The Controller Area Network (CAN) specification defines the Data Link Layer. ISO 11898 defines the Physical Layer.

The CAN bus is a Balanced (differential) 2-wire interface running over either a Shielded Twisted Pair (STP), Unshielded Twisted Pair (UTP), or Ribbon cable. Each node uses a Male 9-pin D connector.

The Bit Encoding used is: Non Return to Zero (NRZ) encoding (with bit-stuffing) for data communication on a differential two wire bus.

The use of NRZ encoding ensures compact messages with a minimum number of transitions and high resilience to external disturbance.
A number of different data rates are defined, with 1Mbps (Bits per second) being the top end, and 10kbps the minimum rate. All modules must support 20kbps. Cable length depends on the data rate used. Normally all the devices in a system transfer uniform and fixed bit-rates. The maximum line length is 1Km, 40 meters at 1Mbps. Termination resistors are used at each end of the cable. The worst-case transmission time of an 8-byte frame with an 11-bit identifier is 134 bit times (that's 134 microseconds at the maximum baud rate of 1Mbits/sec).

Can Message Frame

The CAN Bus interface uses an asynchronous transmission scheme controlled by start and stop bits at the beginning and end of each character. This interface is used, employing serial binary interchange. Information is passed from transmitters to receivers in a data frame. The data frame is composed of an Arbitration field, Control field, Data field, CRC field, ACK field. The frame begins with a 'Start of frame' [SOF], and ends with an 'End of frame' [EOF] space. The data field may be from 0 to 8 bytes. The frame check sequence is derived from a Cyclic Redundancy Code (CRC); the coefficients are generated modulo-2: X15 + X14 + X10 + X8 + X7 + X4 + X3 + 1. CAN implements five error detection mechanisms; 3 at the message level and 2 at the bit level [Also incorporates error flags]. At the message level: Cyclic Redundancy Checks (CRC), Frame Checks, Acknowledgment Error Checks. At the bit level: Bit Monitoring, Bit Stuffing. The CANbus pinout is shown in the table below.

The Application for CAN bus in the automotive area include;
A low speed CANbus may be employed to operate window and seat controls. A high speed CANbus may be employed for engine management or brake control.
Many other applications are possible [Engine Sensors, Anti-Skid Systems].

Can Voltages and Currents
equivalent Input and Output IC Schematic Diagrams.
For additional information refer to: CAN Bus Specification; Version 2.0, ISO 11898/11519.
CANbus is used as a vehicle bus, for other vehicle Buses see Automotive Buses.
CANbus is also used as an Industrial Field bus, for other Field Buses see Field Buses.

Detailed info on CANbus {Robert Bosch GmbH}, Detailed info on CANbus {Kvaser}

CAN may also sometimes be found as Car Area Network

[Industrial CANbus Index]
The Can Bus pinout for the 9-pin D connector is shown in the table below. Additional connector styles are listed on the CAN Bus Connector Pin out page, or CAN Bus Round Connector Pin out. Many of the additional connector pin outs are used with CANopen and include: 10-pin header [5 x 2 multipole], RJ10 [Modular Connector Jack], RJ45 [Modular Connector Jack], 5-pin mini [circular], 5-pin micro [circular], Open Style, 7/8/9-pin round connectors.

### 9 Pin (male) D-Sub CANbus PinOut

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Signal names</th>
<th>Signal Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reserved</td>
<td>Upgrade Path</td>
</tr>
<tr>
<td>2</td>
<td>CAN_L</td>
<td>Dominant Low</td>
</tr>
<tr>
<td>3</td>
<td>CAN_GND</td>
<td>Ground</td>
</tr>
<tr>
<td>4</td>
<td>Reserved</td>
<td>Upgrade Path</td>
</tr>
<tr>
<td>5</td>
<td>CAN_SHLD</td>
<td>Shield, Optional</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td>Ground, Optional</td>
</tr>
<tr>
<td>7</td>
<td>CAN_H</td>
<td>Dominant High</td>
</tr>
<tr>
<td>8</td>
<td>Reserved</td>
<td>Upgrade Path</td>
</tr>
<tr>
<td>9</td>
<td>CAN_V+</td>
<td>Power, Optional</td>
</tr>
</tbody>
</table>

Some systems may use pin 8 as an error line, to indicate an error on the net.

