Miniaturised Pulsed Relay Driver for 28V Microwave Relays

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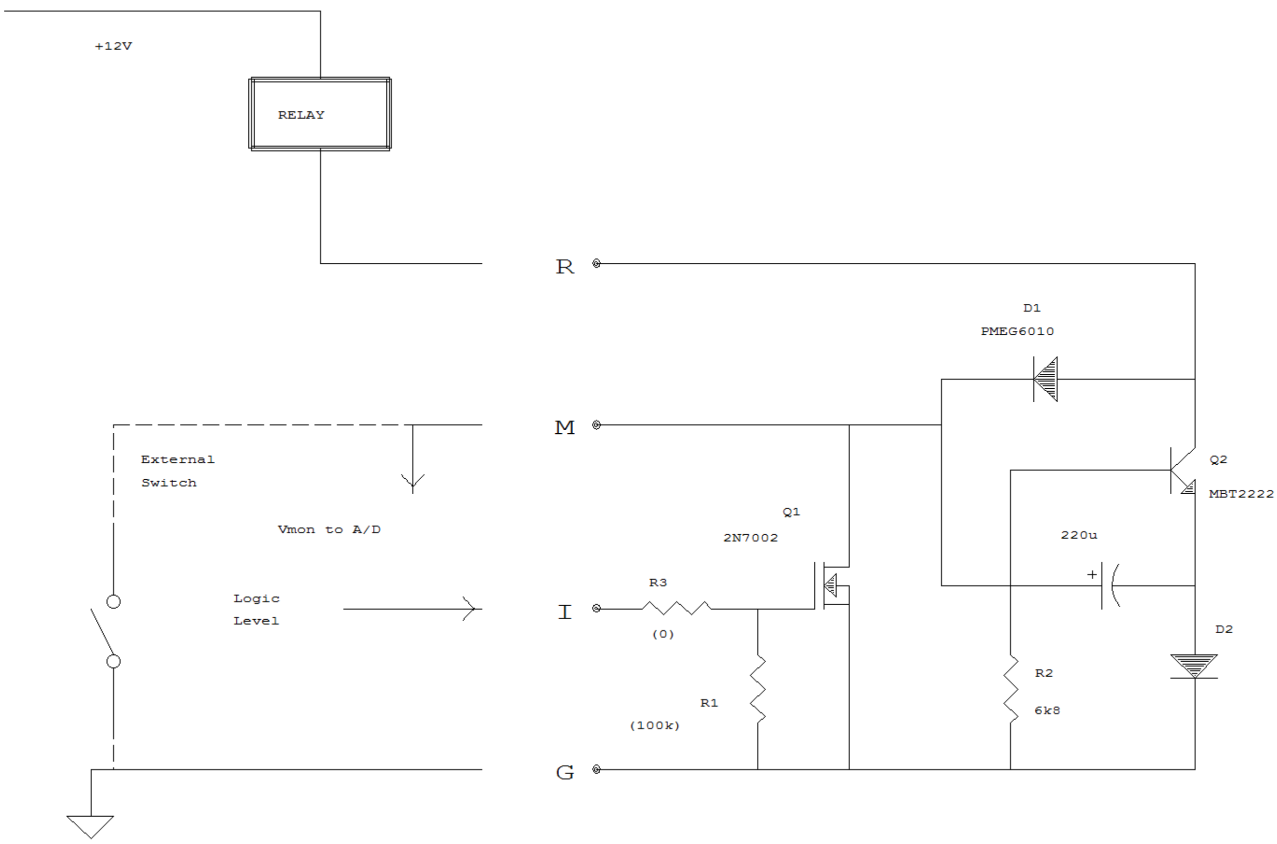
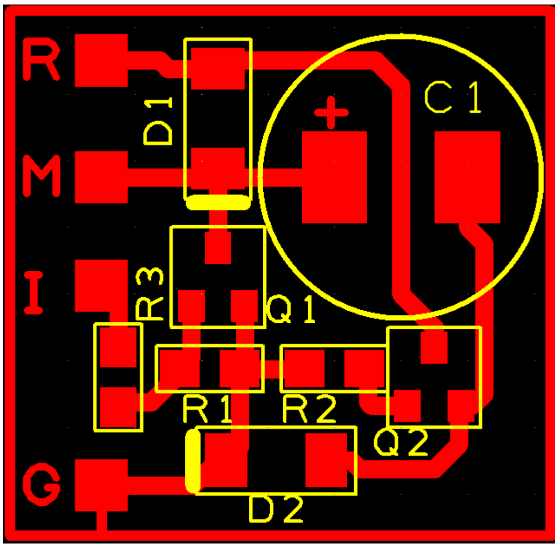
Circuit arrangements abound for driving relays with 28V coils from a nominal 12V supply. The Nov/December 2017 QEX [page 12] has a whole article dedicated to the subject, written by Joseph Haas, KE0FF. A minimum component-count solution is to give the relay an initial kick from a capacitor of a few 100uF that has been pre-charged from the supply voltage, and connected in series with the supply to the relay. This delivers an initial pulse of about twice that of the supply rail to start the pull in process. Once the relay coil has started its travel, a lower holding voltage, the nominal 12V supply, is more than adequate to hold it on. This is described fully in KE0FF's article.

