User Manual

Original Instructions

Allen-Bradley

# ArmorStart ST Motor Controller

Bulletin Numbers 281E and 284E (includes safety versions)

Allen-Bradley • Rockwell Software

Rockwell Automation

## 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 can be impaired.

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

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

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

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

**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which can lead to personal injury or death, property damage, or economic loss.

**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

**IMPORTANT** Identifies information that is critical for successful application and understanding of the product.

Labels can 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).

# European Communities (EC) Directive Compliance

If this product has the CE mark it is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

## Low Voltage and EMC Directives

This product is tested to meet Council Directive 2006/95/EC Low Voltage Directive and Council Directive 2004/108/EC Electromagnetic Compatibility (EMC) by applying the following standard(s):

- Bulletin 281E controller: EN 60947-4-1 — Low-voltage switchgear and controlgear — Part 4-1: Contactors and motor-starters — Electromechanical contactors and motor-starters.
- Bulletin 284E controller: EN/IEC 60947-4-2, EN50178, EN 61800-3 — CE Marked per Low Voltage Directive 2006/95/EC and EMC Directive 2004/108/EC

This product is intended for use in an industrial environment.

## Notes:

## Chapter 3

## Functional Safety

## Chapter 6

## Adding an ArmorStart Selection to Studio 5000 Software



## Chapter 7

## Bulletin 281E/284E Programmable Parameters

## Chapter 11

**Specifications for ArmorStart Controllers with EtherNet/IP**

## Chapter 12

## Accessories



## Appendix A

## Applying More Than One ArmorStart Motor Controller in a Single Branch Circuit on Industrial Machinery



## Appendix B

## Common Industrial Protocol (CIP) Information

## Appendix C
## DeviceLogix



## Appendix D
## Replacement Parts

## Appendix E

## System Design Considerations When Using a Line Reactor



## Appendix F

## Application Examples



## Appendix G

## Cable System Quick Reference Diagram

# Notes:

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

## Software Requirements

| Network | Software | Version |
|---|---|---|
| EtherNet/IP® | RSLinx® Classic | 2.56 or later |
| | RSLogix 5000® | 17.01 or later |
| | Add-on Profile | Download the most current version of the Add-on Profile from: https://rockwellautomationcusthelp.com/ |
| | BOOTP/DHCP | Version 2.3 or later |

## Summary of Changes

This manual contains new and updated information as indicated in the following table.

| Topic | Page |
|---|---|
| Updated short circuit protection specifications. | 245, 253 |
| Updated accessories. | 267, 268 |
| Added missing dimension for Dynamic Brake Resistor. | 270 |

## Additional Resources

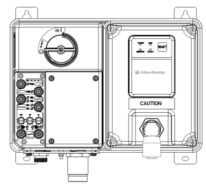
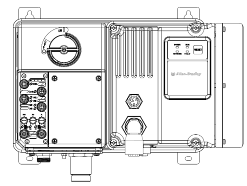
These documents contain additional information concerning related products from Rockwell Automation.

| Resource | Description |
|---|---|
| ArmorStart ST Motor Controller Product Information, 280ES-PC001 | Provides basic information on how to install, configure, and program, the ArmorStart controllers. |
| ArmorStart Distributed Motor Controller and ArmorConnect Power Media Selection Guide, 280PWR-SG001 | Provides information on product specifications, ratings, certifications, system interface, wiring diagrams, and dimensions, to aid in product selection. |
| Wiring and Grounding Guidelines for Pulse-width Modulated (PWM) AC Drives, DRIVES-IN001 | Provides information to install, protect, wire, and ground pulse-width modulated (PWM) AC drives. |
| Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1 | Provides general guidelines for installing a Rockwell Automation industrial system. |
| Product Certifications website, http://www.rockwellautomation.com/global/certification/overview.page | Provides declarations of conformity, certificates, and other certification details. |

You can view or download publications at http://www.rockwellautomation.com/global/literature-library/overview.page. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

# Notes:

# Product Overview

| |  |  |
|---|---|---|
| **Bulletin** | **281E** | **284E** |
| **Type** | EtherNet/IP | |
| **Horsepower Range:** | | |
| 0.5…10 Hp (0.37…7.5 kW) | ✓ | — |
| 1…5 Hp (0.4…3.0 kW) | — | ✓ |
| **Start Method:** | | |
| Full-Voltage and Reverse | ✓ | — |
| Sensorless Vector Control | — | ✓ |
| **Environmental Rating:** | | |
| IP67/NEMA Type 4/12(1) | ✓ | ✓ |
| **Control Voltage:** | | |
| 24V DC | ✓ | ✓ |
| **Operational Voltage Ratings:** | | |
| 200…480V AC | ✓ | — |
| 380…480V AC | — | ✓ |
| **Rated for Group Motor Installations** | ✓ | ✓ |
| **Local logic with DeviceLogix** | ✓ | ✓ |
| **I/O Capability:** | ✓ | |
| Four Inputs | ✓ | ✓ |
| Two Outputs | ✓ | ✓ |
| **Light-emitting Diode (LED) Status Indication** | ✓ | ✓ |
| **Gland Plate Entry:** | | |
| ArmorConnect Power Media | ✓ | ✓ |
| **Quick Disconnects (I/O, Communications, Motor Connection, Three-Phase, and Control Power)** | ✓ | ✓ |
| **Extended Length Motor and Brake Cables** | ✓ | ✓ |
| **Factory-Installed Options:** | | |
| Source Brake Connector | — | ✓ |
| Dynamic Brake Connector | — | ✓ |
| Redundant Safety Output Contactor | ✓(2) | ✓(1) |
| EMI Filter | — | ✓ |
| Non-shielded/Shielded Motor Cable | — | ✓ |

(1) A sealing cap must be installed on any unused connection to achieve IP67 and Type 4/12 environmental rating.

(2) Only applies to ArmorStart Safety version controller.

## Description

The ArmorStart® ST controller is an integrated, pre-engineered, motor-starting solution that implements a safety-related stop function that conforms to Category 0 of IEC 60204-1. The ArmorStart ST controller has different quick connectors versus the ArmorStart controller. The ArmorStart ST controller provides the equivalent of an embedded dual-port EtherNet/IP switch. Model 281E-*-RRG is used in full-voltage and reverse applications. Model 284E-*-RRG-* is used in variable frequency applications where more precise motor control is needed. The ArmorStart ST controller offers IP67/NEMA Type 4/12 enclosure design, which is suitable for water wash down environments, when connectors or a sealing cap in place.

The ArmorStart ST safety version controller is used with an Allen-Bradley® Safety I/O ArmorBlock®, catalog number 1732ES-IB12XOBV2 or 1732ESIB8XOBV4. Over-molded cables (Allen-Bradley® 889N series) connect the ArmorBlock unit to the ArmorStart units. This configuration provides for implementation of a safety-related stop function in machines with the capability of Cat. 4/PL e, according to EN ISO 13849-1 and SIL 3, according to
EN 62061/IEC 61508.

**Note:** For additional information regarding the1732ES Safety I/O module, see Guard I/O EtherNet/IP Safety Modules User Manual, publication 1791ES-UM001.

The ArmorStart ST controller has four configurable (sink/source) DC inputs and two sourcing solid-state outputs. These inputs and outputs are used with sensors and actuators respectively, for monitoring and controlling the application process.

An Add-on Profile (AOP) for ControlLogix® is available. Launch the associated AOP for the device to set up and configure it, by using Studio 5000® software, revision 17.01 or later.

UL Lists the ArmorStart controller and its mating cable assemblies for use ONLY with each other. Both are suitable for installation in motor groups in accordance with 7.2.10.4 of NFPA® 79, *Electrical Standard for Industrial Machinery®*. 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 Appendix A).

Variable Frequency Drive (VFD) with Safety

Direct Online Reversing (DOLR) with Safety

Variable Frequency Drive (VFD)

Direct Online Reversing (DOLR)

## 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.

**Figure 1 - Catalog Number Explanation for 281E**

| 281 | E | – | F | 12 | Z | – | 10 | C | – | RRG |
|---|---|---|---|---|---|---|---|---|---|---|
| a | b | | c | d | e | | f | g | | h |

a

| Bulletin Number | |
|---|---|
| Code | Description |
| 281 | Reversing Starter |

b

| | |
|---|---|
| Code | Description |
| E | EtherNet/IP |

c

| Enclosure Type | |
|---|---|
| Code | Description |
| F | IP67/NEMA Type 4/12 |

d

| Contactor Size |
|---|
| 12 |
| 23 |

e

| Control Voltage | |
|---|---|
| 24V DC | |
| Code | Description |
| Z | Standard Version |
| S | Safety Version |

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 | | | |
|---|---|---|---|
| Code | Description | | |
| | Control Power | 3-Phase Power | Motor Cable |
| RRG | Round Media (Male Receptacle) | Round Media (Male Receptacle) | No cables supplied |

**Figure 2 - Catalog Number Explanation for 284E**

| 284 | E | – | F | V | D2P3 | Z | – | 10 | – | RRG | – | SBG – DB1 | – | EMI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | b | | c | d | e | f | | g | | h | | i | | j |

*a*

| Bulletin Number | |
|---|---|
| Code | Description |
| 284 | VFD Starter |

*b*

| Communications | |
|---|---|
| Code | Description |
| E | EtherNet/IP |

*c*

| Enclosure Type | |
|---|---|
| Code | Description |
| F | IP67/NEMA Type 4/12 |

*d*

| Torque Performance Mode | |
|---|---|
| Code | Description |
| V | Sensorless Vector Control and Volts per Hertz |

*e*

| Output Current | |
|---|---|
| 380…480V | |
| Code | Description |
| D2P3 | 2.3 A, 0.75 kW, 1.0 Hp |
| 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*

| Control Voltage | |
|---|---|
| Code | Description |
| S | 24V DC (Safety Version) |
| Z | 24V DC (Standard Version) |

*g*

| Short Circuit Protection (Motor Circuit Protector) | |
|---|---|
| Code | Description |
| 10 | 10 A Rated Device |
| 25 | 25 A Rated Device |

*i*

| Brake | |
|---|---|
| Code | Description |
| DB1 | Connectivity to IP67 DB Resistor |
| SBG | Source (EM) Brake |

*j*

| Filter | |
|---|---|
| Code | Description |
| EMI | EMI Filter |

*h*

| Control and 3-Phase Power Connections / Motor Cable Connection | | | |
|---|---|---|---|
| Code | Description | | |
| | Control Power | 3-Phase Power | Motor Cable |
| RRG | Round Media (Male Receptacle) | Round Media (Male Receptacle) | No cable |

# Operation

The ArmorStart ST distributed motor controllers operate three-phase, squirrel-cage induction motors as follows:

Bulletin 281E controller: up to 10 Hp (7.4 kW) at 480V AC
Bulletin 284E controller: up to 5 Hp (3.0 kW) at 480V AC

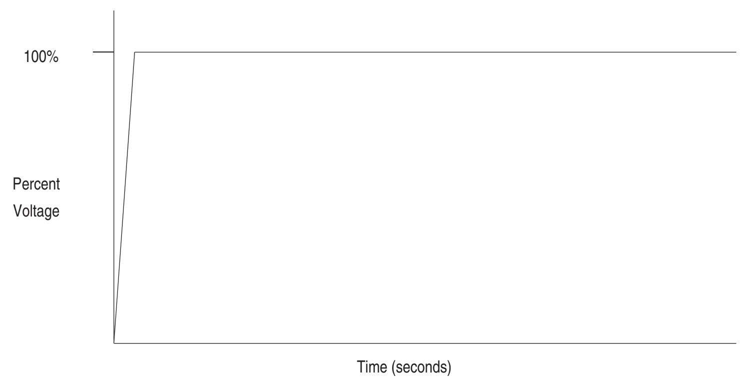
## Mode of Operation

### Bulletin 281E Controller

### Full-voltage and Reversing Start

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**

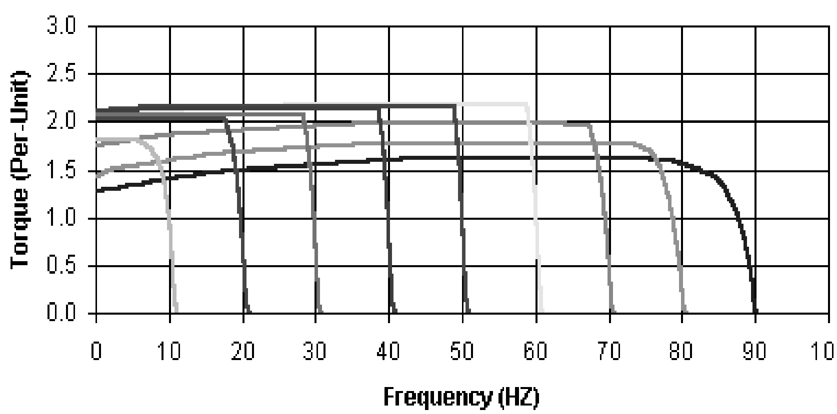



### Bulletin 284E Controller

### Sensorless Vector Control

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

**Figure 4 - Sensorless Vector Control**



# Description of Features

## 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 Chapter 11 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)

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

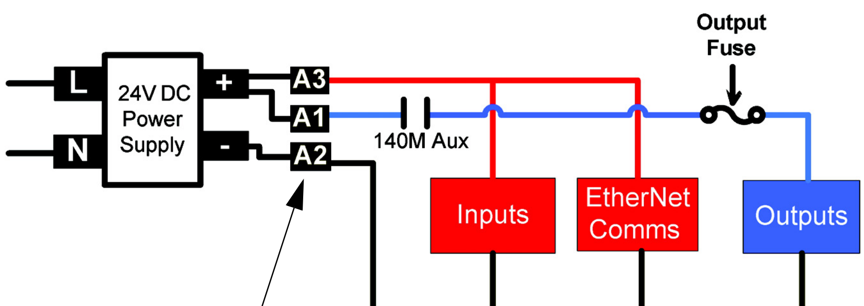
## Switched, Unswitched, and Safety Power Connections

Switched control power (A1/A2) supplies power to outputs, contactor coil, and VFD enable, in the standard controller version, see Figure 5 and Figure 6. 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. In the safety controller version, the internal safety contactors are controlled from the safety I/O block P/M signals.

**Figure 5 - Standard Version Connectors**


Switched Control Power: A1/A2
Unswitched Control Power: A3/A2

**Figure 6 - Standard Version Control Power Diagram**




Switched Control Power: A1/A2
Unswitched Control Power: A3/A2

Unswitched control power (A3/A2) supplies power to inputs, communications, and the electronic control module, see Figure 5 and Figure 6. When this power is removed, the device turns off, with no further control of the motor. There is no communication or I/O activity.

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

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

The safety I/O block (1732ES safety I/O) interfaces with the ArmorStart ST safety controller version. The P and M safety outputs (SO) control the internal safety contactor. The safety inputs (SI) monitor the safety contactor via SM1 and SM2, see Figure 7 and Figure 8.

**Figure 7 - Safety Connectors**

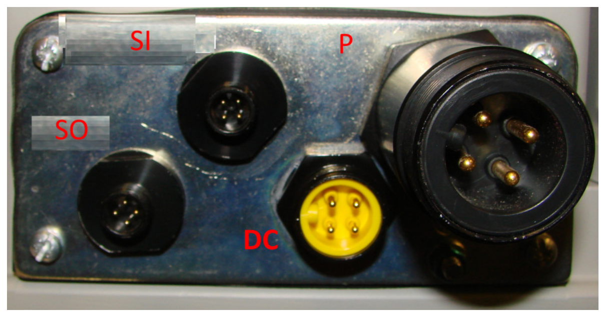
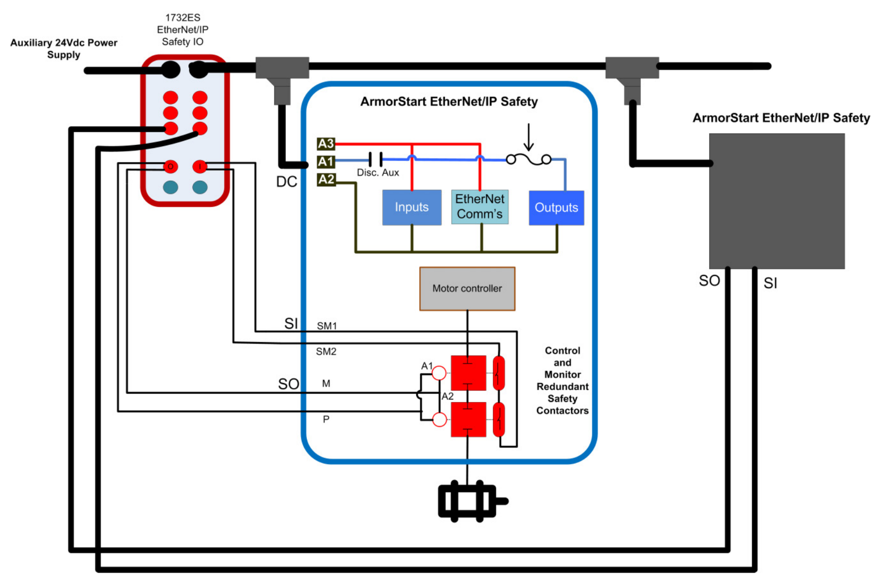



**Figure 8 - Safety Power Block Input and Output Configuration**



## EtherNet/IP Ports

The Ethernet switch supports 10/100 Mbps. It uses a sealed D-coded micro (M12) style Ethernet connector. Dynamic Host Configuration Protocol (DHCP) is enabled as the factory default.

**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.

## Embedded Web Server

The embedded web server enables the viewing of information and the configuring of the ArmorStart controller via a web browser. The default login is “Administrator”. **There is no password set by default.**

**IMPORTANT** Set the password to a unique value for authorized personnel. If the Login and password are lost, you have to reset the device to factory defaults. Note: The configuration will be lost.

### Email Notification Configuration

The embedded web server supports configuration of the Simple Mail Transfer Protocol (SMTP). Once properly configured, the motor controller emails you with specific fault/trip messages.

## EtherNet/IP Light-emitting Diode (LED) Status Indication

**Figure 9 - EtherNet/IP LED**

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

- Link Activity/Status LEDs
  - Ethernet Link1 Activity/Status (Port 1) – LED Color: Bicolor (Green/Yellow)
  - Ethernet Link2 Activity/Status (Port 2) – LED Color: Bicolor (Green/Yellow)
- “MOD” LED – Bicolor Red/Green represents the Ethernet module status
- “NET” LED – Bicolor Red/Green represents the Ethernet network status

## Control Module LED Status and Reset

**Figure 10 - LED Status Indication and Reset**


The Control Module LED status and diagnostics consist of four status LEDs and a Reset button.

- **POWER LED**
  The LED is illuminated solid green when switched (+A1/A2) control power is present with the proper polarity.

- **RUN LED**
  This LED is illuminated solid green when a start command and control power are present.

- **NETWORK LED**
  This bicolor (red/green) LED indicates the status of the internal communication link.

- **FAULT LED**
  This LED indicates a Controller Fault (trip) condition.

The “Reset Button” is a local trip reset.

## 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 all ArmorStart EtherNet/IP devices can also be uploaded directly from the device via the web server interface. Rockwell Automation® product EDS files are also available at: http://www.ab.com/networks/eds.

# Fault Diagnostics

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

## Protection Faults

Protection faults are generated when potentially dangerous or damaging conditions are detected. Protection faults are also known as "Trips."

**Table 1 - Protection Faults**

| Bulletin 281E Trip Status | Bulletin 284E Trip Status | PowerFlex® 40 Fault Codes |
|---|---|---|
| Short Circuit | Short Circuit | — |
| Overload | Overload | (Drive Codes 7 and 64) |
| Phase Loss | Phase Short | (Drive Codes 38…43) |
| Reserved | Ground Fault | (Drive Code 13) |
| Reserved | Stall | (Drive Code 6) |
| Control Pwr Loss | Control Pwr Loss | — |
| Input Fault | Input Fault | — |
| Over Temperature | Over Temperature | — |
| Phase Imbalance | Over Current | (Drive Codes 12 and 63) |
| A3, Unswitched Power Loss | A3, Unswitched Power Loss | — |
| Reserved | Internal Comm | (Drive Code 81) |
| Reserved | DC Bus Fault | (Drive Codes 3, 4 and 5) |
| EEprom | EEprom | (Drive Code 100) |
| Hdw Flt | Hdw Flt | (Drive Codes 70 and 122) |
| Reserved | Restart Retries | (Drive Code 33) |
| Reserved | Misc. Fault(1) | (Drive Codes 2, 8, 29, 48 and 80) |

(1) Included is DB1 monitoring or resistor issue.

Parameter Group "Start Protection," Parameter 24 "PrFault Enable" is used to enable and disable these listed protection faults. See Parameter 61 "LastPR Fault" for additional details of the last protection fault.

# Standard Features

## Inputs

Four 24V DC inputs are included that are single keyed (two inputs per connector) and sourced from A3/A2 control power. The inputs use two M12 connectors. Each input has an LED status indication. They are configurable as sinking or sourcing.

## Outputs

Two self-protected solid-state outputs are included that are single keyed (one per connector) and sourced from A1/A2 control power. Outputs are sourcing type with a maximum current per output of 0.5 A DC. The outputs use one M12 connector per output, each having LED status indication.

## 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 female connector for three-phase power input and one 22 mm (mini size), 4-pin female connector for control power input. The safety version controller adds two 12 mm (micro), 4-pin male connectors for P/M and SM1/SM2 connection.

## Motor Cable

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 Chapter 12 for available catalog numbers.

## 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 will be reset. Preset values are maintained over a power cycle.

## Factory-installed Options

### Source Brake Contactor and Connector (Bulletin 284E Controller Only)

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 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 instructions for the controller, to comply with the UL Listing of the controller. See Chapter 12 for available catalog numbers.

### EMI Filter (Bulletin 284E Controller Only)

The EMI filter is required to be CE 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 instructions for the controller, to comply with the UL Listing of the controller. See Chapter 12 for available catalog numbers.

### Dynamic Brake Connector (Bulletin 284E Controller Only)

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. The IP67 Dynamic Brake is separately ordered. See Chapter 11 for available IP67 Dynamic Brake Resistors.

**Note:** The IP67 Dynamic Brake Resistor is used only with the **-DB1** factory-installed option. 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.

### Safety Output Contactor

The safety controller version includes two internal safety contactors in series. The 1732ES Safety I/O module controls and monitors these contactors.

**Note:** There is no LED indication on the ArmorStart controller for the status of these contactors. The status can be seen from the LEDs on the 1732ES Safety I/O module.

# ArmorStart ST Controller Features

**Figure 11 - Bulletin 281E ArmorStart ST Direct Online and Reversing (DOLR) Starter**

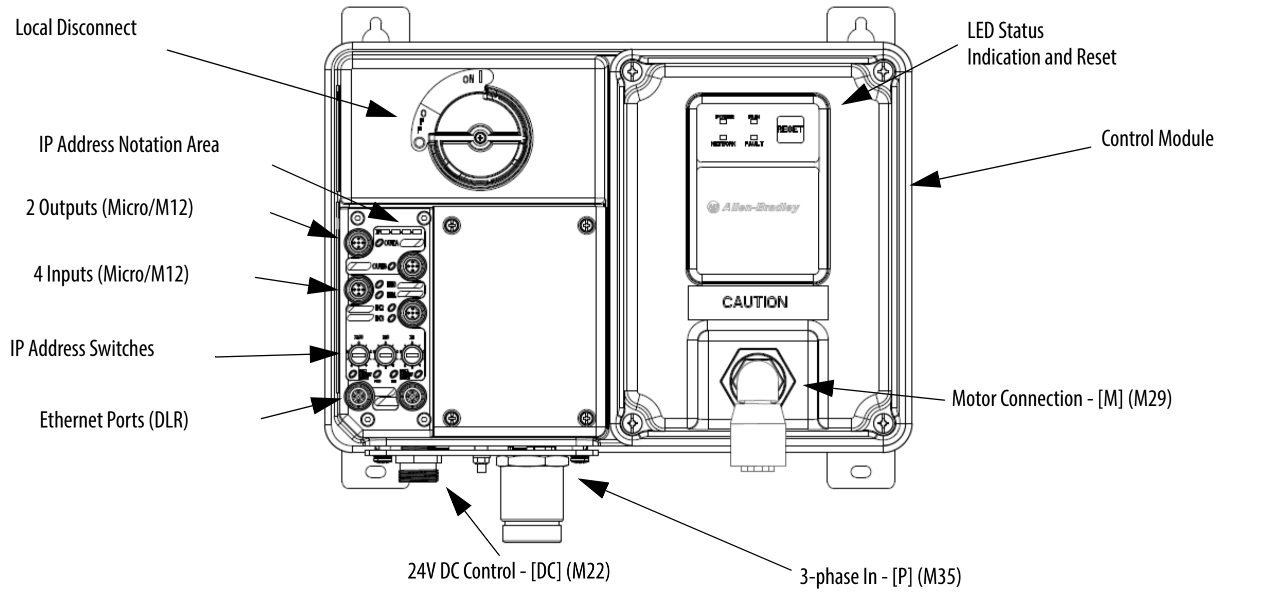
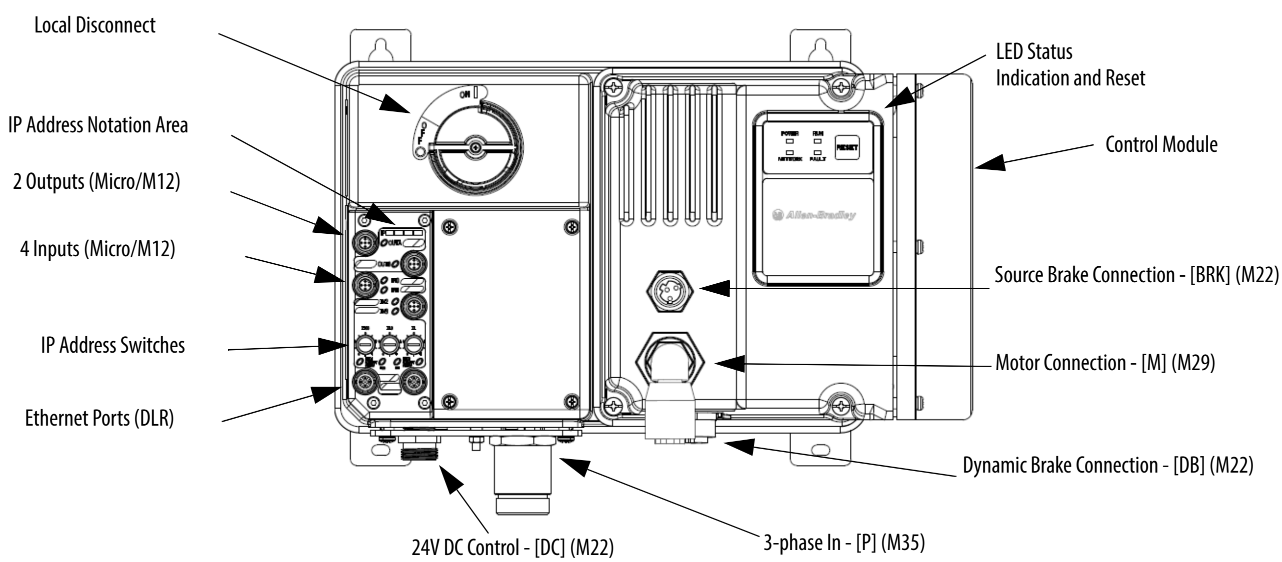



**Figure 12 - Bulletin 284E ArmorStart ST DOLR Starter**



## ArmorStart ST Controller - Safety Features

**Figure 13 - Bulletin 281E ArmorStart ST - Safety Starter**

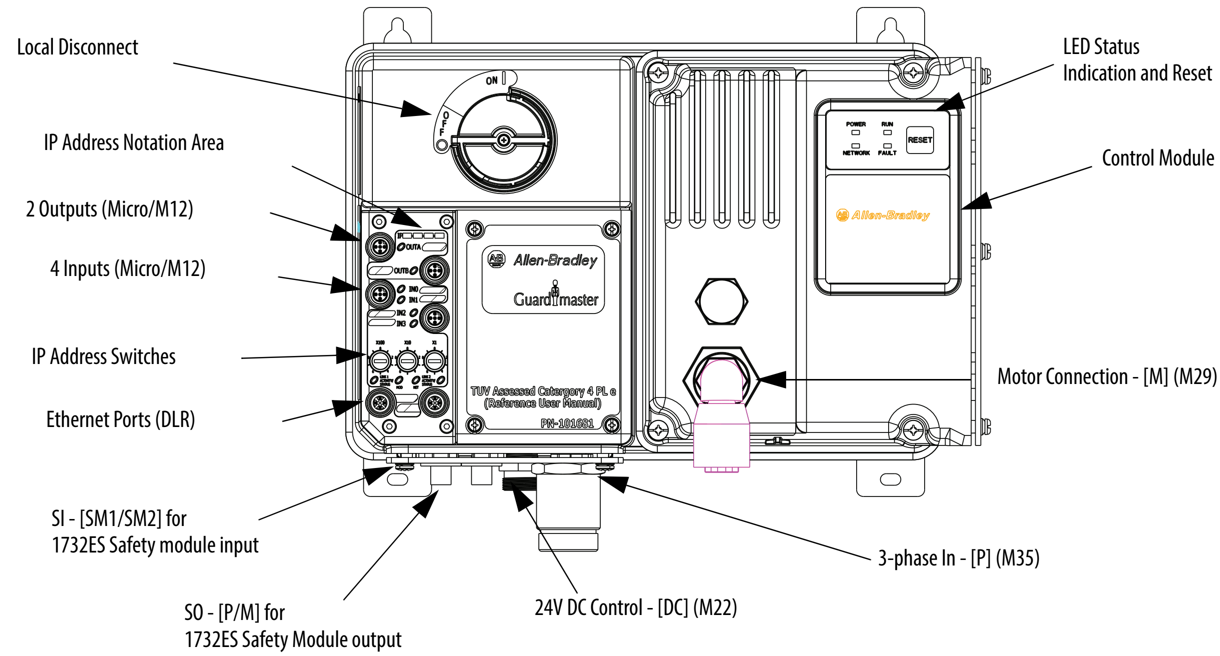
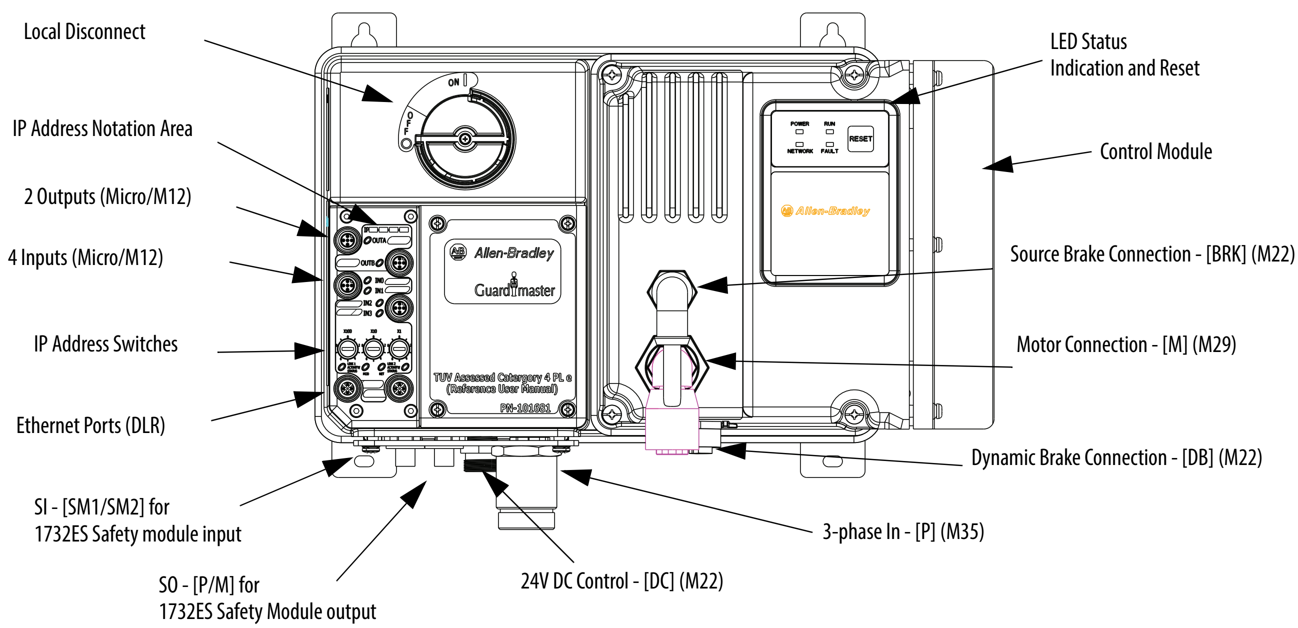



**Figure 14 - Bulletin 284E ArmorStart ST - Safety Starter**



# Notes:

# Chapter 2

# Installation, Wiring, and Maintenance

## Receiving

You are responsible to thoroughly inspect 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 start-up 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 Chapter 1 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.

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

**ATTENTION:** Total circuit impedance must be low enough to confirm that any short circuit or ground fault current is large enough to operate the fuse or circuit breaker. Failure to comply can result in death, personal injury, and/or equipment damage.

**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.

**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:** Only personnel familiar with the controller and associated machinery can plan or implement the installation, startup, and subsequent maintenance of the system. Failure to follow this step can result in personal injury and/or equipment damage.

**ATTENTION:** To avoid electrical shock, open the disconnect switch before you connect and disconnect cables. Risk of shock – environment rating cannot be maintained with open receptacles.

## Precautions for Bulletin 284E Applications

**WARNING:** The drive contains high-voltage capacitors that take time to discharge after removal of mains supply. Before working on a drive, verify 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 LED status indicators are not an indication that capacitors have discharged to reasonable voltage levels. Risk of shock – environment rating cannot be maintained with open receptacles.

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

## Bulletin 281E ArmorStart Controller Connections and Dimensions

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

**Figure 15 - Terminal Designations and Dimensions for Bulletin 281E Controller (RRG Option)**

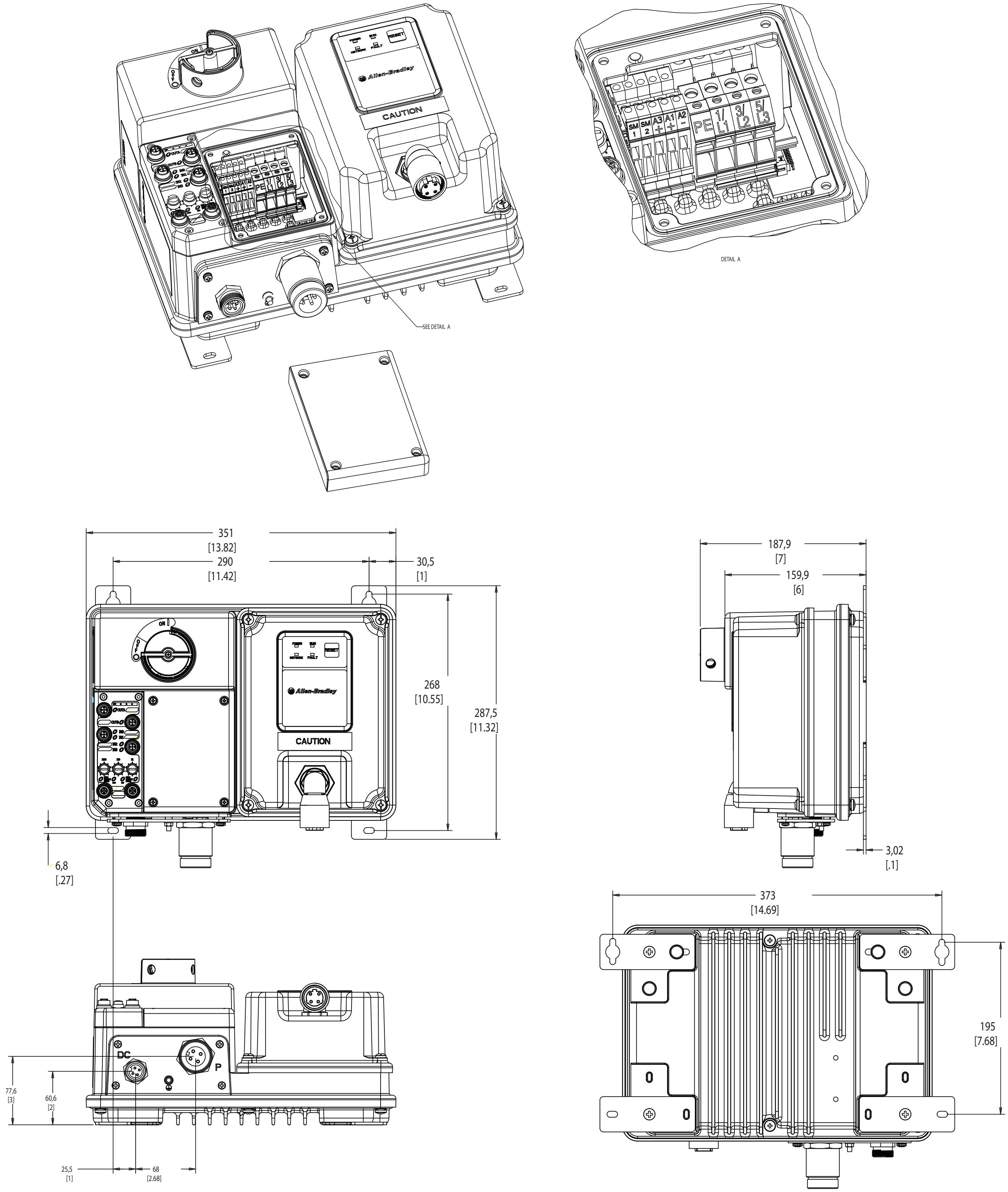
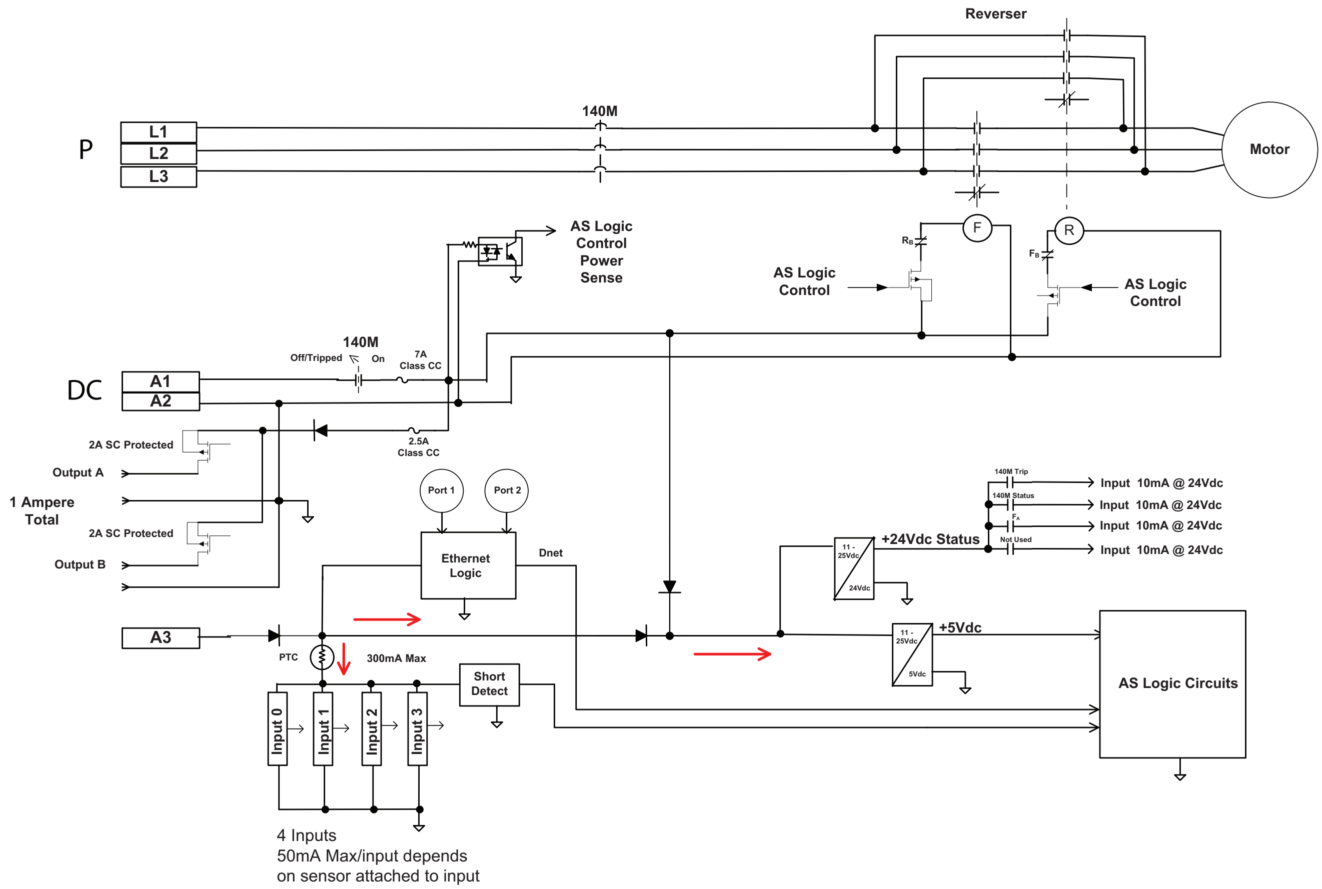


**Figure 16 - Bulletin 281E ArmorStart ST Controller Internal Wiring**



# Bulletin 284E ArmorStart Controller Connections and Dimensions

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

**Figure 17 - Terminal Designations and Dimensions for Bulletin 284E Controller (RRG Option)**

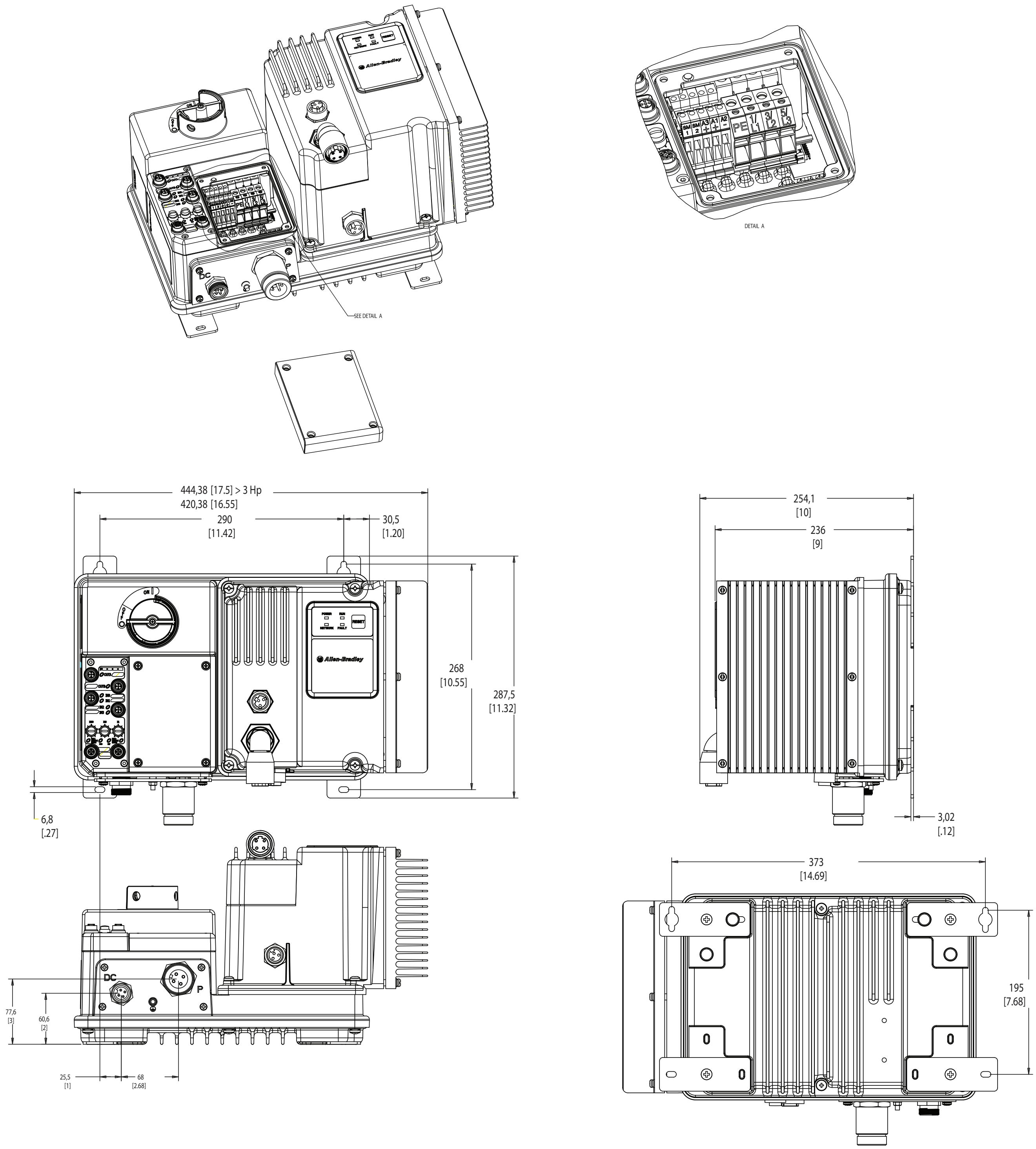
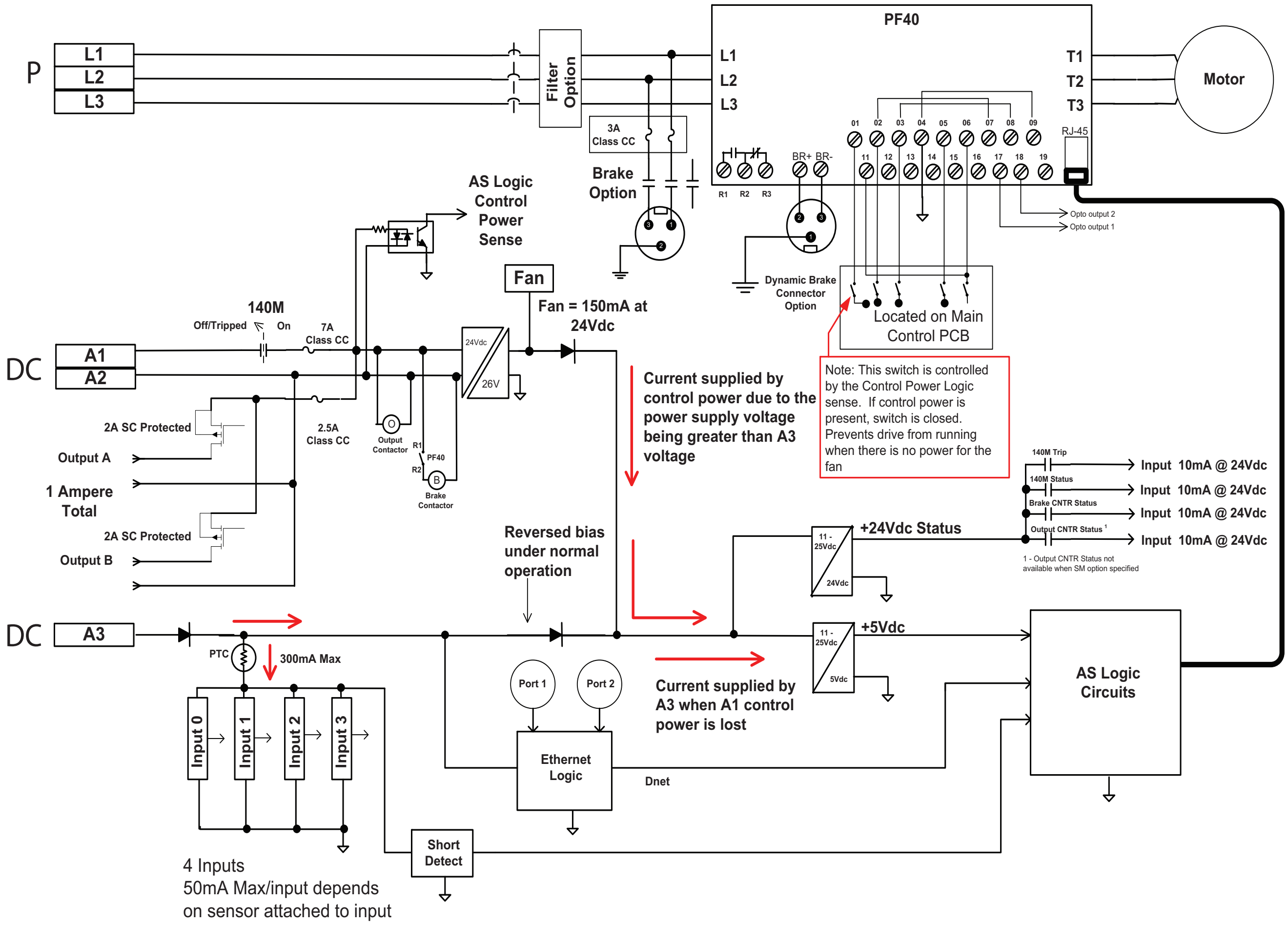
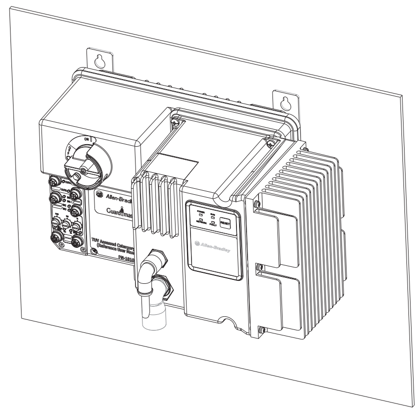


**Figure 18 - Bulletin 284E ArmorStart ST Controller Internal Wiring**



## Mount Orientation

The recommended mounting orientation of ArmorStart ST controller is the vertical configuration. This orientation is especially important for the Bulletin 284. It lets proper airflow over the heat sink. 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.



| | |
|---|---|
| **IMPORTANT** | For proper heat dissipation and product operation, mount in the vertical orientation as shown. |

## ArmorConnect Power Media

### Description

Details of ArmorConnect power media are described in the ArmorConnect Power and Control Media 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.

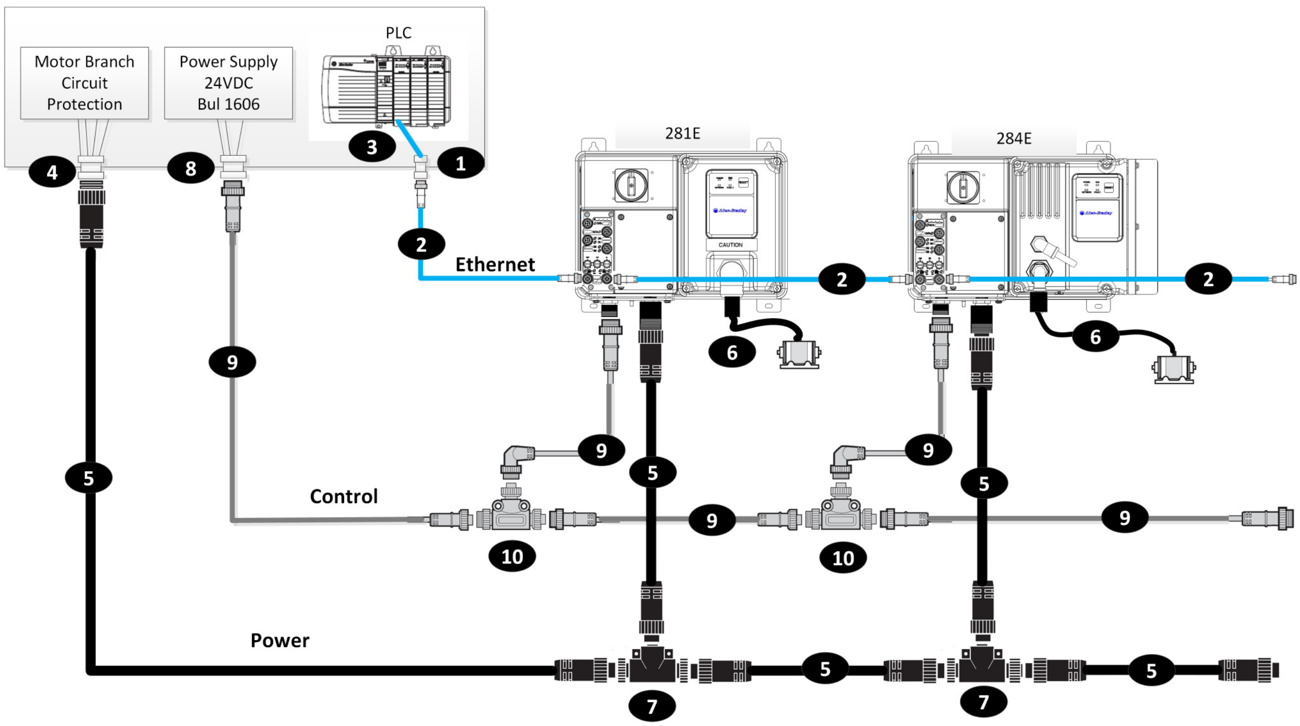
**IMPORTANT** The UL Listing of the ArmorStart controller requires its mating output motor and input power cable assemblies to be only those assemblies that are specified by the instructions for the controller. By using other cable assemblies, you violate the Listing of the controller, which NFPA 79 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 19 - Cable System Overview**




❶ CAT5e Bulkhead Connector and Receptacle – Example **Cat.No. 1585A-DD4JD**

❷ CAT5e Patchcord, IP67, M12 D-Code, Male Straight, Male Right Angle – Example **Cat.No. 1585D-M4TBDE-***

❸ CAT5e, Patch Cable, IP20, RJ45 Male to RJ45 Male – Example **Cat.No. 1585J-M4TB-***

❹ Three-phase Power Receptacles -
Female receptacles are a panel mount connector with flying leads – Example **Cat. No. 280-M35F-M1**

❺Three-phase Power Trunk- Patchcord cable with integral female or male connector on each end – Example **Cat. No. 280-PWR35A-M***

❻Three-phase Motor Cable - Example **Cat. Nos. 284-PWRM29A-M3 or 280-PWRM29A-M3**

❼Three-phase Power Tee connects to a single M35 drop line to trunk connectors – **Cat. No. 280-T35**

❽ Control Power Receptacles - Female receptacles are a panel mount connector with flying leads – **Cat. No. 888N-D4AF1-1F**

❾ Control/Auxiliary Power Media Patchcords – Patchcord cable with integral female or male connector on each end – Example **Cat. No. 889N-F4AFNM-***

❿ Control/Auxiliary Power Tees - The Tee is used with cordset or patchcord to connect several ArmorStart ST controllers to the same control power source.– Example **Cat. No. 898N-43PB-N4KT**

## Control Power

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 Characteristics*

- 5-pin female connectors (M12)
- Four fixed inputs (two per connector) – software selectable sink or source
- Two sourcing outputs DC (solid-state) – (one per connector)

*Input and Output Power Connection*

- 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. |

## AC Supply Considerations for Bulletin 284E Units

### Ungrounded and High Resistive Distribution Systems

**ATTENTION:** The Bulletin 284E controller contains protective Metal Oxide Varistors (MOVs) that are referenced to a ground. These devices must not be disconnected or installed on an ungrounded and high resistive distribution system.

| | |
|---|---|
| **IMPORTANT** | Do not apply the EMI filter option 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 will be detected and cause the EMI filter to be damaged. |

## 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.

**Note:** For additional information about group motor installations with the ArmorStart distributed motor controller, see Appendix A.

## 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.

(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.

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:

- 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.

The ArmorStart controller or control module is meant to be disconnected and replaced after proper lockout/tagout procedures have been employed.

