

NXEE2

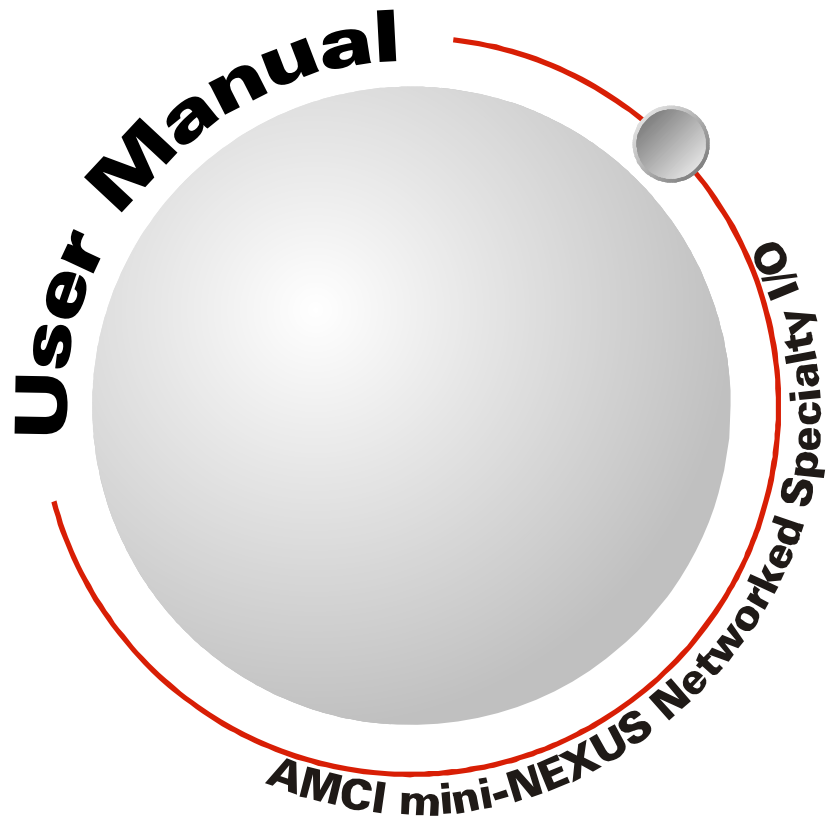
mini-NEXUS

SSI Interface Module

with Integral 2-Port Ethernet Switch

Device Level Ring functionality for EtherNet/IP

Media Redundancy Protocol for PROFINET



EtherNet/IP™



GENERAL INFORMATION

Important User Information

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Waste Electrical and Electronic Equipment (WEEE)



At the end of life, this equipment should be collected separately from any unsorted municipal waste.

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ABOUT THIS MANUAL

Read this chapter to learn how to navigate through this manual and familiarize yourself with the conventions used in it. The last section of this chapter highlights the manual's remaining chapters and their target audiences.

Audience

This manual explains the set-up, installation, and operation of AMCI's NXEE2 SSI Interface Module. It is written for the engineer responsible for incorporating these modules into a design, as well as the engineer or technician responsible for their actual installation.

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Revision Record

This manual, 940-0N110, is the first release of this manual. It was released May 14th, 2021.

Revision History

940-0N110 May14, 2021: Initial release.

Navigating this Manual

This manual is designed to be used in both printed and on-line formats. Its on-line form is a PDF document, which requires Adobe Acrobat Reader version 7.0+ to open it. The manual is laid out with an even number of pages in each chapter. This makes it easier to print a chapter to a duplex (double sided) printer.

The PDF file is password protected to prevent changes to the document. You are allowed to select and copy sections for use in other documents and, if you own Adobe Acrobat version 7.0 or later, you are allowed to add notes and annotations.

Manual Conventions

Three icons are used to highlight important information in the manual:



NOTES highlight important concepts, decisions you must make, or the implications of those decisions.



CAUTIONS tell you when equipment may be damaged if the procedure is not followed properly.



WARNINGS tell you when people may be hurt or equipment may be damaged if the procedure is not followed properly.

Manual Conventions (continued)

The following table shows the text formatting conventions:

Format	Description
Normal Font	Font used throughout this manual.
<i>Emphasis Font</i>	Font used the first time a new term is introduced.
<i>Cross Reference</i>	When viewing the PDF version of the manual, clicking on the cross reference text jumps you to referenced section.
<i>HTML Link</i>	When viewing the PDF version of the manual, clicking on the link will connect you with the www.amci.com website.

Where To Go From Here

You will most likely read this manual for one of two reasons:

- If you are curious about the NXEE2 SSI Interface Module from AMCI, this manual contains the information you need to determine if these product is the right one for your application. The first chapter, *Introduction to the NXEE2*, contains all of the information you will need to fully specify the right product for your application.
- If you need to install and use the NXEE2 SSI Interface Module, then the rest of the manual is written for you. To simplify installation and configuration, the rest of the manual is broken down into *references* and *tasks*. Using this product requires you to complete multiple tasks, and the manual is broken down into sections that explain how to complete each one.

Chapter Title	Page #	Intended Audience
<i>Introduction to the NXEE2</i>	7	Anyone new to the NXEE2. This chapter gives a basic overview of the features available on the unit, typical applications, and specifications.
<i>Data Formats</i>	17	Anyone that needs detailed information on the data formats used by the NXEE2 to communicate with its host controller.
<i>Configuring Network Interfaces</i>	23	Basic information on configuring a PC or laptop to successfully communicate with an NXEE2 to set its IP address.
<i>Installing the NXEE2</i>	25	Anyone that must install an NXEE2 on a machine. Includes information on mounting, grounding, and wiring specific to the units.
<i>Set the IP Address and Protocol</i>	33	Anyone that needs to change the IP address or communications protocol used by the NXEE2.
<i>Implicit Communications with an EDS</i>	43	Anyone that wants to use EtherNet/IP Implicit Messaging on platforms that support EDS files.
<i>Implicit Communications Without an EDS</i>	49	Anyone that wants to use EtherNet/IP Implicit Messaging on platforms that do not support EDS files.
<i>EtherNet/IP Explicit Messaging</i>	55	Anyone using EtherNet/IP Explicit Messaging to communicate with the NXEE2.
<i>Modbus TCP Configuration</i>	61	Anyone using Modbus TCP to communicate with the NXEE2.
<i>PROFINET Network Configuration</i>	65	Anyone using PROFINET to communicate with the NXEE2.

INTRODUCTION TO THE NXEE2

This reference section contains the information you need to decide if the NXEE2 SSI Interface Module is the right product for your application.

The NXEE2

The NXEE2 is a two channel SSI interface module that accepts 24 to 48 Vdc as its power source. *Synchronous Serial Interface (SSI)* is an industry standard serial protocol for transmitting sensor data. The SSI protocol is most commonly used in rotary and linear distance sensors, but any type of data can be transmitted using the protocol.

The NXEE2 is a two channel SSI interface module that allows you to lower transducer wiring cost by placing the NXEE2 close to the transducers and running a single network cable back to the host controller. The NXEE2 also future-proofs your SSI feedback design. The host controller can be updated to any future platform that supports EtherNet/IP, PROFINET, or Modbus TCP and the NXEE2 will operate with the new system.

E2 Technology

The NXEE2 is a member of the growing line of products from AMCI that incorporate our *E2 Technology*. E2 Technology by AMCI is an innovative new multi-protocol approach to Ethernet distributed I/O.

E2 Technology products are simple and intuitive, allowing easy transition between Ethernet/IP, PROFINET, or Modbus/TCP protocols without the need to physically switch parts. An advanced web server integrated into all AMCI E2 Technology devices facilitates simple network configuration and troubleshooting via a web-browser. Furthermore, an impressive array of advanced features for each supported protocol has been incorporated into the devices to meet many unique application requirements.

Each unit has two Ethernet ports which are internally connected through an onboard, two port, 10/100 Mbps ethernet switch. These ports allow you to wire your network in a “daisy-chain” fashion, which may lower network wiring costs and complexities.

The two ports also allow the units to function as members of a redundant Device Level Ring (DLR) network when using the EtherNet/IP protocol or as clients in a Media Redundancy Protocol (MRP) network when using PROFINET.

In DLR environments, the units act as Beacon-Based Ring Nodes. All units can process beacon packets at the default rate of every 400 microseconds. Beacon-based nodes can respond faster to network changes than nodes that only process Announce packets.

SSI Sensor Interface

The NXEE2 contains several parameters that allows the module to interface with any SSI sensor on the market today and extract the data value from it. A total of four values are available. These four values are:

- Data Value (Typically a position value.)
- Rate of Change (The velocity value when the Data Value represents a position.)
- Actual SSI Value (The data stream read from the SSI sensor. This stream will include any available status bits.)
- Captured Data Value (Captures and reports the Data Value when an input makes a transition. The NXEE2 sets a status bit to signal that a new value is available. This bit must be reset by a write to the NXEE2 from the host controller before another capture can occur.)

Any two of these values can be reported to the host controller at a time. The two that are reported is programmable from the host controller.

Each channel has a dedicated DC input. As mentioned above, the input can be programmed to capture the Data Value on a transition. The input can also be programmed for a different function. The input can be programmed to preset the Data Value on a transition. The Preset Value is programmable from the host controller.

The NXEE2 (continued)

SSI Sensor Interface

Communication is performed through input registers and output registers assigned to the module. The NXEE2 can be completely configured from your host controller. This allows you to:

- Configure the NXEE2 to work with all popular SSI sensors.
- Scale the Data Value to engineering units.
- Read status bits from the SSI sensor.
- Preset the Data Value when aligning the machine.
- Copy setup data from one machine to another
- Design custom HMI interfaces for configuration and alignment that can simplify machine training, startup, and repair.

SSI protocol

The original SSI protocol specification defined a twenty-five bit serial data stream from the sensor that is synchronized to clock pulses generated by a controller such as the NXEE2. The protocol defines minimum and maximum clock frequencies. (The sensor cable dictates the maximum allowable frequency for each application.) In addition to the clock frequency, the SSI protocol specifies signal timing and electrical characteristics. However, the protocol does not specify the content, or format, of the data bits.

Since its introduction, several companies have chosen not to follow the twenty-five bit convention of the SSI protocol. For example, single turn rotary encoders typically use a thirteen bit transfer. Figure R1.1 below shows a typical SSI data transfer.

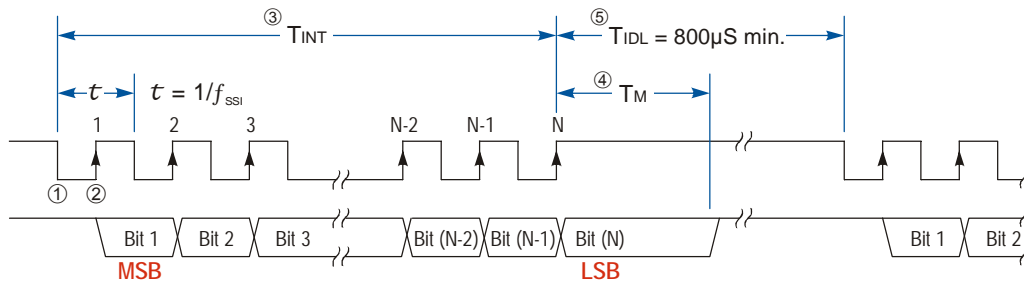


Figure R1.1 SSI Transfer

- ① Sensor data is latched on the first falling clock edge.
- ② The most significant data bit is shifted out on first rising edge. Subsequent rising clock edges shift out the rest of the data.
- ③ T_{INT} is the total interrogation time for the sensor. It is equal to $\tau * N + 0.5\tau$ where $\tau = 1/(\text{SSI clock frequency})$ and N equals the number of data bits in the SSI stream.
- ④ T_M is the time that the last bit is valid, which is determined by the sensor. It is typically 12 to 20 microseconds. It must be at least 5 microseconds to be compatible with the NXEE2. Also note that the diagram shows the last bit as data. The original SSI protocol specification defined this bit as a stop bit which is always low. AMCI is aware of several manufacturers that are using this bit position for data, so the NXEE2 treats it as such.
- ⑤ T_{IDL} is the time between interrogations and is controlled by the NXEE2. The NXEE2 guarantees a minimum of 800 microseconds between interrogations. Your SSI sensor must have new data available within this time.

NOTE Multi-word transfers are accomplished by holding the clock signal low for the T_M time period and restarting the clock. This signals the transducer to transfer additional bits of data instead of restarting at bit 1. Because multi-word transfers are rarely used in applications, the NXEE2 does not support this protocol.

NXEE2 Programmable Parameters

The NXEE2 is configured by setting its *Programmable Parameters*. Each channel of the NXEE2 has its own set of parameters, which allows the NXEE2 to interface with two completely different SSI sensors. These parameters are broken down into three groups.

SSI Setup Parameters – Six parameters that are used to extract the Data Value from the SSI bit stream. These parameters define the SSI clock speed, number of bits in the SSI stream, the position and length of the Data Value within the stream, and the format of the data.

Data Setup Parameters – Six parameters that affect the Data Value and Velocity information. These parameters allow you to scale the Data Value, preset it to a programmable count, change the direction of increasing counts, set its rollover position in rotary applications, and set the update time of the Velocity information.

Channel Setup Parameters – Three parameters that are used to enable or disable the channel’s LED, define the function of the channel’s discrete DC input, and define the data that is transmitted to the host controller.

SSI Setup Parameters

SSI Clock Frequency

This parameter allows you to set the SSI clock frequency to one of four values: 125 kHz, 250 kHz, 500 kHz or 1 MHz. The default frequency of 125KHz allows for the greatest sensor cable length. Increasing the frequency will not decrease the network transfer time to your host controller. The frequency should only be increased if your sensor cannot operate at 125KHz.

Number of SSI Data Bits

This parameter sets the number of bits in the entire SSI data transfer. This parameter has a range of one to thirty-two. Its default value is twenty-four.

MSB Number & Number of Data Value Bits Parameters

As the examples show in figure R1.2, these two parameters tell the NXEE2 where the Data Value is embedded in the SSI data stream. The MSB Number parameter specifies the location of the first bit of the Data Value in the SSI data stream. The Number of Data Value Bits parameter specifies the length of the Data Value. The default value of the MSB Number parameter is one. The default value for the Number of Data Value Bits parameter is twenty-four. The default values will work with AMCI multi-turn SSI DuraCoders as well as many other multi-turn rotary SSI encoders and linear sensors.

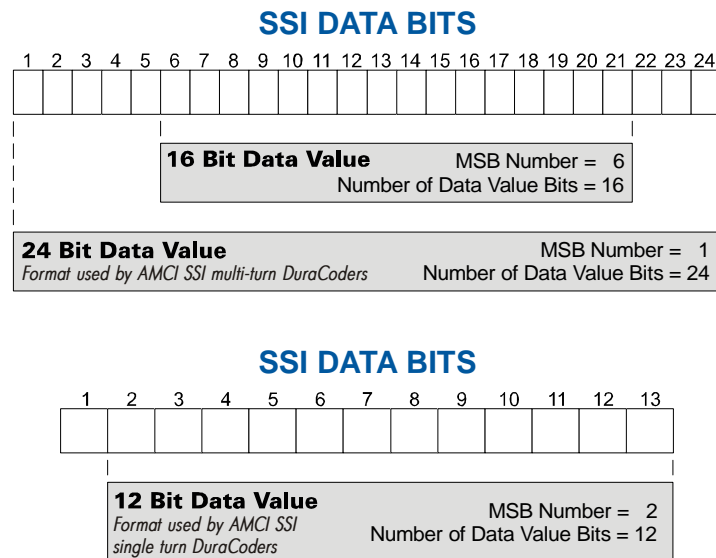


Figure R1.2 Data Value in SSI Data Stream Examples

NXEE2 Programmable Parameters (continued)**SSI Setup Parameters (continued)****Data Type**

This parameter tells the NXEE2 to interpret the data from the SSI sensor as a binary number or as a gray code encoded number. The default is *Binary*.

Data Logic

This parameter is included to handle rare situations where the Data Value is reported with negative logic. If this parameter is set, the NXEE2 will invert the data bits before performing any scaling. The default value is *Positive*, which means that the NXEE2 will not invert the Data Value bits from the sensor.

Data Setup Parameters


These six parameters affect the Data Value and Velocity information. These parameters allow you to scale the Data Value, preset it to a programmable count, change the direction of increasing counts, set its rollover position in rotary applications, and set the update time of the Velocity information.

Full Scale Count

The Full Scale Count parameter is important only if you are using a rotary encoder. If you have a linear device, such as a magneto-restrictive linear displacement sensor or a laser range finder, leave this parameter at its default value of *zero*.

If you are using a rotary encoder, the Full Scale Count parameter sets the number of counts the NXEE2 can expect before the position rolls over to zero. If this value is not set, or set incorrectly, the NXEE2 will not be able to handle the roll over between the maximum value and zero correctly.

The Full Scale Count parameter must be set to the total number of counts generated by the encoder. For example, the single turn SSI DuraCoder from AMCI is a twelve bit encoder by default. For this encoder, the Full Scale Count should be set to $2^{12} = 4,096$. For multi-turn encoders, the Full Scale Count parameter should be set to (the number of counts per turn) * (the total number of turns). For example, the multi-turn SSI DuraCoder from AMCI defaults to 4,096 counts per turn and 4,096 turns. In this example, the Full Scale Count should be set to $4,096 * 4,096 = 16,777,216$.


NOTE  The SSI DuraCoders from AMCI are fully programmable with a software utility available on our website. While programming, you set the DuraCoder's Full Scale Count parameter. When configuring the NXEE2, make sure that the NXEE2's Full Scale Count parameter matches the DuraCoder's Full Scale Count parameter.

Count Direction

The Count Direction parameter allows you to reverse the direction of travel needed to increase the Data Value. For simplicity's sake, the two values for this parameter are called *Positive* and *Negative*. When this parameter is set to its default of *Positive*, the Data Value is not changed. When this parameter is set to *Negative*, the change in Data Value depends on the value of the Full Scale Count parameter.

If the Full Scale Count parameter equals zero, a linear sensor is assumed and the Data Value is changed to $(2^n - (\text{Data Value}))$, where 'n' is the value of the Number of Data Value Bits parameter.

If the Full Scale Count parameter is non-zero, a rotary sensor is assumed. The Data Value is change to $((\text{Full Scale Count} - \text{Data Value}) \text{ MOD Full Scale Count})$. The modulus function is required to keep the zero position as zero.

NOTE  Changing this parameter will most likely change the Data Value reported by the NXEE2. The only time this does not occur is if you are using a rotary encoder and the position is at zero when you reverse the count direction. Because of this, set the Count Direction parameter before you preset the Data Value.

NXEE2 Programmable Parameters (continued)

Data Setup Parameters (continued)

Scalar Multiplier and Scalar Divisor

These two parameters are used to scale the Data Value before it is transmitted to the host controller. Both parameters have a default value of one and can range in value from 1 to 32,767. The Scalar Multiplier must be less than or equal to the Scalar Divisor. In other words, the ratio of Multiplier to Divisor cannot be greater than one.

The first example of their use is with linear displacement transducers (LDT's), such as the ones available from Balluff and MTS. Each of these manufacturers have resolutions measured in $\mu\text{m}/\text{count}$. The NXEE2 can easily convert these measurements to the US customary system of inches. Figure R1.3 below shows the Multiplier and Divisor values needed to convert from various metric resolutions to US customary resolutions. For example, to convert data from a LDT with $5\mu\text{m}/\text{count}$ resolution to $0.0005"/\text{count}$ resolution, use a Scalar Multiplier of 50 and a Scalar Divisor of 127.

		Desired Resolution						
		0.00005"	0.0001"	0.0002"	0.0005"	0.001"	0.002"	0.005"
LDT Resolution	1 μm	$\frac{100}{127}$	$\frac{50}{127}$	$\frac{25}{127}$	$\frac{10}{127}$	$\frac{5}{127}$	$\frac{5}{254}$	$\frac{1}{127}$
	2 μm		$\frac{100}{127}$	$\frac{50}{127}$	$\frac{20}{127}$	$\frac{10}{127}$	$\frac{5}{254}$	$\frac{2}{127}$
	5 μm			$\frac{125}{127}$	$\frac{50}{127}$	$\frac{25}{127}$	$\frac{25}{254}$	$\frac{5}{127}$
	10 μm				$\frac{100}{127}$	$\frac{50}{127}$	$\frac{25}{127}$	$\frac{10}{127}$
	20 μm					$\frac{100}{127}$	$\frac{50}{254}$	$\frac{20}{127}$
	40 μm						$\frac{100}{127}$	$\frac{40}{127}$


 = Desired resolution exceeds resolution of LDT.

