A bouquet of CAN FD compliant transceivers

Infineon has launched different versions of stand-alone transceivers and system base chips (SBC) supporting bit-rates of up to 5 Mbit/s. They are qualified for automotive applications according to AEC-Q100.

The CAN high-speed media access unit is standardized in ISO 11898-2:2016. It specifies the transceiver parameters for 2 Mbit/s as well as for 5 Mbit/s. CiA recommends to use even for 2-Mbit/s CAN FD networks implementations that comply with the 5-Mbit/s parameters. Nearly all automakers have started the migration from Classical CAN to CAN FD networks. Other industries are slower, except commercial vehicles. The market-leading truck OEMs and some manufacturers of construction machines have also launched internally CAN FD projects.

Infineon has developed a broad range of products compliant with ISO 11898-2:2016 supporting bit-rates of up to 2 Mbit/s respectively 5 Mbit/s. One of these products is the TLE9250X stand-alone transceiver. The product coming in a PG-DSO-8 or in a leadless PG-TSON-8 package is qualified for transmission rates up to 5 Mbit/s. While the transceiver is not supplied, the network is switched off and illustrates an ideal passive behavior with the lowest possible load to all other nodes of the CAN FD network. Fail-safe features like over-temperature protection, output-current limitation or the TxD time-out feature protect the product and the external circuitry from irreparable damage.

Based on symmetric CAN-H and CAN-L output signals, the component provides a low level of electromagnetic emission (EME) within a wide frequency range. The transceiver fulfills even stringent EMC test limits without additional external circuit, like a common mode choke, for example. The transmitter symmetry combined with the optimized delay symmetry of the receiver enables the transceiver to support 5 Mbit/s. Of course, this depends on the size of the network and the along coming parasitic effects.

Modes of operations

The TLE9250X supports three modes of operation: normal-operating, receive-only, and forced-receive-only mode. Mode changes are either triggered by the RM mode selection input pin or by an under-voltage event on the transmitter supply. An under-voltage event on the VIO digital supply powers-down the transceiver.

In normal-operating mode, the transmitter is active and drives the serial data stream on the TxD input pin to the CAN-H and CAN-L pins. The receiver is also enabled and converts the signals from the network to a serial data stream on the RxD output. The forced-receive-only mode is a fail-safe mode, which is entered when the transmitter supply is not available. The transmitter is disabled and the data available on the TxD input is blocked, but the normal-mode receiver is enabled. In receive-only mode, the transmitter is disabled and the receiver is active. The user triggers this mode.

There is also a power-down state, in which the differential input resistors of the receiver are switched off. The CAN-H and CAN-L lines are floating. The transceiver acts as a high-impedance input with a very small leakage current. The high-ohmic input does not influence the “recessive” level of the CAN FD network and allows an optimized EME performance. In power-down state, the transceiver is an invisible node to the network.

Fail-safe functions

The transceiver provides fail-safe functions like short-circuit protection, TxD time-out, and over-temperature protection. Additionally, the RM input pin has an internal pull-down current source to GND. All other logic input pins have an internal pull-up current source to VIO. In case the VIO and VCC supply is activated and the logical pins are open, the transceiver enters into the normal-operating mode by default.

The TxD time-out feature protects the CAN network against permanent blocking in case the logical signal on the TxD pin is continuously “low”. A continuous “low” signal on the TxD pin might have its root cause in a locked-up micro-controller or in a short circuit on the printed circuit board, for example. All these fail-safe functions are not required by the ISO 11898-2:2016 standard. They are implementation-specific, but usually requested by the automakers.

Further transceivers and SBCs

Infineon has also introduced the TLE9251X transceiver family providing the same features, but with additional wake-up...
behavior. It supports 3,3-V and 5-V operations. Such as the TLE9251, the TLE9252X chips feature regular wake-up functionality and are coming in 14-pin packages. They also support Battery Supply Access. The TLE9255WXX provide selective wake-up functionality according to ISO 11898-2:2016. Of course, all these products are qualified for bit-rates up to 5 Mbit/s. There are also 14-pin dual-port transceivers available. All these products comply with ISO 11898-2:2016. This standard substitutes the three predecessors: ISO 11898-2, ISO 11898-5, and ISO 11898-6. The related conformance test plan will be standardized in ISO 16845-2:2018.

The CAN transceivers are also available in SBCs. These are chips providing additional functionality. Infineon’s Lite SBC family comprises LDO (low-dropout) regulators and DC/DC modules as well as one CAN transceiver. The mid-range SBCs feature one CAN and up to four LIN transceivers. There are also CAN products with DC/DC unit and up to four LIN transceivers. Besides those products in development, Infineon offers already the Multi-CAN SBC with four CAN transceivers.

Just the first step

The availability of ISO 11898-2:2016 compliant chips is just the first step. For device and network system more standardization is needed. It is necessary to standardize other physical layer components. CiA, Jaspar (Japan), and SAE (U.S.A) develop such specifications. Recently, CiA started a recommendation for common-mode chokes and for cables. SAE has released already the SAE J2284-4/5 recommendations for dedicated CAN FD networks and Jaspar has launched also some device and system design recommendations.

Some applications would benefit from ringing suppression circuitry integrated into the CAN transceiver chips. In particular, if non-linear topologies are used, for example hybrid topologies with one or multiple stars. The usage of ringing suppression circuitry is also suitable, when higher bit-rates than 5 Mbit/s are demanded. There is a CiA task force specifying the requirements for ringing suppression. Infineon is actively participating as well as Denso and NXP. Of course, OEMs participate, too.

Figure 1: Block diagram of the TLE9250X transceiver supporting several modes and providing fail-safe functions (Photo: Infineon)