User Manual

Original Instructions

Allen-Bradley

Guardmaster®

CIP Safety Encoder

Bulletin Number 843ES

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

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

Labels may also be on or inside the equipment to provide specific precautions.

	**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	**ARC FLASH HAZARD:** Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

Chapter 3

Installation

Chapter 4

Add Device to an EtherNet/IP Network

Chapter 5

Configure the Encoder with Studio 5000 Environment

Notes:

This manual is a reference guide for the Bulletin 843ES CIP Safety™ over EtherNet/IP™ encoder. The manual explains:

- How to install the encoder to maintain encoder safety rating
- Provide an overview of the encoder
- How to integrate the encoder with EtherNet/IP communication modules
- How to configure the encoder with the Studio 5000 Logix Designer® application to integrate the encoder with a Logix 5000™ controller-based system.

IMPORTANT Read and thoroughly understand the manual before installing or operating a system that contains this device.

Who Should Use This Manual?

Use this manual if you are responsible for the design, installation, programming, or troubleshooting of systems that use the 843ES CIP Safety over EtherNet/IP encoder.

Make sure that you are familiar with the following:

- Use of a safety controller in a Logix 5000 control system.
- Use of safety systems.
- Use Studio 5000 Logix Designer application environment.

ATTENTION: Personnel responsible for the application of safety-related programmable electronic systems (PES) must be aware of the safety requirements in the application of the system and be trained in the use of the system.

Conventions

These conventions are used throughout this publication:

- Bulleted lists such as this one provide information, not procedural steps.
- Numbered lists provide steps or hierarchical information.
- When the phrase GuardLogix® controller is used in this publication, it refers to either of the following controller families:
  - GuardLogix 5580
  - Compact GuardLogix 5380
- When the phrase Logix 5000 controller is used in this publication, it refers to any of the following controller families:
  - ControlLogix® 5580 or GuardLogix 5580
  - CompactLogix™ 5380 or Compact GuardLogix 5380

Terminology

This table defines common safety terms that are used throughout this publication.

Abbreviation	Full Term	Definition
—	Control application	Program that is designed using Studio 5000 Logix Designer and downloaded to the controller.
—	Safety control application	Safety program that is designed using Studio 5000 Logix Designer and downloaded to the GuardLogix controller for functional safety.
—	Safe motion monitoring drive	A drive that supports safety feedback and communicates safety function status or control over the EtherNet/IP network.
—	Standard	Automation devices, logic, or functions that do not participate in safety-related functions. Other commonly used terms are “not safety-related,”“non-safe,”“unsafe,” and “normal integrity.”
1oo2	One out of two	Refers to the behavioral design of a dual-channel safety system.
CAT.*x*	Category	ISO 13849-1 safety category. Categories define the structure, either single or dual. (CAT.1 and CAT.2 = single, CAT.3 and CAT.4 = dual).
CIP™	Common Industrial Protocol	Protocol for industrial automation applications and trademarked by ODVA, Inc.
DC	Diagnostic Coverage	The ratio of the detected failure rate to the total failure rate.
EN	European Norm	European Standards (EN specifications) developed by the European Committee for Standardization for the European Union.
FMEA	Failure Mode and Effects Analysis	Analysis of potential failure modes to determine the effect upon the system and identify ways to mitigate those effects.
HFT	Hardware Fault Tolerance	The HFT equals *n*, where *n*+1 faults could cause the loss of the safety function. An HFT of 1 means that 2 faults are required before safety is lost.
IEC	International Electrotechnical Commission	Non-profit, non-governmental international standards organization that prepares and publishes international standards for all electrical, electronic, and related technologies, collectively known as electrotechnology.
ISO	International Organization for Standardization	Voluntary organization whose members are recognized authorities on standards, each one represents a different country.
PES	Programmable Electronic Systems	System for control, protection, or monitoring based on one or more programmable electronic devices, including all elements of the system such as power supplies, sensors and other input devices, data highways and other communication paths, and actuators and other output devices.
PFD	Probability of a dangerous failure on demand	The average probability of a system to fail to perform its design function on demand.
PFH	Average Frequency of a Dangerous Failure	The average frequency of a system to have a dangerous undetected failure occur per hour.
PL*x*	Performance Level	ISO 13849-1 safety category. Replace the *x* with an a, b, c, d, or e (e is the highest level of safety performance).
RPI	Requested Packet Interval	The update rate specified for a particular piece of data on the network.
SFF	Safe Failure Fraction	The sum of safe failures plus the sum of dangerous detected failures divided by the sum of all failures.
SIL*x*	Safety Integrity Level	A measure of a products ability to lower the risk that a dangerous failure could occur. Replace the *x* with a 1, 2, or 3 (4 is not applicable to automation).
SNN	Safety Network Number	Safety network number, which uniquely identifies a network across all networks in the safety system. You are responsible for assigning a unique number for each safety network or safety subnet within a system.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Cordsets and Field Attachables Technical Data, publication 889-TD002	Provides technical specifications for power cables and attachables.
Ethernet Media Specifications Technical Data, publication 1585-TD001	Provides technical specifications for Ethernet media cables and accessories
High-Resolution Incremental Optical Encoders Tech Data, publication 847-TD001	This publication includes descriptions of Allen-Bradley® encoder accessories.
Kinetix® 5700 Safe Monitor Functions, publication 2198-RM001	Provides information on how to use the Safety Functions in Studio 5000 environment for installing a Rockwell Automation® industrial system.
843ES CIP Safety Encoder Installation Instructions, publication 843ES-IN001	Information on how to install the CIP Safety Encoder.
EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM006	Information on how to use EtherNet/IP communication modules in Logix 5000 control systems.
Guidance for Selecting Cables for EtherNet/IP Networks, publication ENET-WP007	Provides guidance on selection of cables based on the application, environmental conditions, and mechanical requirements.
System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001	Information, examples, and techniques that are designed to minimize system failures caused by electrical noise.
Integrated Motion on the EtherNet/IP Network Configuration and Startup User Manual, publication MOTION-UM003	Information on configuration and troubleshooting your ControlLogix and CompactLogix EtherNet/IP network modules.
ControlFLASH Firmware Upgrade Kit User Manual, publication 1756-UM105	Provides information on how to upgrade your module firmware by using ControlFLASH™ software.
GuardLogix 5580 and Compact GuardLogix 5380 Controller Systems Safety Reference Manual, publication 1756-RM012	Provides information for development, operation, and/or maintenance of a GuardLogix or Compact GuardLogix controller-based safety system that uses the Studio 5000 Logix Designer application.
GuardLogix Safety Application Instruction Set Reference Manual, publication 1756-RM095	Provides information that describes the GuardLogix Safety Application Instruction Set.
Safety Automation Builder and SISTEMA Library: rok.auto/sistema	Download Safety Automation Builder® software to help simplify machine safety design and validation, and reduce time and costs. Integration with our risk assessment software provides you with consistent, reliable, and documented management of the Functional Safety Lifecycle. The SISTEMA tool, also available for download from the Safety Automation Builder page, automates calculation of the attained Performance Level from the safety-related parts of a machine's control system to (EN) ISO 13849-1.
Open DeviceNet Vendors Association (ODVA) Media Planning and Installation Manual, publication PUB00148R0	Provides information on Equipotential grounding and bonding.
Safety of Machinery – Safe Related Parts of Control Systems, standard ISO 13849	Provides safety requirements and guidance on the principles for the design of safety-related parts of control systems.
Functional safety of Electrical/Electronic/Programmable Electronic safety-related systems, standard IEC 61508	Provides considerations when electrical/electronic/programmable electronic systems are used to conduct safety functions.
Rockwell Automation Industrial Automation Glossary, publication AG-7.1	A glossary of industrial automation terms and abbreviations.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website: rok.auto/certifications	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at rok.auto/literature.

Notes:

Product Overview

Encoders electronically monitor the position of a rotating shaft to measure information such as speed, position, and acceleration.

Features

The features of the 843ES CIP Safety encoder over EtherNet/IP include:

- PLe capable according to ISO 13849-1 and 13849-2, and SIL 3 capable according to IEC 61800-5-2, IEC 62061, and IEC 61508
- Compatibility with star, linear, and Device Level Ring topology
- Configurable resolution per revolution: 1...32,768 for the safety connection and 1...262,144 for the standard connection
- Solid shaft with clamping, synchro, and square flanges available
- Safety-related communication performed via CIP Safety connections over EtherNet/IP
- Blind-hollow shaft available with stator coupling
- 15-bit single-turn resolution for safety connection, 18-bit single-turn resolution for standard connection
- 12-bit multi-turn resolution + single-turn resolution
- ControlFLASH update compatible
- Add-on Profile for configuration in Studio 5000 Logix Designer®

Encoder Overview

The 843ES CIP Safety encoder is an absolute encoder. An absolute encoder has a unique digital output for each shaft position. The use of absolute encoders verifies that true position is always available, regardless of power interruptions to the system. Absolute encoders can be single-turn or multi-turn.

Multi-turn units assign a unique digital output for each shaft position across multiple shaft rotations and have high-resolution capability. Applications include steel mills, overhead cranes, punch presses, transfer lines, oil rigs, wind mills, machine tools, and packaging.

Single-turn vs. Multi-turn Encoders

Absolute encoders are either single-turn or multi-turn. Single-turn encoders are used if the absolute position of the shaft for one revolution is required. Multiturn encoders are used if the absolute position is required for multiple shaft revolutions. Compared to single-turn encoders, multi-turn encoders feature an additional gear to allow measuring absolute positions larger than 360°.

Operating Principle of the Encoder

The 843ES CIP Safety encoder acquires the position of rotating axes and outputs the position in the form of a unique digital numeric value. Optical acquisition of the rotary position value is from an internal coded disk.

Intended Use

The 843ES CIP Safety encoder can be used as a rotation angle, position, or speed sensor. It supports functions that are based on speed and rotation direction information (for example, in industrial processes or controls).

As a sensor, the 843ES CIP Safety encoder supports safety functions regarding speed and rotation direction. It is not able to achieve a safe state in the safety function on its own.

A superordinate evaluation device must detect rotational speed, rotation direction, and standstill, as well as failures that may represent a danger.

The 843ES CIP Safety encoder and the encoder evaluation device must meet the requirements that are stated in Specifications on page 79.

Foreseeable Misuse

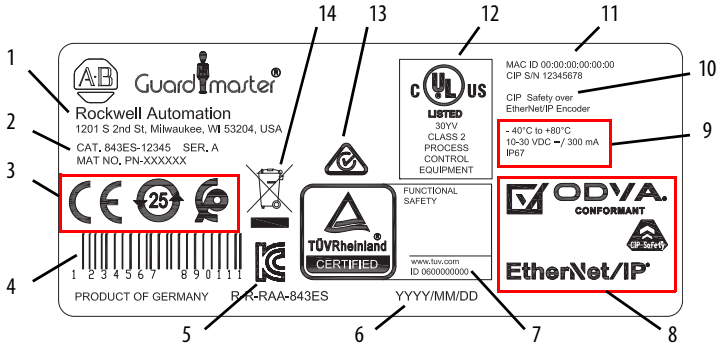
The encoder is not suitable for the following uses:

- Underwater
- In publicly accessible areas
- Outside of the specifications stated in Specifications on page 79.
- Areas where more serious EMC events may occur than those areas defined in IEC 61326-1.

Scalable Resolution

The steps per revolution can be scaled in integers from 1...262,144 for the standard connection, and 1...32,768 for the safety connection. The total resolution of the 843ES CIP Safety multi-turn encoder must be 2n times the steps per revolution.

Product Label



Item	Description
1	Manufacturer and address
2	Catalog number and part number
3	CE, China RoHS, and Morocco markings
4	Barcode
5	KCC marking
6	Date of manufacture
7	TÜV marking
8	ODVA conformance and EtherNet I/P marking
9	Operating temperature, supply voltage, current consumption, and washdown rating
10	CIP serial number
11	MAC ID
12	UL marking
13	RCM marking
14	WEEE marking

Product Selection

Table 1 - Encoder Catalog Number Explanation

843ES	-	M	IP	7	BA	6
		a		b		c

a	
Number of Turns	
Code	**Description**
M	Multi-turn (4096 turns)
S	Single-turn (1 turn)

b	
Shaft	
Code	**Description**
7	Hollow shaft 9.52 mm (3/8 in.)
8	Hollow shaft 10 mm (0.39 in.)
9	Hollow shaft 12 mm (0.47 in.)
10	Hollow shaft 12.7 mm (1/2 in.)
11	Hollow shaft 14 mm (0.55 in.)
12	Hollow shaft 15 mm (0.59 in.)
14	Solid shaft 10 mm (0.39 in.) with key
15	Solid shaft 12 mm (0.47 in.) with key
16	Solid shaft 9.52 mm (3/8 in.) with key

c	
Flange	
Code	**Description**
1	Clamping flange 58 mm (2.28 in.) (1) (2)
4	Synchro flange 58 mm (2.28 in.) (2) (3)
6	Diameter flange 63 mm (2.48 in.) (4) (5)
7	Square flange 63.5 mm (2.5 in.) (2) (6)

(1) See Figure 4 on page 32.
(2) Only available for solid shaft encoders.
(3) See Figure 5 on page 33.
(4) See Figure 7 on page 35.
(5) Only available for hollow shaft encoders.
(6) See Figure 6 on page 33.

Recommended Patchcords and Cordsets

We recommend the following power and Ethernet patchcords and cordsets.

Power

Table 2 - Pinout and Color Code

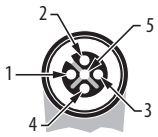
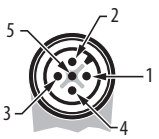
	Face View Pinout			
	4-pin		5-pin	
	 Female		 Male	
Color Code				
A	1 Brown 2 White 3 Blue	4 Black 5 NA	1 Brown 2 White 3 Blue	4 Black 5 Gray
B	1 Brown 2 White 3 Blue	4 Black 5 Drain wire	—	

Table 3 - Cordsets — DC Micro (22 AWG, Yellow PVC Shielded)

No. of Pins	Color Code	Shield	Wire Size [AWG]	Cat. No. (1) (2)			
				Straight Female	Right Angle Female	Straight Male	Right Angle Male
4-pin	A	Braided shield	22	889D-F4EC-2	889D-R4EC-2	889D-M4EC-2	889D-E4EC-2
	A	Foil shield		889D-F4FC-2	889D-R4FC-2	889D-M4FC-2	889D-E4FC-2
	B			889D-F5FC-J2	889D-R5FC-J2	889D-M5FC-J2	889D-E5FC-J2

(1) The 2 at the end of the cat. no. is for 2 m (6.6 ft) cable length. Replace the 2 with 5 (5 m [16.4 ft]) or 10 (10 m [32.8 ft]) for standard cable lengths.

(2) Stainless steel connectors can be ordered by adding an S to the bulletin number (for example, 889DS-F4EC-2).

Table 4 - Cordsets — DC Micro (22 AWG, Yellow PVC Shielded)

No. of Pins	Color Code	Shield	Wire Size [AWG]	Cat. No. (1) (2)			
				Straight Female Straight Male	Straight Female Right Angle Male	Right Angle Female Straight Male	Right Angle Female Right Angle Male
4-pin	A	Braided shield	22	889D-F4ECDM-2	889D-F4ECDE-2	889D-R4ECDM-2	889D-R4ECDE-2
	A	Foil shield		889D-F4FCDM-2	889D-F4FCDE-2	889D-R4FCDM-2	889D-R4FCDE-2
	B			889D-F5FCDM-J2	889D-F5FCDE-J2	889D-R5FCDM-J2	889D-R5FCDE-J2

(1) The 2 at the end of the cat. no. is for 2 m (6.6 ft) cable length. Replace the 2 with OM3 (0.3 m [1 ft]), 1 (1 m [3.3 ft]), 5 (5 m [16.4 ft]) or 10 (10 m [32.8 ft]) for standard cable lengths.

(2) Stainless steel connectors can be ordered by adding an S to the bulletin number (for example, 889DS-F4ECDM-2).

Ethernet

Table 5 - Pinout

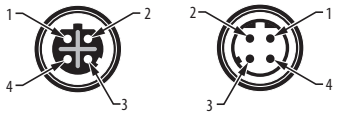
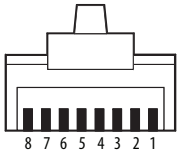
Color Code	Face View Pinout			
	4-pin		8-pin	
				
A	1 White-Orange 2 White-Green	3 Orange 4 Green	4-pin	
			1 White/Orange	Transmit Data +
			2 Orange	Transmit Data -
			3 White/Green	Receive Data +
			4 NA	—
			5 NA	—
			6 Green	Receive Data -
			7 NA	—
			8 NA	—

Table 6 - Cordset — M12 Flex-rated

First End Connector	Second End Connector	Cable Type	Cat. No. (1)
Male M12 D-Code, straight	Flying leads	Foil and braided shield, 4 conductor, teal PUR, flex rated, halogen-free	1585D-M4UB-2

(1) The 2 at the end of the cat. no. is for 2 m (6.6 ft) cable length. Replace the 2 with 1 (1 m [3.3 ft]), 5 (5 m [16.4 ft]) or 10 (10 m [32.8 ft]) for standard cable lengths.

Table 7 - Patchcord — M12 Flex-rated

First End Connector	Second End Connector	Cable Type	Cat. No. (1)
Male M12 D-Code, Straight	Male M12 D-Code, Straight	Foil and braided shield, 4 conductor, teal PUR, flex rated, halogen-free	1585D-M4UBDM-2
Male M12 D-Code, Right Angle	Male M12 D-Code, Right Angle		1585D-E4UBDE-2
Male M12 D-Code, Straight	Male M12 D-Code, Right Angle		1585D-M4UBDE-2
Male M12 D-Code, Straight	Female M12 D-Code, Straight		1585D-M4UBDF-2

(1) The 2 at the end of the cat. no. is for 2 m (6.6 ft) cable length. Replace the 2 with 1 (1 m [3.3 ft]), 5 (5 m [16.4 ft]) or 10 (10 m [32.8 ft]) for standard cable lengths.

Table 8 - Patchcord — M12 to RJ45 Flex-rated

First End Connector	Second End Connector	Cable Type	Cat. No. (1)
Male M12 D-Code	RJ45	Foil and braided shield, 4 conductor, teal PUR, flex rated, halogen-free	1585D-M4UBJM-2

(1) The 2 at the end of the cat. no. is for 2 m (6.6 ft) cable length. Replace the 2 with 1 (1 m [3.3 ft]), 5 (5 m [16.4 ft]) or 10 (10 m [32.8 ft]) for standard cable lengths.

