Technical Article

Achieving reliable data transfer in industrial systems with 3.3V CAN transceivers

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The industrial market is rapidly evolving, with emerging technologies meeting the growing demand for innovation and efficiency. Industrial applications use many different interfaces, including Ethernet, RS-485 and Controller Area Network (CAN), to communicate time-sensitive data between different pieces of equipment. Designers have to consider many different objectives and trade-offs when selecting which interface to use.

CAN was one of the first protocols to provide reliable data communication in harsh and noisy industrial environments, and it remains popular. CAN transceivers, which provide the physical layer of the CAN protocol, offer high power efficiency, high data rates and a small physical size while remaining robust and reliable, making them a good choice for many industrial applications. In this article, we will introduce the benefits of CAN transceivers and discuss their role in maximizing efficiency in industrial applications.

Figure 1 shows various industrial applications that typically use CAN transceivers to deliver data.

Figure 1. Solar inverter, uninterruptible power supply (UPS), HVAC system, programmable logic controllers and an energy storage system rely on CAN

Ensuring communication in industrial environments: the role of CAN transceivers

CAN transceivers are essential in industrial automation systems because they enable devices such as sensors, controllers and actuators to communicate by converting digital signals into analog differential signals that can be sent long distance on a bus. The transceiver ensures that data is transmitted reliably and the network is protected from electrical damage. This makes data exchange more efficient and communication more accurate. Therefore, reliability, small size, and low power consumption are crucial when selecting a new CAN transceiver in industrial applications.

Let's discuss the importance of robustness in an industrial environment. Electrical hazards such as voltage spikes, transients and electrostatic discharge (ESD) are common sources of interference in the industrial environment. Devices in areas or products susceptible to ESD, such as assembly lines and robotics and automation systems, need to have ESD protection in their CAN transceivers to ensure the safety of the network. Integrating ESD protection into the CAN transceiver helps ensure that it can withstand high-voltage discharges without malfunctioning. Additionally, industrial applications often use long CAN bus cables, which increases the risk of bus faults such as short circuits and overvoltage conditions. Equipment connected to such extended networks requires transceivers with high bus-fault protection. Without this protection, these faults can damage the transceiver and potentially propagate through the entire network, leading to communication disruptions and system downtime.

Various products use the CAN interface today, such as industrial programmable logic controllers (PLCs), motor drives, remote sensors and actuators. Industrial PLCs control several industrial processes and are typically connected to extensive sensor networks, causing long bus cable lengths. Motor drives control high-power motors, which may cause voltage spikes and transients on the CAN bus. In both of these cases, it is crucial to have robust bus-fault protection in place for the CAN transceiver. Remote sensors and actuators are often

located at the network's periphery, thus requiring strong ESD protection given their potential exposure to static electricity in the environment.

In industrial settings where CAN covers long distances, ground potential differences and common-mode noise buildup can lead to signal degradation. CAN transceivers have a wider common-mode range to help ensure reliable signal transmission across the entire network. For example, motor drives, which often produce ground-loop currents and common-mode noise, require transceivers with wider common-mode ranges to minimize communication errors which is to enhance data integrity of motor control and feedback signals.

Both 5V CAN and 3.3V CAN transceivers are popular in industrial applications. However, a 3.3V CAN transceiver can provide additional benefits, such as eliminating the low-dropout regulator (LDO) and level-shifting circuitry between the 3.3V microcontroller and the 5V CAN transceiver. This 3.3V CAN transceivers simplifies system designs, reduces component count, and makes the end product more compact. Additionally, removing the LDO can reduce overall system costs. Figure 2 shows a typical configuration for the 3.3V microcontroller and 3.3V CAN transceiver operation.

