

CAN XL ecosystem and product availability



(Source: Adobe Stock)

Since 2018, the CiA special interest group (SIG) CAN XL is specifying the CAN XL ecosystem. In the meantime, the SIG CAN XL has established four task forces (TF): TF CAN XL physical layer, TF CAN XL higher layer, TF CAN XL security, and TF simulation. The related CiA meetings are participated by more than 30 attendees working with auto-makers (OEMs), Tier-1 suppliers, semiconductor manufacturers as well as tool vendors and service providers.

There are three CAN protocol (data link layer) generations, which have been specified internationally.

- ◆ 1993: ISO 11898 standard (1st generation), also known as Classical CAN protocol;
- ◆ 2015: ISO 11898-1 standard (2nd generation), includes the CAN FD protocol option;
- ◆ 2021: CiA 610-1 specification (3rd generation), also known as CAN XL protocol, XL stands for “extended data field length”, and the ISO 11898-1 is under review to include CAN XL in the next edition.

Today there are different transceiver technologies (physical layer) that are used in CAN networks. Figure 1

shows the evolution of the most used CAN transceiver type, and the newly developed transceiver types. In principle, the compatibility between the used transceiver types in one network is guaranteed. But you should be aware of the configuration possibilities, as to enable/disable error signaling and transceiver mode switching (fast Tx/Rx mode or SIC mode).

Editor’s note: For more details about the physical layer options, you can find another two articles from [Infineon](#) and [NXP](#) in this CAN Newsletter issue.

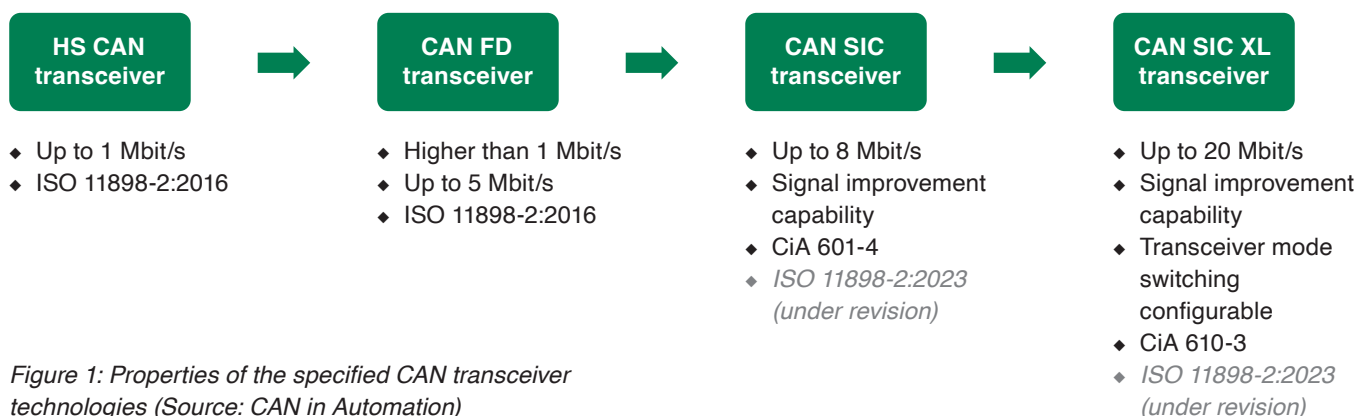
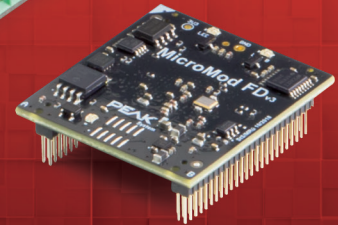
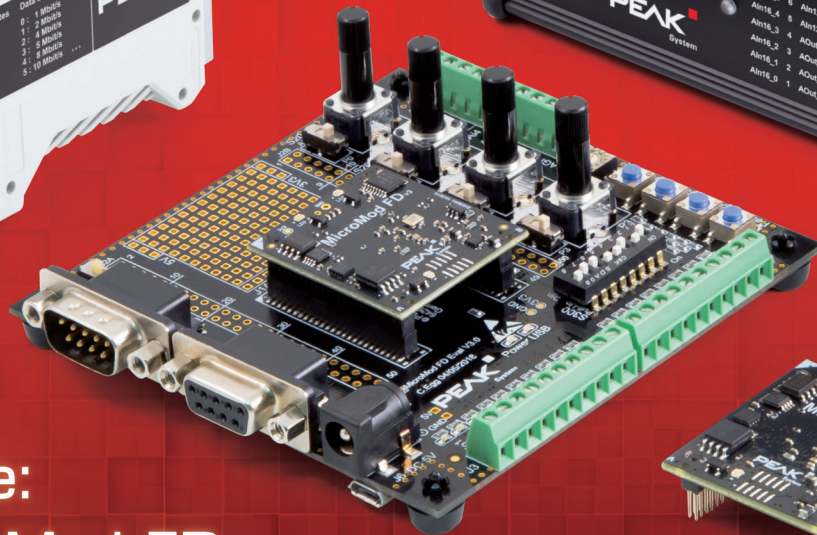