## Other System Design Considerations

3-phase power cabling must be kept at least 150 mm (6 in.) away from the EtherNet/IP network to avoid noise issues. EtherNet/IP is an unpowered network therefore, if device status is important when the power distribution disconnect is in the OFF position, the A3 terminal must have an unswitched power source.

## Electromagnetic Compatibility (EMC)

The following guidelines are provided for EMC installation compliance.

### General Notes (Bulletin 284E Controller Only)

- The motor cable must be kept as short as possible to avoid electromagnetic emission and also capacitive currents.
- Conformity of the drive with CE EMC requirements does not short circuit that an entire machine installation complies with CE EMC requirements. Many factors can influence total machine/installation compliance.
- 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.
- When using a shielded motor cable, the drain wire must be bonded to chassis ground at the motor. The recommended motor connection must use a shielded concentric connector. This connection provides 360° shielding.

### 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

An effectively grounded product is one that is "intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to prevent the buildup of voltages that can result in undue hazard to connected equipment or to persons" (as defined by the US National Electric Code NFPA70, Article 100B). Grounding is done for two basic reasons: safety (defined above) 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.

## Grounding Safety Grounds

The object of safety grounding is to verify that all metalwork is at the same ground (or Earth) potential at power frequencies. Impedance between the drive 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.

## Grounding PE or Ground

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, bus bar, 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.

| | |
|---|---|
| **IMPORTANT** | 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. |

## Shield 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 13.7 m (45 ft) unless otherwise noted in the device specifications.

### Unshielded Cable

The use of cables without shielding is generally acceptable for installations where drive-created 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

# ArmorConnect Connections

## Control Power Overview — 4-pin Auxiliary Power

**Figure 20 - ArmorConnect Receptacles - Standard Version Gland**


Control Power Receptacle

Three-phase Power Receptacle

Factory-installed ArmorConnect gland plate and terminal connections

**Figure 21 - Internal ArmorConnect Connections (for Reference)**

Standard Version

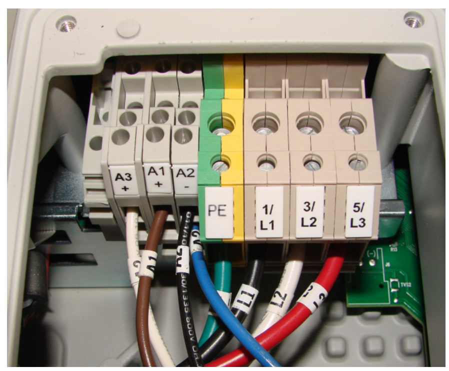



**Table 2 - ArmorConnect Gland Plate Conductor Color Code**

| Terminal Designations | Description | Color Code |
|---|---|---|
| A1 (+) | Control Power Input | Brown |
| A2 (–) | Control Power Common | Blue |
| A3 (+) | Unswitched Control Power | White |
| PE | Ground | Green/Yellow |
| 1/L1 | Line Power – Phase A | Black |
| 2/L2 | Line Power – Phase B | White |
| 3/L3 | Line Power – Phase C | Red |

## ArmorConnect Cable Ratings

The ArmorConnect power media cables are rated per UL Type TC 600V 90 °C Dry 75 °C Wet, Exposed Run (ER) or MTW 600V 90 °C or STOOW 105 °C 600V - Canadian Standards Association (CSA) STOOW 600V FT2. For additional information regarding ArmorConnect power media see ArmorConnect Power and Control Media Selection Guide, publication 280PWR-SG001.

Power cable assemblies and associated wiring devices are suitable for installation in motor groups in accordance with 7.2.10.4 of NFPA 79.

### Branch Circuit Protection Requirements for ArmorConnect Three-Phase Power Media When Used with ArmorStart Controllers

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 30 000 rms symmetrical amperes at 480V AC maximum when protected by Class CC, J, or T fuses, with a maximum ampere rating of 60 A.

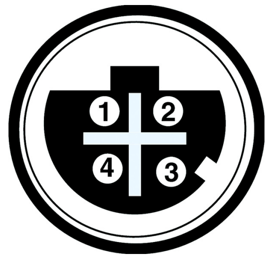
**WARNING:** The total circuit impedance including the impedance of each cable assembly, must be low enough to confirm that any short circuit or ground fault current that can flow through any assembly, is large enough to operate the magnetic trip of the circuit breaker. See your local electrical code for acceptable practices for this evaluation.

## Ethernet and I/O Connections

**Note:** Pinouts are based on view into the connector.

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

**Figure 22 - EtherNet/IP Connector (M12) - Female**

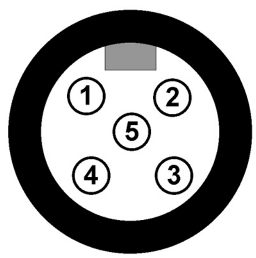



Pin 1 - (White/Orange) TxData+

Pin 2 - (White/Green) RecV Data+

Pin 3 - (Orange) TxData-

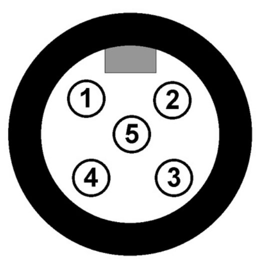
**Figure 23 - I/O Receptacle Input Pinout (M12) - Female**




Pin 1 - +24V (A3 pwr)
Pin 2 - Input 1
Pin 3 - Common
Pin 4 - Input 2

Pin 5 - NC (no connection)

**Figure 24 - I/O Receptacle Output Pinout (M12) - Female**

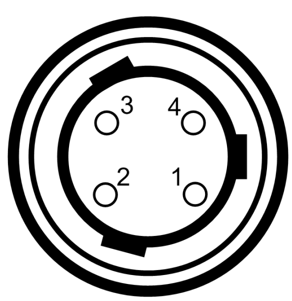



Pin 1 - NC (no connection)
Pin 2 - NC (no connection)
Pin 3 - Common
Pin 4 - Output +24V DC (A1 pwr)

Pin 5 - NC (no connection)

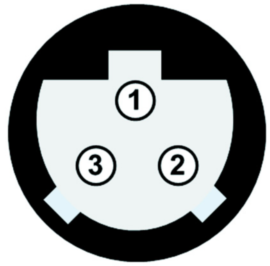
## Power Connections

**Figure 25 - Motor Connector Pinout (M29) - Female**



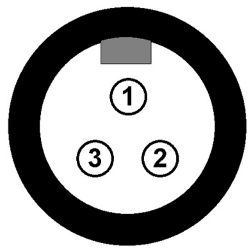

Pin 1 - T1 (black)
Pin 2 - T2 (white)
Pin 3 - T3 (red)
Pin 4 - Ground (green/yellow)

**Figure 26 - EM Brake Contactor Connector (M22) - Female**




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

**Figure 27 - Dynamic Brake Connection (M22) - Female**

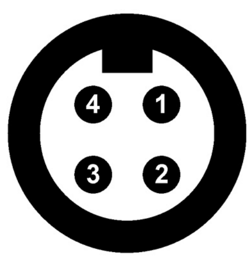



Pin 1 - Ground (green/yellow)
Pin 2 - BR+ (black)
Pin 3 - BR– (white)

**Figure 28 - Incoming Control Power (M22) – 24V DC Only - Male**


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

**Figure 29 - Incoming Three-phase Power (M35) - Male**




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

## 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. Bulletin 284 includes 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. If the fan rpm falls below 1740, a Hardware Fault F14 is generated. Also in parameter 61, 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. Refer to Hardware Fault - Fan RPM Warning on page 226 for information regarding the monitoring of the Fan RPM. |

## Notes:

# Functional Safety

## Bulletin 281E Safety Version ArmorStart ST Controller Connections and Dimensions

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

**Figure 30 - Terminal Designations and Dimensions for Bulletin 281E Safety Version Controller (RRG Option)**

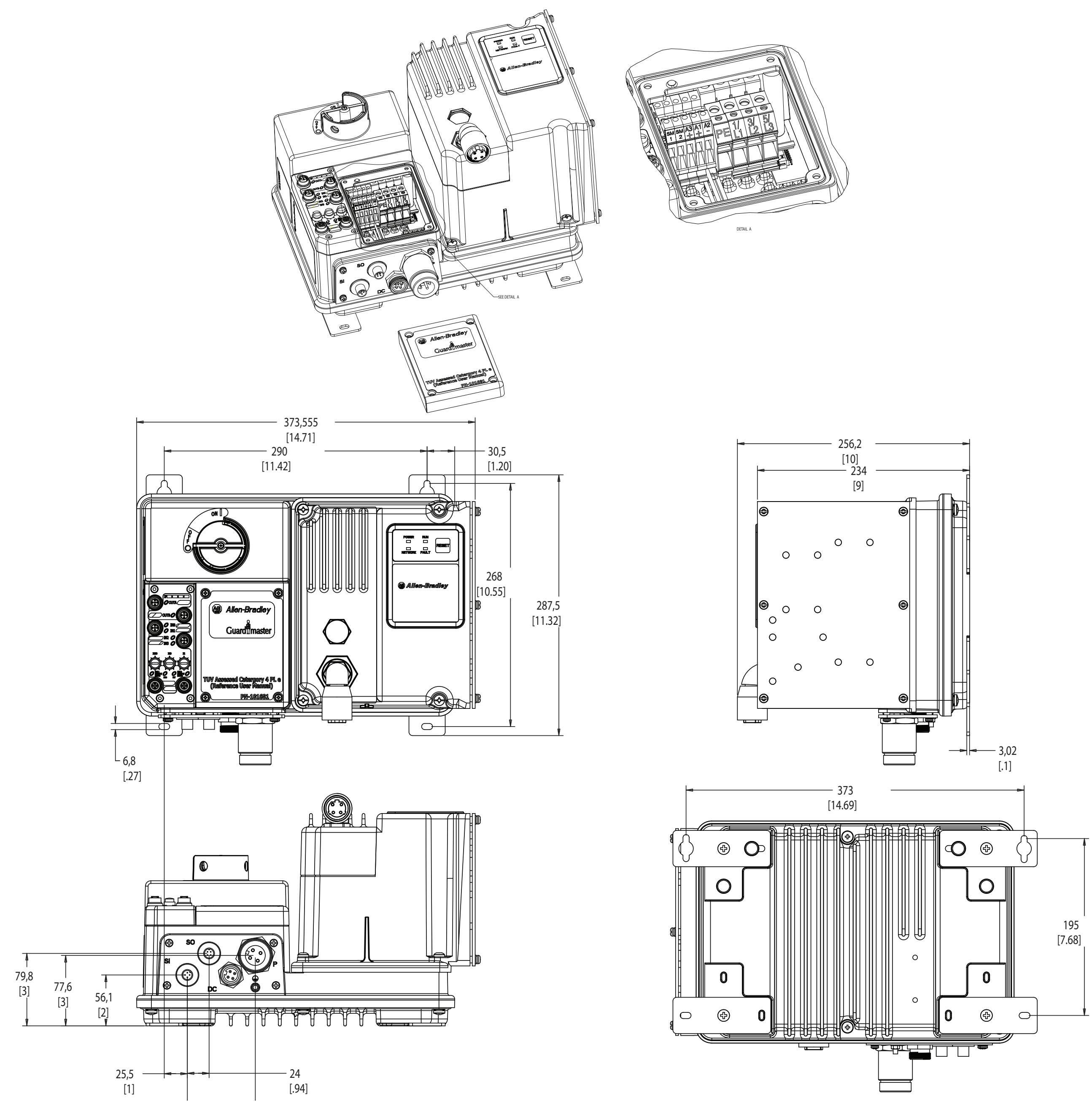
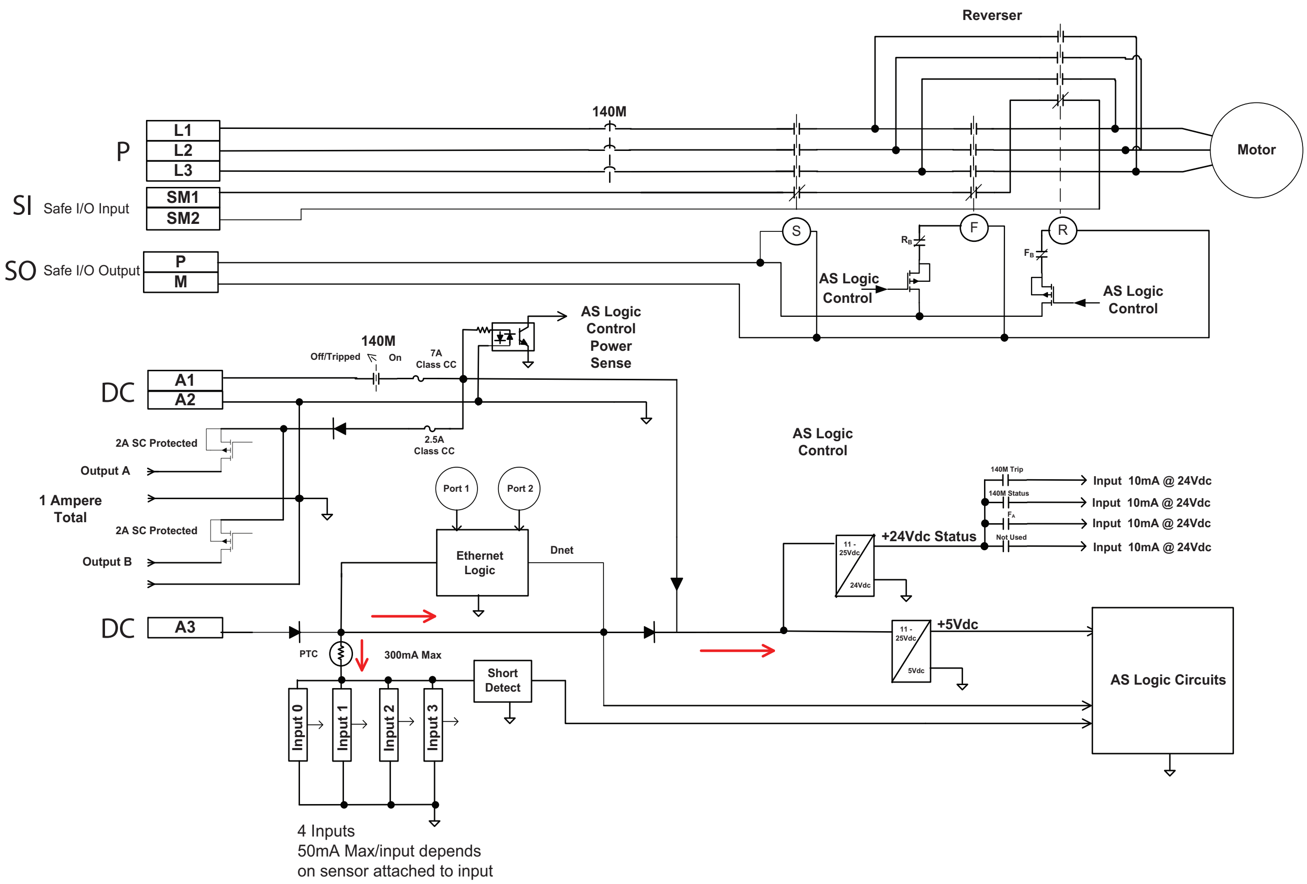


**Figure 31 - Bulletin 281E Safety Version ArmorStart ST Controller Internal Wiring**



## Bulletin 284E Safety Version ArmorStart ST Controller Connections and Dimensions

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

**Figure 32 - Terminal Designations and Dimensions for Bulletin 284E Safety Version Controller (RRG Option)**

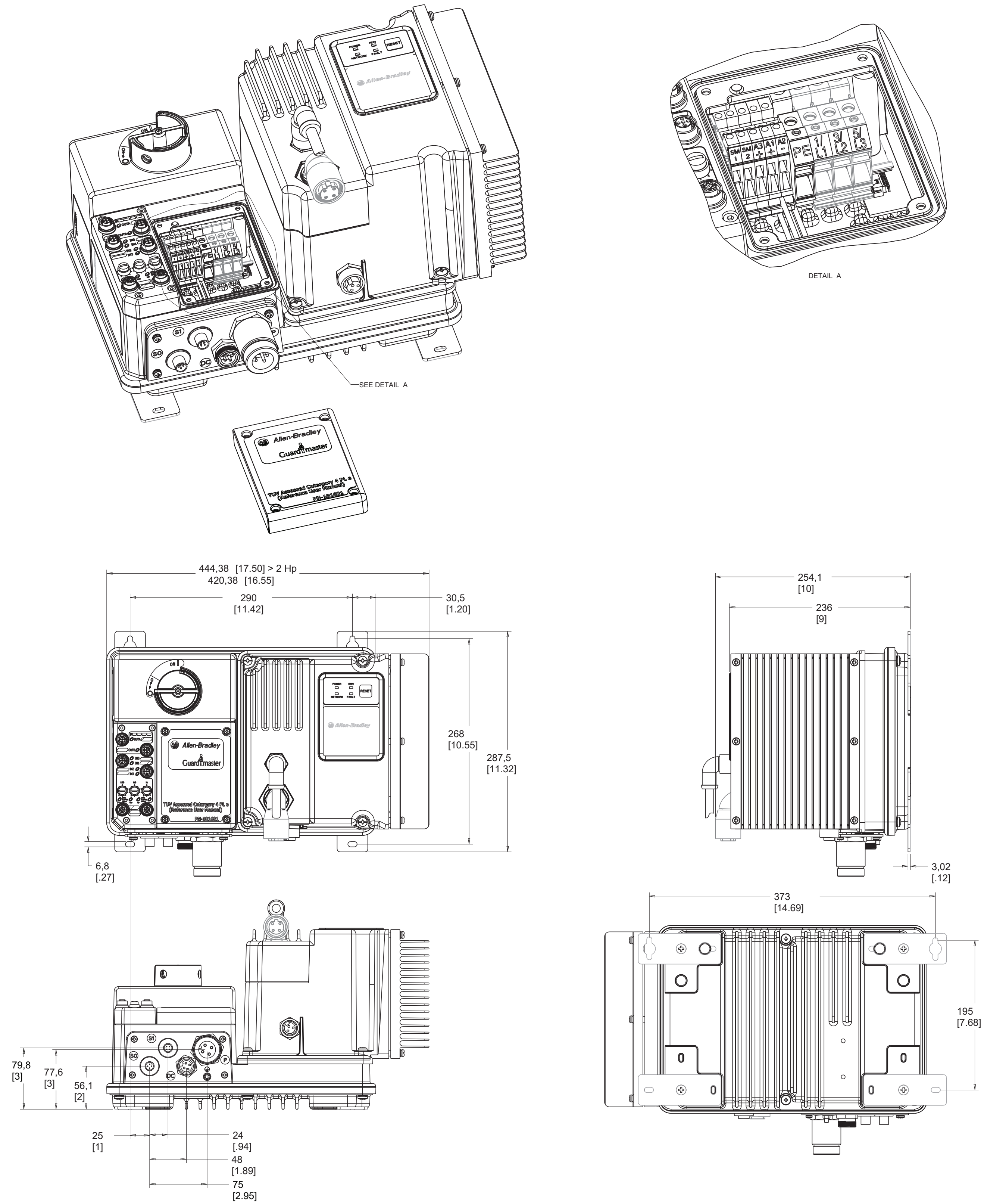


**Figure 33 - Bulletin 284E Safety Version ArmorStart ST Controller Internal Wiring**

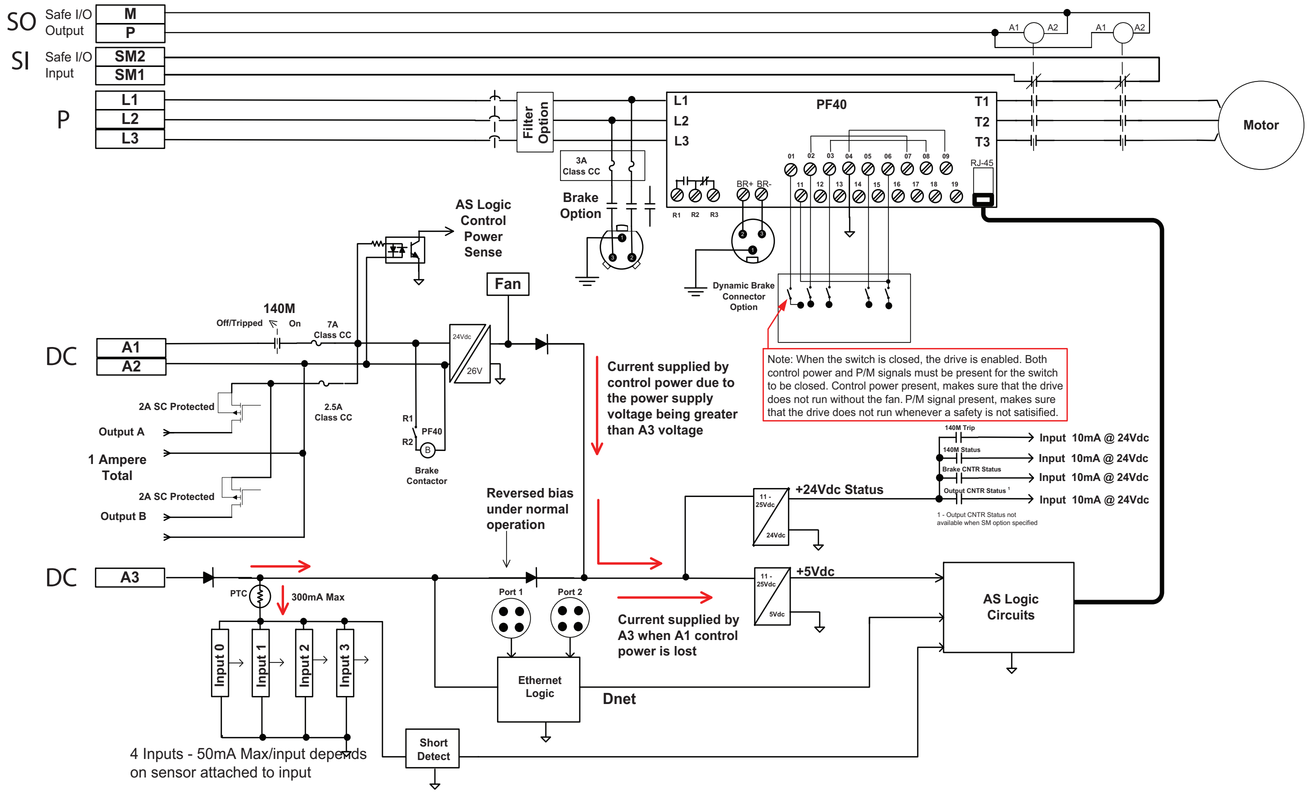
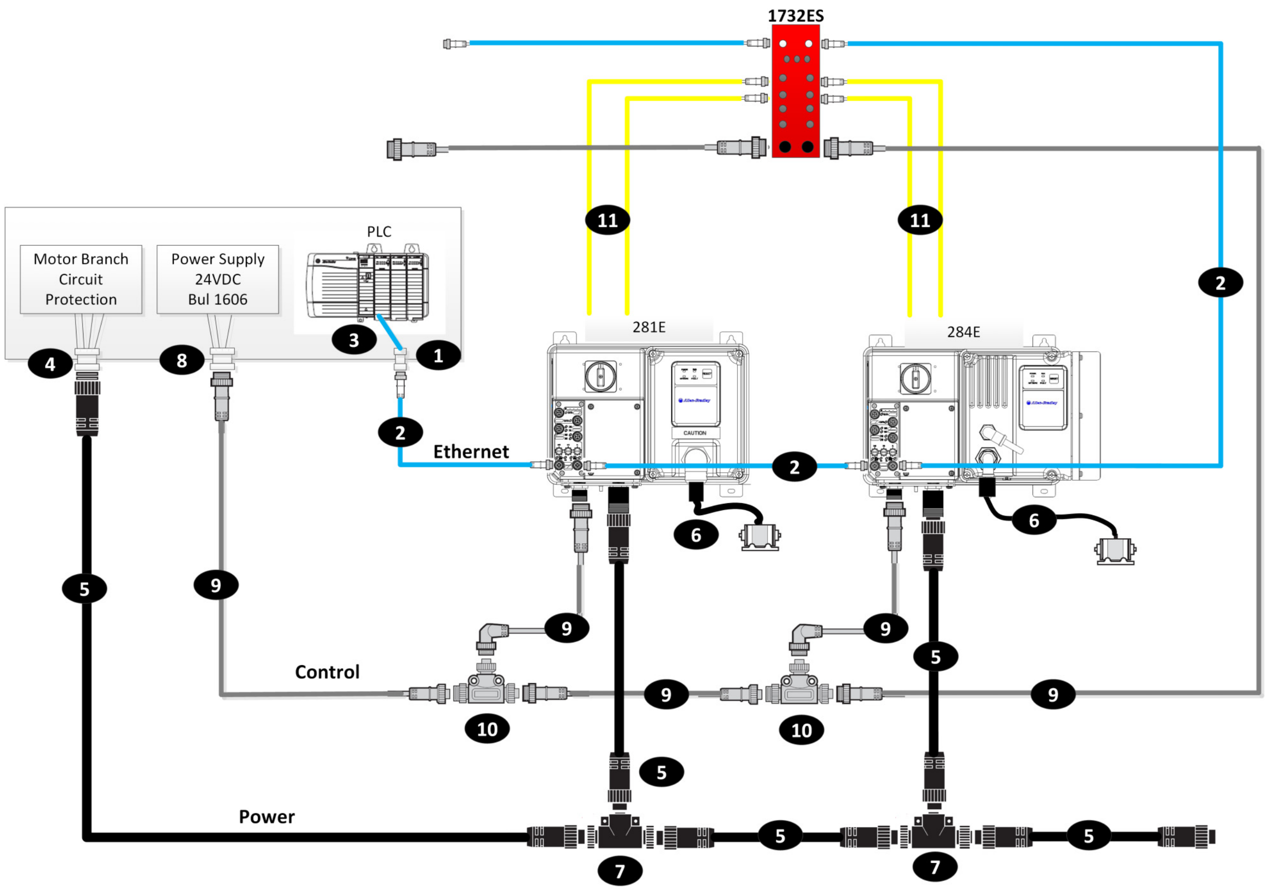


**Figure 34 - Safety Cable System Overview**




❶ CAT5e Bulkhead Connector and Receptacle – Example **Cat.No. 1585A-DD4JD**

❷ CAT5e Patchcord, IP67, M12 D-Code, Male Straight, Male Right Angle – Example **Cat.No. 1585D-M4TBDE-***

❸ CAT5e, Patch Cable, IP20, RJ45 Male to RJ45 Male – Example **Cat.No. 1585J-M4TB-***

❹ Three-phase Power Receptacles -
Female receptacles are a panel mount connector with flying leads – Example **Cat. No. 280-M35F-M1**

❺Three-phase Power Trunk- Patchcord cable with integral female or male connector on each end –
Example **Cat. No. 280-PWR35A-M***

❻Three-phase Motor Cable - Example **Cat. Nos. 284-PWRM29A-M3 or 280-PWRM29A-M3**

❼Three-phase Power Tee connects to a single M35 drop line to trunk connectors – **Cat. No. 280-T35**

❽ Control Power Receptacles - Female receptacles are a panel mount connector with flying leads –
**Cat. No. 888N-D4AF1-1F**

❾ Control/Auxiliary Power Media Patchcords – Patchcord cable with integral female or male connector on each end –
Example **Cat. No. 889N-F4AFNM-***

❿ Control/Auxiliary Power Tees - The Tee is used with a cordset or patchcord to connect several ArmorStart ST controllers to the same control power source.– Example **Cat. No. 898N-43PB-N4KT**

⓫ Patch cable between Safety I/O module input and ArmorStart connector labeled “SM” and "P/M". This cable provides status and control feedback to the safety system. – Example **Cat. No. 889D-F4AEDM-***

# Safety Wiring

## Safety I/O Module and TÜV Requirements

Each ArmorStart ST safety distributed motor controller is intended to be combined with the 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 safety I/O module to form a subsystem that is part of the overall machine stop function. The motor controllers are connected to the safety I/O module through specified cable assemblies. The combination of one of these controllers, the safety module, and the specified interconnecting cables are referred to as the ArmorStart safety-related parts. The part numbers for each of these components is specified in the following table. The safety I/O module and PLC program must be configured as outlined. See configuration of Safety I/O Module and PLC program.

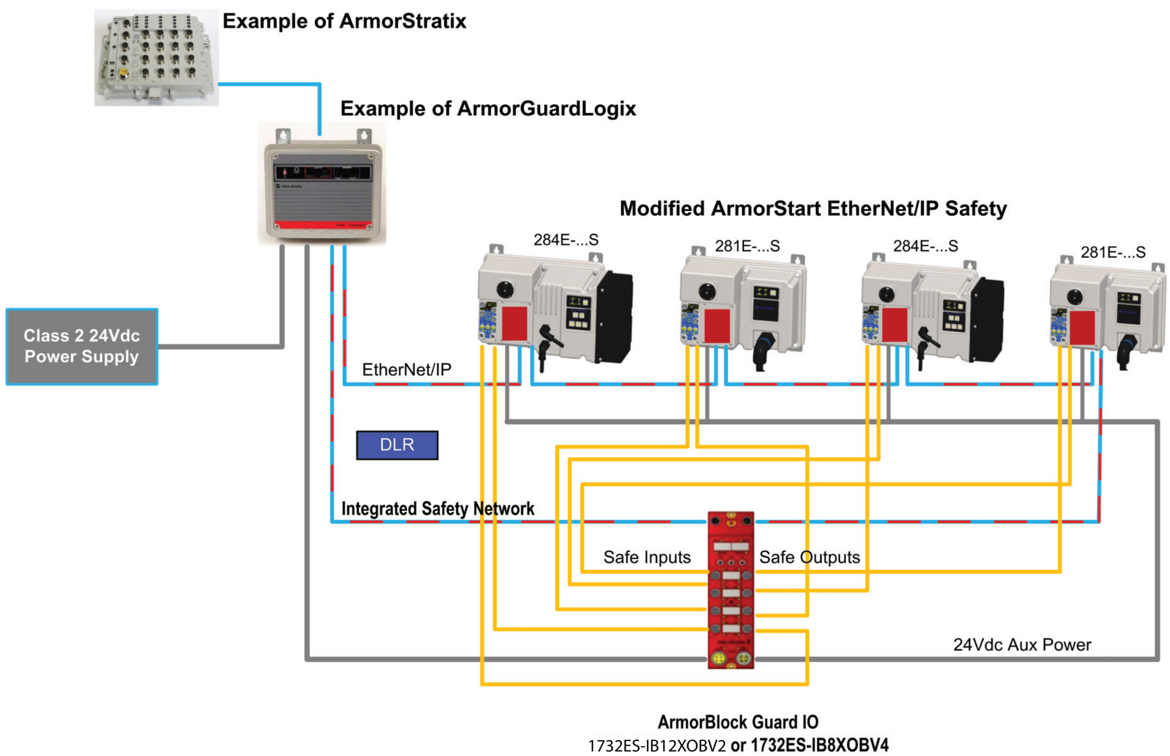
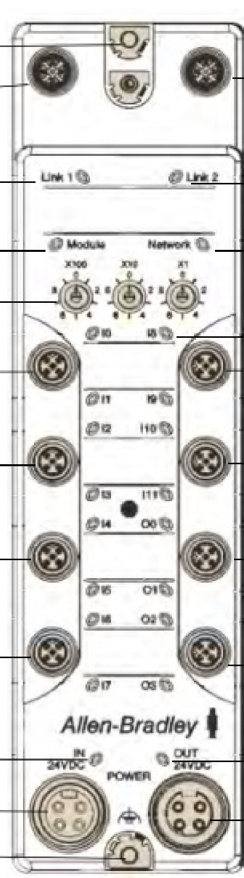



**Table 3 - Safety-related Parts**

| Catalog Number | Description |
|---|---|
| 281…S*<br><br>* - denotes safety version of Bulletin 281 controller | Bulletin 281 distributed motor controller – controller is full-voltage, reverse start |
| 284…S*<br><br>* - denotes safety version of Bulletin 284 controller | Bulletin 284 distributed motor controller – controller is variable-frequency AC drive |
| 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 | Guard I/O EtherNet/IP Safety Module |
| 889D-F4HJDM-*, 889D-F4AEDM-* or equivalent<br><br>* - denotes length | SM cable assembly - Interconnecting cable assembly between safety module input and ArmorStart controller connector labeled "SI". Assembly provides contactor position feedback.<br>P/M cable assembly - Interconnecting cable assembly between safety module output and ArmorStart controller connector labeled "SO". Assembly provides output contactor coil power. |

# ArmorBlock Guard I/O Modules

| | Description | Cat. No. |
|---|---|---|
|  | The ArmorBlock I/O family provides a low-cost, hardened, digital I/O product suitable for On-Machine™ use. Water- and corrosion-proof, it can mount anywhere on a machine, so OEMs and end-users reduce installation and operating costs. ArmorBlock® Guard I/O™ is available in 16-point combined input and output versions, for use with your choice of safety input and actuator devices. This module supports multi-cast and unicast for user flexibility, and features embedded EtherNet/IP that enables flexibility in choice of topographies. | 1732ES-IB12XOBV2 - 24V DC, 12 Input/ 2 Bipolar Pair Out, EtherNet/IP Safety<br><br>1732ES-IB8XOBV4 - 24V DC, 8 Input/ 4 Bipolar Pair Out, EtherNet/IP Safety |



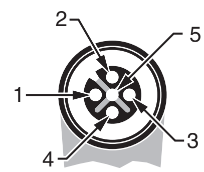
## ArmorBlock Guard I/O Recommended Cables and Connectors

### Micro Cables

| Description | | Cat. No. |
|---|---|---|
|  | DC Micro (M12) Male Cordset | 889D-F4HJ-(1) |
|  | DC Micro Style Patchcord | 889D-F4HJDM-(1) |

(1) Replace symbol with 1 (1 m [3.3 ft]), 2 (2 m [6.6 ft]), 5 (5 m [16.4 ft]), or 10 (10 m [32.8 ft]) for standard cable length.

*Safety I/O Connector Pin Assignments*

| Face View Pinout | | | | Female |
|---|---|---|---|---|
| Input Configuration | | Output Configuration | | |
| Pin | Signal | Pin | Signal | |
| 1 | Test Output n+1 | 1 | Output +24V DC Power |  |
| 2 | Safe Input n+1 | 2 | Output n+1 (sinking) | |
| 3 | Input Common | 3 | Output Power Common | |
| 4 | Safe Input n | 4 | Output n (sourcing) | |
| 5 | Test Output n | 5 | Output Power Common | |

**Note:** ArmorStart 284E and 281E safety version controllers use "Test output N+1" and "Safe Inputs N+1"

### Safety Function Definition

Safety-related stop functions in machines are capable of Cat. 4/PL e according to EN ISO 13849-1 and SIL 3 according to EN 62061/IEC 61508. The stop function that is provided conforms to IEC 60204-1:2006 Category 0.

### Limitations of the Safety-related Parts

You must provide other components to implement the safety function: A Bulletin 1756 GuardLogix® programmable controller or equivalent that is equipped with EtherNet/IP CIP Safety™ communication capability and the proper media for connection.

The programmable controller must execute logic to process the "SI" feedback and command the safety output contactor open. This logic results in a Category 0 stop at the motor where the ArmorStart controller is connected. See configuration of safety I/O module and Safety PLC Program.

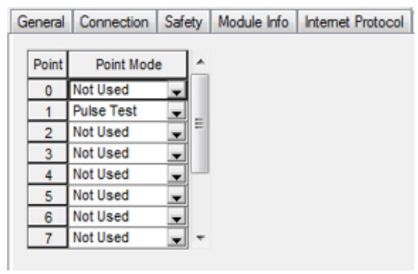
## Safety Configuration

### Catalog Number 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 Safety I/O Module and PLC Program

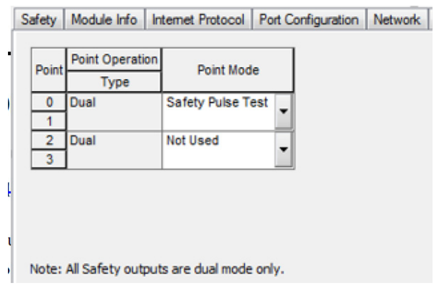
**Configure the 1732ES-* as follows:**

Configure the output that is connected to the I/O output cable assembly for:

- Dual (bipolar mode)
- Safety Pulse Test




| Point | Point Mode |
|---|---|
| 0 | Not Used |
| 1 | Pulse Test |
| 2 | Not Used |
| 3 | Not Used |
| 4 | Not Used |
| 5 | Not Used |
| 6 | Not Used |
| 7 | Not Used |

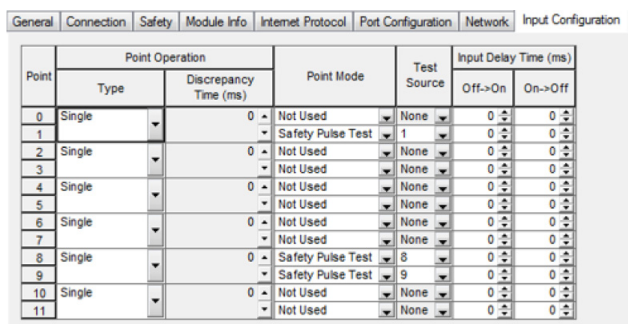



| Point | Point Operation Type | Point Mode |
|---|---|---|
| 0 | Dual | Safety Pulse Test |
| 1 | | |
| 2 | Dual | Not Used |
| 3 | | |

Configure the input that is connected to the I/O Input cable assembly as follows:

- Channel Type = Single
- Point Mode = Safety Pulse Test Input from Test Source X
- Source = Pulsed output from X

**Note:** Input must be n+1, for example: 1, 3, 5, 7.




| Point | Point Operation | | Point Mode | Test Source | Input Delay Time (ms) | |
|---|---|---|---|---|---|---|
| | Type | Discrepancy Time (ms) | | | Off->On | On->Off |
| 0 | Single | 0 | Not Used | None | 0 | 0 |
| 1 | | | Safety Pulse Test | 1 | 0 | 0 |
| 2 | Single | 0 | Not Used | None | 0 | 0 |
| 3 | | | Not Used | None | 0 | 0 |
| 4 | Single | 0 | Not Used | None | 0 | 0 |
| 5 | | | Not Used | None | 0 | 0 |
| 6 | Single | 0 | Not Used | None | 0 | 0 |
| 7 | | | Not Used | None | 0 | 0 |
| 8 | Single | 0 | Safety Pulse Test | 8 | 0 | 0 |
| 9 | | | Safety Pulse Test | 9 | 0 | 0 |
| 10 | Single | 0 | Not Used | None | 0 | 0 |
| 11 | | | Not Used | None | 0 | 0 |

### ArmorStart ST Controller - No Special Configuration Is Required

## Safety PLC Program:

- Before applying output power from the drive, check the safety feedback status of SI (SM1/SM2) from the Safety I/O block. SI are the normally closed auxiliary contact signals from each contactor. When there is no demand on the safety system, a properly configured program and cable connection shows an input signal.
- The program must force the output contactors to the open state when a safety-related stop is demanded (Turn 1732ES Output X OFF).
- Read the safety feedback 100 milliseconds later, which can be improved based on program scan time. A properly configured program and connection shows the SI signal off.
- 1732ES Output X must remain OFF if the SI feedback is 0 after the safety function is demanded. This setting tests the safety-related parts. If SI is 0 after a safety function is demanded, there can be a faulty component. (see Note 1 and Note 2)

**Note 1:** The program must inhibit the contactor closure to satisfy Category 4 of EN ISO 13849-1.

**Note 2:** The SM feedback logic must be implemented only after the safety function is demanded. It must be ignored during normal operation. One of the series contactors is used for the normal stop/start function for these controllers. Therefore, a malfunctioning output contactor cannot be distinguished from a normal running state.

There is no visual LED that indicates the status of the internal ArmorStart ST safety contactors. This indication is found on the 1732ES via LED or via the network I/O module status. But a Message instruction can be used to inspect the status of ArmorStart P/M signal over the network by using the following Class-Instance-Attribute.

- Verify 284E wiring P/M to 1732ES over the Network
- Create a [MSG] instruction in Logix with the following:
  - Service Code of Get Single
  - Class 0x000F
  - Instance 113 [parameter 113]
  - Attribute 1
- Stop Input bit 2 is set "1" if both A1/A2 and P&M are active

If any of these tests fail, there is a safety system failure that MUST IMMEDIATELY de-energize the contactors via SO (P/M) and trigger a Safety Fault Condition.

See Using Guardlocking Interlock Switch and Light Curtains with DeviceNet Guard I/O, publication SAFETY-AT018, for programming examples.

# Safety-related Specifications

## Component Response Time

| Component | Response Time (ms) |
|---|---|
| 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 | See ArmorBlock Guard I/O DeviceNet Installation Instructions, publication 1732DS-IN001 |
| Bulletin 281 | 20…57 |
| Bulletin 284 | 8…17 |

## Probability of a Dangerous Failure Per Hour and $MTTF_d$ for Uncontrolled Stop

| ArmorStart Safety Controller That Is Used in Combination with ArmorStart Safety-related Parts | MTTFd (Years) | Average Probability of a Dangerous Failure Per Hour (1/h) |
|---|---|---|
| Bulletin 281… | 100 | 6.0E-9 |
| Bulletin 284… | 100 | 6.0E-9 |

# Maintenance and Internal Part Replacement

The ArmorStart ST safety controllers do not have any internal maintenance procedures. See the 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 safety module documentation for maintenance requirements that pertain to it. We recommend that the operation of the 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 safety module and the ArmorStart output contactor circuits, be verified once per year by performing the contactor circuit verification procedure. The contactor circuit verification procedure must be performed on an ArmorStart Safety controller that has experienced an output short circuit fault before placing the controller back into service.

## Contactor Circuit Verification Procedure

- Initiate a stop from the safety PLC to the 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4
- Verify that the ArmorStart controller output motor voltage is removed.
- Verify the output contactor that is located in the ArmorStart controller has transitioned from closed to open by examining the related 1732ES input.

# Troubleshooting

## 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 Safety Module

See 1732ES documentation for troubleshooting instructions.

## ArmorStart ST - Safety Bulletin 281/284 Distributed Motor Controllers Safety Circuit Troubleshooting

| Symptom | ArmorStart Controller LED Status Indication | | | Probable Cause | Recommended Action |
|---|---|---|---|---|---|
| | Power | Fault | Run | | |
| Motor does not start | Off | Off | Off | 1. The disconnect switch of the ArmorStart controller is open.<br>2. 24V DC not supplied to A1 and A2 at A1/A2 connector because cable or connections are defective.<br>3. Polarity is reversed. | 1. Check disconnect switch.<br>2. Verify cable and connections.<br>3. Verify positive voltage A3 to A2 and A1 to A2. |
| | Off | Flashing | Off | There is an ArmorStart controller fault. and power to A1 has been removed. | See ArmorStart Manual for controller fault. |
| | On | Off | Off | After standard stop(1)<br>1. The controller is not receiving a RUN command.<br><br>After safety stop(2)<br>1. The controller is not receiving a RUN command.<br>2. SI cable connections (SM1, SM2) open.<br>3. SI feedback is open inside control module.<br>4. 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 is reporting open SM feedback from the IN0...INn inputs. | After standard stop(1)<br>1. Check RUN command source.<br><br>After safety stop(2)<br>1. Check RUN command source.<br>2. Check SI cable and connections.<br>3. Check SI feedback inside control module.<br>4. See I/O Indicators in 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 manual. |
| | On | Flashing | Off | ArmorStart controller fault is inhibiting ArmorStart controller start function. | See ArmorStart Manual for controller fault. |
| | On | Off | On | 1. Three-phase power is not being supplied to controller (Bulletin 281 controllers).<br>2. 24V DC not supplied to P and M at A1/A2 connector because cable or connections are defective.<br>3. 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 OUT0...OUTn outputs are not supplying 24V DC to pins P and M. | 1. Verify 3-phase voltage at ArmorStart controller input.<br>2. Verify cable and connections.<br>3. See I/O Indicators in 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 manual. |

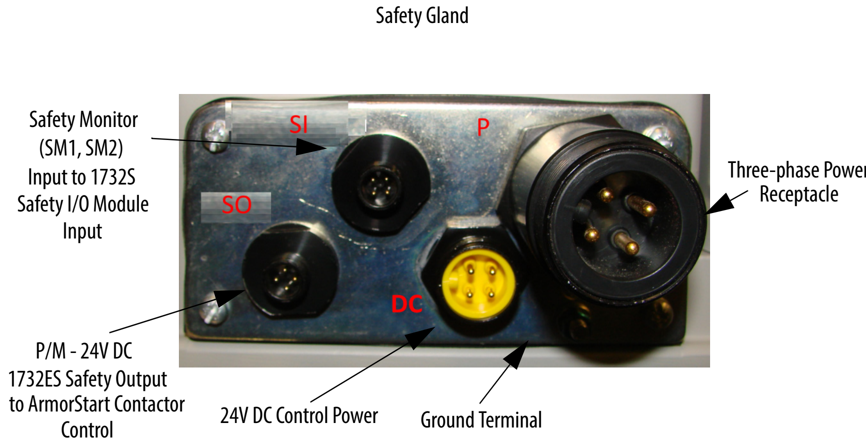
(1) Standard stop – The 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 does not remove 24V DC from P and M when a standard stop is executed. The safety circuit does not inhibit a restart of the controller after a standard stop.

(2) Safety stop – The 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 removes 24V DC from P when a safety stop is executed. This action opens both contactors. A restart of the controller stop is inhibited if the SM feedback is open. The program in the safety controller does not let the 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 apply 24V DC to P and M in the cable.

# ArmorConnect Connections

## Control Power Overview — 4-pin Auxiliary Power

**Figure 35 - ArmorConnect Receptacles**




Factory-installed ArmorConnect gland plate and terminal connections

**Figure 36 - ArmorConnect Connections**

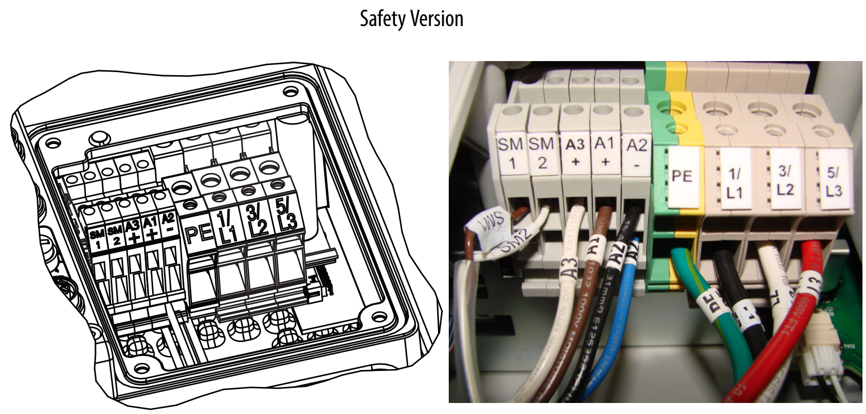


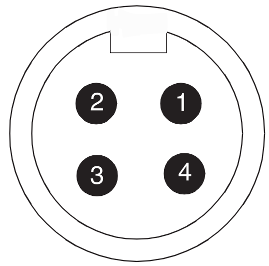

**Table 4 - ArmorConnect Gland Plate Conductor Color Code**

| Terminal Designations | | Description | Color Code |
|---|---|---|---|
| A1 (+) | | Control Power Input | Brown |
| A2 (–) | | Control Power Common | Black/Blue |
| A3 (+) | | Unswitched Control Power | White |
| PE | | Ground | Green/Yellow |
| 1/L1 | | Line Power – Phase A | Black |
| 2/L2 | | Line Power – Phase B | White |
| 3/L3 | | Line Power – Phase C | Red |
| SI | SM1 | Safety Monitor Input | Brown |
| | SM2 | Safety Monitor Input | White |
| SO | P | Safety Output | Blue |
| | M | Safety Output Common | Brown |

## I/O Connections

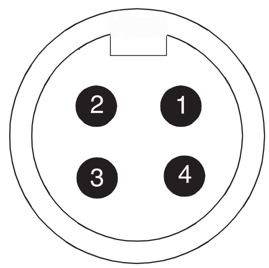
ArmorStart ST controller uses a sealed D-coded M12 (micro) style Ethernet connector.

**Figure 37 - Safety Monitor (SM1/SM2) - Male**




Pin 1 - SM1 (brown)
Pin 2 - SM2 (white)
Pin 3 - NC (no connection) (blue)
Pin 4 - NC (no connection) (black)

**Figure 38 - Safety Output Power (P/M) - Male**




Pin 1 - NC (no connection) (brown)
Pin 2 - M (white)
Pin 3 - NC (no connection) (blue)
Pin 4 - P (black)

# Introduction to EtherNet/IP and Device Level Ring Technology

## Terminology

See the table for the meaning of common terms.

| This Term | Means |
|---|---|
| Consumer | A destination device in the CIP networking model. See CIP. |
| CSMA/CD | Carrier sense multiple access/collision detection (CSMA/CD) is the access method that is used in Ethernet. When a device wants to gain access to the network, it checks to see if the network is quiet (senses the carrier). If it is not, it waits a random amount of time before retrying. If the network is quiet and two devices access the line simultaneously, their signals collide. When the collision is detected, they both back off and each waits a random amount of time before retrying. |
| Determinism | The ability to predict when information is delivered. Important in time-critical applications. |
| DHCP | The Dynamic Host Configuration Protocol (DHCP) is an Internet Protocol, similar to BOOTP, for automating the configuration of computers that use TCP/IP. DHCP can be used to automatically assign IP addresses, to deliver IP stack configuration parameters, such as the subnet mask and default router, and to provide other configuration information, such as the addresses for printer, time, and news servers. |
| DNS | The domain name system (DNS) is a hierarchical, distributed method of organizing the name space of the Internet. The DNS administratively groups hosts into a hierarchy of authority that allows addressing and other information to be widely distributed and maintained. The DNS has a significant advantage because it does not need to rely on a centrally maintained file that maps host names to addresses. |
| Ethernet | A physical layer standard that uses carrier sense multiple access with collision detection (CSMA/CD) methods. |
| EtherNet/IP | Ethernet industrial protocol applies a Common Industrial Protocol (CIP) over Ethernet by encapsulating messages in TCP/UDP/IP. |
| Ethernet network | A local area network that is designed for the high-speed exchange of information between computers and related devices. |
| Explicit Messaging | Non-time critical messaging that is used for device configuration and data collection, such as program downloads or peer-to-peer messaging between two PLC units. |
| Full duplex | A mode of communication that lets a device send and receive information simultaneously, which effectively doubles the bandwidth. |
| Fully qualified domain name | A fully qualified domain name (FQDN) is a domain name that includes all higher-level domains relevant to the entity named. Think of the DNS as a tree-structure with each node having its own label. Then a fully qualified domain name for a specific node would be its label followed by the labels of all other nodes between it and the root of the tree. For example, for a host, an FQDN would include the string that identifies the particular host, plus all domains of which the host is a part, up to and including the top-level domain (the root domain is always null). For example, PARIS.NISC.SRI.COM is a fully qualified domain name for the host at 192.33.33.109. |
| Gateway | A module or set of modules that provides communications between nodes on dissimilar networks. |
| Hardware address | Each Ethernet device has a unique hardware address (sometimes called a MAC address) that is 48 bits. The address appears as six digits that are separated by colons (such as, xx:xx:xx:xx:xx:xx). Each digit has a value from 0 to 255 (0x00 to 0xFF). This address is assigned in the hardware and cannot be changed. The hardware address is required to identify the device if you are using a BOOTP utility. |

| This Term | Means |
|---|---|
| Host name | The host name is the unique name for a computer within its domain. It's always the first element of a full name, and, with its domain and top-level domain suffix, creates the unique name of that computer on the Internet. For example, let's say a trading website is www.trading.com. The host name is www, which is not unique on the web, but is unique within the trading domain.<br>The host name can also see the fully qualified domain name (FQDN), or in this example, www.trading.com. Both naming methods seem to be used interchangeably in various documents. For the purposes of this document, the host name sees the FQDN, or as in this example, www.trading.com. |
| Hub | A central connecting device that joins devices together in a star configuration. Hubs are generally not suitable for use in I/O control systems, since they are time-critical applications that cannot tolerate lost packets. |
| Implicit messaging | Real-time messaging of I/O data. |
| IP | Internet Protocol (IP) that provides the routing mechanism for messages. All messages contain not only the address of the destination station, but also the address of a destination network, which lets messages get sent to multiple networks within an organization or around the world. |
| IP address | A 32-bit identification number for each node on an Internet Protocol network. These addresses are represented as four sets of 8-bit numbers (numbers from 0 to 255), with decimals between them. Each node on the network must have a unique IP address. |
| Latency | The time between the initiating of a request for data and the beginning of the actual data transfer. |
| Multicast | In the CIP Producer/Consumer model, one producer multicasts (broadcasts) the data once to all consumers. |
| Producer | The source of information in the CIP networking model. See CIP. |
| Subnet mask | An extension of the IP address that lets a site use a single net ID for multiple networks. |
| Switch | A network device that cross connects devices or network segments. A switch provides each sender/receiver the full network bandwidth (2x in full-duplex mode), reduces collisions, and increases determinism. |
| TCP | The Transport Control Protocol (TCP) is a more dependable but slower transport protocol than UDP. It is used for explicit (not time critical) messaging in EtherNet/IP. |

## Introduction to EtherNet/IP

Automation architectures must provide you with three primary services:

- Control services involve the exchange of time-critical data between controlling devices and I/O devices.
- Networks must provide you with configuration capabilities to build and maintain your automation systems.
- Automation architecture must provide for collection of data.

EtherNet/IP, provides installation flexibility and leverages commercially available industrial infrastructure products. It is also compatible with other communication standards, such as Hypertext Transfer Protocol (HTTP), Simple Networks Management Protocol (SNMP), and Dynamic Host Configuration (DHCP).

EtherNet/IP is a CIP adaptation of TCP/IP that fully uses the IEEE standard. The relationship between the TCP/IP and CIP to form EtherNet/IP is shown in the ISO/OSI 7-layer model is shown in Figure 40. The OSI model is an ISO standard for network communications that define all functions from a physical layer to the protocol.

This diagram shows how Rockwell Automation EtherNet/IP communication modules fit into a control system.

