

International IOR Rectifier DESIGN TIPS

DT 94-5A

INTERNATIONAL RECTIFIER • APPLICATIONS ENGINEERING • 233 KANSAS CITY • EL SEGUNDO, CA. 90245 • TEL. (310) 322-3331 • FAX. (310) 322-3332

USING MOS-GATED POWER TRANSISTOR IN AC SWITCH APPLICATIONS

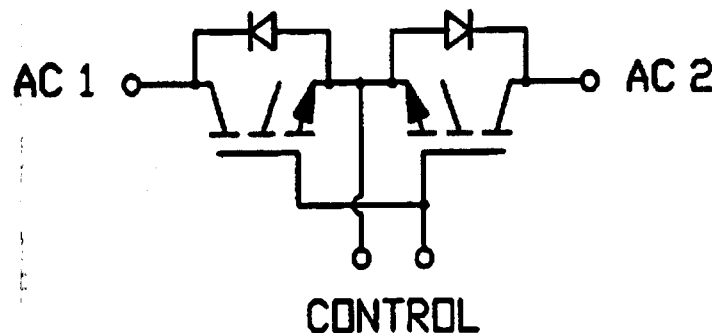
by Donald A. Dapkus II

Problem:

The IGBT and the power MOSFET are not suited to switching AC waveforms directly. The IGBT can only conduct current in one direction due to its use of conductivity modulation, while the power MOSFET has an anti-parallel diode that will conduct for every negative cycle. MOSFETs are the device of choice in applications below approximately 200V, while IGBTs will take over at higher voltages due to their relative voltage drops.

Solution:

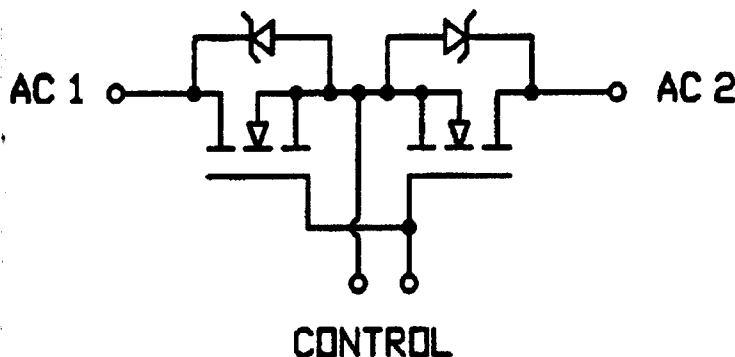
By placing copackaged IGBTs (IGBT + HEXFRED Ultrafast, ultra-soft recovery diode in the same package) in a series configuration (emitter to emitter), the problem of violating the conductivity modulation is solved. For each half of the AC waveform, one IGBT, and the opposite diode is in conduction. Of course, it is also possible to use discrete IGBTs with discrete diodes around each IGBT.



DT94-5A

IGBT AC Switch

Similarly, by placing two power MOSFETs source to source, the intrinsic anti-parallel diodes will prevent each other from conducting. Also, the current flow will most likely be through both MOSFET channels, instead of opposite MOSFETs and diodes. The MOSFET channel is a bidirectional switch, that is, it can conduct current in the reverse direction. If the voltage across the MOSFET channel is less than the V_F of the intrinsic diode (which typically has a higher V_F than discrete diodes), then the majority of the current will flow through the MOSFET channel instead of the intrinsic diode.

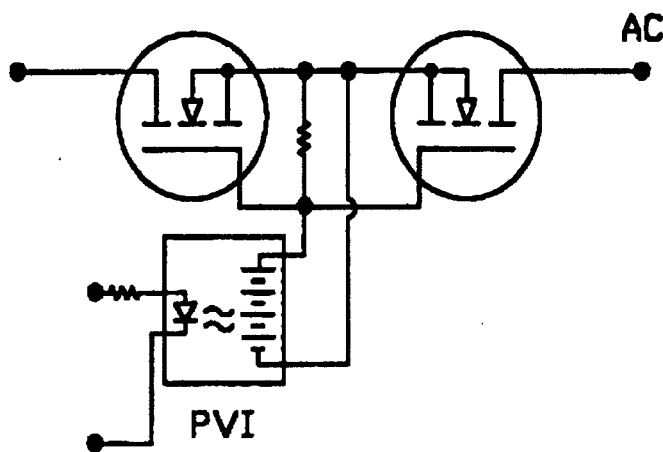


MOSFET AC Switch

3794-53

Driving the AC Switch:

No discussion of an AC switch would be complete without discussing the technique used to drive the devices. The gate drive for both the MOSFETs and IGBTs must be referenced to either the common sources or emitters of the devices. The problem is that this node will be swinging along the AC waveform. The two gates must be driven approximately 10V above this waveform. International Rectifier manufactures a photovoltaic isolator which generates an electrically isolated 10 VDC output upon receipt of a DC input signal. Depending on the devices being driven, switching times can be greater than 1 ms. For more information on this technique, please see Application Note GBAN-PVI-1 which appears in the *Microelectronic Relay Designer's Manual (MPIC-5)*. This data book also contains the data sheet for the photovoltaic isolator, the PVI1050. A circuit is also provided in the AN to significantly speed up turn-off of the switch.



Driving the Switch

3794-5C