Technical Article

Simplify automotive interface design with fully interoperable and EMC-compliant 3.3V CAN transceivers

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Vehicles are evolving to include more advanced features enhancing safety, comfort and convenience. More features require more complex electronics, which emphasize the importance of power efficiency. Power efficiency enables longer driving ranges and lowers operational costs, resulting in semiconductor manufacturers lowering the typical supply voltage of an electrical component such as a microcontroller (MCU) from 5V to 3.3V. In many automotive systems, you now only need a 5V power rail for the 5V Controller Area Network (CAN) transceiver, while all other components can use a 3.3V or lower supply rail derived from the 12V, 24V or 48V battery. CAN transceivers operating from the 3.3V power supply would eliminate the need for the 5V rail and facilitate seamless interfacing with the MCU.

For automotive CAN networks currently in production, the only transceivers available that pass electromagnetic compatibility (EMC) standards also require a 5V power supply. Figure 1 shows a simplified block diagram of a 5V CAN node where the CAN controller is integrated into the MCU. With a 3.3V CAN transceiver, it is possible to use the 3.3V power supply for both the MCU and transceiver therefore reducing the overall bill-of-materials cost and board space.

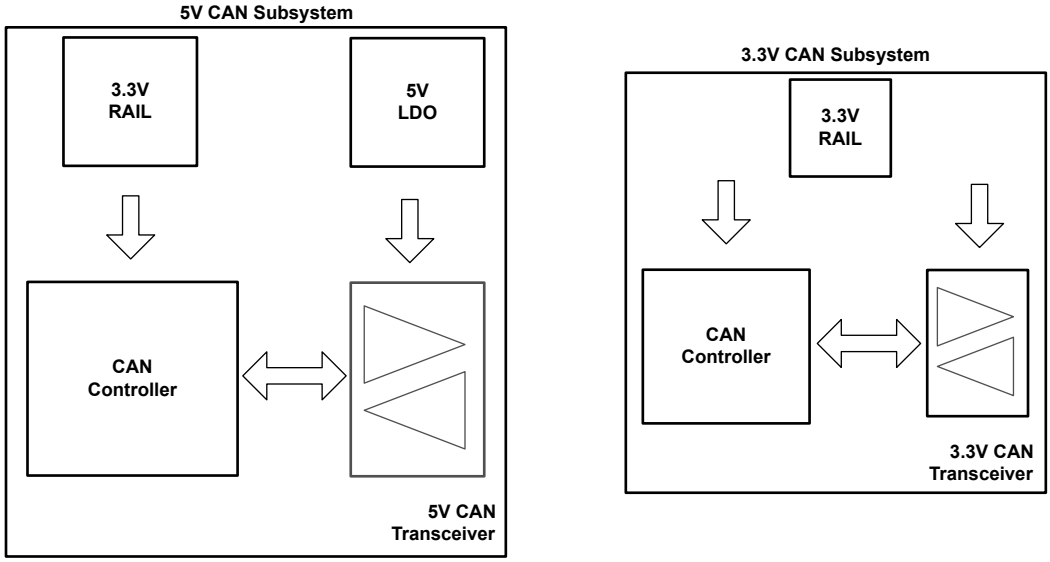

Figure 1. Simplification of a design with 3.3V CAN

3.3V CAN transceivers have existed in the industrial market for decades. Designers face two challenges when transitioning them to the automotive market, however; how to interoperate with existing 5V CAN transceivers and how to pass strict automotive EMC requirements. In this article, I'll explain how TI's 3.3V CAN transceivers can help overcome these challenges.

5V CAN transceiver interoperability

5V CAN transceivers are the incumbent solution for CAN networks, so it is essential that 3.3V CAN transceivers are fully interoperable within existing networks and architectures. For Tier1 automotive suppliers, interoperability is especially important, because they typically do not own the design of the whole CAN network. These suppliers will not know if the portion of the CAN bus they are designing will connect to a 3.3V or 5V transceiver. Interoperability between 3.3V and 5V CAN mitigates this risk. If 5V and 3.3V CAN transceivers are fully interoperable, it is no longer necessary to change all of the nodes on the communication bus to 3.3V. Subsystem designers have the flexibility to decide whether a single node on the CAN bus would benefit from a 3.3V transceiver.

