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APPLICATION NOTE

DC POWER SUPPLY DIODE PROTECTION CIRCUITS

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1 Introduction

This application note covers the use of protection diode circuits between the output of a programmable DC power supply and the EUT. These protections circuits are important when testing inductive loads or when testing batteries. Each type of circuit is described separately for but can be combined as needed if both types of loads are tested with the same DC power supply.

2 Inductive Load Discharge Protection Circuits

Examples of inductive loads are manifold, i.e. inductors, relays, fans, dc motors, solenoids etc. When an inductive load is powered up by a DC power supply, a DC current flows through the inductor creating a magnetic field. This magnetic field represent a certain amount of stored energy. When the DC power supply is turned off, this DC current disappears. Once that happens, the magnetic fields starts to collapse, discharging this stored energy into the output stage of the DC power supply that is still connected to it as a reverse current. This reverse current will result in potentially large voltage spikes often exceed the maximum output voltage rating of the DC power supply. This type of voltage is called a fly-back voltage or back EMF (Electro Magnetic Force).

The amount of fly back voltage is determined by the rate of the decay of the reverse current (di/dt) and the load inductance L in Henry. The faster the current change rate and the higher the inductance, the higher the fly-back voltage will be, often far exceeded the maximum DC voltage rating of the supply. In these instance, severe damage can be caused to the DC Supplies output circuitry.

To prevent this from happening, a pair of diodes can be used, one to block the reverse current and one to allow a low impedance path for the energy to dissipate through. This is shown in Figure 1 below.

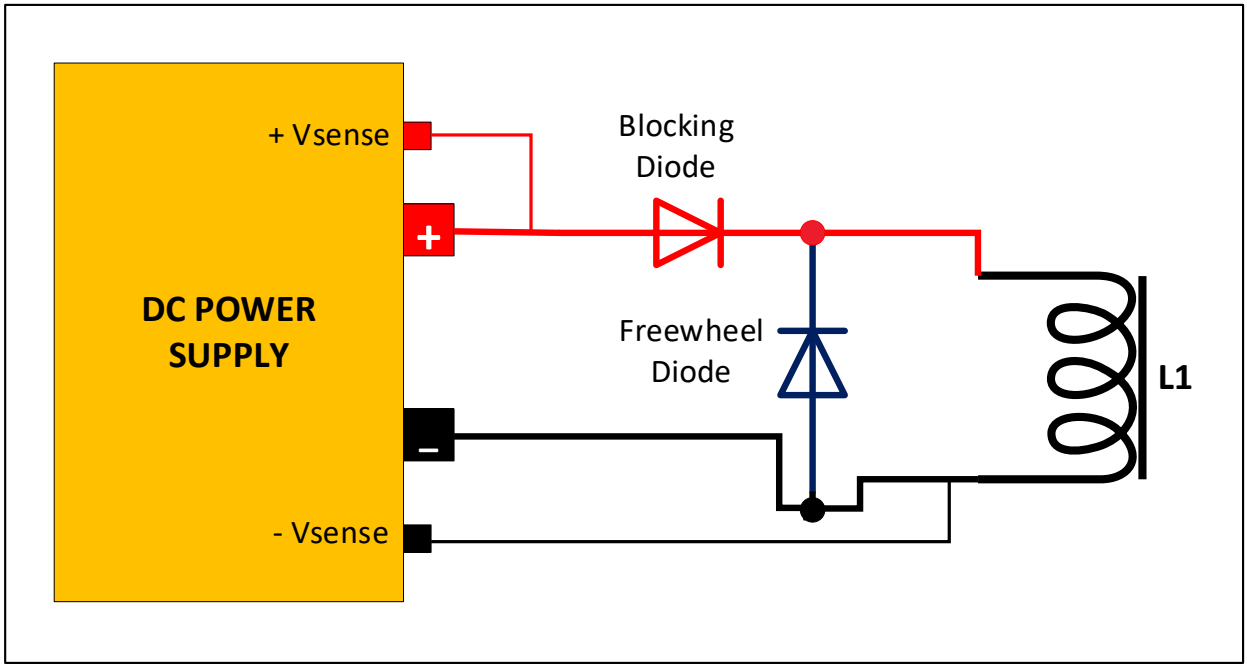

Figure 1: Inductive DC Load Protection Diodes Circuit

2.1 Freewheel Diode

The function of a freewheeling diode is to freewheel the energy stored within the inductor by giving a short circuit path. The operation of this diode can be done only in forward bias direction, not in reverse bias. Therefore, the diode will dissipate the stored energy within the inductor by providing a short circuit path so that a high voltage cannot be induced. As such, the DC Power supply is protected from excessive

voltage. The freewheeling diode voltage rating must be sufficient to withstand any back-EMF, at least twice that of the maximum voltage rating of the DC power supply used.

Note: A freewheeling diode is also called a kickback, clamp, commutating, snubber otherwise suppression diode.

2.2 Blocking Diode

The function of the second diode shown is to prevent the reverse DC current generated by the collapsing magnetic field of the inductor from getting to the DC power supply output stage. Hence the reference to "blocking" diode. This diode must be rated for at least 50% more than the maximum current rating of the DC power supply used. Depending on the diode part used, a heatsink may be needed if back EMF events occur frequently.

Note that when using a freewheel diode, any external voltage sense connection must be made **before** the diode, not after the diode – as shown in Figure 1. That means this diode should be located as close to the EUT as possible to minimize voltage drop on the load wires.

3 Battery Test Applications

The blocking diode shown in Figure 1 is also recommend when testing batteries using a DC power supply. When turning off the dc voltage to the battery, the battery will retain this voltage and current may flow into the DC power supply output stage. The same blocking diode method used for inductive load testing is also recommended for battery test applications.

4 Contact Information

For product information or technical support by region, contact our exclusive equipment representative shown below.

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