networx

Field Networking Solutions

Courtesy of Steven Engineering, Inc. • 230 Ryan Way, South San Francisco, CA 94080-6370 • Main Office: (650) 588-9200 • Outside Local Area: (800) 258-9200 • www.stevenengineering.com

Field Networking 101

The combination of intelligent field devices, digital bus networks, and various open communications protocols is producing extraordinary results at process plants around the world.

Just as our ability to retrieve, share, and analyze data has increased tremendously by use of the Internet and PC network technology in our homes and at our desktops, so has our ability to control and manage our process plants improved. Digital connectivity in process manufacturing plants provides an infrastructure for the flow of real-time data from the process level, making it available throughout our enterprise networks. This data is being used at all levels of the enterprise to provide increased process monitoring and control, inventory and materials planning, advanced diagnostics, maintenance planning, and asset management. These digital networks are generally referred to as a "fieldbus network."

Today's advanced and scalable process control systems allow for multiple fieldbus networks to be deployed simultaneously using one engineering tool. This provides for a high degree of flexibility in control options and allows users to install the required devices and bus functionality for a specific control task. Proper selection and deployment of fieldbus networks are providing unprecedented results in process plants worldwide.

Features and Benefits of Fieldbus Networks

Fieldbus networks provide an array of features and benefits that make them an excellent choice in nearly all process control environments.

Compared to conventional technology, fieldbus networks deliver the following benefits:

Reduced field wiring costs
- Two wires from the control room to many devices

Reduced commissioning costs
- Less time and personnel needed to perform I/O wiring checkouts
- No time spent calibrating intermediate signals (such as 4-20mA signals)
- Digital values are delivered directly from field devices, increasing accuracy

Reduced engineering/operating costs
- Much smaller space required for panels, I/O racks, and connectivity boxes
- Fewer I/O cards and termination panels for control system equipment
- Lower power consumption by control system hardware

Reduced maintenance costs
- Diagnostics are predictive and delivered directly to the control and maintenance systems

Interoperability of different manufacturers
- Open architectures provide much easier and faster integration of a multiple vendor control strategy

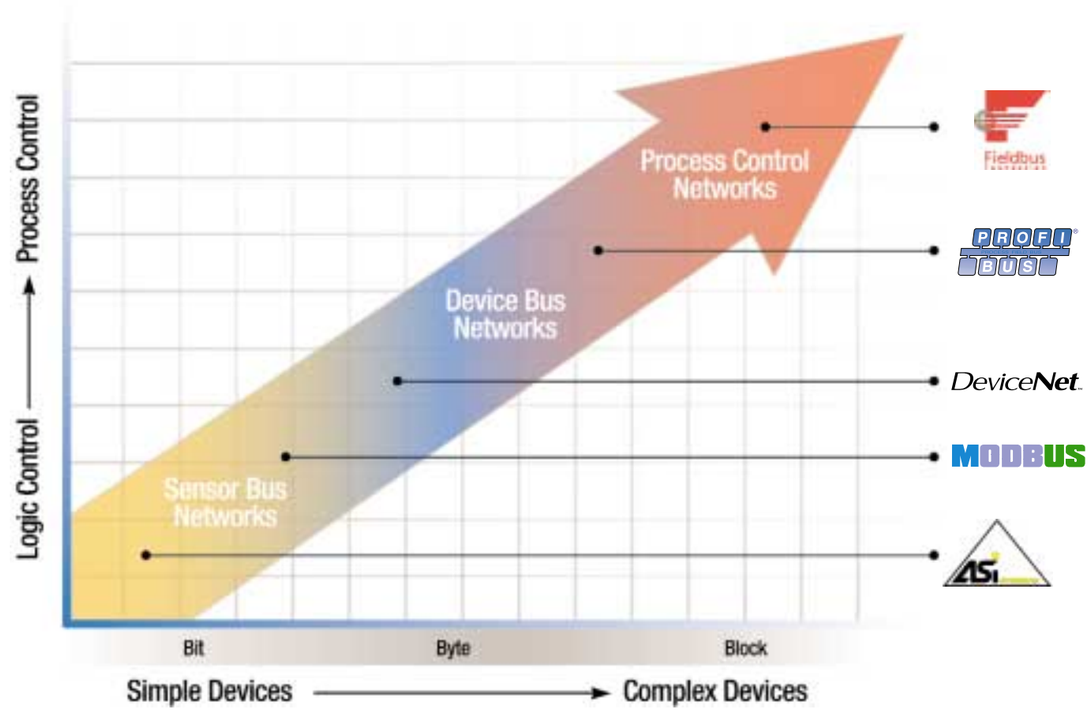
More production uptime
- Initial commissioning and startup is much easier and faster than with conventional systems
- Maintenance and shutdown periods can be planned and minimized, increasing productivity

Bus Network Overview

	Ease of Use	Richness of Info.	Intrinsically Safe	Device Cost	Installed Cost*	Operating Cost
FOUNDATION Fieldbus	High	High	Yes	High	High	Low
Profibus–PA	Medium	High	Yes	High	High	Low
Profibus–PB	Medium	Medium	No	Medium	Medium	Medium
DeviceNet	Medium	Medium	No	Medium	Medium	Medium
Modbus	Medium	Low	No	Medium	Medium	High
AS-Interface	High	Low	No	Low	Medium	High

* Total system, field device, and wiring costs in a Zone 2 (Class I, Div 2) hazardous area.

TYPES OF FIELDBUS NETWORKS*



Sensor Bus Networks

At the lowest level of process automation, the Sensor Bus is a low-cost way to extend the benefits of networking to simpler devices and still be able to connect with higher-level protocols using gateways.

Sensor busses focus solely on discrete devices and offer little connectivity for analog inputs.

AS-i (Actuator Sensor Interface) is the most common Sensor Bus worldwide.

Field devices typically connected to Sensor Bus Networks include on/off valves, limit switches, solenoid valves, and pressure, temperature, level, and flow switches.

Device Bus Networks

Moving up a level in complexity, device busses provide for control of complex discrete devices and equipment power. Device Bus Networks are typically used for connectivity in areas with a high density of discrete devices, variable speed drives, and motor control centers.

The most commonly used Device Bus Networks include DeviceNet and Profibus-DP.

DeviceNet is used extensively in factory automation and is also proving useful in process automation.

Field devices typically connected to Device Bus Networks include on/off valves, motor control centers, variable frequency drives, and numerous discrete sensors and actuators.

Process Control Networks

Process Control Networks are the most advanced fieldbus networks in use today. They provide connectivity of sophisticated process measuring and control equipment. While more complex in functionality, today's process control networks can be easily deployed for new or existing process equipment, and today's engineering tools allow for correct, efficient design. The advanced characteristics of the host interfaces and devices make connectivity, addressing, and commissioning much simpler than conventional devices.

FOUNDATION Fieldbus is emerging as a leader at this level, with strong market share in North America and increasing share throughout the world. Profibus PA is also a viable alternative, with particularly good acceptance in Europe.

Field devices typically connected to Process Control Networks include control valves, temperature and pressure transmitters, level measurement equipment, flow meters, process analytical instruments, and on/off valves where appropriate.

Did You Know?

TopWorx has experience and expertise in a variety of bus protocols, including AS-Interface, FOUNDATION Fieldbus, DeviceNet, Profibus and Modbus.

* Modified version of a graph by Automation Research Corporation

Fieldbus Network Architecture

Today's process automation systems begin with low-cost, commercial PC-based technologies, then connect to proven fieldbus protocols appropriate for a variety of applications.

The result? Precise control, predictive maintenance, and rich information - a proven recipe for improving process plant performance.

Did You Know?

TopWorx offers an array of networking support services, including fieldbus network selection, design and implementation, as well as several training classes.

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The Batch Process

Batch processes contain a dense population of discrete and analog devices, and are well suited for multiple busses: a sophisticated Process Control Network for analog instrumentation, and a simpler Sensor or Device Bus Network for discrete devices.

TopWorx field networking solutions enable seamless integration of multiple busses in a single application.

Key

- Lumitech Discrete Valve Controller
- Switchpak Discrete Valve Monitor
- HazLink Input/Output Module
- GO Switch Leverless Limit Switch
- HazLink Disconnect Switch
- AS-Interface Network Cable
- Conventional Wiring
- FOUNDATION Fieldbus Cable
- HazLink Wiring Tee

Key

- Lumitech Discrete Valve Controller
- Networx Connection Module
- HazLink Input/Output Module
- GO Switch Leverless Limit Switch
- Conventional Wiring
- FOUNDATION Fieldbus Cable
- Intrinsic Safe Barrier/Repeater

The Continuous Process

Continuous processes use sophisticated process measurement and flow control devices, and are well suited for Process Control Networks such as FOUNDATION Fieldbus or Profibus PA.

TopWorx field networking solutions make it easy to connect analog and discrete devices into high level Process Control Networks.

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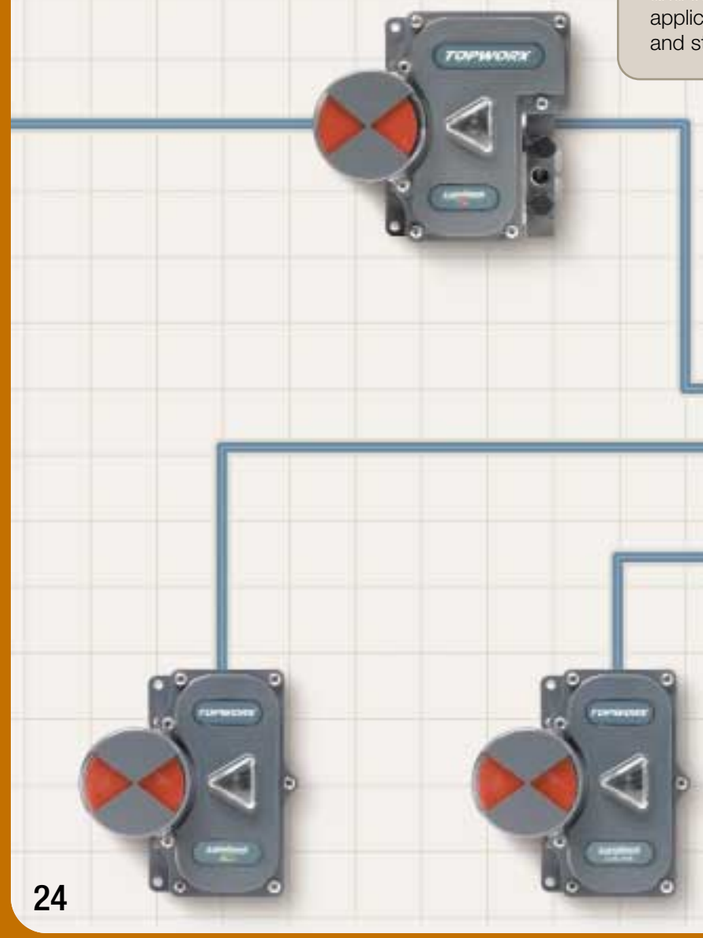
The TopWorx Field Networking Program

With our experience in process plants and expertise in bus networking, TopWorx has created Networx™ - the most complete, customer-focused, cost-effective field networking solutions available anywhere.

Complete
Networx is a comprehensive, single solution with everything you need to build a modern network.

Networx field networking products bridge the gap between process control systems and field devices, minimizing installation costs and maximizing uptime and productivity.

And Networx support services help select, design, and implement the right bus network for your application, ensuring fast, easy commissioning and start-up, and trouble-free operation.



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Complementary
Networx complements global process control system suppliers like Emerson Process Management, Rockwell Automation, Honeywell, ABB, Seimens, Yokogawa, Smar, and Foxboro with practical solutions that help customers implement field-bus technology more effectively.

In fact, several of these companies have shown their trust in TopWorx by frequently recommending our products and services to meet customers' needs.

Customer-Focused
Networx is a direct response to the needs of today's process plants. The focus of the program is to deliver practical networking solutions that help take the architecture into the field effectively and affordably.

Networx field networking solutions focus on the process field environment – where the real work gets done.

Outstanding Value
Networx is so complementary to today's control architectures, so practical for field personnel, so simple to install and maintain, and so cost-effective that it is hard to justify not using it.

Interactive demo of how Networx can reduce costs in your plant.

www.topworx.com

Field Networking Solutions Overview

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Masters & Gateways

Masters provide control functions for sensor level bus networks and devices. Gateways provide the necessary protocol translation that enables the connection of sensor level busses to higher level busses.

Gateways become a node on the higher-level network and a Master for the sensor level bus. Masters and Gateways allow users the flexibility to easily deploy multiple fieldbus networks that correctly match their device and application requirements.

With Masters and Gateways, end-users may eliminate the cost of having multiple home run network cables from the Control System to the field devices, while still deploying cost-effect sensor bus devices in the field.

Masters and Gateways perform the following functions:

- Initialize the network
- Identify field devices
- Diagnose the network
- Control field devices

I/O Modules, Tees & Disconnect Switches

Often there is a need to connect conventional (non-bus) devices to a network. Our Input/Output modules do just that by enabling users to connect conventional analog and discrete devices to their industrial fieldbus networks.

I/O Modules allow users to cost-effectively use new or existing conventional devices in their fieldbus design.

Wiring Tees make it easy to connect field devices to bus lines using wire terminals or plug-in connectors.

Disconnect Switches enable users to repair or replace a field device, without disturbing the network, with the simple flip of a lever-operated switch.

I/O Modules, Wiring Tees and Disconnect Switches are available as stand-alone products or inside HazLink connectivity enclosures.

HazLink™ Connectivity Enclosures

Most bus networks were originally designed to be used for factory automation rather than process automation. Therefore, in the process industries there has been a need for easy, cost-effective ways to make wiring connections in hazardous areas.

Our HazLink™ products are rugged connectivity enclosures that provide flexible wiring options in hazardous areas.

Options include:

- I/O Modules
- Wiring Tees
- Disconnect Switches

Power Supplies & Repeaters

TopWorx provides power supplies to meet every field network requirement. Since each bus protocol has its own power and data specification, TopWorx offers the appropriate power supplies required for the intended protocols.

Our selection includes:

- Bulk power supplies for control system and device level power needs
- Bus-level power supplies and conditioners for network communications isolation
- Repeaters for extending network power and communication limits

Cables, Connectors & Cordsets

Proper wiring, termination, and connectivity are the framework of any bus or network solution. Since the vast majority of networking problems occur at the physical layer, the proper wiring and connection techniques help to keep your fieldbus network robust and problem free.

Whether you choose plug-in style connections or terminal screw connections, TopWorx offers a vast selection of connectivity options to meet your needs. We offer bulk cabling, field installable connectors, linking modules, tees, terminators, and pre-molded cordsets that meet the specifications of your fieldbus network.

Networx Support Services

As part of our Networx program, TopWorx offers a system of support services to help process plants understand and implement bus networking technologies.

Networx Support Services can help:

- Select the appropriate bus network for your application
- Map out an accurate I/O plan
- Design a sound architecture and implementation plan
- Configure and connect the field devices
- Commission and start-up the process
- Support the operation all day every day
- Troubleshoot any potential problems

Field Networking Quick Selection Guide

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Lumitech DVM
see page 132

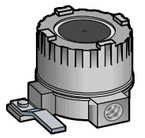
Switchpak DXS
see page 136

Lumitech DVC
see page 130

Switchpak DXP
see page 134

Sensor-Communications Module

Masters & Gateways



HazLink Connectivity Enclosures

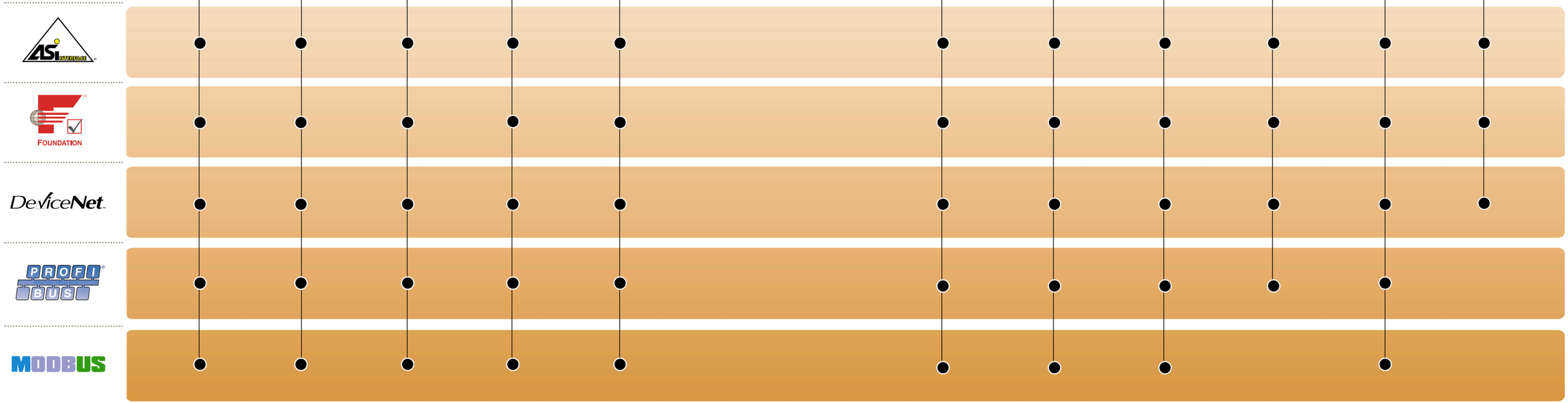
I/O Modules & Wiring Tees

Power Supplies & Repeaters

Cables, Connectors & Cordsets

Support Services
see page 30

Bus Network



Networx Support Services

Experience in process plants. Expertise in bus networking. Exceptional support for you.

With all of the attention given recently to the benefits of bus technology, many process manufacturers are excited about the potential results that sound so promising. But often they lack the resources and time to educate themselves on all of the new buzzwords and technologies that have suddenly become so important.

The fact is, many process manufacturers are ready to reap the rewards available through bus networking technologies, but they don't always know how to do it, or even where to turn for help.

Enter TopWorx. As part of our Networx portfolio of field networking solutions, we have created a system of support services to make it easier for plant personnel to understand, implement, and enjoy the benefits of bus networking technologies.

With Networx Support Services, you know where to turn for help.

Networx Support Services

Experience + Expertise wherever and whenever you need it.

In the processing industries, availability is critical to success. And most process plants operate 24 hours a day, 7 days a week. So part of the vision of Networx Support Services is to make sure that if you need help, you can get it wherever and whenever you need it.

That's why we have created a support structure to serve the needs of process plants. Whether you need training for your personnel, configuration of your devices, or quick answers during a start-up, Networx Support Services can help deliver the kind of support you need.

An important part of Networx Support Services is the partnerships that TopWorx enjoys with hundreds of companies around the world. These partnerships give TopWorx customers an array of choices to meet their unique needs.

To ensure consistent delivery of superior service from our channel partners to our customers, TopWorx has created a channel certification and specialization program for the selection, education, and certification of our partners.

Channel Specialization
By setting high standards for our partners in specialized areas of expertise such as bus networking, valve automation, and systems integration, TopWorx makes sure that its customers receive only the highest quality of support.

Channel Certification
Only those partners who meet certain rigid criteria can become or continue to be a Certified Channel Partner. Periodic reviews ensure that partners in fact have the expertise, capabilities, and customer commitment required by our customers and set forth in our partnership agreements.

Types of TopWorx Channel Partners include:

Certified Product Distributor TOPWORX

These partners are authorized to sell and support one or more of the three TopWorx product groups: field networking, valve control, or position sensing products.

Certified Service Provider TOPWORX

These partners are qualified to deliver Networx Support Services to our customers on behalf of TopWorx.

Certified Product Integrator TOPWORX

These partners are able to integrate one or more of the three TopWorx product groups into larger, more sophisticated control architectures and automated systems.

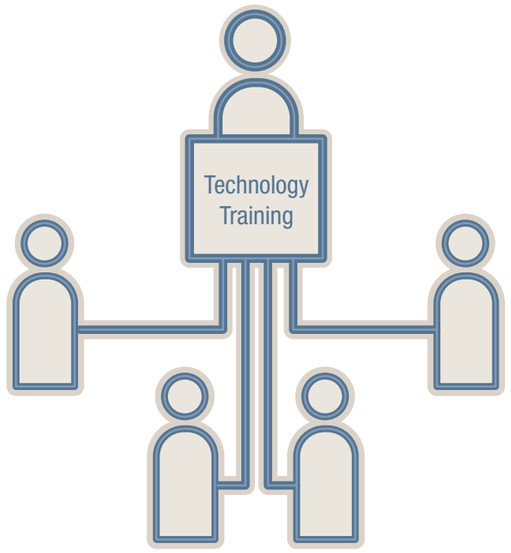
Networx Support Services

Technology Training delivers practical knowledge of bus networking.

Process plants sometimes lack the resources necessary to keep pace with rapidly changing technology and its impact on competitive strategy. Therefore, the key to success often is a company's ability to quickly deliver technical knowledge to its personnel and convert that knowledge into practical solutions that can be applied to field operations.

As part of our Networx Support Services, TopWorx has created a means to deliver knowledge to your employees. We offer a number of training classes and seminars to educate staff personnel on the theories, realities, and practicalities of modern bus networking technologies, including AS-Interface, FOUNDATION Fieldbus, DeviceNet, and Profibus.