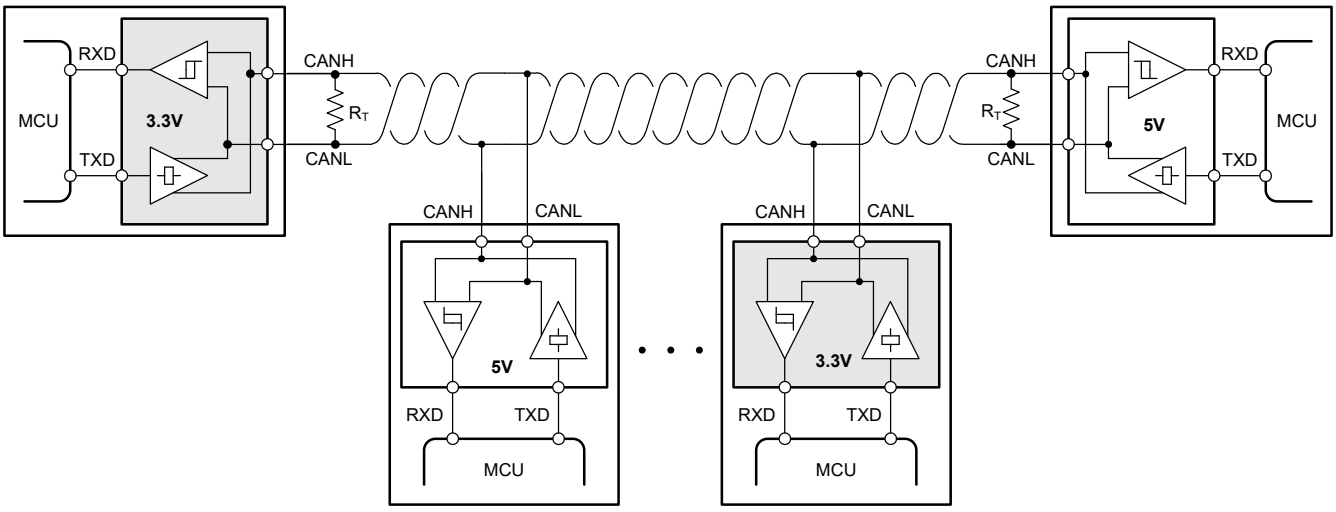

Figure 2. Interoperability of 3.3V and 5V CAN transceivers

TI's 3.3V CAN families have been successfully tested to International Organization for Standardization (ISO) 16845-2. The testing covers a homogeneous network of all 3.3V transceivers and a heterogeneous network where four out of 16 CAN nodes are the 3.3V transceiver and the remaining 12 CAN nodes are a mix of three other industry-accepted 5V CAN transceivers. TI's automotive 3.3V TCAN3403-Q1 and TCAN3404-Q1 transceivers have successfully passed this interoperability testing.

EMC requirements

EMC performance of CAN transceivers is measured through two parameters: emissions produced by the device itself and immunity from interference present in the system. The TCAN3404-Q1 and TCAN3403-Q1 are compliant with the International Electrotechnical Commission (IEC) 62228-3 standard for EMC performance.

Emissions are the release of electromagnetic energy. Ideally, low emissions ensure that normal operation will not affect the performance of other nearby components. Immunity is a device's ability to function without error in the presence of interference, such as emissions from other nearby components. Testing performed by third-party testing houses are among the most stringent tests for automotive applications and characterize the emissions and immunity performance of CAN transceivers.

5V CAN transceivers became popular because commercially available devices influenced the creation of EMC standards, while 3.3V CAN transceivers have struggled to overcome the challenges of meeting pre-existing standards. With TCAN3404-Q1 and TCAN3403-Q1's ability to pass EMC requirements in a homogenous or heterogeneous network, this barrier has been overcome.

Conclusion

The TCAN3403-Q1 and TCAN3404-Q1 can pass stringent automotive EMC requirements and are fully interoperable with 5V CAN transceivers. As 3.3V becomes the standard supply voltage for automotive components, 3.3V CAN transceivers enable design flexibility to reduce the number of power supplies in the system to save power and cost.

Additional resource

For more technical information about 3.3V CAN transceivers, check out the technical white paper, “Automotive-Qualified Electromagnetic Compliant 3.3V CAN FD Transceivers.”

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