**Figure 39 - EtherNet/IP Communication Modules in a Control System**

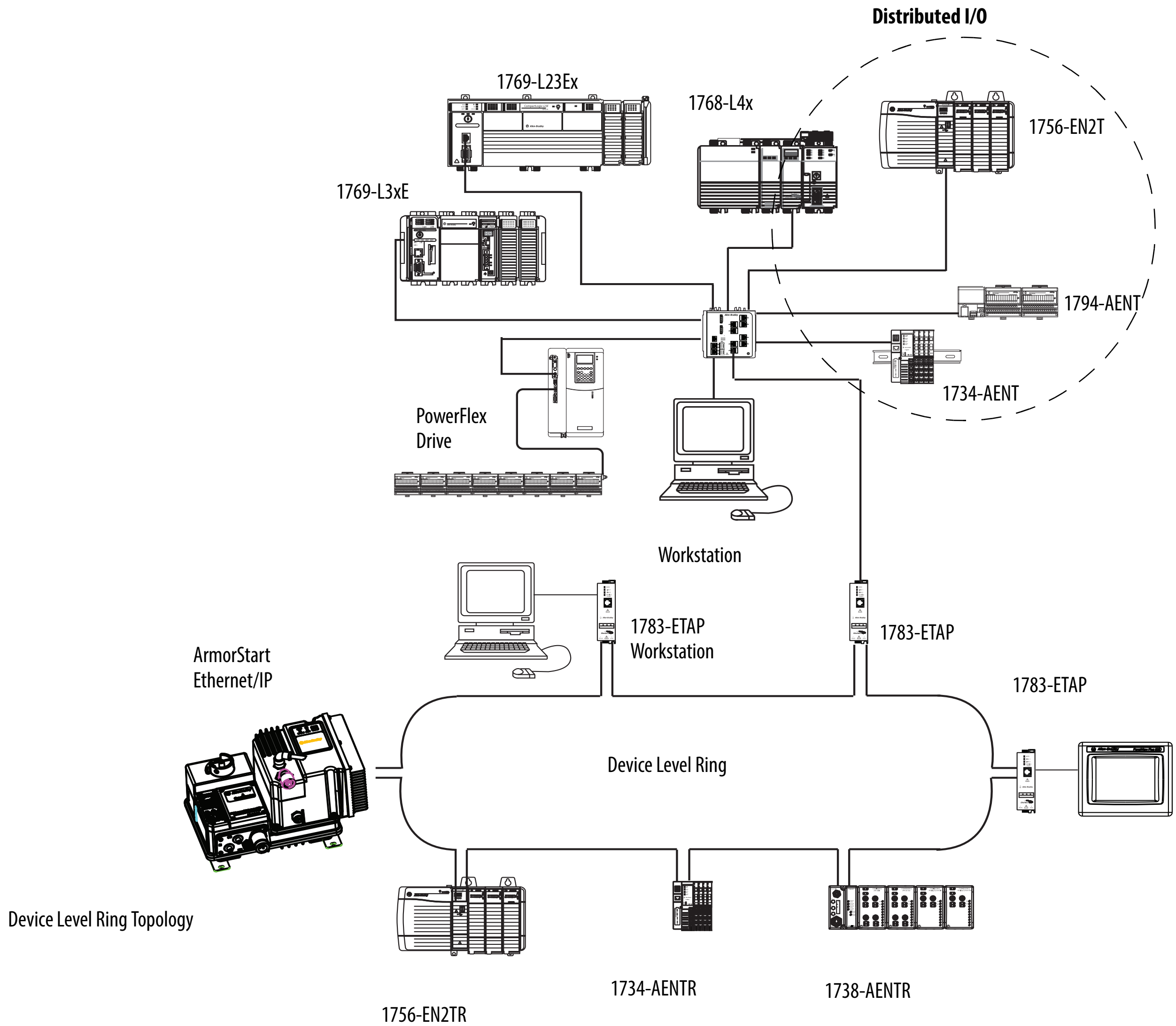
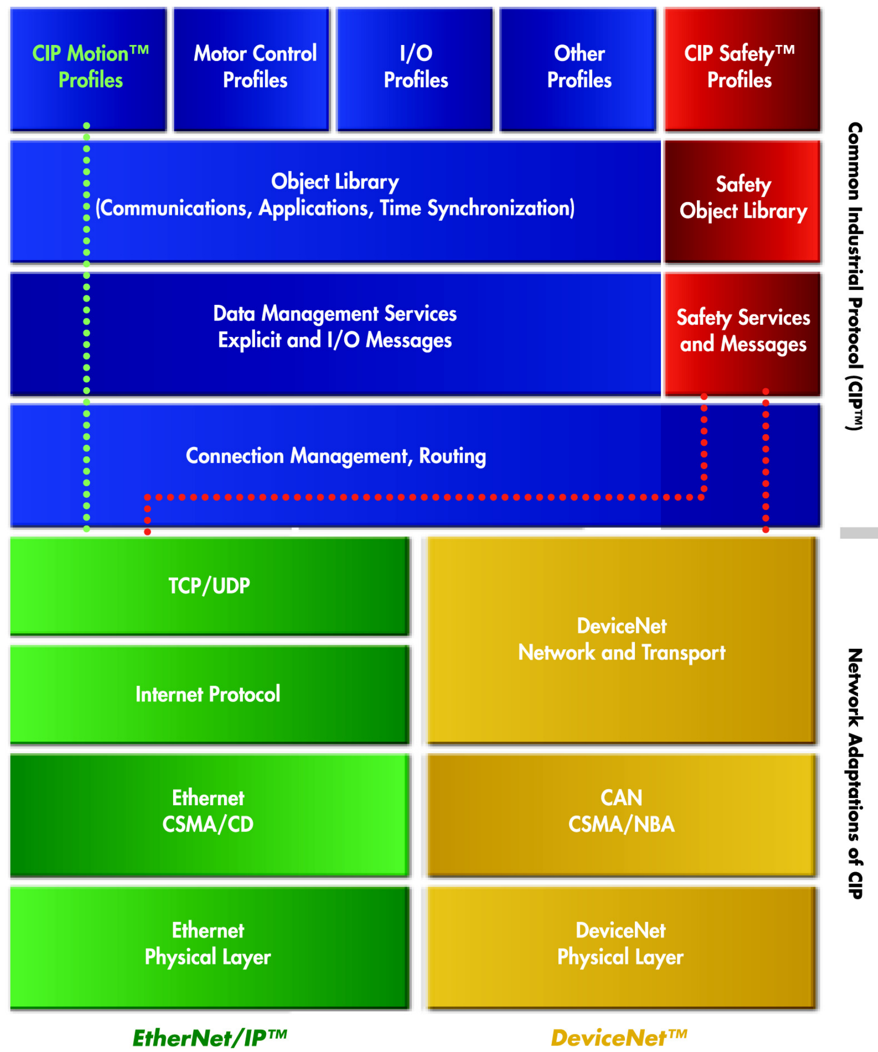


Figure 40 - OSI Model for ISO Standard for Network Communications

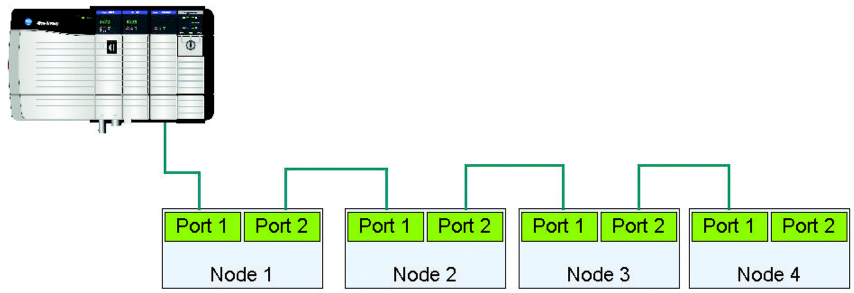



This approach provides real-time technology into the Ethernet domain. With the network extensions of CIP Safety, CIP Sync, and CIP Motion, CIP networks provide for safety communication, time synchronization, and simple-to-high performance motion all over the same EtherNet/IP network.

## Linear Network Introduction

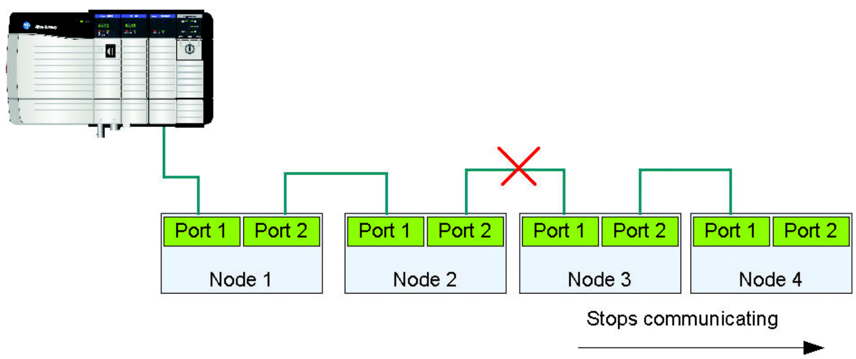
A linear network is a collection of devices that are daisy-chained together.

**Figure 41 - Linear Network Collection of Devices**




In this topology, a communication issue in the media or device helps stop nodes downstream from communicating.

**Figure 42 - Communication Issue in the Media or Device Line**




The EtherNet/IP embedded switch technology lets this topology be implemented at the device level. No additional switches are required.

The primary advantages of a linear network are:

- The network simplifies installation and reduces wiring and installation costs.
- The network requires no special software configuration.
- Embedded switch products offer improved CIP Sync application performance on linear networks.

The primary disadvantage of a linear network is that any break of the cable disconnects all devices downstream from the break from the rest of the network.

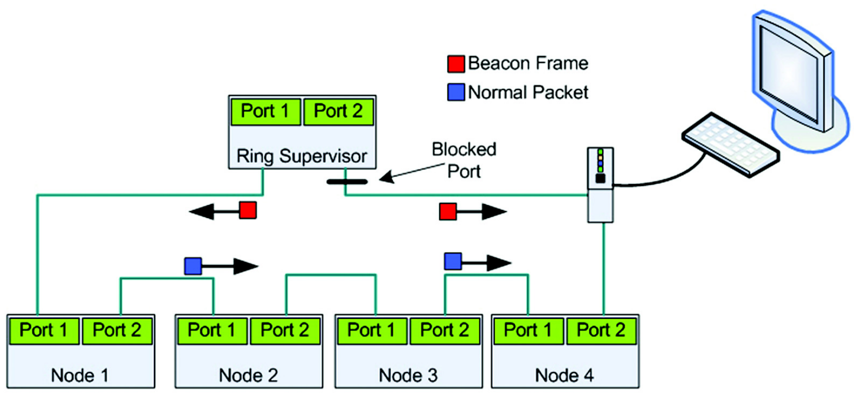
| | |
|---|---|
| **IMPORTANT** | Products with EtherNet/IP embedded switch technology have two ports to connect to a linear or DLR network in a single subnet.<br>You cannot use these ports as two Network Interface Cards (NICs) connected to two different subnets |

# Device Level Ring

## Introduction

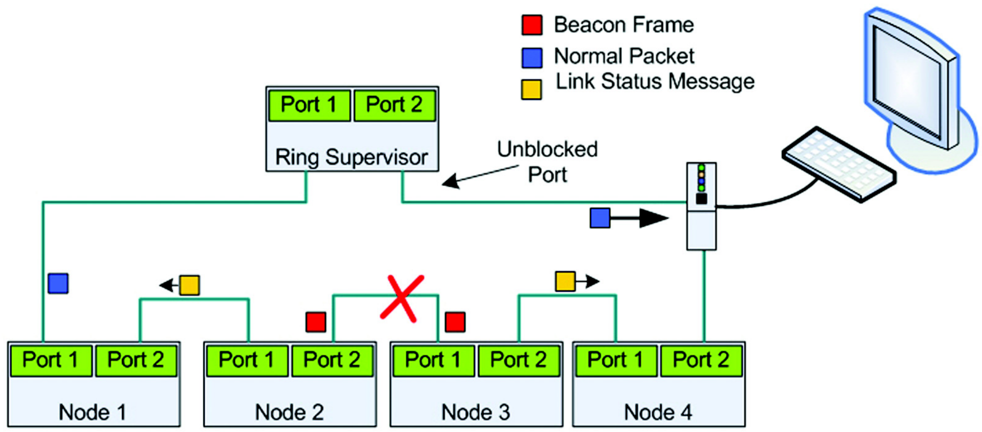
A Device Level Ring (DLR) protocol defines a set of behaviors, see Figure 43. A ring supervisor keeps packets of information from circulating infinitely around the ring by blocking one of the ports. A beacon frame constantly is detected on both ring supervisor ports. If a beacon frame is not detected the supervisor detects the physical layer issue and reconfigures the network to a linear topology without the loss of any node communication or data. Once repaired the ring supervisor reconfigures back to ring mode.

**Figure 43 - DLR Protocol**




As shown in Figure 44, when a physical layer failure is detected the adjacent nodes to the fault generate a link status message that the ring supervisor acknowledges. The ring supervisor unblocks the port to allow communication. The neighboring nodes to the fault identify the fault and reconfigure themselves to support a linear topology. Now, both the ring supervisor and nodes are configured to support a linear topology.

**Figure 44 - Physical Layer Failure Is Detected**




When the physical layer fault is corrected, the supervisor will "hear" the beacon frame again on both ports. Once the beacon frame is detected, the ring supervisor re-establishes and configures the ring topology. All neighboring nodes detect this update and reconfigure themselves back to ring. A DLR network is a single-fault tolerant network that is intended for the interconnection of automation devices.

At least one ring supervisor must be configured before a ring is formed.

| | |
|---|---|
| **IMPORTANT** | Any nodes that do not support DLR must not be directly connected to the ring. |

The node must be connected to the ring through a switch that supports DLR.

The advantages of the DLR network include:

- Simple installation
- Resilience to a single point of failure on the network
- Fast recovery time when a single fault occurs on the network

The primary disadvantage of the DLR topology is the additional effort that is required to create and use the network as compared to a linear or star network.

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

| | |
|---|---|
| **IMPORTANT** | ArmorStart EtherNet/IP cannot be configured as a ring supervisor. |

## Number of Nodes on a DLR Network

Rockwell Automation recommends that you use no more than 50 nodes on a single DLR or linear network. If your application requires more than 50 nodes, we recommend that the DLR networks are 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.

Additionally, on a DLR network with more than 50 nodes, network recovery times from faults are higher. For DLR networks with 50 or less nodes, ring recovery time can be as low as 3 ms. If more than 50 nodes are required without segmentation, contact your local Allen-Bradley distributor. A detail review is recommended to confirm that bandwidth and response time are within application requirements.

## Ethernet Switches

Ethernet managed switches are key components that provide determinism and the required throughput to achieve automation needs. Switches are able to manage network traffic that reduces unnecessary delays or bandwidth needs. A properly designed EtherNet/IP infrastructure that implement segregation via managed switch technology achieves a more dependable and secure network.

## Ethernet Media

Today, unshield twisted pair (UTP) wiring is the standard in most applications and provides for greatest flexibility and ease of installation and maintenance. Category 5e (e-enhanced) cable is specifically designed to meet automation needs of today.

**Figure 45 - Network Media - Ethernet M12 D-Code Media**

## EtherNet/IP General Wiring Guideline

Ethernet is found in automation equipment, panels, and components. There are a few guidelines, that if followed, will reduce the number of issues an EtherNet/IP application may experience.

- Many EtherNet/IP applications share space with power conductors. If the Ethernet media must cross power conductors, do so at right angles. This configuration reduces the coupling effect and reduce the potential for communication noise.
- Where possible, route the EtherNet/IP media five feet or more from high-voltage sources (for example, lights, ballasts, motors, ...) or sources of radio frequency, such as variable frequency drives.
- Verify that the application or equipment follows industry acceptable grounding practices.
- Maintain media lengths between nodes to less than 100 m (328 ft). It can be challenging to maintain these guidelines, however these reduce potential application issues.

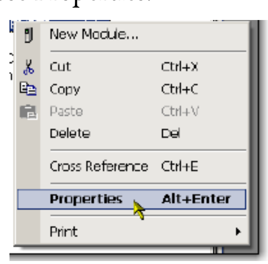
## Requested Packet Interval

The Requested Packet Interval (RPI) is the update rate that is specified for a particular piece of data on the network. This value specifies how often to produce the data for that device. For example, if you specify an RPI of 50 ms, it means that every 50 ms the device must send data to the controller or the controller must send data to the device.

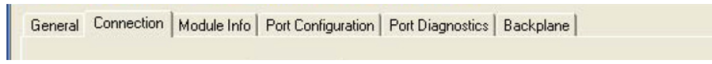
Only data-producing modules require an RPI. For example, a local EtherNet/IP communication module requires no RPI because it produces no data for the system. Instead it functions only as a bridge.

To set an RPI, follow these steps.

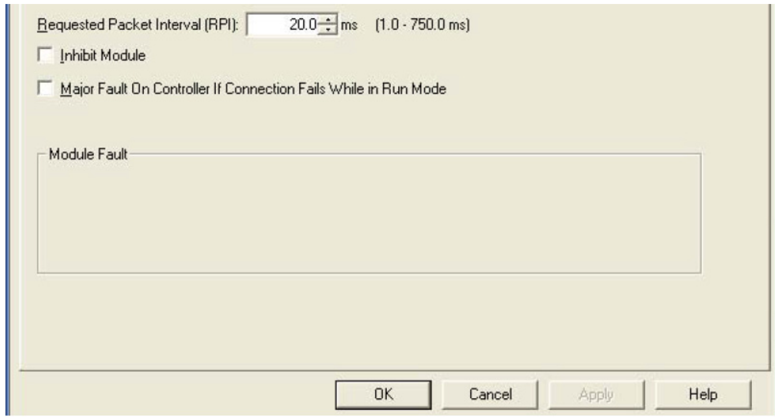
1. Verify the ArmorStart EtherNet/IP module AOP is installed, started, and connected to the controller.
2. In the Controller Organizer tree, right-click the ArmorStart EtherNet/IP module and choose Properties.



The Module Properties dialog box appears.




3. Click the Connection tab.




4. From the Requested Packet Interval (RPI) menu, enter the rate at which you want data to be updated over a connection.

   Only set the RPI to the rate the application requires.

**IMPORTANT** The RPI determines the number of packets per second that the module produces on a connection. Each module can produce only a limited number of packets per second. Exceeding this limit helps stop the module from opening more connections.

5. Click OK.

Chapter 5

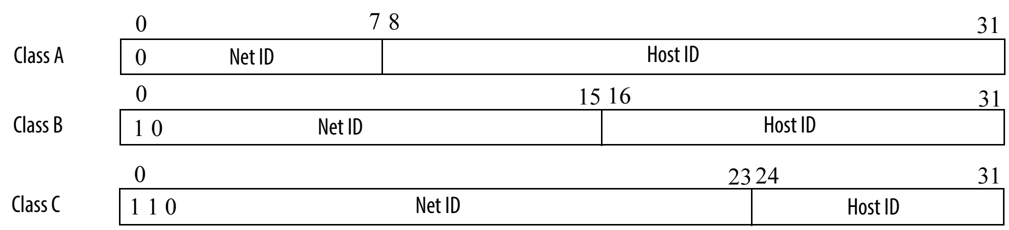
# Product Commissioning

## IP Address

The IP address identifies each node on the IP network (or system of connected networks). Each TCP/IP node on a network must have a unique IP address.

The IP address is 32 bits long and has a net ID part and Host ID part. Networks are classified A, B, C, or other. The class of the network determines how an IP address is formatted.

**Figure 46 - IP Address on the IP Network**




You can distinguish the class of the IP address from the first integer in its dotted-decimal IP address as follows:

| Range of First Integer | Class | Range of First Integer | Class |
|---|---|---|---|
| 0…127 | A | 192…223 | C |
| 128…191 | B | 224…255 | other |

There are reserved values that you cannot use as the first octet in the address. These numbers are examples of values you cannot use:

- 001.*xxx.xxx.xxx*
- 127.*xxx.xxx.xxx*
- 223 to 255.*xxx.xxx.xxx*

The specific reserved values that cannot be used vary according to the conditions of each application. The previous values are only examples of reserved values.

Each node on the same physical network must have an IP address of the same class and must have the same net ID. Each node on the same network must have a different Host ID thus that gives it a unique IP address.

### Gateway Address

A gateway connects individual physical networks into a system of networks. When a node must communicate with a node on another network, a gateway transfers the data between the two networks. This field is set to 192.168.1.1 by default, when the IP range is [192.168.1 ] 002…254.

### Subnet Mask

Subnet addressing is an extension of the IP address scheme that lets a site use a single network ID for multiple physical networks. The routing outside of the site continues by dividing the IP address into a net ID and a host ID via the class. Inside a site, the subnet mask is used to redivide the IP address into a custom network ID portion and host ID portion. This field is set to 255.255.255.0by default.

If you change the subnet mask of an already-configured module, you must cycle the power to the module for the change to take effect.

## Configuring EtherNet/ IP Address

Before using the ArmorStart controller, you may need to configure an IP address, subnet mask, and optional Gateway address. The rotary network address switches found on the I/O section of the ArmorStart controller are set to 999 and DHCP is enabled as the factory default. The ArmorStart controller reads these switches first to determine if the switches are set to a valid IP address between 1…254. When switches are set to a valid number, then the IP address is 192.168.1._ _ _ [switch setting].

The IP address can also be set by using DHCP.

- If DHCP is preferred, use Rockwell Automation BootP/DHCP utility, version 2.3 or later, which ships with RSLogix 5000® or RSLinx software.
- Or use a third-party DHCP server.

This document assumes that you have set the IP address to 192.168.1.1. You can change this IP address to any address either statically or dynamically.

**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.

## Manually Configure the Network Address Switches

Remove the protective caps from the rotary switches. Set the network address by adjusting the three switches on the front of the I/O module.

**Figure 47 - Switches on the I/O Module**

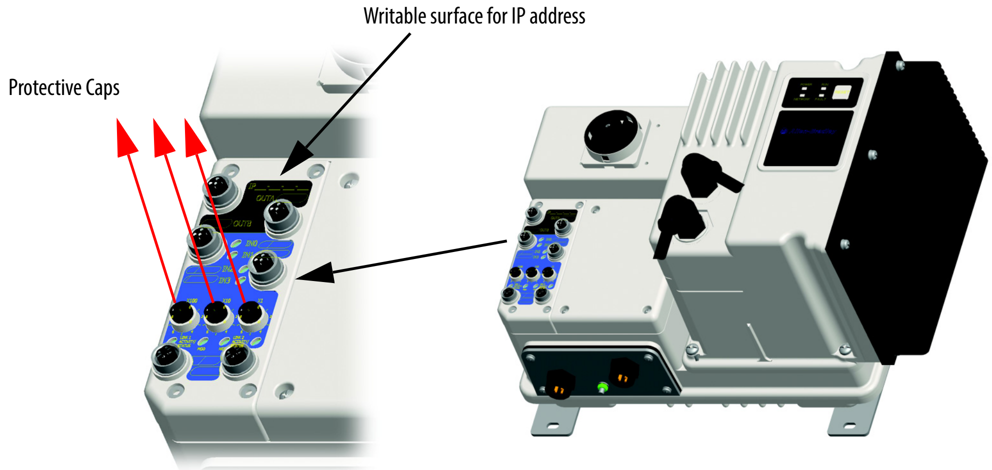
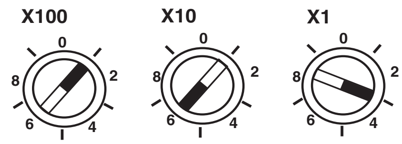


**Figure 48 - Network Address Example**

This example shows the
IP address set to 163
for IP Address 192.168.1.163




Valid IP address switch settings range from 002 to 254. When the switches are set to a valid number, then the IP address of the adapter is 192.168.1.*xxx* (where *xxx* represents the number set on the switches; see Figure 48). The subnet mask of the adapter is 255.255.255.0 and the gateway address is set to 192.168.1.1. A power cycle is required for any new IP address to take effect.

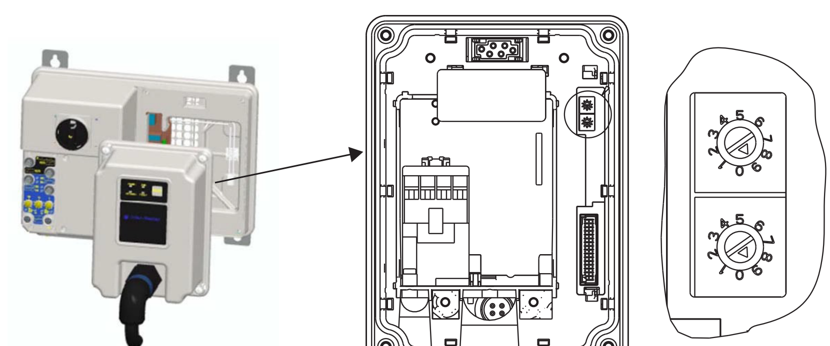
**Note:** When the switches are set to 192.168.1.1, the subnet mask is set to 255.255.255.0 and the gateway address is set to 0.0.0.0.

**Note:** The upper three octets are fixed. DHCP or the embedded web server must be used to configure the IP address to a value other than 192.168.1.*xxx*.

If the switches are set to an invalid number (such as 000 or a value greater than 254), then the adapter checks to see if DHCP is enabled. If DHCP is enabled, the adapter requests an address from a DHCP server. If DHCP is not enabled, then the adapter uses the IP address (along with other TCP configurable parameters) stored in nonvolatile memory.

| | |
|---|---|
| **IMPORTANT** | See Figure 49. 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. |

**Figure 49 - Rotary Switch on Control Module**




**DO NOT CHANGE!**

## Rockwell Automation BootP/DHCP Utility

The Rockwell Automation BootP/DHCP utility is a standalone program that incorporates the functionality of standard BootP/DHCP software with a user-friendly graphical interface. It is located in the Utils directory on the RSLogix 5000 installation CD. The ArmorStart EtherNet/IP adapter must have DHCP enabled (factory default) to use the utility.

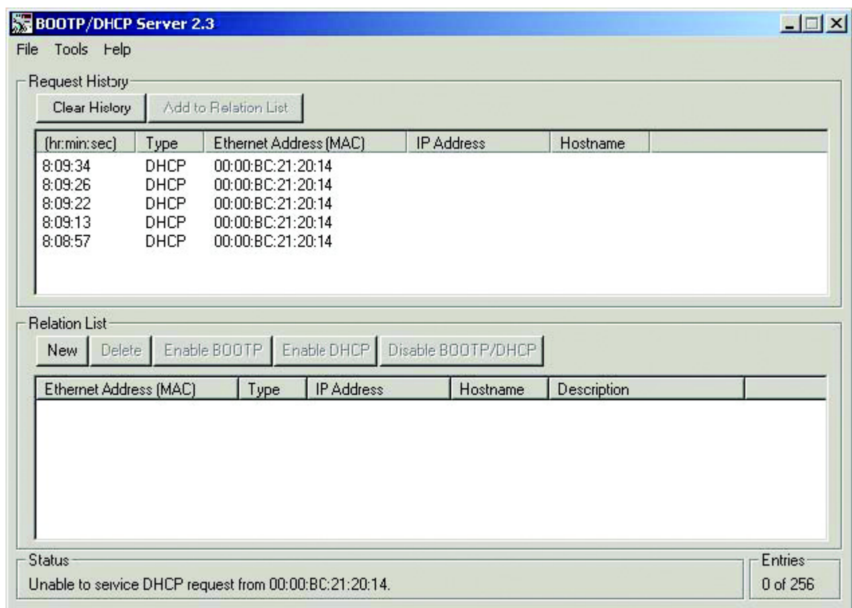
| | |
|---|---|
| **IMPORTANT** | ArmorStart EtherNet/IP does not support BOOTP. |

To configure your adapter by using the BootP/DHCP utility, perform the following steps:

1. Run the BootP/DHCP software.

   In the BootP/DHCP Request History panel, the hardware addresses of the devices that are issuing BootP/DHCP requests are shown.

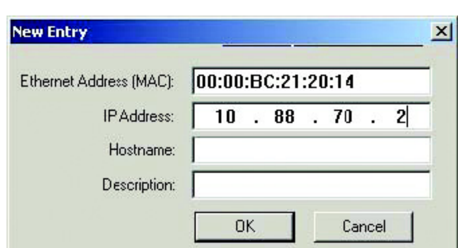
**Figure 50 - BootP/DHCP Request History Panel**




2. Double-click the hardware address of the device that you want to configure.

   The New Entry dialog with the Ethernet Address (MAC) of the device is shown.

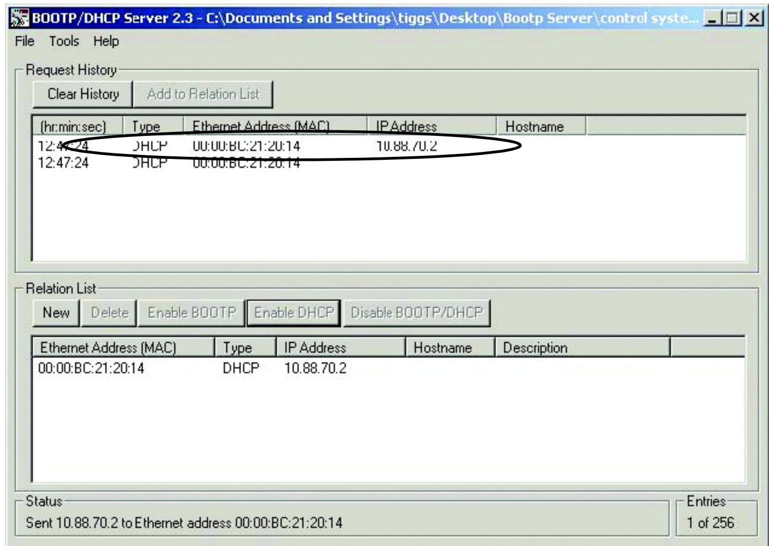
**Figure 51 - New Entry Dialog Box**



3. Enter the IP address that you want to assign to the device, and click OK.

   The device is added to the Relation List, which displays the Ethernet Address (MAC) and the corresponding IP address, host name, and Description (if applicable).

**Figure 52 - Relation List**




   When the address displays in the IP address column in the Request History section, it signifies that the IP address assignment has been made.

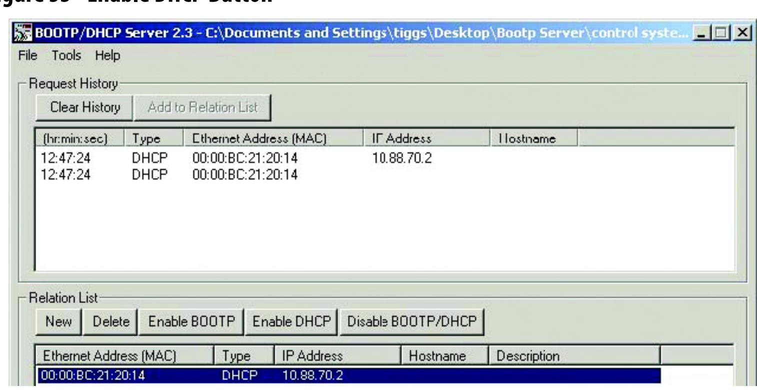
4. To assign this configuration to the device, highlight the device in the Relation List panel, and click the Disable BOOTP/DHCP button.

   When power is cycled to the device, it uses the configuration you assigned and does not issue a DHCP request.

5. To enable DHCP for a device with DHCP disabled, highlight the device in the Relation List, and click the Enable DHCP button.

   You must have an entry for the device in the Relation List panel to re-enable DHCP.

**Figure 53 - Enable DHCP Button**

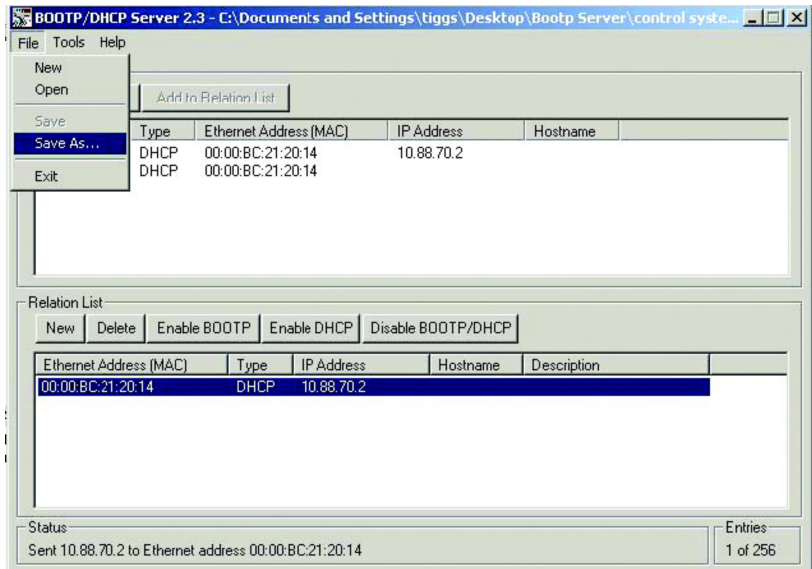


## Save the Relation List

You can save the Relation List to use later. To save the Relation List, perform the following steps:

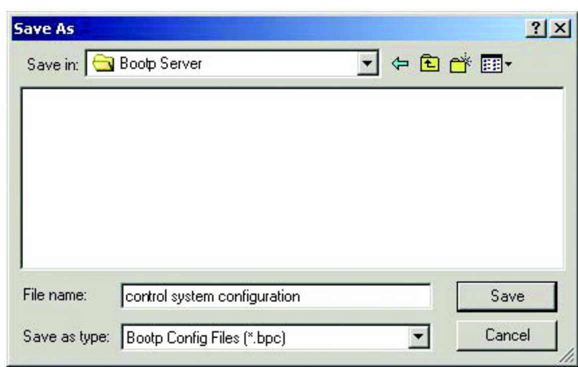
1. Select Save As... from the File menu.

**Figure 54 - Save the Relation List**




The Save As Dialog is shown.

**Figure 55 - Save As Dialog Box**




2. Select the folder that you want to Save in.
3. Enter a File name for the Relation List (for example, Control System Configuration), and click Save.

   You can leave the Save as type at the default setting: BOOTP

   You can then open the file that contains the Relation List at a later session.

## DHCP IP Support

DHCP (Dynamic Host Configuration Protocol) software automatically assigns IP addresses to client stations logging on to a TCP/IP network.

When DHCP is enabled (factory default Enabled), then the unit requests its network configuration from a DHCP/BOOTP server. Any configuration that is received from a DHCP server is stored in nonvolatile memory.

ArmorStart EtherNet/IP remembers the last successful address if DHCP is enabled. The unit tries to obtain the same IP address from the DHCP server. If the server is not present (for example, server fails to power up), then the unit uses the IP address it previously received from the server. The DHCP timeout = 30 s.

Use caution when configuring your adapter with DHCP software. A DHCP server typically assigns a finite lease time to the offered IP address. When 50% of the leased time has expired, the ArmorStart Ethernet adapter attempts to renew its IP address with the DHCP server. The possibility exists that the adapter can be assigned a different IP address, which would cause the adapter to cease communicating with the controller.

# Rockwell Automation Embedded Web Server

## Internal Web Server

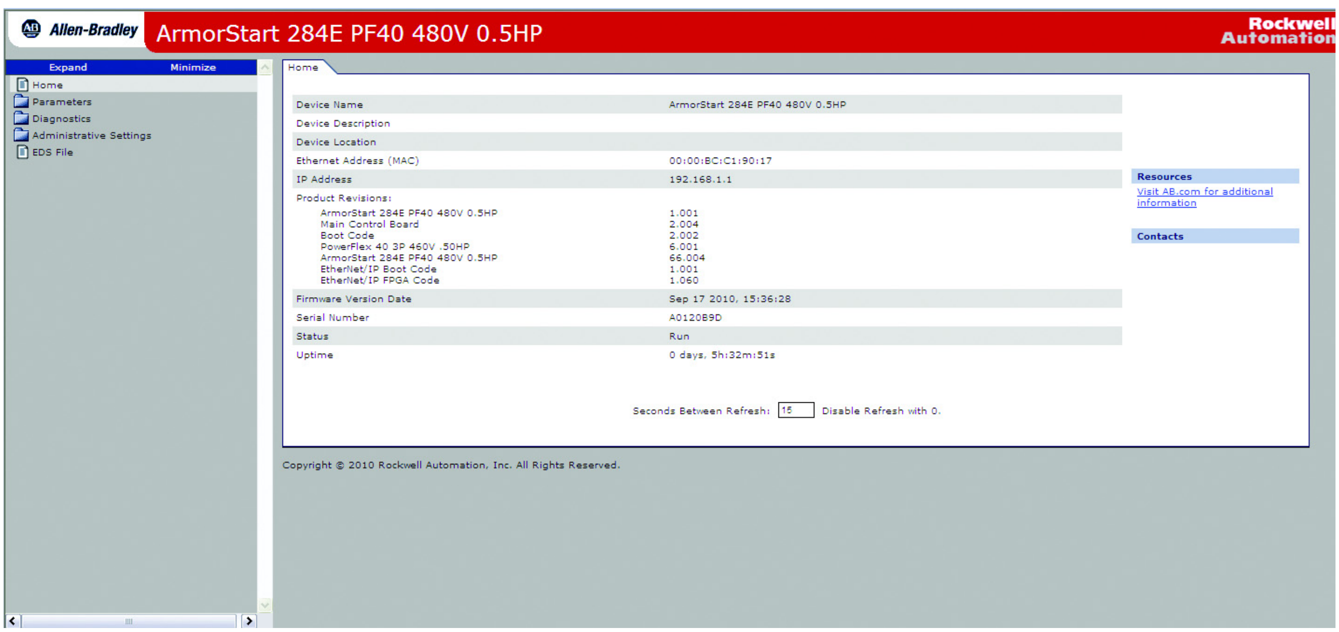
ArmorStart EtherNet/IP internal web server lets you view information and configure the ArmorStart controller via a web browser. The embedded web server is used to access configuration and status data. Security in the form of an administrative password can be set. The default Login is Administrator. **There is no password set by default.**

| IMPORTANT | You must set the password to a unique value for authorized personnel.<br>If the login and password are lost, then you must reset the device to the factory defaults, which results in a loss of its configuration. |
|---|---|

To access the internal web browser, open your computers internet browser and enter the IP address of the desired ArmorStart controller (for example, 192.168.1.1).

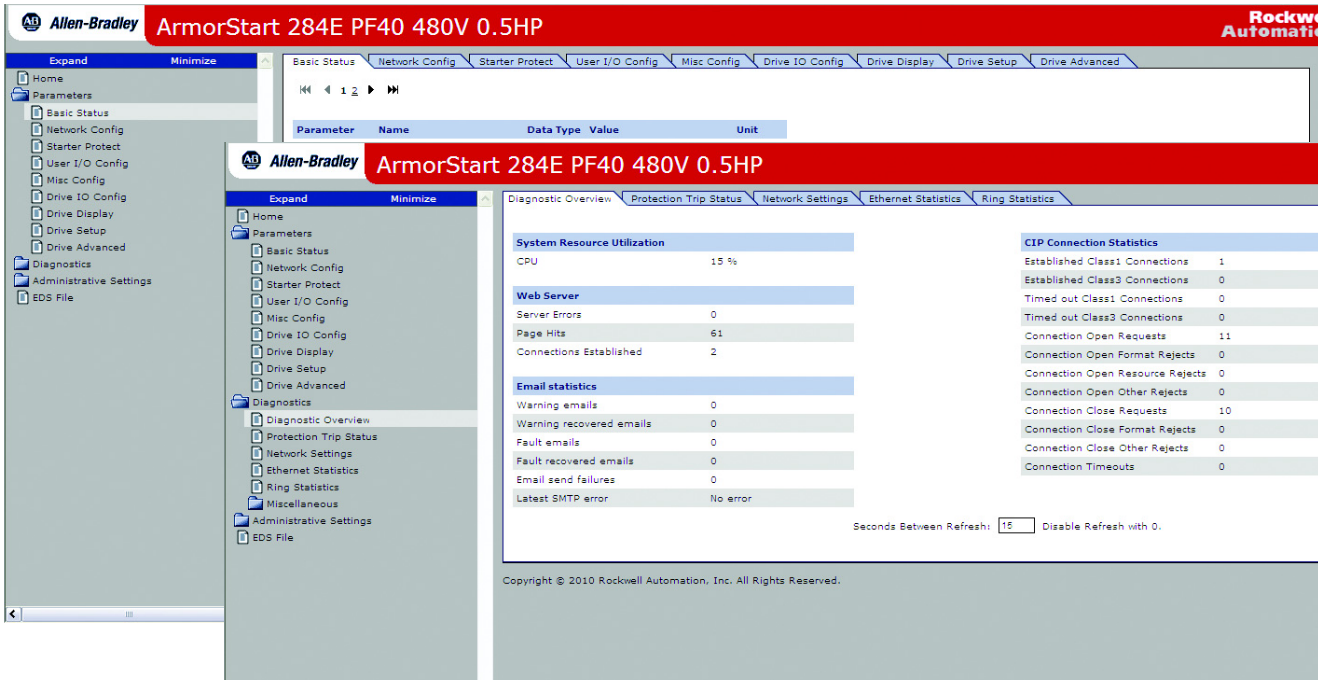
**Note:** 192.168.1.1 is **NOT** the factory default IP address as DHCP is enabled by default.

**Figure 56 - Internal Web Browser**



From here, you are able to view parameter settings, device status, and diagnostics from multiple tab views.

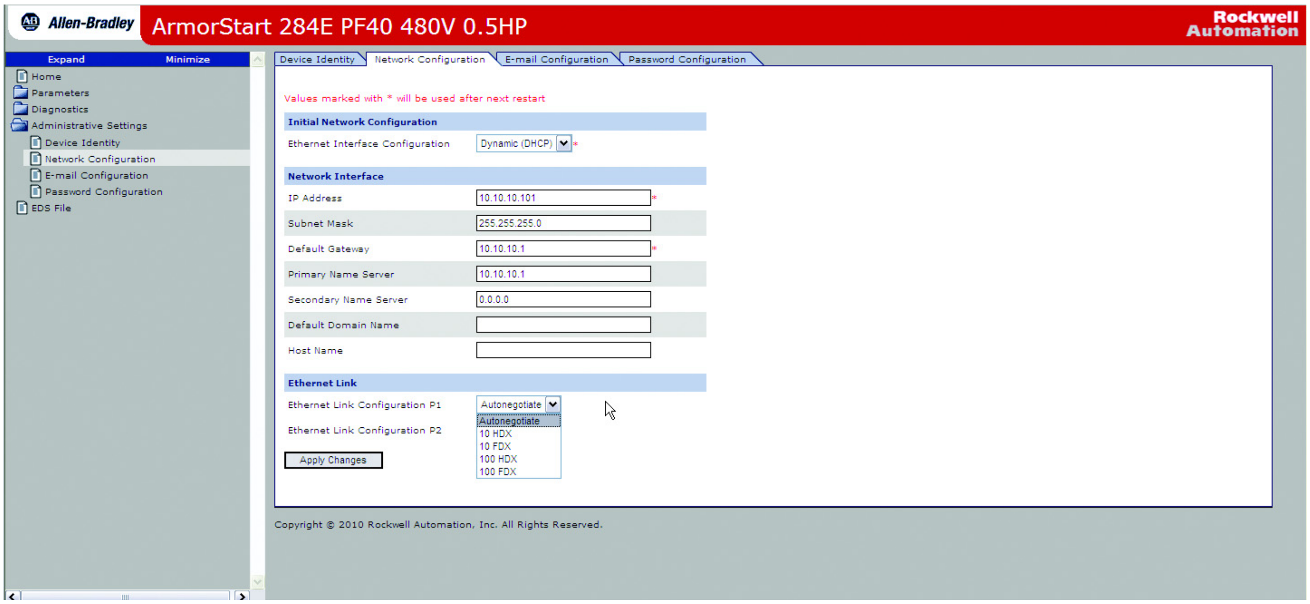
**Figure 57 - Multiple Tab Views**



## Network Configuration

To access the network configuration, log in to the Administrative Setting. The factory default login is Administrator. The factory default password is not used. You must change the password so unauthorized personnel do not gain access and modify the device configuration.

**Figure 58 - Network Configurations**



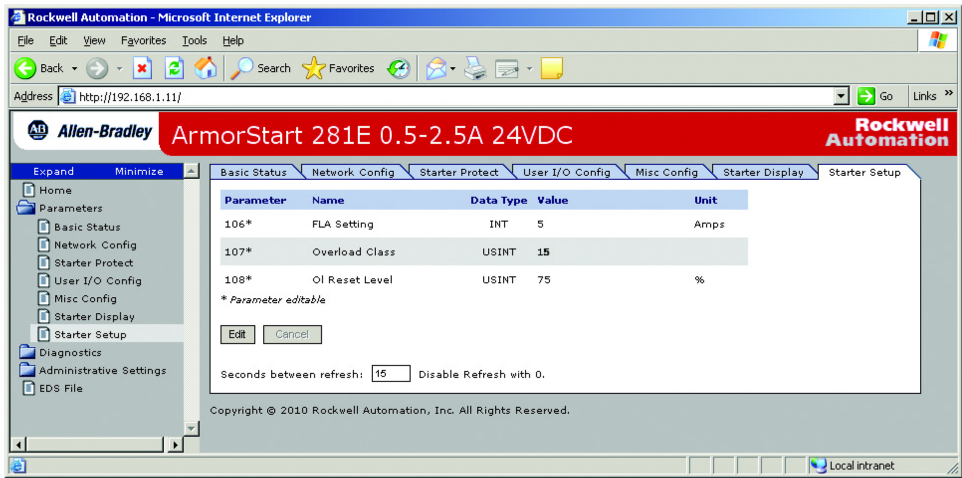

From this screen, you can change the Ethernet Configuration. In the example that is shown, the default IP address was changed from 192.168.1.1 to 10.10.10.101. To access the web page after a power cycle, the new address must be used.

It is also important to leave the Ethernet link configuration P1/P2 set to auto negotiate to minimize network issues. But if this configuration is not acceptable you must verify that all devices on the network are set to the same setting or network issues can result.

## Parameter Configuration

ArmorStart EtherNet/IP embedded web server provides you the ability to view and modify the device configuration without having to access Studio 5000. To view the device configuration from the web server, select the Parameters folder. For the parameter configuration, you log in through the Administrative Settings, or when prompted.

**Figure 59 - Starter Setup**

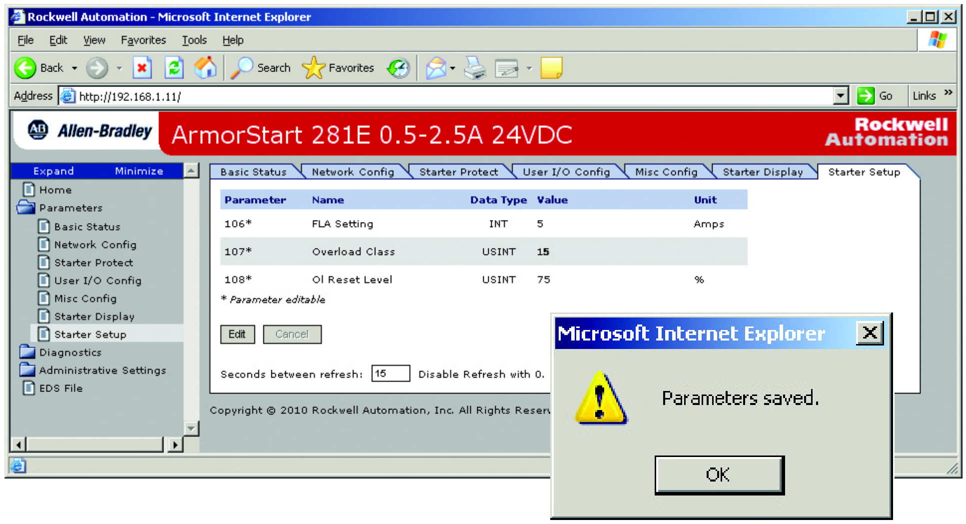



In Figure 59, the Starter set-up parameters are viewed. You can view all parameters from this screen. To modify a parameter, click the “Edit” button.

**Figure 60 - Enter Network Password**


You are prompted to enter the default user name (Administrator). There is no password set by default. You are expected to change the user name (login) and password to avoid unauthorized access to the device configuration.

Figure 61 - Overload Class Settings

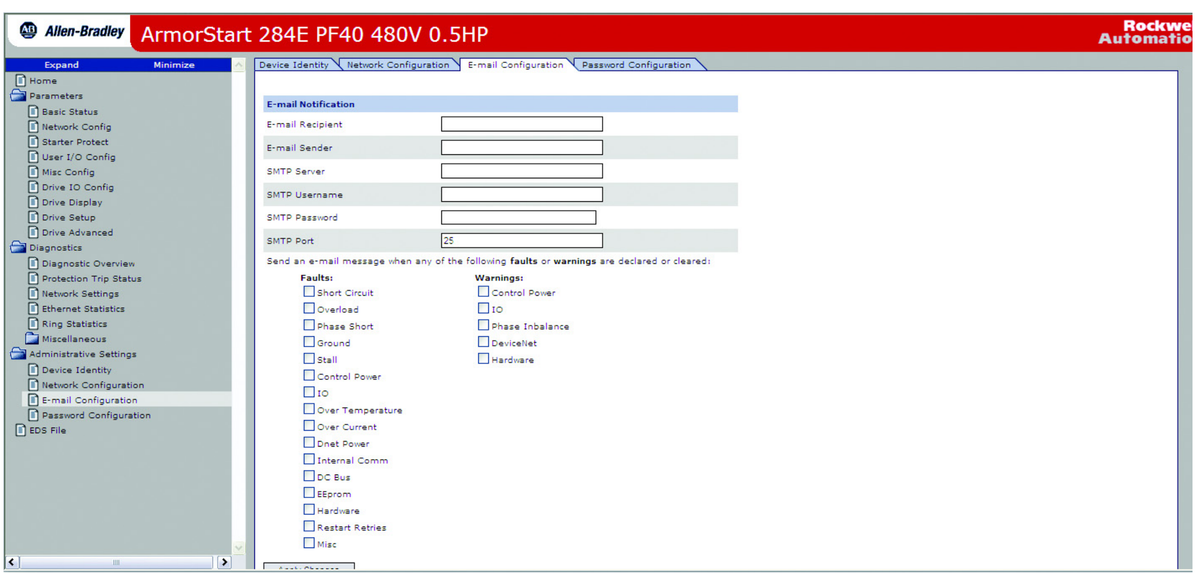



The example screen shows a change of the Overload Class setting to 15. Once all changes are made, select Apply.

## Email Notification Configuration

ArmorStart EtherNet/IP internal web server supports the e-mailing of warning and trip messages via Simple Mail Transfer Protocol (SMTP). The configuration parameters for the IP address, user login, and port number of the SMTP Server, are configurable through the Administrative Settings page of the internal web server. You configure the device name, device description, and device trip type.

Figure 62 - Email Notification Configuration



Email triggers when a:

- Trip occurs
- Trip is cleared
- Warning occurs
- Warning is cleared

**Note:** “Cleared Event” e-mails are only sent when all events have been cleared and if a trip event email has previously been sent. For example, if the device is configured to send emails when a phase loss trip and an overload trip are detected, no email is sent when both the overload and the phase loss are cleared.

The following is an example trip email:

| | |
|---|---|
| Subject: | ArmorStart 281E, 0.5…2.5 A, 24V DC has detected a trip. |
| Body: | |
| Trip Type: | Overload |
| Trip Info: | Load has drawn excessive current that is based on the trip class that is selected. |
| Device Name: | ArmorStart 281E, 0.5…2.5 A, 24V DC<br>(From Identity Object) |
| Device Description: | Lift conveyor On-Machine™ motor starter<br>(From email Config web page) |
| Device Location: | Customer Plant<br>(From email Config web page) |
| Contact Info: | J Customer<br>(From email Config web page)<br>j.customer@microsoft.com |

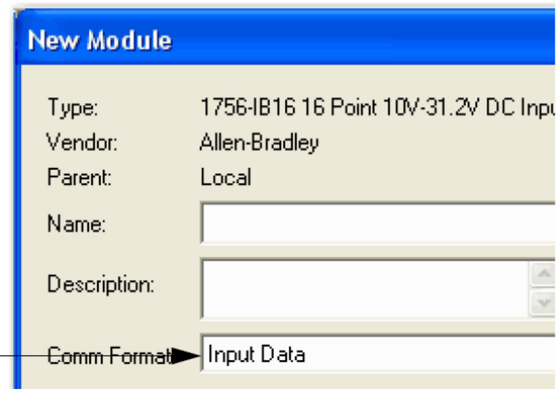
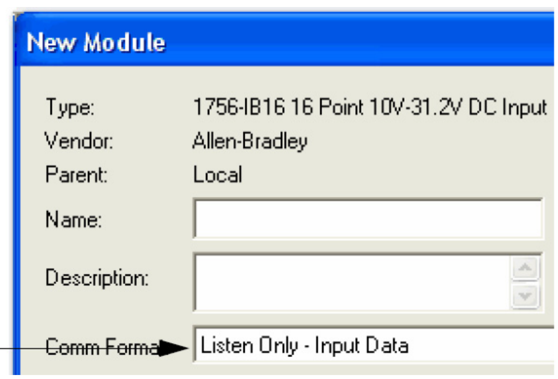
## Device Connections

The device supports both scheduled (Class 1) and unscheduled (Class 3 and UCMM) CIP connections. A maximum of two Class 1 CIP connections (one exclusive owner and one listen only) are supported, one per PLC. Six Class 3 CIP connections are supported.

## Ownership

In a Studio 5000 system, modules multicast data. Therefore, multiple modules can receive the same data simultaneously from a single module. When choosing a communication format, decide whether to establish an owner-controller or listen-only relationship with the module.

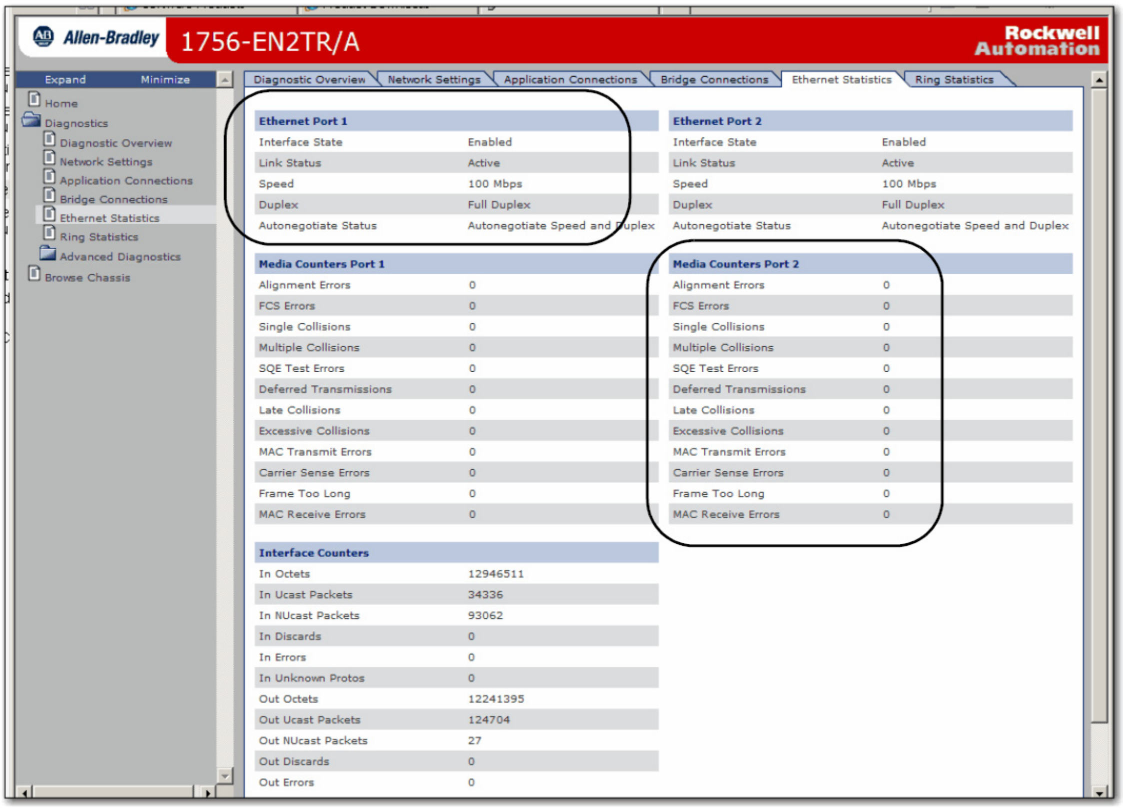
**Table 5 - Communication Relationship**

| Ownership Type | Description |
|---|---|
| Owner controller | The controller that creates the primary configuration and communication connection to a module. The owner controller writes configuration data and can establish a connection to the module.<br>An owner connection is any connection that does not include Listen-Only in its Comm Format.<br><br> |
| Listen-only connection | 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.<br>Listen-only connection<br><br> |

## Ethernet Statistics Web Page

The Ethernet Statistics web page of a scanner provides a summary of the status of communication activity on the Ethernet network.