Our technology training program is building rapidly. New locations, dates, and courses are being added occasionally, so please visit our website at **www.topworx.com** for more updated learning opportunities.



Technology Training

NSS - TT101
Discovering Bus Networking

This course covers the world of bus networking using simple, easy to understand terms, and provides the basics that everyone should know about today's most prominent bus protocols. At the end of the course, the student will see the benefits of modern bus technologies and the differences among the major protocols. The student will also understand how bus networking technologies improve the performance of process plants, and which bus or busses will deliver the quickest return on investment in his or her specific application.

Overview of Bus Networks
- Terminology and networking "buzzwords"
- Sensor Bus Networks (AS-Interface)
- Device Bus Networks (DeviceNet, Profibus DP)
- Process Control Networks (FOUNDATION)

Comparison of Bus Networks
- Common benefits of all bus networks
- Differences in various bus networks
- When and where to use each technology

Choosing the Appropriate Bus Network
- Which bus is right for you?

NSS - TT1AS
Practical AS-Interface

This course covers the practical issues of implementing an AS-i bus network. At the end of the course, the student will be able to design an AS-i system, select the proper components to build the network, and configure and connect AS-i and conventional field devices to the network. He or she will also have a solid understanding of proper AS-i wiring practices in hazardous areas, as well as an appreciation for the financial aspect of project justification.

Overview of AS-Interface
- Key features and benefits of AS-i
- When to use AS-i
- Topologies, cable types, and constraints
- Components required to build an AS-i network

Hands-on AS-Interface
- Design an AS-i network
- Wire and configure masters, gateways, and devices
- Installation techniques in hazardous areas

Economics of AS-Interface
- Quantifying potential savings
- Justifying an AS-i project

NSS - TT1FF
Practical FOUNDATION Fieldbus

This course covers the practical issues of implementing FOUNDATION Fieldbus segments. At the end of the course, the student will be able to design fieldbus segments, select the proper components to build the segments, and configure and connect FF field devices to the network. He or she will also have a solid understanding of proper wiring practices when applying FF in non-incendive, explosion-proof, and intrinsically safe hazardous areas.

Overview of FOUNDATION Fieldbus
- Theory of FF technology
- Key features and benefits of FF
- Topologies, cable types, and constraints
- Components required to build FF segments

Hands-on FOUNDATION Fieldbus
- Design of FF segments - power, voltage, device load constraints
- Wire and configure devices to a process control system
- Installation in hazardous areas

Economics of FOUNDATION Fieldbus
- Quantifying potential savings
- Justifying an FF project

NSS - TT1DN
Practical DeviceNet

This course covers the practical issues of implementing a DeviceNet device bus network. At the end of the course, the student will be able to design a DeviceNet system, select and assemble the proper components to build the network, and configure and connect Devicet and conventional field devices to the network. He or she will also have a solid understanding of proper wiring practices in hazardous areas, as well as an appreciation for the financial aspect of project justification.

Overview of DeviceNet
- Key features and benefits of DeviceNet
- When to use DeviceNet
- Topologies, cable types, and constraints
- Components required to build a DeviceNet network

Hands-on DeviceNet
- Design a DeviceNet network
- Wire and configure devices to a process control system
- Installation techniques in hazardous areas

Economics of DeviceNet
- Quantifying potential savings
- Justifying a DeviceNet project

AS-Interface Overview

The AS-i (Actuator Sensor Interface) protocol was created in Germany in 1994 by a consortium of factory automation suppliers. Originally developed to be a low-cost method for addressing discrete sensors in factory automation applications, AS-i has since gained acceptance in process industries due to its high power capability, simplicity of installation and operation, and low cost adder for devices.

Each AS-i segment can network up to 31 devices. This provides for 124 inputs and 124 outputs, giving a maximum capacity of 248 I/O per network on a v2.0 segment. The AS-i v2.1 specification doubles this to 62 devices per segment, providing 248 inputs and 186 outputs for a total network capacity of 434 I/O points.

Both signal and power are carried on two wires. Up to 8 amps at 30VDC of power are available for field devices such as solenoid valves.

AS-i Network Highlights

Technology Developer AS-i Consortium

Year Introduced 1993

Openness Multiple vendors
800+ products, 150 Vendors

Type of Network Sensor Bus

Physical Media 2-wire cable (flat or round)

Network Topology Bus, Ring, Tree, Star

Maximum Devices
- v2.0 31 nodes (or 248 I/O points)
- v2.1 62 nodes (or 434 I/O points)

Maximum Distance
- Maximum Distance 100 meters
- Maximum Distance with repeaters 300 meters (max. of 2 repeaters can be used)

Communication Methods
- Master/Slave with cyclic polling
- Manchester Bit Encoding implemented via Alternating Pulse Modulation (APM)

Transmission Properties
- 5 mSec latency max. on fully loaded segment

Primary usage
- v2.0 Discrete Signals
- v2.1 Discrete Signals (supports 12 bit analog signals accessed over 5 cycles)

Power and Communications on same twisted pair
- Limited to 200mA per device power consumption
- Requires AS-i specific power supply on communications bus for de-coupling

Device Power Supply
- Devices can be supplied from bus (<200mA)
- Additional power can be supplied by AS-i power bus cable having multiple power supplies (required for higher power outputs)

Wiring Types
Round: Normal 2 wire cable #16AWG (1.5mm)

Flat: 2 wire flat AS-i cable (1.5mm conductors) Yellow for communications Black for additional power

Grounding aspects Ungrounded communications bus

Shielding Unshielded wire

Terminators No terminators required

Hazardous Area Installations Explosion Proof wiring required

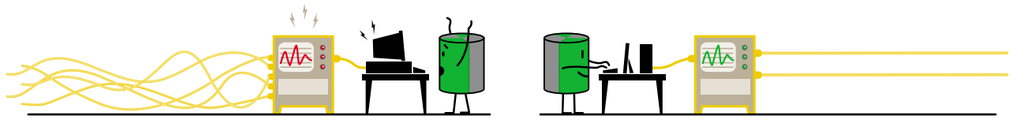
Device Addressing
- Automatic when connected one at a time to the segment or with Handheld Addressing Unit

Governing Body ATO (AS-i Trade Organization)

Web Site **www.as-interface.com**

Conventional I/O System vs. AS-i Bus Network

AS-i is so simple and so inexpensive that it makes using traditional wiring methods difficult to justify.



CONVENTIONAL I/O SYSTEM

Advantages
- Technology is already understood
- Slightly lower device cost
- Independent wiring from devices to the control system means wiring problems with one device don't affect other field devices

Drawbacks
- Higher installed cost
- Point-to-point wiring is expensive
- Many wiring connections:
  - are labor intensive to install
  - create many points of failure
  - increase complexity when troubleshooting
  - require large amounts of cabinet or rack space for installation of terminal blocks
  - create time-consuming initial checkout and startup
- Expansion requires duplicating the entire wiring scheme for each additional point

AS-i BUS NETWORK

Advantages
- Technology is easy to understand
- Very low device cost adder
- Lower installed cost
- High speed network for sensor level devices
- Ability to integrate conventional devices into AS-i network
- Easy addressing for devices; auto-addressing capabilities on most masters
- Many gateways available to integrate AS-i network into higher-level networks, allowing for easy integration of a lower cost, sensor level network with a more sophisticated, higher-cost control level network
- AS-i network provides for use of higher power devices
- Easily expandable with network redesign
- Requires no terminators or special shielding requirements yet still less susceptible to RFI interface than some networks
- Wide variety of masters/gateways available for PLC's, DCS's, PC's
- Power and bus communications are on same pair of wires
- Wide variety of topologies available, including point-to-point, line, tree, and ring

Drawbacks
- Not available for Intrinsically Safe applications
- Wiring runs limited to 100 meters
- v2.0 supports only discrete devices (v2.1 has limited analog support)
- No control in the field
- Limited data quality and status messaging
- Limited analog support
- Requires specific AS-i power supply for bus communications isolation
- Limited redundancy capabilities

AS-i is inexpensive, simple, supplies plenty of power and offers end users a variety of wiring strategies.

TopWorx Comments on AS-i

Strengths
AS-i is inexpensive, especially in general purpose environments.

AS-i is simple. Unlike other communication protocols, AS-i is not designed to bring control system functionality to the field. AS-i is simply a better way to connect field devices to the control system. AS-i offers end users a variety of topologies (wiring strategies). And AS-i's principle of operation makes it easy to install and configure as well as add new devices later.

AS-i supplies plenty of power. AS-i delivers plenty of power to operate virtually all field devices, including solenoid valves.

Limitations
Wiring length
The maximum length of cable run is limited to 100 m per segment. Up to two repeaters can be added to increase this length to 300 m.

Hazardous Areas
Since AS-i is an 8 amp bus, it cannot be intrinsically safe. TopWorx has recognized the difficulties of installing AS-i in hazardous areas and offers a variety of solutions suitable for use in Class I, Div 1 (Zone 1) and Class I, Div 2 (Zone 2) environments.

When to Use AS-i
Generally speaking, TopWorx recommends AS-i when:
- device populations are all discrete
- plants are not intrinsically safe
- cable length limitations are not an issue
- users desire the ultimate in simplicity
- existing discrete devices need to be incorporated into a bussed environment
- conventional discrete devices need to be incorporated into a bus network
- large numbers of discrete devices need to be cost-effectively incorporated into an existing control level network via a gateway device

Sensor Bus Network

AS-Interface Sensor-Communications Module

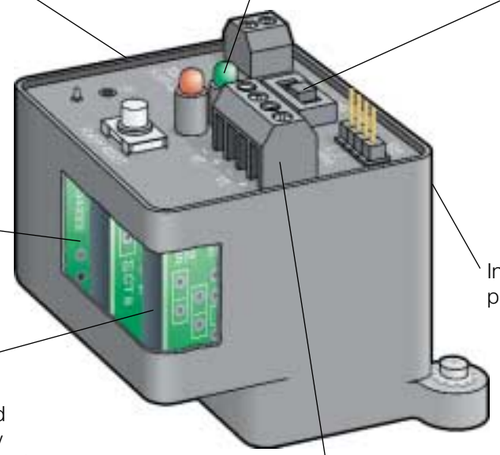
The TopWorx Sensor-Communications Module (SCM) combines position sensors, AS-i communication, solenoid outputs, and wiring terminals into a compact enclosure that is potted and sealed from the environment.

SCM-ASi enclosure is **resistant to high levels of impact, moisture, shock, and vibration.**

Britelite LEDs indicate valve position and facilitate sensor set up.

Calibration Switch facilitates initial setup. The three position On-Off-ASi switch enables the valve to be test cycled open and closed offline, then put onto the network when ready.

All electronics are **short-circuit protected,** eliminating the expense of adding separate short-circuit protection.



Integrated position sensors provide valve position feedback.

All micro-processor based electronics are completely **potted and sealed,** preventing premature failure due to moisture or contamination.

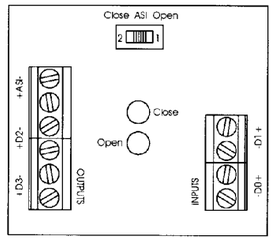
Onboard terminals provide connection points for **auxiliary discrete inputs.**

SCM-ASi Highlights

The Sensor-Communications Module delivers valve position feedback, communicates directly on the AS-Interface network, pilots the valve actuator, and provides extra wiring terminals for auxiliary inputs.

The TopWorx SCM-ASi is a compact, sealed module that can be used in a variety of enclosures suitable for use in any hazardous or corrosive process environment.

2 Discrete Inputs (DI)	Open/Closed valve position feedback
2 Discrete Outputs (DO)	Solenoid outputs for single or double acting
Calibration Switch	Open-Close-ASi
BriteLite LEDs	Open, Closed
Conformance Tested	Yes
Short Circuit Protection	Yes
Maximum Output Current	160mA per output
Maximum Output Power	4 watts per output
Voltage	24-30 VDC



SCM-ASi Wiring Diagram

The AS-i Sensor-Communications Module fits conveniently into a variety of valve control enclosures suitable for any process environment.

Lumitech DVC-ASi

Discrete Valve Controller
- Zone 2, (Class I, Div 2)
- Integral Solenoid Valve
- Direct Mount

See page 130 for more details.

Did You Know?

TopWorx makes it easy to use AS-Interface in hazardous areas. HazLink connectivity enclosures offer multiple explosion proof wiring options, and Switchpak valve controllers and monitors are suitable for use in Zone 1 (Class I, Div 1) hazardous areas.

Lumitech DVM-ASi

Discrete Valve Monitor
- Zone 2 (Class I, Div 2)
- Direct Mount

See page 132 for more details.

Switchpak DXP-ASi
Switchpak DXS-ASi (Stainless Steel enclosure)

Discrete Valve Monitor
- Zone 1 (Class I, Div 1)

See page 134, 136 for more details.

The AS-Interface sensor bus network was originally designed to be used for factory automation rather than process automation. Therefore, in the process industries there has been a need for easy, cost-effective ways to make wiring connections in hazardous areas.

Our HazLink products are rugged junction enclosures that provide flexible wiring options in hazardous areas, making AS-Interface more suitable for use in the process industries.

HazLink Features: Zone 1 (Class I, Div 1)
(3) 3/4" NPT conduit outlets

HazLink Options: I/O Modules
Wiring Tees
Disconnect Switches

Item

HazLink Connectivity Enclosure

General Specifications

Enclosure: Die-cast aluminum; O-ring sealed

Coating: Dichromate conversion (inside); powder polyester coating (outside)

O-rings: Buna N

Cover: Screw cover with O-ring seal

Conduit Outlets: Three 3/4" NPT

Environment: NEMA Type 4, 4X, 7 and 9

Approvals: Explosion Proof
Zone 1
Class I, Div 1 & 2, Groups A,B,C,D
Class II, Div 1 & 2, Groups E,F,G

c UL us LISTED

CE

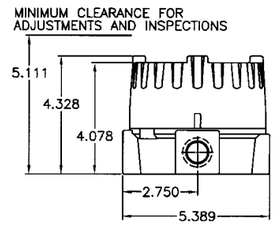
I/O Modules

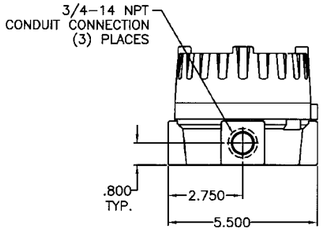
HazLink I/O Modules allow users to cost-effectively connect new or existing conventional devices into the AS-Interface network in Zone 1 (Class I, Div 1) hazardous areas.

NHL-ASIO Hazlink Connectivity Enclosure with AS-Interface I/O
2 input, 2 output knifegate valve or cylinder controller

AS-Interface

Dimensions



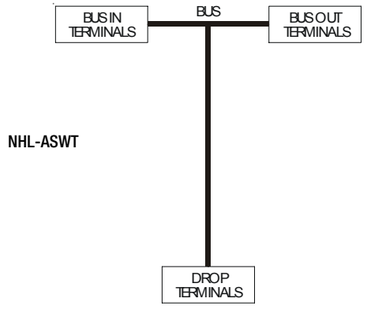


Wiring Tees

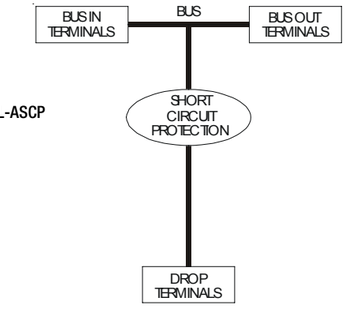
HazLink Wiring Tees make it easy to connect field devices to bus lines using wire terminals or plug-in connectors.

NHL-ASWT AS-Interface tee with 3 x 2 position wiring terminals

NHL-ASCP Short circuit protection



NHL-ASWT



NHL-ASCP

Disconnect Switches

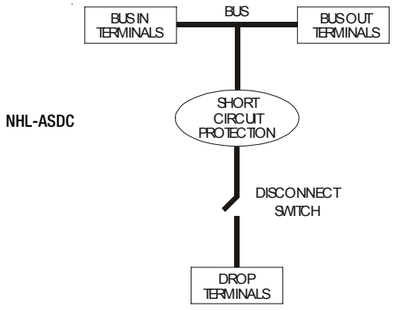
HazLink Disconnect Switches enable users to repair or replace a field device without disturbing the network with the simple flip of a lever-operated switch.

Disconnect Switches are designed to be locked if desired. Locking prevents tampering or accidental device connection or disconnection.

TopWorx offers Disconnect Switches in HazLink enclosures with or without short circuit protection.

NHL-ASDS Disconnect switch

NHL-ASDC Disconnect switch with short circuit protection



NHL-ASDC

AS-i to Modbus Gateways

502.969.8000

AS-i to Modbus Gateways control the field devices on the AS-Interface network, and connect the AS-i network to the Modbus protocol via RS 232C, RS 422, or RS 485 serial interface.

General Specifications

Operating Temperature: 32° to 131°F (0° to 55°C)
Voltage of insulation: ≥ 500V
Protection Category: Housing IP40, Terminals IP20

Item

AS-i to Modbus Gateways

Gateways function as a master on the AS-i network and as a single node on the Modbus network.

Dual Gateways function as two complete masters on the AS-i network and as a single node on the Modbus network.

These devices include demonstration software that performs addressing, monitoring, and diagnostics of the network.

Additional Specifications

AS-i Specification: 2.1 (Gateways); 2.0 (Dual Gateways)

With AS-i Power Supply

Operating Voltage: 30VDC AS-i voltage

Operating Current:
Single Gateways: 200mA (from AS-i)
Dual Gateways: 200mA (from AS-i 1), 70mA (from AS-i 2)

With Standard Power Supply

Operating Voltage: 24VDC

Operating Current: 70mA (from AS-i), 150mA at 18VDC (from power)

Check it out! - D-sub-data transmission cords, page 117

Part Number & Description

Single Gateways

	Serial Interface	Power Supply
NAS-GM11	RS 232C	AS-i
NAS-GM12	RS 232C	Standard
NAS-GM13	RS 485	AS-i
NAS-GM14	RS 485	Standard
NAS-GM15	RS 422	AS-i
NAS-GM16	RS 422	Standard

Dual Gateways

	Serial Interface	Power Supply
NAS-GM21	RS 232C	AS-i
NAS-GM22	RS 232C	Standard
NAS-GM23	RS 485	AS-i
NAS-GM24	RS 485	Standard
NAS-GM25	RS 422	AS-i
NAS-GM26	RS 422	Standard

AS-i to DeviceNet Gateways

TOPWORX

AS-i to DeviceNet Gateways provide a means of easily connecting an AS-i network to a higher level DeviceNet network. The Gateway is recognized as a single node on the higher level DeviceNet network while controlling the field devices on the AS-Interface network.

General Specifications

Operating Temperature: 32° to 131°F (0° to 55°C)
Mounting: DIN rail
Voltage of insulation: ≥ 500V
Protection Category: Housing IP40, Terminals IP20

Item

AS-i to DeviceNet Gateways

Gateway

Gateway with graphical display

Functions as a master on the AS-i network and as a single node on the DeviceNet network.

These devices include demonstration software that performs addressing, monitoring, and diagnostics of the network.

Additional Specifications

Single Gateways

Operating Voltage: 30VDC AS-i voltage

Operating Current: 200mA (from AS-i circuit)

Dual Gateways

Operating Voltage: 24VDC

Operating Current: 200mA (from AS-i 1), 70mA (from AS-i 2)

Check it out! - D-sub-data transmission cords, page 117
- Master simulators for testing, page 78

Part Number & Description

	Graphical Display	# AS-i Masters	AS-i Specification
NAS-GD01	Yes	Single	2.1
NAS-GD02	Yes	Dual	2.1
NAS-GD03	No	Single	2.0

AS-i to Profibus DP Gateways

502.969.8000

AS-i to Profibus DP Gateways provide a means of easily connecting an AS-i network to a higher level Profibus DP network. The Gateway is recognized as a single node on the higher level Profibus DP network while controlling the field devices on the AS-Interface network.

General Specifications

Operating Temperature: 32° to 131°F (0° to 55°C)
Mounting: DIN rail
Voltage of insulation: ≥ 500V
Protection Category: Housing IP40, Terminals IP20
AS-i Specification: 2.1

Item	Part Number & Description

AS-i to Profibus DP Gateways

Gateway

Gateway with graphical display

Functions as a master on the AS-i network and as a single node on the Profibus DP network.

Dual Gateways function as two complete masters on the AS-i network and as a single node on the Profibus DP network.

These devices include demonstration software that performs addressing, monitoring, and diagnostics of the network.

Additional Specifications

Connection Type: Screw terminals

Gateway

Operating Voltage: 30VDC AS-i voltage

Operating Current: 200mA (from AS-i circuit)

Dual Gateway

Operating Voltage: 24VDC

Operating Current:
AS-i Power: 200mA (from AS-i 1), 70mA (from AS-i 2)
Standard Power: 70mA (from each AS-i), 150mA at 18VDC (from power)

Check it out!
- D-sub-data transmission cords, page 117
- Master simulators for testing, page 99

Single Gateways

	Graphical Display	Power Supply
NAS-GP11	Yes	AS-i
NAS-GP12	No	AS-i

Dual Gateways

	Serial Interface	Power Supply
NAS-GP21	Yes	AS-i
NAS-GP22	No	AS-i
NAS-GP23	Yes	Standard
NAS-GP24	No	Standard

AS-i to Ethernet TCP-IP Dual Gateways

TOPWORX

Dual AS-i to Ethernet Gateways control the field devices on the AS-Interface network, and connect the AS-i network to Ethernet TCP-IP. The Dual Gateway controls two AS-i networks and appears as a single node on Ethernet.

