

Protecting Devices from Inductive Loads



HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Follow safe electrical work practices. See NFPA 70E in the USA, or applicable local codes.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Read, understand and follow the instructions before installing this product.
- Turn off all power supplying equipment before working on or inside the equipment.
- Use a properly rated voltage sensing device to confirm power is off.
DO NOT DEPEND ON THIS PRODUCT FOR VOLTAGE INDICATION
- Only install this product on insulated conductors.

Failure to follow these instructions will result in death or serious injury.

The information provided herein is intended to supplement the knowledge required of an electrician trained in high voltage installations. There is no intent to foresee all possible variables in individual situations, nor to provide all training needed to perform these tasks. The installer is ultimately responsible to assure that a particular installation will be and remain safe and operable under the specific conditions encountered.

Introduction

When an inductive device, such as a contactor coil, solenoid, relay coil, or motor turns off, large voltage spikes known as back-EMF can be introduced in the circuit. Parallel connection of inductive devices can substantially increase the amplitude of the voltage spike. To avoid damage to a control panel's D.O. (digital output) switching circuit or other circuit components, a means of reducing or "clamping" the back-EMF effect should be used. This application note discusses available transient limiting devices which can be used to provide that protection. The selection of specific components should be referred to a competent designer. Selection is usually based on cost and mechanical considerations, since mounting, connecting, and insulating the selected parts will add cost to the job.

Methods

There are four types of transient suppression circuitry commonly in use: metal oxide varistors (MOV), transient voltage suppressors (TVS), diodes (in DC circuits) and resistor/capacitor (R/C) "snubber" combinations. Of these choices, the first three offer single component solutions that can often be connected along with the usual wiring to the component needing suppression. The resistor/capacitor method essentially creates a tuned circuit to reduce voltage excursions. Although potentially lowering component cost, engineering and wiring considerations usually limit use to OEM circuitry.

MOVs

MOVs offer easy selection based on clamping voltage, energy ratings, and low cost. The negatives are mechanical fragility, physical bulk, and a characteristic reduction in the clamp voltage after repeated absorption of high-energy spikes eventually reaching the operating voltage. If the latter occurs, the device will heat and potentially be a fire hazard. Some form of current limiting, thermal fusing, or other thermal isolation is advised by safety agencies when using these devices.

TVSs and Diodes

TVSs and diodes are similar for DC applications. TVSs are designed to withstand higher energy levels and can be obtained in bidirectional versions for AC circuits. Diodes can be sized to protect the circuit without damage to themselves. Both are a single component answer to the back-EMF problem and are mechanically robust, though especially the TVSs are often a higher cost component.

Solutions

Usually, any one of the protection devices shown below is enough to solve the problem. For small relays in DC circuits, a 1N4004 diode, or a P6KE30A TVS (one per device) may do the trick, but remember that the requirements of your application should be reviewed to select the correct components for the job.

