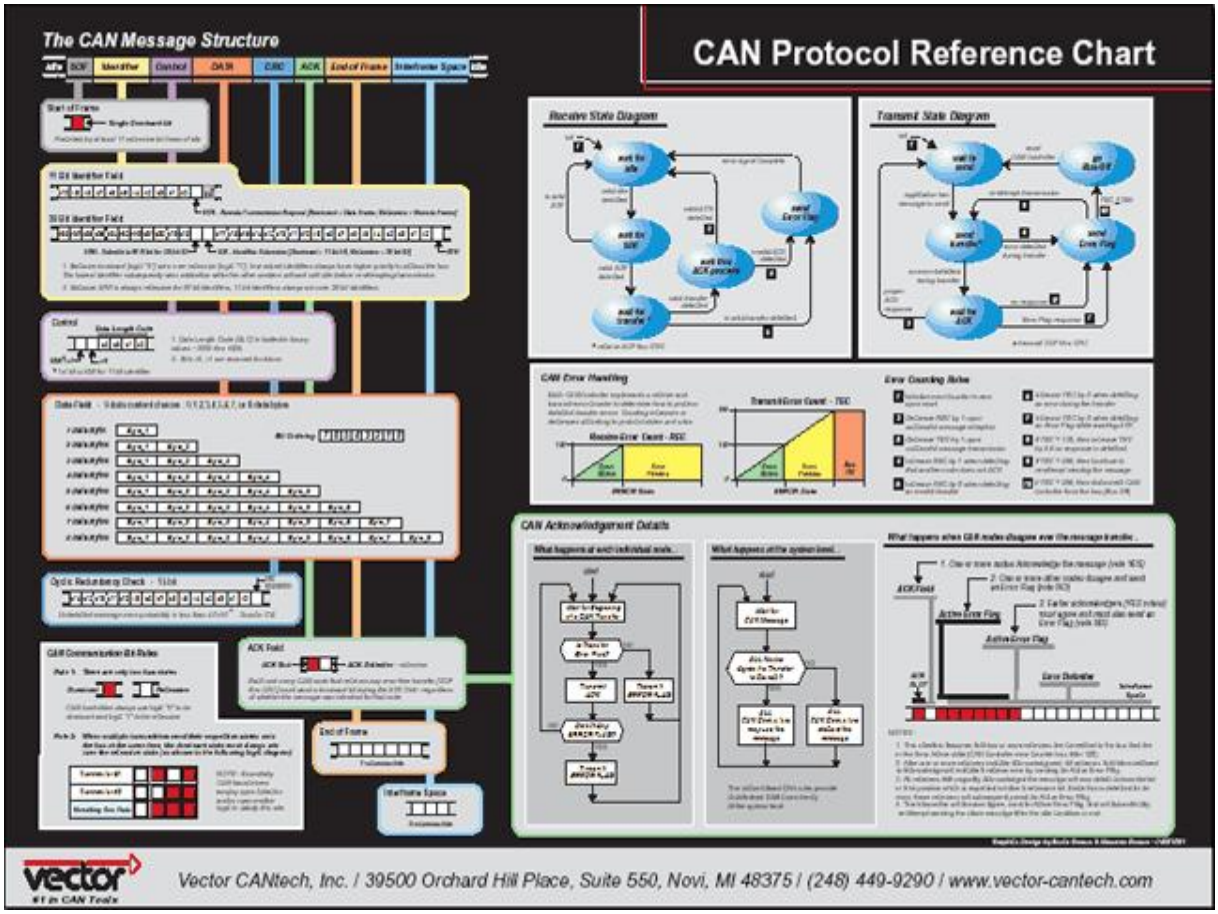
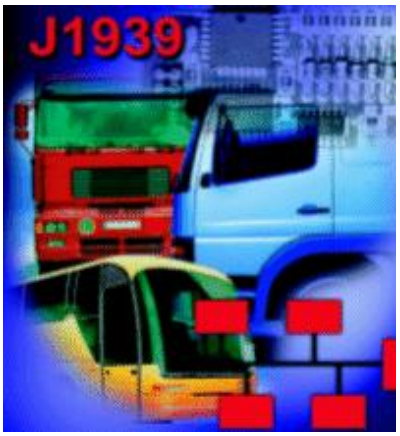
Controller Area Network (CAN)

What is Controller Area Network (CAN)?