The most commonly monitored fields are circled in the graphic and described in the table that follows.




This table describes the field that is most commonly used on the Ethernet Statistics web page.

**Table 6 - Ethernet Statistics Web Page**

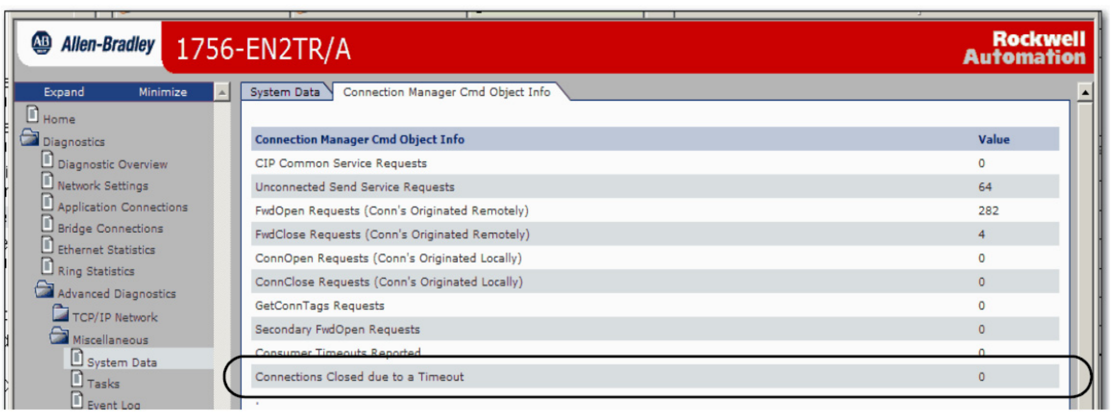
| Field | Specifies |
|---|---|
| **Ethernet Port 1 (These definitions apply to the same fields in the Ethernet Port 2 section.)** | |
| Interface State | Whether the port is turned off or on. Active or inactive indicates whether there is a cable that is connected. |
| Link Status | Whether the port is blocked for DLR protocol frames. |
| Speed | Whether the Ethernet port is operating at 10 MBps or 100 MBps. |
| Duplex | Whether the Ethernet port is operating at half duplex or full duplex. |
| Autonegotiate Status | Whether the port speed and Duplex mode were determined via autonegotiation or whether they were manually configured. |
| **Media Counters Port 1** | |
| Alignment Errors | A frame containing bits that do not total an integral multiple of eight. |
| FCS Errors | A frame containing 8 bits, at least one of which has been corrupted. |
| 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. |

| Field | Specifies |
|---|---|
| SQE Test Errors | A test to detect the collision-present circuit between a transceiver and a network interface card (NIC).<br>**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. |
| Late Collisions | The number of times two devices transmit data simultaneously. |
| Excessive Collisions | The number of frames that experience 16 consecutive collisions. |
| MAC Transmit Errors | Frames for which transmission fails due to an internal MAC sublayer transmit error. |
| Carrier Sense Errors | Times that the carrier sense condition was lost or never asserted when attempting to transmit a frame. |
| Frame Too Long | The number of incoming packets that exceed the maximum Ethernet packet size. |
| MAC Receive Errors | Frames for which reception on the Ethernet interface failed due to an internal MAC sublayer receive error. |

## Connection Manager Cmd Object Info Web Page

The Connection Manager Cmd Object Info web page of a scanner provides a summary of connection request activity on the Ethernet network.

The most commonly used field on this page is Connections Closed due to a Timeout. This field shows the number of CIP connection timeouts that have occurred on the module.

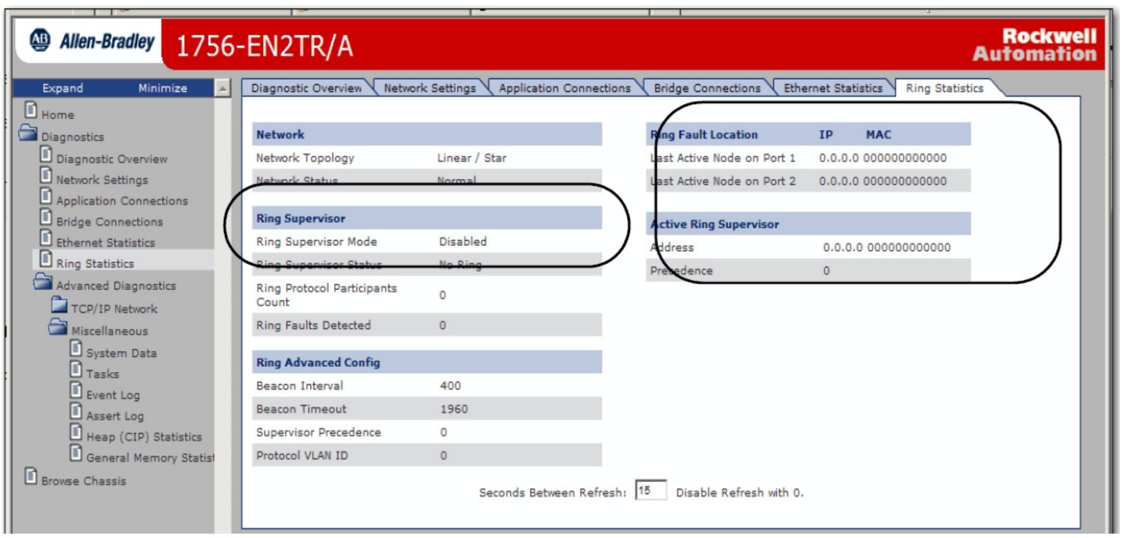


# Ring Statistics Web Page

| | |
|---|---|
| **IMPORTANT** | The Ring Statistics web page, and the descriptions in this section, only apply to modules you can use in a Device Level Ring (DLR) network:<br>• 1756-EN2TR communication module<br>• 1756-EN3TR communication module |

The Ring Statistics web page of a scanner provides a operating state summary of the module in a DLR application.

The most commonly monitored fields are circled in the graphic and described in the table that follows.




This table describes the field that is most commonly used on the Ring Statistics web page.

**Table 7 - Ring Statistics Web Page**

| Field | Specifies |
|---|---|
| **Ring Supervisor** | |
| Ring Supervisor Mode | Whether a module is configured to function as supervisor node or a ring node. |
| Ring Supervisor Status | Whether a module that is configured to function as a supervisor node is functioning as the active ring supervisor or a backup supervisor node. |
| **Ring Fault Location** | |
| Last Active Node on Port 1 | The IP or MAC ID address of the last active node between port 1 on the module and the faulted part of the network. |
| Last Active Node on Port 2 | The IP or MAC ID address of the last active node between port 2 on the module and the faulted part of the network. |
| **Active Ring Supervisor** | |
| Address | The IP or MAC ID address of the active ring supervisor. |
| Precedence | The precedence value of the module. If the operation of the active supervisor node is interrupted, the backup supervisor with the next highest precedence value becomes the active supervisor node. |

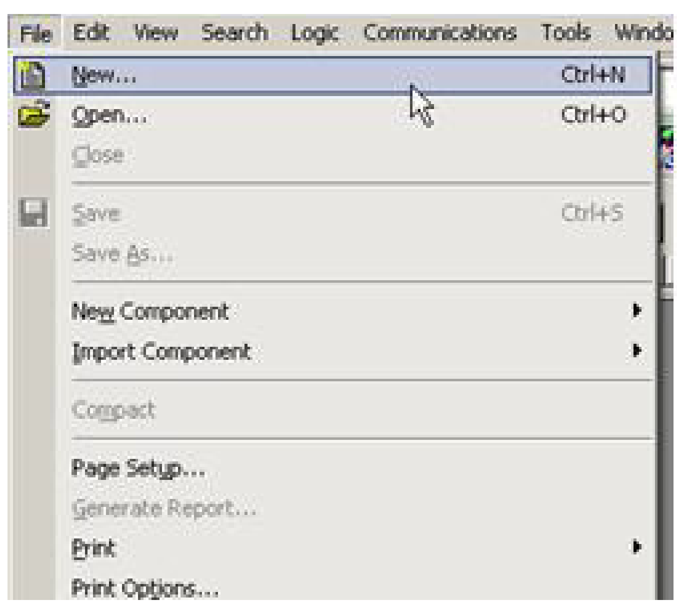
# Adding an ArmorStart Selection to Studio 5000 Software

## Setup

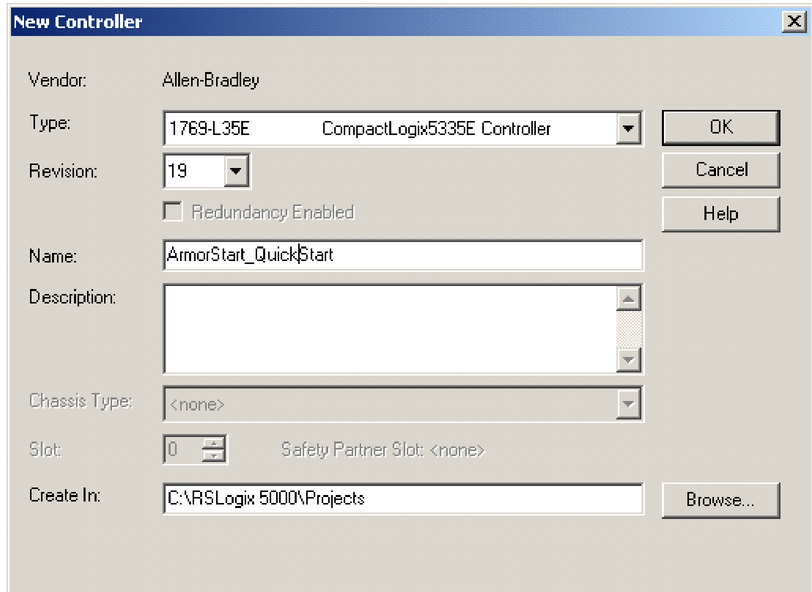
This section shows you how to add an ArmorStart AOP to Studio 5000 software. It is assumed that you have downloaded and installed the AOP so that the Studio 5000 software can fully support the ArmorStart EtherNet/IP. The AOP can be downloaded from: http://support.rockwellautomation.com/controlflash/LogixProfiler.asp.

1. Open Studio 5000 software by double-clicking the icon on your desktop.

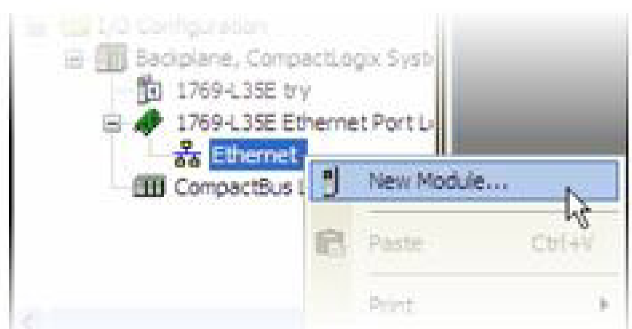

2. To create a new project, select File > New.



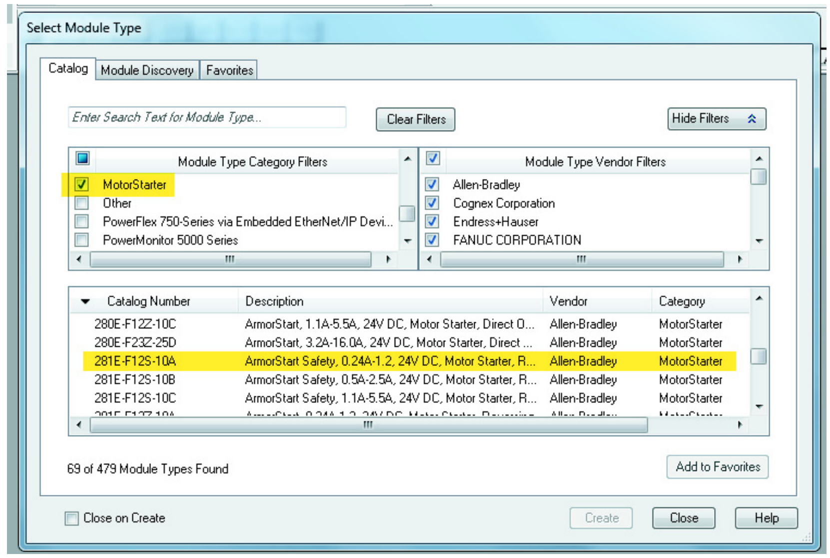
3. Enter the name of the project and select your controller from the Type pull-down menu. (For this example, catalog number 1769-L35E and software version 19 are used.) Click OK.




4. To add a new module to the tree, right-click Ethernet and select New Module. This action lets you add a new ArmorStart selection to the Logix Project.

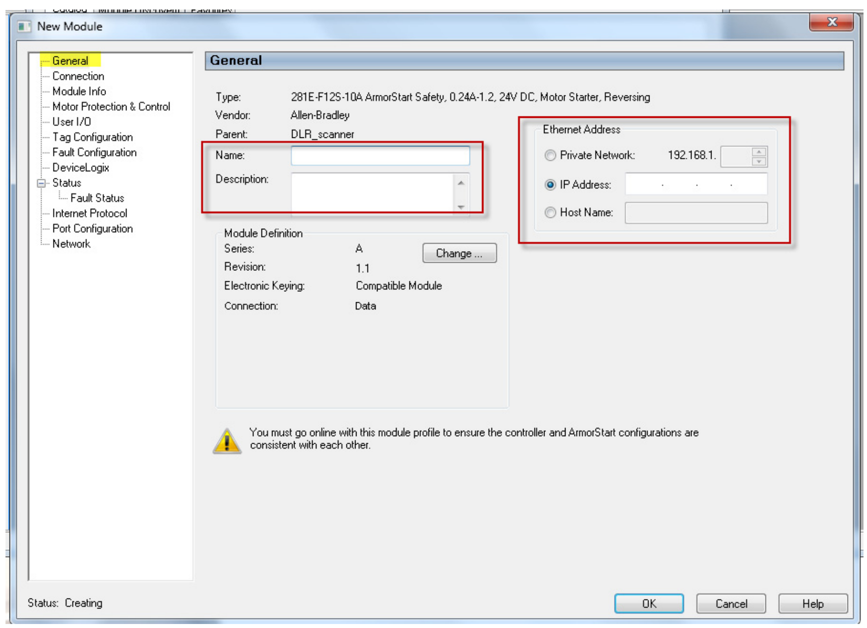


5. Select the ArmorStart controller in your application and click OK.



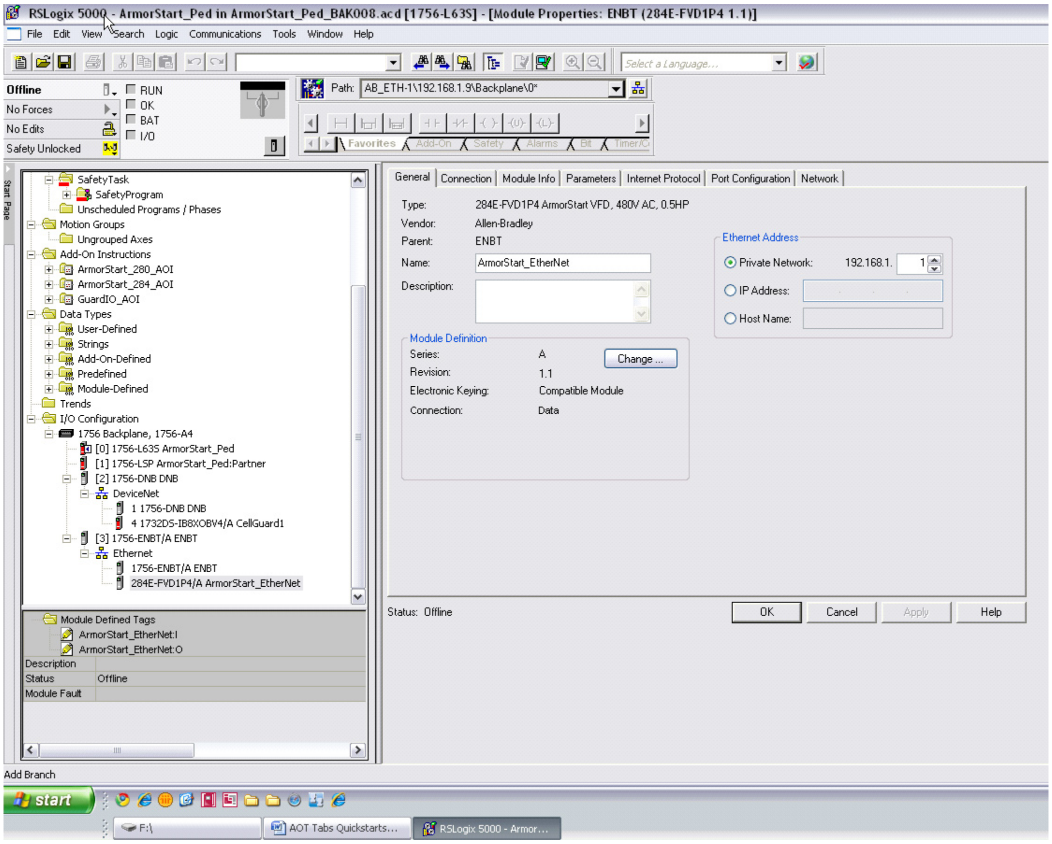

6. The AOP is shown in the next example. Enter a Name for this ArmorStart selection and an Ethernet address. For this example, the Private Network setting is used. This setting must be set to match the IP address switch setting on the ArmorStart selection. Click OK.

**Note:** See Configuring EtherNet/IP Address in Chapter 5to set an IP address on the device.

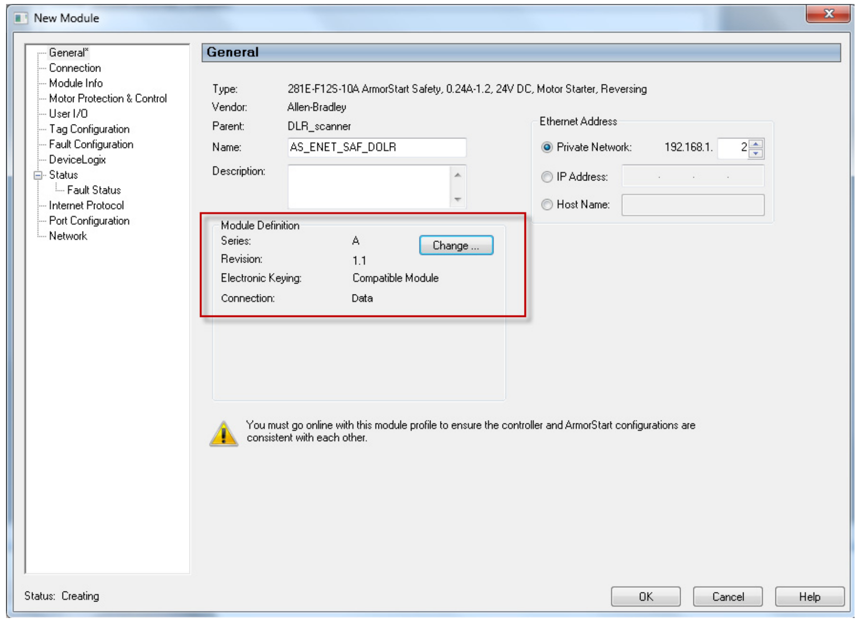


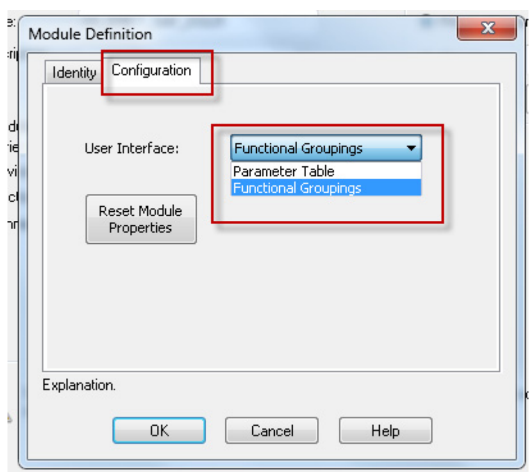
## Connect and Configure ArmorStart Controller with Add-on Profile (AOP)

This section shows the AOP tabs and how they can be used to connect, obtain status, and configure the ArmorStart selection. Before the walkthrough is started, the Studio 5000 software must be open and an AOP displayed as shown next.



Choose the Module Definition as shown. You can change from parameter view to a more user-friendly graphic view.

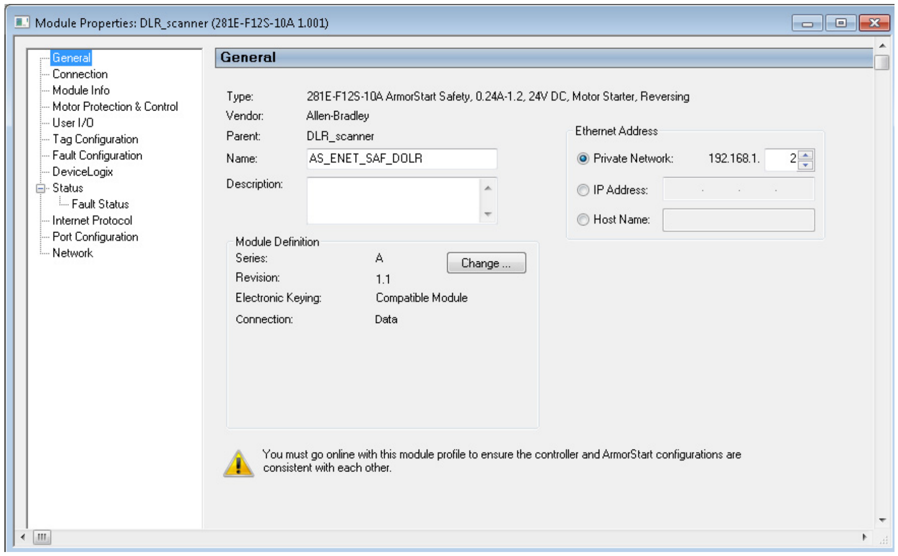


# Offline Connection

## General Tab

Click the General tab to display the following:

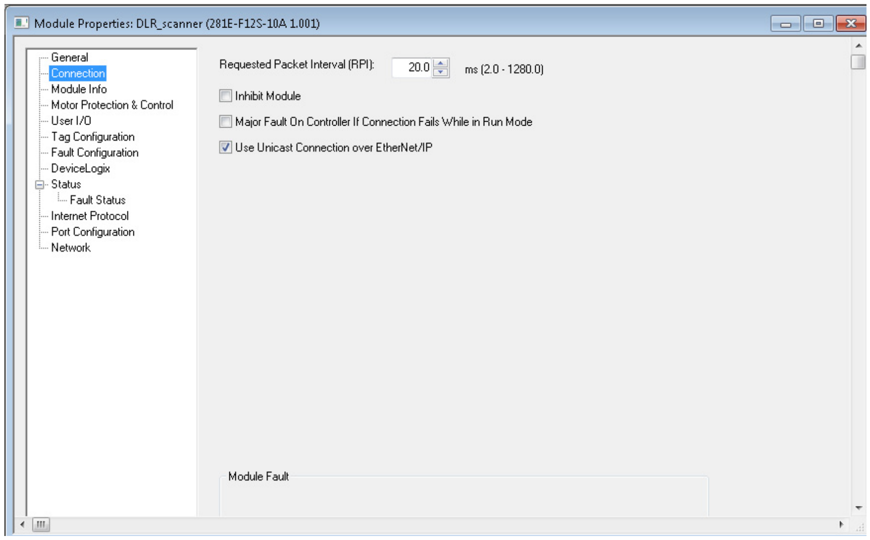



This tab lets you name your module, which must be descriptive and representative of the module. You must also input the IP address of the module so that communication can be established. The IP Address must be the one defined when the BootP/DHCP Server, the Rotary Network Address Switches, or the ArmorStart internal web server. is used.

For most cases, the Host Name and Module Definition section of this tab do not require any adjustment. Changes to either of these sections must only be made if you are familiar with the functionality of each of these sections.

## Connection Tab

Click the Connection tab to display the following:

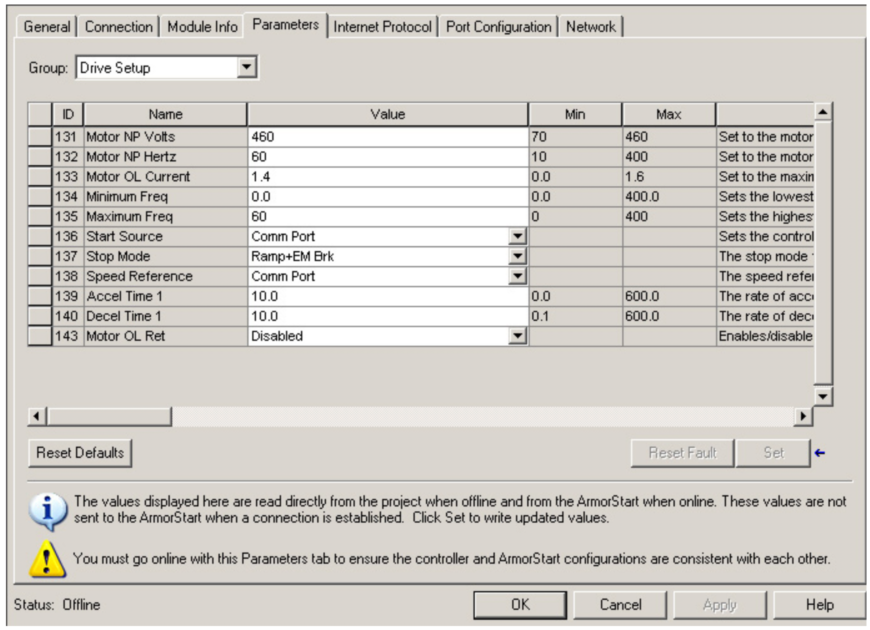



The Request Packet Interval (RPI) indicates the maximum frequency at which data is received. It is possible that data can come more quickly than the time interval assigned in the RPI. In most cases, the default 20 ms is the optimal setting. If you check the Inhibit Module option, connection to controller tags are broken. The Major Fault on Controller if Connection Fails While in Run Mode option, must be checked to make sure that the controller processes the connection fault with the ArmorStart controller. The Use Unicast Connection over EtherNet/IP is checked to use the Unicast mode instead of the EtherNet/IP mode. This choice appears only for modules that are using Studio 5000 software version 18 or later that supports Unicast.

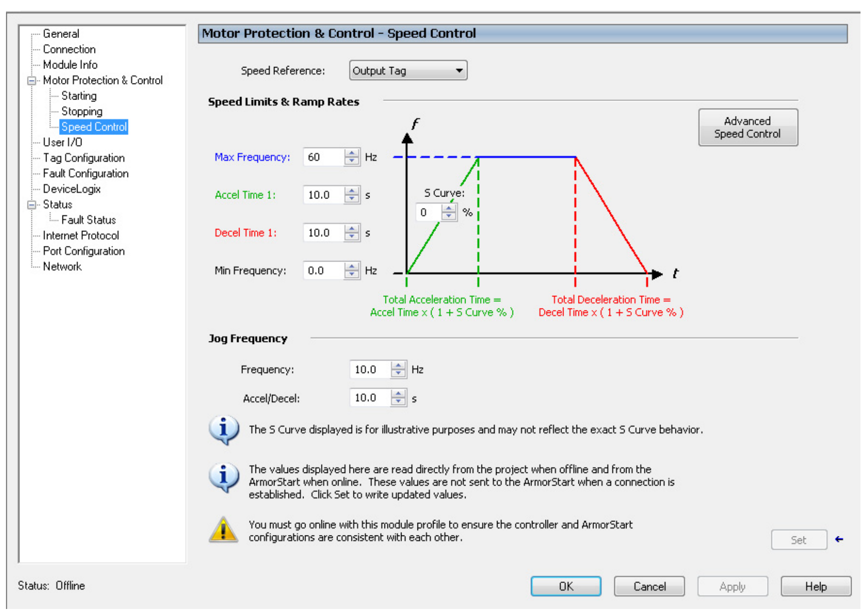
## Parameters and Configuration Tab

Based on the configuration in the module definition tab, configure the ArmorStart controller by using one of the following screens. The parameters are divided into groups that are based on the type of ArmorStart controller and set-up function.

### Parameter View, Selected




### Functional Group View, Selected

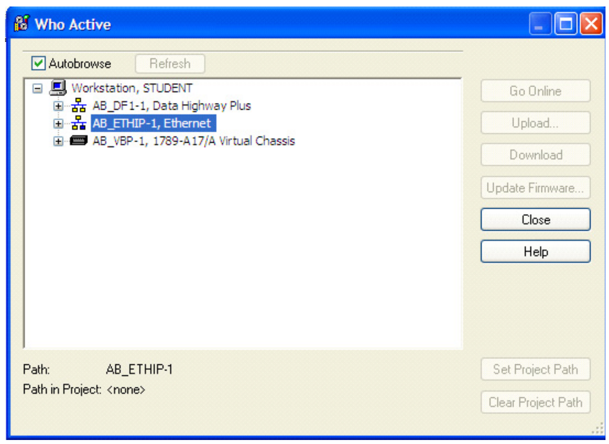


## Online Connection

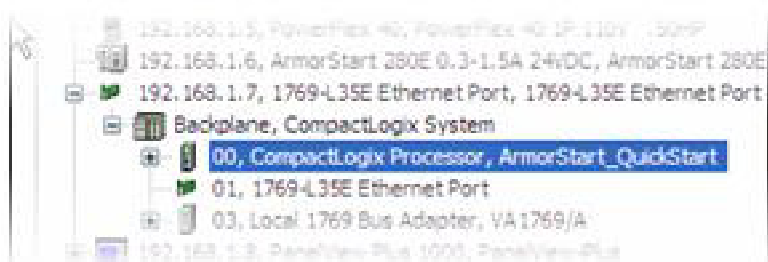
**Note:** If you are using a catalog number 1756-ENBT Ethernet module to communicate with the PLC, verify that you have updated the firmware of the module to Revision 6.001 or later. The latest firmware can be found at http://support.rockwellautomation.com/controlflash/.

1. If a controller path is not set in the field that is shown, you must first set a path before the controller can go online. Click the  RSwho button shown.

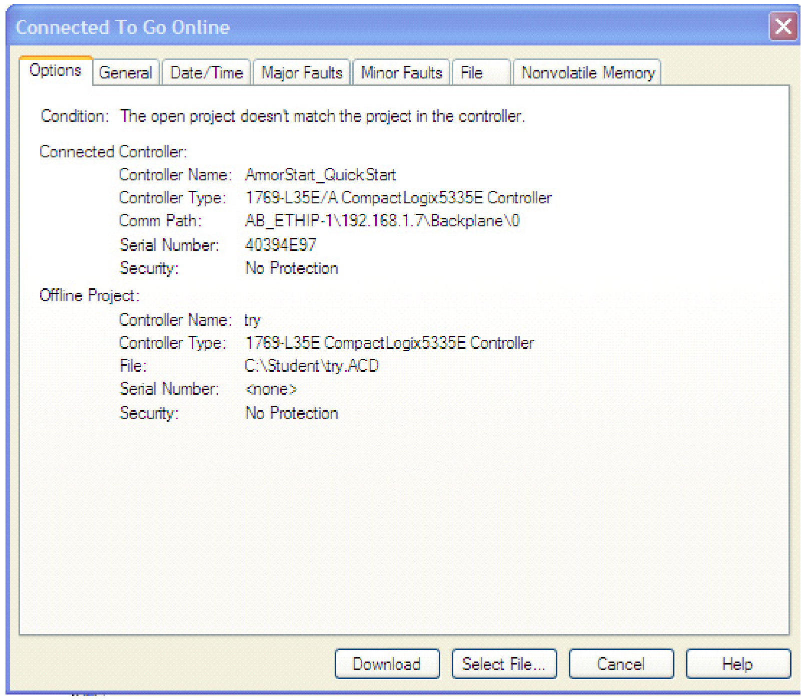

2. Expand and browse the AB_ETHIP-1, Ethernet driver.



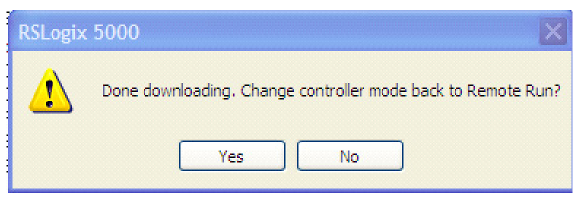

3. Select the Controller path. Then click Go Online.



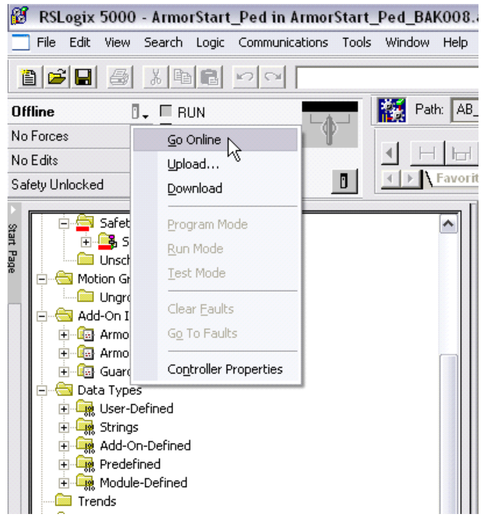
4. The following appears and for this example, click Download to connect to the controller.



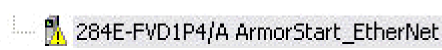

5. If a download confirmation dialog box appears, click Download again.
6. Click Yes to bring the controller back to Remote Run.



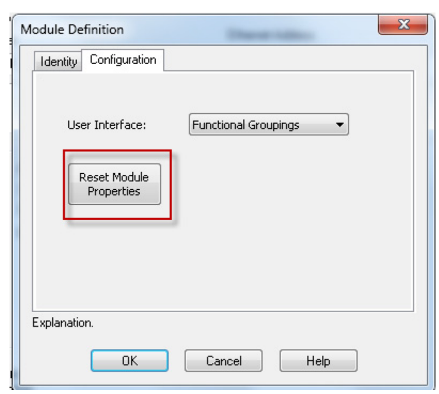
7. The controller is now online. If at any point you go offline and a path is selected, you can also go online by clicking the Offline pull-down in the upper left corner of the screen. Click Go Online to connect to the ArmorStart device, as shown next.




If a yellow triangle appears next to the ArmorStart Icon in the Controller Organizer Tree as shown next, it means that the connection is faulted. The problem must be fixed before you can connect to the ArmorStart device.

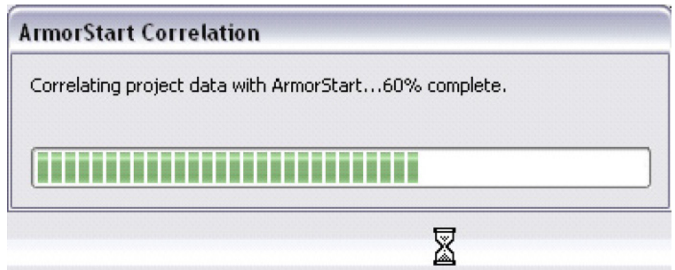



First make sure that you have selected the correct AOP for the device being communicated to, for example the correct horse power or product type. Second, reset the ArmorStart device to factory defaults from the web page. Lastly, reset the module properties from the Module Definition window as shown.

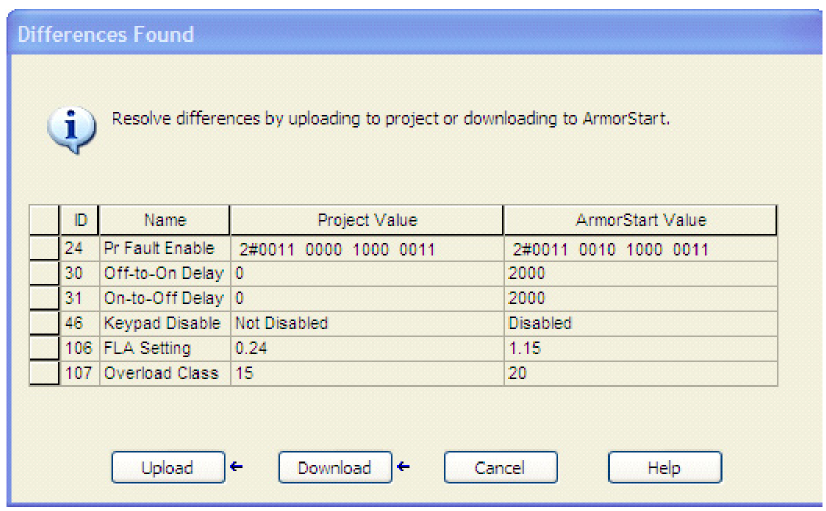


## Correlation

When the AOP is first opened and the PLC project is online with the ArmorStart device a correlation step occurs. The Correlation pop-up window is displayed, as shown next.




This window indicates that the AOP is comparing the parameter data entered offline vs. the parameter data that is stored in the ArmorStart device. If any discrepancies are found between the parameters in the AOP and the parameters in the ArmorStart device, a window pops up, as shown. The window prompts you to decide which parameters to keep.

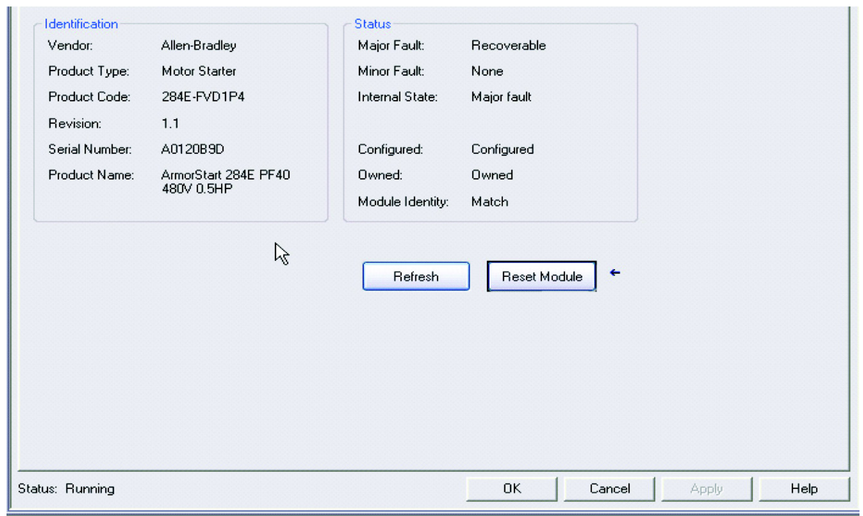


If you want to keep the parameters in the AOP, select Download. If you want to keep the parameters in the ArmorStart device, select Upload. Otherwise, select Cancel. When you click Cancel, you are locked out of viewing the values. If you are connected to a new ArmorStart device and just created the ArmorStart object and have not made changes in the parameters, the ArmorStart correlation must not find any discrepancy.

**Note:** If you change any parameters offline, you must go online with the PLC then open the corresponding AOP. This step triggers the correlations step to make those changes effective in the ArmorStart device.

## Module Info Tab

Click the Module Info tab to display the following:

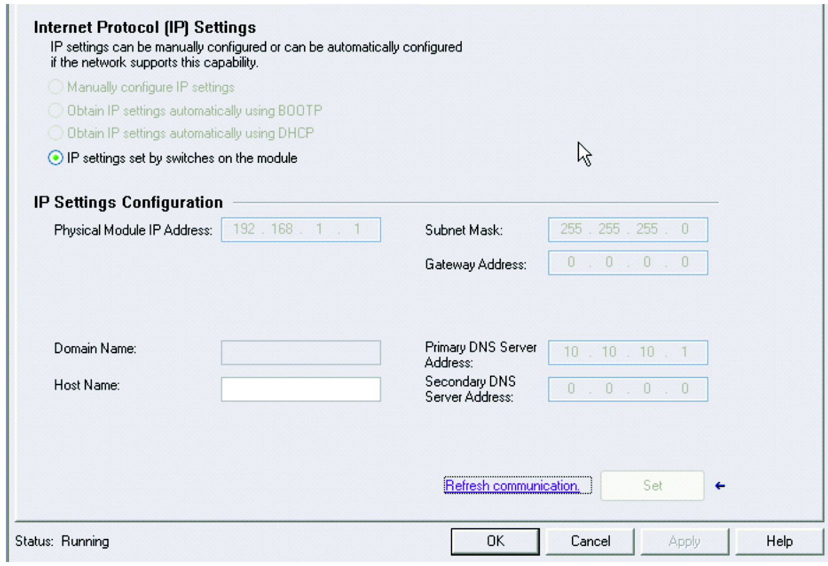



This tab displays general identification information and status information about the ArmorStart device. It is important to note that the information that is displayed in this tab is not constantly updated. After you click the Module Info tab, the AOP queries the ArmorStart device once for the information that is displayed in this tab and does not query the ArmorStart device for the values again. If after the initial query the status of the ArmorStart device changes, for example a fault occurs, the change in the status will not be automatically updated. The **Refresh** button must be pressed to request the AOP for another ArmorStart query.

**Note:** A connection status (offline, online, downloading, or uploading) is provided at the bottom left of the tab window. The connection status appears in all tabs.

## Internet Protocol Tab

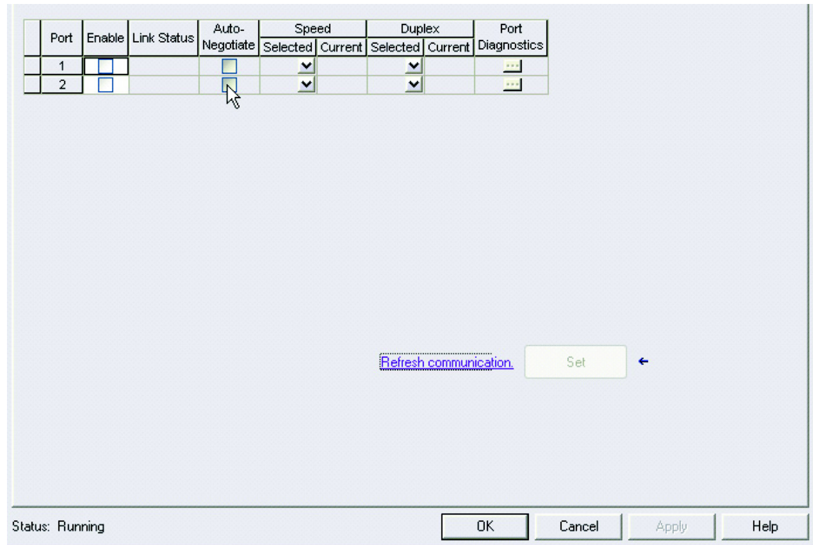
Click the Internet Protocol tab to display the following:




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 tab. In most cases, you would not need to make any changes in this tab and it only displays the current IP Settings Configuration.

## Port Configuration Tab

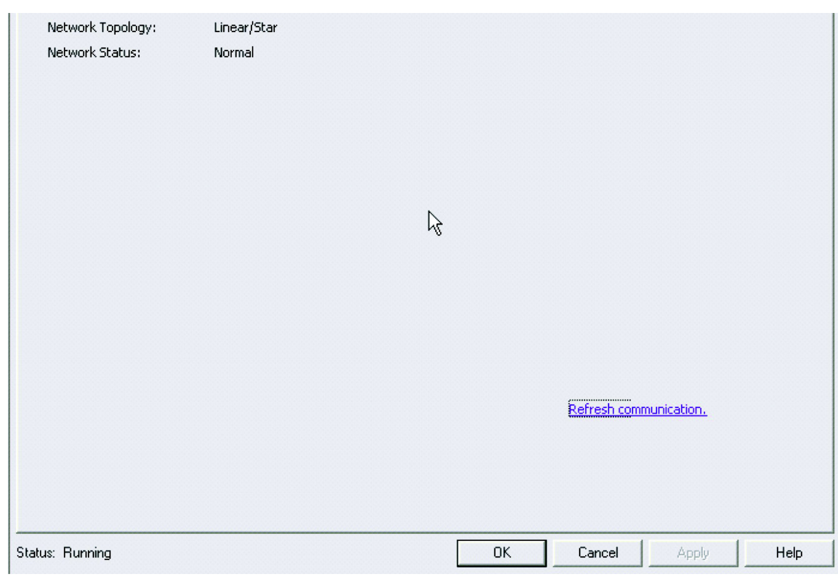
Click the Port Configuration tab to display the following:




This tab is used 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 in this tab. It is important to note that although there are two physical ports, they act as one. Therefore, when you press either of the Port Diagnostic buttons, information that comes from both of the physical ports is displayed.

## Network Tab

Click this tab to display the following:




This tab displays information about the network configuration, such as the type of topology (linear or Device Level Ring).

## Auto-generated Tags

After you install and configure the AOP, the controller tags are generated. The tags names are descriptive and automatically generated which greatly simplifies programming. The next figure shows an example of the auto-generated tags for an ArmorStart selection.

| Name | Alias For |
|---|---|
| + ASEIP_DEMO:I | |
| − ASEIP_DEMO:O | |
| + ASEIP_DEMO:O.CommandData | |
| ASEIP_DEMO:O.RunForward | |
| ASEIP_DEMO:O.ResetFault | |
| ASEIP_DEMO:O.OutA | |
| ASEIP_DEMO:O.OutB | |
| ASEIP_DEMO:O.Pt00DeviceIn | |
| ASEIP_DEMO:O.Pt01DeviceIn | |
| ASEIP_DEMO:O.Pt02DeviceIn | |
| ASEIP_DEMO:O.Pt03DeviceIn | |
| ASEIP_DEMO:O.Pt04DeviceIn | |
| ASEIP_DEMO:O.Pt05DeviceIn | |
| ASEIP_DEMO:O.Pt06DeviceIn | |
| ASEIP_DEMO:O.Pt07DeviceIn | |
| ASEIP_DEMO:O.Pt08DeviceIn | |
| ASEIP_DEMO:O.Pt09DeviceIn | |
| ASEIP_DEMO:O.Pt10DeviceIn | |
| ASEIP_DEMO:O.Pt11DeviceIn | |
| ASEIP_DEMO:O.Pt12DeviceIn | |
| ASEIP_DEMO:O.Pt13DeviceIn | |
| ASEIP_DEMO:O.Pt14DeviceIn | |
| ASEIP_DEMO:O.Pt15DeviceIn | |

The next tables provide more clarification regarding the Produce and Consume assemblies and how they correlate with the auto-generated names.

When an AOP is used, the data in the Consumed and Produced Assemblies is automatically created as descriptive tag names. To re-enforce this point, a few of the commands are highlighted to demonstrate the AOP tag alignment to the Consumed and Produced Assemblies in the next tables.

**Table 8 - Default Consume Assembly for Bulletin 284E Controller**

| 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 | Pt9DeviceIn | Pt8DeviceIn |

(1) See Digital In 1…4 SEL - Parameters 151…154.

**Table 9 - Bulletin 284E Consume Assembly Command Tags**

| Controller Output/ Command Tags | | |
|---|---|---|
| **Ex. Controller Name** | **Name** | **Logix Tag Name** |
| AS_DEMO | RunForward | AS_DEMO:0.RunForward |
| AS_DEMO | RunReverse | AS_DEMO:0.RunReverse |
| AS_DEMO | ResetFault | AS_DEMO:0.ResetFault |
| AS_DEMO | JogForward | AS_DEMO:0.JogForward |
| AS_DEMO | JogReverse | AS_DEMO:0.JogReverse |
| AS_DEMO | OutA | AS_DEMO:0.OutA |
| AS_DEMO | OutB | AS_DEMO:0.OutB |
| AS_DEMO | AccelCtrl_0 | AS_DEMO:0.AccelCtrl_0 |
| AS_DEMO | AccelCtrl_1 | AS_DEMO:0.AccelCtrl_1 |
| AS_DEMO | DecelCtrl_0 | AS_DEMO:0.DecelCtrl_0 |
| AS_DEMO | DecelCtrl_1 | AS_DEMO:0.DecelCtrl_1 |
| AS_DEMO | DriveInput1 | AS_DEMO:0.DriveInput1 |
| AS_DEMO | DriveInput2 | AS_DEMO:0.DriveInput2 |
| AS_DEMO | DriveInput3 | AS_DEMO:0.DriveInput3 |
| AS_DEMO | DriveInput4 | AS_DEMO:0.DriveInput4 |
| AS_DEMO | FreqCommand | AS_DEMO:0.FreqCommand |
| AS_DEMO | Pt00DeviceIn | AS_DEMO:0.Pt00DeviceIn |
| AS_DEMO | Pt01DeviceIn | AS_DEMO:0.Pt01DeviceIn |
| AS_DEMO | Pt02DeviceIn | AS_DEMO:0.Pt02DeviceIn |
| AS_DEMO | Pt03DeviceIn | AS_DEMO:0.Pt03DeviceIn |
| AS_DEMO | Pt04DeviceIn | AS_DEMO:0.Pt04DeviceIn |
| AS_DEMO | Pt05DeviceIn | AS_DEMO:0.Pt05DeviceIn |
| AS_DEMO | Pt06DeviceIn | AS_DEMO:0.Pt06DeviceIn |
| AS_DEMO | Pt07DeviceIn | AS_DEMO:0.Pt07DeviceIn |
| AS_DEMO | Pt08DeviceIn | AS_DEMO:0.Pt08DeviceIn |
| AS_DEMO | Pt09DeviceIn | AS_DEMO:0.Pt09DeviceIn |
| AS_DEMO | Pt10DeviceIn | AS_DEMO:0.Pt10DeviceIn |

| Controller Output/ Command Tags | | |
|---|---|---|
| **Controller Name** | **Name** | **Logix Tag Name** |
| AS_DEMO | Pt11DeviceIn | AS_DEMO:O.Pt11DeviceIn |
| AS_DEMO | Pt12DeviceIn | AS_DEMO:O.Pt12DeviceIn |
| AS_DEMO | Pt13DeviceIn | AS_DEMO:O.Pt13DeviceIn |
| AS_DEMO | Pt14DeviceIn | AS_DEMO:O.Pt14DeviceIn |

**Table 10 - Default Produce Assembly for Bulletin 284E Controller.**

| Produce Assembly - Instance 151 "Drive Status" - Bulletin284E Starters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte** | **Bit 7** | **Bit 6** | **Bit 5** | **Bit 4** | **Bit 3** | **Bit 2** | **Bit 1** | **Bit 0** |
| 0 | Reserved - {name}:I.Fault(1) | | | | | | | |
| 1 | Reserved - {name}:I.Fault(1) | | | | | | | |
| 2 | Reserved - {name}:I.Fault(1) | | | | | | | |
| 3 | Reserved - {name}:I.Fault(1) | | | | | | | |
| 4 | AtReference | Network ReferenceStatus | NetControlStatus | Ready | RunningReverse | RunningForward | WarningPresent | TripPresent |
| 5 | Output ContactorStatus | Brake ContactorStatus | DisconnectClosed | Hand | In3 | In2 | In1 | In0 |
| 6 | OutputFrequency (Low) (xxx.x Hz) | | | | | | | |
| 7 | OutputFrequency (High) (xxx.x Hz) | | | | | | | |
| 8 | Pt07DeviceOut | Pt06DeviceOut | Pt05DeviceOut | Pt04DeviceOut | Pt03DeviceOut | Pt02DeviceOut | Pt01DeviceOut | Pt00DeviceOut |
| 9 | LogicEnable | Pt14DeviceOut | Pt13DeviceOut | Pt12DeviceOut | Pt11DeviceOut | P10DeviceOut | Pt09DeviceOut | Pt08DeviceOut |
| 10 | Value of the parameter pointed to by "Parameter 13 Prod Assy Word 0" (low byte)" - Int00DeviceOut | | | | | | | |
| 11 | Value of the parameter pointed to by "Parameter 13 Prod Assy Word 0" (high byte)" - Int00DeviceOut | | | | | | | |
| 12 | Value of the parameter pointed to by "Parameter 14 Prod Assy Word 1" (low byte)" - Int01DeviceOut | | | | | | | |
| 13 | Value of the parameter pointed to by "Parameter 14 Prod Assy Word 1" (high byte)" - Int01DeviceOut | | | | | | | |
| 14 | Value of the parameter pointed to by "Parameter 15 Prod Assy Word 2" (low byte)" - Int02DeviceOut | | | | | | | |
| 15 | Value of the parameter pointed to by "Parameter 15 Prod Assy Word 2" (high byte)" - Int02DeviceOut | | | | | | | |
| 16 | Value of the parameter pointed to by "Parameter 16 Prod Assy Word 3" (low byte)" - Int03DeviceOut | | | | | | | |
| 17 | Value of the parameter pointed to by "Parameter 16 Prod Assy Word 3" (high byte)" - Int03DeviceOut | | | | | | | |

(1) Identifies if a Communication Fault exists. If a communication loss is present, the PLC writes four bytes of 1's to this tag. You must monitor this tag to verify that the data is valid.

**IMPORTANT** Your PLC control program monitors the **I.Fault** tag to verify that the data is accurate. When a communications fault occurs, the data in the consume and produce tags does not accurately reflect the status.

