Running 28V Latched Relays from a 12 V Rail

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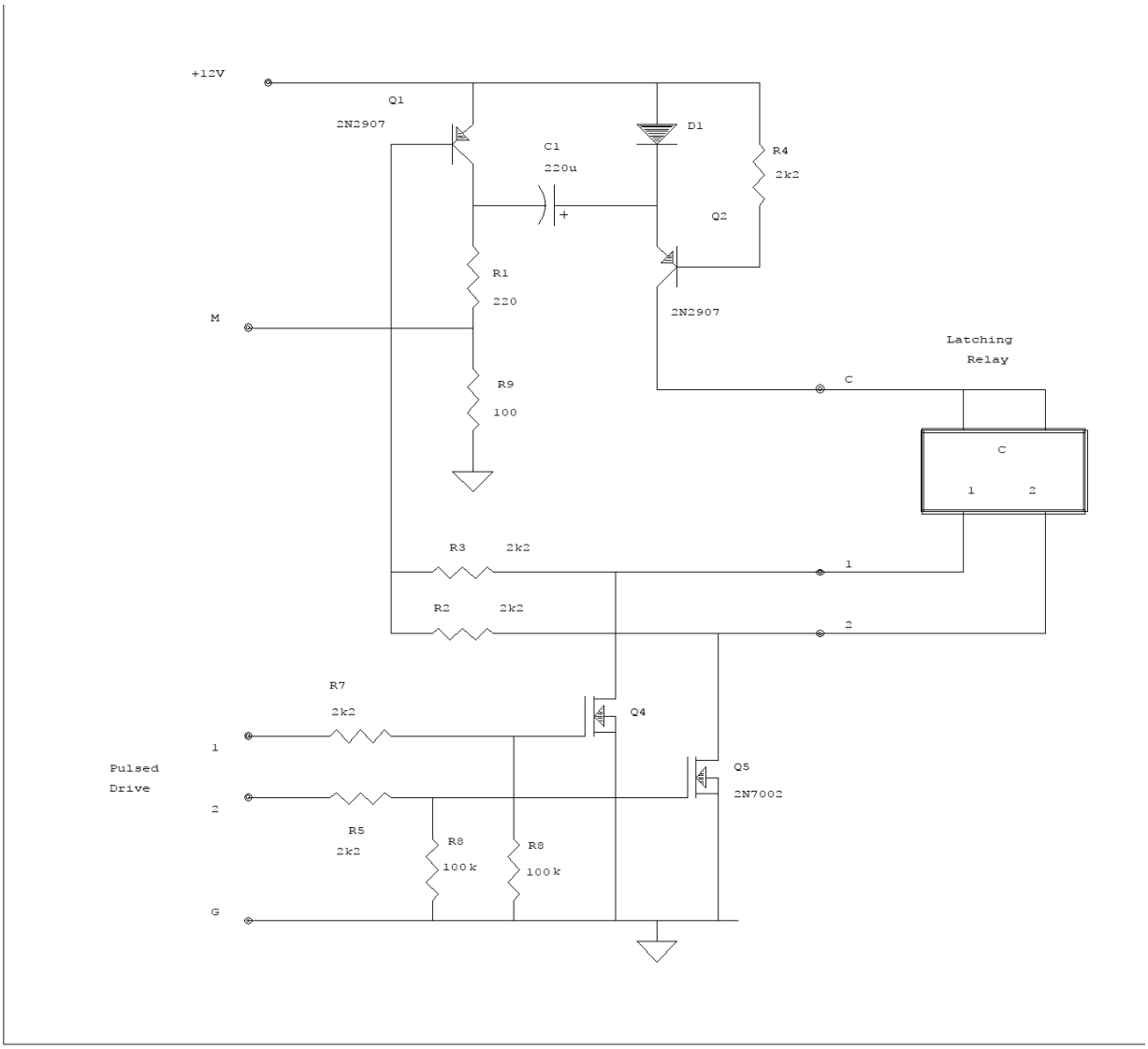
A previous design http://www.g4jnt.com/DownLoad/minipulsedrelaydriver.pdf showed how a 28V standard (non-latching) relay can be driven from a 12V supply by providing an initial 'voltage doubling' pulse from a capacitor. Here we carry the concept a stage further to drive dual-coil latching relays using circuitry derived from that design.