Figure R1.3 Common LDT Scalar Values

Use the following procedure to calculate your Scalar Multiplier and Divisor values if either your LDT Resolution or Desired Resolution does not appear in the above table.

$$\text{Conversion Factor} = \frac{\text{Desired Resolution (counts/inch)}}{\text{LDT Resolution (counts/inch)}}$$

- 1) Convert your LDT resolution from μm to inches. For example, you are using a sensor with $1\mu\text{m}$ resolution in your application.

$$1\mu\text{m} \times \frac{1\text{mm}}{1000\mu\text{m}} \times \frac{1\text{ inch}}{25.4\text{ mm}} = 0.00003937\text{ inches/count} = 25,400\text{ counts/inch}$$

- 2) Determine the number of counts per inch for the desired resolution. For example, $0.0001"$.

$$0.0001\text{ inches/count} = 10,000\text{ counts/inch}$$

- 3) Determine the Scalar Multiplier and Divisor values.

$$\frac{\text{Desired Resolution (counts/inch)}}{\text{LDT Resolution (counts/inch)}} = \frac{10,000\text{ counts/inch}}{25,400\text{ counts/inch}} = \frac{100}{254} = \frac{50}{127}$$

Therefore, to use a sensor with $1\mu\text{m}$ resolution and get 0.0001 inches per count resolution, use a Scalar Multiplier of 50 and a Scalar Divisor of 127.


NXEE2 Programmable Parameters (continued)**Data Setup Parameters (continued)****Preset Value**

The Preset Value parameter gives you the ability to offset the Data Value. When you preset the Data Value, the NXEE2 calculates an internal offset. The internal offset is the value needed to make the Data Value equal to the Preset Value. The default Preset Value is zero. Its range depends on the value of the Full Scale Count Parameter

- If the Full Scale Count is zero, the range of the Preset Value is $\pm 268,435,455$
- If the Full Scale Count is not zero, the range of the Preset Value is 0 to (Full Scale Count – 1)

The type of internal offset that is generated when you preset the Data Value is also affected by the value of the Full Scale Count.

- If the Full Scale Count is zero, the internal offset is a *linear offset*. The range of values that you will see in the Data Value will be shifted by the amount of the internal offset. For example, without a preset applied, the Data Value ranges from 0 to 100. If you are at position zero, and apply a Preset Value of 1,000, the Data Value will now range from 1,000 to 1,100.
- If the Full Scale Count is not zero, the internal offset is a *circular offset*. This offset shifts the zero point of the Data Value. It does not change the range of values that you will see from the Data Value.

NOTE  Programming this parameter does not change the Data Value. There is a separate command for presetting the Data Value to the Preset Value. This command uses the Apply Preset to Data Value bit in the *Network Output Data* as described in reference chapter 2 starting on page 17.

Velocity Update Time

Velocity data, which is the rate of change in the Data Value, is always reported to the network host in terms of counts per second. It is based on the scaled Data Value, not the value extracted from the SSI data stream. The Velocity Update Time parameter allows you to choose between 24 and 160 milliseconds between updates, with a default of 160 milliseconds. The 160 millisecond setting give you a better velocity average, while the 24 millisecond setting give you a faster response to accelerations. This parameter has no effect on the Data Value itself. Specifically, it does not alter how often the Data Value is updated in the Network Input Data.

Channel Setup Parameters**Turn Off Channel LED**

This parameter allows you to disable the channel's status LED. This is most commonly done if the channel is unused. Network Input Data for the channel is unaffected, so it is possible to disable the channel's status LED once it is configured and operating. The NXEE2 ships from the factory with the channel 2 LED disabled.

Channel Input Function

This parameter allow you to choose the functionality of the channel's discrete DC input. Your choices are:

- **General Purpose Input.** Its state is reported in the Network Input Data. The data bit is on when the input is receiving power.
- **Apply Preset to Data Value.** The Data Value is set equal to the programmed Preset Value. This can be programmed to occur on the rising edge of the input, the falling edge, or both edges. The calculated offset is stored in RAM and is lost when power is cycled to the NXEE2.
- **Capture Data Value.** The Data Value can be captured and can be reported in the Network Input Data. This can be programmed to occur on the rising edge of the input, the falling edge, or both edges.

NXEE2 Programmable Parameters (continued)


Channel Setup Parameters (continued)

Network Input Data Format

The following values can be transmitted to the host controller in the Network Input Data:

- Data Value
- Velocity
- Captured Data Value
- Actual SSI Data


There are only five data words available to each channel. Therefore the NXEE2 can only transmit two values at a time. The Network Input Data Format parameter allows you to choose which values are transmitted.

NOTE  The NXEE2 can take up to four milliseconds to accept a change in format and begin transmitting the newly selected values. If your network interface updates the Network Input Data at a rate faster than four milliseconds, it may take multiple reads before the change in selected values is seen.

Programming Cycle

New parameter values are written to the NXEE2 through a Programming Cycle. A Programming Cycle consists of six steps and is controlled by the Transmit Bit in the Network Output Data and the Acknowledge Bit in the Network Input Data.

- 1) Write the new programming data into the registers assigned to the module with the Transmit Bit reset. This step insures that the correct data is in the registers before the Programming Cycle begins.
- 2) Set the Transmit bit. A Programming Cycle is initiated when this bit makes a 0→1 transition.
- 3) Once the NXEE2 is done with the programming data, it will set any necessary error bits and the Acknowledge Bit in the Network Input Data.
- 4) Once you see the Acknowledge Bit set, check for any errors. The error bits are guaranteed valid while the Acknowledge Bit is set.
- 5) Respond to any errors and reset the Transmit Bit.
- 6) The NXEE2 responds by resetting the Acknowledge Bit. The Programming Cycle is now complete.

NOTE  All parameters are checked before any of them are applied. If there is an error in the block of data, the NXEE2 will only set the appropriate error bits in the Network Input Data. Parameters are not applied to the NXEE2 until all of the data is correct.

Status LED's

Module Status (MS) LED

The Module Status LED is a bi-color red/green LED. The state of the LED depends on the state of the network adapter module.

LED State	EtherNet/IP Definition	Modbus TCP Definition	PROFINET Definition
Off	No Power		
Alternating Red/Green	Power up Self-Test (Occurs very quickly on power up.)		
Flashing Green	Waiting for valid physical connection to the network.	Not Implemented	
Steady Green	Drive and Network are operational.	Device Name or IP Address are set.	
Flashing Red	Initializing: IP Address Conflict	Initializing: Device Name or IP Address are not set.	
	If the Network Status LED is also flashing red, the IP Address or Network Protocol has been changed. Cycle power to the unit to continue. If the Network Status LED is in any other state, a write to flash memory has failed. Cycle power to the unit to clear this fault.		
Steady Red	Major Fault. Cycle power to the unit to attempt to clear the fault.		

Table R1.1 Module Status LED States

Network Status (NS) LED

The Network Status LED is a bi-color red/green LED. The state of the LED depends on the protocol the NXEE2 is configured to for.

LED State	EtherNet/IP Definition	Modbus TCP Definition	PROFINET Definition
Off	No Power	No power or no TCP connections	No power, duplicate IP address, mismatch in Device Name, or no connection to the IO Controller.
Alternating Red/Green	Power up Self-Test (Occurs very quickly when power is applied.)		
Flashing Green	Ethernet connection, but no CIP connections	Indicates number of connections with 2 second delay between group. The NXEE2 supports up to 5 concurrent connections.	On-line, Stop state. A connection with the IO Controller is established and it is in its STOP state.
Steady Green	Valid Ethernet network and CIP connections	Not Implemented	On-line, Run state. A connection with the IO Controller is established and it is in its RUN state.
Blinking Red	If the MS LED is steady green: Network Connection Timeout	Not Implemented	Not Implemented
	If the MS LED is blinking red: IP Address or Network Protocol changed: Cycle power		
Steady Red	Duplicate IP address on network.	Not Implemented.	

Table R1.2 Network Status LED States

Power Connectors

NXEE2 Power

Power connections for the NXEE2 are made through a plug in connector on the bottom of the module. This connector also has a pin for attaching the module to chassis ground. Detailed information on NXEE2 power wiring can be found in the *Power Wiring* section of the installation chapter, starting on page 27. The mate to this connector is included with the NXEE2. Spares are available from AMCI under the part number MS-4M. They are also available from Phoenix Contact under their part number 187 80 37.

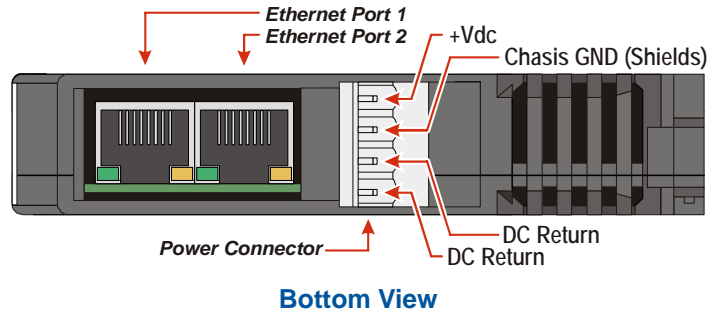


Figure R1.4 Power and Ethernet Connectors

Sensor Power

The sensor interface circuitry is opto-isolated from the rest of the NXEE2. In order to maintain this isolation, the NXEE2 has separate power pins for the sensors. This also give you the ability to power the NXEE2 and sensors at two different voltage levels. If you do not need this isolation, there are NXEE2 power pins on the I/O connector that allow you to easily jumper power from the NXEE2 to the sensors. Detailed information on sensor power wiring can be found in the *Powering the SSI Sensor* section of the installation chapter, starting on page 30.

Ethernet Connectors

Figure R1.4 also shows the location of the two Ethernet connections. These two RJ-45 ports are internally connected through a switch. Both ports are used in redundant ring networks. Either can be used in non-redundant networks. In non-redundant networks, the unused port can be used to daisy chain to the next device if this simplifies wiring in your application.

I/O Connector

As shown in figure R1.5, the I/O Connector is located on the top of the module. All sensor connections are made at this connector as well as the channel's discrete DC input. Power connections for the NXEE2 are made through the connector on the bottom of the module.

The mate for this connector is included with the NXEE2. Spares are available from AMCI under the part number MS-2X11. They are also available from Phoenix Contact under their part number 173 88 98.

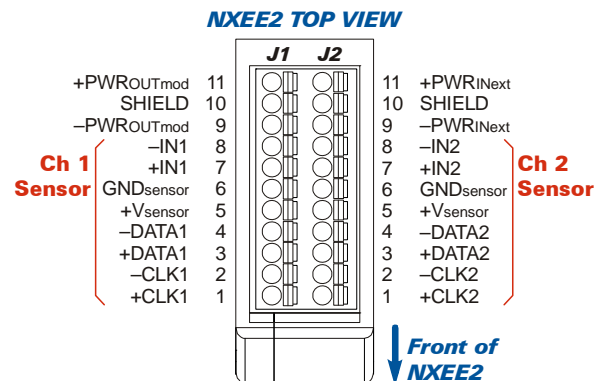


Figure R1.5 I/O Connector

Specifications

Sensors Supported

Any sensor that outputs data in single word SSI format. Multi-word transfers are not supported.

Number of SSI bits transferred programmable from 1 to 32.

SSI clock frequency programmable to 125 kHz, 250 kHz, 500kHz, or 1 MHz.

Binary and Gray Scale formats supported.

Data Value

NXEE2 can be programmed to extract a Data Value from the SSI data stream.

Data Value can be treated as a linear or rotary position. (Data Values that are not positions can be treated as linear values.)

Data Value can be scaled to engineering units through use of Scalar Multiplier and Scalar Divisor parameters.

Data Value can be offset with the Preset Value parameter.

NXEE2 calculates velocity information based on the rate of change in the Data Value

Number of Input Channels

Two

Number of I/O Words Required (16 bits each)

10 input words and 10 output words

Physical Dimensions

Width: 0.9 inches max.

Depth: 4.5 inches max.

Height: 3.9 inches

5.0 inches min. with mating connectors

Weight

0.38 lbs. (0.17 kg.) with mating connectors

Power Supply Requirements

24 to 48 Vdc \pm 20%,
2 watts maximum (without sensors)

Channel DC Input

Used as general purpose I/O, to preset the Data Value, or capture the Data Value on state change.

Differential. 560 Vac/dc opto-isolated. Will withstand 3750VAC (RMS) for 60 seconds. (UL1577) Can be wired as single ended input. Accepts 3.5 to 27 Vdc without the need for an external current limiting resistor. 10mA current needed to turn input on.

Status LED's

See *Status LED's* starting on page 14.

Mounting Location

DIN rail mount
EN 05 022 - 35 x 7.5 (35 x 7.5 mm) or
EN 05 022 - 35 x 15 (35 x 15 mm)

Environmental Specifications

Module rating of IP20.

Location must conform to IEC *Pollution Degree 2* and *Over Voltage Category II* designations.

Input Power 24 to 48Vdc, surge to 60Vdc without damage to module.

Ambient Operating Temperature

..... -4° to 122°F (-20° to 50°C)

Storage Temperature

..... -40° to 185°F (-40° to 85°C)

Humidity 0 to 95%, non-condensing

Connectors

Mating connectors are included with the NXEE2 and are available separately under the following AMCI part numbers.

Connector	AMCI Part #	Wire	Strip Length	Min. Tightening Torque
I/O	MS-2X11	28 - 16 AWG	0.275 inches	Spring Cage Connector
Power	MS-4M	28 - 12 AWG	0.394 inches	4.43lb-in (0.5 Nm)

REFERENCE 2

DATA FORMATS

This reference chapter details the output and input data formats used to communicate with the NXEE2.

Network Output Data

		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Network Output Data Word Numbers	0	Command Word															
		Transmit Bit	Save to FLASH Memory	0	0	0	0	0	0	0	0	Change Reported Input Values: CH2	Change Reported Input Values: CH1	Apply Preset to Data Value CH2	Apply Preset to Data Value CH1	Write Config. to CH2	Write Config. to CH1
	1	Configuration Word															
		Turn Off Channel LED	Swap 32 bit words_endian	SSI Clk f 00 = 125 kHz 01 = 250 kHz 10 = 500 kHz 11 = 1.0 MHz	Velocity Update Time	Count Direction	Data Type	Data Logic	Channel Input Function (See table R2.2 below.)				Network Input Data Values (See table R2.3 below)				
	2	Number of SSI Data Bits Range of 1 to 32, Default of 24.															
	3	MSB Number Range of 1 to 32, Default of 1								Number of Data Value Bits Range of 1 to 28, Default of 24							
	4	Scalar Multiplier Range of 1 to {Scalar Divisor}, Default of 1															
	5	Scalar Divisor Range of 1 to 32,767, Default of 1															
	6	Preset Value in 32 bit, 2's-compliment format Combined value of $\pm 268,435,455 (\pm \{2^{28} - 1\})$, Default of 0															
	7																
8	Full Scale Count in 32 bit, 2's-compliment format Combined value of 0, or 2 to 268,435,456 (2^{28}), Default of 0																
9																	

Table R2.1 Network Output Data Format

Command Word Format

Bit 15, Transmit Bit - Used to control the flow of programming data to the NXEE2. The NXEE2 will not accept new programming data until this bit makes a 0→1 transition. Once this bit is set, it should remain set until the NXEE2 responds by setting the Acknowledge bit in the Network Input data. See [Programming Cycle](#) on page 13 for a complete explanation of the NXEE2 programming sequence.

Bit 14, Save to FLASH Memory - This bit is used to store parameter values and calculated offsets into non-volatile FLASH memory. Once stored, the parameter values will be used on every power up. This means that you will not have to configure the NXEE2 on every start up.




The FLASH memory is limited to 10,000 write cycles. Do not save the offset to non-volatile memory more than necessary to prevent a failure in the NXEE2.

Bits 13-6, Reserved - Must be set to '0'. A command error will result if any of these bits are set to '1' when the Transmit Bit makes a 0→1 transition.


Network Output Data (continued)**Command Word Format (continued)**

- Bit 5, Change Reported Input Values: CH2 - Set this bit to change the channel 2 data values transmitted from the NXEE2 to the host. The transmitted data values are selected by the Network Input Data Values bits of the Configuration Word. Note that the two channels can be programmed at the same time.
- Bit 4, Change Network Data Format: CH1 - Set this bit to change the channel 1 data values transmitted from the NXEE2 to the host. The transmitted data values are selected by the Network Input Data Values bits of the Configuration Word. Note that the two channels can be programmed at the same time.
- Bit 3, Apply Preset to Data Value: CH2 - Set this bit to preset the Data Value for channel 2. The Data Value will change to the last programmed Preset Value for channel 2. The Preset Value is programmed as part of the configuration data when bit 1 of this word, the Write Configuration: Channel 2 bit is set. If you want to change the Preset Value and set the Data Value to it in one cycle, then both of these bits must be set.
- Bit 2, Apply Preset to Data Value: CH1 - Set this bit to preset the Data Value for channel 1. The Data Value will change to the last programmed Preset Value for channel 1. The Preset Value is programmed as part of the configuration data when bit 0 of this word, the Write Configuration: Channel 1 bit is set. If you want to change the Preset Value and set the Data Value to it in one cycle, then both of these bits must be set.
- Bit 1, Write Configuration: CH2 - Set this bit to change the configuration for channel 2. All of the parameters in the remaining output words are programmed when this bit is set. Note that the two channels can be programmed at the same time.
- Bit 0, Write Configuration: CH1 - Set this bit to change the configuration for channel 1. All of the parameters in the remaining output words are programmed when this bit is set. Note that the two channels can be programmed at the same time.

NOTE  It is possible to write configuration data, apply the new preset to the data value, and change the reported input values with one write cycle. Any combination of these actions can be performed within one write cycle.

Configuration Word Format

- Bit 15, Turn Off Channel LED - Set this bit to '1' to disable the channel's front panel status LED. The channel will still operate and send data in the Network Input Data words associated with the channel.
- Bit 14, Swap_32_bit_words_endian - The unit will select the big or small endian format for 32 bit values based on the protocol that the NXEE2 is configured for. For EtherNet/IP, the default order is *little endian*, (least significant bits first). For PROFINET and Modbus-TCP, the default format is big endian, (most significant bits first). To use the default format, reset this bit to "0". If your host controller does not use the default order of the protocol, set this bit to "1" to reverse the word order.
- Bits 13&12, SSI Clock Frequency - These two bits set the frequency of the channel's SSI clock. The default frequency of 125KHz allows for the greatest sensor cable length. Also, increasing the frequency will not decrease the network transfer time to your host controller. The frequency should only be increased if your sensor cannot operate at 125KHz.
- Bit 11, Velocity Update Time - Set this bit to '0' to have the velocity data update every 160 milliseconds. Set this bit to '1' to have the channel's velocity data update every 24 milliseconds.

NOTE  This parameter only affects the calculation rate of the Velocity data. It has no effect on the network transfer rate to and from your host controller.

- Bit 10, Count Direction - Set this bit to '0' to have the count direction be the same as the SSI sensor's. Set this bit to '1' to have the count direction be the reverse of the sensor's.

Network Output Data (continued)**Configuration Word Format (continued)**

Bit 9, Data Type - Set this bit to '0' if your SSI sensor transmits its data in binary. Set this bit to '1' if your SSI sensor transmits its data in Gray Code.

Bit 8, Data Logic - Set this bit to '0' if your SSI sensor transmits its data using positive logic. Set this bit to '1' if your SSI sensor transmits its data using negative logic.

Bits 7–4, Channel Input Function - Use the table below to define the functionality of the channel's discrete input.

