Allen-Bradley

CompactBlock LDX Analog Modules

1790D-N4CO/TN4CO, -N4VO/TN4VO, -NOC2/TNOC2, -NOV2/TNOV2, 1790P-TN4CO, -TNOC2

User Manual

Rockwell Automation

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of these products must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards. In no event will Allen-Bradley be responsible or liable for indirect or consequential damage resulting from the use or application of these products.

Any illustrations, charts, sample programs, and layout examples shown in this publication are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Allen-Bradley does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen-Bradley publication SGI-1.1, *Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control* (available from your local Allen-Bradley office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

Throughout this publication, notes may be used to make you aware of safety considerations. The following annotations and their accompanying statements help you to identify a potential hazard, avoid a potential hazard, and recognize the consequences of a potential hazard:

WARNING	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
ATTENTION	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Rockwell Automation Support

Before you contact Rockwell Automation for technical assistance, we suggest you please review the troubleshooting information contained in this publication first.

If the problem persists, call your local distributor or contact Rockwell Automation in one of the following ways:

Phone	United States/Canada	1.440.646.5800
	Outside United States/Canada	You can access the phone number for your country via the Internet: 1. Go to http://www.ab.com 2. Click on *Product Support* (http://support.automation.rockwell.com) 3. Under *Support Centers*, click on *Contact Information*
Internet	⇒	1. Go to http://www.ab.com 2. Click on *Product Support* (http://support.automation.rockwell.com)

Your Questions or Comments on this Manual

If you find a problem with this manual, please notify us of it on the enclosed How Are We Doing form.

Read this preface to familiarize yourself with the rest of the manual. This preface covers the following topics:

- who should use this manual
- how to use this manual
- related publications
- conventions used in this manual
- Rockwell Automation support

Who Should Use This Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting control systems that use Allen-Bradley CompactBlock LDX modules.

How to Use This Manual

As much as possible, we organized this manual to explain, in a task-by-task manner, how to install, configure, program, operate and troubleshoot a control system using the 1790D analog I/O modules.

Manual Contents

If you want...	See
An overview of the analog input and output modules	Chapter 1
Installation and wiring guidelines	Chapter 2
Input module addressing, configuration and status information	Chapter 3
Output module addressing, configuration and status information	Chapter 4
Information on module diagnostics and troubleshooting	Chapter 5
Specifications for the input and output modules	Appendix A
PROFIBUS information	Appendix B
Definitions of terms used in this manual	Glossary

Related Documentation

The table below provides a listing of publications that contain important information about CompactBlock LDX systems.

For	Read this document	Document number
Introduction to CompactBlock LDX	Product Profile	1790-PP002
DeviceNet Analog Base D-Shell CompactBlock LDX 1790D-N4C0, -N0C2, -N4V0, -N0V2	Installation Instructions	1790-IN004
DeviceNet Analog Base Terminal Block CompactBlock LDX 1790D-TN4C0, -TN4V0, -TN0V2, -TN0C2	Installation Instructions	1790-IN002
DeviceNet Cable System	Planning and Installation Manual	DN-6.7.2
In-depth information on grounding and wiring Allen-Bradley programmable controllers.	Allen-Bradley Programmable Controller Grounding and Wiring Guidelines	1770-4.1

If you would like a manual, you can:

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- purchase a printed manual by:
  - contacting your local distributor or Rockwell Automation representative
  - visiting **www.theautomationbookstore.com** and placing your order
  - calling 1.800.963.9548 (USA/Canada) or 001.330.725.1574 (Outside USA/Canada)

Conventions Used in This Manual

The following conventions are used throughout this manual:

- Bulleted lists (like this one) provide information not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- *Italic* type is used for emphasis.
- Text in this `font` indicates words or phrases you should type.

Chapter 1

Overview

Chapter 2

Installation and Wiring

Chapter 3

Module Data, Status, and Channel Configuration for Analog Input Modules

Chapter 4

Module Data, Status, and Channel Configuration for Analog Output Modules

Chapter 5

Module Diagnostics and Troubleshooting

Appendix A

Specifications

PROFIBUS Modules Installation, Wiring, Module Data, Status and Channel Configuration

Appendix B

Glossary

Index

Overview

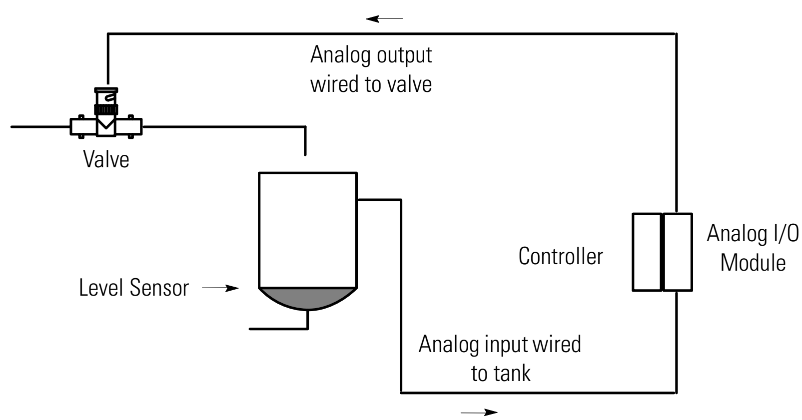
This chapter explains how analog data is used, and describes CompactBlock LDX analog input and output modules. Included is information about:

- the use of analog I/O
- the modules' hardware and diagnostic features
- an overview of the analog input system operation
- an overview of the analog output system operation

How to Use Analog I/O

Analog refers to the representation of numerical quantities by the measurement of continuous physical variables. Analog applications are present in many forms. The following application shows a typical use of analog data.

In this application, the processor controls the amount of fluid in a holding tank by adjusting the valve opening. The valve is initially open 100%. As the fluid level in the tank approaches the preset point, the processor modifies the output to close the valve 90%, 80%, and so on, continuously adjusting the valve to maintain the fluid level.



General Description

The analog input module converts and digitally stores analog data for retrieval by controllers, such as the SLC-500 programmable controller. The module supports connections from any combination of up to four voltage or current analog sensors. The four high-impedance input channels can be wired as single-ended inputs.

The output module provides two single-ended analog output channels, either voltage or current, depending on the module selected.

Table 1.1 lists the CompactBlock LDX module types and corresponding operating ranges:

Table 1.1
CompactBlock LDX Module Types and Operating Ranges

CompactBlock LDX Module	Type:	Operating Range:
1790D-N4CO 1790D-TN4CO	Current Input	4-20mA or 0-20mA
1790D-NOC2 1790D-TNOC2	Current Output	0-20mA
1790D-N4VO 1790D-TN4VO	Voltage Input	0-10V dc
1790D-NOV2 1790D-TNOV2	Voltage Output	0-10V dc

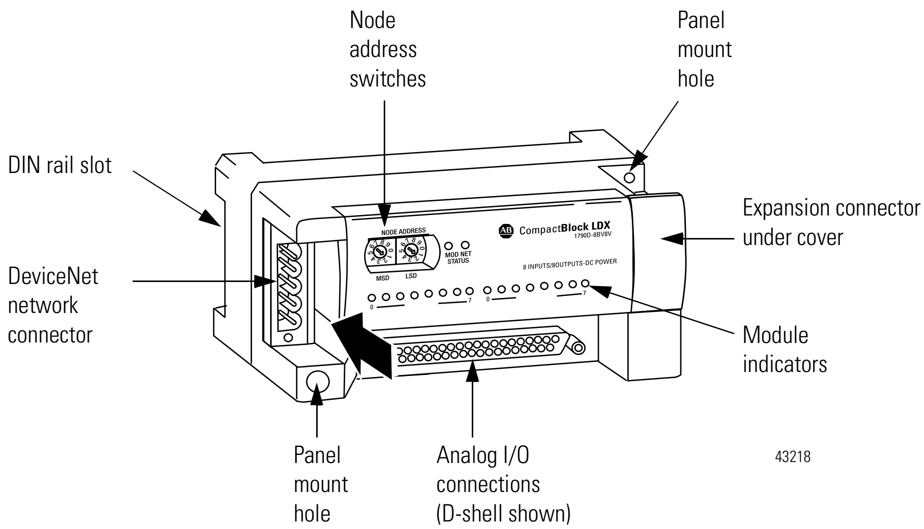
Each analog base module supports up to two CompactBlock LDX discrete expansion modules.

Hardware Features

The modules contain either removable D-shell connectors or fixed terminal blocks. The CompactBlock LDX four input channels are single-ended. The CompactBlock LDX two output channels are also single-ended. Module configuration is normally done via the controller's programming software. In addition, some controllers support configuration via the user program.

Figure 1.1 shows the CompactBlock LDX analog modules' hardware features.

Figure 1.1



General Diagnostic Features

The CompactBlock LDX modules contain diagnostic features that can help you identify the source of problems that may occur during power-up or during normal channel operation. These power-up and channel diagnostics are explained in Chapter 5, Module Diagnostics and Troubleshooting.

System Overview

The modules communicate to the controller through the DeviceNet network. Module power is derived from DeviceNet. Additionally, the analog I/O requires 24V dc field power separate from DeviceNet. CompactBlock LDX analog bases support up to two discrete LDX expansion modules.

System Operation

At power-up, the analog base module performs a check of its internal circuits, memory, and basic functions. During this time, the module status LED remains off. If no faults are found during power-up diagnostics, the module status LED is turned on.

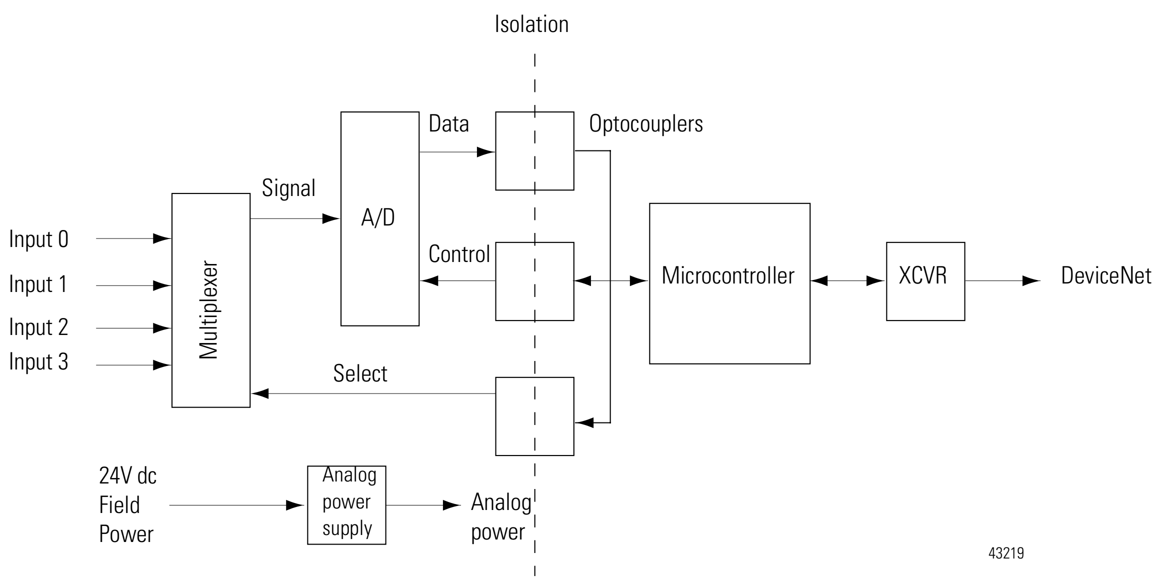
After power-up checks are complete, the module waits for valid channel configuration data. If an invalid configuration is detected, the module generates a configuration error. Once a channel is properly configured and enabled, it begins the analog-to-digital or digital-to-analog conversion process.

Module Operation

Input Module

The input module's input circuitry consists of four analog inputs multiplexed into a single analog-to-digital (A/D) converter. The A/D converter reads the selected input signal and converts it to a digital value that is presented to the network. The multiplexer sequentially switches each input channel to the module's A/D converter. Figure 1.2 on page 1-5 shows a block diagram of the circuitry.

Figure 1.2

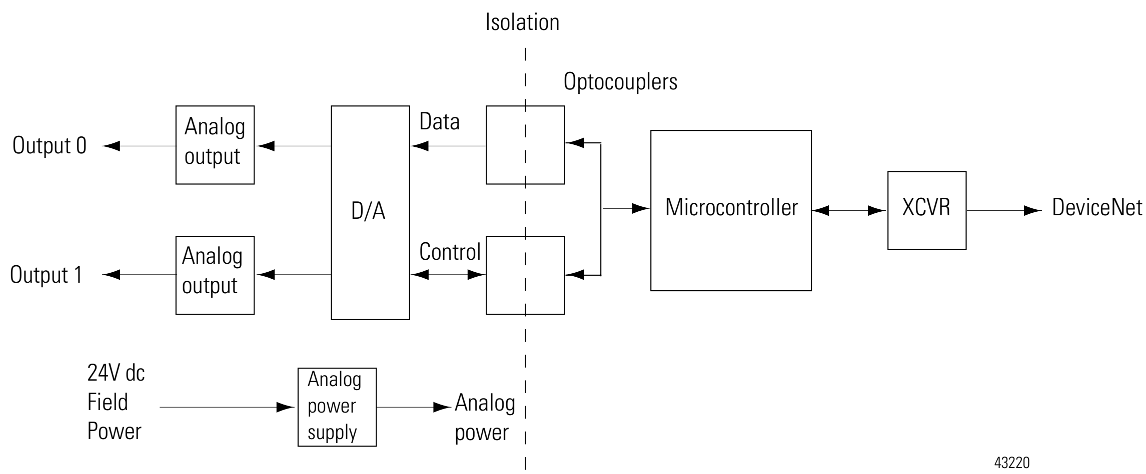


Each time the input module reads a channel, the module tests that analog data value for an overrange or underrange condition. If such a condition is detected, a unique bit is set in the channel status word. The channel status word is described in Chapter 4, Module Data, Status, and Channel Configuration for Analog Output Modules.

Output Module

The output module uses a digital-to-analog (D/A) converter to read the digital output data from the network and convert it to an analog output signal. Figure 1.3 below shows a block diagram of the circuitry.

Figure 1.3



Installation and Wiring

This chapter tells you how to:

- determine the power requirements for the modules
- avoid electrostatic damage
- install the module
- wire the module's terminal block
- wire input devices
- wire output devices

Power Requirements

The modules receive power through the DeviceNet network and from an auxilary 24V dc field supply. The maximum power drawn by the modules is shown in Table 2.1.

Table 2.1
CompactBlock LDX Module Power Requirements

	Voltage Range:	Power:
DeviceNet Power:	11-28.8 V dc	1.2W @ 28.8V dc
Auxilary 24V dc Field Power:	21.6-26.4V dc	1.5W @ 26.4V dc

Module Installation

CompactBlock LDX is suitable for use in an industrial environment when installed in accordance with these instructions. Specifically, this equipment is intended for use in clean, dry environments (Pollution degree 2[(1)]) and to circuits not exceeding Over Voltage Category II[(2)] (IEC 60664-1).[(3)]

(1) Pollution Degree 2 is an environment where, normally, only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation shall be expected.

(2) Over Voltage Category II is the load level section of the electrical distribution system. At this level transient voltages are controlled and do not exceed the impulse voltage capability of the product's insulation.

(3) Pollution Degree 2 and Over Voltage Category II are International Electrotechnical Commission (IEC) designations.

Prevent Electrostatic Discharge

ATTENTION

Electrostatic discharge can damage integrated circuits or semiconductors if you touch analog I/O module bus connector pins or the terminal block on the input module. Follow these guidelines when you handle the module:

- Touch a grounded object to discharge static potential.
- Wear an approved wrist-strap grounding device.
- Do not touch the bus connector or connector pins.
- Do not touch circuit components inside the module.
- If available, use a static-safe work station.
- When it is not in use, keep the module in its box.

Environmnet and Enclosure

ATTENTION

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC publication 60664-1), at altitudes up to 2000 meters without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR Publication 11. Without appropriate precautions, there may be potential difficulties ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbance.

This equipment is supplied as "open type" equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

See NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure. Also, see the appropriate sections in this publication, as well as the Allen-Bradley publication 1770-4.1 ("Industrial Automation Wiring and Grounding Guidelines"), for additional installation requirements pertaining to this equipment.

Remove Power

ATTENTION

Remove power before removing or inserting this module or an expansion module. When you remove or insert a module with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing unintended machine motion
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector and may lead to premature failure.

General Considerations

Reducing Noise

Most applications require installation in an industrial enclosure to reduce the effects of electrical interference. Analog inputs and outputs are highly susceptible to electrical noise. Electrical noise coupled to the analog inputs will reduce the performance (accuracy) of the module.

Group your modules in the enclosure to minimize adverse effects from radiated electrical noise and heat. Consider the following conditions when selecting a location for the analog module. Position the module:

- away from sources of electrical noise such as hard-contact switches, relays, and AC motor drives
- away from modules which generate significant radiated heat.

