



This manual links to ArmorStart ST Motor Controller with Integrated Safety Fault Codes Reference Data, publication [280ES-RD001](#) for fault codes; download the spreadsheet now for offline access.



AarmorStart ST Motor Controller with Integrated Safety

Bulletins 281ES, 281GS, 284ES, 284GS



Allen-Bradley

by ROCKWELL AUTOMATION

User Manual

Original Instructions

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.

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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.

These 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).

The following icon may appear in the text of this document.



Identifies information that is useful and can help to make a process easier to do or easier to understand.

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About This Publication

This manual describes the ArmorStart® ST motor controller with integrated safety. It includes information on installation, configuration, programming, and use.

Download Firmware, AOP, EDS, and Other Files

Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes from the Product Compatibility and Download Center at rok.auto/pcdc.

Summary of Changes

This publication contains the following new or updated information. This list includes substantive updates only and is not intended to reflect all changes.

Topic	Page
Added CE / EU EMC Compliance for motor cable considerations.	35

Conventions

In this manual, we use the term GuardLogix® controller to collectively refer to all of the following safety programmable controllers: GuardLogix, Compact GuardLogix, Armor™ GuardLogix®, and Armor Compact GuardLogix controllers. See [Compatible Safety Controllers on page 18](#) for more information.

Access Fault Code and CIP Object and Attribute Data



This manual links to ArmorStart ST Motor Controller with Integrated Safety Fault Codes Reference Data, publication [280ES-RD001](#). Download the spreadsheets from Literature Library.

Terminology

[Table 1](#) defines the abbreviations that are used in this manual.

Table 1 - Abbreviations and Definitions

Abbreviation	Full Term	Definition
1oo2	One out of Two	Refers to the behavioral design of a dual-channel safety system.
CAT	Category	Classification of the safety-related parts of a control system in respect of their resistance to faults and their subsequent behavior in the fault condition, and which is achieved by the structural arrangement of the parts, fault detection, and/or by their reliability (source ISO 13849).
CL	Claim Limit	The maximum SIL rating that can be claimed for a safety-related electrical control system subsystem in relation to architectural constraints and systematic safety integrity (source IEC 62061).
DC	Diagnostic Coverage	The ratio of the detected failure rate to the total failure rate.
DeviceID	Device ID	A unique identifier, which is comprised of the module number and SNN, to make sure that duplicate module numbers do not compromise communication between the correct safety devices.
EN	European Norm	The official European Standard.
ESD	Emergency Shutdown Systems	A system, usually independent of the main control system, which is designed to safely shut down an operating system.
ESPE	Electro-sensitive Protective Equipment	An assembly of devices and/or components working together for protective tripping or presence-sensing purposes and includes as a minimum: • A sensing device. • Controlling/monitoring devices. • Output signal-switching devices (OSSD).
HFT	Hardware Fault Tolerance	The HFT equals n , where $n+1$ faults could cause the loss of the safety function. An HFT of one means that two faults are required before safety is lost.
HIM	Human Interface Module	A module that is used to configure a device.
IEC	International Electrotechnical Commission	The International Electrotechnical Commission (IEC) is the organization that prepares and publishes international standards for all electrical, electronic, and related technologies.
IGBT	Insulated Gate Bipolar Transistors	Typical power switch that is used to control main current.

Table 1 - Abbreviations and Definitions

Abbreviation	Full Term	Definition
ISO	International Organization for Standardization	The International Organization for Standardization is an international standard-setting body that is composed of representatives from various national standards organizations.
MTTF	Mean Time to Failure	The length of time that a device or other product is expected to remain reliable in operation.
NC	Normally Closed	A set of contacts on a relay or switch that are closed when the relay is de-energized or the switch is de-activated.
NO	Normally Open	A set of contacts on a relay or switch that are open when the relay is de-energized or the switch is de-activated.
OSSD	Output Signal Switching Device	The component of the electro-sensitive protective equipment (ESPE) connected to the control system of a machine. When the sensing device is actuated during normal operation, the device responds by going to the OFF-state.
PELV	Protective Extra Low Voltage	An electrical system where the voltage cannot exceed ELV under normal conditions, and under single-fault conditions, except earth faults in other circuits.
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 per hour	The average frequency of a system to have a dangerous failure per hour.
PL	Performance Level	EN ISO 13849-1 safety rating
PM	Permanent Magnet	In permanent magnet (PM) motors, magnets mounted on or embedded in the rotor, couple with the current-induced internal magnetic fields of the motor generated by electrical input to the stator.
SELV	Safety Extra Low Voltage Circuit	A secondary circuit that is designed and protected so that, under normal and single fault conditions, its voltages do not exceed a safe value.
SIL	Safety Integrity Level	A measure of a products ability to lower the risk that a dangerous failure could occur.
SSN	Safety Network Number	A unique number that identifies a section of a safety network.
STR	Spurious Trip Rate	That part of the overall failure rate that does not lead to a dangerous undetected failure.
STO	Safe Torque Off	The Safe Torque Off (STO) function is used to help prevent unexpected motor rotation during an emergency while the drive remains connected to the power supply. When STO is activated, the torque power cannot reach the drive, which stops and helps prevent any motor shaft rotation.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation. You can view or download publications at rok.auto/literature.

Resource	Description
ArmorStart ST Motor Controller with Integrated Safety Fault Codes Reference Data, publication 280ES-RD001	Provides a spreadsheet of the fault codes for ArmorStart ST Motor Controller with Integrated Safety.
ArmorStart ST Motor Controller Product Information, publication 280ES-PC001	Provides basic information on how to install, configure, and program, the ArmorStart controllers.
ArmorStart Distributed Motor Controllers Selection Guide, publication 280-SG002	Provides information on product specifications, ratings, certifications, system interface, wiring diagrams, and dimensions, to aid in product selection.
ArmorStart Distributed Motor Controller and ArmorConnect Power Media Selection Guide, publication 280PWR-SG001	Provides information on product specifications, ratings, certifications, system interface, wiring diagrams, and dimensions, to aid in product selection.
ArmorStart ST Distributed Motor Controller Specifications Technical Data, publication 280ES-TD001	Provides product information about the ArmorStart ST Distributed Motor Controller
Applying More Than One ArmorStart Motor Controller in a Single Branch Circuit on Industrial Machinery, publication 280-AT003	This document explains how to use this Listing to apply the ArmorStart product family of motor controllers in multiple-motor branch circuits.
Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001	Provides access to the Logix5000® Controllers set of programming manuals. The manuals cover such topics as how to manage project files, organize tags, program logic, test routines, handle faults, and more.
Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003	Provides information on the programming instructions available to use in Logix Designer application projects.
GuardLogix Safety Application Instruction Set Reference Manual, publication 1756-RM095	Provides information on the GuardLogix Safety application instruction set.
GuardLogix 5570 and Compact GuardLogix 5370 Controller Systems Safety Reference Manual, publication 1756-RM099	Provides information on safety application requirements for GuardLogix 5570 and Compact GuardLogix 5370 controllers in Studio 5000 Logix Designer® applications.
GuardLogix 5580 and Compact GuardLogix 5380 Controller Systems Safety Reference, publication 1756-RM012	Provides information on safety application requirements for GuardLogix 5580 and Compact GuardLogix 5380 controllers in Studio 5000 Logix Designer applications.
GuardLogix 5570 Controllers User Manual, publication 1756-UM022	Provides information on how to use standard Guard Logix 5570 controllers.
ControlLogix 5580 and GuardLogix 5580 Controllers User Manual, publication 1756-UM543	Provides information on how to use standard ControlLogix® 5580 controllers.
Compact GuardLogix 5370 Controllers User Manual, publication 1769-UM022	Provides information on how to use Compact GuardLogix 5370 controllers.

Resource	Description
CompactLogix 5380 and Compact GuardLogix 5380 Controllers User Manual, publication 5069-UM001	Provides information on how to use CompactLogix™ 5380 and Compact GuardLogix 5380 controllers.
Wiring and Grounding Guidelines for Pulse-width Modulated (PWM) AC Drives, publication DRIVES-IN001	Provides information to install, protect, wire, and ground pulse-width modulated (PWM) AC drives.
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.
Safety Automation Builder and SISTEMA Library	Download Safety Automation Builder® software to help simplify machine safety design and validation, and reduce time and costs. 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.
EtherNet/IP Device Level Ring Application Technique, publication ENET-AT007	Describes Device Level Ring (DLR) topologies, configuration considerations, and diagnostic methods.
EtherNet/IP Network Devices User Manual, ENET-UM006	Describes how to configure and use EtherNet/IP devices to communicate on the EtherNet/IP network.
Ethernet Reference Manual, ENET-RM002	Describes basic Ethernet concepts, infrastructure components, and infrastructure features.
System Security Design Guidelines Reference Manual, publication SECURE-RM001	Provides guidance on how to conduct security assessments, implement Rockwell Automation products in a secure system, harden the control system, manage user access, and dispose of equipment.
Configure System Security Features User Manual, publication SECURE-UM001	Describes how to configure and use Rockwell Automation products to improve the security of your industrial automation system.
UL Standards Listing for Industrial Control Products, publication CMPNTS-SR002	Assists original equipment manufacturers (OEMs) with construction of panels, to help ensure that they conform to the requirements of Underwriters Laboratories.
American Standards, Configurations, and Ratings: Introduction to Motor Circuit Design, publication IC-AT001	Provides an overview of American motor circuit design based on methods that are outlined in the NEC.
Industrial Components Preventive Maintenance, Enclosures, and Contact Ratings Specifications, publication IC-TD002	Provides a quick reference tool for Allen-Bradley industrial automation controls and assemblies.
Safety Guidelines for the Application, Installation, and Maintenance of Solid-state Control, publication SGI-1.1	Designed to harmonize with NEMA Standards Publication No. ICS 1.1-1987 and provides general guidelines for the application, installation, and maintenance of solid-state control in the form of individual devices or packaged assemblies incorporating solid-state components.
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.

Notes:

ArmorStart ST Integrated Safety Distributed Motor Controllers

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Description

The ArmorStart® ST with integrated safety version controller provides integrated Safe Torque Off (STO) over the EtherNet/IP™ network and safety input and output connections, and two options for standard I/O connections.

The integrated safety version is capable of up to:

- Category 4, PLe, according to EN ISO 13849-1
- SIL 3 according to IEC 61508
- SIL CL 3 according to EN 62061

Integrated Safety Inputs and Outputs

The integrated safety version controller offers as an option, one dual-channel safety input that can be used as two single-channel inputs and a one bipolar output that can be applied as a single-channel sourcing safety output.

Standard Input and Outputs

The ArmorStart ST with integrated safety version controller offers two options for standard I/O connections:

- Four 24V DC sinking/sourcing inputs with two sourcing solid-state outputs
- Six 24V DC inputs and no outputs

Inputs are sourced from A3/A2 control power. Outputs are sourced from A1/A2 control power. Each input and output has its own light-emitting diode status indicator.

Table 2 - Product Overview

Type	Bulletin	Start Method	HP Range	Operating Voltage	Inputs and Outputs	Onboard Safety Inputs and Outputs
ArmorStart ST Integrated Safety Versions	281ES	Full-voltage and reverse	0.5...10 HP (0.37...7.5 kW)	200...600V AC	4 sinking/sourcing inputs 2 sourcing solid-state outputs	1 dual-channel sourcing input or 1 bipolar output
	284ES	VFD - Sensorless Vector Control	1...5 HP (0.4...3.3 kW)	380...480V AC		
	281GS	Full-voltage and reverse	0.5...10 HP (0.37...7.5 kW)	200...600V AC	6 inputs 0 outputs	
	284GS	VFD - Sensorless Vector Control	1...5 HP (0.4...3.3 kW)	380...480V AC		

The ArmorStart ST with integrated safety version controller offers two options for standard I/O connections:

- Four 24V DC sinking/sourcing inputs with two sourcing solid-state outputs. Outputs are sourced from A1/A2 control power. Each input and output has its own LED status indicator.
- Six 24V DC sinking/sourcing inputs and no outputs. Inputs are sourced from A3/A2 control power.

All ArmorStart ST controllers feature an embedded dual-port EtherNet/IP switch, which supports linear and DLR topologies.

Bulletin 281ES, and 281GS starters are used in full-voltage and reverse applications. Bulletin 284ES, and 284GS variable frequency drives (VFDs) are used in variable frequency applications where more precise motor control is needed.

The ArmorStart ST controller offers IP67/UL Type 4/12/13 enclosure design, which is suitable for water wash down environments, when appropriate cables are attached or sealing caps are in place.

Studio 5000 Logix Designer® is the single software that is used for setup and commissioning. It is accomplished through the installation and use of an Add-on Profile (AOP) downloaded from Product Compatibility and Download Center (PCDC). Download the most current version of the AOP from the [Product Compatibility and Download Center \(PCDC\)](#).

Fault diagnostic capabilities, including status indicators, are built in to the ArmorStart ST distributed motor controller to help you pinpoint a problem for easy troubleshooting and quick restarting.

Figure 1 - Bulletin 281ES ArmorStart ST Direct Online and Reversing (DOLR) Starter

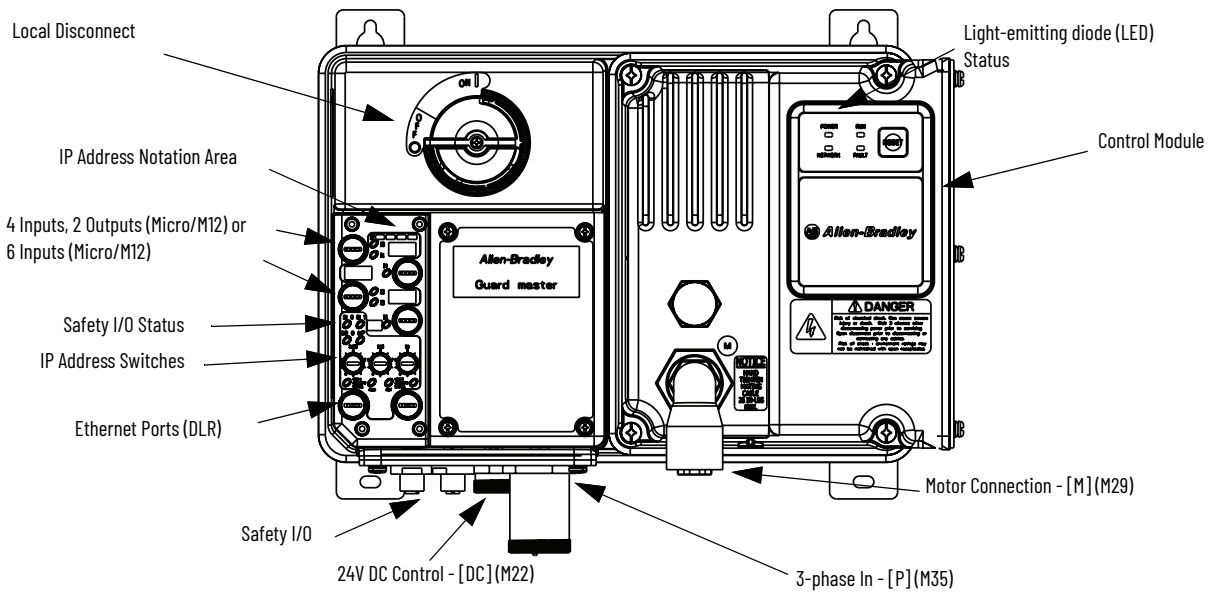
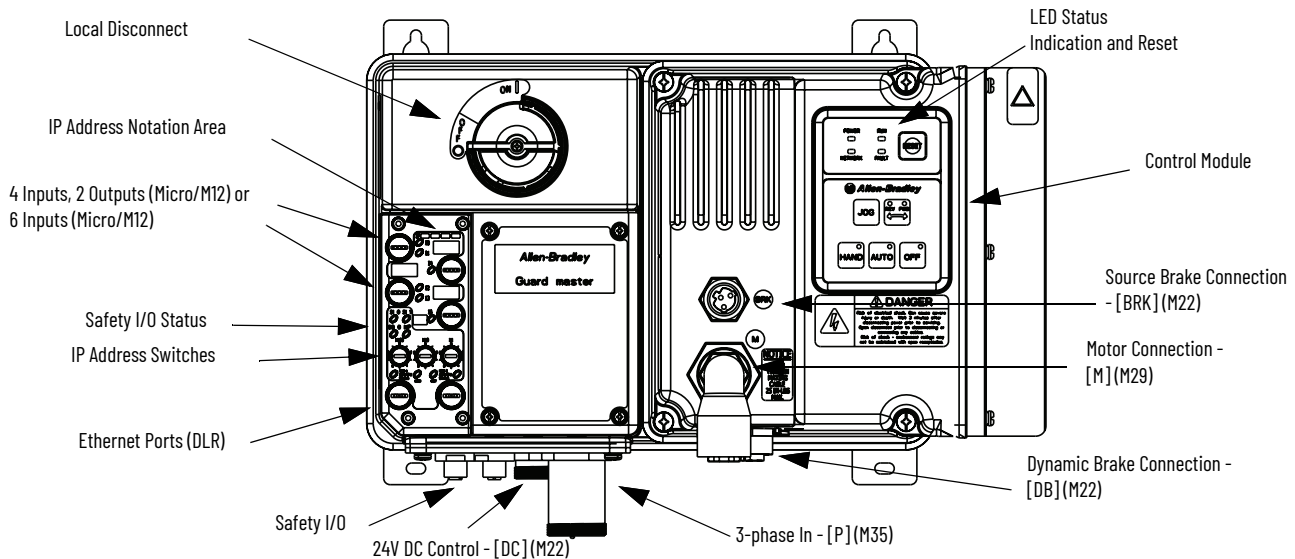


Figure 2 - Bulletin 284ES ArmorStart ST Variable Frequency Drive (VFD) Starter



Catalog Number Explanation

Examples that are given in this section are for reference purposes. This basic explanation cannot be used for product selection because not all combinations produce a valid catalog number.

Catalog Number Explanation for Bulletin 281ES/GS Starters

281	ES	-	F	12	S	-	10	C	-	RRG	-	3FR	-	00
a	b		c	d	e		f	g		h		i		j

a	
Bulletin Number	
Code	Description
281	Reversing Starter

b	
Communication Type	
Code	Description
ES	EtherNet/IP, 4 inputs/2 outputs
GS	EtherNet/IP, 6 inputs/0 outputs

c	
Enclosure Type	
Code	Description
F	IP67/UL Type 4/12/13

d	
Contactor Size	
Code	Description
12	12 A
23	23 A

e	
Control Voltage	
Code	Description
S	24V DC

f	
Short-circuit Protection (Motor Circuit Protection)	
Code	Description
10	10 A rated device
25	25 A rated device

g	
Overload Selection Current Range	
Code	Description
A	0.24...1.2 A
B	0.5...2.5 A
C	1.1...5.5 A
D	3.2...16 A

h	
Control and 3-Phase Power Connections/Motor Cable Connection ⁽¹⁾	
Code	Description
RRG	Round Media—male receptacle for control and power cables, female receptacle for motor cable

i	
HOA Option	
Code	Description
3FR	Hand/Off/Selector Keypad with Forward/Reverse

j	
Safe I/O Option	
Code	Description
00	No Safe I/O
22	Safe I/O

(1) Cables are sold separately.

Catalog Number Explanation for Bulletin 284ES/GS VFDs

284	ES	-	F	V	D2P3	S	-	10	-	RRG	-	3	-	SBG-DB1	-	EMI	-	00
a	b	c	d	e	f	g	h	i	j	k	l							

a		b		c		d		e	
Bulletin Number		Communication Type		Enclosure Type		Torque Performance Mode		Output Current (380...480V)	
Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
284	VFD	ES	EtherNet/IP, 4 inputs/2 outputs	F	IP67/UL Type 4/12/13	V	Sensorless Vector Control and Volts per Hertz	D2P3	2.3 A, 0.75 kW, 1.0 Hp
		GS	EtherNet/IP, 6 inputs/0 outputs					D4P0	4.0 A, 1.5 kW, 2.0 Hp
								D6P0	6.0 A, 2.2 kW, 3.0 Hp
								D7P6	7.6 A, 3.3 kW, 5.0 Hp

f		g		h		i		j	
Control Voltage		Short-circuit Protection (Motor Circuit Protection)		Control and 3-Phase Power Connections/Motor Cable Connection ⁽¹⁾		HOA Option		Brake	
Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
S	24V DC	10	10 A rated device	RRG	Round Media—male receptacle for control and power cables, female receptacle for motor cable	3	Hand/Off/Auto Selector Keypad with Jog function	DB1	Connectivity to IP67 DB Resistor
		25	25 A rated device					SBG	Source (EM) Brake

k		l	
Filter		Safety I/O Option	
Code	Description	Code	Description
EMI	EMI Filter	00	No Safe I/O
		22	Safe I/O

(1) Cables are sold separately.

Software Requirement

Network	Software	Version
EtherNet/IP®	RSLink® Classic	2.56 or later
	Studio 5000®	30.0 or later
	Add-on Profile	Download the most current version of the Add-on Profile from the Product Compatibility and Download Center .
	BOOTP/DHCP	Version 2.3 or later (BOOTP is not supported.)
Programmable Controller		Firmware Version
Compact GuardLogix® 5370/GuardLogix 5570 (L7)		30.0 or later
Compact GuardLogix 5380/GuardLogix 5580 (L8)		31.0 or later

Compatible Safety Controllers

One of the following safety controllers is required for integrated safety control of the ArmorStart ST STO function and safety I/O connections. The safety controller can control both the standard and safety I/O or the standard I/O can be controlled by a separate standard connection to another controller.

- GuardLogix 5570 or GuardLogix 5580 controller
- Compact GuardLogix 5370 or Compact GuardLogix 5380 controller
- Armor™ GuardLogix 5570 or Armor Compact GuardLogix 5370 controller

Check for minimum versions of Studio 5000 Logix Designer for your controller in the [Product Compatibility and Download Center \(PCDC\)](#).

Studio 5000 Logix Designer version 30 or later supports the Add-on Profile for configuring the ArmorStart ST motor controller.

Security Considerations

For information on how to mitigate Security Risks on industrial automation control systems (IACS) networks, see these publications:

System Security Design Guidelines Reference Manual, publication [SECURE-RM001](#).

Configure System Security Features User Manual, publication [SECURE-UM001](#).

Additional Features

Mode of Operation

Bulletin 281ES and 281GS Full-voltage and Reversing Starters

This method is used in applications that require across-the-line starting, where full inrush current and locked-rotor torque are realized.

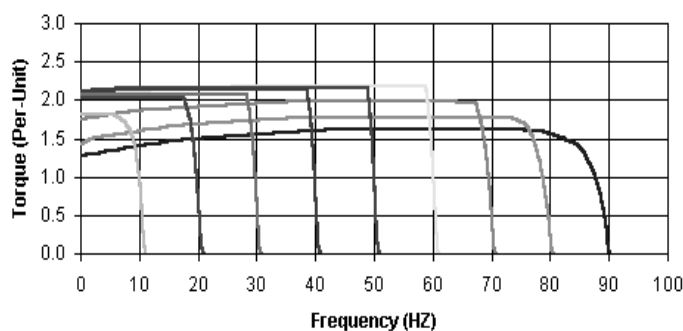
Figure 3 - Full-voltage Start



Bulletin 284ES and 284GS Sensorless Vector Control VFDs

Sensorless vector control provides optimal speed regulation and high levels of torque across the entire speed range of the drive. It provides a static Autotune feature, which lets the motor controller adapt to individual motor characteristics.

Figure 4 - Sensorless Vector Control



Common Features

The following features are common to all ArmorStart ST distributed motor controller safety and standard versions.

Overload Protection

The ArmorStart ST distributed motor controller has, as standard, electronic motor overload protection. This overload protection is accomplished electronically with an I^2t algorithm. The overload protection of the ArmorStart ST controller is programmable via the communication network (see ArmorStart ST Distributed Motor Controller Specifications Technical Data, publication [280ES-TD001](#) for overload trip curves specifications).

Embedded Switch Technology

The ArmorStart ST controller includes embedded switch technology, as standard. Each ArmorStart ST controller consumes one Common Industrial Protocol (CIP™) connection.

Common features are:

- Designed according to the ODVA specification for EtherNet/IP. ODVA specification is at <http://www.odva.org/>
- Embedded switch technology design enables end devices to form linear and ring network topologies
- Supports Device Level Ring (DLR) protocol
- Supports IEEE 1588 transparent clock for CIP Motion™ and CIP Sync™ applications
- Supports the management of network traffic to achieve timely delivery of critical data (QoS and IGMP protocols are supported)

DLR ports cannot be used as two Network Interface Cards (NICs) that are connected to two different subnets.

DeviceLogix

DeviceLogix™ is a standalone Boolean program that resides within the ArmorStart distributed motor controller. DeviceLogix is programmed locally by using the AOP and implements Boolean math operations, such as, AND, OR, NOT, Timers, Counters, and Latches. DeviceLogix can run as a standalone application, independent of the network. However, 24V DC via A3 unswitched control power, must be maintained. After a power cycle, all DeviceLogix accumulator data, including timers and counter, is reset. Preset values are maintained over a power cycle.

IMPORTANT Close the DeviceLogix editor before attempting to go online with the project. Wait until the connection is made before opening DeviceLogix editor.

Automatic Device Configuration

Automatic Device Configuration (ADC) is available for ArmorStart ST with integrated safety controllers. See [Using Automatic Device Configuration \(ADC\) on page 115](#) for details.

Electronic Data Sheet (EDS)

EtherNet/IP devices have Electronic Data Sheets (EDSs). EDSs are specially formatted text files, as defined by the CIP specifications, which represent the object model of the device. EDS files contain details about the readable and configurable parameters of the EtherNet/IP device. EDS files also provide information about the I/O connections the device supports and the content of the associated data structures. EDS files are used by EtherNet/IP device configuration tools, such as RSNetWorx™ for EtherNet/IP, and data servers such as RSLinx Classic.

EDS files for Bulletin 281ES/GS and 284ES/GS controllers can be uploaded directly from the device. EDS files are available from the [Product Compatibility and Download Center \(PCDC\)](#).

IMPORTANT UL Lists the ArmorStart family of motor controllers and their mating cable assemblies as listed factory assemblies that are suitable for installation in motor groups in accordance with 7.2.10.4 of NFPA® 79, Electrical Standard for Industrial Machinery®.

Group Motor Application

From the perspective of the ArmorStart product family, being Listed for group installation means one set of fuses or one circuit breaker can protect a branch circuit that has two or more of these motor controllers that are connected to it. (See Applying More Than One ArmorStart Motor Controller in a Single Branch Circuit on Industrial Machinery, publication [280-AT003](#) for information on branch circuits and group motor installations.)

Motor cable assemblies are not supplied and have to be ordered separately. To comply with the UL Listing of the controller, use the Rockwell Automation® motor cable assembly that is specified by the instructions for the controller. See the On-Machine Media for Armor PowerFlex, ArmorStart, and ArmorConnect® Products Selection Guide, publication, [280PWR-SG001](#).

Gland Plate Entrance

The ArmorStart ST controller offers connectivity to the ArmorConnect power media. Factory-installed receptacles are provided for connectivity to three-phase control power media and safety I/O.

The power input gland connectors include: one 35 mm, 4-pin male connector for three-phase power input and one 22 mm (mini size), 4-pin male connector for control power input. When the safety I/O option is selected, it adds two 12 mm (micro) connectors for safety connections.

ControlFLASH Software Update

The ArmorStart ST motor controller firmware can be updated by using ControlFLASH™ software. Download is available from the [Product Compatibility and Download Center \(PCDC\)](#).

Factory-installed Features

The following factory-installed features either come as standard. Factory-installed features that are defined as options must be selected by the user and added to the catalog number selection before ordering. Options are not modular and cannot be installed by the user.

Source Brake Contactor and Connector

An internal contactor is used to switch the electromechanical motor brake On/Off. The motor brake contactor sources power to the motor brake solenoid from the line side power circuit. The configuration of the R1 relay controls the operation (coil) of the contactor. A brake status bit is accessible for diagnostic purposes over the network. A customer-accessible 3 A fuse is provided to help protect the brake cable from overcurrent. The cable is ordered separately. Use the Rockwell Automation® power media and cable assemblies that are specified by the selection guide or instructions for the controller, to comply with the UL Listing of the controller. See the On-Machine Media for Armor PowerFlex, ArmorStart, and ArmorConnect Products Selection Guide, publication, [280PWR-SG001](#).

EMI Filter

The EMI filter is required to be IEC/EN 61800-3 compliant. The filter must only be used in installations with solidly grounded wye AC supply distribution and must be bonded to the power distribution ground. The shielded motor cable is ordered separately. Use the Rockwell Automation® power media and cable assemblies that are specified by the selection guide or instructions for the controller, to comply with the UL Listing of the controller. See the On-Machine Media for Armor PowerFlex, ArmorStart, and ArmorConnect Products Selection Guide, publication, [280PWR-SG001](#).

Dynamic Brake Connector

The DB1 provides the quick disconnect connector and an internal resistor-monitoring circuit. The IP67 Dynamic Brake Resistor design offers simplicity in wiring and installation, using a pluggable connector. The IP67 Dynamic Brake is separately ordered. See the ArmorStart Distributed Motor Controllers Selection Guide, [280-SG002](#), for available catalog numbers.



ATTENTION: The DB1 fault status should be monitored by user PLC code to externally isolate input power under a fault condition. See [Appendix D on page 179](#).

ATTENTION: The resistor protection found in Bulletin 284 controllers when the DB1 function is applied, requires a user-supplied isolator that is configured to disconnect 3-phase power to the controller if the IGBT switch is shorted. Failure to comply can result in personal injury, equipment damage, or fire.

The IP67 Dynamic Brake Resistor is used only with the **-DB1** factory-installed function. Only the specified IP67 Dynamic Brake Resistor can be used based on the VFD horsepower. If non-specified connecting resistors are used, a DB1 fault occurs.

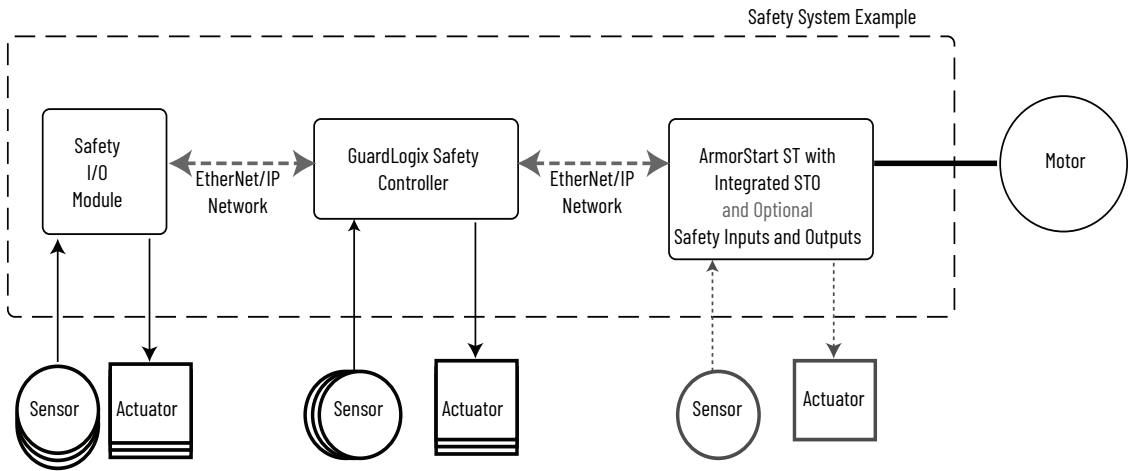
Notes:

Safety Concept

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User Safety I/O Feature	24
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The safety system includes the ArmorStart® ST motor controller with integrated Safe Torque Off (STO) and optional safety inputs and safety output. A safety programmable controller is required and the system can also include additional safety I/O modules and sensors, actuators, and a motor.

Figure 5 - Typical Safety System



Safe Torque Off Feature

With integrated Safe Torque Off (STO), the safety programmable controller issues the STO command over the EtherNet/IP network and the ArmorStart ST motor controller executes the STO command. The STO function controls a pair of contactors in series that are built into the ArmorStart ST integrated safety motor controller.

The integrated safety motor controller includes these features.

- It is designed to remove power from the gate-firing circuits of the drive output power device (IGBTs). With the power removed, the drive output power devices cannot turn on to generate AC power to the motor.
- Can be used in combination with other safety devices to satisfy the requirements of IEC 61508, IEC 61800-5-2 SIL 3, ISO 13849-1 PLe, and Category 4 of STO.



ATTENTION: The motor controller is suitable for performing mechanical work on the drive train or affected area of a machine only. It does not provide electrical safety.



ATTENTION: The motor controller does not remove dangerous voltages at the drive output. Before performing any electrical work on the drive or motor, turn off the input power to the drive, and follow all safety procedures.

The ArmorStart ST with integrated STO is suitable for use in safety-related applications up to ISO 13849-1 Performance Level e (PL_e), SIL 3 per IEC 61508, IEC 61800-5-2, and SIL CL 3 per IEC 62061, in which the removal of motion-producing power is considered to be the safe state. All components in the system must be chosen and applied correctly to achieve the desired level of operator safeguarding. The STO feature is independent of any external safety input or safety output connections on the motor controller.

For product certifications currently available from Rockwell Automation, go to rok.auto/certifications.

Safe State

The following are the safe states of the ArmorStart ST safety I/O:

- STO safety outputs from network data: OFF (STO)
- Safety outputs from network data: OFF (single channel and dual-channel equivalent)
- Safety input data to network: OFF (single channel and dual-channel equivalent)
- Safety input data to network: OFF/ON for input channels n/n+1 (dual-channel complimentary, See [Dual-channels. Complementary on page 56](#) for additional details)

The module is designed for use in applications where the safe state is the off state.

User Safety I/O Feature

Some ArmorStart ST catalog numbers feature a dual-channel safety input and a bipolar safety output. Communication for safety I/O data is performed through safety connections that support CIP Safety™ protocol over an EtherNet/IP network.

The ArmorStart ST safety I/O is suitable for use in a safety-control network that meets the requirements up to and including the following:

- SIL CL 3 according to IEC 62061 and IEC 61508
- Category 4, PL_e as defined in ISO 13849-1

Safety Input Features

- Safety devices, such as emergency stop push buttons, gate switches, and safety light curtains, can be connected.
- Dual-channel mode evaluates consistency between two input signals (channels), which allows use of the module for safety Category 3 and 4 and in applications that are rated up to and including Performance Level e/SIL 3 when both channels' Point Mode configurations are set to Safety Pulse Test.
- Single-channel mode evaluates one input signal (channel), which allows use of the module for safety Category 2 and in applications that are rated up to and including Performance Level d/SIL 2 when the channel's Point Mode configuration is set to Safety Pulse Test.
- You can configure a discrepancy time to control how long two channels are allowed to be discrepant before a fault is declared.
- An external wiring short-circuit check is possible when inputs are wired in combination with test outputs. The motor controller must be wired in combination with test outputs when this function is used.

- Independently adjustable on- and off-delays are available per channel.
- Separate test outputs are provided for short-circuit detection of a safety input or inputs.
 - Power (24V) can be supplied to devices, such as safety sensors.

Safety Output Features

- Current sourcing/current sinking-bipolar pair
- Configurable as a single-channel sourcing output
- Dual-channel mode provides redundant control by using two output signals (channels), which allows use of the module for safety Category 3 and 4, and applications that are rated up to and including Performance Level e/SIL 3 when both channels' Point Mode configurations are set to Safety Pulse Test.
- Single-channel mode provides control by using one sourcing output signal (channel), which allows use of the module for safety Category 2, and applications that are rated up to and including Performance Level d/SIL 2 when the channel's Point Mode configuration is set to Used, Safety Pulse Test.
- Safety outputs can be pulse tested to detect field wiring short circuits to 24V DC.

Integrated Safety System Application Requirements

Safety application requirements include evaluating average frequency of dangerous failure rates (PFH), system reaction time settings, and functional verification tests that fulfill SIL 3 criteria.

Create, record, and verify the safety signature as part of the required safety application development process. The safety controller creates the safety signature. The safety signature consists of an identification number, date, and time that uniquely identifies the safety portion of a project. This signature covers 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, see the GuardLogix Controller Systems Safety Reference Manuals. See [Additional Resources on page 10](#).

IMPORTANT You must read, understand, and fulfill the requirements that are detailed in the appropriate GuardLogix® controller systems safety reference manual before operating a safety system that uses a GuardLogix controller and an ArmorStart ST motor controller. See [Additional Resources on page 10](#)

Safety Considerations

The system operator is responsible for the following:

- Set-up, safety rating, and validation of any sensors or actuators connected to the system
- Completing a machine-level risk assessment and reassess the system anytime a change is made
- Certification of the machine to the desired ISO 13849-1 performance level or IEC 62061 SIL CL level
- Project management and proof testing in accordance with ISO 13849-1
- Programming the application software and the motor controller configurations in accordance with the information in this manual
- Access control to the system
- Analyze all configuration settings and choose the proper setting to achieve the required safety rating
- Validation and documentation of all safety functions used

IMPORTANT Applications where Bulletin 281ES or 281GS starters are used, must be appropriate for contactor utilization and must not be greater than AC-3 Per IEC 60947-4-1. For details, see ArmorStart ST Distributed Motor Controller Specifications, publication [280ES-TD001](#).

IMPORTANT IEC 60947-4-1 refers to utilization category AC-3 and is defined as occasional inching (jogging) or plugging for a limited time periods. An example of this, is machine setup. During this time the number of operations (e.g. one close and then open cycle of the contact) of inching or plugging should not exceed 5 operations/minute or more than 10 operations/10 minutes. If the application exceeds this, then refer to AC-4 utilization category or the product's mixed AC-3/AC-4 utilization category.



ATTENTION: Be Aware of Safety Requirements

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 use of the system.



ATTENTION: When designing your system, consider how various personnel can interact with the machine. Additional safeguard devices can be required for your specific application.



ATTENTION: In circumstances where external influences (for example, suspended loads that can fall) are present, additional measures (for example, mechanical brakes) can be necessary to help prevent any hazard.

Stop Category Definitions

Stop Category 0 is achieved with immediate removal of power to the machine actuators, which results in an uncontrolled coast-to-stop. An STO operation accomplishes a Stop Category 0 stop.

Proof Tests

IEC 61508 requires you to perform various proof tests of the equipment that issued in the system. Proof tests are performed at user-defined times. For example, proof tests can be once a year, once every 15 years, or whatever time frame is appropriate. See [Safety Data for ArmorStart ST Motor Controllers with Integrated Safety on page 27](#) and proof test interval requirements.

IMPORTANT The time frame for the proof test interval depends on the specific application.

Performance Level and Safety Integrity Level

For safety-related control systems, Performance Level (PL), according to ISO 13849-1, and SIL levels, according to IEC 61508 and EN 62061, include a rating of the ability of the system to perform its safety 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 the ISO 13849-1, IEC 61508, and EN 62061 standards for complete information on requirements for PL and SIL determination. See the rok.auto/certifications website for product certifications.

PFD and PFH Definitions

Safety-related systems can be classified as operating in either a Low Demand mode, or in a High Demand/Continuous mode.

- Low Demand mode: where the frequency of demands for operation, made on a safety-related system, is no greater than one per year, or no greater than twice the proof test frequency.
- High Demand/Continuous mode: where the frequency of demands for operation, made on a safety-related system, is greater than once per year, or greater than twice the proof test interval.

The SIL value for a High Demand/Continuous mode safety-related system is directly related to the average frequency of a dangerous failure (PFH) per hour.

IMPORTANT For Safe Torque Off (STO) function only: the determination of safety parameters is based on the assumptions that the system operates in High-demand mode and that the STO function is requested at least once every 24 hours to achieve maximum safety rating.

Safety Data for ArmorStart ST Motor Controllers with Integrated Safety

For redundant parts of a Safety-related Power Drive System (PDS (SR)) which cannot be tested without disrupting the application in which the PDS (SR) is used (machine or plant) and where no justifiable technical solution can be implemented, the following maximum diagnostic test intervals can be considered as acceptable:

Table 3 - Maximum Diagnostic Test Intervals

To achieve the listed safety rating	Maximum STO demand interval
SIL 3/Category 4, PLe	one STO operation per day
SIL 3/Category 3, PLe	one STO operation per three months
SIL 2/Category 3, PLd	one STO operation per year

These PFH calculations are based on the equations from Part 6 of EN 61508 and show worst-case values.

Table 4 - Safety Data for Safe Torque Off Function

Attribute	Bulletin 281ES/GS Starters	Bulletin 284ES/GS VFDs
PFH (1/hour)	3.62E-09	3.56E-09
SIL	3	3
PL	e	e
Category	4	4
Safe Failure Fraction (SFF)	99.1%	99.0%
MTTF _D years	83.1	94.2
DC _{avg} %	98.2% (High)	98.0% (High)
HFT	1	1
Mission time	20 years ⁽¹⁾	20 years ⁽²⁾

(1) The Bulletin 281ES/GS starter requires no maintenance if the average number of contactor operations is below an average of 49,970 cycles per year. An operation includes start-stop and Safe Torque Off (STO). An average rate higher than this will require replacement of the control module before the end of mission time. See SISTEMA library listed in the [Additional Resources](#), for further information and calculation of maintenance.

(2) The Bulletin 284 VFD requires no maintenance if the number of STO operations is below an average of 34,900 cycles per year. An average rate higher than this annual average will require replacement of the control module before the end of mission time. See SISTEMA library listed in the [Additional Resources](#), for further information and calculation of maintenance.

[Table 5](#) provides PFH values to add for safety functions that use the safety I/O provided on the ArmorStart ST motor controller.

Table 5 - Safety Data for Safety I/O

Attribute	Single Channel Safety I/O	Dual Channel Safety I/O
PFH (1/hour)	3.97E-09	3.44E-09
SIL	2	3
PL	d	e
Category	2	4
Safe Failure Fraction (SFF)	98.6%	94.5%
MTTF ₀ years	177.8	100
DCavg%	97.2% (High)	97.2 (High)
HFT	0	1
Mission time	20 years	20 years

IMPORTANT Single channel safety I/O is only certified for use in functional safety applications with process safety times greater than or equal to 300 ms; or applications with demand rates for both input and output, less than or equal to 1 demand per 90 s.

IMPORTANT If single channel safety I/O is used, pulse testing (external pulse testing for safety inputs, pulse testing for safety outputs) **MUST** be enabled on the single channel I/O points.

Safety Reaction Time

The safety reaction time for the Safe Torque Off function is the length of time from when the ArmorStart ST STO command receives the CIP Safety™ packet with an STO request and the time when motion-producing power is removed from the motor.

- Bulletin 281ES/GS starters and Bulletin 284ES/GS VFDs' safety reaction time is 60 ms maximum

IMPORTANT An input signal condition that is present for less than the reaction time may not result in the safety function being performed. Repeated requests of the safety function for less than the reaction time can result in a spurious detection of a fault.

Safety reaction time for the safety inputs (signal change until sending CIP safety package) and safety outputs (receiving safety package until output change) on the ArmorStart ST motor controller with integrated safety are:

- Safety input reaction time is 10 ms maximum
- Safety output reaction time is 10 ms maximum

IMPORTANT The safety reaction times that are listed above exclude the connection reaction time.

Safety reaction time is influenced by a number of factors, including the configuration of the safety I/O on your device and the configuration of your safety controller. These factors include:

- Safety Input On-Off and Off-On delay settings, if applicable
- Safety Input Connection Reaction Time Limit settings
- Safety controller Safety Task Period and Watchdog settings
- Produced and consumed safety Connection Reaction Time Limit settings
- Safety Output Connection Reaction Time Limit settings

See [Safety Input and Output Configuration for ArmorStart ST with Integrated Safety I/O on page 91](#), for information on configuring these settings.

For details on reaction time calculation of your safety system, see Reaction Times in the GuardLogix Controller Systems Safety Reference Manual for your safety programmable controller. These manuals are listed in the [Additional Resources on page 10](#).

Spurious Trip Rate

[Table 6](#) shows the Spurious Trip Rate (STR) and Mean Time to Failure Spurious (MTTF_{Spurious}) values, calculated according to the ISA TR-84 method.

Table 6 - STR and MTTF Spurious Trip Rates

Attribute	Value
Spurious Trip Rate (per hour)	1.19E-05
MTTF Spurious (years)	9.62

Contact Information If Safety Failure Occurs

If you experience a failure with any safety-certified device, contact your local Allen-Bradley distributor to request any of these actions:

- Return the device to Rockwell Automation so the failure is appropriately logged for the catalog number that is affected and a record is made of the failure.
- Request a failure analysis (if necessary) to determine the probable cause of the failure.

The control module and I/O modules can be replaced. See [Chapter 8](#).

Notes:

Install the ArmorStart ST Distributed Motor Controller

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This chapter covers installation information.

Receiving

You are responsible for thoroughly inspecting the equipment before accepting the shipment from the freight company. Check the items that are received against the purchase order. If any items are damaged, it is your responsibility not to accept delivery until the freight agent has noted the damage on the freight bill. If any concealed damage is found during unpacking, it is again your responsibility to notify the freight agent. Leave the shipping container intact and request the freight agent to make a visual inspection of the equipment.

Unpacking

Remove all packing material, wedges, or braces from within and around the ArmorStart® distributed motor controller. Remove all packing material from the device or devices. Check the contents of the package. Contact your local Allen-Bradley representative if any items are missing.

IMPORTANT Before the installation and startup of the drive, a general inspection of mechanical integrity (for example: loose parts, wires, connections, packing materials, and so on) must be made.

Inspecting

After unpacking, check the items nameplate catalog numbers against the purchase order. See [Catalog Number Explanation on page 16](#) and for an explanation of the catalog number system that aids in nameplate interpretation.

Storing

The controller must remain in its shipping container before installation. If the equipment will not be used for some time, it must be stored according to the following instructions to maintain warranty coverage.

- Store in a clean, dry location.
- Store within an ambient temperature range of -25...+85 °C (-13...+185 °F).
- Store within a relative humidity range of 0...95%, noncondensing.
- Do not store equipment where it can be exposed to a corrosive atmosphere.
- Do not store equipment in a construction area.

General Precautions

In addition to the precautions listed throughout this manual, the following statements, which are general to the system, must be read and understood.



ATTENTION: This publication is intended for qualified service personnel responsible for installing and servicing these devices. You must have previous experience with and a basic understanding of electrical terminology, configuration procedures, required equipment, and safety precautions.



ATTENTION: This unit has remote sources of power. Disconnect all power sources before the cover is removed. Failure to comply could result in death or serious injury.

ATTENTION: Do not attempt to service internal components when the unit is energized. Complete lockout/tagout procedures for all input power sources.



SHOCK HAZARD: To avoid electrical shock, open the appropriate upstream protection (disconnect switch or branch circuit protection) before connecting and disconnecting cables.

SHOCK HAZARD: Risk of shock exists. Unused receptacles must be capped, the environmental rating might not be maintained with uncapped receptacles.

SHOCK HAZARD: Do not operate controls or open covers without appropriate personal protective equipment. Failure to comply can result in serious injury or death.



ATTENTION: An incorrectly applied or installed controller can damage components or reduce product life. Wiring or application errors, such as undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures, can result in malfunction of the system.



ATTENTION: The controller contains ESD (electrostatic discharge) sensitive parts and assemblies. Static control precautions are required for install, test, service, or repair of the assembly. Component damage can result if ESD control procedures are not followed. If you are not familiar with static control procedures, see Guarding Against Electrostatic Discharge, publication [8000-4.5.2](#), or any other applicable ESD protection handbooks.



SHOCK HAZARD: Packaged drives contain high-voltage capacitors that take time to discharge after removal of the mains supply. Before working on the drive, isolate the main power supply from line inputs (L1, L2, L3). Wait 3 minutes for the capacitors to discharge to minimal voltage levels. Failure to do so could result in personal injury or death.

Precautions for Motor Start/Stop



ATTENTION: A contactor or other device that routinely disconnects and reapplies the AC line to the drive to start and stop the motor can cause drive hardware damage. The drive is designed to use control input signals that start and stop the motor. If used, the input device must not exceed one operation per minute or drive damage can occur.

Group Motor Installations for USA and Canada Markets

The ArmorStart distributed motor controllers are listed for use in group installations per National Fire Protection Association® (NFPA®) 79, Electrical Standard for Industrial Machinery. When applied according to the group motor installation requirements, two or more motors, of any rating or controller type, are permitted on a single branch circuit. Group motor installation has been successfully used for many years in the USA and Canada.

For additional information about group motor installations with the ArmorStart distributed motor controller, see Applying More Than One ArmorStart Motor Controller in a Single Branch Circuit on Industrial Machinery, publication [280-AT003](#).

Wiring and Workmanship Guidelines

In addition to conduit and seal-tite raceway, it is acceptable to use cable that is rated Tray Cable Exposed Runs (TC-ER), for power and control wiring on ArmorStart installations. The National Electrical Code (NEC) and NFPA 79 outline the following guidance for installations in the USA and Canada.

In industrial establishments where the conditions of maintenance and supervision verify that only qualified persons service the installation, and where the exposed cable is continuously supported and protected against physical damage, by using mechanical protection, such as struts, angles, or channels, Type TC tray cable that complies with the crush and impact requirements of Type MC (Metal Clad) cable and is identified for such use with the marking Type TC-ER (Exposed Run)⁽¹⁾ shall be permitted between a cable tray and the utilization equipment or device as open wiring. The cable shall be secured at intervals not exceeding 1.8 m (6 ft) and installed in a good workman-like manner. Equipment grounding for the utilization equipment shall be provided by an equipment grounding conductor within the cable.

While the ArmorStart controller is intended for installation in factory floor environments of industrial establishments, the following must be considered when locating the ArmorStart controller in the application:

(1) Historically, cable that meets these crush and impact requirements was designated and marked "Open Wiring". Cable so marked is equivalent to the present Type TC-ER and can be used.

- Cables that include control voltage cables, for example, 24V DC and communications, are not to be exposed to operator or building traffic on a continuous basis.
- Location of the ArmorStart controller to minimize exposure to continual traffic is recommended. If location to minimize traffic flow is unavoidable, other barriers to minimize inadvertent exposure to the cabling must be considered.
- Cables must be routed to minimize inadvertent exposure and/or damage.
- If conduit or other raceways are not used, we recommend that strain relief fittings be used when installing the cables for the control and power wiring through the conduit openings.
- Use shielded cables on 284ES and GS applications.
- Cable bend radius must not exceed 10x the cable diameter, see cable specifications in the On-Machine Media for Armor PowerFlex, ArmorStart, and ArmorConnect Products Selection Guide, publication, [280PWR-SG001](#).
- Using a 90° or right angle connector can reduce strain on the connection.
- Provide proper strain relief for all other connectors to avoid cable degradation.
- Use patchcords for motor and electromechanical brake wiring.
- If the motor is mounted so that it physically moves relative to the ArmorStart unit, use flex cables. The cables must be secured at both ends so that the receptacles are not under tension. Consider using a festoon system or field dressing, so that there is no movement at the receptacle.
- Power cabling, such as three-phase, source brake, and dynamic brake, must be kept at least 150 mm (6 in.) away from the EtherNet/IP network and I/O cables to avoid noise issues.

IMPORTANT Excessive tension could cause wear to cables and receptacles.

Use proper lockout/tagout procedures before disconnecting or replacing the ArmorStart controller or control module.

Input Power Conditioning

The controller is suitable for direct connection to input power within the rated voltage of the controller (see [page 14](#)). Listed in [Table 7](#) are certain power conditions that can cause component damage or reduction in product life. If any of these conditions exist, install one of the devices that are listed under Corrective Action, on the line side of the controller.

IMPORTANT Only one device per branch circuit is required. Mount the device closest to the group motor branch circuit protection device and size it to handle the total current of the branch circuit.

Table 7 - Potentially Damaging Power Conditions

Input Power Condition	Corrective Action
Low line impedance (less than 1% line reactance)	Install line reactor or isolation transformer
Greater than 120 kVA supply transformer	
Line has power factor correction capacitors	
Line has frequent power interruptions	
Line has intermittent noise spikes in excess of 6000V (lightning)	
Phase to ground voltage exceeds 125% of normal line-to-line voltage	

Electromagnetic Compatibility (EMC)

Conformity of the drive with CE EMC and UKCA requirements does not short circuit that an entire machine installation complies with CE EMC and UKCA requirements. Many factors can influence total machine/installation compliance.

The following guidelines are provided for EMC installation compliance.

Cabling and Grounding

- The motor cable must be kept as short as possible to avoid electromagnetic emissions and capacitive currents. CE conformity of ArmorStart ST controller with EMC Directive does not confirm that the entire machine installation complies with CE EMC requirements.
- By using an EMI filter with any drive rating, you can achieve relatively high ground leakage currents. Therefore, the filter must only be used in installations that are solidly grounded (bonded) to the building power distribution ground. Grounding must not rely on flexible cables and must exclude any form of plug or socket that would permit inadvertent disconnection. Some local codes can require redundant ground connections. The integrity of all connections must be periodically checked.
- For Bulletin 284E EMC compatibility, the motor cable connector that is selected must provide good 360° contact and low transfer impedance from the shield or armor of the cable to the conduit entry plate at both the motor and the ArmorStart ST controller, for electrical bonding.

IMPORTANT CE / EU EMC Compliance to EN 61800-3: Bulletins 284E, 284ES, and 284GS with a manufacturing date code of 03/01/2026 or later (as shown on the product nameplate) to meet CE requirements under the EU EMC Directive, for these products the motor cable length must not exceed 8 meters.

Additionally, Bulletin 284R dynamic brake resistors are not approved for use in applications requiring compliance to EN 61800-3.

Wiring

Wire in an industrial control application can be divided into three groups: power, control, and signal. The following recommendations for physical separation between these groups, are provided to reduce the coupling effect:

- Minimum spacing between different wire groups in the same tray must be 16 cm (6 in.).
- Wire runs outside an enclosure must be run in conduit or have shielding/armor with equivalent attenuation.
- Different wire groups must be run in separate conduits.
- Minimum spacing between conduits that contain different wire groups must be 8 cm (3 in.).

Grounding

Grounding is done for two basic reasons: safety and noise containment or reduction. While the safety ground scheme and the noise current return circuit can sometimes share the same path and components, they must be considered different circuits with different requirements.