**Table 11 - Bulletin 284E Produced Assembly Status Tags**

| Controller Input/ Status Tags | | |
|---|---|---|
| **Ex. Controller Name** | **Name** | **Logix Tag Name** |
| AS_DEMO | Fault | AS_DEMO:I.Fault |
| AS_DEMO | TripPresent | AS_DEMO:I.TripPresent |
| AS_DEMO | WarningPresent | AS_DEMO:I.WarningPresent |
| AS_DEMO | RunningForward | AS_DEMO:I.RunningForward |
| AS_DEMO | RunningReverse | AS_DEMO:I.RunningReverse |
| AS_DEMO | Ready | AS_DEMO:I.Ready |
| AS_DEMO | NetworkControlStatus | AS_DEMO:I.NetworkControlStatus |
| AS_DEMO | NetworkReferenceStatus | AS_DEMO:I.NetworkReferenceStatus |
| AS_DEMO | AtReference | AS_DEMO:I.AtReference |
| AS_DEMO | In0 | AS_DEMO:I.In0 |
| AS_DEMO | In1 | AS_DEMO:I.In1 |
| AS_DEMO | In2 | AS_DEMO:I.In2 |
| AS_DEMO | In3 | AS_DEMO:I.In3 |
| AS_DEMO | Hand | AS_DEMO:I.Hand |
| AS_DEMO | DisconnectClosed | AS_DEMO:I.DisconnectClosed |
| AS_DEMO | BrakeContactorStatus | AS_DEMO:I.BrakeContactorStatus |
| AS_DEMO | OutputContactorStatus | AS_DEMO:I.OutputContactorStatus |
| AS_DEMO | OutputFrequency | AS_DEMO:I.OutputFrequency |
| AS_DEMO | Pt00DeviceOut | AS_DEMO:I.Pt00DeviceOut |
| AS_DEMO | Pt01DeviceOut | AS_DEMO:I.Pt01DeviceOut |
| AS_DEMO | Pt02DeviceOut | AS_DEMO:I.Pt02DeviceOut |
| AS_DEMO | Pt03DeviceOut | AS_DEMO:I.Pt03DeviceOut |
| AS_DEMO | Pt04DeviceOut | AS_DEMO:I.Pt04DeviceOut |
| AS_DEMO | Pt05DeviceOut | AS_DEMO:I.Pt05DeviceOut |
| AS_DEMO | Pt06DeviceOut | AS_DEMO:I.Pt06DeviceOut |
| AS_DEMO | Pt07DeviceOut | AS_DEMO:I.Pt07DeviceOut |
| AS_DEMO | Pt08DeviceOut | AS_DEMO:I.Pt08DeviceOut |
| AS_DEMO | Pt09DeviceOut | AS_DEMO:I.Pt09DeviceOut |
| AS_DEMO | Pt10DeviceOut | AS_DEMO:I.Pt10DeviceOut |
| AS_DEMO | Pt11DeviceOut | AS_DEMO:I.Pt11DeviceOut |
| AS_DEMO | Pt12DeviceOut | AS_DEMO:I.Pt12DeviceOut |
| AS_DEMO | Pt13DeviceOut | AS_DEMO:I.Pt13DeviceOut |
| AS_DEMO | Pt14DeviceOut | AS_DEMO:I.Pt14DeviceOut |
| AS_DEMO | LogicEnabled | AS_DEMO:I.LogicEnabled |
| AS_DEMO | Int00DeviceOut | AS_DEMO:I.Int00DeviceOut |
| AS_DEMO | Int01DeviceOut | AS_DEMO:I.Int01DeviceOut |
| AS_DEMO | Int02DeviceOut | AS_DEMO:I.Int02DeviceOut |
| AS_DEMO | Int03DeviceOut | AS_DEMO:I.Int03DeviceOut |

**Table 12 - Bulletin 284E Consume Assembly/Command Tag Explanation**

| Controller Output/ Command Tags | Tag Description/Use |
|---|---|
| RunForward | Command VFD forward |
| RunReverse | Command VFD reverse |
| ResetFault | Fault reset |
| JogForward | Command Jog forward per internal frequency |
| JogReverse | Command Jog reverse per internal frequency |
| OutA | Output A |
| OutB | Output B |
| AccelCtrl_0 | VFD acceleration ramp 1 |
| AccelCtrl_1 | VFD acceleration ramp 2 |
| DecelCtrl_0 | VFD deceleration ramp 1 |
| DecelCtrl_1 | VFD deceleration ramp 2 |
| DriveInput1 | VFD Digit Input 1 |
| DriveInput2 | VFD Digit Input 2 |
| DriveInput3 | VFD Digit Input 3 |
| DriveInput4 | VFD Digit Input 4 |
| FreqCommand | Logix commanded frequency |
| Pt00DeviceIn | Network input to DeviceLogix engine |
| Pt01DeviceIn | Network input to DeviceLogix engine |
| Pt02DeviceIn | Network input to DeviceLogix engine |
| Pt03DeviceIn | Network input to DeviceLogix engine |
| Pt04DeviceIn | Network input to DeviceLogix engine |
| Pt05DeviceIn | Network input to DeviceLogix engine |
| Pt06DeviceIn | Network input to DeviceLogix engine |
| Pt07DeviceIn | Network input to DeviceLogix engine |
| Pt08DeviceIn | Network input to DeviceLogix engine |
| Pt09DeviceIn | Network input to DeviceLogix engine |
| Pt10DeviceIn | Network input to DeviceLogix engine |
| Pt11DeviceIn | Network input to DeviceLogix engine |
| Pt12DeviceIn | Network input to DeviceLogix engine |
| Pt13DeviceIn | Network input to DeviceLogix engine |
| Pt14DeviceIn | Network input to DeviceLogix engine |
| Pt15DeviceIn | Network input to DeviceLogix engine |

**Table 13 - Bulletin 284E Produced Assembly/Status Tag Explanation**

| Controller Input/ Status Tags | Tag Description/Use |
|---|---|
| Fault | Communication Fault between PLC and Device (all 1's = Fault, all 0's = Normal) |
| TripPresent | Fault exists with unit |
| WarningPresent | Warning of potential fault |
| RunningForward | Motor commanded to run forward |
| RunningReverse | Motor commanded to run reverse |
| Ready | Control Power and 3-phase present |
| NetworkControlStatus | Start and Stop command comes from network (PLC or Connected Explicit Messaging) |
| NetworkReferenceStatus | Speed reference comes from the network (not DeviceLogix) |
| AtReference | At commanded speed reference |
| In0 | Input 0 |
| In1 | Input 1 |
| In2 | Input 2 |
| In3 | Input 3 |
| Hand | HOA is in Auto mode |
| DisconnectClosed | Disconnect is closed |
| BrakeContactorStatus | Source brake contactor status (1=close, 0=open) |
| OutputContactorStatus | Ouput contactor status (1=close, 0=open) |
| OutputFrequency | VFD frequency |
| Pt00DeviceOut | DeviceLogix network output status |
| Pt01DeviceOut | DeviceLogix network output status |
| Pt02DeviceOut | DeviceLogix network output status |
| Pt03DeviceOut | DeviceLogix network output status |
| Pt04DeviceOut | DeviceLogix network output status |
| Pt05DeviceOut | DeviceLogix network output status |
| Pt06DeviceOut | DeviceLogix network output status |
| Pt07DeviceOut | DeviceLogix network output status |
| Pt08DeviceOut | DeviceLogix network output status |
| Pt09DeviceOut | DeviceLogix network output status |
| Pt10DeviceOut | DeviceLogix network output status |
| Pt11DeviceOut | DeviceLogix network output status |
| Pt12DeviceOut | DeviceLogix network output status |
| Pt13DeviceOut | DeviceLogix network output status |
| Pt14DeviceOut | DeviceLogix network output status |
| LogicEnabled | DeviceLogix is enabled |
| Int00DeviceOut | Data reference by Parameter 13 |
| Int01DeviceOut | Data reference by Parameter 14 |
| Int02DeviceOut | Data reference by Parameter 15 |
| Int03DeviceOut | Data reference by Parameter 16 |

**Table 14 - Default Consume Assembly for Bulletin 281E Controller**

| 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 15 - Bulletin 281E Controller Output/Command Tags**

| Ex. Controller Name | Name | Logix Tag Name |
|---|---|---|
| DEMO_REV | RunForward | DEMO_REV:O.RunForward |
| DEMO_REV | RunReverse | DEMO_REV:O.RunReverse |
| DEMO_REV | ResetFault | DEMO_REV:O.ResetFault |
| DEMO_REV | OutA | DEMO_REV:O.OutA |
| DEMO_REV | OutB | DEMO_REV:O.OutB |
| DEMO_REV | Pt00DeviceIn | DEMO_REV:O.Pt00DeviceIn |
| DEMO_REV | Pt01DeviceIn | DEMO_REV:O.Pt01DeviceIn |
| DEMO_REV | Pt02DeviceIn | DEMO_REV:O.Pt02DeviceIn |
| DEMO_REV | Pt03DeviceIn | DEMO_REV:O.Pt03DeviceIn |
| DEMO_REV | Pt04DeviceIn | DEMO_REV:O.Pt04DeviceIn |
| DEMO_REV | Pt05DeviceIn | DEMO_REV:O.Pt05DeviceIn |
| DEMO_REV | Pt06DeviceIn | DEMO_REV:O.Pt06DeviceIn |
| DEMO_REV | Pt07DeviceIn | DEMO_REV:O.Pt07DeviceIn |
| DEMO_REV | Pt08DeviceIn | DEMO_REV:O.Pt08DeviceIn |
| DEMO_REV | Pt09DeviceIn | DEMO_REV:O.Pt09DeviceIn |
| DEMO_REV | Pt10DeviceIn | DEMO_REV:O.Pt10DeviceIn |
| DEMO_REV | Pt11DeviceIn | DEMO_REV:O.Pt11DeviceIn |
| DEMO_REV | Pt12DeviceIn | DEMO_REV:O.Pt12DeviceIn |
| DEMO_REV | Pt13DeviceIn | DEMO_REV:O.Pt13DeviceIn |
| DEMO_REV | Pt14DeviceIn | DEMO_REV:O.Pt14DeviceIn |
| DEMO_REV | Pt15DeviceIn | DEMO_REV:O.Pt15DeviceIn |

**Table 16 - Default Produce Assembly for Bulletin 281E Controller**

| Instance 150 "Starter Stat" - Default Status Assembly for Bulletin 281E Starters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte** | **Bit 7** | **Bit 6** | **Bit 5** | **Bit 4** | **Bit 3** | **Bit 2** | **Bit 1** | **Bit 0** |
| 0 | Reserved - {name}:I.Fault(1) | | | | | | | |
| 1 | Reserved - {name}:I.Fault(1) | | | | | | | |
| 2 | Reserved - {name}:I.Fault(1) | | | | | | | |
| 3 | Reserved - {name}:I.Fault(1) | | | | | | | |
| 4 | — | — | — | Ready | RunningReverse | RunningForward | WarningPresent | TripPresent |
| 5 | — | — | DisconnectClosed | Hand | In3 | In2 | In1 | In0 |
| 6 | Pt07DeviceOut | Pt06DeviceOut | Pt05DeviceOut | Pt04DeviceOut | Pt03DeviceOut | Pt02DeviceOut | Pt01DeviceOut | Pt00DeviceOut |
| 7 | LogicEnable | Pt14DeviceOut | Pt13DeviceOut | Pt12DeviceOut | Pt11DeviceOut | Pt10DeviceOut | Pt09DeviceOut | Pt08DeviceOut |
| 8 | Value of the parameter pointed to by "Parameter 13 Prod Assy Word 0" (low byte)" - ProducedWord0Param | | | | | | | |
| 9 | Value of the parameter pointed to by "Parameter 13 Prod Assy Word 0" (high byte)" - ProducedWord0Param | | | | | | | |
| 10 | Value of the parameter pointed to by "Parameter 14 Prod Assy Word 1" (low byte)" - ProducedWord1Param | | | | | | | |
| 11 | Value of the parameter pointed to by "Parameter 14 Prod Assy Word 1" (high byte)" - ProducedWord1Param | | | | | | | |
| 12 | Value of the parameter pointed to by "Parameter 15 Prod Assy Word 2" (low byte)" - ProducedWord2Param | | | | | | | |
| 13 | Value of the parameter pointed to by "Parameter 15 Prod Assy Word 2" (high byte)" - ProducedWord2Param | | | | | | | |
| 14 | Value of the parameter pointed to by "Parameter 16 Prod Assy Word 3" (low byte)" - ProducedWord3Param | | | | | | | |
| 15 | Value of the parameter pointed to by "Parameter 16 Prod Assy Word 3" (high byte)" - ProducedWord3Param | | | | | | | |

(1) Identifies if a Communication Fault exists. If a communication loss is present the PLC writes four bytes of 1s to this tag. You must monitor this tag to verify that the data is valid.

| | |
|---|---|
| **IMPORTANT** | Your PLC control program monitors the **I.Fault** tag to verify that the data is accurate. When a communications fault occurs, the data in the consume and produce tags does not accurately reflect the status. |

**Table 17 - Bulletin 281E Controller Input/ Status Tags**

| Ex. Controller Name | Name | Logix Tag Name |
|---|---|---|
| DEMO_REV | Fault | DEMO_REV:I.Fault |
| DEMO_REV | TripPresent | DEMO_REV:I.TripPresent |
| DEMO_REV | WarningPresent | DEMO_REV:I.WarningPresent |
| DEMO_REV | RunningForward | DEMO_REV:I.RunningForward |
| DEMO_REV | RunningReverse | DEMO_REV:I.RunningReverse |
| DEMO_REV | Ready | DEMO_REV:I.Ready |
| DEMO_REV | In0 | DEMO_REV:I.In0 |
| DEMO_REV | In1 | DEMO_REV:I.In1 |
| DEMO_REV | In2 | DEMO_REV:I.In2 |
| DEMO_REV | In3 | DEMO_REV:I.In3 |
| DEMO_REV | Hand | DEMO_REV:I.Hand |
| DEMO_REV | DisconnectClosed | DEMO_REV:I.DisconnectClosed |
| DEMO_REV | Pt00DeviceOut | DEMO_REV:I.Pt00DeviceOut |
| DEMO_REV | Pt01DeviceOut | DEMO_REV:I.Pt01DeviceOut |
| DEMO_REV | Pt02DeviceOut | DEMO_REV:I.Pt02DeviceOut |
| DEMO_REV | Pt03DeviceOut | DEMO_REV:I.Pt03DeviceOut |
| DEMO_REV | Pt04DeviceOut | DEMO_REV:I.Pt04DeviceOut |
| DEMO_REV | Pt05DeviceOut | DEMO_REV:I.Pt05DeviceOut |
| DEMO_REV | Pt06DeviceOut | DEMO_REV:I.Pt06DeviceOut |
| DEMO_REV | Pt07DeviceOut | DEMO_REV:I.Pt07DeviceOut |
| DEMO_REV | Pt08DeviceOut | DEMO_REV:I.Pt08DeviceOut |
| DEMO_REV | Pt09DeviceOut | DEMO_REV:I.Pt09DeviceOut |
| DEMO_REV | Pt10DeviceOut | DEMO_REV:I.Pt10DeviceOut |
| DEMO_REV | Pt11DeviceOut | DEMO_REV:I.Pt11DeviceOut |
| DEMO_REV | Pt12DeviceOut | DEMO_REV:I.Pt12DeviceOut |
| DEMO_REV | Pt13DeviceOut | DEMO_REV:I.Pt13DeviceOut |
| DEMO_REV | Pt14DeviceOut | DEMO_REV:I.Pt14DeviceOut |
| DEMO_REV | LogicEnabled | DEMO_REV:I.LogicEnabled |
| DEMO_REV | ProducedWord0Param | DEMO_REV:I.ProducedWord0Param |
| DEMO_REV | ProducedWord1Param | DEMO_REV:I.ProducedWord1Param |
| DEMO_REV | ProducedWord2Param | DEMO_REV:I.ProducedWord2Param |
| DEMO_REV | ProducedWord3Param | DEMO_REV:I.ProducedWord3Param |

**Table 18 - Bulletin 281E Consume Assembly Command Tag Explanation**

| Controller Output/ Command Tags | Tag Description/Use |
|---|---|
| RunForward | Command VFD forward |
| RunReverse | Command VFD reverse |
| ResetFault | Fault reset |
| OutA | OutputA |
| OutB | OutputB |
| Pt00DeviceIn | Network input to DeviceLogix engine |
| Pt01DeviceIn | Network input to DeviceLogix engine |
| Pt02DeviceIn | Network input to DeviceLogix engine |
| Pt03DeviceIn | Network input to DeviceLogix engine |
| Pt04DeviceIn | Network input to DeviceLogix engine |
| Pt05DeviceIn | Network input to DeviceLogix engine |
| Pt06DeviceIn | Network input to DeviceLogix engine |
| Pt07DeviceIn | Network input to DeviceLogix engine |
| Pt08DeviceIn | Network input to DeviceLogix engine |
| Pt09DeviceIn | Network input to DeviceLogix engine |
| Pt10DeviceIn | Network input to DeviceLogix engine |
| Pt11DeviceIn | Network input to DeviceLogix engine |
| Pt12DeviceIn | Network input to DeviceLogix engine |
| Pt13DeviceIn | Network input to DeviceLogix engine |
| Pt14DeviceIn | Network input to DeviceLogix engine |
| Pt15DeviceIn | Network input to DeviceLogix engine |

**Table 19 - Bulletin 281E Produced Assembly Status Tag Explanation**

| Controller Input/Status Tags | Tag Description/Use |
|---|---|
| Fault | Communication Fault between PLC and Device<br>(all 1's = Fault, all 0's = Normal) |
| TripPresent | Fault exists with unit |
| WarningPresent | Warning of potential fault |
| RunningForward | Motor commanded to run forward |
| RunningReverse | Motor commanded to run reverse |
| Ready | Control Power and 3-phase present |
| In0 | Input 0 |
| In1 | Input 1 |
| In2 | Input 2 |
| In3 | Input 3 |
| Hand | HOA is in Auto mode |
| DisconnectClosed | Disconnect is closed |
| Pt00DeviceOut | DeviceLogix network output status |
| Pt01DeviceOut | DeviceLogix network output status |
| Pt02DeviceOut | DeviceLogix network output status |
| Pt03DeviceOut | DeviceLogix network output status |
| Pt04DeviceOut | DeviceLogix network output status |
| Pt05DeviceOut | DeviceLogix network output status |
| Pt06DeviceOut | DeviceLogix network output status |
| Pt07DeviceOut | DeviceLogix network output status |
| Pt08DeviceOut | DeviceLogix network output status |
| Pt09DeviceOut | DeviceLogix network output status |
| Pt10DeviceOut | DeviceLogix network output status |
| Pt11DeviceOut | DeviceLogix network output status |
| Pt12DeviceOut | DeviceLogix network output status |
| Pt13DeviceOut | DeviceLogix network output status |
| Pt14DeviceOut | DeviceLogix network output status |
| LogicEnabled | DeviceLogix is enabled |
| ProducedWord0Param | Data reference by Parameter 13 |
| ProducedWord1Param | Data reference by Parameter 14 |
| ProducedWord2Param | Data reference by Parameter 15 |
| ProducedWord3Param | Data reference by Parameter 16 |

# Bulletin 281E/284E Programmable Parameters

## Basic Set-up Parameters

To configure the basic ArmorStart functionality, see Table 20. These parameters are the minimum set-up configurations that are required for Bulletin 281E or Bulletin 284E controllers. There are additional capabilities and motor protection that are not enabled or left at their default values.

**Table 20 - Quick Parameter Setup**

| Bulletin 281E Controller | Bulletin 284E Controller |
|---|---|
| **106** FLA Setting<br>**107** Overload Class<br>**108** OL Reset Level | **131** Motor NP Volts<br>**132** Motor NP Hertz<br>**133** Motor OL Current<br>**134** Minimum Freq<br>**135** Maximum Freq<br>**137** Stop Mode<br>**138** Speed Reference<br>**139** Accel Time 1<br>**140** Decel Time 1 |

# Parameter Groups

| Common to Bulletin 281E and Bulletin 284E Units | | | | | Bulletin 284E Units Only |
|---|---|---|---|---|---|
| **Basic Status** | **Produced Assembly Config Group** | **Starter Protection** | **User I/O Config** | **Miscellaneous Config** | **Drive I/O Config** |
| **1** Hdw Inputs | **13** Int00DeviceOut Cfg | **23** Pr FltResetMode | **30** Anti-bounce On Delay | **8** Network Override | **48** Drive Control |
| **2** DeviceIn Data | **14** Int01DeviceOut Cfg | **24** Pr Fault Enable | **31** Anti-bounce OFF Delay | **9** Comm Override | **49** DrvIn Pr FltState |
| **3** DeviceOut Data | **15** Int02DeviceOut Cfg | **25** Pr Fault Reset | **32** In Sink/Source | **45** Keypad Mode | **50** DrvIn Pr FltValue |
| **4** Trip Status | **16** Int03DeviceOut Cfg | **26** Str Net FltState | **33** OutA Pr FltState | **46** Keypad Disable | **51** DrvIn Net FltState |
| **5** Starter Status | | **27** Str Net FltValue | **34** OutA Pr FltValue | **47** Set To Defaults | **52** DrvIn Net FltValue |
| **6** InternalLinkStat | | **28** Str Net IdlState | **35** OutA Net FltState | | **53** DrvIn Net IdlState |
| **7** Starter Command | | **29** Str Net IdlValue | **36** OutA Net FltValue | | **54** DrvIn Net IdlValue |
| **22** Breaker Type | | | **37** OutA Net IdlState | | |
| **56** Base Enclosure | | | **38** OutA Net IdlValue | | |
| **57** Base Options | | | **39** OutB Pr FltState | | |
| **58** Wiring Options | | | **40** OutB Pr FltValue | | |
| **59** Starter Enclosure | | | **41** OutB Net FltState | | |
| **60** Starter Options | | | **42** OutB Net FltValue | | |
| **61** Last Pr Fault | | | **43** OutB Net IdlState | | |
| **62** Warning Status | | | **44** OutB Net IdlValue | | |
| **63** Base Trip | | | | | |

| Bulletin281E Units Only | Bulletin 284E Units Only | | | | |
|---|---|---|---|---|---|
| **Starter Display** | **Drive Display** | **Drive Setup** | **Drive Advanced Setup** | | |
| **101** Phase A Current | **101** Output Freq | **131** Motor NP Volts | **151** Digital In 1 Sel | **181** DC Brake Level | **201** Program Lock |
| **102** Phase B Current | **102** Commanded Freq | **132** Motor NP Hertz | **152** Digital In 2 Sel | **182** DB Resistor Sel | **205** Comm Loss Action |
| **103** Phase C Current | **103** Output Current | **133** Motor OL Current | **153** Digital In 3 Sel | **183** S Curve % | **206** Comm Loss Time |
| **104** Average Current | **104** Output Voltage | **134** Minimum Freq | **154** Digital In 4 Sel | **184** Boost Select | **214** Slip Hertz @ FLA |
| **105** Therm Utilized | **105** DC Bus Voltage | **135** Maximum Freq | **155** Relay Out Sel | **185** Start Boost | **217** Bus Reg Mode |
| **Starter Setup** | **106** Drive Status | **136** Start Source | **156** Relay Out Level | **186** Brake Voltage | **218** Current Limit 2 |
| | **107** Fault 1 Code | **137** Stop Mode | **167** Accel Time 2 | **187** Brake Frequency | **219** Skip Frequency |
| **106** FLA Setting | **108** Fault 2 Code | **138** Speed Reference | **168** Decel Time 2 | **188** Maximum Voltage | **220** Skip Freq Band |
| **107** Overload Class | **109** Fault 3 Code | **139** Accel Time 1 | **169** Internal Freq | **189** Current Limit 1 | **221** Stall Fault Time |
| **108** OL Reset Level | **110** Process Display | **140** Decel Time 1 | **170** Preset Freq 0 | **190** Motor OL Select | **224** Var PWM Disable |
| | **112** Control Source | **141** Reset To Defaults | **171** Preset Freq 1 | **191** PWM Frequency | **225** Torque Perf Mode |
| | **113** Contrl In Status | **143** Motor OL Ret | **172** Preset Freq 2 | **192** Auto Rstrt Tries | **226** Motor NP FLA |
| | **114** Dig In Status | | **173** Preset Freq 3 | **193** Auto Rstrt Delay | **227** Autotune |
| | **115** Comm Status | | **174** Preset Freq 4 | **194** Start At PowerUp | **228** IR Voltage Drop |
| | **116** Control SW Ver | | **175** Preset Freq 5 | **195** Reverse Disable | **229** Flux Current Ref |
| | **117** Drive Type | | **176** Preset Freq 6 | **196** Flying Start En | **260** EM Brk OFF Delay |
| | **118** Elapsed Run Time | | **177** Preset Freq 7 | **197** Compensation | **261** EM Brk On Delay |
| | **122** Output Power | | **178** Jog Frequency | **198** SW Current Trip | **262** MOP Reset Sel |
| | **123** Output Power Fctr | | **179** Jog Accel/Decel | **199** Process Factor | **263** DB Threshold |
| | **124** Drive Temp | | **180** DC Brake Time | **200** Fault Clear | **264** Comm Write Mode |
| | **125** Counter Status | | | | |
| | **126** Timer Status | | | | |
| | **129** Torque Current | | | | |

# ArmorStart EtherNet/IP Parameters

## Introduction

This chapter describes each programmable parameter and its function.

## How to Program Parameters

Each distributed motor controller type has a common set of parameters followed by a set of parameters that pertain to the individual starter type. Parameters 1…100 are common to all ArmorStart devices.

| | |
|---|---|
| **IMPORTANT** | Parameter value changes take effect immediately unless otherwise noted in the parameter list. These changes maybe immediate even during the "running" status. |

# Bulletin 281E Controller

## Basic Status Group

| **Hdw Inputs**<br><br>This parameter provides status of hardware inputs. | Parameter Number | 1 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 15 |
| | Default Value | 0 |

| **Bit** | | | | **Function** |
|---|---|---|---|---|
| **3** | **2** | **1** | **0** | |
| — | — | — | X | In0 |
| — | — | X | — | In1 |
| — | X | — | — | In2 |
| X | — | — | — | In3 |

| **DeviceIn Data** | Parameter Number | 2 |
|---|---|---|
| This parameter provides status of network device inputs. | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 65535 |
| | Default Value | 0 |

| **Bit** | | | | | | | | | | | | | | | | **Function** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | Pt00DeviceIn |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | Pt01DeviceIn |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | Pt02DeviceIn |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | Pt03DeviceIn |
| — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | Pt04DeviceIn |
| — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | Pt05DeviceIn |
| — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | Pt06DeviceIn |
| — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | Pt07DeviceIn |
| — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | Pt08DeviceIn |
| — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | Pt09DeviceIn |
| — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | Pt10DeviceIn |
| — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | Pt11DeviceIn |
| — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | Pt12DeviceIn |
| — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | Pt13DeviceIn |
| — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Pt14DeviceIn |
| X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Pt15DeviceIn |

| **DeviceOut Data**<br><br>This parameter provides status of network device outputs. | Parameter Number | 3 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 32767 |
| | Default Value | 0 |

| **Bit** | | | | | | | | | | | | | | | | **Function** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | Pt00DeviceOut |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | Pt01DeviceOut |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | Pt02DeviceOut |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | Pt03DeviceOut |
| — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | Pt04DeviceOut |
| — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | Pt05DeviceOut |
| — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | Pt06DeviceOut |
| — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | Pt07DeviceOut |
| — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | Pt08DeviceOut |
| — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | Pt09DeviceOut |
| — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | Pt10DeviceOut |
| — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | Pt11DeviceOut |
| — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | Pt12DeviceOut |
| — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | Pt13DeviceOut |
| — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Pt14DeviceOut |
| X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Reserved |

| **Trip Status**<br><br>This parameter provides trip identification. | Parameter Number | 4 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 16383 |
| | Default Value | 0 |

| **Bit** | | | | | | | | | | | | | | | | **Function** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | Short Circuit |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | Overload |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | Phase Loss |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | Reserved |
| — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | Reserved |
| — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | Control Power |
| — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | I/O Fault |
| — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | Over Temperature |
| — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | Phase Imbalance |
| — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | A3 Power Loss |
| — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | Reserved |
| — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | Reserved |
| — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | EEprom |
| — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | HW Fault |
| X | X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Reserved |

| **Starter Status**<br><br>This parameter provides the status of the starter. | Parameter Number | 5 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 16383 |
| | Default Value | 0 |

| **Bit** | | | | | | | | | | | | | | | | **Function** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | TripPresent |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | WarningPresent |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | RunningForward |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | RunningReverse |
| — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | Ready |
| — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | Net Ctl Status |
| — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | Reserved |
| — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | At Reference |
| — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | Reserved |
| — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | Reserved |
| — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | Reserved |
| — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | Keypad Hand Mode |
| — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | HOA Status |
| — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | DisconnectClosed |
| X | X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Reserved |

| **InternalLinkStat**<br><br>Status of the internal network connections. | Parameter Number | 6 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 31 |
| | Default Value | 0 |

| **Bit** | | | | | | | | | | | | | | | | **Function:** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | Explicit Connection |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | I/O Connection |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | Explicit Fault |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | I/O Fault |
| — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | I/O Idle |
| X | X | X | X | X | X | X | X | X | X | X | — | — | — | — | — | Reserved |

| **Starter Command**<br><br>The parameter provides the status of the starter command. | Parameter Number | 7 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 255 |
| | Default Value | 0 |

| **Bit** | | | | | | | | **Function:** |
|---|---|---|---|---|---|---|---|---|
| **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | X | Run Fwd |
| — | — | — | — | — | — | X | — | Run Rev |
| — | — | — | — | — | X | — | — | Fault Reset |
| — | — | — | — | X | — | — | — | Reserved |
| — | — | — | X | — | — | — | — | Reserved |
| — | — | X | — | — | — | — | — | Reserved |
| — | X | — | — | — | — | — | — | OutA |
| X | — | — | — | — | — | — | — | OutB |

| **Breaker Type**<br><br>This parameter identifies the Bulletin 140M used in this product.<br>0 = 140M-D8N-C10<br>1 = 140M-D8N-C25 | Parameter Number | 22 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Base Enclosure**<br><br>Indicates the ArmorStart Base unit enclosure rating.<br>Bit 0 = IP67<br>Bit 1 = Reserved<br>Bit 2…15 = Reserved | Parameter Number | 56 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 1 |

| **Base Options**<br><br>Indicates the options for the ArmorStart Base unit.<br>Bit 0 = Output Fuse<br>Bit 1 = Safety Monitor<br>Bit 2 = CP Fuse Detect<br>Bits 3…7 = Reserved<br>Bit 8 = 10A Base<br>Bit 9 = 25A Base<br>Bit 10…15 = Reserved | Parameter Number | 57 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 517 |
| | Default Value | 0 |

| **Wiring Options**<br><br>Bit 0 = Conduit<br>Bit 1 = Round Media<br>Bit 2 = 28xG Gland<br>Bits 3…15 = Reserved | Parameter Number | 58 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 4 |
| | Default Value | 0 |

| Starter Enclosure<br><br>Bit 0 = IP67<br>Bit 1 = Reserved<br>Bit 2 = Sil3/Cat4<br>Bit 3…15 = Reserved | Parameter Number | 59 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 4 |
| | Default Value | 1 |

| Starter Options<br><br>Bit 0 = Full Keypad<br>Bit 1 = Safety Monitor<br>Bit 2 = Source Brake<br>Bit 3 = Reserved<br>Bit 4 = Reserved<br>Bit 5 = Reserved<br>Bit 6 = Reserved<br>Bit 7 = Reserved<br>Bit 8 = Reserved<br>Bit 9…15 = Reserved | Parameter Number | 60 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 66535 |
| | Default Value | 0 |

| Last PR Fault<br><br>0 = None<br>1 = Hardware Short Circuit<br>2 = Software Short Circuit<br>3 = Motor Overload<br>4 = Reserved<br>5 = Phase Loss<br>6…12 = Reserved<br>13 = Control Power Loss<br>14 = Control Power Fuse<br>15 = I/O Short<br>16 = Output Fuse<br>17 = Overtemp<br>18 = Reserved<br>19 = Phase Imbalance<br>20 = Reserved<br>21 = A3 Power Loss<br>22 = Internal Comm<br>23…26 = Reserved<br>27 = MCB EEPROM<br>28 = Base EEPROM<br>29 = Reserved<br>30 = Wrong Base<br>31 = Wrong CTs<br>32…100 = Reserved | Parameter Number | 61 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 100 |
| | Default Value | 0 |

| **Warning Status**<br><br>This parameter warns you of a condition, without faulting. | Parameter Number | 62 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 65535 |
| | Default Value | 0 |

Warnings are always enabled. The warning conditions are reported even if the corresponding fault conditions are disabled.

Warning bits in the Warning Status parameter are cleared automatically when the warning condition is no longer present.

| **Bit** | | | | | | | | | | | | | | | | **Warning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | Reserved |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | Reserved |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | Phase Loss |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | Reserved |
| — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | Reserved |
| — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | Control Power |
| — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | I/O Warning |
| — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | Reserved |
| — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | Phase Imbalance |
| — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | A3 Power Loss |
| — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | Reserved |
| — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | Reserved |
| — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | Reserved |
| — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | Hardware |
| X | X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Reserved |

| **Base Trip**<br><br>The parameter determines the status of the Base Module Trip Status. | Parameter Number | 63 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 65535 |
| | Default Value | 0 |

| Bit | | | | | | | | | | | | | | | | Warning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | EEPROM Fault |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | Internal Comm |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | Hardware Fault |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | Control Module |
| X | X | X | X | X | X | X | X | X | X | X | X | — | — | — | — | Reserved |

## Produced Assembly Config Group

| **Int00DeviceOut Cfg** | Parameter Number | 13 |
|---|---|---|
| This parameter is used to specify Int00DeviceOut of produced assembly 150 or 151. | Access Rule | GET/SET |
| | Data Type | USINT |
| | Group | Produced Assembly Config |
| | Units | — |
| | Minimum Value | 1 |
| | Maximum Value | 108 |
| | Default Value | 1 |

| **Int01DeviceOut Cfg** | Parameter Number | 14 |
|---|---|---|
| This parameter is used to specify Int01DeviceOut of produced assembly 150 or 151. | Access Rule | GET/SET |
| | Data Type | USINT |
| | Group | Produced Assembly Config |
| | Units | — |
| | Minimum Value | 1 |
| | Maximum Value | 108 |
| | Default Value | 4 |

| **Int02DeviceOut Cfg** | Parameter Number | 15 |
|---|---|---|
| This parameter is used to specify Int02DeviceOut of produced assembly 150 or 151. | Access Rule | GET/SET |
| | Data Type | USINT |
| | Group | Produced Assembly Config |
| | Units | — |
| | Minimum Value | 1 |
| | Maximum Value | 108 |
| | Default Value | 5 |

| **Int03DeviceOut Cfg**<br><br>This parameter is used to specify Int03DeviceOut of produced assembly 150 or 151. | Parameter Number | 16 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | USINT |
| | Group | Produced Assembly Config |
| | Units | — |
| | Minimum Value | 1 |
| | Maximum Value | 108 |
| | Default Value | 6 |

## Starter Protection Group

| **Pr FltReset Mode**<br><br>This parameter configures the Protection Fault reset mode.<br>0 = Manual<br>1 = Automatic (Faults are cleared automatically when the fault condition is corrected) | Parameter Number | 23 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Starter Protection |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Pr Fault Enable**<br><br>This parameter enables the Protection Fault by setting the bit to 1. | Parameter Number | 24 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | WORD |
| | Group | Starter Protection |
| | Units | — |
| | Minimum Value | 12419 |
| | Maximum Value | 13287 |
| | Default Value | 12419 |

| Bit | | | | | | | | | | | | | | Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | Short Circuit(1) |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | Overload(1) |
| — | — | — | — | — | — | — | — | — | — | — | X | — | — | Phase Loss |
| — | — | — | — | — | — | — | — | — | — | X | — | — | — | Reserved |
| — | — | — | — | — | — | — | — | — | X | — | — | — | — | Reserved |
| — | — | — | — | — | — | — | — | X | — | — | — | — | — | Control Power |
| — | — | — | — | — | — | — | X | — | — | — | — | — | — | I/O Fault |
| — | — | — | — | — | — | X | — | — | — | — | — | — | — | Over Temperature(1) |
| — | — | — | — | — | X | — | — | — | — | — | — | — | — | Phase Imbalance |
| — | — | — | — | X | — | — | — | — | — | — | — | — | — | A3 Power Loss |
| — | — | — | X | — | — | — | — | — | — | — | — | — | — | Reserved |
| — | — | X | — | — | — | — | — | — | — | — | — | — | — | Reserved |
| — | X | — | — | — | — | — | — | — | — | — | — | — | — | EEprom(1) |
| X | — | — | — | — | — | — | — | — | — | — | — | — | — | HW Fault(1) |

(1) Cannot be disabled

| **Pr Fault Reset**<br><br>This parameter resets the Protection Fault on a transition of 0 > 1. | Parameter Number | 25 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Starter Protection |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Str Net FltState**<br><br>This parameter along with Parameter 27 (Str Net FltValue), defines how the starter responds when a fault occurs as determined by Parameter 27. Allows Starter to hold last state or go to FltValue on NetFaults.<br>0 = Goto Fault Value<br>1 = Hold Last State | Parameter Number | 26 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Starter Protection |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Str Net FltValue**<br><br>This parameter determines how the starter is commanded if a fault occurs. State the Starter goes to on a Net Flt if Parameter 26 (Str Net FltState) = 0 (Goto Fault Value).<br>0 = OFF<br>1 = ON | Parameter Number | 27 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | BOOL |
| | Group | Starter Protection |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Str Net IdlState**<br><br>This parameter along with Parameter 29 (Str Net IdlValue), defines how the starter will respond when a network is idle as determined by Parameter 29.<br>0 = Goto Idle Value<br>1 = Hold Last State | Parameter Number | 28 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Starter Protection |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Str Net IdlValue**<br><br>This parameter determines the state that starter assumes when the network is idle and Parameter 28 (Str Net IdlState) is set to "0".<br>0 = OFF<br>1 = ON | Parameter Number | 29 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | BOOL |
| | Group | Starter Protection |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

## User I/O Configuration Group

| **Anti-bounce On Delay**<br><br>This parameter lets the installer program a time duration before an input is reported "ON" (Anti-bounce). | Parameter Number | 30 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | User I/O Config. |
| | Units | ms |
| | Minimum Value | 0 |
| | Maximum Value | 65 |
| | Default Value | 0 |

| **Anti-bounce OFF Delay**<br><br>This parameter lets the installer program a time duration before an input is reported "OFF" (Anti-bounce). | Parameter Number | 31 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | User I/O Config. |
| | Units | ms |
| | Minimum Value | 0 |
| | Maximum Value | 65 |
| | Default Value | 0 |

| **In Sink/Source**<br><br>This parameter lets the installer program the inputs to be sink or source.<br>0 = Sink<br>1 = Source | Parameter Number | 32 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutA Pr FltState**<br><br>This parameter along with Parameter 34 (OutA Pr FltValue), defines how Output A will respond when a protection trip occurs.<br>0 = Goto Pr FltValue<br>1 = Ignore Pr Flt<br>When set to "1", Output A continues to operate as command via the network. When set to "0", Output A opens or closes as determined by setting in Parameter 34. | Parameter Number | 33 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutA Pr FltValue**<br><br>This parameter determines the state the Output A assumes when a trip occurs and Parameter 33 (OutA Pr FltState) is set to "0".<br>0 = Open<br>1 = Close | Parameter Number | 34 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutA Net FltState**<br><br>This parameter along with Parameter 36 (OutA Net FltValue), defines how Output A will respond when a network fault occurs.<br>0 = Goto Net FltValue<br>1 = Hold Last State<br>When set to "1", Output A will hold state before trip occurrence. When set to "0", Output A opens or closes as determined by setting in Parameter 36. | Parameter Number | 35 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutA Net FltValue**<br><br>This parameter determines the state that Output A assumes when a network fault occurs and Parameter 35 (OutA Net FltState) is set to "0".<br>0 = Open<br>1 = Close | Parameter Number | 36 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutA Net IdlState**<br><br>This parameter along with Parameter 38 (OutA Net IdlValue), defines how Output A will respond when the network is idle.<br>0 = Goto Net IdlValue<br>1 = Hold Last State<br>When set to "0", Output A opens or closes as determined by the setting in Parameter 38. | Parameter Number | 37 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutA Net IdlValue**<br><br>This parameter determines the state that Output A assumes when the network is idle and Parameter 37 (OutA Net IdlState) is set to "0".<br>0 = Open<br>1 = Close | Parameter Number | 38 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutB Pr FltState**<br><br>This parameter along with Parameter 40 (OutB Pr FltValue), defines how Output B will respond when a protection trip occurs.<br>0 = Goto PrFlt Value<br>1 = Ignore PrFlt<br>When set to “1”, Output B continues to operate as command via the network. When set to “0”, Output B opens or closes as determined by setting in Parameter 40. | Parameter Number | 39 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutB Pr FltValue**<br><br>This parameter determines the state the Out B assumes when a protection trip occurs and Parameter 39 (OutB Pr FltState) is set to “0”.<br>0 = Open<br>1 = Close | Parameter Number | 40 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutB Net FltState**<br><br>This parameter along with Parameter 42 (OutB Net FltValue), defines how Output B will respond when a network fault occurs.<br>0 = Goto Idle Value<br>1 = Hold Last State<br>When set to “1”, Output B will hold state before trip occurrence. When set to “0”, Output B opens or closes as determined by setting in Parameter 42. | Parameter Number | 41 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutB Net FltValue**<br><br>This parameter determines the state that Output B assumes when a network fault occurs and Parameter 41 (OutB Net FltState) is set to “0”.<br>0 = Open<br>1 = Close | Parameter Number | 42 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutB Net IdlState**<br><br>This parameter along with Parameter 44 (OutB Net IdlValue), defines how Output B will respond when the network is idle.<br>0 = Goto PrFlt Value<br>1 = Ignore PrFlt<br>When set to "0", Output B opens or closes as determined by the setting in Parameter 44. | Parameter Number | 43 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutB Net IdlValue**<br><br>This parameter determines the state that Output B assumes when the network is idle and Parameter 43 (OutB Net IdlState) is set to "0".<br>0 = Open<br>1 = Close | Parameter Number | 44 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

## Miscellaneous Configuration Group

| **Network Override**<br><br>This parameter lets the local logic override a Network fault.<br>0 = Disable<br>1 = Enable | Parameter Number | 8 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Misc. Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Comm Override**<br><br>This parameter lets local logic override the absence of an I/O connection.<br>0 = Disable<br>1 = Enable | Parameter Number | 9 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Misc. Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Keypad Mode**<br><br>This parameter selects if the keypad operation is maintained or momentary.<br>0 = Maintained<br>1 = Momentary | Parameter Number | 45 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Misc. Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Keypad Disable**<br><br>This parameter disables all keypad function except for the “OFF” and “RESET” buttons.<br>0 = Not Disabled<br>1 = Disabled | Parameter Number | 46 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Misc. Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Set to Defaults**<br><br>This parameter if set to “1” will set the device to the factory defaults (but will not cause the ArmorStart controller to restart).<br>0 = No Operation<br>1 = Set to Defaults | Parameter Number | 47 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Misc. Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

## Starter Display Group (Bulletin 281E Controller Only)

| **Phase A Current**<br><br>This parameter provides the current of Phase A measured n increments of 1/10$^{th}$ of an ampere. | Parameter Number | 101 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | INT |
| | Group | Starter Display |
| | Units | xx.x amps |
| | Minimum Value | 0 |
| | Maximum Value | 32767 |
| | Default Value | 0 |

| **Phase B Current**<br><br>This parameter provides the current of Phase B measured in increments of 1/10th of an ampere. | Parameter Number | 102 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | INT |
| | Group | Starter Display |
| | Units | xx.x amps |
| | Minimum Value | 0 |
| | Maximum Value | 32767 |
| | Default Value | 0 |

| **Phase C Current**<br><br>This parameter provides the current of Phase C measured in increments of 1/10th of an ampere. | Parameter Number | 103 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | INT |
| | Group | Starter Display |
| | Units | xx.x amps |
| | Minimum Value | 0 |
| | Maximum Value | 32767 |
| | Default Value | 0 |

| **Average Current**<br><br>This parameter provides the average current that is measured in increments of 1/10th of an ampere. | Parameter Number | 104 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | INT |
| | Group | Starter Display |
| | Units | xx.x amps |
| | Minimum Value | 0 |
| | Maximum Value | 32767 |
| | Default Value | 0 |

| **Therm Utilized**<br><br>This parameter displays the % Thermal Capacity used. | Parameter Number | 105 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | USINT |
| | Group | Starter Display |
| | Units | % FLA |
| | Minimum Value | 0 |
| | Maximum Value | 100 |
| | Default Value | 0 |

## Starter Set-up Group (Bulletin 281E Controller Only)

| **FLA Setting**<br><br>The full load current rating of the motor is programmed in this parameter. | Parameter Number | 106 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | INT |
| | Group | Starter Setup |
| | Units | xx.x amps |
| | Minimum Value | See Table 21. |
| | Maximum Value | See Table 21. |
| | Default Value | See Table 21. |

**Table 21 - FLA Setting Ranges and Default Values (with indicated setting precision)**

| FLA Current Range (A) | | Default Value |
|---|---|---|
| **Minimum Value** | **Maximum Value** | |
| 0.24 | 1.2 | 0.24 |
| 0.5 | 2.5 | 0.5 |
| 1.1 | 5.5 | 1.1 |
| 3.2 | 16.0 | 3.2 |

| **Overload Class**<br><br>This parameter lets the installer select the overload class.<br>1 = Overload Class 10<br>2 = Overload Class 15<br>3 = Overload Class 20 | Parameter Number | 107 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | USINT |
| | Group | Starter Setup |
| | Units | xx.x amps |
| | Minimum Value | 1 |
| | Maximum Value | 3 |
| | Default Value | 1 |

| **OL Reset Level**<br><br>This parameter lets the installer select the % Thermal Capacity that an overload can be cleared. | Parameter Number | 108 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | USINT |
| | Group | Starter Setup |
| | Units | % FLA |
| | Minimum Value | 0 |
| | Maximum Value | 100 |
| | Default Value | 75 |

# Bulletin 284E Controller

## Basic Status Group

| **Hdw Inputs**<br><br>This parameter provides status of hardware inputs. | Parameter Number | 1 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 15 |
| | Default Value | 0 |

| **Bit** | | | | **Function** |
|---|---|---|---|---|
| **3** | **2** | **1** | **0** | |
| — | — | — | X | In0 |
| — | — | X | — | In1 |
| — | X | — | — | In2 |
| X | — | — | — | In3 |

| **DeviceIn Data** | Parameter Number | 2 |
|---|---|---|
| This parameter provides status of network device inputs. | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 65535 |
| | Default Value | 0 |

| **Bit** | | | | | | | | | | | | | | | | **Function** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | Pt00DeviceIn |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | Pt01DeviceIn |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | Pt02DeviceIn |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | Pt03DeviceIn |
| — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | Pt04DeviceIn |
| — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | Pt05DeviceIn |
| — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | Pt06DeviceIn |
| — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | Pt07DeviceIn |
| — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | Pt08DeviceIn |
| — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | Pt09DeviceIn |
| — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | Pt10DeviceIn |
| — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | Pt11DeviceIn |
| — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | Pt12DeviceIn |
| — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | Pt13DeviceIn |
| — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Pt14DeviceIn |
| X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Pt15DeviceIn |

| **DeviceOut Data**<br><br>This parameter provides status of network device outputs. | Parameter Number | 3 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 32767 |
| | Default Value | 0 |

| **Bit** | | | | | | | | | | | | | | | | **Function** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | Pt00DeviceOut |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | Pt01DeviceOut |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | Pt02DeviceOut |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | Pt03DeviceOut |
| — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | Pt04DeviceOut |
| — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | Pt05DeviceOut |
| — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | Pt06DeviceOut |
| — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | Pt07DeviceOut |
| — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | Pt08DeviceOut |
| — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | Pt09DeviceOut |
| — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | Pt10DeviceOut |
| — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | Pt11DeviceOut |
| — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | Pt12DeviceOut |
| — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | Pt13DeviceOut |
| — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Pt14DeviceOut |
| X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Reserved |

| **Trip Status** | Parameter Number | 4 |
|---|---|---|
| This parameter provides trip identification. | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 65535 |
| | Default Value | 0 |

| **Bit** | | | | | | | | | | | | | | | | **Function** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | Short Circuit |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | Overload |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | Phase Short |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | Ground Fault |
| — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | Stall |
| — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | Control Power |
| — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | I/O Fault |
| — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | Over Temperature |
| — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | Over Current |
| — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | A3 Power Loss |
| — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | Internal Comm(1) |
| — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | DC Bus Fault |
| — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | EEprom |
| — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | HW Fault(1) |
| — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Restart Retries |
| X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Misc. Fault(1) |

(1) See Parameter 61, Last PR Fault, for details.

| **Starter Status** | Parameter Number | 5 |
|---|---|---|
| This parameter provides the status of the starter. | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 65535 |
| | Default Value | 0 |

| **Bit** | | | | | | | | | | | | | | | | **Function** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | TripPresent |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | WarningPresent |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | RunningForward |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | RunningReverse |
| — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | Ready |
| — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | Net Ctl Status |
| — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | Net Ref Status |
| — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | At Reference |
| — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | DrvOpto1 |
| — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | DrvOpto2 |
| — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | Keypad Jog |
| — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | Keypad Hand |
| — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | HOA Status |
| — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | Disconnect Closed |
| — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Contactor 1[1] |
| X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Contactor 2[2] |

(1) Refers to source brake contactor status

(2) Refers to output contactor status

| **InternalLinkStat**<br><br>This parameter provides status of the internal network connections. | Parameter Number | 6 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 31 |
| | Default Value | 0 |

| **Bit** | | | | | | | | | | | | | | | | **Function:** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | Explicit Connection |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | I/O Connection |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | Explicit Fault |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | I/O Fault |
| — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | I/O Idle |
| X | X | X | X | X | X | X | X | X | X | X | — | — | — | — | — | Reserved |

| **Starter Command**<br><br>The parameter provides the status of the starter command. | Parameter Number | 7 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 255 |
| | Default Value | 0 |

| **Bit** | | | | | | | | **Function:** |
|---|---|---|---|---|---|---|---|---|
| **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | X | Run Fwd |
| — | — | — | — | — | — | X | — | Run Rev |
| — | — | — | — | — | X | — | — | Fault Reset |
| — | — | — | — | X | — | — | — | Jog Fwd |
| — | — | — | X | — | — | — | — | Jog Rev |
| — | — | X | — | — | — | — | — | Reserved |
| — | X | — | — | — | — | — | — | OutA |
| X | — | — | — | — | — | — | — | OutB |

| **Breaker Type**<br><br>This parameter identifies the Bulletin 140M used in this product.<br>0 = 140M-D8N-C10<br>1 = 140M-D8N-C25 | Parameter Number | 22 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | BOOL |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | — |

| **Base Enclosure**<br><br>Indicates the ArmorStart Base unit enclosure rating.<br>Bit 0 = IP67<br>Bits 1 …15 = Reserved | Parameter Number | 56 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | — |
| | Default Value | 0 |

| **Base Options**<br><br>Indicates the options for the ArmorStart Base unit.<br><br>Bit 0 = Output Fuse<br>Bit 1 = Safety Monitor<br>Bit 2 = CP Fuse Detect<br>Bits 3…7 = Reserved<br>Bit 8 = 10A Base<br>Bit 9 = 25A Base<br>Bit 10…15 = Reserved | Parameter Number | 57 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | — |
| | Default Value | 0 |

| **Wiring Options**<br><br>Bit 0 = Conduit<br>Bit 1 = Round Media<br>Bits 2 …15 = Reserved | Parameter Number | 58 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | — |
| | Default Value | 0 |

| **Starter Enclosure**<br><br>Bit 0 = IP67<br>Bits 1…15 = Reserved | Parameter Number | 59 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | — |
| | Default Value | 0 |

| **Starter Options**<br><br>Bit 0 = Full Keypad<br>Bit 1 = Safety Monitor<br>Bit 2 = Source Brake<br>Bit 3 = Reserved<br>Bit 4 = Dynamic Brake<br>Bit 5 = Output Contactor<br>Bit 6 = EMI Filter<br>Bit 7 = Reserved<br>Bit 8 = Fused DynBrake<br>Bit 9…15 = Reserved | Parameter Number | 60 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 66535 |
| | Default Value | 0 |

| **Last PR Fault** | Parameter Number | 61 |
|---|---|---|
| 1 = Hdw Short Ckt<br>2 = Reserved<br>3 = Motor Overload (PF Fault Code 7)<br>4 = Drive Overload (PF Fault Code 64)<br>5 = Phase U to Gnd (PF Fault Code 38)<br>6 = Phase V to Gnd (PF Fault Code 39)<br>7 = Phase W to Gnd (PF Fault Code 40)<br>8 = Phase UV Short (PF4 Fault Code 41)<br>9 = Phase UW Short (PF Fault Code 42)<br>10 = Phase VW Short (PF Fault Code 43)<br>11 = Ground Fault (PF Fault Code 13)<br>12 = Stall (PF Fault Code 6)<br>13 = Control Pwr Loss<br>14 = Control Pwr Fuse<br>15 = Input Short<br>16 = Output Fuse<br>17 = Over Temp<br>18 = Heatsink OvrTmp (PF Fault Code 8)<br>19 = HW OverCurrent (PF Fault Code 12)<br>20 = SW OverCurrent (PF Fault Code 63)<br>21 = A3 Power Loss<br>22 = Internal Comm<br>23 = Drive Comm Loss (PF Fault Code 81)<br>24 = Power Loss (PF Fault Code 3)<br>25 = Under Voltage (PF Fault Code 4)<br>26 = Over Voltage (PF Fault Code 5)<br>27 = MCB EEPROM<br>28 = Base EEPROM<br>29 = Drive EEPROM (PF Fault Code 100)<br>30 = Wrong Base<br>31 = Fan RPM<br>32 = Power Unit (PF Fault Code 70)<br>33 = Drive I/O Brd (PF Fault Code 122)<br>34 = Restart Retries (PF Fault Code 33)<br>35 = Drive Aux In Flt (PF Fault Code 2)<br>36 = Analog Input (PF Fault Code 29)<br>37 = Drv Param Reset (PF Fault Code 48)<br>38 = SCV Autotune (PF Fault Code 80)<br>39 = Source Brake<br>40 = Reserved<br>41 = DB1 Comm<br>42 = DB1 Fault<br>43 = DB Switch Short<br>45 = Incompatible Drive Firmware | Access Rule | GET |
| | Data Type | UINT |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 43 |
| | Default Value | 0 |

| **Warning Status**<br><br>This parameter warns you of a condition, without faulting. | Parameter Number | 62 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 65535 |
| | Default Value | 0 |

| **Bit** | | | | | | | | | | | | | | | | **Warning**(1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | Reserved |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | Reserved |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | Phase Loss |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | Reserved |
| — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | Reserved |
| — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | Control Power |
| — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | I/O Warning |
| — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | Reserved |
| — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | Phase Imbalance |
| — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | A3 Power Loss |
| — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | Reserved |
| — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | Reserved |
| — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | Reserved |
| — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | Hardware |
| — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Reserved |
| X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Miscellaneous(2) |

(1) The warning is triggered simultaneously, the fault is generated. If the fault is disabled, a warning will still occur.