Bit 7	Bit 6	Bit 5	Bit 4	Function
0	0	0	0	General Purpose Input. State reported in network input data. (Factory Default)
0	0	0	1	Apply Preset to Data Value on Rising Edge and save offset in RAM
0	0	1	0	Apply Preset to Data Value on Falling Edge and save offset in RAM
0	0	1	1	Apply Preset to Data Value on Both Edges and save offset in RAM
0	1	0	0	Capture the Data Value on Rising Edge
0	1	0	1	Capture the Data Value on Falling Edge
0	1	1	0	Capture the Data Value on Both Edges
All other combinations				Reserved

Table R2.2 Function of Channel Input

Bits 3–0, Network Input Data Values - Use the table below to define the data transmitted to the host in the Network Input Data.

Bit 3	Bit 2	Bit 1	Bit 0	Function
0	0	0	0	Data Value in words 2 & 3 for channel 1, words 6 & 7 for channel 2 Actual SSI Value in words 4 & 5 for channel 1, words 8 & 9 for channel 2 (Factory Default)
0	0	0	1	Data Value in words 2 & 3 for channel 1, words 6 & 7 for channel 2 Velocity Data in words 4 & 5 for channel 1, words 8 & 9 for channel 2
0	0	1	0	Velocity Data in words 2 & 3 for channel 1, words 6 & 7 for channel 2 Actual SSI Value in words 4 & 5 for channel 1, words 8 & 9 for channel 2
0	0	1	1	Data Value in words 2 & 3 for channel 1, words 6 & 7 for channel 2 Captured Value in words 4 & 5 for channel 1, words 8 & 9 for channel 2
0	1	0	0	Velocity Data in words 2 & 3 for channel 1, words 6 & 7 for channel 2 Captured Value in words 4 & 5 for channel 1, words 8 & 9 for channel 2
All other combinations				Reserved

Table R2.3 Network Input Data Values

Error Response

If there is an error in the data sent to the NXEE2, the module responds by setting the appropriate error bit in the Network Input Data. See the [Network Input Data](#) section, starting on page 20 for a full explanation of the error bits. The only way to clear an error bit is to program the module with valid data. A global "Clear Errors" bit does not exist.

Network Input Data

Figure R2.1 shows the format of the data sent to the host by the NXEE2.

		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Network Input Data Word Numbers	0	Channel 1 Status Word															
		Acknowledge Bit	Heartbeat	CH1 Value Captured	CH1 Input State	Memory Error	CH1 FSC Exceeded	CH1 FSC Error	CH1 Preset Value Error	CH1 Scalar Errors	CH1 SSI Setup Errors	CH1 Config. Error	CH1 Cmd Error	CH1 Velocity at Zero	CH1 Motion Direction	0	0
	1	Channel 2 Status Word															
		0	0	CH2 Value Captured	CH2 Input State	0	CH2 FSC Exceeded	CH2 FSC Error	CH2 Preset Value Error	CH2 Scalar Errors	CH2 SSI Setup Errors	CH2 Config. Error	CH2 Cmd Error	CH2 Velocity at Zero	CH2 Motion Direction	0	0
	2	Channel 1 Value 1															
	3	Value determined by <i>Network Input Data Values</i> bit field. See table R2.3 on page 19.															
	4	Channel 1 Value 2															
	5	Value determined by <i>Network Input Data Values</i> bit field. See table R2.3 on page 19.															
	6	Channel 2 Value 1															
	7	Value determined by <i>Network Input Data Values</i> bit field. See table R2.3 on page 19.															
8	Channel 2 Value 2																
9	Value determined by <i>Network Input Data Values</i> bit field. See table R2.3 on page 19.																

Figure R2.1 Network Input Data

Status Word Format

Each channel has a status word associated with it. These bits show the status of the channel as well as any programming errors that may have occurred. The status word for channel 1 also contains status bits for the module as a whole. These bits are not repeated for channel 2.

Bit 15, Acknowledge Bit (Ch1 Only) - Used to control the flow of programming data to the NXEE2. The NXEE2 sets this bit in response to the Transmit bit being set by the host. Programming error bits in the two status words are only valid while the Acknowledge bit is set. Once this bit is set, it will remain set until your host controller resets the Transmit Bit. See *Programming Cycle* on page 13 for a complete explanation of the NXEE2 programming sequence.

Bit 14, Heartbeat Bit (Ch1 Only) - This bit changes state every 500 milliseconds. It is used to verify active network communications with the NXEE2.

Bit 13, Value Captured - When the channel’s discrete DC input is configured to capture the Data Value, this bit is set to ‘1’ whenever a new captured Data Value is available. If the Network Input Data Values parameter is configured to transmit the captured Data Value, it will be available in the channel’s Value 2 words. A 0 → 1 transition on the Transmit Bit is the only way to clear the Value Captured bits. This is accomplished by three writes to the first Network Output Data word in the following sequence: 16#0000, 16#8000, 16#0000. This will clear the Value Captured bits without changing any of the module’s programmable parameters.

NOTE The NXEE2 will not capture a value while this bit is set to “1”. The state of the input is still reported with the CH Input State bit, (see below), but the Captured Data Value registers will not be updated.

Network Input Data (continued)**Status Word Format (continued)**

- Bit 12, CH Input State - Set to '1' whenever power is applied to the channel's discrete input. Reset to '0' when power is removed from the input.
- Bit 11, Memory Error (Ch 1 Only) - Set to '1' if the non-volatile memory in the NXEE2 is corrupt. The NXEE2 leaves the factory with reasonable parameter defaults. This error may be a sign of a problem in the installation environment, such as high electrical noise. You should attempt to reprogram the NXEE2. If this fails, contact AMCI technical support for assistance.
- Bit 10, FSC Exceeded - Set to '1' if the Data Value ever exceeds the programmed Full Scale Count Value. This error condition does not exist if the Full Scale Count parameter is left at its default value of zero. Once set, this bit will remain set until the Full Scale Count parameter is reprogrammed or power to the NXEE2 is cycled. The Full Scale Count parameter is only used in rotary encoder applications. See *Full Scale Count* on page 10 for a full description of how to use this parameter.
- Bit 9, FSC Error - Set to '1' if you attempt to program the Full Scale Count parameter outside of its range of 0, or 2 to 268,435,456. The Full Scale Count parameter is only used in rotary encoder applications. See *Full Scale Count* on page 10 for a full description of how to use this parameter.
- Bit 8, Preset Value Error - Set to '1' if you attempt to program the Preset Value outside of its valid range.
- ▶ When the Full Scale Count Parameter equals zero, this bit is set to '1' if you attempt to program the Preset Value parameter outside of its range of $\pm 268,435,455$.
 - ▶ When the Full Scale Count Parameter does not equal zero, this bit is set to '1' if you attempt to program the Preset Value parameter outside of its range of 0 to (Full Scale Count - 1).
- Bit 7, Scalars Error - Set to '1' if the Scalar Divisor parameter is outside of its range of 1 to 32,767 or if the Scalar Multiplier is outside of its range of 1 to (Scalar Divisor).
- Bit 6, SSI Setup Error - Set to '1' if the Number of SSI Bits, MSB Number, or Number of SSI Data Value Bits parameters are outside their valid ranges. Also set if (MSB Number + {Number of Data Value Bits-1} > Number of SSI Bits).
- Bit 5, Configuration Error - Set to '1' if the bit fields that set the Channel Input Function or Network Input Data Values are set to any invalid combinations. Valid combinations for these bit fields are given in the *Configuration Word Format* section starting on page 18.
- Bit 4, Command Error - Set to '1' if any of the reserved bits in the Network Output Data are set when the Transmit bit makes a 0→1 transition.
- Bit 3, Velocity at Zero - Set to '1' if the velocity data equals zero. This bit is set even if the velocity data is not being transmitted to the host by the NXEE2.
- Bit 2, Motion Direction - Set to '0' if motion is increasing. Set to '1' if motion is decreasing. This bit stays in its last state if there is no motion.
- Bit 1, Reserved - This bit will always equal "0".
- Bit 0, Reserved - This bit will always equal "0".

Notes

CONFIGURING NETWORK INTERFACES

This section lists suggestions for configuring the network interfaces on your computer or laptop before attaching to the NXEE2.

Firewall Settings

Firewalls are hardware devices or software that prevent unwanted network connections from occurring. Firewall software has been present on Windows based computers since XP, and it may prevent your computer from communicating with the NXEE2. The internal webserver uses port 80, which is the default http port, and should work without changing any firewall settings. Configuring your firewall to allow communication with the NXEE2 is beyond the scope of this manual.


Disable All Unused Network Interfaces

Routing and default gateway setting on your computer might prevent connection to the NXEE2. When using the Net Configurator utility, broadcast packets that are used to find the NXEE2 often go out the wrong port. The easiest way to avoid this problem is to temporarily disable all network interfaces that are not attached to the NXEE2.

This includes all wireless interfaces as well as all Bluetooth interfaces.

Configure Your Network Interface

Before you can communicate with the NXEE2, your network interface must be on the same subnet as the encoder.

NOTE  The rest of this procedure assumes you are using the 192.168.0.xxx subnet. If you are not, you will have to adjust the given network addresses accordingly.

The easiest way to check the current settings for your NIC is with the 'ipconfig' command.

- For Windows 7, click on the [Start] button, and type "cmd" in the "Search programs and files" text box. Press [Enter] on the keyboard.
- For Windows 8 and 10, press the [Win+X] keys and select "Command Prompt" from the resulting popup. There is no need to run the command prompt as the administrator, so do not select "Command Prompt (Admin)".

Configure Your Network Interface (continued)

A DOS like terminal will open. Type in ‘ipconfig’, press [Enter] on the keyboard and the computer will return the present Address, Subnet Mask, and Default Gateway for all of your network interfaces. If your present address is 192.168.0.xxx, where ‘xxx’ does not equal 50, and your subnet mask is 255.255.255.0, then you are ready to configure your NXEE2 module. Figure R3.1 shows the output of an ipconfig command that shows the “Local Area Connection 2” interface on the 192.168.0.xxx subnet.

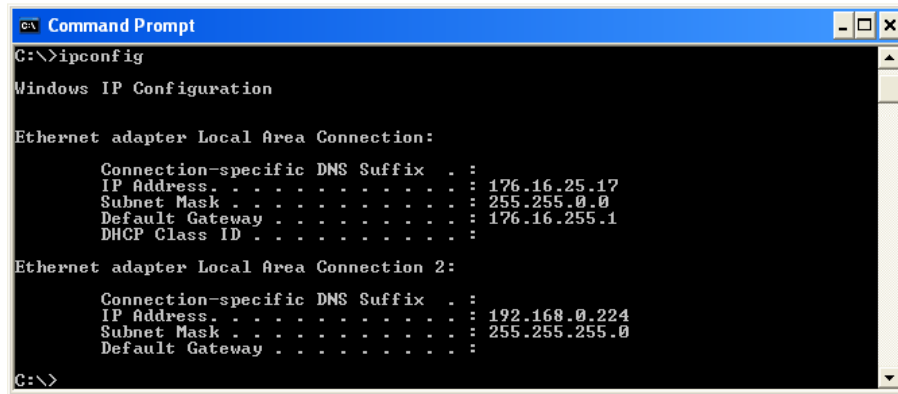


Figure R3.1 ipconfig Command

If your present address is not in the 192.168.0.xxx range, type in ‘ncpa.cpl’ at the command prompt and hit [Enter] on the keyboard.

- For Windows 7, this open the *Network Connections* window. Double click on the appropriate interface. In the window that opens, select “Internet Protocol Version 4 (TCP/IP v4)” from the list and then click on the [Properties] button.
- For Windows 8 and 10, this open the *Network Connections* window. Double click on the appropriate interface. In the window that opens, select “Internet Protocol Version 4 (TCP/IP v4)” from the list and then click on the [Properties] button.

Set the address and subnet mask to appropriate values. (192.168.0.1 and 255.255.255.0 will work for an NXEE2 that has factory default settings.) The default gateway and DNS server settings can be ignored.

Test Your Network Interface

Going back to the terminal you opened in the last step, type in ‘ping aaa.bbb.ccc.ddd’ where ‘aaa.bbb.ccc.ddd’ in the IP address of the NXEE2. The computer will ping the unit and the message “Reply from aaa.bbb.ccc.ddd: bytes=32 time<10ms TTL=128” should appear four times.

If the message “Request timed out.” or “Destination host unreachable” appears, then one of four things has occurred:

- You set a new IP address, but have not yet cycled power to the NXEE2
- You did not enter the correct address in the ping command.
- The IP address of the NXEE2 is not set correctly.
- The NXEE2 and the computer are not on the same subnet.

TASK 1

INSTALLING THE NXEE2

This chapter covers the physical installation of the NXEE2.

1.1 Safe Handling Guidelines

1.1.1 Prevent Electrostatic Damage

CAUTION

Electrostatic discharge can damage the NXEE2 if you touch connector pins. Follow these guidelines when handling the module.

- 1) Touch a grounded object to discharge static potential before handling the module.
- 2) Work in a static-safe environment whenever possible.
- 3) Wear an approved wrist-strap grounding device.
- 4) Do not touch the pins of the rear, I/O, or Ethernet connectors.
- 5) Do not disassemble the module
- 6) Store the module in its anti-static bag and shipping box when it is not in use.

1.1.2 Prevent Debris From Entering the Module

WARNING

During DIN rail mounting of all devices, be sure that all debris (metal chips, wire strands, tapping liquids, etc.) is prevented from falling into the module. Debris may cause damage to the module or unintended machine operation with possible personal injury. The DIN rail for the modules should be securely installed and grounded before the modules are mounted on it.

1.1.3 Remove Power Before Servicing

WARNING

Remove power before removing or installing the NXEE2 module.

1.2 Mounting

1.2.1 DIN Rail Installation

NXEE2 modules can be mounted on following DIN Rail

- EN 05 022 - 35 x 7.5 (35 x 7.5 mm)
- EN 05 022 - 35 x 15 (35 x 15 mm)

The DIN Rail must be securely mounted to a panel and solidly grounded before the modules are installed. Grounding is usually accomplished through the mounting hardware, by first removing any paint or other material from all surfaces that may interfere with proper grounding. Another option is to install a heavy gauge wire from the DIN rail to your system's ground bus.

When installing the 7.5mm deep DIN rail there is a 0.40 inch clearance for bolt heads between the rail and the NXEE2 module. When installing a module on 15mm deep rail, the clearance is 0.70 inches.

1.2 Mounting (continued)

1.2.2 Dimensions

Figure T1.1 shows the dimensions of the NXEE2 module. The NXEE2 module is a low power module that does not require any additional spacing when mounting the unit.

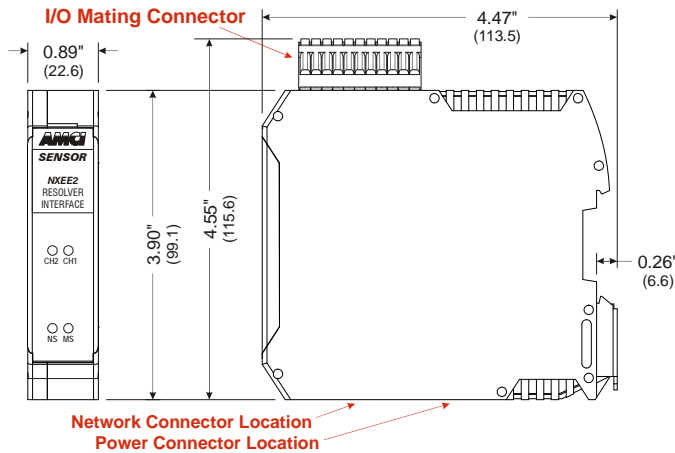


Figure T1.1 NXEE2 Outline

NOTE You will need to ground the cable shields at the module. There are two pins on the I/O Mating Connector to ground the shields, but you have the option to ground them on the DIN rail.

1.2.3 Mounting the NXEE2 Module

CAUTION If replacing an AMCI AnyNET-I/O ANE2 or ANE2E SSI Interface Module with an NXEE2 module, remove any IC-5 backplane connectors from the DIN rail before installing the NXEE2 module. These connectors are not necessary. Additionally, connecting AnyNET and mini-Nexus modules may damage either of them.

Mounting the NXEE2 on a DIN rail is a very simple process thanks to the design of the enclosure.

- 1) Partially engage the connector into the enclosure.
- 2) Engage the top clip in the enclosure with the top of the DIN rail and rotate the module down until the metal bracket snaps on to the DIN Rail.

Once all of your modules are installed, it is strongly suggested to use the end caps from Phoenix Contact with the part number of 271 37 80 to secure the modules on the DIN Rail. These end caps prevent the module from sliding along the DIN rail if it is subjected to shock or vibration during machine operation.

1.3 Power Wiring

The NXEE2 accepts 24 to 48 Vdc as its input power. Maximum power draw is 2 watts (83 mA @ 24 Vdc). This does not include the power draw of the SSI sensor. If the sensor is powered from the NXEE2, add its power requirements when determining the size of the power supply. The mating connector accepts 24 to 12 AWG wire. Consult the electrical code in your area for minimum allowable wire size.

As shown in the figure below, the power connector is located on the bottom of the module. The mating connector is included with the NXEE2. Spares are available from AMCI under the part number MS-4N. They are also available from Phoenix Contact under their part number 187 80 37.

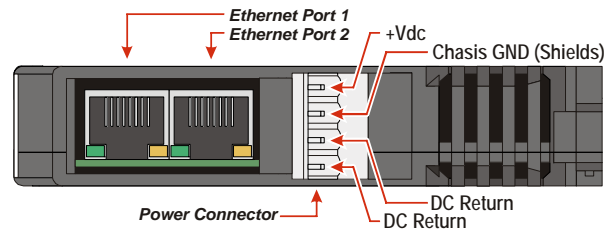


Figure T1.2 Power Connector Location

Power connections should be tight, as loose connections may lead to arcing which will heat the connector. Phoenix Contact specifies a tightening torque of 4.4 to 5.4 lb-in (0.5 to 0.6 Nm).

The power supply is connected to the pins marked “+Vdc In” and “DC Return”. The “Chassis GND” pin is used to attach the NXEE2 to earth ground.

1.4 Network Connections

As shown in figure T1.2 above, the NXEE2 modules have two Ethernet ports with a built-in Ethernet switch connecting the two. In non-redundant applications, either port can be used to attach the module to the network. The remaining port can be used to extend the network to another device if this would reduce wiring costs.

1.4.1 EtherNet/IP DLR Applications

In Device Level Ring applications, the NXEE2 modules function as Beacon-Based Ring Nodes. In these applications, both ports are used when wiring the ring, daisy chaining from one unit in the ring to the next.

1.4.2 PROFINET MRP Applications

In Media Redundancy Protocol applications, the NXEE2 modules function as a Media Redundancy Client (MRC). In these applications, both ports are used when wiring the ring, daisy chaining from one unit in the ring to the next.

1.5 I/O Connector Pin Out

The I/O Connector is located on the top of the module. The mate for this connector is included with the NXEE2. Spares are available from AMCI under the part number MS-2X11 and are also available from Phoenix Contact under their part number 173 88 98. Figure T1.3 shows the pin out for the I/O connector.

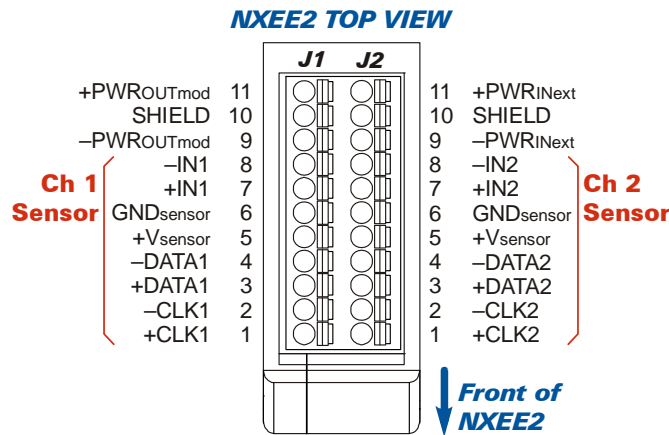


Figure T1.3 I/O Connector

1.6 SSI Transducer Wiring

The following diagram shows how to wire an SSI sensor to channel 1 of the NXEE2. Wiring to channel 2 is identical. Wire colors are not shown in the diagram because they are not standardized for SSI sensors. Refer to the documentation that is available for your sensor to determine the correct color code.

NOTE The diagram shows a cable with a single overall shield. If your cable has individually shielded pairs, then all of the shields can be terminated to the SHIELD pin. The two SHIELD pins, J1-10 and J2-10, are directly connected to the Chassis GND pin of the power connector. If the shields cannot be terminated to the J1-10 and J2-10 pins of the I/O connector, you can terminate them to your grounded DIN rail at the same point the NXEE2 is connected to it.