In addition, route shielded, twisted-pair analog input and output wiring away from any high voltage I/O wiring.

Protecting the Circuit Board from Contamination

The printed circuit boards of the analog modules must be protected from dirt, oil, moisture, and other airborne contaminants. To protect these boards, the system must be installed in an enclosure suitable for the environment. The interior of the enclosure should be kept clean and the enclosure door should be kept closed whenever possible.

Installing CompactBlock LDX I/O

Follow these steps to install the block:

1. Set the Node Address on the Base Block
2. Mount the Base Block
3. Mount the Optional Expansion Blocks
4. Connect the DeviceNet Cable

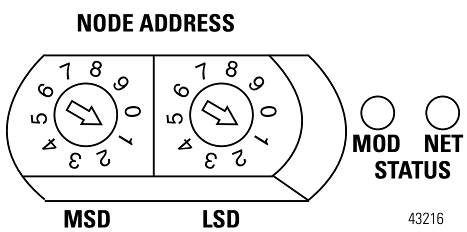
Set the Node Address on the Base Block

Each base block comes with its internal program set for node address 63. To reset the node address, adjust the switches on the front of the block. The two switches are most significant digit (MSD) and least significant digit (LSD). The switches can be set between 00 and 63.

The rotary switches are read at block power up only. Switch settings between 64 and 99 cause the block to use the last valid node address stored internally.

Figure 2.1

Node Address is set to 11



The node address may also be set through RSNetWorx for DeviceNet or a similar configuration tool. When software configuration is used for the node address, the switches must be set between 64 and 99.

Mount the Base Block

You can mount the base block to a panel or DIN rail. We recommend that you ground the panel or DIN rail before mounting the block.

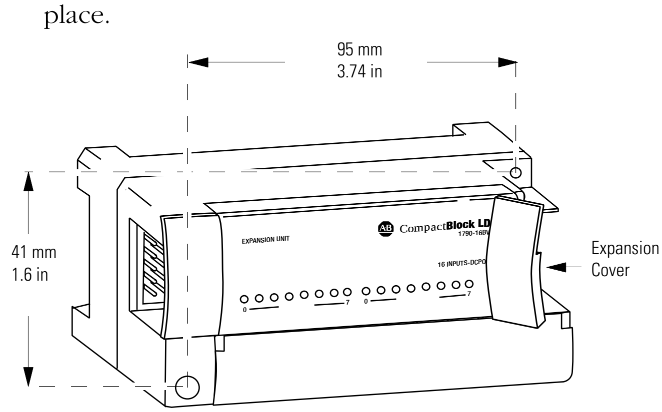
IMPORTANT The analog base module can accommodate a **maximum** of two discrete expansion modules.

WARNING

When used in a Class I, Division 2, hazardous location, this equipment must be mounted in a suitable enclosure with proper wiring method that complies with the governing electrical codes.

Panel Mounting

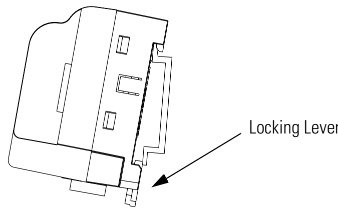
1. Place the block against the panel where you want to mount it.
2. Gently pull and position the expansion cover to the left.
3. Place a center punch, nail or similar device through the mounting holes in the block and make two marks on the panel (lower left and upper right corners of the module).
4. Remove the block and drill two holes in the panel to accommodate each of the mounting screws.
5. Replace the block on the panel and place a screw through each of the two mounting holes. Tighten the screws until the block is firmly in place.



DIN Rail Mounting

1. Hook the top of slot of the block over the DIN Rail.

2. Pull down on the locking lever while pressing the block against the rail.



3. Push up on the locking lever to secure the block to the rail when block is flush against the rail.

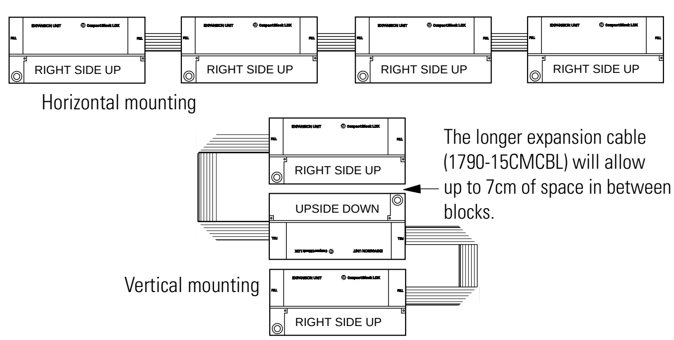
Mount the Optional Expansion Blocks

Mount the expansion block by connecting it to a previously-installed CompactBlock LDX I/O base or expansion block.

Beginning with the base block, you can mount your expansion blocks horizontally or vertically:

- horizontally (left to right) - add expansion blocks in a end-to-end configuration

- vertically (up or down) - add expansion blocks either up or down in a back-to-back configuration. In this configuration, you must use the optional 15cm ribbon cable (1790-15CMCBL) and alternately position the blocks in a right-side up, upside-down fashion.



You can mount your blocks on a panel or DIN rail as described in the previous section.

Connect the DeviceNet Cable

Follow these procedures when connecting the DeviceNet cable to the base block.

The required DeviceNet connector **is not supplied** with the block - you must purchase it separately. There are three types of connectors that you can order directly from Rockwell Automation or your local distributor:

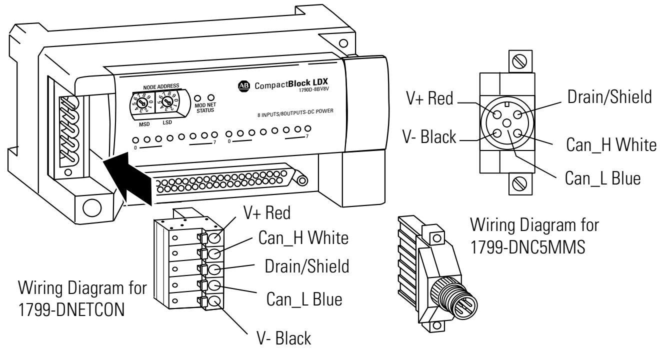
- 1799-DNETCON - 5-position open style connector
- 1799-DNETSCON - 5-position open style connector with locking screws
- 1799-DNC5MMS - 5-position open style to 12mm connector with locking screws

WARNING

If you connect or disconnect the DeviceNet cable with power applied to this module or any device on the network, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

Connect the DeviceNet wiring (drop line) to one of the DeviceNet connectors as shown below. A color-coded wiring diagram is also printed next to the connector on the left side of the module



Once you have properly wired the drop line to the connector, attach the connector to the block. If applicable, use the locking screws on the connector to fasten it to the block.

I/O System Wiring Guidelines

Consider the following when wiring your system:

General

- All module commons (COM) are connected in the analog module. The analog common (COM) is not connected to earth ground inside the module.
- Channels are not isolated from each other.
- Do not use the analog module's NC terminals as connection points.
- To ensure optimum accuracy, limit overall cable impedance by keeping your cable as short as possible. Locate the I/O system as close to your sensors or actuators as your application will permit.
- Use Belden™ 8761, or equivalent, shielded wire.
- Keep shield connection to ground as short as possible.
- Under normal conditions, the drain wire and shield junction must be connected to earth ground via a panel or DIN rail mounting screw at the analog I/O module end.(1)

Input Modules

- If multiple power supplies are used with analog inputs, the power supply commons must be connected together.
- The module does not provide loop power for analog inputs. Use a power supply that matches the input transmitter specifications.

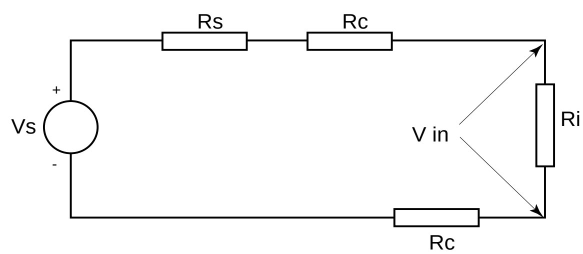
Output Modules

- Voltage outputs (CH0 and CH1) of the 1790D-NOV2/TNOV2 modules are referenced to COM. Load resistance for a voltage output channel must be equal to or greater than 1KΩ.
- Current outputs (CH0 and CH1) of the 1790D-NOC2/TNOC2 modules source current that returns to COM. Load resistance for a current output channel must remain between 0 and 600Ω.

(1) In environments where high-frequency noise may be present, it may be necessary to directly ground cable shields to earth at the module end and via a 0.1µF capacitor at the sensor end.

Effect of Transducer/Sensor and Cable Length Impedance on Voltage Input Accuracy

For voltage inputs, the length of the cable used between the transducer/sensor and the module can affect the accuracy of the data provided by the module.



Where:

Rc = DC resistance of the cable (each conductor) depending on cable length

Rs = Source impedance of analog transducer/sensor output

Ri = Impedance of the voltage input (500KΩ for 1790D-N4VO/TN4VO)

Vs = Voltage source (voltage at the transducer/sensor input device)

Vin = Measured potential at the module input

%Ai = Percent added inaccuracy in a voltage-based system due to source and cable impedance.

$$Vin = \frac{[Ri \times Vs]}{[Rs + (2 \times Rc) + Ri]}$$

For example, for Belden 8761 two conductor, shielded cable:

Rc = 16 Ω/1000 ft

Rs = 0 (ideal source)

$$\%Ai = \left(1 - \frac{Vin}{Vs}\right) \times 100$$

Table 2.2
Effect of Cable Length on Input Accuracy

Length of Cable (m)	dc resistance of the cable, Rc (Ω)	Accuracy impact at the input module
50	2.625	0.00105%
100	5.25	0.00210%
200	10.50	0.00420%
300	15.75	0.00630%

As input source impedance (Rs) and/or resistance (dc) of the cable (Rc) get larger, system accuracy decreases. If you determine that the inaccuracy error is significant, implementing the following equation in the control program can compensate for the added inaccuracy error due to the impedance of the source and cable.

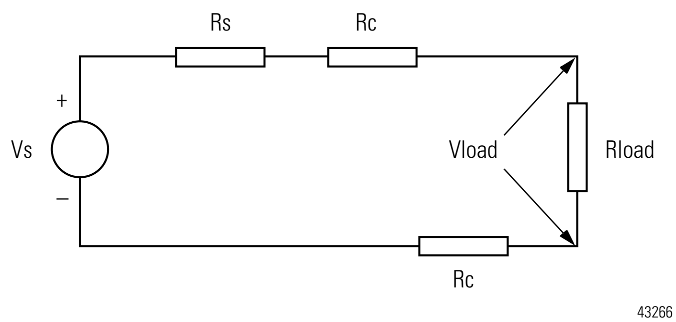
$$Vs = Vin \times \frac{[Rs + (2 \times Rc) + Ri]}{Ri}$$

TIP

In a current loop system, source and cable impedance do not impact system accuracy.

Effect of Device and Cable Output Impedance on Output Module Accuracy

The maximum value of the output impedance is shown in the example below, because it creates the largest deviation from an ideal voltage source.



Where:

Rc = DC resistance of the cable (each conductor) depending on cable length

Rs = Source impedance of 1790D-NOV2/TNOV2 (0.5 Ω)

R_{load} = Impedance of the load device

Vs = Voltage at the output of 1790D-NOV2/TNOV2

V_{load} = Measured potential at the load device

%Ai = Percent added inaccuracy in a voltage-based system due to source and cable impedance.

$$V_{load} = \frac{[R_{load} \times V_s]}{[R_s + (2 \times R_c) + R_{load}]}$$

For example, for Belden 8761 two conductor, shielded cable and a 1790D-NOV2/TNOV2 module:

Rc = 16Ω/1000 ft

Rs = 0.5Ω

$$\%AV_{load} = (1 - \frac{V_{load}}{V_s}) \times 100$$

Table 2.3
Effect of Output Impedance and Cable Length on Accuracy

Length of Cable (m)	dc resistance of the cable, Rc (Ω)	Accuracy impact at the load		
		1,000Ω	**10,000Ω**	**100,000Ω**
1	0.0525	0.0605%	0.00605%	0.000605%
10	0.525	0.155%	0.0155%	0.00155%
50	2.625	0.575%	0.0575%	0.00575%
100	5.25	1.1%	0.11%	0.011%

As output impedance (Rs) and/or resistance (dc) of the cable (Rc) get larger, system accuracy decreases. If you determine that the inaccuracy error is significant, implementing the following equation in the control program can compensate for the added inaccuracy error due to the impedance of the output module and cable.

$$V_s = V_{load} \times \frac{[R_s + (2 \times R_c) + R_{load}}{[R_{load}]}$$

TIP In a current loop system, source and cable impedance do not impact system accuracy.

Wiring the Modules

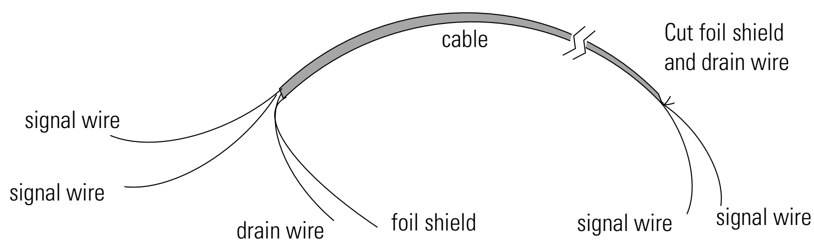
ATTENTION

To prevent shock hazard, care should be taken when wiring the module to analog signal sources. Before wiring any analog module, disconnect power from the system power supply and from any other source to the analog module.

After the analog module is properly installed, follow the wiring procedure below. To ensure proper operation and high immunity to electrical noise, always use Belden™ 8761 (shielded, twisted-pair) or equivalent wire.

ATTENTION

Never connect a voltage or current source to an analog output channel.



To wire your module follow these steps.

1. At each end of the cable, strip some casing to expose the individual wires.

2. Trim the signal wires to 2-inch lengths. Strip about 3/16 inch (5 mm) of insulation away to expose the end of the wire.

ATTENTION

Be careful when stripping wires. Wire fragments that fall into a module could cause damage at power up.

3. At one end of the cable, twist the drain wire and foil shield together.

   Under normal conditions, this drain wire and shield junction must be connected to earth ground, via a panel or DIN rail mounting screw at the analog I/O module end. Keep the length of the drain wire as short as possible.

   In environments where high frequency noise may be present, it may be necessary to ground the cable shields to earth at the module and via a 0.1µF capacitor at the sensor end for analog inputs and at the load end for analog outputs.

4. At the other end of the cable, cut the drain wire and foil shield back to the cable.

5. Connect the signal wires to the terminal block as shown in analog input wiring on page 2-15 and page 2-16 and analog output wiring on page 2-17 and page 2-18.

6. Connect the other end of the cable to the analog input or output device.

7. Repeat steps 1 through 5 for each channel on the module.

1790D-N4C0, 1790D-N4V0 Analog 4 Input Base D-Shell Modules Wiring

Table 2.4 lists the module pin descriptions. Figure 2.2 and Figure 2.3 show how to wire each module.

Table 2.4
1790D-N4C0 and 1790D-N4V0 Module Pin Descriptions

Pin Number	1	2	3	4	5	6	7	8	9	10
Description:	NC	NC	NC	NC	NC	CH3	NC	CH2	NC	CH1
Pin Number:	11	12	13	14	15	16	17	18	19	20
Description:	NC	CH0	NC	NC	NC	NC	+24V	+24V	+24V	NC
Pin Number	21	22	23	24	25	26	27	28	29	30
Description:	NC	NC	NC	COM	NC	COM	NC	COM	NC	COM
Pin Number:	31	32	33	34	35	36	37			
Description:	NC	NC	NC	NC	GND	GND	GND			

NC = No Connect +24V = Field Power (+) 24V dc GND = Field Power (-) GND

Figure 2.2 Example of Input Wiring to the 1790D-N4C0 Module

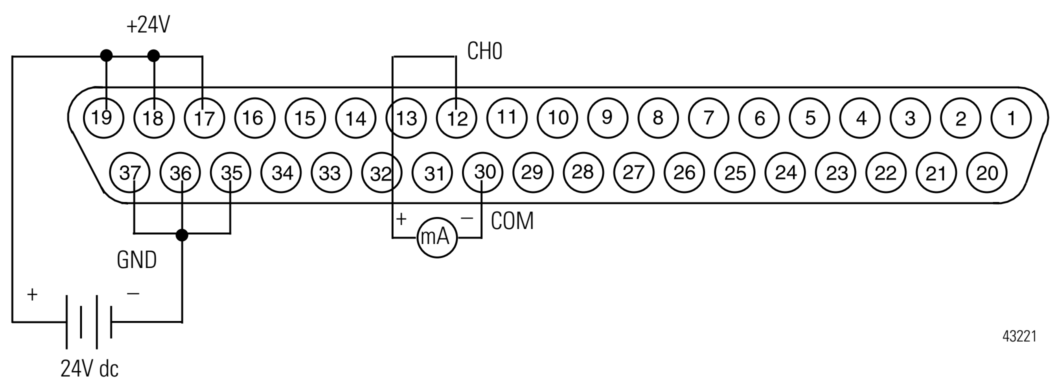
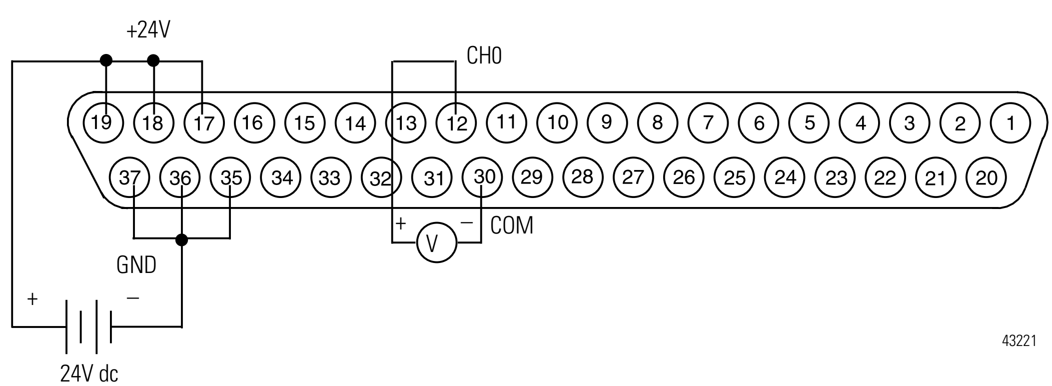


Figure 2.3 Example of Input Wiring to the 1790D-N4V0 Module



1790D-TN4C0, 1790D-TN4V0 Analog 4 Input Base Modules Wiring

Table 2.5 lists the module pin descriptions. Figure 2.4 and Figure 2.5 show how to wire each module.