One of the neatest arrangements I've seen is that on GM3SEK's website https://gm3sek.com/ that can be connected in series with the relay, (the circuitry doesn't need the +V supply going to the board) and provides its kick using what amounts to a [minus] -12V pulse on the bottom of the relay coil. It "…seems to have originated from K1KP and K6XX"'

Ian's designs are targeted at big chunky VHF high power relays so he uses appropriately rated components. For lower power microwave use, smaller components can be used, for example a 2N7002 MOSFET for the main switch and MBT2222 type for the auxiliary dump switch. Figure 1 below shows my implementation.



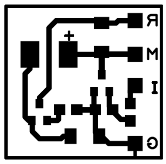
External connection nomenclature : [R]elay, [M]onitor [I]nput, [G]round. R1 is there to stop the input floating if left unconnected. R3 - just in case it may be needed. (It costs nothing to provide PCB pads and link them if unwanted but more effort to cut tracks and add them later). The value of R2 is not critical, D1 and D2 were just what I had available.



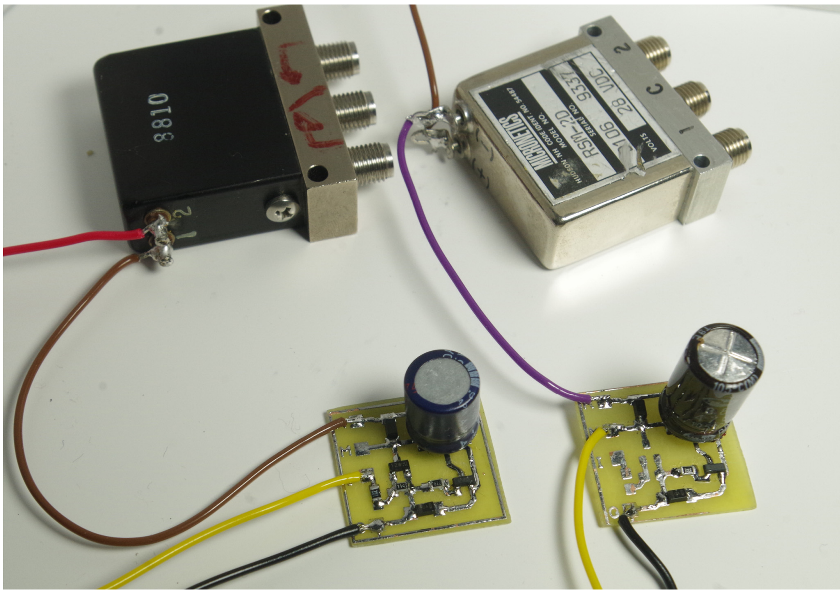
The design has the option for logic level drive (+5V Tx / 0V Rx) to the 'I' terminal or an external switch that may already be available can be connected to the 'M' terminal.

All the components fit easily onto a PCB of about 21mm square, with the layout shown. This is small enough to glue onto the side of a typical Transco type SMA relay, or can be squeezed in somewhere.

Mirror imaged 1:1 PCB layout for home constructors. A higher resolution version in .PDF format can be found at.



http://www.g4jnt.com/DownLoad/PulsedRelayDriverPCB_Mirrored.pdf



Two boards made up and connected to their respective relays. The one on the left is a Dynatech relay with a coil resistance of 180Ω. Although rated at 28V, it appears to pull-in at 14V and drops out at around 7V. In the doubling circuit here it works from a supply as low as 9V

The one on the right, configured for an external switch (Q1 etc. missing) is a Micronetics relay with a coil resistance of 180Ω which, although also rated for 28V, appears to pull in at the ridiculously low value of 9V and drop out around 5V. It pulls-in here from a supply as low as 6.5V.

C1 Recharge Monitor.

As a nice touch that can add higher reliability to a system, the voltage on C1 can be monitored during its recharge cycle, just after the transition from Tx to Rx. If Tx/Rx switching is done too rapidly, C1 may not recharge enough to pull-in some relays when operating from a lowered supply. Just after the Tx to Rx transition, the voltage on the M pad rises from about 0.7V towards the supply as C1 charges. The time is determined by the value of C1 and the relay coil resistance, and typically should be complete in 100 to 300ms.

If a microcontroller such as a PIC or Arduino etc with A/D inputs is already in use for Tx/Rx sequence control – for example it also monitors RF levels or supply current – it is little effort to include an additional A/D channel from this point. Then the control software reads the capacitor voltage, and safely inhibits the sequence to Tx until the voltage is sufficient. Belt-and-braces, but worth adding if a spare A/D channel exists.