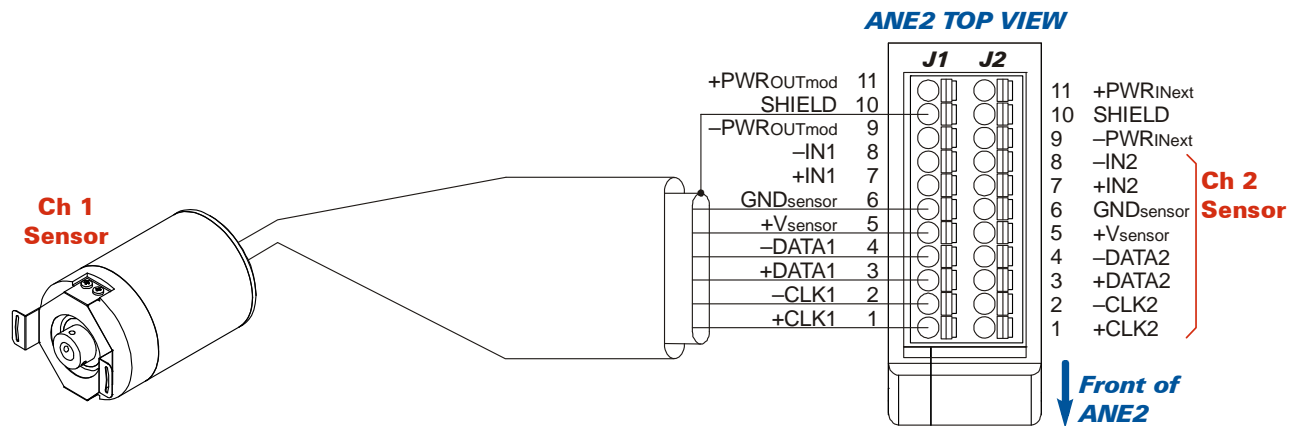


Figure T1.4 SSI Sensor Wiring

1.6 SSI Transducer Wiring (continued)

1.6.1 AMCI DC25 SSI DuraCoder Wiring

Table T1.1 below lists wire colors of the CSL-(x) cable for the AMCI DC25 SSI DuraCoder along with connections to the NXEE2.

Signal	CSL-(x) Wire Color	Pin # J1 for CH1 J2 for CH2	Notes
GNDsensor	BLU/RED	6	See <i>Powering the SSI Sensor</i> on page 30 for additional information on powering the sensor.
+Vsensor	RED/BLU	5	
-Data	WHT/BLU	4	
+Data	BLU/WHT	3	
-CLK	WHT/ORN	2	
+CLK	ORN/WHT	1	
SHIELD	Bare Wire	10 or DIN rail	Shield must be connected to chassis ground. If wire will not fit in pin 10, attach to grounded DIN rail.
Reset	GRY/WHT	No Conn.	100mS positive pulse resets position to zero.
Count Dir.	WHT/GRY	See Note	Float, or connect to GNDsensor for CW increasing. Connect to +Vsensor for CCW increasing
-RS485 Tx	WHT/GRN	No Conn.	Serial interface used during DC25 configuration.
+RS485 Tx	GRN/WHT	No Conn.	Serial interface used during DC25 configuration.
-RS485 Rx	WHT/BRN	No Conn.	Serial interface used during DC25 configuration.
+RS485 Rx	BRN/WHT	No Conn.	Serial interface used during DC25 configuration.

Table T1.1 DC25 SSI DuraCoder Wiring

1.6.2 Extending the Sensor Cable

Your sensor manufacturer should have a suggested cable if you need to extend the sensor cable. If you cannot find a suggested cable, the following Belden cables can be used. Three is the minimum number of pairs needed for an SSI sensor. If your sensor has additional signals, then choose a cable with additional pairs. AMCI uses Belden 1423A or equivalent for our CSL-(x) cable.

Belden #	# of Pairs
1420A	3
1421A	4
1422A	5
1423A	6

Table T1.2 Suggested Extension Cables

1.6 SSI Transducer Wiring (continued)

1.6.3 Avoiding Ground Loops

A ground loop occurs when the shields of a cable are attached to earth ground in two places. It is possible, and the likelihood increases as the cable length increases, for these two earth ground points to have a voltage potential between them. The shield acts as a low impedance path between the two points which results in a constant current flowing through the shield. To avoid a ground loop, the cable shields must not be grounded in two places.

- ▶ If the shield of the transducer cable is isolated from the body of the SSI sensor, connect the shield of the cable to the shields of the extension cable and ground the shield at the NXEE2. Treat the shield of the sensor cable as a signal carrying conductor and do not connect it to earth ground at any other point.
- ▶ If the shield of the cable is connected to the body of the SSI sensor, but the body of the sensor is isolated from chassis ground by its mounting, connect the shield of the sensor cable to the shields of the extension cable and ground the shield at the NXEE2. Treat the shields of the sensor cable and the extension cable as signal carrying conductors and do not connect them to earth ground at any junction point.

1.7 Powering the SSI Sensor

The SSI sensor interface electronics are electrically isolated from the rest of the NXEE2 module. This gives you the ability to power the sensor with a different supply than the module.

In order to power the sensors, you must apply power to the \pm PWRInext pins. The sensor is then powered from the +Vsensord and GNDsensord pins.

- ▶ To power the NXEE2 and the sensor from the same supply, jumper the \pm PWRoutmod pins to the \pm PWRInext pins. (Pin J1-9 to J2-9 and pin J1-11 to J2-11.)
- ▶ To power the sensor from an external supply, wire the supply directly into the \pm PWRInext pins, J2-9 and J2-11.

CAUTION

If the voltage used to power the NXEE2 is higher than the sensor can accept, you must use an external supply to power the sensor. Jumpering \pm PWRoutmod to \pm PWRInext in this case will damage your SSI sensor.

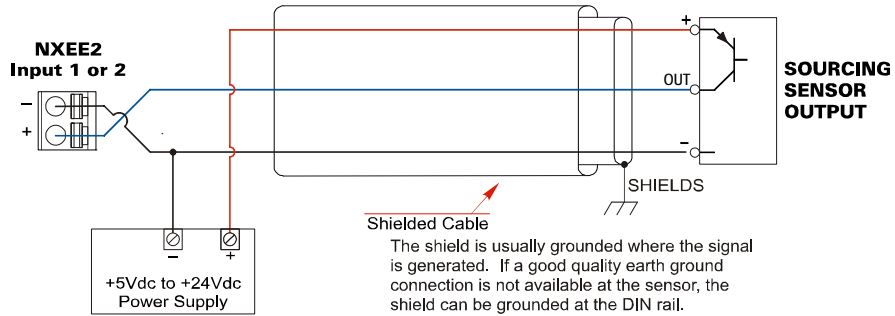
1.7.1 Actual SSI Data is all 1's

Because of the design of the NXEE2, the \pm Data input circuitry outputs a logic 1 to the NXEE2 processor when an SSI sensor is not attached to the channel, or when the sensor is not powered. The Actual SSI data will change to $(2^x - 1)$ where 'x' is equal to the Number of SSI Data Bits parameter. If you know that your sensor will not output these values under normal operating conditions, you can use these values for error checking.

1.8 Input Wiring

Each channel has a differential DC input that can be programmed to preset the Data Value, capture the Data Value, or as a general purpose input. Each input is a fully differential, opto-isolated input. They accept 3.5 to 27Vdc (5 Vdc to 24 Vdc nominal), without the need for an external current limiting resistor. Figure T1.5 below shows how to wire discrete DC sourcing and sinking sensors to inputs 1 and 2 of the NXEE2.

NXEE2 Connection to Sourcing Sensor Output



NXEE2 Connection to Sinking Sensor Output

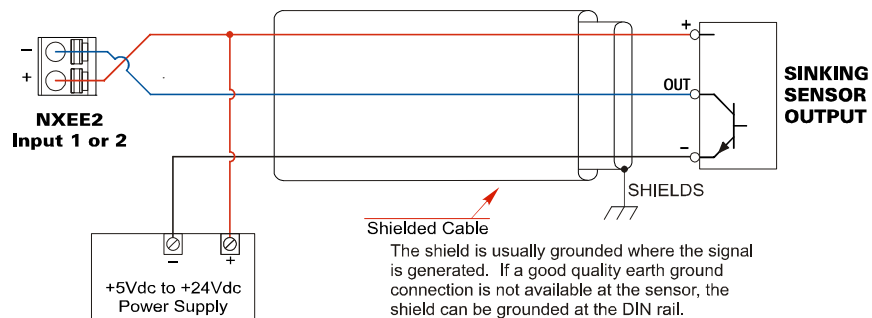


Figure T1.5 Input Wiring

1.8.1 Cable Shields

Because they are low power signals, cabling from a sensor to the NXEE2 should be done using a twisted pair cable with an overall shield. The shield should be grounded at the end when the signal is generated, which is the sensor end. If this is not practical, the shield should be grounded to the same ground bus as the NXEE2.

Notes

TASK 2

SET THE IP ADDRESS AND PROTOCOL

This section is intended for the engineer or technician responsible for setting the IP address of an AMCI NXEE2.

2.1 Determine the Best Method for Setting the IP Address

There are three methods for setting the IP address on an NXEE2. Table T2.1 below outlines the available methods and when you can use them.

Method	Restrictions	Section
<i>Use Factory Default Settings</i>	1) The machine must use 192.168.0.xxx subnet. 2) The 192.168.0.50 address must be available.	2.2a
<i>Use the Embedded Web Server</i>	No restrictions on use. This is the preferred method. The internal webserver can be used to set the NXEE2 to any IPv4 address. The IP address and protocol will be stored in nonvolatile memory and used on subsequent power-ups.	2.2b
<i>Use the AMCI NET Configurator Utility</i>	No restrictions on use. The software can be used to set the NXEE2 to any IPv4 address. The IP address and protocol choice will be stored in nonvolatile memory and used on subsequent power-ups.	2.2c

Table T2.1 Methods for Setting the IP Address

NOTE 

There is a MAC address label on each NXEE2 which has a writable surface. There is room on the label for writing the programmed IP address of the unit. It is a best practice to use this label to document the IP address of the unit in case it is ever repurposed.

NOTE 

In order to conform to the ODVA specification for EtherNet/IP, the NXEE2 also supports the DHCP protocol. You will need an EtherNet/IP DHCP server, such as the one available from Rockwell Automation, in order to use this protocol. It is supported, but AMCI encourages you to use the embedded web server if your company policy prevents you from installing third-party software, such as the AMCI NET Configurator.

2.2a Use Factory Default Settings

The factory default address for the NXEE2 is 192.168.0.50 with a subnet mask of 255.255.255.0. The easiest way to verify this address is with the ping command as described in the section *Configure Your Network Interface* which starts on page 23.

If the module does not respond to this address then it may take some effort to determine the correct address. There is a label on the unit that lists the MAC address of the device. There is space on the label for noting the IP address of the device if it is changed. If the address was not documented, a program called Wireshark (<https://www.wireshark.org/>) can be used to determine the address of the unit. An FAQ is available on the AMCI website that gives simple instructions on using wireshark to determine the IP address. At the time of the manual's release, a direct link to the FAQ is:

- https://www.amci.com/files/3315/7652/6333/FAQ_Determining_unknown_IP_address.pdf

Task Complete

2.2b Use the Embedded Web Server

PREREQUISITE: You must know the present IP address of the NXEE2. The factory default address is 192.168.0.50.

PREREQUISITE: Task 1.3: *Power Wiring*, found on page 27. You must be able to power the NXEE2.

PREREQUISITE: Task 1.4 *Network Connections*, found on page 27. You must attach your NXEE2 to your computer.

PREREQUISITE: Reference 3: *Configuring Network Interfaces*, which starts on page 23. The network interfaces on your computer must be on the same subnet before you can communicate with an NXEE2.

2.2b.1 Disconnect the NXEE2 from the host controller and cycle power to the NXEE2.

This ensures that the unit does not have any open connections to the host controller.

2.2b.2 Start your web browser and connect to the NXEE2

The internal HTML pages should work with any browser. Once your web browser is running, enter the present IP address of the NXEE2 into the address bar. The default address is 192.168.0.50. The unit will respond with the following page. Note that the Firmware Version number may be different.

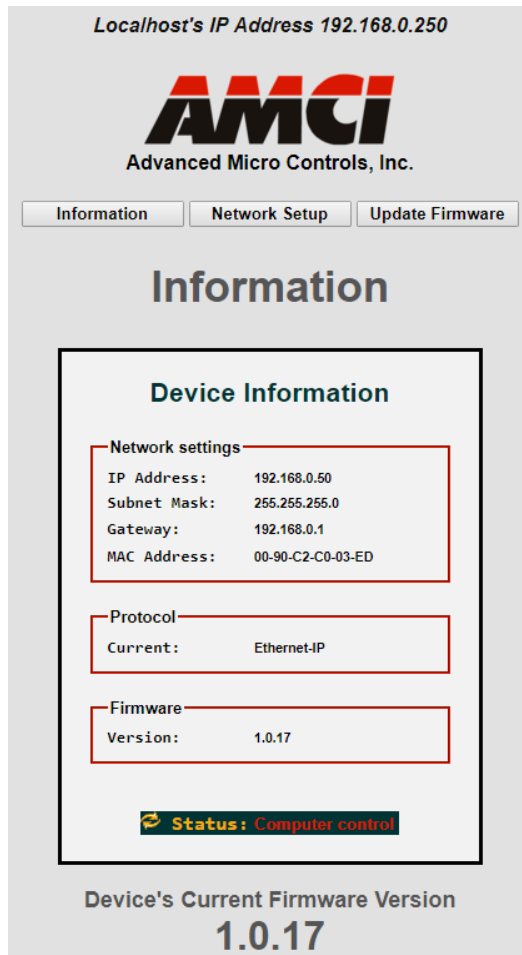


Figure T2.1 NXEE2 Information Webpage

2.2b Use the Embedded Web Server (continued)

2.2b.3 Network Setup Page

- 1) Click on the [Network Setup] button to switch to the Network Setup page shown below. This page shows the current IP address settings, as well as the configured protocol.

Figure T2.2 NXEE2 Network Setup Web Page

- 2) Enter your desired values into the IP Address, Subnet Mask, and Default Gateway fields.

NOTE ⚠ The Default Gateway setting is not optional! It must be set to a valid address on the chosen subnet. Because the Default Gateway is often not used in device level networks, if you do not have a required value for it, AMCI suggests setting the Default Gateway to the IP address of your host controller.

- 3) If need be, click on the proper radio button to select the required protocol.
- 4) Click on the [Write Configuration] button to write the new configuration to the unit. If there are any errors with the data, the unit will display a warning message instead of accepting the new values.

2.2b Use the Embedded Web Server (continued)

2.2b.3 Network Setup Page (continued)

5) If the values are accepted, the following pages will be displayed while the data is being written to the unit.

NOTE ⚠️ Wait for the pop up window to appear before cycling power to the NXEE2. Cycling power before this window appears may corrupt the non-volatile memory of the NXEE2. The NXEE2 will also flash the Network Status LED red to indicate that power must be cycled.

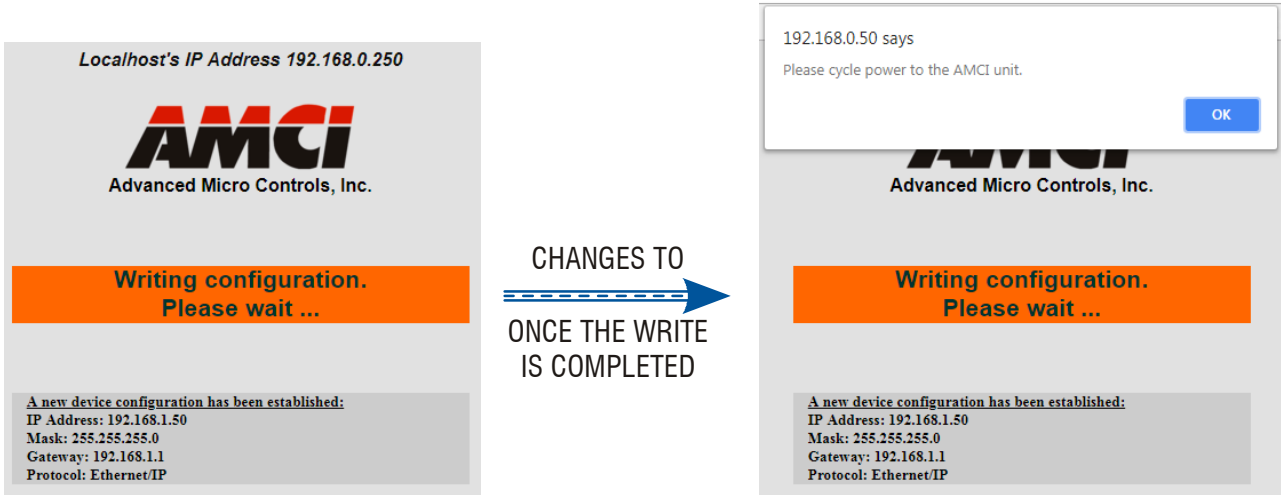


Figure T2.3 Write Configuration to Flash Memory Pages

6) Once instructed to, cycle power to the unit. You can now enter the new IP address into the address bar of your web browser to reconnect with the NXEE2.

Task Complete

2.2c Use the AMCI NET Configurator Utility

PREREQUISITE: You must know the present IP address of the NXEE2. The factory default address is 192.168.0.50.

PREREQUISITE: Task 1.3: *Power Wiring*, found on page 27. You must be able to power the NXEE2.

PREREQUISITE: Task 1.4 *Network Connections*, found on page 27. You must attach your NXEE2 to your computer.

PREREQUISITE: Reference 3: *Configuring Network Interfaces*, which starts on page 23. The network interfaces on your computer must be on the same subnet before you can communicate with an NXEE2.

2.2c.1 Download the AMCI Net Configurator Utility

The AMCI Net Configurator utility is available on our website, www.amci.com. The latest version available should be used. It can be found in the *Support* section under *Software*. The program exists as a ZIP file, and at the time of this writing, the link was “AMCI NET Configurator Utility for all networked products...”.

2.2c.2 Install the AMCI Net Configurator Utility

Once downloaded, simply extract the program from the ZIP file and run the program to install the AMCI Net Configurator utility on your computer. The software installs as most products do, giving you the option to change the file locations before installing the utility. Once the install is complete, a link to the utility is available on the Start Menu.

The install process only copies the utility to the designated location and creates links to the Start Menu. No changes are made to your registry settings.

2.2c Use the AMCI Net Configurator Utility (continued)

2.2c.3 Verify that Your Host Controller is Disconnected from the NXEE2

In order to program the NXEE2, the AMCI Net Configurator utility must act as a bus master. Therefore, physically disconnect your host controller from the NXEE2 before starting the Net Configurator utility. Conflicting commands from the Net Configurator utility and the host controller will prevent the NXEE2 from communicating properly with either bus master.

2.2c.4 Apply or Cycle Power to the NXEE2

Cycling power to the NXEE2 will reset any connections it may have with the host controller.

2.2c.5 Start the AMCI Net Configurator Utility

Double click on the utility’s icon. A welcome screen similar to the one in figure T2.4 below will appear.