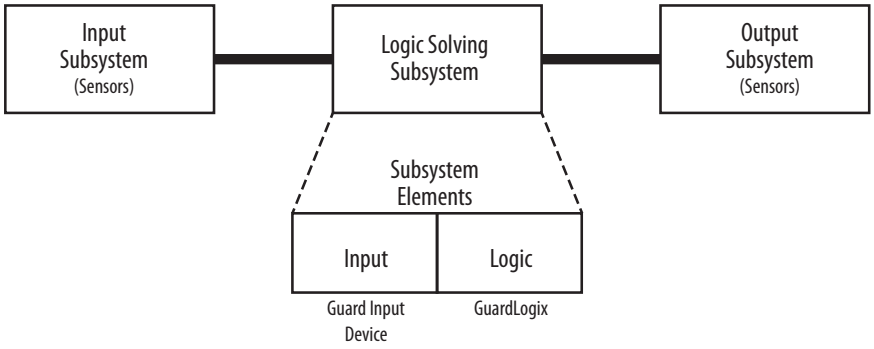
Safety Concept

Introduction

This section introduces you to the functional safety specifications and how the 843ES CIP Safety encoder meets those requirements.

The 843ES CIP Safety encoder supports controller-based safety functions that are based on the speed and rotation direction information. The internal diagnostics do not allow the encoder to trigger on its own actions such as initiating a safe state. Therefore, the 843ES CIP Safety encoder is considered an input device, which a safety logic controller monitors as part of the overall safety system. The 843ES CIP Safety encoder is considered a component in the sensor subsystem (see Figure 1).

Figure 1 - Example Functional Safety Chain



Safety Certification

TÜV Rheinland has certified the Bulletin 843ES CIP Safety Encoder for use in safety applications up to and including Performance Level e (PLe) and Category 3 in compliance with ISO 13849-1, and up to and including System Integrity Level (SIL) CL 3 per IEC 61508, IEC 61800-5-2, and IEC 62061, for integration in safety-related functions regarding rotational speed, direction, and position.

IMPORTANT Requirements are based on the standards current at the time of certification.

The encoder must be installed in accordance with the applicable regulation and standards.

For product certifications currently available from Rockwell Automation, see the Product Certifications website link in Additional Resources on page 9.

IMPORTANT Functional safety certification and performance of the 843ES CIP Safety encoder requires that the encoder operates in conditions at or below the ambient operating temperature specification.

The probability of a dangerous failure on demand (PFD) and average frequency of a dangerous failure per hour (PFH) calculations for these modules are based on the module operating conditions adhering to the ambient operating temperature specification.

For more information on the maximum ambient operating temperature specification, see Specifications on page 79.

ATTENTION: Use only appropriate components or devices that comply with the relevant safety standards and meet the required safety integrity level or Performance Level and safety category.

- Conformity to the requirements of the relevant safety standards must be determined for the entire system by conducting a risk assessment.
- Use devices properly according to the installation environment, performance rating, and functions of the machine.
- Use devices within their specified ratings.
- We recommend that you consult a certification body regarding assessment of conformity to the required safety integrity level or Performance Level.

You are responsible for confirming compliance with the applicable standards for the entire system. You must read, understand, and fulfill the functional safety requirements of the standard applicable to your safety application.

Determine Conformity

The installed system, including the safety control system and the means by which the machine stops, must achieve the needed safety performance. The encoder is one element in the safety system.

Before safety components are used, a risk assessment must be performed on the machine in accordance with:

- ISO 12100, Safety of machinery – Basic concepts - General principles for design - Risk assessment and risk reduction.
- ISO 13849-1, Safety of machinery. Safety-related parts of control systems. General principles for design, Annex B
- IEC 62061, Safety of Machinery – Functional safety of safety-related electrical, electronic, and programmable electronic control systems.

Correct use includes compliance with the relevant requirements for installation and operation, in particular:

- ISO 13849-1, Safety of machinery. Safety-related parts of control systems. General principles for design

- IEC 60204-1, Safety of machinery. Electrical equipment of machines. General requirements.

The 843ES CIP Safety encoder can be applied using the following GuardLogix controller-based safety instructions, according to IEC 61800-5-2:

- SS1 – Safe Stop 1
- SS2 – Safe Stop 2
- SOS – Safe Operating Stop
- SLS – Safely-limited Speed
- SDI – Safe Direction
- SLP – Safe-limited Position

Encoders that are used for speed or position monitoring safety functions are likely used with other safety functions such as: enabling, guard locking, and guard interlocking. Additional guidance for those safety functions can be found in the following:

- ISO 12100 Safety of machinery—General principles for design— Risk assessment and risk reduction
- ISO 13855 Safety of machinery—Positioning of safeguards concerning the approach speeds of parts of the human body

The type approval, certification, and suitability levels for the 843ES CIP Safety encoder describe a system with an overall system safety function of SIL 3. However, you are not required to use 843ES CIP Safety encoders only in safety applications with an overall system safety function of SIL 3.

For example, a GuardLogix 5580 controller without a 1756-L8SP safety partner is suitable for use in safety applications that are rated up to, and including, SIL CL2, PLd, Cat. 3 as defined in IEC 61508, IEC 61511, IEC 62061, and ISO 13849-1. You can use 843ES CIP Safety encoders in such an application.

GuardLogix 5580 controllers, when used with a 1756-L8SP safety partner are suitable for use in safety applications that are rated up to, and including SIL 3, and PLe, cat. 4 as defined in IEC 61508, IEC 61511, IEC 62061, and ISO 13849-1. You can use 843ES CIP Safety encoders in such an application to achieve SIL 3 and PLe, Cat. 3.

For more information on the suitability level of Logix 5000™ safety controllers, see publication 1756-RM012.

Average Frequency of a Dangerous Failure

Safety-related systems are classified as operating in a high-demand/continuous mode. The SIL value for a high-demand/continuous mode safety-related system is directly related to the average frequency of a dangerous undetected failure per hour (PFH). PFH calculation is based on the equations from IEC 61508 and shows worst-case values.

IMPORTANT Determination of safety parameters is based on the assumption that the system operates in high-demand mode and that the safety function is requested at least once every three months.

For safety data, see Appendix A on page 79.

Mount the Encoder

The connection of the encoder and the drive unit must be assessed from a safety-related point of view. This assessment applies to both to the connection with the rotary element (shafts connection) and to the stationary section (stator connection).

The following are the mechanical designs of the shaft connections available in the 843ES CIP Safety encoders:

- Solid shaft with key
- Hollow shaft with clamping ring

For the stator connection, the provided tether arms, stator couplings, and torque stops are assessed from a safety-related point of view.

The mechanical connections have been designed so that a fault exclusion can be claimed due to over-dimensioning and/or diagnostics. Reference and comply with the mechanical limits that are specified in the proper assembly that is described in Chapter 3, and publication 843ES-IN001.

Firmware Revision

The 843ES CIP Safety encoders are manufactured with module firmware installed. If updated module firmware revisions are available in the future, you can update the firmware.

If the module is configured for Exact Match, the controller checks to make sure that the module has the correct firmware revision.

Updated firmware revisions are made available for various reasons, for example, to correct an anomaly that existed in previous module firmware revisions.

IMPORTANT Verify that the firmware revision of the device is correct before commissioning the system. Firmware information for safety I/O devices is available with the safety certificates at rok.auto/certifications.

Only download firmware and access product release notes from the Product Compatibility and Download Center (rok.auto/pcdc).

IMPORTANT Do not download firmware from non-Rockwell Automation sites.

Safety Function During Firmware Update

The 843ES CIP Safety encoders are not safety capable when a firmware update is in process. You must use other methods to maintain the safety function during the update process.

For information on how to maintain the safety function during the update process, for example, remove the module from service to perform the update, see publication 1756-RM012.

Safety Precautions

ATTENTION: Personnel responsible for the application of safety-related programmable electronic systems (PES) must be aware of the safety requirements in the application of the system and must be trained in the use of the system.

Observe these precautions for the proper use of a 843ES CIP Safety encoder.

ATTENTION: As serious injury can occur due to loss of required safety function, follow these safety precautions.

- Do not use standard I/O data or explicit message data as safety data.
- Do not use the light-emitting diode (LED) status indicators on the encoder for safety operations.
- Apply properly specified voltages to the encoder. The application of inappropriate voltages can cause the module to fail to perform its specified function, which could lead to loss of safety functions or damage to the module.
- Install the 843ES CIP Safety encoder as shown in Installation on page 29.
- Set unique network node addresses before you connect devices to the network.
- Perform testing to confirm that device wiring, configuration, and operation is correct before you start system operation.
- Do not disassemble, repair, or modify the encoder. This action can result in loss of safety functions.

For more information about safety precautions, see Configuration Ownership – Reset Ownership on page 59.

Install and Replace Encoders

ATTENTION:

- Configure the replacement device properly and confirm that it operates correctly.
- After installation of the module, a safety administrator must confirm the installation and conduct trial operation and maintenance.

Replacing a safety module that sits on a CIP Safety network is more complicated than replacing standard devices because of the Safety Network Number (SNN).

Safety devices require this more complex identifier to verify that module numbers that are duplicated on separate subnets across all networks in the application do not compromise communication between the correct safety devices.

The SNN is a unique identifier that is automatically assigned to each subnet in a safety application. The same SNN is assigned to all devices on the subnet.

For example, when an EtherNet/IP adapter is used in a safety application, the Logix Designer application project assigns it an SNN. All safety modules that are installed with that adapter, are automatically assigned the same SNN.

However, each safety module requires a unique identifier within the same subnet. A DeviceID is used to identify each safety module uniquely. The SNN and node/IP address constitute the DeviceID of the safety module.

GuardLogix controllers retain I/O device configuration on-board and are able to download the configuration to the replacement device.

IMPORTANT If the 843ES CIP Safety encoder was used previously, clear the existing configuration before installing it on a safety network by resetting the encoder to factory default. See Reset an 843ES CIP Safety Encoder to Out-of-Box State on page 26 for more information.

Safety Application Requirements

Safety application requirements include the evaluation of probability of failure rates (PFH), system reaction time settings, and functional verification tests that fulfill your required SIL level criteria. See Average Frequency of a Dangerous Failure on page 20 for more PFH information.

Creation, recording, and verification of the safety signature is also a required part of the safety application development process. The safety controller creates the safety signatures. The safety signature consists of an identification number, date, and time that uniquely identifies the safety portion of a project. This includes all safety logic, data, and safety I/O configuration.

For safety system requirements, including information on the safety network number (SNN), verifying the safety signature, and functional verification tests refer to the appropriate GuardLogix controller publication as defined in Additional Resources on page 9.

IMPORTANT You must read, understand, and fulfill the requirements that are detailed in the GuardLogix controller systems safety reference manual before operating a safety system that uses a GuardLogix controller and a 843ES CIP Safety encoder.

Controller-based Safety Functions

Controller-based safety functions operate in a GuardLogix 5580 or Compact GuardLogix 5380 controller and use the EtherNet/IP network to communicate with the safety I/O. This includes the safety functions provided by the Drive Safety tab of your Studio 5000 Logix Designer project.

The Bulletin 843ES CIP Safety encoder also supports the safety feedback (SFX) instruction that provides safety position and velocity data to a GuardLogix safety controller for use in controller-based monitoring functions.

Important Safety Considerations

You are responsible for the following:

- Validation of any sensors or actuators that are connected to the system
- Completing a machine-level risk assessment
- Certification of the machine to the desired ISO 13849 Performance Level or IEC 62061 SIL level
- Project management and proof testing in accordance with ISO 13849

Performance Level (PL) and Safety Integrity Level (SIL)

For safety-related control systems, Performance Level (PL), according to ISO 13849-1, and SIL levels, according to IEC 61800-5-2, IEC 61508, and IEC 62061, include a rating of the ability of the system to perform its safety-related functions. All safety-related components of the control system must be included in both a risk assessment and the determination of the achieved levels.

See ISO 13849-1, IEC 61508, and IEC 62061 standards for complete information on requirements for PL and SIL determination.

Compatible Safety Controllers

A GuardLogix 5580 or Compact GuardLogix 5380 safety controller is required for integrated safety control with the 843ES CIP Safety encoder.

The Studio 5000 Logix Designer application, version 31.00 or later, supports the programming, commissioning, and maintaining GuardLogix safety controllers with the 843ES CIP Safety encoders.

The safety connection can originate from either of these GuardLogix controllers:

- One GuardLogix 5580 or Compact GuardLogix 5380 safety controller that provides both safety and non-safety control
- A GuardLogix 5580 or Compact GuardLogix 5380 safety controller that controls only the safety connection, while a separate ControlLogix® 5580 or CompactLogix 5380 controller that controls the non-safety control connection.

Safety Task

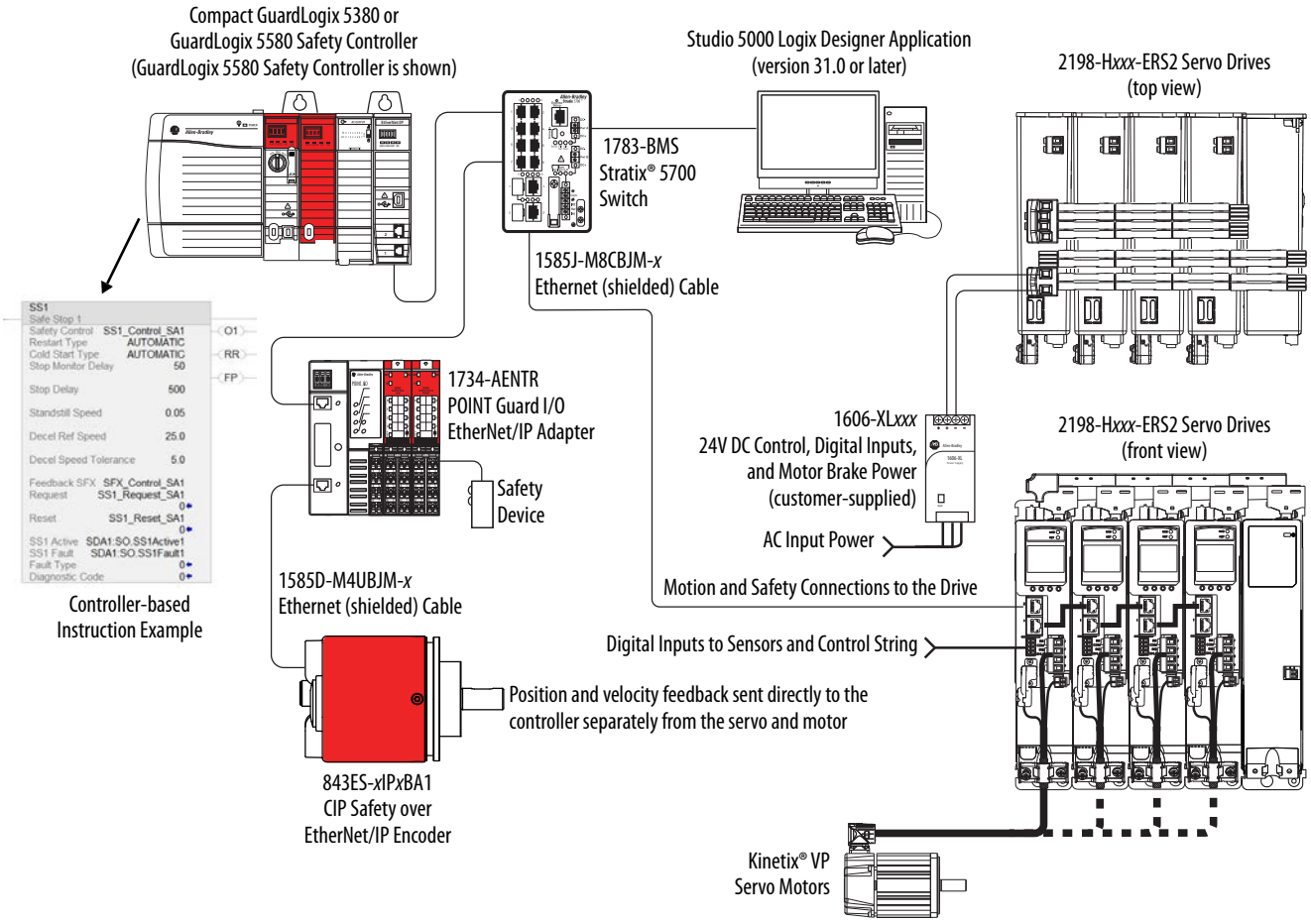
Safety functions operate in a safety task of only GuardLogix 5580 or Compact GuardLogix 5380 controllers

The safety task, operating in a GuardLogix controller, communicates with the encoder over a safety connection on the EtherNet/IP network.

Feedback from the encoder is supported in both the safety task and non-safety task.

See publication 1756-RM095, for more information on safe motion-monitoring instructions.

Figure 2 - Safety Configuration



Configuration Signature and Ownership

Every 843ES CIP Safety encoder in a system has a configuration signature and configuration ownership.

Configuration Signature

Each safety device has a unique configuration signature that defines the module configuration. The configuration signature includes the following:

- ID number
- Date
- Time

The configuration signature is used to verify the configuration of a module.

Configuration Ownership

The connection between the owner-controller and the 843ES CIP Safety encoder is based on the following:

- 843ES CIP Safety encoder node number
- 843ES CIP Safety encoder safety network number
- Controller node or slot number

IMPORTANT If the owner-controller is a GuardLogix 5580 controller, the controller has a slot number.

- Controller safety network number
- Path from the controller to the 843ES CIP Safety encoder
- Configuration signature

If any differences are detected, the connection between the owner-controller and the 843ES CIP Safety encoder is lost, the yellow yield icon appears in the controller project tree.

Reset an 843ES CIP Safety Encoder to Out-of-Box State

If an 843ES CIP Safety encoder was used previously, you must clear the configuration ownership before you can install it on a safety network. That is, you must return the module configuration to its out-of-box state.

When an 843ES CIP Safety encoder is in the out-of-box state, a controller does not own its configuration.

The Safety category on the Module Properties dialog box displays the module Configuration Ownership. The Logix Designer application project must be online to check.

If the module configuration is owned, the Safety category displays whether the controller for the opened project owns the module configuration or another controller owns it.

For information on how to reset the module in the Logix Designer application, see Reset to Out-of-Box Configuration on page 58.

You cannot reset the module to its out-of-box configuration if any of the following conditions exist:

- There are pending edits to the module properties.
- When a safety signature exists in the controller project.

You use the Studio 5000 Logix Designer application to configure the encoder.

Safety Connection

The safety controller communicates with the safety instances in the encoder module over the safety connection. Cyclic data are passed in each direction over the safety connection that appears in safety Controller tag structures that are called input and output assemblies. The safety connection cyclic rate is configured in the Logix Designer application. The Safety Input Assembly tag structure is data from the encoder module safety instances to the safety controller. The Safety Output Assembly tag structure is data from the safety controller to the encoder module safety instances.

Table 9 - Safety Input Assembly Tags

Safety Input Assembly Tag Name (Input to Safety Controller)	Type/ [bit]	Description
module:SI.RunMode	BOOL	The encoder is able to accomplish its primary function.
module:SI.ConnectionFaulted	BOOL	The controller overwrites the zero with a 1 when the connection is not up.
module:SI.DiagnosticActive	BOOL	One or more diagnostic or prognostics thresholds reached.
module:SI.DiagnosticSequenceCount	SINT	Increments for each time a distinct diagnostic condition is detected, and also each time a distinct diagnostic condition transitions from detected to not detected. Set to 0 by product reset or power cycle.
module:SI.Encoder.Fault	BOOL	A rollup of any fault designated internal fault by the Safety Position Sensor Object.
module:SI.Encoder.Uncertain	BOOL	Module is operating outside its designed operating range, or data is under manual or override control. A rollup of any fault designated uncertain by the Safety Position Sensor Object.
module:SI.Encoder.Status	BOOL	Indicates that the safety channel data is valid based on module diagnostics.
module:SI.Encoder.FeedbackValidFlag	BOOL	Indicates that the Safety Position Sensor Object has been configured for use and has valid data that is supplied in the safety input assembly. Always the INVERSE of module:SI.Encoder.Fault
module:SI.Encoder.Position	DINT	Position in number of counts
module:SI.Encoder.Velocity	REAL	Current velocity. The velocity units define the format.
module:SI.Encoder.Acceleration	REAL	Current acceleration. The acceleration units define the format.