The object of safety grounding is to verify that all metal work is at the same ground (or Earth) potential at power frequencies. Impedance between the motor controller and the building scheme ground, must conform to the requirements of national and local industrial safety regulations or electrical codes. These requirements vary based on country, type of distribution system, and other factors. Periodically check the integrity of all ground connections.

General safety dictates that all metal parts are connected to earth with separate copper wire or wires of the appropriate gauge. Most equipment has specific provisions to connect a safety ground or PE (protective earth) directly to it.

The safety ground - PE, must be connected to earth ground. This ground point must be connected to adjacent building steel (girder, joist), a floor ground rod, busbar, or building ground grid. Grounding points must comply with national and local industrial safety regulations or electrical codes. Some codes can require redundant ground paths and periodic examination of connection integrity.



ATTENTION: To avoid electrolytic corrosion on the external earth terminal, avoid the spraying of moisture directly on the terminal. When used in washdown environments apply a sealant or other corrosion inhibitor on the external ground terminal to minimize any negative effects of galvanic or electro-chemical corrosion. Ground connections must be inspected regularly.

The following considerations apply to ungrounded and high resistive distribution systems:



ATTENTION: The Bulletin 284E VFD contains protective Metal Oxide Varistors (MOVs) that are referenced to a ground. Do not disconnect or install these devices on an ungrounded and high resistive distribution system.



ATTENTION: Do not apply the EMI filter to grounded or ungrounded delta power source. The EMI option requires a solidly grounded wye (Y) power source (for example, 480/277 or 400/230V AC, 3-phase power source). If applied to a grounded or ungrounded 480V AC delta power source, abnormal ground currents are detected that cause the EMI filter to be damaged.

Shielding and Grounding of Motors and Motor Cables

The motor frame or stator core must be connected directly to the PE connection with a separate ground conductor. We recommend that each motor frame is grounded to building steel at the motor.

Motor Cable Considerations

Most recommendations about motor cable address issues come from the nature of the drive output. A PWM drive creates AC motor current by sending DC voltage pulses to the motor in a specific pattern. These pulses affect the wire insulation and can be a source of electrical noise. The rise time, amplitude, and frequency of these pulses must be considered when choosing a wire/cable type. The choice of cable must consider:

1. The effects of the drive output once the cable is installed
2. The need for the cable to contain drive output noise
3. The amount of cable-charging current available from the drive
4. Possible voltage drop (and subsequent loss of torque) for long wire runs

Keep the motor cable lengths less than 14 m (45.9 ft) unless otherwise noted in the device specifications.

Unshielded Cable

The use of cables without shielding is generally acceptable for installations where motor controller electrical noise does not interfere with the operation of other devices such as: communication cards, photoelectric switches, weigh scales, and others. Be certain the installation does not require shielded cable to meet specific EMC standards for CE, C-Tick, or FCC. Cable specifications depend on the installation type.



ATTENTION: Shielded motor cable is mandatory for CE-compliant installations.

Branch Circuit Protection Requirements

When using ArmorConnect® three-phase power media with the ArmorStart ST controller, fuses or circuit breakers can be used for the motor branch circuit protective device, for the group motor installations.

For rated ArmorConnect motor cable assemblies:

- **Circuit Breaker:** Suitable for use on a circuit capable of delivering not more than 30 000 rms symmetrical amperes at 480V AC maximum, when protected by a catalog number 140G-H6C3-C60 circuit breaker with a maximum ampere rating of 60 A and an interrupting rating not less than of 65 000 rms symmetrical amperes, 480V.
- **Fuses:** Suitable for use on a circuit capable of delivering not more than 65 000 rms symmetrical amperes at 480V AC maximum when protected by Class CC, J, or T fuses, with a maximum ampere rating of 60 A.

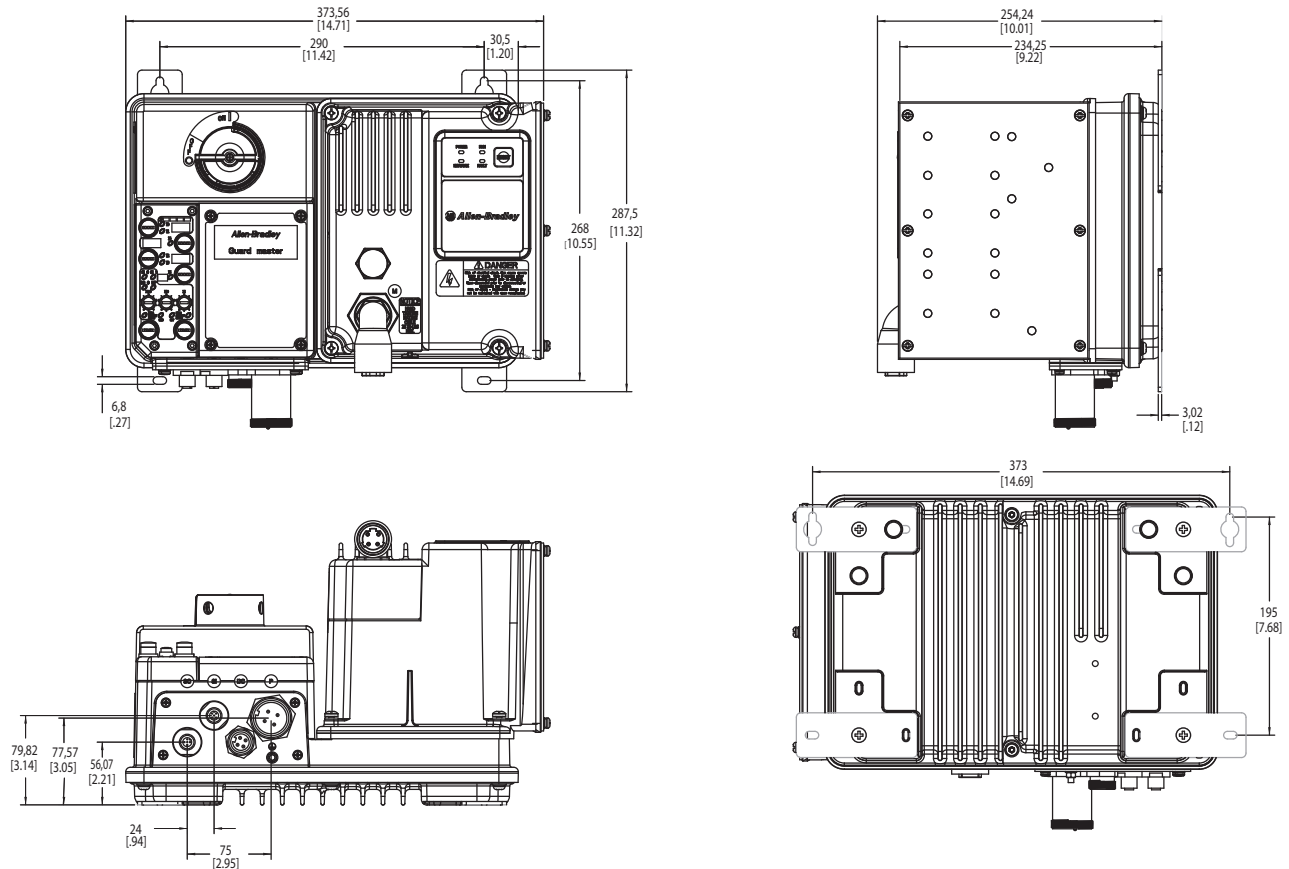


WARNING: The total circuit impedance including the impedance of each cable assembly, must be low enough to confirm that any short circuit or ground fault current that can flow through any assembly, is large enough to operate the magnetic trip of the circuit breaker. Failure to comply can result in death, personal injury, and/or equipment damage. See your local electrical code for acceptable practices for this evaluation.

Bulletin 281ES/GS ArmorStart Starter Dimensions

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

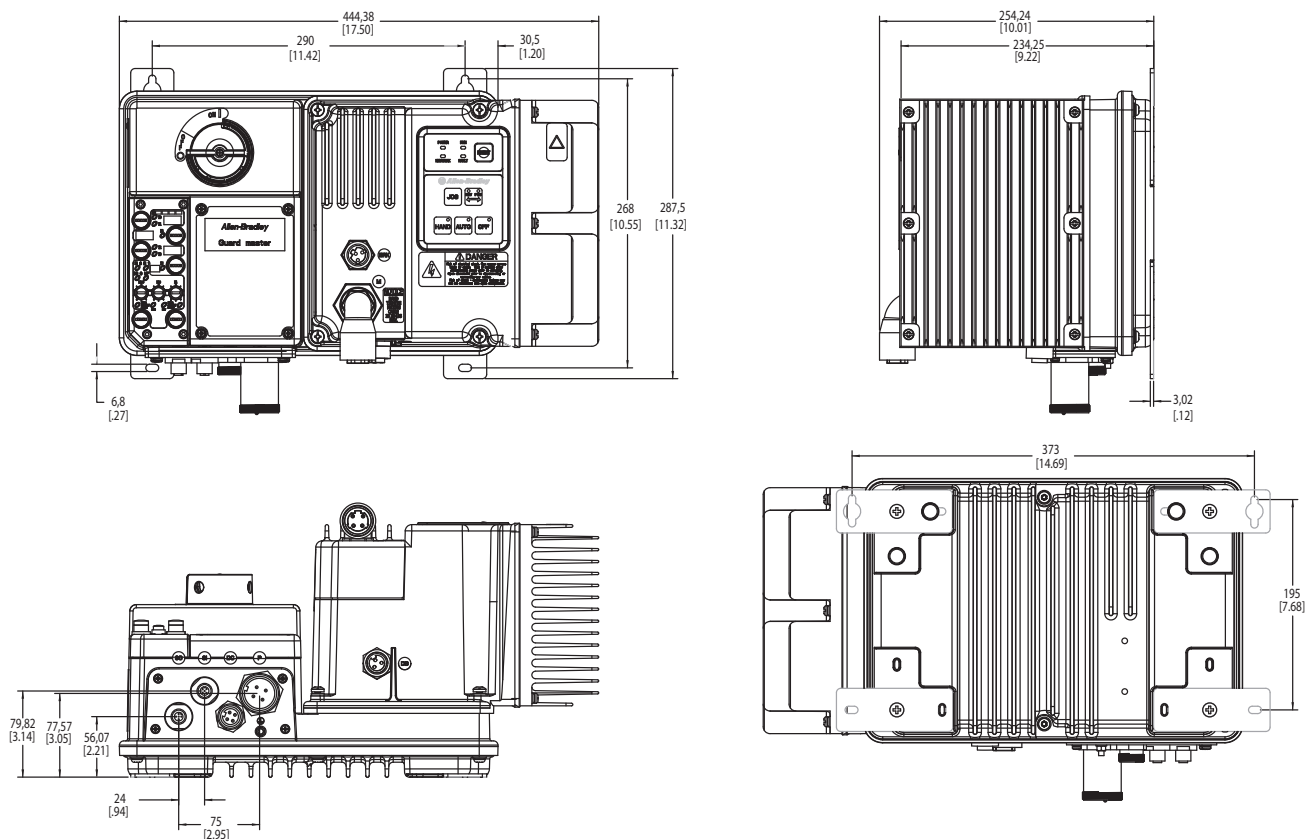
Figure 6 - Dimensions for Bulletin 281ES and GS Starter (RRG Gland)



Bulletin 284ES/GS ArmorStart VFD Dimensions

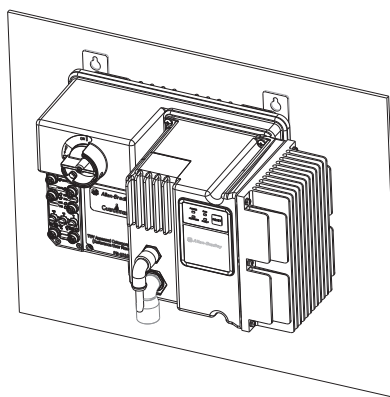
Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes. All dimensions are subject to change.

Figure 7 - Dimensions for Bulletin 284ES and GS VFD (RRG Gland)



Mounting Orientation

The recommended mounting orientation of ArmorStart ST controller is the vertical configuration. This orientation is especially important for the Bulletin 284ES/GS VFD because it allows proper airflow over the heatsink. Improper mounting or debris buildup reduces airflow and increases internal temperatures. This improper mounting can reduce the overall life of the product. For alternate mounting, contact your local sales representative.



ATTENTION: For proper heat dissipation and product operation, mount in the vertical orientation as shown.

Figure 10 - Terminal Designations for Bulletin 284ES and 284GS VFDs

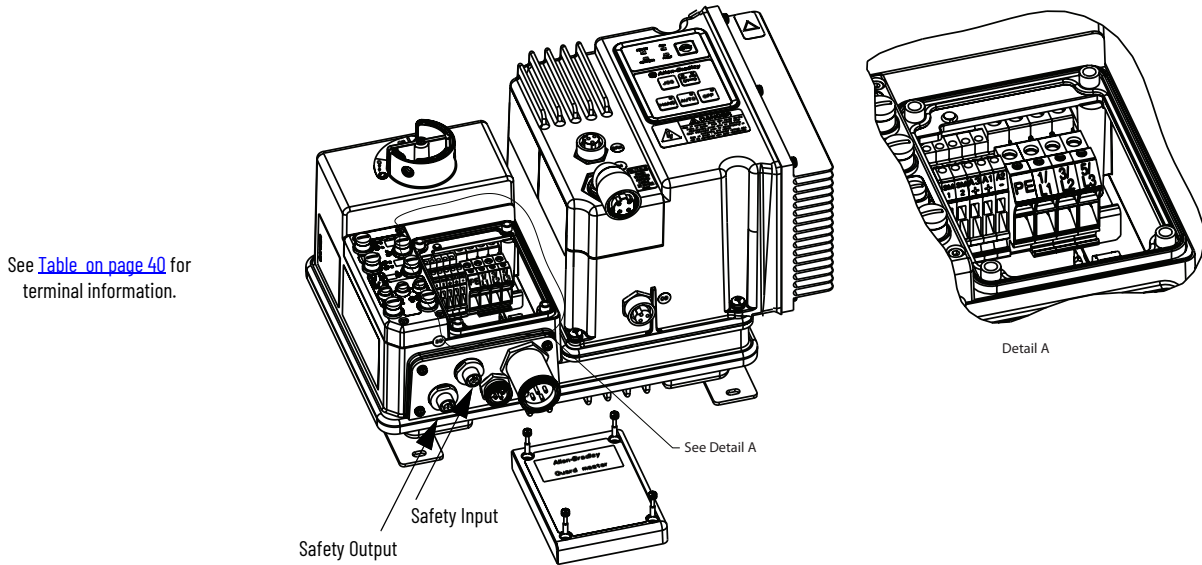
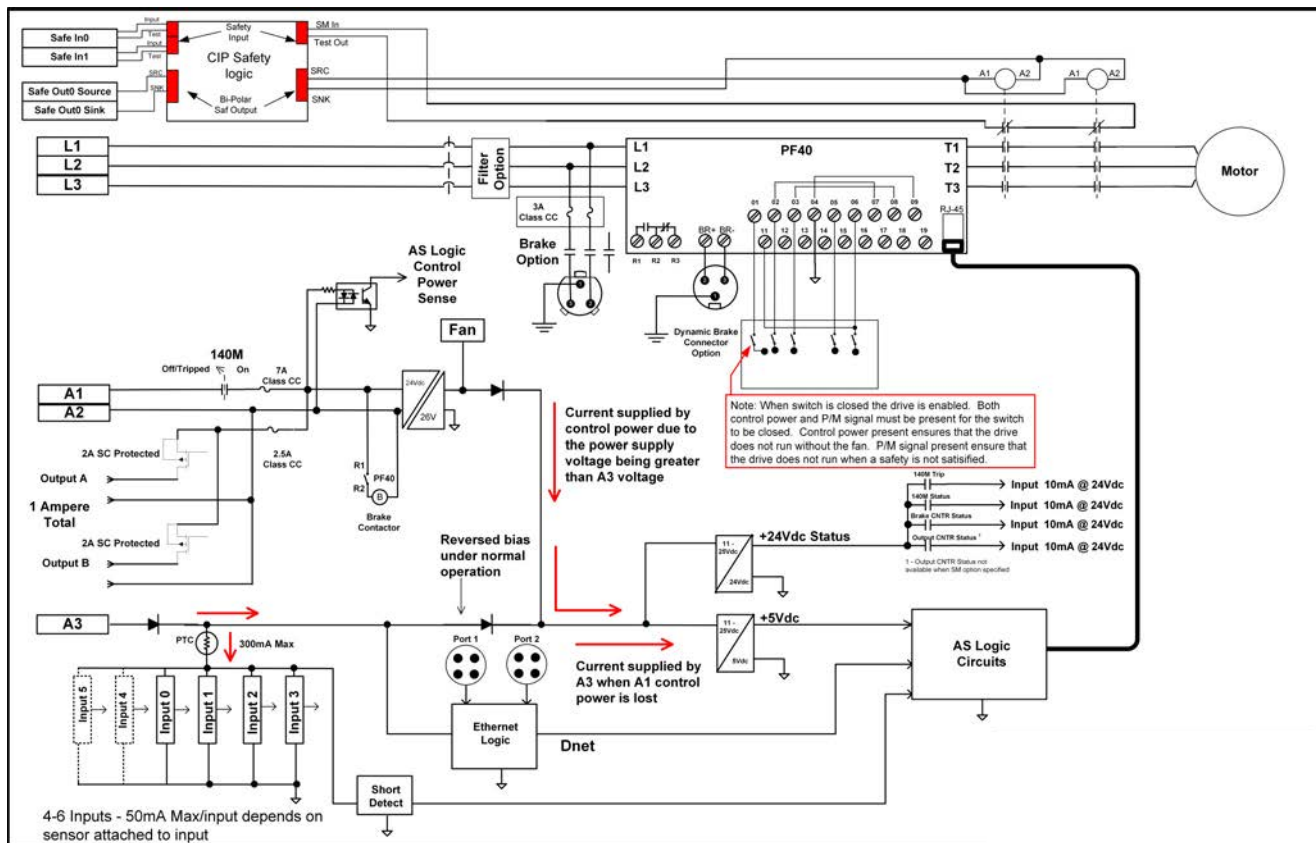


Figure 11 - Bulletin 284ES Integrated Safety Version ArmorStart ST VFD Internal Wiring



IMPORTANT

You must protect the dynamic brake resistor if a shorted switch occurs in the VFD, which is done via PLC control. An example ControlLogix program can be downloaded from the Product Compatibility and Download Center at rok.auto/pcdc.

Table 8 - Terminals

Designations	Wire/Connections	Description
A1	2	Switched 24V DC Control Power
A2	2	Control Power Common
A3	2	Unswitched 24V DC Control Power
PE	2	Ground/PE
1/L1/R	2	Line Power - Phase A
3/L2/S	2	Line Power - Phase B
5/L3/T	2	Line Power - Phase C
Saf In	2	External Safety Input
Saf Out	2	External Safety Output
SM1	2	STO Safety Signal (internal)
SM2	2	Contactor NC Contact Status (internal)



ATTENTION: To comply with the CE Low Voltage Directive (LVD), all connections to this equipment must be powered from a source compliant with the following:

- Safety Extra Low Voltage (SELV) Supply
- Protected Extra Low Voltage (PELV) Supply

If the devices (sensors) connected to the input connections require Class 2 power to operate, the auxiliary power connections of this equipment must be powered by a Class 2 source.

ArmorConnect Power Media

Details of ArmorConnect power media are described in the On-Machine Media for Armor PowerFlex, ArmorStart, and ArmorConnect Products Selection Guide, publication, [280PWR-SG001](#).

The ArmorConnect power media offers both three-phase and control power cable cord set systems including patchcords, receptacles, tees, reducers and accessories to be used with the ArmorStart distributed motor controller. These cable system components let quick connection of ArmorStart controllers, reducing installation time. They provide for repeatable, consistent connection of the three-phase and control power to the ArmorStart controller and motor by providing a plug and play environment that also avoids system mis-wiring.

IMPORTANT ArmorConnect connections must be hand tight. See the ArmorConnect instructions for the recommended tightening torque. The use of a tool to help in the tightening of the connector is not recommended.

To specify power media for use with the ArmorStart distributed motor controllers, use only motor and power cables that are listed for use with ArmorStart controllers.

IMPORTANT The UL Listing of the ArmorStart controller requires its mating output motor and input power cable assemblies to be only those assemblies that are specified by the instructions for the controller. By using other cable assemblies, you violate the Listing of the controller, which NFPA 79 prohibits (see 1.5 of NFPA 79 and 110.3(B) of NFPA 70 (NEC)).



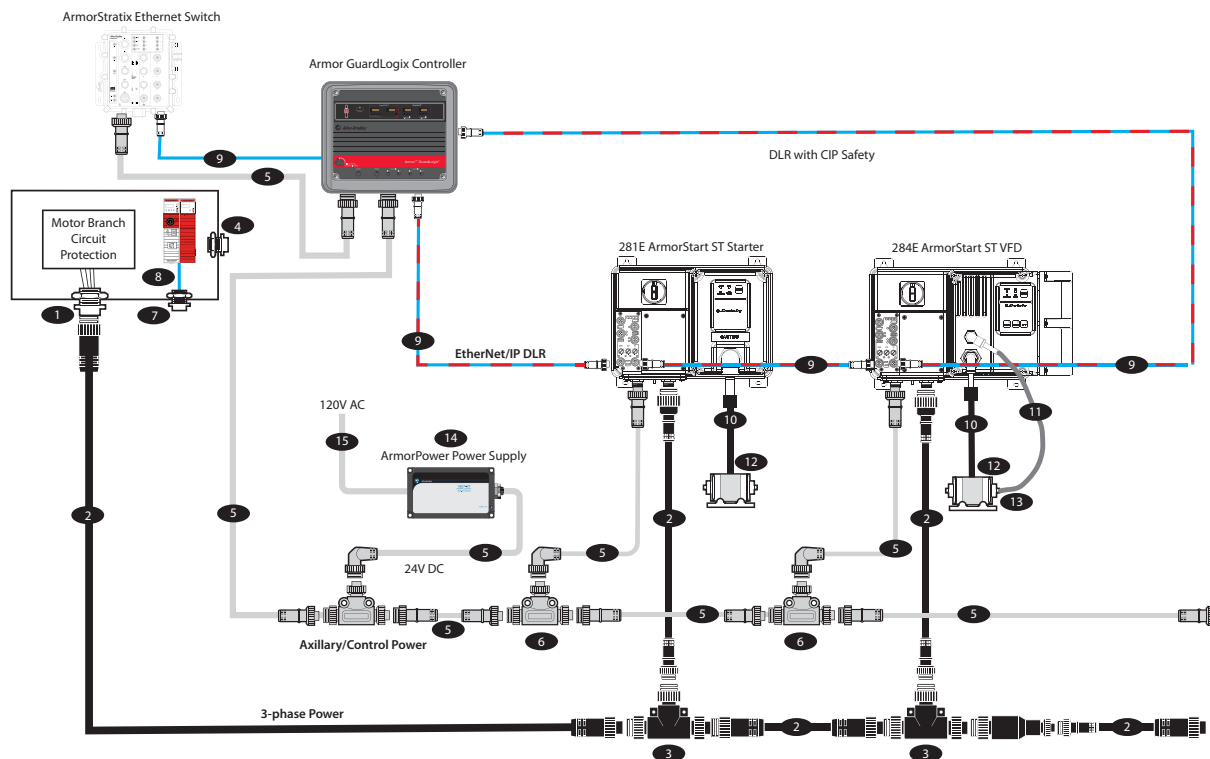
SHOCK HAZARD: Risk of electrical shock. Do not disconnect or connect power cables under load.



ATTENTION: ArmorConnect cables are not intended to be connected or disconnected under load. If this task is done, it can result physical injury or equipment damage as a result of high make and break currents and potential fault currents.

The following shows example configurations for power, control, and communication media.

Figure 12 - Cable System Overview



Description	Example Cat. Nos.
1 Three-phase power receptacle	280-M35F-Mxx ⁽¹⁾
2 Three-phase power trunk cable & drop cable	280-PWRM35A-Mxx ⁽¹⁾
3 Three-phase power t-port	280-T35
4 Auxiliary/Control power receptacle	888N-D4AF1-xx ⁽¹⁾
5 Auxiliary/Control power trunk & drop cable	889N-F4AFNM-xx ⁽¹⁾
6 Auxiliary/Control power t-port	898N-43PB-N4KT
7 Ethernet bulkhead adapter (RJ45-M12)	1585A-DD4JD
8 Ethernet transition cable (RJ45 patchcord-M12 receptacle)	1585D-D4TBJMxx ⁽¹⁾
9 Ethernet patchcord	1585D-M4TBDM-xx ⁽¹⁾
10 Motor cable	280-PWRM29A-Mxx ⁽¹⁾ 284-PWRM29A-Mxx ⁽¹⁾
11 Brake cable	285-BRC22-Mxx ⁽¹⁾ D
12 Motor receptacle	284-M29M-M05
13 Brake receptacle	285-M24M-M05
14 24V DC power supply	1607-XT50D1A
15 120V AC line in cable, 3-pin	889N-F3AFC-F-xx ⁽¹⁾

(1) xx specifies the available cable lengths.

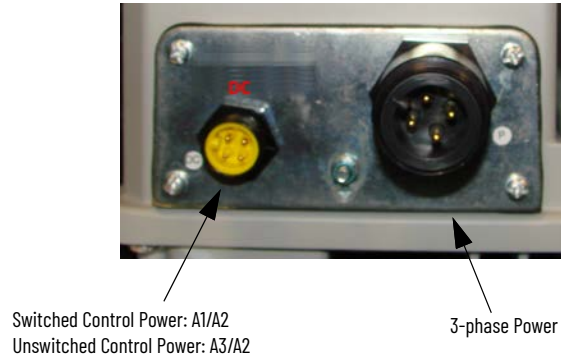
See the On-Machine Media for Armor PowerFlex, ArmorStart, and ArmorConnect Products Selection Guide, publication, [280PWR-SG001](#), for available options and technical specifications.

Switched, Unswitched, and Safety Power Connections

Switched and Unswitched Control Power Connections

Switched control power (A1/A2) supplies power to outputs, contactor coil, and VFD enable, in the standard controller version, see [Figure 13](#). When this power is removed or when the disconnect is turned Off, the outputs turn Off and power is removed from the motor output connector.

Figure 13 - Standard Version Connectors



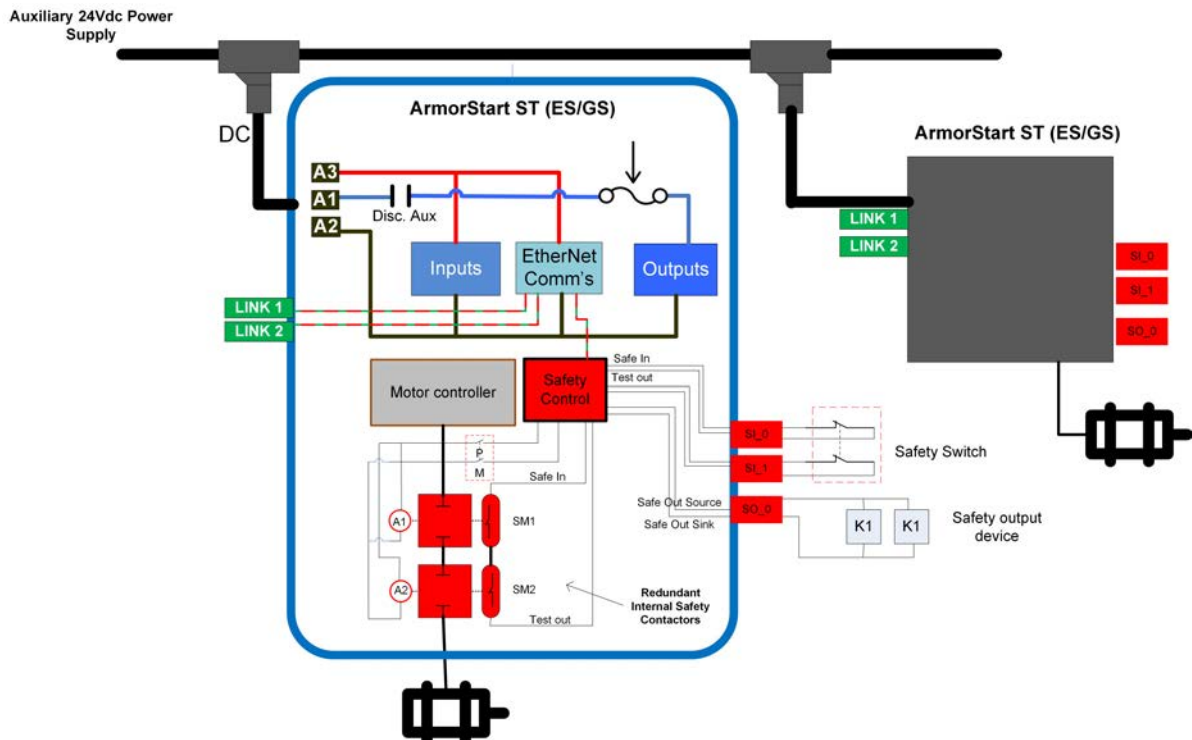
Unswitched control power (A3/A2) supplies power to inputs, communications, and the electronic control module, see [Figure 14](#). When this power is removed, the device turns off, with no further control of the motor. There is no communication or I/O activity.

When the local disconnect is turned OFF, it does not inhibit communication or input status.

EtherNet/IP is an unpowered network therefore, if device status and I/O functionality are important when the power distribution disconnect is in the OFF position, the A3 terminal must have an unswitched power source.

Safety Power Connections

Figure 14 - Safety Power Block Input and Output Configuration



The ArmorStart ST safety version controller has additional inputs and outputs that come from the internal safety contactors. The safety I/O block monitors these inputs and outputs.

The safety I/O is powered from the switched and unswitched power source.

Figure 15 - Safety I/O Power

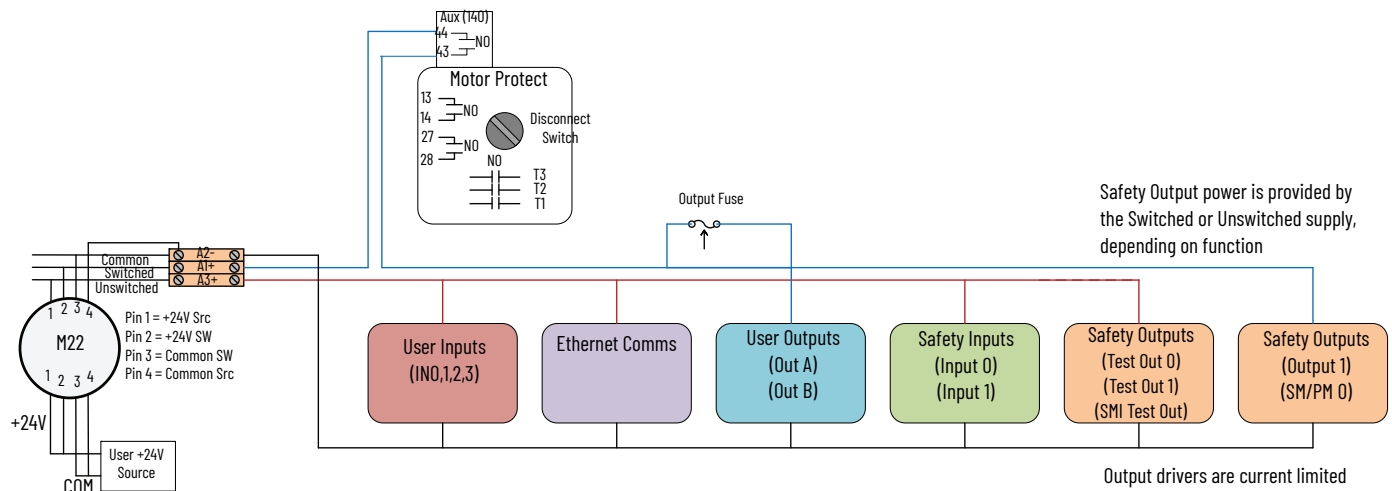


Figure 16 - Safety Version Connectors



IMPORTANT Control power connections share a common (A2), so do not use a bipolar output safety pair for the switched power source (with pulse testing on the switched power supply) or safety I/O faults will occur.

IMPORTANT A3 must be present at all times or communication with the Logix controller will be lost.



The safety circuits on the Armorstart ST motor controller with integrated safety can be directly controlled from the GuardLogix® safety controller to disable motion. Alternately, you can open the access cover and jumper A1 and A3 from the unswitched power supply, so that they are supplied from a common source.

Control Power Connections

The ArmorStart ST controller uses 24V DC control power for communications and I/O. Switched power supplies the outputs. Unswitched power supplies logic power and sensor inputs.

24V DC Control Power

- A1 = Switched +V
- A2 = Common for both switched and unswitched (-V)
- A3 = Unswitched +V

Input and Output Power Connections

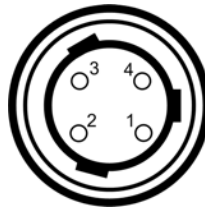
- Sensor Power is sourced from +24V supplied from A3(+) and A2(-).
- Output power is sourced from +24V supplied from A1(+) and A2(-).
- Max. current per output point is 0.5 A and is not to exceed 1.0 A total.

IMPORTANT There is an instantaneous capacitive inrush for less than 10 ms, which can exceed 20 A. The power supply must be able to support this amount of instant power demand when multiple ArmorStart controllers are turned ON simultaneously. For supplies without this capacity, we recommend applying unswitched power (A3-A2) first and after a 2...4 second delay, apply switched power. If control power falls below 19V DC, there is a higher risk of communications issues or device faults.

IMPORTANT Both a switched and unswitched 24V supply from this source are provided to the safety subsystem. The External supply must meet IEC 61800-5-2 Annex e Table E.1 requirements for supply stability. You are responsible for providing safety power that is PELV or SELV rated.

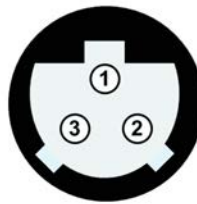
Power Connector Pinouts

Figure 17 - Motor Connector (M29, socket)



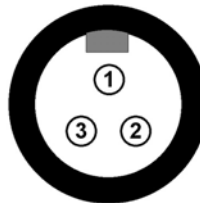
- Pin 1 - T1 (black)
- Pin 2 - T2 (white)
- Pin 3 - T3 (red)
- Pin 4 - Ground (green/yellow)

Figure 18 - EM Brake Contactor Connector (M22, socket)



- Pin 1 - Ground (green/yellow)
- Pin 2 - B1 (black)
- Pin 3 - B2 (white)

Figure 19 - Dynamic Brake Connection (M22, socket)



- Pin 1 - Ground (green/yellow)
- Pin 2 - BR+ (black)
- Pin 3 - BR- (white)

Figure 20 - Incoming Control Power (M22, plug) - 24V DC Only



- Pin 1 - 24V DC switched (brown)
- Pin 2 - 24V DC unswitched (white)
- Pin 3 - Common unswitched (blue)
- Pin 4 - Common switched (blue)

Figure 21 - Incoming Three-phase Power (M35, plug)



- Pin 1 - L1 (black)
- Pin 2 - Ground (green/yellow)
- Pin 3 - L3 (red)
- Pin 4 - L2 (white)

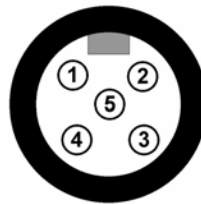
Standard I/O Connection Pinouts

The following characteristics are common to the I/O connections for ArmorStart ST standard versions:

- 5-pin socket connectors (M12)
- Four fixed inputs (two per connector)
- Two sourcing outputs DC (solid state) - (one per connector)

[Figure 22](#) shows the 24V DC input connections for IN0 through IN3 on Bulletin 281ES, Bulletin 281GS, Bulletin 284ES, and Bulletin 284GS controllers.

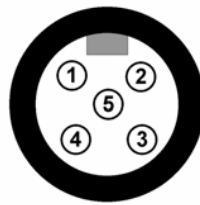
Figure 22 - I/O Receptacle Input (M12, socket) - I1 and I2



- Pin 1 - +24V (A3 pwr)
- Pin 2 - Input 1, 3
- Pin 3 - Common
- Pin 4 - Input 0, 2
- Pin 5 - NC (no connection)

[Figure 23](#) shows the two 24V DC output connections for OUTA and OUTB on Bulletin 281ES and Bulletin 284ES controllers.

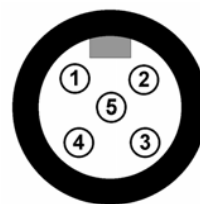
Figure 23 - I/O Receptacle Output (M12, socket) - OUTA and OUTB



- Pin 1 - Not used (+24V DC)
- Pin 2 - NC (no connection)
- Pin 3 - Common
- Pin 4 - Output +24V DC (A1 pwr)
- Pin 5 - NC (no connection)

[Figure 24](#) shows the optional two 24V DC input connections for IN4 and IN5 for Bulletin 281GS and Bulletin 284GS controllers.

Figure 24 - I/O Receptacle Input (M12, socket) - I4 and I5

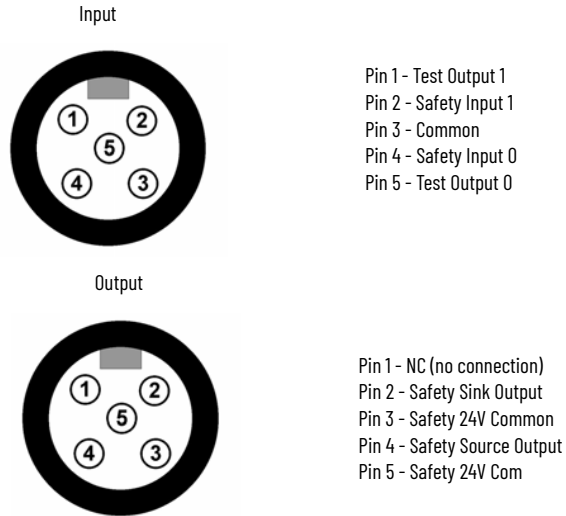


- Pin 1 - +24V (A3 pwr)
- Pin 2 - NC (no connection)
- Pin 3 - Common
- Pin 4 - Input (4, 5)
- Pin 5 - NC (no connection)

Safety Input and Safety Output Connection Pinouts

For specific user safety I/O wiring examples, see [Appendix F](#).

Figure 25 - I/O Receptacle Input (M12, socket) - I1 and I2



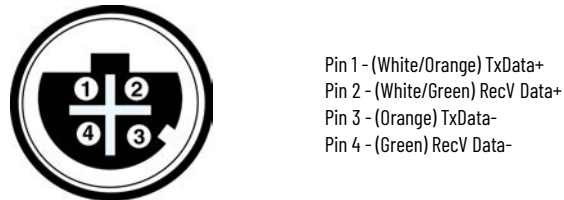
Input and Output Characteristics

- Two single-channel or one dual-channel 24V DC safety input
- Two single-channel 24V DC test output
- One bipolar 24V DC safety output or one single channel source output

Ethernet Connection Pinout

The ArmorStart ST controller uses a sealed D-coded M12 (micro) style Ethernet connector.

Figure 26 - EtherNet/IP Connector (M12, socket)



Local Disconnect Behavior

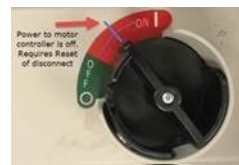
To properly turn the local disconnect from Off to On, rotate the handle clockwise 90° until the stop is reached and the handle is vertical and points to the On position.

Figure 27 - Local Disconnect in On Position



When the handle is rotated from On toward the Off position, power to the internal motor controller is removed once the handle reaches the 10 o'clock position. See [Figure 28](#).

Figure 28 - Local Disconnect in Improper Position



Rotate the handle fully counter-clockwise to the Off position before turning ON or for reset of a short-circuit current fault. See [Figure 29](#).

Figure 29 - Local Disconnect in Off Position



When the switch is in the Off position, a lock can be applied on the switch accessory to lock the disconnect in the Off position.



ATTENTION: This unit has remote sources of power. Disconnect all power sources before the cover is removed. Failure to comply could result in death or serious injury.

ATTENTION: Do not attempt to service internal components when the unit is energized. Complete lockout/tagout procedures for all input power sources.



SHOCK HAZARD: Packaged drives contain high-voltage capacitors that take time to discharge after removal of the mains supply. Before working on the drive, isolate the main power supply from line inputs (L1, L2, L3). Wait 3 minutes for the capacitors to discharge to minimal voltage levels. Failure to do so could result in personal injury or death.

Maintenance

The ArmorStart ST controller does not require regular maintenance. When using ArmorConnect media or conductors, verify that the connections remain tight where exposed to shock and vibration. Check that the heatsink has good airflow. VFDs include an internal circulating fan to support heat conduction in high ambient applications. This fan operates when control power is applied and cannot be controlled by any other means. Monitor the fan speed to receive early warning of fan failure. The fan rpm is displayed in the Status page of the unit in the Studio 5000® project and the value is only updated when online with the PLC. See [Chapter 6](#) for details about how to configure the ArmorStart ST controller in the Studio 5000 environment.



If the fan rpm falls below 1740, a Hardware Fault F14 is generated. Also, Last Pr Fault indicates a FAN RPM fault has occurred.

IMPORTANT

The FAN RPM fault reset function is modified to allow normal operation for 24 hours before the fault reoccurs. The replacement fan is PN 284-FAN. See [Fan RPM Fault on page 136](#) for information regarding the monitoring of the Fan RPM.

Safe Torque Off and Safety I/O Operation

Topic	Page
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Safety Output Operation	60
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Safety Input or Output Fault Recovery	68
Reset to Out-of-Box	68
Replacing an ArmorStart ST Motor Controller on a Safety Network	69
Using Autotune and Integrated Safety	71
Using a Message Instruction	71

Safe Torque Off Operation

The Safe Torque Off (STO) feature provides a method, with sufficiently low probability of failure, to force the output power to a disabled state. When the command to execute the STO function is received from the GuardLogix® controller, the output power device transitions to an OFF-state, which results in a condition where the motor is coasting.



ATTENTION: Safe Torque Off (STO) will prevent the motor from applying torque to a system but in some systems torque is also applied to the mechanical system by a suspended load, unbalanced load, back pressure, and so on. In such a system, application of a mechanical brake is required to hold the load while motor torque is disabled by STO.



ATTENTION: When STO is demanded, the motor output provides mechanical isolation of the electrical output that is required for some applications.

You can use the STO circuit in combination with other safety devices to achieve the stop and protection-against-restart as specified in IEC 60204-1. These conditions must be met for integrated control of the STO function:

- You must have a GuardLogix family of safety controllers project with an EtherNet/IP network connection configured.
- You must add the motor controller to the Ethernet network connection in the safety controller I/O tree.

The safety reaction time is the time from when the ArmorStart® ST controller STO command receives the CIP Safety packet that triggers a safe stop to the initiation of the configured Stop Type. See [Safety Reaction Time on page 28](#) for details.

Stop Category 0 as defined in IEC 60204 or STO as defined by IEC 61800-5-2 is achieved with immediate removal of motion-producing power to the actuator.

IMPORTANT If a malfunction occurs, the most likely stop category is Stop Category 0. When designing the machine application, timing and distance must be considered for a coast to stop. For more information regarding stop categories, refer to IEC 60204-1.



ATTENTION: The Safe Torque Off (STO) feature is suitable only for performing mechanical work on the ArmorStart system or affected area of a machine. It does not provide electrical safety.

Safe Torque Off Assembly Tags

The safety controller controls the integrated STO function through the SO.STOOutput tag in the safety output assembly:

- The SO.SafetyStopFunctions tags are sent from the controller safety output assembly to the drive safety output assembly to control the Safe Torque Off function.
- The SI.StopStatus tags are sent from the drive to the controller safety input assembly and indicate the safety control status of the drive.

[Table 9](#) list the safety tags added to the controller tags when a drive is added to a controller I/O configuration and the connection is configured for safety-only, or standard and safety. The attribute values that are listed are the Assembly Object attribute values.

IMPORTANT Only the data that is listed in [Table 9](#) is safety data with SIL 3 integrity.

Table 9 - Safety Assembly Tags

Safety Input Assembly Tag Name	Type/[bit]	Description
DeviceName:SI.ConnectionStatus	SINT	A collection of the following bits.
DeviceName:SI.RunMode	[0]	Safety Connection 0 = Idle 1 = Run
DeviceName:SI.ConnectionFaulted	[1]	Safety Connection 0 = Normal 1 = Faulted
DeviceName:SI.FeedbackPosition	DINT	Primary Feedback Position from drive-module safety instance. Value is in encoder counts.
DeviceName:SI.FeedbackVelocity	REAL	Primary Feedback Velocity from drive-module safety instance. Value is in Rev/s or Meter/s.
DeviceName:SI.SecondaryFeedbackPosition	DINT	Secondary Feedback Position from drive-module safety instance. Value is in encoder counts. Secondary channel may only be used for discrepancy comparison with primary channel.
DeviceName:SI.SecondaryFeedbackVelocity	REAL	Secondary Feedback Velocity from drive-module safety instance. Value is in Rev/s or Meter/s. Secondary channel may only be used for discrepancy comparison with primary channel.
DeviceName:SI.StopStatus	SINT	A collection of the following bits.
DeviceName:SI.STOActive	[0]	Safe Torque Off (STO) function status 0 = Permit Torque 1 = Disable torque



ATTENTION: Safety I/O connections and produced/consumed connections cannot be automatically configured to fault the controller if a connection is lost and the ArmorStart ST controller transitions to the safe state. Therefore, if you must detect a module fault to be sure that the system maintains SIL 3, you must monitor the SI.ConnectionStatus bits and initiate the fault via program logic.

Out-of-Box STO Configuration



ATTENTION: The out of the box state of the ArmorStart ST motor controller is Torque Enabled, where the GuardLogix controller has not established a safety connection to the ArmorStart ST motor controller.

You can determine if the motor controller is in an out-of-box state by using an MSG instruction in the Studio 5000 Logix Designer® application to read the Safety Supervisor Status. If the state is waiting (8) or waiting with torque permitted (51), then the safety control is in the out-of-box state.

You can use the integrated STO function of the ArmorStart ST motor controller only after a safety connection has been established at least once in the Studio 5000 Logix Designer application. To bypass the STO feature while commissioning or testing the ArmorStart ST motor controller, you can restore the drive to the out-of-box state with no safety connection, by resetting ownership. Once you have reset ownership, you must reconfigure the motor controller. See [Reset to Out-of-Box on page 68](#).



ATTENTION: If you bypass the STO feature, the safety system will permit motor torque that could result in unintended motion. Use additional preventative measures to maintain the safety integrity of the machinery.

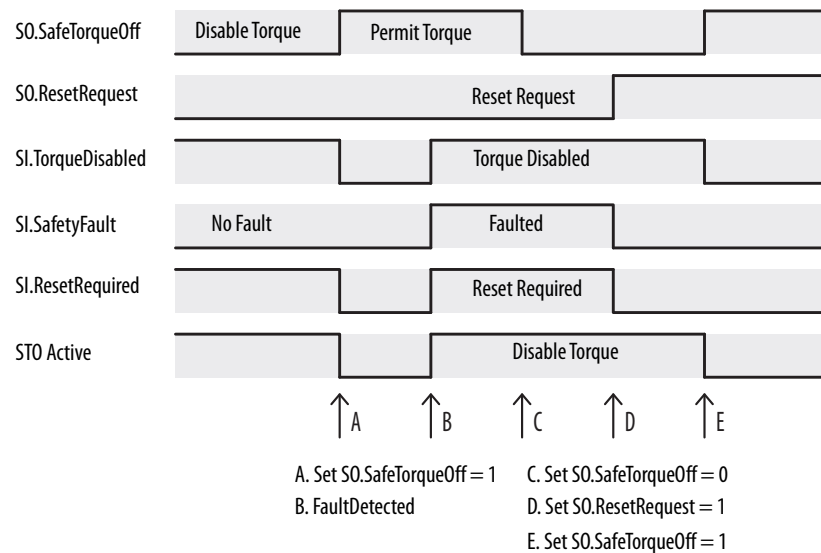
STO Fault Recovery

If the safety controller detects a fault, the input assembly tag SI.SafetyFault is set to 1.

To clear the STO Fault condition, a transition from logic 0 to 1 of the SO.ResetRequest tag is required after the SO.SafeTorqueOff tag has transitioned from logic 0 to 1. See [Safe Torque Off Assembly Tags on page 50](#).

IMPORTANT Transition of the SO.SafeTorqueOff tag to logic 1 must always be executed before transition of the SO.ResetRequest tag to logic 1.

Figure 30 - Fault Reset Diagram



Safety Input Operation

Safety inputs are used to monitor safety input device and can be configured as single or dual channel inputs. They also support configuration of on- and off-delay times. A configurable latch error time allows you to specify the minimum amount of time that a safety input alarm is reported.

Using a Test Output with a Safety Input

A test output can be used in combination with a safety input for short circuit, cross-channel, and open-circuit fault detection. Configure the test output as a pulse test source and associate it to a specific safety input.

Figure 31 - Test Output Wiring Example

(view is into the connector)

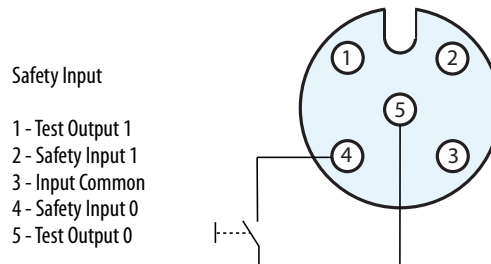
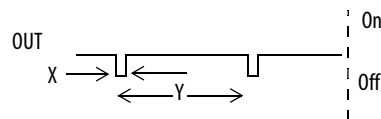


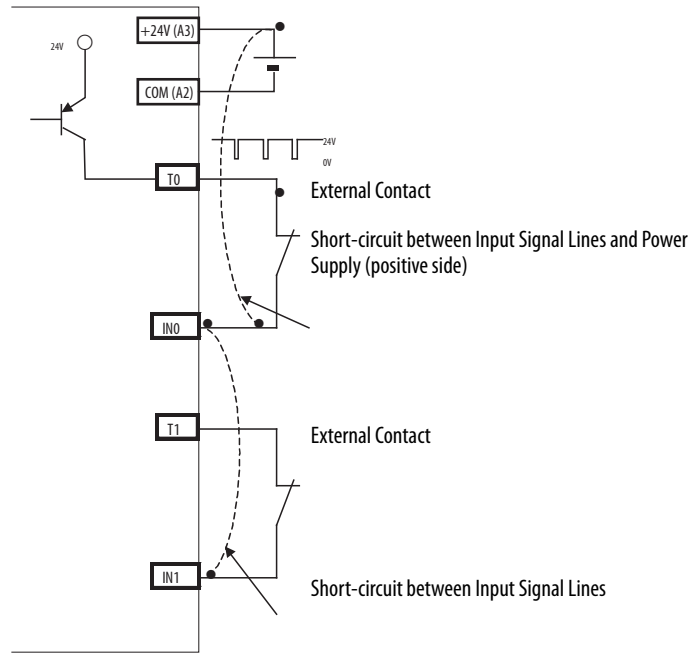
Figure 32 - Test Pulse in a Cycle



The pulse width (X) is typically 500 μ s. The pulse period (Y) is typically 300 ms. The relation between pulse period and width is fixed.

When the external input contact is closed, a test pulse is output from the test output terminal to diagnose the field wiring and input circuitry. By using this function, short-circuits between inputs and 24V power, and between input signal lines and open circuits can be detected.

Figure 33 - Short-circuit between Input Signal Lines



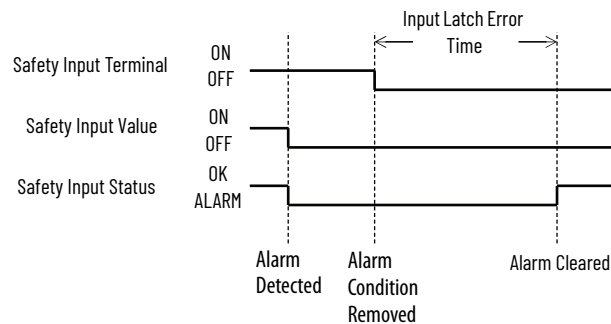
Single-channel Mode (Safety Inputs)

The next paragraph describes the status and value that the I/O subsystem reports for normal and alarm states. In normal operation, the I/O value reported is the value being read on the input terminal. The I/O status is on. When a fault is detected, the Safety Input value and status are forced off.

The safety input subsystem allows for a configurable time for which an alarm state is held, which is referred to as Input Latch Error Time. In single channel mode, the input latch error time describes the period between when the alarm condition is removed and when the safety input stops reporting the alarm.

[Figure 34](#) shows the operation of input latch error time in single channel mode. See [Safety Input or Output Fault Recovery on page 68](#) for information on removing an alarm.

Figure 34 - Single-channel Mode



Dual-channel Mode and Discrepancy Time (Safety Inputs)

To support redundant safety devices, the consistency between signals on two input points can be evaluated, which is referred to as Dual-channel operation. Two modes are available when using dual-channel inputs: equivalent and complementary.

When using either dual-channel input mode, the time from when a discrepancy is created and when the discrepancy is reported can be configured, which is referred to as Discrepancy Time. The configured discrepancy time is 0 (deactivated)...65,530 ms in increments of 1 ms.

IMPORTANT The dual-channel function is used with two consecutive inputs that are paired together, this process starts at an even input number, such as inputs 0 and 1; 2 and 3; and so on.

IMPORTANT Do not set the discrepancy time longer than necessary. The purpose of the discrepancy time is to allow for normal differences between contact switching when demands are placed on safety inputs. For discrepancy checking to operate correctly, only one demand on the safety input is expected during the discrepancy time. If the discrepancy time is set too high, and multiple demands occur during this time, then both safety input channels will alarm.

[Table 10](#) shows the relation between physical input terminal states, and the data and status reported by the Safety Input subsystem.

