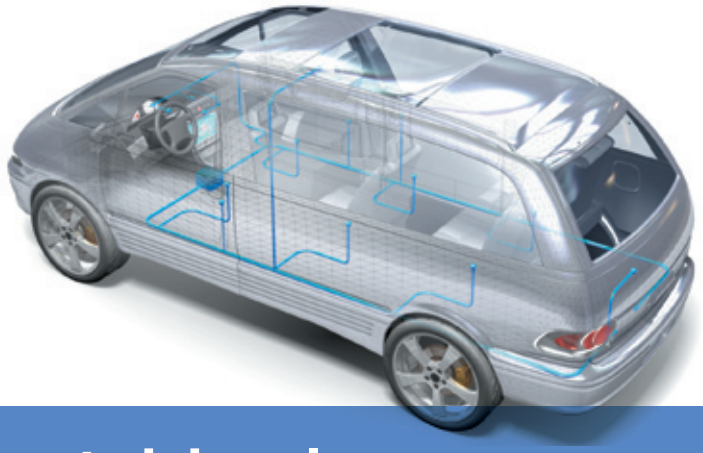


A complete CAN family from transceivers to gateways

Add value to your networks with CAN solutions that set the standard

NXP Semiconductors has played a leading role in establishing CAN as the automotive networking standard. Covering all CAN physical layer options, our product portfolio includes automotive-grade high-speed, single-wire and fault-tolerant transceivers along with stand-alone protocol controllers and Fail-Safe System Basis Chips. And all our next-generation devices use the flexible SOI technology for best-in-class EMC performance.

Key features

- CAN is a robust protocol – essential for automotive applications
- ISO 11898 and SAE/J2411 are open standards
  - Well documented and fully supported worldwide
- Choice of three CAN physical layer options
  - High-speed (HS) for high data rates
  - Fault-tolerant (FT) for additional robustness
  - Single-wire (SW) for minimum wiring

NXP CAN portfolio

- Vast experience with CAN in automotive applications
  - Over one billion transceivers shipped in September 2005
- Range of transceivers and protocol controllers for all three CAN physical layer implementations
- A family of innovative products
  - Offer additional fail-safe and low-power features
  - Golden devices for new CAN standards
  - Best-in-class EMC performance using versatile SOI technology
- Further integration simplifies individual node and system design
  - Gateway controllers integrating multiple CAN controllers with a 32-bit ARM processor
  - Fail-Safe System Basis Chips (SBCs) combining transceivers and voltage regulators with an autonomous node Fail-Safe system

The Controller Area Network (CAN) bus is the primary automotive networking protocol for powertrain, backbone bus and body electronics. NXP has been recognized as the leading CAN innovator ever since our first industry-standard PCA82C250 transceiver set the benchmark for high-speed CAN. We now offer designers a comprehensive portfolio comprising automotive-grade transceivers for all CAN physical layer options (high-speed, fault-tolerant and single-wire), stand-alone protocol controllers, System Basis Chips and the latest in IVN gateway ICs, delivering the performance and functionality needed for today's wide variety of in-vehicle networking applications.

NXP founded by Philips

As the initial choice of CAN physical layer depends mostly on the network performance required, our CAN solutions ensure your selection meets the highest standards possible. Of the three current implementations of the CAN physical layer, high-speed CAN offers the highest transmission speed (up to 1 Mbits/s). Fault-tolerant CAN operates at a slower rate (125 kbits/s) but maintains functionality in the case of a broken or shorted bus wire – particularly important in body electronics where the wiring harness is more vulnerable. Both of these CAN physical layer implementations interconnect network nodes via a two-wire twisted pair bus with end-termination. Single-wire CAN is used primarily to reduce wiring in body electronics implementations and for diagnostic purposes, and operates up to 41.6 kbits/s.

Delivering value-added performance to automotive CAN networks

The CAN protocol assumes good connections and interference-free signals between nodes in a network. As the CAN protocol itself is not application specific, the automotive environment presents a significant challenge to achieving accurate operation. Obvious risks include physical damage or disturbance and electromagnetic interference. Another important factor is the battery power source, which puts additional demands on power consumption and short-circuit protection. The ISO and SAE CAN standards do not cover all these eventualities, leaving scope for extra functionality and reliability improvements when implementing CAN networks.