Table 10 - Safety Output Assembly Tags

Safety Output Assembly Tag Name (Output to Safety Controller)	Type/ [bit]	Description
module:SO.Encoder.SetZeroPosition	BOOL	0 = OK, 1 = Reset the encoder Position value, by applying the value in Preset of the configuration assembly

Protected Operations

To maintain the secure operation of your safety I/O modules, operations that can disrupt module operation are restricted based on the module operating mode.

Table 11 describes the restrictions.

Table 11 - Protected Operations on safety I/O modules

Current Module Operation	Activity						
	Firmware Update Request	Module Reset Request	Connection Request	Configuration Change	Connection or Data Format Change	Electronic Keying Change	RPI Change
Connection not running	Accepted						
Connection running	Rejected		Accepted (1)	Accepted (2)	Not allowed (3)	Accepted (4)	
Firmware update is in process	Rejected						

(1) Only requests for Listen Only connections are accepted.

(2) Configuration change is accepted in the following scenarios:
- Changes are made in the Module Properties dialog box and you click Apply.
- Changes are made in the Configuration tags and you send a Reconfigure Module MSG to the module.

(3) The difference between Rejected and Not allowed is that rejected activities can be attempted in the Logix Designer application but do not take effect. The activities that are not allowed, that is, attempts to change the Connection or Data Format used, do not occur in the Logix Designer application.
For example, if you attempt to reset a module that is connected to the owner-controller, the Logix Designer application executes the request and alerts you that it was rejected. If you attempt to change the data format on a module that is connected to an owner-controller, the Logix Designer application does not execute the attempted change. The application only alerts you that the change is not allowed. In the case, if the change is attempted online, the Module Definition dialog box field that changes the data format is disabled.

(4) The change occurs after the connection is closed and reopened. You can close and reopen the connection in the following ways:
- Change the project while it is offline and download the updated project before going online again.
- Change the project while it is online and click Apply or OK in the Module Properties dialog box. In this case, before the change is made, a dialog box alerts you of the ramifications before the change is made.

Installation

This chapter describes how to install the 843ES CIP Safety encoder.

See the installation instructions provided in the box, publication 843ES-IN001.

ATTENTION: Warranty is voided if any of the following occur:

- Do not disassemble or open the encoder
- Do not modify the encoder. Doing so damages the encoder and reduces the accuracy and functions of bearings and seals
- Do not machine the shaft or the housing (for example, grind, saw, or drill)
- Avoid impacts to stress to the encoder, such as hammering the encoder for alignment. Doing so damages the encoder and reduces the accuracy and functions of bearings and seals
- Do not subject the encoder shaft to axial or radial loads that exceed the values that are specified in the data sheets.
- Do not rigidly connect the encoder shaft to the machine. A rigid connection causes premature failure of the encoder or machine bearings. Always use flexible couplings.

Mechanical

ATTENTION: Do not connect rigidly the stator and the rotor. The encoder would be mechanically constrained and thus damaged.

- With solid shaft encoders, always use a tolerance-compensating element between the drive shaft and the encoder shaft
- With hollow shaft encoders, always use a tolerance-compensating element between the encoder flange and the drive flange.

IMPORTANT Comply with the maximum permissible shaft offset.

- Axial offset: $< \pm 0.25$ mm [0.01 in.]
- Radial offset: $< \pm 0.20$ mm [0.008 in.]

The values that are specified for the radial and axial offset are maximum values, which must not occur simultaneously. If shaft displacements nevertheless occur simultaneously, their share in the sum must not exceed 100% of the specified maximum values.

IMPORTANT Clean and degrease the encoder shaft and the load shaft before installation.

When installing, follow the descriptions and specifications of the couplings that are used. The coupling influences the system accuracy of the drive unit, so verify that the coupling is stiff and non-slip.

Make sure that the shaft couplings are designed so that a breakage of the connection can be excluded. Conduct a risk analysis before installation and consider the following aspects:

- Counter-torque of the encoder
- Maximum permissible shocks and vibrations
- Maximum permissible acceleration
- Permissible geometrical deviations in the ideal orientation of the shafts
- Permissible temperatures and humidity ranges
- Required angular accuracy

For this assembly, use only inspected and calibrated tooling that is subject to the quality system. Unless otherwise specified, a friction coefficient of 0.14 assumed for all screw connections, and a strength property class of 8.8 (metric) or Grade 5 (imperial) assumed for the screws. Secure the screws against loosening by using coated screws, threadlocker, or SCHNORR® washers to keep screws secure. We recommend adding additional protection against manipulation by marking the fastening screws with locking varnish or similar.

Before You Begin

After unpacking the encoder, verify that the nameplate catalog number matches the catalog number on the purchase order.

1. Remove the encoder carefully from the shipping container.
2. Visually inspect the encoder and connectors for damage.
3. Immediately notify the carrier of any shipping damage.

Couplings

The encoder coupling affects the system accuracy of the load unit. It must therefore be made sure that the coupling is rigid, without any slipping.

Consider the following when you procure or install couplings:

- Counter-torque of the encoder
- Maximum permissible shocks and vibrations
- Maximum permissible acceleration
- Permissible geometrical deviations in the ideal orientation of the shafts
- Permissible temperature and humidity ranges

For the hollow shaft encoders, the coupling elements, such as a stator coupling or a compensating torque stop, are supplied mounted.

ATTENTION: IEC 61800-5-2 defines the loosening of mechanical connection (between the encoder and the drive) as a fault that requires consideration. Fault exclusion is required for the coupling elements if the control cannot detect this fault. Therefore, design the coupling between the encoder and apparatus for fault exclusion so that any possibility of breakage at the coupling can be ruled out. To achieve this fault exclusion, the encoder mechanical limits and mounting practices in this document must be considered.

Screws and Screwed Connections

Unless otherwise specified, a friction coefficient of 0.14 is assumed for all screwed connections.

Unless otherwise specified, a strength class of 8.8 is assumed for all screws. The screws must be secured against loosening by using one of the following:

- Coated screws
- Threadlocker, example Loctite®
- SCHNORR® washers

We recommend an additional protection against manipulation by marking the fastening screws such as with locking varnish.

IMPORTANT For assembly, use only checked and calibrated tools.

Shaft Rotation Direction

When you view the encoder from the shaft side, the shaft rotation is clockwise (CW) or counterclockwise (CCW), as shown in Figure 3.

Figure 3 - Shaft Rotation

Mount with a Solid Shaft

IMPORTANT For solid shaft encoders, a suitable shaft coupling that meets the requirements of the application must be used.

1. Be sure to select the proper size flexible coupling clamp to mate to the encoder shaft. See publication 847-TD001 for encoder accessories.
2. To determine the encoder mounting hole locations, see Solid Shaft Approximate Dimensions on page 32.
3. Fasten the encoder and tighten with three size M3 mounting screws (provided with the flange).
4. Tighten the screws at a torque of 1 N•m (8.9 lb•in) and secure them against loosening.
5. Check the shafts for offset. The maximum permissible tolerances depend on the selected shaft coupling.
6. Connect the encoder and load shaft with a flexible coupling.
7. During assembly, protect the coupling element against excessive bending and damage.
8. Center the flexible coupling, screw the coupling without pre-load, and secure it against loosening.
9. Rotate the machine slowly and verify that the flexible coupling is not deforming beyond specifications.
10. Align machine to its mechanical zero or home position.

Solid Shaft Approximate Dimensions

IMPORTANT To simplify the drawings and information, unless otherwise specified, the general tolerances with tolerance class m (medium) according to ISO 2768-1 apply.

Figure 4 - Solid Shaft with Clamping Flange [mm (in.)]

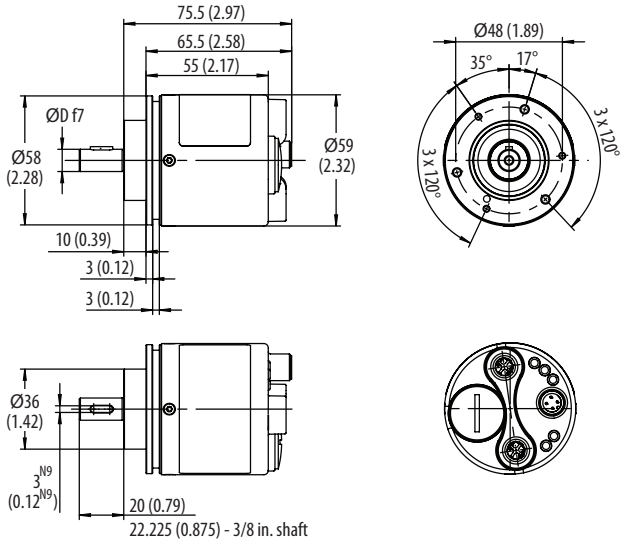


Figure 5 - Solid Shaft with Synchro Flange [mm (in.)]

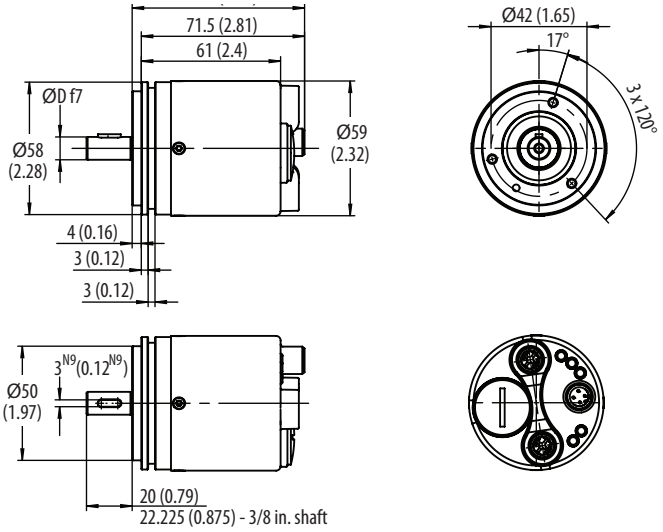
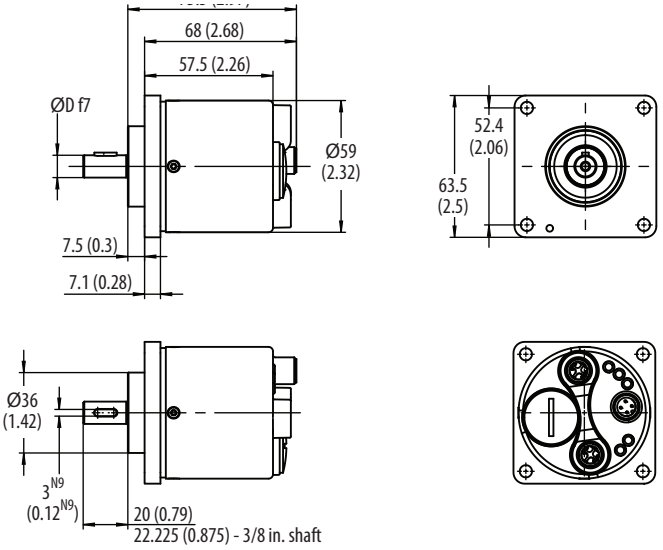


Figure 6 - Solid Shaft with Square Flange [mm (in.)]



Mount with a Hollow Shaft

For hollow shaft encoders, the coupling elements (for example, a stator coupling or a compensating torque stop) are factory-mounted.

IMPORTANT
- Verify that the insertion depth of the load shaft into the hollow shaft encoder is ≥25.5 mm (1.0 in.)
- Verify that the mating shaft is chamfered and grease-free.

1. Check the shafts for offset. The maximum allowed shaft connection tolerances are:
   - Axial offset < ±0.25 mm (0.01 in.)
   - Radial offset < ±0.20 mm (0.008 in.)
2. Slide the encoder onto the mating shaft until the flex mount rests on the machine surface. Minimum insertion depth for hollow shaft is 25.5 mm (1.0 in.).

ATTENTION: The encoder slides freely onto the shaft; if not, do not force. Check the shaft for interferences such as gouges, burrs, rust, or size.

3. Hold encoder firmly and mark the two mounting holes. To determine the encoder mounting hole locations, see Hollow Shaft Approximate Dimensions. (If mounting holes exist, proceed to step 6.)

IMPORTANT Do not stress the flex mount while tightening the screws.

4. Slide the encoder off. To accept M3 (or equivalent) screws, drill and tap the marked holes.
5. Slide the encoder back onto the shaft until the flex mount rests on the machine surface.
6. Attach the encoder with two M3 (or equivalent) screws. Screw the stator coupling and the torque stop without preload on the drive flange. Tighten the screws to 1 N•m [8.9 lb•in].
7. Tighten the clamping ring screw to 2.5 N•m (22.1 lb•in).
8. Align machine to its mechanical zero or home position.

Hollow Shaft Approximate Dimensions

IMPORTANT To simplify the drawings and information, unless otherwise specified, the general tolerances with tolerance class m (medium) according to ISO 2768-1 apply.

Figure 7 - Hollow Shaft 63 mm (2.5 in.) Diameter [mm (in.)]

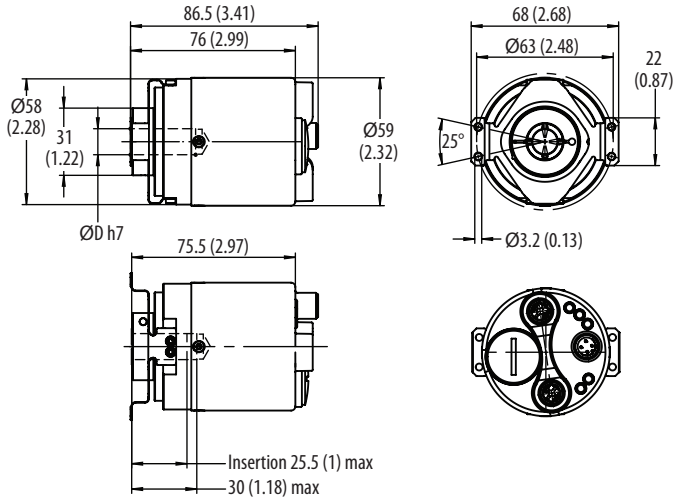
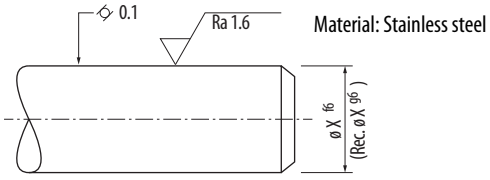


Figure 8 - Application Side Requirements for Hollow Shaft Encoders



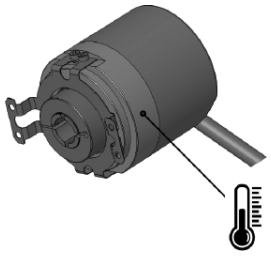
Mechanical Specifications

See Appendix A on page 79.

Temperature Measurement

Under specific conditions, the maximum permissible ambient temperature must be limited. Therefore, one also refers for encoders to a maximum operating temperature, which is composed of several components.

An encoder is a mechatronics system that heats up differently according to the variant. For critical applications close to the maximum values, we recommend measuring the actual temperature of the encoder in operation on the flange.



Both the ambient temperature and the mechanical and electrical self-heating are included when measuring the temperature on the flange. Therefore, the temperature that is measured on the flange gives the operating temperature of the encoder.

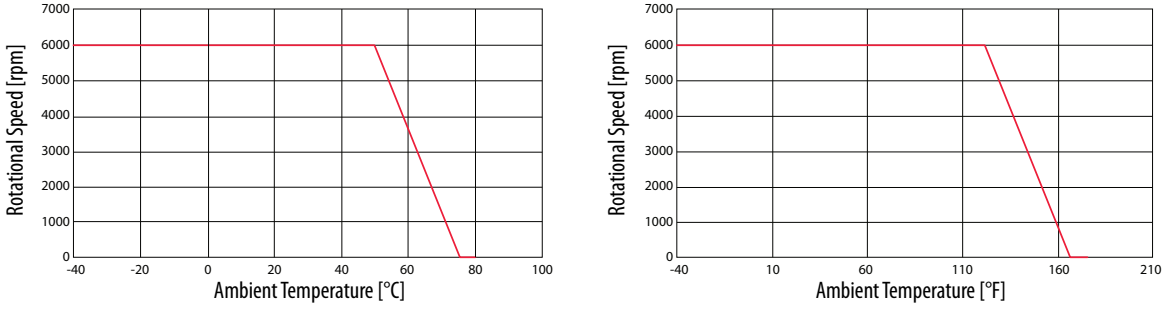
IMPORTANT When selecting accessories and connection technology, pay attention to the maximum temperature of these components, especially the connection technology.

Due to the cable material (PVC as standard), the lowest temperature an encoder with direct cable outlet can be used is -30 °C [-22 °F]. If you need a wider temperature range, please contact your local Allen-Bradley distributor or Rockwell Automation sales office.

Figure 9 shows a relationship between rotational speed and ambient temperature. More consideration of your rotational speed is necessary as ambient temperature increases.

Flange temperature is represented by the operating temperature and is the decisive factor. Depending on the temperature at the flange, the rotational speed may change.

Figure 9 - Derated Rotational Speed



Disassembly

When disassembling, take care not to damage the parts necessary for housing tightness. Never reuse damaged devices.

ATTENTION: Before disassembly:

- Switch off the power supply and secure it against being switched on again.
- Physically disconnect the energy supply lines and discharge possibly remaining residual energies.
- Remove operating and auxiliary materials and remaining processing materials.

To disassemble the device, proceed in the reverse order of the assembly, see Mechanical on page 29.

Reassembly

Reassembling the device is only permitted under the following conditions:

- The device is undamaged.
- The screws can be newly secured against loosening.
- All safety instructions have been complied with.
- All the steps that are described in Mechanical on page 29 have been conducted and complied with.

Electrical

ATTENTION:

- Make sure that the operating voltage is switched on or off simultaneously for the encoder and the downstream device.
- Electrostatic discharges at the contacts of the connector or at the cable ends could damage or destroy the device. Take appropriate precautionary measures.
- Use a PELV supply voltage source according to IEC 60204-1 complying with the proper operating voltage and the maximum permissible output current. To meet UL requirement, a Class 2 power supply is required for North America.

IMPORTANT To connect the encoder, refer to the corresponding operating and safety instructions of the external drive system/encoder evaluation system.

When assembling a mating connector, comply with the instructions that are attached to the connector.

IMPORTANT Verify that all required cable wires/connectors are connected before commissioning. Insulate individually all unused ends of the output signals to avoid short-circuits.