Figure 1: Properties of the specified CAN transceiver technologies (Source: CAN in Automation)



Product Line: PCAN-MicroMod FD

■ I/O Modules with CAN FD & CANopen FD

The PCAN-MicroMod FD is a plug-in board that provides a CAN FD interface and I/O functionality for the integration into your hardware. An evaluation board facilitates developing your custom solution. The modules are configured with a Windows software via CAN and then operate independently.

Ready-to-Use Motherboards

The PCAN-MicroMod FD is available with motherboards providing peripherals for specific applications.

Common Features:

- Board with plugged on PCAN-MicroMod FD
- CAN FD connection with switchable CAN termination
- 2 frequency outputs (Low-side switches, adjustable range)
- Analog input for voltage monitoring up to 30 V (12 bit)
- Aluminum casing with spring terminal connectors
- Extended operating temperature range from -40 to +85 °C
- Operating voltage 8 to 30 V

PCAN-MicroMod FD Analog 1:

- 8 analog inputs (16 bit, adjustable range)
- 4 analog inputs (12 bit, 0 to 10 V)
- 4 analog outputs (12 bit, adjustable range)
- 4 digital inputs (pull-up or pull-down)

PCAN-MicroMod FD Digital 1 / Digital 2:

- 8 digital inputs (pull-up or pull-down)
- 3 analog inputs (12 bit, 0 to 10 V)
- Digital 1: 8 digital outputs with Low-side switches
- Digital 2: 8 digital outputs with High-side switches

CANopen & CANopen FD Solutions

The PCAN-MicroMod FD DR CANopen Digital 1 is an I/O module for operation in CANopen (FD)[®] networks.

Main Features:

- CANopen[®] and CANopen FD[®] connection
 - Communication profiles according to CiA[®] 301 version 4.2.0 and CiA[®] 1301 version 1.0.0
 - Device profile according to CiA[®] 401 version 3.0.0
 - Certified CANopen[®] and CANopen FD[®] conformity
- 8 digital inputs, comply with the IEC 61131-2 standard
- 8 digital outputs with High-side switches
- Plastic casing (width: 22.5 mm) for mounting on a DIN rail

All PCAN-MicroMod FD products can alternatively be operated with CANopen[®] and CANopen FD[®] firmware from our partner Embedded Systems Academy.

Specifications and other documents

Inside the SIC CAN XL and the TFs, the ecosystem of CAN XL is developed. Table 1 shows the CAN XL related specifications and documents. The SIG CAN XL has already released the CiA 610-1 CAN XL data link layer requirements, the CiA 610-3 CAN XL physical layer requirements, and the CiA 611-1 SDU (service data unit) types for the CAN XL higher-layer services.

The CiA 120 document will specify test and measurement methods for EMC evaluation of CAN SIC transceiver ICs and CAN SIC XL transceiver ICs under network conditions. It should be compliant with IEC 62228-3:2019. It defines test configurations, test conditions, test signals, failure criteria, test procedures, test setups, and test boards. It covers the emission of RF disturbances, the immunity against RF disturbances, the immunity against impulses, and the immunity against electrostatic discharges (ESD). The aim is to submit this specification to IEC for international standardization.

The CiA 610 series provides requirement specifications and conformance test plans for the CAN XL data link layer and physical layer. It is intended for chip implementers

of e.g. CAN XL protocol controllers as well as CAN SIC XL transceivers. Optionally, the CAN XL protocol controller provides the PWM encoding to be linked to a CAN SIC XL transceiver, which provides the PWM decoding. The CAN XL specifications and test plans series comprises five parts as shown in Table 1. CiA 610-5 is the interoperability test plan for heterogeneous networks comprising nodes with transceiver ICs from different suppliers. It recommends interoperability test set-ups using dedicated PMA implementations. The interoperability test plan completes the CiA 610-4 PMA conformance test plan.