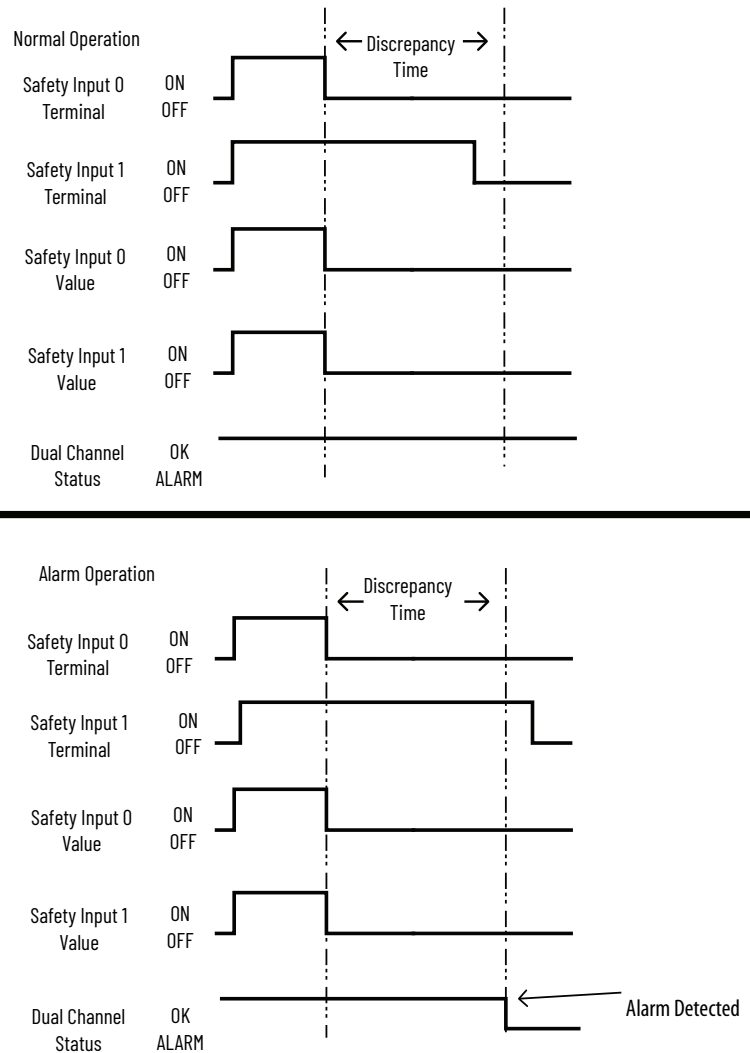
Table 10 - Terminal Input Status and Controller I/O Data

Dual-channel Mode	Input Terminal		Controller Input Data and Status				Dual-channel Resultant Data	Dual-channel Resultant
	IN0	IN1	Safety Input 0 Data	Safety Input 1 Data	Safety Input 0 Status	Safety Input 1 Status		
Dual-channels, Equivalent	OFF	OFF	OFF	OFF	ON	ON	OFF	Normal
	OFF	ON	OFF	OFF	OFF	OFF	OFF	Alarm
	ON	OFF	OFF	OFF	OFF	OFF	OFF	Alarm
	ON	ON	ON	ON	ON	ON	ON	Normal
Dual-channels, Complementary	OFF	OFF	OFF	ON	OFF	OFF	OFF	Alarm
	OFF	ON	OFF	ON	ON	ON	OFF	Normal
	ON	OFF	ON	OFF	ON	ON	ON	Normal
	ON	ON	OFF	ON	OFF	OFF	OFF	Alarm

Dual-channel, Equivalent

In Equivalent mode, both inputs of a pair must be in the same (equivalent) state. When a transition occurs in one channel of the pair before the transition of the second channel of the pair, a discrepancy occurs. If the second channel transitions to the appropriate state before the discrepancy time elapsing, the inputs are considered equivalent. If the second transition does not occur before the discrepancy time elapses, the channels transition to the alarm state. In the fault state, the input and status for both channels are set low (OFF). When configured as an equivalent dual pair, the data bits for both channels are sent to the controller as equivalent, both high or both low.

Figure 35 - Equivalent, Normal Operation and Fault Detection (Not to Scale)

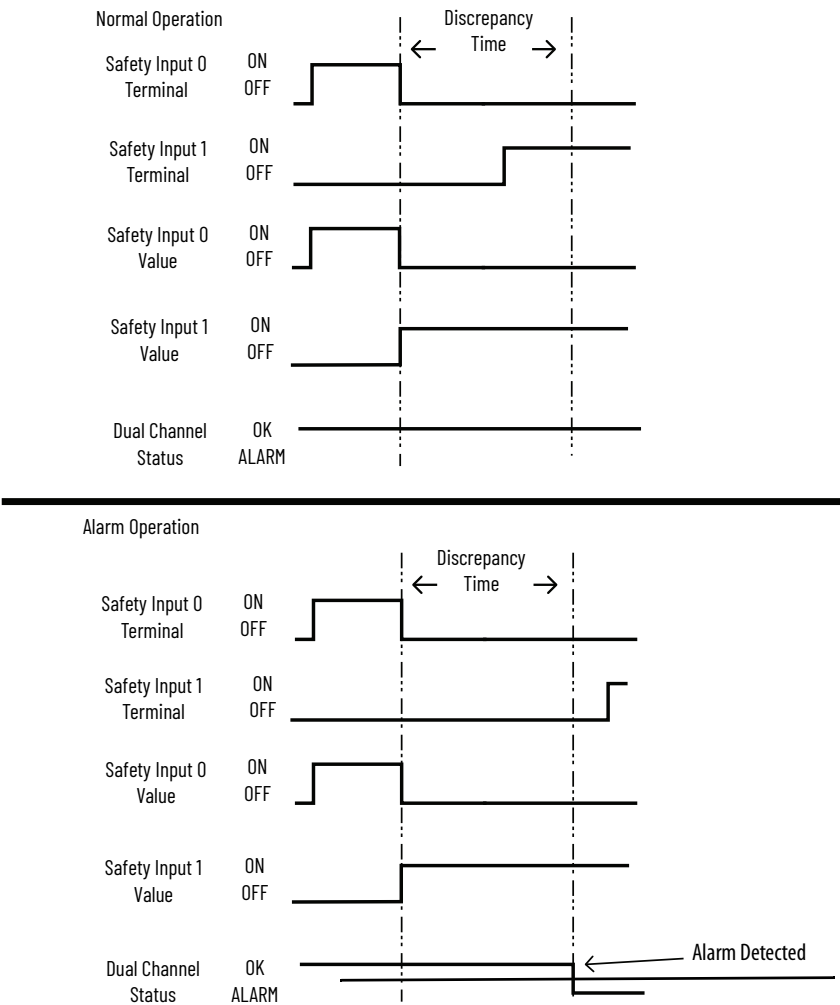


Dual-channels, Complementary

In Complementary mode, the inputs of a pair must be in the opposite (complementary) state. When a transition occurs in one channel of the pair before the transition of the second channel of the pair, a discrepancy occurs. If the second channel transitions to the appropriate state before the discrepancy time elapsing, the inputs are considered complementary.

If the second transition does not occur before the discrepancy time elapses, the channels transition to the alarm state. The alarm state of complementary inputs is the even-numbered input that is turned off and the odd-numbered input turned ON. Note that if faulted, both channel status bits are set low. When configured as a complementary dual-channel pair, the data bits for both channels are sent to the controller in complementary, or opposite states.

Figure 36 - Complementary, Normal Operation and Fault Detection (not to scale)



Standard Input Operation

When a safety input is configured for standard input operation, no diagnostics are performed on the input. Unlike safety inputs, a standard input cannot be used with pulse testing and can only be used in single channel mode. A standard input can still be configured to have an on→off and off→on filter time.

IMPORTANT Do not use standard inputs for safety purposes.

Table 11 - Standard Input Value Attribute

Parameter	Value	Description
Service Code	0x0E	Get Attribute Single
Class	0x3D	Safety Discrete Input Point Object
Instance	$i + 1$	Safety Input Instance (where i is the number of the safety input being used as a standard input)
Data Type	BYTE	8 Bits
Attribute	0xA	Filtered Input Value 0 = Input OFF 1 = Input ON

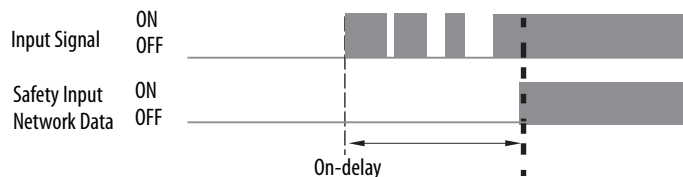
Input Delays

Each safety input has a configurable filter time for sampling the input. Both the on→off and off→on filter values can be configured. Unlike other configuration values, these values can be configured in standard input mode.

Off-On Delay

On-delay—An input signal is treated as Logic 0 during the on-delay time (0...126 ms, in increments of 6 ms) after the rising edge of the input contact. The input turns on only if the input contact remains on after the on delay time has elapsed. This setting helps prevent rapid changes of the input data due to contact bounce.

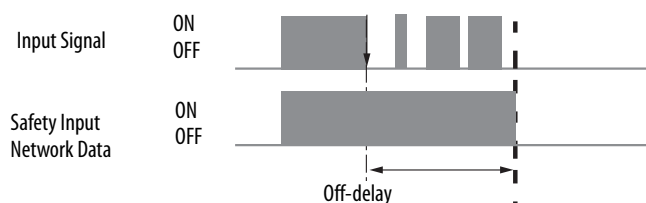
Figure 37 - On-delay



On-Off Delay

Off-delay—An input signal is treated as Logic 1 during the off-delay time (0...126 ms, in increments of 6 ms) after the falling edge of the input contact. The input turns off only if the input contact remains off after the off delay time has elapsed. This setting helps prevent rapid changes of the input data due to contact bounce.

Figure 38 - Off-delay



Safety Input Safety Data

The Safety Input data can be monitored through:

- Safety Input Assembly
- CIP™ Messaging

IMPORTANT Only the Safety Input Value and Status in the Safety Input Assembly can be considered safety data. Input values that are read through CIP messages are not safety data. Do not use standard inputs for safety purposes.

The following Safety Input data is available:

- Safety Input Status
- Safety Input Value (Data)
- Safety Input Valid

Each safety input point reports its own status, value, and valid attributes.

IMPORTANT If a safety input is configured for standard input mode, its associated safety data is forced in the safe state.

Safety Input Status

The safety input status indicates whether an alarm is present in the safety input point. The safety input status is provided in the safety input assembly, as shown in [Table 12](#). [Table 13](#) describes the attributes for reading the safety status via CIP messaging.

Table 12 - Safety Input Assembly Tags for Safety Input Status

Safety Input Assembly Tag Name (safety controller)	Type/[bit]	Description
<i>DeviceName:SI.InputStatus</i>	SINT	A collection of safety input values and status for each safety input
<i>DeviceName:SI.In00Status</i>	[4]	Status of Safety Input 0 0 = Alarm 1 = OK
<i>DeviceName:SI.In01Status</i>	[5]	Status of Safety Input 1 0 = Alarm 1 = OK
<i>DeviceName:SI.In02Status</i>	[6]	Status of Safety Input 2 0 = Alarm 1 = OK
<i>DeviceName:SI.In03Status</i>	[7]	Status of Safety Input 3 0 = Alarm 1 = OK

Table 13 - MSG Configuration for Safety Input Status

Service Code	0x0E	Get attribute single
Class	0x3D	Safety Discrete Input Point Object
Instance	i + 1	Where i is the number of the safety input
Data Type	USINT	
Attribute	0x4 4	Safety Status 0 = Alarm 1 = OK

Safety Input Value

The safety input value is the value of the input after safety and on/off delay evaluations when the safety input is not in the alarm state. If the safety input is in the alarm state, this value will always be 0.

The safety input value is provided in the safety input assembly, as shown in [Table 14](#). [Table 15](#) describes the attributes for reading the safety value via CIP™ messaging.

Table 14 - Safety Input Assembly Tags for Safety Input Values

Safety Input Assembly Tag Name (safety controller)	Type/[bit]	Description
<i>DeviceName:SI.InputStatus</i>	SINT	A collection of safety input values and status for each safety input
<i>DeviceName:SI.In00Data</i>	[0]	Value of Safety Input 0 0 = OFF 1 = ON
<i>DeviceName:SI.In01Data</i>	[1]	Value of Safety Input 1 0 = OFF 1 = ON
<i>DeviceName:SI.In02Data</i>	[2]	Value of Safety Input 2 0 = OFF 1 = ON
<i>DeviceName:SI.In03Data</i>	[3]	Value of Safety Input 3 0 = OFF 1 = ON

Table 15 - MSG Configuration for Safety Input Value

Service Code	0x0E	Get attribute single
Class	0x3D	Safety Discrete Input Point Object
Instance	$i + 1$	Where i is the number of the safety input
Data Type		USINT
Attribute	0x7 7	Safety Input Logical Value 0 = OFF 1 = ON

Safety Input Valid

When set, the safety input valid attribute indicates that the safety input is configured for safety use and producing valid data. If this value is not set, the data that is associated with the safety input is no longer valid safety data.

IMPORTANT The Safety Input Valid attribute should be checked before using safety input data in a safety application.

The safety input valid attribute is provided in the safety input assembly, as shown in [Table 16](#). [Table 17](#) describes the attributes for reading the safety value via CIP messaging.

Table 16 - Safety Input Assembly Tags for Safety Input Valid

Safety Input Assembly Tag Name (safety controller)	Type/[bit]	Description
<i>DeviceName:SI.IOSupport</i>	SINT	A collection of bits describing safety IO
<i>DeviceName:SI.In00Valid</i>	[0]	Safety Input 0 Valid 0 = Data invalid 1 = Data valid

Table 16 - Safety Input Assembly Tags for Safety Input Valid

<i>DeviceName:Sl.In01 Valid</i>	[1]	Safety Input 1 Valid 0 = Data invalid 1 = Data valid
<i>DeviceName:Sl.In02 Valid</i>	[2]	Safety Input 2 Valid 0 = Data invalid 1 = Data valid
<i>DeviceName:Sl.In03 Valid</i>	[3]	Safety Input 3 Valid 0 = Data invalid 1 = Data valid

Table 17 - MSG Configuration for Safety Input Valid

Service Code	0x0E	Get attribute single
Class	0x3D	Safety Discrete Input Point Object
Instance	<i>i + 1</i>	Where <i>i</i> is the number of the safety input
Data Type	USINT	
Attribute	0x64 100	Safety Input Valid 0 = Data invalid 1 = Data Valid

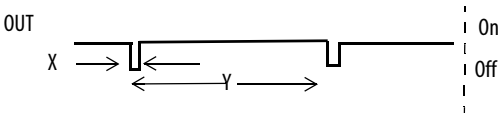
Safety Output Operation

The safety outputs can operate in single channel sourcing mode or dual channel bipolar mode. In either mode, the safety output can also be configured to run pulse test diagnostics.

Safety Output with Test Pulse

When the safety output is on, the safety output can be configured to pulse test the safety output channel. By using this function, you can continuously test the ability of the safety output to remove power from the output terminals of the module. If an error is detected, the safety output data and individual safety output status turn off.

Figure 39 - Test Pulse in a Cycle



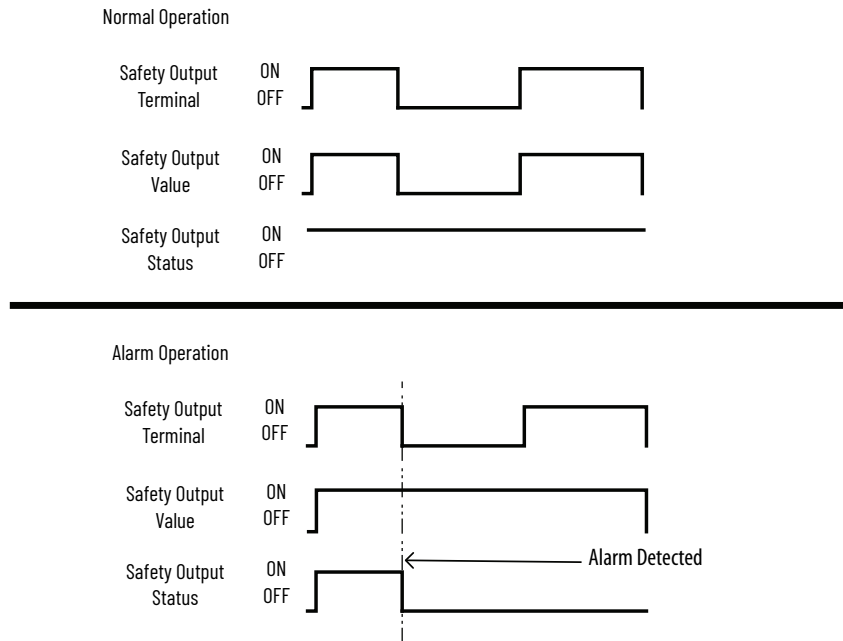
For the ArmorStart ST motor controllers, the pulse width (X) is typically 500 µs; the pulse period (Y) is typically 300 ms.

IMPORTANT To help prevent the test pulse from causing the connected device to malfunction, pay careful attention to the input response time of the output device.

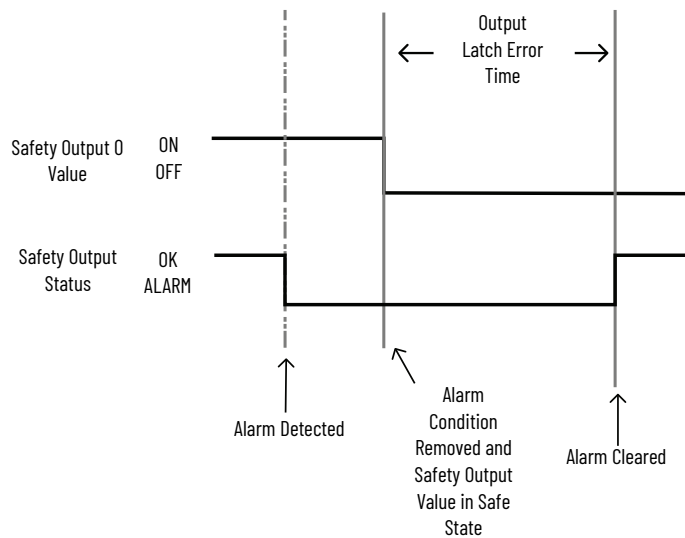
Single-channel Mode (Safety Outputs)

IMPORTANT When using pulse testing in single channel mode, the demand rate of the output must be greater than 30 seconds.

In single-channel sourcing mode, when the safety output is requested to the on state, the output will turn on if there is no alarm. If an alarm is detected on the channel, the safety output data and safety output status turn off, and commanding the output has no effect.

Figure 40 - Single-channel Setting (Not to Scale)

The safety output subsystem allows for a latch error time to be configured. The latch error time is the minimum time an output alarm is held before the alarm can be cleared. This latch error time is used by all safety outputs. [Figure 41](#) shows the behavior of the safety output latch time in single channel mode. See [Safety Input or Output Fault Recovery on page 68](#) for information on clearing alarms.

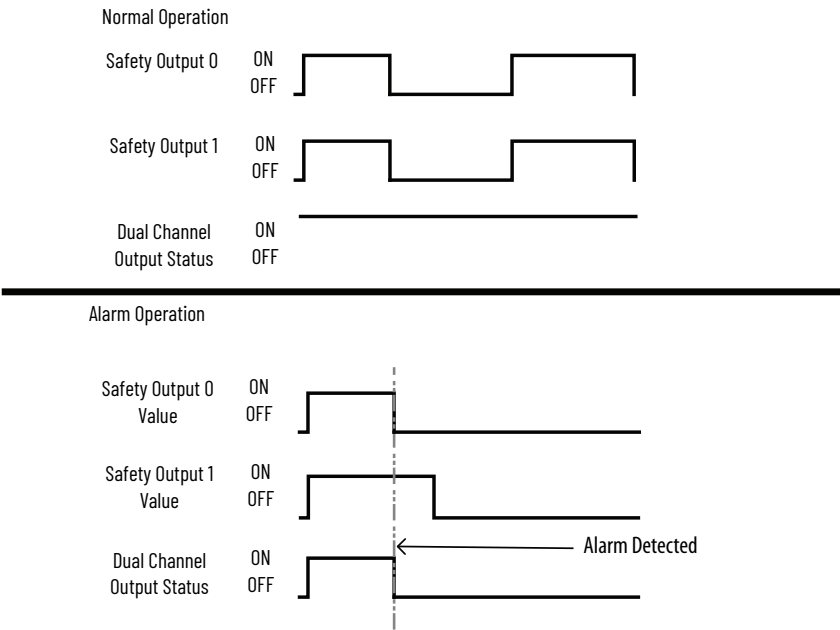
Figure 41 - Single Channel Output Latch Error Behavior

Dual-channel Mode (Safety Outputs)

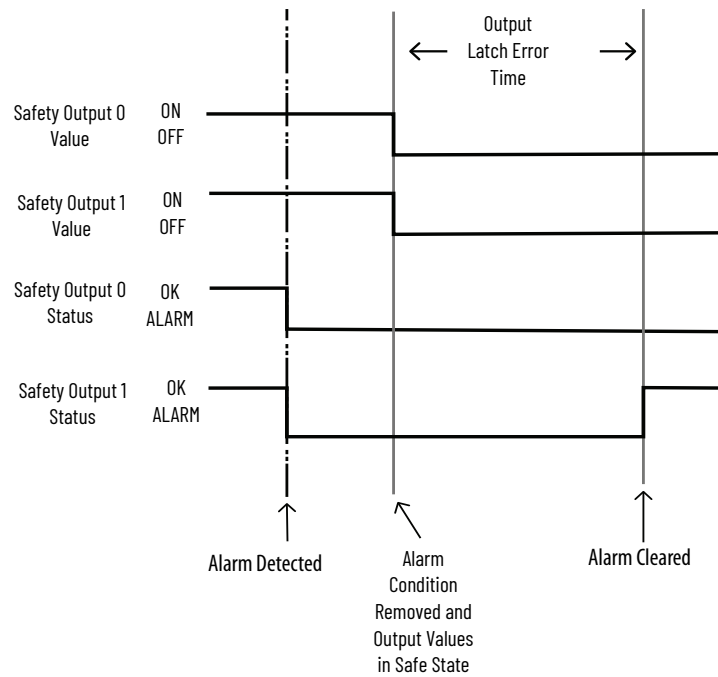
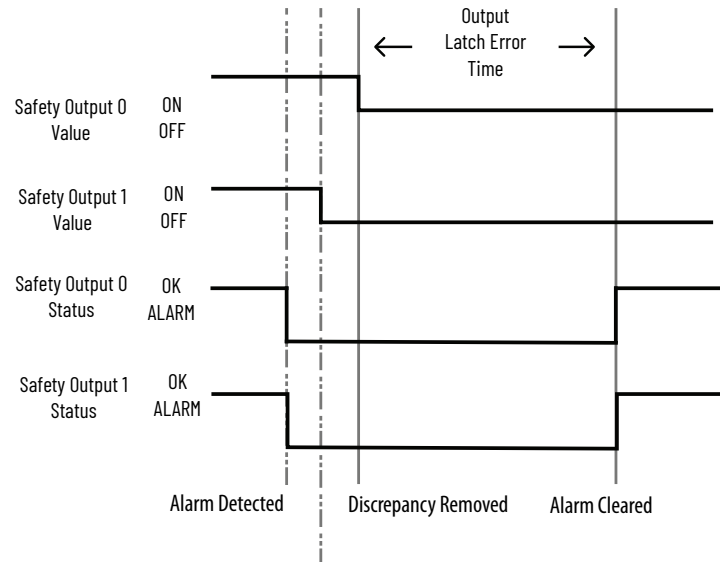
When the data of both channels is in the on state, and neither channel has an alarm, the outputs are turned on. The status is normal. If an alarm is detected on one channel, the safety output data and individual safety output status turn off for both channels.

[Figure 42](#) shows the operation of dual channel outputs under normal and alarm conditions.

Figure 42 - Dual-channel Setting (Not to Scale)



In dual channel mode, the output latch error time describes the period between when the alarm condition is removed and when the dual channel safety output stops reporting the alarm. [Figure 43](#) shows the normal operation of output latch error time in dual channel mode. When one or both of the associated output points have an alarm (such as a Pulse Test Failure), and there is a discrepancy between the two channels, the alarm and discrepancy must be cleared before the latch error timer begins counting. [Figure 44](#) shows this special case operation. See [Safety Input or Output Fault Recovery on page 68](#) for information on removing an alarm.

Figure 43 - Dual Channel Output Latch Error Behavior**Figure 44 - Dual Channel Output Latch Error Behavior With Alarm and Discrepancy**

Safety Output Safety Data

The safety output data can be monitored through:

- Safety input assembly
- CIP Messaging

The following Safety Output data is available:

- Safety output status
- Safety output ready
- Output monitor value

Each safety output point reports its own status, monitor value, and ready attributes.

Safety Output Status

The safety output status indicates whether an alarm is present in the safety output point. The safety output status is provided in the safety input assembly, as shown in [Table 18](#). [Table 19](#) describes the attributes for reading the safety status via CIP messaging.

Table 18 - Safety Input Assembly Tags for Safety Output Status

Safety Input Assembly Tag Name (safety controller)	Type / [bit]	Description
<i>DeviceName:SI.OutputStatus</i>	SINT	A collection of safety output status, safety output monitor values, and test output status
<i>DeviceName:SI.Out00Status</i>	[2]	Status of Safety Output 0 0 = Alarm 1 = OK
<i>DeviceName:SI.Out01Status</i>	[3]	Status of Safety Output 1 0 = Alarm 1 = OK

Table 19 - MSG Configuration for Safety Output Status

Service Code	0x0E	Get attribute single
Class	0x3B	Safety Discrete Output Point Object
Instance	i + 1	Where <i>i</i> is the number of the safety output
Data Type		USINT
Attribute	0x5 5	Safety Status 0 = Alarm 1 = OK

Safety Output Ready

When set, the safety output ready attribute indicates that the safety output is configured for safety use and ready to be commanded.

IMPORTANT Check the Safety Output Ready attribute before commanding the safety output.

The safety output ready attribute is provided in the safety input assembly, as shown in [Table 20](#). [Table 21](#) describes the attributes for the Safety Output Ready attribute via CIP messaging.

Table 20 - Safety Input Assembly Tags for Safety Output Ready

Safety Input Assembly Tag Name (safety controller)	Type/[bit]	Description
DeviceName:SI.IOSupport	SINT	A collection of bits describing safety I/O functionality
DeviceName:SI.Out00Ready	[4]	Safety Output 0 Ready 0 = Not Ready 1 = Ready
DeviceName:SI.Out01Ready	[5]	Safety Output 1 Ready 0 = Not Ready 1 = Ready

Table 21 - MSG Configuration for Safety Output Ready

Service Code	0x0E	Get attribute single
Class	0x3B	Safety Discrete Output Point Object
Instance	i + 1	Where i is the number of the safety output
Data Type	USINT	
Attribute	0x64 100	Safety Status 0 = Not Ready 1 = Ready

Safety Output Monitor

IMPORTANT Safety Output Monitor Value is not safety data and has no defined safe state. Use Output Monitor Value for diagnostic purposes only.

The output monitor value of a safety output is the value of the output that is read by module. It is expected that the output monitor value is the same as the commanded safety output value in normal operation. The output monitor value can be used to diagnose output alarms.

The output monitor value is provided in the safety input assembly, as shown in [Table 22](#). [Table 23](#) describes the attributes for reading the output monitor value via CIP messaging.

Table 22 - Safety Input Assembly Tags for Safety Output Monitor Value

Safety Input Assembly Tag Name (safety controller)	Type/[bit]	Description
DeviceName:SI.OutputStatus	SINT	A collection of safety output status, safety output monitor values, and test output status
DeviceName:SI.Out00Monitor	[0]	Output Monitor Value of Safety Output 0 0 = OFF 1 = ON
DeviceName:SI.Out01Monitor	[1]	Output Monitor Value of Safety Output 1 0 = OFF 1 = ON

Table 23 - MSG Configuration for Safety Output Monitor Value

Service Code	0x0E	Get attribute single
Class	0x3B	Safety Discrete Output Point Object
Instance	i + 1	Where i is the number of the safety output
Data Type	USINT	
Attribute	0x4 4	Output Monitor Value 0 = OFF 1 = ON

Test Output

The pulse test outputs of the Integrated Safety Function module can be configured in the following modes:

- Test output. When in test output mode, the test output point operates with a safety input to perform pulse testing on the external safety input circuitry.
- Power supply output. In power supply output mode, the output point is forced on, and only shuts off for a critical fault. For safety input and output specifications, see ArmorStart ST Distributed Motor Controller Specifications, publication [280ES-ID001](#).



ATTENTION: Test Output points that are configured as Pulse Test or Power Supply become active whenever you apply input power to the module. These configured functions are independent of the I/O connections to the module.



ATTENTION: If a module with Test Outputs configured as Pulse Test or Power Supply is incorrectly installed in an application where actuators are connected to these Test Output points, the actuators are activated when input power is applied.

To prevent this possibility, follow these procedures:

- When installing or replacing a module, be sure that the module is correctly configured for the application or in the out-of-box condition before applying input power.
- Reset modules to their out-of-box condition when removing them from an application.
- Be sure that all modules in replacement stock are in their out-of-box condition.



ATTENTION: Do not use test outputs as safety outputs. Test outputs do not function as safety outputs.

Test Output Data

The Test Output data of the Integrated Safety Functions module can be monitored through:

- Safety Input Assembly
- CIP Messaging

The following Test Output data is available in the Integrated Safety Functions module:

- Test Output Status
- Test Output Ready

Each test output point reports its own status and ready attributes.

IMPORTANT Test Output data is not safety data and cannot be used for safety applications.

Test Output Status

The test output status indicates whether an alarm is present in the test output point. When in standard output mode, the status will always be OK, unless there is a critical fault, in that case, the status is forced to Alarm. In all other modes test output status is set to Alarm.

The test output status is provided in the safety input assembly, as shown in [Table 24](#). [Table 25](#) describes the attributes for reading the test output status via CIP messaging.

Table 24 - Safety Input Assembly Tags for Test Output Status

Safety Input Assembly Tag Name (safety controller)	Type/ [bit]	Description
DeviceName.SI.OutputStatus	SINT	A collection of safety output and test output data
DeviceName.SI.Test00Status	[6]	Status of Test Output 0 0 = Alarm 1 = OK
DeviceName.SI.Test01Status	[7]	Status of Test Output 1 0 = Alarm 1 = OK

Table 25 - MSG Configuration for Test Output Status

Service Code	0x0E	Get attribute single
Class	0x9	Discrete Output Point Object
Instance	i + 1	Where i is the number of the test output
Data Type	USINT	—
Attribute	0x4 4	Output Status 0 = Alarm 1 = OK

Test Output Ready

When set, the test output ready attribute indicates that the test output is configured for standard output mode, and is ready to be commanded. In other modes, the test output ready attribute is forced to the safe (alarm) state.

IMPORTANT The Test Output Ready attribute should be checked before commanding the test output.

The test output ready attribute is provided in the safety input assembly, as shown in [Table 26](#). [Table 27](#) describes the attributes for ready the test output ready attribute via CIP messaging.

Table 26 - Safety Input Assembly Tags for Test Output Ready

Safety Input Assembly Tag Name (safety controller)	Type/ [bit]	Description
DeviceName.SI.IOSupport	SINT	A collection of bits describing safety IO functionality
DeviceName.SI.Test00Ready	[6]	Test Output 0 Ready 0 = Not Ready 1 = Ready
DeviceName.SI.Test01Ready	[7]	Test Output 1 Ready 0 = Not Ready 1 = Ready

Table 27 - MSG Configuration for Test Output Ready

Service Code	0x0E	Get attribute single
Class	0x9	Discrete Output Point Object
Instance	i + 1	Where i is the number of the test output
Data Type	USINT	—
Attribute	0x82 130	Output Status 0 = Not Ready 1 = Ready

Safety Input or Output Fault Recovery

If an error is detected, the safety data remains in the OFF state. Follow this procedure to activate the safety data again.

1. Remove the cause of the error.
2. Place the safety input or safety output into the safe state.
3. Allow the input- or output-error latch time to elapse.

After these steps are completed, the I/O indicator (red) turns off. The safety input or output data is now active.

IMPORTANT Stuck high faults on safety outputs require a power reset to clear the error.

Reset to Out-of-Box

You can reset the ArmorStart ST motor controller to the out-of box state in three ways:

- By resetting ownership via the Logix Designer application. See [Reset Ownership on page 68](#).
- By setting the IP address switches to 888. (See [Set the IP Address on page 73](#).)
- By using a message instruction with these formats:
 - Read Target UNID (service 0x0, class 0x39, inst 1, attr 27 [decimal])
 - Send Safety Reset (service 0x54, class 0x39, inst 1, type 2 [decimal])

See [Using a Message Instruction on page 71](#) for details on formatting an MSG instruction.

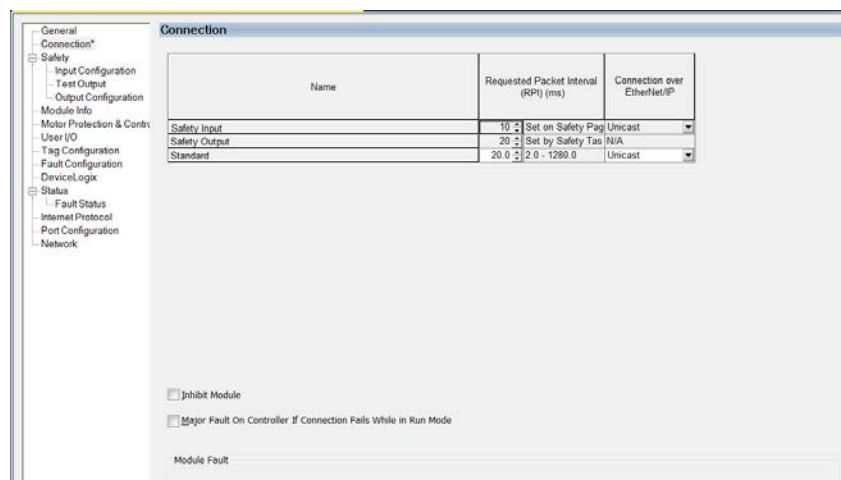
IMPORTANT Only authorized personnel should attempt to reset ownership. The safety connection must be inhibited before the reset is attempted. If any active connection is detected, the safety reset is rejected.

Reset Ownership

After the integrated safety connection configuration is applied to the motor controller at least once, you can restore the ArmorStart ST motor controller to the out-of-box state by resetting ownership in the Logix Designer application while online. When you reset the ArmorStart ST motor controller, all configuration settings, including standard and safety I/O configuration and parameters are returned to their out-of-box settings.

Follow these steps to inhibit the module:

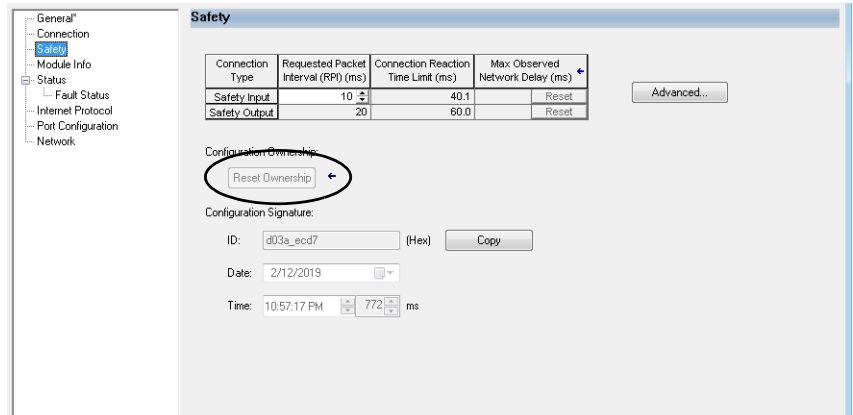
1. Right-click the device and choose Properties.
2. Choose Connection.
3. Check the inhibit module checkbox.



4. Click Apply and then OK.

Follow these steps to reset the device to its out-of-box configuration when online.

1. Right-click the module and choose Properties.
2. Choose Safety.
3. Click Reset Ownership.



Replacing an ArmorStart ST Motor Controller on a Safety Network

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

IMPORTANT If the ArmorStart ST motor controller was used previously, clear the existing configuration before installing it on a safety network by resetting the device to out-of-box condition. See [Reset Ownership on page 68](#).

Replacing an ArmorStart ST motor controller that sits on an integrated safety network is more complicated than replacing standard devices because of the safety network number (SNN). The device number and SNN constitute the DeviceID of the safety device. Safety devices require this more complex identifier to make sure that duplicate device numbers do not compromise communication between the correct safety devices. The SNN is also used to provide integrity on the initial download to the device.

Replace an Integrated Safety ST Motor Controller in a GuardLogix System

When you replace an integrated safety ST motor controller, the replacement device must be configured properly and the replacement ST motor controllers' operation be user-verified.

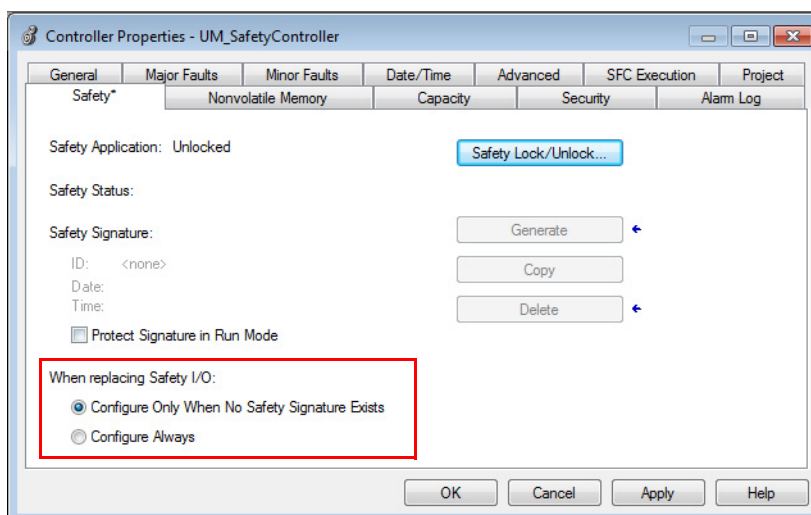


ATTENTION: During ST motor controller replacement or functional test, the safety of the system must not rely on any portion of the affected ST motor controller.

Two options for safety ST motor controller replacement are available on the Safety category of the Controller Properties dialog box in the Logix Designer application:

- Configure Only When No Safety Signature Exists
- Configure Always

Figure 45 - Safety ST Motor Controller Replacement Options



Configure Only When No Safety Signature Exists

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

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 the user manual for your GuardLogix controller.

Configure Always

When the Configure Always feature is enabled, the controller automatically checks for and connects to a replacement ST motor controller that meets the following requirements:

- The controller has configuration data for a compatible ST motor controller at that network address.
- The ST motor controller is in out-of-box condition mode or 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 a ArmorStart ST motor controller. Do not place ST motor controllers that are in out-of-box condition mode on an integrated safety network when the Configure Always feature is enabled. 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 the user manual for your GuardLogix controller.

Using Autotune and Integrated Safety

Autotune cannot be used if a safety connection has already been made and the project is online. Motion power is being controlled via the safety connection, so you must inhibit the ArmorStart motor controller and reset ownership before running Autotune. See [Reset Ownership on page 68](#).

1. Take project offline. Make project Standard connection only in module definition dialog. This should remove the Safety Ownership and revert the Motion Power status to being ON, allowing the drive to be put into Run mode without a safety connection.
2. Download/Go Online/Inhibit module.
3. Perform Autotune. Uninhibit->apply.

Using a Message Instruction

You can use explicit messages to obtain additional diagnostic information from the safety controller by using an MSG instruction.

Safety Supervisor State

The safety supervisor state provides information on the state of the integrated safety connection and the mode of operation. There is only one safety supervisor object per drive module.

Table 28 - Safety Supervisor State: MSG

Parameter	Value	Description
Service Code	0x0E	Get attribute single
Class	0x39	Safety supervisor
Instance	1	Revision
Attribute	0x0B	Device status
Data Type	SINT	Short integer

Table 29 - Safety Supervisor States

Value	Safety Supervisor State	Definition
2	Configured (no safety connection)	No active connections
4	Running	Normal running state
7	Configuring	Transition state
51	Not Configured (torque permitted)	Torque permitted (out of box state)
52	Running (torque permitted)	STO bypass state

Notes:

EtherNet/IP Operation

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EtherNet/IP LED Status Indication	78
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ArmorStart® ST distributed motor controllers incorporate the advantages of EtherNet/IP™ communication for access to parameters, status, and diagnostics. These controllers feature:

- Dual-port embedded switch⁽¹⁾
- Star Linear and Device Level Ring topologies
- End-to-end transparent clock support

The ArmorStart controller supports:

- Six message connections to Logix® 5000 controllers
- One owner connection to a Logix 5000 controller
- One listen-only connection to another Logix 5000 controller

For more information see Ethernet Design Considerations Reference Manual, publication [ENET-RM002](#).

Set the IP Address

Choose the method you want to use to set the IP address:

- [Setting the IP Address without the BOOTP/DHCP Tool](#)
- [Setting the IP Address with BOOTP/DHCP Tool \(RSLinx\)](#)

Before you set the IP address, make sure that you have the following information:

- MAC ID for the device
- Recommended IP address for your network

Setting the IP Address without the BOOTP/DHCP Tool

Use this procedure if you cannot or do not want to use the BOOTP/DHCP tool.

For initial startup, perform the following steps to set the last digits of the IP address 192.168.1.xxx.



When the configuration specifies that DHCP is enabled, the ArmorStart ST motor controller automatically tries to obtain its previously used IP address.

(1) Products with EtherNet/IP embedded switch technology have two ports to connect to a linear or DLR network in a single subnet. You cannot use these ports as two Network Interface Cards (NICs) connected to two different subnets.

1. Remove the protective caps from the rotary switches on the I/O section of the ArmorStart controller, and set the network address by adjusting the three switches on the front of the I/O module to a valid number 0...254). (For example: set the rotary switches to 123).

IMPORTANT When the static IP address switch settings are from 002 to 254, then the gateway is set to 192.168.1.1 and the subnet is set to 255.255.255.0 by default.

IMPORTANT When the switches are set to 192.168.1.1, the subnet mask is set to 255.255.255.0 and the gateway address is set to 0.0.0.0. Switch settings 000 and 255...998 are reserved and cannot be used.

2. Cycle power to communicate the change.
3. Confirm that you can detect the controller by seeing it in RSLinx® (For this example you should see the IP address 192.168.1.123). Stop here if this IP address is acceptable, otherwise proceed to step 4 to set a unique static address or to use DHCP.
4. Change the rotary switches to 999 and cycle power.
5. At power up, the controller retains the last valid address (For this example: 192.168.1.123).
6. Again, confirm that you can detect the controller by seeing it in RSLinx (For this example you should see the IP address 192.168.1.123).

Figure 46 - Switches on the I/O Module

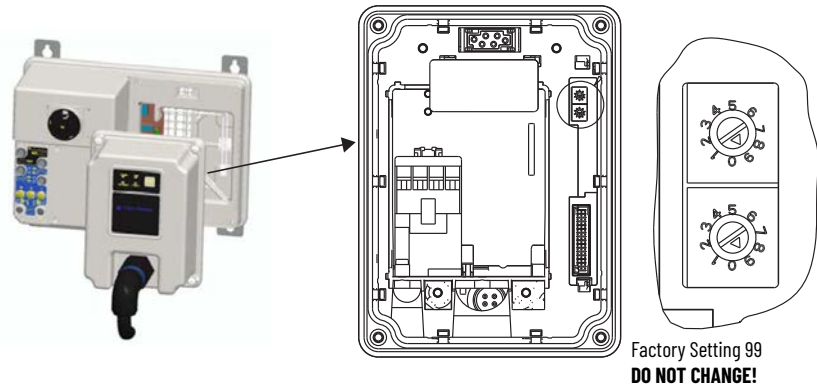


Figure 47 - Network Address Example

This example shows the IP address set to 123 for IP Address 192.168.1.123



Figure 48 - Rotary Switch on Control Module



IMPORTANT The ArmorStart controller is shipped with the control module rotary switches set to a value of 99. **Do NOT modify this setting.** If these settings are changed, then the unit stops responding and the switches must be manually set to node address 63 and power cycled.

If the network does not use 192.168.1.xxx, after you install and power up the controller, use the following tools to set the network IP address:

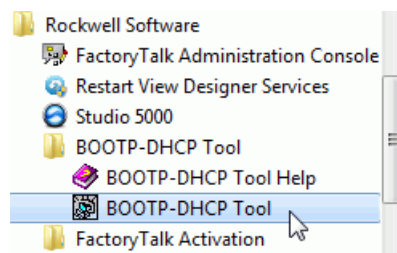
- BOOTP/DHCP Server utility (the controller is DHCP enabled by default and does not support BOOTP)
- RSLinx Classic software



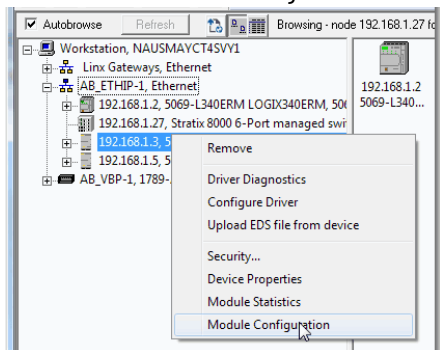
ATTENTION: To avoid unintended operation, the adapter must be assigned a fixed IP address. If a DHCP server is used, it must be configured to assign a fixed IP address for your adapter. Failure to observe this precaution can result in unintended machine motion or loss of process control.

Setting the IP Address with BOOTP/DHCP Tool (RSLinx)

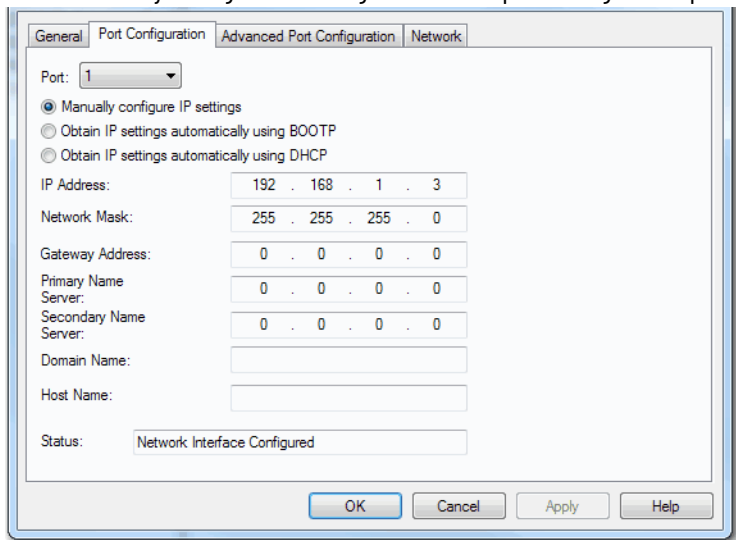
1. Confirm that the ArmorStart controller is connected to the network.
2. Start the BOOTP/DHCP tool.



3. Right-click the device and choose Module Configuration.



4. After the Module Configuration dialog box appears, Select the Port configuration tab.
5. Click Manually Configure IP Settings and set the port configuration parameters.



For more information on how to configure the adapter with the BOOT/DHCP and RSLinx tools, see online help or the EtherNet/IP Network Devices User Manual, publication [ENET-UM006](#).

Device Level Ring (DLR)

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

A DLR network includes the following types of ring nodes.

Table 30 - Ring Nodes

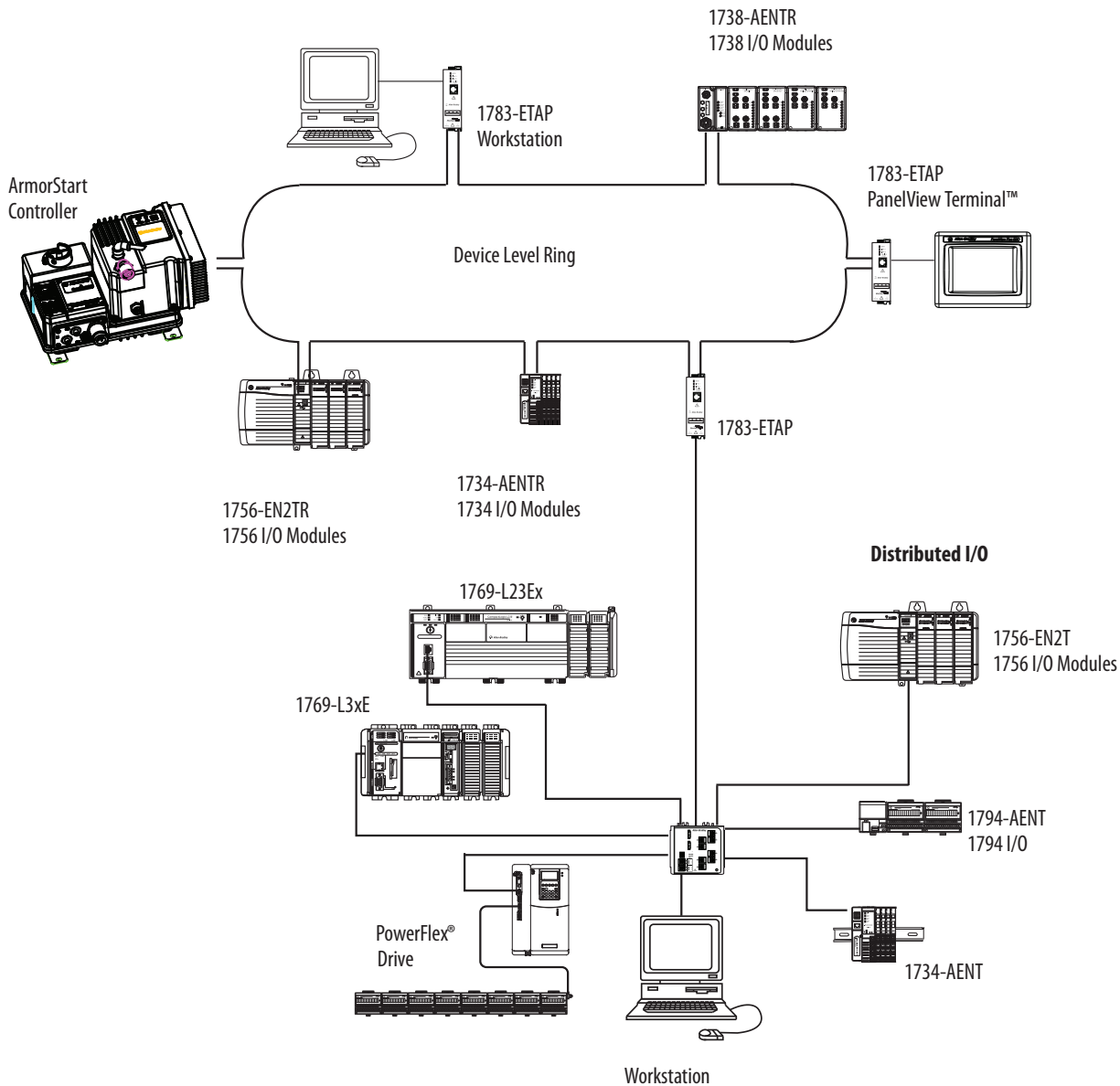
Node	Description
Ring supervisor	A ring supervisor provides these functions: • Manages traffic on the DLR network • Collects diagnostic information for the network A DLR network requires at least one node to be configured as ring supervisor. By default, the supervisor function is disabled on supervisor-capable devices.
Ring participants	Ring participants provide these functions: • Process data that is transmitted over the network. • Pass on the data to the next node on the network. • Report fault locations to the active ring supervisor. When a fault occurs on the DLR network, ring participants reconfigure themselves and relearn the network topology.
Redundant gateways (optional)	Redundant gateways are multiple switches that are connected to a single DLR network and also connected together through the rest of the network. Redundant gateways provide DLR network resiliency to the rest of the network.

Depending on their firmware capabilities, both devices and switches can operate as supervisors or ring nodes on a DLR network. Only switches can operate as redundant gateways.

IMPORTANT The ArmorStart controller cannot be configured as a ring supervisor.

For more information about DLR, see the EtherNet/IP Device Level Ring Application Technique, publication [ENET-AT007](#).

Figure 49 - ArmorStart Controller in a DLR Configuration



It is recommended that no more than 50 nodes are on a single DLR. If your application requires more than 50 nodes, it is recommended that the DLR networks be segmented.

With smaller networks:

- There is better management of traffic on the network.
- The networks are easier to maintain.
- There is a lower likelihood of multiple faults.

EtherNet/IP LED Status Indication

Figure 50 - EtherNet/IP LEDs



EtherNet/IP light-emitting diode (LED) status and diagnostics consist of four LEDs.

- Link Activity/Status LEDs
 - Link1 Activity/Status (Port 1) – LED Color: Bicolor (Green/Yellow), see [Table 31](#)
 - Link2 Activity/Status (Port 2) – LED Color: Bicolor (Green/Yellow), see [Table 31](#)
- MOD LED – Bicolor Red/Green represents the Ethernet Module status, see [Table 75 on page 131](#)
- NET LED – Bicolor Red/Green represents the Ethernet Network status, see [Table 32](#)

Table 31 - Link 1 or Link 2 Port Activity/Status

Link 1 or 2 Status LED	Description	Recommended Action
OFF	No link established	Verify network cabling, and correct, as needed.
Green	Link established at 100 Mbps	None
Flashing green	Transmit or receive activity present at 100 Mbps	None
Yellow	Link established at 10 Mbps	None
Flashing yellow	Transmit or receive activity present at 10 Mbps	None

Table 32 - Network Status Indicator

Indicator State	Summary	Requirement
Steady OFF	Not powered, no IP address	If the device does not have an IP address (or is powered OFF), the network status indicator is steady OFF.
Flashing Green	No connections	If the device has no established connections, but has obtained an IP address, the network status indicator is flashing green.
Steady Green	Connected	If the device has at least one established connection (even to the Message Router), the network status indicator is steady green.
Flashing Red	Connection timeout	If one or more of the connections in which this device is the target has timed out, the network status indicator is flashing red. This indicator is left if only all timed out connections are re-established or if the device is reset.
Steady Red	Duplicate IP	If the device has detected that the IP address is already in use, the network status indicator is steady red.
Flashing Red/Green	Self-test	While the device is performing its power-up test, the network status indicator is flashing green/red.