ATTENTION: Commissioning requires a thorough check by authorized personnel.

Before you operate a system that is equipped with the 843ES CIP Safety absolute encoder, verify that authorized personnel check and release the system.

General Safety Instructions

- Individually insulate all unused ends of the output signals to avoid short-circuit.
- When assembling the cable mating connector, comply with the instructions that are attached to the connector.
- Only connect or disconnect the mating connector to or from the encoder when the encoder is disconnected from the power supply.
- Electrostatic discharges at the contacts of the connector or at the cable ends could damage or destroy the device. Take appropriate precautionary measures.
- Make sure that the operating voltage is switched on and off simultaneously for the encoder and the downstream device.
- Comply with the proper operating voltage and the maximum admissible output current.
- Use a PELV supply voltage source according to IEC 60204-1. To meet UL requirement, a Class 2 power supply is required for North America.

Cabling

IMPORTANT Before connecting or disconnecting the signal cable, always disconnect the power supply and secure it against switching on again.

Consider using the shortest length possible for both Ethernet and power cables. Run Ethernet cables separate from power cables and run the DC power cable away from AC power.

Verify that no other devices with high interference levels such as frequency converters, solenoid valves, or contactors, are connected to the same power supply as the encoder. Otherwise, use suitable voltage filtering.

We recommend shielded twisted-pair cables for both Ethernet and power connections. These cables help avoid disruptions of signals from electrical noise and from mechanical vibration and shock that are common in most industrial environments. When installing the shielded cables, you must follow the recommended installation guidelines to avoid ground loops. You must comply with the maximum permissible connection cable length.

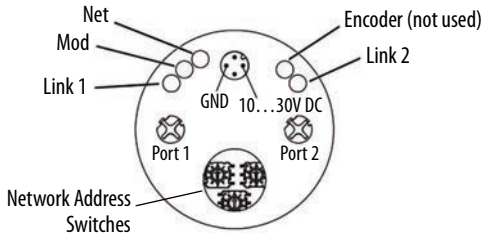
For shielded Ethernet cables, you must provide an equipotential grounding network that overlays the existing electrical grounding and bonding system for safety and fire. If you cannot provide an equipotential ground and the second connection from the encoder is going to a switch, install a patch panel to break the shield to the switch. Switches typically connect jack shield directly to the ground lug, which connects the shield directly to ground.

Electrical Wiring Instructions

Three electrical connections are on the back of the housing.

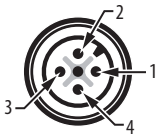
A 4-pin M12 connector is used for the power supply connection. Two 4-pin M12 connectors are used for the Ethernet connection.

Figure 10 - Connectors



Pin Assignments

Table 12 - Four-pin M12 Power Connector

	Pin	Signal	Color	Function
	1	Voltage +	Brown	Supply voltage (10…30V DC)
	2	—	White	—
	3	Voltage -	Blue	Supply voltage (0V)
	4	—	Black	—

IMPORTANT Both Ethernet ports are provided with a plastic cap. If only one port is used, the cap of the unused port must be tightened at a torque of 1 N•m [8.9 lb•in] to maintain the IP protection level.

Table 13 - Four-pin M12 Ethernet Connector

	Pin	Signal	Color	Pair Assignment
	1	Transmit Data +	White orange	Pair 1
	2	Receive Data +	White green	
	3	Transmit Data -	Orange	Pair 2
	4	Receive Data -	Green	

See Recommended Patchcords and Cordsets on page 14 for recommended power and Ethernet cordsets.

Electrical Specifications

See Appendix A on page 79.

Add Device to an EtherNet/IP Network

Set the IP Address

The 843ES CIP Safety encoder is shipped with the network address switches set to 999. Use one of the following methods to assign an IP address:

- To set the last octet of the IP address (192.168.1.xxx), use the network address switches (see Figure 11) on the encoder.
- Use the network address switches to enable BOOTP / DHCP and use a BOOTP utility or DHCP server to assign the IP address of the unit on powerup. To use the BOOTP/DHCP, see publication ENET-UM006.
- Set the rotary dials to 999 to use RSLinx® Classic software. To use RS Linx Classic software, see publication ENET-UM006.
- Set the rotary dials to 999 to use Studio 5000 Logix Designer application. To use Studio 5000 Logix Designer application, see publication ENET-UM006.

Assign the Last Octet in an IP Address Scheme of 192.168.1.xxx with the Network Address Switches

1. Set the three network address switches to 999.
2. Cycle power to the encoder.
3. Set the three network address switches to a valid address of 001...254.
4. Cycle power to the encoder.
5. The encoder powers up with the IP address set to 192.168.1.xxx, where xxx is the position of the three network address switches.

Figure 11 - Network Address Switches Set to 123

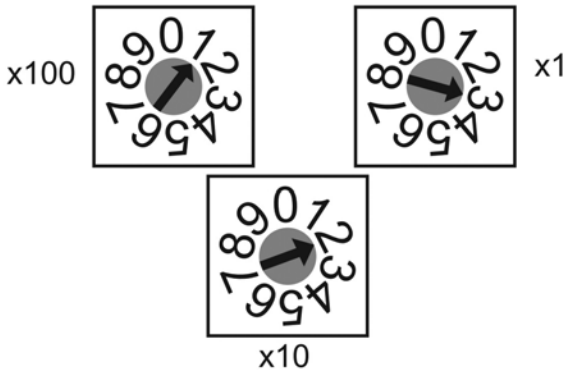
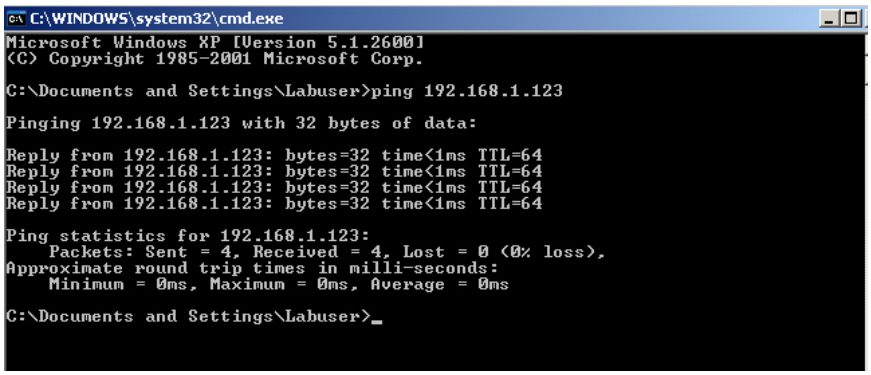


Table 14 - Function of Network Address Switch Settings

Setting of Network Address Switches	Function
001…254	Sets last octet of the IP address to the value indicated (xxx in 192.168.1.xxx)
888	Restores all factory default settings in the encoder and clears its IP address
999	Clears the encoder IP address

After setting the IP address, from a DOS prompt, you can ping the new address. The response is four packets sent, four packets received, and zero lost.



Duplicate IP Address Detection

Duplicate IP address detection verifies that an IP address does not match any other device IP address on the network when you perform either of these tasks:

- Connect the device to an EtherNet/IP network
- Change the IP address on the device

If the IP address matches that of another device on the network, the EtherNet/IP port on the device transitions to conflict mode. In conflict mode, these conditions exist:

- Module (MOD) status indicator blinks red
- Network (NET) status indicator is solid red

To resolve duplicate IP address conditions, see publication ENET-UM006.

Reset the IP Address to Factory Default

You can reset the IP address of the device to its factory default value by following these steps:

1. Set the switches to 888.
2. Cycle the power.

Network Topologies

The 843ES CIP Safety encoder supports linear, ring, and star network topologies.

A linear topology is a collection of devices that are daisy chained together.

Device Level Ring (DLR) supports a ring topology. As defined by the Open DeviceNet Vendor Association (ODVA), Device Level Ring is an EtherNet/IP protocol. DLR provides a means to detect, manage, and recover from single faults in a ring-based network.

The star topology consists of a number of modules that are connected to a central switch. Modules can be added or removed without affecting the rest of the network.

For more information on the supported EtherNet/IP network topologies and other EtherNet/IP features, see publication ENET-UM006.

Protected Modes

The 843ES CIP Safety encoder supports both implicit and explicit protected modes.

Implicit Protected Mode

Implicit Protected mode is a security enhancement that is automatically triggered as soon as one of the following occur:

- The device bridges I/O connections.
- The device is a target of I/O connections.

Implicit Protected mode is a state where the device is operational, but has implemented defenses against disruptive changes that would take the product out of service for the process.

This security enhancement occurs on the I/O module level and helps prevent unauthorized configuration changes that can affect system behavior and cause unintended and unforeseen changes.

Enable and Disable Implicit Protected Mode

Implicit Protected mode is enabled on the device as soon as I/O connections are established through the device. Implicit Protected mode is enabled on the device as soon as all I/O connections through the device are stopped.

Restrictions Imposed By Implicit Protected Mode

Implicit Protected mode prevents access to services that are not required after the device is configured and in normal operation. Implicit Protected mode disables features that can make the device vulnerable to disruptive actions. By doing so, Implicit Protected mode helps to reduce the attack surface.

IMPORTANT Implicit Protected mode is not configurable.

When it is in Implicit Protected mode, the device prevents execution of the following tasks:

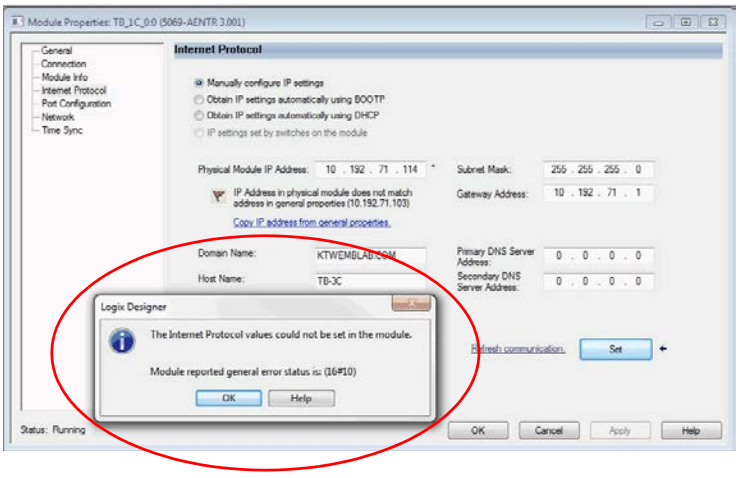
- Changing Ethernet configuration settings, such as port speed.
- Changing IP settings, such as IP address, mask, and DHCP mode.
- Updating the device firmware.
- Disabling or re-enabling external product ports.
- Performing remote resets.

Perform Tasks When Not Restricted

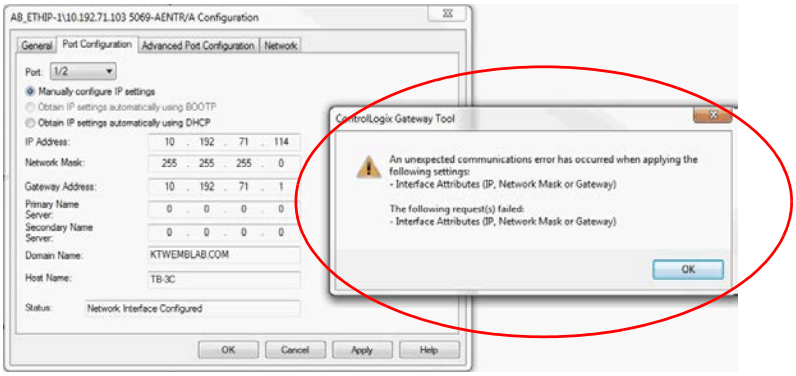
If the device is in Implicit Protected mode and you attempt to perform any of the restricted tasks, you are alerted that such a task cannot be performed because the device is in Implicit Protected mode.

The following are example alerts that result from an attempt to set IP values on a device when the device is in Implicit Protected mode:

- Studio 5000 Logix Designer® application



- RSLinx software



If the device is not in Implicit Protected mode, the device does not reject attempts to perform the tasks that are described previously.

For example, after the device is initially powered up, but no I/O connections are established yet, the device is not in Implicit Protected mode. You can attempt to update the device firmware and the device does not reject the attempt.

TIP If the device enters Implicit Protected mode each time the device powers up, check the application to determine if there are active I/O connections that are opened via the device.

Explicit Protected Mode

The 843ES CIP Safety encoder supports Explicit Protected mode. When in this mode, the device does not allow any configuration changes.

Enable Explicit Protected Mode

To enable Explicit Protected mode, follow these steps:

1. Set the rotary switches to position 900.
2. Power up the device, and wait for the Module Status indicator to blink red, the Network Status indicator to turn off, and the Link Status indicators to turn off.
3. Power down the device.
4. Set the switches for normal operation.
5. Power up the device.
6. The device is now in Explicit Protected mode.

While working in protected mode, the device rejects any CIP explicit messages that would change the configuration of the device. For example, you cannot change the IP address, speed, or duplex settings when the device had Explicit Protected mode enabled.

Disable Explicit Protected Mode

To disable Explicit Protected mode, follow these steps:

1. Set the rotary switches on position 000.
2. Power up the device, and wait for the Module Status indicator to blink red, the Network Status indicator to turn off, and the Link Status indicator to turn off.
3. Power down the device.
4. Set the switches for normal operation.
5. Power up the device.
6. The device is now in Explicit Protected mode.

Configure the Encoder with Studio 5000 Environment

This chapter describes how to configure your 843ES CIP Safety encoder in a Logix Designer application project. You can use the default module configuration or edit the module configuration.

IMPORTANT The 843ES CIP Safety encoder is compatible with ControlLogix 5580 and CompactLogix 5380 controllers. The encoder is not compatible with ControlLogix 5570, CompactLogix 5370, and any Logix controllers released prior.

Table 15 - Encoder Compatibility

Product	Version
Logix Controller Platform	• GuardLogix 5580 • Compact GuardLogix 5380 • ControlLogix 5580 (1) • CompactLogix 5380 (1)
Studio 5000 Environment	Version 31 and later
RS Linx Classic Software	Version 3.51 and later
FactoryTalk® Linx	Version 6.00 and later

(1) For standard only connection only.

For more information and to check compatibility between products and other products in a system, see the Product Compatibility and Download Center (PCDC) site (rok.auto/pcdc).

Before You Begin

You must configure your 843ES CIP Safety encoder upon installation before it can do any of the following:

- Verify the IP addresses for your programming terminal and 843ES CIP Safety encoder.
- Verify that you connected all wiring and cabling properly.
- Be sure that you configured your communication driver (for example, AB_ETH-1 or AB-ETHIP-1) in the RSLinx® Classic software.
- Create a Logix Designer application project.

The encoder does not work until it has been configured with at least the default configuration.

Studio 5000 Configuration Software

You must use Studio 5000 Logix Designer, version 31 or later to set configuration for your encoder. The instructions in this chapter use version 32. There is an option to accept the default configuration for your encoder or to write point level configuration specific to your application. Both options are explained in detail, including views of software screens, in this chapter. The 843ES CIP Safety encoder Add-on Profile (AOP) is required, see Appendix B on page 83 for information on how to download it.

Check the Integration in EtherNet/IP Via RSLinx Classic

With the aid of the tool RSLinx Classic, you can again check whether the IP address set detects the control system.

The EDS file (Electronic Data Sheet) contains all information that is related to the parameters and the operating modes of the EtherNet/IP encoder. The EDS file is stored in the encoder. If needed, the EDS can also be found on PCDC (rok.auto/pcdc) by searching for 843ES. Use the EDS hardware installation tool in the tools menu of RSLinx Classic software to register the EDS file.

Connections with the 843ES CIP Safety Encoder

During module configuration, you must define the module. Among the Module Definition parameters with the 843ES CIP Safety encoder, you must choose a connection type for the module. A connection is a real-time data transfer link between the owner-controller and the module that is a node on an Ethernet network that the configuration references.

When you download module configuration to a controller, the controller attempts to establish a connection to each module in the configuration.

If a module is detected on the Ethernet network, the owner-controller sends the configuration. One of the following occurs:

- If the configuration is appropriate to the module detected, a connection is made and operation begins.
- If the configuration is not appropriate to the module detected, the data is rejected and the Logix Designer application indicates that an error occurred. The configuration can be inappropriate for many reasons. For example, a mismatch in electronic keying that prevents normal operation.

The owner-controller monitors its connection with a module. Any break in the connection, for example, the loss of power to the system, causes a fault. The Logix Designer application monitors the fault status tags to indicate when a fault occurs on a module.

A real-time data transfer link is established between the controller and the module that is a node on an Ethernet network that the configuration references.

When you download module configuration to a controller, the controller attempts to establish a connection to each module in the configuration.

Requested Packet Interval

The Requested Packet Interval (RPI) is a configurable parameter that defines a rate at which the owner-controller and the module exchange data.

You set the RPI value during initial module configuration and can adjust it as necessary after module operation has begun. Valid RPI values for 843ES CIP Safety encoders are 6...500 ms.

IMPORTANT You can change the RPI while the project is online. If you change the RPI while the project is online, however, the connection to the module is closed and reopened in one of the following ways:

- You inhibit the connection to the module, change the RPI value, and uninhibit the connection.
- You change the RPI value. In this case, the connection is closed and reopened immediately after you apply the change to the module configuration.

Connection Reaction Time Limit With 843ES CIP Safety Encoders

With 843ES CIP Safety encoders, the Connection Reaction Time Limit (CRTL) configuration affects the module RPI.

The CRTL defines the maximum time that is allowed between valid safety packets on the associated connection. If the Max Network Delay exceeds the CRTL, a connection fault occurs.

By default, the CRTL is four times the RPI.

For more information on how to specify RPI rates, see Connection on page 56.

Module Data Quality Reporting

The 843ES CIP Safety encoders indicate the quality of channel data that is returned to the owner-controller. Data quality represents accuracy. Levels of data quality are reported via module input tags.

These input tags indicate the level of data quality.

IMPORTANT Once the condition that causes the Fault or Uncertain tag to change to 1 is removed, the tag automatically resets to 0. The Logix Designer application controls the tags. You cannot change the status of the tags.

Keep in mind that in some system configurations, the tag is not reset immediately after the condition is removed. The tag typically resets after a small delay.

Tag	Description
Encoder.Fault	This tag indicates that the reported channel data is inaccurate and cannot be trusted for use in your application. If the tag is set to 1, you cannot trust the data reported. You must troubleshoot the module to correct the cause of the inaccuracy. Example causes of inaccurate data include: • Field Power Loss condition • Short Circuit condition We recommend that you troubleshoot the module for the typical causes first.
Encoder.Uncertain	This tag indicates that the reported channel data can be inaccurate but the degree of inaccuracy is unknown. If the module sets this tag to 1, you know that the data can be inaccurate. You must troubleshoot the module to discover what degree of inaccuracy exists. Example causes of uncertain data include: • Module is operating outside its designed operating range • Data is under manual or override control

IMPORTANT We strongly recommend that you monitor the tags in your program to make sure that the application is operating as expected with accurate channel input data.