Table 2.5
1790D-TN4C0 and 1790D-TN4V0 Module Pin Descriptions

Pin Number	1	2	3	4	5	6	7	8	9	10
Description:	+24V	GND	CH0	COM	CH1	COM	CH2	COM	CH3	COM
Pin Number:	11	12	13	14	15	16	17	18	19	20
Description:	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

+24V = Field Power (+) 24V dc   GND = Field Power (-) GND

Figure 2.4
Example of Input Wiring to the 1790D-TN4C0 Module

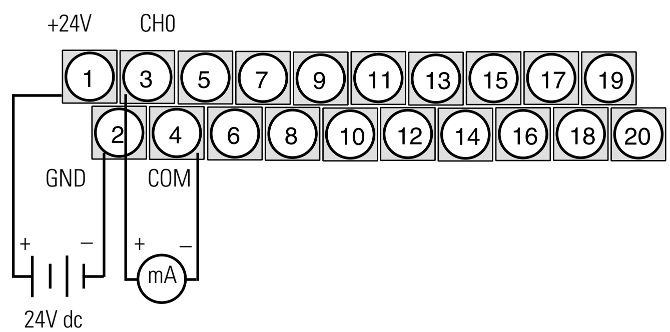
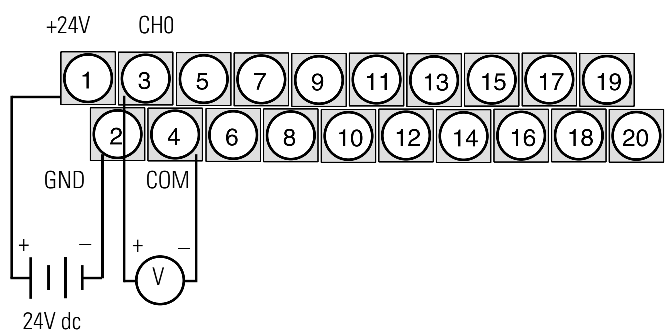


Figure 2.5
Example of Input Wiring to the 1790D-TN4V0 Module



1790D-N0C2, 1790D-N0V2 Analog 2 Output Base D-Shell Modules Wiring

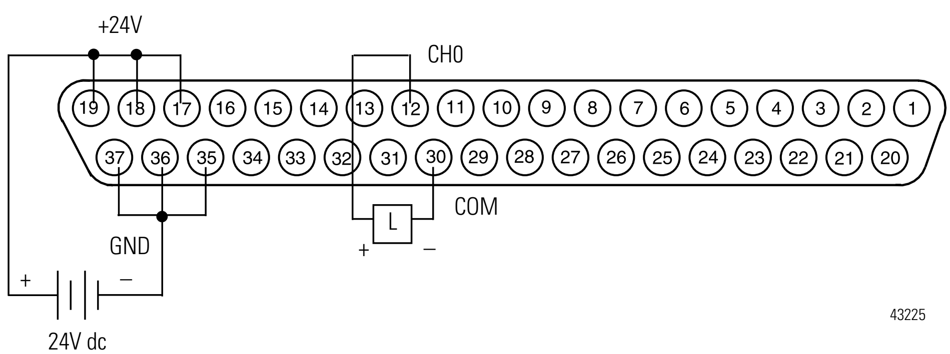
Table 2.6 lists the module pin descriptions. Figure 2.6 shows how to wire each module.

Table 2.6
1790D-N0C2 and 1790D-N0V2 Module Pin Descriptions

Pin Number	1	2	3	4	5	6	7	8	9	10
Description:	NC	NC	NC	NC	NC	NC	NC	NC	NC	CH1
Pin Number:	11	12	13	14	15	16	17	18	19	20
Description:	NC	CH0	NC	NC	NC	NC	+24V	+24V	+24V	NC
Pin Number	21	22	23	24	25	26	27	28	29	30
Description:	NC	NC	NC	NC	NC	NC	NC	COM	NC	COM
Pin Number:	31	32	33	34	35	36	37			
Description:	NC	NC	NC	NC	GND	GND	GND			

NC = No Connect +24V = Field Power (+) 24V dc GND = Field Power (-) GND

Figure 2.6
Example of Input Wiring to the 1790D-N0C2 and 1790D-N0V2 Modules



1790D-TN0C2, 1790D-TN0V2 Analog 4 Input Base Modules Wiring

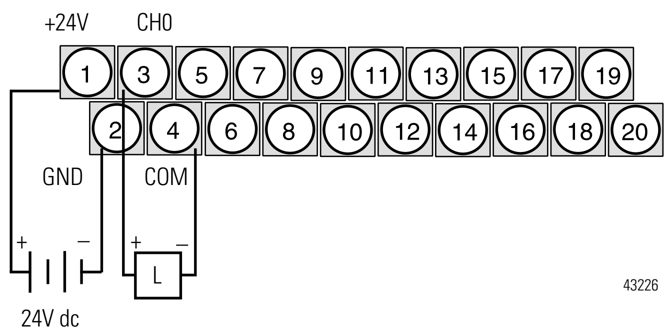
Table 2.7 lists the module pin descriptions. Figure 2.7 shows how to wire each module.

Table 2.7
1790D-TN0C2 and 1790D-TN0V2 Module Pin Descriptions

Pin Number	1	2	3	4	5	6	7	8	9	10
Description:	+24V	GND	CH0	COM	CH1	COM	NC	NC	NC	NC
Pin Number:	11	12	13	14	15	16	17	18	19	20
Description:	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

+24V = Field Power (+) 24V dc GND = Field Power (-) GND

Figure 2.7
Example of Input Wiring to the 1790D-TN0C2 and 1790D-TN0V2 Modules



Module Data, Status, and Channel Configuration for Analog Input Modules

This chapter examines the analog input module's data table, channel status, and channel configuration.

Analog Input Image

The input image file represents data words and status bits. Input words 0 through 3 hold the input data that represents the value of the analog inputs for channels 0 through 3. These data words are valid only when the channel is enabled and there are no errors. Input word 4 holds the status bits. Analog input data is presented as raw/proportional.

Input words 5 and 6 contain input data for two optional discrete input expansion modules.

1790D-N4C0/TN4C0 Configuration

Each analog current input may be configured for either the 4-20mA or 0-20mA range. This is most easily accomplished via RSNetWorx for DeviceNet, as shown on page 3-8.

Analog Input Data File

The input data table allows you to access analog input module and data for use in the control program, via word and bit access. The data table structure is shown below.

1790D-N4C0/-TN4C0, 1790D-N4V0/-TN4V0 Input Data File

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Not Used				Analog Input Data Channel 0											
1	Not Used				Analog Input Data Channel 1											
2	Not Used				Analog Input Data Channel 2											
3	Not Used				Analog Input Data Channel 3											
4	Not Used												S3	S2	S1	S0

Word/Bit Descriptions

Word	Decimal Bit	Description
Read Word 0	Bits 00-11	Channel 0 input data
	Bits 12-15	Not used: Set to 0
Read Word 1	Bits 00-11	Channel 1 input data
	Bits 12-15	Not used: Set to 0
Read Word 2	Bits 00-11	Channel 2 input data
	Bits 12-15	Not used: Set to 0
Read Word 3	Bits 00-11	Channel 3 input data
	Bits 12-15	Not used: Set to 0
Read Word 4	Bits 00-03	Status bits for individual channels - Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1 and so on. When set (1) indicates: • No field power • Open wire (4-20mA current input only) • Under range (4-20mA current input only) • Recoverable module fault (whole channel to be set) • Unrecoverable module fault (whole channel to be set)
	Bits 04-15	Not used: Set to 0

Analog Input Data File With Discrete Input Expansion Modules

The data table below shows the structure for an analog base module with one (1) of the following 8-input modules:

- 1790-8BV8BX/-T8BV8BX
- 1790-T8A0X discrete expansion module.

1790D-N4C0/-TN4C0, 1790D-N4V0/-TN4V0 Input Data File with 8-Bit Discrete Expansion Module

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Not Used				Analog Input Data Channel 0											
1	Not Used				Analog Input Data Channel 1											
2	Not Used				Analog Input Data Channel 2											
3	Not Used				Analog Input Data Channel 3											
4	Not Used												S3	S2	S1	S0
5	Not Used								D7	D6	D5	D4	D3	D2	D1	D0

Word/Bit Descriptions

Word	Decimal Bit	Description
Read Word 0	Bits 00-11	Channel 0 input data
	Bits 12-15	Not used: Set to 0
Read Word 1	Bits 00-11	Channel 1 input data
	Bits 12-15	Not used: Set to 0
Read Word 2	Bits 00-11	Channel 2 input data
	Bits 12-15	Not used: Set to 0
Read Word 3	Bits 00-11	Channel 3 input data
	Bits 12-15	Not used: Set to 0
Read Word 4	Bits 00-03	Status bits for individual channels - Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1 and so on. When set (1) indicates: • No field power • Open wire (4-20mA current input only) • Under range (4-20mA current input only) • Recoverable module fault (whole channel to be set) • Unrecoverable module fault (whole channel to be set)
	Bits 04-15	Not used: Set to 0
Read Word 5	Bits 00-07	Discrete Input expansion data
	Bits 08-15	Not Used

The data table below shows the structure for an analog base module with two (2) of the following 8-input modules:

- 1790-8BV8BX/-T8BV8BX modules,
- 1790-T8A0X discrete expansion modules

or one (1) of the following 16-input modules:

- 1790-16BV0X/-T16BV0X discrete expansion modules

1790D-N4C0/-TN4C0, 1790D-N4V0/-TN4V0 Input Data File with 16-Bit Discrete Expansion Module(s)

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Not Used				Analog Input Data Channel 0											
1	Not Used				Analog Input Data Channel 1											
2	Not Used				Analog Input Data Channel 2											
3	Not Used				Analog Input Data Channel 3											
4	Not Used												S3	S2	S1	S0
5	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

Word/Bit Descriptions

Word	Decimal Bit	Description
Read Word 0	Bits 00-11	Channel 0 input data
	Bits 12-15	Not used: Set to 0
Read Word 1	Bits 00-11	Channel 1 input data
	Bits 12-15	Not used: Set to 0
Read Word 2	Bits 00-11	Channel 2 input data
	Bits 12-15	Not used: Set to 0
Read Word 3	Bits 00-11	Channel 3 input data
	Bits 12-15	Not used: Set to 0
Read Word 4	Bits 00-03	Status bits for individual channels - Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1 and so on. When set (1) indicates: • No field power • Open wire (4-20mA current input only) • Under range (4-20mA current input only) • Recoverable module fault (whole channel to be set) • Unrecoverable module fault (whole channel to be set)
	Bits 04-15	Not used: Set to 0
Read Word 5	Bits 00-15	Discrete Input expansion data

The data table below shows the structure for an analog base module with one (1) of the following 16-input modules:

- 1790-16BV0X/-T16BV0X discrete expansion module

and one (1) of the following 8-input modules:

- 1790-8BV8BX/-T8BV8BX discrete expansion module
- 1790-8BV8VX/T8BVX discrete expansion module
- 1790-T8A0X discrete expansion module

1790D-N4C0/-TN4C0, 1790D-N4V0/-TN4V0 Input Data File with 24-Bit Discrete Expansion Modules

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Not Used				Analog Input Data Channel 0											
1	Not Used				Analog Input Data Channel 1											
2	Not Used				Analog Input Data Channel 2											
3	Not Used				Analog Input Data Channel 3											
4	Not Used												S3	S2	S1	S0
5	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
6	Not Used								D23	D22	D21	D20	D19	D18	D17	D16

Word/Bit Descriptions

Word	Decimal Bit	Description
Read Word 0	Bits 00-11	Channel 0 input data
	Bits 12-15	Not used: Set to 0
Read Word 1	Bits 00-11	Channel 1 input data
	Bits 12-15	Not used: Set to 0
Read Word 2	Bits 00-11	Channel 2 input data
	Bits 12-15	Not used: Set to 0
Read Word 3	Bits 00-11	Channel 3 input data
	Bits 12-15	Not used: Set to 0
Read Word 4	Bits 00-03	Status bits for individual channels - Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1 and so on. When set (1) indicates: • No field power • Open wire (4-20mA current input only) • Under range (4-20mA current input only) • Recoverable module fault (whole channel to be set) • Unrecoverable module fault (whole channel to be set)
	Bits 04-15	Not used: Set to 0
Read Word 5	Bits 00-15	First discrete Input expansion data
Read Word 6	Bits 00-07	Second discrete Input expansion data
	Bits 08-15	Not Used

The data table below shows the structure for an analog base module with two (2) 16-input 1790-16BV0X/-T16BV0X discrete expansion modules.

1790D-N4C0/-TN4C0, 1790D-N4V0/-TN4V0 Input Data File with 32-Bit Discrete Expansion Modules

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Not Used				Analog Input Data Channel 0											
1	Not Used				Analog Input Data Channel 1											
2	Not Used				Analog Input Data Channel 2											
3	Not Used				Analog Input Data Channel 3											
4	Not Used												S3	S2	S1	S0
5	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
6	D31	D30	D29	D28	D27	D26	D25	D24	D23	D22	D21	D20	D19	D18	D17	D16

Word/Bit Descriptions

Word	Decimal Bit	Description
Read Word 0	Bits 00-11	Channel 0 input data
	Bits 12-15	Not used: Set to 0
Read Word 1	Bits 00-11	Channel 1 input data
	Bits 12-15	Not used: Set to 0
Read Word 2	Bits 00-11	Channel 2 input data
	Bits 12-15	Not used: Set to 0
Read Word 3	Bits 00-11	Channel 3 input data
	Bits 12-15	Not used: Set to 0
Read Word 4	Bits 00-03	Status bits for individual channels - Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1 and so on. When set (1) indicates: No field power Open wire (4-20mA current input only) Under range (4-20mA current input only) Recoverable module fault (whole channel to be set) Unrecoverable module fault (whole channel to be set)
	Bits 04-15	Not used: Set to 0
Read Word 5	Bits 00-15	First discrete Input expansion data
Read Word 6	Bits 00-15	Second discrete Input expansion data

Analog Input Data Format

Analog input data is presented as raw/proportional. The full 12-bit resolution is used over the entire span of the input full scale range, as shown in Table 3.1.

Table 3.1

Module:	Input Full Scale Range:	HEX Data Range:	Decimal Data Range:	Input Resolution:
1790D-N4V0/-TN4V0	0-10V dc	0000-0FFF	0-4095	2.44mV
1790D-N4C0/-TN4C0	4-20mA	0000-0FFF	0-4095	3.90μA
	0-20mA	0000-0FFF	0-4095	4.88μA

Configuring Analog Input Module

Configuring CompactBlock LDX modules is as easy as POINT and click. RSNetWorx for DeviceNet™ allows you to simply identify the network and configure the I/O modules with easy-to-use Electronic Data Sheets (EDS). Just POINT to the field and click on your selection.

To obtain EDS files for use in configuration, go to:

http://www.ab.com/networks/eds.

EDS files for blocks with matching catalog numbers (for D-Shell and terminal block versions) are the same. Thus on the website or in RSNetWorx for DeviceNet, there may be only one catalog number listed for both versions.