Ethernet Communication Troubleshooting

The EtherNet/IP communication module can experience intermittent network connectivity due to these conditions:

- Duplex mismatch
- Electrical noise that is induced into a cable or results from a Logix/switch ground potential difference
- Bad hardware, such as a cable or switch part

To help troubleshoot the EtherNet/IP network, a managed switch must be used.

Here are the important features in a managed switch:

- Internet Group Multicast Protocol (IGMP) snooping
- Support for Virtual Local Area Networks (VLAN)
- Port mirroring

IMPORTANT Use a switch that is equipped with wire-speed switching fabric. The switch fabric is a measure of the maximum traffic that a switch can handle without dropping a packet and without storing a packet in memory. Wire-speed switching fabric refers to a switch that can handle the maximum data rate of the network on each of its ports. Switches are typically rated in GBps. For a 10-port switch connected to EtherNet/IP products, the maximum data rate that is needed, is typically 100...200 MB/s. Therefore, a 10-port-switch that is rated at least 1 GB/s is adequate for an EtherNet/IP application.

For more information on how to use a managed switch in an EtherNet/IP network, see Ethernet Design Considerations Reference Manual, publication [ENET-RM002](#).

General Solutions for Linear or DLR Networks

Before attempting to correct specific faults on the linear or DLR network, we recommend to first take the following actions when a fault appears.

- For a DLR network check that:
 - At least one node is configured as a supervisor on the network and that Network Topology = Ring.
 - All cables on the network are securely connected to each device.
 - All devices that require an IP address have one assigned correctly.
 - The Network Status field on the status page of the active supervisor node to determine the fault type.
- For a linear network check that:
 - None of the nodes are configured as a supervisor on the network and that Network Topology = Linear.
 - If any nodes on a linear network are configured as a supervisor, it can impact communication to other devices connected to the network.
 - All cables on the network are securely connected to each device.
 - All devices that require an IP address have one assigned correctly.
- If the fault is not cleared after completing the actions listed, use the tables in the rest of this chapter to troubleshoot issues specific to a DLR network or a linear network.

Specific Issues on Your DLR or Linear Network

Use the following table to troubleshoot possible specific issues on your DLR or linear network, where the actions that were described previously did not solve them.

Table 33 - Troubleshoot DLR or Linear Network

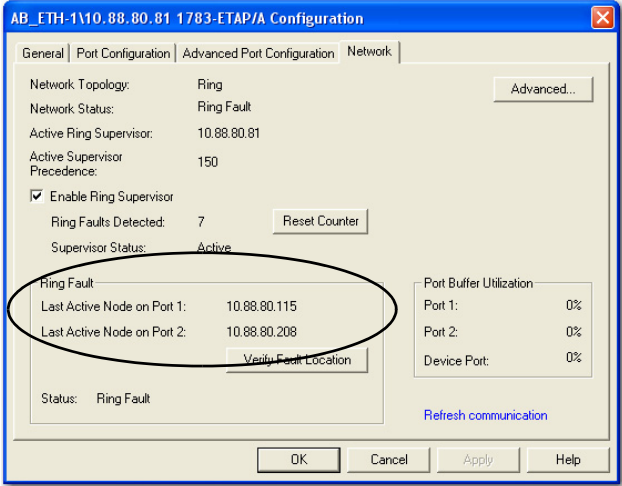
Issue	Description	Solution
Supervisor Reports a Ring Fault	A link on the DLR network can be broken: • Intentionally, for example, because you added or deleted nodes but did not make all physical connections to restore the setup of the network with/without the node. • Unintentionally, for example, because a cable is broken or a device malfunctions. When this fault occurs, the adjacent nodes to the faulted part of the network are displayed in the Ring Fault group and the Network Status field = Ring Fault. The screen capture shows the Ring Fault section with IP addresses appearing for the last active nodes. The faulted node is between nodes 10.88.80.115 and 10.88.80.208. If the IP address of either node is not available, the software displays the MAC ID. of the node Figure 51 - Ring Fault Section  Once the fault is corrected, the ring is automatically restored, and the Network Status field returns to Normal.	Determine where the fault condition exists and correct it. It can be necessary to click the Refresh Communication link to update the Ring Fault information to determine where the fault condition exists.

Table 34 - Troubleshoot DLR or Linear Network

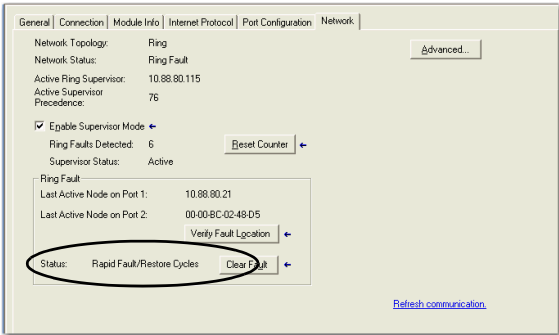
Issue	Description	Solution
Rapid Ring Fault	When a Rapid Ring Fault occurs, the following events occur: • The active supervisor blocks traffic on port 2, which results in possible network segmentation, that is, some nodes can become unreachable. • The Link 2 status indicator on the active supervisor is off. • As soon as the fault occurs, the Status field = Rapid Fault/Restore Cycles. Figure 52 - Rapid Fault/Restore Cycles Status  Any of the following can cause a Rapid Ring Fault: • Five intentional disconnections/reconnections of a node from the network within 30 s • A duplex mismatch between two connected devices • Electromagnetic noise on the network • Unstable physical connections, such as intermittent connectors Given the nature of a Rapid Ring Fault, the Last Active Node information cannot be accurate when a Rapid Ring Fault condition is present	Multiple possible solutions exist. • For the disconnections and reconnections issue, no solution is required. Clear the fault when you have reconnected the device to the network permanently. • For the duplex mismatch issue, reconfigure the duplex parameters to verify that they match between the devices. • For the electromagnetic noise issue, determine where the noise exists and remove it or use a protective shield in that location. • For the unstable connections issue, determine where they exist on the network and correct them. • Check the media counters for all devices on the network. The device with the highest media counter count is most likely causing the Rapid Ring Fault. • Remove devices from the network one by one. When you see that the Rapid Ring Fault disappears after a device is removed, it indicates that specific device is causing the fault. • Finally, your Beacon Interval or Timeout configuration cannot be appropriate for your network. However, if you think it is necessary to change these values, we recommend that you call Rockwell Automation technical support. Once the fault is fixed, click Clear Fault.
Partial Fault Condition	A partial network fault occurs when traffic is lost in only one direction on the network because a ring member is not forwarding beacons in both directions for some reason, such as a component failure. The active ring supervisor detects a partial fault by monitoring the loss of Beacon frames on one port and the fault location appears in the Ring Fault section of the Network tab. When a partial fault is detected, the active ring supervisor blocks traffic on one port. At this point, the ring is segmented due to the partial fault condition. The nodes that are next to the faulted part of the network are displayed in the Ring Fault group with either IP addresses or MAC IDs for each node displayed. When this fault occurs, the Network Status field = Partial Fault Condition. Once the fault is corrected, it automatically clears, and the Network Status field returns to Normal.	Determine where the fault condition exists and correct it.

Table 34 - Troubleshoot DLR or Linear Network

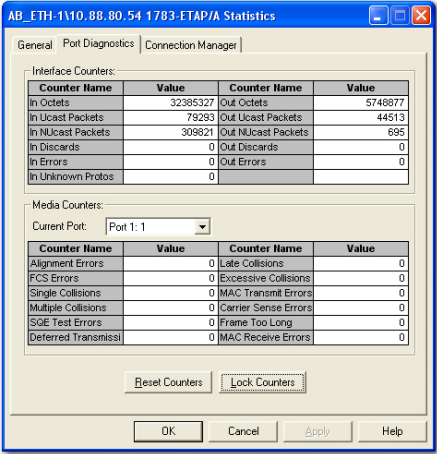
Issue	Description	Solution
Media Counter Errors or Collisions	The media counters screen displays the number of physical layer errors or collisions. The screen indicates where to check for errors that are encountered. Error levels are displayed depending on what caused the error. For example, an Alignment Error is displayed in the Alignment Error field. Figure 53 - Media Counter Screen  On a DLR network, it is not uncommon to see low levels of media counter errors. For example, if the network breaks, a low level of media counter errors appear. With a low level of media counter errors, the value typically does not continuously increase and often clears. A high level of media counter errors typically continues to increase and does not clear. For example, there is a mismatch of speed between two linked nodes, a high level of media counter errors appear that steadily increase and do not clear. To access the RSLinx® screen that is shown, browse the network, right-click the device, select Module Properties, and click Port Diagnostics.	Some example solutions include: • Check for a mismatch of speed and/or duplex between two linked nodes. • Check that all cables on the network are securely connected to each device. • Check for electromagnetic noise on the network. If you find it, remove it or use a protective shield in that location.

Table 34 - Media Counter Errors

Media Counter	Definition
Alignment Errors	A frame that contains bits that do not total an integral multiple of eight. Alignment errors often result from: - Starting or stopping of a module. - MAC-layer packet formation problems. - Cable problems that corrupt or delete data. - Packets that pass through more than two cascaded multi-port transceivers.
FCS Errors	A frame that contains 8 bits, at least one of which has been corrupted. Frame Check Sequence (FCS) errors often result from: - Starting or stopping of a module. - Cable problems that corrupt or delete data. Important: Even though the acceptable Ethernet bit-error rate is 1 in 10⁸, the typical rate is 1 in 10¹² or better.
Single Collisions	The number of outgoing packets that encountered only one collision during transmission.
Multiple Collisions	The number of outgoing packets that encountered 2...15 collisions during transmission.
SQE Test Errors	A test to detect the collision-present circuit between a transceiver and a network interface card (NIC). Important: Because most NICs now have an integrated transceiver, the SQE test is unnecessary. Ignore this media counter.
Deferred Transmissions	The number of outgoing packets whose transmission is deferred because the network is busy when the first attempt is made to send them. Important: The module only defers the first attempt to transmit a packet. After the first attempt, the module transmits the packet without checking. However, if the network is still busy, a collision is recorded.
Late Collisions	The number of times two devices transmit data simultaneously. Neither device detects a collision because the time it takes to send the signal from one end of the network to the other exceeds the time that is required to put the entire packet on the network. Consequently, neither device senses the transmission of the other until the entire packet is out on the network. Late collisions often result from these conditions: - Excessive network segment length - Repeaters between devices Important: Late collisions can affect large and small packets. However, the transmitter cannot detect late collisions between small packets. Consequently, a network that experiences measurable late collisions between large packets also loses small packets.
Excessive Collisions	The number of frames that experience 16 consecutive collisions.
MAC Transmit Errors	The number of frames for which transmission via a particular interface fails due to an internal MAC sublayer transmission error. Important: MAC transmit errors are only counted if either late collisions, excessive collisions, or carrier sense errors are not counted.
MAC Receive Errors	The number of frames for which reception via a particular interface fails due to an internal MAC sublayer transmission error. Important: MAC receive errors are only counted if the frame too long count, alignment errors, or FCS errors are not counted.
Carrier Sense Errors	Carrier sense errors fall into these categories: - No Carrier Sense Present - The number of times the carrier is not present when a transmission starts. - Carrier Sense Lost - The number of times the carrier is lost during a transmission. Carrier sense errors usually indicate a problem with a cable on the Ethernet infrastructure.
Frame Too Long	The number of incoming packets that exceed the maximum Ethernet packet size.

Notes:

Adding an ArmorStart Distributed Motor Controller to a Studio 5000 Project

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The options and configuration dialog boxes available in the Studio 5000 Logix Designer® application vary depending on which version of ArmorStart® motor controller you have and also on the configuration choices you make when setting up your motor controller.

Availability	Page
All configurations	General Connection Module Info Internet Protocol Port Configuration Network Status Fault Status
Only when motor controller connection type is set to standard only or safety and standard on the Module Definition dialog box.	Motor Protection & Control User I/O Tag Configuration Fault Configuration
Only when motor controller connection type is set to standard only or safety and standard on the Module Definition dialog box.	DeviceLogix™(1)
Only when the connection type is set to safety and standard or safety only.	Safety

(1) See [DeviceLogix Programming on page 172](#) for information on how to use DeviceLogix.

Install ArmorStart Add-on Profile

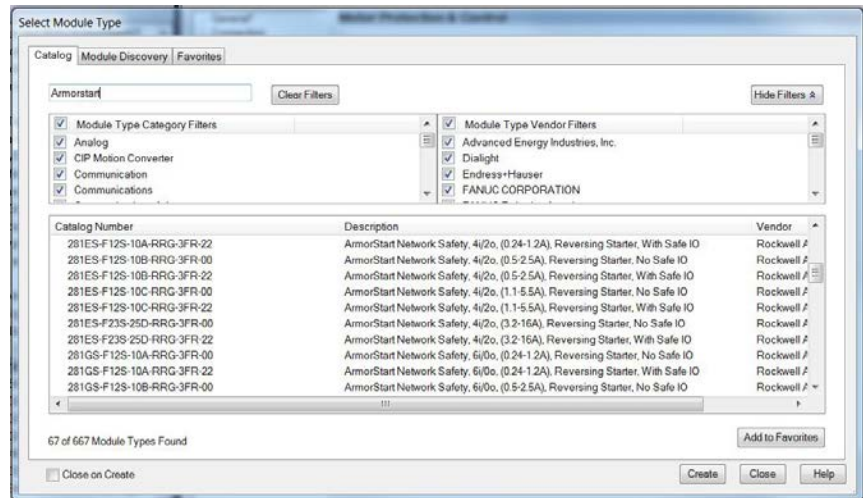
Download and install the Add-on Profile (AOP) for the ArmorStart controller so that the Studio 5000 Logix Designer application can fully support the features of the ArmorStart controller. Download AOPs from the Product Compatibility Download Center (PCDC) website: rok.auto/pcdc.

Create a Studio 5000 Logix Designer Project

Before you can add the ArmorStart ST controller, you must create a Studio 5000 Logix Designer project that includes a Logix 5000 controller with a connection to the EtherNet/IP network. Some controllers require an Ethernet communication module, while others feature an embedded Ethernet port for network communication. If you are using integrated Safe Torque Off or the ArmorStart ST motor controller's safety I/O, your system must include an integrated safety controller, such as an Armor GuardLogix® 5570 controller. [Additional Resources on page 10](#) for a listing of integrated safety controller user manuals.

Add an ArmorStart ST Motor Controller to the Project

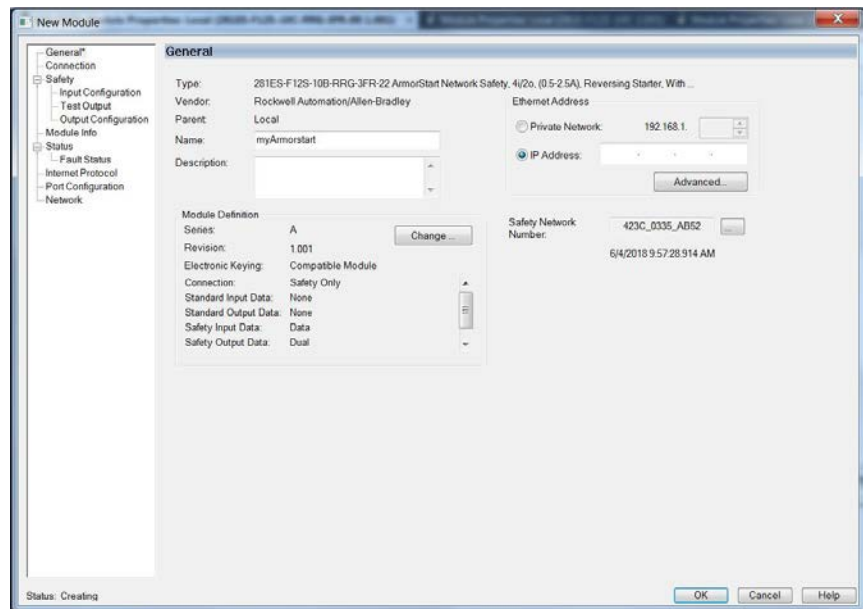
1. Right-click the Ethernet network and choose New Module.
2. Select your ArmorStart ST motor controller and click Create.



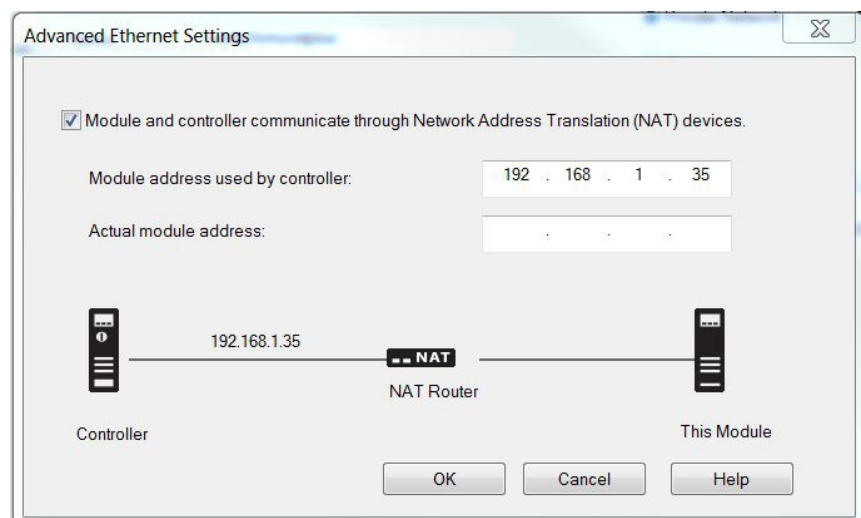
Configure General Properties

1. On the New Module dialog box, type a name for your motor controller.

2. Type the IP address. This setting must match the IP address that you set on the ArmorStart controller by using one of the methods that are outlined in Set the IP Address on [page 73](#).



3. If you are using Network Address Translation (NAT), follow the next steps.
 - a. Click Advanced.



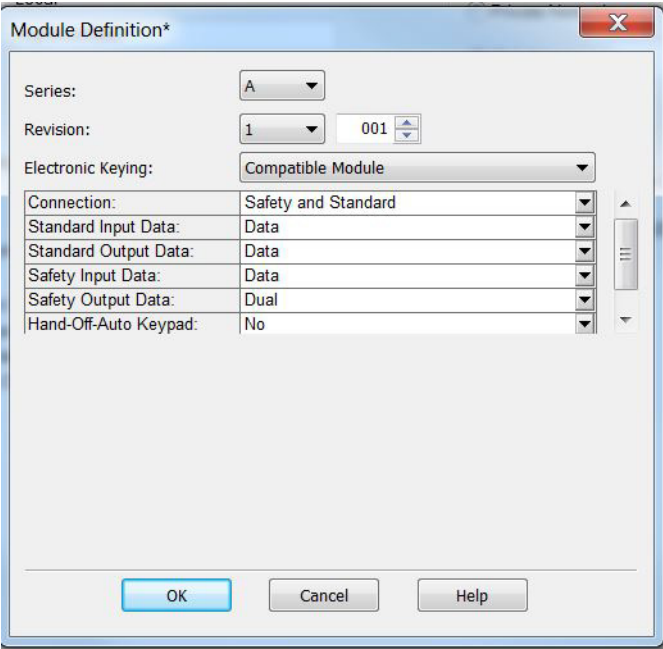
- b. On the Advanced Ethernet Settings dialog box, check the checkbox to indicate that this device uses NAT.
 - c. Type the actual device address.
If you configured the IP address with the rotary switches, this address is the address that you set on the module.
 - d. Click OK to close the dialog box.

IMPORTANT When NAT is used in a safety application with a GuardLogix controller, the module does not accept a safety connection unless the actual module address is provided.

Edit the Module Definition

To change the default module definition for your motor controller, follow these steps.

1. Click Change to open the Module Definition dialog box.



2. Edit the module hardware series, major and minor revision levels, if needed.
3. Use the pull-down menu to choose an Electronic Keying setting.

Table 35 - Electronic Keying Settings

Field	Description	
Series	Module hardware series	
Revision	Module firmware revision, including major and minor revision levels	
Electronic Keying	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.
	Disable Keying	Indicates that the keying attributes are not considered when attempting to communicate with a device. With Disable Keying, communication can occur with a device other than the type specified in the project.
		ATTENTION: Be cautious when using Disable Keying; if used incorrectly, this option can lead to personal injury or death, property damage, or economic loss. We strongly recommend that you do not use Disable Keying. If you use Disable Keying, you must take full responsibility for understanding whether the device being used can fulfill the functional requirements of the application.
		IMPORTANT: Do not use this option in safety applications.
Electronic Keying	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.

4. Use the pull-down menus to choose the Connection types.

The connection types available are dependent on the ArmorStart motor controller version and the configuration choices you make.

Table 36 - Connection Types

I/O Connection Type	Description
Standard Only	An exclusive standard I/O connection that lets the standard input and standard output connections be configured for Data or Listen Only connections as described above. The safety input and output connections are set to None.
Safety Only	An exclusive safety I/O connection where a programmable controller owns the communication channel and provides safety data and configuration from the safety I/O. The standard input and output connections, if available on the motor controller, are set to None.
Safety and Standard	There is a data connection and separate safety connection that provides an exclusive communication channel for standard I/O and safety I/O data.

IMPORTANT The Safety and Standard connection can be one PLC or several PLCs. For example, GuardLogix for Safety and CompactLogix for Standard.

Table 37 - Data Types

Data Connection Type	Description
Standard Input Data	Choose Data or Listen Only when motor controller is configured for a standard only or safety and standard connection type.
Standard Output Data	Automatically set to Data if the motor controller is configured for a standard only or safety and standard connection type.
Safety Input Data	Automatically set to Data if the motor controller is configured for a safety only or safety and standard connection type. Automatically set to none if the motor controller is configured for a standard only connection type.
Safety Output Data	Choose single-channel or dual-channel when the motor controller is configured for a safety only or safety and standard connection type. - Single - The outputs are treated as single channels. - Dual (default) - The ArmorStart ST motor controller treats the outputs as a pair and sets them high (1) or low (0) as a matched pair. Safety logic must set both of these outputs ON or OFF simultaneously or the module declares a channel fault. Automatically set to none if the motor controller is configured for a standard only connection type.

Table 38 - Hand-off-auto Keypad

Hand-off-auto Keypad	Description
Hand-off-auto Keypad	Lets you select whether or not the HOA mode is available on the module. The default is No. Not available when the motor controller is configured for a safety only connection type.

- Data: The owner controller writes configuration data and can establish a connection to the module.
 - Listen Only: An I/O connection where another controller owns/provides the configuration data for the I/O module. A controller with a listen only connection monitors only the module. It does not write configuration data and can only maintain a connection to the I/O module when the owner controller is actively controlling the I/O module.
5. Click OK to close the dialog box.

View or Generate a Safety Network Number

The Studio 5000 Logix Designer application automatically assigns a SNN to each ArmorStart ST integrated safety motor controller as it is added to the project. The SNN is a time-based number that uniquely identifies subnets across all networks in the safety system. All

ArmorStart ST integrated safety distributed motor controllers in a same system use the same SNN by default.

Manual manipulation of an SNN is required in the following situations:

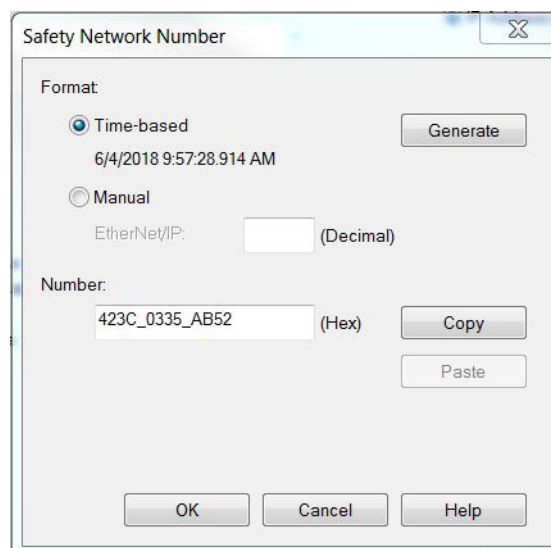
- If safety consumed tags are used
- If the project consumes safety input data from a device whose configuration is owned by some other device
- If a safety project is copied to another hardware installation within the same routable safety system

If an SNN is assigned manually, the SNN has to be unique.

IMPORTANT If you assign an SNN manually, make sure that the system expansion does not result in duplication of SNN and node address combinations. A warning appears if your project contains duplicate SNN and node address combinations. You can still verify the project, but we recommend that you resolve the duplicate combinations.

To edit the SNN, follow these steps.

1. To open the Safety Network Number dialog box, click the ellipsis button to the right of the Safety Network Number.



2. Select either Time-based or Manual.
3. If you select Manual, enter a value from 1...9999 decimal.
4. Click Generate.
5. Click OK.

Configure Standard Connections

Choosing the Connection page lets you complete the following tasks:

- Set the RPI rate.
- Set the connection type to use on the EtherNet/IP network.

For more information on unicast and multicast connections, see the EtherNet/IP Network Devices User Manual, publication [ENET-UM006](#).

- Inhibit the module.

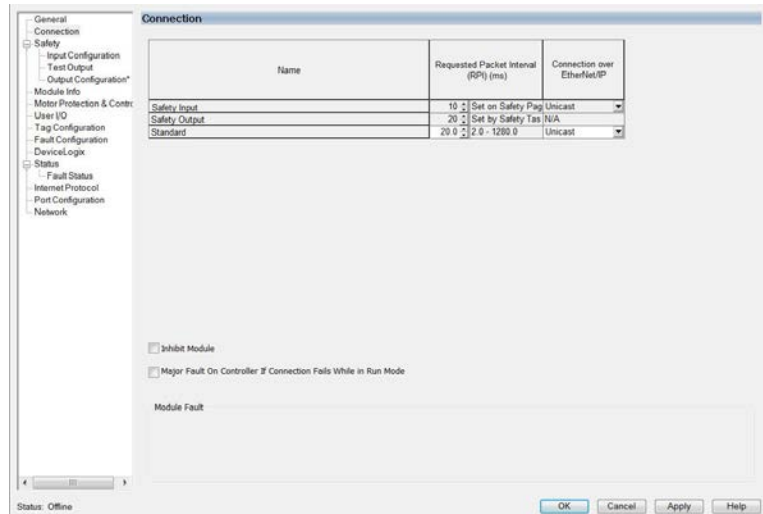
Inhibiting the module allows you to indefinitely suspend a connection, including Listen Only connections, between an owner-controller and a digital I/O module without removing the module from the configuration. This process lets you temporarily disable a module, to perform maintenance.

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

- Configure whether a connection failure while the controller is in Run module causes a major or minor fault.



The Module Fault area of the Connection page provides a fault description and error code for troubleshooting.



Safety Input and Output Configuration for ArmorStart ST with Integrated Safety I/O

You configure the safety input and output connections and advanced connection settings on the safety page. When you are online, this page also displays the configuration signature and provides a method to reset ownership.

The connection between the owner and the ArmorStart ST motor controller is based on the following:

- ArmorStart ST motor controller safety network number
- GuardLogix safety controller slot number
- GuardLogix safety controller safety network number
- Path from the GuardLogix safety controller to the ArmorStart ST motor controller
- ArmorStart ST motor controller configuration signature

If any differences are detected, the connection between the GuardLogix safety controller and the ArmorStart ST motor controller is lost, and the yellow yield icon appears in the controller project tree after you download the program.

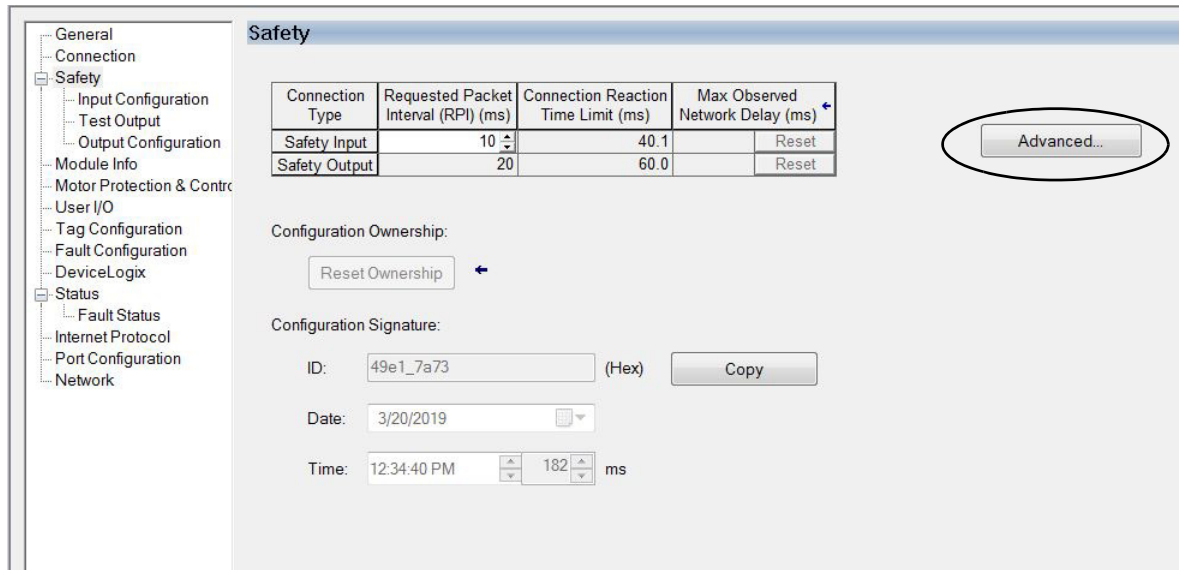
The following sections describe how to configure inputs and outputs:

- [Configure the Safety Input Connection on page 91](#)
- [Configure Safety Digital Inputs on page 93](#)
- [Configure Test Outputs on page 94](#)
- [Configure Safety Outputs on page 95](#)

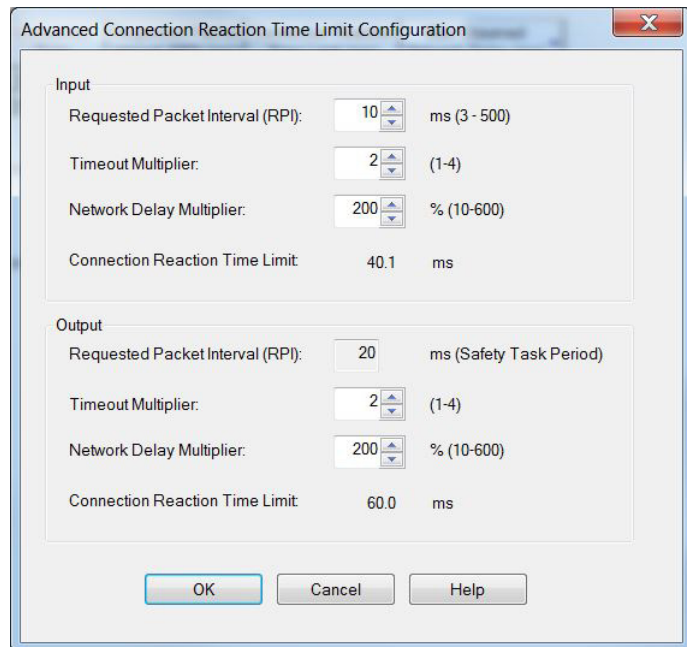
Configure the Safety Input Connection

Follow these steps to configure the safety input connection.

1. From the Module Properties dialog box, choose Safety.



2. Click Advanced to open the Advanced Connection Reaction Time Limit Configuration dialog box.



- a. In the Requested Packet Interval (RPI) field, enter the input connection RPI to support your application (3...500 ms).
 Use the default values for Timeout Multiplier (2) and Network Delay Multiplier (200).
 When you select appropriate RPIs, the system has maximum performance.

IMPORTANT

To determine what is appropriate, analyze each safety channel. The default Timeout Multiplier of 2 and Network Delay Multiplier of 200 creates a worst-case input connection-reaction time limit of 4 times the RPI, and an output connection-reaction time limit of 3 times the RPI. Changes to these settings must be approved only after a thorough review by a safety administrator.

The Connection Reaction Time Limit sets the maximum age of safety packets on the associated connection. If the age of the data that is used by the consuming device exceeds the connection reaction time limit, a connection fault occurs.

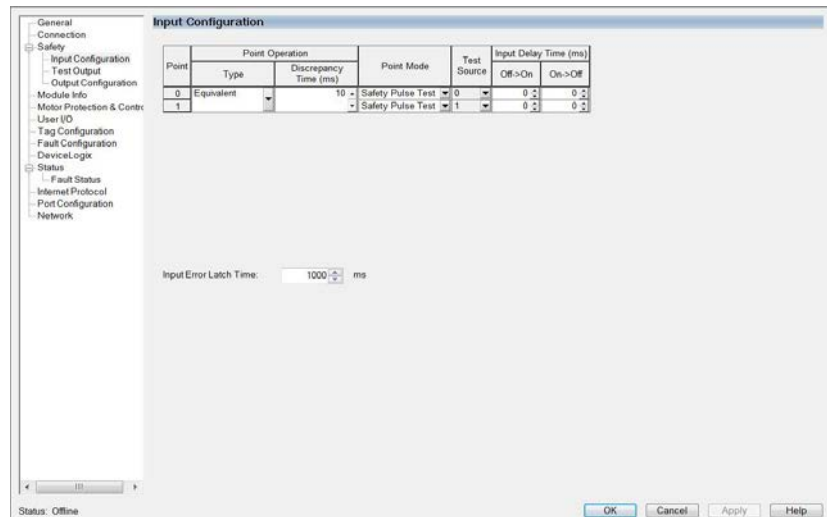
A connection status tag, called ConnectionFaulted, exists for every connection. If the RPI and connection reaction time limit for the network are set appropriately, then this status tag must always remain low. Monitor all connection status bits to verify that they are not going high intermittently due to timeouts.

For more information about the Advanced Connection Reaction Time Limit Configuration dialog box, see the user manual for your safety controller.

Configure Safety Digital Inputs

Follow these steps to configure the safety digital inputs.

1. From the Module Properties dialog box, choose Input Configuration.



2. Assign the Point Operation Type.

Table 39 - Point Operation Types

Choice	Description
Single	Inputs are treated as single channels. Dual-channel safety inputs can be configured as two individual single channels. This configuration does not affect pulse tests because it is handled on an individual channel basis. IMPORTANT: Use single-channel mode when you intend to use the GuardLogix safety application instructions.
Equivalent	Inputs are treated as a dual-channel pair. The channels must match within the discrepancy time or an error is generated.
Complementary	Inputs are treated as a dual-channel pair. They must be in opposite states within the discrepancy time or an error is generated.

When you choose Equivalent or Complementary, you must also assign a Discrepancy Time. A discrepancy time must be set to a minimum of 10 ms. Discrepancy times greater than 10 ms must be set as a multiple of 10 (for example: 20, 30, or 40 ms).

A 'cycle inputs' required condition occurs when one input terminal goes from its normal Active->Inactive->Active state while the other input terminal remains in its normal Active state. Even though no fault is declared, the inputs must be cycled through the safe state before the evaluated status of the inputs can return to the Active state. When in a 'cycle inputs' required condition, the logical state does not necessarily match the voltage at the terminals.

IMPORTANT Configuring discrepancy time on ArmorStart ST safety inputs masks input discrepancies that are detected by the controller safety instructions. The controller reads status to obtain this fault information.

3. Assign the Point Mode.

- Not used = The input is disabled. If 24V is applied to the input terminal, it remains logic 0.
- Safety Pulse Test = The input point is enabled and performs a pulse test on the input. When the input is energized, the input pulses low briefly. The pulse test detects whether the input is functioning properly.
- Safety = The input point is enabled and does not perform a pulse test on the input.
- Standard = The safety input is treated as a standard input. No diagnostics are run. When using a safety input as a standard input, the Point Operation Type must be set to Single Channel.

When the input Point Mode is Safety Pulse Test, test output channel 0 is mapped to input channel 0, and test output 1 is mapped to input 1.

4. Assign the Input Delay Time, Off -> On (0...126 ms, in increments of 6 ms).
Filter time is for OFF to ON transition. Input must be high after input delay has elapsed before it is set logic 1. This delay time is configured per channel with each channel tuned to match the characteristics of the field device, for maximum performance.
5. Assign the Input Delay Time, On -> Off (0...126 ms, in increments of 6 ms).
Filter time is ON to OFF transition. Input must be low after input delay has elapsed before it is set logic 0. This delay time is configured per channel with each channel tuned to match the characteristics of the field device, for maximum performance.
6. From the Input Error Latch Time field, enter the time that the module holds an error to make sure that the controller can detect it (0...65,530 ms, in increments of 10 ms - default 1000 ms).

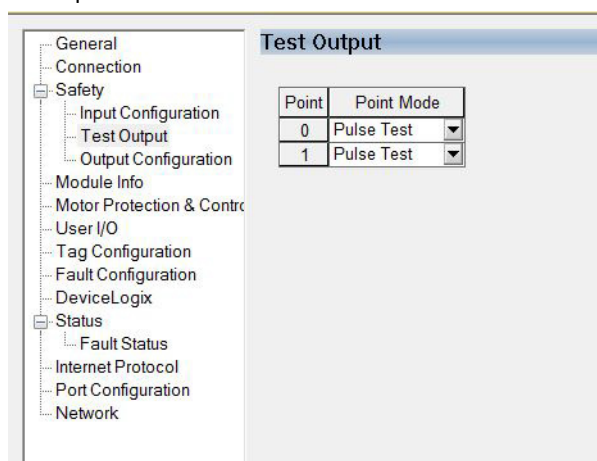
This setting provides more accurate diagnostics. The purpose for latching input errors is to make sure that intermittent faults that can exist only for a few milliseconds are latched long enough for the controller to read. The amount of time to latch the errors are based on the RPI, the safety task watchdog, and other application-specific variables.

7. Click Apply.

Configure Test Outputs

If you have configured safety inputs to use a test output, follow these steps to configure the test outputs:

1. Choose Test Output.



2. Assign a point mode.
 - Not Used - The test output is disabled.
 - Pulse Test - Used to test a safety input for short circuit detection.
 - Power Supply - A constant 24V is placed on the output terminal. It can be used to provide power to a field device. For test output specifications, see ArmorStart ST Distributed Motor Controller Specifications, publication [280ES-TD001](#).

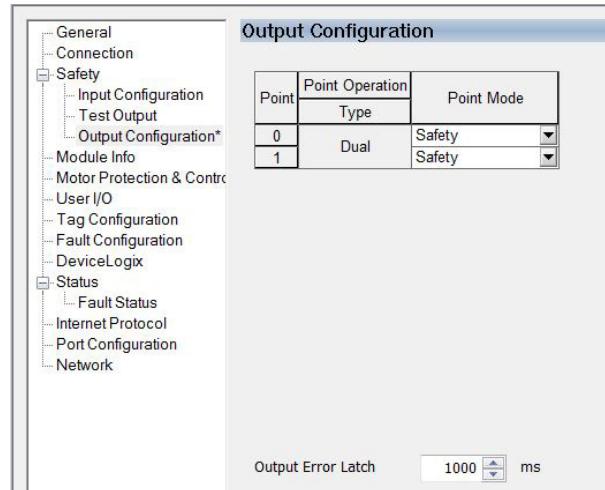
Configure Safety Outputs

The ArmorStart ST motor controller treats the outputs as a pair and sets them high (1) or low (0) as a matched pair.

IMPORTANT The Safety Output Point Operation Type (Single- or Dual-channel) is previously set up in the [Data Connection Type Table on page 89](#), as part of the [Edit the Module Definition](#) procedure.

Safety logic must set both of these outputs ON or OFF simultaneously or the module declares a channel fault. This Point Operation Type setting is made on the Module Definition dialog box. Follow these steps to configure the Point Mode for the safety digital outputs.

1. Choose Output Configuration.



2. Assign the Point Mode.
 - Not Used -The output is disabled.
 - Safety - The output point is enabled and does not perform a pulse test on the output.
 - Safety Pulse Test- The output point is enabled and performs a pulse test on the output. When the output is energized, the output pulses low briefly. The pulse test detects whether the output is functioning properly.

Standard Configuration for Motor Control

When the ArmorStart motor controller is configured for safety and standard or standard only connections and the standard input connection type is set to data, the following categories are available for configuring operation:

- Motor Protection & Control
- User I/O
- Tag Configuration
- Fault Configuration
- DeviceLogix



ATTENTION: Safety I/O connections and produced/consumed connections cannot be automatically configured to fault the controller if a connection is lost and the system transitions to the safe state. If you must detect a device fault so that the system maintains the required SIL level, you must monitor the Safety I/O CONNECTION_STATUS bits and initiate the fault via program logic.

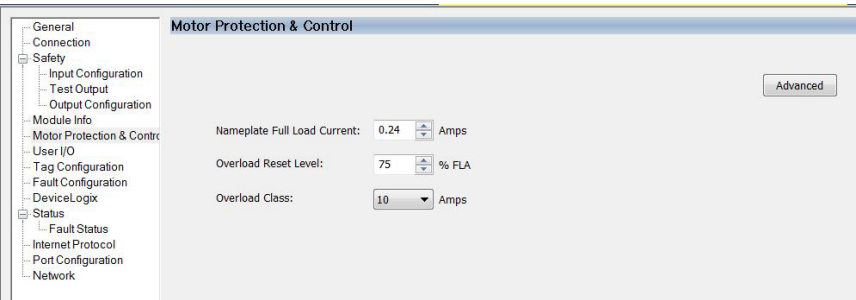
The Motor Protection & Control settings are different for Bulletin 281ES/GS starters and Bulletin 284ES/GS VFDs.

- See [Motor Protection and Control Configuration for Bulletin 281ES and 281GS Starters](#), or

- See [Motor Protection and Control Configuration for Bulletin 284ES and 284GS VFDs on page 97](#)

Motor Protection and Control Configuration for Bulletin 281ES and 281GS Starters

1. Choose Motor Protection & Control.

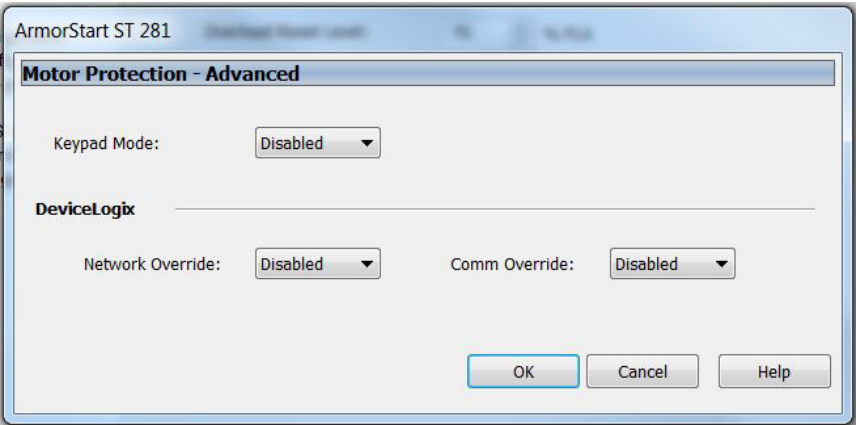


2. Set Motor Nameplate Full Load to the motor's full load current rating.

Table 40 - Current Ratings

Catalog Number	Current Rating		
	Minimum	Maximum	Default
281ES-F12S-10A 281GS-F12S-10A	0.24 A	1.2 A	0.24 A
281ES-F12S-10B 281GS-F12S-10B	0.5 A	2.5 A	0.5 A
281ES-F12S-10C 281GS-F12S-10C	1.1 A	5.5 A	1.1 A
281ES-F23S-25D 281GS-F23S-25D	3.2 A	16.0 A	3.2 A

3. Set Motor Overload Reset Level to the percent thermal capacity at which the overload is reset. Valid values are from 0...100%, with a default value of 75%.
4. Use the pull-down menu to set the Overload Class.
5. Click Advanced to access Keypad mode and DeviceLogix settings.



6. Choose a Keypad mode if using a Hand-Off-Auto keypad.
 - Disabled - this setting disables keypad buttons, except for the Off and Auto buttons.
 - Momentary - sets the keypad HAND button to function as a momentary push button.
 - Maintained - sets the keypad HAND button to function as a maintained push button.

7. Choose a Network Override option to determine whether local logic (DeviceLogix) is enabled or disabled when a major network fault condition (failure to obtain an IP address, for example) is present.
8. Choose a Comm Override option to determine whether local logic (DeviceLogix) is enabled or disabled when a communications fault condition is present. This setting also applies to controller program mode (Ethernet/IP net idle).

Enabling this setting causes the ArmorStart to ignore the following parameters if they are controlled in DeviceLogix. These parameters determine response settings for fault conditions.

- Starter Net Fault Mode
 - Starter Program Mode
 - User OutA Net Fault Mode
 - User OutA Program Mode
 - User OutB Net Fault Mode
 - User OutB Program Mode
9. Click OK to close the dialog box.

Motor Protection and Control Configuration for Bulletin 284ES and 284GS VFDs

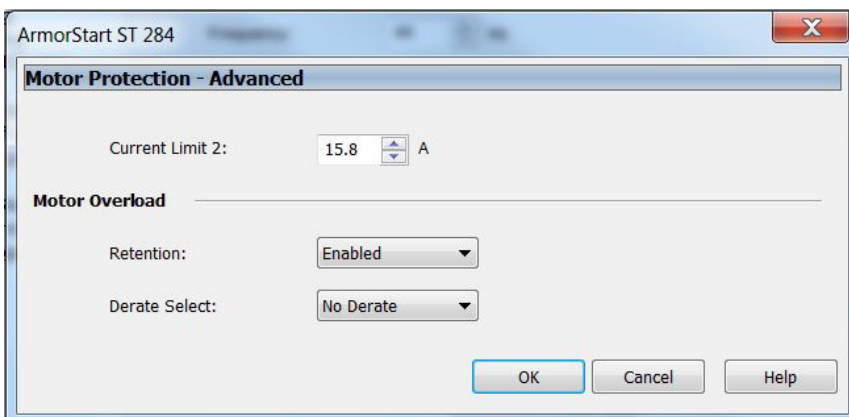
1. Choose Motor Protection & Control.

2. Enter motor nameplate data for Voltage, Frequency, and Full Load Current.

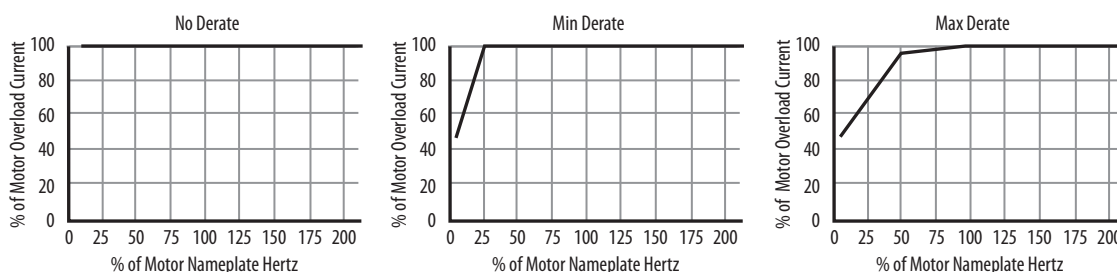
Table 41 - Motor Nameplate Data

Motor Nameplate		Minimum	Maximum	Default
Voltage		380V AC	460V AC	460V AC
Frequency		10 Hz	400 Hz	60 Hz
Full Load Current	284ES-FVD2P3S 284GS-FVD2P3S	0.0 A	2.3 A	2.3 A
	284ES-FVD4POS 284GS-FVD4POS	0.0 A	4.0 A	4.2 A
	284ES-FVD6POS 284GS-FVD6POS	0.0 A	6.0 A	6.0 A
	284ES-FVD7P6S 284GS-FVD7P6S	0.0 A	7.6 A	7.6 A

3. Set the Motor Overload Current to the maximum allowable current. A Motor Overload fault occurs if this value is exceeded by 150% for 60 s.
4. Configure Motor Current Limit, which sets the maximum output current that, is allowed before current limiting occurs.
5. Click Advanced Motor Protection to access more settings.



6. Edit Motor Current Limit 2 to set the maximum output current that is allowed before current limiting occurs. This setting is available only when the Output tag O.DriveInputX is configured as Activate Current Limit 2. See [Configure Input and Output Tags on page 110](#), for more information.
7. Enable or disable the motor overload Retention function.
When enabled, the value that is held in the motor overload counter is saved at power-down and restored at power-up. A change to this setting resets the counter.
8. Choose a derating factor for I^2t overload function: No Derate, Min Derate, Max Derate.

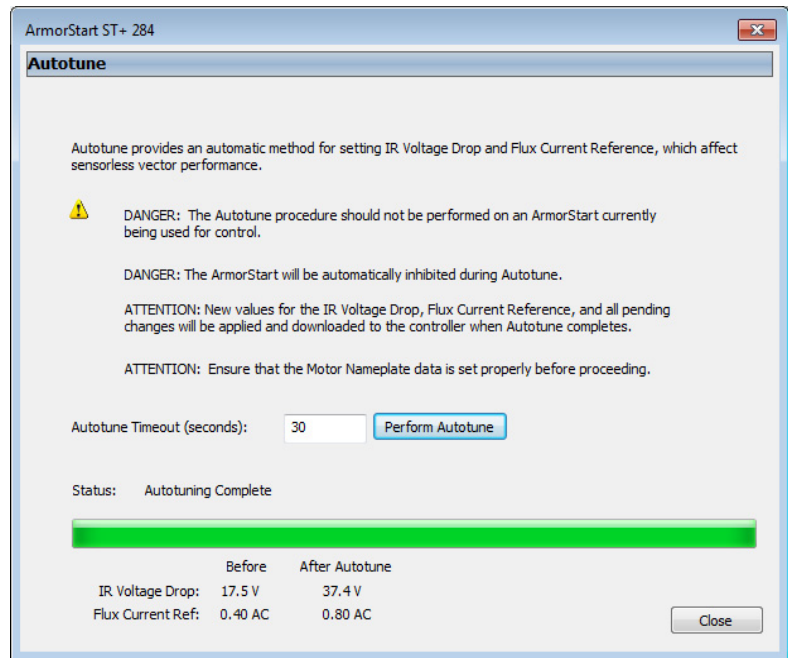


9. Click OK to close the Motor Protection -Advanced dialog box.
10. On the Motor Protection & Control page, choose a Torque Performance Mode, either Volts/Hz or Sensorless Vector Control.
11. If the Torque Performance Mode is set to Sensorless Vector Control, you can configure additional settings.
 - a. Set a value for IR Voltage Drop, the volts dropped across the resistance of the motor stator.
The valid range is 0.0...115.0VAC.
 - b. Enter a value for Flux Current Reference, the value of amps for full motor flux.
The valid range is 0...(Motor Nameplate Volts) Amps.
12. When online and the controller is in Run or Remote Run mode, you can Autotune the motor controller from the Motor Protection & Control page.

IMPORTANT

If motor control performance is important, the Autotune function should be performed. This is especially true for Sensorless Vector Control mode. If the performance does not improve after the Autotune function is completed, contact the motor manufacturer for the optimal flux current reference and overwrite the value that is identified in the Autotune step.

Autotune provides an automatic method for setting IR Voltage Drop and Flux Current Reference, which affect Sensorless voltage performance. Only Static tune is supported. Static tune issues a temporary command that initiates a non-rotational motor stator resistance test for the best possible automatic setting of IR Voltage Drop. A start command is required within 30 seconds of setting this parameter following initiation of this setting.

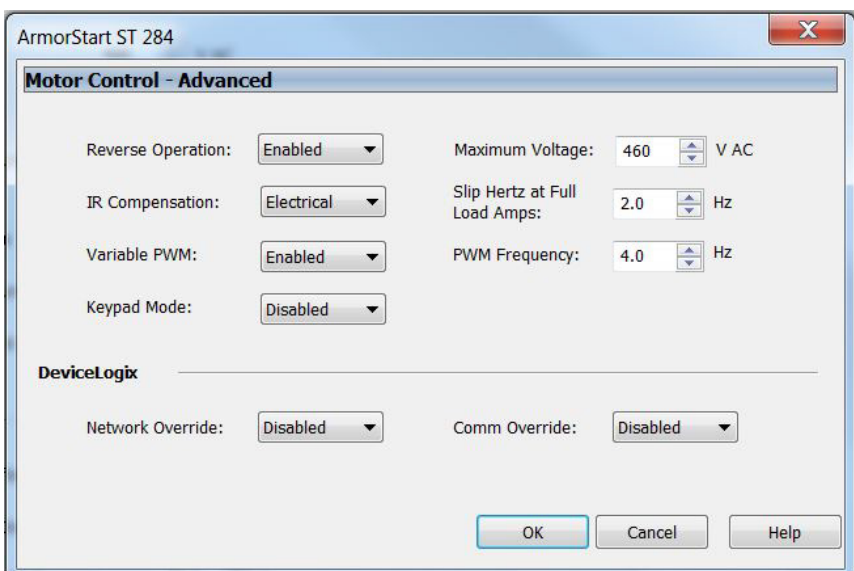


ATTENTION: Autotune cannot be performed when a safety connection has been configured.

See [Using Autotune and Integrated Safety on page 71](#).

ATTENTION: Rotation of the motor in an undesired direction can occur during this procedure. To guard against possible injury and/or equipment damage, we recommend disconnecting the motor from the load before you continue.

13. Click Close when Autotune is complete.
14. Click Advanced Motor Control to access more settings.



15. Enable or disable Reverse Operation, the function that allows the direction of the motor rotation to be changed.

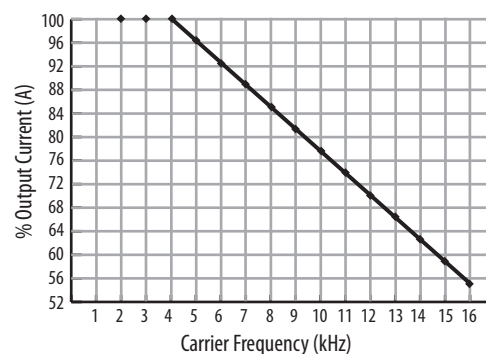
IMPORTANT Stop the motor before changing this setting.

