Application Note

How to Use Bi-directional Input Signal for Digital Input Modules

TEXAS INSTRUMENTS

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ABSTRACT

Digital Input (DI) modules are fundamental to industrial automation systems, enabling Programmable Logic Controllers (PLCs) and motor drives to receive 24V digital signals from field devices. Isolation and current-limiting are critical for making sure of system reliability, especially in high-density applications. This document discusses the requirements defined by IEC 61131-2 for digital input types and presents a robust design for detecting bi-directional AC input signals using the ISO1228 isolated digital input receiver. By incorporating a series diode to perform half-wave rectification, the ISO1228 can safely interpret AC signals intended for DC input devices. This approach makes sure of reliable operation, surge protection, and makes the ISO1228 a designed for choice for modern PLC digital input applications.

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1 Introduction

Digital Input (DI) modules are used in Programmable Logic Controllers (PLCs) and Motor Drives to receive 24V digital inputs from field sensors and switches. Isolation is used to manage ground potential differences. The input signal is interpreted as a logic high or low using a voltage comparator with hysteresis. Some form of current limit is also implemented to avoid excess current draw from the 24V inputs; power dissipation is a critical concern in high-density compact multichannel designs.

The IEC 61131-2 standard for programmable controllers specifies three different types of digital input receivers: Types 1, 2, and 3. Designed for implementations for Type 1 and 3 need to draw as close to 2mA as possible in the ON-state, and have voltage transition thresholds between 5V and 11V.

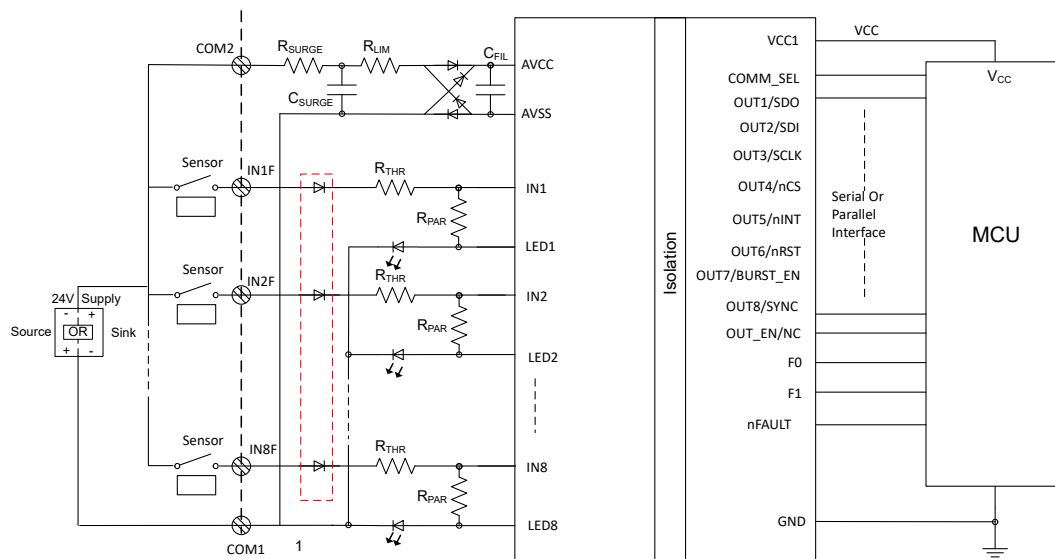## 2 Bi-Directional Input Signal Detection

For AC input signals to a PLC module, the input voltage alternates between positive and negative relative to ground — making this bi-directional. However, isolated digital input devices like the ISO1228 are typically designed to detect unidirectional (DC) signals. To correctly detect the AC signal while protecting the ISO1228, the input circuit can be designed as shown in Figure 2-1.

In this configuration, a series diode (highlighted in red) is used to block the negative half of the AC signal. This allows only the positive half-cycle to reach the ISO1228 input, effectively converting the AC signal into a form the device can process. The diode essentially performs a half-wave rectification.

Since the diode experiences inrush or surge currents—especially during switching or when the AC signal has fast transients—this must be selected with appropriate ratings. The diode can be capable of withstanding:

*   High surge current
*   Frequent switching
*   Must have designed for voltage and current ratings for the application

This design makes sure of safe and reliable detection of AC signals using a digital input device intended for DC operation, without damaging the device or misreading the signal.

Figure 2-1. Channel Operation of a Digital Input Module for Bi-Directional Input Signal Using ISO1228

3 Summary

The ISO1228 is an isolated digital input receiver designed to interface with industrial PLC inputs. This supports 24V logic levels and provides robust isolation between the input and logic sides. To detect a bi-directional AC input using the ISO1228, a series diode is used to block the negative half-cycle of the signal. This protects the device and makes sure of correct detection. The diode must be rated to handle surge currents safely. With this configuration, the ISO1228 becomes a highly reliable and efficient design for PLC digital input applications.

4 References

*   Texas Instruments, *ISO1228 Eight-Channel Isolated Digital Input with Current Limit and Diagnostics*, data sheet
*   Texas Instruments, *ISO1228DFBEVM ISO1228 Evaluation Module for 8-Channel Isolated Digital Inputs in Sink Mode*
*   Texas Instruments, *Space-Saving Design Techniques for Multichannel High- Voltage Digital Input Modules*, application brief.

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