Controller Area Network **(CAN)** is a common, small area network solution that supports distributed product and distributed system architectures. The **Controller Area N etwork (CAN)** bus is used to interconnect a network of electronic nodes or modules. Typically, a two wire, twisted pair cable is used for the network interconnection. The **Controller Area Network (CAN)** protocol is a set of stringent rules, implemented in silicon, that supports the serial transfer of information between two or more nodes. **Controller Area Network (CAN)** is implemented by a large number of industries including automotive, truck, bus, agriculture, marine, construction, medical, factory automation, textile, and many others. **Controller Area Network (CAN)** is used as the basis for several major "7-layer" protocol developments such as J1939, CANopen, ISO11783, DeviceNet, and NMEA2000. Each of these large protocol architectures are essentially complete industry-specific network solutions packaged to include defined requirements for the physical layer, address structure, message structure, conversation structure, data structure, and application/ network interface. Pre-packaged "7-layer" protocols provide high value for vertically integrated industries like heavy truck, marine, or factory automation. On the other end of the spectrum, many other companies choose to develop a proprietary distributed product strategy. For both business and technical reasons, these companies internally create a customized "7-layer" CAN-based protocol that is optimized to satisfy their own application-specific requirements.


The CAN Message Structure
CAN Protocol Reference Chart
Receive State Diagram
Transmit State Diagram
CAN Error Handling
Error Counting Rules
CAN Acknowledgment Details
Vector CANtech, Inc. / 39500 Orchard Hill Place, Suite 550, Novi, MI 48375 / (248) 449-9290 / www.vector-cantech.com



J1939

J1939 is a communications protocol based on Controller Area Network for real-time data exchange between control devices in the area of commercial vehicles. It describes the information which are exchanged between the control units in such a system. ISO11783 is a further development for agricultural engineering.

Application areas: (J1939) Agriculture Equipment, Forestry Electronics, Heavy Truck & Bus, Off-Highway, RV, Diesel Engine Control, Railway, Public Transportation, Maritime Electronics, etc... / (ISO11783) Agriculture Equipment and Forestry Electronics / (ISO11992) Truck & Trailer.

Vector Products:

- CANalyzer Option .J1939
- CANoe Option .J1939
- CANbedded J1939
- J1939 Source Code

NAME	BIT RATE (BPS)	DESCRIPTION	TYPICAL TRANSCEIVER	APPLICATION AREA
ISO 11898	100K - 1M	2 wire, twisted pair	250-type	General high speed distributed functions
SAE J1939-11	250K	2 wire, twisted pair, with shield	250-type	Heavy Truck, Bus, Construction
SAE J1939-12	250K	2 wire, twisted pair, shielded with integrated 12V power	250-type	Agriculture
SAEJ2284	500K	2 wire, twisted pair, unshielded	250-type	Automotive - High speed, motion control
SAE J2411	33.3K, 83.3K	1 wire	SWC-type	Automotive - Low speed, human control
NMEA-2000	62.5K,125K 250K,500K 1M	2 wire, twisted pair, shielded with integrated power	250-type	Marine
DeviceNet	125K 250K 500K	2 wire, twisted pair, shielded with integrated 24 power	250-type	Factory Automation
CANopen	10K, 20K 50K, 125K 250K, 500K 800K, 1M	2 wire, twisted pair, optional shield, with optional power	250-type	Industrial Automation, Medical, many others
SDS	125K, 250K 500K, 1M	2 wire, twisted pair, shielded with optional power	250-type	Factory Automation
Fault Tolerant	<125K	2 wire, twisted pair, unshielded	252-type	Communicates with single wiring fault

Features/Advantages:

CANalyzer/DENalyzer is controlled from a graphic block diagram, which depicts data flow from the bus over the PC interface to the various screen evaluation windows and to the log file. The system is parameterised in this block diagram. Additionally the user may place function blocks on the diagram and configure them, e.g. Filter, Generator and Replay blocks.