Inhibit a Module

Module inhibiting lets you indefinitely suspend a connection, including Listen Only connections, between an owner-controller and an I/O module without removing the module from the configuration. This process lets you temporarily disable a module, such as to perform maintenance.

IMPORTANT You cannot inhibit a connection when the controller is safety-locked or a safety signature exists for the controller.

You can inhibit a module in these ways:

- You write a configuration for an I/O module but inhibit the module to help prevent it from communicating with the owner-controller. The owner does not establish a connection and the configuration is not sent to the module until the connection is uninhibited.
- In your application, a controller already owns a module, has downloaded the configuration to the module, and is exchanging data over the connection between the devices.

In this case, you can inhibit the module and the connection to the module does not exist.

IMPORTANT Whenever you inhibit an output module that is ProgMode enabled, it enters Program mode, and all outputs change to the state configured for Program mode.

For example, if an output module is configured so that the state of the outputs transition to zero during Program mode, whenever that module is inhibited, outputs transition to zero.

You can inhibit a module in these instances:

- You want to update an I/O module, for example, update the module firmware revision. Use this procedure.
  a. Inhibit the module.
  b. Perform the update.
  c. Uninhibit the module.
- You use a program that includes a module that you do not physically possess yet. You do not want the controller to look for a module that does not yet exist. In this case, you can inhibit the module in your program until it physically resides and is active on the EtherNet/IP Network.

You can inhibit the connection to a 843ES CIP Safety encoder on the Connection category of the Module Properties dialog box.

To see where to inhibit a connection, see Connection on page 56.

Electronic Keying

Electronic Keying reduces the possibility that you use the wrong device in a control system. It compares the device that is defined in your project to the installed device. If keying fails, a fault occurs. These attributes are compared.

Attribute	Description
Vendor	The device manufacturer.
Device Type	The general type of the product, for example, digital I/O module.
Product Code	The specific type of the product. The Product Code maps to a catalog number.
Major Revision	A number that represents the functional capabilities of a device.
Minor Revision	A number that represents behavior changes in the device.

The following Electronic Keying options are available.

Keying Option	Description
Compatible Module	The default keying option. Compatible Module lets the installed device accept the key of the device that is defined in the project when the installed device can emulate the defined device. With Compatible Module, you can typically replace a device with another device that has the following characteristics: • Same catalog number • Same or higher Major Revision • Minor Revision as follows: – If the Major Revision is the same, the Minor Revision must be the same or higher. – If the Major Revision is higher, the Minor Revision can be any number.
Exact Match	Indicates that all keying attributes must match to establish communication. If any attribute does not match precisely, communication with the device does not occur. Exact match is a suitable keying option for safety applications.
Disable Keying (1)	Indicates that all keying attributes do not need to match to the established communication.

(1) Only available if connection is set for Standard Only.

Carefully consider the implications of each keying option when selecting one.

IMPORTANT If you change electronic keying parameters online, it interrupts connections to the device and any devices that are connected through the device. Connections from other controllers can also be broken.

If an I/O connection to a device is interrupted, the result can be a loss of data.

For more detailed information, see Electronic Keying in publication LOGIX-AT001.

Add the Device to the Controller Organizer

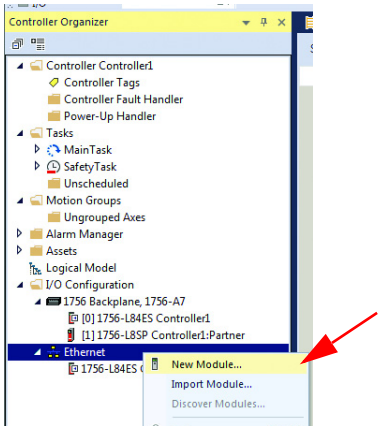
After you create a Logix Designer application project and install an 843ES CIP Safety encoder to the project, add the module as a New Module to the project. Discover Modules is not supported for this encoder because it is considered a safety device and safety devices cannot be added to a project while online with Logix.

IMPORTANT Verify that the Logix Designer application project is offline.

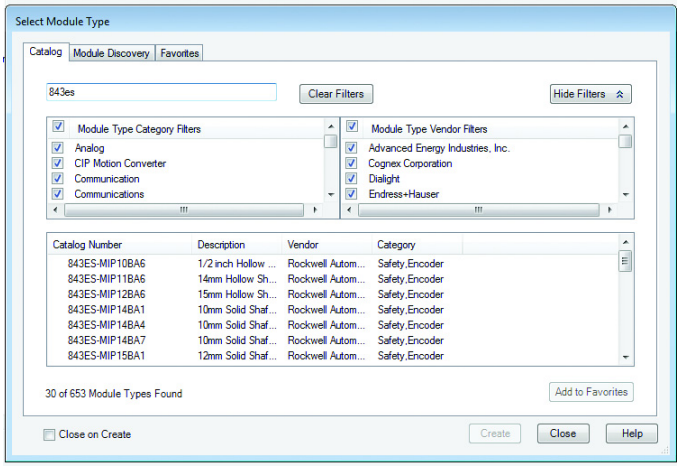
To create a 843ES CIP Safety encoder, complete the following steps:

1. Right-click the Ethernet adapter and choose New Module.

   This example uses a 1756-L84ES and 1756-L8P, and the encoder is on the network that is connected to the 1 GB Ethernet Port on the 1756-L84ES.

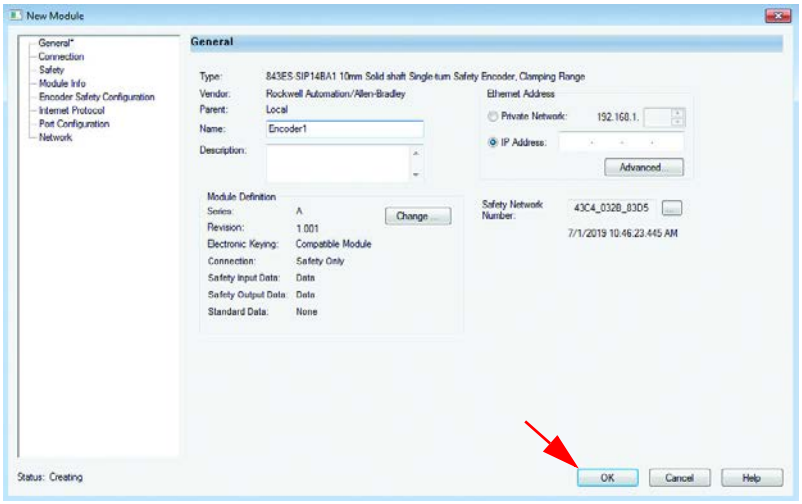


2. Select the module that matches the description of your 843ES CIP Safety encoder and click Create.



The New Module dialog box appears with a list of categories on the left side. The number and type of categories varies by module type.

3. Click OK to use the default configuration as shown or edit the module configuration. The rest of this chapter describes how to edit module configuration categories.



Edit the Module Configuration Common Categories

You click the category names in the New Module dialog box to view and change the configuration parameters.

IMPORTANT This chapter shows how to edit configuration when you add the module to the Logix Designer application project. If you access the module configuration after it is added to the project, the dialog box is named Module Properties. The same categories are displayed as the categories displayed on the New Module dialog box.

The following common categories are described in this section:

- General
- Connection
- Safety
- Module Info

General

The General page appears first when you create a module. The parameters in this category are the same for all 843ES CIP Safety encoder modules. You use this category to complete the following tasks:

- Name the module
- Describe the module
- Access the module definition

Safety Network Number

The purpose of the safety network number (SNN) is to make sure that every module in a system can be uniquely identified. During configuration, the Logix Designer application defaults an SNN of a safety device to match the SNN of the first safety node on each network. In most cases, you can use the default SNN.

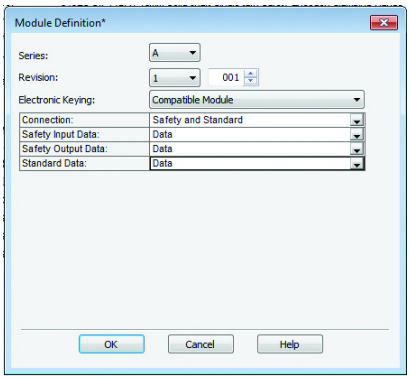
Module Definition

Module Definition parameters are available on the General page of the Module Properties dialog box in the Logix Designer application project. Table 16 describes the parameters on the Module Definition dialog box.

Table 16 - Parameter Definitions

Parameter	Definition	Available Choices
Series	Module hardware series	Module-specific
Revision	Module firmware revision, including major and minor revision levels	Module-specific
Electronic Keying	Software method by which you reduce the possibility of using the wrong device in a control system. For more information, see Electronic Keying in publication LOGIX-AT001.	Exact Match Compatible Module Disable Keying(1)
Connection	Determines the following for the module type you configure: • Available configuration parameters • Data type transferred between the module and the controller • Which tags are generated when configuration is complete	Safety Only Safety and Standard Standard Only
Safety Input Data	All available configurations, safety input data. This connection type creates all controller tags specific to the module type being used.	Data (2) None
Safety Output Data	All available configurations, safety output data. This connection type creates all controller tags specific to the module type being used.	Data (2) None
Standard Data	All available configurations, standard input and output data. This connection type creates all controller tags specific to the module type being used.	Data (3) None

(1) Disable Keying is only available if Standard Only connection is set.
(2) If Safety Only or Safety and Standard connection is set, then Safety Data parameter is locked as Data. If Standard Only connection is made, then the Safety Data parameter is set to None.
(3) If Standard Only or Safety and Standard connection is set, then Standard Data parameter is set to Data. If Safety Only connection is made, then the Standard Data parameter is set to None.



Connection

The Connection page lets you complete the following tasks:

- Set the RPI rate for the Standard Data. The RPI rate for the Safety Data is done on the Safety page. The fastest RPI that the standard connection of the encoder supports is 1 ms.

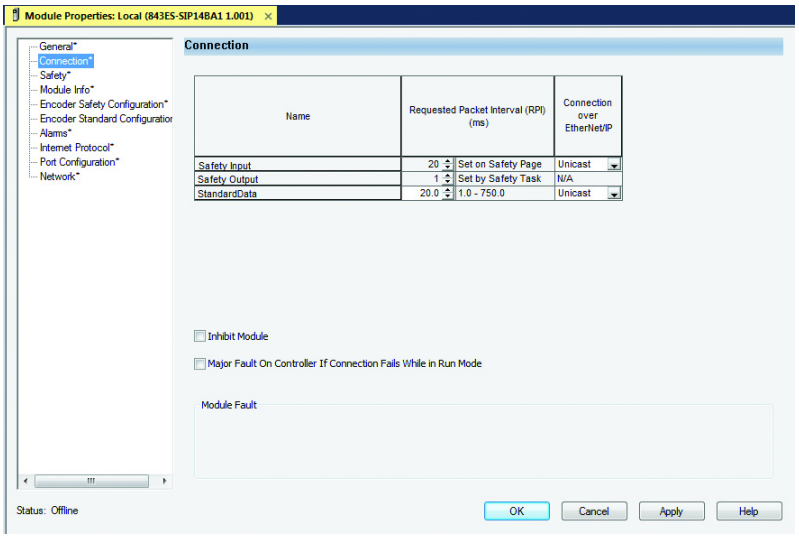
IMPORTANT You cannot set the Requested Packet Interval (RPI) for the safety modules on the Connections category. For safety modules, you set the RPI on the Safety category.

IMPORTANT The 843ES CIP Safety encoder does not support multicast connections.

For more information on unicast and multicast connections, see publication ENET-UM004.

- Inhibit the module. If the application program is safety-locked or a safety signature exists, you cannot inhibit or uninhibit the module. Before you inhibit the module, make sure that you are aware of the impact it has on your application. For more information, see Inhibit a Module on page 50.
- Configure whether a connection failure while the controller is in Run module causes a major or minor fault.

TIP The Module Fault area of the Connection category is useful during module troubleshooting.



Safety

The Safety page is only available if the module connection is established for Safety Only or Safety and Standard. The Safety page allows you to complete the following:

- Set the RPI rate for the Safety Input. When the RPI is changed, the Connection Reaction Time Limit (CRTL) is adjusted immediately. The fastest RPI rate that the safety input connection of the encoder supports is 6 ms.

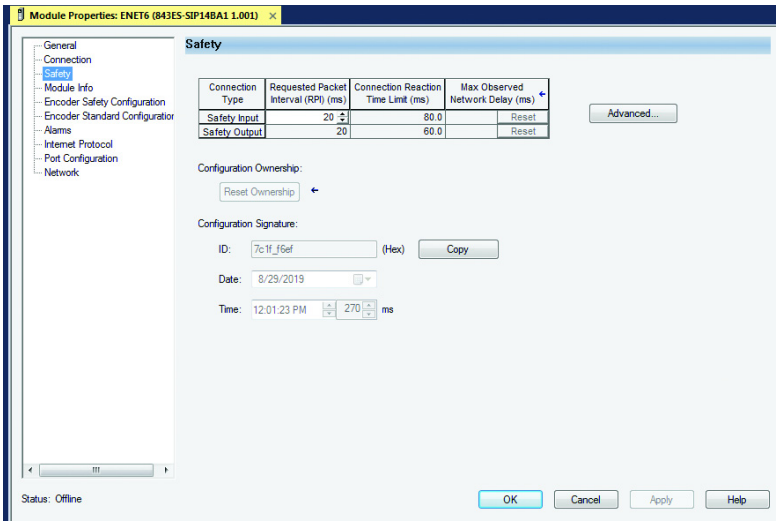
  IMPORTANT For the Safety Output connection, the RPI is fixed at the safety task period. If the corresponding CRTL is not satisfactory, you can adjust the safety task period via the Safety Task Properties dialog box. The fastest RPI rate the safety output connection of the encoder supports is 6 ms.

- Configure the safety signature and safety ownership. For more information on ownership configuration, see Configuration Ownership – Reset Ownership on page 59.

Configure the Safety Connection

Follow these steps on the Safety tab to configure the safety connection:

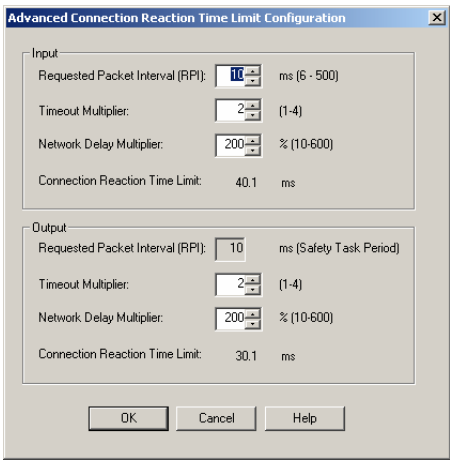
1. From the Module Properties dialog box, choose the Safety tab to see the Safety dialog box.



IMPORTANT Both standard and safety rated signals are included in the CIP Safety connection.

Safety rated signals can be used in safety functions. Standard rated signals can be used in the safety task, but must not be relied on for safety functions.

2. Click Advanced to configure Requested Packet Interval (RPI) and Configure Connection Reaction Time Limit (CRTL)



We suggest that you keep the Timeout Multiplier and Network Delay Multiplier at their default values of 2 and 200.
See the GuardLogix Controllers User Manual, which is listed in the Additional Resources on page 9, for more information about the CRTL.

Make sure that input RPI is set to match the application need. The smallest safety input RPI supported by the module is 6 ms. A smaller RPI consumes more network bandwidth.This can cause spurious trips because other modules cannot get access to the network.

Selecting an appropriate RPI results in a system with maximum (best) performance.

IMPORTANT Analyze each safety channel to determine what is appropriate. The default timeout multiplier of 2 and network delay multiplier of 200 create an input CRTL of four times the RPI and an output CRTL of three times the RPI. A safety administrator must approve changes to these parameters.

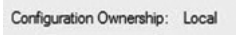
A connection status bit (ConnectionFaulted) exists for every connection.

If the RPI and CRTL for the network are set appropriately, then this status tag must always have a value of 0. Monitor all connection status bits to verify that they are not changing to 1 intermittently due to timeouts.

Reset to Out-of-Box Configuration

When the Logix Designer application is online, the Safety tab of the Module Properties dialog box displays the current configuration ownership. When the opened project owns the configuration, Local is displayed.

Figure 12 - Configuration Ownership



A communication error is displayed if the module read fails. See Replace an 843ES CIP Safety Encoder in a GuardLogix System on page 61 for integrated safety encoder replacement information.

You must inhibit the module connection before you reset ownership. To inhibit the module:

1. Right-click the module and choose Properties.
2. On the Connection tab, click Inhibit module.
3. Click Apply and then OK.

Configuration Ownership – Reset Ownership

ATTENTION: The replacement of safety devices such as the 843ES CIP Safety encoder requires that the replacement device is configured properly and operation of the replacement device must be verified.

Configuration ownership must be established when a new safety I/O module is added to a project and anytime there is a change in one of the following items.

- EtherNet/IP address
- Safety Network Number (SNN)
- GuardLogix slot number
- GuardLogix Safety Network Number
- Communication path from GuardLogix controller to module

The connection between the owner and the safety I/O device is based on the following:

- Device module number
- Device safety network number
- Controller slot number
- Controller safety network number
- Path from the controller to the device
- Configuration signature

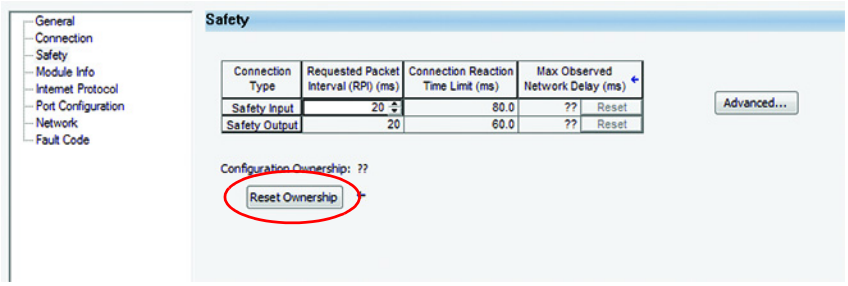
If any differences are detected, the connection between the controller and the device is lost, and the yellow yield icon appears in the controller project tree.

IMPORTANT When replacing an encoder, if the controller does not automatically re-establish the safety connection, it may be necessary to reset the ownership and the SNN (see procedure on page 60).

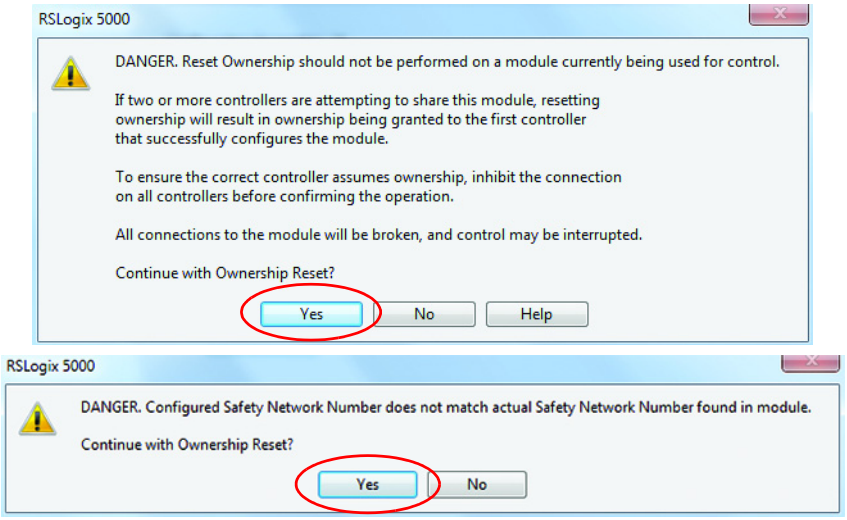
If any of these items change, the connection between the GuardLogix controller and the module is lost, and the yellow yield in the project tree appears. Reset ownership to re-establish the connection by using this procedure.