Listing of 'D-sub' Connectors Manufactures ......... Listing of Cable Manufactures

[Industrial CANbus Index]

### CAN Bus Standard Organizations

All other Standard Organizations

[Industrial CANbus Index]
CAN Bus Standard/Specifications Information

ISO/DIS 11898-1: Road vehicles -- Controller area network (CAN) -- Part 1: Data link layer and physical signaling
ISO/DIS 11898-2: Road vehicles -- Controller area network (CAN) -- Part 2: High-speed medium access unit
ISO/CD 11898-3: Road vehicles -- Controller area network (CAN) -- Part 3: Low-speed fault tolerant medium dependent interface
ISO/CD 11898-4: Road vehicles -- Controller area network (CAN) -- Part 4: Time triggered communication

CAN Bus Specification Version 2.0

All other Interface bus specifications [Non-CANbus]

[Industrial CANbus Index]

CAN Bus Interface ICs

CAN Bus uses a Drive Voltage: High; 2.75v to 4.5 volts, Low; 0.5 to 2.25 volts, Differential 1.5v to 3.0 volts

Driver Side

Receiver Side

www.interfacebus.com

CAN Bus Interface IC Logic Transition Levels

Analog Devices, Inc. {Mixed-Signal-DSPs (ADSP-21992) with 160MIPS and On-Chip CAN V2.0b}

Atmel Corp. {8-bit RISC transceivers and microcontrollers. CAN bus standard (2.0A & 2.0B) with 80C51 core and AVR core}

austriamicrosystems AG {Smart Power Management device with high speed CAN interface}

Bosch {IP Modules; CAN Core, C_CAN, D_Can, TTCAN}

Cast {CAN Core, Bus Controller ICs}
Dallas Semiconductor 'Maxim' {DS80C390 Dual CAN High-Speed Microprocessor, bus controller ICs}

freescale {33389/33388 low speed fault tolerant CANBus transceiver}

Infineon {82C900 Stand-alone TwinCan Controller-TLE6250 CAN Transceiver IC Manufacturer}

Inicore Inc. {CAN IP Core IC Manufacturer}

Intel, Intel App Notes {CanBus Interface 82527 IC}

Linear Technology {CAN Transceiver IC Manufacturer}

Maxim Integrated Products {DS80C390 Dual CAN High-Speed Microprocessor, bus controller IC}

Melexis {CAN Bus Transceiver IC Manufacturer}

Microchip {MCP2510 Stand-alone CanBus Controller IC}

National Semiconductor {uP with CANBus Interface}

NXP {8/16-bit CAN Bus 2.0 Controllers/Transceiver}

Renesas Technology Corp {Micro-Controller [uC] with CAN / LIN Interface}

STMicroelectronics {uP with CAN Interface}

Xilinx {CAN IP Core, Spartan, Virtex}

Yamar Electronics {DC-BUS for digital communication overcome hostile in-vehicle power line communication environment. Power line Communication multiplex semiconductor transceivers for automotive and industrial CAN, LIN networks.}

TI {TMS320F241 with CANbus Interface-3.3v Line Transceiver ICs}

IC Manufacturers Listing {All other types}

V62/09611: SN65HVD233; Controller area network (CAN) transceiver
V62/06629: SN65HVD230; 3.3 V CAN transceiver

<table>
<thead>
<tr>
<th>CAN Bus I/O Characteristics</th>
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<tbody>
<tr>
<td>CANbus Signal Type</td>
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<tr>
<td>Output Voltage (High)</td>
</tr>
<tr>
<td>Output Voltage (Low)</td>
</tr>
<tr>
<td>Output Voltage</td>
</tr>
<tr>
<td>Output Current</td>
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<tr>
<td><strong>Impedance</strong></td>
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<td>---------------</td>
</tr>
<tr>
<td><strong>Circuit Type</strong></td>
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<td><strong>Bit Times</strong></td>
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<tr>
<td><strong>Encoding Format</strong></td>
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<tr>
<td><strong>Transmit/Receive Frequency</strong></td>
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<tr>
<td><strong>Topology</strong></td>
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<tr>
<td><strong>Medium</strong></td>
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<tr>
<td><strong>Access Control</strong></td>
</tr>
</tbody>
</table>

[Industrial CANbus Index]

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**CANbus Electronic Equipment**

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**OEM COT Cards and Board Manufacturers** {With CANbus interfaces}

