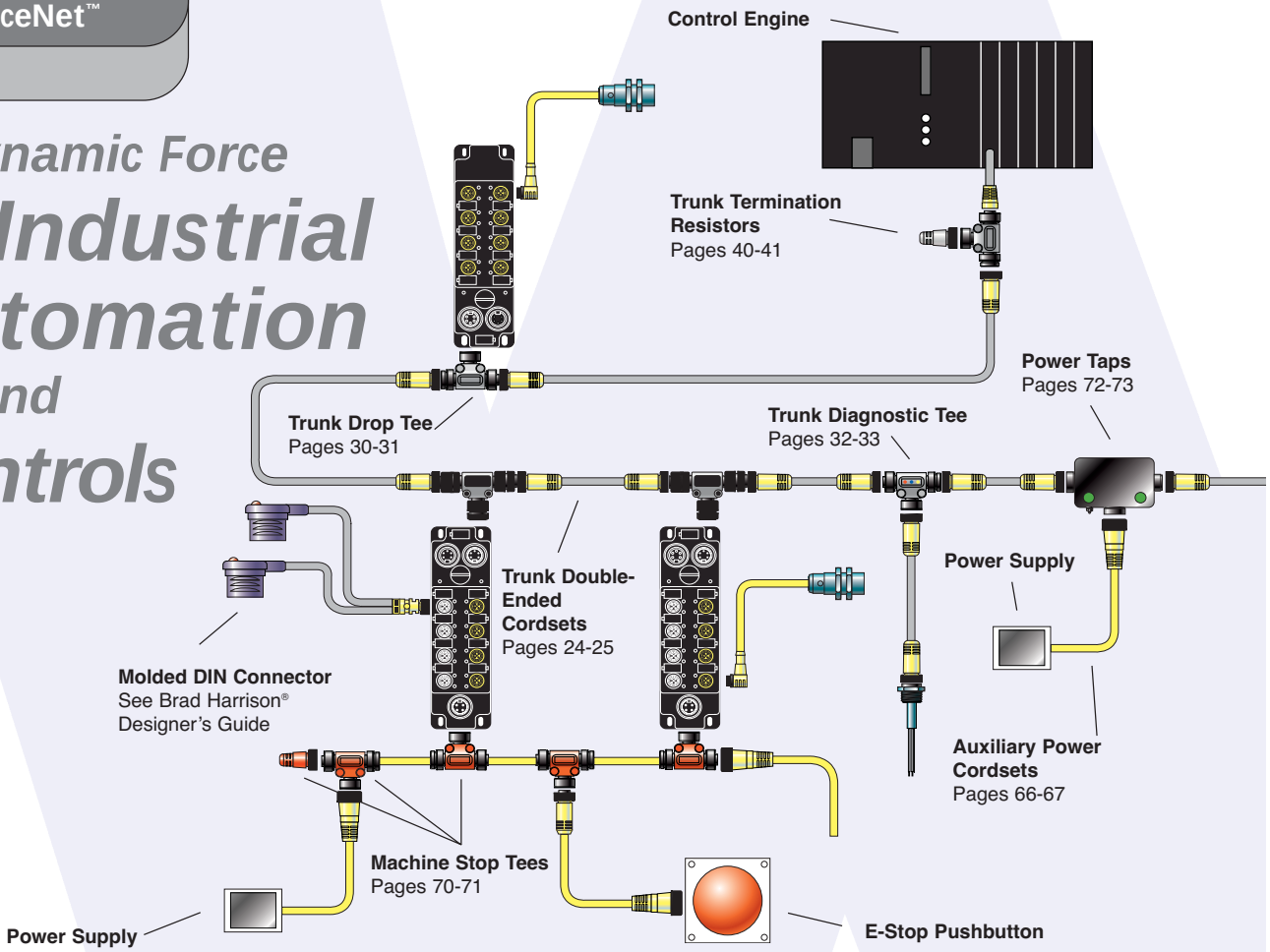
A Dynamic Force in Industrial Automation and Controls



BRAD® AND DEVICENET

Through its leading product lines Brad Harrison®, mPm®, SST™ and applicom®, Brad automation products give the designer and users of a DeviceNet™ system a complete Communication and Connectivity solution – from scanner through media infrastructure to I/O connection. No other supplier provides a comprehensive backbone of connectivity while giving you the power to choose other elements of the control system. You select which control engine you want, whether it be PC or PLC-based; Brad gets you onto the network. You choose which control architecture – centralized or distributed – which makes the most sense. You choose which type of motor controllers, valve banks or sensors you want; Brad insures connectivity to all these devices. Brad products can be your provider of DeviceNet connectivity from control engine to sensor.