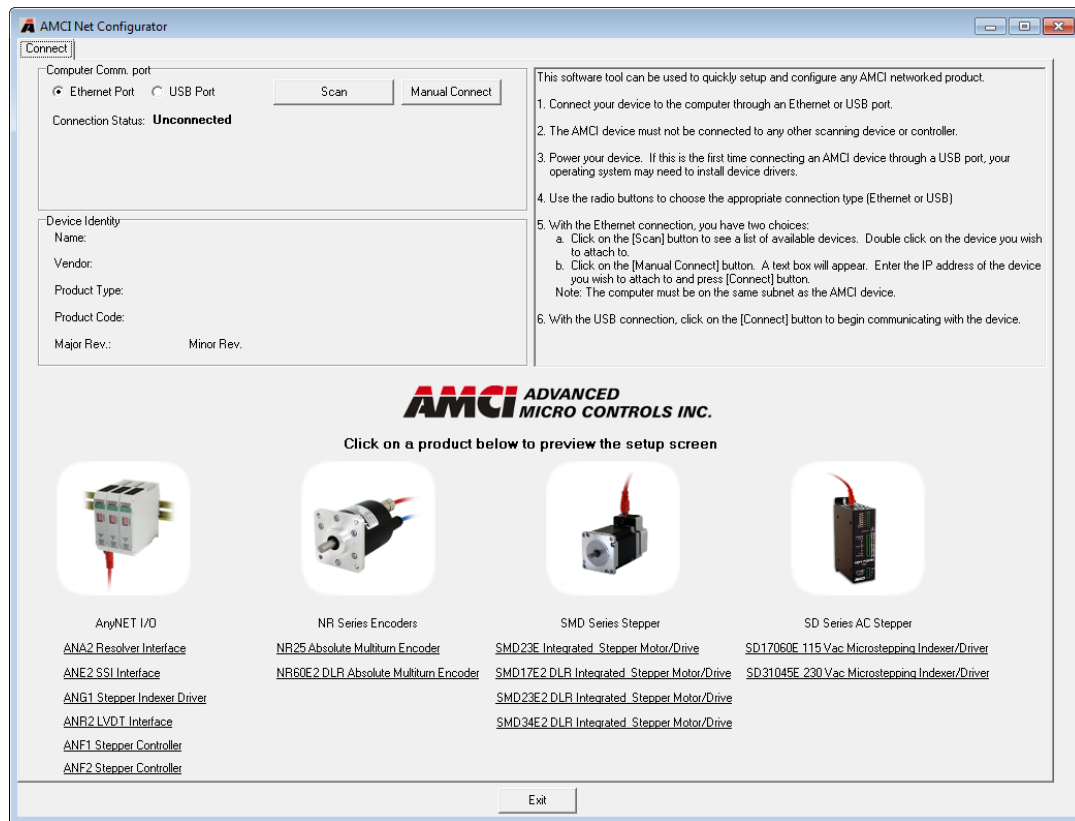


Figure T2.4 Net Configurator Welcome Screen

2.2c Use the AMCI Net Configurator Utility (continued)

2.2c.6 Press the [SCAN] button and Connect to the NXEE2

Pressing the [Scan] button will open the window shown in figure T2.5. The NXEE2 will appear in the scan list only if the unit and your network interface are on the same subnet. Optionally, you can press the [Manual Connect] button and enter the IP address of the NXEE2.

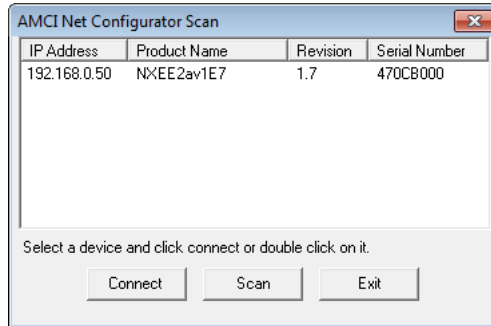


Figure T2.5 Scan for NXEE2

If scanning for the NXEE2, click on the IP Address of the module and click on the [Connect] button. The Net Configurator utility will connect to the unit.

2.2c.7 Click on the "Allow IP..." Checkbox to Access the IP Settings

Figure T2.6 below shows the screen that results when you are connected to the NXEE2. In order to change the IP Address of the unit, you must first click on the checkbox next to the text "Allow IP configuration changes. You will need to restart the device." Once the checkbox is selected, the [Set IP Address] button will be enabled.

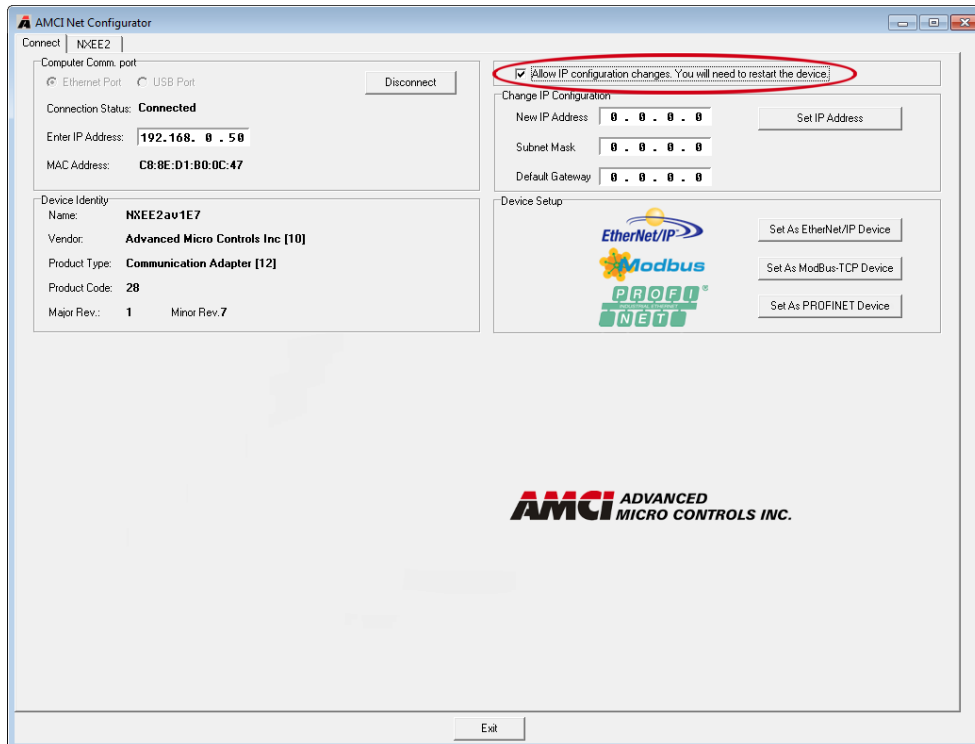


Figure T2.6 Enable IP Address Changes

2.2c Use the AMCI Net Configurator Utility (continued)

2.2c.8 Set the IP Address, Subnet Mask, and Default Gateway

Enter your desired values into the IP Address, Subnet Mask, and Default Gateway fields.



The Default Gateway setting is not optional! It must be set to a valid address on the chosen subnet. Because the Default Gateway is often not used in device level networks, if you do not have a required value for it, AMCI suggests setting the Default Gateway to the IP address of your host controller.

2.2c.9 Set the Communications Protocol

The factory default protocol for the NXEE2 is EtherNet/IP. In order to use the Modbus TCP or PROFINET protocols, simply click on the appropriate button.

2.2c.10 Write the New IP Address to the NXEE2

Click on the [Set IP Address] button. If there is an error in the settings, the utility will tell you what is wrong. Once all of the settings are correct, the utility will write the new IP address settings to the unit. These settings are automatically saved to nonvolatile memory.

2.2c.11 Remove Power from the NXEE2

The new IP address will not be used until power to the NXEE2 has been cycled.

Task Complete

Notes

PROTOCOL SPECIFIC INFORMATION

Manual Sections

The remainder of this manual is divided into three sections, one for each supported protocol. Each section has the protocol name in the page header.

Starting Pages

EtherNet/IP protocol: Page 43

Modbus TCP protocol: Page 61

PROFINET protocol: Page 65

Notes

IMPLICIT COMMUNICATIONS WITH AN EDS

Many EtherNet/IP platforms support the use of EDS files to simplify the addition and configuration of devices. This chapter covers the installation and use of the EDS file for systems that are programmed with Rockwell Automation Studio 5000 version 20 and above. Other systems will follow a similar pattern. Consult your controller's documentation if you need additional information.

Note: Use of an EDS file is completely optional. The NXEE2 can always be added to a system as a generic module. If you are using RSLogix 5000 version 19 and below, or RSLogix 500, adding the unit as a generic device is the only option available.

Using the EDS file simplifies configuration by sizing the configuration values appropriately.

3.1 Obtain the EDS file

All AMCI EDS files are located on our website at the following address:

➤ <http://www.amci.com/industrial-automation-support/configuration-files/>

Products are listed in alphabetical order. Simply download the ZIP file and extract it to its own directory. The ZIP file contains the EDS text file and a custom icon file for the device.

3.2 Install the EDS file

3.2.1 Start the EDS Hardware Installation Tool

1) Once Studio 5000 is running, in the menu bar select Tools → EDS Hardware Installation Tool. This will open the EDS Wizard.

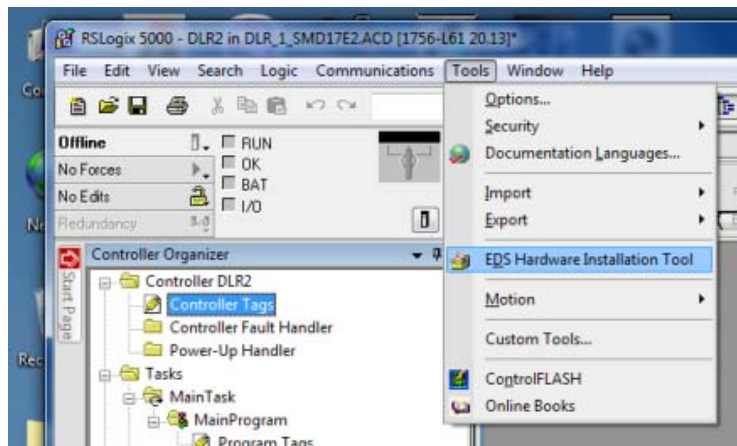


Figure T3.1 Opening the EDS Wizard

2) Click on [Next >] to advance to the Options screen.

3.2 Install the EDS file (continued)

3.2.2 Install the EDS File

1) On the Options screen, select the Register an EDS file(s) radio button and press [Next >].

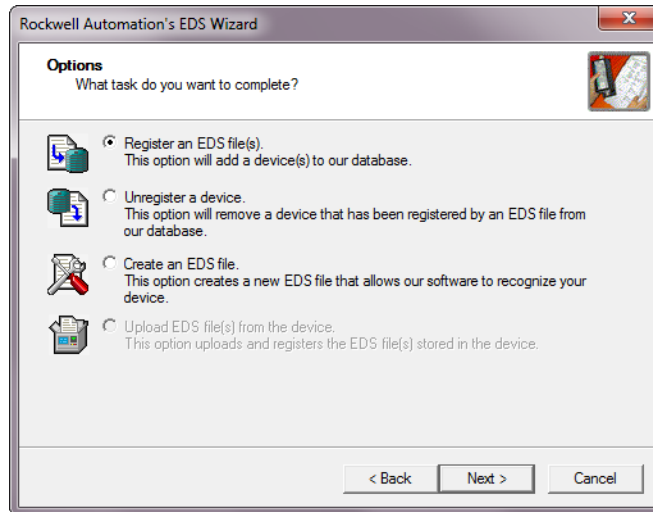


Figure T3.2 EDS Options Screen

2) The registration screen will open. Select the Register a single file radio button.

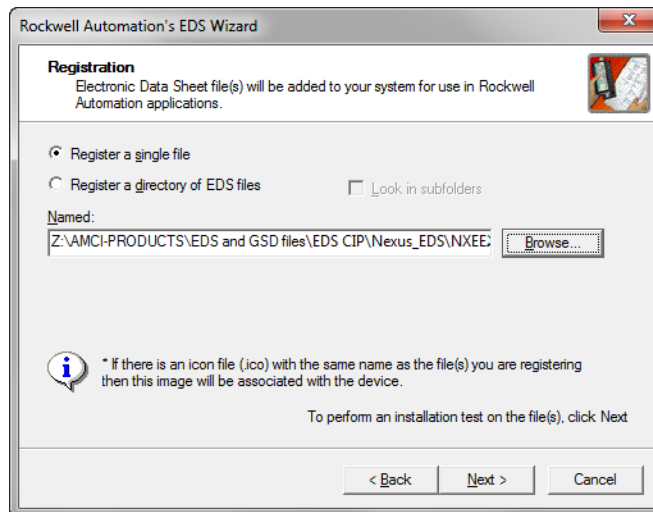


Figure T3.3 EDS Registration Screen

3) Click on the [Browse...] button and browse to the folder that contains the extracted EDS file you downloaded from the AMCI website. Select the EDS file and click on the [Open] button to return to the registration screen. Click on the [Next >] button to advance to the EDS file test screen.

3.2 Install the EDS file (continued)

3.2.2 Install the EDS File (continued)

- 4) Once at the EDS File Installation Test Results screen, expand the tree as needed to view the results of the installation test for the EDS file. You should see a green check mark next to the file name indicating that the EDS file is correct.

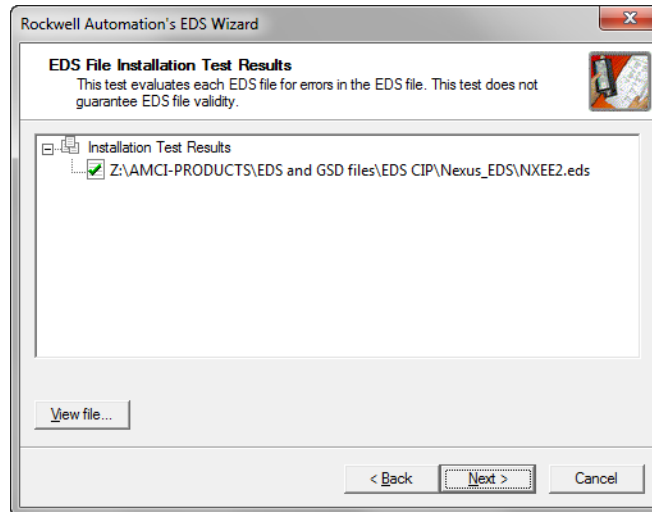


Figure T3.4 EDS Test Screen

- 5) Press on the [Next >] button to advance to the Change Graphic Image screen. This screen gives you the ability to change the icon associated with the device.

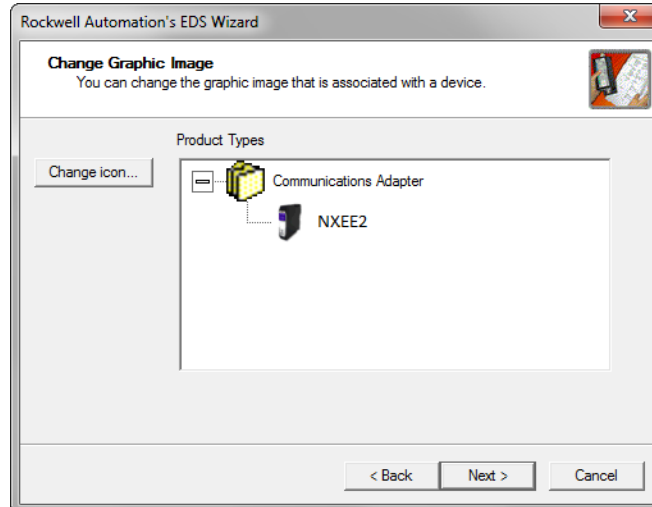


Figure T3.5 Change ECS Icon Screen

- 6) Click on the [Change icon...] button. In the window that opens, click on [Browse...] and browse to the folder that contains the extracted EDS and icon files you downloaded from the AMCI website.
- 7) Select the icon file (*.ico) associated with the device. Click on the [Open] button and then on [OK] to return to the Change Graphic Image screen.
- 8) Click on the [Next...] button to advance to the completion screen. The Completion screen tells you that you have successfully completed the wizard.
- 9) Click on the [Finish] button to exit the EDS wizard.

3.3 Host System Configuration

Studio 5000 is used to configure both the ControlLogix and CompactLogix platforms. When using these platforms, you have the option of using a separate Ethernet Bridge module or an Ethernet port built into the processor.

If the Ethernet port is built into processor, the only step you have to take before adding an AMCI NXEE2 is to create a new project with the correct processor or modify an existing project. Once this is done, the Ethernet port will automatically appear in the Project Tree. If you are using an Ethernet bridge module, you will have to add it to the I/O Configuration tree before adding the unit to your project.

Refer to your Rockwell Automation documentation if you need instructions for configuring the ethernet port.

3.4 Add the NXEE2 to Your Project

You can add an NXEE2 to the project once the Ethernet port (built-in or bridge module) is configured. As shown in figure T3.6 below, the Ethernet port will be listed under the I/O Configuration tree.

- 1) Right click on the Ethernet port and then click on “New Module...” in the pop-up menu.

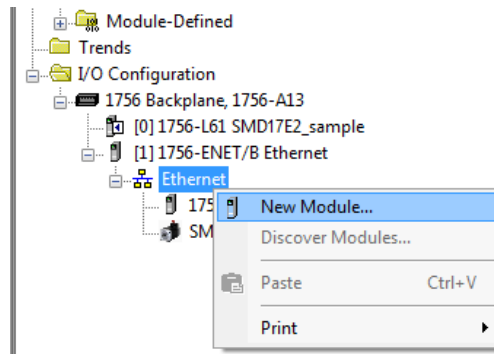


Figure T3.6 Adding an AMCI Ethernet Unit

- 2) In the resulting Select Module Type screen, select “Advanced Micro Controls Inc. (AMCI)” in the Vendor Filters. This will limit the results to catalog numbers from AMCI.
- 3) Select “NXEE2” in the resulting list.
- 4) Click on the [Create] button to create the module.
- 5) Click on [Close] if necessary to close the Select Module Type screen.

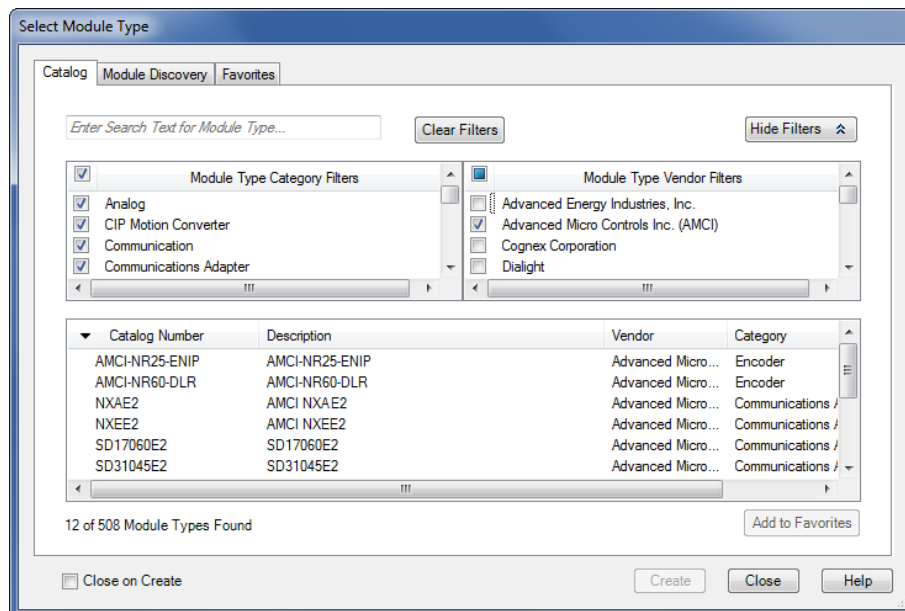



Figure T3.7 Selecting the NXEE2

3.5 NXEE2 Properties

If you are continuing from step 3.4, the resulting New Module screen is used to configure the network connection between the NXEE2 and your controller. If you need to open the screen to perform this task at a later time, right click on the unit in the project tree and then select “Properties” from the drop-down menu

NOTE  Tabs that are not listed in the steps below are filled with reasonable defaults by the EDS file.

3.5.1 General Tab

The Name, Description, and IP address of the device must be specified here. The [Change...] button allows you to change the Module Definition if needed.