When using 3rd-party configuration software, simply load the EDS files into the software and follow the vendor's instructions.

Configuring Analog Modules With RSNetWorx

To configure analog modules, proceed as described in the steps below:

1. Open RSNetWorx for DeviceNet.

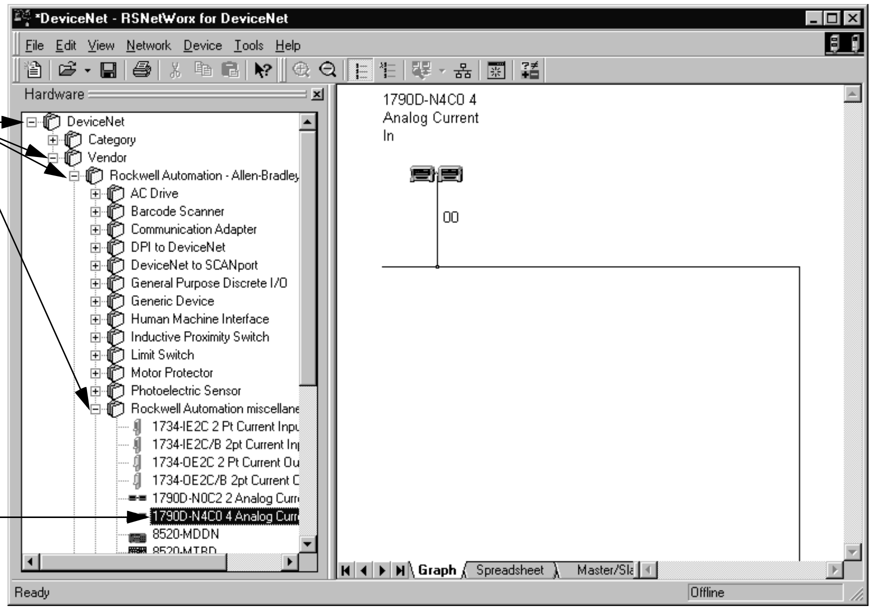
2. Add an analog input module (e.g. 1790D-N4C0) to the network, as shown below..

A. Use the + signs to open the following path:

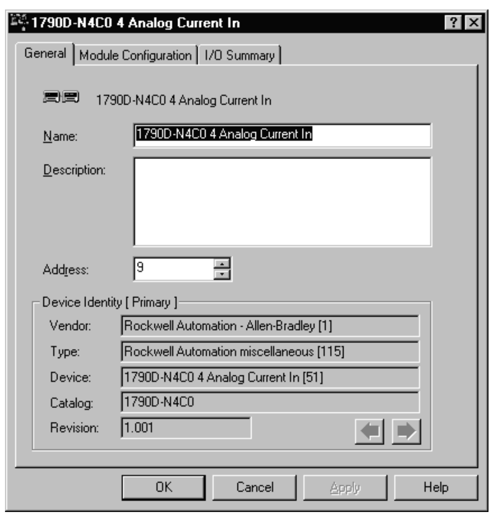
DeviceNet
⇨Vendor
⇨ Rockwell Automation - Allen-Bradley
⇨ Rockwell Automation miscellaneous

B. Double-click on the module.

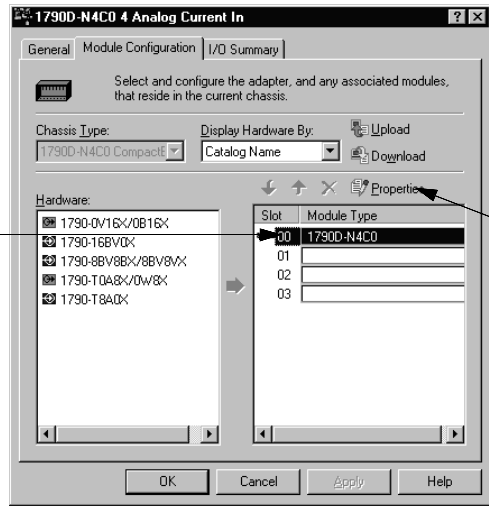
It appears on the network.



3. Double-click on the module icon on the DeviceNet network. If you are online, upload the configuration and existing module parameters are shown. A page similar to the one below appears.



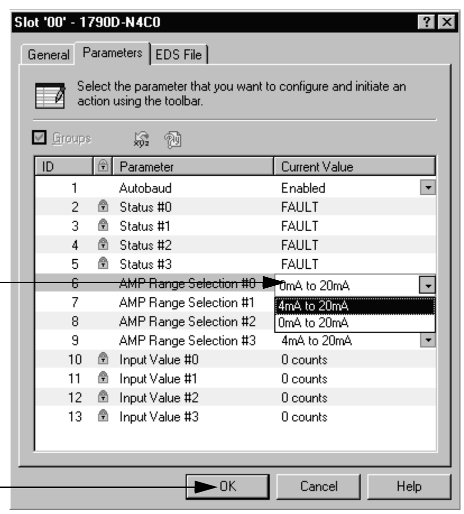
4. Click on the Module Configuration tab. Analog input modules have a configuration screen similar to the screen shown below for the 1790D-N4C0 module.



A. Click on the catalog number.

B. Click on Properties.

Use the Parameters tab to change module configuration. For example, the screen below shows how to change an AMP range selection.



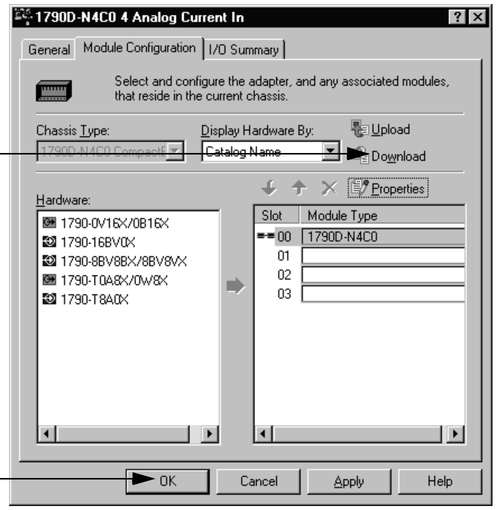
C. Use the pull-down menu to change range selection.

D. Click on OK after making all configuration changes.

The screen returns to "Module Configuration".

A. Click on Download to save your configuration.

B. Click on OK after making all configuration changes.



Module Data, Status, and Channel Configuration for Analog Output Modules

This chapter examines the analog output module's output data file and configuration.

Analog Output Image

The output image file represents data words. Output words 0 and 1 hold the output data that represents the value of the analog outputs for channels 0 and 1. Analog output data is presented as raw/proportional.

Output words 2 and 3 contain output data for two optional discrete output expansion modules.

Analog Output Data File

The structure of the output data file is shown below.

1790D-N0C2/-TN0C2, 1790D-N0V2/-TN0V2 Output Data File

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Not Used				Analog Output Data Channel 0											
1	Not Used				Analog Output Data Channel 1											

Word/Bit Descriptions

Word	Decimal Bit	Description
Write Word 0	Bits 00-11	Channel 0 output data
	Bits 12-15	Not used: Set to 0
Write Word 1	Bits 00-11	Channel 1 output data
	Bits 12-15	Not used: Set to 0

Analog Output Data File With Discrete Output Expansion Modules

The data table below shows the structure for an analog base module with one of the following 8-output modules:

- 1790-8BV8BX/-T8BV8BX discrete expansion module
- 1790-8BV8VX/-T8BV8VX discrete expansion module
- 1790-TOA8X discrete expansion module
- 1790-T0W8X discrete expansion module.

1790D-N0C2/-TN0C2, 1790D-N0V2/-TN0V2 Output Data File with 8-Bit Discrete Expansion Module

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Not Used				Analog Output Data Channel 0											
1	Not Used				Analog Output Data Channel 1											
2	Not Used								D7	D6	D5	D4	D3	D2	D1	D0

Word/Bit Descriptions

Word	Decimal Bit	Description
Write Word 0	Bits 00-11	Channel 0 output data
	Bits 12-15	Not used: Set to 0
Write Word 1	Bits 00-11	Channel 1 output data
	Bits 12-15	Not used: Set to 0
Write Word 2	Bits 00-07	Discrete output expansion data
	Bits 08-15	Not used: Set to 0

The data table below shows the structure for an analog base module with one (1) of the following 16-output modules:

- 1790-OB16X/-TOB16X discrete expansion module
- 1790-OV16X/-TOV16X discrete expansion module

or two (2) of the following 8-output modules:

- 1790-8BV8BX/-T8BV8BX discrete expansion modules
- 1790-8BV8VX/-T8BV8VX discrete expansion modules
- 1790-TOA8X discrete expansion modules
- 1790-TOW8X discrete expansion modules

1790D-N0C2/-TN0C2, 1790D-N0V2/-TN0V2 Output Data File with 16-Bit Discrete Expansion Module(s)

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Not Used				Analog Output Data Channel 0											
1	Not Used				Analog Output Data Channel 1											
2	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

Word/Bit Descriptions

Word	Decimal Bit	Description
Write Word 0	Bits 00-11	Channel 0 output data
	Bits 12-15	Not used: Set to 0
Write Word 1	Bits 00-11	Channel 1 output data
	Bits 12-15	Not used: Set to 0
Write Word 2	Bits 00-15	Discrete output expansion data

The data table below shows the structure for an analog base module with one (1) of the following 16-output modules:

- 1790-OB16X/-TOB16X discrete expansion module
- 1790-OV16X/-TOV16X discrete expansion module

and with one (1) of the following 8-input modules

- 1790-8BV8BX/-T8BV8BX discrete expansion module
- 1790-8BV8VX/T8BV8VX discrete expansion module
- 1790-TOA8X discrete expansion module
- 1790-TOW8X discrete expansion module

1790D-N4C0/-TN4C0, 1790D-N4V0/-TN4V0 Output Data File with 24-Bit Discrete Expansion Modules

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Not Used				Analog Output Data Channel 0											
1	Not Used				Analog Output Data Channel 1											
2	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
3	Not Used								D23	D22	D21	D20	D19	D18	D17	D16

Word/Bit Descriptions

Word	Decimal Bit	Description
Write Word 0	Bits 00-11	Channel 0 output data
	Bits 12-15	Not used: Set to 0
Write Word 1	Bits 00-11	Channel 1 output data
	Bits 12-15	Not used: Set to 0
Write Word 2	Bits 00-15	First discrete output expansion data
Write Word 3	Bits 00-07	Second discrete output expansion data
	Bits 08-15	Not used: Set to 0

The data table below shows the structure for an analog base module with two (2) of the following 16-output modules:

- 1790-OB16X/-TOB16X discrete expansion modules
- 1790-OV16X/-TOV16X discrete expansion modules

1790D-N4C0/-TN4C0, 1790D-N4V0/-TN4V0 Output Data File with 32-Bit Discrete Expansion Modules

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Not Used				Analog Output Data Channel 0											
1	Not Used				Analog Output Data Channel 1											
2	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
3	D31	D30	D29	D28	D27	D26	D25	D24	D23	D22	D21	D20	D19	D18	D17	D16

Word/Bit Descriptions

Word	Decimal Bit	Description
Write Word 0	Bits 00-11	Channel 0 output data
	Bits 12-15	Not used: Set to 0
Write Word 1	Bits 00-11	Channel 1 output data
	Bits 12-15	Not used: Set to 0
Write Word 2	Bits 00-15	First discrete output expansion data
Write Word 3	Bits 00-15	Second discrete output expansion data

Analog Output Data Format

Analog output data is presented as raw/proportional. The full 12-bit resolution is used over the entire span of the output full scale range, as shown in Table 4.1.

Table 4.1

Module:	Output Full Scale Range:	HEX Data Range:	Decimal Data Range:	Output Resolution:
1790D-NOV2/-TNOV2	0-10V dc	0000-0FFF	0-4095	2.44mV
1790D-N0C2/-TNOC2	0-20mA	0000-0FFF	0-4095	4.88µA

Output Fault and Idle States

Analog output fault (communication failure) and idle (processor in program mode) state can be defined for each output. Both fault state and idle state can have the behavior defined in Table 4.2 for each output.

Table 4.2

Behavior:	1790D-N0C2/-TN0C2:	1790D-N0V2/-TN0V2:
Go to low clamp	0mA	0V dc
Go to high clamp	20mA	10V dc
Go to fault/idle value	User configurable	User configurable
Hold last state	Hold last value	Hold last value

The user-specified value is entered in raw/proportional notation. For example:

- 0 is the low clamp. This value equals 0mA or oV dc.
- 4095 is the high clamp. This value equals 20mA or 10V dc.
- Values between 0 and 4095 denote proportional values. 2048 equals 10mA or 5V dc.

The values in the output data file are retained. Once a fault or idle condition is cleared, the retained output values are sent to the analog output channels.

Configuring Analog Output Module

Configuring CompactBlock LDX modules is as easy as POINT and click. RSNetWorx allows you to simply identify the network and configure the I/O modules with easy-to-use Electronic Data Sheets (EDS). Just POINT to the field and click on your selection.

To obtain EDS files for use in configuration, go to:

http://www.ab.com/networks/eds.

EDS files for blocks with matching catalog numbers (for D-Shell and terminal block versions) are the same. Thus on the website or in RSNetWorx for DeviceNet, there may be only one catalog number listed for both versions.

When using 3rd-party configuration software, simply load the EDS files into the software and follow the vendor's instructions.

Using RSNetWorx for DeviceNet

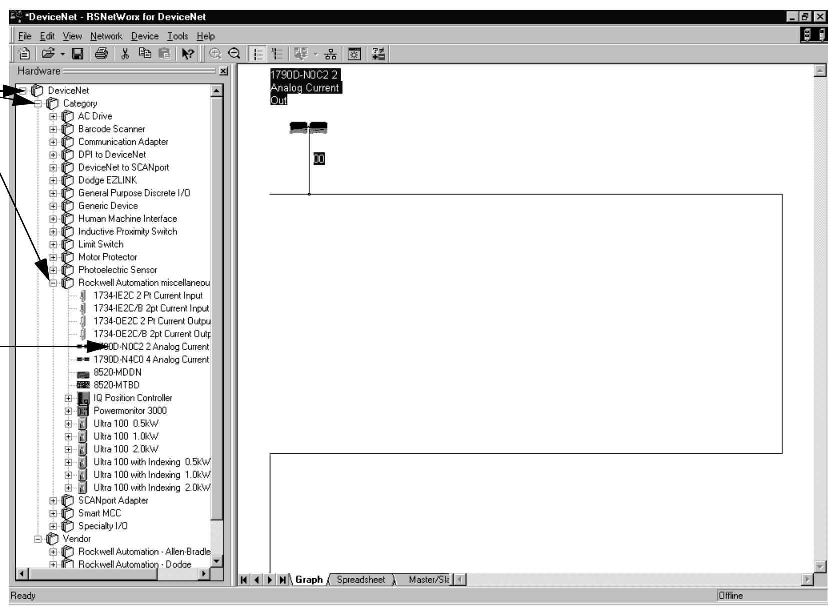
To configure analog input modules, follow these steps:

1. Open RSNetWorx for DeviceNet.
2. Add an analog output module (e.g. 1790D-N0C2) to the network, as shown below..

A. Use the + signs to open the following path:

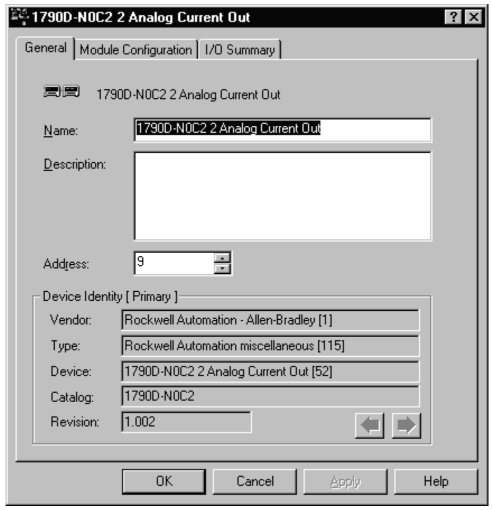
DeviceNet
⇨Rocwell Automation - Allen-Bradley
⇨ Rockwell Automation - miscellaneous

B. Double-click on the module. It appears on the network.

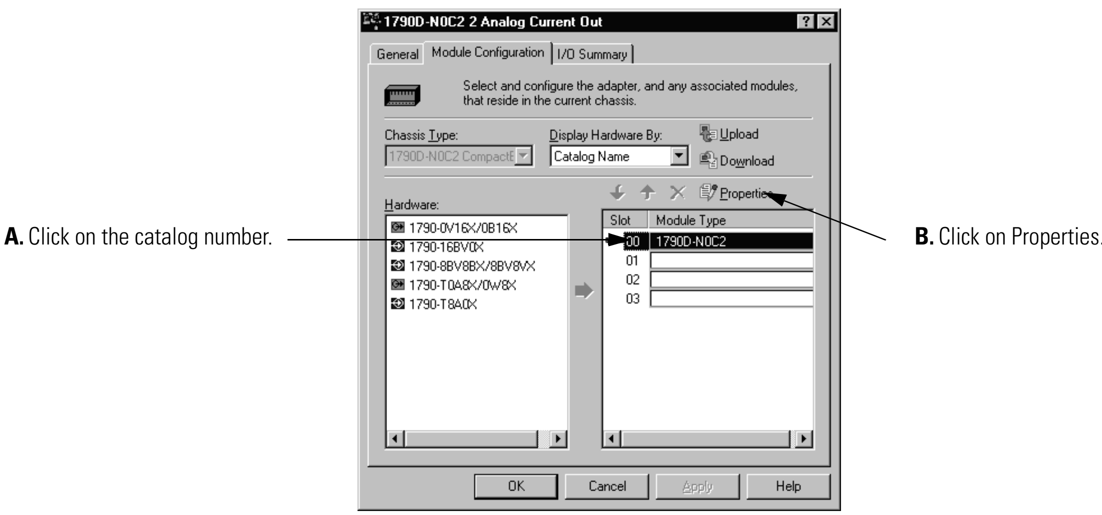


If your network is running, you can also click on the Browse button to see what modules are on the network.