Define IR Compensation options that can improve problems with motor instability. Possible values are:

- Disabled
 - Electrical (Default) - Some drive/motor combinations have inherent instabilities, which are exhibited as non-sinusoidal motor currents. This setting attempts to correct this condition.
 - Mechanical - Some motor/load combinations have mechanical resonances, which can be excited by the drive current regulator. This setting slows down the current regulator response and attempts to correct this condition.
 - Both
16. Enable or disable Variable PWM, a feature that varies the carrier frequency for the PWM output waveform.

IMPORTANT Stop the drive before changing this setting.

17. Choose a Keypad mode if using a Hand-Off-Auto keypad.
- Disabled - this setting disables keypad buttons, except for the Off and Auto buttons.
 - Momentary - sets the keypad HAND button to function as a momentary push button
 - Maintained - sets the keypad HAND button to function as a maintained push button.
18. Set the Maximum Voltage that the drive will output.
The valid range is 20...460VAC.
19. Define a value for Slip Hertz at Full Load Amps, which compensates for the inherent slip in an induction motor. This frequency is added to the commanded output frequency based on motor current.
The valid range is 0.0...10.0 Hz
20. Set the PWM Frequency, which defines the carrier frequency the PWM output waveform. The next figure provides derating guidelines that are based on the PWM frequency setting.
The valid range is 2.0...16.0 Hz



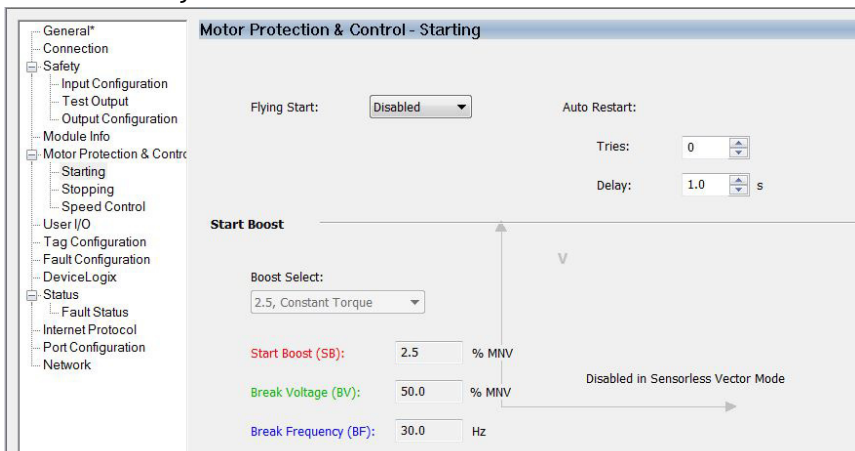
21. Choose a Network Override option to determine whether local logic (DeviceLogix) is enabled or disabled when a major network fault condition (failure to obtain an IP address, for example) is present.
22. Choose a Comm Override option to determine whether local logic (DeviceLogix) is enabled or disabled when a communications fault condition is present. This setting also applies to controller program mode (Ethernet/IP net idle).
Enabling this setting causes the ArmorStart to ignore the following parameters (if they are controlled in DeviceLogix). These parameters determine response settings for fault conditions.

- Starter Net Fault Mode
- Starter Program Mode
- User OutA Net Fault Mode
- User OutA Program Mode
- User OutB Net Fault Mode
- User OutB Program Mode

Configure Starting Functions

Follow these steps to configure the Starting settings.

1. Choose Starting.



2. Enable or disable Flying Start, which lets the drive reconnect to a spinning motor at actual RPM.
3. Choose the number of Auto Restart Tries, which sets the maximum number of times the drive attempts to reset a fault and restart.

IMPORTANT A drive restart does not clear all types of faults. It only clears type 1 faults.



ATTENTION: Equipment damage and/or personal injury can result if this function is used in an inappropriate application. Do not use this function without review of applicable local, national, and international codes, standards, regulations, or industry guidelines.

4. Choose an Auto Restart Delay time, which defines the time between restart attempts if Auto Restart Tries is set to a value greater than zero.
5. Use the Boost Select pull-down menu to choose the boost voltage (% of Motor Nameplate Volts), which redefines the Volts per Hz curve.



This field is only active when Volts/Hertz is selected as the Torque Performance Mode.

6. Type a Start Boost value to set the boost voltage (% of Motor Nameplate Volts [MNV]).

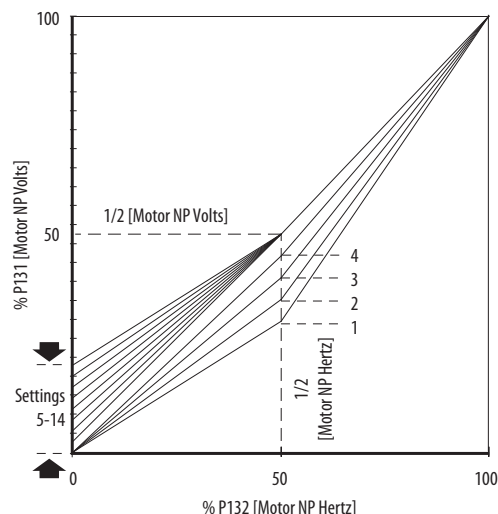


Table 42 - Variable and Constant Torques

Options	Description	
0	Custom V/Hz	Variable Torque (Typical fan/pump curves)
1	30.0, VT	
2	35.0, VT	
3	40.0, VT	
4	45.0, VT	
5	0.0 no IR	Constant Torque
6	0.0	
7	2.5, CT (default for 5 Hp/4.0 kW Drive)	
8	5.0, CT (default)	
9	7.5, CT	
10	10.0, CT	
11	12.5, CT	
12	15.0, CT	
13	17.5, CT	
14	20.0, CT	

7. This setting redefines the Volts per Hz curve when Boost Select = Custom V/Hz and Torque Performance Mode = Volts/Hertz. The range is 0.0...25.0%, with a default setting of 2.5%.



You can modify this setting by dragging the red triangle next to SB in the chart.

8. Type a Break Voltage value to set the voltage (% of Motor Nameplate Volts [MNV]) where the break frequency is applied when Boost Select = Custom V/Hz and Torque Performance Mode = Volts/Hertz.

The range is 25.0...100.0%, with a default setting of 25.0%



You can modify this setting by dragging the green triangle next to BV in the chart.

9. Type a Break Frequency value to set the frequency at which the break frequency is applied when Boost Select = Custom V/Hz and Torque Performance Mode = Volts/Hertz.

The range is 0.0...400.0 Hz, with a default setting of 15.0 Hz.

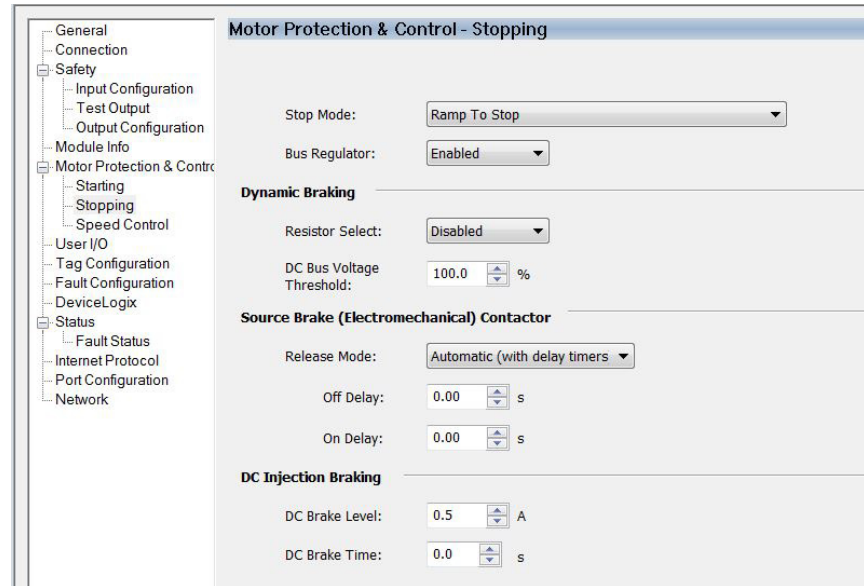


You can modify this setting by dragging the blue triangle next to BF in the chart.

Configure Stopping Functions

Follow these steps to configure the Stopping settings.

1. Choose Stopping.



2. Use the pull-down menu to choose a stopping mode.
 - Ramp To Stop, Clear Fault - A stop command clears active fault.
 - Coast To Stop, Clear Fault - A stop command clears active fault.
 - DC Injection Brake Stop, Clear Fault - A stop command clears active fault.
 - DC Injection Brake Stop with AutoShutoff, Clear Fault - DC Injection Braking for value set in DC Brake Time parameter OR drive shuts off if current limit exceeded.
 - Ramp To Stop (Default)
 - Coast To Stop
 - DC Injection Brake Stop
 - DC Injection Brake Stop with Auto Shutoff - DC Injection Braking for value set in DC Brake Time field or the drive shuts off if current limit exceeded.
3. Enable or disable the Bus Regulator function.
 The Bus Regulator reduces the Decel Rate as required to prevent the DC Bus Voltage from increasing to the trip limit.



ATTENTION: The bus regulator function is useful for helping prevent nuisance overvoltage faults that result from aggressive decelerations, overhauling loads, and eccentric loads. However, it can also cause either of the following two conditions to occur.

1. Fast positive changes in input voltage or imbalanced input voltages can cause uncommanded positive speed changes;
2. Actual deceleration times can be longer than commanded deceleration times

ATTENTION: However, a Stall Fault is generated if the drive remains in this state for 1 minute. If this condition is unacceptable, Bus Regulator must be disabled. In addition, installing a properly sized dynamic brake resistor provides equal or better performance in most cases.

4. Choose a Resistor Select function, which enables external dynamic braking.
 - Disabled (Default)
 - Normal RA Resistor (5% Duty Cycle)
 - No Protection (100% Duty Cycle)
 - 3...99% Duty Cycle (customer-defined third-party resistor)

IMPORTANT Stop the drive before changing this setting.

5. Set the DC bus Voltage Threshold value for Dynamic Brake operation.

If the DC bus voltage falls below the value set in this parameter, the Dynamic Brake does not turn on. Lower values make the Dynamic Braking function more responsive, but can result in nuisance Dynamic Brake activation.

The valid range is 0.0...110.0%.



ATTENTION: Equipment damage can result if this parameter is set to a value that causes the dynamic braking resistor to dissipate excessive power. Parameter settings less than 100% should be carefully evaluated to confirm that the dynamic brake resistor's wattage rating is not exceeded. In general, values less than 90% are not needed. This parameter's setting is especially important if DB Resistor Select is set to No Protection.

6. Use the pull-down menu to set the Source Brake Release Mode.

- Always Engaged - The integrated EM (source) brake contactor does not energize. Therefore, if the ArmorStart motor controller is connected to a motor with an electromechanical brake, it never releases.
- Automatic with Delay Mode Timers (Default) - The EM brake releases once the Brake Off Delay timer is satisfied and it engages once the Brake On Delay timer is satisfied (see the following diagram). When the delay is set to 0, the brake releases once a valid start is detected by the motor controller and engages once a valid stop condition has been detected. If Source Brake Release Mode is set to Automatic with Delay Timers, then the Stop Mode must be set to either Ramp To Stop or Ramp To Stop, Clear Fault.
- Above Frequency - The EM brake can be released once the drive reached the threshold value set in the Release Threshold field.
- Above Current - The EM brake can be released once the drive reached the threshold value set in the Release Threshold field.

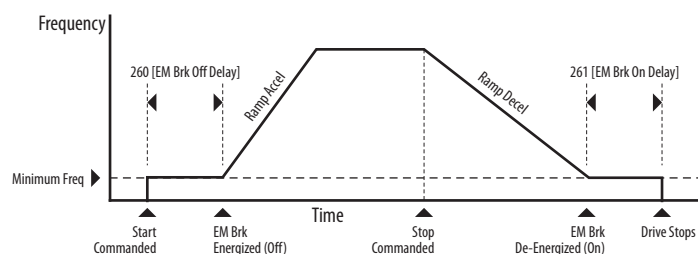
See [Appendix G](#) for an example of manual brake control.

- a. If the Source Brake Release Mode is set to Automatic with Delay Mode Timers, set a Brake Off Delay and a Brake On Delay.

The valid range is 0.00...10.00s.

The Brake Off Delay sets the time that the drive remains at minimum frequency before ramping to the commanded frequency and energizing the electromechanical (EM) brake contactor.

The Brake On Delay sets the time that the drive remains at minimum frequency before stopping and de-energizing the electromechanical (EM) brake contactor.



- b. If the Source Brake Release Mode is set Above Frequency, set a Brake Release Threshold value (0...400Hz).

- c. If the Source Brake Release Mode is set Above Current, set a Brake Release Threshold value (0...400Hz).

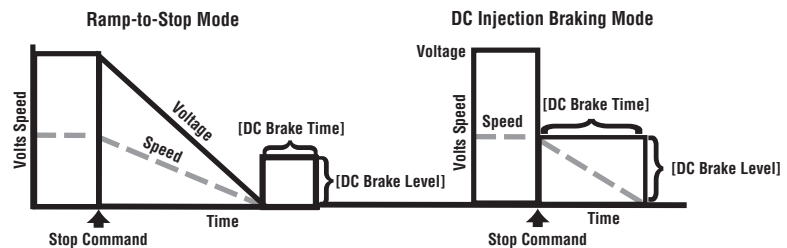
Table 43 - Brake Release Threshold

Catalog Number	Range (default is 0%)
284ES-FVD2P3S 284GS-FVD2P3S 284ES-FVD4POS 284GS-FVD4POS 284ES-FVD6POS 284GS-FVD6POS	0...180%
284ES-FVD7P6S 284GS-FVD7P6S	0...130%

7. Set values for DC Brake Level to define the maximum DC brake current, in Amps, applied to the motor when Stop Mode is set to Ramp to Stop or DC Injection Brake Stop.

Table 44 - DC Brake Current

Catalog Number	Minimum	Maximum	Default
284ES-FVD2P3S 284GS-FVD2P3S	0.0 A	4.1 A	0.1 A
284ES-FVD4POS 284GS-FVD4POS	0.0 A	7.2 A	0.2 A
284ES-FVD6POS 284GS-FVD6POS	0.0 A	10.8 A	0.3 A
284ES-FVD7P6S 284GS-FVD7P6S	0.0 A	18.9 A	0.5 A



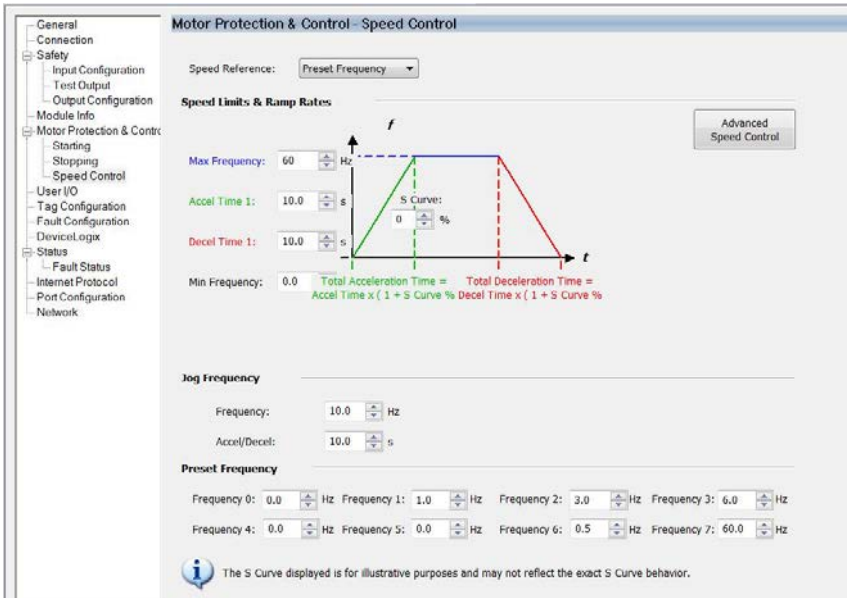
ATTENTION: If a hazard of injury due to movement of equipment or material exists, an auxiliary mechanical braking device must be used. This feature must not be used with synchronous or permanent magnet motors. Motors can be demagnetized during braking.

8. Set a value for DC Brake Time (0...99.9 s) to specify the length of time that DC brake current is injected into the motor.

Configure Speed Control Functions

Follow these steps to configure the Speed Control settings.

1. Choose Speed Control.



2. Use the pull-down menu to choose a source of Speed Reference.
- Preset Frequency - control via Preset Frequency settings (see [step 15](#))
 - Output Tag - control via output tag (DeviceName.O.FreqCommand) of the connected controller
3. Set a Maximum Frequency for the drive.
- The valid range is 0.0...400 Hz, with a default value of 60.0 Hz.

IMPORTANT Stop the drive before changing this setting.

4. Set a value for Accel Time 1, which sets the rate of acceleration for all speed increases except during a jog function.
- The valid range is 0.0...600.0 s, with a default value of 10.0 s.
- You can activate this setting by setting the AccelCtrl output tags as shown.

Table 45 - AccelCtrl Output Tags

Tag	Setting
DeviceName:O.AccelCtrl_0	1
DeviceName:O.AccelCtrl_1	0

5. Set a value for Decel Time 1, which sets the rate of deceleration for all speed decreases except during a jog function.
- The valid range is 0.1...600.0 s, with a default value of 10.0 s.
- You can activate this setting by setting the DecelCtrl output tags as shown.

Table 46 - DecelCtrl Output Tags

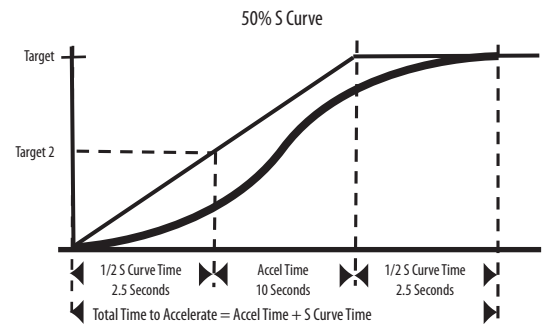
Tag	Setting
DeviceName:O.DecelCtrl_0	1
DeviceName:O.DecelCtrl_1	0

6. Set an S Curve Percentage value to define the percentage of acceleration or deceleration time that is applied to ramp as an S curve. Half of the time is added at the beginning and half at the end of the ramp.

The valid range is 0...100%.

Example:

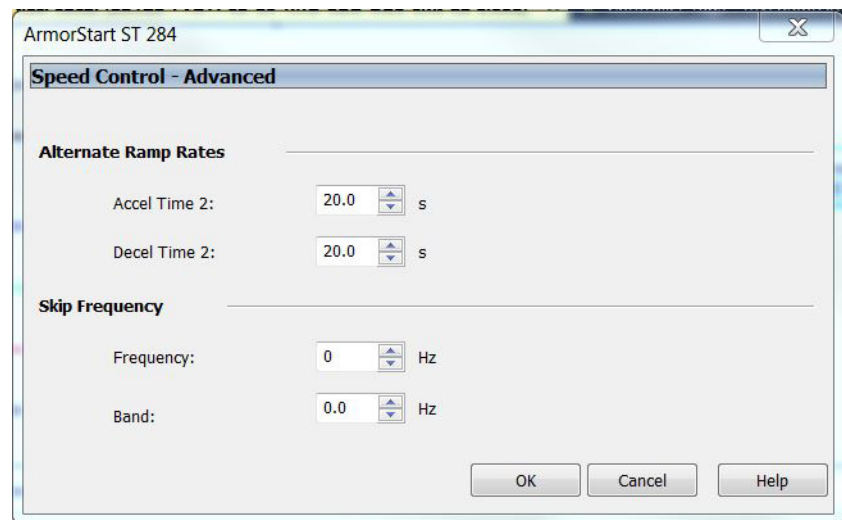
- Accel Time = 10 seconds
- S Curve Setting = 50 %
- S Curve Time = $10 \times 0.5 = 5$ seconds
- Total Time = $10 + 5 = 15$ seconds



- Set a value for Minimum Frequency to define the lowest frequency that the drive will output continuously.

The valid range is 0.0...400.0 Hz.

- Click Advanced Speed Control to access additional settings.



- Set a value for Accel Time 2 which sets the rate of acceleration for all speed increases except during a jog function.

The valid range is 0.0...600.0 s, with a default value of 20.0 s.

You can activate this setting by setting the AccelCtrl output tags as shown.

Table 47 - AccelCtrl Output Tags

Tag	Setting
DeviceName:0.AccelCtrl_0	0
DeviceName:0.AccelCtrl_1	1

- Set a value for Decel Time 2, which sets the rate of deceleration for all speed decreases except during a jog function.

The valid range is 0.1...600.0 s, with a default value of 20.0 s.

You can activate this setting by setting the DecelCtrl output tags as shown.

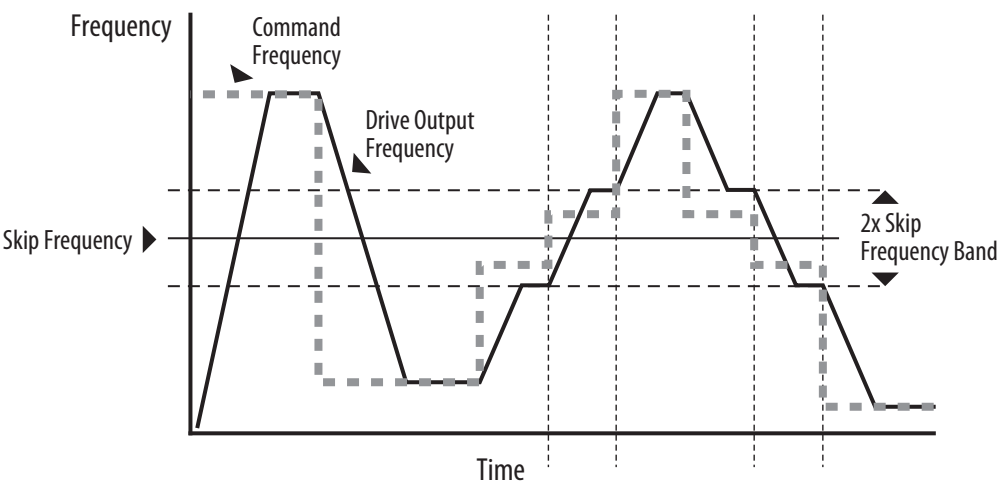
Table 48 - DecelCtrl Output Tags

Tag	Setting
DeviceName:0.DecelCtrl_0	0
DeviceName:0.DecelCtrl_1	1

- Set a value for Skip Frequency, which defines the frequency at which the drive will not operate.

The valid range is 0...400 Hz.

12. Set a value for Skip Frequency Bandwidth to set a bandwidth around the Skip Frequency.
- The bandwidth is split, with half applying above and half applying below the actual skip frequency. Set to 0 (default) to disable this function.
- The valid range is 0.0...30.0 Hz.



13. Set a value for Jog Frequency to define the output frequency when a jog command is issued.
- The valid range is 0.0...400.0 Hz.
14. Set a value for Jog Accel/Decel to define the acceleration and deceleration time when a jog command is issued.
- The valid range is 0.1...600.0 s.
15. Set values for each of the eight Preset Frequencies to provide a fixed frequency command value when Speed Reference is set to Preset Frequency.
- The valid range is 0...400 Hz. Default values are shown in the table.

Table 49 - Default Preset Frequencies

Frequency	Default (Hz)
0	0.0
1	5.0
2	10.0
3	20.0
4	30.0
5	40.0
6	50.0
7	60.0

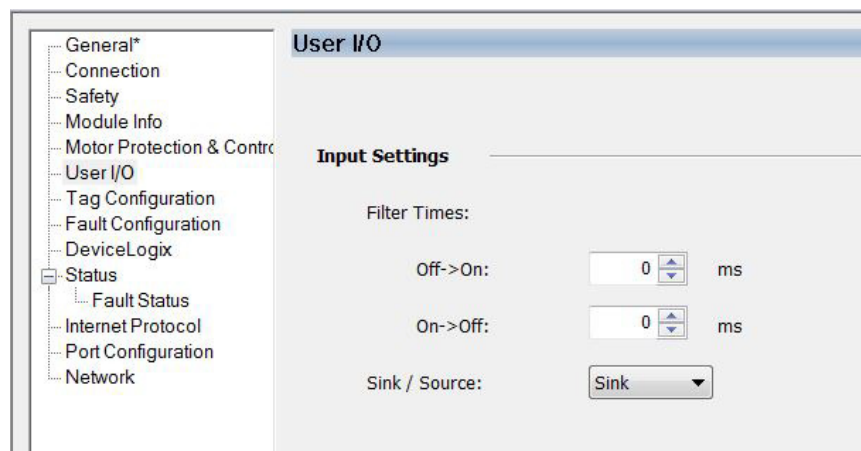
The preset frequency that is chosen also depends on the values of the drive's inputs as described in the next table. The values of the digital inputs are shown in the controller tags: DeviceName.O.DriveInput1, DeviceName.O.DriveInput2, and DeviceName.O.DriveInput3. You can also use a MSG instruction to get the values from the Consume Assembly, Instance 166. See [Table 62 on page 123](#).

Table 50 - Input States

Input State of Digital Input 1	Input State of Digital Input 2	Input State of Digital Input 3	Frequency Source	Accel/Decel Setting Used
0	0	0	Frequency 0 setting	Accel Time 1/Decel Time 1
1	0	0	Frequency 1 setting	Accel Time 1/Decel Time 1
0	1	0	Frequency 2 setting	Accel Time 2/Decel Time 2
1	1	0	Frequency 3 setting	Accel Time 2/Decel Time 2
0	0	1	Frequency 4 setting	Accel Time 1/Decel Time 1
1	0	1	Frequency 5 setting	Accel Time 1/Decel Time 1
0	1	1	Frequency 6 setting	Accel Time 2/Decel Time 2
1	1	1	Frequency 7 setting	Accel Time 2/Decel Time 2

Configure User I/O Settings

1. Choose User I/O.

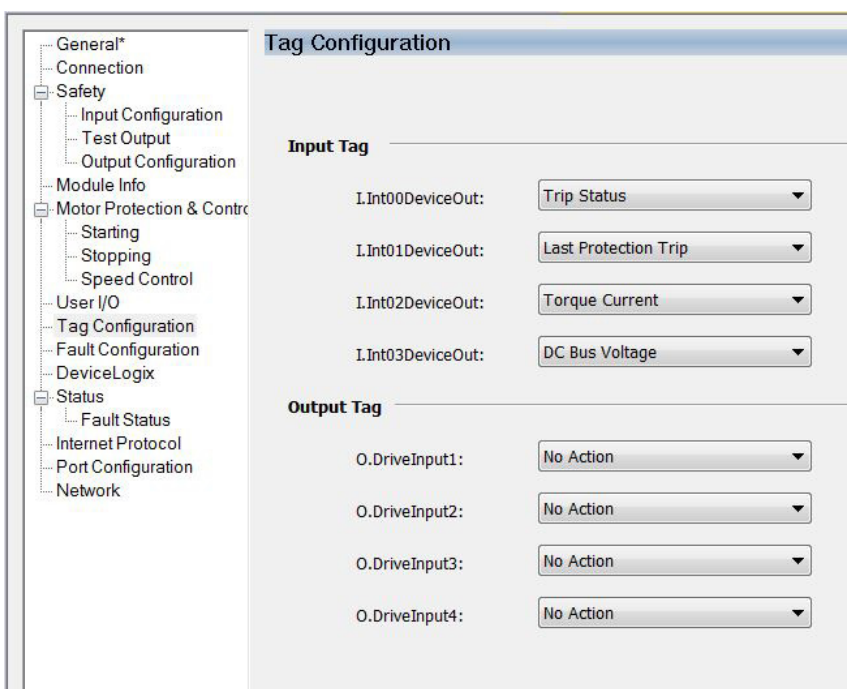


2. Choose sink or source for the input source.
3. Choose the value for the off to on filter time in milliseconds. The off to on time is used to set a delay in responding to transitions from off to on and is useful for filtering out transients in noisy environments (Anti-bounce).
4. Choose the value for the on to off filter time in milliseconds. The on to off time is used to set a delay in responding to transitions from on to off and is useful for filtering out transients in noisy environments (Anti-bounce).

Configure Input and Output Tags

The input and output tag options available for configuration are dependent upon the inputs and outputs available on your specific ArmorStart ST motor controller.

1. Choose Tag Configuration.



2. Use the pull-down menus to configure the customizable input tags (I.IntXXDeviceOut) to specify the type of data reported by the input tag.

Bulletin 281ES/GS Starters		Bulletin 284ES/GS VFDs	
Value	Definition	Value	Definition
Trip Status	Provides trip identification See Blink Patterns and Trip Status on page 131 .	Trip Status	Provides trip identification See Blink Patterns and Trip Status on page 131 .
Last Protection Trip	Displays the last protection fault code. See the ArmorStartST_IntSafety_Fault_Codes.xlsx files that are attached to this publication. For Fault Codes, see the ArmorStart ST Motor Controller with Integrated Safety Fault Codes Reference Data, publication 280ES-R0001 .	Last Protection Trip	Displays the last protection fault code. See the ArmorStartST_IntSafety_Fault_Codes.xlsx files that are attached to this publication. For Fault Codes, see the ArmorStart ST Motor Controller with Integrated Safety Fault Codes Reference Data, publication 280ES-R0001 .
Warning Status	Warns you of a condition, without faulting. Warnings are always enabled. The warning conditions are reported even if the corresponding fault conditions are disabled. Warning bits are cleared automatically when the warning condition is no longer present. 0 = Reserved 1 = Reserved 2 = Phase Loss 3 = Reserved 4 = Reserved 5 = Control Power 6 = I/O Warning 7 = Reserved 8 = Phase Imbalance 9 = A3 Power Loss 10 = Reserved 11 = Reserved 12 = Reserved 13 = Hardware 14 = Reserved 15 = Miscellaneous	Warning Status	Warns you of a condition, without faulting. Warnings are always enabled. The warning conditions are reported even if the corresponding fault conditions are disabled. Warning bits are cleared automatically when the warning condition is no longer present. 0 = Reserved 1 = Reserved 2 = Phase Loss 3 = Reserved 4 = Reserved 5 = Control Power 6 = I/O Warning 7 = Reserved 8 = Phase Imbalance 9 = A3 Power Loss 10 = Reserved 11 = Reserved 12 = Reserved 13 = Hardware 14 = Reserved 15 = Miscellaneous

Bulletin 281ES/GS Starters		Bulletin 284ES/GS VFDs	
Base Trip Status	Provides the status of the Base Module Trip Status. 0 = EEPROM Fault 1 = Internal Comm 2 = Hardware Fault 3 = Control Module	Base Trip Status	Provides the status of the Base Module Trip Status. 0 = EEPROM Fault 1 = Internal Comm 2 = Hardware Fault 3 = Control Module
Phase A Current	Displays the current of Phase A measured in increments of 1/10th of an ampere	Output Current	Displays output current
Phase B Current	Displays the current of Phase B measured in increments of 1/10th of an ampere	Output Voltage	Displays output voltage
Phase C Current	Displays the current of Phase C measured in increments of 1/10th of an ampere	DC Bus Voltage	Displays DC Bus voltage
Average Current	Displays the average current that is measured in increments of 1/10th of an ampere	Internal Comm Status	Display status of internal communication
Percent TCU	Displays the % Thermal Capacity used	Elapsed Run Time	Provides elapsed runtime
		Output Power	Displays output power
		Output Power Factor	Displays output power factor
		Drive Temp	Displays drive temperature
		Torque Current	Displays torque current

- Use the pull-down menus to specify the drive function that is activated when the output tag O.DriveInputX is set.

IMPORTANT Stop the drive before changing this value.
If Speed Reference is set to Preset Frequency via the Motor Protection & Control - Speed Control page, then O.DriveInput0...O.DriveInput3 default to Preset Frequency and O.DriveInput4 is set to No Action.

Table 51 - Drive Functions

Setting	Description
Not Used	Default value
Ramp to Stop, Clear Fault	Causes drive to immediately ramp to stop
Coast to Stop, Clear Fault	Causes drive to immediately coast to stop
DC Brake, Clear Fault - DC Injection Braking	Causes drive to immediately begin a DC Injection stop
Activate Current Limit 2	Activates current limiting based on the Activate Current Limit 2 setting
Release Electromechanical Brake	If the EM Brake function is enabled, this input releases the brake
User Fault	Causes drive to ramp to stop and fault based on user-defined input

Configure Fault Actions

The options available for configuration are dependent upon your specific ArmorStart ST motor controller model.

1. Choose Fault Configuration.

Figure 54 - ArmorStart Bulletin 281ES/GS Starters

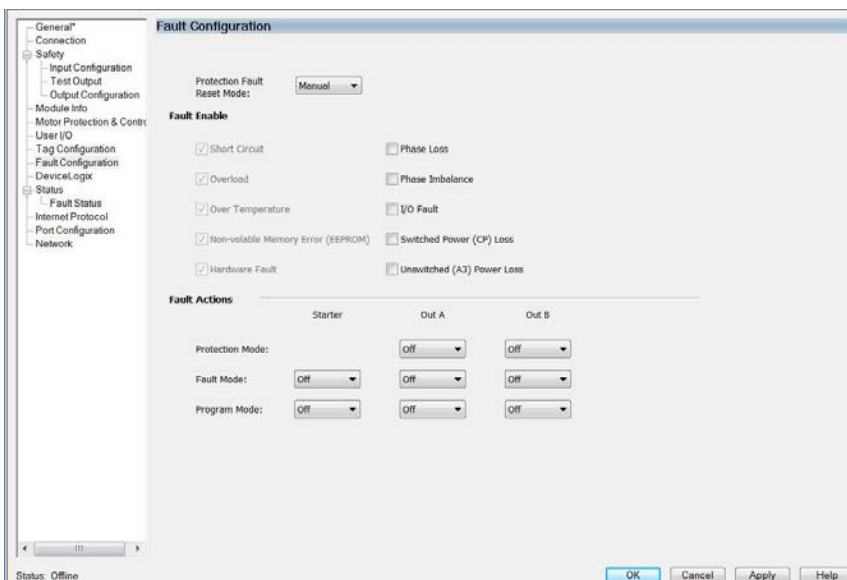
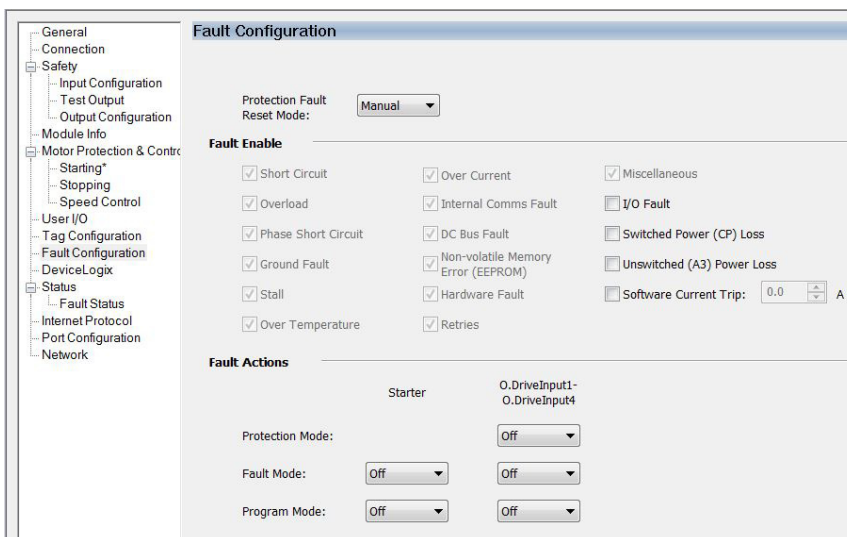


Figure 55 - ArmorStart Bulletin 284 VFDs



2. Choose a Protection Fault Reset Mode to specify how a protection fault reset is activated.
 - Manual – the fault resets when the fault condition clears and you send a Fault Reset command to the motor controller via: local reset button, AOP, fault reset in consume assembly, or through a message instruction. For details, see [Clear Faults on page 130](#).
 - Automatic – the fault resets as soon as the fault condition clears.
3. Check the boxes to enable or disable events that can cause a fault condition. Some events cannot be disabled.
4. Choose a Starter Fault Mode and Starter Program Mode.

The Start Fault Mode specifies how the starter is commanded when a network communications fault occurs. This setting can be ignored if the starter's run command is control in DeviceLogix and a network or communication fault override is enabled.

The Starter Program mode specifies how the starter is commanded when the connected controller enters the Program mode. This setting can be ignored if the starter's run command is control in DeviceLogix and a communication fault override is enabled.

Table 52 - Starter Program Mode

Setting	Description
Off	Clears the motor run command.
On	Sets the motor run command.
Hold	Causes the motor run command bit to hold its value.

5. Choose a Protection Fault Mode for the outputs (OutA or Out B) or output members (O.DriveInput1...O.DriveInput4) to specify the state of the outputs when a protection fault occurs.
 - Off
 - On
 - Ignore
6. Choose a Fault Mode for the outputs (OutA or Out B) or output members (O.DriveInput1...O.DriveInput4) to specify the state of the outputs when a network communication fault occurs.
 - Off
 - On
 - Hold

This setting can be ignored if the starter's run command is control in DeviceLogix and a network or communication fault override is enabled.

7. Choose a Program Mode for the outputs (OutA or Out B) or output members (O.DriveInput1...O.DriveInput4) to specify the state of the outputs when the controller is set to Program mode.
 - Off
 - On
 - Hold

This setting also applies to if the EtherNet/IP network is idle.

This setting can be ignored if the starter's run command is controlled in DeviceLogix and a network or communication fault override is enabled.

View or Edit Additional Settings

The following procedures describe how to view module and network topology information and how to view and edit Internet protocol and port configuration settings.

View Module Information

Follow these steps to view module information.

1. Choose Module Info to display general identification information and status information about the ArmorStart motor controller.

Information that is displayed here is not automatically updated. After you choose Module Info, the Studio 5000 Logix Designer application queries the ArmorStart device once but does not repeat the query. If after the initial query, the status of the ArmorStart device changes, for example a fault occurs, the change in the status is not automatically updated. The Refresh button must be pressed to update the data.



A connection status (offline, online, running, downloading, or uploading) is provided at the bottom left of the page. The connection status appears in all pages.

View Internet Protocol Settings

Follow these steps to view and edit Internet protocol settings.

1. Choose the Internet Protocol to display the following:

If the IP address was created by using the Rotary Network Address Switches, default settings for the IP would already be established and you cannot make any changes in this page. In most cases, you would not need to make any changes in this page and it only displays the current IP Settings Configuration.

View and Edit Port Configuration Settings

Follow these steps to view port configuration settings.

1. Choose Port Configuration to display the following:

Port	Enable	Link Status	Auto-Negotiate	Speed		Duplex		Port Diagnostics
				Selected	Current	Selected	Current	
1	☒		☒					
2	☐		☐					

[Refresh communication.](#)

Status: Running

2. Use the checkbox to enable or disable a physical port in the module.

The ports are normally in Auto Negotiate mode, which in general, is the recommended setting. Otherwise, you have to physically set the Speed or Duplex selection here.

View Network Topology and Status

Choose Network to view information about the network configuration, such as the type of topology (linear or Device Level Ring).

Network Topology: Linear/Star
Network Status: Normal

[Refresh communication.](#)

Status: Running

Using Automatic Device Configuration (ADC)

Automatic Device Configuration (ADC) is a Studio 5000 Logix Designer application feature that supports the automatic download of ArmorStart controller configuration data. When the Logix controller establishes an I/O connection with a drive and its associated peripherals, it checks a configuration signature for each port. This is to determine if an ADC download is needed. The purpose is to reduce downtime in a field replacement situation by automatically downloading the configuration rather than manually with a separate tool.

ADC is available with the following software:

- Studio 5000 Logix Designer, Version 21 or later

The latest drive AOPs ship with each release of Studio 5000 Logix Designer and are also available for free download at:

<http://compatibility.rockwellautomation.com/Pages/home.aspx>



To identify the drive AOP version you are using, open the AOP, click the icon in the upper left corner of the window and select “About Module Profile”.

ADC only works with ArmorStart ST with integrated safety when the Logix I/O connection is made through the embedded Ethernet port.

Firmware updates are available for free download at:

<http://compatibility.rockwellautomation.com/Pages/home.aspx>

If you do not have the minimum levels of software and hardware, the ADC feature is not available (ADC icon is missing or appears dimmed).

ArmorStart controller configuration settings are stored inside the ADC project file. With ADC, the ArmorStart controller automatically downloads the configuration settings for the standard connection and the safety connection of a particular drive if it detects that there is a configuration signature mismatch.

A configuration signature is a globally unique ID number. The ArmorStart controller uses the number to perform a quick compare to determine if a download is needed. If the signatures match, no download is needed. If the entire drive is replaced, the configuration signature for the respective ArmorStart controller does not match and a download occurs.



ATTENTION: Logix holds the Master copy of the drive configuration.

ADC is triggered any time the ArmorStart controller detects a configuration signature mismatch when establishing an EtherNet/IP network I/O connection.

- No other configuration tools are supported. ADC writes over any configuration changes made by the other tools. Any ArmorStart controller configuration changes must be made by editing the Module Properties in the Studio 5000 Logix Designer project.
- The use of a Message instruction to perform parameter writes in the Logix program must be limited to RAM memory by setting the proper Attribute in the MSG instruction. Any writes to parameter nonvolatile storage (NVS) will clear the configuration signature and cause a mismatch the next time the Logix controller connects to the device. This triggers ADC, which writes over any configuration changes that were previously made.
- Any writes to parameters using a Message instruction will clear the configuration signature and cause a mismatch the next time Logix controller connects to the device. This triggers ADC, which writes over any configuration changes that were previously made.

IMPORTANT

ADC executes the first time the ArmorStart controller connects to the PLC. The configuration signature in the PLC and drive synchronize, and stops future ADC downloads from occurring unless a configuration change is made or the drive is replaced.

If a configuration requires a reset to default, ADC will reset to default after the next PLC is downloaded.

IMPORTANT	ADC is activated if the controller is in Run or Program mode. Select 'Inhibit Module' when changes are made to the drive to stop ADC from writing over your changes. 'Inhibit Module' is on the Connection tab in the drive module profile.
IMPORTANT	Use select Stratix switches to provide the dynamic IP address assignment by port. This removes the need to manually enter the IP address, subnet mask, and Gateway address before connecting a replacement drive to the Ethernet network.
IMPORTANT	ADC can work in tandem with the Firmware Supervisor. If the Firmware Supervisor is configured and enabled for a drive ('Exact Match' keying must be used), the drive/ peripheral firmware is automatically updated (if necessary) before any ADC operation for that port.

The integrated safety connection and configuration is not changed using ADC. Its configuration is managed by the Safety Controller and downloaded in the Safety Forward, which opens automatically when the safety connection is opened.

Only two Electronic Keying selections are recommended when using ADC:

Table 53 - Electronic Keying Selections

Electronic Keying Selection	Recommendation
Exact Match	Use this selection only if: - Your system design specification requires that a replacement drive/ peripheral is identical—down to the Minor revision of firmware (x.xxx). - You are implementing Firmware Supervisor upgrade support and ADC. ControlFLASH™ firmware kits for the revision of firmware that is used for each drive/peripheral must be installed on the computer that runs the programming software. Upgrade files can be downloaded from: http://compatibility.rockwellautomation.com/Pages/home.aspx
Compatible Module	This is the recommended setting to use for ADC when Firmware Supervisor is not used.
Disable Keying	When using ADC, this selection is not recommended. This selection allows a replacement to have any different Device Type, Product Code, or Major (X.xxx) and/or Minor (X.xxx) firmware revision. It is up to the user to provide a replacement that has a firmware revision greater than or equal to the original. If a replacement with older firmware is used, the ADC download can fail.

Parameter Changes

If a you decide to change a parameter value through an HMI, you must change it in the Logix .C folder. This is where ADC resides. If you change the parameter directly and not the value in the .C folder, upon the next network connection ADC will take over and overwrite what you just did. So there are only two ways to change a value from default to user defined:

1. The recommended method is to always use the AOP.
2. In some cases the OEM will create a simple operator screen on a HMI. If an HMI is used, then the OEM must change the value for the specific field in the .C folder, using logic and HMI.

Auto-generated Tags

After you configure the ArmorStart motor controller, the controller tags are generated for standard and safety inputs and outputs. The data from the input (produced) and output (consumed) assemblies is used as descriptive tag names to simplify programming. The standard input and output tag tables in this section are each followed by a table that shows the assemblies, to illustrate the correlation.

IMPORTANT The total number of bytes that are listed in these tables may not include hidden bytes. So, the resulting total number of bytes may be greater than what is shown in this publication.

Table 54 - Configuration Tags

Bulletin 281ES/GS Starters	Bulletin 284ES/GS VFDs
DeviceName.C.MotorFullLoadCurrent	DeviceName.C.MotorFullLoadCurrent
DeviceName.C.MotorOverloadCurrent	DeviceName.C.MotorOverloadCurrent
DeviceName.C.MotorCurrentLimit1	DeviceName.C.MotorCurrentLimit1
DeviceName.C.MotorCurrentLimit2	DeviceName.C.MotorCurrentLimit2
DeviceName.C.MotorOverloadRetention	DeviceName.C.MotorOverloadRetention
DeviceName.C.MotorOverloadDerateSelect	DeviceName.C.MotorOverloadDerateSelect
—	DeviceName.C.IRVoltageDrop
—	DeviceName.C.FluxCurrentRef
—	DeviceName.C.IRCompensation
—	DeviceName.C.MaxVoltage
—	DeviceName.C.SlipHertzAtFLA
—	DeviceName.C.PWMFrequency
DeviceName.C.NetworkOverride	DeviceName.C.NetworkOverride
DeviceName.C.CommFaultOverride	DeviceName.C.CommFaultOverride
—	DeviceName.C.FlyingStartEn
—	DeviceName.C.AutoRestartTries
—	DeviceName.C.AutoRestartDelay
—	DeviceName.C.BoostSelect
—	DeviceName.C.StartBoost
—	DeviceName.C.BreakVoltage
—	DeviceName.C.MinFrequency
—	DeviceName.C.StopMode
—	DeviceName.C.BusRegulatorEn
—	DeviceName.C.DCBusVoltageThreshold
—	DeviceName.C.EMOffDelay
—	DeviceName.C.EMOnDelay
—	DeviceName.C.DCBrakeLevel
—	DeviceName.C.DCBrakeTime
—	DeviceName.C.SpeedReference
—	DeviceName.C.AccelTime1
—	DeviceName.C.DecelTime1
—	DeviceName.C.JogFrequency
—	DeviceName.C.JogAccelDecel
—	DeviceName.C.AccelTime2
—	DeviceName.C.DecelTime2
—	DeviceName.C.SkipFrequency
—	DeviceName.C.SkipFrequencyBand
—	DeviceName.C.SCurvePercentage
DeviceName.C.UserIOFilterOffOn	DeviceName.C.UserIOFilterOffOn
DeviceName.C.UserIOFilterOnOff	DeviceName.C.UserIOFilterOnOff
DeviceName.C.InputSinkSource	DeviceName.C.InputSinkSource

Table 54 - Configuration Tags

Bulletin 281ES/GS Starters	Bulletin 284ES/GS VFDs
DeviceName.C.IntXXDeviceOutConfig (where XX = 00...03)	DeviceName.C.IntXXDeviceOutConfig (where XX = 00...03)
DeviceName.C.FaultResetMode	DeviceName.C.FaultResetMode
DeviceName.C.ControlPowerTripEn	DeviceName.C.ControlPowerTripEn
DeviceName.C.IOFaultTripEn	DeviceName.C.IOFaultTripEn
DeviceName.C.A3PowerLossTripEn	DeviceName.C.A3PowerLossTripEn
DeviceName.C.StarterNetFaultState	DeviceName.C.StarterNetFaultState
DeviceName.C.StarterNetFaultValue	DeviceName.C.StarterNetFaultValue
DeviceName.C.StarterNetIdleState	DeviceName.C.StarterNetIdleState
DeviceName.C.StarterNetIdleValue	DeviceName.C.StarterNetIdleValue
DeviceName.C.OutputAProtectionFaultState	—
DeviceName.C.OutputAProtectionFaultValue	—
DeviceName.C.OutputANetFaultState	—
DeviceName.C.OutputANetFaultValue	—
DeviceName.C.OutputANetIdleState	—
DeviceName.C.OutputANetIdleValue	—
DeviceName.C.OutputBProtectionFaultState	—
DeviceName.C.OutputBProtectionFaultValue	—
DeviceName.C.OutputBNetFaultState	—
DeviceName.C.OutputBNetFaultValue	—
DeviceName.C.OutputBNetIdleState	—
DeviceName.C.OutputBNetIdleValue	—
—	DeviceName.C.DrvInPrFltState
—	DeviceName.C.DrvInPrFltValue
—	DeviceName.C.DrvInNetFltState
—	DeviceName.C.DrvInNetFltValue
—	DeviceName.C.DrvInNetIdleState
—	DeviceName.C.DrvInNetIdleValue
DeviceName.C.SoftwareCurrentTrip	DeviceName.C.SoftwareCurrentTrip
DeviceName.C.PresetFrequencyX (where X = 0...7)	DeviceName.C.PresetFrequencyX (where X = 0...7)

Table 55 - Standard Input Tags

Bulletin 281ES/GS Starters	Bulletin 284ES/GS VFDs	Function
DeviceName.I.Fault	DeviceName.I.Fault	Communication Fault between PLC and Device (all 1's = Fault, all 0's = Normal)
DeviceName.I.TripPresent	DeviceName.I.TripPresent	Fault exists with unit
DeviceName.I.WarningPresent	DeviceName.I.WarningPresent	Warning of potential fault
DeviceName.I.RunningForward	DeviceName.I.RunningForward	Motor commanded to run forward
DeviceName.I.RunningReverse	DeviceName.I.RunningReverse	Motor commanded to run reverse
DeviceName.I.Ready	DeviceName.I.Ready	Control Power and 3-phase present
—	DeviceName.I.NetControlStatus	Start and Stop command comes from network (PLC or Connected Explicit Messaging)
—	DeviceName.I.NetReferenceStatus	Speed reference comes from the network (not DeviceLogix)
—	DeviceName.I.AtReference	At commanded speed reference
DeviceName.I.KeypadHand	DeviceName.I.KeypadHand	HOA is in Auto mode
DeviceName.I.DisconnectClosed	DeviceName.I.DisconnectClosed	Disconnect is closed
—	DeviceName.I.BrakeContactorStatus	Source brake contactor status (1=close, 0=open)
—	DeviceName.I.OutputFrequency	VFD frequency
DeviceName.I.PtXXDeviceOut (where XX = 00...14)	DeviceName.I.PtXXDeviceOut (where XX = 00...14)	DeviceLogix network output status
DeviceName.I.LogicEnabled	DeviceName.I.LogicEnabled	DeviceLogix is enabled

Table 55 - Standard Input Tags

Bulletin 281ES/GS Starters	Bulletin 284ES/GS VFDs	Function
DeviceName.I.IntXXDeviceOut (where XX = 00...03)	DeviceName.I.IntXXDeviceOut (where XX = 00...03)	Data referenced by DeviceName.C.IntXXDeviceOutCfg
DeviceName.I.InX (where X = the number of standard inputs)	DeviceName.I.InX (where X = the number of standard inputs)	Input XX
DeviceName.I.SafetyTorqueEnabled	DeviceName.I.SafetyTorqueEnabled	Motor torque permitted
DeviceName.I.SafetyIn00Data	DeviceName.I.SafetyIn00Data	The value read from Safety Input 0
DeviceName.I.SafetyIn01Data	DeviceName.I.SafetyIn01Data	The value read from Safety Input 1
DeviceName.I.SafetyIn00Status	DeviceName.I.SafetyIn00Status	The status of safety input 0
DeviceName.I.SafetyIn01Status	DeviceName.I.SafetyIn01Status	The status of safety input 1
DeviceName.I.SafetyOut00Monitor	DeviceName.I.SafetyOut00Monitor	The readback value of Safety Output 0
DeviceName.I.SafetyOut01Monitor	DeviceName.I.SafetyOut01Monitor	The readback value of Safety Output 1
DeviceName.I.SafetyOut00Status	DeviceName.I.SafetyOut00Status	The status of Safety Output 0
DeviceName.I.SafetyOut01Status	DeviceName.I.SafetyOut01Status	The status of Safety Output 1
DeviceName.I.Fault	DeviceName.I.Fault	Communication Fault between PLC and Device (all 1's = Fault, all 0's = Normal)
DeviceName.I.TripPresent	DeviceName.I.TripPresent	Fault exists with unit
DeviceName.I.WarningPresent	DeviceName.I.WarningPresent	Warning of potential fault
DeviceName.I.RunningForward	DeviceName.I.RunningForward	Motor commanded to run forward
DeviceName.I.RunningReverse	DeviceName.I.RunningReverse	Motor commanded to run reverse
DeviceName.I.Ready	DeviceName.I.Ready	Control Power and 3-phase present
—	DeviceName.I.NetControlStatus	Start and Stop command comes from network (PLC or Connected Explicit Messaging)
—	DeviceName.I.NetReferenceStatus	Speed reference comes from the network (not DeviceLogix)
—	DeviceName.I.AtReference	At commanded speed reference
DeviceName.I.KeypadHand	DeviceName.I.KeypadHand	HOA is in Auto mode
DeviceName.I.DisconnectClosed	DeviceName.I.DisconnectClosed	Disconnect is closed
—	DeviceName.I.BrakeContactorStatus	Source brake contactor status (1=close, 0=open)
—	DeviceName.I.OutputFrequency	VFD frequency
DeviceName.I.PtXXDeviceOut (where XX = 00...14)	DeviceName.I.PtXXDeviceOut (where XX = 00...14)	DeviceLogix network output status
DeviceName.I.LogicEnabled	DeviceName.I.LogicEnabled	DeviceLogix is enabled
DeviceName.I.IntXXDeviceOut (where XX = 00...03)	DeviceName.I.IntXXDeviceOut (where XX = 00...03)	Data referenced by DeviceName.C.IntXXDeviceOutCfg
DeviceName.I.InX (where X = the number of standard inputs)	DeviceName.I.InX (where X = the number of standard inputs)	Input XX
DeviceName.I.SafetyTorqueEnabled	DeviceName.I.SafetyTorqueEnabled	Motor torque permitted
DeviceName.I.SafetyIn00Data	DeviceName.I.SafetyIn00Data	The value read from Safety Input 0
DeviceName.I.SafetyIn01Data	DeviceName.I.SafetyIn01Data	The value read from Safety Input 1
DeviceName.I.SafetyIn00Status	DeviceName.I.SafetyIn00Status	The status of safety input 0
DeviceName.I.SafetyIn01Status	DeviceName.I.SafetyIn01Status	The status of safety input 1
DeviceName.I.SafetyOut00Monitor	DeviceName.I.SafetyOut00Monitor	The readback value of Safety Output 0
DeviceName.I.SafetyOut01Monitor	DeviceName.I.SafetyOut01Monitor	The readback value of Safety Output 1
DeviceName.I.SafetyOut00Status	DeviceName.I.SafetyOut00Status	The status of Safety Output 0
DeviceName.I.SafetyOut01Status	DeviceName.I.SafetyOut01Status	The status of Safety Output 1

Table 56 - Default Status Assembly for Bulletin 281ES/GS-22* Starters

Instance 156 'Starter Stat' - Default Status Assembly for Bulletin 281ES/GS-22* Starters								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved							
1	Reserved							
2	Reserved							
3	Reserved							
4	—	—	—	Ready	Running Rev	Running Fwd	Warning	Trip
5	—	—	DisconnectClosed	Hand	—	—	—	—
6	Net Out 7	Net Out 6	Net Out 5	Net Out 4	Net Out 3	Net Out 2	Net Out 1	Net Out 0
7	Logic Enable	Net Out 14	Net Out 13	Net Out 12	Net Out 11	Net Out 10	Net Out 9	Net Out 8
8	Value of the parameter pointed to by "Produced Word 0 Param" (low byte)							
9	Value of the parameter pointed to by "Produced Word 0 Param" (high byte)							
10	Value of the parameter pointed to by "Produced Word 1 Param" (low byte)							
11	Value of the parameter pointed to by "Produced Word 1 Param" (high byte)							
12	Value of the parameter pointed to by "Produced Word 2 Param" (low byte)							
13	Value of the parameter pointed to by "Produced Word 2 Param" (high byte)							
14	Value of the parameter pointed to by "Produced Word 3 Param" (low byte)							
15	Value of the parameter pointed to by "Produced Word 3 Param" (high byte)							
16	—	—	—	—	Input 4	Input 3	Input 2	Input 1
17	Safety Torque Enabled ⁽¹⁾	—	—	—	Safety In01 Status ⁽¹⁾	Safety In00 Status ⁽¹⁾	Safety In01 Data ⁽¹⁾	Safety In00 Data ⁽¹⁾
18	—	—	—	—	Safety Out01 Status ⁽¹⁾	Safety Out00 Status ⁽¹⁾	Safety Out01 Monitor ⁽¹⁾	Safety Out00 Monitor ⁽¹⁾

(1) Safety status bit brought over from the safety assemblies.