**AnaGate** {CAN TCP/IP gateways (Ethernet protocol)}

**Detailed info on CANbus** {Robert Bosch GmbH}

**ESD Electronic Systems** {CanBus Cards and Modules}

**Kvaser** {CAN interface for the PCI-X bus, CAN interface for the PCI bus}

**LeCroy Corp.** {Canbus Trigger and Decoding oscilloscope Package}

**National Instruments** {Controller CAN interfaces for PCI, PXI, PCMCIA. CAN Device Simulator, high-speed CAN cables}

**Squarell Technology** {CANbus components for harsh environments and automotive applications. Interfaces, Data-loggers, Sensor devices and Output devices. Configurable without programming.}

**Vector-CANtech** {CAN-Bus Development Tools-Interfaces}
**CAN Bus Higher Layer Protocols**

Following the ISO/OSI layer model, the protocol layer is implemented over the data link layer [which conforms to CAN 2.0A and/or 2.0B], and the physical layer which specified in the ISO 11898 standard. The data link layer and the physical layer is implemented in hardware.

**TTCAN**

TTCAN: Time Triggered CAN protocol. Allows the bus to appear more deterministic

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**CANOpen**

CANOpen is based on the CANbus data link layer and high-speed transceiver as specified in ISO 11898, part 1 and 2.
In addition, CANopen specifies bit-timing and recommends pin-assignments for connectors. Uses Device profiles [defines four types of messages]; Manufactures follow guidelines in the CANOpen spec producing devices with characteristics which will operate with each other.
There are a number of Bit rates based on bus length: [based on 5nS/m cable propagation delay].
1Mbps [Maximum transfer speed] up to a 25 meter maximum bus length [Nominal bit time is 1uS]
800kbps [Maximum transfer speed] up to a 50 meter maximum bus length [Nominal bit time is 1.25uS]
500kbps [Maximum transfer speed] up to a 100 meter maximum bus length [Nominal bit time is 2uS]
250kbps [Maximum transfer speed] up to a 250 meter maximum bus length [Nominal bit time is 4uS]
125kbps [Maximum transfer speed] up to a 500 meter maximum bus length [Nominal bit time is 8uS]
50kbps [Maximum transfer speed] up to a 1000 meter maximum bus length [Nominal bit time is 20uS]
20kbps [Maximum transfer speed] up to a 2500 meter maximum bus length [Nominal bit time is 50uS]
10bps [Maximum transfer speed] up to a 5000 meter maximum bus length [Nominal bit time is 100uS]
Pinout for a number of CANopen connectors are listed on the [CAN Bus Connector Pin out](#) page.
CAN Kingdom

CAN Kingdom defines a set of protocol primitives, based on the CAN protocol. A bus Master is defined during initialization, the Master checks to see which nodes are connected to the network. CAN Kingdom uses either an Event driven or Time driven timing model.

DeviceNet

CENELEC standard - EN50325

DeviceNet identifies the physical layer but does not use the same physical layer interface as ISO 11898, and is based on the CanBus protocol. DeviceNet provides optical isolation for additional protection and does not use 9-pin sub-D connectors. DeviceNet only supports three baud rates: 125, 250 and 500 Kbaud (@ 500 meters) with up to 64 devices on the (differential) bus. In addition the cable carries 24 volts which powers the devices.

DeviceNet description {ODVA.org}

Info {Rockwell Automation ~ Allen Bradley}

DeviceNet Cable Specifications (Appendix B)

Smart Distributed System (SDS)

SDS description and Specs, Honeywell, http://sensing.honeywell.com

SDS Smart Distributed System defines the physical layer and application layer (based on CANbus). Used for intelligent sensors and actuators, operating over a single 4-wire cable, interfacing up to 64 nodes with a maximum of 126 addresses.

Application Layer Protocol Specification (Rev 2.0)
Physical Layer Specification (Rev 2.0)
J1939 is another protocol based on the Controller Area Network [Canbus]. NMEA2000 is another protocol based on the Controller Area Network.

CANaerospace / AGATE databus is a 1Mbps two-wire bus used to interconnect sensors and navigation systems for General Aviation [GA]. The AGATE databus is based on the CANbus. AGATE [Advanced General Aviation Experiments] is an alliance [consortium] of Government [NASA] and Industry.

Industrial CANbus Index


Distributors Components Equipment Software Standards Buses Design Reference

Modified 2/29/12
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