General Specifications

Operating Temperature: 32° to 131°F (0° to 55°C)
Voltage of insulation: ≥ 500V
Protection Category: Housing IP40, Terminals IP20
AS-i Specification: 2.1

Item	Part Number & Description
NAS-GE01	AS-i to Ethernet Dual Gateway using AS-i power supply

AS-i to Ethernet TCP-IP Dual Gateways

Functions as two complete masters on the AS-i network and as 256 bit digital I/O module per the AS-i network for Ethernet. Modbus is used as the fieldbus application layer.

These devices include demonstration software that performs addressing, monitoring, and diagnostics of the network.

Additional Specifications

Operating Voltage: 18.0 to 31.6VDC

Operating Current:
AS-i Power: 200mA (from AS-i 1), 70mA (from AS-i 2)
Standard Power: 70mA (from each AS-i), 150mA at 18VDC (from power)

Quick Disconnect I/O Modules

502.969.8000

Input/Output Modules are used to interface conventional devices with an AS-i network bus using Quick Disconnect (QDC) style connectors.

General Specifications

Protection Class: IP67

Item	Part Number & Description

Heavy Duty I/O Modules

These modules provide QDC connectors for input and output devices. The AS-i bus communication and external power cables can be connected via QDC style connector or AS-i flat cable using piercing technology. These modules have outputs rated at a total of 2A.

Additional Specifications

Operating Temperature: -13° to 158°F (-25° to 70°C)

Material: PA6-GF30; nickel-plated brass connectors

No. of Pins: 4

Quick Ship! - Connectors & Cordsets, page 49-50
- Power Supplies, pages 48 & 116

NAS-1A01	4 discrete inputs
NAS-1A02	2 discrete inputs and 2 discrete outputs
NAS-1A03	4 discrete inputs and 4 discrete outputs
NAS-1A04	4 discrete outputs

Passive Junctions

These junctions provide an easy method of connecting and expanding an AS-i network using AS-i round cable and QDC style connectors. QDC connectors allow for easy connecting and disconnecting of the device and prevent accidental shorting of communication and power wiring.

Additional Specifications

Operating Voltage: 300V

Operating Current per Conductor: 9.0A (minifast), 4.0A (eurofast)

Operating Temperature Range: -22° to 176°F (-30° to 80°C)

Material: Die-cast aluminum, black powder coated

Receptacle Housing: Stainless steel

No. of Pins: 4

NAS-1B01	8 ports, eurofast, with minifast trunk connectors [1]
NAS-1B02	8 ports, eurofast
NAS-1B03	6 ports, eurofast
NAS-1B04	4 ports, eurofast
NAS-1B05	8 ports, minifast

[1] **Operating Temperature**: -13° to 158°F (-25° to 70°C)
Material: Black nylon
Receptacle Housing: Nickel-plated brass

I/O Modules & Couplers

TOPWORX

AS-Interface

These standard consortium-style Input/Output modules are used for interfacing conventional devices with an AS-i network. I/O modules must be combined with a coupler to use either round or flat AS-i bus cable.

General Specifications

Operating Temperature: -13° to 158°F (-25° to 70°C)
Protection Class: IP67

Quick Ship! - AS-i specific power supplies, page 48

Item	Part Number & Description

Standard User I/O Modules

Input Modules are used for connecting conventional discrete devices to an AS-Interface.

Output Modules are used to connect conventional discrete actuators to an AS-Interface.

These Output Modules can supply 200mA total from the AS-Interface. Supplemental Power is required for higher current devices.

Quick Ship! - User coupler modules, below

Input Modules

NAS-2A11	4 inputs, 100mA
NAS-2A12	4 inputs, 200mA
NAS-2A13	4 inputs, 100mA, SPDT
NAS-2A14	4 inputs, 200mA, SPDT

Output Modules

NAS-2A21	4 relay outputs, 1A with supplemental power
NAS-2A22	4 relay outputs, 1A - M12 supplemental power connection
NAS-2A23	4 solid-state outputs, 2A with supplemental power - watchdog
NAS-2A24	4 solid-state outputs, 2A with supplemental power - watchdog - NPN

Combo Input/Output Modules

NAS-2A31	2 inputs, 100mA; 2 relay outputs, 1A
NAS-2A32	2 inputs 100mA; 2 relay outputs, 1A - M12 power connection
NAS-2A33	2 inputs, 100mA; 2 solid-state outputs, 2A - watchdog
NAS-2A34	2 inputs, 100mA; 2 solid-state outputs, 2A - watchdog SPDT
NAS-2A35	2 inputs, 100mA; 2 solid-state outputs, 2A - NPN

User Coupler Modules

Coupler Modules provide a base for connecting the Standard User Modules above to the AS-Interface network cabling.

They can also provide terminal block connections for a supplemental power source when using higher current discrete actuating devices.

Choose a coupler module that matches your specific AS-i wiring and output power requirements.

For Ribbon Cable

NAS-2B11	Coupler module
NAS-2B12	Coupler module with terminal for additional supply

For Circular Cable

NAS-2B21	Coupler module
NAS-2B22	Coupler module with terminal block for additional supply
NAS-2B23	Coupler module with shielded terminal
NAS-2B24	Coupler module with shielded terminal without accessories

Junction Box I/O Modules

502.969.8000

These Input/Output modules provide screw terminal connections for conventional input/output devices to be connected to an AS-i network. The I/O modules are powered via the AS-i network. For modules with outputs, the outputs are powered by a conventional external 24VDC power supply that can be connected directly to the module.

General Specifications

Operating Temperature: -13° to 140°F (-25° to 60°C)
Protection Class: IP20
Mounting: DIN rail
Approvals: Class I, Div 2

Item	Part Number & Description
Junction Box I/O Modules	
	Input Modules
	NAS-3A11 4 inputs
	NAS-3A12 4 inputs with input filter
	Output Modules
	NAS-3A21 4 Form C relay outputs
	Combo Input/Output Modules
	NAS-3A31 2 inputs, 2 outputs with watchdog
	NAS-3A32 4 inputs, 4 outputs with watchdog

Additional Specifications

Output Modules

Operating Current: ≤ 40mA

Load Capacity per relay: 115VAC, 500mA
24VDC, 500mA
60VA max

Input Modules

Operating Current: ≤ 60mA, ≤ 30mA with filter

Combo Modules

Operating Current: ≤ 30mA (2 I/O), ≤ 60mA (4 I/O)

Load Capacity per output: 24VDC, 500mA
1A total (2 I/O)
2A total (4 I/O)

Don't forget! - 24VDC power supplies, page 116

Analog Stations

TOPWORX

These analog stations are compliant with AS-i specification 2.1, which provides limited support for analog devices. These modules provide 16 bit resolution of analog signals. Your AS-i master device must be AS-i 2.1 compliant.

Don't forget! - Cordsets, cable & connectors, pages 49-51
- Power Supplies, pages 48 & 116

General Specifications

Operating Temperature: 32° to 158°F (0° to 70°C)
Protection Class: IP65
AS-i Specification: 2.1
Output Stations Operating Current: <80mA total

Item	Part Number & Description
Analog Stations	
These modules provide support for non-time sensitive analog signals via an AS-Interface and are recommended for monitoring applications.	Input Stations
Up to 40mA of current is available per device from the AS-i bus or a supplemental power source.	**NAS-4A11** Two 4-20mA inputs, 1µA resolution
On input stations, power for sensors can be supplied by AS-i or an external source via the black ribbon cable.	**NAS-4A12** Two 0-10V inputs, 1mV resolution
On output stations, power for actuators can be supplied by AS-i or external voltage via the black ribbon cable.	**NAS-4A13** Four Pt100 inputs, 0.1°C resolution
	Output Stations
	NAS-4A21 Two 4-20mA outputs, 1µA resolution
	NAS-4A22 Two 0-10V outputs, 1mV resolution

AS-i Power Supplies & Repeaters

502.969.8000

AS-i networks require AS-i specific power supplies to maintain proper voltage and communications on the AS-i bus.

Item	Part Number & Description
AS-i Power Supply Units  These units are DIN rail mounted. Specifications **Operating Temperature:** 14° to 158°F (-10° to 70°C) **Protection Class:** IP20 **Operating Voltage:** 115/230VAC, selectable **Output Voltage:** 29.5 to 31.6VDC	**NAS-5A01** 2.8A power supply unit **NAS-5A02** 8A power supply unit
AS-i Repeater  Repeaters can be used to extend the communications portion of an AS-i network beyond 100 m. A maximum of two repeaters may be used to achieve a maximum AS-i segment length of 300 m. The repeater can work in conjunction with the AS-I Power Extender below. Specifications **Operating Voltage:** via AS-i **Operating Current:** 60mA per segment, 120mA total **Operating Temperature:** 14° to 131°F (-10° to 55°C) **Protection Class:** IP65 **Connections:** AS-i flat or round cable	**NAS-5B01** AS-i repeater
Power Extender  Power Extenders are designed to maintain the bus power within specifications when extending an AS-i network. This device can work in conjunction with the AS-i Repeater above to extend an AS-i network beyond the standard 100 m limitation. Specifications **Operating Temperature:** 32° to 158°F (0° to 70°C) **Protection Class:** IP65 **Operating Voltage:** 30VDC **Operating Current:** <2.8A at 30V	**NAS-5C01** AS-i power extender

Field Wirable Connectors

TOPWORX

These plug-style, quick-disconnect (QDC) connectors are designed for easy installation in the field after AS-i cable has been routed through the conduit, wire-ways, panel enclosures, and other locations.

General Specifications

Operating Temperature: -40° to 185°F (-40° to 85°C)
Protection Class: IP67

Item	Part Number & Description
Minifast Connectors Additional Specifications **Housing:** Nylon, type PA 6.6 GV **Connector Insert:** Polyurethane; V2 acc. UL 94 **Contact Materials:** CuZn plated copper alloy **Coupling Nuts:** Anodized aluminum **Protection:** NEMA 1, 3, 4, 6 & 13	**NFC-MFS** Minifast field wirable straight female connector **NFC-MMS** Minifast field wirable straight male connector
Eurofast Connectors Additional Specifications **Housing:** Polyester, PBT Black **Connector Insert:** PBT; spacings to VDE 0110 Group C **Contact Materials:** Nickel plated copper alloy **Coupling Nuts:** Female - PBT; Male - Nickel Plated Brass **Protection:** NEMA 1, 3, 4 & 6p	Female Connectors **NFC-EFS** Eurofast field wirable straight female connector **NFC-EFR** Eurofast field wirable right angle female connector Male Connectors **NFC-EMS** Eurofast field wirable straight male connector **NFC-EMR** Eurofast field wirable right angle male connector

Molded Connector Cordsets

502.969.8000

These cordsets provide AS-i cable with pre-installed, plug-in connectors, reducing installation time in the field.

Available in 1, 3, 5, and 10 meter lengths. Consult the factory for additional cordset lengths.

Item	Part Number & Description
Molded Connector Cordsets TopWorx offers AS-Interface molded connector cordsets in AS-i 300V PVC yellow round data cable. Cordsets are available with a molded connector on each end or with one end bare to facilitate routing of cable through conduit or panel enclosures. All double cordsets have one straight male connector and one straight female connector. See page 51 for cable specifications. **Connector Specifications** **Plug Body:** Molded polyurethane **Contacts:** Gold plated brass **Coupling Nuts:** Stainless steel **Temperature:** -40° to 158°F (-40° to 70°C) **Protection:** NEMA 1,3,4,6,13; IP67 **Rated Current:** 9.0A (minifast); 4.0A (eurofast)	**To create your cordset part number, use the chart below to select the appropriate cordset length for your application, where ☐ = cordset length.** *Example* *NAS-DE1 = 300V PVC yellow round data cable double eurofast connector cordset, 1 m* Double Connector Cordsets **NAS-DE☐** Eurofast Connectors **NAS-DM☐** Minifast Connectors Single Connector Cordsets Eurofast Connector **NAS-SEM☐** Male eurofast connector **NAS-SEF☐** Female eurofast connector Minifast Connector **NAS-SMM☐** Male minifast connector **NAS-SMF☐** Female minifast connector

Part Number ☐	Cordset Length
1	1 m
3	3 m
5	5 m
10	10 m

Consult factory for additional cordset lengths.

AS-i Bulk Cable

TOPWORX

Cable that meets the requirements of EN50170-2-2:1996 for communication up to 12 Mbaud.

Available in 30, 75, and 150 meter spools. Consult the factory for additional cable lengths.

- Field wirable connectors, page 49

Item	Part Number & Description
AS-i Bulk Cable Cable is approved for 300V. 	**To create your bulk cable part number, use the chart below to select the appropriate cable length for your application, where ☐ = cable length.** *Example* *NAS-AC1-030 = PTE yellow flat data cable in 30 meter spool* Bulk Cable Types **NAS-AC1-☐** PTE yellow flat data cable **NAS-AC2-☐** PTE black flat power cable **NAS-AC3-☐** PVC yellow round data cable **NAS-AC4-☐** PVC light gray flat data cable

Part Number ☐	Cable Length
030	30 m
075	75 m
150	150 m

Consult factory for additional cable lengths.

Diagnostic Tools

502.969.8000

Our selection of diagnostic tools is designed to reduce the total cost of ownership of AS-i networks and devices.

Our AS-i addressing unit can reduce startup and commissioning time by allowing the addressing of devices prior to field installation. Our AS-i bus testers provide addressing and advanced troubleshooting functionality to allow for quick identification and correction of network problems.

Item	Part Number & Description	
Handheld Programming Unit Used to pre-program AS-i node addresses before the nodes are physically placed on the network. Light duty stations connect directly to the top portion of the unit. Heavy duty stations interface via a eurofast connection. General Specifications **Protection:** IP20 **Operating Temperature:** 32° to 122°F (0° to 50°C) **Weight:** 550g	**NAS-DT1**	Handheld programming unit
Handheld AS-Interface System Tester Used to measure, test, monitor, and address the AS-i bus and AS-i slaves for professional initial start-up and troubleshooting.  General Specifications **Protection:** IP20 (jacks); IP52 (housing) **Operating Temperature:** 14° to 122°F (-10° to 50°C)	**NAS-DT2**	AS-Interface System Tester - AS-i addressing device and tester with neck strap - NiMh rechargeable battery pack - Battery charger - Addressing cable (M12 to jack plug) - Ground cable - Hard shell carrying case - Operating instructions
Handheld Diagnosis and Addressing Tool A rugged, handy addressing and diagnosis tool for initial start-up, maintenance, and service of the AS-i network.  General Specifications **Protection:** IP20 (jacks); IP50 (housing) **Operating Temperature:** 32° to 122°F (0° to 50°C)	**NAS-DT3**	Addressing and diagnosis device - AS-i addressing and diagnosis device - Protective rubber cover and carrying strap - Connector cable set (banana plug to jack plug) - Module base with addressing socket - One set of batteries - Hard shell carrying case - Operating instructions

Notes

FOUNDATION Fieldbus Overview

The FOUNDATION Fieldbus (FF) protocol was created in 1994 by a group of process automation suppliers. Unlike other protocols, FF was developed specifically for the process industries. It is therefore capable of handling all of the complexities of process management, including process variables, real-time deterministic process control, and diagnostics.

FOUNDATION Fieldbus features intrinsic safety, long wiring run length, and delivery of blocks of data over a two-wire system. In intrinsically safe applications, only 83mA of power are available for each segment, so it is important that field devices consume very little power. TopWorx FF products consume less than 17mA of power, so up to five devices can be used on each segment.

FOUNDATION Fieldbus is the ideal digital replacement for the traditional 4-20mA analog standard. Although it is tailor-made for analog instruments, such as control valves and transmitters, it is often appropriate for on/off valves as well. For example, in continuous processes (low discrete population), it is often logical to tie the on/off valves into the FF system rather than use conventional wiring or a completely different bus network for a small number of valves. And in batch operations (high discrete population) that are intrinsically safe, FF is often the only logical choice for networking on/off valves.

TopWorx has recognized these issues and has created several cost-effective ways to extend the benefits of FF to on/off valves and other discrete devices.

FOUNDATION Fieldbus Network Highlights

Type of Network Process Control Network

Physical Media Twisted pair, fiber

Network Topology Star, Bus

Maximum Devices
32 nodes/segment (16 nodes/segment on some Host systems)

Maximum Devices using Intrinsically Safe wiring
4-6 per repeated segment depending on power requirements of devices and the type of I.S. barrier used.

Maximum Distance
- Maximum Distance 1,900 meters
- Maximum Distance with repeaters (max. of 4 repeaters can be used) 9,500 meters

Communication Methods
- Client/server, Publisher/subscriber, Event
- Both scheduled and onscheduled communications

Primary usage
Used for analog and discrete process control devices

Power and Communications on same twisted pair
Requires FF power supply (conditioner) to protect the digital communications

Device Power Supply
Can be supplied from bus (typical)

Wiring Types
(Recommend using Type A cable only for new installations)

Type A:	Shielded Twisted Pair #18AWG (0.8mm) 1900m (6232 ft.)
Type B:	Multi-twisted Pair with shield #22AWG (0.32mm) 1200m (3936 ft.)
Type C:	Multi-twisted Pair without shield #26AWG (0.13mm) 400m (1312 ft.)
Type D:	Multi-core without twisted pairs and having an overall shield #16AWG (1.25mm) 200m (656 ft.)

Grounding aspects Wiring is ungrounded. If bus wires are grounded or shorted, communication to all devices is interrupted. (short circuit protection is recommended)

Shielding Shields should be grounded at only one point

Terminators 2 near each end of each bus segment

Hazardous Area Installations Intrinsically Safe devices available

Device Addressing Automatic when connected to segment

Governing Body Fieldbus Foundation

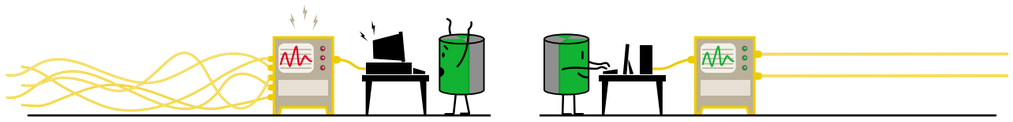
Web Site **www.fieldbus.org**

Did You Know?

The TopWorx DVC-FF has received the FOUNDATION Fieldbus "checkmark" from the Fieldbus Foundation, ensuring its interoperability with other devices and host systems.

Conventional I/O System vs. FOUNDATION Fieldbus Network

FOUNDATION Fieldbus is the ideal protocol for the process industries.



CONVENTIONAL I/O SYSTEM

Advantages
- Technology is already understood
- Lower device cost
- Independent wiring from devices to the control system means wiring problems with one device don't affect other field devices

Drawbacks
- Higher installed cost
- Point-to-point wiring is expensive
- Many wiring connections:
  - are labor intensive to install
  - create many points of failure
  - increase complexity when troubleshooting
  - require large amounts of cabinet or rack space for installation of terminal blocks
  - create time-consuming initial checkout and startup
- Expansion requires duplicating the entire wiring scheme for each additional point

FOUNDATION Fieldbus can handle process variables, deterministic process control, and diagnostics, and is the ideal protocol for the process industries.

FOUNDATION FIELDBUS NETWORK

Advantages
- Excellent support for analog I/O
- Incorporates discrete devices into same segments
- Provides control in the field capabilities
- Provides redundancy options for power and communications devices
- Available for Intrinsically Safe installations
- Largely supported by process control manufacturers
- Complete digital communications to transmitter microprocessors:
  - Eliminates inaccuracies of A/D and D/A conversions of analog representative signals, such as 4-20mA
  - Eliminates calibration of representative signals to improve accuracy
  - Eliminates setting of upper and lower range limits at the device level
- Devices contain diagnostic information and alarming capabilities
- Interoperability certification ensures that various field devices work with a variety of host systems, regardless of manufacturer

Drawbacks
- Limited power requirements in Intrinsically Safe applications, extended for FISCO installations
- Segment power, grounding, and loading must be considered when designing segments
- Training for commissioning, troubleshooting, and calibration may be required
- Requires proper grounding and power isolation for error free network communications

TopWorx Comments on FOUNDATION Fieldbus

Strengths

FF is made for process control. FF was designed by the world's leading process automation suppliers for the process industries.

FF is proven worldwide. At the time of publication, FF systems have been implemented in over 25 countries.

FF is intrinsically safe. In the processing world, hazardous areas are common. Other bus networks got their start in factory automation before migrating to the process industries, and thus often fall short in hazardous areas. But FF, designed for process automation, incorporates intrinsic safety. TopWorx solutions for discrete valves are intrinsically safe as well.

FF users want on/off solutions. Due to the sophistication of the FF protocol, occasionally a plant's on/off valves become an afterthought in the design of the system.

Later the realization hits that those valves are important, raising the question, "What are we going to do with the discretes?"