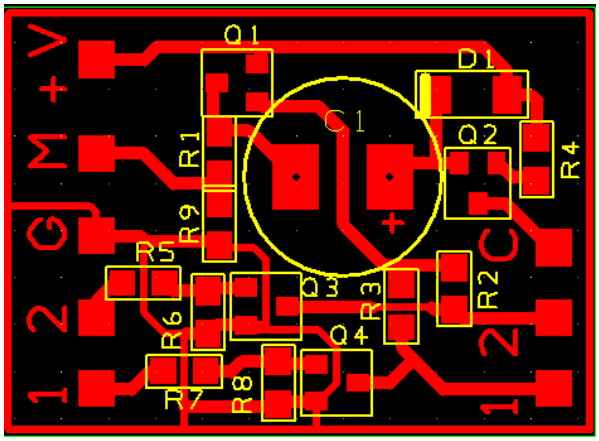
The circuit is shown in Figure 1 below. Q1 and Q2 function in a similar manner to that on the non-latching circuit, although the polarity has been swapped so they run on the high side. The DC holding path has been removed as only the initial pulse is needed – Q2 switches off when C1 has discharged. With no DC path through the relay, an alternative route has to be provided to recharge C1 during the waiting period. This is provided through R1 (and R9, see later).



Q3 and Q4 form the interface from the controller and select which coil is to be activated. A resistive OR function from these via R2 and R3 activates Q1. R6 and R8 are present just to stop the gates floating if left unconnected; R5 and R7 are there more as jumpers on the PCB than for any real function.

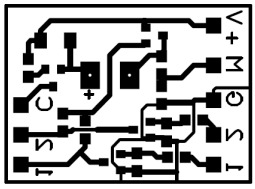
The Logic level drive (to the input terminals labelled ‘1’ and ‘2’) should consist of a pulse of a few tens or 100s of milliseconds, and should not be a continuous level. Whilst a DC level will cause no damage as the relay itself is powered only via a the capacitor defined pulse drive, it does mean there will be continuous excessive dissipation of around 500mW in R1/R9.

No back-EMF protection diodes should be installed on the relay coils; they are not hard switched-off with the current reducing as C1 charges. Hence no damaging high voltage spikes can be generated.

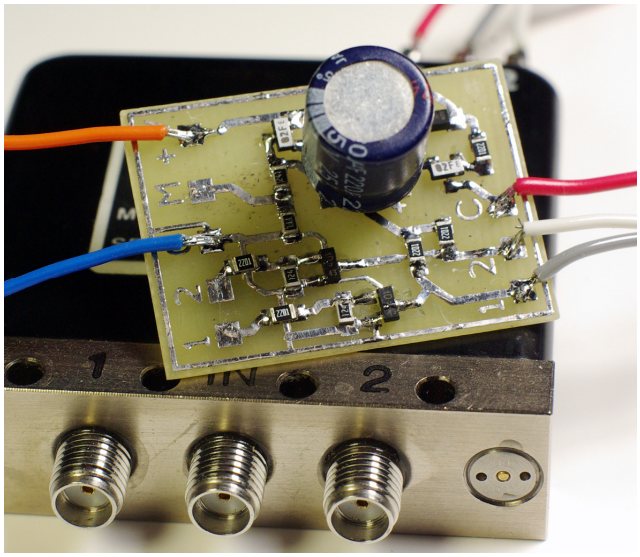


All the components fit easily onto a PCB of 32 x 23mm with the layout shown. This is small enough to attach onto the side of a typical SMA relay, or can be squeezed in somewhere.

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/LatchedRelayDriver_PCBMirrored.pdf



The board made up and connected to a relatively large relay with a coil resistance of 180Ω. The majority of latched SMA relays are smaller than this with a higher coil resistance, typically in the region of 500Ω. Although rated at 28V, it pulls-in at 15V. In the doubling circuit here it works from a supply as low as 8.5V

C1 Recharge Monitor.

An option that can add increased reliability to a system is to monitor the voltage on C1 during its recharge cycle, after the driving pulse has completed. If switching is done too rapidly, C1 may not recharge sufficiently to pull-in some relays when operating from a lowered supply. Just after transition, the voltage on the C1 negative terminal falls from V_{DD} towards zero as C1 charges. The time is determined by the value of C1 and the value of the charging resistor, and typically should be complete in 200 - 300ms.

The charging resistor is split into two, R1 and R9, to give a potential divider so the voltage on the [M]onitor pad will not exceed 5V. If a microcontroller such as a PIC or Arduino or similar, with A/D inputs, is used for sequence control and pulse generation – for example it may be used to also monitor 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 until the A/D reading indicates sufficient charge has built up. Belt-and-braces, but worth adding if a spare A/D channel exists.