All NXP CAN transceiver and controller devices deliver more than the minimum CAN standard requirements, such as comprehensive fail-safe features, diagnostics and low-power modes. Many of these additional features are then actually adopted by newer versions of the standards, another process in which our leading role continues. We were also first to introduce automotive-grade transceivers to the market.

Failure management in an automotive CAN network serves one goal: keeping the car going. When a failure is detected, the robust CAN protocol handles bus arbitration and the re-transmission of messages, helping minimize effects on the rest of the network and the car. Supplementing the error handling capabilities of the CAN protocol and the selected physical layer, NXP transceivers all provide additional protective functionality to help safeguard against hardware failures.

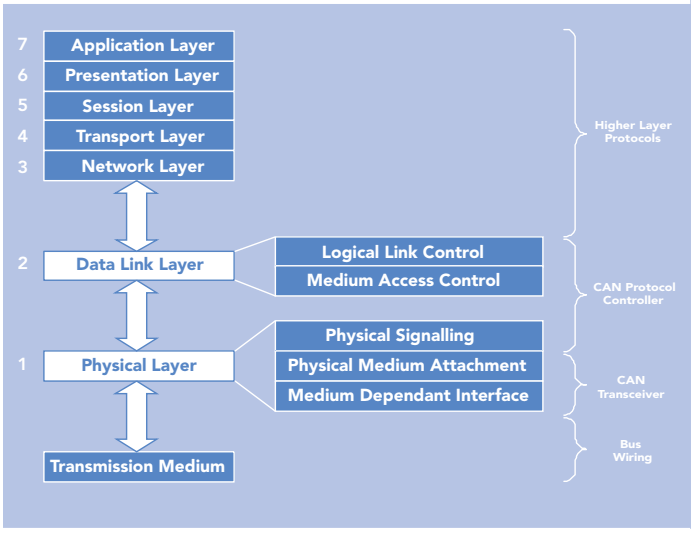
Power saving is important for key-off functionality, with networks remaining in standby when the car's engine is switched off. These systems are directly connected to the battery, so power consumption must be kept low. Also, in partial networks (where some nodes remain active when the rest of the network is switched off) the key-on transceivers have to leave the active part of the network unaffected when their power supply is cut. Once again, this is an area where our CAN family delivers the added-value features required by today's automotive applications.

The CAN protocol

In networked applications the generic ISO/OSI reference model (illustrated) identifies seven distinct communication layers, excluding the actual bus wiring. What is commonly referred to as CAN involves only two of these layers – the data link layer and the physical layer – and is covered by the ISO 11898 standard. In CAN applications the higher-level layers of the ISO/OSI model deal with the application-specific processing of the CAN messages. As the actual CAN standard only addresses the basic network communications, this leaves the implementation of features such as fail-safe behaviour and low-power modes as proprietary options.

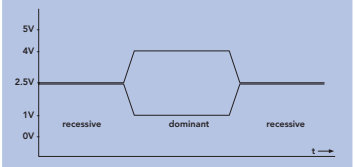
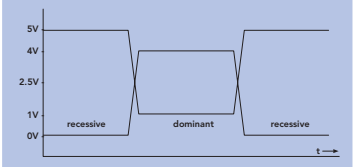
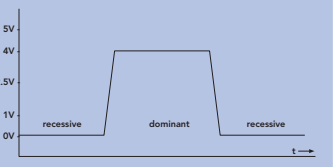
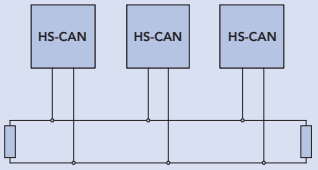
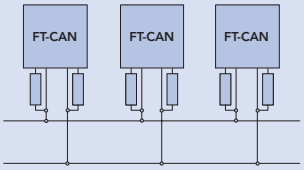
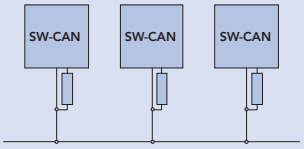
The ISO 11898 standard is divided into three sections: ISO 11898-1 covers the CAN protocol, while parts -2 and -3 handle two of the three standardized implementations of the CAN physical layer (HS-CAN and FT-CAN respectively). Although the transmission medium is not included in the standard, ISO does assume CAN_L and CAN_H bus connections and defines the electrical signal levels for them.