3. Double-click on the module icon on the DeviceNet network. If you are online, upload the configuration and existing module parameters are shown. A page similar to the one below appears.

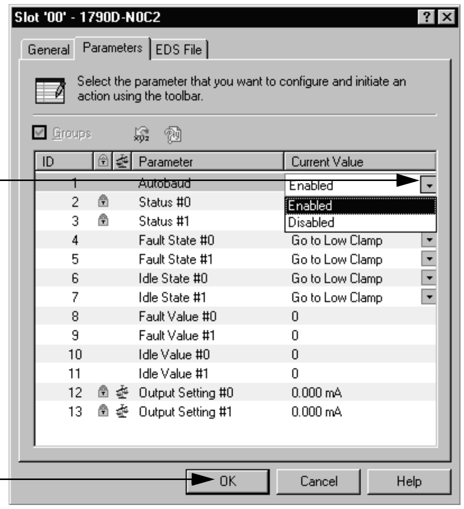


4. Click on the Module Configuration tab. Analog input modules have a configuration screen similar to the screen shown below for the 1790D-N0C2 module.



Use the Parameters tab to change module configuration. For example, the screen below shows how to change the Autobaud selection.

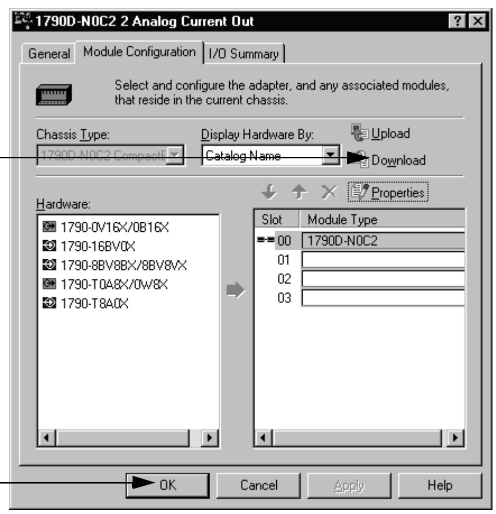
C. Use the pull-down menu to change range selection.



D. Click on OK after making all configuration changes.

The screen returns to "Module Configuration".

A. Click on Download to save your configuration.



B. Click on OK after making all configuration changes.

Chapter 5

Module Diagnostics and Troubleshooting

This chapter describes troubleshooting the analog input and output modules. This chapter contains information on:

- safety considerations when troubleshooting
- module vs. channel operation
- the module's diagnostic features

Safety Considerations

Safety considerations are an important element of proper troubleshooting procedures. Actively thinking about the safety of yourself and others, as well as the condition of your equipment, is of primary importance.

The following sections describe several safety concerns you should be aware of when troubleshooting your control system.

ATTENTION

Never reach into a machine to actuate a switch because unexpected motion can occur and cause injury.

Remove all electrical power at the main power disconnect switches before checking electrical connections or inputs/outputs causing machine motion.

Indicator Lights

When the green MOD and NET LED indicator lights on the analog module are illuminated, it indicates that power is applied to the module, and the module is communicating on the network.

Activating Devices When Troubleshooting

When troubleshooting, never reach into the machine to actuate a device. Unexpected machine motion could occur.

Stand Clear of the Machine

When troubleshooting any system problem, have all personnel remain clear of the machine. The problem could be intermittent, and sudden unexpected machine motion could occur. Have someone ready to operate an emergency stop switch in case it becomes necessary to shut off power to the machine.

Program Alteration

There are several possible causes of alteration to the user program, including extreme environmental conditions, Electromagnetic Interference (EMI), improper grounding, improper wiring connections, and unauthorized tampering. If you suspect a program has been altered, check it against a previously saved program on an EEPROM or UVPROM memory module.

Safety Circuits

Circuits installed on the machine for safety reasons, like over-travel limit switches, stop push buttons, and interlocks, should always be hard-wired to the master control relay. These devices must be wired in series so that when any one device opens, the master control relay is de-energized, thereby removing power to the machine. Never alter these circuits to defeat their function. Serious injury or machine damage could result.

Module Operation vs. Channel Operation

The module performs operations at two levels:

- module level - power-up, configuration, and communication with a controller
- channel level - data conversion and over- or under-range detection

Internal diagnostics are performed at both levels of operation. When detected, module error conditions are indicated by the module status and individual channel LED lights.

Power-up Diagnostics

Module Status

At module power-up, a series of internal diagnostic tests are performed. These diagnostic tests must be successfully completed. Table 5.1 shows module status LED indicator operation.

Table 5.1

LED indicator:	Status:	Description:
Module status	Solid red	Unrecoverable fault in base unit
	Flashing red	Recoverable fault
	Solid green	Normal operation
	Flashing green	Stand by
	Off	No power

Network Status

The network status LED indicator shows the condition of the DeviceNet connection. Table 5.2 shows network status LED indicator operation.

Table 5.2

LED indicator:	Status:	Description:
Network status	Solid red	Unrecoverable communication fault
	Flashing red	Recoverable communication fault
	Solid green	Communication path complete
	Flashing green	Communication path incomplete
	Off	Device is not online or not powered

Channel Diagnostics

When an input or output module channel is enabled, the module performs a diagnostic check to see that the channel has been properly configured. In addition, the module checks each channel on every scan for configuration errors, under-range, open-circuit (input module in 4 to 20 mA range only).

Out-of-Range Detection (Input Modules Only)

An out-of-range low test is performed on all channels configured for 4-20mA inputs. Whenever an out-of-range low condition occurs, the status bit for that channel is set in input data word 4.

Open-Circuit Detection (Input Module Only)

The module performs an open-circuit test on all channels configured for 4 to 20 mA inputs. Whenever an open-circuit condition occurs, the status bit for that channel is set in input data word 4.

Possible causes of an open circuit include:

- the sensing device may be broken
- a wire may be loose or cut
- the sensing device may not be installed on the configured channel

Analog Input Module Error Definition Table

Analog input module errors are expressed on a channel bases in input read word 4. The structure of the status data is shown below.

Table 5.3

Word	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
4	Not used												S3	S2	S1	S0

Word/Bit Descriptions

Word	Decimal Bit	Description
Read Word 4	Bits 00-03	Status bits for individual channels - Bit 00 corresponds to input channel 0, bit 01 corresponds to input channel 1 and so on. When set (1) indicates: • No field power • Open wire (4-20mA current input only) • Under range (4-20mA current input only) • Recoverable module fault (whole channel to be set) • Unrecoverable module fault (whole channel to be set)
	Bits 04-15	Not used: Set to 0

Module Errors

Table 5.4 lists possible errors that cause the analog input module status bits to be set.

Table 5.4
Status Bit Table 1790D-N4CO/-TN4CO, 1790D-N4VO/-TN4VO

Range Setting	Underrange	In Range	Overrange	Open Circuit	Short Circuit	No Field Power
4-20mA	<4mA Set	Not set	>20mA Not set	Set	Set	Set
0-20mA	<0mA Not set	Not set	>20mA Not set	Not set	Not set	Set
0-10V dc	<0V dc Not set	Not set	>10V Not set	Not set	Not set	Set

Channel LED Indicator Operation

Individual channel LED indicator operation is shown in the following tables.

Analog Input Modules

1790D-TN4V0	
Status:	**Description:**
Flashing Green/Red	Power up
Off	Off line
Red	On line and no field power
Red	DeviceNet connection and no field power
Green	Field power and open wire
Green	Field power and valid input
Green	Input over range
Green	Input under range
Flashing Red	Recoverable fault

1790D-TN4C0	
Status:	**Description:**
Flashing Green/Red	Power up
Off	Off line
Red	On line and no field power
Red	DeviceNet connection and no field power
Flashing Red(1)	Field power and open wire (4-20mA range only)(2)
Green	Field power and valid input
Green	Input over range
Flashing Red1	Input under range <3mA (4-20ma range only)2
Flashing Red	Recoverable fault

(1) Green for 0-20mA range.

(2) Can be determined from the data table.

Analog Output Modules

1790D-TN0V2	
Status:	**Description:**
Flashing Green/Red	Power up
Off	Off line
Off	On line and no field power
Green	DeviceNet connection and no field power
Green	Field power and open wire
Green	Field power and valid output
Flashing Red	Field power and output out of range
Flashing Green	Output idle
Flashing Red	Recoverable fault

1790D-TN0C2	
Status:	**Description:**
Flashing Green/Red	Power up
Off	Off line
Off	On line and no field power
Green	DeviceNet connection and no field power
Green	Field power and open wire
Green	Field power and valid output
Flashing Red	Field power and output out of range
Flashing Green	Output idle
Flashing Red	Recoverable fault

Contacting Rockwell Automation

If you need to contact Rockwell Automation for assistance, please have the following information available when you call:

- a clear statement of the problem, including a description of what the system is actually doing. Note the LED state; also note input and output image words for the module.
- a list of remedies you have already tried
- processor type and firmware number (See the label on the processor.)
- hardware types in the system, including all I/O modules
- fault code if the processor is faulted

Notes:

Specifications

DeviceNet Analog Base Terminal Block

The following table contains specifications that are common to all of the blocks in this document. Individual base block specifications are detailed after this table.

Environmental Specifications	
Operating Temperature	0 to 55°C (32 to 131°F) IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)
Storage Temperature	-40 to 85°C (-40 to 185°F) IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold), IEC 60068-2-2 (Test Bb, Un-packaged Non-operating Dry Heat), IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock)
Relative Humidity	5-90% non-condensing IEC 60068-2-30 (Test Db, Un-packaged Non-operating)
Operating Altitude	2000m
Vibration	IEC60068-2-6 (Test Fc, Operating): 2g @ 10-500Hz
Shock Operating Non-operating	IEC60068-2-27 (Test Ea, Unpackaged Shock): 10g 30g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity	IEC 61000-4-2: 8kV air discharges
Radiated RF Immunity	IEC 61000-4-3: 10V/m with 1kHz sine-wave 80%AM from 80MHz to 1000MHz 10V/m with 200Hz 50% Pulse 100%AM @ 900Mhz
EFT/B Immunity	IEC 61000-4-4: ±1kV @ 5kHz on power ports +2kV @ 5kHz on signal ports ±2kV @ 5kHz on communications ports
Surge Transient Immunity	IEC 61000-4-5: ±1kV line-line(DM) and ±2kV line-earth(CM) on power ports ±1kV line-line(DM) and ±2kV line-earth(CM) on signal ports ±2kV line-earth(CM) on shielded ports
Conducted RF Immunity	IEC 61000-4-6: 10Vrms with 1kHz sine-wave 80%AM from 150kHzto 80MHz

Environmental Specifications (continued)	
Enclosure Type Rating	None (open style)
Mounting	DIN rail or screw
Dimensions	52x104x42mm (2.03x4.07x1.64in)
Weight	0.3lb (0.1kg)
DeviceNet Specifications	
Network protocol	I/O Slave messaging: - Poll command - Bit Strobe command - Cyclic command - COS command
Network length	500 meters maximum @ 125Kbps 100 meters maximum @ 500Kbps
Indicators	1 red/green module status 1 red/green network status
Number of nodes	64 maximum - rotary switch type node address setting
Communication rate	125Kbps, 250Kbps, 500Kbps - auto baud rate selection
Isolation	Type test 1250Vac rms for 60 seconds between field power and DeviceNet (I/O to logic)
Wiring	Refer to publication DN-6.7.2
General Specifications	
Wiring Category	2[(1)]
Product Certifications (when product or packaging is marked)	c-UL-us UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada CE[(2)] European Union 89/336/EEC EMC Directive, compliant with: EN 50081-2; Industrial Emissions EN 50082-2; Industrial Immunity EN61326; Meas./Control/Lab., Industrial Requirements EN 61000-6-2; Industrial Immunity C-Tick[2] Australian Radiocommunications Act, compliant with: AS/NZS 2064; Industrial Emissions ODVA ODVA conformance tested to ODVA DeviceNet specifications

(1) Use this conductor category information for planning conductor routing as described in the system level installation manual. Refer to publication 1770-4.1 “Industrial Automation Wiring and Grounding Guidelines”.

(2) See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

4-Channel Analog Current Input Module

1790D-TN4C0	
Inputs per module	4 channel single-ended, non-isolated
Input Current (software configurable)	4-20mA (default) 0-20mA
Resolution	12 bits-unipolar 1/4096 maximum 3.90µA/bit (4-20mA) 4.88µA/bit (0-20mA)
Converted Data	Binary data 0000 to 0fff (max scale)
Conversion Time	10ms/channel
Overall accuracy	0.2% Full scale @0°-55°C
Calibration	None required
Input Impedance	249Ω
Insulation Resistance	20MΩ minimum @ 250V dc (between insulated circuits)
General Specifications	
DeviceNet Power	Supply voltage - 24V dc nominal Voltage range - 11-28.8V dc Power dissipation - 1.2W maximum @ 28.8V dc
Field Power	Supply Voltage - 24Vdc nominal Voltage Range - 21.6-26.4V dc (±10%) Power Dissipation - 1.5W maximum @26.4V dc
Isolation	I/O to logic: photocoupler isolation Isolation voltage: Type Test 1250V ac rms for 60 seconds DeviceNet to logic: non-isolated Field power: non-isolated
Indicators	4 red/green I/O status
Wiring	Terminal block connector Screw torque: 7 inch-pounds maximum
IMPORTANT: This analog base module can accommodate a **maximum** of two discrete expansion modules.	

2-Channel Analog Current Output Module

1790D-TN0C2	
Outputs per module	2 channel single-ended, non-isolated
Output Current	0-20mA
Resolution	12 bits 1/4096 maximum 4.88µA/bit
Converted Data	Binary data 0000 to 0fff (max scale)
Conversion Time	2ms/channel
Overall accuracy	0.2% Full scale @0°-55°C
Calibration	None required
Allowable external output load resistance	600Ω maximum
Insulation Resistance	20MΩ minimum @ 250V dc (between insulated circuits)
General Specifications	
DeviceNet Power	Supply voltage - 24V dc nominal Voltage range - 11-28.8V dc Power dissipation - 1.2W maximum @ 28.8V dc
Field Power	Supply Voltage - 24Vdc nominal Voltage Range - 21.6-26.4V dc (±10%) Power Dissipation - 1.5W maximum @26.4V dc
Isolation	I/O to logic: photocoupler isolation Isolation voltage: Type Test 1250V ac rms for 60 seconds DeviceNet to logic: non-isolated Field power: non-isolated
Indicators	2 red/green I/O status
Wiring	Terminal block connector Screw torque: 7 inch pounds maximum
IMPORTANT: This analog base module can accommodate a **maximum** of two discrete expansion modules.	

4-Channel Analog Voltage Input Module

1790D-TN4V0	
Inputs per module	4 channel single-ended, non-isolated
Input Voltage	0-10V
Resolution	12 bits-unipolar 1/4096 maximum 2.44mV/bit
Converted Data	Binary data 0000 to 0fff (max scale)
Conversion Time	10ms/channel
Overall accuracy	0.2% Full scale @0°-55°C
Calibration	None required
Input Impedance	500KΩ minimum
Insulation Resistance	20MΩ minimum @ 250V dc (between insulated circuits)
General Specifications	
DeviceNet Power	Supply voltage - 24V dc nominal Voltage range - 11-28.8V dc Power dissipation - 1.2W maximum @ 28.8V dc
Field Power	Supply Voltage - 24Vdc nominal Voltage Range - 21.6-26.4V dc (±10%) Power Dissipation - 1.5W maximum @26.4V dc
Isolation	I/O to logic: photocoupler isolation Isolation voltage: Type Test 1250V ac rms for 60 seconds DeviceNet to logic: non-isolated Field power: non-isolated
Indicators	4 red/green I/O status
Wiring	Terminal block connector Screw torque: 7 inch pounds maximum
IMPORTANT: This analog base module can accommodate a **maximum** of two discrete expansion modules.	

