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White Paper

Ensure Safe System Operation with Certified Isolator Devices

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Introduction

Isolation components such as optocouplers that are used in applications that have user safety issues as a key aspect must not fail under continuous high-working-voltage bias conditions. Safety hazards exist, and human life is at risk when such insulation fails and the high voltages come in contact with the user. To prevent such occurrences, continuous working voltage ratings and test methodologies are regulated by international component standards and equipment safety standards.

To provide designer confidence, isolator products must be certified to ensure that they meet the required insulation levels for the desired safety ratings. Equipment manufacturers, to meet the system safety ratings, will often use isolators that are certified to meet recognized standards in order to ensure safety and compliance to regulations. These isolation requirements are met through mechanical, constructional guidelines and component safety standards. Optocouplers are a prime example of components that are currently regulated by component-level safety standards.

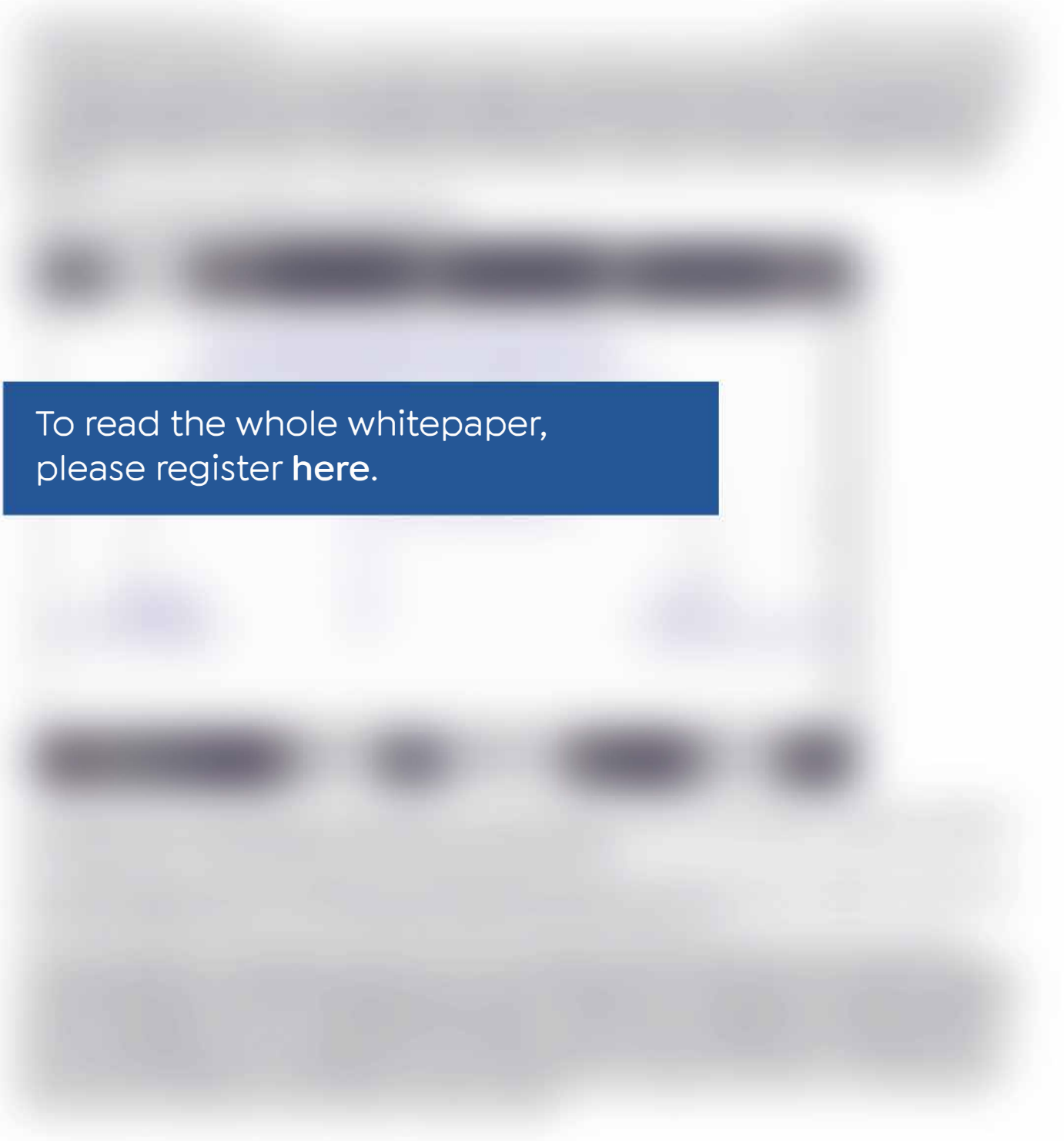
An example of an optocoupler standard is VDE0884, which was subsequently replaced by DIN/EN 60747-5-2, DIN/EN 60747-5-5. This standard was developed to address all of the specific safety aspects of optocoupler technology. One of the key achievements of this standard is the implementation of 100% manufacturing test methodology. This methodology is able to reliably prove the long-term high-voltage endurance of every manufactured optocoupler.

In recent years, alternative isolators using different coupling technologies, e.g. magnetic and capacitive isolators, have been introduced to the market. These alternative isolators are typically built using ultra thin (10 µm to 20 µm) insulation layers, while optocouplers have insulation thicknesses of 80 µm to 1000 µm. The thinner insulation barrier in the alternative isolators experiences higher electric-field stress for the same working voltage, and thus can be more prone to failure than the optocouplers.

Aside from the mechanical differences, optocouplers and alternative isolators use different insulation materials. Optocouplers typically use homogenous polyimide/silicone while alternative isolators use either spin coat polyimide or silicon dioxide (SiO_2). And since there are no existing standards for these alternative isolators, as a compromise, some test houses offer certified compliance to the optocoupler standard DIN/EN 60747-5-2. Test bodies have only issued certification of BASIC insulation, which implies a partial compliance but not a full certification. That is because the quality and characteristics of thin-film polyimide and CMOS insulation with respect to safe insulation application is not well understood. Additionally, there is the question of whether the high-voltage aging mechanisms for the optocoupler and alternative isolators are similar.

VDE0884-10 is a draft standard that has its roots in the VDE0884 optocoupler standard. This standard relies on the partial discharge principle to predict safe, continuous high-voltage lifetimes. Since the drafting of VDE0884-10, it has been proven that partial discharge is not the principle aging mechanism of alternative isolators. There are other aging mechanisms active at lower stress voltage levels for these alternative isolators.

The practice of using optocoupler test methods for alternative isolators has raised concerns and questions. This article is intended to provide experimental test data and analysis to address such concerns.



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