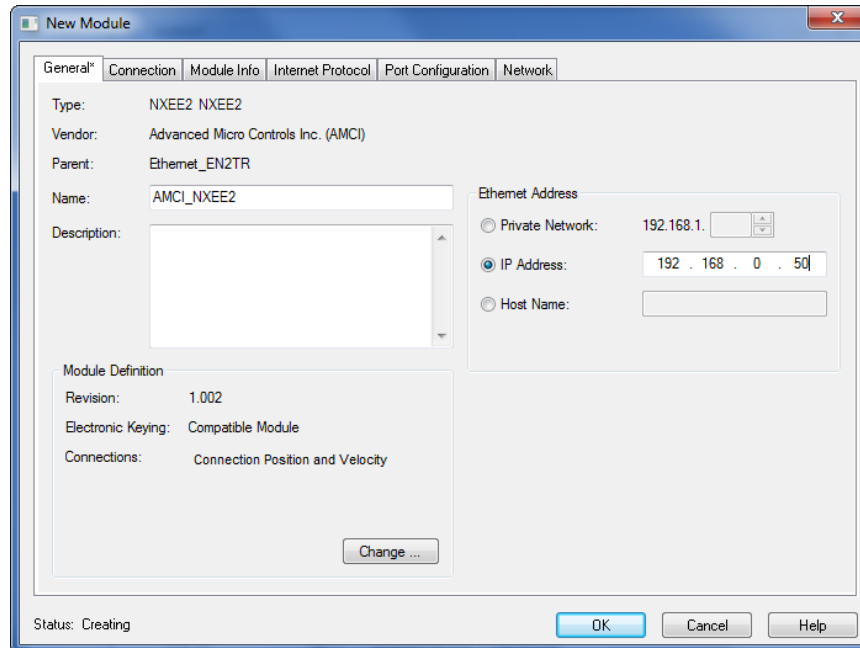


Figure T3.8 NR60E2 Properties Screen - EDS

3.5.2 Connection Tab

The default RPI time is eight milliseconds. The minimum allowable time is two milliseconds. This value can be changed in this tab.

3.5 NXEE2 Properties (continued)

3.5.3 Configuration Tab

Use the Configuration tab to eliminate the need to configure the NXEE2 through the Output Words assigned to the module. This tab is used to define configuration data that is written down to the NXEE2 whenever it connects to the EtherNet/IP network. You can also click on the [Apply] button at any time to write the configuration data to the NXEE2.

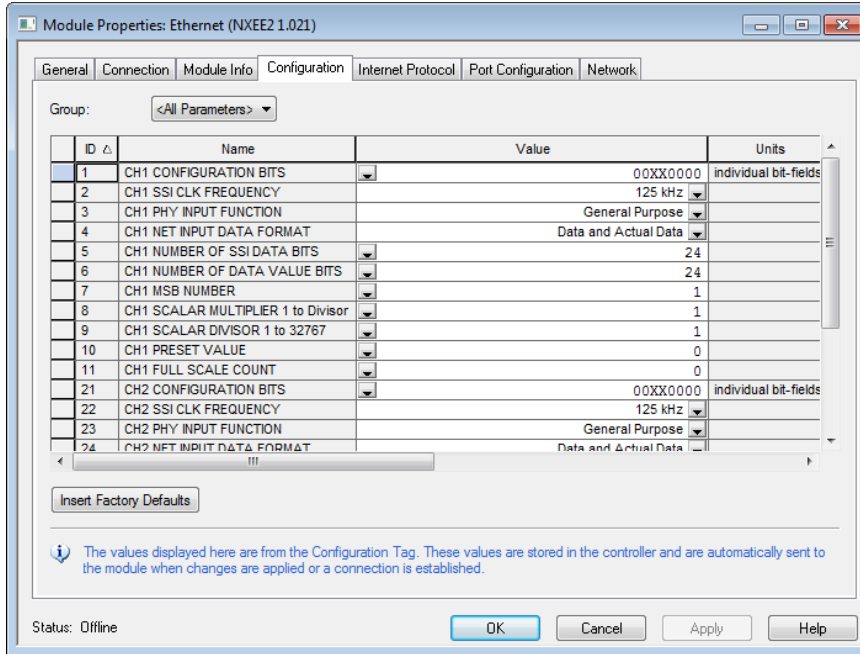


Figure T3.9 EDS Configuration Screen Example

The EDS file defines tags that follow the format of the Configuration Data given in the *Network Output Data* section of reference chapter 2 starting on page 17. Refer to that section to determine the proper format of the parameter values.

3.6 Buffering the Input Data

Input data is updated asynchronously to the program scan. The input data should be buffered with Synchronous Copy File instructions to guarantee stable data during the program scan.

The data from the NXEE2 is updated is asynchronously to the program scan. The following rung ensures that the data from the unit does not change in the middle of the ladder logic program by copying it to the internal tag array buffered_NXEE2_data[0] through buffered_NXEE2_data[9].

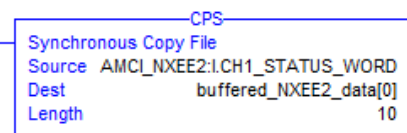


Figure T3.10 Buffer Input Data

IMPLICIT COMMUNICATIONS WITHOUT AN EDS

This chapter tells you how to configure implicit connections in EtherNet/IP systems that do not use EDS files. Implicit connections can be used to read position and velocity data from the NXEE2. Configuring the NXEE2, and presetting the position, requires explicit messaging. Refer to the next chapter for information on using message instructions for explicit messaging.

Rockwell Automation's RSLogix 5000 version 20+ software is used for the example installation in this chapter.

4.1 Host System Configuration

RSLogix 5000 is used to configure both the ControlLogix and CompactLogix platforms. When using these platforms, you will use a separate Ethernet Bridge module or an Ethernet port built into the processor.

If the Ethernet port is built into processor, the only step you have to take before adding the NXEE2 is to create a new project with the correct processor or modify an existing project. Once this is done, the Ethernet port will automatically appear in the Project Tree. If you are using an Ethernet bridge module, you will have to add it to the I/O Configuration tree before adding the unit to your project.

Refer to your Rockwell Automation documentation if you need instructions for configuring the ethernet port.

4.2 Add the NXEE2

You can add the NXEE2 to the project once the Ethernet port (built-in or bridge module) is configured.

1) Right click on the Ethernet port and then click on "New Module..." in the pop-up menu.

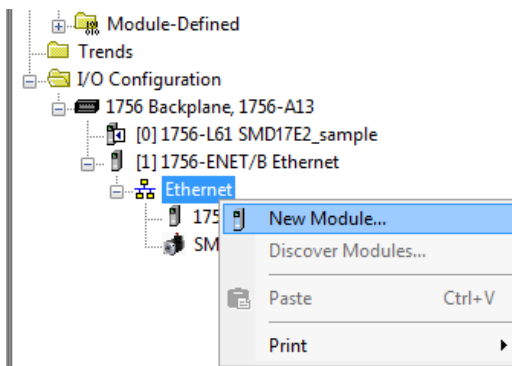


Figure T4.1 Adding an AMCI NXEE2

4.2 Add the NXEE2 (continued)

- 2) In the resulting Select Module Type screen, type “generic” into the filter as shown in figure T4.2. This will limit the results in the Catalog Number list.
- 3) Select the Catalog Number “ETHERNET-MODULE” in the list.
- 4) Click on the [Create] button to create the module.
- 5) Click on [Close] if necessary to close the Select Module Type screen.

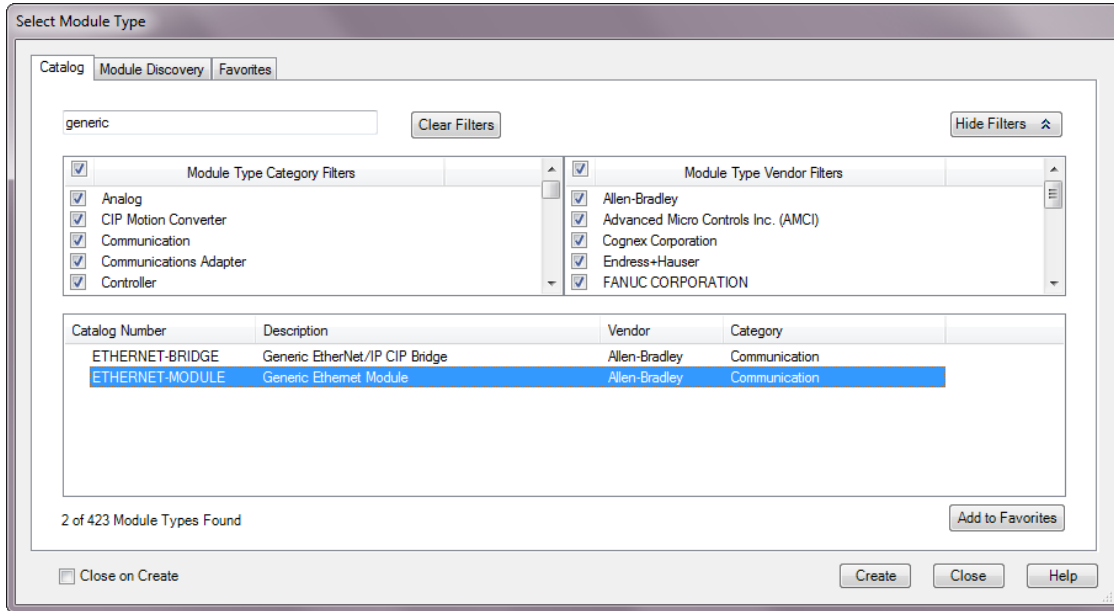


Figure T4.2 Selecting a Generic Device

4.2 Add the NXEE2 (continued)

- 6) Set the following parameters in the Module Properties window. All parameters not listed here are optional. Figure T4.3 shows a completed screen.

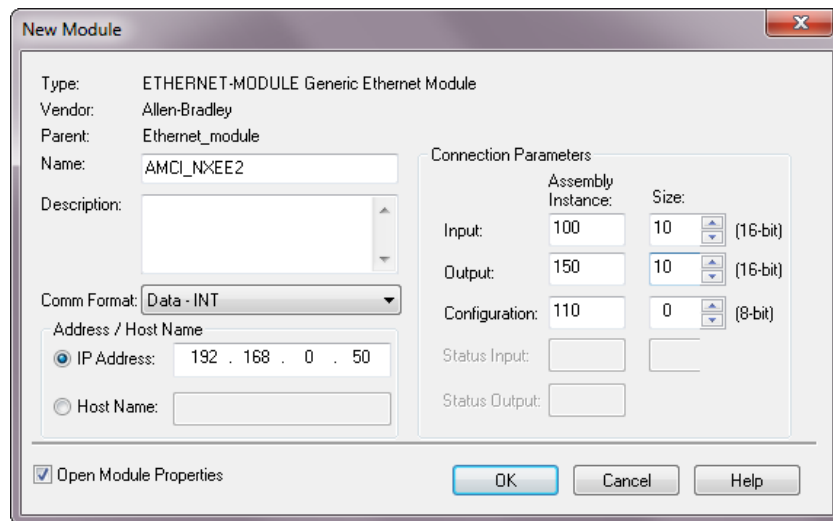


Figure T4.3 Configuration Screen - Generic Device

- **Name:** A descriptive name for the NXEE2
- **Comm Format:** Data - INT

! CAUTION

The Comm Format defaults to Data - DINT. The NXEE2 will not be able to communicate with the host controller if this format is not changed when the device is added to the system. Once added, the Comm Format cannot be changed. The device must be deleted and again added to the project if the Comm Format is incorrect.

- **IP Address:** Must be the address you set for the NXEE2. Refer to the [Set the IP Address and Protocol](#) task chapter starting on page 33 for information on setting the IP Address of the unit.
 - **Input:** Assembly Instance = 100, Size = 10 words.
 - **Output:** Assembly Instance = 150, Size = 10 words.
 - **Configuration:** Assembly Instance = 110, Size = 0 bytes.
- 7) Verify that the “Open Module Properties” check box is selected and click on [OK]. The Module Properties window will open.

4.2 Add the NXEE2 (continued)

8) Click on the “Connections” tab and set the RPI time that is required for your system. The suggested RPI time for an NXEE2 is eight milliseconds. The minimum RPI time is two milliseconds. The number of nodes on the network has an effect on the minimum RPI time. You may have to increase this RPI time if your network is heavily loaded. The remaining checkboxes can be left at their default settings. *The Unicast Connection field that is shown as checked in the figure is an optional setting.* When done, click on [OK] to complete the setup.

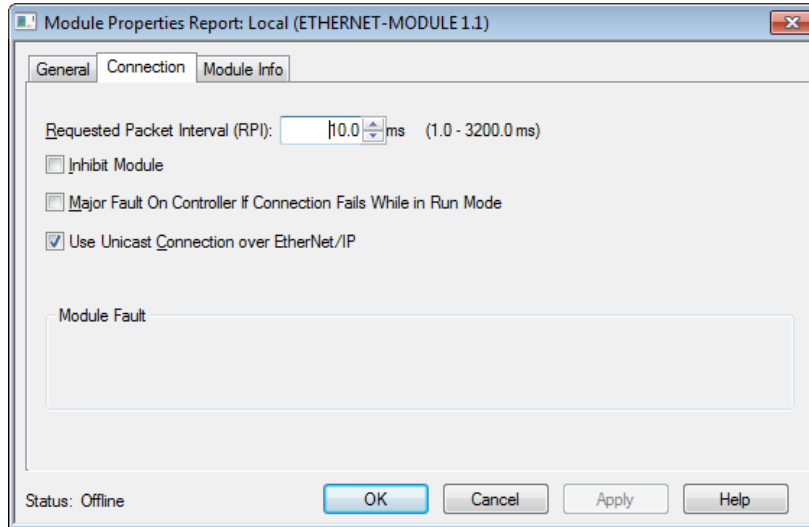


Figure T4.4 Setting the RPI Time

4.3 Check for Communication Errors

You can immediately check for errors if you are on-line with the processor while setting up the NXEE2. These error codes will appear in the Module Fault section of the Connection tab of the Module Properties window.

- **Error Code 16#0315 Connection Request Error: Invalid Segment Type.** You have specified an invalid assembly instance in the connection parameters.
- **No communications, but no error code.** Most commonly caused when the Comm Format not set to “Input Data - INT” or when the number of inputs words is incorrect.

4.4 Configure the NXEE2

The device will join the EtherNet/IP network as soon as the request is made to it. The NXEE2 will use the configuration data stored in flash memory to configure the unit on power up. You can change this configuration at anytime and store this new configuration to flash. Configuration is accomplished by writing a block of data to the device that is formatted according to the specifications in the *Data Formats* reference, starting on page 17.

It is possible to store configuration data in the flash memory of the NXEE2 using the AMCI Net Configurator software, and this configuration will be used on power up.

4.5 Buffer I/O Data

Data to and from the NXEE2 should be buffered once per scan using Synchronous Copy instructions. This is to insure stable input data during the program scan and guarantee that complete command data is delivered to the device. Ten word integer arrays can be used for this purpose.

These data tags should be buffered with Synchronous Copy File instructions to guarantee stable input data during the program scan and guarantee that complete command data is delivered to the device.

The data from the NXEE2 is updated asynchronously to the program scan. The following rung ensures that the data from the unit does not change in the middle of the ladder logic program by copying it to the internal tag array buffered_NXEE2_data[0] through buffered_NXEE2_data[9].

It is these buffered registers that should be used by your ladder logic program when referencing the data from the NXEE2.

CPS

Synchronous Copy File	
Source	AMCI_NXEE2:1:DATA[0]
Dest	buffered_NXEE2_data[0]
Length	10

Figure T4.5 Buffer I/O Data

Notes

ETHERNET/IP EXPLICIT MESSAGING

All controllers that support EtherNet/IP support explicit messaging. When using explicit messaging, Message Instructions must be added to your program to communicate with the NXEE2. Explicit messaging can be used on platforms that also support implicit messaging.

Rockwell Automation controllers which are programmed with the RSLogix 500 software only support explicit messaging. A MicroLogix 1100 will be used as an example in this chapter.

5.1 Required Message Instructions

Only two instructions are required to transfer data between the PLC and the NXEE2. One instruction reads data from the unit and the other writes data to it. The sample programs available from AMCI use this style of programming. The two instructions are alternately triggered using the instruction's ENABLE bits. The remainder of the program controls when data in the source tags of the write instruction changes. The following table gives the required attributes for the instructions.

	Read Instruction	Write Instruction
Service Type	Read Assembly	Write Assembly
Service Code	E (hex)	10 (hex)
Class	4 (hex)	4 (hex)
Instance	100 (decimal)	150 (decimal)
Attribute	3 (hex)	3 (hex)
Length	20 bytes	20 bytes

Table T5.1 Message Instruction Attributes



Only RSLogix 500 version 8.0 or above can be used to configure Message Instructions to communicate with an EtherNet/IP device. Message Instructions do not work correctly in version 10 of RSLogix 500.

5.2 Create Four New Data Files.

- An Integer file to contain the data read from the NXEE2. This file must be at least 10 words in length.
- An Integer file to contain the data written to the NXEE2. This file must be at least 10 words in length.
- A Message (MG) data file. This file must have at least two elements, one to control the Read Operation and one to control the Write Operation.
- An Extended Routing Information (RIX) data file. This file is used to store information used by the Message Instructions. This file must have at least two elements, one for the Read Operation and one for the Write Operation.

5.3 Add the Message Instructions to your Ladder Logic

The following rungs show how you can alternately read data from and write data to the unit.

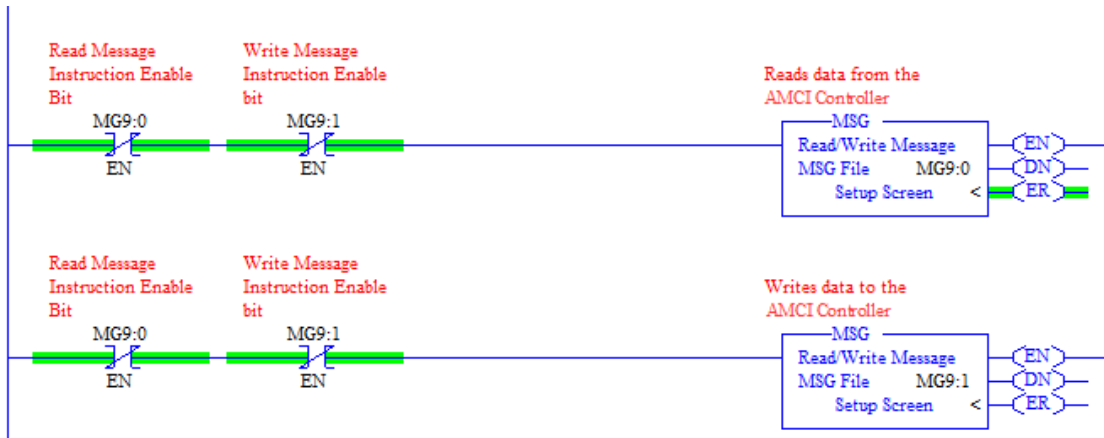


Figure T5.1 Message Instruction Example

- 1) Double click on *Setup Screen* text inside the Message Instruction. The following window will open. Note that this is the default window and its appearance will change considerably as you progress through these steps.

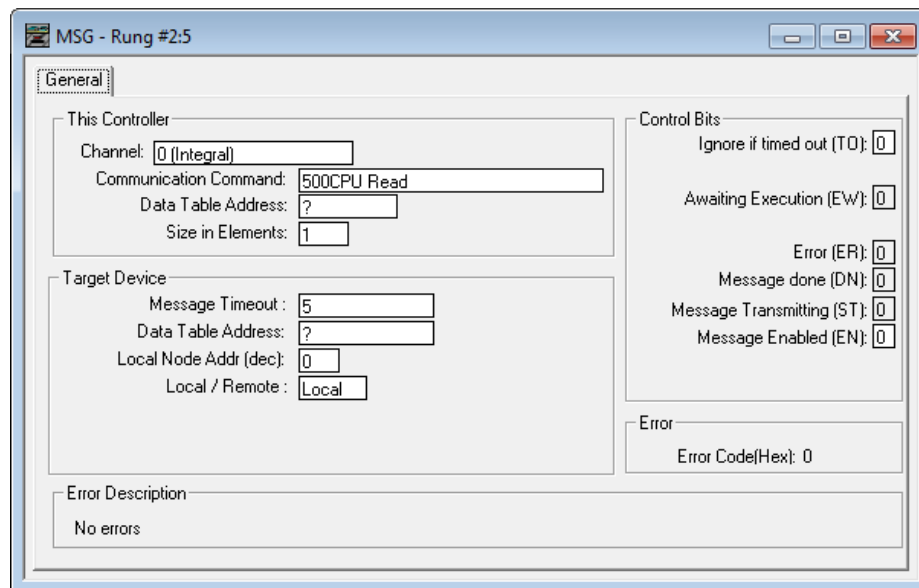


Figure T5.2 Message Instruction Setup Screen

- 2) Double click in the *Channel* field, click on the ▼, select “1 (Integral)”, and press Enter.
- 3) Double click in the *Communication Command* field, click on the ▼, select “CIP Generic” and press Enter.
- 4) If the Message Instruction is being used to read data from the NXEE2, enter the integer file where the data will be placed in the *Data Table Address (Received)* field and press enter.
- 5) If the Message Instruction is being used to write data to the NXEE2, enter the integer file where the source data will be located in the *Data Table Address (Send)* field and press Enter.
- 6) Enter “20” as the number of bytes needed in either the *Size In Bytes (Receive)* or *Size In Bytes (Send)* fields. The NXEE2 requires 20 bytes for both Receive and Send.
- 7) Enter a RIX address in the *Extended Routing Info* field. Please note that each Message Instruction must have its own RIX address.