Additional assembly information is available, see [I/O Assemblies on page 148](#).

Table 57 - Produced Assembly for Bulletin 284ES/GS-22* VFDs

Instance 157 'Drive Status' - Produced Assembly for 284ES/GS-22* VFDs								
Byte ⁽¹⁾	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved							
1	Reserved							
2	Reserved							
3	Reserved							
4	At Reference	Net Ref Status	Net Ctl Status	Ready	Running Rev	Running Fwd	Warning	Trip
5	—	BrakeContactor Status	DisconnectClosed	Hand	—	—	—	—
6	Output Frequency (Low) (xxx.x Hz)							
7	Output Frequency (High) (xxx.x Hz)							
8	Net Out 8	Net Out 7	Net Out 6	Net Out 5	Net Out 4	Net Out 3	Net Out 2	Net Out 1
9	Logic Enabled	Net Out 15	Net Out 14	Net Out 13	Net Out 12	Net Out 11	Net Out 10	Net Out 9
10	Value of the parameter pointed to by "Produced Word 0 Param" (low byte)							
11	Value of the parameter pointed to by "Produced Word 0 Param" (high byte)							
12	Value of the parameter pointed to by "Produced Word 1 Param" (low byte)							
13	Value of the parameter pointed to by "Produced Word 1 Param" (high byte)							
14	Value of the parameter pointed to by "Produced Word 2 Param" (low byte)							
15	Value of the parameter pointed to by "Produced Word 2 Param" (high byte)							
16	Value of the parameter pointed to by "Produced Word 3 Param" (low byte)							
17	Value of the parameter pointed to by "Produced Word 3 Param" (high byte)							
18	—	—	—	—	Input 4	Input 3	Input 2	Input 1
19	Safety Torque Enabled ⁽²⁾	—	—	—	Safety In01 Status ⁽¹⁾	Safety In00 Status ⁽¹⁾	Safety In01 Data ⁽¹⁾	Safety In00 Data ⁽¹⁾
20	—	—	—	—	Safety Out01 Status ⁽¹⁾	Safety Out00 Status ⁽¹⁾	Safety Out01 Monitor ⁽¹⁾	Safety Out00 Monitor ⁽¹⁾

(1) Hidden bytes are not listed so the total number of bytes is more than what is shown.

(2) Safety status bit brought over from the safety assemblies.

Additional assembly information is available, see [I/O Assemblies on page 148](#).

Table 58 - Consumed Assembly for Bulletin 281ES/GS Starters

Instance 162 'Starter Cmd' - DeviceLogix Consumed Assembly for Bulletin 281ES/GS Starters								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	User Out B	User Out A	—	—	—	Fault Reset	Run Rev	Run Fwd
1	Net In 7	Net In 6	Net In 5	Net In 4	Net In 3	Net In 2	Net In 1	Net In 0
2	Net In 15	Net In 14	Net In 13	Net In 12	Net In 11	Net In 10	Net In 9	Net In 8

Table 59 - Consumed Assembly for Bulletin 284ES/GS VFDs

Instance 166 'Drive Cmd' - DeviceLogix Consumed Assembly for Bulletin 284ES/GS VFDs								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	User Out B	User Out A	—	Jog Rev	Jog Fwd	Fault Reset	Run Rev	Run Fwd
1	Drive In 4	Drive In 3	Drive In 2	Drive In 1	Decel Control 2	Decel Control 1	Accel Control 2	Accel Control 1
2	Comm Freq Command (Low) (xxx.x Hz)							
3	Comm Freq Command (High) (xxx.x Hz)							
4	Net In 8	Net In 7	Net In 6	Net In 5	Net In 4	Net In 3	Net In 2	Net In 1
5	Net In 16	Net In 15	Net In 14	Net In 13	Net In 12	Net In 11	Net In 10	Net In 9

Additional assembly information is available, see [I/O Assemblies on page 148](#).

Table 60 - Standard Output Tags

Bulletin 281ES/GS Starters	Bulletin 284ES/GS VFDs	Function
DeviceName.O.RunForward	DeviceName.O.RunForward	Command VFD forward
DeviceName.O.RunReverse	DeviceName.O.RunReverse	Command VFD reverse
DeviceName.O.ResetFault	DeviceName.O.ResetFault	Fault reset
—	DeviceName.O.JogForward	Command Jog forward per internal frequency
—	DeviceName.O.JogReverse	Command Jog reverse per internal frequency
—	DeviceName.O.AccelCtrl_0	VFD acceleration ramp 1
—	DeviceName.O.AccelCtrl_1	VFD acceleration ramp 2
—	DeviceName.O.DecelCtrl_0	VFD deceleration ramp 1
—	DeviceName.O.DecelCtrl_1	VFD deceleration ramp 2
DeviceName.O.OutA	DeviceName.O.OutA	OutputA
DeviceName.O.OutB	DeviceName.O.OutB	OutputB
—	DeviceName.O.DriveInput1	VFD Digit Input 1
—	DeviceName.O.DriveInput2	VFD Digit Input 2
—	DeviceName.O.DriveInput3	VFD Digit Input 3
—	DeviceName.O.DriveInput4	VFD Digit Input 4
—	DeviceName.O.FrequencyCommand	Logix commanded frequency
DeviceName.O.PtXXDeviceIn (where XX = 00...15)	DeviceName.O.PtXXDeviceIn (where XX = 00...15)	Network input to DeviceLogix engine

Table 61 - Default Consume Assembly for Bulletin 281ES/GS Starters

Instance 162 Default Consumed DOL and Reversing Starter								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	OutB	OutA	—	—	—	ResetFault	RunReverse	RunForward
1	Pt07DeviceIn	Pt06DeviceIn	Pt05DeviceIn	Pt04DeviceIn	Pt03DeviceIn	Pt02DeviceIn	Pt01DeviceIn	Pt00DeviceIn
2	Pt15DeviceIn	Pt14DeviceIn	Pt13DeviceIn	Pt12DeviceIn	Pt11DeviceIn	Pt10DeviceIn	Pt09DeviceIn	Pt08DeviceIn

Table 62 - Default Consume Assembly for Bulletin 284ES/GS VFDs

Instance 166 Consumed Inverter Type Starter with Network Inputs								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Out B	Out A	—	JogReverse	JogForward	ResetFault	RunReverse	RunForward
1	DriveInput4 ⁽¹⁾	DriveInput3 ⁽¹⁾	DriveInput2 ⁽¹⁾	DriveInput1 ⁽¹⁾	DecelCtrl_1	DecelCtrl_0	AccelCtrl_1	AccelCtrl_0
2	FreqCommand (Low) (xxx.x Hz)							
3	FreqCommand (High) (xxx.x Hz)							
4	Pt07DeviceIn	Pt06DeviceIn	Pt05DeviceIn	Pt04DeviceIn	Pt03DeviceIn	Pt02DeviceIn	Pt01DeviceIn	Pt00DeviceIn
5	Pt15DeviceIn	Pt14DeviceIn	Pt13DeviceIn	Pt12DeviceIn	Pt11DeviceIn	Pt10DeviceIn	Pt09DeviceIn	Pt08DeviceIn

(1) See [Configure Input and Output Tags on page 110](#)

See [Safe Torque Off Operation on page 49](#) for information on the functions of the safety input and output tags.

Table 63 - Safety Input Tags

Bulletin 281ES/GS Starters	Bulletin 284ES/GS VFDs
DeviceName.SI.RunMode	DeviceName.SI.RunMode
DeviceName.SI.ConnectionFaulted	DeviceName.SI.ConnectionFaulted
DeviceName.SI.ST0Active	DeviceName.SI.ST0Active
DeviceName.SI.TorqueDisabled	DeviceName.SI.TorqueDisabled
DeviceName.SI.SafetyFault	DeviceName.SI.SafetyFault
DeviceName.SI.RestartRequired	DeviceName.SI.RestartRequired
DeviceName.SI.Out00Monitor	DeviceName.SI.Out00Monitor
DeviceName.SI.Out01Monitor	DeviceName.SI.Out01Monitor
DeviceName.SI.Out00Status	DeviceName.SI.Out00Status
DeviceName.SI.Out01Status	DeviceName.SI.Out01Status
DeviceName.SI.Out00Ready	DeviceName.SI.Out00Ready
DeviceName.SI.Out01Ready	DeviceName.SI.Out01Ready
DeviceName.SI.In00Data	DeviceName.SI.In00Data
DeviceName.SI.In01Data	DeviceName.SI.In01Data
DeviceName.SI.In02Data	DeviceName.SI.In02Data
DeviceName.SI.In03Data	DeviceName.SI.In03Data
DeviceName.SI.In00Status	DeviceName.SI.In00Status
DeviceName.SI.In01Status	DeviceName.SI.In01Status
DeviceName.SI.In02Status	DeviceName.SI.In02Status
DeviceName.SI.In03Status	DeviceName.SI.In03Status
DeviceName.SI.In00Valid	DeviceName.SI.In00Valid
DeviceName.SI.In01Valid	DeviceName.SI.In01Valid
DeviceName.SI.In02Valid	DeviceName.SI.In02Valid
DeviceName.SI.In03Valid	DeviceName.SI.In03Valid

Table 64 - Safety Output Tags

Bulletin 281ES/GS Starters	Bulletin 284ES/GS VFDs
DeviceName.S0.SafeTorqueOff	DeviceName.S0.SafeTorqueOff
DeviceName.S0.ResetRequest	DeviceName.S0.ResetRequest
DeviceName.S0.Output00Data	DeviceName.S0.Output00Data
DeviceName.S0.Output01Data	DeviceName.S0.Output01Data

Diagnostics and Troubleshooting

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Status Indicators

The ArmorStart® ST motor control has several groups of light-emitting diode (LED) status indicators, including control module status, I/O status, and motion power status, as described in this section.

The EtherNet/IP network status indicators are described in [EtherNet/IP LED Status Indication on page 78](#).

IMPORTANT	Status indicators are not reliable for safety functions. Use status indicators only for general diagnostics during commissioning or troubleshooting. Do not attempt to use status indicators to determine operational status.
------------------	---

Control Module Status and Reset

The Control module status and diagnostics consist of four status LEDs and a Reset button. The following is a brief explanation of the operation of each status indicator that is found on the control module.

Table 65 - Control Module Status Indication

LED	Definition	Recommended Action
Power	This LED is illuminated solid green when switched control power is present and with the proper polarity.	Verify that 24V DC is present on A1 and A2. Check if the local disconnect is in the OFF position.
Run	This LED is illuminated solid green when a start command and control power are present.	Verify that 24V DC is present on A1 and A3. Check if you are properly commanding to RUN via Instance 162 or 166. See Instance 162 on page 157 or see Instance 166 on page 158 for more information. Verify that the safety function is satisfied for the safety version controller. Check that the safety I/O module output for SM1 is on. If Run command is coming from the H0A, check that the keypad is not disabled.
Network	This bicolor LED is used to indicate the status of the internal network connection.	See Table 32 on page 78 for additional information.
Fault	This LED is used to indicate the fault status of the ArmorStart controller.	See the Blink Patterns and Trip Status on page 131 for more information.

LED Status Indication and Reset



The Reset button is a local trip reset.

Module Status

Represents the status of the Ethernet communication and safety supervisor status.

Table 66 - Module (MOD) Status Indicator

Indicator	Summary/Safety Supervisor State	Description
OFF	No Power	No Power is applied to the device.
Steady Green	Device operational/ Executing with torque permitted	The device is operating correctly and the programmable controller is in Run mode.
Flashing Green	Standby/Idle or Not configured (torque permitted)	The device has not been configured, or the programmable controller is not in Run mode.
Flashing Red/ Green	Self-test or Standby/Configuring	The device is performing a power-up test or is in a transitional state (configuring or waiting for configuration).
Flashing Red	Major recoverable fault/Abort	The device detected a recoverable fault.
Steady Red	Major unrecoverable fault/ Critical fault	The device detected a nonrecoverable major fault. ⁽¹⁾

(1) You can configure an output tag to display base trip status for more information on some major faults. See [Configure Input and Output Tags on page 110](#).

Standard I/O and Safety I/O Point Status

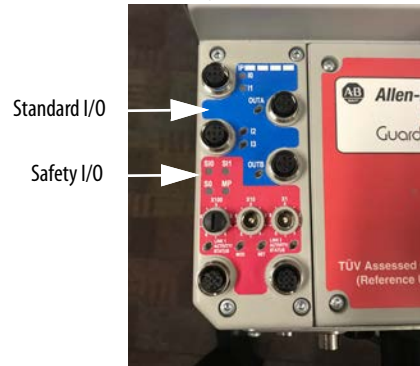


Table 67 - Standard I/O Point Status

Indicator	Status	Description
Inputs: IO...I3 (Bulletin 281ES and 284ES units) IO...I5 (Bulletin 281GS and 284GS units)	Solid yellow	The input/output point is on.
Outputs: OutA and OutB (Bulletin 281ES and 284ES units)	Off	The input/output point is off.

Table 68 - Safety I/O Point Status

Indicator	Status	Description
Inputs: SI0 and SI1	Solid yellow	The safety input is on.
	Off	The safety input is off.
	Solid red	A fault in the external wiring or input circuit has been detected.
	Flashing red	A fault in the partner circuit of a dual input configuration has been detected.
Output: SO	Solid yellow	The safety output is on.
	Off	The safety output is off or the device is being configured.
	Solid red	A fault in the output circuit has been detected or the tag values in a dual output configuration do not have the same value.
	Flashing red	A fault in the partner circuit of a dual output configuration has been detected.

Motion Power Status

Table 69 - Motion Power Status

State	Status Indicator	Description
Torque disabled	Off	Torque is disabled.
Torque permitted	Solid green	The STO circuit is permitting torque.
Circuit fault	Flashing red	The STO circuit is faulted.

View Status and Trip Log

View the Status page and Fault Status page to monitor the status of the motor controller. You can also create a report to save the status and configuration of the ArmorStart motor controller to a text file.

View ArmorStart Status

The display varies based on your type of ArmorStart motor controller.

Figure 56 - Status for ArmorStart Bulletin 281ES/GS Starters



Figure 57 - Status for ArmorStart Bulletin 284ES/GS VFDs



Using the Create Report button on the Status screen, generates a report that shows the Module Definition, Module Status, Trip Log data, Motor Protection and Control Settings, as well as I/O, Tag, and Fault configurations.

In the Starter section, the text above the status LED indicates the current state of the motor controller, for example, Running Forward. The indicator states are described in the next table.

Table 70 - Motor Controller Status Indicators

ArmorStart Status	Indicator State
Not Ready	Off
Running with no faults or warnings	Green
Warning exists without a fault	Yellow
Fault condition	Red
Offline/indeterminate	Gray

In the User I/O section, the indicators show the on (solid yellow) or off (not lit) status of each standard I/O point.

The Miscellaneous Data section displays the current operating values. The values that are shown are dependent upon the type of ArmorStart motor controller.

The Unit data section displays serial number and MAC ID of the ArmorStart motor controller.

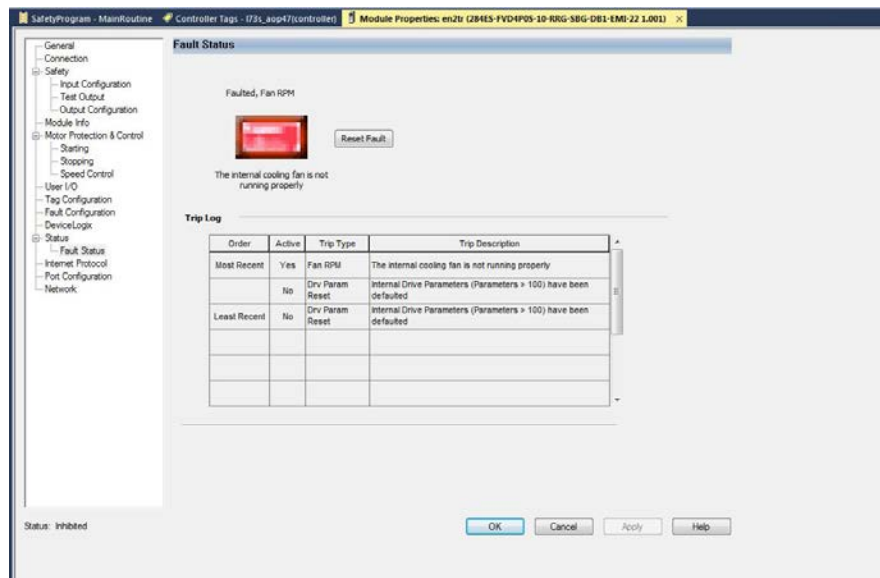
In the Safety Status section, indicators display the follow status.

Table 71 - Safety Status Indicators

Indicator	State	Description
Motion Power	Gray	Motion power is disabled or offline
	Green	Motion power exists/STO circuit is permitting torque
	Red	No motion power/STO circuit is faulted
Safety Fault	Amber	No safety fault
	Red	A safety fault exists
	Gray	Unit is disabled or offline
Restart Required	Amber	No restart required
	Red	Restart required
	Gray	Unit is disabled or offline

View Fault Status and Trip Log

On the Fault Status page, the text above the status LED indicates the current state of the motor controller, or the current fault/warning condition. The text below the indicator provides a more detailed description of the fault or warning condition, if one exists.



The indicator states are described in the next table.

Table 72 - Fault Status

AarmorStart Status	Indicator State
Not Ready	Off
Running with no faults or warnings	Green
Warning exists without a fault	Yellow
Fault condition	Red
Offline/indeterminate	Gray

If the ArmorStart is currently in the faulted state, the Reset Fault button is enabled. To reset the ArmorStart fault state, press Reset Fault.

The Trip Log displays the most recent trip at the top.

Clear Faults

You can clear a fault by using the following methods:

- Remotely via network communications
- A remote reset is attempted upon detection of a rising edge (0 to 1 transition) of the Fault Reset bit in the various I/O assemblies. A remote reset is also attempted upon detection of the rising edge of the PR Fault reset (Parameter 25).
- Locally via the Fault Clear button on the front of the drive
- Via the Reset Fault button on the Fault Status page in Logix Designer project. See [Monitor ArmorStart ST Motor Control Faults on page 131](#).

Monitor Safety Status and Faults

To obtain more detailed information about safety status or safety faults, you can create a MSG instruction in your ladder logic program to read specific attribute information.

See [Overview on page 167](#) for an example on how to use the MSG instruction to read status.

Safety Supervisor State

The Safety Supervisor State provides information on the state of the safety connection and the mode of operation. It can be read in your Logix program by using a MSG instruction.

Table 73 - Safety Supervisor State

Parameter	Value	Description
Service Code	0x0E	Get Attribute Single
Class	0x39	Safety Supervisor
Instance	1	Safety Supervisor Instance
Attribute	0x0B	Device Status
Data Type	SINT	Unsigned Short Integer

Safe Torque Off Faults

When a safety fault is indicated in the SI.SafetyFault tag, you can also use an MSG instruction to read the cause of the fault. The safe stop function records the specific fault type in the STO Fault Type attribute.

Table 74 - STO Fault Type

Parameter	Value	Description
Service Code	0x0E	Get Attribute Single
Class	0x5A	Safety stop functions
Instance	1	Drive-module safety instance
Attribute	0x108	STO fault type 3 = Circuit Err: Internal STO diagnostics has found an issue with STO circuitry. 4 = Stuck Low: Internal STO health and/or power input stuck low. 5 = Stuck High: Internal STO health and/or power input stuck high.
Data Type	SINT	Unsigned Short integer



ATTENTION: You cannot reset safety and issue a run command at the same time. The safety enable must be present before a run command can be issued.

Monitor ArmorStart ST Motor Control Faults

When diagnosing faults, check the following:

1. The Fault status indicator on the front of the unit indicates trips with a blink pattern that corresponds to the Trip Status as described in [Blink Patterns and Trip Status on page 131](#).
2. For more detail than is provided by the blink pattern and trip status, see the Last Protection Trip value, which is displayed on the Fault Status page or from an input tag that is configured to report the data.
3. For some Last Protection Trips on Bulletin 284 VFDs, a corresponding Drive Fault provides additional information. See [Drive Faults on Bulletin 284 ArmorStart ST VFDs on page 132](#).

The Last Protection Fault codes (bit values) and Drive Fault Codes are listed with corrective actions in the ArmorStart ST Motor Controller with Integrated Safety Fault Codes Reference Data, publication [280ES-RD001](#).

Blink Patterns and Trip Status

For certain faults, the motor controller responds with a specific blink pattern to identify the fault. The blink pattern corresponds to data stored in Trip Status bits as shown in [Table 75](#).

[Table 75](#) also indicates which faults are auto-resettable and which faults can be enabled or disabled.

Table 75 - Blink Pattern Faults and Trip Status Bits

Blink Pattern	Bulletin 281ES/GS Starters		Bulletin 284ES/GS VFDs		Definition ⁽¹⁾
	Trip Status Bits	Auto-resettable ⁽²⁾	Trip Status Bits	Auto-resettable	
1	0 = Short Circuit	No	0 = Short Circuit	No	Short Circuit indicates that the Bulletin 140M motor protector has tripped, or that the internal wiring protection algorithm has detected an unsafe current surge. This fault cannot be disabled.
2	1 = Overload	Yes	1 = Overload	Drive Controlled ⁽³⁾	The load has drawn excessive current and based on the overload trip class that is selected, the device has tripped. This fault cannot be disabled.
3	2 = Phase Loss	Yes	—	—	Indicates a missing supply phase. This fault can be disabled and is disabled by default.
	—	—	2 = Phase Short	Drive Controlled	Indicates that the drive has detected a phase short. This fault cannot be disabled.
4	Reserved		3 = Ground Fault	Drive Controlled	Indicates that the drive has detected a ground fault. This fault cannot be disabled.
5	Reserved		4 = Stall	Drive Controlled	Indicates that the drive has detected a stall condition, which indicates the motor, has not reached full speed. This fault cannot be disabled.
6	5 = Control Power	Yes	5 = Control Power	Yes	Indicates a loss of control power voltage or a blown control power circuit. This fault can be disabled and is disabled by default.
7	6 = I/O Fault	Yes	6 = I/O Fault	Yes	This error can indicate a shorted sensor, shorted input device, or input wiring mistakes. It can also indicate a blown output fuse. This fault can be disabled and is disabled by default.
8	7 = Over Temperature	Yes	7 = Over Temperature	Yes	Indicates that the operating temperature has been exceeded. This fault cannot be disabled.
9	8 = Phase Imbalance	Yes	—	—	Indicates an imbalance supply voltage. This fault can be disabled and is disabled by default.
	—		8 = Over Current	Drive Controlled	Indicates that the drive has detected an overcurrent fault. This fault cannot be disabled.
10	9 = A3 Power Loss	Yes	9 = A3 Power Loss	Yes	Power has been lost or has dropped below the 12V threshold. This fault can be disabled and is disabled by default.
11	Reserved	—	10 = Internal Communications	No	Indicates that an internal communication fault has been detected. There is a 10 second delay before an Internal Comm fault is present. This fault cannot be disabled. Check the Fault Status category on the Module Properties dialog box for more details.

Table 75 - Blink Pattern Faults and Trip Status Bits

Blink Pattern	Bulletin 281ES/GS Starters		Bulletin 284ES/GS VFDs		Definition ⁽¹⁾
	Trip Status Bits	Auto-resettable ⁽²⁾	Trip Status Bits	Auto-resettable	
12	Reserved	—	11 = DC Bus Fault	Drive Controlled	Indicates that the drive has detected a DC Bus Fault. This fault cannot be disabled.
13	12 = EEPROM	No	12 = EEPROM	No	A major fault that renders the ArmorStart controller inoperable. This fault cannot be disabled.
14	13 = Hardware Fault	No	13 = Hardware Fault	No	Indicates an Internal FAN RPM is low, Internal temperature monitor failure, Internal Brake fuse opened, or incorrect base or control module. This fault cannot be disabled. For Bulletin 284 units, see also Drive Faults F70 (Power Unit) and F122 (I/O Board Fail).
15	Reserved	—	14 = Restart Retries	Drive Controlled	This fault is generated when the drive detects that the auto retries count has been exceeded. This fault cannot be disabled.
16	Reserved	—	15 = Misc. Fault	Drive Controlled	For Bulletin 284 VFDs, this fault is actually the logical AND of several drive faults that are not specifically enumerated. These faults include DB1 Brake fault, Heatsink Over Temperature, Params Defaulted fault, and SVC Autotune fault, which are indicated by the value of the Last Protection Trip. This fault cannot be disabled.

(1) When a DB1 Fault is announced, see [IP67 Dynamic Brake Diagnostic \(DB1\) on page 134](#).

(2) See [Auto-resettable Faults on page 132](#) for information on how the Protection Fault Reset Mode setting affects how faults are reset.

(3) Whether the drive can be reset is determined by the type of internal drive fault that occurred. See [Drive Faults on Bulletin 284 ArmorStart ST VFDs on page 132](#).

Auto-resettable Faults

Some faults on the main control board are auto-resettable, see [Table 75](#). The Protection Fault Reset Mode setting on the Fault Configuration category of the Module Properties dialog box determines how a fault is reset.

- If Manual is selected, a local or remote fault reset is required to reset the fault.
- If Automatic is selected, faults are cleared automatically when the fault condition goes away.

For Bulletin 284 VFDs, the Auto Restart Tries setting, found on the Motor Protection & Control - Starting page, must also be set to a value greater than 0.



The Auto Restart Tries setting has no effect when the Protection Fault Reset Mode is set to Manual.

See [Configure Fault Actions on page 112](#) for details on configuring the Protection Fault Reset Mode for automatic or manual, and on enabling or disabling faults in the Logix Designer application.

Drive Faults on Bulletin 284 ArmorStart ST VFDs

The Bulletin 284 ArmorStart main control detects some faults, while the internal drive detects other faults. The ArmorStart main control polls the drive for the existence of faults and reports the fault state as part of overall fault status.

Internal drive faults are conditions that stop the drive. The fault type determines whether the fault can be automatically reset. There are two fault types.

Table 76 - Internal Drive Faults

Fault Type		Description
1	Auto-Reset/Run	When the Auto Restart Tries, Relay Output Select, and Auto Restart Delay settings are set to a value greater than 0 and an Auto-reset/Run fault occurs, the Auto Restart Tries and the Auto Restart Delay timers begin counting. When the timer reaches zero, the drive automatically attempts to reset the fault. If the condition that caused the fault is no longer present, the fault is reset and the drive is restarted.
2	Non-Resettable	This type of fault can require drive or motor repair, or is caused by wiring or programming errors. The cause of the fault must be corrected before the fault can be cleared.

The Auto Restart (Type 1 = Auto-Reset/Run) feature provides the ability for the drive to perform a fault reset automatically, followed by a start attempt without user or application intervention. This feature allows remote or unattended operation. Only certain faults can be reset. Certain faults (Type 2) that indicate possible drive component malfunction cannot be reset. Use caution with this feature, because the drive attempts to issue its own start command that is based on user-selected programming.

To determine if a Drive Fault has occurred, create a MSG instruction with the following:

Table 77 - MSG Instruction Data to Check for Drive Fault

Parameter	Value	Description
Service Code	0x0E	Get Attribute Single
Class	0x000F	Parameter Object
Instance	107, 108, 109	Drive Fault 1, 2, and 3 (oldest)
Attribute	1	Parameter Value
Data Type	UINT	Unsigned Short Integer

For details on Drive Fault Codes, including corrective actions, see the ArmorStart ST Motor Controller with Integrated Safety Fault Codes Reference Data, publication [280ES-RD001](#).

Enable Auto-Reset to Clear a Type 1 Fault and Restart the Drive

On the Motor Protection & Control - Starting category:

1. Set Auto Restart Tries to a value other than **0**.
2. Set Auto Restart Delay to a value other than **0**.

Clear an Overvoltage, Undervoltage, or Heatsink OvrTmp Fault without Restarting the Drive

On the Motor Protection & Control - Starting category:

1. Set Auto Restart Tries to a value other than **0**.
2. Set Auto Restart Delay to **0**.

Follow these precautions when troubleshooting the ArmorStart ST motor controller.



ATTENTION: The service of energized industrial control equipment can be hazardous. Electrical shock, burns, or unintentional actuation of controlled industrial equipment can cause death or serious injury. For safety of maintenance personnel and others who can be exposed to electrical hazards associated with maintenance activities, follow the local safety-related work practices (for example, the NFPA 70E, Part II in the United States). Maintenance personnel must be trained in the safety practices, procedures, and requirements that pertain to their respective job assignments.

Troubleshooting Precautions



ATTENTION: Do not attempt to defeat or override fault circuits. Determine the cause of the fault indication and correct it before an operation attempt. Failure to correct a control system of mechanical malfunction can result in personal injury and /or equipment damage due to uncontrolled machine system operation.



ATTENTION: The drive contains high-voltage capacitors that take time to discharge after removal of mains supply. Before working on the drive, verify the isolation of mains supply from line inputs (R, S, T, [L1, L2, L3]). Wait 3 minutes for capacitors to discharge to reasonable voltage levels. Failure to do so can result in personal injury or death. Darkened display LEDs is not an indication that capacitors have discharged to reasonable voltage levels.



ATTENTION: Only qualified personnel familiar with adjustable frequency AC drives and associated machinery must plan or implement the installation, startup, and subsequent maintenance of the system. Failure to comply can result in personal injury and/or equipment damage.



ATTENTION: This drive contains electrostatic discharge (ESD) – sensitive parts and assemblies. Static control precautions are required during installation, test, service, or repair of this assembly. Component damage can result if ESD control procedures are not followed. If you are not familiar with static control procedures, see Guarding against Electrostatic Damage, publication [8000-4.5.2](#), or any other applicable ESD protection handbook.



ATTENTION: An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as motor undersize, incorrect or inadequate AC supply, or excessive ambient temperatures can result in malfunction of the system.

IP67 Dynamic Brake Diagnostic (DB1)

The ArmorStart controller includes a specialized function that helps protect the IP67 DB. This capability is located in the control module of the Bulletin 284 VFD that is included when the DB1 option is selection.

The following conditions cause a fault anytime the DB switch is active:

- DB Shorted Switch - detected current when Drive bus voltage is below the DB threshold
- DB Overtemp - DB resistor is too hot
- DB Bus Voltage Link Open - Bus voltage from the drive is not measured for 2 seconds. Occurs if the internal connection between the main control and the DB1 module has an issue.

The DB1 option also provides the following warning:

- A DB1 Thermal Warning is issued if the predicted future resistor body temperature is greater than the Max DB1 resistor temperature x DB1 Thermal Warning Percent. The warning occurs once the DB1 resistor thermal value has exceeded the preset threshold of 90% of the thermal value. At 100%, a DB1 over temperature occurs resulting in a DB1 over temperature fault.
- When a DB1 thermo warning is announced, the resistor has reached 90% of the thermo-utilization and a fault can occur. The user PLC code should be designed to monitor this bit. If this bit is a '1', then review the application for issues otherwise a fault can occur.

This warning is also reported in Attribute 157 (DB Status) bit 1 of the Control Supervisor Object (Class Code: 29 Hex).

Table 78 - DB Status Attribute (157) Values

Bit	Description
0	DB Faulted
1	DB Over temperature Warning
2	DB On
3	DB Fault Reset Inhibit

A DB1 fault is not annunciated until the DB switch in the drive is activated and conducts current. Enable the dynamic braking by configuring Resistor Select on the Motor Protection & Control - Stopping page in the Logic designer project.

DB1 faults are indicated by the blink pattern of the Fault status indicator LED on the front of the module and by the Last Protection Trip value.

The DB1 faults are detected and reported as Last Protection Trips. These faults are classified as either a DB1 Fault, DB1 Comm fault or DB1 Switch Short.

Table 79 - DB1 Faults

DB1 Fault Type	Blink Pattern	Last Protection Trip Bit	Trip Status Bit
DB1 Comm Fault	11	41	10
DB1 Fault	16	42	15
DB1 Switch Short	16	43	15

If a DB1 fault occurs, the Control Supervisor Object provides the detailed information specific to the fault. Create an Message instruction with Class = 0029hex, Instance = 0001hex, and Attribute = 158. A bit enumerated WORD of information is returned. See [Table 80 on page 136](#) for details and troubleshooting of DB1 Faults.



BURN HAZARD: Use caution when troubleshooting because the DB1 resistor can still be hot.

Table 80 - DB Faults Reported in the Control Supervisor Object (Class Code: 29Hex) Attribute 158

Bit	Fault	Description	Troubleshooting
0	DB Overtemp Fault	The DB1 measures current continuously, and models resistor body temperature that is based on measured current and resistor model parameters. The DB1 not only calculates the present resistor body temperature, but also predicts the future resistor body temperature. The resistor overtemperature level is based on the predicted future resistor body temperature, not on the present resistor body temperature. This fault is disabled when Resistor Select is set to Disabled (Motor Protection & Control - Stopping category).	DB1 Resistor body temperature is too hot. Allow the resistor to cool.
1	Reserved	—	—
2	Reserved	—	—
3	DB Shorted Switch	A DB Shorted Switch fault is issued when continuous DB1 resistor current is detected when the Drive Bus Voltage level is less than the DB1 Voltage Level. If five consecutive samples of Drive Bus Voltage less than DB1 Level is detected along with continuous DB1 resistor current flow, then a shorted DB1 IGBT fault (DB1 Switch) is recorded. It is your responsibility to provide an input power contactor to each ArmorStart controller with a drive. You must write logic to control (open) the input contactor to the ArmorStart controller if a DB1 Switch Fault occurs. Appendix D provides an example on how to implement this in PLC code.	Remove all power to the unit and restart it to attempt to reset the fault. If the fault persists, replace control module. ⁽¹⁾
4	Reserved	—	—
5	Reserved	—	—
6	DB Bus Voltage Link Fault	For proper operation, the DB1 monitors parameters from the Drive internally inside the ArmorStart controller. If the internal communication to the drive is lost, then this fault is issued. Since the DB1 can no longer provide resistor protection, you must implement logic to open the input contactor.	1. Verify that 3-phase line power and control power are applied to unit. 2. Attempt to reset fault. 3. If fault persists, replace control module ⁽¹⁾
7	Reserved	—	—
8	DB Comm Fault	Communication loss exists between the Dynamic Brake board and the main control board. The communications link is monitored continuously. If the DB1 stops responding, then the main control board issues this fault. Since the DB1 can no longer provide resistor protection, you must implement logic to open the input contactor.	Replace the control module. ⁽¹⁾
9...15	Reserved	—	—

(1) See [Control Module Removal and Installation on page 140](#) for information on replacing the control module.

Fan RPM Fault

If the RPM of the internal fan drops below the minimum threshold, Starter Status, on the Status page of the Module Properties dialog box displays Warning Present. A 24-hour count down timer begins. If the warning flag is set continuously for the 24-hour period and time expires, the Fault LED status indicator on the front of the unit flashes 14 times to indicate a Hardware fault. Also a Last Protection Fault, shown on the Fault Status page, indicates a Fan RPM fault (Bit 31). If within the 24-hour period, the fan RPM climbs above the minimum threshold, the warning flags are removed and the timer is reset and turned off.



Fan speed is also displayed on the Status page of the Module Properties dialog box.

Annunciation with Program Logic

Because other types of warnings can cause Starter Status to show a Warning Present and a Hardware warning is actually an OR of two warnings, you must write logic to determine when only a Fan RPM warning occurs and to trigger a CIP message. The DPI Alarm Object Class Code 0x0098 provides a structure of data that includes the fault code of Fan RPM (31). Create a program that monitors the Starter Status Warning bit and Warning Status Hardware bit. When they are both set to '1' the PLC code generates a Get Single explicit message of Class 0x0098, Instance 1, and Attribute 1.

This message returns a structure of the following data:

- — Alarm Code UINT <-----
- — Alarm Source Struct of:
 - — — DPI Port Number USINT
 - — — Device Object Instance USINT
- — Alarm Time Stamp Struct of:
 - — — Timer Value ULINT
 - — — Timer Descriptor WORD

When Alarm Code UINT = 31 (decimal), it is a FAN RPM warning. For a full list of fault code references, see the ArmorStart ST Motor Controller with Integrated Safety Fault Codes Reference Data, publication [280ES-RD001](#).

When the fault occurs, the following indications are present:

- Trip Status, bit 13 turns to a '1' indicating that a hardware trip has occurred.
- Starter Status, which is shown on the Status page of the Module Properties dialog box indicates a TripPresent
- The Fault Status page of the Module Properties dialog box, displays 'Fan RPM' (bit 31) as the Last Protection fault.

General Troubleshooting

These conditions do not always result in a fault code, but can require troubleshooting to improve operation or performance.

Table 81 - Safety Connection Faulted

Causes	Indication	Corrective Action
Safety Connection faulted.	A yellow icon is present next to the motor controller in the Controller Organizer and the Connection page on the Module Properties dialog box shows a safety network number mismatch.	• Make sure that safety network number is correct. (See View or Generate a Safety Network Number on page 89) • Reset ownership (See Reset Ownership on page 68)

Table 82 - Motor Does Not Start

Causes	Indication	Corrective Action
No output voltage to the motor.	None	Check the power circuit. • Check the supply voltage. • Check all fuses and disconnects Check the motor. • Check that the motor is connected properly. • Check that the local disconnect on the front of the unit is in the ON position. • Check that the DeviceName.O.RunForward tag is set to 1. • Check the Status page on the Module Properties dialog box to make sure that there are no active faults. • Confirm that if Reverse Operation is set to Disable, it is not prohibiting movement. • Run Autotune Check the safety system. • Verify that the Motion Power indicator on the Status page is steady green. • Check that the DeviceName.SO.SafeTorqueOFF tag is set to 1.
Drive is Faulted	Flashing red status light	To reset the fault, do one of the following: • Press the blue Reset button on the front of the unit. • Cycle power • Click the Reset Fault button on the Fault Status page of the Module Properties dialog box.

Table 83 – Drive Does Not Respond to Changes in Speed Command

Causes	Indication	Corrective Action
No value is coming from the source of the command.	The drive Run indicator is lit and output is 0 Hz.	- Verify that Speed Reference is set to Output Tag on the Motor Protection & Control – Speed Control page. - Check that the controller tag DeviceName.0.FreqCommand shows the commanded frequency value. For example, a value of 600 equates to a command frequency of 60 Hz.
Torque is not enabled.	Motion power status indicator is off.	Check that the DeviceName.S0.SafeTorqueOFF tag is set to 1.
Incorrect reference source is being selected via remote device or digital inputs.	None	- Set the Speed Reference to Preset Frequency on the Motor Protection & Control – Speed Control page and define the preset values. - Check the controller output tags DeviceName.0.DriveInput1...3. (See the Preset Frequency table on page 108).
Some applications create an intermittent voltage regeneration condition and the bus regulator tries to compensate.	None	- Disable Bus Regulator function so that the drive reacts faster to changes in speed. - This condition can also cause DC bus voltage faults if an external resistor is not attached.

Table 84 – Motor and/or Drive Does Not Accelerate to Commanded Speed

Causes	Indication	Corrective Action
Acceleration time is excessive.	None	- Reprogram Accel Time 1 or Accel Time 2, which are configured on the Motor Protection & Control – Speed Control page. - Set Boost Selection to a value from 5 to 14. Start with 5.
Excess load or short acceleration times force the drive into current limit, slowing, or stop of acceleration.	None	- Compare Output Current setting to Current Limit1 setting. - Remove excess load or change Accel Time 1 or Accel Time 2 settings. - Check for improper Boost Select setting.
Speed command source or value is not as expected.	None	Verify that speed reference settings are correct. (See the Preset Frequency table on page 108).
Programming is stopping the drive output so it does not exceed limit values.	None	Check Maximum Frequency setting to verify that speed is not limited by programming.
Torque performance does not match motor characteristics.	None	- Verify motor nameplate full load amps. - Perform Autotune procedure. - Set Torque Performance Mode to V/Hz.

Table 85 – Motor Operation Is Unstable

Causes	Indication	Corrective Action
Motor data was incorrectly entered.	None	- Correctly enter motor nameplate data. - Enable IR Compensation. - Use Boost Select setting to reduce boost level.

Table 86 – Drive Does Not Reverse Motor Direction

Causes	Indication	Corrective Action
Motor wiring is improperly phased for reverse.	None	Switch two motor leads.
Reverse is disabled.	None	Confirm that Reverse Operation is set to Enabled.

Replace Control Module I/O and Fuses

Topic	Page
Precautions	139
Control Module Removal and Installation	140
I/O Module Replacement	141
Fuse Replacement	142

This chapter describes how to replace control modules and fuses.



For a detailed listing of replacement parts, see ArmorStart ST Distributed Motor Controller Specifications Technical Data, publication [280ES-TD001](#).

Precautions

Be aware of the following precautions while replacing control modules and fuses.



ATTENTION: Before replacing a component in a safety system, see [Replacing an ArmorStart ST Motor Controller on a Safety Network on page 69](#).



ATTENTION: The service of energized industrial control equipment can be hazardous. Electrical shock, burns, or unintentional actuation of controlled industrial equipment can cause death or serious injury. For safety of maintenance personnel and others who can be exposed to electrical hazards associated with maintenance activities, follow the local safety-related work practices (for example, the NFPA 70E, Part II in the United States). Maintenance personnel must be trained in the safety practices, procedures, and requirements that pertain to their respective job assignments.



ATTENTION: The drive contains high-voltage capacitors that take time to discharge after removal of mains supply. Before working on the drive, verify the isolation of mains supply from line inputs (R, S, T, [L1, L2, L3]). Wait 3 minutes for capacitors to discharge to reasonable voltage levels. Failure to do so can result in personal injury or death. Darkened display light-emitting diode (LEDs) is not an indication that capacitors have discharged to reasonable voltage levels.



ATTENTION: Only qualified personnel familiar with adjustable frequency AC drives and associated machinery must plan or implement the installation, startup, and subsequent maintenance of the system. Failure to comply can result in personal injury and/or equipment damage.



ATTENTION: This drive contains electrostatic discharge (ESD) – sensitive parts and assemblies. Static control precautions are required during installation, test, service, or repair of this assembly. Component damage can result if ESD control procedures are not followed. If you are not familiar with static control procedures, see Guarding against Electrostatic Damage, publication [8000-4.5.2](#), or any other applicable ESD protection handbook.



ATTENTION: An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as motor undersize, incorrect or inadequate AC supply, or excessive ambient temperatures can result in malfunction of the system.

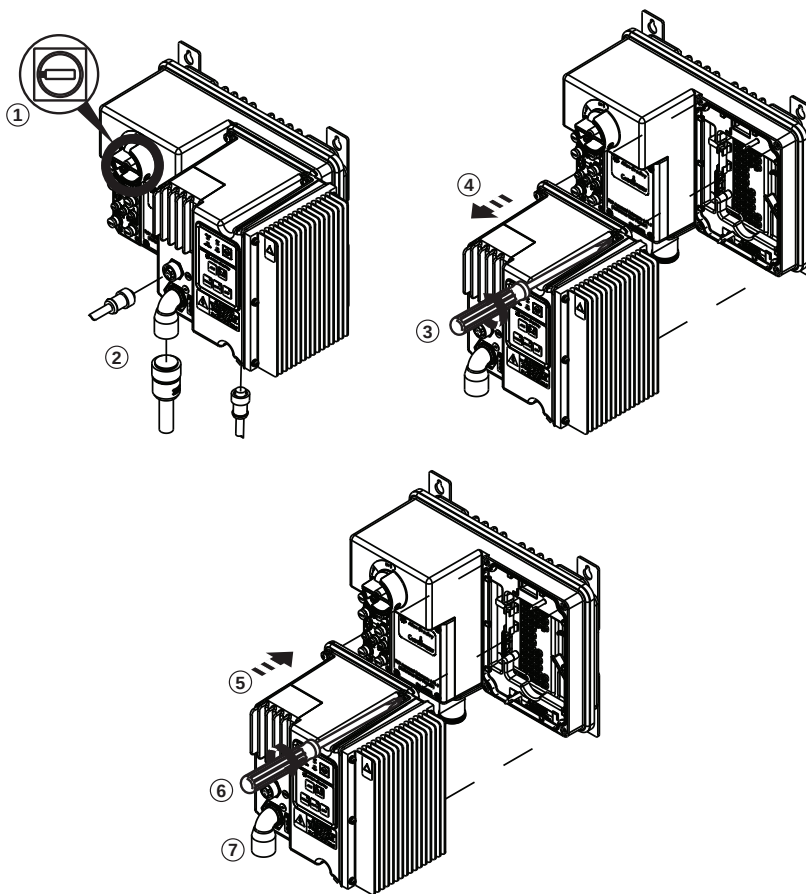
Control Module Removal and Installation



ATTENTION: To avoid shock hazard, disconnect main power before working on the controller, motor, or control devices.

1. Disconnect power by turning OFF the at-motor disconnect switch on the control module and performing lockout/tagout per your company policy.
2. Remove motor cable.
3. Loosen the four mounting screws.
4. Unplug the control module from the base by pulling forward.
5. Install control module.
6. Tighten four mounting screws.
7. Install motor cable.

Figure 58 - Control Module Replacement



I/O Module Replacement

If the I/O module becomes damaged, it can be replaced. See ArmorStart® I/O Module Replacement Installation Instructions, publication 280-IN001, for detailed information. This publication provides instruction on how to replace the input/output module.

ArmorStart ST I/O Module Kits

Specific replacement kits are available for the following ArmorStart ST configurations.

Table 87 - Replacement Kits

Short-circuit Protection	Discrete I/O Connectors	Safety I/O Connectors	Cat. No.
10 A	6 inputs, 0 outputs	1 input, 1 output	280GS-FN-10-RG-22
25 A	6 inputs, 0 outputs	1 input, 1 output	280GS-FN-25-RG-22
10 A	4 inputs, 2 outputs	1 input, 1 output	280ES-FN-10-RG-22
25 A	4 inputs, 2 outputs	1 input, 1 output	280ES-FN-25-RG-22
10 A	6 inputs, 0 outputs	none	280GS-FN-10-RG-00
25 A	6 inputs, 0 outputs	none	280GS-FN-25-RG-00
10 A	4 inputs, 2 outputs	none	280ES-FN-10-RG-00
25 A	4 inputs, 2 outputs	none	280ES-FN-25-RG-00

ArmorStart ST I/O Replacement Kit Components

Each kit contains the following items:

- I/O module with attached wire, ribbon cable, and O-ring (The O-ring is required for IP67/UL Type 4/12/13 rating.)
- Four mounting screws for the new I/O module
- Cable tie

Fuse Replacement



ATTENTION: To avoid shock hazard, disconnect main power before working on the controller, motor, or control devices.

Table 88 - Control Voltage and Output Fuse Replacement

Specification	Output Fuse	Control Power Fuse
Cat. No.	25176-155-03	25172-260-17
Description	Fast-acting, high-interrupting capacity tubular fuse	UL Listed Class CC, CSA HRC-1, Interrupting, Rejection Feature
Current	2.5 A	7 A
Interrupting Capacity	1500 A	200 ka
Voltage Rating	250V	600V (Maximum)
Manufacturer	Littlefuse PN 021602.5	Cooper Bussman PN KTK-R-7 or Littlefuse PN KLKR007.T
Dimension mm (in.):	20 (0.8) x 5 (0.2)	38.1 (1.5) x 10.2 (0.4)

Figure 59 - Control Voltage and Output Fuse Replacement

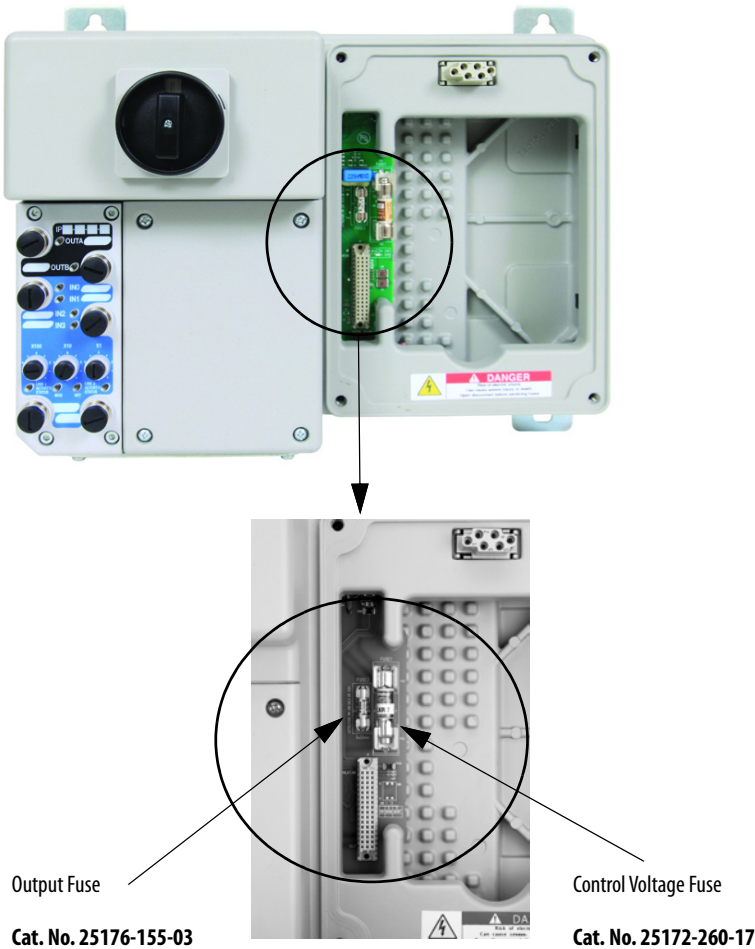
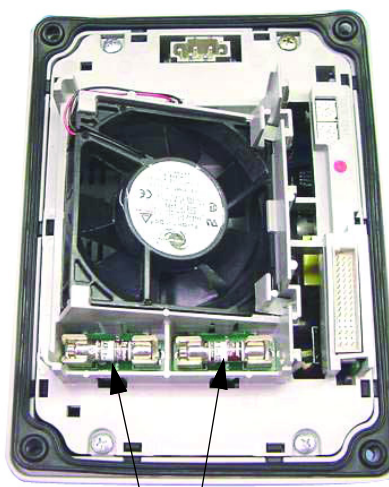


Table 89 - Source Brake Fuse Replacement (Bulletin 284E Controller Only)

Specification	Source Control Brake Fuse
Cat. No.	W25172-260-12
Description	3.0 A UL Listed Class CC,CSA HRC-1, Rejection Feature
Current	3.0 A
Interrupting Capacity	200ka
Voltage Rating	600V (Maximum)
Manufacturer	Cooper Bussman PN KTK-R-3 or Littlefuse PN KLKR003.T
Dimension mm (in.):	38.1 (1.5) x 10.2 (0.4)

Figure 60 - Source Brake Fuse Replacement (Bulletin 284 Controller Only)

Source Control Brake Fuses

Cat. No. W25172-260-12

To reset the fault, perform the following step:

1. Replace the fuse.
2. Cycle unswitched power.

Notes:

Common Industrial Protocol (CIP) Information

CIP Explicit Connection Behavior

The ArmorStart® controller allows run, jog, and user outputs to be driven by connected explicit messages when no I/O connection exists, or when an I/O connection exists in the idle state. A single EtherNet/IP™ Class 3 explicit connection is allowed to send explicit control messages via an Active Explicit connection.

