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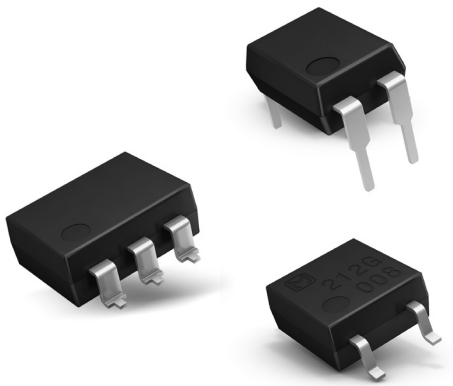
Driving Triacs with Phototriacs

Triacs have emerged as an attractice alternative to EMRs in many applications. One effective way of driving these triacs is the use of phototriacs and a snubber circuit protecting both the main triac and the phototriac driver.

Application Note



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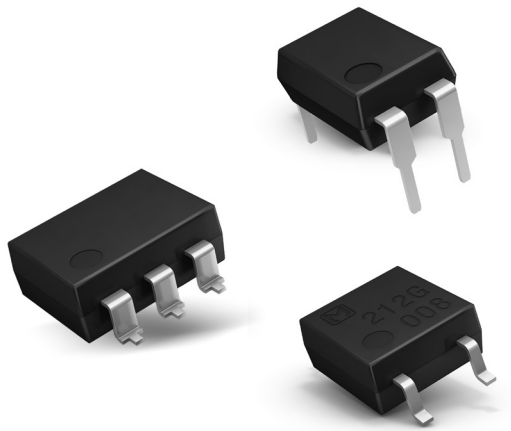
Triac driving circuit



Product

Phototriacs: APT***

Purpose

Phototriacs can be applied as drivers for a main triac – an effective and safe configuration.

Features

Zero-crossing and non-zero-crossing options available

Max. peak off-state voltage 600 V

On-state current 50 mA

Available in SOP4, DIP4 or DIP6

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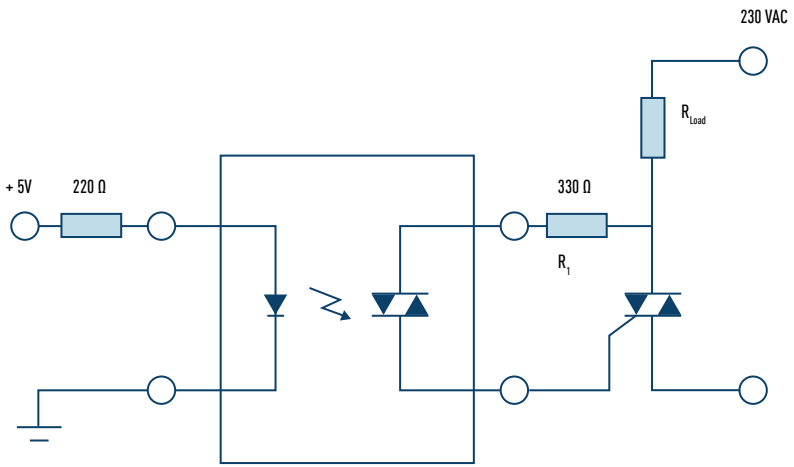
Triac driving circuit

Facts & Figures

As switching devices are facing more challenging operating environments, electromagnetic relays (EMRs) are increasingly being replaced with more stable and reliable semiconductor switching solutions. Among them is the use of triacs, which offer a small size, longer lifetime, better switching speed, and lower power consumption than EMRs. In cases where galvanic isolation of control and load circuit should be realized with triacs, optically isolated phototriacs can be used to drive a main triac.

A phototriac device consist of two main components: An LED and a photo diode detector chip. If current flows through the LED, it emits infrared light, which is detected by the photo sensor. This in turn triggers the switching of the phototriac device, making its output conductible – an output that can be used to drive a larger triac's gate.

