Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.

Solid state "soft start" relay

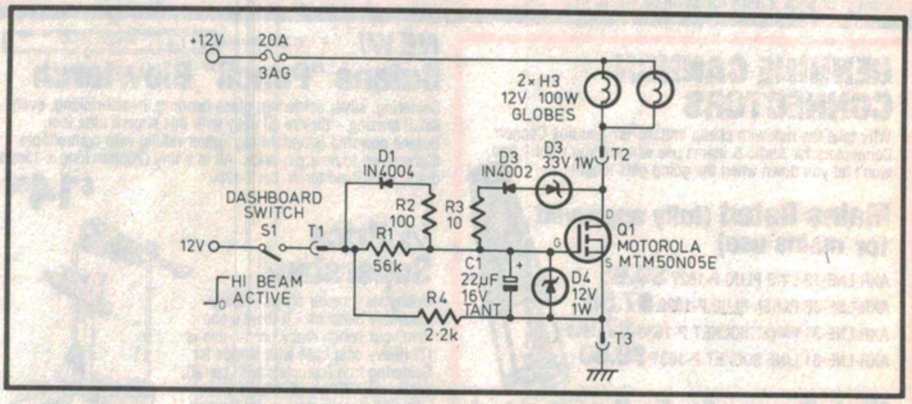
I designed this soft-start solid state relay for the two spotlights (100W each) on my car, after the original one began to weld. The advantages of it are:

(a) Solid state, no contacts to weld.

(b) A soft-start feature gives the lamp filaments a longer life as most failures occur at switch-on due to inrush current.

The heart of the circuit is an MTM50N05E N-channel MOSFET, and obtainable from (Arlec)-Soanar for about $19 including tax. I obtained mine from the Perth branch. It is rated at 50V, 50A with an Rds-on of 0.028 ohm. It was mounted on a heatsink predrilled for two TO-3 cases, costing around $5 from Altronics, Dick Smith etc.

The rest of the circuit takes up the spare space normally occupied by the other TO-3 case on this heatsink.



The circuit employs the Id/Vgs characteristic of MOSFETS, which is a sloped staircase starting at the Vgs threshold of about 2V and reaching nearly maximum Id at about Vgs. = 4V.

In normal operation the switch S1 is ON and the driver switches on HI-BEAM. C1 begins charging via R1 and after about half a second, the filaments in the spots begin to glow. After this the transition to full current is fairly rapid, due to the staircase nature of the characteristic. However the soft-start is genuine, giving the filaments a longer life.

When the driver switches to LO-BEAM the spotlights need to be de-energised immediately, thus C1 is discharged rapidly via D1 and R2. In the case of the dashboard switch being opened when the headlights are on high beam, the discharge takes place via D1, R2 R4. This is still very rapid, almost instant.

D3, D2 and R3 form a spike suppression circuit in case of spikes occuring at the drain due to stray inductance. Although considering the finite time-constant even at switch off, such a spike is unlikely to be large. For a few cents the MOSFET is protected anyway.

D4 prevents the Miller capacitance ever taking the gate to more than +12V during switch-off and protects the gate from ever reaching −20V (or less) (±20V are the maximum VGS ratings). It also protects the 16V tantalum from exceeding its rated voltage.

R2 and R3 function as current limiting for their respective functions. Possibly R3 can be omitted.

Voltage drop across Q1 and heatsink temperature rise have proven to be negligible whilst operating two 100W "H3" quartz halogen spotlights.

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$40