

## Q&A – What is CAN?

### **What is a CAN bus?**

A Controller Area Network (CAN) refers to a network of independent controllers. It is a serial communications protocol that efficiently supports distributed real-time control with a very high level of security. The CAN bus standard was developed by Bosch and Intel and the version of the current standard has been in use since 1990.

### **What is meant when referring to a physical layer, or an application layer?**

The International Organization for Standardization (ISO) developed the Open System Interconnect (OSI) model in 1984 as a model of computer communication architecture. There are seven layers to the OSI model: Physical, Data Link, Network, Transport, Session, Presentation, and Application. The intent is that protocols be developed to perform the functions of each layer as needed.

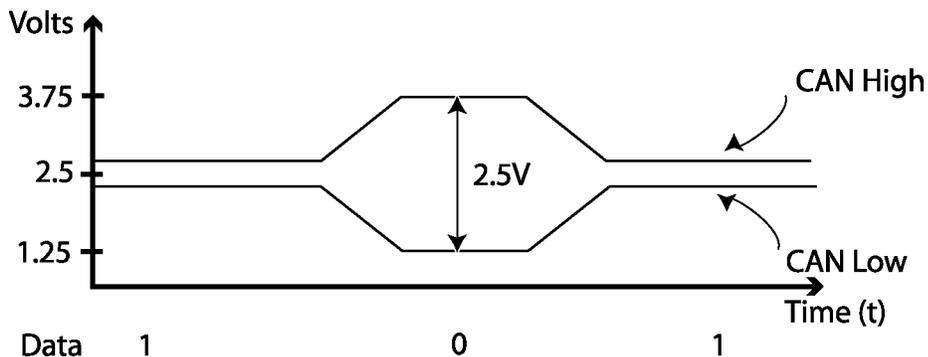
*[Source: SAE J1939 Revised Aug 2003]*

### **What is CAN 2.0B?**

CAN was divided into different layers according to the ISO/OSI model in order to achieve design transparency and implementation flexibility. CAN 2.0B refers to the specification that defines the Physical Layer and the Data Link Layer for all CAN buses.

### **How do CAN bus modules communicate?**

CAN bus uses two dedicated wires for communication. The wires are called CAN high and CAN low. When the CAN bus is in idle mode, both lines carry 2.5V. When data bits are being transmitted, the CAN high line goes to 3.75V and the CAN low drops to 1.25V, thereby generating a **2.5V differential** between the lines. Since communication relies on a voltage differential between the two bus lines, the CAN bus is NOT sensitive to inductive spikes, electrical fields or other noise. This makes CAN bus a reliable choice for networked communications on mobile equipment.



CAN power can be supplied through CAN bus. Or a power supply for the CAN bus modules can be arranged separately. The power supply wiring can be either totally separate from the CAN bus lines (using suitable gauge wiring for each module) resulting in two 2-wire cables being utilized for the network, or it can be integrated into the same cable as the CAN bus lines resulting in a single 4-wire cable. CAN bus cabling is available from multiple vendors.

### **What is the difference between CANopen and SAE J1939?**

These protocols are higher level CAN bus protocols. They both use the CAN 2.0B standard for the physical and data link layer. Each protocol, however, has different standards for the higher layers in the OSI model, and thus the way in which data is transmitted and interpreted is unique to each.

### **Are there master and slave modules on the CAN bus?**

The nature of CAN bus communications allows all modules to transmit and receive data on the bus. Any module can transmit data, which all the rest of the modules receive permitting both peer-to-peer and broadcast data transmissions. In CANopen, the CAN bus normally includes one module acting as a network master which starts the bus communications, but a dedicated master module is not needed. In J1939, the master and slave concept is not used.

### **What is the practical limit of data throughput on the CAN bus?**

CAN bus can use multiple baud rates up to 1 Mbit/s. The most common baud rates are 125 kbit/s (default CANopen) and 250 kbit/s (J1939). The CAN bus communication enables bus loads of up to 100% (data being transmitted all the time and all nodes can transmit), allowing full usage of the nominal bit rate.

### **Are there distance limitations?**

CAN bus is a synchronous network, where all receiving modules synchronize to the data coming from a transmitting module. The electrical characteristics of the CAN bus cable restrict the cable length according to the selected bit rate. You can use cabling up to 250 meters with the baud rate of 250 kbit/s. The maximum bus length with a bit rate of 10 kbit/s is 1 km, and the shortest with 1 Mbit/s is 40 meters.

### **Do I need expensive cabling?**

In standard industrial environments, the CAN bus can use standard cabling without shielding or twisted-pair wiring. If very low EMI is required, a twisted-pair cable is recommended. However, this will normally not be required in most applications.

### **Is the number of nodes (modules on the bus) limited?**

In CANopen, there are unique addresses available for up to 127 nodes on the bus. However the practical physical limit of nodes is about 110 units per bus. In J1939, there are 253 unique addresses available for the bus.

### **Can I use units from different vendors in the same system?**

Yes. If the same higher-level protocol such as CANopen or J1939 is used by all the modules on the bus, you can mix components from different vendors in the same control system without software changes.

### **How popular is CAN?**

Currently there are hundreds of millions of CAN nodes in use in the world. CAN is being widely used in passenger cars, buses, factory automation, work machines, agriculture, forestry and mining applications. The applications for CAN are increasing all the time.

### **Where can I get more information about CAN?**

The higher-level protocol support organizations provide information about CAN bus, protocols and keep a database of CAN bus products. The CANopen protocol is developed by CiA (CAN in Automation) at [www.can-cia.org](http://www.can-cia.org). SAE (Society of Automotive Engineers) can provide information about the J1939 protocol at [www.sae.org](http://www.sae.org).