5.3 Add the Message Instructions to your Ladder Logic (continued)

- 8) Double click in the *Service* field and select “Read Assembly” for a Message Instruction that is being used to read data from the NXEE2, or “Write Assemble” for a Message Instruction that is being used to send data to the NXEE2, and press Enter.
- 9) For *Read* operations, the *Service Code* field will change to “E” (hex). For *Write* operations, the *Service Code* field will change to “10” (hex). For both read and write operations, the *Class* field will change to “4” (hex), and the *Attribute* field will change to “3” (hex).
- 10) For Read operations, enter a value of 100 decimal (64 hex) in the *Instance* field.
For Write operations, enter a value of 150 decimal (96 hex) in the *Instance* field.

The figure below show a typical configuration for Message Instructions being used to read data from the NXEE2. Please note that the Data Table Address (Receive) field may be different in your application.

The screenshot shows the configuration window for a Read Message Instruction. The 'General' tab is selected. The 'This Controller' section includes fields for Channel (1 (Integral)), Communication Command (CIP Generic), Data Table Address (Receive: N9:0, Send: N/A), and Size in Bytes (Receive: 20, Send: N/A). The 'Target Device' section includes Message Timeout (5), Local / Remote (Local), MultiHop (Yes), and Extended Routing Info File (RIX: RIX10:0). The 'Service' section is set to 'Read Assembly' with Service Code (hex: E), Class (hex: 4, dec: 4), Instance (hex: 64, dec: 100), and Attribute (hex: 3, dec: 3). The 'Control Bits' section has several checkboxes set to 0: Ignore if timed out (TO), Break Connection (BK), Awaiting Execution (EW), Error (ER), Message done (DN), Message Transmitting (ST), and Message Enabled (EN). The 'Error' section shows Error Code(Hex): 0. The 'Error Description' field contains the text 'No errors'.

Figure T5.3 Read Message Instruction Setup Screen

5.3 Add the Message Instructions to your Ladder Logic (continued)

The figure below show a typical configuration for Message Instructions being used to write data to the NXEE2. Please note that the Data Table Address (Send) field may be different in your application.

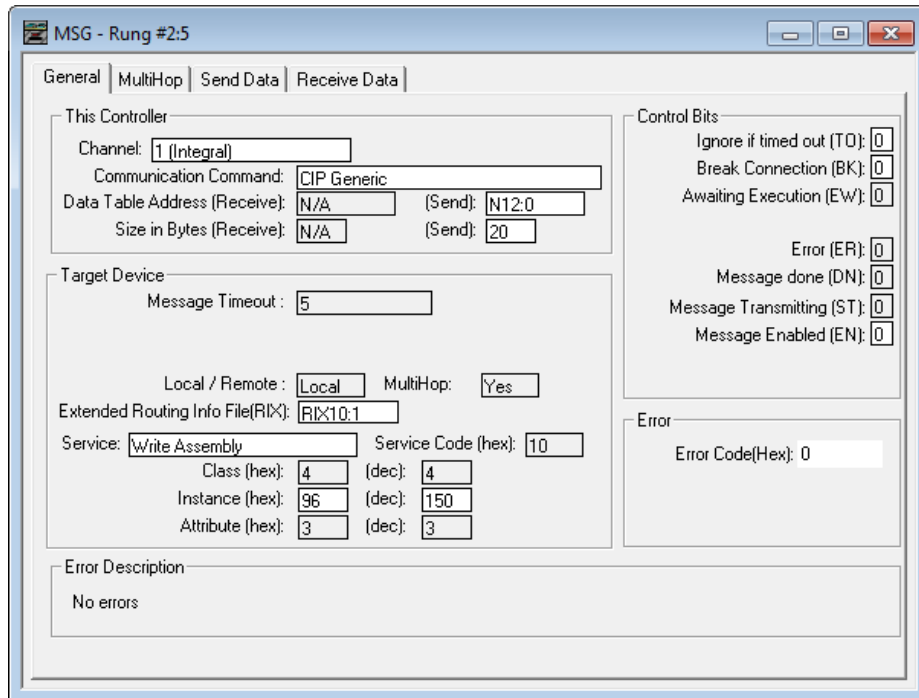


Figure T5.4 Write Message Instruction Setup Screen

Click on the MultiHop tab on the top of the window. As shown in figure T5.5, enter the IP address of the NXEE2 and press Enter.

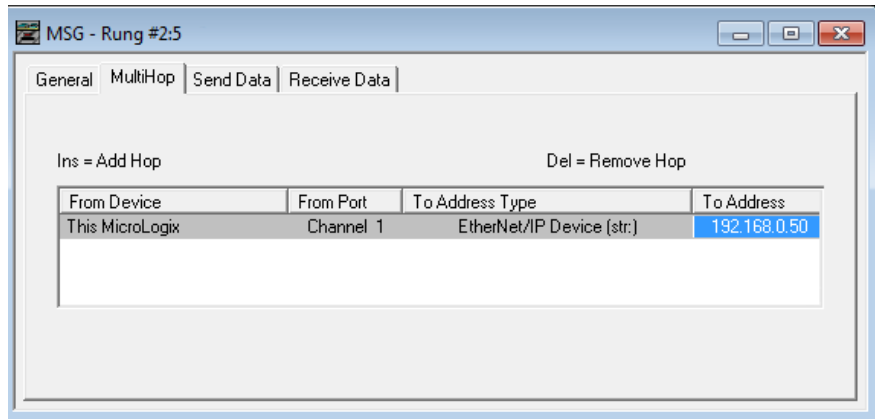


Figure T5.5 Message Instruction MultiHop Settings

After you are finished adding both the read and write message instructions to your program, save and download the program to the PLC.

5.4 Troubleshooting

If you are unable to communicate with the NXEE2, the problem may be that the Ethernet port of your MicroLogix 1100 has not been configured. To check this:

- 1) Double click on Channel Configuration in the Project Tree and then select the Channel 1 tab. The following window will open.

Figure T5.6 MicroLogix Ethernet Configuration Screen

- 2) Enter the IP address and Subnet Mask of your MicroLogix 1100, (not the address of the NXEE2) and click on [Apply]. The Ethernet Port should now be working.

NOTE AMCI is aware of an issue with the RIX data type in version 10 of RSLogix 500. If you are experiencing communications errors and are running version 10, please contact Rockwell Automation for support.

Notes

MODBUS TCP CONFIGURATION

An AMCI NXEE2 that has been configured for the Modbus TCP protocol requires a host controller to issue configuration data and read data from the unit. This chapter tells you how the I/O words used by an AMCI NXEE2 are mapped to the Modbus I/O registers.

Enable Modbus TCP Protocol

The internal web page utility can be used to change the communications protocol used by the NXEE2. This is typically done while setting the IP address. Specifically, follow the steps in section 2.2b, *Use the Embedded Web Server* which starts on page 34.

Modbus Addressing

The register addresses used in this manual are the *Modbus logical reference numbers*[†], which are unsigned integers starting at zero. This is often called *zero based* addressing. In this scheme, the first register is given an address of zero. This is the actual addressing scheme used in the Modbus packets.

Another common addressing scheme is *one based* or *data model* addressing. In this scheme, the register's number is used as its address, so the first register, Register 1 in the data model, has an address of 1.

Modbus Table Mapping

The Discrete Input and Input Register tables in the Modbus data model map to the same physical memory locations in the NXEE2 units.

- These registers hold data that is reported from the NXEE2 to the host controller.
- Addresses for these registers and inputs start at 0 in zero based addressing.

As examples:

- Discrete Input 0 is the same memory location as bit 0 of the first Input Register.
- Register address 3, the fourth register, contains Discrete Inputs 48 through 63.

The Coil and Holding Register tables in the Modbus data model map to the same physical memory locations in the NXEE2 units.

- These registers hold data that is from the host controller to the unit. This data is typically commands.
- Addresses for these registers start at 1024 in zero based addressing. Coil addresses start at 16,384 in zero based addressing (1024*16).

As examples:

- Coil 16384 is the same memory location as bit 0 of the first Holding Register.
- Register address 1025, the address of the second Holding Register, contains Discrete Inputs 16,400 through 16,415 in zero based addressing.

Host Addressing

Your host controller may not use these basic addressing schemes for communicating over a Modbus connection. For example, Modicon controllers use addresses starting at 30000 for Input Registers and addresses starting at 40000 for Holding Registers. GE hosts internally use their %R memory for Holding Registers and %AI memory for Input Registers.

If this is the case, you will define a mapping between your host controller's addressing scheme and the zero based Modbus TCP addresses when you add the NXEE2 to your host controller. Refer to your host controller's documentation for information on how to accomplish this.

[†] MODBUS Application Protocol Specification V1.1b3, section 4.3: MODBUS Data model. www.modbus.org

AMCI Modbus TCP Memory Layout

The NXEE2 has a starting Input Register address of 0 and a starting Output Register address of 1024. Input Registers hold the data from the unit while Output Registers hold the data to be written to the unit. Figure T6.1 shows how an NXEE2 is mapped to the Modbus data reference. The complete specification for the Modbus protocol can be downloaded at <http://www.modbus.org/specs.php>.

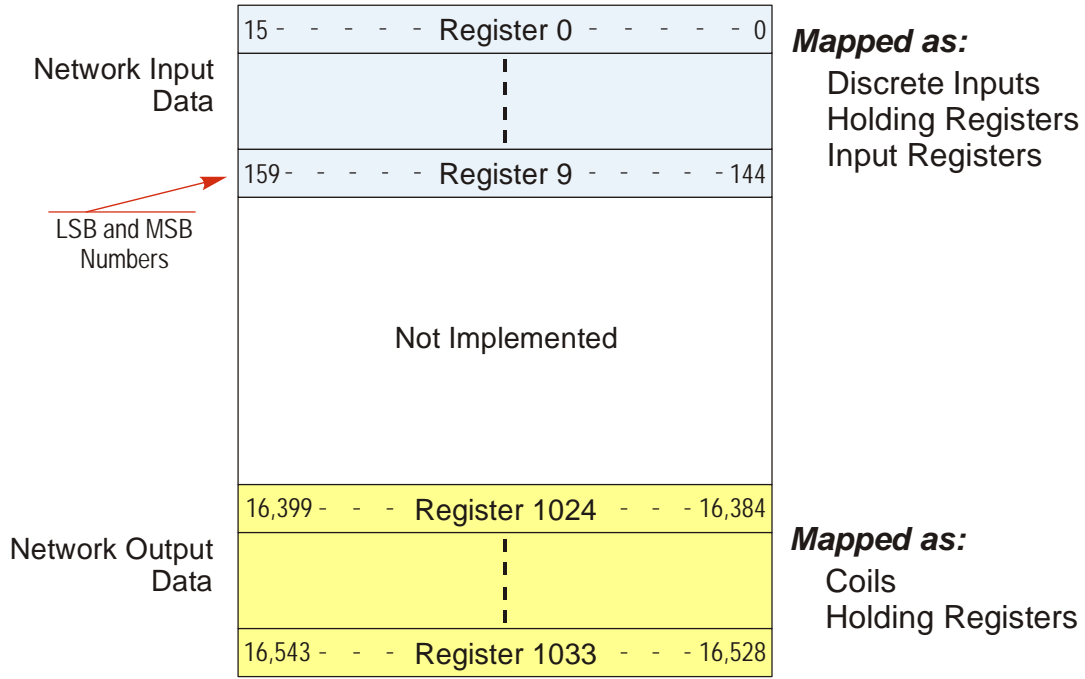


Figure T6.1 Modbus Data Reference Map

Supported Number of Connections


All NXEE2 units support five concurrent connections. When connections exist, the Network Status (NS) LED on the front of the unit will flash green. The number of blinks indicate the number of active connections. There is a two second break between groups of flashes.

Supported Modbus Functions

Function Code	Function Name	NXEE2 Register	Addressing method
1	Read Coils	OUTPUT	Bit:Addresses starting at 16,384
2	Read Discrete Inputs	INPUT	Bit:Addresses starting at 0
3	Read Holding Registers	OUTPUT & INPUT	Word: Out Regs.Starting at 1024 In Regs.Starting at 0
4	Read Input Registers	INPUT	Word:Addresses starting at 0.
5	Write Single Coil	OUTPUT	Bit:Addresses starting at 16,384
6	Write Single Register	OUTPUT	Word:Addresses starting at 1024
15	Write Multiple Coils	OUTPUT	Bit:Addresses starting at 16,384
16	Write Multiple Registers	OUTPUT	Word:Addresses starting at 1024
22	Mask Write Register	OUTPUT	Word:Addresses starting at 1024
23	Read/Write Registers	INPUT/OUTPUT	Word: Out Regs.Starting at 1024 In Regs.Starting at 0

Table T6.1 Supported Modbus Functions

Table T6.1 above lists all of the Modbus functions supported by an NXEE2. AMCI supports all of these functions so that you can control the unit as you see fit. However, if you are looking for the easiest way to interface with your unit, then you only need to use the *Read/Write Registers* function, which is function code 23.

NOTE  Each NXEE2 buffers the data that is sent to it over the network. If you use the *Read/Write Registers* function to write data to the unit, the data read with that command will not contain the response to the new write data. The response to the new data will be sent with the next data read.

Supported Modbus Exceptions

Code	Name	Description
01	Illegal function	The NXEE2 does not support the function code in the query.
02	Illegal data address	The data address received in the query is outside the initialized memory area.
03	Illegal data value	The data in the request is illegal.

Table T6.2 Supported Modbus Exceptions

Notes

PROFINET NETWORK CONFIGURATION

This chapter outlines the steps commonly needed to get an NXEE2 communicating with the PROFINET master. A Siemens SIMATIC S7-1212C controller is used in this example.

Basic Steps

Configuring a PROFINET host requires a few basic steps.

- 1) Download the ZIP archive that contains the GSDML files for the NXEE2 from the www.amci.com website.
- 2) Install the GSDML file into the configuration software for your host controller.
- 3) Add the NXEE2 to the PROFINET Network.
- 4) Set the I/O word addresses used to communicate with the unit.

7.1 Download the GSDML files

The GSDML files are available on the AMCI website on the <http://www.amci.com/industrial-automation-support/configuration-files/> web page. The file is a ZIP archive that has to be extracted to a folder on your computer. Extracting the ZIP file will leave you with multiple files. One is the GSDML file and the others are icon files for the various devices.

7.2 GSDML File Installation

- 1) Open or create a new project that will include the NXEE2 and open the Project View of the project.
- 2) In the menu, select *Options -> Manage general station description files (GSD)*.
- 3) In the window that opens, click on the [...] button and navigate to the folder that contains the extracted GSDML file you downloaded from the AMCI website. Once at the folder, click on the [OK] button.
- 4) Click on the check box next to the name of the GSD file and click on the [Install] button. The system will install the GSD file.
- 5) Click the [Close] button and wait for the software to finish installing the file and updating the Hardware Catalog.

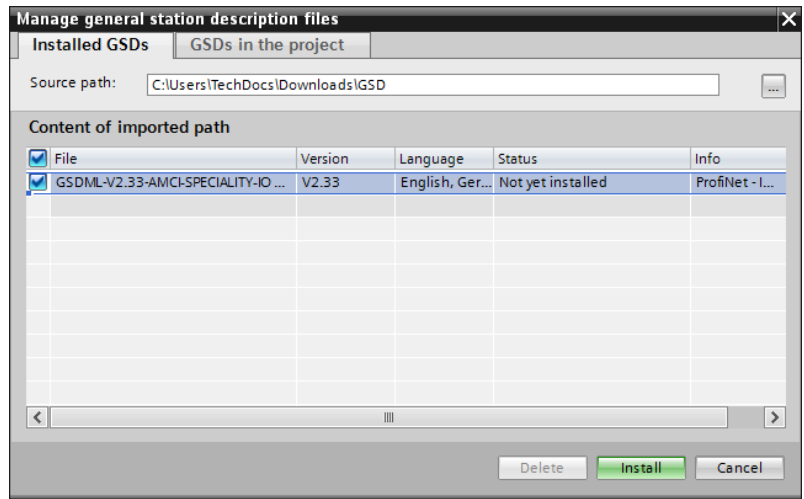


Figure T7.1 GSD File Installation

7.3 Configure the PROFINET Network

A CPU must be added to the project and the PROFINET network must be configured before an NXEE2 can be added to the system.

Refer to Siemens documentation for information on configuring the PROFINET network to suit your application.

7.4 Add the NXEE2 to the PROFINET Network

- 1) With the project open in Project View, double click on “Device & Networks” in the project tree.
- 2) If need be, click on the “Hardware Catalog” vertical tab to open the Hardware Catalog.
- 3) You can search for “NXE”, or browse to the NXEx2 icon by clicking through *Other field devices* +> *PROFINET IO* +> *IO* +> *Advanced Micro Controls Inc.* +> *AMCI_Products* +> *AMCI_Speciality_IO*. Drag and drop the appropriate icon onto the PROFINET network.
- 4) Drag the green square on the NXEx2 icon onto the PROFINET network line to connect the device to the network.

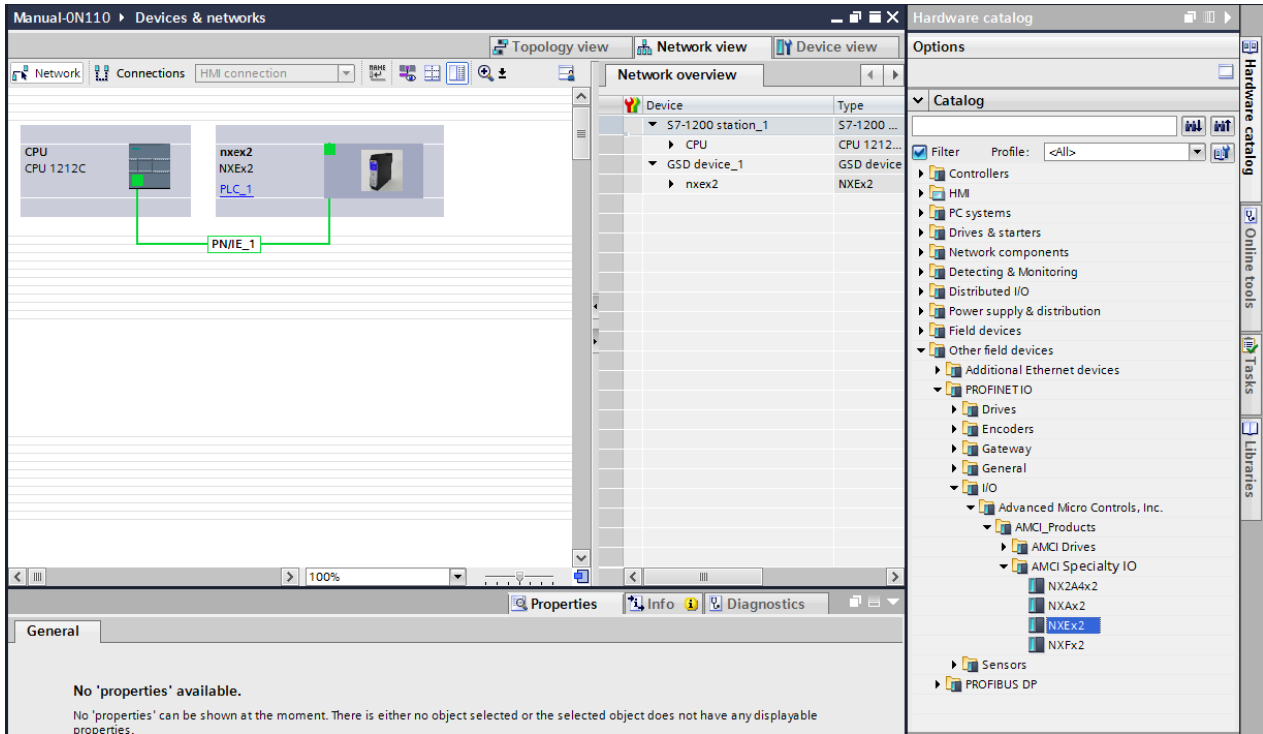


Figure T7.2 NXEE2 Added to PROFINET Network

7.4 Add the NXEE2 to the PROFINET Network (continued)

- 5) Right click on the NXEEx2 icon and select “Properties” from the pop up menu. The Inspector window will open at the bottom of the screen. Under the “General” tab, select the “►General” heading. You can rename the NXEE2 by changing the Name: field.
- 6) Under the “►PROFINET interface [x1]” heading, select “Ethernet addresses”. Under the IP protocol section, set the desired IP address and subnet mask for the NXEE2.