TopWorx has created several long-awaited discrete solutions that are two-wire, intrinsically safe, interoperability certified, and proven to work with process control systems such as Emerson's Delta V.

Process Control Network

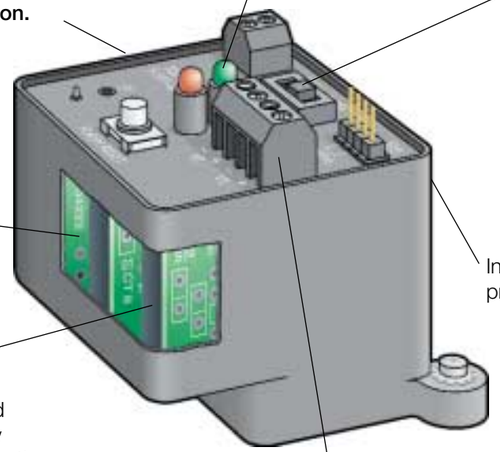
FOUNDATION Fieldbus Sensor-Communications Module

The TopWorx Sensor-Communications Module (SCM) combines position sensors, FF communication, pilot valve outputs, and wiring terminals into a compact enclosure that is potted and sealed from the environment.

Britelite LEDs indicate valve position and facilitate sensor set up.

SCM-FF enclosure is **resistant to high levels of impact, moisture, shock, and vibration.**

Calibration Switch facilitates initial setup. The three position On-Off-FF switch enables the valve to be test cycled open and closed offline, then put onto the network when ready.



All electronics are **short-circuit protected,** eliminating the expense of adding separate short-circuit protection.

Integrated position sensors provide valve position feedback.

All micro-processor based electronics are completely **potted and sealed,** preventing premature failure due to moisture or contamination.

Onboard terminals provide connection points for **auxiliary discrete and analog inputs.**

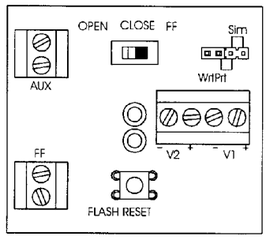
SCM-FF Highlights

The Sensor-Communications Module delivers valve position feedback, communicates directly on the FOUNDATION Fieldbus network, pilots the valve actuator, and provides extra wiring terminals for auxiliary inputs.

The TopWorx SCM-FF is a compact, sealed module that can be used in a variety of enclosures suitable for use in any hazardous or corrosive process environment.

Because of its ultra-low power requirements, the SCM-FF consumes less than 17mA of power; therefore, up to five devices can be loaded onto a single Intrinsically Safe segment.

5 Discrete Inputs (DI)	Open/Closed valve position feedback
3 Discrete Outputs (DO)	Pilot valve outputs for single or double acting
Calibration Switch	Open-Close-FF
Status/Warning LEDs	Open, Closed, Alarm State
FF Interoperability Tested	Yes
Emerson Delta V Tested	Yes
Short Circuit Protection	Yes
Intrinsically Safe	Yes
Max Current Consumption	<17mA (22mA with LEDs on full-time)
Voltage	9-32 VDC
Diagnostic Features	
Cycle Counter	Records number of cycles
Cycle Time Alarms	User settable values for Open & Close cycle times
Visual Alarm Indication	Blinking LEDs



SCM-FF Wiring Diagram

The FF Sensor-Communications Module fits conveniently into a variety of valve control enclosures suitable for any process environment.

Lumitech DVC-FF

Discrete Valve Controller
- Intrinsically Safe Zone 0 (Class I, Div 1)
- Integral Pilot Valve
- Direct Mount

See page 130 for more details.

Did You Know?

The TopWorx DVC-FF is the world's most widely used discrete valve controller for FOUNDATION Fieldbus applications.

Lumitech DVM-FF

Discrete Valve Monitor
- Intrinsically Safe Zone 0 (Class I, Div 1)

See page 132 for more details.

Did You Know?

TopWorx is an official member of Emerson Process Management's "Alliance" Program, a third-party product referencing program for qualified suppliers that complement Emerson's solutions offering.

Switchpak DXP-FF
Switchpak DXS-FF (Stainless Steel enclosure)

Discrete Valve Monitor
- Intrinsically Safe Zone 0 (Class I, Div 1)
- Explosion Proof Zone 1 (Class I, Div 1)

See page 134, 136 for more details.

HazLink Connectivity Enclosures

502.969.8000

Our HazLink products are rugged junction enclosures that provide flexible wiring options in hazardous areas, making it easy to connect conventional devices to the FOUNDATION Fieldbus network as well as make wiring connections and disconnect field devices in hazardous areas.

HazLink Features: Zone 1 (Class I, Div 1)
(3) 3/4" NPT conduit outlets

HazLink Options: I/O Modules
Wiring Tees
Disconnect Switches

Item

HazLink Connectivity Enclosure

General Specifications

Enclosure: Die-cast aluminum; O-ring sealed

Coating: Dichromate conversion (inside); powder polyester coating (outside)

O-rings: Buna N

Cover: Screw cover with O-ring seal

Conduit Outlets: Three 3/4" NPT

Environment: NEMA Type 4, 4X, 7 and 9

Approvals: Explosion Proof
Zone 1
Class I, Div 1 & 2, Groups A,B,C,D
Class II, Div 1 & 2, Groups E,F,G

I/O Modules

HazLink I/O Modules allow users to cost-effectively connect new or existing conventional devices into the FOUNDATION Fieldbus network in Zone 1 (Class I, Div 1) hazardous areas.

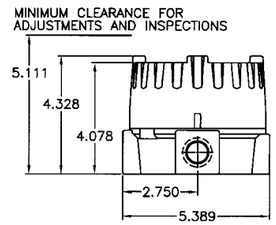
NHL-FFIO Hazlink Connectivity Enclosure with FOUNDATION Fieldbus I/O
2 input, 2 output knifegate valve or cylinder controller

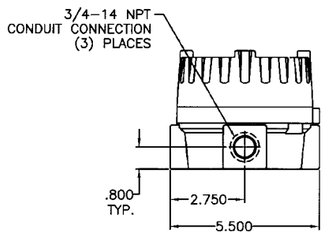
HazLink Connectivity Enclosures

TOPWORX

FOUNDATION Fieldbus

Dimensions



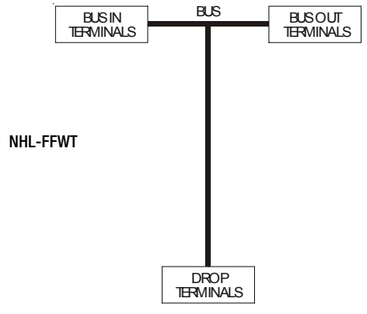


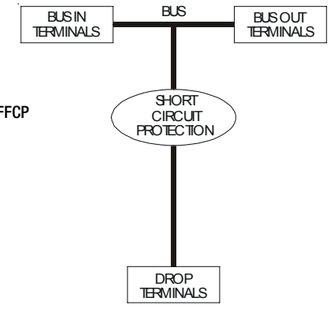
Wiring Tees

HazLink Wiring Tees make it easy to connect field devices to bus lines using wire terminals or plug-in connectors.

NHL-FFWT FOUNDATION Fieldbus tee with 3 x 3 position wiring terminals

NHL-FFCP Short circuit protection





Disconnect Switches

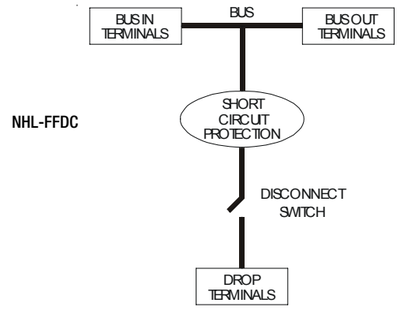
HazLink Disconnect Switches enable users to repair or replace a field device without disturbing the network with the simple flip of a lever-operated switch.

Disconnect Switches are designed to be locked if desired. Locking prevents tampering or accidental device connection or disconnection.

TopWorx offers Disconnect Switches in HazLink enclosures with or without short circuit protection.

NHL-FFDS Disconnect switch

NHL-FFDC Disconnect switch with short circuit protection



Terminal Block Junctions & Accessories

502.969.8000

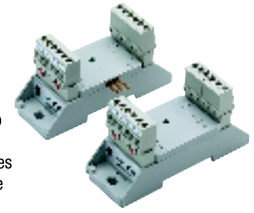
These products provide for the interconnection of a FOUNDATION Fieldbus network using standard wiring and DIN rail mountable terminal connections. The pluggable screw terminal connectors allow users to disconnect devices from the network without disconnecting individual wires.

General Specifications

Operating Temperature: -49° to 158°F (-45° to 70°C)

Item	Part Number & Description	
Megablocks These DIN rail mounted blocks provide a preassembled, fixed configuration for connection of 4 or 8 FOUNDATION Fieldbus devices. Additional blocks may be added for additional device connections. Integrated short circuit protection is available and will maintain network integrity in the event of a direct connection between two fieldbus conductors on an individual spur or drop cable.   Megablocks require terminator NFF-1A05.	**NFF-1A01**	4-drop block
	NFF-1A02	4-drop block with integrated short circuit protection [1]
	NFF-1A03	8-drop block
	NFF-1A04	8-drop block with integrated short circuit protection [1]
	NFF-1A05	Megablock terminator, 39V limit

[1] <60mA per spur; CSA approved Class I, Div 2, Groups A,B,C,D

Item	Part Number & Description	
Spur Blocks & Expanders Spur blocks provide for the connection of two trunk cable connections and two fieldbus device drop (spur) cables. Expanders are used to provide additional device connections to the spur. Each Expander block allows four additional drop cables for device connections. Multiple Expander blocks may be added as needed to expand the spur.  Additional Specifications **Surge Limit Start:** 39V **Approvals:** Class I, Div. 1, Groups A,B,C,D Short Circuit Protection - Terminators, page 61	Spur Blocks	
	NFF-1B11	Fieldbus Spur Block with pluggable screw terminal connectors [2]
	NFF-1B12	Fieldbus Spur Block with fixed screw terminal connectors
	NFF-1B13	Fieldbus Spur Block with cage clamp connectors
	Expanders	
	NFF-1B21	Fieldbus expander with pluggable screw terminal connectors [2]
	NFF-1B22	Fieldbus expander with fixed screw terminal connectors
	NFF-1B23	Fieldbus expander with cage clamp connectors

[2] SpurGuard compatible

Terminal Block Terminators & Protection

TOPWORX

Proper Power Conditioning and Short Circuit Protection are vital to any robust and successful FOUNDATION Fieldbus installation.

General Specifications

Operating Temperature: -40° to 158°F (-40° to 70°C)

Item	Part Number & Description			
Terminators FOUNDATION Fieldbus requires a terminator at each end of the main trunk line. Terminators reduce noise on the segments that is caused by signal reflections at the end of an open cable.  The grounded terminating blocks are used at the beginning of the trunkline in the system cabinet, while the isolated terminating blocks are used at the end of the trunkline in the field. Additional Specifications **Approvals:** Class I, Div. 1, Groups A,B,C,D **Surge Limit Start:** 39V (TI designation only)		Description	Connector Type	Surge Limit Start
	NFF-2A01 [1]	Isolated	Pluggable screw term.	39V
	NFF-2A02	Isolated	Fixed terminal	39V
	NFF-2A03	Isolated	Cage clamp	39V
	NFF-2A04 [1]	Grounded	Pluggable screw term.	-
	NFF-2A05	Grounded	Fixed terminal	-
	NFF-2A06	Grounded	Cage clamp	-

[1] SpurGuard compatible

Item	Part Number & Description	
Short Circuit Protection Short circuit protection will maintain network integrity in the event of a direct connection between the two fieldbus conductors on an individual spur or drop cable.  Additional Specifications **Approvals:** Class I, Div. 1, Groups A,B,C,D	**NFF-2B01**	Short circuit protection for nominal 20mA transmitter
	NFF-2B02	Short circuit protection for nominal 40mA transmitter

Short Circuit Current Limit		
	NFF-2B01	**NFF-2B02**
-40°C	60mA	91mA
20°C	52mA	78mA
50°C	47mA	71mA

The current limit decreases under prolonged short circuit conditions due to heating of the Spur Guards.

Quick Disconnect Junctions & Accessories

502.969.8000

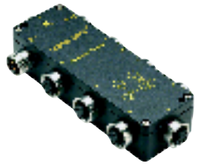
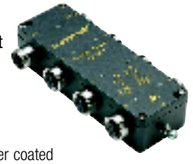
These junction blocks are used for the interconnection of a FOUNDATION Fieldbus segment when using quick disconnect style connectors.

Available with or without short-circuit protection.

- Terminators, page 64

General Specifications

Operating Temperature: -40° to 158°F (-40° to 70°C)
Protection Class: NEMA 1,3,4,12,13; IP67

Item	Part Number & Description
Passive Junctions  These junction blocks are used for the interconnection of a FOUNDATION Fieldbus segment when using quick disconnect style connectors. Additional Specifications **Housing:** Die-cast aluminum, black powder coated **Operating Current:** 9.0A (minifast); 4.0A (eurofast) **Operating Voltage:** 300V **No. of Pins:** 4	Minifast Passive Junctions **NFF-3A11** Minifast 8-port passive junction **NFF-3A12** Minifast 6-port passive junction **NFF-3A13** Minifast 4-port passive junction Eurofast Passive Junctions **NFF-3A21** Eurofast 8-port passive junction **NFF-3A22** Eurofast 6-port passive junction **NFF-3A23** Eurofast 4-port passive junction
Junctions with Short-Circuit Protection  These junction blocks are used for the interconnection of a FOUNDATION Fieldbus segment when using minifast connectors and allow for short circuit protection. Additional Specifications **Housing:** Die-cast aluminum, black powder coated **Voltage Surge Protection:** >36VDC **Output Current Limit:** 35mA per spur **No. of Pins:** 4	**NFF-3B01** 8-port junction with short-circuit protection **NFF-3B02** 6-port junction with short-circuit protection **NFF-3B03** 4-port junction with short-circuit protection
Junction Tees with Short-Circuit Protection  These minifast junction tees provide short circuit protection to 4 or 6 spurs in an overmold design that provides exceptional corrosion resistance. Additional Specifications **Housing:** Black polyurethane **Voltage Surge Protection:** >36VDC **Output Current Limit:** 55mA per spur **No. of Pins:** 4	**NFF-3C01** 6-port junction with short-circuit protection **NFF-3C02** 4-port junction with short-circuit protection

Tees & Terminators

TOPWORX

Tees and terminators are designed for use with Quick Disconnect connectors on page 68.

General Specifications

Protection Class: IP67

Item	Part Number & Description
System Tees   Tees provide for the addition of one drop cable to the trunkline using quick disconnect style or screw terminal connectors. For use with 490 or 491 FOUNDATION Fieldbus Cable. Additional Specifications **Operating Temperature:** -40° to 158°F (-40° to 70°C) **Protection Class:** NEMA 1,3,4,12,13	Die-cast Aluminum Enclosure **NFF-4A11** Tee with ground lug **NFF-4A12** Tee with terminal strip bus connectors Plastic Enclosure **NFF-4A21** Tee with ground lug **NFF-4A22** Tee with terminal strip bus connectors
FOUNDATION Fieldbus Tee  Tees provide for the addition of one drop cable to the trunkline using quick disconnect style connectors. For use with 490 or 491 FOUNDATION Fieldbus Cable. Additional Specifications **Operating Temperature:** -40° to 170°F (-40° to 80°C) **Connector:** Molded polyurethane construction **Protection Class:** NEMA 1,3,4,6,13 **Rating:** 9A, 600V (minifast); 4A, 300V (eurofast) **No. of Pins:** 4	**NFF-4B01** Minifast spur bus line Fieldbus tee **NFF-4B02** Eurofast spur bus line Fieldbus tee

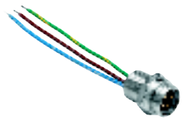
Tees & Terminators

502.969.8000

Tees and terminators are designed for use with Quick Disconnect (QDC) connectors on page 68.

General Specifications

Protection Class: IP67

Item	Part Number & Description	
Terminator Resistor Terminator Resistors with minifast and eurofast connectors.  Additional Specifications **Operating Temperature:** -40° to 170°F (-40° to 80°C) **Connector:** Oil resistant grey polyurethane body material and contact carrier, 300V rating **Coupling Nuts:** Stainless steel **Protection:** NEMA 1,3,4,6p **No. of Pins:** 4	**NFF-4C01**	Minifast terminator resistor with male minifast connector
	NFF-4C02	Eurofast terminator resistor with male eurofast connector
Device Gland Receptacle and Bulkhead Fittings The device gland receptacle provides wiring to the terminals inside a FOUNDATION Fieldbus device and an external receptacle for a QDC drop cable connection.  Bulkhead fittings provide QDC connection for inside and outside an electrical housing. Additional Specifications **Operating Temperature:** -40° to 221°F (-40° to 105°C) **Contact Carrier:** Polyurethane (minifast); Nylon (eurofast) **Protection:** NEMA 1,3,4,6 **No. of Pins:** 4	**NFF-4D01**	Minifast device gland receptacle, 4.5 in, 9A, 600V
	NFF-4D02	Eurofast device gland receptacle, 4.5 in, 4A, 300V
	NFF-4D03	Minifast bulkhead fitting, 9A, 600V
	NFF-4D04	Eurofast bulkhead fitting, 4A, 250V

Terminal Block Repeaters

TOPWORX

Repeaters provide a means of maintaining signal quality over long distance cable runs or powering multiple I.S. segments on the same FF segment.

While I.S. segments can support a limited number of devices, a typical FF segment may contain 16 or 32 devices per segment. Multiple I.S. segments can be interconnected on the same FF segment.

General Specifications

Operating Temperature: -4° to 140°F (-20° to 60°C)
Power Supply Nominal Voltage: 20-35VDC

FOUNDATION Fieldbus

Item	Part Number & Description	
Fieldbus Repeaters & Power Supply  NFF-5A11 and NFF-5A12 contain integrated I.S. barriers for repeated I.S. segment installations. Intrinsically safe repeaters are approved for Class I, Div 1, Groups A-D. Quick Connect - Terminators, page 64	For Intrinsically Safe Applications	
	NFF-5A11	I.S. Fieldbus Repeater with 70mA output current
	NFF-5A12	I.S Fieldbus Repeater acc. to FISCO with 100mA output current
	For Standard Applications	
	NFF-5A21	Fieldbus Repeater with 400mA output current
	NFF-5A22	Fieldbus Power Supply with 400mA output current

Terminal Block Power Conditioners

502.969.8000

Fieldbus Power Conditioning provides a means of connecting a conventional power source to a FOUNDATION Fieldbus segment. Power Conditioning is required to maintain proper segment voltage and isolate FF communications. These power conditioners are stand-alone, DIN rail mountable, and can be used for any FF segment wiring style.

Power conditioners require a 24V power supply. See our selection of power supplies on page 116.

Item	Part Number & Description
Power Conditioners	
	**NFF-6A01** Isolater/Power supply (I.S.) 80mA output current (max.)
	**NFF-6A02** Fieldbus power supply 350mA output current (max.) Switch selectable internal FF terminator
	NFF-6A03 Shunt-diode safety barrier for use with MTL-5995 100mA output current (max.)
	NFF-6A04 [1] Redundant Fieldbus Power System 350mA output current (max.) Contains an internal FF terminator

The NFF-6A01 model provides an integrated I.S. barrier and connections for hazardous area installations as well non-I.S. safe area connections.

The NFF-6A02 has no integrated I.S. barrier functionality and requires use of the 791 for any hazardous area device connections.

The NFF-6A04 provides redundant power conditioning for an FF segment and can be supplied by redundant 24VDC power supplies.

Specifications

Operating Temperature: -6° to 140°F (-20° to 60°C)

[1] **Operating Temperature:** -40° to 149°F (-40° to 65°C)

Terminal Block Power Conditioners & Multiplexers

TOPWORX

Fieldbus Power Conditioning provides a means of connecting a conventional power source to a FOUNDATION Fieldbus segment. Power Conditioning is required to maintain proper segment voltage and isolate FF communications.

General Specifications

Operating Temperature: -40° to 158°F (-40° to 70°C)

FOUNDATION Fieldbus

Power Conditioners

These power conditioners are available with screw terminal, fixed terminal, or cage clamp connectors and are typically used with the Terminal Block Junctions and Accessories on page 60.

Additional Specifications

Surge Limit Start: 39V (Conditioners)

Output Current: 330mA min. (Conditioners)
2.5A max. (Multiplexer)

Item	No. of Terminators	Connector Type	Part Number & Description
NFF-6B01	-	Pluggable screw terminal	
NFF-6B02	-	Fixed terminal	
NFF-6B03	-	Cage clamp	
NFF-6B04	1	Pluggable screw terminal	
NFF-6B05	1	Fixed terminal	
NFF-6B06	1	Cage clamp	
NFF-6B07	2	Pluggable screw terminal	
NFF-6B08	2	Fixed terminal	
NFF-6B09	2	Cage clamp	

Power Multiplexer

The fieldbus power multiplexer provides uninterrupted power to the fieldbus segments and are available with screw terminal, fixed terminal, or cage clamp connectors and are typically used with the Terminal Block Junctions and Accessories on page 60.