2-Channel Analog Voltage Output Module

1790D-TN0V2	
Outputs per module	2 channel single-ended, non-isolated
Output Voltage	0-10V
Resolution	12 bits-unipolar 1/4096 maximum 2.44mV/bit
Converted Data	Binary data 0000 to 0fff (max scale)
Conversion Time	2ms/channel
Overall accuracy	0.2% Full scale @0°-55°C
Calibration	None required
Allowable external output load resistance	1KΩ minimum
Output Impedance	0.5Ω maximum
Insulation Resistance	20MΩ minimum @ 250V dc (between insulated circuits)
General Specifications	
DeviceNet Power	Supply voltage - 24V dc nominal Voltage range - 11-28.8V dc Power dissipation - 1.2W maximum @ 28.8V dc
Field Power	Supply Voltage - 24Vdc nominal Voltage Range - 21.6-26.4V dc (±10%) Power Dissipation - 1.5W maximum @26.4V dc
Isolation	I/O to logic: photocoupler isolation Isolation voltage: Type Test 1250V ac rms for 60 seconds DeviceNet to logic: non-isolated DeviceNet power: non-isolated Field power: non-isolated
Indicators	2 red/green I/O status
Wiring	Terminal block connector Screw torque: 7 inch pounds maximum
IMPORTANT: This analog base module can accommodate a **maximum** of two discrete expansion modules.	

PROFIBUS Modules Installation, Wiring, Module Data, Status and Channel Configuration

This appendix tells you how to:

- determine the power requirements for the PROFIBUS modules
- avoid electrostatic damage
- install the module
- view the module memory map
- access the input image file
- configure channels

Power Requirements

Modules require external supplies for both system power and for the analog I/O channels. Table B.1 lists the maximum power.

Table B.1

PROFIBUS Power	Supply voltage - 24V dc nominal Voltage range - 19.2 - 28.8V dc Power dissipation - 2W maximum @ 28.8V dc
Field Power	Supply voltage - 24V dc nominal Voltage range - 21.6 - 26.4V dc (± 10%) Power dissipation - 1.5W maximum @ 26.4V dc

Module Installation

CompactBlock LDX is suitable for use in a commercial or light industrial environment when installed in accordance with these instructions. Specifically, this equipment is intended for use in clean, dry environments (Pollution degree 2[1]) and to circuits not exceeding Over Voltage Category II[2] (IEC 60664-1)[3].

Prevent Electrostatic Discharge

ATTENTION

Electrostatic discharge can damage integrated circuits or semiconductors if you touch analog I/O module bus connector pins or the terminal block on the input module. Follow these guidelines when you handle the module:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- If available, use a static-safe workstation.
- When not in use, store the module inits box.

(1) Pollution Degree 2 is an environment where, normally, only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation shall be expected.

(2) Over Voltage Category II is the load level section of the electrical distribution system. At this level, transient voltages are controlled and do not exceed the impulse voltage capability of the product’s insulation.

(3) Pollution Degree 2 and Over Voltage Category II are International Electrotechnical Commission (IEC) designations.

Environment and Enclosure

ATTENTION

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC publication 60664-1), at altitudes up to 2000 meters without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR Publication 11. Without appropriate precautions, there may be potential difficulties ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbance.

This equipment is supplied as "enclosed" equipment. It should not require additional system enclosure when used in locations consistent with the enclosure type ratings stated in the Specifications section of this publication. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings, beyond what this product provides, that are required to comply with certain product safety certifications.

See NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure. Also, see the appropriate sections in this publication, as well as the Allen-Bradley publication 1770-4.1 ("Industrial Automation Wiring and Grounding Guidelines"), for additional installation requirements pertaining to this equipment.

Remove Power

ATTENTION

Remove power before removing or inserting this module or expansion module. When you remove or insert a module with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing unintended machine motion.
- causing an explosion in a hazardous environment.

Electrical arcing causes excessive wear to contacts on both the module and its mating connector and may lead to premature failure.

General Considerations

Reducing Noise

Most applications require installation in an industrial enclosure to reduce the effects of electrical interference. Analog inputs and outputs are highly susceptible to electrical noise. Electrical noise coupled to the analog inputs will reduce the performance (accuracy) of the module.

Group your modules in the enclosure to minimize adverse effects from radiated electrical noise and heat. Consider the following conditions when selecting a location for the analog module. Position the module:

- away from sources of electrical noise such as hard-contact switches, relays, and AC motor drives
- away from modules which generate significant radiated heat.

In addition, route shielded, twisted-pair analog input and output wiring away from any high voltage I/O wiring.

Protecting the Circuit Board from Contamination

The printed circuit boards of the analog modules must be protected from dirt, oil, moisture, and other airborne contaminants. To protect these boards, the system must be installed in an enclosure suitable for the environment. The interior of the enclosure should be kept clean and the enclosure door should be kept closed whenever possible.

Installing CompactBlock LDX I/O

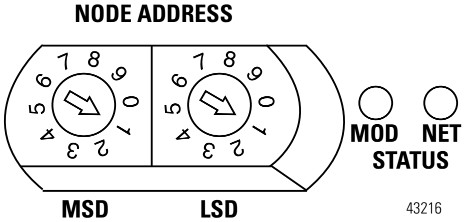
Follow these steps to install the block:

1. Set the Station Address on the Base Block
2. Mount the Base Block
3. Connect the PROFIBUS DP Terminal Connector
4. Connect Power to the Block

Set the Station Address on the Base Block

To set the station address, adjust the switches on the front of the base block. The two siwtches are most significant digit (MSD) and least significant digit (LSD). The switches can be set between 00 and 99 and are read at base block power-up only. Figure B.1 shows an example base block set for station address 11.

Figure B.1



Mount the Base Block

You can mount the base block to a panel or DIN rail. We recommend that you ground the panel or DIN rail before mounting the block.

IMPORTANT	The analog base module can accommodate a **maximum** of two discrete expansion modules.

WARNING	When used in a Class I, Division 2, hazardous location, this equipment must be mounted in a suitable enclosure with proper wiring method that complies with the governing electrical codes.

Panel Mounting

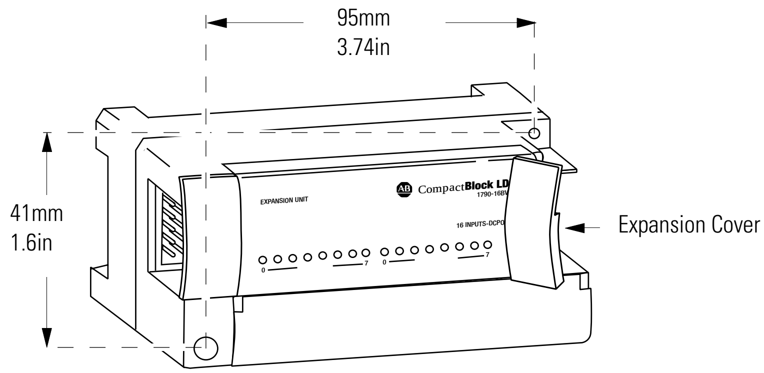
1. Place the block against the panel where you want to mount it.

2. Gently pull and position the expansion cover to the left.

3. Place a center punch, nail or similar device through the mounting holes in the block and make two marks on the panel (lower left and upper right corners of the module).

4. Remove the block and drill two holes in the panel to accommodate each of the mounting screws.

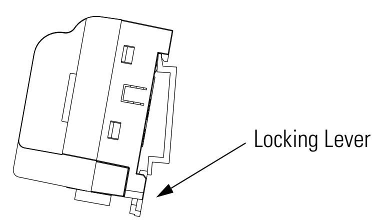
5. Replace the block on the panel and place a screw through each of the two mounting holes. Tighten the screws until the block is firmly in place.



DIN Rail Mounting

1. Hook the top of slot of the block over the DIN Rail.

2. Pull down on the locking lever while pressing the block against the rail.



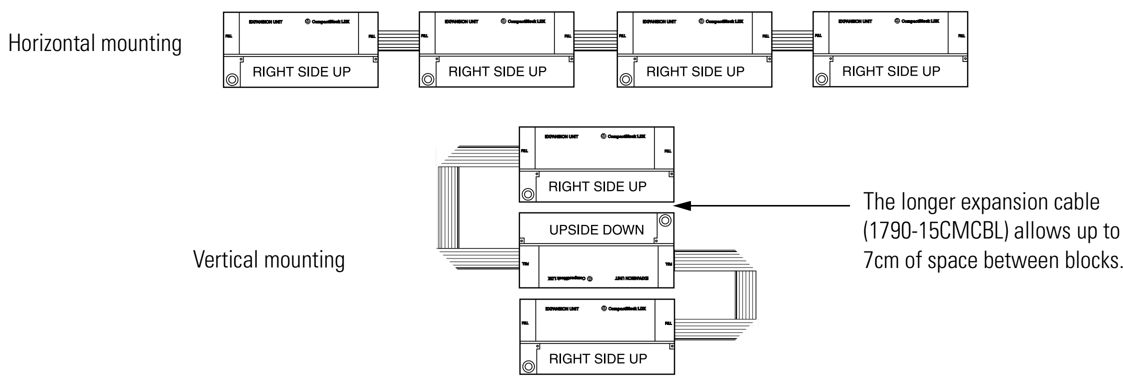
3. Push up on the locking lever to secure the block to the rail when block is flush against the rail.

Mount the Optional Expansion Blocks

Mount the expansion block by connecting it to a previously-installed CompactBlock LDX I/O base or expansion block.

Beginning with the base block, you can mount your expansion blocks either horizontally or vertically:

- horizontally (left to right) - add expansion blocks in a end-to-end configuration
- vertically (up or down) - add expansion blocks either up or down in a back-to-back configuration. In this configuration, you must use the optional 15cm ribbon cable (1790-15CMCBL) and alternately position the blocks in a right-side up, upside-down fashion.



You can mount your blocks on a panel or DIN rail as described in the previous section.

Connect the PROFIBUS DP Terminal Connector

Follow these procedures when connecting the PROFIBUS DP terminal connector to the base block.

WARNING

If you connect or disconnect the PROFIBUS cable with power applied to this module or any device on the network, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

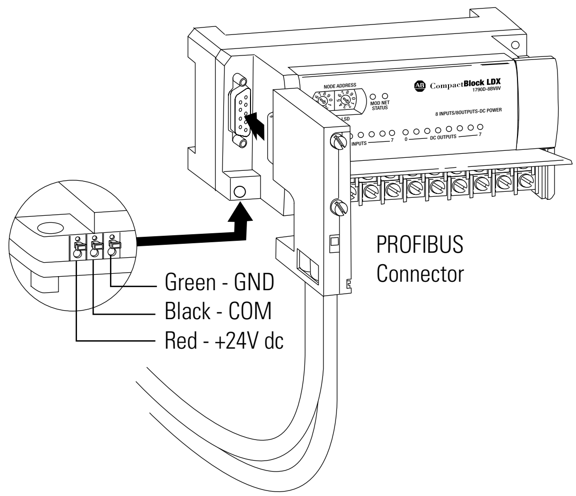
The required PROFIBUS female 9-pin D-sub connector is not supplied with the base block; you must purchase it separately. Before you connect female 9-pin D-sub connector to the base block, make sure it is wired correctly, as shown in Table B.2.

Table B.2
Wiring Connections

Pin Number:	Name:	Description:
1	Shield	Shield, Protective Ground
2	M24V	Minus 24V Output Voltage
3	RxD/TxD-P	Receive/Transmit-Data-P
4	CNTR-P	Control-p
5	DGND	Data Ground
6	VP	Voltage-Plus
7	P24V	Plus 24V Output Voltage
8	RxD/TxD-N	Receive/Transmit-Data-N
9	CNTR-N	Control-N

Once you have properly wired the connector, attach it to the base block as shown in . Use the locking screws on the connector to fasten it to the base block.

Figure B.2



Connect Power to the Block

To apply power to the block, refer to Figure B.2.

Connecting I/O Wiring

Consider the following guidelines when wiring your system:

General Guidelines

- All module commons (ANLG COM) are connected in the analog module. The analog common (ANLG COM) is not connected to earth ground inside the module.
- Channels are not isolated from each other.
- Do not use the analog module's NC terminals as connection points.
- To ensure optimum accuracy, limit overall cable impedance by keeping your cable as short as possible. Locate the I/O system as close to your sensors or actuators as your application will permit.
- Use Belden™ 8761, or equivalent, shielded wire.
- Keep shield connection to ground as short as possible.
- Under normal conditions, the drain wire and shield junction must be connected to earth ground via a panel or DIN rail mounting screw at the analog I/O module end.

Guidelines for Input Modules

- If multiple power supplies are used with analog inputs, the power supply commons must be connected together.
- The module does not provide loop power for analog inputs. Use a power supply that matches the input transmitter specifications.

Guidelines for Output Modules

- Current outputs (CH0 and CH1) of the 1790P-TNOC2 module source current that returns to COM. Load resistance for a current output channel must remain between 0 and 600Ω .

Wiring the Modules

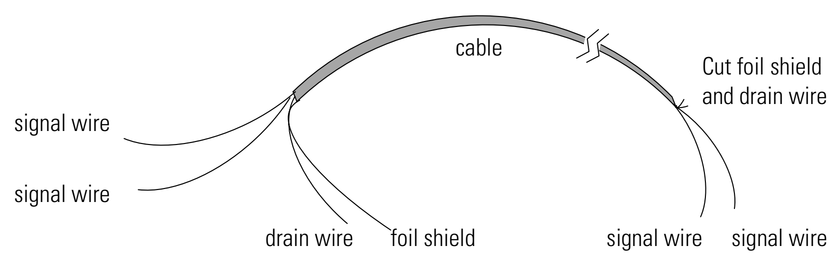
ATTENTION

To prevent shock hazard, care should be taken when wiring the module to analog signal sources. Before wiring any analog module, disconnect power from the system power supply and from any other source to the analog module.

After the analog module is properly installed, follow the wiring procedure below. To ensure proper operation and high immunity to electrical noise, always use Belden™ 8761 (shielded, twisted-pair) or equivalent wire.

ATTENTION

Never connect a voltage or current source to an analog output channel.



To wire your module follow these steps.

1. At each end of the cable, strip some casing to expose the individual wires.
2. Trim the signal wires to 2-inch lengths. Strip about 3/16 inch (5 mm) of insulation away to expose the end of the wire.

ATTENTION Be careful when stripping wires. Wire fragments that fall into a module could cause damage at power up.

3. At one end of the cable, twist the drain wire and foil shield together.

   Under normal conditions, this drain wire and shield junction must be connected to earth ground, via a panel or DIN rail mounting screw at the analog I/O module end. Keep the length of the drain wire as short as possible.

   In environments where high frequency noise may be present, it may be necessary to ground the cable shields to earth at the module end via a 0.1µF capacitor at the sensor end for analog inputs and at the load end for analog outputs.

4. At the other end of the cable, cut the drain wire and foil shield back to the cable.

5. Connect the signal wires to the terminal block as shown in Analog Input Wiring on page B-13 and Analog Output Wiring on page B-14.

6. Connect the other end of the cable to the analog input or output device.

7. Repeat steps 1 through 5 for each channel on the module.

Analog Input Wiring

Use the information in Table B.3 and Figure B.3 to wire the 1790P-TN4C0 terminal block modules.

Table B.3
1790P-TN4C0 Pin Descriptions

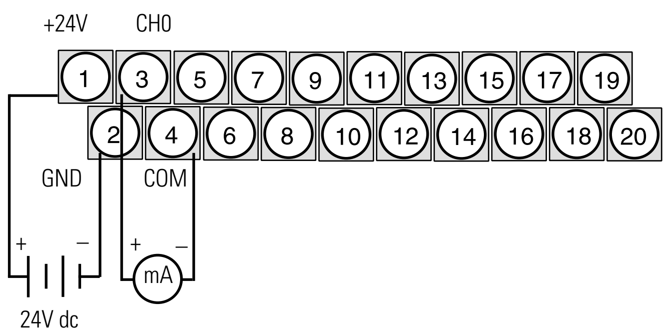
Pin Number:	1	3	5	7	9	11	13	15	17	19
Description:	+24V(1)	CH0	CH1	CH2	CH3	NC	NC	NC	NC	NC

Pin Number:	2	4	6	8	10	12	14	16	18	20
Description:	GND(2)	COM	COM	COM	COM	NC	NC	NC	NC	NC

(1) +24V: Field Power (+) 24V dc

(2) GND: Field Power (-) Ground

Figure B.3



Analog Output Wiring

Use the information in Table B.4 and Figure B.4 to wire the 1790P-TN0C2 terminal block modules.