An EtherNet/IP Class 3 explicit connection becomes the 'explicit control' connection when it becomes the first EtherNet/IP Class 3 explicit connection to send a 'set' service to one of the following:

- The 'value' attribute of any DOP instance (class code 0x09).
- The 'data' attribute of any output (consumed) Assembly Instance (class code 0x04).
- Attribute 3 or 4 of the Control Supervisor Object (class code 0x29).

EDS Files

EDS (Electronic Data Sheet) files can be extracted directly from the ArmorStart ST controller via the network.

CIP Object Requirements

These CIP objects are covered in the following subsections.

- [Identity Object](#)
- [Assembly Object](#)
- [Connection Manager Object](#)
- [Discrete Input Point Object](#)
- [Discrete Output Point Object](#)
- [Device Level Ring \(DLR\) Object](#)
- [Qos Object](#)
- [TCP/IP Interface Object](#)
- [Ethernet Link Object](#)

For convenience, all objects that are accessible via the EtherNet/IP port are included.

Identity Object

CLASS CODE 0x0001

The following class attributes are supported for the Identity Object.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	1
2	Get	Max Instance	UINT	9

Up to nine instances (Instance 1...9) of the Identity Object are supported. The following table shows what each instance represents, and what the revision attribute reports.

Instance	Name	Revision Attribute
1	EtherNet/IP Module	The firmware rev of the EtherNet/IP board main firmware.
2	EtherNet/IP Boot	The firmware rev of the EtherNet/IP board boot firmware.
3	FPGA	The rev of the FPGA program
4	Control Module	A coded revision that reflects the revision attribute of the other various identity object instances (excluding boot code). Major revisions are coded as: OSSMMMM • 0 = reserved by DeviceNet® • SSS = Revision of Soft-start or inverter. Initial release = 0 • MMM = Revision of Main ArmorStart board. Initial release = 1
5	Main Control Board Operating System	The firmware rev of the Main ArmorStart board OS stored in flash memory.
6	Main Control Board Boot Code	The firmware rev of the Main ArmorStart board boot code stored in flash memory.
7	The Internal PF 40 Inverter	The firmware rev of the Inverter as read from the RS-485 connection.
8 ⁽¹⁾	MCB IIC Daughter Board	The firmware rev of the MCB IIC Daughter Board
9 ⁽¹⁾	BASE IIC Daughter Board	The firmware rev of the Base IIC Daughter Board

(1) These instance numbers assume the next available instance base on the unit configuration. (If the unit is a DOL (No Drive) and there is an MCB Daughter board present its instance number is 7.)

IMPORTANT Attempts to access Attribute 10 of all DeviceNet Main Control Board instances are blocked. If Attribute 10 (Heartbeat Interval) is accessed, an 'Attribute Not Supported' error is generated.

Instance 1 of the Identity Object contains the following attributes.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Vendor	UINT	1
2	Get	Device Type	UINT	22
3	Get	Product Code	UINT	Starter Rating specific
4	Get	Revision Major Revision Minor Revision	Structure of: USINT USINT	See table.
5	Get	Status	WORD	Bit 0...0 = Not Owned; 1 = Owned by Master Bit 2...0 = Factory Defaulted; 1 = Configured Bit 8 - Minor Recoverable fault Bit 9 - Minor Unrecoverable fault Bit 10 - Major Recoverable fault Bit 11 - Major Unrecoverable fault
6	Get	Serial Number	UDINT	Unique number for each device
7	Get	Product Name String Length ASCII String	Structure of: USINT STRING	Product Code specific
8	Get	State	USINT	Returns the value '3 = Operational'
9	Get	Configuration Consistency Value	UINT	'Module FRS'
10 ⁽¹⁾	Get	Build Number	UDINT	Build number of EtherNet/IP Module firmware.

(1) Instance 1 only.

The following common services are implemented for Instance 1. Service requests to other instances are serviced through the bridge.

Service Code	Implemented for:		Service Name
	Class	Instance	
0x01	Yes	Yes	Get_Attributes_All
0x05	No	Yes	Reset
0x0E	Yes	Yes	Get_Attributes_Single

The Type 0 and 1 reset service types, reset the Control Module. The EtherNet/IP module performs the Type 0 or 1 reset on itself.

Assembly Object

CLASS CODE 0x0004

The following class attributes are supported for the Assembly Object.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	1

The following static Assembly instance attributes are supported for each Assembly instance.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Number of Members in Member List	UINT	—
2	Get	Member List	Array of STRUCT	Array of CIP paths
		Member Data Description	UINT	Size of Member Data in bits
		Member Path Size	UINT	Size of Member EPATA in bytes
		Member Path	Packed EPATH	Logically encoded member name
3	Conditional	Data	Array of BYTE	—
4	Get	Size	UINT	Number of bytes in attribute 3
100	Get	Name String	STRING	—

The following services are implemented for the Assembly Object.

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single
0x18	No	Yes	Get_Member

I/O Assemblies

The following table summarizes the Assembly instances that are supported in the ArmrorStart EtherNet/IP product.

Instance	Type	Description
3	Consumed	Required ODVA Consumed Instance
52	Produced	Required ODVA Produced Instance
150	Produced	Default Bulletin 281ES/GS Produced Assembly
151	Produced	Default Bulletin 284ES/GS Produced Assembly
152	Produced	Default Bulletin 281ES/GS Produced Assembly
153	Produced	Default Bulletin 284ES/GS Produced Assembly
154	Produced	Default Bulletin 281ES/GS Produced Assembly
155	Produced	Default Bulletin 284ES/GS Produced Assembly
156	Produced	Default Bulletin 281ES/GS Produced Assembly
157	Produced	Default Bulletin 284ES/GS Produced Assembly
158	Produced	Default Bulletin 281ES/GS Produced Assembly
159	Produced	Default Bulletin 284ES/GS Produced Assembly
162	Consumed	Default Consumed Instance for Bulletin 281ES/GS Produced Assembly
166	Consumed	Default Consumed Instance for Bulletin 284ES/GS Produced Assembly
168	Consumed	Default Consumed Instance for Bulletin 281ES/GS Produced Assembly
169	Consumed	Default Consumed Instance for Bulletin 284ES/GS Produced Assembly
191	Consumed	Empty assembly for Input Only I/O Connection
192	Consumed	Empty assembly for Listen Only I/O Connection

The ODVA Motor Starter Profile requires Instances 3 and 52. When used as an EtherNet/IP Class 1 connection point, the I/O data attribute is simply passed through the bridge.

Instance 3

Here is the required output (consumed) assembly.

Instance 3 ODVA Starter								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	—	—	—	—	—	—	—	Run Fwd

Instance 52

Here is the required input (produced) assembly:

Instance 52 ODVA Starter								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
—	—	—	—	—	—	Running	—	Fault

Instance 150

Here is the default input (produced) assembly for Bulletin 281ES/GS starters.

Instance 150 'Starter Stat' - Default Status Assembly for Bulletin 281ES/GS Starters								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved							
1	Reserved							
2	Reserved							
3	Reserved							
4	—	—	—	Ready	Running Rev	Running Fwd	Warning	Trip
5	—	—	DisconnectClose d	Hand	Input 4	Input 3	Input 2	Input 1
6	Net Out 7	Net Out 6	Net Out 5	Net Out 4	Net Out 3	Net Out 2	Net Out 1	Net Out 0
7	Logic Enable	Net Out 14	Net Out 13	Net Out 12	Net Out 11	Net Out 10	Net Out 9	Net Out 8
8	Value of the parameter pointed to by "Produced Word 0 Param" (low byte)							
9	Value of the parameter pointed to by "Produced Word 0 Param" (high byte)							
10	Value of the parameter pointed to by "Produced Word 1 Param" (low byte)							
11	Value of the parameter pointed to by "Produced Word 1 Param" (high byte)							
12	Value of the parameter pointed to by "Produced Word 2 Param" (low byte)							
13	Value of the parameter pointed to by "Produced Word 2 Param" (high byte)							
14	Value of the parameter pointed to by "Produced Word 3 Param" (low byte)							
15	Value of the parameter pointed to by "Produced Word 3 Param" (high byte)							

Instance 151

Here is the default input (produced) assembly for Bulletin 284ES/GS VFDs.

Instance 151 'Drive Status' - Produced Assembly for 284ES/GS VFDs								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved							
1	Reserved							
2	Reserved							
3	Reserved							
4	At Reference	Net Ref Status	Net Ctl Status	Ready	Running Rev	Running Fwd	Warning	Trip
5	OutputContactor Status ⁽¹⁾	BrakeContactor Status	DisconnectClose d	Hand	Input 4	Input 3	Input 2	Input 1
6	Output Frequency (Low) (xxx.x Hz)							
7	Output Frequency (High) (xxx.x Hz)							
8	Net Out 8	Net Out 7	Net Out 6	Net Out 5	Net Out 4	Net Out 3	Net Out 2	Net Out 1
9	Logic Enabled	Net Out 15	Net Out 14	Net Out 13	Net Out 12	Net Out 11	Net Out 10	Net Out 9
10	Value of the parameter pointed to by "Produced Word 0 Param" (low byte)							
11	Value of the parameter pointed to by "Produced Word 0 Param" (high byte)							
12	Value of the parameter pointed to by "Produced Word 1 Param" (low byte)							
13	Value of the parameter pointed to by "Produced Word 1 Param" (high byte)							
14	Value of the parameter pointed to by "Produced Word 2 Param" (low byte)							
15	Value of the parameter pointed to by "Produced Word 2 Param" (high byte)							
16	Value of the parameter pointed to by "Produced Word 3 Param" (low byte)							
17	Value of the parameter pointed to by "Produced Word 3 Param" (high byte)							

(1) Does not support the safety contactors.

Instance 152

Here is the default input (produced) assembly for Bulletin 281ES/GS-00* starters.

Instance 152 'Starter Stat' - Default Status Assembly for Bulletin 281ES/GS-00* Starters								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved							
1	Reserved							
2	Reserved							
3	Reserved							
4	—	—	—	Ready	Running Rev	Running Fwd	Warning	Trip
5	—	—	DisconnectClosed	Hand	—	—	—	—
6	Net Out 7	Net Out 6	Net Out 5	Net Out 4	Net Out 3	Net Out 2	Net Out 1	Net Out 0
7	Logic Enable	Net Out 14	Net Out 13	Net Out 12	Net Out 11	Net Out 10	Net Out 9	Net Out 8
8	Value of the parameter pointed to by "Produced Word 0 Param" (low byte)							
9	Value of the parameter pointed to by "Produced Word 0 Param" (high byte)							
10	Value of the parameter pointed to by "Produced Word 1 Param" (low byte)							
11	Value of the parameter pointed to by "Produced Word 1 Param" (high byte)							
12	Value of the parameter pointed to by "Produced Word 2 Param" (low byte)							
13	Value of the parameter pointed to by "Produced Word 2 Param" (high byte)							
14	Value of the parameter pointed to by "Produced Word 3 Param" (low byte)							
15	Value of the parameter pointed to by "Produced Word 3 Param" (high byte)							
16	—	—	Reserved	Reserved	Input 4	Input 3	Input 2	Input 1
17	Safety Torque Enabled ⁽¹⁾	—	—	—	Reserved	Reserved	Reserved	Reserved
18	—	—	—	—	Reserved	Reserved	Reserved	Reserved

(1) Safety status bit brought over from the safety assemblies.

Instance 153

Here is the default input (produced) assembly for Bulletin 284ES/GS-00* VFDs.

Instance 153 'Drive Status' - Produced Assembly for 284ES/GS-00* VFDs								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved							
1	Reserved							
2	Reserved							
3	Reserved							
4	At Reference	Net Ref Status	Net Ctl Status	Ready	Running Rev	Running Fwd	Warning	Trip
5	—	BrakeContactor Status	DisconnectClosed	Hand	—	—	—	—
6	Output Frequency (Low) (xxx.x Hz)							
7	Output Frequency (High) (xxx.x Hz)							
8	Net Out 8	Net Out 7	Net Out 6	Net Out 5	Net Out 4	Net Out 3	Net Out 2	Net Out 1
9	Logic Enabled	Net Out 15	Net Out 14	Net Out 13	Net Out 12	Net Out 11	Net Out 10	Net Out 9
10	Value of the parameter pointed to by "Produced Word 0 Param" (low byte)							
11	Value of the parameter pointed to by "Produced Word 0 Param" (high byte)							
12	Value of the parameter pointed to by "Produced Word 1 Param" (low byte)							
13	Value of the parameter pointed to by "Produced Word 1 Param" (high byte)							
14	Value of the parameter pointed to by "Produced Word 2 Param" (low byte)							
15	Value of the parameter pointed to by "Produced Word 2 Param" (high byte)							
16	Value of the parameter pointed to by "Produced Word 3 Param" (low byte)							
17	Value of the parameter pointed to by "Produced Word 3 Param" (high byte)							
18	—	—	Reserved	Reserved	Input 4	Input 3	Input 2	Input 1
19	Safety Torque Enabled ⁽¹⁾	—	—	—	Reserved	Reserved	Reserved	Reserved
20	—	—	—	—	Reserved	Reserved	Reserved	Reserved

(1) Safety status bit brought over from the safety assemblies.

Instance 154

Here is the default input (produced) assembly for Bulletin 281ES/GS-00* starters.

Instance 154 'Starter Stat' - Default Status Assembly for Bulletin 281ES/GS-00* Starters								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved							
1	Reserved							
2	Reserved							
3	Reserved							
4	—	—	—	Ready	Running Rev	Running Fwd	Warning	Trip
5	—	—	DisconnectClosed	Hand	—	—	—	—
6	Net Out 7	Net Out 6	Net Out 5	Net Out 4	Net Out 3	Net Out 2	Net Out 1	Net Out 0
7	Logic Enable	Net Out 14	Net Out 13	Net Out 12	Net Out 11	Net Out 10	Net Out 9	Net Out 8
8	Value of the parameter pointed to by "Produced Word 0 Param" (low byte)							
9	Value of the parameter pointed to by "Produced Word 0 Param" (high byte)							
10	Value of the parameter pointed to by "Produced Word 1 Param" (low byte)							
11	Value of the parameter pointed to by "Produced Word 1 Param" (high byte)							
12	Value of the parameter pointed to by "Produced Word 2 Param" (low byte)							
13	Value of the parameter pointed to by "Produced Word 2 Param" (high byte)							
14	Value of the parameter pointed to by "Produced Word 3 Param" (low byte)							
15	Value of the parameter pointed to by "Produced Word 3 Param" (high byte)							
16	—	—	Input 6	Input 5	Input 4	Input 3	Input 2	Input 1
17	Safety Torque Enabled ⁽¹⁾	—	—	—	Reserved	Reserved	Reserved	Reserved
18	—	—	—	—	Reserved	Reserved	Reserved	Reserved

(1) Safety status bit brought over from the safety assemblies.

Instance 155

Here is the default input (produced) assembly for Bulletin 284ES/GS-00* VFDs.

Instance 155 'Drive Status' - Produced Assembly for 284ES/GS-00* VFDs								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved							
1	Reserved							
2	Reserved							
3	Reserved							
4	At Reference	Net Ref Status	Net Ctl Status	Ready	Running Rev	Running Fwd	Warning	Trip
5	—	BrakeContactor Status	DisconnectClosed	Hand	—	—	—	—
6	Output Frequency (Low) (xxx.x Hz)							
7	Output Frequency (High) (xxx.x Hz)							
8	Net Out 8	Net Out 7	Net Out 6	Net Out 5	Net Out 4	Net Out 3	Net Out 2	Net Out 1
9	Logic Enabled	Net Out 15	Net Out 14	Net Out 13	Net Out 12	Net Out 11	Net Out 10	Net Out 9
10	Value of the parameter pointed to by "Produced Word 0 Param" (low byte)							
11	Value of the parameter pointed to by "Produced Word 0 Param" (high byte)							
12	Value of the parameter pointed to by "Produced Word 1 Param" (low byte)							
13	Value of the parameter pointed to by "Produced Word 1 Param" (high byte)							
14	Value of the parameter pointed to by "Produced Word 2 Param" (low byte)							
15	Value of the parameter pointed to by "Produced Word 2 Param" (high byte)							
16	Value of the parameter pointed to by "Produced Word 3 Param" (low byte)							
17	Value of the parameter pointed to by "Produced Word 3 Param" (high byte)							
18	—	—	Input 6	Input 5	Input 4	Input 3	Input 2	Input 1
19	Safety Torque Enabled ⁽¹⁾	—	—	—	Reserved	Reserved	Reserved	Reserved
20	—	—	—	—	Reserved	Reserved	Reserved	Reserved

(1) Safety status bit brought over from the safety assemblies.

Instance 156

Here is the default input (produced) assembly for Bulletin 281ES/GS-22* starters.

Instance 156 'Starter Stat' - Default Status Assembly for Bulletin 281ES/GS-22* Starters								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved							
1	Reserved							
2	Reserved							
3	Reserved							
4	—	—	—	Ready	Running Rev	Running Fwd	Warning	Trip
5	—	—	DisconnectClosed	Hand	—	—	—	—
6	Net Out 7	Net Out 6	Net Out 5	Net Out 4	Net Out 3	Net Out 2	Net Out 1	Net Out 0
7	Logic Enable	Net Out 14	Net Out 13	Net Out 12	Net Out 11	Net Out 10	Net Out 9	Net Out 8
8	Value of the parameter pointed to by "Produced Word 0 Param" (low byte)							
9	Value of the parameter pointed to by "Produced Word 0 Param" (high byte)							
10	Value of the parameter pointed to by "Produced Word 1 Param" (low byte)							
11	Value of the parameter pointed to by "Produced Word 1 Param" (high byte)							
12	Value of the parameter pointed to by "Produced Word 2 Param" (low byte)							
13	Value of the parameter pointed to by "Produced Word 2 Param" (high byte)							
14	Value of the parameter pointed to by "Produced Word 3 Param" (low byte)							
15	Value of the parameter pointed to by "Produced Word 3 Param" (high byte)							
16	—	—	—	—	Input 4	Input 3	Input 2	Input 1
17	Safety Torque Enabled ⁽¹⁾	—	—	—	Safety In01 Status ⁽¹⁾	Safety In00 Status ⁽¹⁾	Safety In01 Data ⁽¹⁾	Safety In00 Data ⁽¹⁾
18	—	—	—	—	Safety Out01 Status ⁽¹⁾	Safety Out00 Status ⁽¹⁾	Safety Out01 Monitor ⁽¹⁾	Safety Out00 Monitor ⁽¹⁾

(1) Safety status bit brought over from the safety assemblies.

Instance 157

Here is the default input (produced) assembly for Bulletin 284ES/GS-22* VFDs.

Instance 157 'Drive Status' - Produced Assembly for 284ES/GS-22* VFDs								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved							
1	Reserved							
2	Reserved							
3	Reserved							
4	At Reference	Net Ref Status	Net Ctl Status	Ready	Running Rev	Running Fwd	Warning	Trip
5	—	BrakeContactor Status	DisconnectClosed	Hand	—	—	—	—
6	Output Frequency (Low) (xxx.x Hz)							
7	Output Frequency (High) (xxx.x Hz)							
8	Net Out 8	Net Out 7	Net Out 6	Net Out 5	Net Out 4	Net Out 3	Net Out 2	Net Out 1
9	Logic Enabled	Net Out 15	Net Out 14	Net Out 13	Net Out 12	Net Out 11	Net Out 10	Net Out 9
10	Value of the parameter pointed to by "Produced Word 0 Param" (low byte)							
11	Value of the parameter pointed to by "Produced Word 0 Param" (high byte)							
12	Value of the parameter pointed to by "Produced Word 1 Param" (low byte)							
13	Value of the parameter pointed to by "Produced Word 1 Param" (high byte)							
14	Value of the parameter pointed to by "Produced Word 2 Param" (low byte)							
15	Value of the parameter pointed to by "Produced Word 2 Param" (high byte)							
16	Value of the parameter pointed to by "Produced Word 3 Param" (low byte)							
17	Value of the parameter pointed to by "Produced Word 3 Param" (high byte)							
18	—	—	—	—	Input 4	Input 3	Input 2	Input 1
19	Safety Torque Enabled ⁽¹⁾	—	—	—	Safety In01 Status ⁽¹⁾	Safety In00 Status ⁽¹⁾	Safety In01 Data ⁽¹⁾	Safety In00 Data ⁽¹⁾
20	—	—	—	—	Safety Out01 Status ⁽¹⁾	Safety Out00 Status ⁽¹⁾	Safety Out01 Monitor ⁽¹⁾	Safety Out00 Monitor ⁽¹⁾

(1) Safety status bit brought over from the safety assemblies.

Instance 158

Here is the default input (produced) assembly for Bulletin 281ES/GS-22* starters.

Instance 158 'Starter Stat' - Default Status Assembly for Bulletin 281ES/GS-22* Starters								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved							
1	Reserved							
2	Reserved							
3	Reserved							
4	—	—	—	Ready	Running Rev	Running Fwd	Warning	Trip
5	—	—	DisconnectClosed	Hand	—	—	—	—
6	Net Out 7	Net Out 6	Net Out 5	Net Out 4	Net Out 3	Net Out 2	Net Out 1	Net Out 0
7	Logic Enable	Net Out 14	Net Out 13	Net Out 12	Net Out 11	Net Out 10	Net Out 9	Net Out 8
8	Value of the parameter pointed to by "Produced Word 0 Param" (low byte)							
9	Value of the parameter pointed to by "Produced Word 0 Param" (high byte)							
10	Value of the parameter pointed to by "Produced Word 1 Param" (low byte)							
11	Value of the parameter pointed to by "Produced Word 1 Param" (high byte)							
12	Value of the parameter pointed to by "Produced Word 2 Param" (low byte)							
13	Value of the parameter pointed to by "Produced Word 2 Param" (high byte)							
14	Value of the parameter pointed to by "Produced Word 3 Param" (low byte)							
15	Value of the parameter pointed to by "Produced Word 3 Param" (high byte)							
16	—	—	Input 6	Input 5	Input 4	Input 3	Input 2	Input 1
17	Safety Torque Enabled ⁽¹⁾	—	—	—	Safety In01 Status ⁽¹⁾	Safety In00 Status ⁽¹⁾	Safety In01 Data ⁽¹⁾	Safety In00 Data ⁽¹⁾
18	—	—	—	—	Safety Out01 Status ⁽¹⁾	Safety Out00 Status ⁽¹⁾	Safety Out01 Monitor ⁽¹⁾	Safety Out00 Monitor ⁽¹⁾

(1) Safety status bit brought over from the safety assemblies.

Instance 159

Here is the default input (produced) assembly for Bulletin 284ES/GS-22* VFDs.

Instance 159 'Drive Status' - Produced Assembly for 284ES/GS-22* VFDs								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved							
1	Reserved							
2	Reserved							
3	Reserved							
4	At Reference	Net Ref Status	Net Ctl Status	Ready	Running Rev	Running Fwd	Warning	Trip
5	—	BrakeContactor Status	DisconnectClosed	Hand	—	—	—	—
6	Output Frequency (Low) (xxx.x Hz)							
7	Output Frequency (High) (xxx.x Hz)							
8	Net Out 8	Net Out 7	Net Out 6	Net Out 5	Net Out 4	Net Out 3	Net Out 2	Net Out 1
9	Logic Enabled	Net Out 15	Net Out 14	Net Out 13	Net Out 12	Net Out 11	Net Out 10	Net Out 9
10	Value of the parameter pointed to by "Produced Word 0 Param" (low byte)							
11	Value of the parameter pointed to by "Produced Word 0 Param" (high byte)							
12	Value of the parameter pointed to by "Produced Word 1 Param" (low byte)							
13	Value of the parameter pointed to by "Produced Word 1 Param" (high byte)							
14	Value of the parameter pointed to by "Produced Word 2 Param" (low byte)							
15	Value of the parameter pointed to by "Produced Word 2 Param" (high byte)							
16	Value of the parameter pointed to by "Produced Word 3 Param" (low byte)							
17	Value of the parameter pointed to by "Produced Word 3 Param" (high byte)							
18	—	—	Input 6	Input 5	Input 4	Input 3	Input 2	Input 1
19	Safety Torque Enabled ⁽¹⁾	—	—	—	Safety In01 Status ⁽¹⁾	Safety In00 Status ⁽¹⁾	Safety In01 Data ⁽¹⁾	Safety In00 Data ⁽¹⁾
20	—	—	—	—	Safety Out01 Status ⁽¹⁾	Safety Out00 Status ⁽¹⁾	Safety Out01 Monitor ⁽¹⁾	Safety Out00 Monitor ⁽¹⁾

(1) Safety status bit brought over from the safety assemblies.

Instance 162

Here is the default output (consumed) assembly for Bulletin 281ES/GS starters.

Instance 162 'Starter Cmd' - DeviceLogix™ Consumed Assembly for Bulletin 281ES/GS Starters								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	User Out B	User Out A	—	—	—	Fault Reset	Run Rev	Run Fwd
1	Net In 7	Net In 6	Net In 5	Net In 4	Net In 3	Net In 2	Net In 1	Net In 0
2	Net In 15	Net In 14	Net In 13	Net In 12	Net In 11	Net In 10	Net In 9	Net In 8

Instance 166

Here is the default output (consumed) assembly for Bulletin 284ES/GS VFDs.

Instance 166 'Drive Cmd'- DeviceLogix Consumed Assembly for Bulletin 284ES/GS VFDs								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	User Out B	User Out A	—	Jog Rev	Jog Fwd	Fault Reset	Run Rev	Run Fwd
1	Drive In 4	Drive In 3	Drive In 2	Drive In 1	Decel Control 2	Decel Control 1	Accel Control 2	Accel Control 1
2	Comm Freq Command (Low) (xxx.x Hz)							
3	Comm Freq Command (High) (xxx.x Hz)							
4	Net In 8	Net In 7	Net In 6	Net In 5	Net In 4	Net In 3	Net In 2	Net In 1
5	Net In 16	Net In 15	Net In 14	Net In 13	Net In 12	Net In 11	Net In 10	Net In 9

Instance 168

Here is the default output (consumed) assembly for Bulletin 281ES/GS starters.

Instance 168 'Starter Cmd' - DeviceLogix Consumed Assembly for Bulletin 281ES/GS Starters								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	—	—	—	—	—	Fault Reset	Run Rev	Run Fwd
1	Net In 7	Net In 6	Net In 5	Net In 4	Net In 3	Net In 2	Net In 1	Net In 0
2	Net In 15	Net In 14	Net In 13	Net In 12	Net In 11	Net In 10	Net In 9	Net In 8

Instance 169

Here is the default output (consumed) assembly for Bulletin 284ES/GS VFDs.

Instance 169 'Drive Cmd'- DeviceLogix Consumed Assembly for Bulletin 284ES/GS VFDs								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	—	—	—	Jog Rev	Jog Fwd	Fault Reset	Run Rev	Run Fwd
1	Drive In 4	Drive In 3	Drive In 2	Drive In 1	Decel Control 2	Decel Control 1	Accel Control 2	Accel Control 1
2	Comm Freq Command (Low) (xxx.x Hz)							
3	Comm Freq Command (High) (xxx.x Hz)							
4	Net In 8	Net In 7	Net In 6	Net In 5	Net In 4	Net In 3	Net In 2	Net In 1
5	Net In 16	Net In 15	Net In 14	Net In 13	Net In 12	Net In 11	Net In 10	Net In 9

Connection Manager Object CLASS CODE 0x0006

The following class attributes are supported for the Connection Manager Object.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	1
2	Get	Max Instance	UINT	–
3	Get	Number of Instances	UINT	–
4	Get	Optional Attribute List	Array of UINT	–
6	Get	Max Number Class Attribs	UINT	–

Two Class 1 connections for I/O transfer are supported.

Six Class 3 explicit connections are supported.

The following instance attributes are supported.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get/Set	Open Requests	UINT	Number of Forward Open service requests received.
2	Get/Set	Open Format Rejects	UINT	Number of Forward Open service requests that were rejected due to bad format.
3	Get/Set	Open Resource Rejects	UINT	Number of Forward Open service requests that were rejected due to lack of resources.
4	Get/Set	Open Other Rejects	UINT	Number of Forward Open service requests that were rejected for reasons other than bad format or lack of resources.
5	Get/Set	Close Requests	UINT	Number of Forward Close service requests received.
6	Get/Set	Close Format Requests	UINT	Number of Forward Close service requests that were rejected due to bad format.
7	Get/Set	Close Other Requests	UINT	Number of Forward Close service requests that were rejected for reasons other than bad format.
8	Get/Set	Connection Timeouts	UINT	Total number of connection timeouts that have occurred in connections that are controlled by this Connection Manager

The following services are implemented for the Connection Manager Object.

Service Code	Implemented for:		Service Name
	Class	Instance	
0E hex	Yes	Yes	Get_Attribute_Single
4E hex	No	Yes	Forward_Close
54 hex	No	Yes	Forward_Open

Class 1 Connections

Class 1 connections are used to transfer I/O data, and can be established to the Assembly Object instances. Each Class 1 connection establishes two data transports, one consuming and one producing. The heartbeat instances are used for connections that only access inputs. Class 1 uses UDP transport.

- Total number of supported Class 1 connections equals 2 (total for: exclusive owner + input only + listen only)
- Supported Actual Packet Interval (API): 2...3200 ms (Note: The minimum API can be higher if processor resources become a problem.)
- T->O (Target to Originator) Connection type: point-to-point, multicast
- O->T (Originator to Target) Connection type: point-to-point
- Supported trigger type: cyclic, change of state

The producing instance can be assigned to multiple transports, by using any combination of multicast and point-to-point connection types.

Only one Exclusive-owner connection is supported at each time. If there is already an Exclusive-owner connection that is established and an originator tries to establish a new Exclusive-owner connection an 'Ownership conflict' (general status = 0x01, extended status = 0x0106) error code is returned.

For a connection to be established, the requested data sizes must be an exact match of the connections points that the connection tries to connect to. If the requested and actual sizes do not match, an 'Invalid connection size' (general status = 0x01, extended status = 0x0109) error code is returned.

Exclusive Owner Connection

This connection type is used for controlling the outputs of the module and is not dependent on any other condition. Only one exclusive owner connection can be opened against the module.

If an exclusive owner connection is already opened 'Connection in use' (general status = 0x01, extend status = 0x0100) error code is returned.

- Connection point O -> T is Assembly Object, Instance 3, 162 or 166 (162 for product codes <= 0x100 only, 166 for product codes > 0x100 only).
- Connection point T -> O is Assembly Object, Instance 52, 150 or 151 (150 for product codes <= 0x100 only, 151 for product codes > 0x100 only).

Listen Only Connection

This connection is dependent on another connection to exist. If that connection (exclusive owner or input only) is closed, the listen-only connection is also closed.

We recommend that the originator sets the data size in the Forward_Open to zero.

- Number of supported listen only connections equals two (shared with exclusive owner and listen only connection).
- Connection point O -> T is Assembly Object, Instance 192 (Listen only heartbeat)
- Connection point T -> O is Assembly Object, Instance 52, 150, or 151 (150 for product codes ≤ 0x100 only, 151 for product codes > 0x100 only)

Class 3 CIP Connections

Class 3 CIP connections are used to establish connections to the message router. The connection is used for Explicit Messaging. Class 3 CIP connections use TCP connections.

- Three concurrent encapsulation sessions are supported
- Six concurrent Class 3 CIP connections are supported
- More than one Class 3 CIP connection per encapsulation session is supported
- Supported Actual Packet Interval (API): 100...10000 ms
- T->O Connection type: point-to-point
- O->T Connection type: point-to-point
- Supported trigger type: application

Discrete Input Point Object CLASS CODE 0x0008

The following class attributes are currently supported for the Discrete Input Point Object.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	2
2	Get	Max Instance	UINT	4

Ten instances of the Discrete Input Point Object are supported. All instances contain the following attributes.

Attribute ID	Access Rule	Name	Data Type	Value
3	Get	Value	BOOL	0 = OFF, 1 = ON
4	Get	Status	BOOL	0 = OFF, 1 = Alarm
115	Get/Set	Force Enable	BOOL	0 = Disable, 1 = Enable
116	Get/Set	Force Value	BOOL	0 = OFF, 1 = ON
119	Set	Off-On Delay	UNIT	10 ms
120	Set	On-Off Delay	UNIT	100 ms
121	Get	Input Port Value	BOOL	0 = OFF, 1 = ON

The following common services are implemented for the Discrete Input Point Object.

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single

Discrete Output Point Object CLASS CODE 0x0009

The following class attributes are supported.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	1
2	Get	Max Instance	UINT	2

Configurable I/O points are supported when configured as outputs.

All instances contain the following attributes.

Attribute ID	Access Rule	Name	Data Type	Value
3	Set	Value	BOOL	0 = OFF, 1 = ON
4	Get	Status	BOOL	0 = OFF, 1 = Alarm
5	Set	Fault Action	USINT	0 = Fault Value attribute, 1 = Hold Last State
6	Set	Fault Value	BOOL	0 = OFF, 1 = ON
7	Set	Idle Action	USINT	0 = Fault Value attribute, 1 = Hold Last State
8	Set	Idle Value	BOOL	0 = OFF, 1 = ON
12	Get	Object State	USINT	1 = Non-Existent 2 = Available 3 = Idle 4 = Ready 5 = Run 6 = Recoverable Fault 7 = Unrecoverable Fault 255 = Reserved

The following common services are implemented for the Discrete Output Point Object.

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single

Device Level Ring (DLR) Object

CLASS CODE 0x0047

The following class attributes are supported for the DLR Object.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	2

A single instance (Instance 1) is supported with the following instance attributes.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Network Topology	USINT	0 = Linear, 1 = Ring
2	Get	Network Status	USINT	0 = Normal 1 = Ring Fault 2 = Unexpected Loop Detect 3 = Partial Network Fault 4 = Rapid Fault/Restore Cycle
10	Get	Active Supervisor Address	Struct of UDINT Array of 6 USINT	Ring Supervisor
12	Get	Capability Flags	DWORD	0x00000002

The following common services are implemented for the DLR Object.

Service Code	Implemented for:		Service Name
	Class	Instance	
0x01	Yes	Yes	Get_Attribute_All
0x0E	Yes	Yes	Set_Attribute_Single

Qos Object

CLASS CODE 0x0048

The following class attributes are supported for the QoS Object.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	1

A single instance (Instance 1) is supported and it contains the following instance attributes.

Attribute ID	Access Rule	Name	Data Type	Value
1	Set	802 1Q Tag Enable	USINT	0 = Disable (Default) 1 = Enable
4	Set	DSCP Urgent	USINT	Default = 55
5	Set	DSCP Scheduled	USINT	Default = 47
6	Set	DSCP High	USINT	Default = 43
7	Set	DSCP Low	USINT	Default = 31
8	Set	DSCP Explicit	USINT	Default = 27

The following common services are implemented for the QoS Object.

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single

TCP/IP Interface Object CLASS CODE 0x00F5

The following class attributes are supported.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	1

One instance of the TCP/IP Interface Object is supported with the following instance attributes.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Status	DWORD	—
2	Get	Configuration Capability	DWORD	0x00000014
3	Get/Set	Configuration Control	DWORD	0 = Configuration from NVS 2 = Configuration from DHCP
4	Get	Physical Link Object	Struct of UINT Padded EPATH	2 words NULL Enet Link Object Instance
5	Get/Set	Interface Configuration	Struct of UDINT UDINT UDINT UDINT UDINT STRING	IP Address Network Mask Gateway Address Primary DNS Secondary DNS Default Domain Name for not fully qualified host names
6	Get/Set	Host Name	STRING	—
8	Get/Set	TTL Value	USINT	Time to Live value for EtherNet/IP multicast packets
9	Get/Set	Multicast Config	Struct of USINT USINT UINT UDINT	Allocation Control Reserved Number of multicast addresses to allocate (1...4) Multicast starting address.
11	Get/Set	LastConflictedDetected	Struct of	
		AcdActivity	USINT	State of last ACD Activity when last conflicted detected. Default = 0
		RemoteMAC	Array of 6 USINT	MAC address of a remote node from the ARP DPU in which a conflict was detected. Default = 0
		ArpPdu	Array of 28 USINT	Copy of raw ARP DPU in which a conflict was detected. Default = 0

The following common services are implemented for the TCP/IP Interface Object.

Service Code	Implemented for:		Service Name
	Class	Instance	
	No	Yes	Get_Attribute_All
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single

Ethernet Link Object

CLASS CODE 0x00F6

The following class attributes are supported.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	3
2	Get	Max Instance	UINT	2
3	Get	Number of Instances	UINT	2

One instance of the Ethernet Link Object is supported with the following instance attributes.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Interface Speed	UDINT	10 or 100 Mbit/Sec
2	Get	Interface Flags	DWORD	See ENet/IP Spec
3	Get	Physical Address	ARRAY of 6 USINTs	MAC Address
4	Get	Interface Counters	Struct of: In Octets In Ucast packets In NUCast packets In Discards In Errors In Unknown Protos Out Octets Out Ucast packets Out NUCast packets Out Discards Out Errors	—
5	Get	Media Counters	Struct of: Alignment Errors FCS Errors Single Collisions SQE Test Errors Deferred Transmits Late Collisions Excessive Collisions MAC Transmit Errors Carrier Sense Errors Frame Too Long MAC Receive Errors	—
6	Get/Set	Interface Control	Struct of: Control Bits Forced Interface Speed	—
7	Get	Interface Type	USINT	—
8	Get	Interface State	USINT	—
9	Get/Set	Admin State	USINT	—
10	Get	Interface Label	SHORT_STRING	Instance 1: Port 1 Instance 2: Port 2

The following common services are implemented for the Ethernet Link Object.

Service Code	Implemented for:		Service Name
	Class	Instance	
0x01	No	Yes	Get_Attribute_All
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single

Notes:

Configure a Message Instruction

Topic	Page
Overview	167
Message Process	168

Overview

A Message instruction (MSG) is used to transfer data that does not require continuous updates. You can use it to configure and monitor the parameters of a slave device on the network.

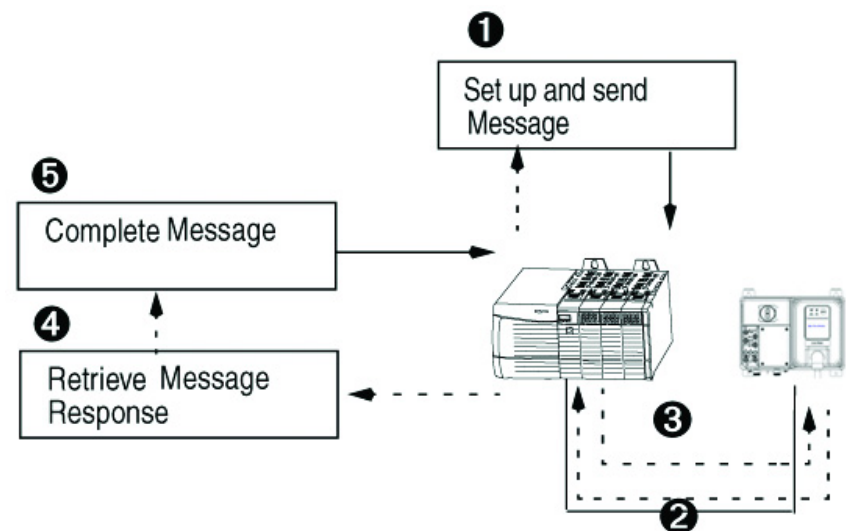
Before you can configure a MSG instruction, you must create a tag with the MESSAGE data type to use in your logic program.

The MSG (message) instruction handles all messaging that is initiated by a Studio 5000 Logix Designer® program. It automatically creates and manages TCP connections and CIP encapsulation sessions.

For details on how to use MSG instructions, see Logix 5000 Controllers Messages Programming Manual, publication [1756-PM012](#).

Message Process

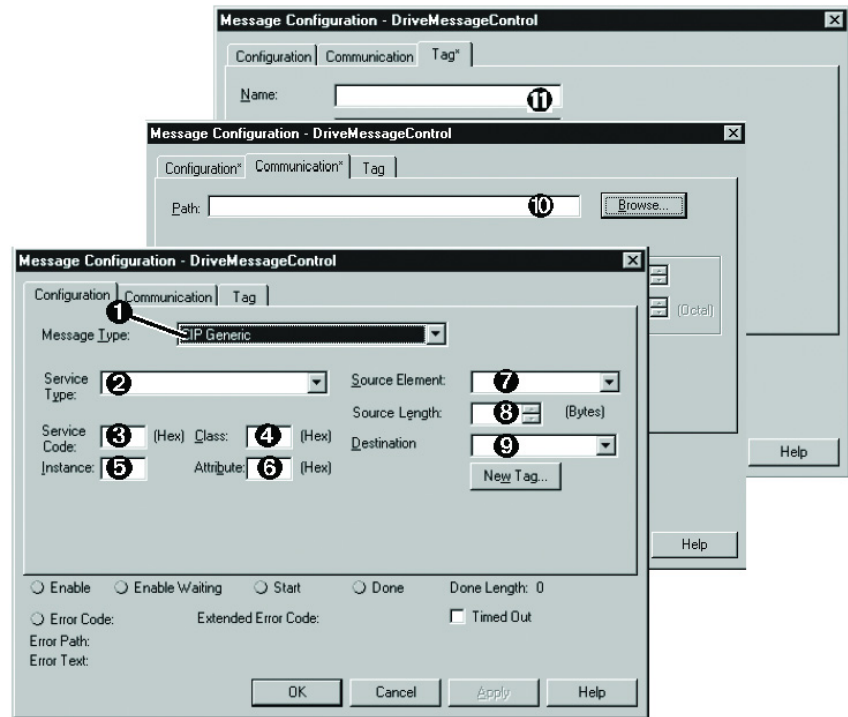
Figure 61 - Message Process



Box	Description
❶	Format the required data and configure the ladder logic program to send a Message Request to the scanner or bridge module (download).
❷	The scanner or bridge module transmits the Message Request to the slave device over the EtherNet/IP network.
❸	The slave device transmits the Message Response back to the scanner. The data is stored in the scanner buffer.
❹	The controller retrieves the Message Response from the buffer of the scanner (upload).
❺	The Message is complete.

The details of each step vary depending on the controller. See the product documentation for your controller.

Figure 62 – ControlLogix Message Format in Studio 5000



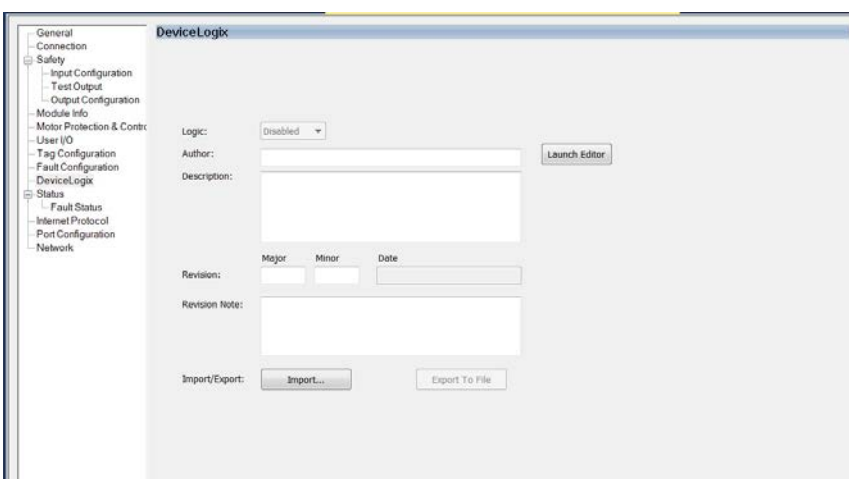
For supported classes, instances, and attributes, see [Appendix A, Common Industrial Protocol \(CIP\) Information](#).

Box	Description
1	Message Type The message type is usually CIP Generic.
2	Service Type The service type indicates the service (for example, Get Attribute Single or Set Attribute Single) that you want to perform.
3	Service Code The service code is the code for the requested EtherNet/IP service. This value changes based on the Service Type that has been selected. In most cases, this is a read-only box. If you select "Custom" in the Service Type box, then you must specify a service code in this box (for example, 4B for a Get Attributes Scattered service or 4C for a Set Attributes Scattered service).
4	Class The class is an EtherNet/IP class.
5	Instance The instance is an instance (or object) of an EtherNet/IP class.
6	Attribute The attribute is a class or instance attribute.
7	Source Element This box contains the name of the tag for any service data to be sent from the scanner or bridge to the module and drive.
8	Source Length This box contains the number of bytes of service data to be sent in the message.
9	Destination This box contains the name of the tag that receives service response data from the module and drive.
10	Path The path is the route that the message follows. Note: Click Browse to find the path or type in the name of a module that you previously mapped.
11	Name The name for the message.

Notes:

DeviceLogix

DeviceLogix™ is a standalone Boolean program that resides within the ArmorStart® controller. The program is embedded in the product software so that there is no additional module that is required to use this technology. To program DeviceLogix, you need the latest Add-on Profile AOP for ArmorStart ST distributed motor controller.



In addition to the actual programming, DeviceLogix can be configured to operate under specific situations. It is important to note that the DeviceLogix program only runs if the logic has been enabled. Configuration can be done within the Logic Editor. The operation configuration is accomplished by setting the Network Override and Communication Override parameters. The following information describes the varying levels of operation:

- If both overrides are disabled and the logic is enabled, the **ONLY** time DeviceLogix runs is if there is an active I/O connection with a master (master is in Run mode). At all other times, DeviceLogix is running the logic, but does **NOT** control the state of the outputs.
- If the Network Override and the logic are enabled, then DeviceLogix controls the state of the outputs when the programmable controller is in Run mode and if a network fault such as Duplicate MAC ID or module Bus off condition occurs.
- If the Communications Override is enabled and the logic is enabled, the device does not need any I/O connection to run the logic. As long as there is an unswitched power source that is connected to the device, the logic controls the state of the outputs.
- DeviceLogix provides a Motion Disable function that is driven from the DeviceLogix program. When this function is active all motor run commands are disabled, including the HOA. The run command is disabled regardless of where the command is initiated from such as DeviceLogix or DeviceNet.

DeviceLogix Programming

DeviceLogix has many applications and the implementation is typically only limited to the imagination of the programmer. Keep in mind that the application of DeviceLogix is only designed to handle simple logic routines.

DeviceLogix is programmed by using simple Boolean math operators such as AND, OR, NOT, timers, counters, and latches. Combine these Boolean operations with any of the available I/O to make decisions. The inputs and outputs that are used to interface with the logic can come from the network or from the device hardware. Hardware I/O is the physical Inputs and Outputs that are on the device, such as push buttons and pilot lights that are connected to the ArmorStart controller.

There are many reasons to use the DeviceLogix functionality, but some of the most common are listed:

- Increased system reliability
- Fast update times (1...2 ms possible)
- Improved diagnostics and reduced troubleshooting
- Operation independent of programmable controller or network status
- Continue to run process if network interruptions occur
- Critical operations can be safely shut down through local logic

DeviceLogix Programming Example

The following example shows how to program a simple logic routine to interface the ArmorStart ST controller with a remote hard-wired start/stop station. In this case, the I/O is wired as shown in [Table 90](#).

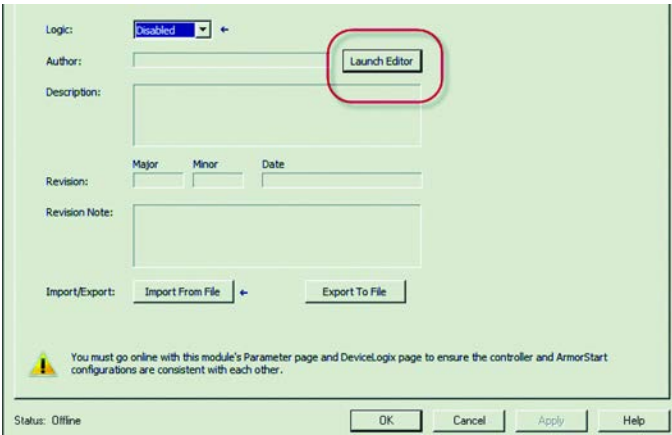
Table 90 - Hardware Bit Assignments and Description for the ArmorStart

Input Table		Output Table	
Bit	Description	Bit	Description
In 0	Start Button	Run Forward	Contacting Coil
In 1	Stop Button	—	—
In 2	—	—	—
In 3	—	—	—

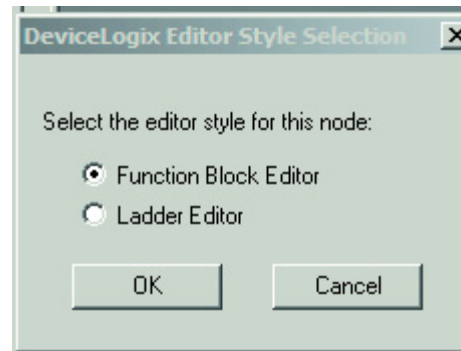
IMPORTANT

Before programming logic, it is important to decide on the conditions to run the logic. As defined earlier, the conditions can be defined by setting Network Override and Comm. Override to the desired value from the Motor Protection & Control - Advanced Motor Control dialog box. Close the DeviceLogix Editor completely before going online with the project in Studio 5000® via the PLC. Once the connection is made, opening the DeviceLogix Editor is allowed.

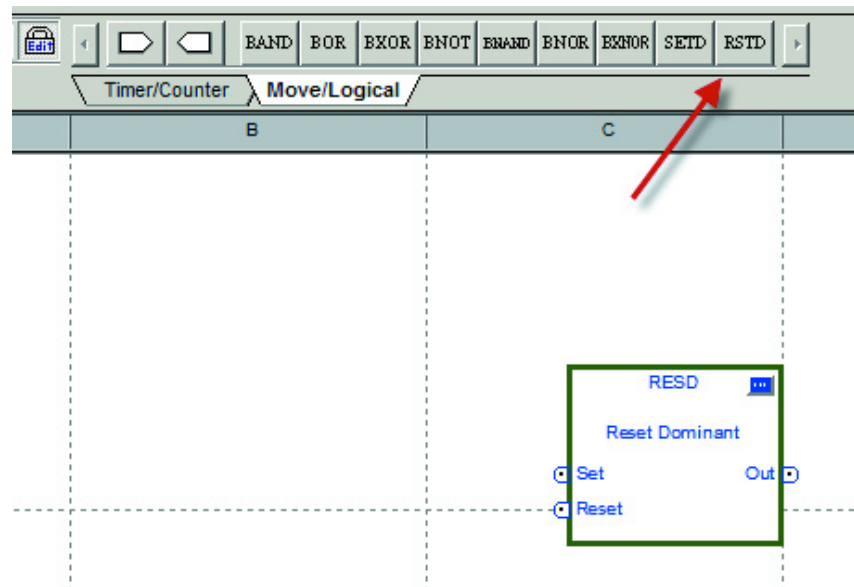
1. From the Module Properties dialog box, click DeviceLogix.
2. Click the Launch Editor button.



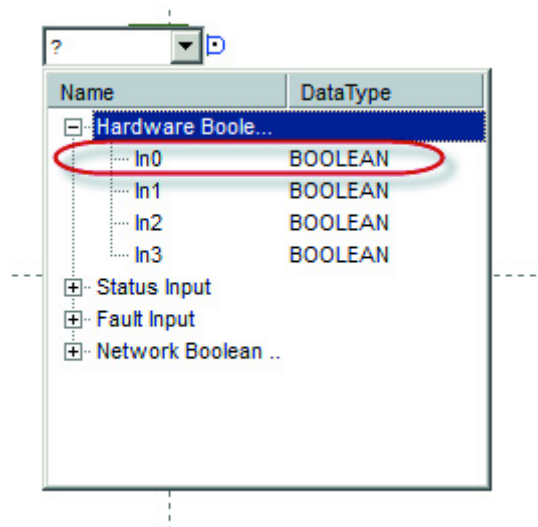
3. Select Function Block or Ladder editor.
Once selected, you are not able to switch back without recreating the logic.



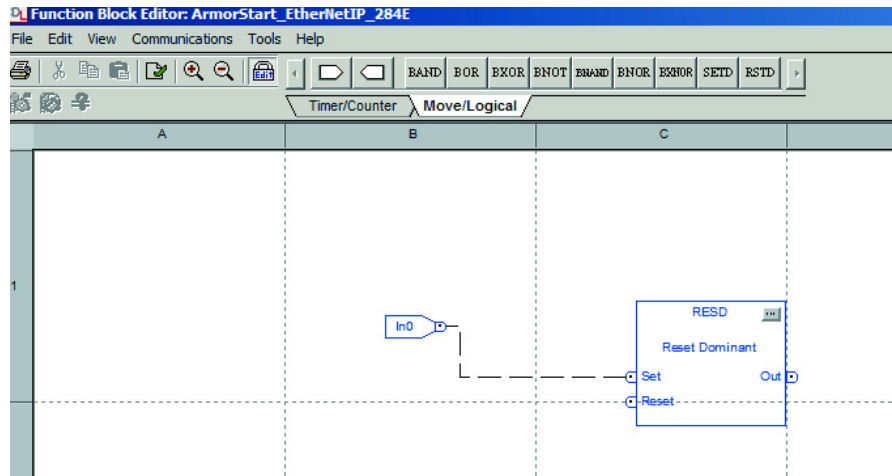
4. Locate the toolbar at the top of the DeviceLogix editor window, click the Move/Logical group, and select the RSTD (Latch Reset). Move it to the work space and click to drop it.