Functions:

The basic functions offer a multitude of usage options. These include:

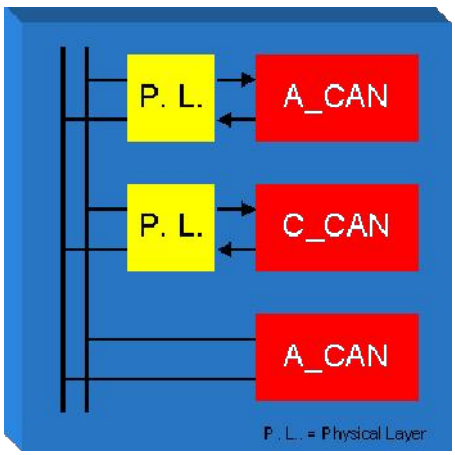
- Listing of bus data traffic (Tracing)
- Display of the data contents of specific messages
- Interactive sending of predefined messages
- Sending of logged messages
- Statistics on messages
- Statistics on bus loading and bus disturbances
- Logging of messages for replay or offline evaluation

CAN is a serial bus system especially suited for networking "intelligent" devices as well as sensors and actuators within a system or sub-system.

The Attributes of CAN

CAN is a serial bus system with multi-master capabilities, that is, all CAN nodes are able to transmit data and several CAN nodes can request the bus simultaneously. The serial bus system with real-time capabilities is the subject of the ISO 11898 international standard and covers the lowest two layers of the ISO/OSI reference model. In CAN networks there is no addressing of subscribers or stations in the conventional sense, but instead, prioritized messages are transmitted.

A transmitter sends a message to all CAN nodes (broadcasting). Each node decides on the basis of the identifier received whether it should process the message or not. The identifier also determines the priority that the message enjoys in competition for bus access. The relative simplicity of the CAN protocol means that very little cost and effort need to be expended on personal training; the CAN chips interfaces make applications programming relatively simple. Introductory courses, function libraries, starter kits, host interfaces, I/O modules and tools are available from a variety of vendors permitting low-cost implementation of CAN networks. Low-cost controller chips implementing the CAN data link layer protocol in silicon and permitting simple connection to microcontrollers have been available since 1989. Today there are more than about 50 CAN protocol controller chips from more than 15 manufacturers announced, and available.



The use of CAN in most of European passenger cars and the decision by truck and off-road vehicle manufacturers for CAN led to the availability of CAN chips for more than 10 years. Other high volume markets, like domestic appliances and industrial control, also increase the CAN sales figures and guarantee the availability for the future. Up to spring 1997 there have been more than 50 million CAN nodes installed. One of the outstanding features of the CAN protocol is its high transmission reliability. The CAN controller registers a stations error and evaluates it statistically in order to take appropriate measures. These may extend to disconnecting the CAN node producing the errors.
Each CAN message can transmit from 0 to 8 bytes of user information. Of course, you can transmit longer data information by using segmentation. The maximum transmission rate is specified as 1 Mbit/s. This value applies to networks up to 40 m. For longer distances the data rate must be reduced: for distances up to 500 m a speed of 125 kbit/s is possible, and for transmissions up to 1 km a data rate of 50 kbit/s is permitted. See also **The Configuration of the CAN Bit Timing (.pdf)**

CAN Applications
CAN networks can be used as an embedded communication system for microcontrollers as well as an open communication system for intelligent devices. The CAN serial bus system, originally developed for use in automobiles, is increasingly being used in industrial field bus systems, the similarities are remarkable. In both cases some of the major requirements are: low cost, the ability to function in a difficult electrical environment, a high degree of realtime capability and ease of use.
Some users, for example in the field of medical engineering, opted for CAN because they have to meet particularly stringent safety requirements. Similar problems are faced by manufacturers of other equipment with very high safety or reliability requirements (e. g. robots, lifts and transportation systems).