IMPORTANT When replacing a device, if the replacement device was used previously and if the connection is local (as shown on the safety tab in the Studio 5000 environment), the device must first be reset to out-of-box condition (see Reset to Out-of-Box Configuration on page 58).

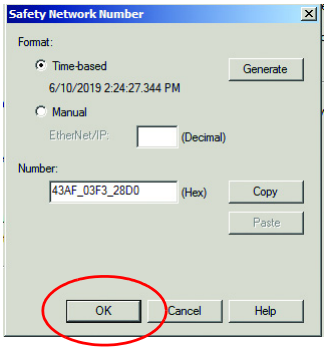
1. From the Module Properties dialog box, choose the Safety tab. You see the Safety dialog box.
2. To re-establish the connection, click Reset Ownership.



3. Click Yes to continue with ownership reset.



4. On the connection page, notice that the module is faulted (Code 16#080d, safety network number (SNN) not set, device-out-of-box).
5. From the General tab, click Safety Network Number. The SNN dialog box appears. Enter the Number, Click Set, then click OK.



6. Select Yes to continue.
7. The module status changes from Faulted to Running, in the lower left corner of the General tab.

Replace a Module in a Logix 5000 System

Consider the following conditions before you replace a safety module in a Logix 5000 system:

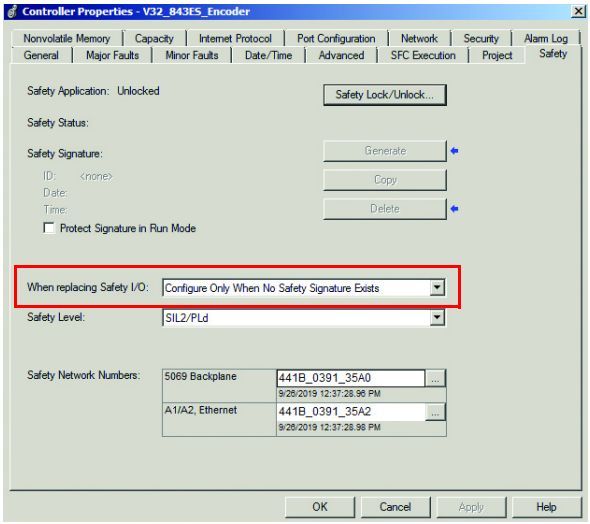
- If you rely on a portion of the CIP Safety system to maintain SIL 3 behavior during module replacement and functional testing, you must use the Configure Only When No Safety Signature Exists feature.
- If there is only one safety controller on the network, or if you do not rely on the entire routable CIP Safety control system to maintain SIL 3/PL (d or e) during the replacement and functional testing of a module, you can use the Configure Always feature.

Replace an 843ES CIP Safety Encoder in a GuardLogix System

When you replace an 843ES CIP Safety encoder, the replacement encoder must be configured properly and the operation of the replacement encoder must be verified.

IMPORTANT During encoder replacement or functional test, the safety of the system must not rely on any portion of the affected encoder.

Figure 13 - Safety Encoder Replacement Options



Two options for safety encoder replacement are available on the Safety tab of the Controller Properties dialog box in the Logix Designer application:

- Configure Only When No Safety Signature Exists

  This setting instructs the GuardLogix controller to configure a safety encoder automatically only when the safety task does not have a safety task signature, and the replacement encoder is in an out-of-box condition, meaning that a safety network number does not exist in the safety encoder.

If the safety task has a safety task signature, the GuardLogix controller automatically configures the replacement CIP Safety I/O device only if the following is true:

- The device already has the correct safety network number.
- The device electronic keying is correct.
- The node or IP address is correct.

For detailed information, see Additional Resources on page 9 for the appropriate user manual for your GuardLogix or Compact GuardLogix controller.

- Configure Always

  With this setting enabled, the controller automatically checks for and connects to a replacement encoder that meets the following requirements:

  - The controller has configuration data for a compatible encoder at that network address
  - The encoder has an SNN that matches the configuration

ATTENTION: Enable the Configure Always feature only if the entire integrated safety control system is not being relied on to maintain SIL 3 behavior during the replacement and functional testing of an 843ES CIP Safety encoder.

If other parts of the integrated safety control system are being relied upon to maintain SIL 3, make sure that the controller's Configure Always feature is disabled.

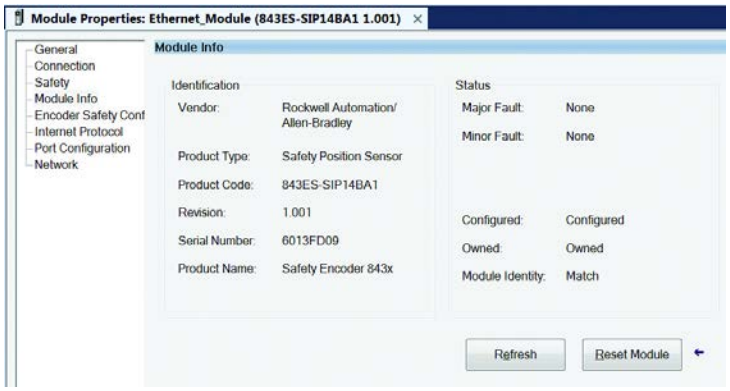
It is your responsibility to implement a process to make sure that proper safety functionality is maintained during device replacement.

ATTENTION: Do not place any devices in the out-of-box condition on any integrated safety network when the Configure Always feature is enabled. For the device replacement procedure, see Additional Resources on page 9 for the appropriate user manual for your GuardLogix or Compact GuardLogix controller.

Module Info

This page displays module and status information about the module when the project is online. You can use this category to complete the following:

- Determine the identity of the module
- Access module diagnostics
- Refresh the data on the screen
- Reset the module



Internet Protocol

This page allows you to edit the Internet Protocol (IP) settings of the encoder. For more information on setting IP address, see Chapter 4 on page 41.

You can use this page to complete the following:

- Set IP configuration settings
- Manually configure the IP settings
- Refresh the communication

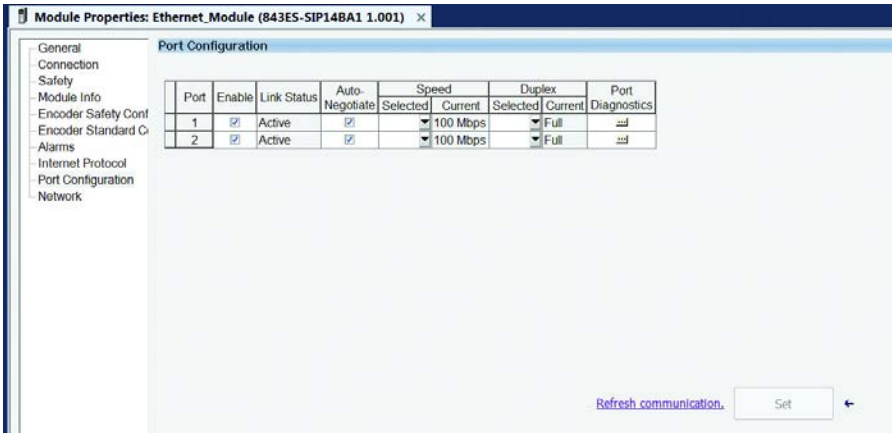
Port Configuration

This page allows you to modify the Ethernet port settings of the encoder.

You can use this page to complete the following:

- Enable or disable Ethernet ports
- Set scheduling on a port
- View the status of an Ethernet port on the encoder by clicking the Port Diagnostics button

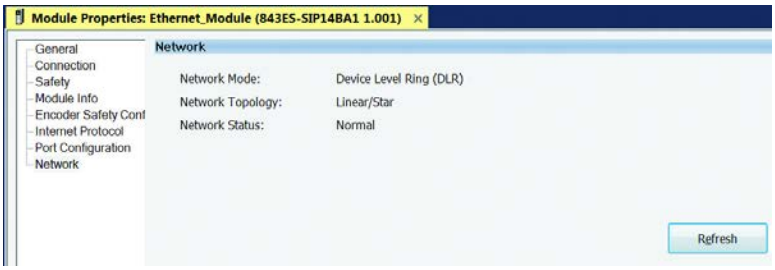
For more information on port settings, see publication ENET-UM006.



Network

The Network page contains read-only data that is populated when the controller goes online.

- Network Topology: Displays the current network topology as either linear/star or ring.
- Network Status: Displays the current network status as normal, ring fault, or unexpected loop detected.
- The Refresh Communication link appears when communication with the encoder has failed. Click Refresh Communication to attempt to restart communication with the encoder.



Edit 843ES CIP Safety Encoder Configuration Categories

The following categories are also available when configuring an 843ES CIP Safety encoder:

- Encoder safety configuration
- Encoder standard configuration
- Alarms

Encoder Safety Configuration

The Encoder Safety Configuration tab is used to determine the safety encoder behavior by configuring position scaling, direction, velocity units, and preset. Click the Enable Position Scaling checkbox to change the encoder resolution. Use the Direction drop down box to set the direction of the encoder. Use the Velocity Units drop down to set the velocity units of the encoder. The Velocity Units also sets the accelerations units.

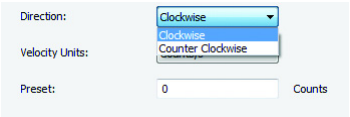
Position Scaling makes it possible to scale the steps per revolution and the total resolution.

If the Enable Position Scaling box is checked, the values can be entered for the steps per revolution and the total resolution applied.

Direction

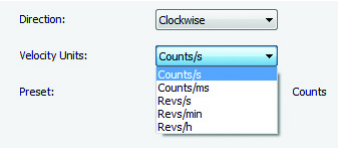
The direction of rotation (increase position value), viewed on the shaft, can be set to clockwise or counterclockwise.

- Clockwise = increase position value on clockwise revolution of the shaft
- Counterclockwise = increase position value on counterclockwise revolution of the shaft



Velocity Units

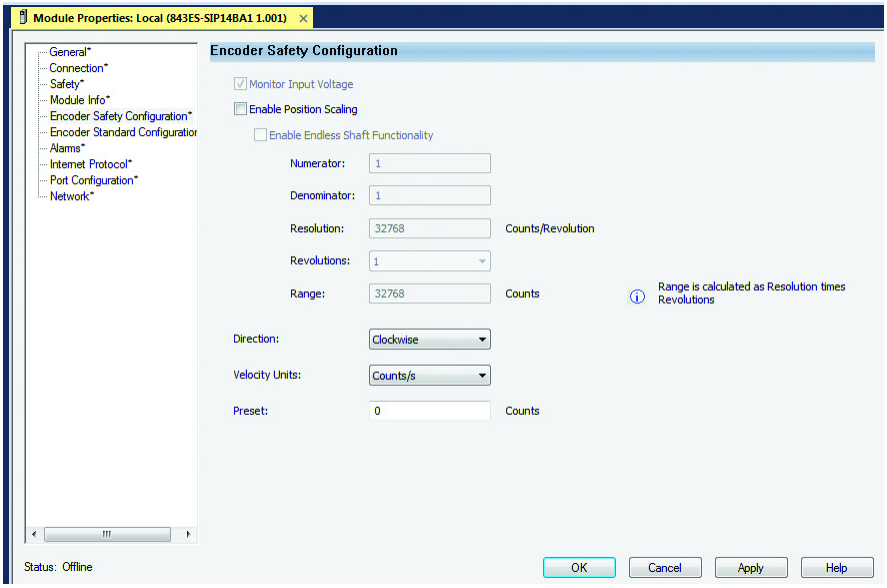
Use this parameter to define the units in which the velocity and acceleration is transmitted. The options are the following:



Velocity Unit Selected	Acceleration Unit Used
Counts/second	Counts/second^2
Counts/milliseconds	Counts/milliseconds^2
Revolutions/second	Revolutions/second^2
Revolutions/minute	
Revolutions/hour	

Preset

Enter the position offset value in counts. The Preset is applied to position value when SetZeroPosition is true. Values allowed from 0 to [Range - 1], where Range is a Position Scaling configured parameter.



IMPORTANT Endless Shaft Functionality for multi-turn encoders is not currently supported.

Resolution

Enter a value for resolution between 1...32768 (15 bits is maximum single-turn resolution for safety connection). Resolution is provided in counts per resolution.

Revolutions

If a multi-turn encoder is used, the revolutions can be set to 1...4096, in increments of 2^n power (4096 is 12 bits, which is the maximum multi-turn revolution that can be set). If a single-turn encoder is used, the revolution is fixed at 1.

Range

Range is the total resolution of the encoder in counts. Range is resolution multiplied by the number of revolutions. If you change resolution or revolutions, the range changes automatically. Range must be a value between 4...134,217,728.

Encoder Standard Configuration

The Encoder Standard Configuration tab is used to determine the standard (non-safety) encoder behavior by configuring position scaling, direction, velocity units, preset, and filters. Click Monitor Input Voltage to enable voltage monitoring for standard data (input voltage monitoring is always enabled for safety data). Enabling Sync Standard Config to Safety sets the configuration parameters for position scaling, direction, velocity units, and preset to follow the corresponding parameter values in the safety configuration page. Click the Enable Position Scaling checkbox to change the encoder resolution. Use the Direction drop down box to set the direction of the encoder. Use the Velocity Units drop down to set the velocity units of the encoder. The Velocity Units also sets the acceleration units.

Position Scaling makes it possible to scale the steps per revolution and the total resolution.

If the Enable Position Scaling box is checked, the values can be entered for the steps per revolution and the total resolution applied.

Direction

The direction of rotation (increase position value), viewed on the shaft, can be set to clockwise or counterclockwise.

- Clockwise = increase position value on clockwise revolution of the shaft
- Counterclockwise = increase position value on counterclockwise revolution of the shaft

Velocity Units

Use this parameter to define the units in which the velocity and acceleration is transmitted. The options are the following:

Velocity Unit Selected	Acceleration Unit Used
Counts/second	Counts/second^2
Counts/milliseconds	Counts/milliseconds^2
Revolutions/second	Revolutions/second^2
Revolutions/minute	
Revolutions/hour	

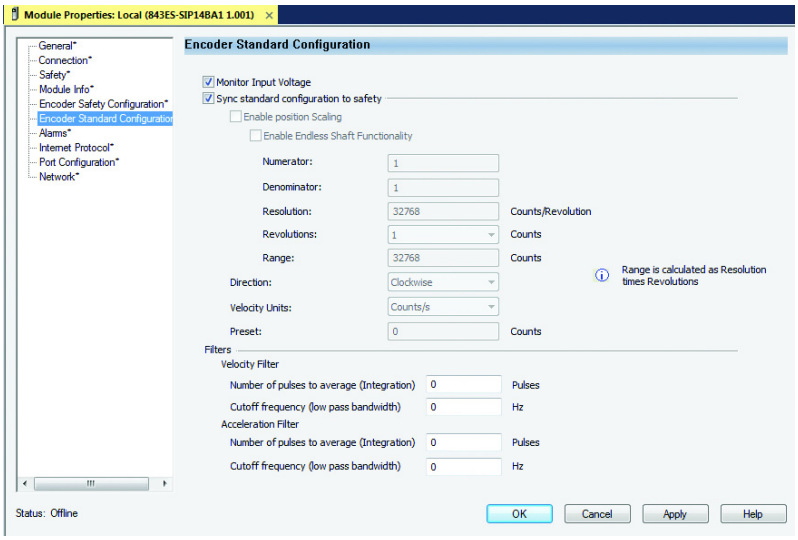
Preset

Enter the position offset value in counts. The Preset is applied to position value when SetZeroPosition is true. The maximum value is 1 less than the total measuring range of the encoder as configured by the position scaling.

Filters

Filter configuration parameters are available for the standard encoder data for velocity and acceleration. If either configuration is set to 0, the filter deactivates. The filter options are the following:

- Number of pulses to average (integration) = number of values from which a moving average is formed. Values that are allowed are 0...128 pulses.
- Cutoff frequency (low pass bandwidth) = sets the bandwidth of the low pass filter. Values that are allowed are 0...500 Hz.



IMPORTANT Endless Shaft Functionality for multi-turn encoders is not currently supported.

Resolution

Enter a value for resolution between 1... 262144 (18 bits is maximum single turn resolution for safety connection). Resolution is provided in counts per resolution.

Revolutions

If a multi-turn encoder is used, the revolutions can be set to 1...4096, in increments of 2^n power (4096 is 12 bits, which is the maximum multi-turn revolution that can be set). If a single-turn encoder is used, the revolution is fixed at 1.

Range

Range is the total resolution of the encoder in counts. Range is resolution multiplied by the number of revolutions. If you change resolution or revolutions, the range changes automatically. Range must be a value between 4...1,073,741,824.

Alarms

The Alarms page is used to configure alarms for the following parameters in the standard data:

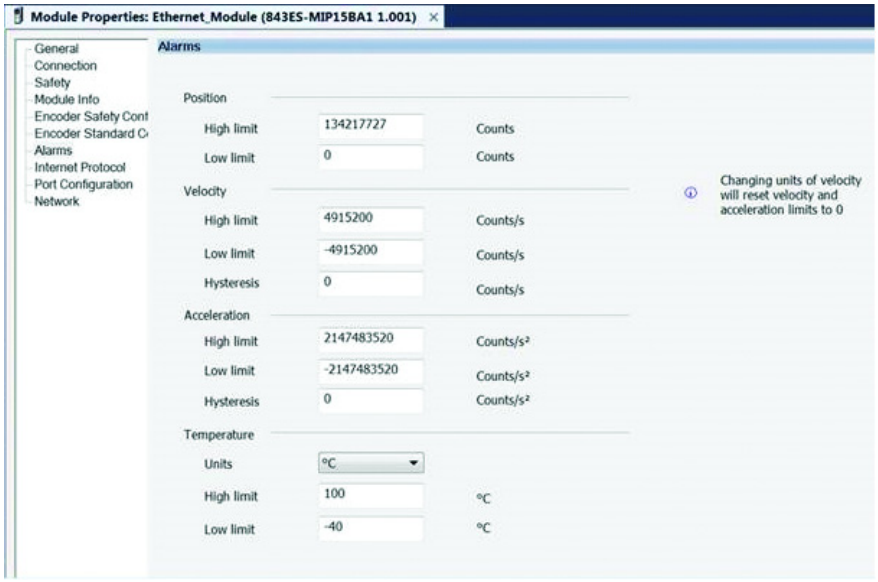
- Position
- Velocity
- Acceleration
- Temperature

The alarm parameters have a corresponding output bit for when the alarms are triggered in the standard input assembly. For all parameters, a high limit and a low limit alarm can be set. The low limit must be less than or equal to the high limit, and the high limit must be greater than or equal to the low limit.