(2) Includes DB1 Thermal Warning

| **Base Trip**<br><br>The parameter provides the Base Module Trip Status. | Parameter Number | 63 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Basic Status |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 65535 |
| | Default Value | 0 |

| **Bit** | | | | | | | | | | | | | | | | **Warning** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | EEPROM Fault |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | Internal Comm |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | Hardware Fault |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | Control Module |
| X | X | X | X | X | X | X | X | X | X | X | X | — | — | — | — | Reserved |

# Produced Assembly Config Group

| **Int00DeviceOut Cfg**<br><br>This parameter is used to specify Int00DeviceOut of produced assembly 150 or 151. | Parameter Number | 13 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | USINT |
| | Group | Produced Assembly Config |
| | Units | — |
| | Minimum Value | 1 |
| | Maximum Value | 263 |
| | Default Value | 1 |

| **Int01DeviceOut Cfg**<br><br>This parameter is used to specify Int01DeviceOut of produced assembly 150 or 151. | Parameter Number | 14 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | USINT |
| | Group | Produced Assembly Config |
| | Units | — |
| | Minimum Value | 1 |
| | Maximum Value | 263 |
| | Default Value | 4 |

| Int02DeviceOut Cfg<br><br>This parameter is used to specify Int02DeviceOut of produced assembly 150 or 151. | | |
|---|---|---|
| | Parameter Number | 15 |
| | Access Rule | GET/SET |
| | Data Type | USINT |
| | Group | Produced Assembly Config |
| | Units | — |
| | Minimum Value | 1 |
| | Maximum Value | 263 |
| | Default Value | 5 |

| Int03DeviceOut Cfg<br><br>This parameter is used to specify Int03DeviceOut of produced assembly 150 or 151. | | |
|---|---|---|
| | Parameter Number | 16 |
| | Access Rule | GET/SET |
| | Data Type | USINT |
| | Group | Produced Assembly Config |
| | Units | — |
| | Minimum Value | 1 |
| | Maximum Value | 263 |
| | Default Value | 6 |

## Starter Protection Group

| Pr FltResetMode(1)<br><br>This parameter is the Protection Fault reset mode.<br>0 = Manual<br>1 = Automatic (Faults are cleared automatically when the fault condition is corrected.) | | |
|---|---|---|
| | Parameter Number | 23 |
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Starter Protection |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

(1) When “Pr FltReset Mode” is set to 0=manual mode, and Parameter 192 (Auto Rstrt Tries) is set to allow the drive faults to auto-reset, the “Pr FltReset Mode” takes precedence. In this case, the ArmorStart remains faulted until the fault is manually cleared.

| **Pr Fault Enable**<br><br>This parameter enables the Protection Fault by setting the bit to 1. | Parameter Number | 24 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | WORD |
| | Group | Starter Protection |
| | Units | — |
| | Minimum Value | 64927 |
| | Maximum Value | 65535 |
| | Default Value | 64927 |

| **Bit** | | | | | | | | | | | | | | | | **Function** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **15** | **14** | **13** | **12** | **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | Short Circuit(1) |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | Overload(1) |
| — | — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | Phase Loss(1) |
| — | — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | Ground Fault(1) |
| — | — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | Stall(1) |
| — | — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | Control Power |
| — | — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | I/O Fault |
| — | — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | Over Temperature(1) |
| — | — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | Over Current(1) |
| — | — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | A3 Power Loss |
| — | — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | Internal Comm(1) |
| — | — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | DC Bus Fault(1) |
| — | — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | EEprom(1) |
| — | — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | HW Fault(1) |
| — | X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Restart Retries(1) |
| X | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | Misc. Fault(1) |

(1) Cannot be disabled

| **Pr Fault Reset**<br><br>This parameter resets the Protection Fault on a transition of 0 > 1. | Parameter Number | 25 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Starter Protection |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| Str Net FltState | Parameter Number | 26 |
|---|---|---|
| This parameter along with Parameter 27 (Str Net FltValue), defines how the starter will respond when a fault occurs as determined by Parameter 27.<br>0 = Goto Fault Value<br>1 = Hold Last State<br>Allows Starter to hold last state or go to FltValue on NetFaults. | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Starter Protection |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| Str Net FltValue | Parameter Number | 27 |
|---|---|---|
| This parameter determines how the starter will be commanded if a fault occurs. State the Starter will go to on a Net Flt if Parameter<br>26 (Str Net FltState) = 0 (Goto Fault Value).<br>0 = OFF<br>1 = ON | Access Rule | GET |
| | Data Type | BOOL |
| | Group | Starter Protection |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| Str Net IdlState | Parameter Number | 28 |
|---|---|---|
| This parameter along with Parameter 29 (Str Net IdlValue), defines how the starter will respond when a network is idle as determined by Parameter 29.<br>0 = Goto Idle Value<br>1 = Hold Last State | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Starter Protection |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| Str Net IdlValue | Parameter Number | 29 |
|---|---|---|
| This parameter determines the state that starter assumes when the network is idle and Parameter 28 (Str Net IdlState) is set to "0".<br>0 = OFF<br>1 = ON | Access Rule | GET |
| | Data Type | BOOL |
| | Group | Starter Protection |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

## User I/O Configuration Group

| **Anti-bounce On Delay**<br><br>This parameter lets the installer program a time duration before being reported "ON" (Anti-bouce). | | |
|---|---|---|
| | Parameter Number | 30 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | User I/O Config. |
| | Units | ms |
| | Minimum Value | 0 |
| | Maximum Value | 65 |
| | Default Value | 0 |

| **Anti-bounce OFF Delay**<br><br>This parameter lets the installer program a time duration before being reported "OFF" (Anti-bouce). | | |
|---|---|---|
| | Parameter Number | 31 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | User I/O Config. |
| | Units | ms |
| | Minimum Value | 0 |
| | Maximum Value | 65 |
| | Default Value | 0 |

| **In Sink/Source**<br><br>This parameter lets the installer program the inputs to be sink or source.<br>0 = Sink<br>1 = Source | | |
|---|---|---|
| | Parameter Number | 32 |
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutA Pr FltState**<br><br>This parameter along with Parameter 34 (OutA Pr FltValue), defines how Output A will respond when a trip occurs.<br>0 = Goto PrFlt Value<br>1 = Ignore PrFlt<br>When set to "1", Output A continues to operate as command via the network. When set to "0", Output A opens or closes as determined by the setting in Parameter 34. | | |
|---|---|---|
| | Parameter Number | 33 |
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutA Pr FltValue**<br><br>This parameter determines the state the Output A assumes when a trip occurs and Parameter 33 (OutA Pr FltState) is set to "0".<br>0 = Open<br>1 = Close | Parameter Number | 34 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutA Net FltState**<br><br>This parameter along with Parameter 36 (OutA Net FltValue), defines how Output A will respond when a network fault occurs.<br>0 = Goto Net FltValue<br>1 = Hold Last State<br>When set to "1", Output A will hold state before trip occurrence. When set to "0", Output A opens or closes as determined by the setting in Parameter 36. | Parameter Number | 35 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutA Net FltValue**<br><br>This parameter determines the state that Output A assumes when a network fault occurs and Parameter 35 (OutA Net FltState) is set to "0".<br>0 = Open<br>1 = Close | Parameter Number | 36 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutA Net IdlState**<br><br>This parameter along with Parameter 38 (OutA Net IdlValue), defines how Output A will respond when the network is idle.<br>0 = Goto Net IdlValue<br>1 = Hold Last State<br>When set to "0", Output A opens or closes as determined by the setting in Parameter 38. | Parameter Number | 37 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutA Net IdlValue**<br><br>This parameter determines the state that Output A assumes when the network is idle and Parameter 37 (OutA Net IdlState) is set to “0”.<br>0 = Open<br>1 = Close | Parameter Number | 38 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutB Pr FltState**<br><br>This parameter along with Parameter 40 (OutB Pr FltValue), defines how Output B will respond when a protection trip occurs.<br>0 = Goto PrFlt Value<br>1 = Ignore PrFlt<br>When set to “1”, Output B continues to operate as command via the network. When set to “0”, Output B opens or closes as determined by setting in Parameter 40. | Parameter Number | 39 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutB Pr FltValue**<br><br>This parameter determines the state the Out B assumes when a protection trip occurs and Parameter 39 (OutB Pr FltState) is set to “0”.<br>0 = Open<br>1 = Close | Parameter Number | 40 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **OutB Net FltState**<br><br>This parameter along with Parameter 42 (OutB Net FltValue), defines how Output B will respond when a network fault occurs.<br>0 = Goto Idle Value<br>1 = Hold Last State<br>When set to “1”, Output B will hold state before trip occurrence. When set to “0”, Output B opens or closes as determined by setting in Parameter 42. | Parameter Number | 41 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| OutB Net FltValue | | |
|---|---|---|
| This parameter determines the state that Output B assumes when a network fault occurs and Parameter 41 (OutB Net FltState) is set to "0".<br>0 = Open<br>1 = Close | Parameter Number | 42 |
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| OutB Net IdlState | | |
|---|---|---|
| This parameter along with Parameter 44 (OutB Net IdlValue), defines how Output B will respond when the network is idle.<br>0 = Goto PrFlt Value<br>1 = Ignore PrFlt<br>When set to "0", Output B opens or closes as determined by the setting in Parameter 44. | Parameter Number | 43 |
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| OutB Net IdlValue | | |
|---|---|---|
| This parameter determines the state that Output B assumes when the network is idle and Parameter 43 (OutB Net IdlState) is set to "0".<br>0 = Open<br>1 = Close | Parameter Number | 44 |
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | User I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

## Miscellaneous Configuration Group

| Network Override | | |
|---|---|---|
| This parameter lets the local logic override a Network fault.<br>0 = Disable<br>1 = Enable | Parameter Number | 8 |
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Misc. Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Comm Override**<br><br>This parameter lets local logic override the absence of an I/O connection.<br>0 = Disable<br>1 = Enable | Parameter Number | 9 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Misc. Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Keypad Mode**<br><br>This parameter selects if the keypad operation is maintained or momentary.<br>0 = Maintained<br>1 = Momentary | Parameter Number | 45 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Misc. Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Keypad Disable**<br><br>This parameter disables all keypad function except for the “OFF” and “RESET” buttons.<br>0 = Not Disabled<br>1 = Disabled | Parameter Number | 46 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Misc. Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Set to Defaults**<br><br>This parameter if set to “1” will set the device to the factory defaults (but will not cause the ArmorStart controller to restart).<br>0 = No Operation<br>1 = Set to Defaults | Parameter Number | 47 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Misc. Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

## Drive I/O Configuration Group (Bulletin 284E controller only)

| **Drive Control**<br><br>This parameter provides the status of drive parameters. | Parameter Number | 48 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | WORD |
| | Group | Drive I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 4095 |
| | Default Value | 0 |

| **Bit** | | | | | | | | | | | | **Function** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **11** | **10** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** | |
| — | — | — | — | — | — | — | — | — | — | — | X | Accel 1 En |
| — | — | — | — | — | — | — | — | — | — | X | — | Accel 2 En |
| — | — | — | — | — | — | — | — | — | X | — | — | Decel 1 En |
| — | — | — | — | — | — | — | — | X | — | — | — | Decel 2 En |
| — | — | — | — | — | — | — | X | — | — | — | — | Freq Sel 0 |
| — | — | — | — | — | — | X | — | — | — | — | — | Freq Sel 1 |
| — | — | — | — | — | X | — | — | — | — | — | — | Freq Sel 2 |
| — | — | — | — | X | — | — | — | — | — | — | — | Reserved |
| — | — | — | X | — | — | — | — | — | — | — | — | Drv In 1 |
| — | — | X | — | — | — | — | — | — | — | — | — | Drv In 2 |
| — | X | — | — | — | — | — | — | — | — | — | — | Drv In 3 |
| X | — | — | — | — | — | — | — | — | — | — | — | Drv In 4 |

| **DrvIn Pr FltState**<br><br>This parameter, along with Parameter 50 (DrvIn Pr FltValue), defines how the Drive Digital Inputs 1…4 will respond when a protection trip occurs. When set to “1”, Drive Digital Inputs 1…4 continue to operate as command via the network. When set to “0”, Drive Digital Inputs 1…4 will open or close as determined by setting in Parameter 50.<br>0 = Go to PrFlt Value<br>1 = Ignore PrFlt | Parameter Number | 49 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Drive I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **DrvIn Pr FltValue**<br><br>This parameter determines the state of Drive Digital Inputs 1…4, assumes when a trip occurs and Parameter 49 (DrvIn Pr FltState) is set to "0".<br>0 = Open<br>1 = Close | Parameter Number | 50 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Drive I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **DrvIn Net FltState**<br><br>This parameter, along with Parameter 52 (DrvIn Net FltValue), defines how the Drive Digital Inputs 1…4 will respond when a network fault occurs. When set to "1", Drive Digital Inputs 1…4 hold to last state occurs. When set to "0", will go to DrvIn Net FltValue as determined by Parameter 52.<br>0 = Go to Fault Value<br>1 = Hold Last State | Parameter Number | 51 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Drive I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **DrvIn Net FltValue**<br><br>This parameter determines the state of Drive Digital Inputs 1…4 when a network fault occurs and Parameter 51 (DrvIn Net FltState) is set to "0".<br>0 = OFF<br>1 = ON | Parameter Number | 52 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Drive I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **DrvIn Net IdlState**<br><br>This parameter, along with Parameter 54 (DrvIn Net IdlValue), defines how the Drive Digital Inputs 1…4 will respond when a network is idle. When set to "1", hold to last state occurs. When set to "0", will go to DrvIn Net IdlState as determined by Parameter 54.<br>0 = Go to Fault Value<br>1 = Hold Last State | Parameter Number | 53 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Drive I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| | | |
|---|---|---|
| **DrvIn Net IdlValue**<br><br>This parameter determines the state that Drive Digital Inputs 1…4 assume when the network is idle and Parameter 53 (DrvIn Net IdlState) is set to "0".<br>0 = OFF<br>1 = ON | Parameter Number | 54 |
| | Access Rule | GET/SET |
| | Data Type | BOOL |
| | Group | Drive I/O Config. |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

## Drive Display Group (Bulletin 284E controller only)

| | | |
|---|---|---|
| **Output Freq**<br><br>Output frequency present at T1, T2, T3. | Parameter Number | 101 |
| | Related Parameters | 102, 110, 134, 135, 138 |
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | 0.1 Hz |
| | Minimum Value | 0.0 |
| | Maximum Value | 400.0 Hz |
| | Default Value | Read Only |

| | | |
|---|---|---|
| **Commanded Freq**<br><br>Value of the active frequency command. Displays the commanded frequency even if the drive is not running. | Parameter Number | 102 |
| | Related Parameters | 101, 113, 134, 135, 138 |
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | 0.1 Hz |
| | Minimum Value | 0.0 |
| | Maximum Value | 400.0 Hz |
| | Default Value | Read Only |

| | | |
|---|---|---|
| **Output Current**<br><br>Output Current present at T1, T2, T3. | Parameter Number | 103 |
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | 0.01 |
| | Minimum Value | 0.00 |
| | Maximum Value | Drive rated amps x 2 |
| | Default Value | Read Only |

| **Output Voltage**<br><br>Output Voltage present at T1, T2, T3. | Parameter Number | 104 |
|---|---|---|
| | Related Parameters | 131, 184, 188 |
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | 1V AC |
| | Minimum Value | 0 |
| | Maximum Value | 480V |
| | Default Value | Read Only |

| **DC Bus Voltage**<br><br>Present DC Bus voltage level | Parameter Number | 105 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | 1V DC |
| | Minimum Value | Based on Drive Rating |
| | Maximum Value | |
| | Default Value | Read Only |

| **Drive Status**<br><br>Present operating condition of the drive<br>Bit 0 = Running<br>Bit 1 = Forward<br>Bit 2 = Accelerating<br>Bit 3 = Decelerating | Parameter Number | 106 |
|---|---|---|
| | Related Parameter | 195 |
| | Access Rule | GET |
| | Data Type | Byte |
| | Group | Drive Display |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | Read Only |

| **Fault 1 Code**<br><br>A code that represents the drive fault. The code appears in this parameter as the most recent fault that has occurred. (See Internal Drive Faults in Chapter 10 for more information). | Parameter Number | 107 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | — |
| | Minimum Value | F2 |
| | Maximum Value | F122 |
| | Default Value | Read Only |

| **Fault 2 Code**<br><br>A code that represents a drive fault. The code appears in this parameter as the second most recent fault that has occurred. | Parameter Number | 108 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | — |
| | Minimum Value | F2 |
| | Maximum Value | F122 |
| | Default Value | Read Only |

| **Fault 3 Code**<br><br>A code that represents a drive fault. The code appears in this parameter as the third most recent fault that has occurred. | Parameter Number | 109 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | — |
| | Minimum Value | F2 |
| | Maximum Value | F122 |
| | Default Value | Read Only |

| **Process Display**<br><br>The output frequency that is scaled by the process factor (Parameter 199). | Parameter Number | 110 |
|---|---|---|
| | Related Parameter | 101. 199 |
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | — |
| | Minimum Value | 0.00 |
| | Maximum Value | 9999 |
| | Default Value | Read Only |

| **Control Source**<br><br>Displays the source of the Start Command and Speed Reference.<br>1 = Internal Frequency<br>4 = Preset Freq x<br>5 = Network Control<br>9 = Jog Freq | Parameter Number | 112 |
|---|---|---|
| | Related Parameters | 136, 138, 151…154 (Digital In x Sel) must be set to Option 4, 169, 170…177 (Preset Freq x), 240…247 (StpLogic x) |
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | 1 |
| | Minimum Value | 0 |
| | Maximum Value | 9 |
| | Default Value | Read Only |

| **Contrl In Status**<br><br>Status of control inputs. These can be used in DeviceLogix.<br>Bit 0 = Start/Run FWD Input<br>Bit 1 = Direction/Run REV Input<br>Bit 2 = Stop Input<br>Bit 3 = Dynamic Brake Transistor On | Parameter Number | 113 |
|---|---|---|
| | Related Parameter | 102, 134, 135 |
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | 1 |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | Read Only |

| **Dig In Status**<br><br>Status of the control terminal block digital inputs:<br>Bit 0 = Digital In 1 Sel<br>Bit 1 = Digital In 2 Sel<br>Bit 2 = Digital In 3 Sel<br>Bit 3 = Digital In 4 Sel | Parameter Number | 114 |
|---|---|---|
| | Related Parameter | 151…154 |
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | 1 |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | Read Only |

| **Comm Status**<br><br>Status of communications ports:<br>Bit 0 = Receiving Data<br>Bit 1 = Transmitting Data<br>Bit 2 = Internal Communications<br>Bit 3 = Communication Error | Parameter Number | 115 |
|---|---|---|
| | Related Parameter | 205, 206 |
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | 1 |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | Read Only |

| **Elapsed Run Time**<br><br>Accumulated time drive is outputting power. Time is displayed in 10-hour increments. | Parameter Number | 118 |
|---|---|---|
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | 1 = 10 hrs |
| | Minimum Value | 0 |
| | Maximum Value | 9999 |
| | Default Value | Read Only |

| | | |
|---|---|---|
| **Output Power**<br><br>The output power present at T1, T2, and T3. | Parameter Number | 122 |
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | |
| | Minimum Value | 0.00 |
| | Maximum Value | Drive rated power X 2 |
| | Default Value | Read Only |

| | | |
|---|---|---|
| **Output Power Fctr**<br><br>The angle in electrical degrees between motor voltage and current. | Parameter Number | 123 |
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | 0.1° |
| | Minimum Value | 0.0° |
| | Maximum Value | 180.0° |
| | Default Value | Read Only |

| | | |
|---|---|---|
| **Drive Temp**<br><br>Present operating temperature of the drive power section. | Parameter Number | 124 |
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | 1 °C |
| | Minimum Value | 0 |
| | Maximum Value | 120 |
| | Default Value | Read Only |

| | | |
|---|---|---|
| **Counter Status**<br><br>The current value of the counter when the counter is enabled. | Parameter Number | 125 |
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | 1 |
| | Minimum Value | 0 |
| | Maximum Value | 9999 |
| | Default Value | Read Only |

| Timer Status | | |
|---|---|---|
| The current value of the timer when timer is enabled. | Parameter Number | 126 |
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | 0.1 sec |
| | Minimum Value | 0 |
| | Maximum Value | 9999 |
| | Default Value | Read Only |

| Torque Current | | |
|---|---|---|
| The current value of the motor torque current. | Parameter Number | 129 |
| | Access Rule | GET |
| | Data Type | UINT |
| | Group | Drive Display |
| | Units | 0.01 |
| | Minimum Value | 0.00 |
| | Maximum Value | Drive Rated amps x 2 |
| | Default Value | Read Only |

## Drive Setup Group (Bulletin 284E controller only)

| Motor NP Volts | | |
|---|---|---|
| O Stop drive before changing this parameter. | Parameter Number | 131 |
| Set to the motor nameplate rated volts. | Related Parameters | 104, 184, 185…187 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Setup |
| | Units | 1V AC |
| | Minimum Value | 20 |
| | Maximum Value | 480V |
| | Default Value | Based on Drive Rating |

| Motor NP Hertz | | |
|---|---|---|
| O Stop drive before changing this parameter. | Parameter Number | 132 |
| Set to the motor nameplate rated frequency. | Related Parameters | 184, 185…187, and 190 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Setup |
| | Units | 1 Hz |
| | Minimum Value | 15 |
| | Maximum Value | 400 |
| | Default Value | 60 Hz |

| **Motor OL Current** | Parameter Number | 133 |
|---|---|---|
| Set to the maximum allowable current. The drive fault on an F7 Motor Over load if the value of this parameter is exceeded by 150% for 60 s. | Related Parameter | 155, 189, 190, 198, 214, 218, 260…261 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Setup |
| | Units | 0.1 A |
| | Minimum Value | 0.0 |
| | Maximum Value | Drive rated amps x 2 |
| | Default Value | Based on Drive Rating |

| **Minimum Freq** | Parameter Number | 134 |
|---|---|---|
| Sets the lowest frequency that the drive will output continuously. | Related Parameter | 101, 102, 113, 135, 185…187, 260, 261 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Setup |
| | Units | 0.1 Hz |
| | Minimum Value | 0.0 |
| | Maximum Value | 400 |
| | Default Value | 0.0 |

| **Maximum Freq** | Parameter Number | 135 |
|---|---|---|
| Stop drive before changing this parameter. | Related Parameter | 101, 102, 113, 134, 135, 178, 185…187 |
| Sets the highest frequency that the drive will output continuously. | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Setup |
| | Units | 0.1 Hz |
| | Minimum Value | 0.0 |
| | Maximum Value | 400 |
| | Default Value | 60.0 |

| **Stop Mode** | Parameter Number | 137 |
|---|---|---|
| Valid Stop Modes for the Bulletin 284E ArmorStart controller are the following:<br>0 = **Ramp, CF** Ramp to Stop. **Stop** command clears active fault.<br>1 = **Coast, CF** Coast to Stop. **Stop** command clears active fault.<br>2 = **DC Brake, CF** DC Injection Braking Stop. **Stop** command clears active fault.<br>3 = **DCBrkAuto, CF** DC injection Braking with Auto Shutoff.<br>Standard DC Injection Braking for value set in Parameter 180 (DC Brake Time) or Drive shuts off if the drive detects that the motor is stopped. **Stop** command clears active fault.<br>4 = **Ramp,** Ramp to Stop<br>5 = **Coast,** Coast to Stop<br>6 = **DC Brake,** DC Injection Braking Stop<br>7 = **DC BrakeAuto,** DC Injection Stop with Auto Shutoff<br>Standard DC Injection Braking for value set in Parameter 180 (DC Brake Time)<br>or<br>Drive shuts off if current limit is exceeded.<br>8 = **Ramp** + **EM B, CF** Ramp to Stop with EM Brake Control. **Stop** command clears active fault. ❶<br>9 = **Ramp** + **EM Brk** Ramp to Stop with EM Brake Control(1) | Related Parameters | 136, 180…182, 205, 260, 261(1) |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 9 |
| | Default Value | 9 |

(1) See Parameter 155 to set the EM brake actuation condition.

| **Speed Reference** | Parameter Number | 138 |
|---|---|---|
| Valid Speed References for the Bulletin 284E ArmorStart controller are the following:<br>1 = Internal Freq<br>4 = Preset Freq<br>5 = Comm Port<br>9 = Jog Freq | Related Parameters | 101, 102, 112, 139, 140, 151…154, 169, 170…177, 232, 240…247, and 250…257 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 7 |
| | Default Value | 5 |

| **Accel Time 1** | Parameter Number | 139 |
|---|---|---|
| Sets the rate of acceleration for all speed increases.<br>$\frac{\text{Maximum Freq}}{\text{Accel Time}} = \text{Accel Rate}$ | Related Parameters | 138, 140, 151…154, 167, 170…177, and 240…247 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Setup |
| | Units | 0.1 sec |
| | Minimum Value | 0.0 sec |
| | Maximum Value | 600.0 sec |
| | Default Value | 10.0 sec |

| **Decel Time 1** | | |
|---|---|---|
| Sets the rate of deceleration for all speed decreases. $\frac{\text{Maximum Freq}}{\text{Decel Time}} = \text{Decel Rate}$ | Parameter Number | 140 |
| | Related Parameters | 138, 139, 151…154, 168, 170…177, and 240…247 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Setup |
| | Units | 0.1 sec |
| | Minimum Value | 0.1 sec |
| | Maximum Value | 600.0 sec |
| | Default Value | 10.0 sec |

| **Reset To Defaults** | | |
|---|---|---|
| **O** Stop drive before changing this parameter. | Parameter Number | 141 |
| Resets all parameter values to factory defaults. | Access Rule | GET/SET |
| 0 = Ready/Idle (Default) | Data Type | BOOL |
| 1 = Factory Rset | Group | Drive Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Motor OL Ret** | | |
|---|---|---|
| Enables/disables 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 parameter setting resets the counter. | Parameter Number | 143 |
| 0 = Disabled (Default) | Access Rule | GET/SET |
| 1 = Enabled | Data Type | BOOL |
| | Group | Drive Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

## Drive Advanced Setup Group (Bulletin 284E controller only)

| **Digital In 1 SEL (151)**<br>**Digital In 2 SEL (152)**<br>**Digital In 3 SEL (153)**<br>**Digital In 4 SEL (154)** | Parameter Number | 151…154 |
|---|---|---|
| | Related Parameters | 112, 114, 138…140, 167, 168, 170…179, 240…247 |
| | Access Rule | GET/SET |
| O Stop drive before changing this parameter. | Data Type | UINT |
| | Group | Drive Advanced Setup |
| Selects the function for the digital inputs. | Units | See Table 22 for details. |
| | Minimum Value | |
| | Maximum Value | |
| | Default Value | |

**Table 22 - Digital Input Options**

| Option | Name | Description |
|---|---|---|
| 1 | Acc2 & Dec2 | • When active, Parameter 167 (Accel Time 2) and Parameter 168 (Decel Time 2) are used for all ramp rates except Jog.<br>• Can only be tied to one input. |
| 2 | Jog | • When input is present, drive accelerates according to the value set in Parameter 179 (Jog Accel/Decel) and ramps to the value set in Parameter 178 (Jog Frequency).<br>• When the input is removed, drive ramps to a stop according to the value set in Parameter 179 (Jog Accel/Decel).<br>• A valid Start command will override this input. |
| 4 | Preset Freq (Parameters 151 and 152 Default) | See Parameters 170…173 and 174…177. |
| 6 | Comm Port | This option is the default setting. |
| 7 | Clear Fault | When active, clears active fault. |
| 8 | RampStop, CF | Causes drive to immediately ramp to stop regardless of how Parameter 137 (Stop Mode) is set. |
| 9 | CoastStop, CF | Causes drive to immediately ramp to stop regardless of how Parameter 137 (Stop Mode) is set. |
| 10 | DCInjStop, CF | Causes drive to immediately begin a DC Injection stop regardless of how Parameter 137 (Stop Mode) is set. |
| 11 | Jog Forward (Parameter 154 Default) | Drive accelerates to Parameter 178 (Jog Frequency) according to Parameter 179 (Jog Accel/Decel) and ramps to stop when input becomes inactive. A valid start will override this command. |
| 12 | Jog Reverse | Drive accelerates to Parameter 178 (Jog Frequency) according to Parameter 179 (Jog Accel/Decel) and ramps to stop when input becomes inactive. A valid start will override this command. |
| 16 | MOP Up | Increases the value of Parameter 169 (Internal Freq) at a rate 2 Hz per second. Default of Parameter 169 is 60 Hz. |
| 17 | MOP Down | Decreases the value of Parameter 169 (Internal Freq) at a rate 2 Hz per second. Default of Parameter 169 is 60 Hz. |
| 27(1) | Em Brk Rls | If EM Brake function is enabled, this input releases the brake. See parameter 155 and set to EM Brk Cntrol (22). |

(1) Provides programmable control of Em Brk via digital input (1...4)

| Relay Out Sel | Parameter Number | 155 |
|---|---|---|
| Sets the condition that changes the state of the output relay contacts. | Related Parameters | 133, 156, 192, 240…247, 250…257, 260, 261 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 22 |
| | Default Value | 22 |

**Table 23 - Options for the Output Relay Contacts**

| Options | Name | Description |
|---|---|---|
| 0 | Ready/Fault (Default) | Relay changes state when power is applied, which indicates that the drive is ready for operation. Relay returns drive to shelf state when power is removed or a fault occurs. |
| 1 | At Frequency | Drive reached commanded frequency. |
| 6 | Above Freq | Drive exceeds the frequency (Hz) value set in Parameter 156 (Relay Out Level) Use Parameter 156 to set threshold. |
| 7 | Above Cur | Drive exceeds the current (% amps) value set in Parameter 156 (Relay Out Level) Use Parameter 156 to set threshold. |
| 20 | ParamControl | Enables the output to be controlled over the network communications by writing to Parameter 156 (Relay Out Level) (0 = OFF, 1 = ON). |
| 22 | EM Brk Cntrl | EM Brake is energized. Program Parameter 260 (EM Brk OFF Delay) and Parameter 261 (EM Brk On Delay) for desired action. (1) |

(1) The customer is responsible to make sure that the brake release function operates properly and safely.

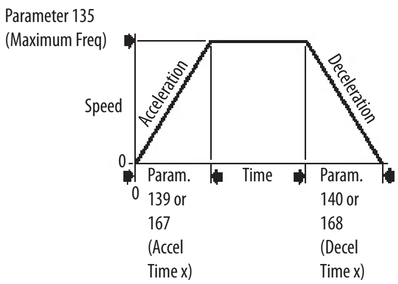
| Relay Out Level | Parameter Number | 156 |
|---|---|---|
| Sets the trip point for the digital output relay if the value of Parameter 155 (Relay Out Sel) is 6, 7, 8, 10, 16, 17, 18, or 20. | Related Parameters | 155 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 |
| | Minimum Value | 0.0 |
| | Maximum Value | 9999 |
| | Default Value | 0.0 |

| Parameters 155 Setting | Parameter 156 Min./Max. |
|---|---|
| 6 | 0/400 Hz |
| 7 | 0/180% |
| 8 | 0/815V |
| 10 | 0/100% |
| 16 | 0.1/9999 sec |
| 17 | 1/9999 counts |
| 18 | 1/180° |
| 20 | 0/1 |

**Accel Time 2**

When active, sets the rate of acceleration for all speed increases except for jog.

$$\frac{\text{Maximum Freq}}{\text{Accel Time}} = \text{Accel Rate}$$

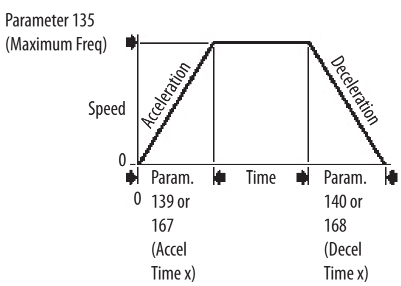



| | |
|---|---|
| Parameter Number | 167 |
| Related Parameters | 139, 151…154, 170…177, 240…247 |
| Access Rule | GET/SET |
| Data Type | UINT |
| Group | Drive Advanced Setup |
| Units | 0.1 sec |
| Minimum Value | 0.0 |
| Maximum Value | 600.0 |
| Default Value | 20.0 |

**Decel Time 2**

When active, sets the rate of deceleration for all speed decreases except for jog.

$$\frac{\text{Maximum Freq}}{\text{Decel Time}} = \text{Decel Rate}$$




| | |
|---|---|
| Parameter Number | 168 |
| Related Parameters | 140, 151…154, 170…177, 240…247 |
| Access Rule | GET/SET |
| Data Type | UINT |
| Group | Drive Advanced Setup |
| Units | 0.1 sec |
| Minimum Value | 0.0 |
| Maximum Value | 600.0 |
| Default Value | 20.0 |

**Internal Freq**

Provide the frequency command to drive when Parameter 138 (Speed Reference) is set to "1" (Internal Freq). When enabled, this parameter will change the frequency command in real time.

| | |
|---|---|
| Parameter Number | 169 |
| Related Parameters | 138 |
| Access Rule | GET/SET |
| Data Type | UINT |
| Group | Drive Advanced Setup |
| Units | 0.1 Hz |
| Minimum Value | 0.0 |
| Maximum Value | 400.0 |
| Default Value | 60.0 |

| **170 (Preset Freq 0)**<br>**171 (Preset Freq 1)**<br>**172 (Preset Freq 2)**<br>**173 (Preset Freq 3)**<br>**174 (Preset Freq 4)**<br>**175 (Preset Freq 5)**<br>**176 (Preset Freq 6)**<br>**177 (Preset Freq 7)**<br><br>Provides a fixed frequency command value when Parameters 151...154 (Digital In x Sel) is set to Option 4 (Preset Frequencies). | Parameter Number | 170…173, 174…177 |
|---|---|---|
| | Related Parameters | 138…140, 151…154, 167, 168, 240…247, 250…257 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 Hz |
| | Minimum Value | 0.0 |
| | Maximum Value | 400.0 |
| | Default Value | See Table 24 |

**Table 24 - Parameters 170…177 Preset Freq Options**

| | | |
|---|---|---|
| | 170 Default | 0.0 Hz |
| | 171 Default | 5.0 Hz |
| | 172 Default | 10.0 Hz |
| | 173 Default | 20.0 Hz |
| | 174 Default | 30.0 Hz |
| | 175 Default | 40.0 Hz |
| | 176 Default | 50.0 Hz |
| | 177 Default | 60.0 Hz |
| | Min./Max. | 0.0/400.0 Hz |
| | Display | 0.1 Hz |

| Input State of Digital In 1 (I/O Terminal 05 when Parameter 151 = 4) | Input State of Digital In 2 (I/O Terminal 06 when Parameter 152 = 4) | Input State of Digital In 3 (I/O Terminal 07 when Parameter 153 = 4) | Frequency Source | Accel/Decel Parameter Used(1) |
|---|---|---|---|---|
| 0 | 0 | 0 | 170 (Preset Freq 0) | (Accel Time 1)/(Decel Time 1) |
| 1 | 0 | 0 | 171 (Preset Freq 1) | (Accel Time 1)/(Decel Time 1) |
| 0 | 1 | 0 | 172 (Preset Freq 2) | (Accel Time 2)/(Decel Time 2) |
| 1 | 1 | 0 | 173 (Preset Freq 3) | (Accel Time 2)/(Decel Time 2) |
| 0 | 0 | 1 | 174 (Preset Freq 4) | (Accel Time 3)/(Decel Time 3) |
| 1 | 0 | 1 | 175 (Preset Freq 5) | (Accel Time 3)/(Decel Time 3) |
| 0 | 1 | 1 | 176 (Preset Freq 6) | (Accel Time 4)/(Decel Time 4) |
| 1 | 1 | 1 | 177 (Preset Freq 7) | (Accel Time 4)/(Decel Time 4) |

(1) When a Digital Input is set to "Accel 2 and Decel 2", and the input is active, that input overrides the settings in this table.

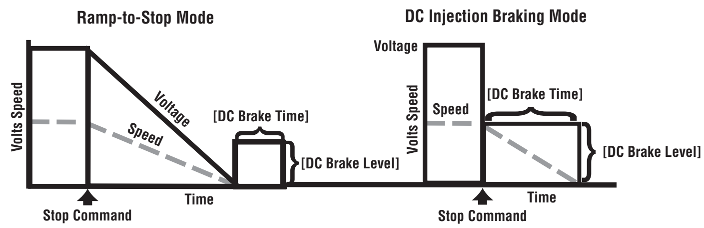
| **Jog Frequency**<br><br>Sets the output frequency when the jog command is issued. | Parameter Number | 178 |
|---|---|---|
| | Related Parameters | 135, 151…154, 179 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 Hz |
| | Minimum Value | 0.0 |
| | Maximum Value | 400.0 |
| | Default Value | 10.0 |

| **Jog Accel/Decel**<br><br>Sets the acceleration and deceleration time when a jog command is issued. | Parameter Number | 179 |
|---|---|---|
| | Related Parameters | 151…154, 178 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 sec |
| | Minimum Value | 0.1 |
| | Maximum Value | 600.0 |
| | Default Value | 10.0 |

| **DC Brake Time**<br><br>Sets the length of time that DC brake current is injected into the motor. See Parameter 181 (DC Brake Level). | Parameter Number | 180 |
|---|---|---|
| | Related Parameters | 137, 181 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 sec |
| | Minimum Value | 0.0 |
| | Maximum Value | 99.9<br>(Setting of 99.9 = Continuous) |
| | Default Value | 0.0 |

| **DC Brake Level**<br><br>Defines the maximum DC brake current, in amps, applied to the motor when Parameter 137 (Stop Mode) is set to either "Ramp" or "DC Brake". | Parameter Number | 181 |
|---|---|---|
| | Related Parameters | 137, 180 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 A |
| | Minimum Value | 0.0 |
| | Maximum Value | Drive rated amps X 1.8 |
| | Default Value | Drive rated amps X 0.05 |

**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 may be demagnetized during braking.

**DB Resistor Sel**

Stop drive before changing this parameter.
Enables/disables external dynamic braking.

| Setting | Min./Max. |
|---|---|
| 0 | Disabled |
| 1 | Normal RA Res (5% Duty Cycle) |
| 2 | No Protection (100% Duty Cycle) |
| 3…99 | x% Duty Cycle Limited (3…99% of Duty Cycle) |

| | |
|---|---|
| Parameter Number | 182 |
| Related Parameters | 137 |
| Access Rule | GET/SET |
| Data Type | UINT |
| Group | Drive Advanced Setup |
| Units | 1 |
| Minimum Value | 0 |
| Maximum Value | 99 |
| Default Value | 0 |

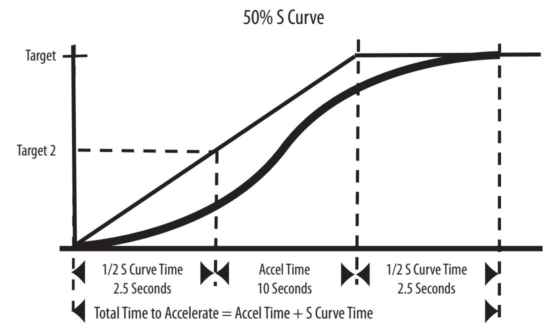
**S Curve %**

Sets the percentage of acceleration or deceleration time that is applied to ramp as S Curve. Time is added, half at the beginning and half at the end of the ramp.

| | |
|---|---|
| Parameter Number | 183 |
| Access Rule | GET/SET |
| Data Type | UINT |
| Group | Drive Advanced Setup |
| Units | 1% |
| Minimum Value | 0 |
| Maximum Value | 100 |
| Default Value | 0% disabled |

**Figure 63 - S Curve**

Example:
Accel Time = 10 Seconds
S Curve Setting = 50%
S Curve Time = 10 x 0.5 = 5 Seconds
Total Time = 10 + 5 = 15 Seconds

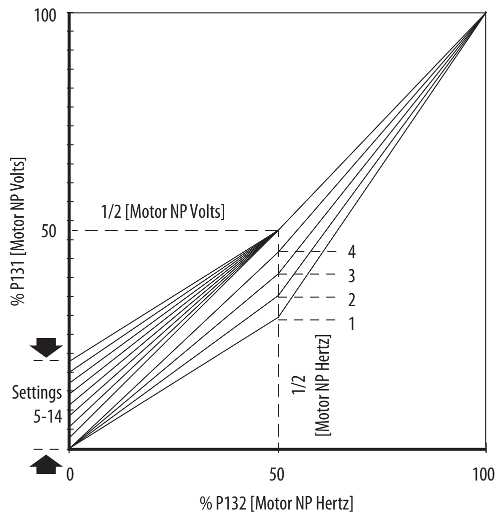



| **Boost Select** | Parameter Number | 184 |
|---|---|---|
| Sets the boost voltage (% of Parameter 131 (Motor NP Volts)) and redefines the Volts per Hz curve. Active when Parameter 225 (Torque Perf Mode) = 0 (V/Hz). Drive may add additional voltage unless Option 5 is selected. | Related Parameters | 104, 131, 132, 185…187, 225 |
| See Table 25 for details. | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 14 |
| | Default Value | 8 |

**Table 25 - Boost Select Options**

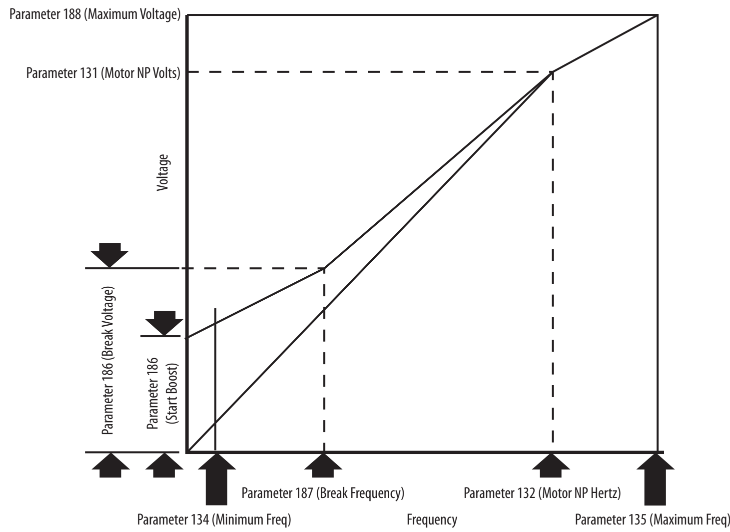
| Options | Description | |
|---|---|---|
| 0 | Custom V/Hz | Variable Torque (Typical fan/pump curves) |
| 1 | 30.0, VT | |
| 2 | 35.0, VT | |
| 3 | 40.0, VT | |
| 4 | 45.0, VT | |
| 5 | 0.0 no IR | Constant Torque |
| 6 | 0.0 | |
| 7 | 2.5, CT (default for 5 Hp/4.0 kW Drive) | |
| 8 | 5.0, CT (default)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

**Figure 64 - Boost Select**




| **Start Boost** | Parameter Number | 185 |
|---|---|---|
| Sets the boost voltage (% of Parameter 131 (Motor NP Volts) and redefines the Volts per Hz curve when Parameter 184 (Boost Select) = 0 (Custom V/Hz) and Parameter 225 (Torque Perf Mode) = 0 (V/Hz) | Related Parameters | 131, 132, 134, 135, 184, 186…188, 225 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 1.1% |
| | Minimum Value | 0.0% |
| | Maximum Value | 25.0% |
| | Default Value | 2.5% |

**Figure 65 - Start Boost**




| **Brake Voltage** | Parameter Number | 186 |
|---|---|---|
| Sets the frequency where brake voltage is applied when Parameter 184 (Boost Select) = 0 (Custom V/Hz) and Parameter 225 (Torque Perf Mode) = 0 (V/Hz). | Related Parameters | 131, 132, 134, 135, 184, 185, 187, 188, 225 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 1.1% |
| | Minimum Value | 0.0% |
| | Maximum Value | 100.0% |
| | Default Value | 25.0% |

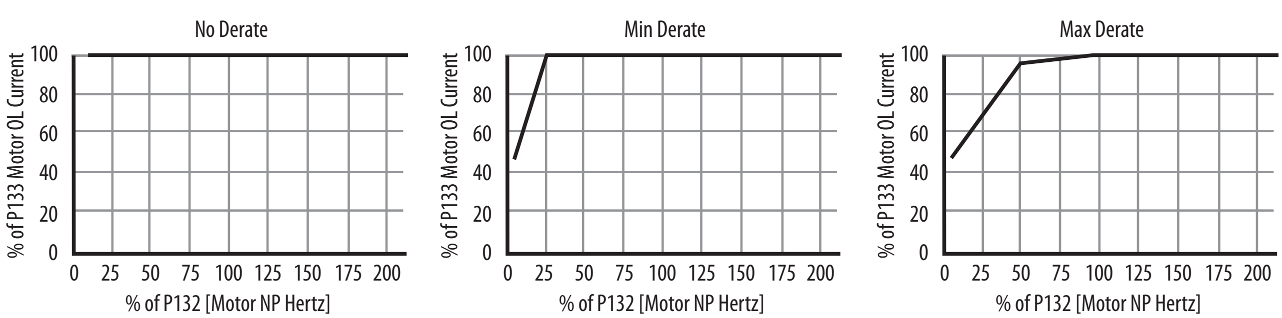
| **Brake Frequency** | Parameter Number | 187 |
|---|---|---|
| Sets the frequency where brake frequency is applied when Parameter 184 (Boost Select) = 0 (Custom V/Hz) and Parameter 225 (Torque Perf Mode) = 0 (V/Hz). | Related Parameters | 131, 132, 134, 135, 184, 185, 186, 188, 225 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 Hz |
| | Minimum Value | 0.0 Hz |
| | Maximum Value | 400.0 Hz |
| | Default Value | 15.0 Hz |

| | | |
|---|---|---|
| **Maximum Voltage** | Parameter Number | 188 |
| Sets the highest voltage that the drive will output. | Related Parameters | 104, 185, 186, 187 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 1V AC |
| | Minimum Value | 20V AC |
| | Maximum Value | Drive Rated Volts |
| | Default Value | Drive Rated Volts |

| | | |
|---|---|---|
| **Current Limit 1** | Parameter Number | 189 |
| Maximum output current that is allowed before current limiting occurs | Related Parameters | 133, 218 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 A |
| | Minimum Value | 0.1 A |
| | Maximum Value | Drive rated amps X 1.8 |
| | Default Value | Drive rated amps X 1.5 |

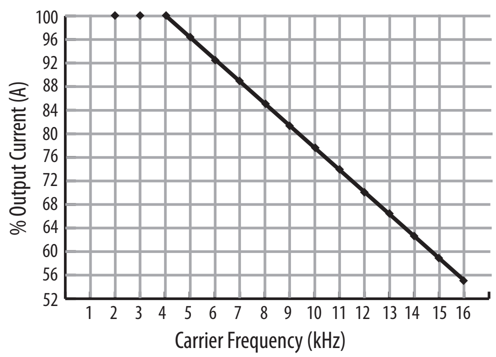
| | | |
|---|---|---|
| **Motor OL Select** | Parameter Number | 190 |
| Drive provides Class 10 motor overload protection. Settings 0…2, select the derating factor for $I^2t$ overload function. | Related Parameters | 132, 133 |
| 0 = No Derate | Access Rule | GET/SET |
| 1 = Min. Derate | Data Type | UINT |
| 2 = Max. Derate | Group | Drive Advanced Setup |
| | Units | 1 |
| | Minimum Value | 0 |
| | Maximum Value | 2 |
| | Default Value | 0 |

**Figure 66 - Overload Trip Curves**



| **PWM Frequency**<br><br>Sets the carrier frequency for the PWM output waveform. The Figure 67 provides derating guidelines that are based on the PWM frequency setting. | Parameter Number | 191 |
|---|---|---|
| | Related Parameters | 224 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.l Hz |
| | Minimum Value | 2.0 Hz |
| | Maximum Value | 16.0 Hz |
| | Default Value | 4.0 Hz |

**Figure 67 - Derating Guidelines that are Based on the PWM Frequency Setting**




| **Auto Rstrt Tries**<br><br>Set the maximum number of times the drive attempts to reset a fault and restart. | Parameter Number | 192 |
|---|---|---|
| | Related Parameter | 155, 193 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 1 |
| | Minimum Value | 0 |
| | Maximum Value | 9 |
| | Default Value | 0 |

## Clear a Type 1 Fault and Restart the Drive

1. Set Parameter 192 (Auto Rstrt Tries) to a value other than 0.
2. Set Parameter 193 (Auto Rstrt Delay) to a value other than 0.

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

1. Set Parameter 192 (Auto Rstrt Tries) to a value other than 0.
2. Set Parameter 193 (Auto Rstrt Delay) to 0.

**ATTENTION:** Equipment damage and/or personal injury can result if this parameter 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.

| **Auto Rstrt Delay**<br><br>Sets time between restart attempts when Parameter 192 (Auto Rstrt Tries) is set to a value other than zero. | | |
|---|---|---|
| | Parameter Number | 193 |
| | Related Parameters | 192 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 sec |
| | Minimum Value | 0.0 |
| | Maximum Value | 300.0 sec |
| | Default Value | 1.0 sec |

| **Start at PowerUp**<br><br>Stop drive before changing this parameter.<br>Enables/disables a feature that lets a Start or Run command automatically cause the drive to resume running at command speed after the drive input is restored. Requires a digital input configured Run or Start and a valid start contact.<br>0 = Disabled<br>1 = Enabled<br><br>**ATTENTION:** Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national, and international codes, standards, regulations, or industry guidelines. | | |
|---|---|---|
| | Parameter Number | 194 |
| | Related Parameters | 192 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Reverse Disable**<br><br>Stop drive before changing this parameter.<br>Enables/disables the function that lets the direction of the motor rotation be changed. The reverse command may come from a digital command or serial command. All reverse inputs including two-wire Run Reverse will be ignored with reverse disabled.<br>0 = Disabled<br>1 = Enabled | Parameter Number | 195 |
|---|---|---|
| | Related Parameters | 106 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Flying Start En**<br><br>Sets the condition that lets the drive reconnect to a spinning motor at actual RPM.<br>0 = Disabled<br>1 = Enabled | Parameter Number | 196 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Compensation**<br><br>Enables/disables correction options that may improve problems with motor instability,<br>0 = Disabled<br>1 = Electrical (Default)<br>Some drive/motor combinations have inherent instabilities that are exhibited as non-sinusoidal motor currents. This setting attempts to correct this condition<br>2 = Mechanical<br>Some motor/load combinations have mechanical resonances that can be excited by the drive current regulator. This setting slows down the current regulator response and attempts to correct this condition.<br>3 = Both | Parameter Number | 197 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 3 |
| | Default Value | 1 |

| **SW Current Trip** | | |
|---|---|---|
| Enables/disables a software instantaneous (within 100 ms) current trip. | Parameter Number | 198 |
| | Related Parameters | 133 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 A |
| | Minimum Value | 0.0 |
| | Maximum Value | Drive rated amps x 2 |
| | Default Value | 0.0 (Disabled) |

| **Process Factor** | | |
|---|---|---|
| Scales the output frequency value that is displayed by Parameter 110 (Process Display).<br>Output Freq x Process Factor = Process Display | Parameter Number | 199 |
| | Related Parameters | 110 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 |
| | Minimum Value | 0.1 |
| | Maximum Value | 999.9 |
| | Default Value | 30.0 |

| **Fault Clear** | | |
|---|---|---|
| Stop drive before changing this parameter.<br>Resets a fault and clears the fault queue. Used primarily to clear a fault over network communications.<br>0 = Ready/Idle (Default)<br>1 = Reset Fault<br>2 = Clear Buffer (Parameters 107…109 (Fault x Code)) | Parameter Number | 200 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 2 |
| | Default Value | 0 |

| **Program Lock** | | |
|---|---|---|
| Protects parameters against change by unauthorized personnel.<br>0 = Unlocked<br>1 = Locked | Parameter Number | 201 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| **Comm Loss Action** | Parameter Number | 205 |
|---|---|---|
| Selects the drive's response to a loss of the communication connection or excessive communication errors.<br>0 = Fault (Default)<br>Drive will fault on an F81 Comm Loss and coast to stop<br>1 = Coast Stop<br>Stops drive via coast to stop<br>2 = Stop<br>Stops via Parameter 137 (Stop Mode) setting<br>3 = Continue Last<br>Drive continues operating at communication commanded speed that is saved in RAM. | Related Parameters | 115, 137, 206 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Advanced Program Group |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 3 |
| | Default Value | 0 |

| **Comm Loss Time** | Parameter Number | 206 |
|---|---|---|
| Sets the time that the drive remains in communication loss before implanting the option selected in Parameter 205 (Comm Loss Action). | Related Parameters | 115, 205 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Advanced Program Group |
| | Units | 0.1 sec |
| | Minimum Value | 0.1 sec |
| | Maximum Value | 60.0 sec |
| | Default Value | 15.0 sec |

| **Slip Hertz @ FLA** | Parameter Number | 214 |
|---|---|---|
| Compensates for the inherent slip in an induction motor. This frequency is added to the commanded output frequency based on motor current. | Related Parameters | 133 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 Hz |
| | Minimum Value | 0.0 Hz |
| | Maximum Value | 10.0 Hz |
| | Default Value | 2.0 Hz |

| **Process Time Lo** | Parameter Number | 215 |
|---|---|---|
| Scales the time value when the drive is running at Parameter 134 (Minimum Freq). When set to a value other than zero, Parameter 110 (Process Display) indicates the duration of the process. | Related Parameters | 110, 134 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | Hz |
| | Minimum Value | 0.00 |
| | Maximum Value | 99.99 |
| | Default Value | 0.00 |

| **Process Time Hi** | Parameter Number | 216 |
|---|---|---|
| Scales the time value when the drive is running at Parameter 135 (Maximum Freq). When set to a value other than zero, Parameter 110 (Process Display) indicates the duration of the process. | Related Parameters | 110, 135 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | Hz |
| | Minimum Value | 0.0 |
| | Maximum Value | 99.99 |
| | Default Value | 0.00 |

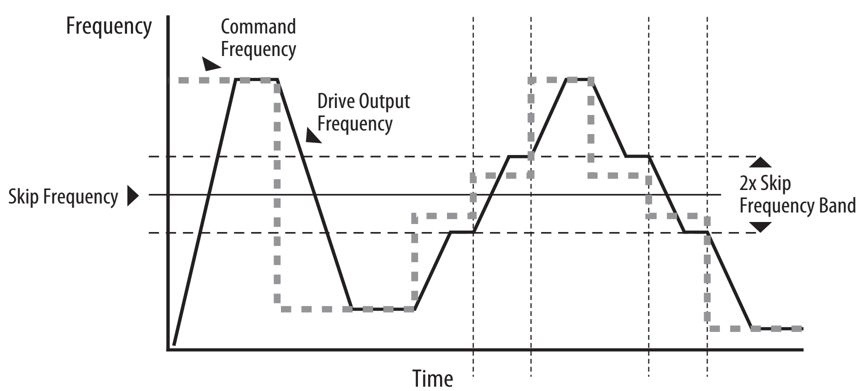
| **Bus Reg Mode** | Parameter Number | 217 |
|---|---|---|
| Enables the bus regulator.<br>0 = Disable<br>1 = Enabled | Related Parameters | — |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 1 |

| **Current Limit 2** | Parameter Number | 218 |
|---|---|---|
| Maximum output current that is allowed before current limiting occurs. This parameter is only active if Parameters 151…154 (Digital In x Sel) is set to Option 25 (Current Lmt2) and is active. | Related Parameters | 133, 151…154, 189 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 A |
| | Minimum Value | 0.0 A |
| | Maximum Value | Drive rated amps x 1.8 |
| | Default Value | Drive rated amps x 1.5 |

| | | |
|---|---|---|
| **Skip Frequency**<br><br>Sets the frequency at which the drive will not operate. | Parameter Number | 219 |
| | Related Parameters | 220 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 Hz |
| | Minimum Value | 0.0 |
| | Maximum Value | 400.0 Hz |
| | Default Value | 0.0 Hz |

| | | |
|---|---|---|
| **Skip Freq Band**<br><br>Determines the bandwidth around Parameter 219 (Skip Frequency). Parameter 220 (Skip Freq Band) is split applying 1/2 above and 1/2 below the actual skip frequency. A setting of 0.0 disables this parameter. | Parameter Number | 220 |
| | Related Parameters | 219 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 Hz |
| | Minimum Value | 0.0 Hz |
| | Maximum Value | 30.0 Hz |
| | Default Value | 0.0 Hz |

**Figure 68 - Skip Frequency Band**




| | | |
|---|---|---|
| **Stall Fault Time**<br><br>Sets for the fault time that the drive will remain in stall mode before a fault is issued.<br>0 = 60 sec (Default)<br>1 = 120 sec<br>2 = 240 sec<br>3 = 360 sec<br>4 = 480 sec<br>5 = Flt Disabled | Parameter Number | 221 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 5 |
| | Default Value | 0 |

| | | |
|---|---|---|
| **Var PWM Disable**<br><br>Stop drive before changing this parameter.<br>Enables/disables a feature that varies the carrier frequency for the PWM output waveform that is defined by Parameter 191 (PWM Frequency).<br>0 = Enabled<br>1 = Disabled<br>Disabling this feature when low frequency condition exists may result in IGBT stress and nuisance tripping. | Parameter Number | 224 |
| | Related Parameters | 191 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

| | | |
|---|---|---|
| **Torque Perf Mode**<br><br>Stop drive before changing this parameter.<br>Enables/disables sensorless vector control operation.<br>0 = V/Hz<br>1 = Sensrls Vect | Parameter Number | 225 |
| | Related Parameters | 184…187, 227 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 1 |

| **Motor NP FLA**<br><br>Set to the motor nameplate full load amps. | Parameter Number | 226 |
|---|---|---|
| | Related Parameters | |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1 A |
| | Minimum Value | 0.1 |
| | Maximum Value | Drive rated amps x 2 |
| | Default Value | Drive rated amps |

| **Autotune**<br><br>Stop drive before changing this parameter.<br>Provides an automatic method for setting Parameter 228 (IR Voltage Drop) and Parameter 229 (Flux Current Ref), that affect sensorless vector performance. Parameter 226 (Motor NP FLA) must be set to the motor nameplate full load amps before running the Autotune procedure.<br>0 = Ready/Idle (Default)<br>1 = Static Tune<br>2 = Rotate Tune<br>**Ready (0) –** Parameter returns to this setting following a Static Tune or Rotate Tune.<br>**Static Tune (1) –** A temporary command that initiates a non-rotational motor stator resistance test for the best possible automatic setting of Parameter 228 (IR Voltage Drop). A start command is required within 30 seconds of setting this parameter following initiation of this setting. The parameter returns to Ready (0) following the test, at which time another start transition is required to operate the drive in normal mode. Used when motor cannot be uncoupled from the load.<br>**Rotate Tune (2) –** A temporary command that initiates a Static Tune followed by a rotational test for the best possible automatic setting of Parameter 229 (Flux Current Ref). A start command is required following initiation of this setting. The parameter returns to Ready (0) following the test, at which time another start transition is required to operate the drive in normal mode. | Parameter Number | 227 |
|---|---|---|
| | Related Parameters | 225, 226, 228, 229 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 3 |
| | Default Value | 0 |

**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 to disconnect the motor from the load before you continue.

**IMPORTANT** Used when motor is uncoupled from the load. Results may not be valid if a load is coupled to the motor during this procedure. Applies to rotate tune only.

