



VO3526 Power Phototriac Design Considerations

The VO3526 power phototriac (also termed a solid-state relay in the industrial and process control industries) is designed to be used as a solid-state AC switch for loads of up to 1 A. As with all power devices, heat dissipation should be kept in mind when using the VO3526 to its maximum load capacity. To achieve maximum heat dissipation from the device through the leads a good PCB layout is necessary, since using a heat sink may conflict with safety agency requirements.

In this application note we examine the impact of the following factors that will influence designs using the VO3526 to drive a resistive or inductive load:

- Load current derating over ambient temperature
- Heat dissipation
- PCB design considerations
- Snubber circuit
- LED degradation

LOAD CURRENT DERATING OVER AMBIENT TEMPERATURE

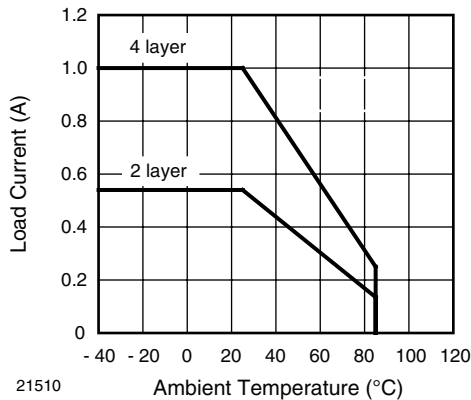


Fig. 1

To avoid exceeding the maximum die junction temperature, the load current must be reduced at ambient temperatures higher than 25 °C.

HEAT DISSIPATION

There are three heat transfer modes for VO3526:

1. Conduction through the leads to the PCB: because of its lower thermal resistance (R_{BA}) most of the heat (~70 % to 75 %) is conducted through the device leads to the PCB
2. Radiation through the device case
3. Convection through the device case

The convection and radiation phenomena are associated with R_{CA} (case-to-ambient thermal resistance), which is typically an order of magnitude larger than R_{BA} . Thus these modes do not transfer as much heat out of the package.

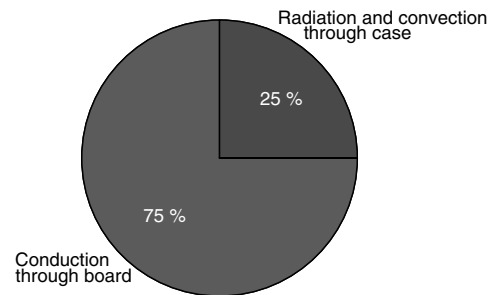


Fig. 4 - Heat Transfer Mode in %

For a detailed explanation of the thermal model, please refer to Vishay's Thermal Characteristics of Power Phototriac Application Note.

PCB DESIGN CONSIDERATIONS

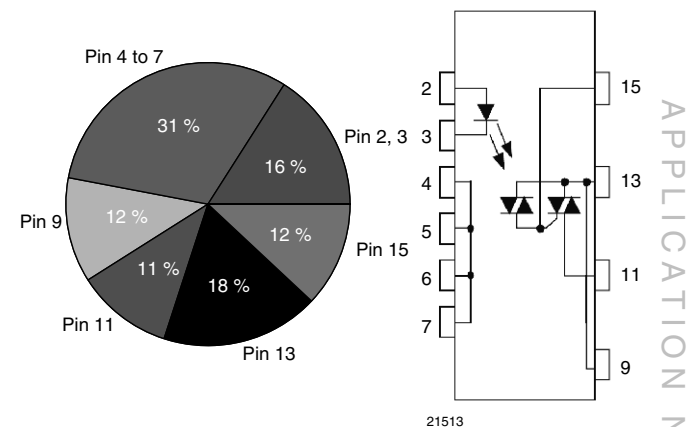


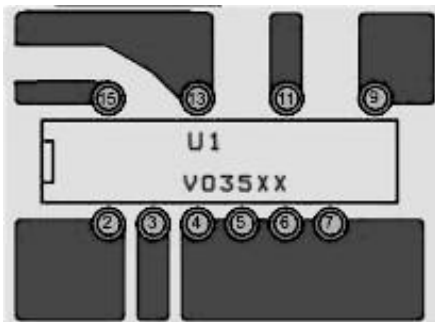
Fig. 5 - Heat Through Leads in %

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The maximum load current value depends whether a 2-layer or 4-layer PCB is used. Since a 4-layer PCB will do a better job of dissipating heat, a higher load current of up to 1 A can be achieved (see figure 1)

The PCB design has a major impact on board-to-ambient thermal resistance. Use the proper pad size, layout, and thickness of copper traces to maximize heat dissipation through the PCB. The size of the pads and copper area on both top and bottom sides should be as big as possible while keeping a minimum safe distance between input and output pins. Additionally thermal vias could be added to the layout to improve upon heat dissipation.

The following is an example of a PCB pads design.



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Fig. 6

As conduction is the major mode of heat transfer, all pins, including pins 4 through 7, should be soldered to the PCB. To avoid safety certification violations, please note that the input and output sides have to be kept isolated. Sockets should not be used as they will reduce the effective rate of thermal conduction of the package.

SNUBBER CIRCUIT

Static dV/dt is the minimum value of the rate-of-rise of the voltage which causes switching on of the VO3526 when it is in off state. When driving inductive loads such as motors and solenoids, the device should be off when its load current is less than the holding current (I_H) and the LED forward current (I_F) drops below phototriac's trigger current threshold (I_{FT}). However, if the slew rate is faster than the VO3526 rated dV/dt , the device may turn on again. A snubber circuit is used to overcome this problem.

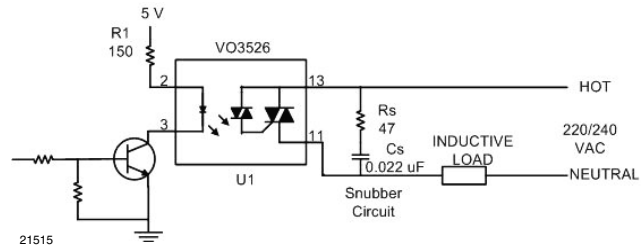


Fig. 7

The value of C_s and R_s depends on the application and should be adjusted accordingly. Locate the snubber circuit as close to the VO3526 as possible.

LED DEGRADATION

All LED emitters degrade over time. This degradation is accelerated by temperature and LED current. Therefore in order to maintain proper operation, it is good practice to provide extra headroom for the minimum triggering current required.

SUMMARY

Using good design practices to lay out the PCB for maximization of heat dissipation through the device pins to the PCB, the VO3526 can be used to drive resistive and inductive loads of up to 1 A. In the case of inductive loads, a snubber may be needed to avoid unwanted turn-on of the VO3526 in the off-state.