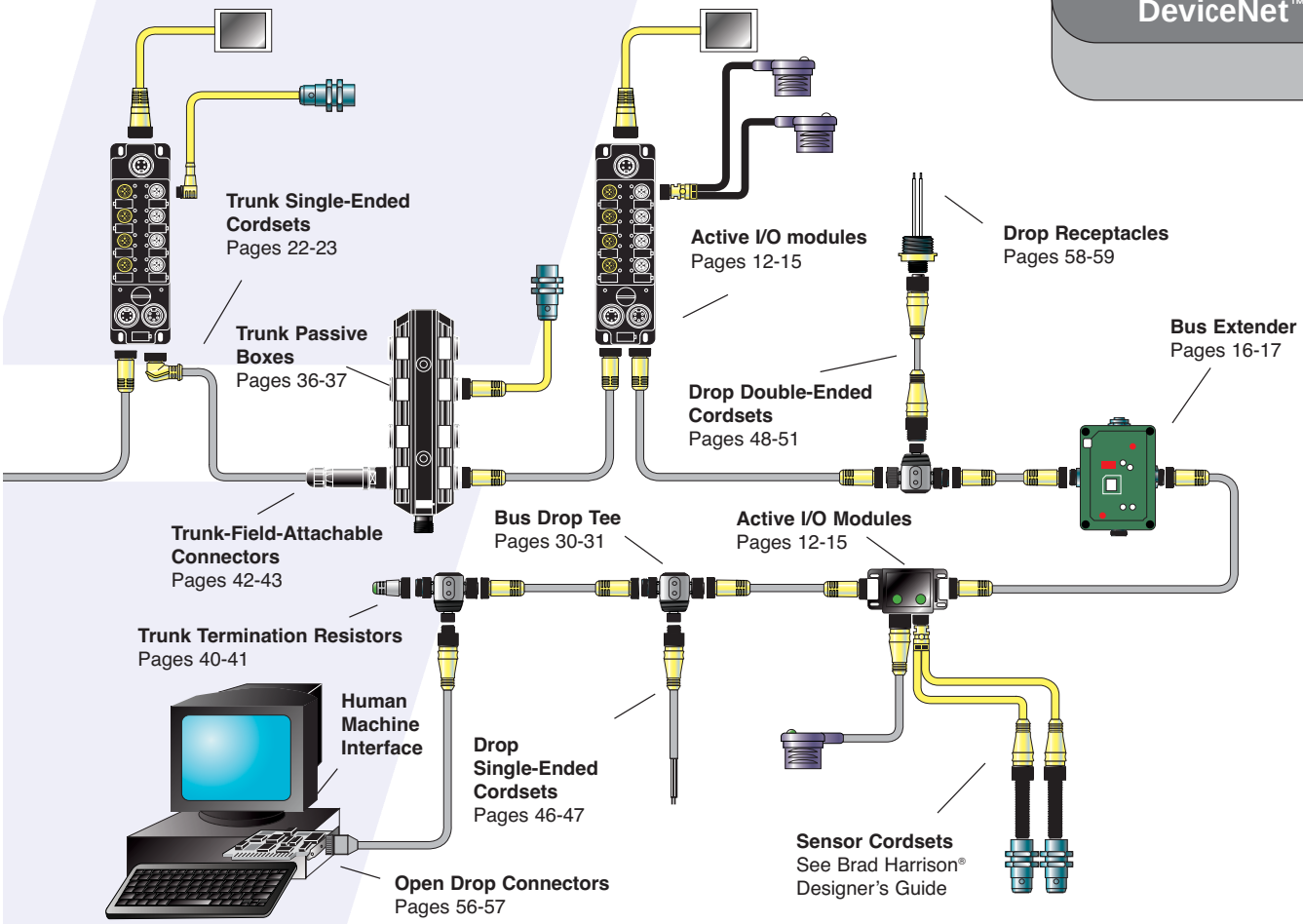
COMPONENTS AND ELEMENTS OF DEVICENET SYSTEM