You can add hysteresis for the velocity and acceleration limits so that the alarms are less sensitive to fluctuations near the respective setpoints.

The Alarms tab is also where the units for temperature are set.

If any units are changed, the parameters on the Alarms tabs are reset to their defaults. The defaults are converted correspondingly and overwrite the current setpoint value of the affected attributes.



Controller Tags

Table 17 - Safety Input Data Types (AB:SENC1:SI:0)

Member Name	Data Type	Description
RunMode	BOOL	0 = NOT Run Mode, 1 = Run Mode If device is in recovery mode or is otherwise unable to accomplish its primary function, then the value is 0.
ConnectionFaulted	BOOL	0 = up and working, 1 = not connected The device always returns a zero in this member. The controller overwrites the zero with a 1 when the connection is not up.
DiagnosticActive	BOOL	0 = No diagnostic active, 1 = One or more diagnostic or prognostics thresholds reached.
DiagnosticSequenceCount	SINT	Increments for each time a distinct diagnostic condition is detected, and also each time a distinct diagnostic condition transitions from detected to not detected. Set to 0 by product reset or power cycle. Wraps from 255 (-1) to 1 skipping 0.
Encoder	SENC_Channel:I:0	Data Type for Safety Encoder Channel

Table 18 - Safety Encoder Channel Input Data Type (SENC_Channel:I:0)

Member Name	Data Type	Description
Fault	BOOL	0 = No fault detected, 1 = Data is not valid A rollup of any fault designated internal fault by the Safety Position Sensor Object. This member triggers both the DiagnosticActive member and increments/decrements the Diagnostic Sequence Count
Uncertain	BOOL	0 = No Question about Data Validity, 1 = Data Validity is Questionable Module is operating outside its designed operating range, or data is under manual or override control. A rollup of any fault designated uncertain by the Safety Position Sensor Object.
Status	BOOL	Indicates that the safety channel data is valid based on module diagnostics. The value is always the opposite of Internal Fault.
Position	DINT	Position in number of counts
Velocity	REAL	Current velocity. The velocity units define the format.
Acceleration	REAL	Current acceleration. The acceleration units define the format.

Table 19 - Standard Input Data Types (AB:ENC1:I:0)

Member Name	Data Type	Description
RunMode	BOOL	0 = NOT Run Mode, 1 = Run Mode If device is in recovery mode or is otherwise unable to accomplish its primary function, then the value is 0.
ConnectionFaulted	BOOL	0 = up and working, 1 = not connected The device always returns a zero in this member. The controller overwrites the zero with a 1 when the connection is not up.
DiagnosticActive	BOOL	0 = No diagnostic active, 1 = One or more diagnostic or prognostics thresholds reached
DiagnosticSequenceCount	SINT	Increments for each time a distinct diagnostic condition is detected, and also each time a distinct diagnostic condition transitions from detected to not detected. Set to 0 by product reset or power cycle. Wraps from 255 (-1) to 1 skipping 0.
Encoder	CHANNEL_ENC:I:0	Data Type for Encoder Channel

Table 20 - Standard Encoder Channel Input Data Type (CHANNEL_ENC:I:0)

Member Name	Data Type	Description
Fault	BOOL	0 = No fault detected, 1 = Data is not valid A rollup of any fault designated internal fault by the Safety Position Sensor Object. This member triggers both the DiagnosticActive member and increments/decrements the Diagnostic Sequence Count
Uncertain	BOOL	0 = No Question about Data Validity, 1 = Data Validity is Questionable Module is operating outside its designed operating range, or data is under manual or override control. A rollup of any fault designated uncertain by the Position Sensor Object.
LVelocityAlarm (1)	BOOL	0 = No alarm 1 = Velocity is below low limit setpoint
HVelocityAlarm (1)	BOOL	0 = No alarm 1 = Velocity is above high limit setpoint
LAccelAlarm (1)	BOOL	0 = No alarm 1 = Acceleration is below low limit setpoint
HAccelAlarm (1)	BOOL	0 = No alarm 1 = Acceleration is above high limit setpoint
LPositionAlarm (1)	BOOL	0 = No alarm 1 = Position is below low limit setpoint
HPositionAlarm (1)	BOOL	0 = No alarm 1 = Position is above high limit setpoint
LTemperatureAlarm (1)	BOOL	0 = No alarm 1 = Temperature is below low limit setpoint
HTemperatureAlarm (1)	BOOL	0 = No alarm 1 = Temperature is above high limit setpoint
Position	DINT	Position in number of counts
Velocity	DINT	Current velocity. The velocity units define the format
Accel	DINT	Current acceleration. The acceleration units define the format

(1) Alarm setpoint limits are defined in the Logix Designer encoder module properties Alarms page, see Alarms on page 69 for more detail.

Table 21 - Output Data Type (AB:ENC1:SO:0 and AB:ENC1:O:0)

Member Name	Data Type	Description
Encoder	CHANNEL_ENC:O:0	Data Type for Encoder Channel

Table 22 - Encoder Channel Output Data Type (CHANNEL_ENC:O:0)

Member Name	Data Type	Description
SetZeroPositon	BOOL	0 = OK, 1 = Reset the encoder Position value, by applying the value in Preset of the configuration assembly

Diagnostics and Troubleshooting

This chapter describes the diagnostic process to correct and clear fault conditions on the 843ES CIP Safety encoder.

ATTENTION: Cease operation if the cause of the malfunction has not been identified.

Stop the machine if you cannot clearly identify the error and/or if you cannot safely rectify the malfunction.

After switching on the power supply, wait at least 10 seconds until the encoder is ready for operation and interfaces are ready for communication. The encoder communicates with the digital interface after this period of time.

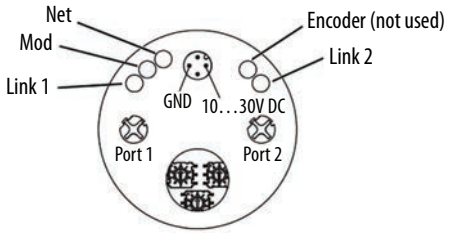
Status Indicators

The Mod status indicator shows the device status. The Net status indicator shows the status of the CIP connection. The Encoder status indicator shows the status of the internal measuring device in the 843ES CIP Safety encoder.

Four status indicators provide status information on the back of the encoder. Figure 14 shows their location and the tables describe their status.

ATTENTION: Status indicators are not reliable indicators and cannot be guaranteed to provide accurate information. They should only be used for general diagnostics during commissioning or troubleshooting. Do not attempt to use status indicators as operational indicators.

Figure 14 - Status Indicator Location



Read the status indicators according to Table 23 on page 74.

Table 23 - Status Indicators

Status Indicator	State	Description
Net	OFF	No power/IP address
	Green flashing	No connection The device has an IP address but no CIP connection.
	Green solid	Connected The device has an IP address and a CIP connection.
	Red flashing	Warning, connection time-out (minor fault) Cleared by reset or a new connection
	Red solid	Error (major fault) IP address has been assigned to another device already.
	Green/red flashing	Self-test at power-on Fast flashing during safety commissioning
Mod	OFF	No power
	Green flashing	Standby/idle
	Green solid	Device operational
	Red flashing	Warning, but device still operational (minor fault)
	Red solid	Error, device not operational (major fault)
	Green/red flashing	Self-test at power-on Device not configured
Encoder	Green solid	Power ON
	OFF	No power
Link 1/Link 2 (1)	OFF	No link/power OFF
	Green solid	Ethernet connection is established
	Green flashing	Data transmission/port active

(1) The Ethernet link status indicators (Link 1 and Link 2) display the status of the physical connection on the Ethernet interface.

Warnings, Alarms, and Errors Via EtherNet/IP

ATTENTION: It is imperative to evaluate the alarms in your application.

If there is a serious error, incorrect position values are output. This change could cause an unexpected movement that results in a hazard for persons or damage to the system or other objects.

Within EtherNet/IP warnings, alarms, and errors can be retrieved using implicit messages and also explicit messages. See Knowledgebase article KB1088713 for information about the CIP Object Model for the 843ES CIP Safety encoder.

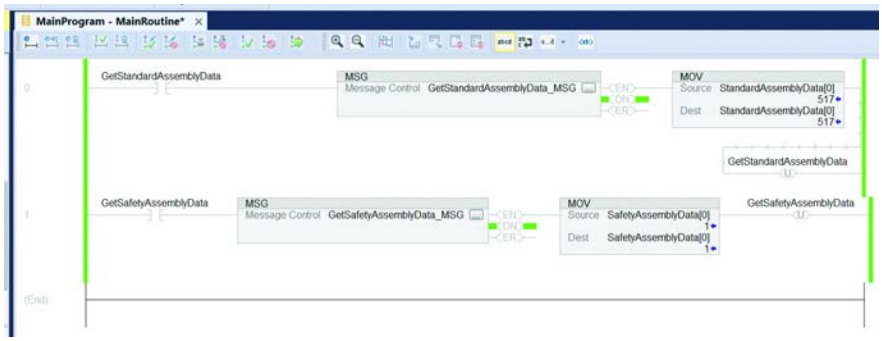
Alarms and warnings for the encoder can be read via the position sensor object with the aid of the attributes.

For errors, alarms, and warning the following applies:

- Bit status = 0: no error, alarm, or warning
- Bit status =1: error, alarm, or warning present
- In addition, the Net status indicator illuminates red continuously.

Use explicit messages to communicate with an encoder and obtain additional fault, status, or configuration information that is not available in the safety I/O or standard I/O tag structures. Any controller can send an explicit message on the network, which can be used to read any attribute. When an explicit message is used, a class ID must be specified. The class ID identifies the safety or standard object type in the encoder that is accessed. For help with message instructions, see Logix Designer application online help and publication 1756-PM012.

Figure 15 - Explicit Message Example



Warnings

Table 24 - Supported Warnings (Attribute 47+48)

Bit	Warning	Description	FALSE (0) (47)	TRUE (1) (47)
0	Frequency exceeded	Max. velocity exceeded	OK	Exceeded
1	Light control reserve	Permissible internal LED current in the sensors exceeded	OK	Out of range
2…5	Not supported	Not implemented	Always 0	—
6	Minimum velocity flag	Minimum velocity setpoint reached	OK	Fall below
7	Maximum velocity flag	Maximum velocity setpoint reached	OK	Exceeded
8	Minimum acceleration flag	Minimum acceleration setpoint reached	OK	Fall below
9	Maximum acceleration flag	Maximum acceleration setpoint reached	OK	Exceeded
10	Position limits exceeded	Max. position exceeded	OK	Exceeded
11	Reserved by CIP	—	Always 0	—
12	Reserved by CIP	—	Always 0	—
13	Vendor: Temperature out of range	Temperature setpoints reached	OK	Out of range
14	Vendor: over/under voltage (9.700…30.300mV)	Supply voltage outside permissible range	OK	Out of range
15	Not supported	—	Always	—

Alarms

The alarm type is coded in a bit field of attributes 44 and 45. If one of the bits listed in the following tables is set, the alarm flag (attribute 46) is also set.

For example, if the velocity or temperature drop below/exceed the limit values, the warning flag is set.

In addition, the Net status indicator blinks red.

The warning type is coded in a bit field of attributes 47 and 48.

IMPORTANT The position value continues to be correctly calculated; the encoder is therefore still ready for operation.

Table 25 - Supported Alarms (Attribute 44+45) (1)

Bit	Description	Description	FALSE (0) (44)	TRUE (1) (44)
0	Position ERROR	Position error	Ok	ERROR
1	Diagnostic ERROR	Diagnostic error during self-test	Ok	ERROR
2…11	Reserved by CIP	—	—	—
12	Vendor: Checksum ERROR	Checksum error	Ok	ERROR
13	Vendor: Startup ERROR	Startup error	Ok	ERROR
14…15	Vendor: Reserved	—	—	—

(1) Alarms are not available in the Safety Position Sensor Object.

Table 26 - Encoder Device Alarms (Attribute 134) (1)

Bit	Description	FALSE (0)	TRUE (1)
0	The lower limit for the velocity that is configured with Low Limit Velocity Alarm has been dropped below.	Ok	ERROR
1	The upper limit for the velocity that is configured with High Limit Velocity Alarm has been exceeded.	Ok	ERROR
2	The lower limit for the acceleration that is configured with Low Limit Acceleration Alarm has been dropped below.	Ok	ERROR
3	The upper limit for the acceleration that is configured with High Limit Acceleration Alarm has been exceeded.	Ok	ERROR
4	The lower limit for the position that is configured with Low Limit Position Alarm has been dropped below.	Ok	ERROR
5	The upper limit for the position that is configured with High Limit Position Alarm has been exceeded.	Ok	ERROR
6	The lower limit for the temperature that is configured with Low Limit Temperature Alarm has been dropped below.	Ok	ERROR
7	The upper limit for the temperature that is configured with High Limit Temperature Alarm has been exceeded.	Ok	ERROR

(1) Alarms are not available in the Safety Position Sensor Object.

Errors

Table 27 - Encoder Error Table (Attribute 135) (1)

Fault Header [byte]	Bit	Description	FALSE (0)	TRUE (1)
0	0	Reserved	-	-
	1	Operating temperature of the encoder outside the permissible range	Ok	ERROR
	2	Permissible internal light-emitting diode (LED) current in the sensors exceeded	Ok	ERROR
	3	Supply voltage outside the permissible range	Ok	ERROR
	4	Maximum velocity has been exceeded	Ok	ERROR
	5	Position error: internal interface	Ok	ERROR
	6	Position error: absolute data error	Ok	ERROR
	7	Position error: configuration error	Ok	ERROR
1	8	Position error: synchronization error	Ok	ERROR
	9	Position error: error in sensor	Ok	ERROR
	10…15	Reserved	-	-
2	16…17	Reserved	-	-
	18	Memory error: internal interface	Ok	ERROR
	19…23	Reserved	-	-

(1) In the Safety Position Sensor Object, no errors can be defined. The device goes to a safe state as it is detecting an error and no longer communicates.

The following error messages stem from the Studio 5000® environment.

Table 28 - Error Messages

Error Code	Message	Possible Cause
16#0108	Connection-request error connection type (multi-cast/ uni-cast) not supported.	Check whether the configuration assembly (instance 100 of the Assembly Object) is activated. If yes, check whether the configuration data are correctly and fully configured in this assembly (see Edit 843ES CIP Safety Encoder Configuration Categories on page 65).
16#0111	Requested Packet Interval (RPI) out of range	Make sure that RPI for Safety Connection is in the appropriate range (6…500 ms) and the Standard Connection is in the appropriate range (1…750 ms). Check that Safety Task RPI is 6 ms or greater.
16#0114	Electronic keying mismatched: electronic keying product code and/or vendor ID mismatched.	Wrong device selected, or incorrect major/minor firmware revision selection based on the real device. For example, single-turn selected instead of multi-turn, or vice versa.
16#0127	Connection request error: invalid output size.	Check whether the correct communication format for the control system is used. The default value in the control system is "Data-DINT." The encoder requires the communication format: "Input Data-DINT."
16#0204	Connection request error: connection timeout.	Check the supply voltage on the encoder. Check the Ethernet cables for the encoder for open circuit. Check whether the IP address of the encoder matches the IP address that is saved in the control system. Possible causes: • The address switches are not engaged correctly. • The encoder has lost the IP address that is assigned to it after switching back on.
16#fd1f	Bad Safety Protocol Format	An error occurred while trying to add the Safety Network Segment to a route in Logix. Check Safety Network Number on Safety Page, refresh Safety Network Number if needed.

Notes:

Specifications

General

Table 29 - Electromagnetic Compatibility (EMC)

Attribute	All Cat. Nos.
Relevant standards	EN 55011 Class B IEC 61326-1 IEC 61326-3-1
ESD immunity	IEC 61000-4-2; 9 kV contact discharges; 10 kV air discharges
Radiated EMF immunity	IEC 61000-4-3: 80…1000 MHz, 10V/m 80% AM 1 kHz; 1.4…2.0 GHz 3V/m 80% AM 1 kHz IEC 61000-4-3: 80…1000 MHz, 20V/m 80% AM 1 kHz; 1.4…2.0 GHz 10v/m 80% AM 1 kHz; 2.0…2.7 GHz 3V/m 80% AM 1 kHz
Surge transient immunity	IEC 61000-4-5: ±2 kV line-earth (CM) on Ethernet ports
EFT/B immunity	IEC 61000-4-4: ±2 kV at 5 kHz on Ethernet ports
Conducted RF immunity	IEC 61000-4-6: 0.15…80 MHz, 3V/m 80% AM 1 kHz
Magnetic influence, max	IEC 61000-4-8, 100 A/m
Protection	Short circuit, overload, reverse polarity, over voltage, loss of ground

Table 30 - Network

Attribute	All Cat. Nos.
EtherNet/IP	IEC 61784-1
IP	IPv4
Ethernet connector	2 Ethernet M12, 4-pin, female, D-coded
EtherNet/IP communication rate	10/100 Mbps
Prioritization	Via. 802.1 Q/D
Coarse update rate, max	1 ms
Safe coarse update rate, max	6 ms
Broadcast rate limiting	1%
Jitter	100 ns
Duplex	Full or half

Safety

Attribute	All Cat. Nos.
Category	Cat. 3, HFT = 1
System structure	2 channels (Cat. 3)
Standards Safety Classification	Safety functions according to IEC 61800-5-2 PLe according to ISO 13849-1, ISO 13849-2 SIL 3 per IEC 62061, IEC 61508, and IEC 61800-5-2
Functional safety data	PFH_d = 8.03E-9 (average frequency of a dangerous failure per hour)
Certifications	CE Marked for all applicable directives, c-UL-us (UL 61010), and TÜV, see rok.auto/certifications
Mission time	20 years
Diagnostic coverage (DC)	≥99%
Error presumptions	IEC 61800-5-2
CIP Safety	ODVA CIP Volume 5

Electrical

Attribute	All Cat. Nos.
Supply voltage	10…30V DC (±5%), IEC 61140 PELV power supply, UL 1310 Class 2
Power consumption, max	3 W
No-load supply current	300 mA (at 10V DC)
Load current, max	300 mA
Inrush current, max	1.5 A (at 1 ms)

Mechanical

IMPORTANT The encoder can calculate both a safe speed and a safe acceleration.