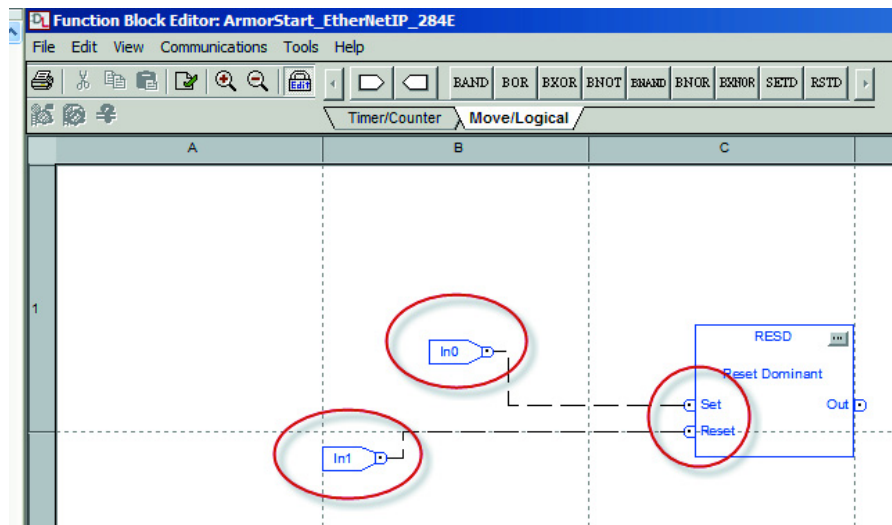
5. From the toolbar, Click **Bit Input** and select **In 0** from the Hardware Boolean tree. This selection is the remote start button that is based on the example I/O table.



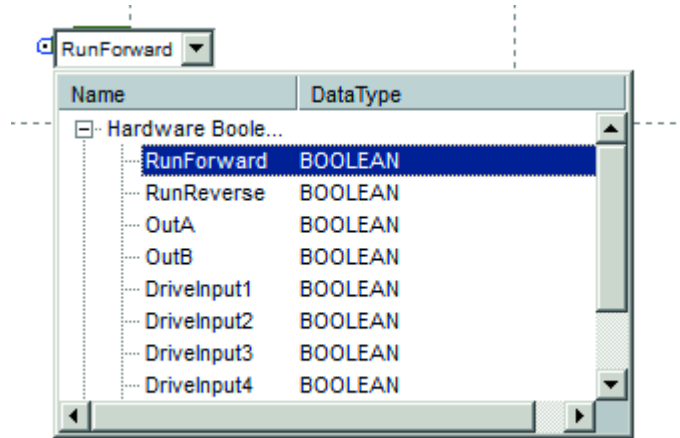
6. Place the input to the left of the reset function. To drop the input on the page, left click the desired position.
7. Place the mouse cursor over the tip of In 0.
The tip turns green.
8. Click the tip when it turns green.
9. Move the mouse cursor toward the Set input of the reset function.
A line follows the cursor. When a connection can be made, the tip of the RSL function also turns green.
10. Click the on Input and the line is drawn from In 0 to the Set Input of the reset function.
If this connection was not valid, one of the pin tips would have turned red rather than green. Left double-clicking the unused portion of the grid or pressing **Esc** at any time cancels the connection process.



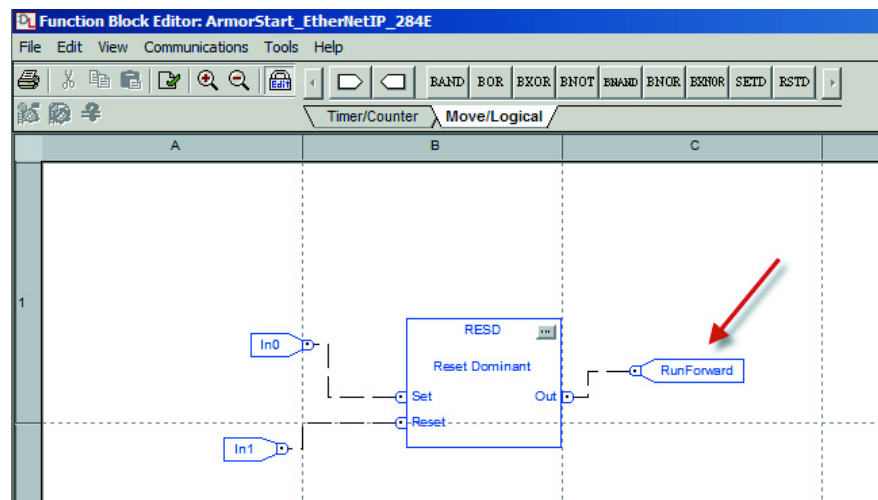
11. From the toolbar, Click **Bit Input** and select **In 1** from the pull-down menu. This selection is the remote stop button that is based on the example I/O table.
12. Place the input to the left of the reset function.
13. Connect the input to the reset input of the reset function.



14. From the toolbar, Click **Bit Output** and select **Run Forward** from the hardware Boolean tree. Run Forward is the relay controlling the coil of the contactor.



15. Move the cursor into the grid and place the Output to the right of the reset function block.
16. Connect the output of the reset function block to **Run Forward**.



17. Click **Verify** in the toolbar or select Logic Verify from the Tools pull-down menu.
18. Click file close. The program is not saved automatically. Enter the information on the following window and accept changes. This action saves the program but has not been downloaded in the product.

DeviceLogix

The DeviceLogix program has been modified.
Accept Edits to save the DeviceLogix program to the project or Discard edits.

Program Properties

Author: Temp

Description: Example

Revision: Major 1 Minor 0 Date Wed May 16 12:37:15 2012 Set to Now

Revision Note: Draft of example DeviceLogix program

Accept Edits Discard Edits

19. Enable the logic via the pull-down menu.

Logic: Enabled

Author: Temp Launch Editor

Description: Example

20. Click OK.
- To download the DeviceLogix program, you must go online with the programmable controller and allow the download. Verify that the DeviceLogix Editor is closed before going online. Verify that the programmable controller is in the Program position. If in any other position, the download does not occur and an error is generated.
21. The ArmorStart controller is now programmed and the logic is Active.

Import and Export

The export function lets the DeviceLogix program be saved to a file. This file can then be imported into a similar product of the same function regardless of horsepower. You cannot import DeviceLogix between unlike products, for example Bulletin 284ES/GS and Bulletin 281ES/GS controllers.

The screenshot displays the DeviceLogix configuration interface. At the top, the 'Logic' dropdown is set to 'Enabled'. Below it, the 'Author' field contains 'test' and a 'Launch Editor' button is to its right. The 'Description' field contains 'Example'. The 'Revision' section includes three sub-fields: 'Major' with the value '1', 'Minor' with the value '0', and 'Date' with the value 'Wed May 16 16:27:36 2012'. The 'Revision Note' field contains 'Example DeviceLogix program'. At the bottom, under the 'Import/Export:' label, there are two buttons: 'Import From File' and 'Export To File'. Both buttons are highlighted with red rectangular boxes.

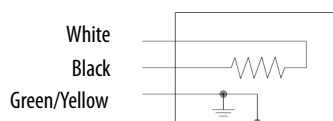
Notes:

DB1 Resistor and Protection Example

This appendix focuses on the safe response for a possible DB fault condition.

The internal wiring diagram of the IP67 resistor is shown in [Figure 63](#). Unlike standard IP20 resistors, this resistor does not support an internal digital thermo switch to protect against over temperature. The ArmorStart® controller, when equipped with the DB1 suffix provides a quick disconnect connector and an internal resistor-monitoring circuit. This circuit models the external IP67 resistor body temperature and provides warning and fault feedback to the system. It does this by measuring the current flowing from the drive to the external resistor.

Figure 63 - Resistor Wiring Diagram



The ArmorStart controller provides several parameters that can be used to control or inspected the state of the resistor. For example, refer to parameters 24, 61, 62, 182, and 263 for status, warning, fault, or configuration details. Also, see [IP67 Dynamic Brake Diagnostic \(DB1\) on page 134](#) for a comprehensive review of the DB1 warning and fault capability.

The following conditions cause a fault anytime the DB1 is active:

- DB Shorted Switch – The monitoring circuit detected current when Drive bus voltage is below the bus overvoltage threshold.
- DB Overtemp – The resistor is too hot.

IMPORTANT You must monitor this bit to check if the maximum resistor temperature is reached. If the maximum resistor temperature is reached, you must provide a means to disconnect the line power.

- DB Comm Fault – Communication loss exists between the DB board and the internal main control board.
- DB Bus Voltage Link Open – Bus voltage from the drive is not measured for 2 seconds. Internal connection loss between the DB board and the internal main control board.

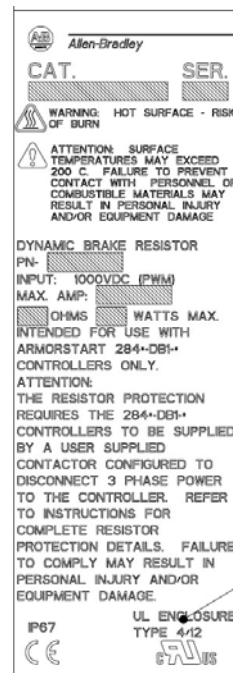
DB Shorted Switch Fault

Normally when the bus voltage is above this threshold the excess power is bled off to the resistor via the 7th IGBT to prevent a bus overvoltage fault of the drive. But the above symptom can occur if the drive has a shorted 7th IGBT. In this case, there is continuous current flowing to the resistor. This exceeds the 5% duty cycle rating and can quickly cause the resistor surface to heat up above 200 °C (392 °F), which can cause a hazardous condition or fire.

When the ArmorStart controller detects continuous resistor current even though the Drive Bus Voltage level is below the upper limit threshold a DB Shorted Switch fault is announced locally and over the network. You should monitor the fault status of the product. In addition, you should also read back the Control Supervisor Object in their PLC code, specifically the DB1 Fault Attribute Bit 3 if the fault is a result of a shorted switch.

It is the responsibility of the system designer or control engineering to properly protect against such an event, refer to resistor marking in [Figure 64](#).

Figure 64 - Example Resistor Label

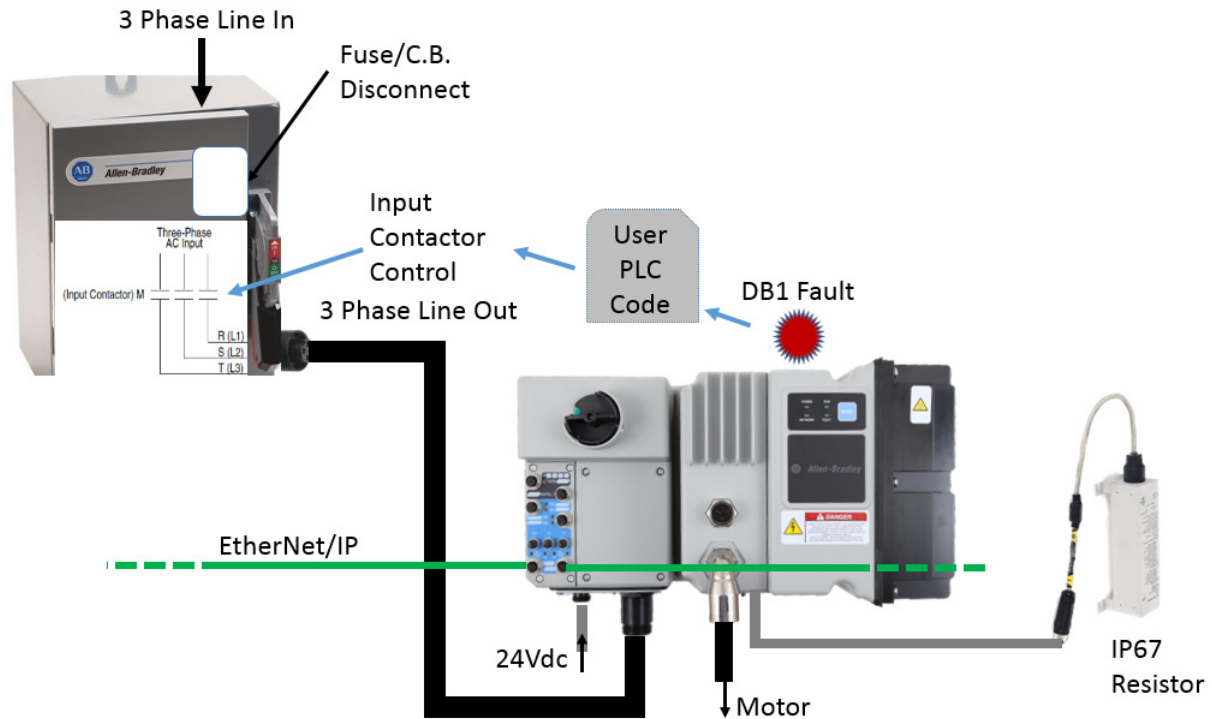


One method is to provide an input power contactor to each ArmorStart controller or a single contactor to a group of ArmorStart controllers, see [Figure 65](#). The system designer or controls engineering must then write logic to control (open) the input contactor to the ArmorStart controller if a DB1 Switch Fault occurs.

For sample code that provides guidance for using logic to protect the resistor if a shorted switch occurs, go to the [Rockwell Automation Sample Code Library](#) and search 78172 for ID78172 (ArmorStart DB1 Protection Code).

This sample code provides a starting point for you to develop your own methodology to monitor the DB Shorted Switch fault.

Figure 65 - Resistor Example



Notes:

System Design Considerations When Using a Line Reactor

Generally a line reactor for an ArmorStart® controller is not required.

Reasons to Use

The most common reasons to use a line reactor are to:

- Extend the working life of the DC-bus capacitors by reducing the associated heat impact that comes from ripple noise currents in these capacitors.
- Reduce the impact of line disturbances on other equipment that result VFD input switching.
- Reduce the RMS input current that is associated with peak changes in current that results from VFD input switching. This current reduction allows the use of smaller input conductors and transformers.
- Mitigate the impact of power system transients on the drive.

Repeated line disturbances in current and voltage can lead to premature input power structure failure for AC drives. One way to mitigate these types of issues is to add impedance to the incoming power line to the drive. Impedance comes in the form of transformers, line reactors, and conductors. When a large power distribution system (>100 kVA) is feeding many small VFDs, the associated input impedance can be lower than 1%. This low impedance can result in voltage and current disturbances that negatively impact performance and the overall life of an AC drive. A line reactor is one possible solution to absorb these power line disturbances, but does not mean that a reactor must be used in every situation. Conductors add impedance. On-Machine™ solutions are typically further away from the power distribution panel therefore the length of cable adds impedance.

ArmorStart Design

The ArmorStart design incorporates features and additional components that make for better heat transfer, which keep the internal components cooler. This cooler design promotes longer life of the DC bus capacitors that extend the life of the VFD. In addition, if line disturbance mitigation is necessary, the ArmorStart controller can be equipped with an EMI filter and shielded motor cable reducing the impact of the power switching components. However, if you specify input line reactors or transformers, the recommendation is to group the ArmorStart controllers at the distribution panel under one line reactor (not individual reactors or transformers).

Lastly, when full voltage ArmorStart controllers are included with VFD ArmorStart controllers, and line reactors are used, the starting currents of the full voltage ArmorStart controllers can be significant. The current must be accounted for in the selection of the line reactor or there is a risk of nuisance faults.

Notes:

User Safety I/O Wiring Examples

Read this chapter for information about wiring and safety categories. See [Table 91](#) for more information on input device connection methods and their safety categories.

Table 91 - Input Device Connection Methods and Safety Categories

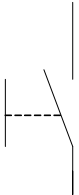
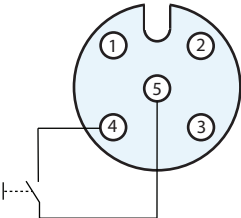
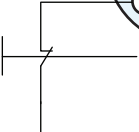
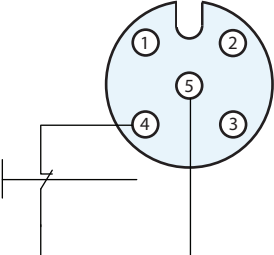
Connected Device	Test Pulse from Test Output	Connection	Schematic Diagram	Safety Category	Maximum Performance Level
Reset switch 	No	Connect the switch between IO and T0. T0 must be configured as 24V power supply.	Safety Input 1 - Test Output 1 2 - Safety Input 1 3 - Common 4 - Safety Input 0 5 - Test Output 0 	-	C
Single-channel safety device 	Yes	Connect the switch between IO and T0	Safety Input 1 - Test Output 1 2 - Safety Input 1 3 - Common 4 - Safety Input 0 5 - Test Output 0 	2	D

Table 91 - Input Device Connection Methods and Safety Categories (Continued)

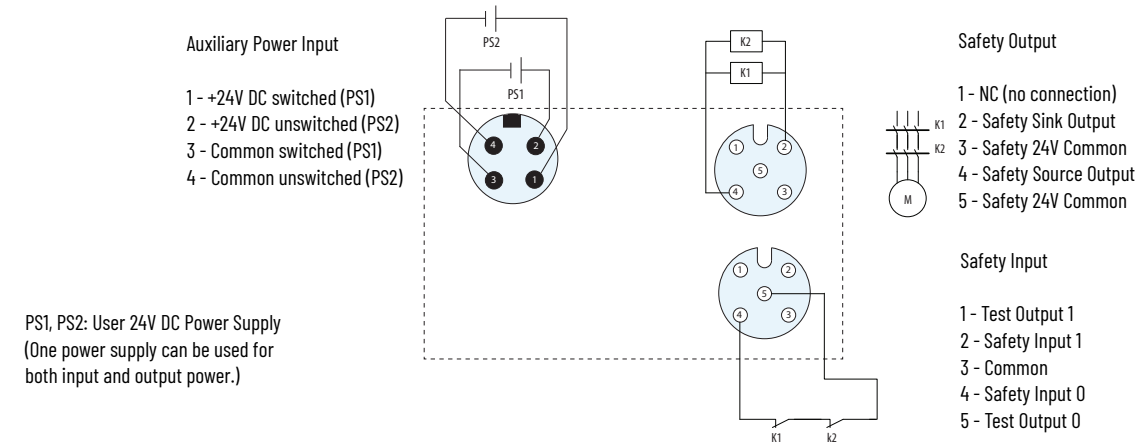
Connected Device	Test Pulse from Test Output	Connection	Schematic Diagram	Safety Category	Maximum Performance Level
Emergency stop switch Door monitor	No	Connect the switches between T0 and I0 and I1. T0 is configured for 24V power supply.	Safety Input 1 - Test Output 1 2 - Safety Input 1 3 - Common 4 - Safety Input 0 5 - Test Output 0	3	D
Emergency stop switch Door monitor	Yes	Connect the switches between I0 and T0, and I1 and T1	Safety Input 1 - Test Output 1 2 - Safety Input 1 3 - Common 4 - Safety Input 0 5 - Test Output 0	4	E
Light curtain 	Yes	Connect the OSSD1 and OSSD2 to I0 and I1, respectively. Connect the 24V power supply commons.	Auxiliary Power Input 1 - +24V DC switched (PS1) 2 - +24V DC unswitched (PS2) 3 - Common switched (PS1) 4 - Common unswitched (PS2) Safety Input 1 - Test Output 1 2 - Safety Input 1 3 - Common 4 - Safety Input 0 5 - Test Output 0	3 or 4 based on light curtain being used	E

Wiring by Application

Read this section for examples of wiring by application. See catalog number details for appropriate module.

IMPORTANT For the bipolar safety outputs to work as intended, you **must** connect the devices that are being controlled as shown in this figure. Connection of devices directly to 24V DC, 0V DC, or ground is strictly prohibited.

Figure 66 - Dual-load Bipolar Outputs

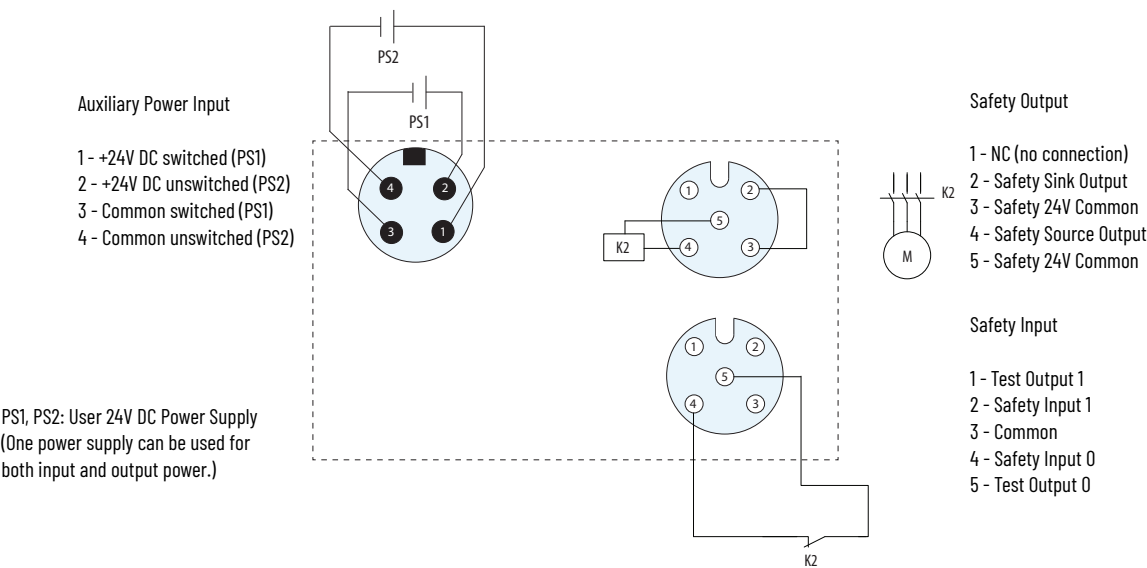


Controller Configuration	Parameter Name	Configuration Setting
Safety Input 0	Safety Input 0 Channel Mode	Test Pulse from Test Output
	Safety Input 0 Test Source	Test Output 0
	Dual-channel Safety Input 0/1 Mode	Single Channel
Test Output 0	Test Output 0 Mode	Pulse Test Output
Safety Output 0	Safety Output 0 Channel Mode	Safety Pulse Test
Safety Output 1	Safety Output 1 Channel Mode	Safety Pulse Test

This example shows wiring and configuration when using solid-state outputs in Dual-channel mode.

All safety outputs are permanently configured for use as Dual-channel mode only. When used in combination with the programs of the safety controller, this circuit configuration is Safety Category 4 in accordance with ISO 13849-1:2015 wiring requirements and is rated up to Performance Level e.

Figure 67 - Single Channel Sourcing Outputs



Controller Configuration	Parameter Name	Configuration Setting
Safety Input 0	Safety Input 0 Channel Mode	Test Pulse from Test Output
	Safety Input 0 Test Source	Test Output 0
	Dual-channel Safety Input 0/1 Mode	Single Channel
Test Output 0	Test Output 0 Mode	Pulse Test Output
Safety Output 0/1	Safety Output 0/1	Single Channel Sourcing
Safety Output 0	Safety Output 0 Channel Mode	Safety Pulse Test

The example shows wiring and configuration when using solid-state outputs in single-channel mode.

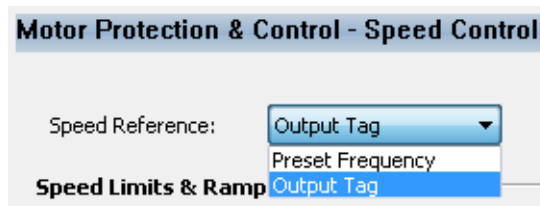
When used in combination with the programs of the safety controller, this circuit configuration is Safety Category 2 in accordance with ISO 13849-1:2015 wiring requirements and is rated up to Performance Level d.

Application Examples

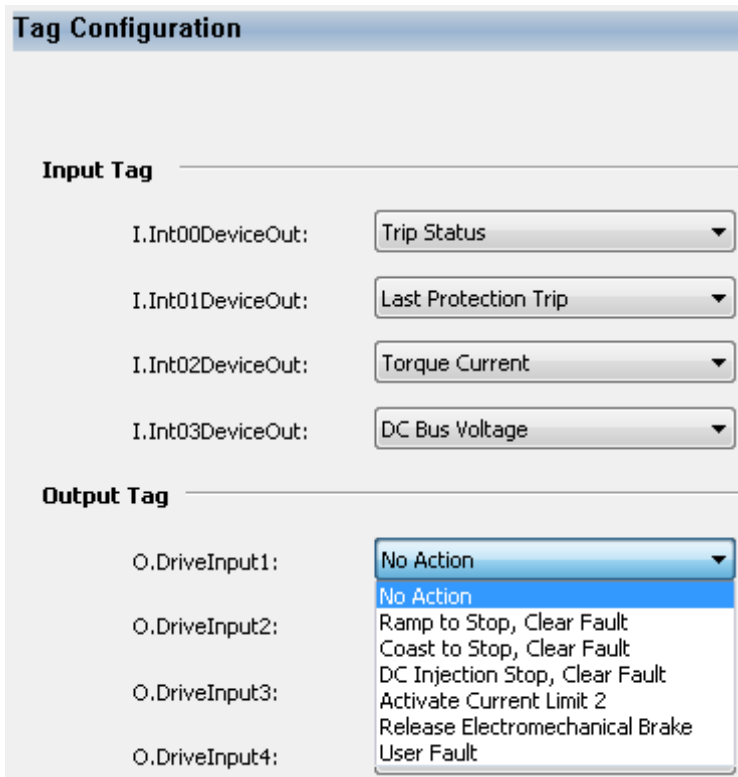
Manual Brake Control

If you want to activate the mechanical brake (source brake option) of the ArmorStart® Bulletin 284ES/GS VFD, there are several settings to configure. The following configuration lets the brake operate normally while running and when the Bulletin 284ES/GS VFD is not running, it allows release of the brake for maintenance.

1. Set Speed control to Output Tag to let the output tag be the speed reference.



2. Select which output tag triggers release of the brake.
See [Table 62 on page 123](#).
Choices for DriveInput1 are shown in the example.



3. Set Stop Mode to either Ramp to Stop (which is the default), or, Ramp to Stop, Clear Fault
 - Ramp To Stop (Default)
 - Ramp To Stop, Clear Fault - A stop command clears active fault

Motor Protection & Control - Stopping

Stop Mode: Ramp To Stop ▼

Bus Regulator: Coast To Stop, Clear Fault

Dynamic Braking

Resistor Select: DC Injection Brake Stop, Clear Fault

DC Bus Voltage Threshold: 100.0 ▼ %

4. Set Source Brake Contactor Release Mode to: Automatic with delay timers.

Motor Protection & Control - Stopping

Stop Mode: Ramp To Stop ▼

Bus Regulator: Enabled ▼

Dynamic Braking

Resistor Select: Disabled ▼

DC Bus Voltage Threshold: 100.0 ▼ %

Source Brake (Electromechanical) Contactor

Release Mode: Automatic (with delay timers) ▼

Off Delay: Always Engaged

On Delay: Automatic (with delay timers)

See [Configure Stopping Functions on page 103](#) for more information.

Bulletin 284ES/GS VFD Preset Speed Example

DeviceLogix™ can be used to select one of multiple preset frequencies cooperatively with the PLC or independently based on your input. This selection can be done by using the four digit inputs or the frequency control bits in DeviceLogix. The digital inputs provide you with the most flexibility, but can be more complex to configure. If a preset speed is needed, the simpler approach is to use frequency control that is found in the produced network bits of DeviceLogix. If you prefer not to apply DeviceLogix for preset speeds, then implement the digit inputs to select preset speed via Instance 166 found in [Table 62 on page 123](#). The following example demonstrates the use of frequency control bits in DeviceLogix.

Frequency control (Freq Cntl) bits allow a maximum of 4 Preset Speeds, each preset has a predefined accel or decel reference. If more are required, then digital inputs must be configured and properly used. The example focuses on Frequency Control 2,1,0 in the Produced Network Bit [Table 92](#). (There are other capabilities that are shown in the table that are not reviewed in this example.)

[Figure 68](#) shows all available network outputs supported by Bulletin 284ES/GS VFD. See [Table 92](#) for preset frequencies definitions in parameter 170,171,172 and 173 of the Bulletin 284ES/GS VFD. Also note the truth table that selects each of those frequencies. For example if Freq Cntl bit 2=1, 1=1, and 0=0 then the controller frequency is based on Preset Frequency 2 value.

Figure 68 – Bulletin 284ES/GS Produced Network Bits in DeviceLogix Output

Name	DataType
Hardware Boolean Output	
Network Boolean Output	
Pt00DeviceOut	BOOLEAN
Pt01DeviceOut	BOOLEAN
Pt02DeviceOut	BOOLEAN
Pt03DeviceOut	BOOLEAN
Pt04DeviceOut	BOOLEAN
Pt05DeviceOut	BOOLEAN
Pt06DeviceOut	BOOLEAN
Pt07DeviceOut	BOOLEAN
Pt08DeviceOut	BOOLEAN
Pt09DeviceOut	BOOLEAN
Pt10DeviceOut	BOOLEAN
Pt11DeviceOut	BOOLEAN
Pt12DeviceOut	BOOLEAN
Pt13DeviceOut	BOOLEAN
Pt14DeviceOut	BOOLEAN
ResetFault	BOOLEAN
AccelCtrl_0	BOOLEAN
AccelCtrl_1	BOOLEAN
DecelCtrl_0	BOOLEAN
DecelCtrl_1	BOOLEAN
FreqCtrl_0	BOOLEAN
FreqCtrl_1	BOOLEAN
FreqCtrl_2	BOOLEAN
DisableMotion	BOOLEAN
DisableKeypad	BOOLEAN

Table 92 - Predefined Accel and Decel Settings

Accel2	Accel1	—	Description
0	0	—	No Command
0	1	—	Accel 1 Enable
1	0	—	Accel 2 Enable
1	1	—	Hold Accel Rate Selected
Decel 2	Decel 1	—	—
0	0	—	No Command
0	1	—	Decel 1 Enable
1	0	—	Decel 2 Enable
1	1	—	Hold Decel Rate Selected
Freq Ctrl 2	Freq Ctrl 1	Freq Ctrl 0	—
0	0	0	No Command
0	0	1	Freq Source = P136 (Start Source)
0	1	0	Freq Source = P169 (Internal Freq)
0	1	1	Freq Source = Comms
1	0	0	Preset Frequency 0 (Accel/Decel 1)
1	0	1	Preset Frequency 1 (Accel/Decel 1)
1	1	0	Preset Frequency 2 (Accel/Decel 2)
1	1	1	Preset Frequency 3 (Accel/Decel 2)

Set the Preset Frequency 0...3 from the Motor Protection & Control - Speed Control page, set them to 0, 10, 30, and 60 respectively. [Figure 69](#) shows the preset frequencies 0...3 from the respective controller tags.

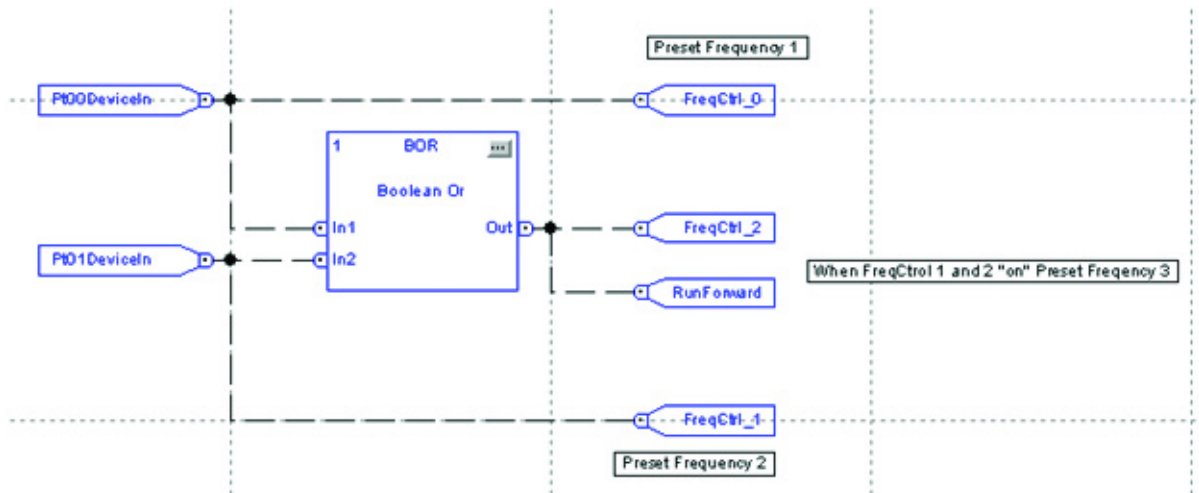
Figure 69 - P170...173 Preset Frequency Settings

▸ ST_284GS:C.PresetFrequency0	0
▸ ST_284GS:C.PresetFrequency1	10
▸ ST_284GS:C.PresetFrequency2	30
▸ ST_284GS:C.PresetFrequency3	60

In this example, DeviceLogix receives data from the programmable controller program. The communication and network overrides are disabled as on the Motor Protection & Control - Advanced Motor Control dialog box.

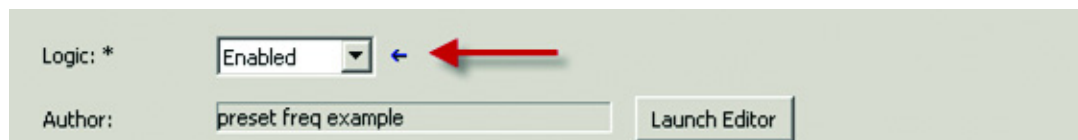
Figure 70 shows the DeviceLogix program. This program lets you select one of three predefined frequencies that are based on two network bits.

Figure 70 - DeviceLogix Program

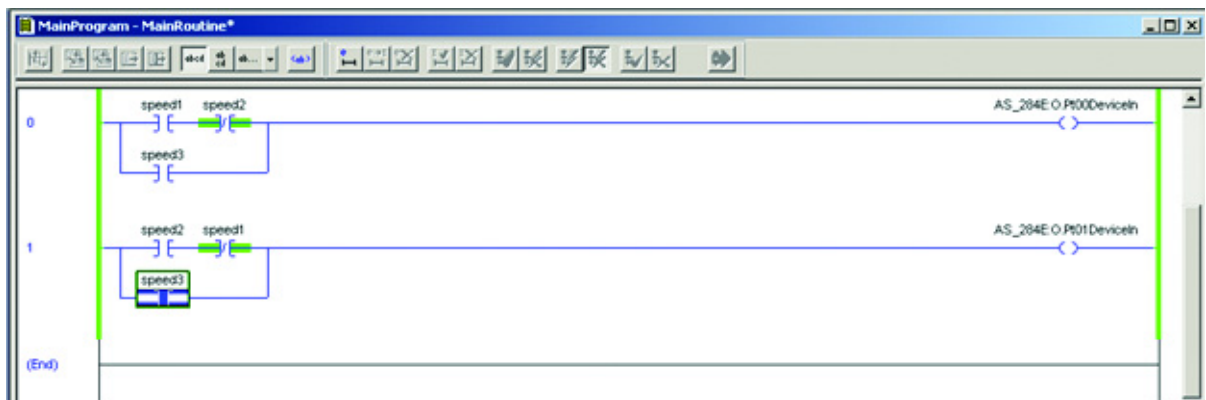


Once you exit the DeviceLogix editor, verify that the logic is Enabled otherwise the preset frequency control does not operate. See Figure 71.

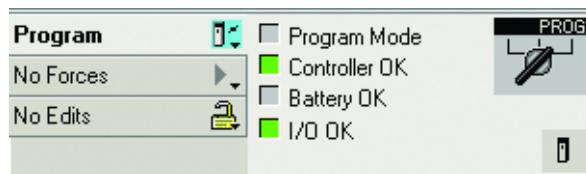
Figure 71 - Logic Enabled



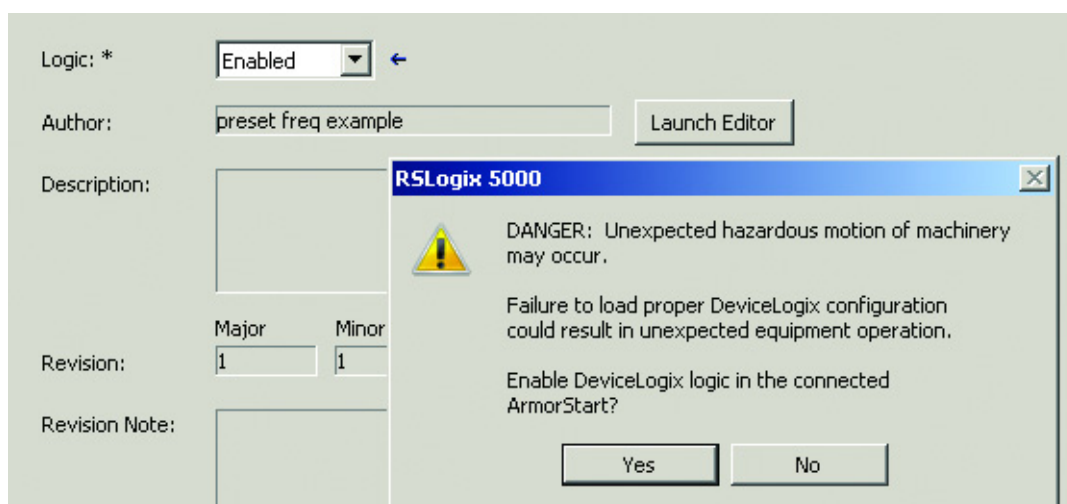
This simple controller logic program is used to select one of three preset speeds, speed 1, 2, or 3. For this example speeds 1, 2, and 3 are BOOL bits but they can be any valid input. Notice that there is an interlock for speed 1 and speed 2 to verify that they do not trigger simultaneously. A simultaneous trigger causes speed 3 to run accidentally.



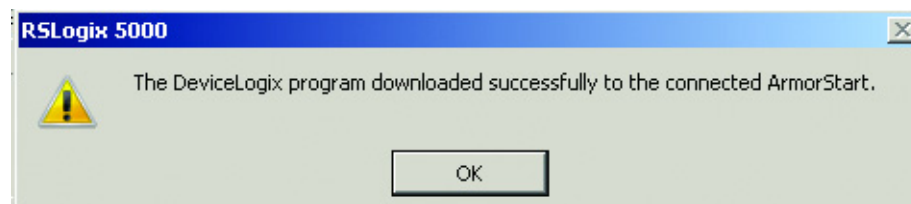
Download the finished program file to the programmable controller. In order for the parameters and DeviceLogix program to update in the device, verify that the programmable controller is in program mode, and open the Module Properties for the Bulletin 284ES/GS VFD.



Note the caution statement before download.



After the DeviceLogix correlation is successful, the following window is displayed.



After both correlations are complete place the programmable controller in run mode and test the program by exercising speed bits 1, 2, and 3.

IMPORTANT To download a new DeviceLogix program, connect to the programmable controller and stay in program mode. There can be no active I/O connections to the device or the download fails. Open the Module Properties and select the DeviceLogix tab to start the correlation process. If a difference exists, then an upload or download is necessary.

Operation

When bit Speed_1 is ON, then the Bulletin 284ES/GS VFD accelerates to 10 Hz or decelerate by using accel/decel Time 2.

When bit Speed_2 is ON, then the Bulletin 284ES/GS VFD accelerates to 30 Hz or decelerate by using accel/decel Time 2.

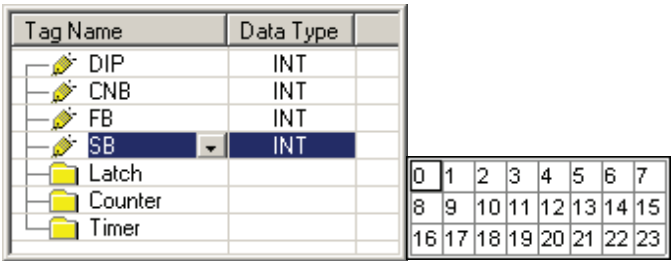
DeviceLogix Ladder Editor Example

ArmorStart ST supports DeviceLogix in a ladder programming environment. When using the ladder editor, additional explanation is needed about naming conventions. Fault bits such as Overload Trip are tagged FB0, FB1, FB2, and so on. Status bits such as Running Fwd are tagged SB0, SB1, SB2, and so on. Outputs such as Run Reverse are tagged DOP0, DOP1, and so on. Produced Network Bits such as Fault Reset are tagged PNBO, PNB1, and so on.

This document helps you interpret the naming conventions.

ArmorStart Bulletin 281ES/GS Status Bits

The screen capture shows how to choose status bits in the ladder editor.

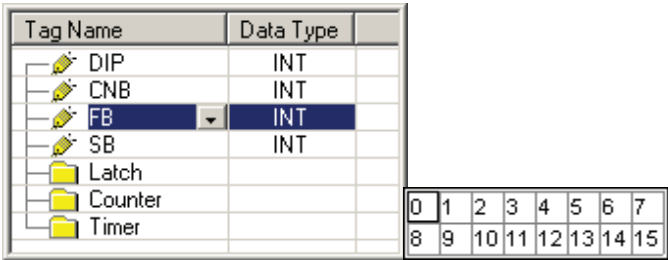


The following table contains the status bit definitions for ArmorStart Bulletin 281ES/GS units:

Status Bit Declaration
0 = Tripped
1 = Running Fwd
2 = Running Rev
3 = Ready
4 = Net Ctl Status
5 = At Reference
6 = Keypad Hand
7 = HOA Status
8 = 140M On
9 = Explicit Msg Cnxn Exists
10 = IO Cnxn Exists
11 = Explicit Cnxn Fault
12 = IO Cnxn Fault
13 = IO Cnxn Idle
14 = Current Flowing
15 = Keypad Hand Direction

ArmorStart Bulletin 281ES/GS Fault Bits

The screen capture shows how to choose fault bits in the ladder editor.

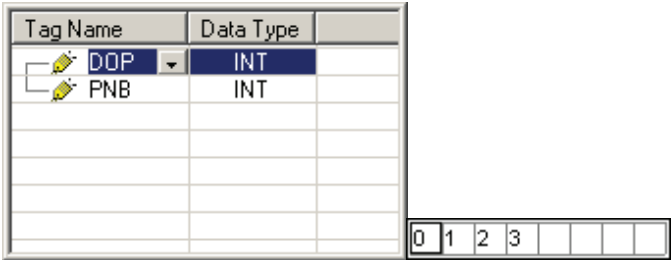


The following table contains the fault bit definitions for ArmorStart Bulletin 281ES/GS units:

Fault Bit Declaration
0 = Short Circuit
1 = Overload
2 = Phase Loss
3 = Control Power
4 = IO Fault
5 = Over Temp
6 = Phase Imbalance
7 = DNet Power Loss
8 = EEprom
9 = HW Flt
10 = PL Warning
11 = CP Warning
12 = IO Warning
13 = Phase Imbal Warn
14 = DN Warning
15 = HW Warning

ArmorStart Bulletin 281ES/GS Outputs

The screen capture shows how to choose outputs in the ladder editor.

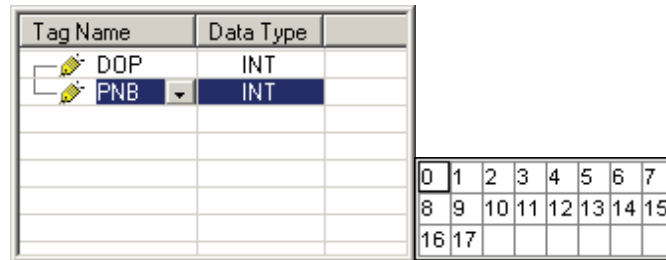


Bulletin 281ES/GS has the following bit definitions:

- 0 = Run Forward
- 1 = Run Reverse
- 2 = User Output A
- 3 = User Output B

ArmorStart Bulletin 281ES/GS Produced Network Bits

The screen capture shows how to choose Produced Network Bits in the ladder editor.



The following table contains the produced network bit definitions for ArmorStart Bulletin 281ES/GS units.

Produce Network bit declaration	
0 = Net Output 0	
1 = Net Output 1	
2 = Net Output 2	
3 = Net Output 3	
4 = Net Output 4	
5 = Net Output 5	
6 = Net Output 6	
7 = Net Output 7	
8 = Net Output 8	
9 = Net Output 9	
10 = Net Output 10	
11 = Net Output 11	
12 = Net Output 12	
13 = Net Output 13	
14 = Net Output 14	
15 = Fault Reset	
16 = Motion Disable	
17 = Keypad Disable	

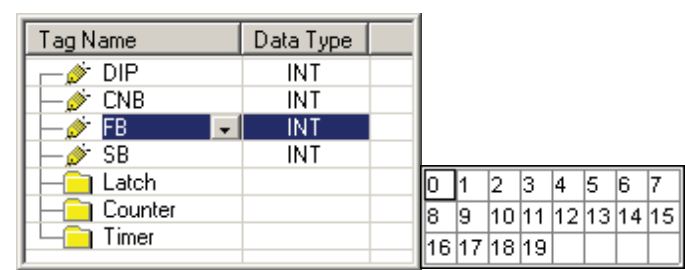
ArmorStart Bulletin 284ES/GS Status Bits

The next table contains the status bit definitions for ArmorStart 284 VFD.

Status bit declaration	
0 = Tripped	
1 = Warning	
2 = Running Fwd	
3 = Running Rev	
4 = Ready	
5 = Net Ctl Status	
6 = Net Ref Status	
7 = At Reference	
8 = Drive Opto 1	
9 = Drive Opto 2	
10 = Keypad Jog	
11 = Keypad Hand	
12 = HOA Status	
13 = 140M On	
14 = Contactor 1	
15 = Contactor 2	
16 = Explicit Msg Cnxn Exists	
17 = IO Cnxn Exists	
18 = Explicit Cnxn Fault	
19 = IO Cnxn Fau	
20 = IO Cnxn Idle	
21 = Keypad Hand Direction	

ArmorStart Bulletin 284ES/GS Fault Bits

The screen capture shows how to choose Fault Bits in the ladder editor.

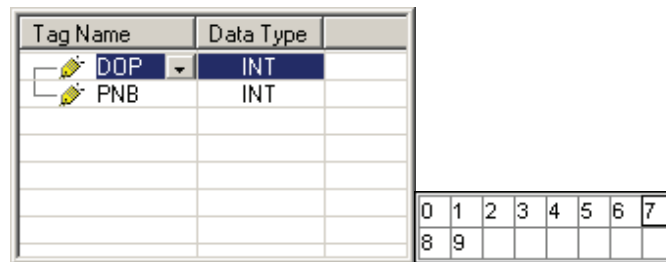


The following table contains the fault bit definitions for Bulletin 284ES/GS VFDs:

Fault bit declaration	
0	Short Circuit
1	Overload
2	Phase Short
3	Ground Fault
4	Stall
5	Control Power
6	IO Fault
7	Over Temp
8	Phase Over Current
9	DNet Power Loss
10	Internal Comm
11	DC Bus Fault
12	EEProm
13	HW Flt
14	Reset Retries
15	Misc. Fault
16	CP Warning
17	IO Warning
18	DN Warning
19	HW Warning

ArmorStart Bulletin 284ES/GS Outputs

The screen capture shows how to choose outputs in the ladder editor.

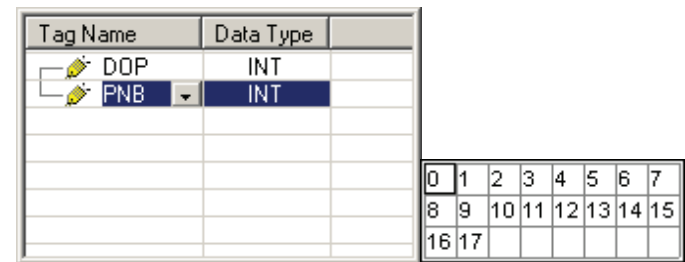


Bulletin 284ES/GS bit definitions:

- 0 = Run Forward
- 1 = Run Reverse (Reserved)
- 2 = User Output A
- 3 = User Output B
- 4 = Drive Digital In 1
- 5 = Drive Digital In 2
- 6 = Drive Digital In 3
- 7 = Drive Digital In 4
- 8 = Jog Forward
- 9 = Jog Reverse

ArmorStart Bulletin 284ES/GS Produced Network Bits

The screen capture shows how to choose Produced Network Bits in the ladder editor.



The following table contains the produced network bit definitions for ArmorStart Bulletin 284ES/GS units:

Produce network bit declaration
0 = Net Output 0
1 = Net Output 1
2 = Net Output 2
3 = Net Output 3
4 = Net Output 4
5 = Net Output 5
6 = Net Output 6
7 = Net Output 7
8 = Net Output 8
9 = Net Output 9
10 = Net Output 10
11 = Net Output 11
12 = Net Output 12
13 = Net Output 13
14 = Net Output 14
15 = Fault Reset
16 = Accel 1
17 = Accel 2
18 = Decel 1
19 = Decel 2
20 = Freq Select 1
21 = Freq Select 2
22 = Freq Select 3
23 = Motion Disable
24 = Keypad Disable

Report Examples

How to Report the RPM of the Bulletin 284ES/GS Internal Fan

To get the fan RPM of the fan, an explicit get single message instruction is needed by using a service of 0x000E.

The fan RPM can be read by using the following CIA Class 0x00B4, Instance 1, and Attribute 103. The nominal fan rpm value is 2800...3000 RPM. The ArmorStart controller trips once the fan speed falls below 62% (1736).

There is no FAN FAULT warning. You must develop your own warning PLC code by using the CIA message that is listed previously, for critical applications.

How to Report the Heat Sink Temperature of the Bulletin 284ES/GS VFD

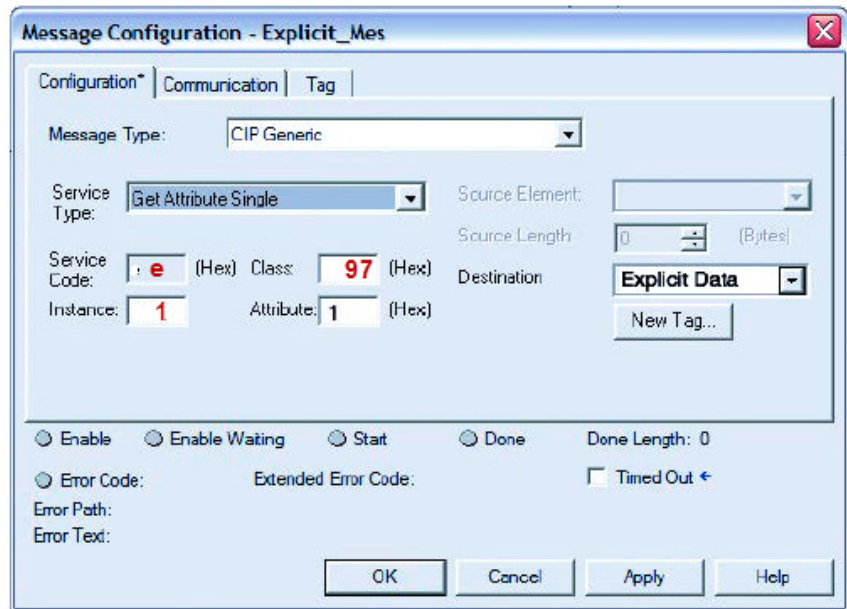
To get the heat sink temperature of the Bulletin 284ES/GS VFD, an explicit get single message instruction is needed.

The heat sink temperature can be read by using the following CIA Class 0x000F, Instance 124, and Attribute 1.

Service: e (hex) Class: f (hex) Instance: 124 Attribute: 1 (hex).

How to Report the Last Four Faults

By default, the ArmorStart controller provides only the last fault as a parameter. To retrieve the last four faults, a Message instruction is required. Class 0x0097 DPI Fault Object is used to extract a structure of information that is related to the last four faults. The following example shows how to configure an explicit message to get all four fault logs. To retrieve information on all four faults, the instance value must be indexed from 1, 2, 3, and 4, where 1 is the most recent fault information. If more detailed information is needed, change the attribute to 0.



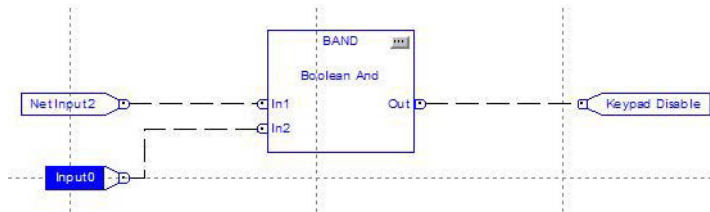
How to Report an IP Address Conflict Detection

Locate CIP Class 0x00F5 address conflict detection. This detection is stored in nonvolatile memory and can be accessed through the TCP/IP Interface Object, instance 1, attribute 11 (LastConflictDetected) via a Message instruction.

Keypad Disable with DeviceLogix

HOA operation can be stopped dynamically without parameter modification, as follows:

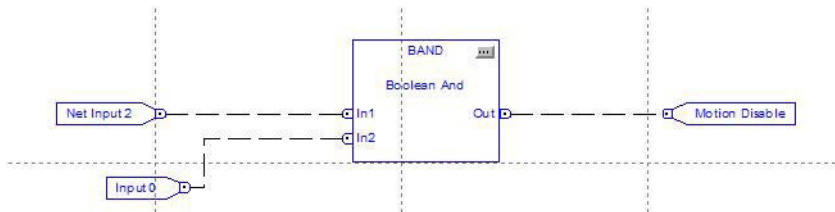
The DeviceLogix program that is shown, turns off the keypad if both inputs are true and the keypad is in either OFF or AUTO mode.



Note: If you are already pressing the HAND button, the program does not disable the keypad; if the inputs are on after the HAND mode is actuated.

Motion Disable

The motion disable program disables motion regardless of the HOA status, PLC control, or DeviceLogix. Once motion disable is turned off, the ArmorStart controller or PLC resumes control of the motor again. The motion disable does not disable the HOA keypad. The keypad operation appears normal but it does not control the run command until the motion disable is off.



History of Changes

This appendix contains the new or updated information for each revision of this publication. These lists include substantive updates only and are not intended to reflect all changes. Translated versions are not always available for each revision.

Change Log

280ES-UM002B-EN-P, November 2019

Change
Maximum diagnostic test interval table for different safety categories

280ES-UM002C-EN-P, December 2022

Change
Updated certifications to include UKCA.
Converted Fault Codes spreadsheet to a separate publication, 280ES-RD001.

280ES-UM002D-EN-P, April 2023

Change
Added publication references for security considerations.
Added Safety I/O Power diagram.
Corrected Fault Reset diagram
Added note about byte size difference between Studio 5000 and this publication.

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Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, Knowledgebase, and product notification updates.	rok.auto/support
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Technical Documentation Center	Quickly access and download technical specifications, installation instructions, and user manuals.	rok.auto/techdocs
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

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Your comments help us serve your documentation needs better. If you have any suggestions on how to improve our content, complete the form at rok.auto/docfeedback.

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 compliance information on its website at rok.auto/pec.

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