Additional Specifications

Surge Limit Start: 39V (Conditioners)

Output Current: 330mA min. (Conditioners)
2.5A max. (Multiplexer)

Item	Part Number & Description
NFF-6C01	Power multiplexer, fixed terminal connectors
NFF-6C02	Power multiplexer, cage clamp connectors

Field Wirable Connectors

502.969.8000

These plug style connectors are designed for easy installation in the field after the FOUNDATION Fieldbus wiring has been routed through the conduit, wire-ways, panel enclosures, and other locations. Available in minifast or eurofast.

General Specifications

Operating Temperature: -40° to 185°F (-40° to 85°C)
Protection Class: IP67

Item	Part Number & Description	
Minifast Connectors		
Additional Specifications **Housing:** Nylon, type PA 6.6 GV **Connector Insert:** Polyurethane; V2 acc. UL 94 **Contact Materials:** CuZn plated copper alloy **Coupling Nuts:** Anodized aluminum **Protection:** NEMA 1, 3, 4, 6 & 13	**NFC-MFS**	Minifast field wirable straight female connector
	NFC-MMS	Minifast field wirable straight male connector
Eurofast Connectors		
Additional Specifications **Housing:** Polyester, PBT Black **Connector Insert:** PBT; spacings to VDE 0110 Group C **Contact Materials:** Nickel plated copper alloy **Coupling Nuts:** Female - PBT; Male - Nickel Plated Brass **Protection:** NEMA 1, 3, 4 & 6p	Female Connectors	
	NFC-EFS	Eurofast field wirable straight female connector
	NFC-EFR	Eurofast field wirable right angle female connector
	Male Connectors	
	NFC-EMS	Eurofast field wirable straight male connector
	NFC-EMR	Eurofast field wirable right angle male connector

Molded Connector Cordsets

TOPWORX

These cordsets provide FOUNDATION Fieldbus cable with pre-installed, plug-in connectors, reducing installation time in the field.

Available in 1, 3, 5, and 10 meter lengths. Consult the factory for additional cordset lengths.

Item	Part Number & Description	
Molded Connector Cordsets		
	**To create your cordset part number:** 1) Select your connector types 2) Select your cable type from the list below (* = cable type) 3) Select your cordset length from the chart below (☐ = cordset length) *Example* *NFF-DEC1 = PVC yellow FF 3-wire double eurofast connector cordset, 1 m*	
TopWorx offers FOUNDATION Fieldbus molded connector cordsets in PVC fieldbus yellow 3-wire cable and 3-wire armor cable. Cordsets are available with a molded connector on each end or with one end bare to facilitate routing of cable through conduit or panel enclosures. All double cordsets have one straight male connector and one straight female connector. See page 70 for cable specifications.	Double Connector Cordsets	
	Eurofast Connectors	**NFF-DE*-☐**
	Minifast Connectors	**NFF-DM*-☐**
	Single Connector Cordsets	
	Eurofast Connector	**NFF-EM*-☐** Male eurofast connector
		NFF-EF*-☐ Female eurofast connector
	Minifast Connector	**NFF-MM*-☐** Male minifast connector
		NFF-MF*-☐ Female minifast connector
Connector Specifications **Plug Body:** Molded polyurethane **Contacts:** Gold plated brass **Coupling Nuts:** Stainless steel **Temperature:** -40° to 158°F (-40° to 70°C) **Protection:** NEMA 1,3,4,6,13; IP67 **Rated Current:** 9.0A (minifast); 4.0A (eurofast)		

*** Cable Types**

FC1 = PVC yellow Fieldbus 3-wire cable

FC2 = PVC yellow Fieldbus 3-wire armor cable

☐ Cordset Length

Part Number ☐	Cordset Length
1	1 m
3	3 m
5	5 m
10	10 m

Consult factory for additional cordset lengths.

FOUNDATION Fieldbus Bulk Cable

502.969.8000

Cable that meets the requirements of ISA/SP50 and the FOUNDATION Fieldbus requirements for Type A cable.

Cable is sunlight resistant and rated from -40° to 221°F (-40° to 105°C).

Available in 30, 75, and 150 meter spools. Consult the factory for additional cable lengths.

Chart Legend - Field wirable connectors, page 68

Item	Part Number & Description
FOUNDATION Fieldbus Bulk Cable Additional Specifications **Type of Drain Wire:** Foil **Connector Insert:** Polyurethane; V2 acc. UL 94 **Contact Materials**: CuZn plated copper alloy **Coupling Nuts:** Stainless steel **Rating:** 300V **Protection:** NEMA 1,3,4,6,13	**To create your bulk cable part number, use the chart below to select the appropriate cable length for your application, where ☐ = cable length.** *Example* *NFF-FC1-030 = PVC yellow FF 3-wire cable in 30 meter spool* Bulk Cable Types **NFF-FC1-☐** PVC yellow FOUNDATION Fieldbus 3-wire cable **NFF-FC2-☐** PVC yellow FOUNDATION Fieldbus 3-wire armor cable

Part Number ☐	Cable Length
030	30 m
075	75 m
150	150 m

Consult factory for additional cable lengths.

Diagnostic Tools

TOPWORX

Our selection of diagnostic tools are is designed to reduce the total cost of ownership of FOUNDATION Fieldbus networks and devices.

These devices provide powerful FOUNDATION Fieldbus troubleshooting tools in a convenient handheld unit.

General Specifications

Operating Temperature: 32° to 122°F (0° to 50°C)

Item	Part Number & Description
Fieldbus Monitor The Monitor provides diagnostics on live Fieldbus segments and tests ten vital segment parameters, including Voltage, Communications Signal Levels, Noise, and LAS device presence. Draws approximately 10mA of current from the Fieldbus network. 	**NFF-DT3** Fieldbus Monitor
Fieldbus Power & Signal Probe The Power & Signal Probe is a simple tool that uses individual LEDs to indicate bus power and signal levels on individual points on a Fieldbus network segment. Draws 12-15mA of current from the Fieldbus network. 	**NFF-DT4** Fieldbus Power & Signal Probe
Fieldbus Wiring Validator The Validator is used to inject DC power and to test communication signal on newly installed FF wiring. It may be used with the Monitor to completely test new or existing wiring segments. The Validator must not be used in hazardous areas or to power wiring that runs into hazardous areas.  Also provides power for calibration of TopWorx DVC-FF and DVM-FF.	**NFF-DT5** Fieldbus Wiring Validator

DeviceNet Overview

DeviceNet is a CAN based Layer 7 protocol originally developed by Allen-Bradley. Operation of the DeviceNet is based on an object-oriented communications model. DeviceNet is maintained by the Open DeviceNet Vendor Association (ODVA).

DeviceNet is designed to connect simple devices from multiple vendors that comply with the DeviceNet network standards. DeviceNet device profile standards provide interchangeability between device manufacturers.

Each DeviceNet segment can connect up to 64 devices. It is a four-wire system delivering 8 amps at 24VDC, sufficient for field devices such as solenoid valves. The four wires carry signal and power typically on a single cable. Multiple power supplies can be used for redundancy and additional power requirements.

DeviceNet uses a trunk (bus) line with drop cables connecting devices. The trunkline requires 121 ohm terminating resistors at each end of the trunk.

DeviceNet supports Master/Slave, Peer-to-Peer, and Multi-Master network models. Data can be transferred on a cyclic or change of state basis using a Producer/Consumer paradigm that conserves network bandwidth. DeviceNet is very commonly used for communications from host systems to motor control centers and variable speed drives.

DeviceNet Network Highlights

Type of Network Device Bus

Physical Media Two Shielded twisted pairs in one shielded thick, thin or flat cable (one pair for signal, one pair for power)

Network Topology Bus with drops

Maximum Devices 62 devices per segment

Maximum Distance (using Thick cable)
Maximum Distance with repeaters 6,000 meters
125Kbps
- 500m (1640 ft)
- 6m (20 ft) individual drop cable length
- 156m (512 ft) cumulative drop cable length

250Kbps
- 250m (820 ft)
- 6m (20 ft) individual drop cable length
- 78m (256 ft) cumulative drop cable length

500K bps
- 100m (328 ft)
- 6m (20 ft) individual drop cable length
- 39m (128 ft) cumulative drop cable length

* Thin cable may be used as trunk. Maximum distance is 100 meters, regardless of data rate

Communication Methods Master/slave, multiple master, peer-to-peer, change of state or cyclic (uses Producer/Consumer Paradigm)

Primary usage
Motor Control Centers, Variable Speed Drives, Remote I/O applications

Power and Communications on same cable
24VDC power on power bus (multiple supplies may be used for additional power or as backup). A separate 24VDC power supply for communication bus is recommended.

Device Power Supply 24VDC on power bus

Wiring Types
Thick Cable (ODVA Type II cable), generally used for trunk cable

Thin Cable (ODVA Type I cable), commonly used for drop cables

Mid Cable (ODVA Type III cable), used when more flexible drop cable is needed

Blue/White conductors for communications
Red/Black conductors for power

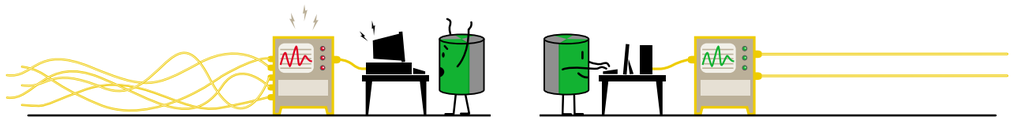
Grounding aspects
Ground only the power supply closest to the middle of the network

Terminators
121 ohm terminator at each trunk line end

Web Site **www.odva.org**

Conventional I/O System vs. DeviceNet Network

DeviceNet is feature-rich, yet cost effective.



CONVENTIONAL I/O SYSTEM

Advantages
- Technology is already understood
- Lower device cost
- Independent wiring from devices to the control system means wiring problems with one device don't affect other field devices

Drawbacks
- Higher installed cost
- Point-to-point wiring is expensive
- Many wiring connections:
  - are labor intensive to install
  - create many points of failure
  - increase complexity when troubleshooting
  - require large amounts of cabinet or rack space for installation of terminal blocks
  - create time-consuming initial checkout and startup
- Expansion requires duplicating the entire wiring scheme for each additional point

DeviceNet is most commonly used when device populations are primarily discrete but have some analog, and when motor control centers and variable frequency drives are present.

DEVICENET NETWORK

Advantages
- Excellent support for motor control centers, variable frequency drives, and conventional I/O
- Moderate device cost adder
- Lower installed cost
- I/O modules allow for conventional analog and discrete device integration
- Relatively fast transmission speeds:
  - Transmission Speed and cable lengths:
    - 125kb @ 420m
    - 250kb @ 200m
    - 500kb @ 100m
- Power and Signal on same cable
- Up to 64 addressable nodes
- Wide variety of topologies available, including Trunk, Line, Drop
- Duplicate node address detection
- Supports some device diagnostics

Drawbacks
- Slaves can only be owned by one master
- Does not support Intrinsically Safe installations

TopWorx Comments on DeviceNet

Strengths
DeviceNet is capable. DeviceNet delivers a solid combination of cost-effective simplicity with a bit of added functionality. It is designed to handle discrete devices but can support analog signals and some diagnostics as well.

DeviceNet is robust. DeviceNet supplies 8 amps of power, offers acceptable cable run lengths, and can control up to 64 devices per segment.

Limitations
Hazardous Areas
Since DeviceNet is an 8 amp bus, it cannot be intrinsically safe. TopWorx has created a variety of solutions for installing DeviceNet in Class I, Div 1 (Zone 1) and Class I, Div 2 (Zone 2) hazardous environments.

Cost When Simplicity is Needed
If customers have only discrete devices and need no added functionality, then some other protocols are less expensive.

When to Use DeviceNet
Generally speaking, TopWorx recommends DeviceNet when:
- device populations are primarily discrete and secondarily analog
- end users desire some diagnostic capability for predictive environments
- plants are not intrinsically safe

Device Bus Network

DeviceNet Sensor-Communications Module

DeviceNet™

The TopWorx Sensor-Communications Module (SCM) combines position sensors, DeviceNet communication, solenoid outputs, and wiring terminals into a compact enclosure that is potted and sealed from the environment.

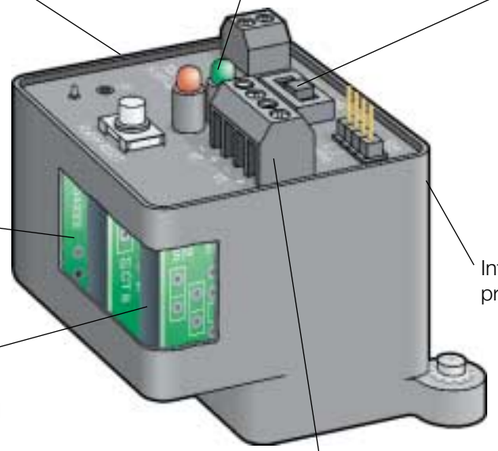
SCM-DN enclosure is **resistant to high levels of impact, moisture, shock, and vibration.**

Britelite LEDs indicate valve position and facilitate sensor set up.

Calibration Switch facilitates initial setup. The three position On-Off-DN switch enables the valve to be test cycled open and closed offline, then put onto the network when ready.

All electronics are **short-circuit protected,** eliminating the expense of adding separate short-circuit protection.

Integrated position sensors provide valve position feedback.



All micro-processor based electronics are completely **potted and sealed,** preventing premature failure due to moisture or contamination.

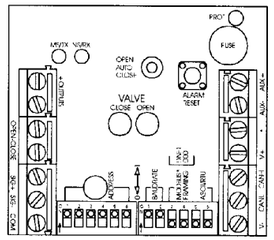
Onboard terminals provide connection points for **auxiliary discrete and analog inputs.**

SCM-DN Highlights

The Sensor-Communications Module delivers valve position feedback, communicates directly on the DeviceNet network, pilots the valve actuator, and provides extra wiring terminals for auxiliary inputs.

The TopWorx SCM-DN is a compact, sealed module that can be used in a variety of enclosures suitable for use in any hazardous or corrosive process environment.

3 Discrete Inputs (DI)	Open/Closed valve position feedback and 1 Auxiliary Input for dry contact
2 Discrete Outputs (DO)	Solenoid outputs for single or double acting
1 Analog Input (AI)	Optional 4-20mA input
Calibration Switch	Open-Close-DeviceNet
Status/Warning LEDs	Open, Closed, Alarm State
ODVA Conformance Tested	Yes
Short Circuit Protection	Yes
Maximum Output Current	500mA per output
Maximum Output Power	12 watts per output
Voltage	11-30 VDC
Diagnostics	
Cycle Counter	Records number of cycles
Cycle Time Alarms	User settable values for Open & Close cycle times
Visual Alarm Indication	Blinking LEDs
Auto Baud Rate Detection	125kb, 250kb, 500kb



SCM-DN Wiring Diagram

The DeviceNet Sensor-Communications Module fits conveniently into a variety of valve control enclosures suitable for any process environment.

Lumitech DVC-DN

Discrete Valve Controller
- Zone 2 (Class I, Div 2)
- Integral Solenoid Valve
- Direct Mount

See page 130 for more details.

Lumitech DVM-DN

Discrete Valve Monitor
- Zone 2 (Class I, Div 2)
- Direct Mount

See page 132 for more details.

Did You Know?

TopWorx is an official member of Rockwell Automation's "Encompass" program, a third-party product referencing program for qualified suppliers that complement Rockwell Automation's solutions offering.

Switchpak DXP-DN
Switchpak DXS-DN (Stainless Steel enclosure)

Discrete Valve Monitor
- Zone 1 (Class I, Div 1)

See page 134, 136 for more details.

HazLink Connectivity Enclosures

502.969.8000

DeviceNet™ The DeviceNet device bus network was originally designed to be used for factory automation rather than process automation. Therefore, in the process industries there has been a need for easy, cost-effective ways to make wiring connections in hazardous areas.

Our HazLink products are rugged junction enclosures that provide flexible wiring options in hazardous areas, making DeviceNet more suitable for use in the process industries.

HazLink Features: Zone 1 (Class I, Div 1)
(3) 3/4" NPT conduit outlets

HazLink Options: I/O Modules
Wiring Tees
Disconnect Switches

Item

HazLink Connectivity Enclosure

General Specifications

Enclosure: Die-cast aluminum; O-ring sealed

Coating: Dichromate conversion (inside); powder polyester coating (outside)

O-rings: Buna N

Cover: Screw cover with O-ring seal

Conduit Outlets: Three 3/4" NPT

Environment: NEMA Type 4, 4X, 7 and 9

Approvals: Explosion Proof
Zone 1
Class I, Div 1 & 2, Groups A,B,C,D
Class II, Div 1 & 2, Groups E,F,G

c UL us LISTED CE

I/O Modules

HazLink I/O Modules allow users to cost-effectively connect new or existing conventional devices into the DeviceNet network in Zone 1 (Class I, Div 1) hazardous areas.

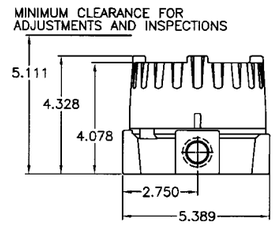
NHL-DNIO Hazlink Connectivity Enclosure with DeviceNet I/O
2 input, 2 output knifegate valve or cylinder controller

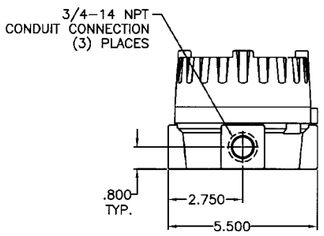
HazLink Connectivity Enclosures

TOPWORX

DeviceNet™

Dimensions





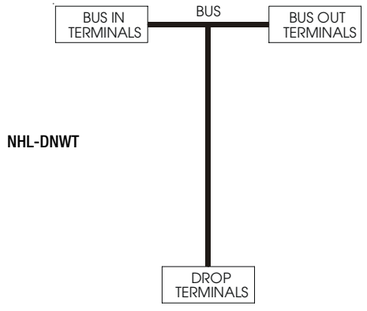
DeviceNet

Wiring Tees

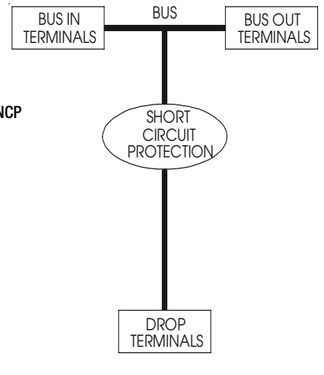
HazLink Wiring Tees make it easy to connect field devices to bus lines using wire terminals or plug-in connectors.

NHL-DNWT DeviceNet tee with 3 x 5 position wiring terminals

NHL-DNCP Short circuit protection



NHL-DNWT



NHL-DNCP

Disconnect Switches

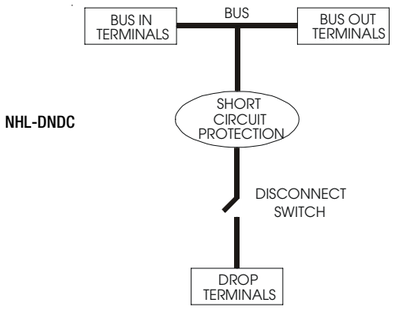
HazLink Disconnect Switches enable users to repair or replace a field device without disturbing the network with the simple flip of a lever-operated switch.

Disconnect Switches are designed to be locked if desired. Locking prevents tampering or accidental device connection or disconnection.

TopWorx offers Disconnect Switches in HazLink enclosures with or without short circuit protection.

NHL-DNDS Disconnect switch

NHL-DNDC Disconnect switch with short circuit protection



NHL-DNDC

AS-i to DeviceNet Gateways

502.969.8000

DeviceNet AS-i to DeviceNet Gateways provide a means of easily connecting an AS-i network to a higher level DeviceNet network. The Gateway is recognized as a single node on the higher level DeviceNet network while controlling the field devices on the AS-Interface network.

General Specifications

Operating Temperature: 32° to 131°F (0° to 55°C)
Mounting: DIN rail
Voltage of insulation: ≥ 500V
Protection Category: Housing IP40, Terminals IP20

Item

AS-i to DeviceNet Gateways

Gateway

Gateway with graphical display

Functions as a master on the AS-i network and as a single node on the DeviceNet network.

These devices include demonstration software that performs addressing, monitoring, and diagnostics of the network.

Additional Specifications

Single Gateways

Operating Voltage: 30VDC AS-i voltage

Operating Current: 200mA (from AS-i circuit)

Dual Gateways

Operating Voltage: 24VDC

Operating Current: 200mA (from AS-i 1), 70mA (from AS-i 2)

Check it out!
- D-sub-data transmission cords, page 117
- Master simulators for testing, below

DeviceNet Master Simulator

This device connects to a parallel port on a PC and allows direct connection to a DeviceNet segment. This is useful when scanning the segment for devices and monitoring low level attributes of slave devices.