These calculations are subject to a standard deviation due to rounding and internal computing times, which are:

- Speed: σ_v <0.5% (4 rpm, min)
- Acceleration: σ_a <0.5% (500 revolutions/s^2, min)

Attribute	Solid Shaft	Hollow Shaft
Housing material	Aluminum: EN AC 44300	
Shaft material	Stainless steel: 1.4305	
Flange material	Aluminum: EN AW-2011	
Moment of inertia	Approx. 10E-6 kg m^2 (4.4E-6 lb•ft-s^2]	
Start torque	0.01 N•m (0.088 lb•in) (20 °C [68 °F])	
Operating torque	0.01 N•m (0.088 lb•in) (20 °C [68 °F])	
Shaft load	80 N (17.9 lb) radial, 40 N (9 lb) axial	
Rotational speed	9000 RPM, max (<10 min) 6000 RPM, typical operation	
Acceleration	1E6 rad/s^2, max	
Shaft sizes [mm (in.)]	• 9.525 (3/8) • 10 (0.39) • 12 (0.47)	• 9.525 (3/8) • 10 (0.39) • 12 (0.47) • 12.7 (1/2) • 14 (0.55) • 15 (0.59)
Shaft keys	Conforms to DIN 6885-A M4 threaded hole	—
Shaft fit	f7	H7
Shaft insertion depth	—	≥25.5 mm (1.0 in.)
Flanges [mm (in.)]	58 (2.28) Clamp flange, 58 (2.28) Synchro flange, 63.5 (2.5) Square flange	With stator coupling, 63 (2.48)
Power connector	4-pin, male, A-coded	
Weight	0.45 kg (15.87 oz) approximately	

Environmental

Attribute	All Cat. Nos.
Temperature, operating (1)	IEC 60068-2-1 (Test Ad, Operating Cold) IEC 60068-2-2 (Test Bd, Operating Dry Heat) IEC 60068-2-14 (Test Nb, Operating Thermal Shock -40…+80 °C (-40…+176 °F)
Temperature, storage	IEC 60068-2-1 (Test Ab, unpackaged nonoperating cold) IEC 60068-2-2 (Test Bb, unpackaged nonoperating dry heat) IEC 60068-2-14 (Test Na, unpackaged nonoperating thermal shock) -40…+100 °C (-40…+212 °F)
Relative humidity	IEC 60068-2-30 (Test Db, unpackaged damp heat); 93%, 40 °C (104 °F) noncondensing
Altitude	<2000 m [6562 ft]
Environment	Dry/wet
Washdown rating	IEC 60529, IP67
Shock	IEC 60068-2-27, 981 m/s^2 (100 g), 6 ms
Vibration	IEC 60068-2-6 (Test Fc, operating), 8.7…200 Hz, 30 m/s^2 (3.06 g), 200…2000 Hz, 200 m/s^2 (20 g)
UL	File E244298, UL 61010-1, indoor use, outdoor use possible, not designed for direct UV radiation
Pollution degree	IEC 61010, 2

(1) Operating temperature is not equal to ambient temperature, see Temperature Measurement on page 36.

Performance Capabilities

Attribute	Single-turn	Multi-turn
Absolute resolution	262,144 counts per turn (18 bit)	4096 turns (12 bit)
Safe absolute resolution	32,768 counts per turn (15 bit)	4096 turns (12 bit)
Smallest safe measuring step	158.4 arcsec (0.044°)	
Startup time	10 s	
Code direction	CW or CCW programmable	

Notes:

Install an Add-on Profile

Introduction

This appendix shows how to install the Add-on Profile (AOP) of the encoder with the Studio 5000 Logix Designer application. Add-on Profiles are files that users add to their Rockwell Automation library. These files contain the pertinent information for configuring a device that is added to the Rockwell Automation network.

The AOP simplifies the setup of devices because it presents the necessary fields in an organized fashion. The AOP allows you to install and configure your systems in a quick and efficient manner.

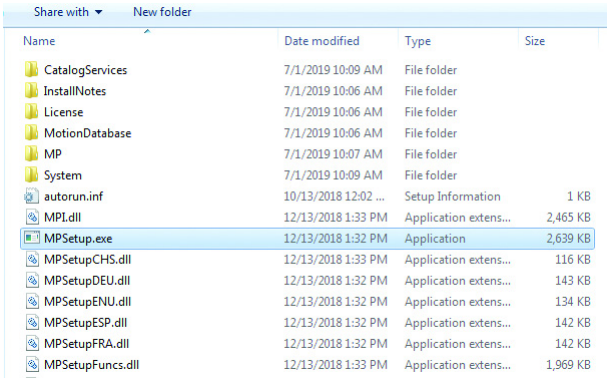
The AOP is a folder, which contains numerous files for the device. It comes as an installation package.

The AOP comes with Studio 5000 starting with V33. If V31 or V32 are used, go to PCDC (rok.auto/pcdc) and search for 843ES.

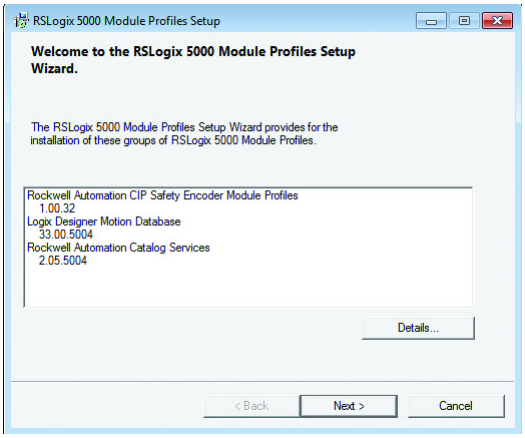
Installation

Install the Add-on Profile following the on-screen instructions.

1. In the file explorer, locate the directory where the installation files were extracted.
2. Click MPSetup.exe.
3. Extract the zip file to a local directory on your computer.
4. To begin the installation, double-click MPSetup.exe.



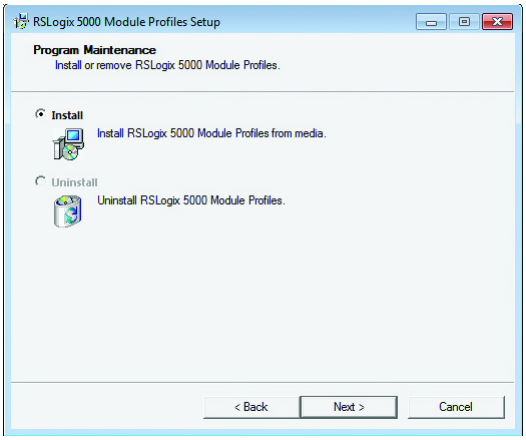
5. At the welcome screen, click Next.



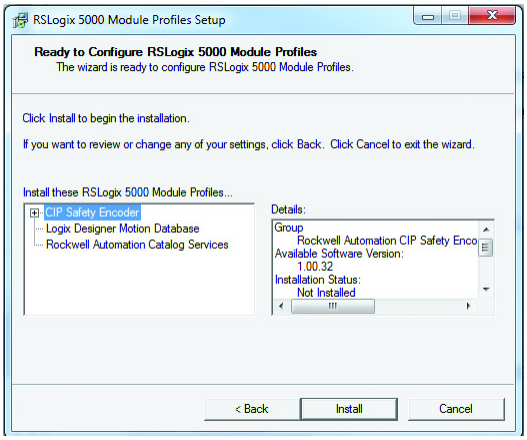
IMPORTANT The shown Module Profile revisions may be different than what is shown in the preceding image.

6. To accept the licensing terms, click the radio button, then click Next.

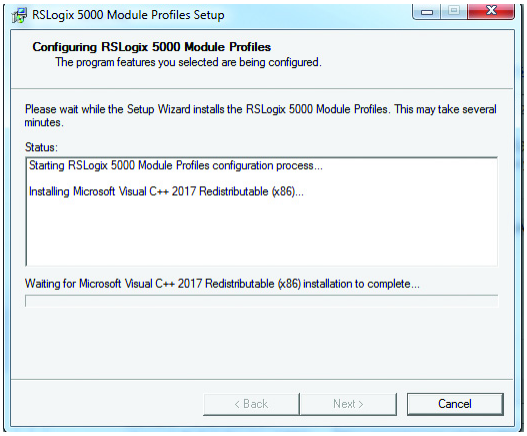
7. Click the Install radio button and then click Next.



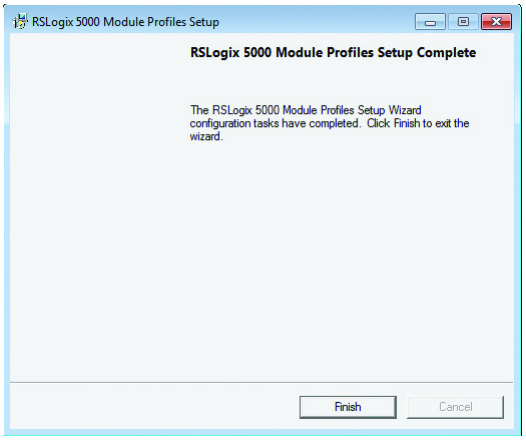
8. Click Install to begin the installation.



9. Click Next to install the Add-on Profile files.



10. Click Finish to complete the installation.



Notes:

Safety Statements for Use of CIP Safety Devices

Safety Statements

When using CIP Safety devices, follow these guidelines:

- The replacement of safety devices requires that the replacement device is configured properly and operation of the replacement device must be verified.
- If you choose to configure safety connections with a safety configuration ID (SCID)=0, you are responsible for verifying that originators and targets have the correct configurations.
- You must assign SNN numbers for each safety network or safety subnet that are unique system-wide.
- When a safety device is configured directly from a workstation, compare the transferred SCID and configuration data with the SCID and configuration data that is originally viewed in the workstation.
- User testing is the means by which all downloads are validated.
- The signature can only be considered verified (and configuration locked) after user testing.
- Configuring an originator with connection data and/or target configuration data must be downloaded to the target so it can be tested and verified. Only then can SCIDs from the target be confirmed.
- You must test the operation of a device completely before setting the Lock Attribute.
- You must clear any pre-existing configuration from any safety device before installing it onto a safety network.
- You must commission all safety devices with MAC ID (and baudrate if necessary) before you install it onto a safety network.
- It is required that safety function implementers carefully consider implications of mixing different SIL level devices on the network.
- You must test safety connection configurations after they are applied in an originator to confirm that the target connection is operating as intended.

ATTENTION:

- Status indicators are not reliable indicators and cannot be guaranteed to provide accurate information. They should only be used for general diagnostics during commissioning or troubleshooting. Do not attempt to use status indicators as operational indicators.
- Originators with an automatic SNN setting feature should only use that feature when the safety system is not being relied upon.
- If a Type 1 SafetyOpen configures a device, you must verify that all originator-configured safety devices have their ownership assignments as part of the final verification process.
- You must visually verify that all configuration data was downloaded correctly.

Notes:

Use of Controller-based Safety Functions with the 843ES CIP Safety Encoder

SFX Instruction

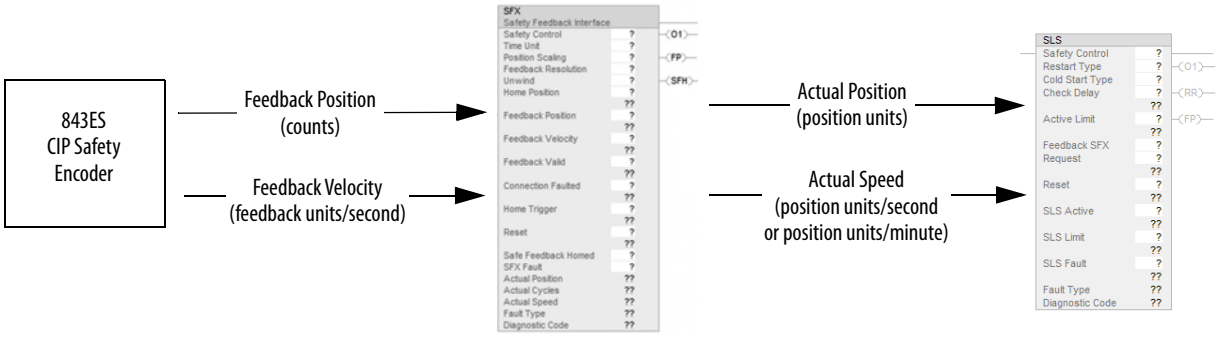
The Safety Feedback Interface (SFX) instruction scales feedback position into position units and feedback velocity into speed units per unit of time. Feedback position and velocity are read from the safety input assembly and become inputs to the instruction. The SFX instruction also sets a reference position from a home input and performs position unwind in rotary applications.

The 843ES CIP Safety encoder provides safe position and velocity feedback, which can achieve up to and including SIL 3 PL e safety rating.

The outputs of the SFX instruction are used as inputs to other Drive Safety instructions. For any drive that can perform a STO, to execute a controller-based safety function, an SFX instruction is required. Although the SFX instruction is a safety instruction, it alone does not perform a safety function.

In Figure 16, the Safely limited Speed (SLS) instruction uses the Actual Speed output from the SFX instruction during execution of the SLS safety function.

Figure 16 - SFX Instruction Feeds Data to SS1 Instruction



IMPORTANT Perform I/O verification and validation before validating your safety ladder program. SFX instruction must be verified within your application.

When possible, use immediate operands for instructions to reduce the possibility of systematic errors in your ladder program.

Instruction operands must be verified for your safety ladder program.

SFX Instruction Example

The SFX instruction scales the applicable safety instructions with feedback position units from the safety encoder, into position feedback units used in applicable safety instructions. It also scales feedback velocity units from the safety encoder into position feedback units per time unit.

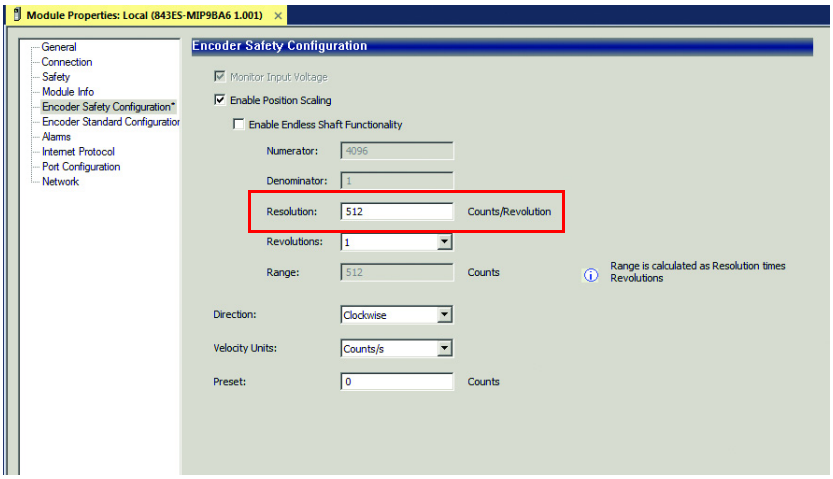
Scaling Setup

When configuring the SFX instruction, calculate the value for Position Scaling so that the Actual Position and Actual Speed output from the instruction matches the Actual Position and Actual Velocity in the motion controller.

Values from Encoder Safety Configuration are required to calculate the instruction input.

The SFX Feedback Resolution is determined based on the feedback device and the Resolution of the feedback. This information is configured on the Encoder Safety Configuration page.

Figure 17 - Effective Resolution Parameter



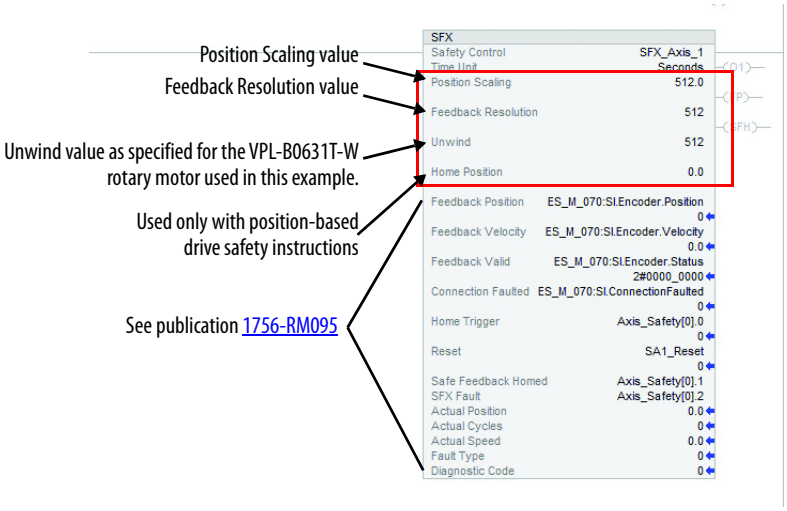
In Figure 17, the encoder is monitoring for a rotary application where the unwind is set to rollover each motor revolution. Therefore, the unwind of 512 counts/revolution was added in the SFX instruction appropriately.

Homing

Setting the Actual Position output to the Home Position input (homing) of the instruction is required if a position-based drive safety instruction like Safely limited Position (SLP) is used. If a position-based drive safety instruction is not being used on an axis, homing the SFX instruction is not required.

The data in Encoder Safety Configuration and motor unwind value is used to populate the SFX instruction.

Figure 18 - SFX Instruction Example



See publication 1756-RM095, for more information on the Drive Safety instructions.

Pass-through Data in Controller

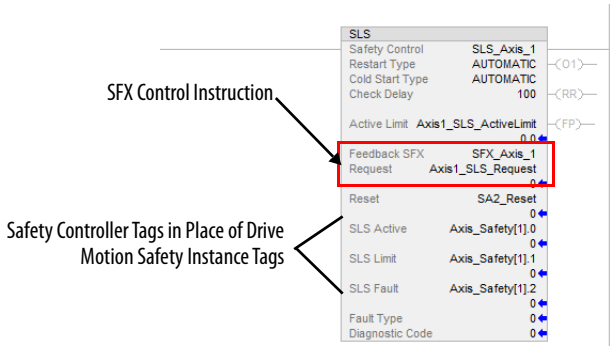
When using a drive that does not have pass-through data for the Drive Safety instruction outputs, the pass-through has to occur in the controller to command the standard or motion control when a drive safety instruction is on. You can use safety tags as inputs in the standard or motion control, but not as an output.

Drive Safety Instructions

When using the drive safety monitoring instructions available in Logix Designer, outputs from the SFX instruction are used as inputs to the monitoring instructions. Figure 19 shows the SLS instruction that is configured with the SFX instruction, which has been configured to monitor the 843ES CIP Safety encoder (see Figure 18). The SLS instruction monitors the speed of a motor or axis and sets the SLS limit output if the speed exceeds the Active Limit input value.

The safety controller tags have been created in place of pass through data tags because safe motion monitoring instance tags are not available.

Figure 19 - Drive Safety Instruction



Numerics

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Rockwell Automation Support

Use the following resources to access support information.

Technical Support Center	Knowledgebase Articles, How-to Videos, FAQs, Chat, User Forums, and Product Notification Updates.	https://rockwellautomation.custhelp.com/
Local Technical Support Phone Numbers	Locate the phone number for your country.	http://www.rockwellautomation.com/global/support/get-support-now.page
Direct Dial Codes	Find the Direct Dial Code for your product. Use the code to route your call directly to a technical support engineer.	http://www.rockwellautomation.com/global/support/direct-dial.page
Literature Library	Installation Instructions, Manuals, Brochures, and Technical Data.	http://www.rockwellautomation.com/global/literature-library/overview.page
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	http://www.rockwellautomation.com/global/support/pcdc.page

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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.

Rockwell Automation maintains current product environmental information on its website at http://www.rockwellautomation.com/rockwellautomation/about-us/sustainability-ethics/product-environmental-compliance.page.

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