BROADCOM®

White Paper

Building Safe and Reliable Electrical Systems with Optocouplers

Overview

Electrical systems, no matter what their purpose, share three primary requirements: reliable, safe, and long life operation. To ensure safe operation, users must be double insulated from any dangerous high voltages the equipment employs. To ensure reliable and long life operation, control electronics must also be protected from hazards such as electromagnetic interference and voltage spikes. Broadcom® optocouplers provide safety and protection unmatched by any other isolation technology.

Designers must consider many factors when selecting an isolation technology. The primary factor, of course, is the safety of equipment and personnel. Industrial equipment typically operates using signals of several hundred to several thousand volts. Yet the threshold of human safety can be as low as 42 V DC or 60 V AC. Electronic equipment can be even more sensitive when composed of integrated circuits that can typically be damaged by even a few tens of volts applied across the wrong pins.

To prevent humans and electronics from harm, they must work in the safety extra low voltage (SELV) realm even though other parts of the electrical system use high voltages. Keeping these two voltage realms separated while also passing information between them is the job of the isolation device. These isolation devices must be able to operate with a continuous stress across their isolation barrier of hundreds of volts.

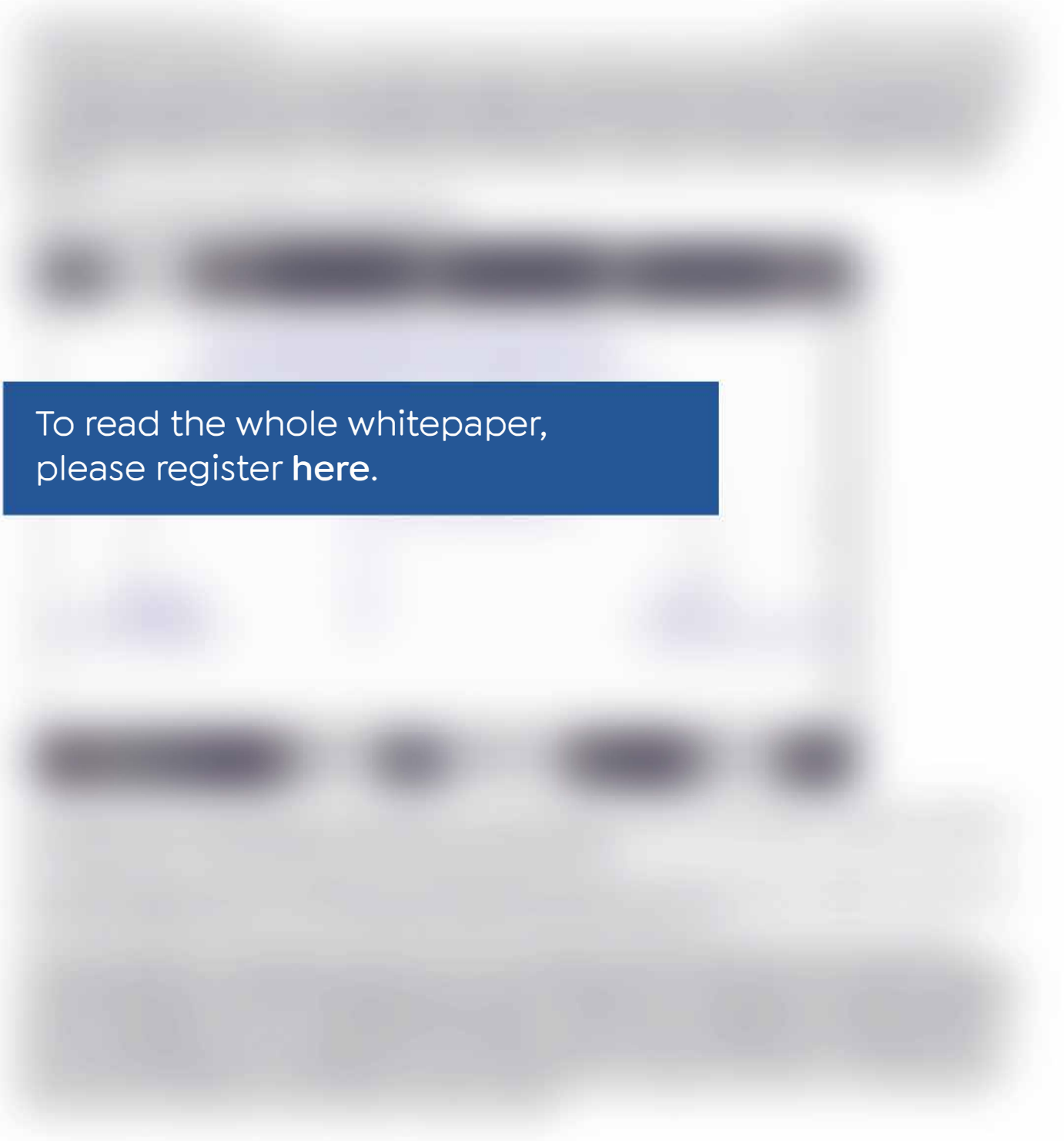
A second factor to consider is the isolation device's insulation rating. There are three levels of insulation rating: functional, basic, and reinforced or double. Functional insulation is that needed for the device to operate and implies nothing about safety. Basic insulation provides protection for users from electrical shock, as long as the insulating barrier remains intact. Reinforced, or double, insulation provides failsafe operation so that if one level of insulation fails, a second level will continue to protect the user. All signal lines going from the high voltage realm to electronic circuits driving interfaces that a user might touch, such as switches and displays, require isolation with a reinforced insulation rating. One of the prime considerations in achieving a reinforced insulation rating is the distance through insulation (DTI) that a high-voltage signal must traverse in order to reach a human.

Consider More Than Safety

While not directly related to human safety, an important factor for the safety of electronic equipment as well as for reliable operation of the equipment is electromagnetic compatibility (EMC). Parameters such as common mode noise immunity and radiated susceptibility are important in assuring that an isolation device will transmit control signals without error. Radiated emissions are an important measure of whether or not an isolation device will generate errors in other signal lines.

Designers should also be aware of the wear out mechanisms that can lead to failure in isolation devices over time. High-voltage transients such as electrostatic discharge (ESD) and voltage surges represent one type of failure mechanism. ESD most often arises from static buildup on human operators while voltage surges arise as the result of changing loads on system power as well as kickback from switching inductive loads. These voltage transients might not themselves result in immediate device failure, but can cause damage that can lead to failure later.

Continuous high-voltage stress across the isolation barrier can also lead to failures, particularly when there are voids in the insulation material. Partial discharges within those voids can wear away the insulating material, eventually leading to failure. To ensure that this failure does not occur during the working lifetime of equipment, designers must consider the high-voltage life rating of their isolation device.



To read the whole whitepaper,
please register **here**.