Control Engine

PC "soft controllers" or PLCs can act as the main control engines, taking the current I/O status off the network and solving these operations through the main control program. The new status of the I/O is then updated via the network interface to the actuators, starters and interface panels. Many times a central control engine acts as the DeviceNet "master" which initiates and controls many of the messaging sequences of the network.

Scanners

The scanner resides in a controller whether it is a PLC or PC, and provides a network connection. The scanner exchanges a data table, which is loaded with the various values of the inputs and outputs, with the logic controller to solve the various logical expressions. Simultaneously the operation of the master and/or slave protocols is completed. The logical expressions are then re-exchanged with the data table for communication out to the various nodes and I/O residing on the network. The scanner generally supports all standard baud rates of the network.



Active I/O Devices

These are otherwise called "smart"I/O devices which can be directly connected as nodes onto the DeviceNet network. Detailed information can be received back from the "smart" I/O devices, such as a sensor being able to report back such information as distance measurements, power status, last-time to maintenance, etc.

Active I/O Modules

Active Modules serve to interconnect a variety of I/O devices as a DeviceNet "node." This allows the use of less costly standard sensors or outputs which are available from a variety of manufacturers and connect them onto the network providing short circuit protection while not disrupting DeviceNet communications. There are a variety of LED status indicators on DeviceNet active modules, including active, not active, and fault condition of input and output circuits and power status.

Media

DeviceNet uses a trunk and drop connection topology. The trunk is the main communications cable; the maximum length is dependent upon the communication rate and cable type used (thick, mid or thin). Drop connections are used to connect active nodes to the trunk. In all cases, DeviceNet cable consists of a shielded twisted pair and an independently shielded twisted power pair for the 24V DC bus power. These independently shielded pairs are then encased in an additional outer shield and jacket.

Thick Media

DeviceNet cable consists of a shielded twisted data pair and an independently shielded twisted power pair for the 24V DC bus power. These independently shielded pairs are then encased in an additional outer shield. Connections from the trunk line to the active nodes are generally made via a 5-pole Mini-Change® connection using "thick" cable (mid cable can also be used). Both ends of the trunk line MUST be terminated with 121 ohm resistors.

Thin Media

Drops are branches off the trunk and generally use "thin" cable up to 6m (20ft) in length. "Mid" cable can also be used for longer drop lengths or to standardize with "mid" trunk cable.

Power Media

I/O modules with output connections require 24V DC auxiliary power which is fed through the block via a 4-pole Mini-Change® connection. For safety reasons, the auxiliary power is brought to the block using a female connector so as to never have "live" power available on exposed pins. In some cases, machine stop circuits are run through the same 4-pole connectors. Machine stop drop or power tees, as well as termination plugs, are generally colored red for fast identification.

Cordsets

Input and output connections from the passive boxes or active I/O modules to devices like sensors or valves are made with industry standard 12mm DC style connections.

I/O Connections

I/O connections can be made to the network via 1) Mini-Change® connections, 2) Micro-Change® connections or 3) Open style 1.5mm spacing 5-pole industrial rated ODVA-approved connections.

DEVICENET – SYSTEM OVERVIEW

DeviceNet is designed to be a low-cost, real-time, device level bus architecture that connects sensors and actuators. Wiring and installation of automation devices is greatly simplified while the diagnostic information about the various I/O of the system is greatly enhanced (the sensor is ON, the lens is dirty, it has not been cleaned for 90 days). It defines a standard device software model that permits multi-vendor interoperability and interchangeability of like devices.
DeviceNet supports a variety of control architectures, giving the control designer the flexibility to choose either:

- Highly distributed control (with "smart" devices and no identifiable central controller)
- Semi-distributed control (with multiple PLCs, PC-based controllers and/or smart controllers), or
- Centralized control (single PC or PLC-based control)

DeviceNet is a CAN (Controller Area Network) based communication protocol that transmits a maximum of 8 bytes as a single message. Its primary usage is with digital I/O and non time-critical analog control. DeviceNet supports on-line node insertion and removal.