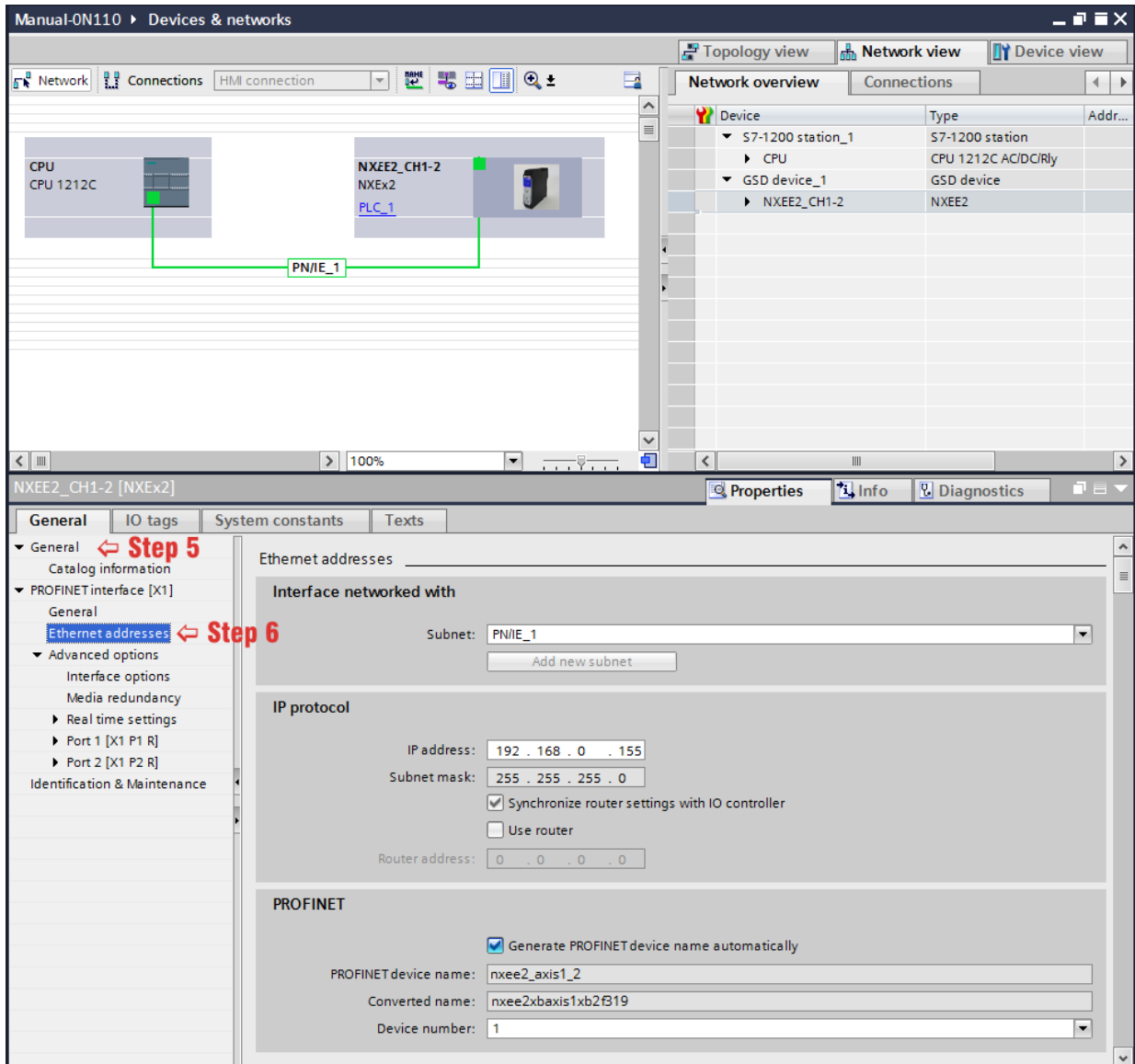


Figure T7.3 NXEE2 IP Addressing

7.5 Configure the NXEE2

- Continuing with the Inspector Window, click on the “Module parameters” heading. The display will change to show all of the parameters of the NXEE2. These configuration parameters are written down to the NXEE2 whenever it connects to the network.

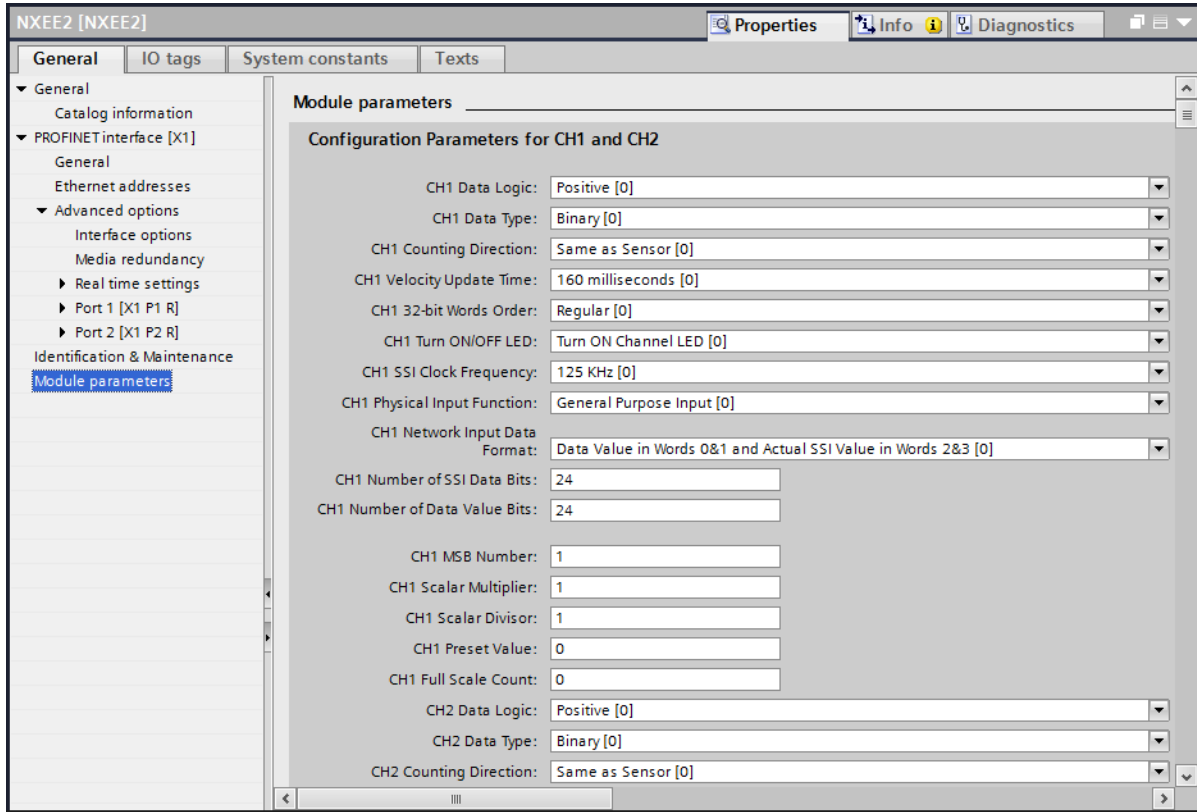


Figure T7.4 Configuration Parameters

- Configuration is done with a combination of drop down menus and value fields. Drop down menus limit you to a set of valid selections. When entering numbers into value fields, a pop up will appear that shows you the valid range of values.

NOTE Even though your selections are limited, it is still possible to misconfigure the NXEE2 by using this screen. If an error occurs, the NXEE2 will show that a configuration error exists after it connects to the network. The NXEE2 will indicate the misconfigured parameter by setting the appropriate status bit for the channel. Status bits are described in the *Status Word Format* section, starting on page 20.

NOTE This data is only written to the unit when it connects to the network, which is typically on power up. The unit can still be reconfigured at any time by writing the appropriate data to the output registers of the NXEE2.

NOTE These configuration parameters cannot be changed while on line. To make any changes, you must go off line, make the changes, save the project, download it, and then go back on line.

7.6 Set the I/O Configuration

The NXEE2 units require 10 Input Words (20 Input Bytes) and 10 Output Words (20 Output Bytes). All required Input and Output Bytes are defined by the GSDML file and divided into suitable modules. These settings are shown in the Table T7.1.

Input / Output Bytes of an NXEE2	Input / Output Modules of an NXEE2
20 Input Bytes	Input Module - Slot 1: 20 bytes
20 Output Bytes	Output Module - Slot 2: 20 bytes

Table T7.1 PROFINET I/O Configuration

- 1) With the NXEx2 icon selected on the PROFINET bus, click on the “Device view” tab. The view in the Hardware Catalog will change. Expand the Module tree to show both the Input and Output modules.
- 2) To map the I/O bytes to the CPU, double click on the “20 bytes IN” and “20 bytes OUT” icons in the Hardware Catalog. The system will automatically assign the next I and Q addresses to the data table.

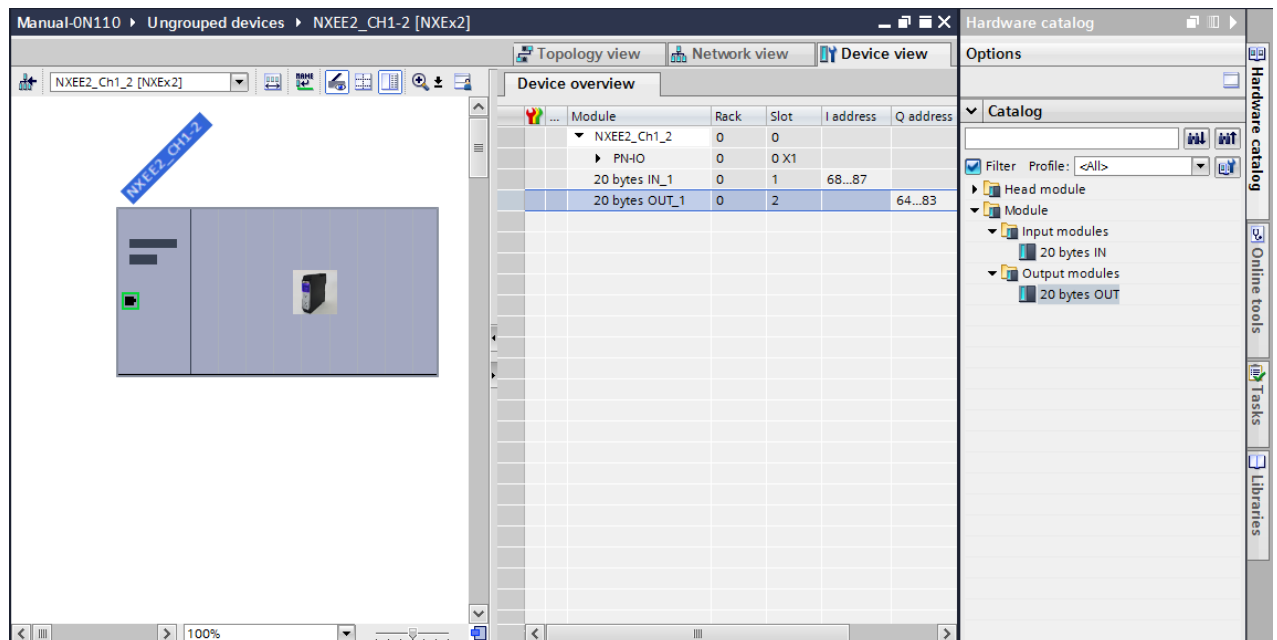


Figure T7.5 I/O Byte Mapping

7.7 Set the NXEE2 Device Name

- 1) Right click on the NXEE2 icon and select “Assign device name” from the resulting popup menu.
- 2) In the “Assign PROFINET device name.” windows that appears, click on the [Update list] button.
- 3) Once the NXEE2 appears in the table, select the NXEE2 in the table.
- 4) Confirm that the “PROFINET device name:” at the top of the screen is correct.
- 5) Click on the [Assign name] button to write the device name to the NXEE2. The “Online status information:” table at the bottom of the screen will show that the name was successfully assigned to the MAC address of the NXEE2.

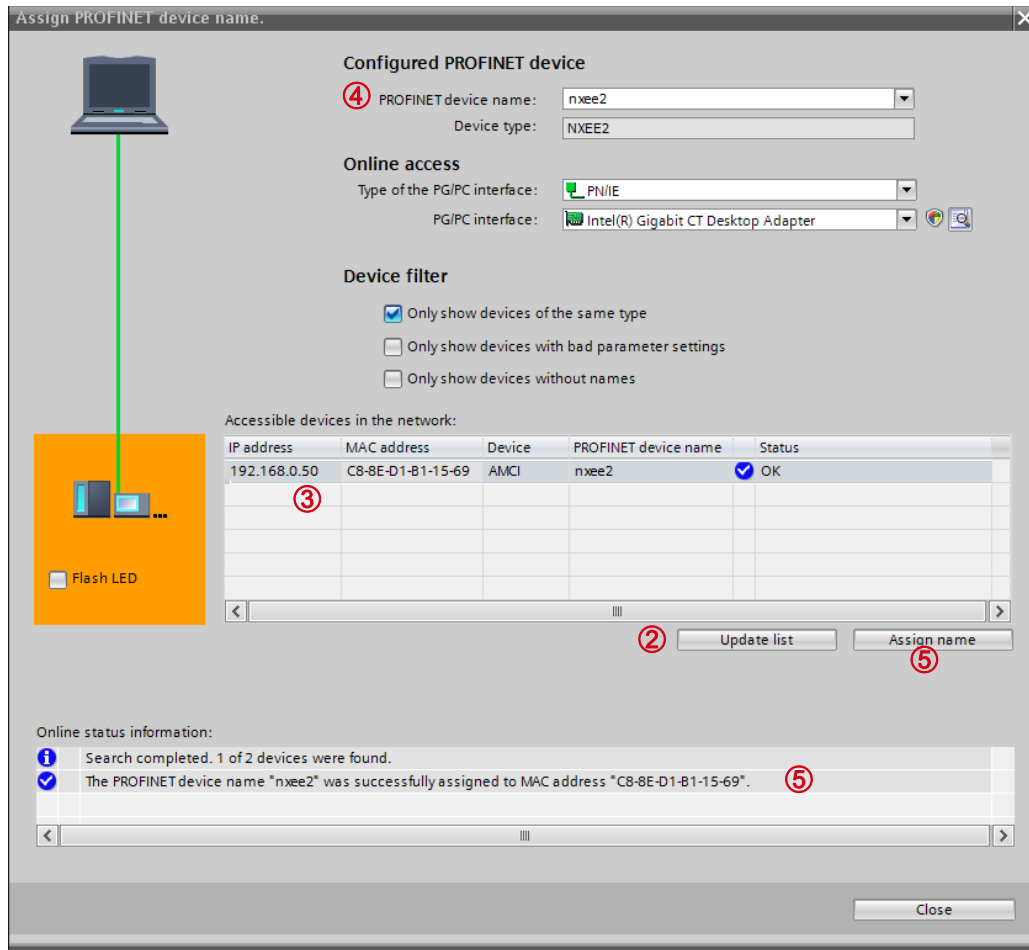


Figure T7.6 Setting NXEE2 Device Name

7.8 Verify and Download the New Configuration

- 1) Continue by adding any remaining devices to your PROFINET network.
- 2) Compile and download the project to the CPU.

MRP Installations

At this point, the NXEE2 is configured and ready to use. If you are using the unit in a redundant, ring based, network that uses the Media Redundancy Protocol (MRP), continue with the following instructions.

Media Redundancy Protocol (MRP) installations require that the NXEE2 be installed in a ring topology. In these applications, both Ethernet ports are used when wiring the ring, daisy chaining from one unit in the ring to the next. The steps below covers typical software configuration that must also be completed.

7.9 Configure the NXEE2 as an MRC

The NXEE2 functions as a Media Redundancy Client (MRC) in an MRP network.

- 1) Switch to Topology view and drag the additional connections between the appropriate ports.
- 2) Click on the NXEx2 icon to select it. In the Inspector window, select *Advanced options* +> *Media redundancy*. Use the “MRP domain:” drop down menu to select the appropriate domain. Use the “Media redundancy role:” drop down menu to select “Client”.
- 3) Continuing in the Inspector window, select *Advanced options* +> *Port 1* +> *Port interconnection*. Under “Partner port:”, the partner port you assigned to the port when you drew the topology is shown. If you do not know which port will be the partner port in the actual installation, you can use the drop down menu to select “Any partner”.
- 4) If need be, repeat step 3 for Port 2 of the NXEE2.

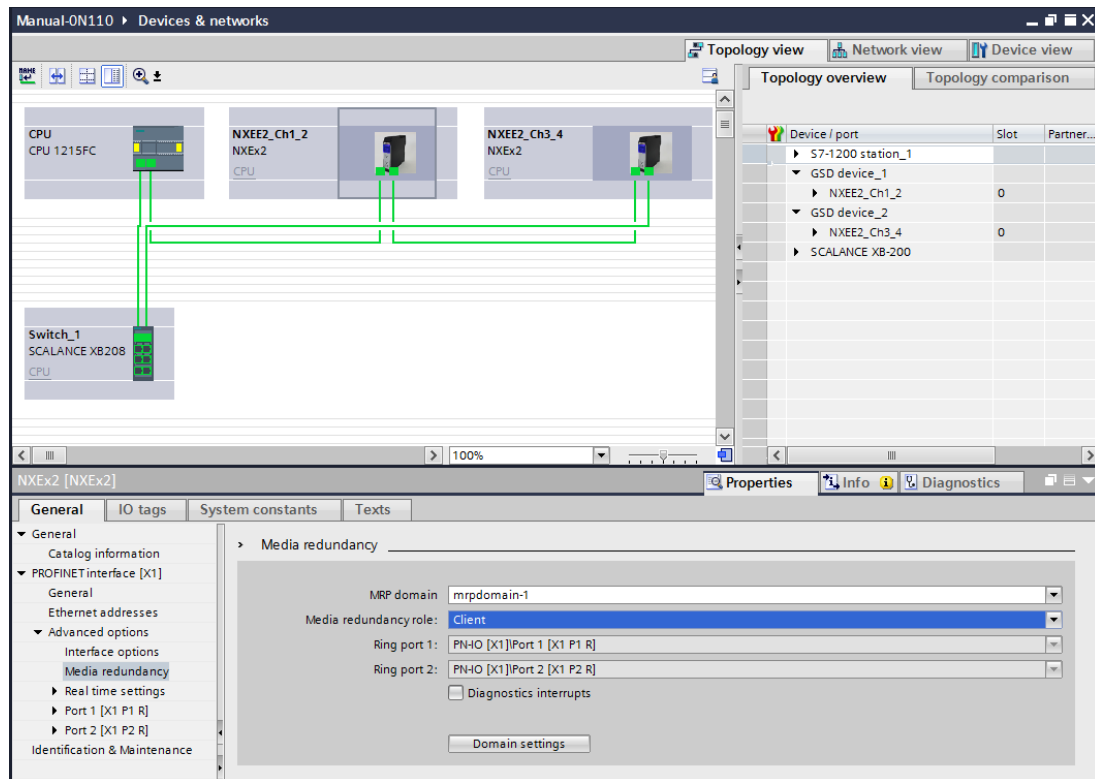


Figure T7.7 MRP Topology and Client settings

- 5) Continue configuring the rest of the devices on the network before compiling the project and downloading it to the CPU.



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