General Specifications

Operating Temperature: 32° to 131°F (0° to 55°C)
Power Supply: Powered by the keyboard interface of the PC
Transfer Rate: 125, 250 or 500 KBaud
Interfaces: CAN interface with 9-pin D-sub-plug
Length of Connector Cable: max. 2 m

Part Number & Description

	Graphical Display	# AS-i Masters	AS-i Specification
NAS-GD01	Yes	Single	2.1
NAS-GD02	Yes	Dual	2.1
NAS-GD03	No	Single	2.0

NDN-1A01 DeviceNet Master Simulator

Modbus to DeviceNet Gateway

TOPWORX

DeviceNet

DeviceNet The Modbus to DeviceNet Gateway allows the connection of slave devices to a DeviceNet network. The gateway becomes a single node on the DeviceNet network.

General Specifications

Baud Rate Selection: Auto/125k/250k/500k baud
Address Selection: Switch selectable 0-63

Item

Modbus to DeviceNet Gateway

The Modbus to DeviceNet allows the connection of Modbus capable slave devices to a DeviceNet network.

The DeviceNet address is set using DIP switches on the device and the DeviceNet baud rate is automatically determined when connected to the network. A single gateway is capable of communicating with one or more Modbus devices.

Additional Specifications

Operating Temperature: 32° to 140°F (0° to 60°C)
Maximum Power: 200mA/11VDC to 90mA/25VDC

Part Number & Description

NDN-1A02 Modbus to DeviceNet gateway, RS 232 interface

Terminal Block Discrete I/O

502.969.8000

DeviceNet™ Terminal Block Discrete Input/Output adaptors and modules provide a means of easily integrating conventional discrete devices into the DeviceNet network.

Item	Part Number & Description

Discrete I/O Adapters

I/O adaptors are DIN rail mountable and accept the Discrete I/O modules listed below.

Select your I/O modules to customize the adaptors for your applications.

Terminals are provided for 24VDC external power source connection for powering field I/O devices (max 10A).

General Specifications

Operating Temperature: 32° to 158°F (0° to 70°C)

Maximum Power: 200mA/11VDC to 90mA/25VDC

Discrete Inputs/Outputs

NDN-2A01 Adapter with 4 discrete inputs/outputs

NDN-2A02 Adapter with 8 discrete inputs/outputs

Discrete I/O Modules

Discrete I/O modules are designed for use with I/O adaptors above.

Select I/O modules to match your requirements.

General Specifications

Isolation: 4000 V rms

Operating Temperature: -22° to 176°F (-30° to 80°C)

Maximum Current: 50mA DC (Input Modules)

Maximum On-State Current: 3A continuous (Output Modules)

Maximum 1 cycle surge: 100A peak

Input Modules

NDN-2B11 AC input, 120V

NDN-2B12 DC input, 24V

NDN-2B13 AC input, 240V

Output Modules

NDN-2B21 AC output, 120V

NDN-2B22 DC output, 60V

NDN-2B23 DC output, 220VAC

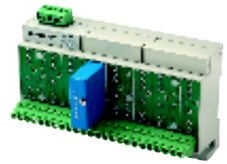
Terminal Block Analog I/O

TOPWORX

DeviceNet™ Terminal Block Analog Input/Output adaptors and modules provide a means of easily integrating conventional analog devices into the DeviceNet network.

Item	Part Number & Description

Analog I/O Adapters



I/O adaptors are DIN rail mountable and accept the Analog I/O modules listed below.

Select your I/O modules to customize the adaptors for your applications.

General Specifications

Operating Temperature: 32° to 158°F (0° to 70°C)

Maximum Power:

NDN-3A01 8 watts: 730mA/11VDC to 320mA/25VDC

NDN-3A02 15 watts: 1.4A/11VDC to 600mA/25VDC

NDN-3A01 Adapter with 4 analog inputs

NDN-3A02 Adapter with 8 analog inputs

Analog Signal Conditioning

Analog I/O modules are designed for use with I/O adaptors above.

Select I/O modules to match your requirements.

General Specifications

Isolation: 60V channel to channel; 1500V channel to network

Accuracy: ± 0.02% of span

mA Input Module (for externally powered field transmitters)

NDN-3B11 4-20mA input

NDN-3B12 0-20mA input

mA Output Module

NDN-3B21 4-20mA output

NDN-3B22 0-20mA output

Voltage Input Module

NDN-3B31 0-10V input

NDN-3B32 0-5V input

RTD Input Module (for 2 or 3 wire Pt RTDs)

NDN-3B41 -100° to 100°C Pt input

NDN-3B42 0° to 200°C Pt input

DeviceNet DeviceNet Modular I/O is DIN rail mountable and recommended for high density, low-cost applications. The modular I/O system is connected to the DeviceNet segment via the fieldbus coupler. Input/Output Modules can contain a mixture of analog, discrete, and speciality modules to meet your specific application requirements.

General Specifications

Operating Temperature: 32° to 131°F (0° to 55°C)
Protection Class: IP20
Connection: Cage clamp wiring connections

Item	Part Number & Description
DeviceNet I/O Coupler The fieldbus coupler interfaces the I/O system to the DeviceNet network and may contain any assortment of discrete, analog and speciality modules listed below. The fieldbus coupler supports a maximum 512 byte input image and a maximum 512 byte output image. Terminals are provided for 24VDC external power source connection for powering field I/O devices (max 10A).	**NDN-4A01** DeviceNet fieldbus coupler, 125-500 KBaud
Discrete I/O Modules These Discrete I/O modules are designed for use with the coupling module above to provide a means of integrating conventional discrete I/O into a DeviceNet network. Discrete signals are transferred by the bus coupler bit by bit. When digital information exceeds 8 bits, a new byte is automatically started. Additional Specifications **Approvals:** Class 1, Div 2 (except Relay Output Modules)	Inputs **NMI-DN01** 4-channel digital input, 24VDC, 3.0 ms input filter **NMI-DN02** 2-channel digital input, 120VAC Outputs **NMI-DT01** 4-channel digital output with diagnostics, 24VDC 0.5A output current **NMI-DT02** 2-channel digital output with diagnostics, 24VDC 2.0A output current Relay Outputs **NMI-DR01** 2-channel relay output, non-floating, 2 SPST contacts Switching voltage: 250V AC/30VDC Switching current: 2.0A AC/DC **NMI-DR02** 2-channel relay output, 2 SPST contacts Switching voltage: 250VAC/30VDC Switching current: 2.0A AC/DC **NMI-DR03** 2-channel relay output, 2 SPDT contacts Switching voltage: 125VAC/30VDC Switching current: 0.5A AC/1.0A DC

DeviceNet

Item	Part Number & Description
DIN Analog I/O Modules These Analog I/O modules are designed for use with the Fieldbus Coupling module to provide a means of integrating conventional analog devices into a Profibus network. Analog signals are transferred via bytes or words. Additional Specifications **Approvals:** Class 1, Div 2 (except Thermocouple modules)	Inputs **NMI-AN01** 2-channel analog input, RTD, PT100 sensor type **NMI-AN02** 2-channel analog input, 0-10VDC, single ended **NMI-AN03** 4-channel analog input, 0-10VDC, single ended **NMI-AN04** 2-channel analog input, type K thermocouple (-148° to 2498°F) **NMI-AN05** 2-channel analog input, type J thermocouple (-148° to 2192°F) **NMI-AN06** 2-channel analog input, 0-20mA, Overload protection, 16Bit **NMI-AN07** 2-channel, 4-20 mA, Overload protection, 16Bit Outputs **NMI-AT01** 2-channel analog output, 0-10VDC **NMI-AT02** 2-channel analog output, 0-20mA **NMI-AT03** 2-channel analog output, 4-20mA
Power Supply Modules These modules can be added to distribute power to field devices via the I/O system. Power is supplied from an external source. See our Power Supply section when 24VDC is required.	**NMI-PS01** 24VDC, 2A power supply **NMI-PS02** 24VDC, max. 6.3A with diagnostics and fuse-holder **NMI-PS03** 230VAC, max. 6.3A with diagnostics and fuse-holder **NMI-PS04** 120VAC, max. 6.3A with fuse-holder, no diagnostics
Separation & End Modules A separation module provides a visual and an electrical separation between field I/O power types (i.e. 24VDC from 120VAC modules). One end module is required at the physical end of each I/O System, with one per Bus Coupler.	**NMI-SM01** Separation module **NMI-EM01** End module

Quick Disconnect I/O Modules

DeviceNet™ Quick Disconnect Input/Output Modules provide a method of connecting conventional field devices to a DeviceNet Network with quick-disconnect (QDC) style connectors in a rugged, field mountable unit.

General Specifications

Housing Material: Glass filled nylon with nickel plated brass connectors
Operating Temperature: -13° to 158°F (-25° to 70°C)
Protection Class: NEMA 1,3,4,12,13; IP67

Item	Part Number & Description	Inputs	Outputs	Max. Output Load
I/O Modules with Advanced Diagnostics With Per Point Diagnostics **Additional Specifications** **Combatibility**: NPN/PNP **Open-circuit Detection**: Individual **Short-circuit Protection**: Individual **Baud Rate Selection:** Auto/125k/250k/500k baud **Address Selection:** Switch selectable 0-63 **No. of Pins:** 5	**NDN-5A01**	8	-	-
	NDN-5A02	16	-	-
	NDN-5A03	4	4	0.5A
	NDN-5A04	8	8	0.5A
	NDN-5A05	8	8	2.0A

Item	Part Number & Description	Inputs	Outputs	Max. Output Load
I/O Modules with Standard Diagnostics With Group Diagnostics **Additional Specifications** **Combatibility**: PNP sensors **Open-circuit Detection**: Individual **Short-circuit Protection**: Group **Baud Rate Selection:** Auto/125k/250k/500k baud **Address Selection:** Switch selectable 0-63 **No. of Pins:** 5	**NDN-5B01**	8	8	0.5A
	NDN-5B02	4	4	0.5A
	NDN-5B03	8	8	0.5A
	NDN-5B04	16	16	0.5A
	NDN-5B05	-	8	0.5A
	NDN-5B06	-	8	1.4A

Quick Disconnect Junctions & Accessories

TOPWORX

DeviceNet™ Junction modules and Junction tees are used to easily construct the physical layer of a DeviceNet network.

These modules provide QDC connections for the trunkline, drop lines, and individual host devices.

General Specifications

Protection Class: IP67

DeviceNet

Item	Part Number & Description	
Eurofast Junction Modules **Additional Specifications** **Housing**: Nylon 6, 30% glass reinforced **Connectors**: Nickel-plated brass **Operating Voltage**: 300V **Operating Current per Conductor**: 9.0A (minifast), 4.0A (eurofast) **Operating Temperature**: -13° to 158°F (-25° to 70°C) **Protection**: NEMA 1,3,4,12,13 **No. of Pins:** 5	**NDN-6A01**	8 ports, eurofast, with minifast trunk connectors, voltage monitoring with low and high voltage LED indication
	NDN-6A02	8 ports, eurofast, with minifast trunk connectors

Item	Part Number & Description	
Junction Tees **Additional Specifications** **Housing:** Polyurethane **Connectors**: Nickel-plated brass **Coupling Nuts:** Stainless steel **Operating Temperature**: -22° to 176°F (-30° to 80°C) **No. of Pins:** 5	Eurofast	
	NDN-6B11	4-port junction tee, minifast bus connection, eurofast device ports
	NDN-6B12	6-port junction tee, minifast bus connection, eurofast device ports
	Minifast	
	NDN-6B21	4-port junction tee, minifast bus connection and device ports
	NDN-6B22	6-port junction tee, minifast bus connection and device ports

Item	Part Number & Description	
Terminators Two terminators are required per each DeviceNet trunkline. The terminators should be located at each physical end of the trunkline. **Additional Specifications** **Connector**: Polyurethane, 300V rating **Contact Materials**: Gold plated copper alloy **Coupling Nuts**: Nickel plated brass **Protection**: NEMA 1,3,4,6p **Operating Temperature**: -40° to 170°F (-40° to 80°C) **No. of Pins:** 5	Eurofast Bus Terminator	
	NDN-6C11	Male eurofast connector, internal resistor
	NDN-6C12	Female eurofast connector, internal resistor
	Minifast Bus Terminator	
	NDN-6C21	Male minifast connector, internal resistor
	NDN-6C22	Female minifast connector, internal resistor

Bus Extenders & Repeaters

502.969.8000

DeviceNet™ Bus Extenders and Repeaters provide a means of extending the DeviceNet cable to its maximum lengths without reducing communication speed.

Item	Part Number & Description
Bus Extenders/Repeaters General Specifications **Maximum Voltage:** 11 to 25VDC **Maximum Power**: 1.8 watts **Operating Temperature:** 32° to 158°F (0° to 70°C) **Protection:** IP65	**NDN-7A01** Bus extender/repeater - manual or automatic speed selection: 125K, 250K, 500K, baud rates - multiple extenders can be used in series - 1 ms latency for each network extension - DIN rail mountable **NDN-7A02** Fiber-optic bus extender/repeater with ST connectors - compatible with 62.5/125 µm multimode cable - maximum distance: 2200 m - pairs of repeaters are required (one at each end of fiber-optic cable - panel-mount, 4 screws
Repeater This modules provides a QDC style DeviceNet repeater to overcome DeviceNet system wiring and/or communication limitations. Specifications **Housing**: Glass filled nylon; nickel plated brass connectors **Operating Temperature**: -13° to 158°F (-25° to 70°C) **Bus Power**: 11-30VDC **Node Current Consumption**: 125mA segment A, 30mA segment B **Protection**: NEMA 1,3,4,12,13; IP67	**NDN-7B01** DeviceNet Repeater

Field Wirable Connectors

TOPWORX

DeviceNet

DeviceNet™ These plug style connectors are designed for easy installation in the field after the DeviceNet wiring has been routed through the conduit, wire-ways, panel enclosures, and other locations.

General Specifications

Operating Temperature: -40° to 185°F (-40° to 85°C)
Protection Class: IP67

Item	Part Number & Description
Minifast Connectors Additional Specifications **Housing**: Nylon **Connector Insert**: Polyurethane **Contact Materials**: CuZn plated copper alloy **Coupling Nuts**: Anodized aluminum **Protection**: NEMA 1,3,4,6,13 **Rating**: 9A, 300VDC **No. of Pins**: 5	Female Connectors **NDN-MFT** Minifast female field wirable connector, thin cable **NDN-MFH** Minifast female field wirable connector, thick cable Male Connectors **NDN-MMT** Minifast male field wirable connector, thin cable **NDN-MMH** Minifast male field wirable connector, thick cable
Eurofast Connectors For use with thin and medium DeviceNet cable only. Additional Specifications **Housing**: Polyester, PBT Black **Connector Insert**: PBT **Contact Materials**: Nickel plated copper alloy **Coupling Nuts**: Female - PBT; Male - Nickel Plated Brass **Protection**: NEMA 1,3,4,6P **Rating**: 3A, 36VDC **No. of Pins**: 5	Female Connectors **NFC-EFS** Eurofast straight female field wirable connector, thin cable **NFC-EFR** Eurofast right angle female field wirable connector, thin cable Male Connectors **NFC-EMS** Eurofast straight male field wirable connector, thin cable **NFC-EMR** Eurofast right angle male field wirable connector, thin cable

Molded Connector Cordsets

502.969.8000

DeviceNet™ These cordsets provide DeviceNet cable with pre-installed, plug-in connectors, reducing installation time in the field.

Available in 1, 3, 5, and 10 meter lengths. Consult the factory for additional cordset lengths.

Item	Part Number & Description
Molded Connector Cordsets	**To complete your cordset part number:** 1) Select your connector types 2) Select your cable type from the list below (* = cable type) 3) Select your cordset length from the chart below (☐ = cordset length) *Example* *NDN-DMDC1-1 = DeviceNet "Thin" cable double connector cordset, 1 m*

TopWorx offers DeviceNet molded connector cordsets in DeviceNet Thin, Medium, and Thick (300V and 600V) cable.

Cordsets are available with a molded connector on each end or with one end bare to facilitate routing of cable through conduit or panel enclosures.

All double cordsets have one straight male connector and one straight female connector.

See page 89 for cable specifications.

Connector Specifications

Plug Body: Molded polyurethane
Contacts: Gold plated brass
Coupling Nuts: Nickel plated brass
Temperature: -40° to 158°F (-40° to 70°C)
Protection: NEMA 1,3,4,6,13; IP67
Rated Current: 9.0A (minifast)

Double Minifast Connector Cordsets

NDN-DM*-☐

Single Minifast Connector Cordsets

NDN-MM*-☐ Male Connector

NDN-MF*-☐ Female Connector

*** Cable Types**

DC1 = DeviceNet "Thin" cable

DC2 = DeviceNet "Medium" cable

DC3 = DeviceNet "Thick" cable, 300V

DC4 = DeviceNet "Thick" cable, 600V

☐ Cordset Length

Part Number ☐	Cordset Length
1	1 m
3	3 m
5	5 m
10	10 m

Consult factory for additional cordset lengths.

DeviceNet Bulk Cable

TOPWORX

DeviceNet™ Cable that meets the requirements of ODVA.

Available in 30, 75, and 150 meter spools. Consult the factory for additional cable lengths.

Quick Connect - Field wirable connectors, page 87

General Specifications

Materials: PVC
Rating: To 176°F (80°C)

Item	Part Number & Description
DeviceNet Bulk Cable	**To create your bulk cable part number, use the chart below to select the appropriate cable length for your application, where ☐ = cable length.** *Example* *NDN-DC1-030 = DeviceNet "Thin" cable in 30 meter spool*

DeviceNet Thin Cable meets ODVA Type I cable requirements. This cable can be used from drop lines with a maximum length of 6 meters or as trunkline cable in networks with a maximum length of 100 meters.

DeviceNet Medium Cable meets ODVA Type III cable requirements. This cable can be used as trunkline cable in networks with a maximum length of 300 meters.

DeviceNet Thick Cable meets ODVA Type II cable requirements. This cable can be used as trunkline cable in networks with a maximum length of 500 meters.

Bulk Cable Types

NDN-DC1-☐ DeviceNet "Thin" cable, 300V

NDN-DC2-☐ DeviceNet "Medium" cable, 300V

NDN-DC3-☐ DeviceNet "Thick" cable, 300V

NDN-DC4-☐ DeviceNet "Thick" cable, 600V

Part Number ☐	Cable Length
030	30 m
075	75 m
150	150 m

Consult factory for additional cable lengths.

DeviceNet™ Our handheld diagnostic and troubleshooting device with a simple user interface is a powerful startup, verification, and troubleshooting tool for any DeviceNet network, featuring NetAlert diagnostic capabilities.

Item	Part Number & Description
Handheld Diagnostic Tool	
The NDN-DT8 provides two modes for monitoring and troubleshooting DeviceNet segments. AUTO search mode rapidly measures key DeviceNet parameters and provides a good, warning, or fault indication. In Expert mode, the NDN-DT8 can be used to monitor a wide array of DeviceNet segment parameters including max/min bus power voltage, max/min CAN bus voltage, error rate, error counter, percent of bandwidth used, as well as device specific traffic and error rates.	**NDN-DT8** Diagnostic and troubleshooting tool - includes carrying bag with strap

General Specifications

Power Supply: Network 11-30VDC < 150mA

Batteries: (2) AA alkaline batteries

Connectors: (1) micro per ODVA (M12), adaptor cables; (2) included for mini-change and pluggable screw terminal

Band Rates: 125K, 250K, and 500K (Auto-detect)

Analog Accuracy: Bus power ± 100mV; Bus signal ± 20mV

Notes

DP Device Bus Network PA Process Control Network

Profibus Overview

The Profibus protocol was created in 1989 in Germany by a consortium of factory automation suppliers. Originally developed to enable discrete manufacturing, it has expanded into process automation and enterprise-wide applications.

Profibus encompasses several Industrial Bus Protocol Specifications, including Profibus-DP, Profibus-PA, Profibus-FMS, and PROFInet.

Profibus-DP is device level bus that supports both analog and discrete signals. Profibus-DP has widespread usage for such items as remote I/O systems, motor control centers, and variable speed drives. Profibus-DP communicates at speeds from 9.6 Kbps to 12 Mbps over distances from 100 to 1,200 meters. Profibus-DP doesn't natively support Intrinsically Safe installations.

Profibus-PA is a full-function fieldbus that is generally used for process level instrumentation. Profibus-PA communicates at 31.25 Kbps and has a maximum distance of 1,900 meters per segment. Profibus-PA is designed to support Intrinsically Safe applications.

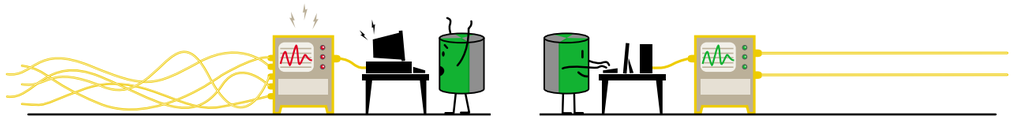
Profibus-FMS is a control bus generally used for communications between DCS and PLC systems, while PROFInet is a protocol being developed to allow Profibus communications across Ethernet Networks.