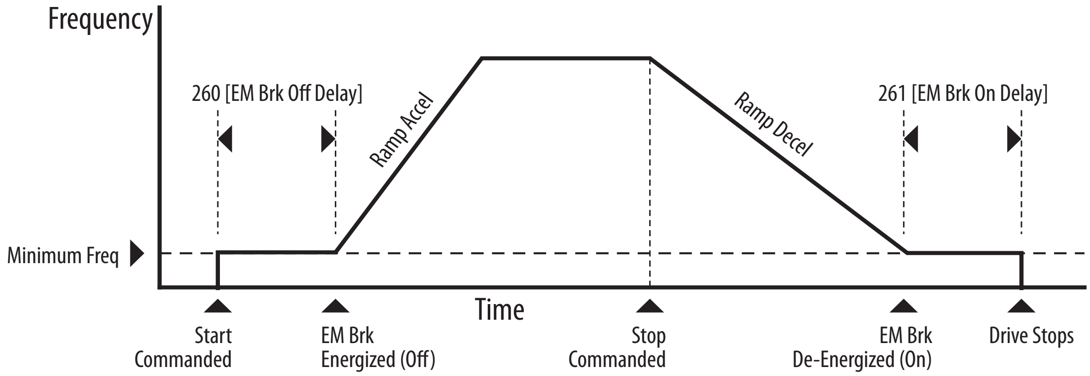
If the Autotune routine fails, an F80 SVC Autotune fault is displayed.

| **IR Voltage Drop**<br><br>Value of volts dropped across the resistance of the motor stator. | Parameter Number | 228 |
|---|---|---|
| | Related Parameters | 227 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.1V AC |
| | Minimum Value | 0.0 |
| | Maximum Value | 230 |
| | Default Value | Based on Drive Rating |

| **Flux Current Ref**<br><br>Value of amps for full motor flux. | Parameter Number | 229 |
|---|---|---|
| | Related Parameter | 227 |
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | 0.01 A |
| | Minimum Value | 0.00 |
| | Maximum Value | Motor NP Volts |
| | Default Value | Based on Drive Rating |

| **EM Brk OFF Delay**<br><br>Sets the time that the drive will remain at minimum frequency before ramping to the commanded frequency and energizing the brake coil relay when Parameter 137 (Stop Mode) is set to Option 8 or 9. | Parameter Number | 260 |
|---|---|---|
| | Related Parameters | 134, 137 |
| | Access Rule | GET/SET |
| | Data Type | UNIT |
| | Group | Drive Advanced Setup |
| | Units | 0.01 sec |
| | Minimum Value | 0.01 sec |
| | Maximum Value | 10 sec |
| | Default Value | 0.0 sec |

**Figure 69 - EM Brk OFF Delay**




| **EM Brk On Delay**<br><br>Sets the time that the drive will remain at minimum frequency before stopping and de-energizing the brake coil relay when Parameter 137 (Stop Mode) is set to Option 8 or 9. | Parameter Number | 261 |
|---|---|---|
| | Related Parameters | 134, 137 |
| | Access Rule | GET/SET |
| | Data Type | UNIT |
| | Group | Drive Advanced Setup |
| | Units | 0.01 sec |
| | Minimum Value | 0.01 sec |
| | Maximum Value | 10.00 sec |
| | Default Value | 0.0 sec |

| **MOP Reset Sel**<br><br>Sets the drive to save the current MOP Reference command.<br>0 = Zero MOP Ref<br>This option clamps Parameter 169 (Internal Freq) at 0.0 Hz when drive is not running.<br>1 = Save MOP Ref (Default)<br>Reference is saved in Parameter 169 (Internal Freq). | Parameter Number | 262 |
|---|---|---|
| | Related Parameters | 169 |
| | Access Rule | Get/Set |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 1 |

| **DB Threshold**<br><br>Sets the DC bus Voltage Threshold for Dynamic Brake operation. If the DC bus voltage falls below the value set in this parameter, the Dynamic Brake will not turn on. Lower values will make the Dynamic Braking function more responsive, but may result in nuisance Dynamic Brake activation. | Parameter Number | 263 |
|---|---|---|
| | Access Rule | GET/SET |
| | Data Type | UINT |
| | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0.0% |
| | Maximum Value | 110.0% |
| | Default Value | 100% |

**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% must be carefully evaluated to make sure that wattage rating of the dynamic brake resistors is not exceeded. In general, values less than 90% are not needed. This parameter setting is especially important if Parameter 182 (DB Resistor Sel) is set to "2" (No Protection).

| **Comm Write Mode** | Parameter Number | 264 |
|---|---|---|
| Determines whether the parameter changes that were made over the communication port are saved and stored in Non-Volatile Storage (NVS) or RAM only. If they are stored in RAM, the values will be lost at power-down. | Access Rule | GET/SET |
| 0 = Save (Default) | Data Type | BOOL |
| 1 = RAM Only | Group | Drive Advanced Setup |
| | Units | — |
| | Minimum Value | 0 |
| | Maximum Value | 1 |
| | Default Value | 0 |

**ATTENTION:** Risk of equipment damage exists. If a controller is programmed to write parameter data to Non-Volatile Storage (NVS) frequently, the NVS will quickly exceed its lifecycle and cause the drive to malfunction. Do not create a program that frequently uses configurable outputs to write parameter data to NVS unless Parameter 264 (Comm Write Mode) is set to Option 1.

# Linear List of Parameters for Bulletins 281E and 284E

**Table 26 - ArmorStart Parameters**

| Parameter Number | Parameter Name | Description | Factory Default | Group | Controller |
|---|---|---|---|---|---|
| 1 | Hdw Inputs | This parameter provides status of hardware inputs. | 0 | Basic Status | Common |
| 2 | Network Inputs | This parameter provides status of network inputs. | 0 | Basic Status | Common |
| 3 | Network Outputs | This parameter provides status of network outputs. | 0 | Basic Status | Common |
| 4 | Trip Status | This parameter provides trip identification. | 0 | Basic Status | Common |
| 5 | Starter Status | This parameter provides the status of the starter. | 0 | Basic Status | Common |
| 6 | InternalLinkStat | Status of the internal network connections. | 0 | Basic Status | Common |
| 7 | Starter Command | The parameter provides the status of the starter command. | 0 | Basic Status | Common |
| 8 | Network Override | This parameter lets the local logic override a Network fault. | 0 | Misc. Configuration | Common |
| 9 | Comm Override | This parameter lets local logic override an absence of an I/O connection. | 0 | Misc. Configuration | Common |
| 13 | Prod Assy Word 0 | This parameter is used to build bytes 0…1 for produced assembly 150 or 151. | 1 | Network Configuration | Common |
| 14 | Prod Assy Word 1 | This parameter is used to build bytes 2…3 for produced assembly 150 or 151. | 1 | Network Configuration | Common |
| 15 | Prod Assy Word 2 | This parameter is used to build bytes 4…5 for produced assembly 150 or 151. | 1 | Network Configuration | Common |
| 16 | Prod Assy Word 3 | This parameter is used to build bytes 6…7 for produced assembly 150 or 151. | 1 | Network Configuration | Common |
| 22 | Breaker Type | This parameter identifies the Bulletin 140M used in this product. | 0 = 140M-D8N-C10 | Basic Status | Common |
| 23 | Pr FltReset Mode | This parameter configures the Protection Fault reset mode. | 0 = Manual | Starter Protection | Common |
| 24 | Pr Fault Enable | This parameter enables the Protection Fault by setting the bit to 1. | 12419 | Starter Protection | Common |
| 25 | Pr Fault Reset | This parameter resets the Protection Fault on a transition 0 > 1. | 0 | Starter Protection | Common |
| 26 | Str Net FltState | This parameter along with Parameter 27 (Str Net FltValue), defines how the starter will respond when a fault occurs as determined by Parameter 27. | 0 = Goto Fault Value | Starter Protection | Common |
| 27 | Str Net FltValue | This parameter determines how the starter will be commanded if a fault occurs. | 0 = OFF | Starter Protection | Common |
| 28 | Str Net IdlState | This parameter determines response when Idle fault occurs. | 0 = Goto Fault Value | Starter Protection | Common |
| 29 | Str Net IdlValue | This parameter determines the state that starter assumes when the network is idle and Parameter 28 (Str Net IdlState) is set to "Goto Fault Value". | 0 = OFF | Starter Protection | Common |
| 30 | Off-to-On Delay | This parameter lets the installer program a time duration before being reported ON. | 0 | User I/O Configuration | Common |
| 31 | On-to-Off Delay | This parameter lets the installer program a time duration before being reported OFF. | 0 | User I/O Configuration | Common |
| 32 | In Sink/Source | This parameter lets the installer program the inputs to be sink or source. | 0 = Sink | User I/O Configuration | Common |
| 33 | OutA Pr FltState | This parameter along with Parameter 34 (OutA Pr FltValue), defines how Output A will respond when a trip occurs. | 0 = Goto PrFlt Value | User I/O Configuration | Common |
| 34 | OutA Pr FltValue | This parameter determines the state the Output A. | 0 = Open | User I/O Configuration | Common |

**Table 26 - ArmorStart Parameters**

| Parameter Number | Parameter Name | Description | Factory Default | Group | Controller |
|---|---|---|---|---|---|
| 35 | OutA Net FltState | This parameter along with Parameter 36 (OutA Net FltValue), defines how Output A will respond. | 0 = Goto Fault Value | User I/O Configuration | Common |
| 36 | OutA Net FltValue | This parameter determines the state that Output. | 0 = Open | User I/O Configuration | Common |
| 37 | OutA Net IdlState | This parameter along with Parameter 38 (OutA Net IdlValue), defines how Output A will respond when the network is idle. | 0 = Goto Idle Value | User I/O Configuration | Common |
| 38 | OutA Net IdlValue | This parameter determines the state that Output A assumes when the network is idle and Parameter 37 (OutA Net IdlState) is set to "0". | 0 = Open | User I/O Configuration | Common |
| 39 | OutB Pr FltState | This parameter along with Parameter 40 (OutB Pr FltValue), defines how Output B will respond when a protection trip occurs. | 0 = Goto PrFlt Value | User I/O Configuration | Common |
| 40 | OutB Pr FltValue | This parameter determines the state the Out B assumes when a protection trip occurs and Parameter 39 (OutB Pr FltState) is set to "0". | 0 = Open | User I/O Configuration | Common |
| 41 | OutB Net FltState | This parameter along with Parameter 42 (OutB Net FltValue), defines how Output B will respond when a network fault occurs. | 0 = Goto Idle Value | User I/O Configuration | Common |
| 42 | OutB Net FltValue | This parameter determines the state that Output B assumes when a network fault occurs and Parameter 41 (OutB Net FltState) is set to "0". | 0 = Open | User I/O Configuration | Common |
| 43 | OutB Net IdlState | This parameter along with Parameter 44 (OutB Net IdlValue), defines how Output B will respond when the network is idle. | 0 = Goto PrFlt Value | User I/O Configuration | Common |
| 44 | OutB Net IdlValue | This parameter determines the state that Output B assumes when the network is idle and Parameter 43 (OutB Net IdlState) is set to "0". | 0 = Open | User I/O Configuration | Common |
| 45 | Keypad Mode | This parameter selects if the keypad operation is maintained or momentary. | 0 = Maintained | Misc. Configuration | Common |
| 46 | Keypad Disable | This parameter disables all keypad function except for the OFF and RESET buttons. | 0 = Not Disabled | Misc. Configuration | Common |
| 47 | Set To Defaults | This parameter if set to 1 will set the device to the factory defaults. | 0 = No Operation | Misc. Configuration | Common |
| 48 | Drive Control | This parameter provides the status of drive parameters. | 0 | Drive I/O Configuration | 284E |
| 49 | DrvIn Pr FltState | This parameter, along with Parameter 50 (DrvIn Pr FltValue), defines how the Drive Digital Inputs 1…4 will respond when a protection trip occurs. | 0 = Go to PrFlt Value | Drive I/O Configuration | 284E |
| 50 | DrvIn Pr FltValue | This parameter determines the state of Drive Digital Inputs 1…4, assumes when a trip occurs. | 0 = Open | Drive I/O Configuration | 284E |
| 51 | DrvIn Net FltState | This parameter, along with Parameter 52 (DrvIn Net FltValue), defines how the Drive Digital Inputs 1…4 will respond when a network fault occurs. | 0 = Go to Fault Value | Drive I/O Configuration | 284E |
| 52 | DrvIn Net FltValue | This parameter determines the state of Drive Digital Inputs 1…4 when a network fault occurs and Parameter 51 (DrvIn Net FltState) is set to "0". | 0 = OFF | Drive I/O Configuration | 284E |
| 53 | DrvIn Net FltState | This parameter, along with Parameter 54 (DrvIn Net FltValue), defines how the Drive Digital Inputs 1…4 will respond when a DeviceNet™ network is idle. | 0 = Go to Fault Value | Drive I/O Configuration | 284E |
| 54 | DrvIn Net FltValue | This parameter determines the state that Drive Digital Inputs 1…4 assume when the network is idle and Parameter 53 (DrvIn Net FltState) is set to "0". | 0 = OFF | Drive I/O Configuration | 284E |
| 56 | Base Enclosure | Indicates the ArmorStart Base unit enclosure rating. | 1 | Basic Status | Common |

**Table 26 - ArmorStart Parameters**

| Parameter Number | Parameter Name | Description | Factory Default | Group | Controller |
|---|---|---|---|---|---|
| 57 | Base Options | Indicates the options for the ArmorStart Base unit. | 0 | Basic Status | Common |
| 58 | Wiring Options | This parameter provides the Wiring Options. | 0 | Basic Status | Common |
| 59 | Starter Enclosure | This parameter provides the Starter Enclosure. | 1 | Basic Status | Common |
| 60 | Starter Options | This parameter provides the Starter Options. | 0 | Basic Status | Common |
| 61 | Last PR Fault | This parameter provides the Last PR Fault. | 0 = None | Basic Status | Common |
| 62 | Warning Status | This parameter provides the Warning Status. | 0 | Basic Status | Common |
| 63 | Base Trip | This parameter provides the Base Module Trip Status. | 0 | Basic Status | Common |
| 101 | Phase A Current | This parameter provides the current of Phase A. | 0 | Starter Display | DOL |
| 102 | Phase B Current | This parameter provides the current of Phase B. | 0 | Starter Display | DOL |
| 103 | Phase C Current | This parameter provides the current of Phase C. | 0 | Starter Display | DOL |
| 104 | Average Current | This parameter provides the average current. | 0 | Starter Display | DOL |
| 105 | Therm Utilized | This parameter displays the % Thermal Capacity used. | 0 | Starter Display | DOL |
| 106 | FLA Setting | The full load current rating of the motor | See Table 21. | Starter Setup | DOL |
| 107 | Overload Class | Selects the overload class. | 1 = Overload Class 10 | Starter Setup | DOL |
| 108 | OL Reset Level | Selects the % Thermal Capacity that an overload can be cleared. | 75 | Starter Setup | DOL |
| 101 | Output Freq | Output frequency present at T1, T2 & T3 (U, V & W) | Read Only | Drive Display | 284E |
| 102 | Commanded Freq | Value of the active frequency command | Read Only | Drive Display | 284E |
| 103 | Output Current | Output current present at T1, T2 & T3 (U, V & W) | Read Only | Drive Display | 284E |
| 104 | Output Voltage | Output voltage present at T1, T2 & T3 (U, V & W) | Read Only | Drive Display | 284E |
| 105 | DC Bus Voltage | Present DC bus voltage level | Read Only | Drive Display | 284E |
| 106 | Drive Status | Present operating condition of the drive. | Read Only | Drive Display | 284E |
| 107…109 | Fault x Code | A code that represents a drive fault. | Read Only | Drive Display | 284E |
| 110 | Process Display | The output frequency that is scaled by Parameter 199 (Process Factor). | Read Only | Drive Display | 284E |
| 112 | Control Source | Displays the source of the Start Command and Speed Reference. | 5 = RS485 (DSI) Port | Drive Display | 284E |
| 113 | Control In | Status of control inputs. These can be used in DeviceLogix | Read Only | Drive Display | 284E |
| 114 | Dig In Status | Status of the control terminal block digital inputs. | 0 | Drive Display | 284E |
| 115 | Comm Status | Status of the communications ports | 0 | Drive Display | 284E |
| 116 | Control SW Ver | Main Control Board software version for AC Drive. | Read Only | Drive Display | 284E |
| 118 | Elapsed Run Time | Accumulated time drive is outputting power. | Read Only | Drive Display | 284E |
| 122 | Output Power | Output power present at T1, T2 & T3 (U, V & W). | Read Only | Drive Display | 284E |
| 123 | Output Power Fctr | The angle in electrical degrees between motor voltage and motor current. | Read Only | Drive Display | 284E |
| 124 | Drive Temp | Present operating temperature of the drive power section. | Read Only | Drive Display | 284E |
| 125 | Counter Status | The current value of the counter when the counter is enabled. | Read Only | Drive Display | 284E |
| 126 | Timer Status | The current value of the timer when timer is enabled. | Read Only | Drive Display | 284E |
| 129 | Torque Current | Displays the current value of the motor torque current as measured by the drive. | Read Only | Drive Display | 284E |

**Table 26 - ArmorStart Parameters**

| Parameter Number | Parameter Name | Description | Factory Default | Group | Controller |
|---|---|---|---|---|---|
| 131 | Motor NP Volts | Set to the motor nameplate rated volts. | Based on Drive Rating | Drive Setup | 284E |
| 132 | Motor NP Hertz | Set to the motor nameplate rated frequency. | 60 Hz | Drive Setup | 284E |
| 133 | Motor OL Current | Set to the maximum allowable current. | Based on Drive Rating | Drive Setup | 284E |
| 134 | Minimum Freq | Sets the lowest frequency that the drive will output continuously. | 0.0 Hz | Drive Setup | 284E |
| 135 | Maximum Freq | Sets the highest frequency that the drive will output continuously. | 60 Hz | Drive Setup | 284E |
| 136 | Start Source | Sets the control scheme that is used to start the Bulletin 284E ArmorStart controller. | 5 = Comm Port (RS485 (DSI)) | Drive Setup | 284E |
| 137 | Stop Mode | Sets the Valid Stop Mode for the Bulletin 284E ArmorStart controller. | 9 = Ramp + EM Brk | Drive Setup | 284E |
| 138 | Speed Reference | Sets the Valid Speed References for the Bulletin 284E ArmorStart controller. | 5 = Comm Port | Drive Setup | 284E |
| 139 | Accel Time 1 | Sets the rate of acceleration for all speed increases. | 10.0 s | Drive Setup | 284E |
| 140 | Decel Time 1 | Sets the rate of deceleration for all speed decreases. | 10.0 s | Drive Setup | 284E |
| 141 | Reset To Defaults | Used to reset drive to factory default settings | 0 = Ready/Idle | Drive Setup | 284E |
| 143 | Motor OL Ret | Enables/Disables the Motor Overload Retention function. | 0 = Disabled | Drive Setup | 284E |

**Table 27 - Bulletin 284E Advance Setup Parameter Descriptions**

| Parameter Number | Parameter Name | Description | Factory Default | Group |
|---|---|---|---|---|
| 151…154 | Digital In 1 Sel<br>Digital In 2 Sel<br>Digital In 3 Sel<br>Digital In 4 Sel | Selects the function for the digital inputs. | See Table 22. | Drive Advanced Setup |
| 155 | Relay Out Sel | Sets the condition that changes the state of the output relay contacts. | 0 = Ready/Fault<br>See Table 23. | Drive Advanced Setup |
| 156 | Relay Out Level | Sets the trip point for the digital output relay if the value of Parameter 155 (Relay Out Sel) is 6, 7, 8, 10, 16, 17, 18, or 20. | 0.0 | Drive Advanced Setup |
| 169 | Internal Freq | Provide the frequency command to drive when Parameter 138 (Speed Reference) is set to "1" (Internal Freq). | 60.0 Hz | Drive Advanced Setup |
| 170…177 | Preset Freq 0<br>Preset Freq 1<br>Preset Freq 2<br>Preset Freq 3<br>Preset Freq 4<br>Preset Freq 5<br>Preset Freq 6<br>Preset Freq 7 | Provides a fixed frequency command value when Parameters 151…154 (Digital In x Sel) is set to Option 4 (Preset Frequencies). | See Table 24. | Drive Advanced Setup |
| 178 | Jog Frequency | Sets the output frequency when the jog command is issued. | 10.0 Hz | Drive Advanced Setup |
| 179 | Jog Accel/Decel | Sets the acceleration and deceleration time when a jog command is issued. | 10.0 s | Drive Advanced Setup |
| 180 | DC Brake Time | Sets the length of time that DC brake current is injected into the motor. See Parameter 181 (DC Brake Level). | 0.0 s | Drive Advanced Setup |

**Table 27 - Bulletin 284E Advance Setup Parameter Descriptions**

| Parameter Number | Parameter Name | Description | Factory Default | Group |
|---|---|---|---|---|
| 181 | DC Brake Level | Defines the maximum DC brake current, in amps, applied to the motor when Parameter 137 (Stop Mode) is set to either Ramp or DC Brake. | Drive Rated amps x 0.05 | Drive Advanced Setup |
| 182 | DB Resistor Sel | Used to set percent duty cycle for external dynamic braking. | 0 = Disabled | Drive Advanced Setup |
| 183 | S Curve % | Sets the percentage of acceleration or deceleration time that is applied to ramp as S Curve. Time is added, half at the beginning and half at the end of the ramp. | 0% (Disabled) | Drive Advanced Setup |
| 184 | Boost Select | Sets the boost voltage (% of Parameter 131 (Motor NP Volts)) and redefines the Volts per Hz curve. Active when Parameter 225 (Torque Perf Mode) = 0 (V/Hz). Drive may add additional voltage unless Option 5 is selected. | 8 = 5.0 (2.5 for 5 Hp drives) | Drive Advanced Setup |
| 185 | Start Boost | Sets the boost voltage (% of Parameter 131 (Motor NP Volts)) and redefines the Volts per Hz curve when Parameter 184 (Boost Select) = 0 (Custom V/Hz) and Parameter 225 (Torque Perf Mode) = 0 (V/Hz). | 2.5% | Drive Advanced Setup |
| 186 | Brake Voltage | Sets the frequency where brake voltage is applied when Parameter 184 (Boost Select) = 0 (Custom V/Hz) and Parameter 225 (Torque Perf Mode) = 0 (V/Hz). | 25.0% | Drive Advanced Setup |
| 187 | Brake Frequency | Sets the frequency where brake frequency is applied when Parameter 184 (Boost Select) = 0 (Custom V/Hz) and Parameter 225 (Torque Perf Mode) = 0 (V/Hz). | 15.0 Hz | Drive Advanced Setup |
| 188 | Maximum Voltage | Sets the highest voltage that the drive will output. | Drive Rated Volts | Drive Advanced Setup |
| 189 | Current Limit 1 | Maximum output current that is allowed before current limiting occurs. | Drive Rated amps x 1.5 | Drive Advanced Setup |
| 190 | Motor OL Select | Drive provides Class 10 motor overload protection. Setting 0…2 select the derating factor for $I^2t$ overload function. | 0 = No Derate | Drive Advanced Setup |
| 191 | PWM Frequency | Sets the carrier frequency for the PWM output waveform. Figure 67 provides derating guidelines that are based on the PWM frequency setting. | 4.0 Hz | Drive Advanced Setup |
| 192 | Auto Rstrt Tries | Set the maximum number of times the drive attempts to reset a fault and restart. | 0 | Drive Advanced Setup |
| 193 | Auto Rstrt Delay | Sets time between restart attempts when Parameter 192 (Auto Rstrt Tries) is set to a value other than zero. | 1.0 s | Drive Advanced Setup |
| 194 | Start At PowerUp | Enables/disables a feature that lets a Start or Run command automatically cause the drive to resume running at command speed after the drive input is restored. | 0 = Disabled | Drive Advanced Setup |
| 195 | Reverse Disable | Enables/disables the function that lets the direction of the motor rotation be changed. | 0 = Disabled | Drive Advanced Setup |
| 196 | Flying Start En | Sets the condition that lets the drive reconnect to a spinning motor at actual RPM. | 0 = Disabled | Drive Advanced Setup |
| 197 | Compensation | Enables/disables correction options that may improve problems with motor instability. | 1 = Electrical | Drive Advanced Setup |
| 198 | SW Current Trip | Enables/disables a software instantaneous (within 100 ms) current trip. | 0.0 (Disabled) | Drive Advanced Setup |
| 199 | Process Factor | Scales the output frequency value that is displayed by Parameter 110 (Process Display). | 30.0 | Drive Advanced Setup |
| 200 | Fault Clear | Resets a fault and clears the fault queue. | 0 = Ready/Idle | Drive Advanced Setup |
| 201 | Program Lock | Protects parameters against change by unauthorized personnel. | 0 = Unlocked | Drive Advanced Setup |
| 205 | Comm Loss Action | Selects the drive's response to a loss of the communication connection or excessive communication errors. | 0 = Fault | Drive Advanced Setup |
| 206 | Comm Loss Time | Sets the time that the drive remains in communication loss before implanting the option selected in Parameter 205 (Comm Loss Action). | 15.0 s | Drive Advanced Setup |

**Table 27 - Bulletin 284E Advance Setup Parameter Descriptions**

| Parameter Number | Parameter Name | Description | Factory Default | Group |
|---|---|---|---|---|
| 214 | Slip Hertz @ FLA | Compensates for the inherent slip in an induction motor. This frequency is added to the commanded output frequency based on motor current. | 2.0 Hz | Drive Advanced Setup |
| 215 | Process Time Lo | Scales the time value when the drive is running at Parameter 134 (Minimum Freq). When set to a value other than zero, Parameter 110 (Process Display) indicates the duration of the process. | 0.00 | Drive Advanced Setup |
| 216 | Process Time Hi | Scales the time value when the drive is running at Parameter 135 (Maximum Freq). When set to a value other than zero, Parameter 110 (Process Display) indicates the duration of the process. | 0.00 | Drive Advanced Setup |
| 217 | Bus Reg Mode | Enables the bus regulator. | 1 = Enabled | Drive Advanced Setup |
| 218 | Current Limit 2 | Maximum output current that is allowed before current limiting occurs. | Drive Rated Amps x 1.5 | Drive Advanced Setup |
| 219 | Skip Frequency | Sets the frequency at which the drive will not operate. | 0.0 Hz | Drive Advanced Setup |
| 220 | Skip Freq Band | Determines the brand width around Parameter 219 (Skip Frequency). Parameter 220 (Skip Freq Band) is split applying 1/2 above and 1/2 below the actual skip frequency. | 0.0 Hz | Drive Advanced Setup |
| 221 | Stall Fault Time | Sets for the fault time that the drive will remain in stall mode before a fault is issued. | 0 = 60 Seconds | Drive Advanced Setup |
| 224 | Var PWM Disable | Enables/disables a feature that varies the carrier frequency for the PWM output waveform that is defined by Parameter 191 (PWM Frequency). | 0 = Enabled | Drive Advanced Setup |
| 225 | Torque Perf Mode | Enables/disables sensorless vector control operation. | 1 = Sensrls Vect | Drive Advanced Setup |
| 226 | Motor NP FLA | Set to the motor nameplate full load amps. | Drive Rated Amps | Drive Advanced Setup |
| 227 | Autotune | Provides an automatic method for setting Parameter 228 (IR Voltage Drop) and Parameter 229 (Flux Current Ref), that affect sensorless vector performance. | 0 = Ready/Idle | Drive Advanced Setup |
| 228 | IR Voltage Drop | Value of volts dropped across the resistance of the motor stator. | Based on Drive Rating | Drive Advanced Setup |
| 229 | Flux Current Ref | Value of amps for full motor flux. | Based on Drive Rating | Drive Advanced Setup |
| 260 | EM Brk OFF Delay | Sets the time that the drive will remain at minimum frequency before ramping to the commanded frequency and energizing the brake coil relay when Parameter 137 (Stop Mode) is set to Option 8 or 9. | 0.0 s | Drive Advanced Setup |
| 261 | EM Brk On Delay | Sets the time that the drive will remain at minimum frequency before stopping and de-energizing the brake coil relay when Parameter 137 (Stop Mode) is set to Option 8 or 9. | 0.0 s | Drive Advanced Setup |
| 262 | MOP Reset Sel | Sets the drive to save the current MOP Reference command. | 1 = Save MOP Ref | Drive Advanced Setup |
| 263 | DB Threshold | Sets the DC bus Voltage Threshold for Dynamic Brake operation. | 100% | Drive Advanced Setup |
| 264 | Comm Write Mode | Determines whether parameter changes made over the communication port are saved and stored in Non-Volatile Storage (NVS) or RAM only. | 0 = Save | Drive Advanced Setup |

# How to Configure an Explicit Message

## Programming ControlLogix Explicit Message

### Explicit Messaging with ControlLogix

In the ControlLogix platform, explicit messaging can be done easily from within a logic program. The request and response is configured within the MSG function. The MSG function can be found in the Input/Output tab of Studio 5000.

### Configuring the MSG Instruction

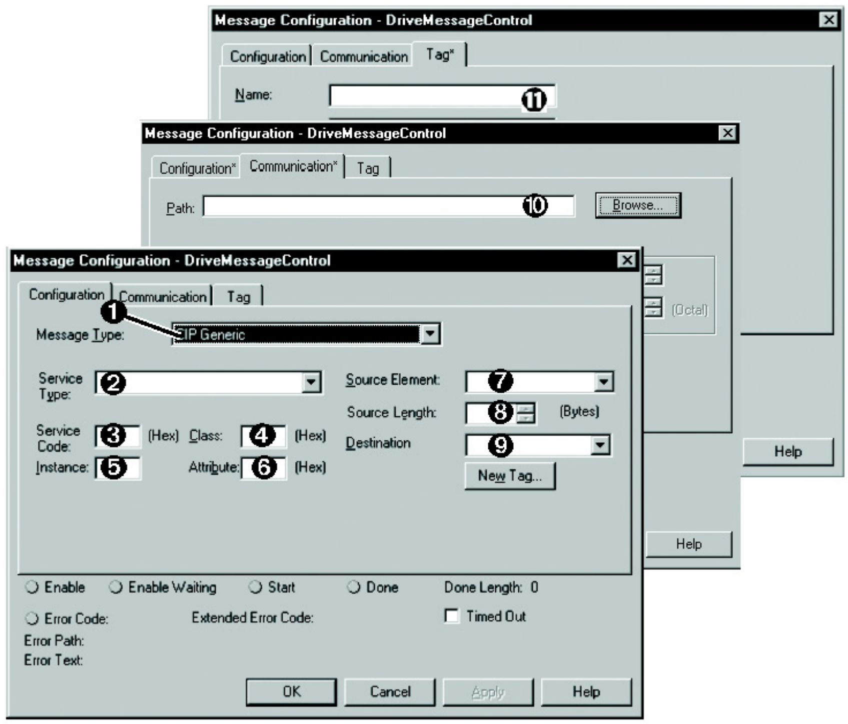
A tag name must be given to the MSG function before the rest of the information can be defined. In this example, a tag was created with the name explicit_mess. After the instruction has been named, click the gray box [...] to define the rest of the instruction.

**Figure 70 - MSG Function Found in the Input/Output Tab**

## Formatting an Explicit Message

ControlLogix scanners and bridges accommodate both downloading Explicit Message Requests and uploading Explicit Message Responses. The message format is shown in Figure 71.

**Figure 71 - ControlLogix Message Format in Studio 5000**



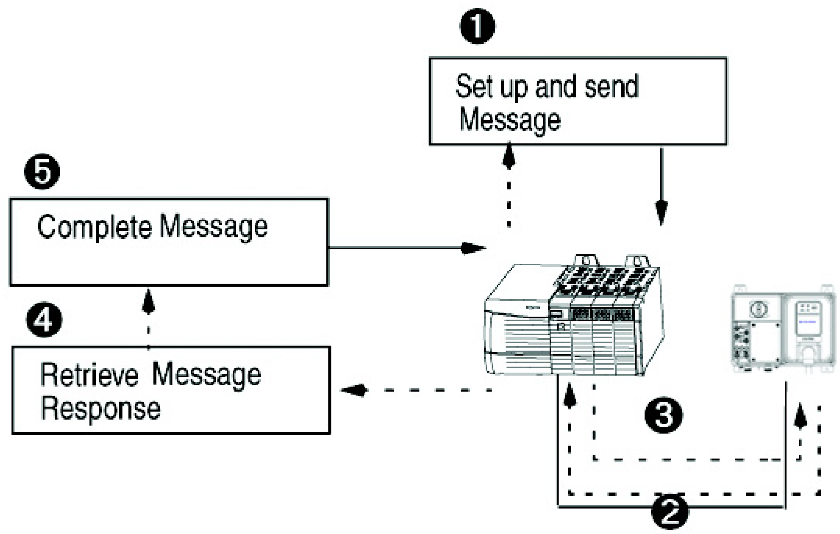

| Box | Description |
|---|---|
| ❶ | **Message Type**<br>The message type is usually CIP Generic. |
| ❷ | **Service Type**<br>The service type indicates the service (for example, Get Attribute Single or Set Attribute Single) that you want to perform. |
| ❸ | **Service Code**<br>The service code is the 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.<br>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). |
| ❹ | **Class**<br>The class is an EtherNet/IP class. |
| ❺ | **Instance**<br>The instance is an instance (or object) of an EtherNet/IP class. |
| ❻ | **Attribute**<br>The attribute is a class or instance attribute. |
| ❼ | **Source Element**<br>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. |
| ❽ | **Source Length**<br>This box contains the number of bytes of service data to be sent in the message. |

| Box | Description |
|---|---|
| ❾ | **Destination**<br>This box contains the name of the tag that receives service response data from the module and drive. |
| ❿ | **Path**<br>The path is the route that the message follow.s<br>**Note:** Click **Browse** to find the path or type in the name of a module that you previously mapped. |
| ⓫ | **Name**<br>The name for the message. |

## Performing Explicit Messages

| | |
|---|---|
| **IMPORTANT** | There are five basic events in the Explicit Messaging process that are defined next. The details of each step vary depending on the controller. See the documentation for your controller. |

**Figure 72 - Explicit Message Process**

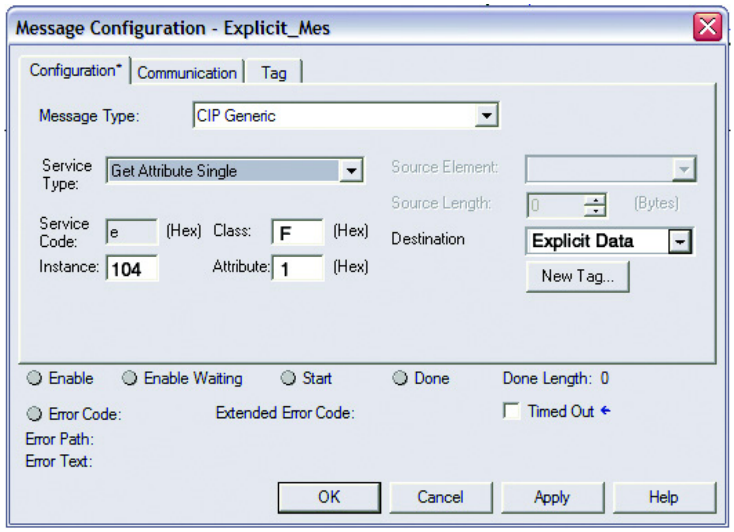



| Box | Description |
|---|---|
| ❶ | Format the required data and set up the ladder logic program to send an Explicit Message Request to the scanner or bridge module (download). |
| ❷ | The scanner or bridge module transmits the Explicit Message Request to the slave device over the EtherNet/IP network. |
| ❸ | The slave device transmits the Explicit Message Response back to the scanner. The data is stored in the scanner buffer. |
| ❹ | The controller retrieves the Explicit Message Response from the buffer of the scanner (upload). |
| ❺ | The Explicit Message is complete. |

The MSG (message) instruction handles all explicit messaging that is initiated by a Logix Controller program.

It automatically creates and manages TCP connections and CIP encapsulation sessions. You have no direct influence on this process.

**Figure 73 - Example — Message Configuration Tab**




The Class, Instance, and Attribute define the actual information being requested. Additional configurations of these parameters can be found in Appendix B.

# Diagnostics

## Overview

This chapter describes the fault diagnostics of the ArmorStart distributed motor controller and the conditions that cause various faults to occur.

### Protection Programming

Many of the protective features available with the ArmorStart distributed motor controller can be enabled and adjusted through the programming parameters provided. For further details on programming, see Chapter 7, Bulletin 281E/284E Programmable Parameters.

## Fault Display

The ArmorStart distributed motor controller comes equipped with a built-in Light-emitting Diode (LED) status indication that provides four status LEDs and a Reset button.

**Figure 74 - LED Status Indication and Reset**


## Clear Fault

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 “Fault Reset” parameter.

- Locally via the “Reset” button on the LED Status indication keypad.

# Fault Codes

Table 28 provides a reference of the Fault LED status indications for Bulletin 281E and Bulletin 284E distributed motor controllers.

**Table 28 - Fault Indication**

| Blink Pattern | Fault Types | |
|---|---|---|
| | Bulletin 281E Controller | Bulletin 284E Controller |
| 1 | Short Circuit | Short Circuit |
| 2 | Overload Trip | Overload Trip |
| 3 | Phase Loss | Phase Short |
| 4 | Reserved | Ground Fault |
| 5 | Reserved | Stall |
| 6 | Control Power | Control Power |
| 7 | I/O Fault | I/O Fault |
| 8 | Over Temperature | Over Temperature |
| 9 | Phase Imbalance | Over Current |
| 10 | A3 Power Loss | A3 Power Loss |
| 11 | Reserved | Internal Communications |
| 12 | Reserved | DC Bus Fault |
| 13 | EEPROM Fault | EEPROM Fault |
| 14 | Hardware Fault | Hardware Fault |
| 15 | Reserved | Restart Retries |
| 16 | Reserved | Misc. Fault |

# Fault Definitions

## Short Circuit

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.

## Overload Trip

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.

A Bulletin 281 controller with a mechanical motor brake actuator that is connected to motor out leads, can cause nuisance phase imbalance or overload faults when used on 1 Hp (0.73 kW) or smaller loads. Current is elevated in the legs that influence the electronic overload on 1 Hp (0.73 kW) or smaller loads. Adjust the Full Load Amps (FLA) setting to offset this additional current, if necessary.

## Phase Loss

Indicates a missing supply phase. This fault can be disabled and is disabled by default.

## Phase Short

Indicates that the drive has detected a phase short. This fault cannot be disabled.

## Ground Fault

Indicates that the drive has detected a ground fault. This fault cannot be disabled.

## Stall

Indicates that the drive has detected a stall condition, which indicates the motor, has not reached full speed. This fault cannot be disabled.

## Control Power

Indicates a loss of control power voltage or a blown control power circuit. This fault can be disabled and *is* disabled by default.

## I/O Fault

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.

## Over Temperature

Indicates that the operating temperature has been exceeded. This fault cannot be disabled.

## Phase Imbalance

Indicates an imbalance supply voltage. This fault can be disabled and *is* disabled by default.

## Over Current

Indicates that the drive has detected an overcurrent fault. This fault cannot be disabled.

## A3 Power Loss

Power has been lost or has dropped below the 12V threshold. This fault can be disabled and *is* disabled by default.

## Internal Communication Fault

Indicates that an internal communication fault has been detected. This fault cannot be disabled.

## DC Bus Fault

Indicates that the drive has detected a DC Bus Fault. This fault cannot be disabled.

## Electrically Erasable Programmable Read-only Memory (EEPROM) Fault

A major fault that renders the ArmorStart controller inoperable. This fault cannot be disabled.

## Hardware Fault

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.

## Restart Retries

This fault is generated when the drive detects that the auto retries count has been exceeded. This fault cannot be disabled.

### Miscellaneous Faults

For Bulletin 284E units, this fault is actually the logical of several drive faults that are not specifically enumerated. The faults include DB1 Brake fault, Heatsink Over Temperature (fault code F8), Params Defaulted fault (fault code F48), and SVC Autotune fault (fault code F80).

This fault cannot be disabled.

## EtherNet/IP LED Status Indication

EtherNet/IP LED status and diagnostics consist of four LEDs.

- Link Activity/Status LEDs
  - Link1 Activity/Status (Port 1) – LED Color: Bicolor (Green/Yellow), see Table 29
  - Link2 Activity/Status (Port 2) – LED Color: Bicolor (Green/Yellow), see Table 29
- "MOD" LED – Bicolor Red/Green represents the Ethernet Module status, see Table 30
- "NET" LED – Bicolor Red/Green represents the Ethernet Network status, see Table 32

**Figure 75 - EtherNet/IP LED**

**Table 29 - 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 30 - Module Status Indicator**

| MOD Status LED | Summary | Requirement |
|---|---|---|
| Steady OFF | No power | If no power is supplied to the device, the module status indicator is steady OFF. |
| Steady Green | Device operational | If the device is operating correctly and the PLC is in Run mode, the module status indicator is steady green. |
| Flashing Green | Standby | If the device has not been configured or the PLC is not in Run mode, the module status indicator is flashing green. |
| Flashing Red | Minor fault | If the device has detected a recoverable minor fault, the module status indicator is flashing red.<br>**Note:** An incorrect or inconsistent configuration would be considered a minor fault. |
| Steady Red | Major fault | If the device has detected a non-recoverable major fault, see Table 31. |
| Flashing Green/Red | Self-test | While the device is performing its power-up test, the module status indicator is flashing green/red. |

See Parameter 63 "Base Trip" for the Base Module Trip Status.

**Table 31 - "Steady Red" MOD LED Status** (See Table 30.)

| | Fault Type | Description |
|---|---|---|
| 0 | EEPROM Fault | Nonvolatile memory value out of range for a local parameter, or a write failure is detected. A solid red MOD status LED also shows this fault. |
| 1 | Internal Comm2 | The Internal communication connection has timed out. A flashing red MOD status LED also shows this fault. |
| 2 | Hardware Fault | Internal diagnostics checks failed. A solid red MOD status LED also shows this fault. |
| 3 | Control Module | An illegal or unsupported Control Module product code or revision has been detected. Also reported if no Control Module is detected on power-up. A solid red MOD status LED also shows this fault. |
| 4…15 | Reserved | Reserved |

**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. |

## Control Module LED Status and Reset

The Control Module LED status and diagnostics consist of four status LEDs and a Reset button. The following is a brief explanation of the operation of each LED found on the Control Module.

**Figure 76 - LED Status Indication and Reset**


**Table 33 - Control Module LED 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 is present. | Verify that 24V DC is present on A1 and A3. Check if you are properly commanding to RUN via Instance 162 or 166.<br>Verify that the safety function is satisfied for the safety version controller. Check that the safety I/O module output for SO (P/M) is on. |
| Network | This bicolor LED is used to indicate the status of the internal network connection. | See Table 32, Network Status Indicator for additional information. |
| Fault | This LED is used to indicate the fault status of the ArmorStart controller. When the unit is faulted, the unit responds with a specific blink pattern to identify the fault. | See Table 34 and Table 35 for additional information. |

The “Reset Button” is a local trip reset.

## Control Module Fault LED Indications

The PrFlt Reset Mode (Parameter 23) determines how a fault is reset. When this parameter is set to the value 0 = manual mode, a local or remote fault reset is required to reset the fault. When this parameter is set to the value 1 = auto reset, faults are cleared automatically when the fault condition goes away. See Table 35 for the Bulletin 284 controller, in addition to the “Pr FltReset Mode”, the Auto Rstrt Tries (Parameter 192) must be set greater than 0.

**NOTE:** The “Pr FltReset Mode” parameter takes precedence. Therefore if P23 is set to manual, there is no effect when you change P192 to a value greater than 0.

**Table 34 - Fault LED Indicators for Bulletin 281E Controllers**

| Blink Pattern | Auto-resettable | Bulletin 281E Trip Status | Description | Action |
|---|---|---|---|---|
| 1 | No | Short Circuit | The circuit breaker (140M) has tripped. | Determine cause of trip. Try to reset the circuit breaker by using the disconnect handle. If the conditions continue, check power wiring or replace based module. This fault cannot be disabled. |
| 2 | Yes | Overload | The load has drawn excessive current and based on the trip class that is selected, the device has tripped. | Verify that the load is operating correctly and the ArmorStart controller is properly set up. The fault cannot be disabled. If there is an EM brake on the motor, check if the brake current is a significant percentage compare to the FLA. Adjust FLA to compensate for the brake current. |
| 3 | Yes | Phase Loss | The ArmorStart controller has detected a missing phase. | Verify that 3-phase voltage is present at the line side connections. This fault can be disabled and is disabled by default. |
| 4 | — | Reserved | Not Used | — |
| 5 | — | Reserved | Not Used | — |

**Table 34 - Fault LED Indicators for Bulletin 281E Controllers**

| Blink Pattern | Auto-resettable | Bulletin 281E Trip Status | Description | Action |
|---|---|---|---|---|
| 6 | Yes | Control Pwr Loss (Switched Power) | The ArmorStart controller has detected a loss of the control power voltage. | Check control voltage, wiring, and proper polarity (A1/A2 terminal). Also, check and replace the control voltage fuse, if necessary. This fault can be disabled and is disabled by default. |
| 7 | Yes | Input Fault | This error indicates a shorted sensor, shorted input device, wiring input mistakes, or a blown output fuse. | Correct, isolate, or remove wiring error before restarting the system. This fault can be disabled and is disabled by default. |
| 8 | Yes | Over Temperature | This fault is generated when the operating temperature has been exceeded. This fault cannot be disabled. | Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 40 °C (104 °F). 1. Clear the fault or cycle power to the drive. |
| 9 | Yes | Phase Imbalance | The ArmorStart controller has detected a voltage imbalance. | Check the power system and correct if necessary. This fault can be disabled and is disabled by default. |
| 10 | Yes | Control Power (24V DC) Lost (Unswitched Power) | The 24V DC power supply is below tolerance threshold. | Check the state of the network power supply (A3/A1 terminal) and look for media problems. This fault can be disabled and is disabled by default. |
| 11 | — | Reserved | Not Used | — |
| 12 | — | Reserved | Not Used | — |
| 13 | No | EEprom | This is a major fault that renders the ArmorStart controller inoperable. Possible causes of this fault are transients that are induced during EEPROM storage routines. | If a transient initiated the fault, cycle the power to clear the problem, otherwise replace the ArmorStart controller, if needed. This fault cannot be disabled. |
| 14 | No | Hdw Flt | This fault indicates that a serious hardware problem exists. | Check for a base/starter module mismatch. If no mismatch exists, see parameter 61 for additional fault detail. Replace the ArmorStart controller, if the fault persists.(Hdw Flt is the factory-enabled default setting.) This fault cannot be disabled. |
| 15 | — | Reserved | Not Used | — |
| 16 | — | Reserved | Not Used | — |

**Table 35 - Fault LED Indicators for 284E Controller**

| Bit/Blink Pattern | Auto-resettable(1) | 284E Trip Status | Description | Action |
|---|---|---|---|---|
| 1 | No | Short Circuit | The circuit breaker (140M) has tripped. | Determine cause of trip. Try to reset the circuit breaker by using the disconnect handle. If the conditions continue, check power wiring or replace based module. This fault cannot be disabled. |
| 2 | Drive Controlled | Overload<br>(Drive Codes 7 and 64) | An excessive motor load exists | 1. Reduce load so drive output current does not exceed the current set by Parameter 133 (Motor OL Current).<br>2. Verify Parameter 184 (Boost Select) setting.<br>3. Drive rating of 150% for 1 minute.<br>4. Reduce load or extend Accel Time 200% or when 3 seconds has been exceeded. |
| 3 | Drive Controlled | Phase Short<br>(Drive Codes 38…43) | 1. Phase U, V, or W to Gnd. A phase to ground fault has been detected between the drive and motor in this phase.<br>2. Phase UV, UW, or VW Short. Excessive current has been detected between these two output terminals. | Check the wires between the drive and motor. Check the motor for grounded phase. Check the motor and drive output terminal wires for a shorted condition. Replace drive if fault cannot be cleared. |
| 4 | Drive Controlled | Ground Fault<br>(Drive Code 13) | A current path to earth ground has been detected at one or more of the drive output terminals. | Check the motor and external wiring to the drive output terminals for a grounded condition. |
| 5 | Drive Controlled | Stall<br>(Drive Code 6) | Drive is unable to accelerate motor. | Increase Parameters 139…167 (Accel Time x) or reduce load so drive output current does not exceed the current set by Parameter 189 (Current Limit 1). |

**Table 35 - Fault LED Indicators for 284E Controller**

| Bit/Blink Pattern | Auto-resettable[1] | 284E Trip Status | Description | Action |
|---|---|---|---|---|
| 6 | Parameter 23 (PrFlt Reset Mode) | Control Pwr Loss (Switched Power) | The ArmorStart controller has detected a loss of the control power voltage. | Check control voltage, wiring, and proper polarity (A1/A2 terminal). Also, check and replace the control voltage fuse, if necessary. This fault can be disabled and is disabled by default. |
| 7 | Parameter 23 (PrFlt Reset Mode) | Input Fault | This error indicates a shorted sensor, shorted input device, wiring input mistakes, or a blown output fuse. | If this fault occurs, the offending problem must be isolated or removed before restarting the system. This fault can be disabled and is disabled by default. |
| 8 | Parameter 23 (PrFlt Reset Mode) | Over Temperature | This fault is generated when the operating temperature has been exceeded. This fault cannot be disabled. | Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 40 °C (104 °F).<br>1. Clear the fault or cycle power to the drive. |
| 9 | Drive Controlled | Over Current (Drive Codes 12 and 63) | The drive output current has exceeded the hardware current limit. | Check programming. Check for excess load, improper Parameter 184 (Boost Select) setting. DC brake volts set too high or other causes of excess current. Parameter 198 (SW Current Trip) has been exceeded, check load requirements and Parameter 198 setting. |
| 10 | Parameter 23 (PrFlt Reset Mode) | Control Power (24V DC) Lost (Unswitched Power) | The 24V DC power supply is below tolerance threshold. | Check the state of the network power supply (A3/A1 terminal) and look for media problems. This fault can be disabled and is disabled by default. |
| 11 | No | Internal Comm (See Parameter 61 for details on this fault. F81 is a VFD fault. This fault can also happen if control power is lost.) | Communication with either the control module (VFD) or Control module has stopped. | See section Fault 11 Detail. If the problem persists replace the unit. |
| 12 | Drive Controlled | DC Bus Fault (Drive Codes Reference 3, 4 and 5) | Power Loss - DC bus voltage remained below 85% of nominal. Undervoltage - DC bus voltage fell below the minimum value. Overvoltage - DC bus voltage exceeded maximum value. | Monitor the incoming AC line for low voltage or line power interruption. Check the input fuses. Monitor the AC line for high line voltage or transient conditions. Motor regeneration can also cause bus overvoltage. Extend the decel time or install dynamic brake option. |
| 13 | No | EEprom (PF Drive Code Reference 100) | The checksum read from the board does not match the checksum that is calculated. | Set Parameter 141 (Reset to Defaults) to Option 1 “Reset Defaults”. |
| 14 | No | Hdw Flt (PF Drive Codes Reference 70 and 122) | Failure has been detected in the drive power section or drive control and I/O section. See Last Protection Fault parameter 61 for details. | 1. Cycle power.<br>2. If Fan RPM fault, replace the fan.<br>3. Replace drive if fault cannot be cleared. |
| 15 | Drive Controlled | Restart Retries (PF Drive Code Reference 33) | Drive unsuccessfully attempted to reset a fault and resume running for the programmed number of Parameter 192 (Auto Rstrt Tries). | Correct the cause of the fault and manually clear. |
| 16 | Drive Controlled | Misc. Fault (PF Drive Code Reference 2, 8, 29, 48 and 80) | Heatsink temperature exceeds a predefined value. The drive was commanded to write default values to EEPROM. Either you canceled the autotune function or it failed. If DB1 option is installed, see P61 for additional diagnostics. | Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 40 °C (104 °F) and mounted properly.<br>1. Clear the fault or cycle power to the drive.<br>2. Program the drive parameters as needed. Restart procedure.<br>3. Check for DB1 fault and see DB1 diagnostics. |

(1) When "Drive Controlled", see Internal Drive Faults in Table 37 for details about which drive faults can be auto reset.

## Fault 11 Detail

Parameter 61 provides a more granular description of the faults that occur.

- An F11 protection fault indicates that the internal communication has stopped
- There is a 10 second delay before an F11 Internal Comm. fault is present
- Common causes of an Internal Comm. fault:
  - The local ArmorStart Disconnect switch is in the OFF position.

    - 3-Phase line power that feeds the ArmorStart controller is not connected or is turned OFF.
    - Switched Control Power is not connected or is turned OFF.
    - Poor power quality (Brown Out)
- First things to check:
    - Verify that the local disconnect is in the ON position.
    - Verify that the unit has 3-Phase Line Voltage present and it is within specified tolerances.
    - Verify that the ArmorStart unit has Control Voltage present and it is within specified tolerances.
    - Press the local reset to attempt to clear the fault or send the ArmorStart controller a network reset.
    - Cycle power to the ArmorStart unit and try to clear the fault again.
- If an Internal Comm. fault persists, see Parameter 61 – LastPR Fault for additional details on the last protection fault. See the next table for troubleshooting information that is based on what Parameter 61 returns. Also see Parameters 107…109 to get the VFD fault code.

| Parameter 61 Fault Code | Description | Recommended Action |
|---|---|---|
| 13 = Control Power Loss | Control power was lost or dipped below the lower threshold long enough to cause the Internal Comm. fault. | • Check that control power is turned on and within specified tolerances.<br>• Check the Control Power fuse, replace if necessary.<br>• Press the local reset or send the unit a network reset once control power is restored. |
| 14 = Control Power Fuse | The control power fuse has blown and the control power circuit no longer is a closed circuit. | • Additional investigation as to why the fuse blew is needed. Take corrective action accordingly.<br>• Replace the fuse and reset the ArmorStart unit either locally or over the network. |
| 21 = A3 Power Loss | Unswitched (A3/A2) control power was lost or dipped below the lower threshold long enough to cause the Internal Comm. fault.<br>• DeviceNet power loss | • Check that the A3 or DeviceNet power terminal does not have any loose connections.<br>• Press the local reset or send the unit a network reset once the unswitched control power is restored |
| 22 = Internal Comm<br>24 = Power Loss (3-Phase)<br>25 = Under Voltage (3-Phase) | • The MCB of the ArmorStart unit lost communication with the VFD. This communication loss is most likely due to a loss of 3-phase power.<br>• PF Fault Code 3 or 4 | • Check that the local disconnect is in the ON position.<br>• Check for a power quality issue, take appropriate corrective actions.<br>• Check that 3-phase power is present.<br>• Press the local reset or send the unit anetwork reset |
| 23 = Drive Comm Loss (PF Fault Code 81) | The PowerFlex VFD lost communications with the MCB. This communication loss is most likely due to a loss of control power or network power. | • Check that control power and the network power are both present.<br>• Press the local reset or send the unit a network reset. |
| 28 = Base EEPROM | The MCB cannot read the EEPROM of the base module or is not communicating correctly with the base module. In the EtherNet/IP units, Parameter 63 – Base Trip provides more detail as to why the base module is not communicating properly with the control module | • Cycle power to the ArmorStart unit.<br>• Verify that the control module is seated correctly in the base module<br>• Check the connector on the control module for bent or broken pins |
| 41 = DB1 Comm | The MCB has lost communications with the Dynamic Brake (DB1) board or the EEPROM on the DB1 board is corrupt. | • Press the local reset or send the unit a network reset<br>• Cycle power to the ArmorStart unit. |

## Resetting Device to Factory Defaults

The switch value of 888 lets you reset to the factory default configuration, including configuration parameters. This setting is useful in situations where you wish to decommission a module or when you wish to commission a previously used module that has an unknown configuration. When the switches are set to 888, upon the next power cycle the ArmorStart controller will return to factory default settings and cease all communications. The Module Status LED transitions to blinking red and the Network Status LED transitions to OFF.