Table B.4
1790P-TN0C2 Pin Descriptions

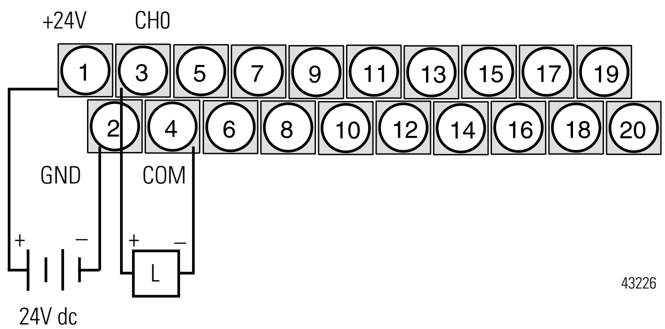
Pin Number:	1	3	5	7	9	11	13	15	17	19
Description:	+24V(1)	CH0	CH1	NC	NC	NC	NC	NC	NC	NC

Pin Number:	2	4	6	8	10	12	14	16	18	20
Description:	GND(2)	COM	COM	NC	NC	NC	NC	NC	NC	NC

(1) +24V: Field Power (+) 24V dc

(2) GND: Field Power (-) Ground

Figure B.4



1790P-TN4C0 Data Structure

Analog Input Image

The input image file represents data words and status bits. Input words 0 through 3 hold the input data that represents the value of the analog inputs for channels 0 through 3. These data words are valid only when the channel is enabled and there are no errors. Input word 4 holds the status bits. Analog input data is presented as raw/proportional.

Input words 5 and 6 contain input data for two optional discrete input expansion modules.

1790P-N4C0/TN4C0 Configuration

Each analog current input may be configured for either the 4-20mA or 0-20mA range. This is most easily accomplished using the programming software compatible with the controller or scanner. See page B-16 for an example of configuration using the SST PROFIBUS Configuration Tool.

Analog input data is presented as raw/proportional. The full 12-bit resolution is used over the entire span of the input full scale range, as shown in Table B.5.

Table B.5

Input Full Scale Range:	HEX Data Range:	Decimal Data Range:	Input Resolution:
4-20mA	0000-0FFF	0-4095	3.90µA
0-20mA	0000-0FFF	0-4095	4.88µA

The input data files are the same as those shown for the 1790D-TN4CO. See page 3-2 for more information.

1790P-TNOC2 Data Structure

Analog Output Image

The output image file represents data words. Output words 0 and 1 hold the output data that represents the value of the analog outputs for channels 0 and 1. Analog output data is presented as raw/proportional.

Output words 2 and 3 contain output data for two optional discrete output expansion modules.

Analog output data is presented as raw/proportional. The full 12-bit resolution is over the entire span of the output full scale range, as shown in Table B.6.

Table B.6

Output Full Scale Range:	HEX Data Range:	Decimal Data Range:	Input Resolution:
0-20mA	0000-0FFF	0-4095	4.88µA

The output data files are the same as those shown for the 1790D-TNOC2. See page 4-2 for more information.

Output Fault and Idle States

For PROFIBUS modules, analog outputs reset to zero (0) under fault (communication failure) and idle (processor in program mode) states. The values in the output data file are retained. Once a fault or idle condition is cleared, the retained output values are sent to the analog output channels.

Configuring PROFIBUS Analog Modules

You can use the PROFIBUS configuration software (with easy-to-use GSD files) to configure the CompactBlock LDX analog modules (1790P-TN4CO & 1790P-TNOC2).

To obtain GSD files, go to:

http://www.ab.com/networks/gsd

To read how to install the GSD file for your module, use the SST PROFIBUS configuration tool documentation (e.g. online help). The next section shows how to configure your analog module with the SST PROFIBUS configuration tool.

Configuring Analog Modules with the SST PROFIBUS Configuration Tool

The following configuration example shows how to configure your analog modules with the SST PROFIBUS configuration tool. Follow these steps:

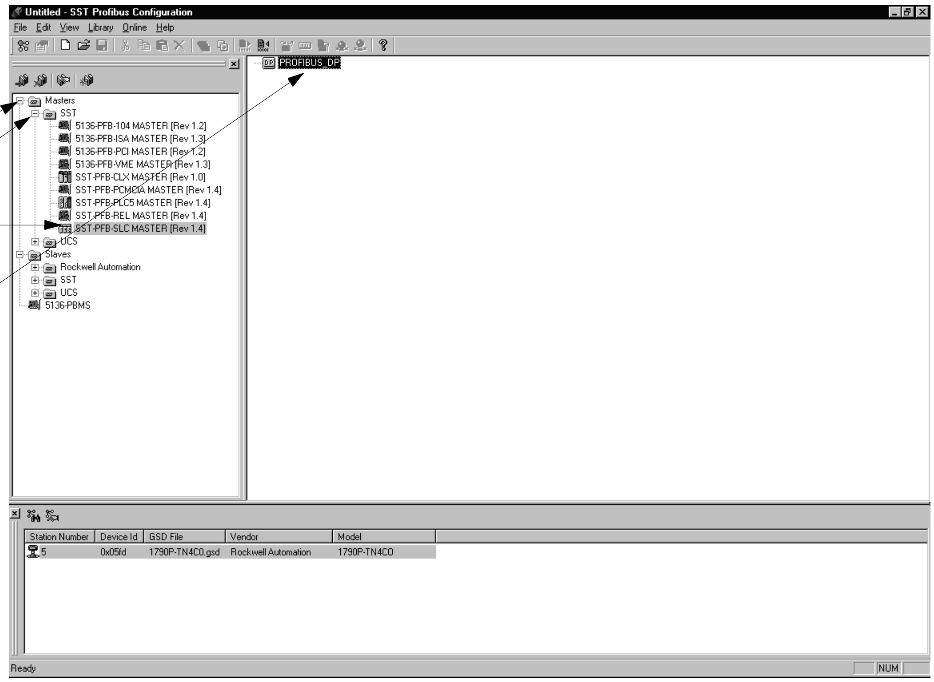
1. Open your SST PROFIBUS configuration tool. If you are online, make sure the processor is in Program mode.

2. Add the PROFIBUS master to your network.

A. Open the Masters and the SST folders.

B. Choose your PROFIBUS master.

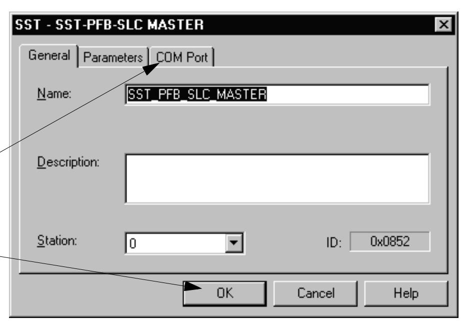
C. Drag and drop the master onto the network.



3. Double-click on the master's icon to see the device properties pop-up screens. The first screen is the General properties.

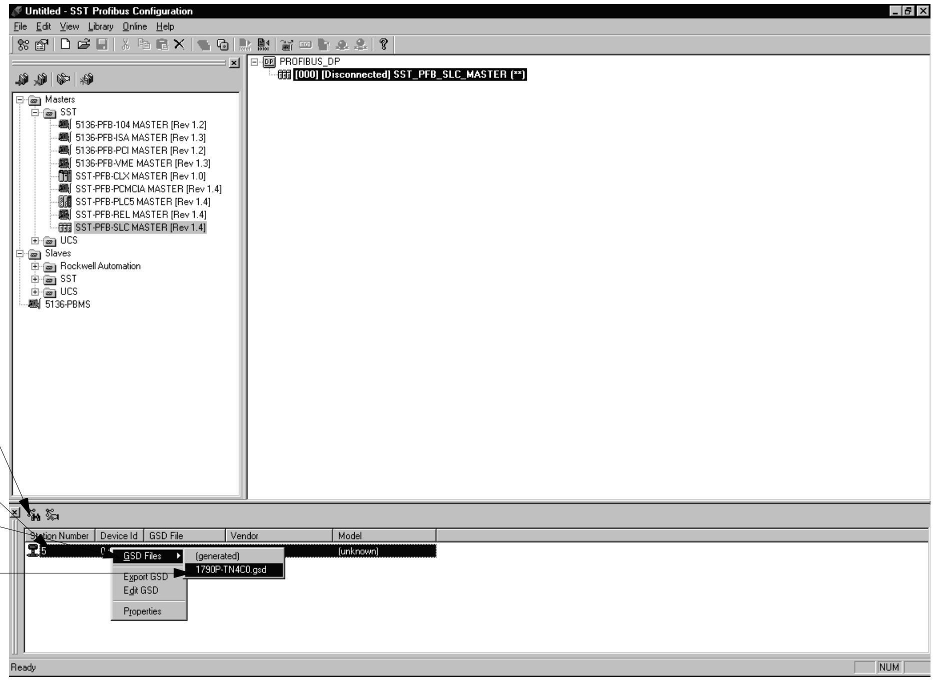
Change any necessary information and either:

- click to another tab
- click OK



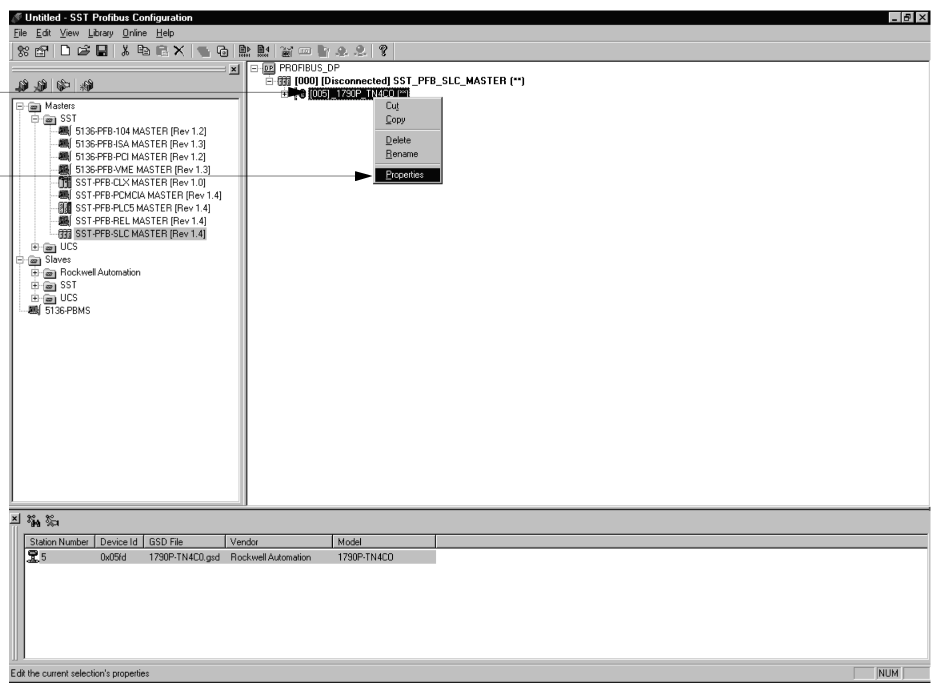
4. Add slaves to the network.

A. If necessary, use the search button to see a list of stations on the network.
B. Select the station.
C. Right-click to see pop-up menu.
D. Choose the appropriate GSD file and the module appears on the network as shown.



5. Access the module's properties.

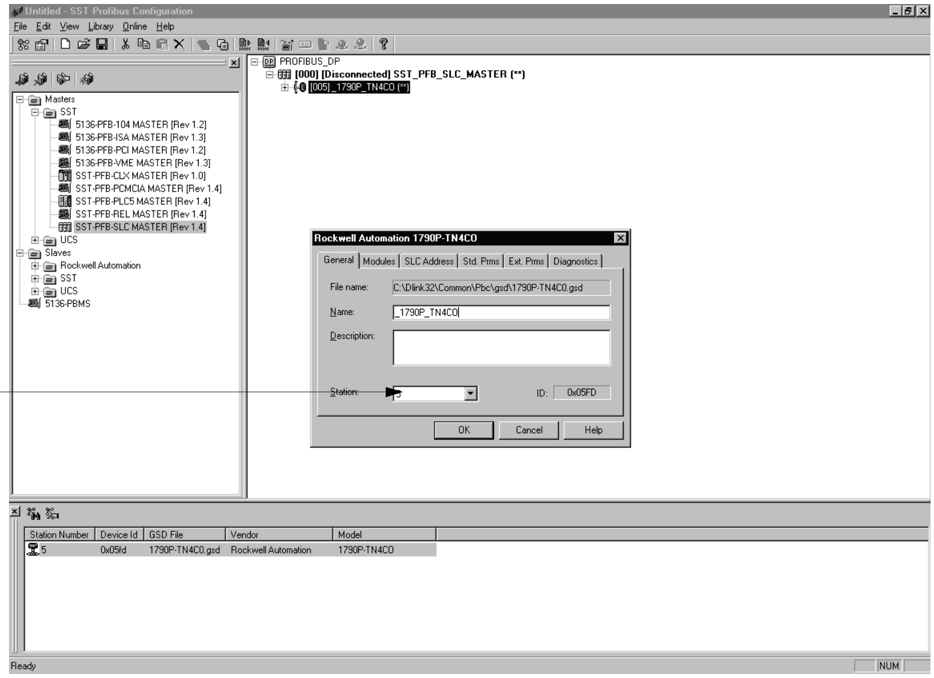
A. Right-click on the module to see the pop-up menu.
B. Select Properties.



6. Use the pop-up screen shown below to change the module's properties.

A. Make sure the station number is correct.

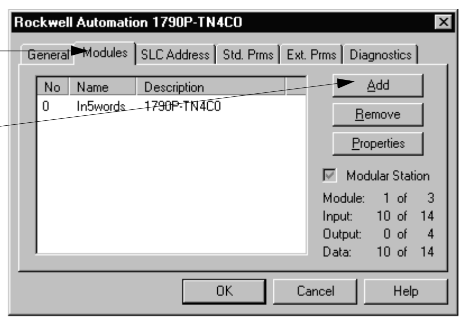
B. Click on other tabs or OK when finished on this screen.



7. If necessary, add additional modules as shown below.

A. Click on the Modules tab.

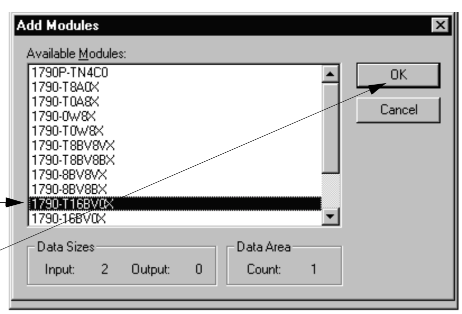
B. Click on Add.



The following screen appears to add modules.

C. Choose the module.

D. Click on OK.

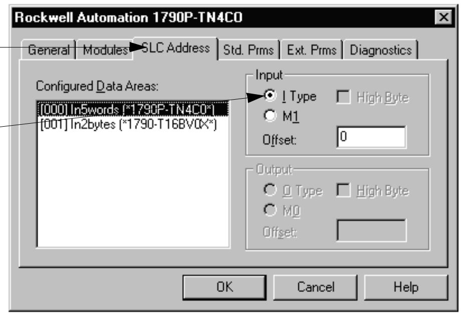


Up to two expansion modules may be added to analog base modules.

8. Set the I/O type. This screen also shows the data size information.

A. Click on the SLC Addresses tab.

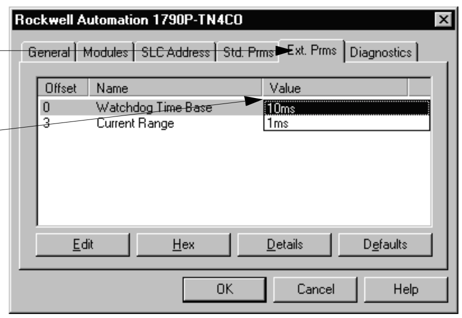
B. Choose the Input. This example uses the I Type input.



9. Set the Watchdog Time Base and Current Range.

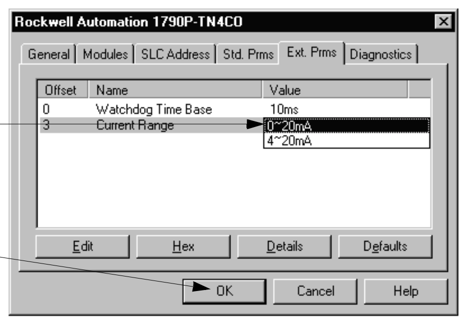
A. Click on the Ext. Prms tab.