Profibus Network Highlights

Type of Network	
DP	Device Bus
PA	Process Control Network
FMS	Control (cell level) Network
Physical Media	Twisted pair, fiber
Network Topology	Bus, Ring, Star
Maximum Devices	
DP	max. 126 stations on one bus (maximum of 244 bytes input and output data possible for each slave)
PA	32 nodes/segment 4-6 per repeated segment depending on power requirements of devices and the type of I.S. barrier used.
Maximum Distance	
DP	93.75Kbps and less – 1200 meters 500Kbps – 400 meters 1.5Mbps – 200 meters 12Mbps – 100 meters
PA	1,900 meters
Max Distance with repeater (max. of 4 repeaters can be used)	9,500 meters with repeaters
Communication Methods	
DP	Peer-to-peer, multicast or cyclic master-slave (uses token passing sequence)
PA	Client/server, Publisher/subscriber, Event Both Scheduled and Unscheduled communications
Primary usage	
DP	Used for Discrete and Analog for PLC, Variable Speed Drives, Remote I/O communications
PA	Analog and discrete process control devices
Power and Communications	
DP	Power is supplied separately from communications bus (can be supplied on a parallel power bus)
PA	Requires PA power supply (conditioner) to protect the digital communications
Device Power Supply	
DP	Devices are powered separately from communications bus
PA	Can be supplied from bus (typical)
Wiring Types	
DP	Shielded twisted pair #22 AWG
PA	Shielded twisted pair #18AWG (0.8mm) 1900m (6232 ft.)
Device Addressing	DIP switch settings or handheld/software
Governing Body	PROFIBUS International (PI)
Web Site	**www.profibus.com**

Conventional I/O System vs. Profibus Network

Profibus offers a variety of solid solutions for all levels of process automation.



CONVENTIONAL I/O SYSTEM

Advantages
- Technology is already understood
- Lower device cost
- Independent wiring from devices to the control system means wiring problems with one device don't affect other field devices

Drawbacks
- Higher installed cost
- Point-to-point wiring is expensive
- Many wiring connections:
  - are labor intensive to install
  - create many points of failure
  - increase complexity when troubleshooting
  - require large amounts of cabinet or rack space for installation of terminal blocks
  - create time-consuming initial checkout and startup
- Expansion requires duplicating the entire wiring scheme for each additional point

PROFIBUS DP-PA-FMS NETWORKS

Advantages
- Widely accepted, with 1,100 member companies worldwide.
- Network support at the device, process control, and Ethernet levels
  - Interfaces are available for variable speed drive and motor control center applications (Profibus-DP)
  - Process instrumentation available with Profibus-PA devices
  - Enterprise-wide applications with PROFInet
- Intrinsically Safe installations available for Profibus-PA instruments
- Gateways allow for Profibus-PA integration directly to Profibus-DP networks
- Host interfaces available for most PLC, DCS and computer systems
- Gateway devices available to directly support lower cost Sensor Bus networks, especially AS-Interface
- More than 2,000 available products

Drawbacks
- Profibus-DP does not support Intrinsically Safe installations
- No control in the field capabilities
- Segment wiring, power, grounding, shielding and termination requirements must be adhered to in the design and installation

PROFIBUS-DP NETWORK

Advantages
- Based on RS-485 physical layer
- Multiple bus transmission speeds and wiring length combinations:
  - Up tp 1000 m distance at 9.6kbits/sec, expandable to 2000 m using repeaters
  - Up to 200 m at maximum speed of 1500kbits/sec.
- Supports both discrete and analog signals
- I/O modules allow connection of conventional analog and discrete devices
- Interfaces available for many variable speed drives, motor control centers, and field devices
- Supports 32 devices per segment, 62 with repeaters
- Supports mono-master and multi-master systems
- Simple integration of new devices to an existing system

Drawbacks
- Not available for Intrinsically Safe installations
- Slaves not powered by network wiring, require separate power source
- Addressing set manually (not dynamic)

Profibus-DP is recommended
- For time critical analog and discrete applications due to its high speed capabilities
- Where variable frequency drives and motor control centers can incorporate bus technologies
- For a mixture of conventional analog and discrete devices

TopWorx Comments on Profibus

Strengths

Profibus offers more choices. Profibus is the only bus protocol that offers different solutions for process automation (PA), factory automation (DP), and enterprise-wide (Net).

Profibus is well accepted across multiple industries, especially in Europe.

Limitations

Profibus has had limited success gaining market share in North America, particularly in the process industries.

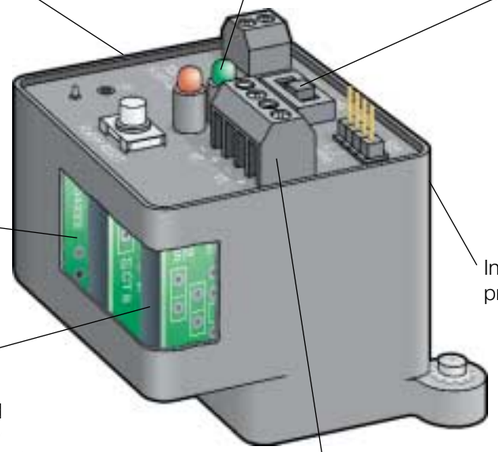
DP Device Bus Network PA Process Control Network

Profibus Sensor-Communications Module

The TopWorx Sensor-Communications Module (SCM) combines position sensors, Profibus communication, solenoid outputs, and wiring terminals into a compact enclosure that is potted and sealed from the environment.

SCM-PB enclosure is **resistant to high levels of impact, moisture, shock, and vibration.**

Britelite LEDs indicate valve position and facilitate sensor set up.



Calibration Switch facilitates initial setup. The three position On-Off-PB switch enables the valve to be test cycled open and closed offline, then put onto the network when ready.

All electronics are **short-circuit protected,** eliminating the expense of adding separate short-circuit protection.

Integrated position sensors provide valve position feedback.

All micro-processor based electronics are completely **potted and sealed,** preventing premature failure due to moisture or contamination.

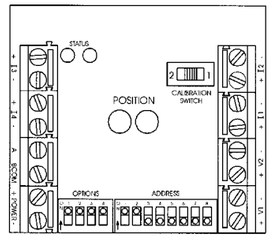
Onboard terminals provide connection points for **auxiliary discrete and analog inputs.**

SCM-PB Highlights

The Sensor-Communications Module delivers valve position feedback, communicates directly on the Profibus DP network, pilots the valve actuator, and provides extra wiring terminals for auxiliary inputs.

The TopWorx SCM-PB is a compact, sealed module that can be used in a variety of enclosures suitable for use in any hazardous or corrosive process environment.

4 Discrete Inputs (DI)	Open/Closed valve position feedback
2 Discrete Outputs (DO)	Solenoid outpts for single or double acting
1 Analog Input (AI)	Optional 4-20mA input
Calibration Switch	Open-Close-Profibus
Status/Warning LEDs	Open, Closed, Alarm State
PTO Conformance Tested	Yes
Short Circuit Protection	Yes
Maximum Current	160mA per output
Maximum Power	4 watts per output
Voltage	24VDC
Diagnostic Features	
Cycle Counter	Records number of cycles
Cycle Time Alarms	User settable values for Open & Close cycle times
Visual Alarm Indication	Blinking LEDs



SCM-PB Wiring Diagram

The Profibus Sensor-Communications Module fits conveniently into a variety of valve control enclosures suitable for any process environment.

Lumitech DVC-PB
Discrete Valve Controller
- Zone 2 (Class I, Div 2)
- Integral Solenoid Valve
- Direct Mount

See page 130 for more details.

Lumitech DVM-PB
Discrete Valve Monitor
- Zone 2 (Class I, Div 2)
- Direct Mount

See page 132 for more details.

Did You Know?

The Profibus Sensor-Communications Module enables TopWorx discrete valve controllers to connect directly to the Profibus-DP network, eliminating the need and expense of AS-i to Profibus gateways.

Switchpak DXP-PB
Switchpak DXS-PB (Stainless Steel enclosure)
Discrete Valve Monitor
- Zone 1 (Class I, Div 1)

See page 134, 136 for more details.

The Profibus DP device bus network was originally designed to be used for factory automation rather than process automation. Therefore, in the process industries there has been a need for easy, cost-effective ways to make wiring connections in hazardous areas.

Our HazLink products are rugged junction enclosures that provide flexible wiring options in hazardous areas, making AS-Interface more suitable for use in the process industries.

HazLink Features: Zone 1 (Class I, Div 1)
(3) 3/4" NPT conduit outlets

HazLink Options: I/O Modules
Wiring Tees
Disconnect Switches

Item

HazLink Connectivity Enclosure

General Specifications

Enclosure: Die-cast aluminum; O-ring sealed

Coating: Dichromate conversion (inside); powder polyester coating (outside)

O-rings: Buna N

Cover: Screw cover with O-ring seal

Conduit Outlets: Three 3/4" NPT

Environment: NEMA Type 4, 4X, 7 and 9

Approvals: Explosion Proof
Zone 1
Class I, Div 1 & 2, Groups A,B,C,D
Class II, Div 1 & 2, Groups E,F,G

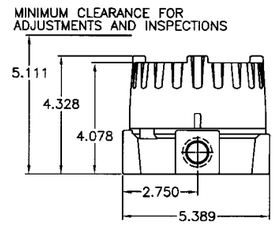
I/O Modules

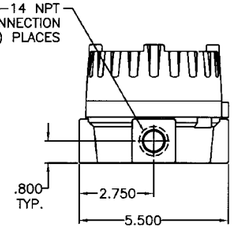
HazLink I/O Modules allow users to cost-effectively connect new or existing conventional devices into the Profibus DP network in Zone 1 (Class I, Div 1) hazardous areas.

NHL-PBIO Hazlink Connectivity Enclosure with Profibus I/O
4 input, 2 output knifegate valve or cylinder controller

Profibus

Dimensions



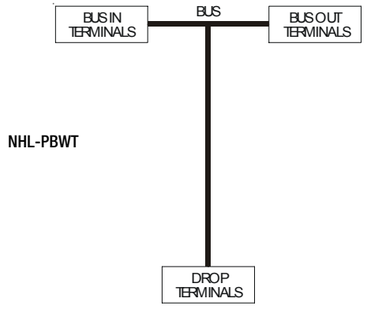


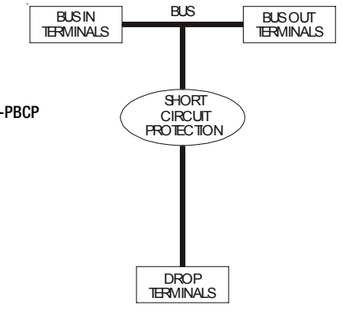
Wiring Tees

HazLink Wiring Tees make it easy to connect field devices to bus lines using wire terminals or plug-in connectors.

NHL-PBWT Profibus tee with 3 x 5 position wiring terminals

NHL-PBCP Short circuit protection





Disconnect Switches

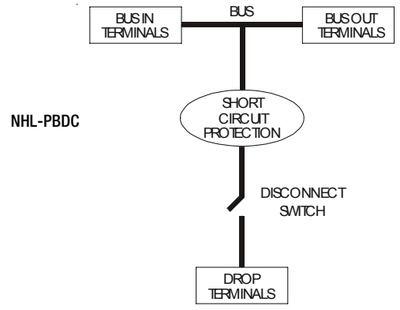
HazLink Disconnect Switches enable users to repair or replace a field device without disturbing the network with the simple flip of a lever-operated switch.

Disconnect Switches are designed to be locked if desired. Locking prevents tampering or accidental device connection or disconnection.

TopWorx offers Disconnect Switches in HazLink enclosures with or without short circuit protection.

NHL-PBDS Disconnect switch

NHL-PBDC Disconnect switch with short circuit protection



AS-i to Profibus DP Gateways

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AS-i to Profibus DP Gateways provide a means of easily connecting an AS-i network to a higher level Profibus DP network. The Gateway is recognized as a single node on the higher level Profibus DP network while controlling the field devices on the AS-Interface network.

General Specifications

Operating Temperature: 32° to 131°F (0° to 55°C)
Mounting: DIN rail
Voltage of insulation: ≥ 500V
Protection Category: Housing IP40, Terminals IP20
AS-i Specification: 2.1

Item	Part Number & Description

AS-i to Profibus DP Gateways

Gateway

Gateway with graphical display

Functions as a master on the AS-i network and as a single node on the Profibus DP network.

Dual Gateways function as two complete masters on the AS-i network and as a single node on the Profibus DP network.

These devices include demonstration software that performs addressing, monitoring, and diagnostics of the network.

Additional Specifications

Connection Type: Screw terminals

Gateway

Operating Voltage: 30VDC AS-i voltage

Operating Current: 200mA (from AS-i circuit)

Dual Gateway

Operating Voltage: 24VDC

Operating Current:
AS-i Power: 200mA (from AS-i 1), 70mA (from AS-i 2)
Standard Power: 70mA (from each AS-i), 150mA at 18VDC (from power)

Check out also
- D-sub-data transmission cords, page 117
- Master simulators for testing, page 99

Single Gateways

	Graphical Display	Power Supply
NAS-GP11	Yes	AS-i
NAS-GP12	No	AS-i

Dual Gateways

	Serial Interface	Power Supply
NAS-GP21	Yes	AS-i
NAS-GP22	No	AS-i
NAS-GP23	Yes	Standard
NAS-GP24	No	Standard

Profibus DP Master Simulator

TOPWORX

Profibus

The Profibus DP Master Simulator is used to connect a PC to a Profibus DP segment for configuration of Profibus DP slave devices, including the configuration of Profibus DP gateways. This tool is particular useful for Profibus devices in the IP67 protection class that do not have DIP switches for address configuration.

Item	Part Number & Description

Profibus DP Master Simulator

The Master Simulator includes RS 232 / RS 485 converter and monitoring software.

General Specifications

Operating Temperature: 32° to 131°F (0° to 55°C)
Operating Current: < 60mA
Power Supply: From the RS485 interface of the Profibus slave (5V)
Transfer Rate: 19200 Baud
Interfaces: Standard PC RS232 interface with 9-pin D-sub-plug (female); RS485-interface with 9-pin D-sub-plug (male)
Cable Length: RS 232 and RS 485: max. 2 m

NPB-1A01	Profibus DP Master Simulator

Profibus DP Modular I/O is DIN rail mountable and recommended for high density, low-cost applications. The modular I/O system is connected to the Profibus DP segment via the fieldbus coupler. Input/Output Modules can contain a mixture of analog, discrete, and speciality modules to meet your specific application requirements.

General Specifications

Operating Temperature: 32° to 131°F (0° to 55°C)
Protection Class: IP20
Connection: Cage clamp wiring connections

Item	Part Number & Description
Profibus DP I/O Coupler  The Profibus DP network may contain any assortment of discrete, analog, and specialty modules offered below. The Profibus DP I/O Coupler supports I/O Modules that can contain a maximum of 256 digital or 122 analog signals. The Profibus DP node address is easily selected by two encoder switches on front of bus coupler. The fieldbus coupler requires 24VDC power supply and terminals are provided for 24VDC power connection to field I/O devices (max. 10A). Network connection is via a 9 pin Sub D style connector. Check it out! - Field wirable D9 connectors, page 104	**NPB-2A01** Profibus DP fieldbus coupler, DP/V1, 12 MBaud
Discrete I/O Modules These Discrete I/O modules are designed for use with the coupling module above to provide a means of integrating conventional discrete I/O into a Profibus DP network. Discrete signals are transferred by the bus coupler bit by bit. When digital information exceeds 8 bits, a new byte is automatically started. Additional Specifications **Approvals:** Class 1, Div 2 (except Relay Output Modules)	Inputs **NMI-DN01** 4-channel digital input, 24VDC, 3.0 ms input filter **NMI-DN02** 2-channel digital input, 120VAC Outputs **NMI-DT01** 4-channel digital output with diagnostics, 24VDC 0.5A output current **NMI-DT02** 2-channel digital output with diagnostics, 24VDC 2.0A output current Relay Outputs **NMI-DR01** 2-channel relay output, non-floating, 2 SPST contacts Switching voltage: 250V AC/30VDC Switching current: 2.0A AC/DC **NMI-DR02** 2-channel relay output, 2 SPST contacts Switching voltage: 250VAC/30VDC Switching current: 2.0A AC/DC **NMI-DR03** 2-channel relay output, 2 SPDT contacts Switching voltage: 125VAC/30VDC Switching current: 0.5A AC/1.0A DC

Item	Part Number & Description
DIN Analog I/O Modules These Analog I/O modules are designed for use with the Fieldbus Coupling module to provide a means of integrating conventional analog devices into a Profibus network. Analog signals are transferred via bytes or words. Additional Specifications **Approvals:** Class 1, Div 2 (except Thermocouple modules)	Inputs **NMI-AN01** 2-channel analog input, RTD, PT100 sensor type **NMI-AN02** 2-channel analog input, 0-10VDC, single ended **NMI-AN03** 4-channel analog input, 0-10VDC, single ended **NMI-AN04** 2-channel analog input, type K thermocouple (-148° to 2498°F) **NMI-AN05** 2-channel analog input, type J thermocouple (-148° to 2192°F) **NMI-AN06** 2-channel analog input, 0-20mA, Overload protection, 16Bit **NMI-AN07** 2-channel, 4-20 mA, Overload protection, 16Bit Outputs **NMI-AT01** 2-channel analog output, 0-10VDC **NMI-AT02** 2-channel analog output, 0-20mA **NMI-AT03** 2-channel analog output, 4-20mA
Power Supply Modules These modules can be added to distribute power to field devices via the I/O system. Power is supplied from an external source. See our Power Supply section when 24VDC is required.	**NMI-PS01** 24VDC, 2A power supply **NMI-PS02** 24VDC, max. 6.3A with diagnostics and fuse-holder **NMI-PS03** 230VAC, max. 6.3A with diagnostics and fuse-holder **NMI-PS04** 120VAC, max. 6.3A with fuse-holder, no diagnostics
Separation & End Modules A separation module provides a visual and an electrical separation between field I/O power types (i.e. 24VDC from 120VAC modules). One end module is required at the physical end of each I/O System, with one per Bus Coupler.	**NMI-SM01** Separation module **NMI-EM01** End module

Quick Disconnect I/O Modules & Accessories

Quick Disconnect Input/Output Modules provide a method of connecting conventional field devices to a Profibus DP Network with quick disconnect (QDC) style connectors in a rugged, field mountable unit.

QDC Accessories provide physical layer connectivity for a Profibus DP network.

General Specifications

Housing Material: Glass filled nylon; nickel plated brass connectors
Operating Temperature: 32° to 151°F (0° to 55°C)
Protection Class: NEMA 1,3,4,12,13; IP67

Item	Part Number & Description

Robust I/O Modules

These modules allow for the address to be selected via two rotary switches under protective cover and have a communication rate up to 12 Mbps, auto-adjusted to the master device.

	Inputs	Outputs	Output Current
NPB-3A01	8	-	-
NPB-3A02	16	-	-
NPB-3A03	-	8	0.5A
NPB-3A04	-	8	2.0A
NPB-3A05	-	16	0.5A
NPB-3A06	8	8	0.5A
NPB-3A07	8	8	0.5A

Additional Specifications

Combatibility: PNP
Internal Current Consumption: <110mA (input stations only)
<150mA (stations with outputs)
Input Voltage: 18 to 30VDC
Input Current: <500mA per 8 inputs, short-circuit protection
Output Voltage: 18 to 30VDC
Input Short-circuit Protection: Group
Output Short-circuit Protection: Individual
No. of Pins: 5

Requires external power source that is connected via minifast connector on front. See our selection of Power Supplies on page 116.

Terminator

Terminators are required at each physical end of a Profibus DP to prevent signal reflections and to provide a defined idle level on the bus. This minimizes communication errors on the bus and maximizes transmission efficiency.

NPB-3B01	Terminating resistor

Specifications

Connector: Polyurethane body material & contact carrier, 300V rating
Coupling Nuts: Nickel plated brass
Temperature: -40° to 170°F (-40° to 80°C)
Protection: NEMA 1,3,4,6p
Rating: 50VDC
No. of Pins: 5

Quick Disconnect Accessories

These Quick Disconnect (QDC) Accessories provide physical layer connectivity for a Profibus DP network.

Tees provide a means of connecting and disconnecting devices to the Profibus network with no interruption or loss of communications to other devices on the bus.

General Specifications

Protection: IP67

Item	Part Number & Description

Bus Tee

This tee allows the connection of devices to a Profibus DP communications bus. The tee allows removal and installation of a signal device without disruption of communications on the Profibus DP segment.

NPB-3C01	Profibus DP fully shielded eurofast bus tee

Additional Specifications

Housing Material: Aluminum with gold-plated brass contacts
Coupling Nuts: Nickel plated brass
Temperature: -40° to 176°F (-40° to 80°C)
Protection: NEMA 1,3,4,6
Rating: 4A, 250V
No. of Pins: 5

Power Tee

This tee is rated at 9A and 600V and is used when providing external power to multiple Profibus DP slave devices.

See our selection of power supplies on page116.

NPB-3D01	Profibus DP minifast power tee

Additional Specifications

Connector: Oil resistant polyurethane, contact carrier, 300V rating
Contact Materials: Gold plated brass
Coupling Nuts: Nickel plated brass
Temperature: -40° to 221°F (-40° to 105°C)
Protection: NEMA 1,3,4,6p
Rating: 9A, 600V
No. of Pins: 5

Field Wirable Connectors

502.969.8000

These plug style connectors are designed for easy installation in the field after the Profibus wiring has been routed through the conduit, wire-ways, panel enclosures, and other locations.

