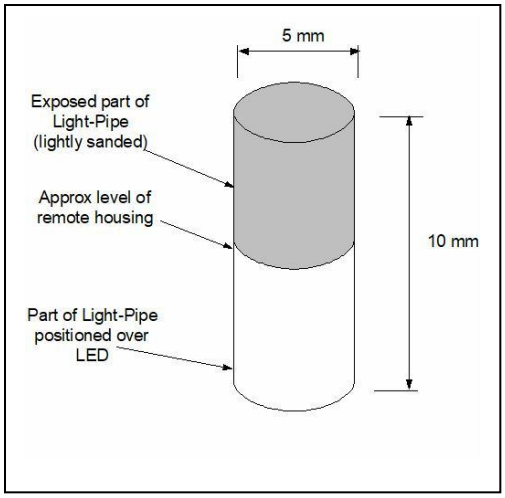
New Parts Required

Other than the MPS, there is nothing critical, so use what works for you.

Ref	Description
MPS	Adafruit MPS, PID 1400
C1	10ufd, 50 volt electrolytic
Mom Pb(NO)	Simlar to Jameco 26023
Q1 NPN	FQP30N06L Fairchild 60v, 32a.or smilar
D2,D3	1N4002 or equiv.(or 1N5819 schottky)
Light-pipe	Make, from 5mm acrylic rod or similar

Notes:

1. **Light-Pipe**
I used a short ~10mm (0.4”) piece of 5mm acrylic rod, with filed flat ends and with the “to-be exposed” part sanded lightly. See fig 5.
For guidance on light-pipes, see “LED Light Design Techniques”, Lawrence Berkley National Laboratory, #I-003, “Lightpipedesign.pdf”



2. **New Capacitor C1**
I found in operation that when the 12 V power was applied to the system, the MPS modules would sometimes power-up in the “ON” mode. To ensure that the MPS modules always power-up in the “OFF” mode, I added C1, a 10ufd, 50V electrolytic capacitor. C1 is best connected close to the ground and “IN” pins of the MPS.

3. **Length considerations for the 4-c cable**
My thanks to reader Guy Hardwick, WD5HZZ, for reminding me of potential voltage drop issues in the 4-c cable, especially if the user wants to extend the length beyond 50 feet. The concern is that the relays have a specified maximum pull-in voltage of 10 volts, and with a 12.0 v power supply, this leaves an allowable “margin” of only 2.0 volts lor circuit voltage loss. (the meaning of “margin” in this instance, is that if the margin value goes to zero or less, then the relays may not operate)

The series diode alone (D1) will take 0.6 volts of that, thereby reducing the margin to 1.4 volts. If one does the math*, noting that the current path for the #24 awg cable will require 2 conductors, then the cable loss for the 100 ft is ~0.93 volts. This is less than the margin which was estimated as 1.4 volts

Therefore the design as presented should have no problems operating with the stated 50 feet. of 4-c cable. This is especially true as relays most often have actual pull-in voltage values much lower than the maximum specified. For reference, I measured the actual pull-in of the 2 relays I used at approximately 8 volts DC.

*The #24 awg telephone wire has a resistance of 2.5 ohms per 100 ft.; the current load for the 2 relays and 3 leds is 0.375 amp

4. **Changes needed for longer 4-c cables**
Should you want to extend the position of the remotes beyond 50 feet, there are several simple changes you can make to increase the margin. One is to use a 13.5 or 13.8 volt power supply

instead of 12 volts. Another is to use 4-c cable with #22 awg wire, which at 1.6 ohms per 100 ft will have lower loss.

5. **12V power source**
I have never specified a particular type of power supply in past, but I would recommend a 12 volt, 2 ampere regulated switching power supply as these types are both short-circuit proof and current limiting, so no external fuse is required.
See Jameco #1950497, or #323300 or similar

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