Broadcast Messaging

DeviceNet provides a good selection of communication mechanisms that fulfill a variety of needs. They may be individually implemented or used all together in the same system. DeviceNet uses a CSMA bus arbitration method where the highest priority message is always assured of being transmitted. Only the dominant node will finish the transmission and win the arbitration.

Strobe/Poll mechanisms – In this type of communication one message containing output data is sent by the master to each slave unit; each slave unit transmits a polled response. This is ideally suited to control systems where many I/O points change rapidly. However this makes inefficient use of the network bandwidth due to the frequent need to check for changed inputs.

Cyclic mechanism – The master and slave transmit unsolicited cyclic messages at a configured rate. This requires a greater effort to configure but generally provides better system performance while using bandwidth more efficiently. This requires knowing the minimum update rate for the individual I/O devices.

Change of state – This technique is used when the message is sent unsolicited at a given rate when the data changes. While this maximizes bandwidth, much more effort is required in the system design and testing. Greater system knowledge is required in this communication mechanism.

Explicit messaging – This can be set up for devices where limits, boundaries and thresholds need to be reported back immediately (but required very infrequently). These are only triggered when the control logic triggers them and therefore have negligible bandwidth impact.

ADDRESSING

The DeviceNet protocol supports 64 nodes which can be addressed from 0 to 63. Software node commissioning can be done as well as through hardware via dip or rotary switches. When these switches are used the device must be switched to the programming mode (usually by setting a dip switch setting) such that the switch dictates the address. EDS (Electronic Data Sheets) are specifically formatted ASCII files which contain detailed device information. Information found in the EDS includes information on how to configure a device, I/O characteristics, device description and the device configurable parameters among other things.

Duplicate MAC IDs or node addresses are not allowed in DeviceNet networks. If the same address is set on multiple nodes one node will take control of the address and the others will go into a "failure" status.

COMMUNICATION RATE

DeviceNet supports data rates of 125k, 250k and 500k baud. All nodes on the network must be communicating at the same specified rate.

Data rates are governed by the length of the bus line as shown in the following table:

MAXIMUM RATINGS (THICK CABLE AS TRUNK, THIN CABLE AS DROP)

TRANSMISSION SPEED (BAUD RATE)	BUSLINE (MAX. LENGTH)	SINGLE DROP LINE (MAX. LENGTH)	DROP LINE (OVERALL LENGTH)	NODES (MAX. NUMBER)
125K BAUD	1640 FEET (500 METERS)	20 FEET (6 METERS)	512 FEET (156 METERS)	64
250K BAUD	820 FEET (250 METERS)	20 FEET (6 METERS)	256 FEET (78 METERS)	64
500K BAUD	328 FEET (100 METERS)	20 FEET (6 METERS)	128 FEET (39 METERS)	64

The cycle time of a DeviceNet network is affected by several factors including:

- The amount of data being produced and consumed by each of the nodes
- The number of nodes being scanned
- Network communications rate
- The type of messaging being used (change of state, polled, strobe, cyclic)
- Explicit messaging going on
- The scan time of the PLC/PC control program

The BradConnectivity™ line up of DeviceNet media is the standard by which all other DeviceNet connection media are measured. We pioneered the market for miniature industrially rated sealed connectors presenting the first quick disconnect alternative to hardwiring. Today BradConnectivity products bring this same quality and durability to the same connectors used in DeviceNet networks. Choices and feature-rich products make them reassuring to specify as part of your DeviceNet system. From tees, splitters and passive boxes, diagnostic aids such as the Power Monitor tees, to the simple-to-use handheld diagnostic Netmeter, BradConnectivity is your choice for DeviceNet infrastructure products.

MINI-CHANGE® CONNECTORS

MICRO-CHANGE® CONNECTORS