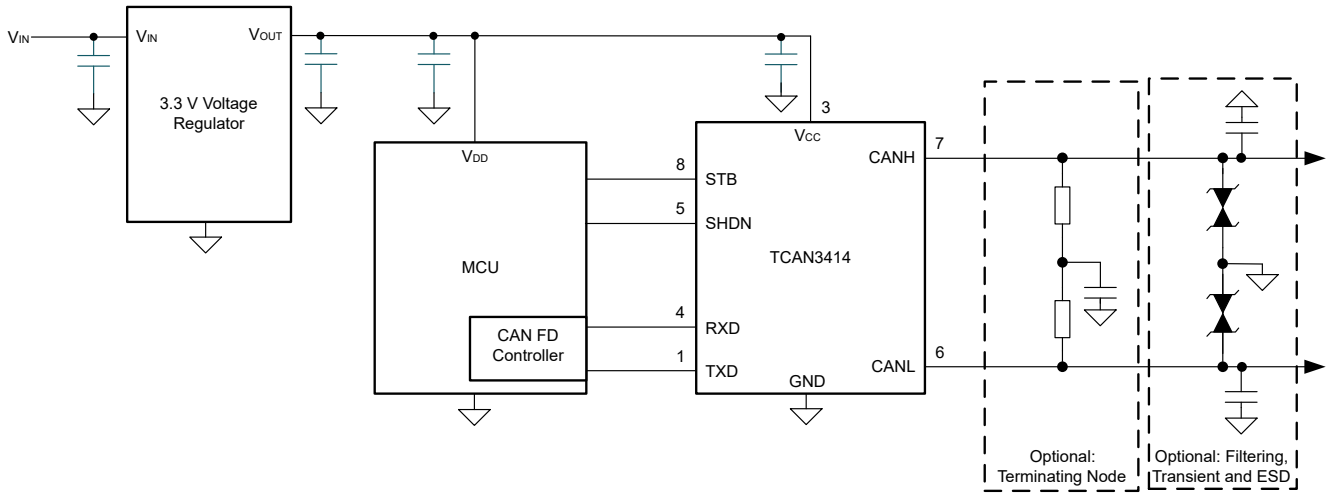

Figure 2. Application schematic of a 3.3V CAN transceiver

When it comes to power consumption, 3.3V CAN transceivers are more efficient than traditional 5V CAN transceivers. In addition, the shutdown function of a 3.3V CAN transceiver such as the TCAN3414 can further reduce current to extend battery life in battery-powered applications or devices with strict power limitations.

Figure 3 shows 3.3V and 5V CAN transceivers operating seamlessly in one network. The 3.3V-supplied CAN transceivers, such as TI's TCAN3413 and TCAN3414, are fully interoperable with 5V CAN transceivers. For further detail, please see the white paper, Automotive-Qualified EMC Certified 3.3V CAN Transceivers.

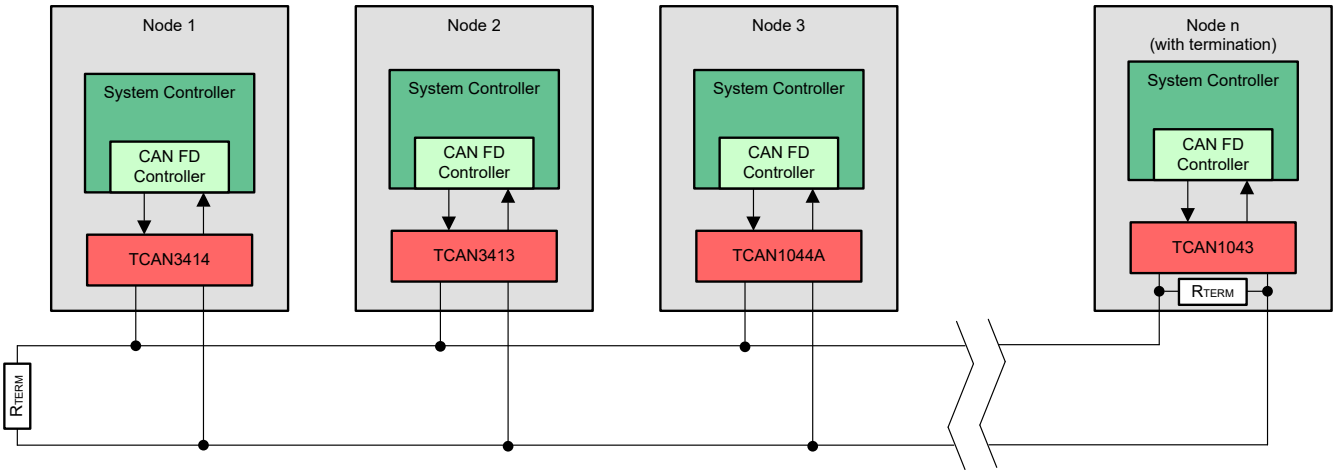

Figure 3. The typical CAN Network with 3.3V and 5V CAN transceivers

Conclusion

3.3V CAN transceivers such as the TCAN3413 and TCAN3414 help designers implement reliable interface that operates efficiently in industrial environments. They provide multiple features that can protect against various problems in industrial environments. These devices include International Electrotechnical Commission IEC-61000-4-2 ESD protection on the bus up to ±10kV, high bus-fault protection of ±58V, and a wide receiver common-mode input voltage range of ±30V. These features help enable you to optimize your design for reliable communication enhancement, while saving board space and system cost.

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