The CiA 611 series specify additional services and protocols, which can be mapped to the CAN XL data link layer as specified in CiA 610-1. This includes OSI (open system interconnect) higher layer communication and OSI layer management functionality. The service data unit (SDU) type field indicates the used next higher OSI layer protocol data unit (PDU). The SDU type defines how management information such as addressing, virtualization, or data size are mapped on dedicated LLC (logical link control) frame fields or how they are mapped into the CAN XL LLC data. SIG CAN XL has released the CiA 611-1 version 1.0.0 as Draft Specification Proposal (DSP) in ▶

Table 1: CAN XL ecosystem specifications and documents

Document number	Document title	Actual status
CiA 120	EMC evaluation of CAN SIC transceivers and CAN SIC XL transceivers	WD
CiA 610-1	CAN XL specifications and test plans – Part 1: Data link layer and physical coding sub-layer requirements	DS version 1.0.0 released
CiA 610-2	CAN XL specifications and test plans – Part 2: Data link layer and physical coding sub-layer conformance test plan	WD
CiA 610-3	CAN XL specifications and test plans – Part 3: Physical medium attachment (PMA) sub-layer requirements	DS version 1.0.0 released
CiA 610-4	CAN XL specifications and test plans – Part 4: Physical medium attachment sub-layer test plan	WD
CiA 610-5	CAN XL specifications and test plans – Part 5: Additional interoperability tests for physical medium attachment	WD (will be released as TR)
CiA 611-1	CAN XL higher-layer services – Part 1: SDU types	DSP version 1.0.0 released
CiA 611-2	CAN XL higher-layer services – Part 2: Multi-PDU	WD
CiA 612-1	CAN XL guidelines and application notes – Part 1: System design recommendations	WD
CiA 612-2	CAN XL guidelines and application notes – Part 2: PWM coding guideline	WD
CiA 613-1	CAN XL add-on services – Part 1: Simple/extended content (SEC) indication	WD
CiA 613-2	CAN XL add-on services – Part 2: Security	WD
CiA 613-3	CAN XL add-on services – Part 3: LLC frame fragmentation	WD
CiA 910-1	CAN simulation model – Part 1: General terms and use cases	WD
CiA 910-2	CAN simulation model – Part 2: PMA simulation model requirements	WD
CiA 910-3	CAN simulation model – Part 3: PMD simulation model requirements	WD
CiA 910-4	CAN simulation model – Part 4: Recommendations between PMA sub-layer and PCS	WD
DS	Draft Specification	
DSP	Draft Specification Proposal	
WD	Work Draft	
TR	Technical Report	

November 2022. Implementation of the CiA 611-1 enables "tunneling" of Classical CAN, CAN FD, and Ethernet frames via CAN XL networks. Directly after, Autosar has integrated CiA 611-1 in its November 2022 release. With Ethernet "tunneling" (Ethernet frame mapping), CAN XL can bring IP communication to any ECU (electronic control unit). By this, CAN XL qualifies itself as cost-efficient and flexible enabler of future E/E architectures.

CiA 612 series provides recommendations for the system design such as CAN clock recommendation, bit timing setting rules, and physical layer design recommendation. Following these, a robust communication with higher bit rate could be achieved easier.

In order to activate the required higher data phase performance in the CAN XL physical layer, CAN XL introduces an optional PWM (pulse-width modulation) encoding and decoding sub-layer at the AUI (attachment unit interface). This sub-layer is used to optionally convert the transmitted NRZ-coded TXD data between PCS (physical coding sub-layer) and PMA (physical media attachment) into a PWM-coded TXD data during the CAN XL data phase within the PCS on demand. The PMA uses the received PWM coded TXD data as an indicator to switch from the known "dominant/recessive" level towards the new "Level_0/Level_1" on the bus wires while decoding the PWM symbols back to NRZ format on the bus lines. The PWM coding acts like a "hidden control signal" towards the PMA switching between the two behaviors of the PMA. Since the PCS resides within the CAN XL protocol controller, the PWM encoding specification can be found in CiA 610-1. The corresponding PWM decoding is done within the PMA and is specified within CiA 610-3. The CiA 612-2 document gives guidelines how to configure the PWM coding and how to configure the node, if the "transceiver mode switching" is supported.

The CiA 613 series specifies the CAN XL add-ons services. They can be added transparently and concatenated independently. Planned add-on services include security functions (in CiA 613-2), and LLC frame fragmentation (in CiA 613-3). The SEC (simple/extended content) bit as specified in CiA 613-1 can signal add-on functions applied to the CAN XL data link layer. The CiA 613-2 document specifies the security protocol (CANsec), which aims to protect the integrity, freshness, authenticity of origin, and confidentiality of data in CAN-based networks using CAN XL communication. The CiA 613-3 document specifies the LLC (logic link control) frame fragmentation, which guarantees latency constraints of the system in a transparent manner. CAN XL allows to transmit frames with a maximum of 2048 bytes in the data field. A CAN XL frame at 10 Mbit/s with 2048 byte occupies the network for approximately 2 ms. For applications that require to transmit high-priority control information, a latency of 2 ms is perhaps too long. Therefore, a service is required that allows to interrupt an ongoing transmission.