Single-wire CAN is the third standardized CAN physical layer implementation in use today and is covered under the SAE/J2411 standard. SW-CAN uses only the CAN_H connection, taking the node's ground as reference level. To maintain low electromagnetic emission, the maximum communication speed of SW-CAN systems is limited.

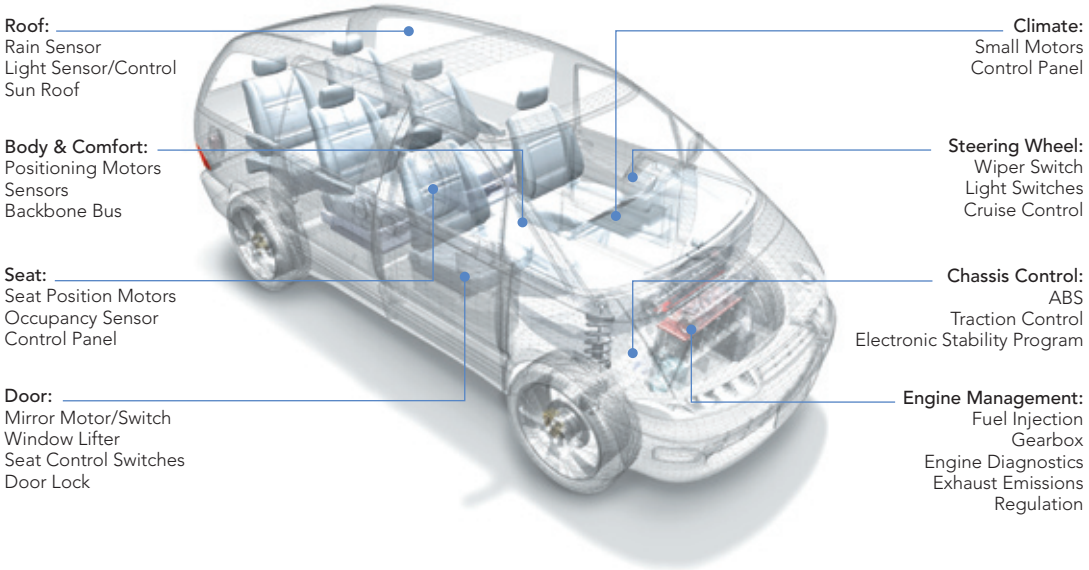


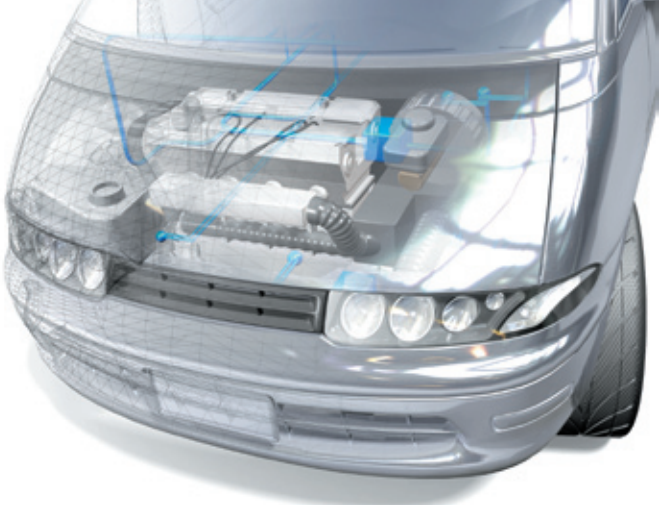
Layer diagram of ISO/OSI reference model