General Specifications

Operating Temperature: -40° to 185°F (-40° to 85°C)
Protection Class: NEMA 1,3,4,6p; IP67

Item	Part Number & Description
Eurofast Connectors Additional Specifications **Housing**: Polyester, PBT Black **Connector Insert**: PBT **Contact Materials**: Nickel plated copper alloy **Coupling Nuts**: Female - PBT; Male - Nickel Plated Brass **No. of Pins**: 5	Female Connectors **NPB-EFS** Straight female field wirable connector **NPB-EFR** Right angle female field wirable connector Male Connectors **NPB-EMS** Straight male field wirable connector **NPB-EMR** Right angle male field wirable connector
Profibus-DP Field Wirable D9 Connector	**NPB-4A01** Right angle 9-pin Sub D connector

Molded Connector Cordsets

TOPWORX

Profibus

These cordsets provide Profibus DP cable with pre-installed, plug-in connectors, reducing installation time in the field.

Available in 1, 3, 5, and 10 meter lengths. Consult the factory for additional cordset lengths.

Item	Part Number & Description
Molded Connector Cordsets  TopWorx offers Profibus DP molded connector cordsets in Profibus DP PVC and PUR cable. Cordsets are available with a molded connector on each end or with one end bare to facilitate routing of cable through conduit or panel enclosures. All double cordsets have one straight male connector and one straight female connector. See page 106 for cable specifications. Connector Specifications **Plug Body:** Molded polyurethane **Contacts:** Gold plated brass **Coupling Nuts:** Nickel plated brass **Temperature:** -40° to 158°F (-40° to 70°C) **Protection:** NEMA 1,3,4,6,13; IP67 **Rated Current:** 4.0A (eurofast)	**To create your cordset part number:** 1) Select your connector types 2) Select your cable type from the list below (* = cable type) 3) Select your cordset length from the chart below (☐ = cordset length) *Example* *NPB-DEPC1-1 = Profibus DP PVC double connector cordset, 1 m* Double Eurofast Connector Cordsets **NPB-DE*-☐** Single Eurofast Connector Cordsets **NPB-EM*-☐** Male eurofast connector **NPB-EF*-☐** Female eurofast connector *** Cable Types** **PC1** = Profibus DP PVC cable **PC2** = Profibus DP PUR cable **☐ Cordset Length** Consult factory for additional cordset lengths.

Part Number ☐	Cordset Length
1	1 m
3	3 m
5	5 m
10	10 m

Profibus Bulk Cable

502.969.8000

Cable that meets the requirements of EN50170-2-2:1996 for communications up to 12Mbaud.

Available in 30, 75, and 150 meter spools. Consult the factory for additional cable lengths.

General Specifications

Rating: 300V, 176°F (80°C)
Type of Drain Wire: Foil/Braid; 22AWG

Item	Part Number & Description
Profibus Bulk Cable Quick Reference - Field wirable connectors, page 104	**To create your bulk cable part number, use the chart below to select the appropriate cable length for your application, where ☐ = cable length.** *Example* *NPB-PC1-030 = Profibus DP PVC cable in 30 meter spool* Bulk Cable Types **NPB-PC1-☐** Profibus DP PVC cable, abrasion resistant **NPB-PC2-☐** Profibus DP PUR cable, oil and abrasion resistant

Part Number ☐	Cable Length
030	30 m
075	75 m
150	150 m

Consult factory for additional cable lengths.

Diagnostic Tools

TOPWORX

Our Profibus diagnostic tool is a powerful, handheld Profibus network test tool that can be used for installation, startup, and troubleshooting.

Item	Part Number & Description
Diagnostic Tools  During installation and startup, the device can be used to verify wiring integrity, bus impedance, existence of terminating resistors, crossed-wires, proper cable type, broken shielding, proper signal strength, slave devices addresses and identification. The NPB-DT7 can perform passive monitoring of signal levels, baud rate, and reflections on an active Profibus segment. The NPB-DT7 can take the place of the Profibus Master to troubleshoot failed devices, wiring breaks, transmission errors, and other vital statistics that help to quickly locate and correct Profibus network problems. The NPB-DT7 has a flash memory that allows storing of 20 test reports for later printing via the RS 232C port and a standard PC. General Specifications **Connections:** DB9 connector **Profibus Data Range**: 9600 bits to 12 Mbits **Measuring inaccuracy with connected devices**: ±10% **Measuring inaccuracy without connected devices**: ±5% **Operating Temperature:** 50° to 104°F (10° to 40°C) **Protection:** NEMA 3; IP50 Plug Charger Specifications **Input Voltage Range**: 100-240VAC, 50-60 Hz **Max. Input Current**; 120mA **Power Input**: max. 12VA **Operating Temperature:** 32° to 86°F (0° to 30°C) **Protection:** IP50	**NPB-DT7** Profibus Test Tool Set - Handheld testing device - Transportation case - 2 accumulators - Power supply - RS-232 cable - Profibus stub line & T-connection cable - Several gender changers - Detailed manual containing troubleshooting hints & guidelines

Modbus Overview

The Modbus protocol was originally developed by Modicon in 1978 to exchange information between products on the factory floor. This protocol became a de facto standard for exchanging data and communication information between PLC systems.

Modbus devices communicate over a serial network in a master/slave (request/response) type relationship using one of two transmission modes: ASCII (American Standard Code for Information Interchange) mode or RTU (Remote Terminal Unit) mode.

In ASCII mode, two eight-bit bytes of information are sent as two ASCII characters. The primary advantage of ASCII mode is the flexibility of the timing sequence. Up to a one second interval can occur between character transmissions without causing communication errors.

In RTU mode, data is sent as two four-bit, hexadecimal characters, providing for higher throughput than in ASCII mode for the same baud rate.

Enhancements to Modbus include Modbus Plus and Modbus/TCP protocols, both of which allow Modbus information to be encapsulated in a network structure to support peer-to-peer communications. Modbus Plus communicates via a single twisted pair of wires and uses a token passing sequence for peer communication sequences. Modbus/TCP is an open standard designed to facilitate Modbus message transfer using TCP/IP protocol and standard Ethernet networks.

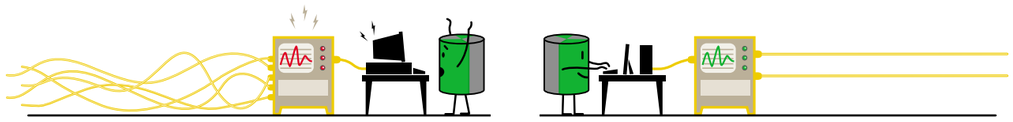
TopWorx's Modbus devices are designed to operate as slave devices on a Modbus network for discrete valve control.

Modbus Network Highlights

Type of Network	
ASCII/RTU	Device Bus
ModbusPlus	Control Bus
Physical Media	Shielded twisted pairs in one shielded cable
Network Topology	Bus, tree, star with drops
Maximum Devices	
ASCII/RTU	One to one communications
ModbusPlus	32 (up to 64 with repeater)
Maximum Distance	
ASCII/RTU	350m
ModbusPlus	1500m (6000m with repeaters)
(up to 3 repeaters may be used)	(min. 1m between devices)
Communication Methods	
ASCII/RTU	Master-Slave Query-Response Cycle (LRC error checking for ASCII) (CRC error checking for RTU)
ModbusPlus	Peer to Peer (Token passing logical ring)
Primary usage	
ASCII/RTU	Serial Communications for PLC, Variable Speed Drives, Control Systems, etc.
ModbusPlus	linking MODBUS and/or RS232/RS485 devices in a peer-to-peer network
Power Supply	12VDC, not used for devices
Power and Communications	Communications only on bus 12VDC, max. 300mA (100mA typical)
Device Power Supply	Devices must be powered separately from communications bus
Wiring Types	
(types used varies on application)	Shielded Twisted Pair #18AWG (0.8mm)
Grounding aspects	Floating communications bus
Shielding	Grounded at one end
Area Classification	General Purpose
Device Addressing	Switch or software selectable
Governing Body	MODBUS.ORG
Web Site	**www.modbus.org**

Conventional I/O System vs. Modbus Network

Modbus is a well understood and broadly used protocol for industrial digital communications.



CONVENTIONAL I/O SYSTEM

Advantages
- Technology is already understood
- Slightly lower device cost
- Independent wiring from devices to the control system means wiring problems with one device don't affect other field devices

Drawbacks
- Higher installed cost
- Point-to-point wiring is expensive
- Many wiring connections:
  - are labor intensive to install
  - create many points of failure
  - increase complexity when troubleshooting
  - require large amounts of cabinet or rack space for installation of terminal blocks
  - create time-consuming initial checkout and start-up
- Expansion requires duplicating the entire wiring scheme for each additional point

MODBUS NETWORK

Advantages
- Well understood and documented protocol
- Widely supported protocol by many host PLC, DCS and process systems
- Protocol is already used in many facilities

Drawbacks
- Limited use as a device bus
- Limited diagnostic capabilities for device applications
- Separate power required for device operations

Recommended
- When similar Modbus devices are being used
- When Modbus network is pre-existing
- When Modbus protocol is well understood and is being used extensively as a facility standard

TopWorx Comments on Modbus

Strengths
Modbus is well accepted and well understood by many in the world of industrial communications.

Modbus delivers cost-effective simplicity with a bit of added functionality supporting limited diagnostic information.

Limitations
The selection and availability of field devices that support the Modbus protocol is limited, especially in the process industries.

From the field device perspective, Modbus is a bit cumbersome to configure with today's advanced process control systems.

Modbus does not support field devices effectively in intrinsically safe applications.

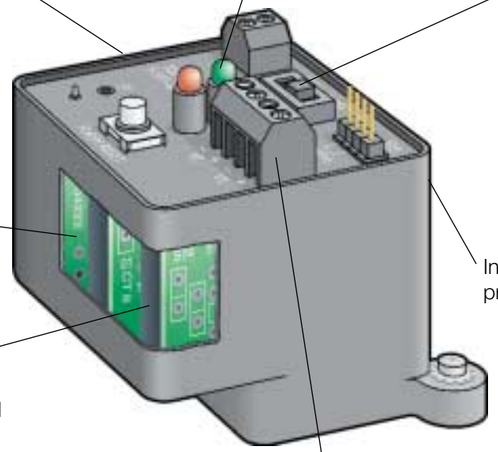
When to Use Modbus
Generally speaking, TopWorx recommends Modbus when:
- device populations are primarily discrete
- end users already have an existing control system that supports Modbus
- end users have a legacy control system that does not support other common protocols
- plants are not intrinsically safe

Device Bus Network

Modbus Sensor-Communications Module

MODBUS

The TopWorx Sensor-Communications Module combines position sensors, Modbus communication, solenoid outputs, and wiring terminals into a compact enclosure that is potted and sealed from the environment.

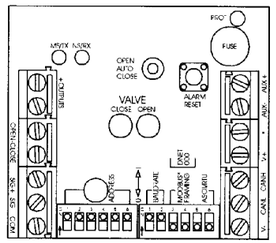


SCM-MB Highlights

The Sensor-Communications Module delivers valve position feedback, communicates directly on the Modbus network, pilots the valve actuator, and provides extra wiring terminals for auxiliary inputs.

The TopWorx SCM-MB is a compact, sealed module that can be used in a variety of enclosures suitable for use in any hazardous or corrosive process environment.

3 Discrete Inputs (DI)	Open/Closed valve position feedback
2 Discrete Outputs (DO)	Solenoid outputs for single or double acting
Calibration Switch	Open-Close-Modbus
Status/Warning LEDs	Open, Closed, Alarm State
Short Circuit Protection	Yes
Maximum Current	500mA per output
Maximum Power	12 watts per output
Voltage	11-30 VDC
Diagnostics	
Cycle Counter	Records number of cycles
Cycle Time Alarms	User settable values for Open & Close cycle times
Visual Alarm Indication	Blinking LEDs



SCM-MB Wiring Diagram

The Modbus Sensor-Communications Module fits conveniently into a variety of valve control enclosures suitable for any process environment.

Lumitech DVC-MB
Discrete Valve Controller
- Zone 2 (Class I, Div 2)
- Integral Solenoid Valve
- Direct Mount

See page 130 for more details.

Lumitech DVM-MB
Discrete Valve Monitor
- Zone 2 (Class I, Div 2)
- Direct Mount

See page 132 for more details.

Switchpak DXP-MB
Switchpak DXS-MB (Stainless Steel enclosure)
Discrete Valve Monitor
- Zone 1 (Class I, Div 1)

See page 134, 136 for more details.

MODBUS Our HazLink products are rugged junction enclosures that provide flexible wiring options in hazardous areas, making it easy to connect conventional devices to the Modbus network as well as make wiring connections and disconnect field devices in hazardous areas.

HazLink Features: Zone 1 (Class I, Div 1)
(3) 3/4" NPT conduit outlets

HazLink Options: I/O Modules
Wiring Tees
Disconnect Switches

Item

HazLink Connectivity Enclosure

<u>General Specifications</u>

Enclosure: Die-cast aluminum; O-ring sealed

Coating: Dichromate conversion (inside); powder polyester coating (outside)

O-rings: Buna N

Cover: Screw cover with O-ring seal

Conduit Outlets: Three 3/4" NPT

Environment: NEMA Type 4, 4X, 7 and 9

Approvals: Explosion Proof
Zone 1
Class I, Div 1 & 2, Groups A,B,C,D
Class II, Div 1 & 2, Groups E,F,G

c UL us LISTED CE

I/O Modules

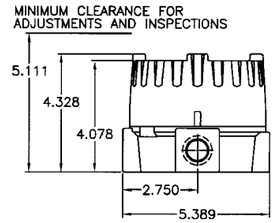
HazLink I/O Modules allow users to cost-effectively connect new or existing conventional devices into the Modbus network in Zone 1 (Class I, Div 1) hazardous areas.

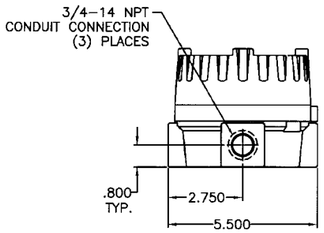
NHL-MBIO Hazlink Connectivity Enclosure with Modbus I/O
2 input, 2 output knifegate valve or cylinder controller

MODBUS

Modbus

Dimensions



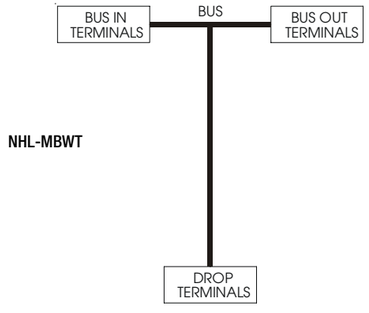


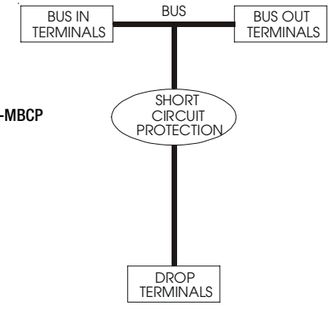
Wiring Tees

HazLink Wiring Tees make it easy to connect field devices to bus lines using wire terminals or plug-in connectors.

NHL-MBWT Modbus tee with 3 x 5 position wiring terminals

NHL-MBCP Short circuit protection





Disconnect Switches

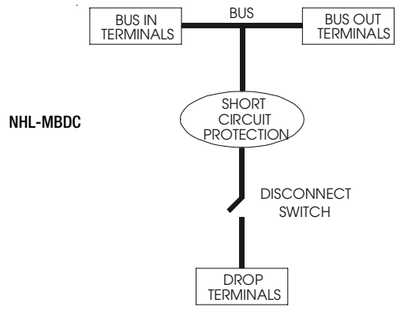
HazLink Disconnect Switches enable users to repair or replace a field device without disturbing the network with the simple flip of a lever-operated switch.

Disconnect Switches are designed to be locked if desired. Locking prevents tampering or accidental device connection or disconnection.

TopWorx offers Disconnect Switches in HazLink enclosures with or without short circuit protection.

NHL-MBDS Disconnect switch

NHL-MBDC Disconnect switch with short circuit protection



AS-i to Modbus Gateways

502.969.8000

MODBUS AS-i to Modbus Gateways control the field devices on the AS-Interface network, and connect the AS-i network to the Modbus protocol via RS 232C, RS 422, or RS 485 serial interface.

General Specifications

Operating Temperature: 32° to 131°F (0° to 55°C)
Voltage of insulation: ≥ 500V
Protection Category: Housing IP40, Terminals IP20

Item	Part Number & Description

AS-i to Modbus Gateways

Gateways function as a master on the AS-i network and as a single node on the Modbus network.

Dual Gateways function as two complete masters on the AS-i network and as a single node on the Modbus network.

These devices include demonstration software that performs addressing, monitoring, and diagnostics of the network.

Additional Specifications

AS-i Specification: 2.1 (Gateways); 2.0 (Dual Gateways)

With AS-i Power Supply

Operating Voltage: 30VDC AS-i voltage

Operating Current:
Single Gateways: 200mA (from AS-i)
Dual Gateways: 200mA (from AS-i 1), 70mA (from AS-i 2)

With Standard Power Supply

Operating Voltage: 24VDC

Operating Current: 70mA (from AS-i), 150mA at 18VDC (from power)

Quick Logic - D-sub-data transmission cords, page 117

Single Gateways

	Serial Interface	Power Supply
NAS-GM11	RS 232C	AS-i
NAS-GM12	RS 232C	Standard
NAS-GM13	RS 485	AS-i
NAS-GM14	RS 485	Standard
NAS-GM15	RS 422	AS-i
NAS-GM16	RS 422	Standard

Dual Gateways

	Serial Interface	Power Supply
NAS-GM21	RS 232C	AS-i
NAS-GM22	RS 232C	Standard
NAS-GM23	RS 485	AS-i
NAS-GM24	RS 485	Standard
NAS-GM25	RS 422	AS-i
NAS-GM26	RS 422	Standard

Modbus to DeviceNet Gateway

TOPWORX

MODBUS The Modbus to DeviceNet Gateway allows the connection of slave devices to a DeviceNet network. The gateway becomes a single node on the DeviceNet network.

General Specifications

Baud Rate Selection: Auto/125k/250k/500k baud
Address Selection: Switch selectable 0-63

Item	Part Number & Description

Modbus to DeviceNet Gateway

The Modbus to DeviceNet allows the connection of Modbus capable slave devices to a DeviceNet network.

The DeviceNet address is set using DIP switches on the device and the DeviceNet baud rate is automatically determined when connected to the network. A single gateway is capable of communicating with one or more Modbus devices.

Additional Specifications

Operating Temperature: 32° to 140°F (0° to 60°C)
Maximum Power: 200mA/11VDC to 90mA/25VDC

NDN-1A02	Modbus to DeviceNet gateway, RS 232 interface

networx

In addition to protocol-specific power supplies, TopWorx also offers a variety of standard 24VDC power supplies.

Item	Part Number & Description	
24VDC Power Supplies These DIN rail mountable power supplies are compact and economical solutions to 24VDC power requirements.  General Specifications **Protection Class:** NEMA 1; IP20 **Operating Temperature:** 14° to 131°F (-10° to 50°C) **Connection:** 12 AWG, 2.5mm², pluggable	**NXS-1101**	24VDC at 2.5A output
	NXS-1102	24VDC at 6A output
	NXS-1101	24VDC at 6A output, parallel connection with integral diode
	NXS-1101	24VDC at 12A output
	NXS-1101	24VDC at 12A output, parallel connection with integral diode
	NXS-1101	24VDC at 20A output, parallel connection with integral diode
Redundant 24VDC Power Supplies This DIN rail mountable redundant power supply system offers up to 90A at 24VDC or 75A with n+1 redundancy. The chassis can hold either 3 or 6 power modules that provide 15A at 24VDC each.  General Specifications **Input Line Voltage:** 115Vrms nominal, 50-60 Hz **Output Voltage:** 24VDC ± 1%, adjustable from 22.5 to 28V on chassis **Output Current:** 1 to 15A nominal per power module **EMI Compatibility:** EN-50081-2, EN-50082-2 **Operating Temperature:** -13° to 131°F (-25° to 55°C)	**NXS-2101**	24VDC at 45A output, 30A with redundancy
	NXS-2102	24VDC at 90A output, 75A with redundancy

networx

Item	Part Number & Description	
D-sub-data Transmission Cords These connector cords work in conjunction with TopWorx Masters and Gateways to facilitate attachment to a computer for configuration or programming. General Specifications **Connection**: D-sub plug; D-sub socket **Length**: 1.8 m	**NXS-3101**	D-sub data transmission 9-pin cordset
Quick Disconnect Guards Quick Disconnect Guards are designed for the protection of Minifast and Eurofast connectors in Class I, Div. 2 applications. The Guards prevent against mechanical separation of male and female connectors. General Specifications **Material**: Nylon 6 **Operating Temperature:** -22° to 212°F (-30° to 100°C) **Environmental**: Sun resistant, UV stable **Flammability:** UL94 (5=V-0; 4=V-1; 3=V-2; 1=HB)	Standard Shields	
	NXS-4101	Standard minifast shield
	NXS-4102	Standard eurofast shield
	Field Wirable Shields	
	NXS-4103	Field wirable minifast shield
	NXS-4104	Field wirable eurofast shield