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White Paper

Safety Considerations When Using Optocouplers and Alternative Isolators for Providing Protection Against Electrical Hazards

Introduction

Optocouplers and alternative isolation technologies find widespread use in a variety of products for signal isolation and high voltage level shifting. These devices can also be used to provide safety related insulation. Considering these electrical concerns, it is necessary to understand the safety related characteristics of the optocoupler or alternative isolator.

Basis of Electrical Safety

Electrical shock caused by the passage of electrical current through the human body can result in physiological effects ranging from injuries caused by involuntary moments to death from ventricular fibrillation. The voltage threshold of risk is somewhat erratic due to variations in health, moisture levels and body impedance, but the level of voltage that is generally considered safe is DC voltages up to 42V and AC voltages up to 60V. Any electrical application that exposes people to voltages greater than this is consider a hazard, and sufficient electrical insulation is required.

Concept of Safety Factor

When human safety comes into the equation, designers are forced to consider so-called safety factors. The aim of safety factors is to take into account user conditions that are not fully deterministic, with the aim of ensuring an extremely remote chance of failure. Safety factors are widely used in a wide range of engineering disciplines.

As an example, in civil engineering a common safety factor frequently used for scaling support members in the construction of buildings is typically 2. A higher factor can be used when the quality of the material is not as well known.

For aerospace a factor of safety of 1.25 is typically used. In these applications, weight penalties are extreme and the costs of higher quality control and frequent servicing checks are more tolerable. So on this basis, a lower safety factor is justifiable. For safe electrical insulation applications, often referred to as reinforced insulation applications, the typical safety factor used is 2.

Continuous Working Voltage

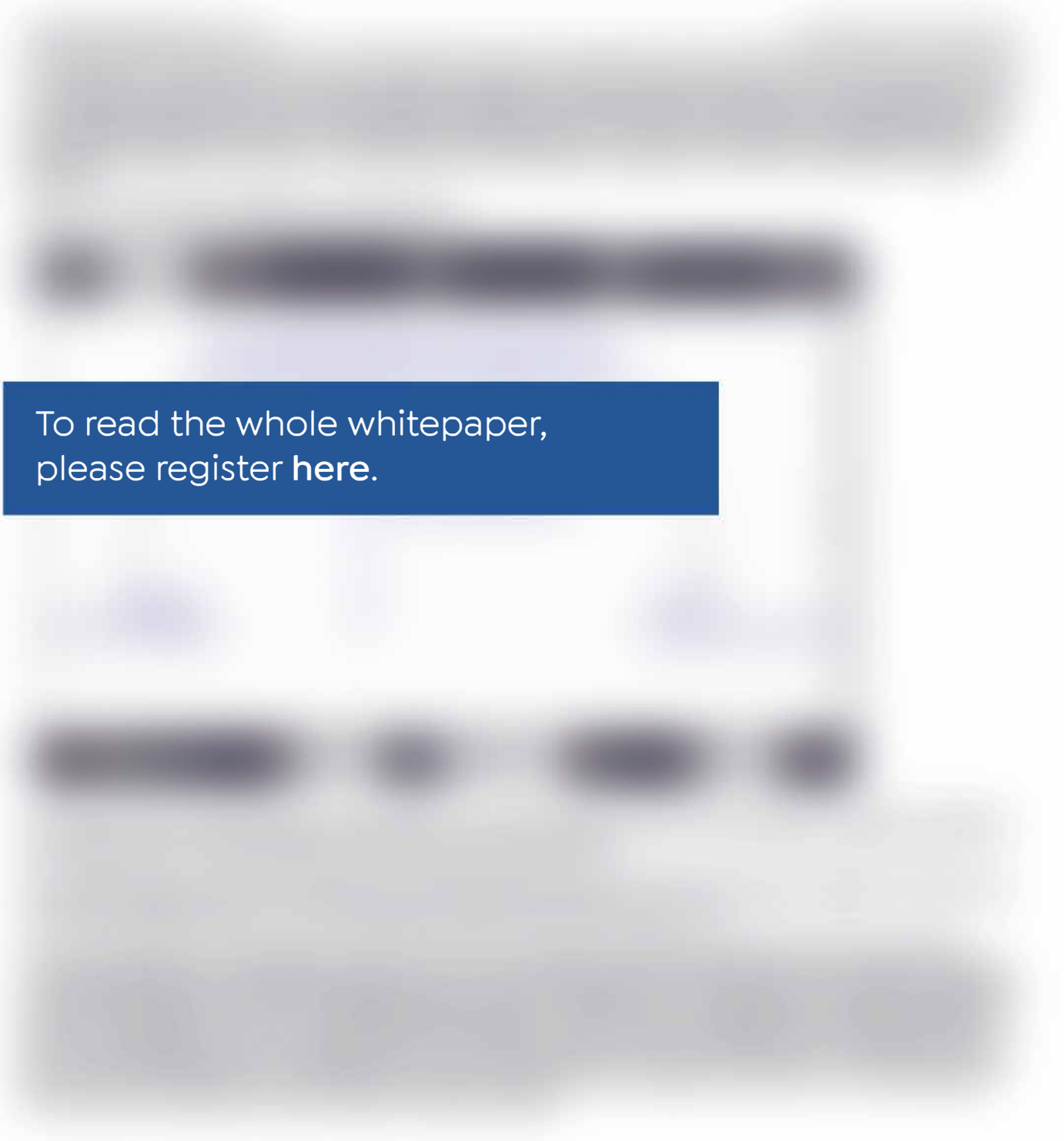
During the course of normal operation, it is expected that the optocoupler or isolator is subjected to a continuous voltage stress. This voltage is typically referred to as the working voltage.

Since this stress voltage is continuous, the probability of risk to people is much higher should the insulation fail. For this reason, the working voltage rating is usually derated by a factor of two from the designed continuous voltage stress capabilities of the optocoupler or isolator.

Transient Voltage Capabilities

In addition to being capable of holding of the continuous working stress voltage, the optocoupler or isolator is also required to hold off or survive high transient voltages. The types of transient voltages can be categorized either into high energy or low energy transients (Figure 1).

High energy transients have the propensity to be hazardous. Although low energy transients are generally not directly hazardous to health, they do present significant risk to the well being of the insulation material, which could in turn lead to a safety hazard.



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