Overview of CAN physical layer characteristics and application areas

Features	HS-CAN	FT-CAN	SW-CAN
Data link layer standard	ISO 11898-1	ISO 11898-1	ISO 11898-1
Physical layer standard	ISO 11898-2	ISO 11898-3	SAE/J2411
Number of bus wires	2 (twisted pair)	2 (twisted pair)	1
Maximum bus speed	1 Mbits/s	125 kbits/s	33/41.6 kbits/s
Bus communication signal			
Bus termination principle			
Bus wire short-circuit and interrupt tolerance	limited short-circuit tolerance	tolerant against any single bus wire short or interrupt	no tolerance
NXP transceiver features 1	- bus dominant time-out - bus clamping protection - partial networking support - stand-by and sleep modes - node power management - local and remote wake-up - failure diagnosis	- bus dominant time-out - bus clamping protection - partial networking support - stand-by and sleep modes - node power management - local and remote wake-up - failure diagnosis	- loss of ground protection - 100 kbits/s flash mode - partial networking support - selective sleep
Automotive applications	- engine management - backbone bus - body & comfort	- body & comfort	- body & comfort

1 depending on the transceiver used





NXP delivers proven CAN solutions that set the standard. As CAN develops further in the car, we enable manufacturers to bring even higher performance to their CAN applications with drop-in upgrades of existing devices as well as innovative new products. The table gives an overview of our CAN product portfolio - further details can be found on separate leaflets.

The transceiver family for all CAN physical layers

The PCA82C250 transceiver became the industry standard for high-speed CAN applications and firmly established NXP as the leading CAN innovator. As CAN developed, we continued to lead with drop-in upgrades of existing high-speed, fault-tolerant and single-wire devices. Fabricated using our unique SOI technology, all our latest CAN transceivers offer best-in-class EMI and EME performance and comply fully with ISO and SAE standards, managing proper signal levels and message filtering. In addition, low reverse currents mean unpowered nodes do not disturb networks, while comprehensive fail-safe features help safeguard operation.

Fail-Safe System Basis Chips – effortless solutions to complex challenges

As more and more systems in cars are network based, the complexity of in-vehicle networks increases. Designing a reliable system becomes an escalating challenge, especially where network nodes are permanently connected to the battery. One effective way to reduce this design effort is through smart integration of common ECU functionality and fail-safe features. Highly integrated, our Fail-Safe System Basis Chips achieve exactly that.

By combining transceivers, voltage regulators, programmable window watchdog and a fully embedded fail-safe system on a single chip, Fail-Safe SBCs greatly simplify design effort and FMEA for ECUs and networks. The autonomous fail-safe system offers excellent protection against network lock-ups and dead batteries. And the uniform Fail-Safe SBC family also makes it very easy to exchange physical layers on ECUs, with maximum re-use of ECU hardware and software.

Managing networks with dedicated protocol and gateway controllers

Supporting our CAN transceiver family, our stand-alone CAN protocol controllers can be used within both automotive and general industrial environments. The successor of the PCA82C200, the SJA1000 implements the enhanced PeliCAN operation mode, which fully supports the CAN 2.0B protocol specification.

With the industry trend to further integrate system functions, we also offer automotive-grade 32-bit ARM-based microcontrollers with embedded CAN protocol controllers. These devices are tailored to the specific demands of vehicle dynamics as well as body and safety applications.

NXP CAN product portfolio

Products	HS-CAN	FT-CAN	SW-CAN
CAN protocol controllers	SJA1000 SJA2020 [1]	SJA1000 SJA2020 [1]	SJA1000 SJA2020 [1]
CAN transceivers	PCA82C250 PCA82C251 TJA1050 TJA1040 TJA1041 TJA1041A	TJA1054 TJA1054A TJA1055 TJA1055/3	AU5790
Fail-Safe System Basis Chips [2]	UJA1065 [3] UJA1066	UJA1061 [3]	

[1] IVN gateway controller with 32-bit ARM7 µC, 6 CAN protocol controllers and 4 LIN protocol controllers
[2] CAN transceiver, 2 voltage regulators, programmable window watchdog and fully embedded fail-safe system
[3] Also includes a LIN transceiver

www.nxp.com

founded by PHILIPS

NXP Semiconductors is in the process of being established as a separate legal entity in various countries worldwide. This process will be finalized in the course of 2006.

Date of release: September 2006
Document order number: 9397 750 15742
Printed in the Netherlands