Since the output of the phototriac introduces a gate current to the main triac, it will proceed to on-state and carry the load current. As soon as the main triac is triggered, the voltage across the driver – and consequently the driver's load current – drops. Even though a typical forward current of 10 mA is still applied to the input side, the phototriac driver will proceed to the off-state when the load current drops below the holding current (typically 0.3 mA). This will happen every half cycle of the load voltage as long as a steady forward current is applied. While the output of the phototriac coupler is conductible, it can carry a continuous current of up to 100 mA with a voltage drop of 2.5 V across its output. The maximum surge current through the phototriac is determined by the maximum load voltage and the value of the resistor.



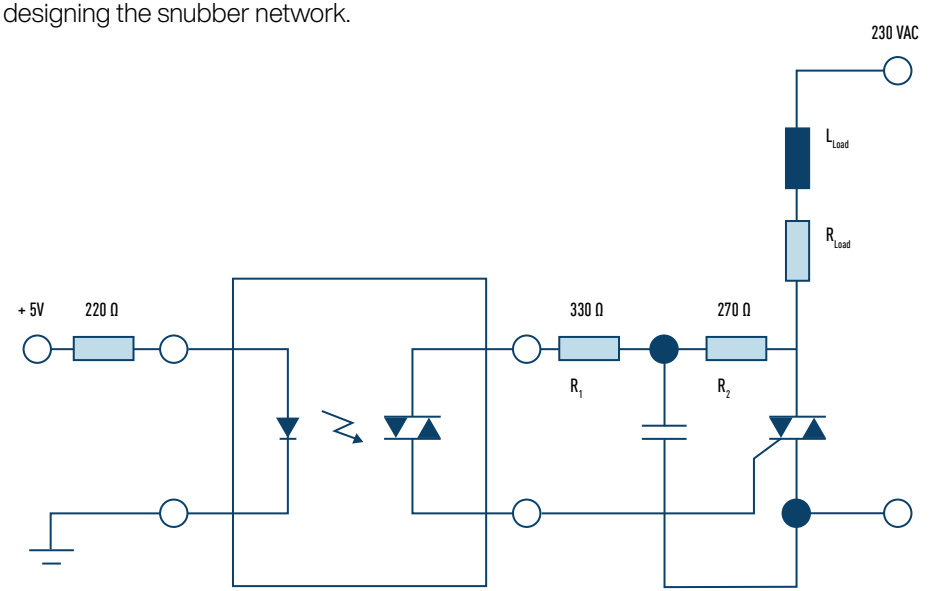
Triac driving circuit

Facts & Figures

Since the main triac requires a gate current and voltage, a certain load voltage value is necessary to trigger the triac. However, the phototriac may also be triggered to on-state accidentally. When switching inductive loads, load voltage and current are not necessary in phase: Since a triac turns off when the load current is zero, load voltage is not necessarily zero, as well. This may lead to a sudden rise in the triac's load voltage to its own output, exceeding the dV/dt rating of the triac driver and hence causing the device to proceed into on-state.

To prevent this from happening, a snubber circuit can be used. In most cases, one snubber circuit will protect the main triac and the phototriac. Depending on whether a non-zero-crossing phototriac (e.g. APT1221) or a zero-crossing phototriac is used, the snubber network may have to be designed differently. When designing the RC snubber network for non-zero-crossing triac drivers, detailed knowledge about the load is necessary, as the maximum turn-off voltage across the output is largely determined by the device's power factor.

A more sensitive triac will typically require a lower gate current and a higher resistor value, which will necessarily increase the value of the capacity. If the dV/dt rating of the main triac is different from the phototriac, the worst-case value must be chosen for designing the snubber network.



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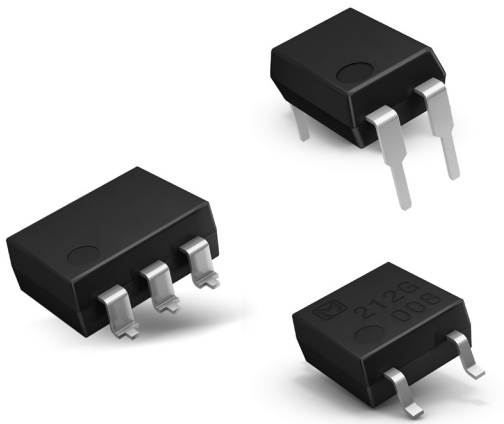

Application Note - How to solve various tasks with driving triacs with Phototriacs
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