Open DeviceNet™ Vendor Association, Inc.

WHAT IS THE DEVICENET?

DeviceNet is a low-cost communications link to connect industrial devices (such as limit switches, photoelectric sensors, valve manifolds, motor starters, process sensors, bar code readers, variable frequency drives, panel displays and operator interfaces) to a network and eliminate expensive hardwiring.

The direct connectivity provides improved communication between devices as well as important device-level diagnostics not easily accessible or available through hardwired I/O interfaces.

DeviceNet is a simple, networking solution that reduces the cost and time to wire and install industrial automation devices, while providing interchangeability of like components from multiple vendors.

DeviceNet is an *open network standard*. The specification and protocol are open – vendors are not required to purchase hardware, software or licensing rights to connect devices to a system. Anyone may obtain the DeviceNet Specification from the Open DeviceNet Vendor Association, Inc. (ODVA) for a nominal reproduction charge (currently $300 USD + postage).
Any company that manufactures (or intends to manufacture) DeviceNet products may join ODVA and participate in technical working groups that are developing enhancements to the DeviceNet Specification.

Buyers of the DeviceNet Specification receive an unlimited, royalty-free license to develop DeviceNet products. Companies looking for assistance may purchase sample code that eases their implementation, development toolkits, and development services from many sources. The key hardware components are available from the largest worldwide suppliers of semiconductors.

Why the DeviceNet Communication Link?

For years the process industry has been attempting to develop a single, open standard to address all kinds of field devices. The original scope of their standards effort was aimed at replacing the 4-20 mA standard with a single digital standard. As the scope increased to address complex and sophisticated services (such as high data rate communications between controllers, time synchronization of large numbers of devices scanning at very high speeds), the development of a single standard became delayed.

At the same time, the cost of communication technology has dropped considerably in recent years, making it cost-effective to connect simple devices never considered for SP50 fieldbus directly to a network. Such a standard for simple devices requires the same level of interchange-ability as exists for 120/220 VAC and 24 VDC discrete, hardwired I/O. DeviceNet allows the interchangeability of simple devices while making interconnectivity of more complex devices possible. In addition to reading the state of discrete devices, DeviceNet provides the capability to report temperatures, to read the load current in a motor starter, to change the deceleration rate of drives, or to count the number of packages that have passed on a conveyor in the previous hour.

Controller Area Network (CAN) is the key to low cost products. The DeviceNet communication link is based on a broadcast-oriented, communications protocol – the Controller Area Network (CAN). The CAN protocol was originally developed by BOSCH for the European automotive market for replacing expensive, wire harnesses with low-cost network cable on automobiles. As a result, the CAN protocol has fast response and high reliability for applications as demanding as control of anti-lock brakes and air-bags. Chips are available in a variety of packages with high temperature ratings and high noise immunity, attributes well suited for the industrial automation market as well.

But it is consumer and commercial demand for CAN that is the key driver in lowering the price and increasing the performance of CAN chips. In 1994, four suppliers of CAN chips (Intel, Motorola, Philips, Siemens) shipped 4+ million CAN chips. Over 137 million are forecasted for the year 2000. Whereas other industrial automation networks use custom chips with annual demand varying from 20,000–200,000 per year, DeviceNet products use the same CAN chips as are used in automotive and other consumer/commercial applications. The chips for DeviceNet products are typically 5–10 times less than chips for other networks.

DEVICENET FEATURES AND FUNCTIONALITY

Network Size	Up to 64 nodes
Network Length	Selectable end-to-end network distance varies with speed
	Baud Rate Distance
	125 Kbps 500 m (1,640 ft)
	250 Kbps 250 m (820 ft)
	500 Kbps 100 m (328 ft)
Data Packets	0-8 bytes
Bus Topology	Linear (trunkline/dropline); power and signal on the same network cable
Bus Addressing	Peer-to-Peer with Multi-Cast (one-to-many); Multi-Master and Master/Slave special case; polled or change-of-state (exception-based)
System Features	Removal and replacement of devices from the network under power

What is the DeviceNet Specification?

The DeviceNet Specification defines a network communication system for moving data between elements of an industrial control system. The specification is divided into two volumes and defines the following elements:

Volume 1
- DeviceNet Communication Protocol and Application (Layer 7 - Application Layer)
- CAN and its use in DeviceNet (Layer 2 - Data Link Layer)
- DeviceNet Physical Layer and Media (Layer 1 - Physical Layer)

Volume 2
- Device Profiles to obtain interoperability and interchangeability among like products

DeviceNet incorporates CAN (Controller Area Network). CAN defines the syntax or form of the data movement. The DeviceNet application layer defines the semantics or meaning of the data moved.

Communication Protocol Features

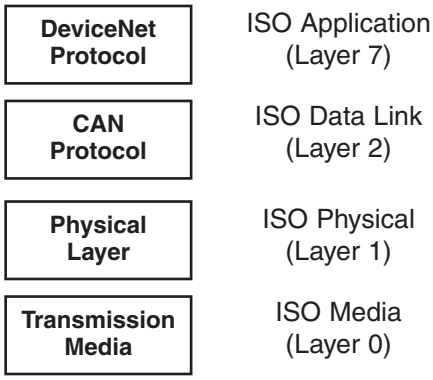

Figure 1. DeviceNet is an Application Layer Protocol (ISO Layer 7)

- Peer-to-Peer data exchange in which any DeviceNet product can produce and consume messages
- Master/Slave operation defined as a proper subset of Peer-to-Peer
- A DeviceNet product may behave as a Client or a Server or both
- A DeviceNet network may have up to 64 Media Access Control Identifiers or MAC IDs (node addresses). Each node can support an infinite number of I/O. Typical I/O counts for pneumatic valve actuators are 16 or 32.

The Object Model

A DeviceNet node is modeled as a collection of Objects. An object provides an abstract representation of a particular component within a product. The realization of this abstract object model with a product is implementation dependent.