B. Use the pull-down menu to change the Watchdog Time Base.



C. Use the pull-down menu to change the Current Range.

D. Click OK when finished.



10. Save the configuration file.

Downloading Configuration

To download configuration to the module, follow these steps:

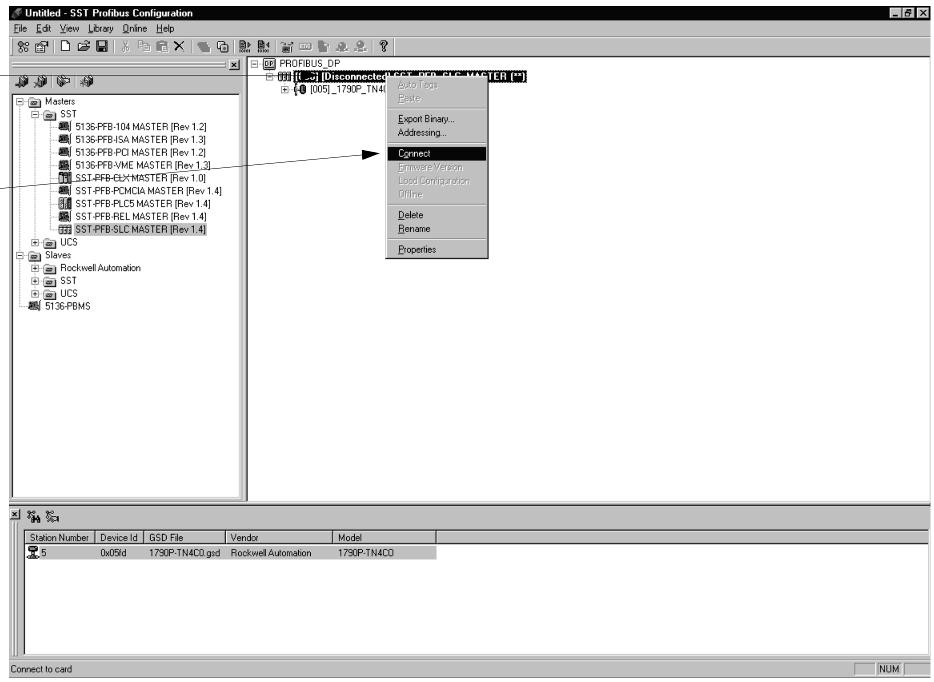
1. Make sure the serial communication cable is connected between the PC com port and the scanner serial port.

2. Verify that the processor is in Program mode.

3. Use the SST PROFIBUS configuration tool to connect to the master.

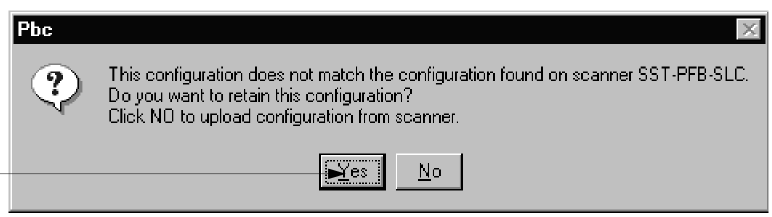
A. Right-click on the master to see the pull-down menu.

B. Click on Connect.



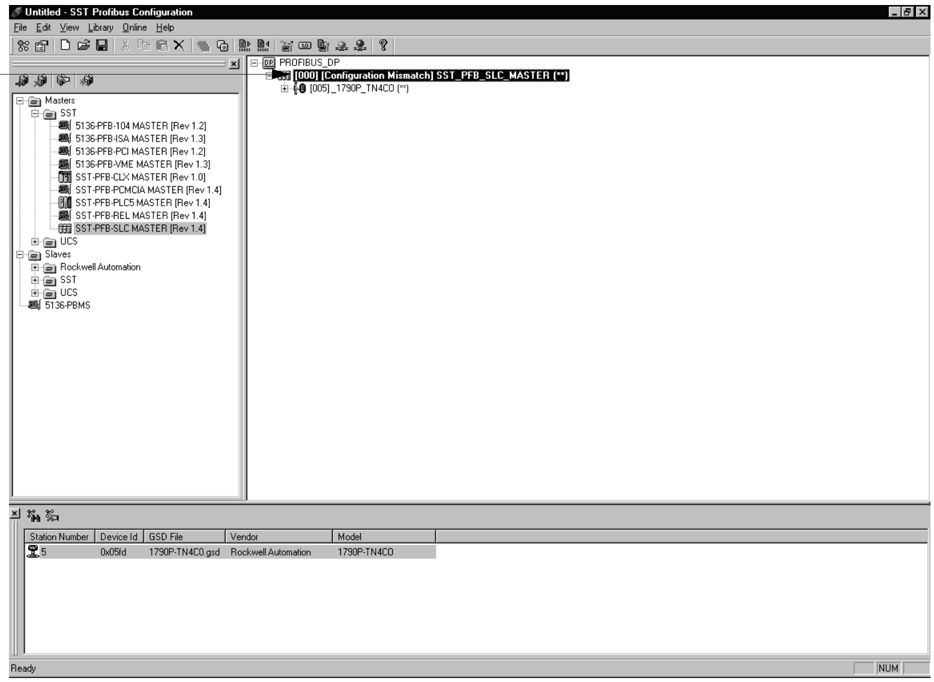
4. You may be notified about a configuration mismatch between what is in the scanner and your current PROFIBUS project. Choose YES to retain your configuration.

Click on OK to retain your configuration.



Any configuration mismatches are displayed in the software, as shown in the screen below.

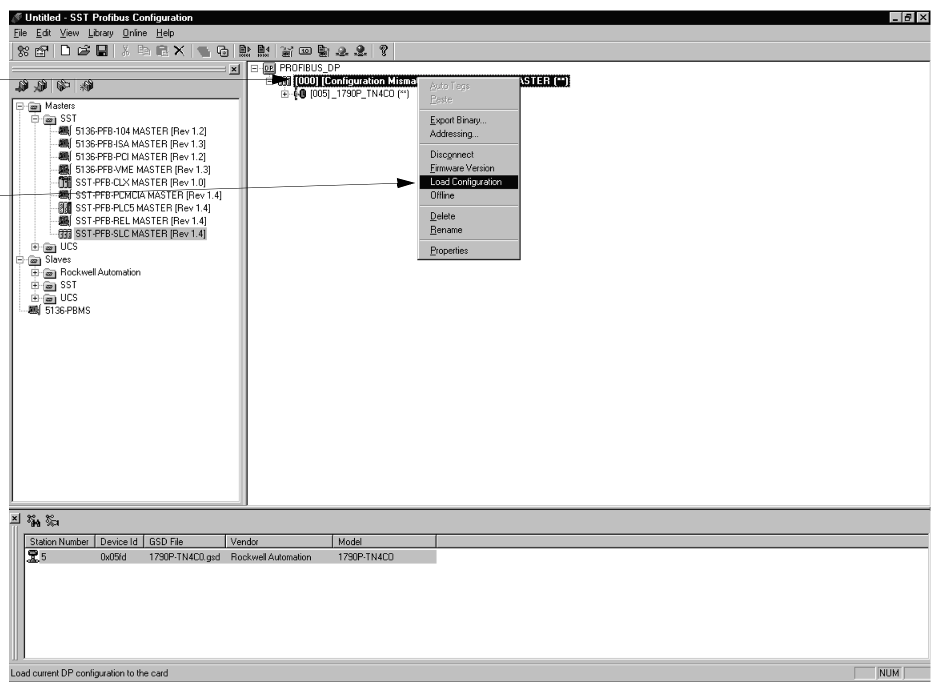
This example shows a mismatch in the master configuration.



5. Load configuration to the master.

A. Right-click on the master to see the pull-down menu.

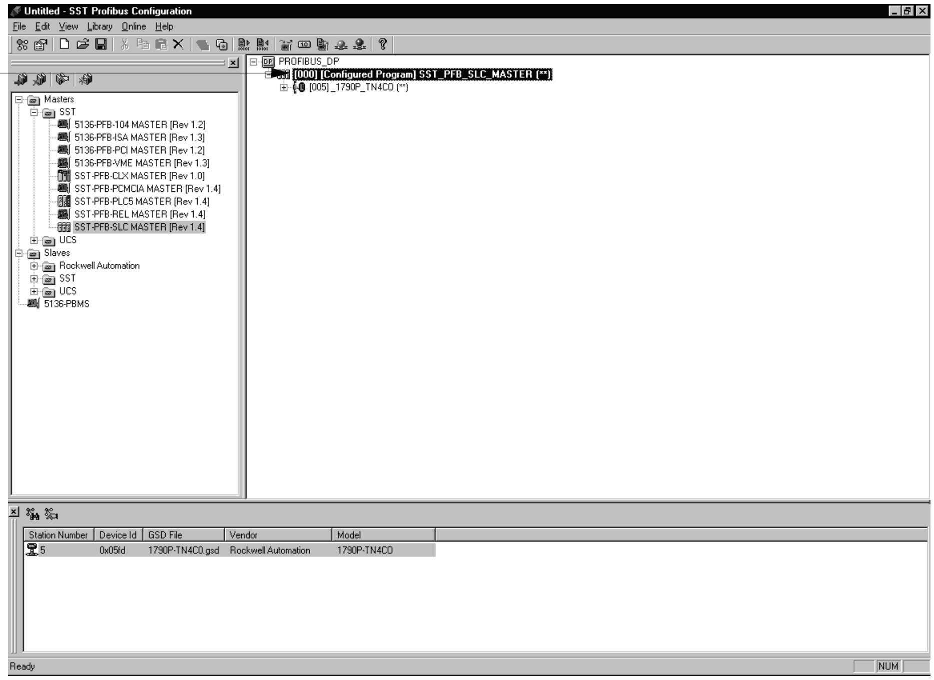
B. Click on Load Configuration.



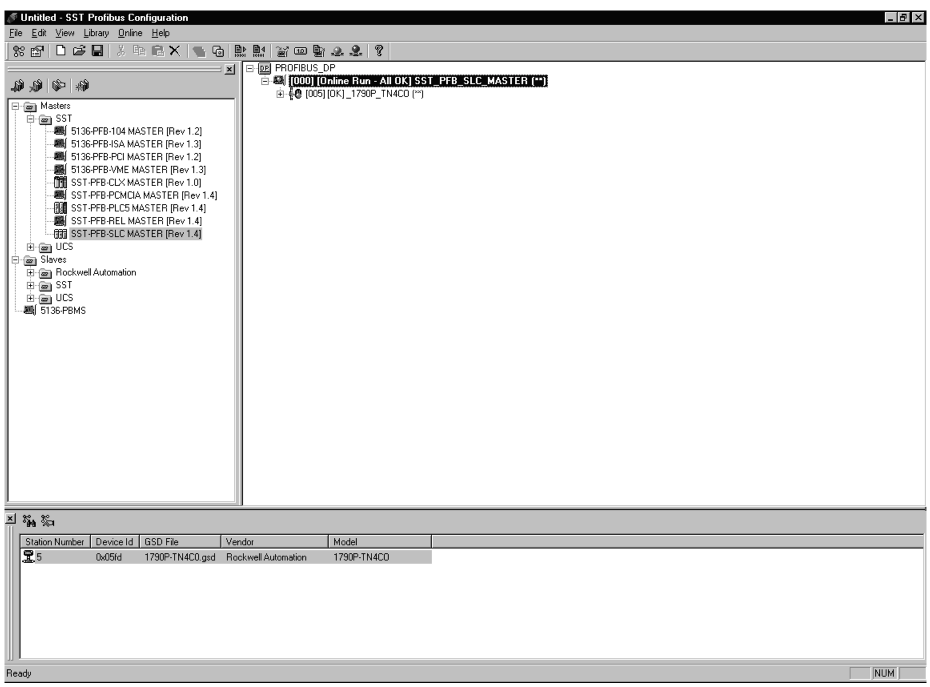
6. If the scanner is online, the software prompts you and asks if you want to load configuration. Choose YES.

The master status changes to the Configured Program mode.

This master is in Configured Program mode.



7. Change the processor to Run mode. In addition to solid green indicator lights on the module, you should see the screen below.



PROFIBUS DP Specifications

Table B.7 lists the module specifications.

Table B.7
PROFIBUS DP Specifications

Network Protocol	PROFIBUS–DP (EN50170)
Redundancy	Not supported
Repeater Control Signal	RS-485 signal
Implementation Type	DPC31
Freeze Mode	Supported
Sync Mode	Supported
Auto Baud Rate	Supported
Fail Safe Mode	Supported
Station Type	Slave
FMS Support	Not supported
Indicators	1 red/green - module status 1 red/green - network status
Number of Nodes	100 maximum - roatary switch type node address setting (0-99)
Network Length/Communication Rate	9.6Kbps @ 1000m (3280ft) 19.2Kbps @ 1000m (3280ft) 45.45Kbps @ 1000m (3280ft) 93.75Kbps @ 1000m (3280ft) 187.5Kbps @ 1000m (3280ft) 500Kbps @ 400m (1312ft) 1.5mbps @ 200m (656ft) 3mbps @ 100m (328ft) 6mbps @ 100m (328ft) 12mbps @ 100m (328ft)
Isolation	Type test 1250Vac rms for 60 seconds between field power and PROFIBUS (I/O to logic)
PROFIBUS Power	Supply voltage - 24V dc nominal Voltage range - 19.2-28.8V dc Power dissipation - 2W maximum @ 28.8V dc
Field Power	Supply voltage - 24V dc nominal Voltage range - 21.6-26.4V dc Power dissipation - 1.5W maximum @ 26.4V dc

Summary

This appendix describes PROFIBUS Modules Installation, Wiring, Module Data, Status and Channel Configuration with the SST PROFIBUS Configuration tool.

For more information, consult your PROFIBUS network, scanner and network configuration tool documentation.

Notes:

The following terms and abbreviations are used throughout this manual. For definitions of terms not listed here refer to *Allen-Bradley's Industrial Automation Glossary*, Publication AG-7.1.

A/D Converter– Refers to the analog to digital converter inherent to the module. The converter produces a digital value whose magnitude is proportional to the magnitude of an analog input signal.

analog input module – A module that contains circuits that convert analog voltage or current input signals to digital values that can be manipulated by the processor.

channel – Refers to analog input or output interfaces available on the module's terminal block. Each channel is configured for connection to a variable voltage or current input or output device, and has its own data and diagnostic status words.

channel update time – The time required for the module to sample and convert the input signals of one enabled input channel and update the channel data word.

configuration word – Contains the channel configuration information needed by the module to configure and operate each channel.

D/A Converter – Refers to the digital to analog converter inherent to the output module. The converter produces an analog dc voltage or current signal whose instantaneous magnitude is proportional to the magnitude of a digital value.

data word – A 16-bit integer that represents the value of the analog input or output channel. The channel data word is valid only when the channel is enabled and there are no channel errors. When the channel is disabled the channel data word is cleared (0).

full scale – The magnitude of voltage or current over which normal operation is permitted.

full scale error – (gain error) The difference in slope between the actual and ideal analog transfer functions.

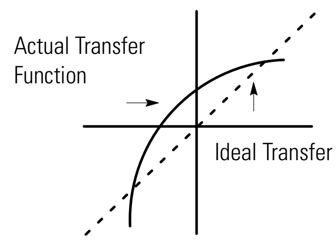
full scale range – (FSR) The difference between the maximum and minimum specified analog input values.

input image – The input from the module to the controller. The input image contains the module data words and status bits.

LSB – (Least Significant Bit) The bit that represents the smallest value within a string of bits.

For analog modules, the LSB is defined as the rightmost bit, bit 0, of the 16-bit field.

linearity error – An analog input or output is composed of a series of voltage or current values corresponding to digital codes. For an ideal analog input or output, the values lie in a straight line spaced by a voltage or current corresponding to 1 LSB. Any deviation of the converted input or actual output from this line is the linearity error of the input or output. The linearity is expressed in percent of full scale input or output. See the variation from the straight line due to linearity error (exaggerated) in the example below.



number of significant bits – The power of two that represents the total number of completely different digital codes an analog signal can be converted into or generated from.

module scan time – same as *module update time*

module update time – For input modules, the time required for the module to sample and convert the input signals of all enabled input channels and make the resulting data values available to the processor. For output modules, the time required for the module to receive the digital code from the processor, convert it to the analog output signal, and send it to the output channel.

multiplexer – An switching system that allows several signals to share a common A/D or D/A converter.

normal operating range – Input or output signals are within the configured range. See for a list of input and output types/ranges.

overall accuracy – The worst-case deviation of the output voltage or current from the ideal over the full output range is the overall accuracy. For inputs, the worst-case deviation of the digital representation of the input signal from the ideal over the full input range is the overall accuracy. this is expressed in percent of full scale.

Gain error, offset error, and linearity error all contribute to input and output channel accuracy.

output accuracy – The difference between the actual analog output value and what is expected, when a given digital code is applied to the d/a converter. Expressed as a ± percent of full scale. The error will include gain, offset and drift elements, and is defined at 25°C, and also over the full operating temperature range (0 to 60°C).

output image – The output from the controller to the output module. The output image contains the analog output data.

analog output module – An I/O module that contains circuits that output an analog dc voltage or current signal proportional to a digital value transferred to the module from the processor.

repeatability – The closeness of agreement among repeated measurements of the same variable under the same conditions.

resolution – The smallest detectable change in a measurement, typically expressed in engineering units (e.g. 1 mV) or as a number of bits. For example a 12-bit system has 4095 possible output states. It can therefore measure 1 part in 4095.

status word – Contains status information about the channel's current configuration and operational state. You can use this information in your ladder program to determine whether the channel data word is valid.

step response time – For inputs, this is the time required for the channel data word signal to reach a specified percentage of its expected final value, given a large step change in the input signal.

update time – see "module update time"

Notes:

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Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

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