The CiA 910 series specifies simulation models for CAN XL networks. Such models can support tool vendors to provide a CAN SIC (XL) system integrator with necessary tools to approve its network designs with confidence and furthermore allow the specific analysis of network design issues arising in the development phases. They will

comprise the physical layer model (e.g., transceivers and cables) requirements and recommendations for models between transceivers and protocol controllers.

CAN XL availability

The availability of CAN XL building blocks is important for engineers to adapt their applications to CAN XL. With the availability of the CAN XL IPs (intellectual properties), the ecosystem around CAN XL is quickly expanding. Hardware and software from different manufacturers are already available or will follow, soon.

CAN XL IPs:

- ◆ Bosch released the new protocol controller IP module X_CAN. It can be implemented in a SoC and supports Classical CAN, CAN FD, and CAN XL.
- ◆ Fraunhofer IPMS provides the CAN XL IP, which is purchased via CAST.
- ◆ NXP and Vector have also developed CAN XL IPs, which are only used for their own MCUs respectively tools.

MCUs with CAN XL on chip:

- ◆ Infineon has announced the Aurix TC4xx MCU family.
- ◆ NXP is developing new processors S32Z2 and S32E2 with respectively two CAN XL channels. The processors are currently in preproduction and samples are available.
- ◆ Renesas is developing the RH850/U2x MCU series, which will support CAN XL.
- ◆ STMicroelectronics has unveiled the MCUs Stellar P6 for EV (electric vehicle) platform system integration. The automotive MCUs are qualifiable components for 2024-model-year vehicles that incorporate the CAN XL on-board communication. Samples are available.

CAN SIC XL transceiver:

- ◆ Bosch's CAN SIC XL (proof of concept) transceiver and the Power Management ICs with CAN SIC XL transceiver are under development. Samples of the concept transceivers are available.
- ◆ NXP is developing the [CAN SIC XL \(proof of concept\) transceiver](#). Samples are available.
- ◆ Texas Instruments' CAN SIC XL transceivers are under development.

Tooling/software:

- ◆ Keysight, LeCroy, and Rohde & Schwarz are developing CAN XL protocol signal decoders.
- ◆ Vector's new CANoe tool version will support CAN XL.

CAN XL plugfest

To test interoperability of the available transceivers and protocol controllers from different sources in network environments, CiA is organizing the so-called CAN XL plugfests.

The first plugfest was held on July 2021 in Nuremberg, Germany. The IP cores from Bosch, Fraunhofer ▷

Documents submitted for ISO standardization

In 2022, CiA has submitted the CiA 610-3 and CiA 601-4 documents for integration into the next edition of ISO 11898-2. The related DIS (draft international standard) has been balloted positively with some technical comments. As already discussed within CiA, new parameters need to be specified. They are already part of the DIS comments.

The CiA 610-1 and CiA 604-1 (CAN FD Light) documents are also submitted to ISO to be integrated into the ISO 11898-1 standard.

The aim of the ISO working group (TC22 SC31 WG3) is to prepare the release of new ISO 11898-1 and ISO 11898-2 versions in 2023. In the meantime, the working group is also considering the review of the conformance test plan for the data link layer and physical layer, i.e., ISO 16845-1 respectively ISO 16845-2.

IPMS, and Vector were under test. NXP and Infineon provided their CAN SIC (XL) transceiver implementations. In May 2022, the companies attended the [second plugfest](#). On both plugfests, the compatibility of CAN XL IPs and CAN SIC XL transceivers have been tested. The experts have also built different topologies to prove the robustness. Currently, the CiA is organizing the third CAN XL plugfest on April 25, 2023, in Detroit area (USA). Interested parties are welcome to contact CiA at secretary@can-cia.org. ◀

Author

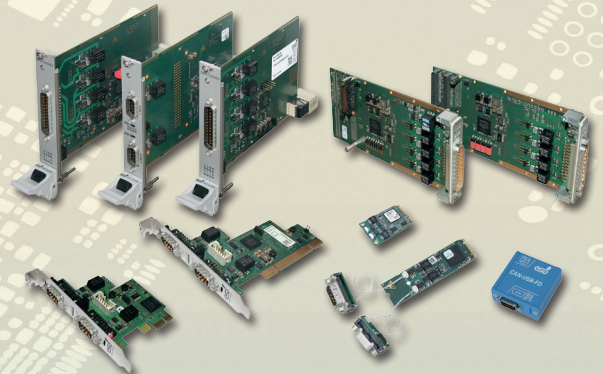


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