After reset, change the IP address to a valid setting and cycle power. The purpose of this step is to help stop you from module reset without a change to the 888 switch setting.

| | |
|---|---|
| **IMPORTANT** | If you set the IP address to "888" followed by a power cycle, the device resets to its factory default configuration. To resume network communication, the address **MUST** be set to DHCP or a valid IP address and power cycled again. |

# Notes:

# Troubleshooting

## Introduction

The purpose of this chapter is to help with troubleshooting the ArmorStart distributed motor controller by using the LED status display and diagnostic parameters.

**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:** 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.

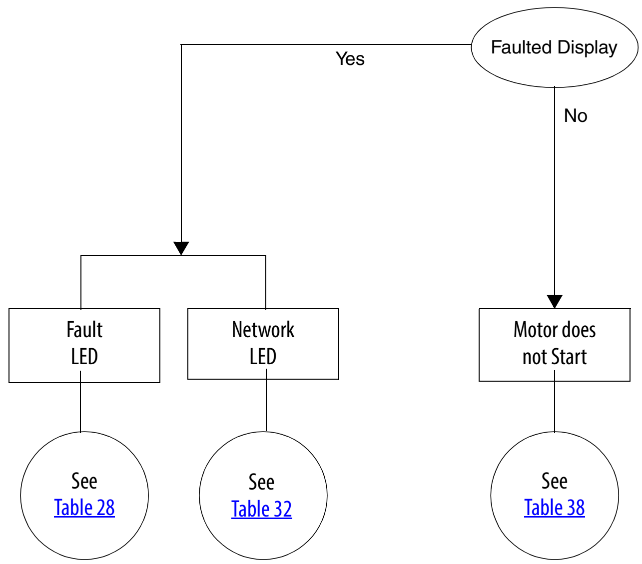
**ATTENTION:** This drive contains electrostatic discharge (ESD) – sensitive parts and assemblies. Static control precautions are required during installation, test, service, or repair of this assembly. Component damage can result if ESD control procedures are not followed. If you are not familiar with 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.

## Bulletin 281E Troubleshooting

The next flowchart for Bulletin 281E units is provided to aid in quick troubleshooting.

**Figure 77 - Bulletin 281E Control Module LED Status**

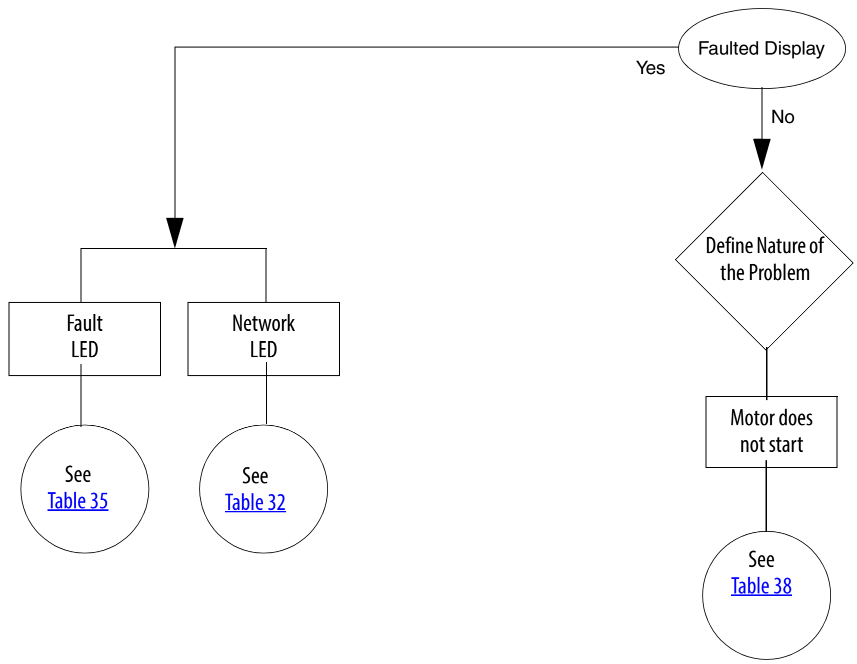


# Bulletin 284E Troubleshooting

## Fault Definitions

The internal hardware of the Bulletin 284E ArmorStart controller detects some of the controller faults, while the internal drive detects other faults. For internal drive faults, the internal hardware of the ArmorStart controller simply polls the drive for the existence of faults and reports the fault state. The internal hardware of the ArmorStart controller does not do fault latching for these faults. The PrFlt ResetMode parameter (Parameter 23) determines the Auto Resettability of only the faults that are detected on the main control board. Internal drive parameters, see Table 36, control the Auto Resettability of the faults that are detected in the internal drive. The next flowchart for Bulletin 284E units is provided to aid in quick troubleshooting.

**Figure 78 - Bulletin 284E Control Module LED Status**



## IP67 Dynamic Brake Diagnostic (DB1)

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

A DB1 fault is not annunciated until the DB switch in the drive is activated and conducts current.

The following conditions are monitored:

- DB Overcurrent resistor value too small (current is too high)
- DB Undercurrent resistor value is too high (current is too low)
- DB Open drive bus voltage is above DB level, but no resistor current was measured

The following conditions cause a fault anytime the DB1 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

## DB1 Faults

### Operation and Troubleshooting of the DB1 - Dynamic Brake

Eight types of DB1 faults are detected and reported in Parameter 61 as either a “DB1 Flt”, “DB1 Comm Fault” or DB1 Switch Short”. DB1 faults are also reported in Attribute 158 “DB1 Fault” of the Control Supervisor Object (Class Code: 29 Hex). See Appendix B for Control Supervisor information.

If the ArmorStart Fault LED blinks 11x's check parameter 61. If value is 41, check the following:

- DB1 Comm Fault - Communication loss exists between the Dynamic Brake board and the main control board.

This condition is also enunciated in the Trip Status parameter 4 bit 10 called Internal Comm fault.

If the ArmorStart Fault LED blinks 16x's check parameter 61. If value is 42 (DB1 Fault), check the following:

- DB1 Resistor Overtemperature Fault
- DB1 Overcurrent Fault
- DB1 Undercurrent Fault
- DB1 Open Fault
- DB1 VBus Link Fault

This condition is also enunciated in the Trip Status parameter 4-bit 15 called Miscellaneous Fault.

If the ArmorStart Fault LED blinks 16x's check parameter 61. If value is 43, check the following:

- DB1 Switch Fault

The DB1 option provides the following warning:

- DB1 Thermal Warning - occurs once the resistor reaches 75% of maximum thermal capacity. Once at 100% a DB1 over temperature occurs resulting in a DB1 over temperature fault.

## DB1 Resistor Overtemperature Fault

*Control Supervisor Object "DB1 Fault" Attribute Bit 0.*

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 Parameter 182 (DB1 Resistor Sel) is "Disabled".

**Troubleshooting** – DB1 Resistor body temperature is too hot. Allow the resistor to cool.

## DB1 Overcurrent Fault

*Control Supervisor Object "DB1 Fault" Attribute Bit 1.*

The DB1 compares each current measurement against the Max Current Level. If five consecutive samples are above the Max Current Level, then a fault is recorded. This fault is intended to notify you if the DB1 resistance is lower than expected. This fault is disabled when Parameter 182 (DB1 Resistor Sel) is "Disabled".

**Troubleshooting** – DB1 monitor has measured a DB1 current higher than expected. Turn off all power to unit. Allow at least 3 minutes for capacitors to discharge.

**BURN HAZARD:** DB1 resistor can still be hot.

Disconnect DB1 resistor from ArmorStart control module. Measure DB1 resistor value at the connector with an ohmmeter. See the specification for minimum DB1 resistor values. If DB1 resistance value is within limits, replace control module. If not, replace DB1 resistor.

## DB1 Undercurrent Fault

*Control Supervisor Object "DB1 Fault" Attribute Bit 2.*

The DB1 compares each current measurement against the Min Current Level. The Min Current Level = Min DB1 Voltage Level/Max DB1 Resistance. If five consecutive samples are below the Min Current Level and the DB1 is ON, then a fault is recorded. This fault is intended to notify you if the DB1 resistance is higher than expected. This fault is disabled when Parameter 182 (DB1 Resistor Sel) is "Disabled".

**Troubleshooting** – DB1 monitor has measured a DB1 current lower than expected. Turn off all power to unit. Allow at least 3 minutes for capacitors to discharge.

**BURN HAZARD:** DB1 resistor can still be hot.

Disconnect DB1 resistor from ArmorStart control module. Measure DB1 resistor value at the connector with an ohmmeter. See the specification for minimum DB1 resistor values. If DB1 resistance value is within limits, replace control module. If not, replace DB1 resistor.

## DB1 Switch Fault

*Control Supervisor Object "DB1 Fault" Attribute Bit 3.*

A DB1 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. The Instruction Literature provides information on how to connect the input contactor, and how to implement the logic.

**Troubleshooting** – Remove all power to the unit and restart it to attempt to reset the fault. If the fault persists, replace control module.

## DB1 Open Fault

*Control Supervisor Object "DB1 Fault" Attribute Bit 4.*

A DB1 Open fault is issued when Bus Voltage is greater than the DB1 Voltage Level, and no DB1 resistor current has been detected. If five consecutive samples of Drive Bus Voltage greater than the DB1 Level is detected along with no DB1 resistor current flow, then an open DB1 fault is recorded. This fault is intended to notify the customer of an open DB1 resistor, or open wire. The fault is disabled when the DB1 Resistor Sel, Parameter (182) is "Disabled".

**Troubleshooting** – DB1 monitor expected to see current flow and measured none. Likely cause is an open DB1 resistor, loose DB1 resistor connector, or open wire in DB1 cable. Check DB1 cable connector for tightness. If problem persists, remove DB1 resistor cable connector from unit and check DB1 resistance. If DB1 resistor is open, replace DB1 resistor. Otherwise replace control module.

## DB1 VBus Link Fault

*Control Supervisor Object "DB1 Fault" Attribute Bit 6.*

For proper operation, the DB1 monitors parameters from the Drive internally inside the ArmorStart controller. If the internal communications 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.

**Troubleshooting** – Verify that 3-phase line power and control power are applied to unit. Attempt to reset fault. If fault persists, replace control module.

## DB1 Comm Fault

*Control Supervisor Object "DB1 Fault" Attribute Bit 8.*

The communications link is monitored continuously. If the DB1 stops responding, then the MCB issues this fault. Since the DB1 can no longer provide resistor protection, you must implement logic to open the input contactor.

**Troubleshooting** – Replace control module.

### DB1 Thermal Warning

*Control Supervisor Object "DB1 Status" Attribute Bit 1.*

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.

**Troubleshooting** – None. DB1 resistor thermal value has exceeded the preset threshold of 90% of thermal value.

### Reading the Control Supervisor Object

If a DB1 fault occurs, the Control Supervisor Object provides the detailed information specific to the fault. Create an Explicit Message Instruction such as Class = 0029hex, Instance = 0001hex, Attribute = 158. A bit enumerated WORD of information is returned. See the CIP section for details.

## Hardware Fault - Fan RPM Warning

### FAN Fault Handling with Firmware 66.21 of 284

The Fan Fault handler was modified in firmware 66.21 of the 284.

### Operation

If the RPM of the internal fan drops below the minimum threshold, a Warning bit in Stater Status, Parameter 5 is set and the Warning Status, Parameter 62 Bit 13 hardware warning is set. A 24-hour count down timer begins. If the warning flag is set continuously for the 24-hour period and time expires, a F14 (LED Flashes 14 times) Hardware fault occurs. Also Last Pr Fault, Parameter 61 shows Fan RPM fault. If within the 24-hour period the fan rpm climbs above the minimum threshold, the warning flags are removed and timer reset and turned off.

### Starter Status, Warning Bit 5:

When set to "1" indicates a Warning if a Fan RPM issue occurs. Other warning type faults that are found in parameter 62, can also trigger the warning bit.

### Warning Status, Parameter 62:

Bit 13 turns to a "1" indicating a Hardware warning. Hardware warning is an OR of two warnings.

### Annunciation with PLC Logic

To determine when only a Fan RPM warning occurs, logic must be written that triggers 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 parameter 61.

When the fault occurs, the following Trip bits are activated:

- Parameter 4, Trip Status, bit 13 turns to a "1" indicating a hardware trip has occurred
- Parameter 5, Starter Status, bit 0 turns to a "1" indicating a TripPresent
- Parameter 61 displays "Fan RPM" Fault 31 as the last protection fault.

## Internal Drive Faults

The 284E controller details the specific VFD fault in parameters 107, 108, and 109 (Fault 1, 2, or 3). A fault is a condition that stops the drive. There are two fault types.

**Table 36 - Internal Drive Faults**

| Type | Name | Description |
|---|---|---|
| 1 | Auto-Reset/Run | When this type of fault occurs, Parameter 192 (Auto Rstrt Tries) and related Parameters: 155 (Relay Out Sel), 193 (Auto Rstrt Delay) are set to a value greater than 0, a user-configurable timer, Parameter 193 (Auto Rstrt Delay) and related Parameter: 192 (Auto Rstrt Tries), begins. 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. |

Automatically Clearing Faults (Option/Step)

**Clear a Type 1 Fault and Restart the Drive:**

1. Set Parameter 192 (Auto Rstrt Tries) to a value other than 0.
2. Set Parameter 193 (Auto Rstrt Delay) to a value other than 0.

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

1. Set Parameter 192 (Auto Rstrt Tries) to a value other than 0.
2. Set Parameter 193 (Auto Rstrt Delay) to 0.

### *Auto Restart (Reset/Run)*

The Auto Restart 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 to enable this feature, since the drive attempts to issue its own start command that is based on user-selected programming.

The next table describes Bulletin 284E Faults as seen in Parameters 107, 108, and 109 (Fault 1, 2, or 3).

**Table 37 - Bulletin 284E Faults – Parameters 107, 108, and 109 (Fault 1, 2 or 3)**

| PF40 Fault No.(1) | Fault | Type(2) | Description | Action |
|---|---|---|---|---|
| F2 | Auxiliary Input | 1 | Auxiliary input interlock is open. | 1. Check remote wiring.<br>2. Check communications. |
| F3 | Power Loss | 2 | DC bus voltage remained below 85% of nominal. | 1. Monitor the incoming AC line for low voltage or line power interruption.<br>2. Check input fuses. |
| F4 | UnderVoltage | 1 | DC bus voltage fell below the minimum value. | 1. Monitor the incoming AC line for low voltage or line power interruption. |
| F5 | OverVoltage | 1 | DC bus voltage exceeded maximum value. | 1. Monitor the AC line for high line voltage or transient conditions. Motor regeneration can also be the cause of bus overvoltage. Extend the decel time or install dynamic brake option. |
| F6 | Motor Stalled | 1 | Drive is unable to accelerate motor. | 1. Increase Parameters 139 or 167 (Accel Time x) or reduce load so drive output current does not exceed the current set by Parameter 189 (Current Limit 1). |
| F7 | Motor Overload | 1 | Internal electronic overload trip | 1. An excessive motor load exists. Reduce load so drive output current does not exceed the current set by Parameter 133 (Motor OL Current).<br>2. Verify Parameter 184 (Boost Select) setting |
| F8 | Heatsink OvrTmp | 1 | Heatsink temperature exceeds a predefined value. | 1. Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 40 °C (104 °F).<br>2. Replace internal fan. |
| F12 | HW OverCurrent | 2 | The drive output current has exceeded the hardware current limit. | 1. Check programming. Check for excess load, improper programming of Parameter 184 (Boost Select), DC brake volts set too high, or other causes of excess current. |
| F13 | Ground Fault | 2 | A current path to earth ground has been detected at one or more of the drive output terminals. | 1. Check the motor and external wiring to the drive output terminals for a grounded condition. |
| F33 | Auto Rstrt Tries | | Drive unsuccessfully attempted to reset a fault and resume running for the programmed number of Parameter 192 (Auto Rstrt Tries). | 1. Correct the cause of the fault and manually clear. |

**Table 37 - Bulletin 284E Faults – Parameters 107, 108, and 109 (Fault 1, 2 or 3)**

| PF40 Fault No.(1) | Fault | Type(2) | Description | Action |
|---|---|---|---|---|
| F38<br>F39<br>F40 | Phase U to Gnd<br>Phase V to Gnd<br>Phase W to Gnd | 2 | A phase to ground fault has been detected between the drive and motor in this phase. | 1. Check the wiring between the drive and motor.<br>2. Check motor for grounded phase.<br>3. Replace starter module if fault cannot be cleared. |
| F41<br>F42<br>F43 | Phase UV Short<br>Phase UW Short<br>Phase VW Short | 2 | Excessive current has been detected between these two output terminals. | 1. Check the motor and drive output terminal wiring for a shorted condition.<br>2. Replace starter module if fault cannot be cleared. |
| F48 | Params Defaulted | 2 | The drive was commanded to write default values to EEPROM. | 1. Clear the fault or cycle power to the drive.<br>2. Program the drive parameters as needed. |
| F63 | SW OverCurrent | 2 | Programmed Parameter 198 (SW Current Trip) has been exceeded. | 1. Check load requirements and Parameter 198 (SW Current Trip) setting. |
| F64 | Drive Overload | 2 | Drive rating of 150% for 1 min or 200% for 3 s has been exceeded. | 1. Reduce load or extend Accel Time. |
| F70 | Power Unit | 2 | Failure has been detected in the drive power section. | 1. Cycle power.<br>2. Replace starter module if fault cannot be cleared. |
| F80 | SVC Autotune | | Either you canceled the autotune function or it failed. | 1. Restart procedure. |
| F81 | Comm Loss | 2 | RS485 (DSI) port stopped communicating. | 1. Turn off by using Parameter 205 (Comm Loss Action).<br>2. Replace starter module if fault cannot be cleared. |
| F100 | Parameter Checksum | 2 | The checksum read from the board does not match the checksum that is calculated. | 1. Set Parameter 141 (Reset To Defaults) to Option 1 (Reset Defaults). |
| F122 | I/O Board Fail | 2 | Failure has been detected in the drive control and I/O section. | 1. Cycle power.<br>2. Replace starter module if fault cannot be cleared. |

(1) PowerFlex 40 drive fault ID. See the PowerFlex User Manual, 22B-UM001*.

(2) See Table 36 for Type description.

**Table 38 - Motor Does Not Start**

| Causes | Indication | Corrective Action |
|---|---|---|
| No output voltage to the motor. | None | Check the power circuit.<br>• Check the supply voltage.<br>• Check all fuses and disconnects<br>Check the motor.<br>• Check that the motor is connected properly.<br>• Check that I/O Terminal 01 is active.<br>• Check that Parameter 136 (Start Source) matches your configuration.<br>• Check that Parameter 195 (Reverse Disable) is not prohibiting movement.<br>• Run Autotune parameter 227<br>Check the safety system.<br>• Check the status of SI from the Safety I/O block.<br>• Check the status of SO from the Safety I/O block. When SO is restored (ON), there is a 50 ms delay before a run command is allowed. |
| Drive is Faulted | Flashing red status light | Clear fault.<br>• Press Stop<br>• Cycle power<br>• Set Parameter 200 (Fault Clear) to Option 1 (Clear Faults).<br>• Cycle digital input is Parameters 151…154 (Digital In x Sel) is set to Option 7, (Clear Faults). |

**Table 39 - Drive Does Not Respond to Changes in Speed Command**

| Causes | Indication | Corrective Action |
|---|---|---|
| No value is coming form the source of the command. | The drive **Run** indicator is lit and output is 0 Hz. | • Check Parameter 112 (Control Source) for correct source.<br>• If the source is an analog input, check wiring and use a meter to check for presence of signal.<br>• Check Parameter 102 (Commanded Freq) to verify correct command. |
| Incorrect reference source is being selected via remote device or digital inputs. | None | • Check Parameter 112 (Control Source) for correct source.<br>• Check Parameter 114 (Dig In Status) to see if inputs are selecting an alternate source. Verify settings for Parameters 151…154 (Digital In x Sel).<br>• Check Parameter 138 (Speed Reference) for the source of the speed reference. Reprogram as necessary. |
| Some applications create an intermittent voltage regeneration condition and the bus regulator tries to compensate. | None | • Disable parameter 217 Bus Regulation. The drive reacts faster to changes in speed.<br>• This condition can also cause DC bus voltage faults if an external resistor is not attached. |

**Table 40 - Motor and/or Drive Does Not Accelerate to Commanded Speed**

| Causes | Indication | Corrective Action |
|---|---|---|
| Acceleration time is excessive. | None | • Reprogram Parameter 139 (Accel Time 1) or Parameter 167 (Accel Time 2).<br>• Try to change parameter 184 Boost selection to a value of 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 Parameter 103 (Output Current) with Parameter 189 (Current Limit1).<br>• Remove excess load or reprogram Parameter 139 (Accel Time 1) or Parameter 167 (Accel Time 2).<br>• Check for improper setting of Parameter 184 (Boost Select). |
| Speed command source or value is not as expected. | None | • Verify Parameter 102 (Commanded Freq).<br>• Check Parameter 112 (Control Source) for the proper Speed Command. |
| Programming is stopping the drive output so it does not exceed limit values. | None | Check Parameter 135 (Maximum Freq) to verify that speed is not limited by programming. |
| Torque performance does not match motor characteristics. | None | • Set motor nameplate full load amps in Parameter 226 (Motor NP FLA).<br>• Use Parameter 227 (Autotune) to perform **Static Tune** or **Rotate Tune** procedure.<br>• Set Parameter 225 (Torque Perf Mode) to Option 0 (V/Hz). |

**Table 41 - Motor Operation Is Unstable**

| Causes | Indication | Corrective Action |
|---|---|---|
| Motor data was incorrectly entered. | None | 1. Correctly enter motor nameplate data into Parameters 131, 132, and 133.<br>2. Enable Parameter 197 (Compensation).<br>3. Use Parameter 184 (Boost Select) to reduce boost level. |

**Table 42 - Drive Does Not Reverse Motor Direction**

| Causes | Indication | Corrective Action |
|---|---|---|
| Digital input is not selected for reverse control. | None | Check Parameters 151…154 (Digital In x Sel). Choose correct input and program for reverse mode. |
| Motor wiring is improperly phased for reverse. | None | Switch two motor leads. |
| Reverse is disabled. | None | Check Parameter 195 (Reverse Disable). |

**Table 43 - Drive Does Not Power Up**

| Causes | Indication | Corrective Action |
|---|---|---|
| No input power to drive. | None | Check the power circuit.<br>• Check the supply voltage.<br>• Check all fuses and disconnects. |
| Jumper between I/O Terminals P2 and P1 not installed and/or DC Bus Inductor not connected. | None | Install jumper or connect DC Bus Inductor. |

## Ethernet Statistics

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

## Troubleshoot and 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 44 - Troubleshoot DLR or Linear Network**

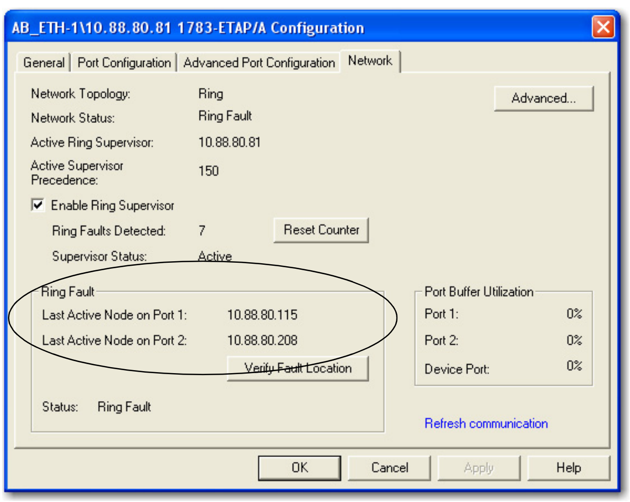
| Issue | Description | Solution |
|---|---|---|
| **Supervisor Reports a Ring Fault** | A link on the DLR network can be broken:<br>• Intentionally, for example, because you added or deleted nodes but did not make all physical connections to restore the setup of the network with/without the node.<br>• Unintentionally, for example, because a cable is broken or a device malfunctions.<br>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.<br>The screen shot 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<br>**Figure 79 - Ring Fault Section**<br><br>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.<br>It can be necessary to click the Refresh Communication link to update the Ring Fault information to determine where the fault condition exists. |

**Table 44 - Troubleshoot DLR or Linear Network**

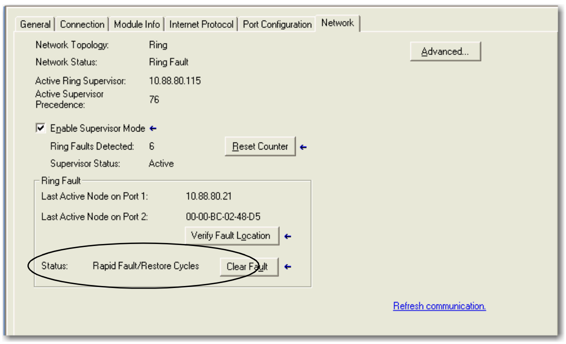
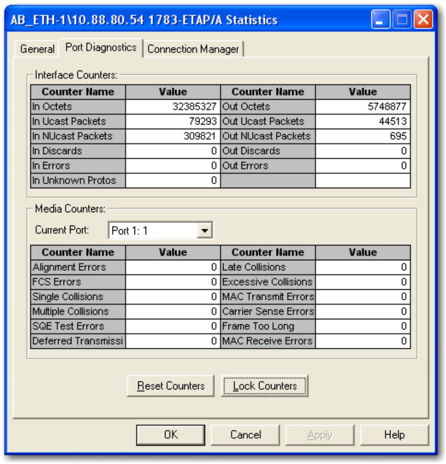
<table>
<tr><th>Issue</th><th>Description</th><th>Solution</th></tr>
<tr><td>Rapid Ring Fault</td><td>When a Rapid Ring Fault occurs, the following events occur:<br>• The active supervisor blocks traffic on port 2, which results in possible network segmentation, that is, some nodes can become unreachable.<br>• The Link 2 status indicator on the active supervisor is off.<br>• As soon as the fault occurs, for both RSLogix 5000 programming software and RSLinx communication software, the Status field = Rapid Fault/Restore Cycles.<br><br>Figure 80 - Rapid Fault/Restore Cycles Status<br><br>
<br>Any of the following can cause a Rapid Ring Fault:<br>• Five intentional disconnections/reconnections of a node from the network within 30 s<br>• A duplex mismatch between two connected devices<br>• Electromagnetic noise on the network<br>• Unstable physical connections, such as intermittent connectors<br>Given the nature of a Rapid Ring Fault, the Last Active Node information cannot be accurate when a Rapid Ring Fault condition is present</td><td>Multiple possible solutions exist.<br>• For the disconnections and reconnections issue, no solution is required.<br>Clear the fault when you have reconnected the device to the network permanently.<br>• For the duplex mismatch issue, reconfigure the duplex parameters to verify that they match between the devices.<br>• For the electromagnetic noise issue, determine where the noise exists and remove it or use a protective shield in that location.<br>• For the unstable connections issue, determine where they exist on the network and correct them.<br>• 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.<br>• 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.<br>• Finally, your Beacon Interval or Timeout configuration cannot be appropriate for your network.<br>However, if you think it is necessary to change these values, we recommend that you call Rockwell Automation technical support.<br>Once the fault is fixed, click Clear Fault.</td></tr>
<tr><td>Partial Fault Condition</td><td>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.<br>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.<br>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.<br>When this fault occurs, the Network Status field = Partial Fault Condition.<br>Once the fault is corrected, it automatically clears, and the Network Status field returns to Normal.</td><td>Determine where the fault condition exists and correct it.</td></tr>
</table>

**Table 44 - Troubleshoot DLR or Linear Network**

<table>
<tr><th>Issue</th><th>Description</th><th>Solution</th></tr>
<tr><td>Media Counter Errors or Collisions</td><td>
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 81 - 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.
</td><td>
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.
</td></tr>
</table>

**Table 45 - Media Counter Errors**

| Media Counter | Definition |
|---|---|
| Alignment Errors | A frame that contains bits that do not total an integral multiple of eight.<br>Alignment errors often result from:<br>• Starting or stopping of a module.<br>• MAC-layer packet formation problems.<br>• Cable problems that corrupt or delete data.<br>• 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.<br>Frame Check Sequence (FCS) errors often result from:<br>• Starting or stopping of a module.<br>• Cable problems that corrupt or delete data.<br>**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).<br>**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.<br>**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. |

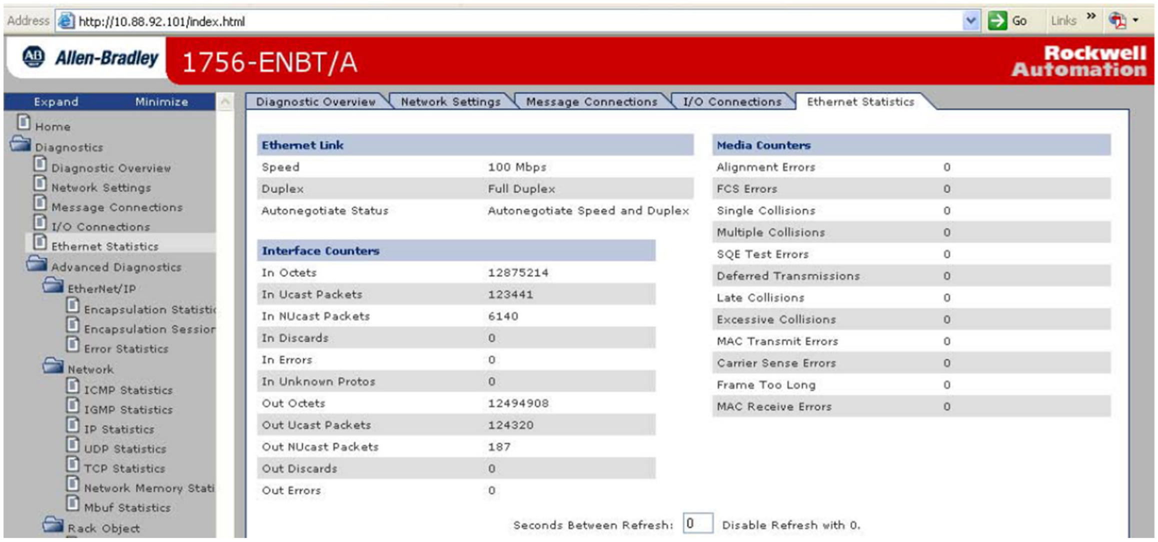
| **Media Counter** | **Definition** |
|---|---|
| Late Collisions | The number of times two devices transmit data simultaneously.<br>Neither device detects a collision because the time it takes to send the signal from one end of the network to the other exceeds the time that is required to put the entire packet on the network. Consequently, neither device senses the transmission of the other until the entire packet is out on the network.<br>Late collisions often result from these conditions:<br>• Excessive network segment length<br>• Repeaters between devices<br>**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.<br>**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.<br>**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:<br>• No Carrier Sense Present - The number of times the carrier is not present when a transmission starts.<br>• Carrier Sense Lost - The number of times the carrier is lost during a transmission.<br>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. |

## Troubleshoot Intermittent Ethernet Connectivity

To troubleshoot intermittent Ethernet connectivity, follow these steps.

1. From the ArmorStart EtherNet/IP and/or the ControlLogix EtherNet/IP bridge, click Ethernet Statistics.

**Figure 82 - Ethernet Statistics**



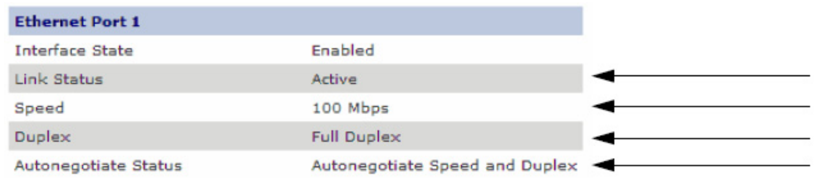

2. Review the values in the Media Counters table.

| If | Then |
|---|---|
| Any media counters are greater than zero | You must investigate further. |
| These errors are counted:<br>• Alignment<br>• FCS<br>• Carrier Sense | A duplex mismatch exists between your EtherNet/IP communication module and the switch port.<br>To clear the duplex mismatch:<br>1. Configure the EtherNet/IP communication module and the corresponding Ethernet switch port for a forced operation, not auto-negotiation.<br>2. Verify that the firmware revision of your Logix controller and switch, or converter are identical.<br>3. If the revisions are not identical, replace the controller, switch, or converter so that they match. |
| Single Collisions or Multiple Collisions are greater than zero | No action is required.<br>**Important:** If two stations attempt to transmit data simultaneously, the packets collide with each other. However, collisions are not errors and do not indicate a network problem. The number of network collisions can vary greatly due to traffic patterns or CPU utilization. Consequently, there is no set range of acceptable collisions for each outgoing packet. Collisions are a normal aspect of Ethernet networking. |
| Late Collisions are greater than zero | 1. Check to see if a network segment is too long.<br>2. Remove repeaters from between devices. |
| Excessive Collisions are greater than zero | Calculate the typical rate of excessive collisions on your network and decide whether the rate of packet loss affects the performance of your network.<br>**Important:** Excessive collisions indicate that your network has become congested. For each collision after the 16th, your network drops a packet. |
| MAC Transit Errors are greater than zero | No action is required. |
| Frame Too Long is greater than zero | Limit the size of your tags to ≤ 500 bytes. |

## Ethernet Statistics

The Ethernet Statistics web page presents the current configuration of an EtherNet/IP communication module and any errors that have occurred on the module.

1. Review the values in the Ethernet Port 1 table.



| Ethernet Port 1 | |
|---|---|
| Interface State | Enabled |
| Link Status | Active |
| Speed | 100 Mbps |
| Duplex | Full Duplex |
| Autonegotiate Status | Autonegotiate Speed and Duplex |

| If | | And you | Then |
|---|---|---|---|
| Link Status is | Active | Do not want to change the status | No action is required |
| | Inactive | Want to establish communication on the network | Reconfigure the module or port that is inactive. |
| Speed is | 100 Mbps or 1000 Mbps | Do not want to change your port speed | No action is required.<br>**Important:** 100 Mbps is the default port speed. |
| | | Want to reduce your port speed to 10 Mbps | You must manually configure your module and reset your module. |
| | 10 Mbps | Want to increase your port speed to 100 Mbps | Reset your module |
| | | Do not want to change your port speed | No action is required. |
| Duplex is | Full | Are sending large amounts of data | No action is required.<br>**Important:** Full Duplex is the default port setting.<br>Full-duplex ports reduce the risk of collisions because each device has separate channels for the transmission and receipt of large amounts of data. |
| | Half | Are not sending large amounts of data | No action is required.<br>**Important:** Delays due to collisions or switch traffic are usually negligible, but can become a problem if you send a large amount of data. |
| | | Are sending large amounts of data | Change the Duplex setting of your module to Full. |
| Autonegotiate Status(1) is | Speed and/or Duplex | Are using a fiber converter | Change the Autonegotiate status of your module to None.<br>**Important:** Fiber links do not support autonegotiation. |
| | | Are not using a fiber converter | No action is required.<br>**Important:** Speed and/or Duplex is the default setting.<br>Autonegotation enables devices to select the best way to communicate without any configuration. All devices with an Ethernet speed rating of 100 Mbps are required to support autonegotiation. |
| | None | Are not using a fiber converter | Change the Autonegotiate status of your module to Speed and/or Duplex. |

(1) When you use an EtherNet/IP communication module with multiple ports, make sure that you use the same Autonegotiate Status configuration for both ports.

2. Review the values in the Media Counters Port 1 table.

| Media Counters Port 1 | |
|---|---|
| Alignment Errors | 0 |
| FCS Errors | 0 |
| Single Collisions | 0 |
| Multiple Collisions | 0 |
| SQE Test Errors | 0 |
| Deferred Transmissions | 0 |
| Late Collisions | 0 |
| Excessive Collisions | 0 |
| MAC Transmit Errors | 0 |
| Carrier Sense Errors | 0 |
| Frame Too Long | 0 |
| MAC Receive Errors | 0 |

| If | Then |
|---|---|
| Any media counters are greater than zero | You must investigate further. |
| These errors are counted:<br>• Alignment<br>• FCS<br>• Carrier Sense | A duplex mismatch exists between your EtherNet/IP communication module and the switch port.<br>To clear the duplex mismatch:<br>1. Configure the EtherNet/IP communication module and the corresponding Ethernet switch port for a forced operation, not autonegotiation.<br>2. Verify that the firmware revision of your Logix controller and switch, or converter are identical.<br>3. If the revisions are not identical, replace the controller, switch, or converter so that they match. |
| Single Collisions or Multiple Collisions are greater than zero | No action is required.<br>**Important:** If two stations attempt to transmit data simultaneously, the packets collide with each other. However, collisions are not errors and do not indicate a network problem. The number of network collisions can vary greatly due to traffic patterns or CPU utilization. Consequently, there is no set range of acceptable collisions for each outgoing packet. Collisions are a normal aspect of Ethernet networking. |
| Late Collisions are greater than zero | 1. Check to see if a network segment is too long.<br>2. Remove repeaters from between devices. |
| Excessive Collisions are greater than zero | Calculate the typical rate of excessive collisions on your network and decide whether the rate of packet loss affects the performance of your network.<br>**Important:** Excessive collisions indicate that your network has become congested. For each collision after the 16th, your network drops a packet. |
| MAC Transit Errors are greater than zero | No action is required. |
| Frame Too Long is greater than zero | Limit the size of your tags to ≤ 500 bytes. |

## Ethernet Managed Switch Considerations

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.<br>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. |

### Internet Group Multicast Protocol

EtherNet/IP implicit (I/O) messaging mostly uses IP multicasting to distribute I/O control data that is consistent with the CIP produced/consumer model. Most switches retransmit multicast packets and broadcast packets to all ports.

IGMP snooping constrains the flooding of multicast traffic by dynamically configuring switch ports so that multicast traffic is forwarded only to ports associated with a particular IP multicast group. This constraint also helps minimize the CPU utilization rate.

Switches that support IGMP snooping learn which ports have devices that are part of a particular multicast group and only forward the multicast packets to the ports that are part of the multicast group.

| | |
|---|---|
| **IMPORTANT** | Not all switches support the IGMP snooping querier function, that is, snooping. Those switches that do not support IGMP snooping querier require a router. For switches that do support IGMP snooping, you can configure them to conduct the polling. |

IGMP snooping cannot control unicast or broadcast traffic. To learn how to control unicast or broadcast traffic, see Virtual Local Area Networks on page 240.

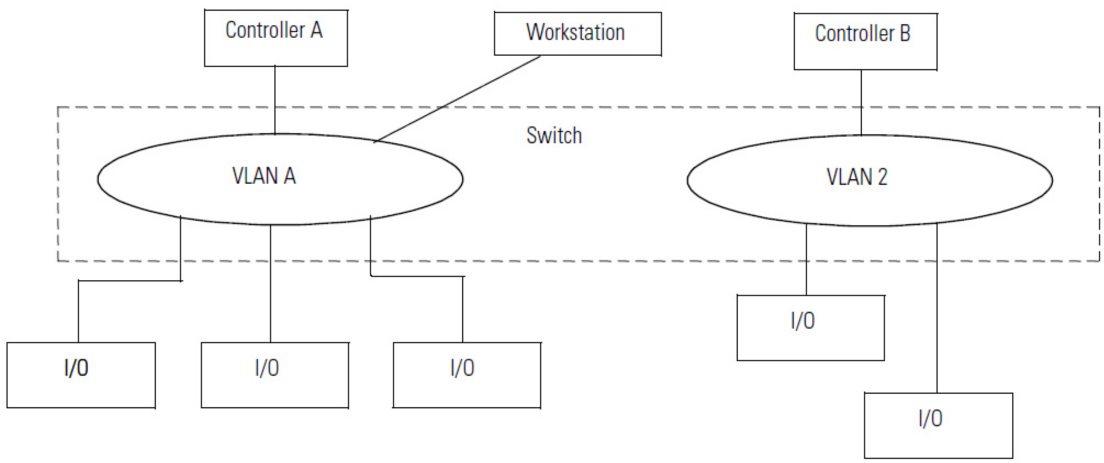
## Virtual Local Area Networks

With a managed switch, virtual local area networks (VLAN) can be established to segregate various kinds of network traffic and also increase security between the networks. Multiple isolated networks can be created so that the traffic from one network does not burden the other network.

As with IGMP snooping, VLAN can control multicast traffic. However, unlike IGMP snooping, VLAN can also control and block this traffic:

- Unicast traffic
- Broadcast traffic

**Figure 83 - Virtual Local Area Networks (VLAN)**




## Port Mirroring

Select a managed switch that supports port mirroring. With port mirroring, frames being transmitted on one port to another port, can be directed for analysis by a traffic analyzer. Besides monitoring the Ethernet media counters, port mirroring lets anomalies in traffic flow be spotted immediately. A traffic analyzer can monitor the traffic on a given port and troubleshoot a problem. Without port mirroring, frames on other ports cannot be seen. The effective support and maintenance of Ethernet networks is often reliant on dependable traffic analysis.

Here are some benefits of port mirroring:

- Monitoring explicit messages between controllers
- Monitoring implicit or I/O traffic

# Control Module Removal and Installation

## Removal of Control Module

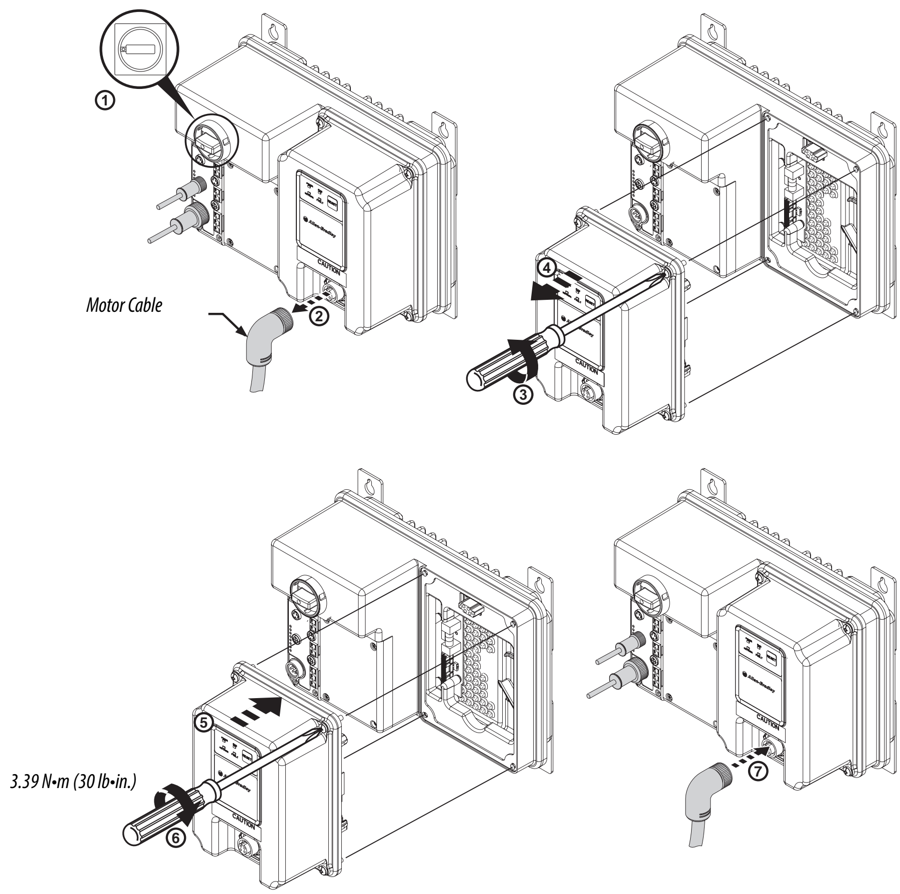
**ATTENTION:** To avoid shock hazard, disconnect main power before working on the controller, motor, or control devices.

1. Disconnect power by going to the control module and turning OFF the At-Motor disconnect 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.

## Installation of Control Module

5. Install control module.
6. Tighten four mounting screws.
7. Install motor cable.

**Figure 84 - Control Module Replacement**




**Note:** DeviceNet™ base module is shown.

# Fuse Replacement

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

**Table 46 - 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 85 - Control Voltage and Output Fuse Replacement**

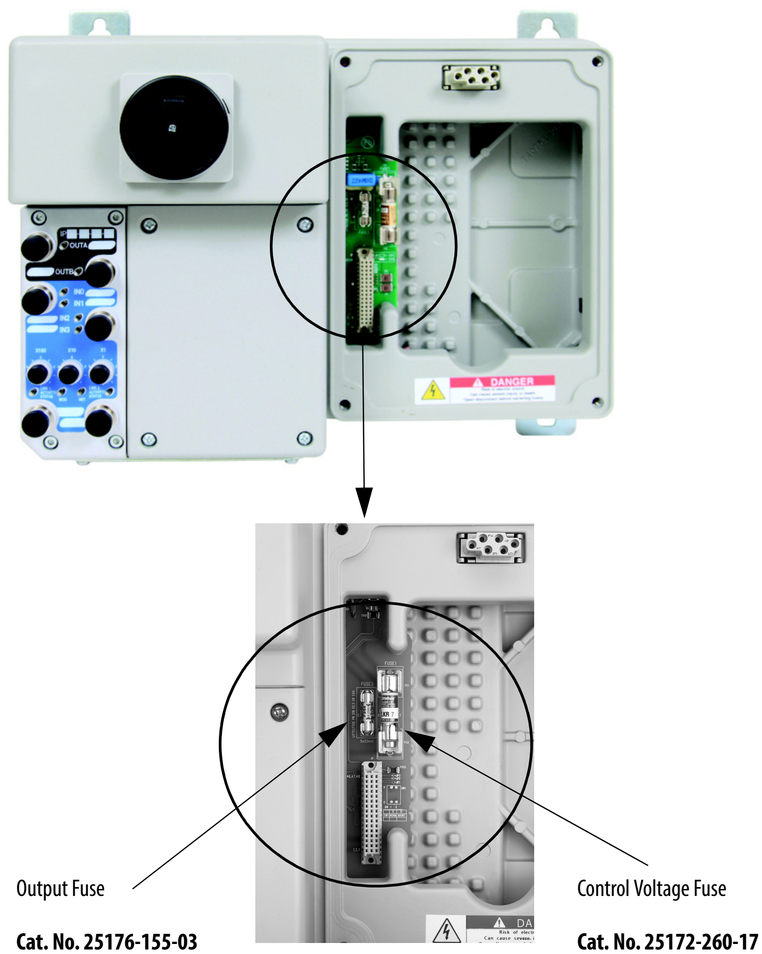
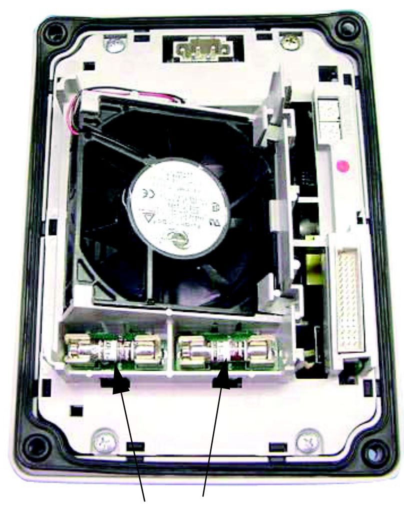


**Table 47 - Source Brake Fuse Replacement (Bulletin 284E Controller Only)**

| 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<br>Littlefuse PN KLKR003.T |
| **Dimension mm (in.):** | 38.1 (1.5) x 10.2 (0.4) |

**Figure 86 - Source Brake Fuse Replacement (Bulletin 284E Controller Only)**



Source Control Brake Fuses

**Cat. No. W25172-260-12**

## Source Brake Fuse Faults Reset

Replace the fuse and cycled unswitched power to reset the fault.

# Notes:

# Specifications for ArmorStart Controllers with EtherNet/IP

## Bulletin 281E Controller

| Electrical Ratings | | UL/NEMA | | IEC |
|---|---|---|---|---|
| Power Circuit | Rated Operation Voltage | 200…575V | | 200…575V |
| | Rate Insulation Voltage | 600V | | 600V |
| | Rated Impulse Voltage | 6 kV | | 6 kV |
| | Dielectric Withstand | 2200V AC | | 2500V AC |
| | Operating Frequency | 50/60 Hz | | 50/60 Hz |
| | Utilization Category | Not applicable | | AC-3 |
| | Protection Against Shock | Not applicable | | IP2X |
| | Rated Operating Current Max. | 281E_-_____-10A-*[1] | 1.2 A | |
| | | 281E_-_____-10B-*[1] | 2.5 A | |
| | | 281E_-_____-10C-*[1] | 5.5 A | |
| | | 281E_-_____-25D-*[1] | 16 A | |
| Control Circuit | Rated Operation Voltage | 24V DC (+10%, –15%), SELV or PELV, (A2 must be grounded at voltage source) | | |
| | Rate Insulation Voltage | 30V | | 30V |
| | Rated Impulse Voltage | — | | 1.5 kV |
| | Dielectric Withstand | 1500V AC | | 2000V AC |
| | Overvoltage Category | — | | III |
| | Operating Frequency | DC | | DC |
| **Short Circuit Protection** | Short Circuit Protection Device (SCPD) Performance Type 1 | **Short Circuit Protection** | | **480Y/277V** |
| | | 10A, 10B, 10C, and 10D | **Sym. Amps rms** | 65 kA |
| | | | **Max. Fuse**[2] | 30 A |
| | | 10A, 10B, 10C, and 10D | **Sym. Amps rms** | 30 kA |
| | | | **Max. Circuit Breaker**[3] | 60 A |

(1) See Contactor Life Load Curves.

(2) Class J, CC, and T fuses only.

(3) Only when used with Cat. No. 140G-H6C3-C60.

| | | UL/NEMA | | IEC |
|---|---|---|---|---|
| **Environmental** | Operating Temperature Range | −20…+40 °C (−4…+104 °F) | | |
| | Storage and Transportation Temperature Range | −25….+85 °C (−13…+185 °F) | | |
| | Altitude[1] | 2000 m | | |
| | Humidity | 5…95% (on-condensing) | | |
| | Pollution Degree | 3 | | |
| | Enclosure Ratings | NEMA Type 4/12 | | IP67 |
| | Approximate Shipping Weight | 10.4 kg (23 lbs) | | |
| **Mechanical** | **Resistance to Shock** | | | |
| | Operational | 15 G | | |
| | Non-Operational | 30 G | | |
| | **Resistance to Vibration** | | | |
| | Operational | 1 G, 0.15 mm (0.006 in.) Displacement | | |
| | Non-Operational | 2.5 G, 0.38 mm (0.015 in.) Displacement | | |
| | **Power and Ground Terminals** | | | |
| | Wire Size | Primary/Secondary Terminal: #16…#10 AWG | | Primary/Secondary Terminal: 1.0…4.0 $mm^2$ |
| | Tightening Torque | Primary Terminal: 10.8 lb·in.<br>Secondary Terminal: 4.5 lb·in. | | Primary Terminal: 1.2 N·m<br>Secondary Terminal: 0.5 N·m |
| | Wire Strip Length | 0.35 in. (9 mm) | | |
| | **Control Terminals** | | | |
| | Wire Size | #18…#10 AWG | | 1.0…4.0 mm2 |
| | Tightening Torque | 6.2 lb·in. | | 0.7 N·m |
| | Wire Strip Length | 0.35 in. (9 mm) | | |
| | Disconnect Lock Out | Recommend 8 mm (5/16 in.) lock shackle or hasp.<br>The hasp must not exceed 8 mm (5/16 in.) when closed. | | |
| **Contactor Mechanical Life** | **Cat. No. 100-** | **Ops** | **C12 (AC3)** | **C23 (AC3)** |
| | 280/1_-_12* | Mil | 13 | — |
| | 280/1_-_23* | Mil | — | 13 |
| **Other Rating** | **EMC Emission Levels** | | | |
| | Conducted Radio Frequency Emissions | 10V rms Communications Cables<br>10V rms (PE)<br>150 kHz…80 MHz | | |
| | Radiated Emissions | Class A, Group 1, Equivalent to C2 emissions | | |
| | **EMC Immunity Levels** | | | |
| | Electrostatic Discharge | 4 kV contact and 8 kV Air | | |
| | Radio Frequency Electromagnetic Field | 10V/m, 80 MHz…1 GHz<br>3V/m, 1.4 GHz…2 GHz<br>1V/m, 2.0 GHz …2.7 GHz | | |
| | Fast Transient | 2 kV (Power)<br>2 kV (PE)<br>1 kV (Communications and Control) | | |
| | Surge Transient | 1 kV (12) L-L, 2 kV (2) L-N (Earth) | | |
| | Overload Current Range | 280_-_____-10A-* | 0.24…1.2 A | |
| | | 280_-_____-10B-* | 0.5…2.5 A | |
| | | 280_-_____-10C-* | 1.1…5.5 A | |
| | | 280_-_____-25D-* | 3.2…16 A | |
| | Trip Classes[2] | 10, 15, 20 | | |
| | Trip Rating | 120% of Full Load current (FLC) setting | | |
| | Number of poles | 3 | | |

(1) See Altitude Derating on page 259 for derating guide

(2) Refer to Motor Overload Trip Curves on page 249

| | UL/NEMA | IEC |
|---|---|---|
| **Standards Compliance** | UL 508<br>CSA C22.2, No. 14<br>EN/IEC 60947-4<br>EN/IEC 60947-4-1<br>CE Marked per Low Voltage 2006/95/EC<br>EMC Directive 2004/108/EC<br>CCC<br>ODVA for EtherNet/IP | |
| **Certifications** | UL, TÜV | |

| Control and I/O Power Requirements | | | | | | |
|---|---|---|---|---|---|---|
| | | **A1/A2(1)** | **A3/A2(2)** | **A1/A2(1)** | **A3/A2(2)** | **A3/A2(3)** |
| | **Units** | **W/O HOA** | | **W/ HOA** | | |
| Control Voltage | Volts | 24V DC | | | | |
| Module Inrush (4) | Amps | 0.92 | 0.30 | 1.09 | 0.125 | 0.295 |
| Module Steady | Amps | 0.06 | 0.30 | 0.23 | 0.125 | 0.295 |
| Total Control Power (Pick Up) | Watts | 22.08 | 7.20 | 26.16 | 3.00 | 7.08 |
| Total Control Power (Running) | Watts | 1.44 | 7.20 | 5.52 | 3.00 | 7.08 |

(1) Add power requirements for outputs (1 A max.) to A1/A2.

(2) Add power requirements for inputs (200 mA max.) to A3/A2.

(3) If A1 power is disconnected.

(4) Instantaneous capacitive inrush exists for less than 10 ms, which can exceed 20 A. The power supply must have sufficient capacity to support this amount of instant power demand when multiple units are turned ON simultaneously. If supplies are weaker, we recommend applying unswitched power (A3-A2) first and after a 2…4 second delay, apply switched power.

| | | UL/NEMA | IEC |
|---|---|---|---|
| **Input Ratings – Sourced from Control Circuit (A3/A2)** | Rated Operation Voltage | 24V DC | |
| | Input On-State Voltage Range | 10…26V DC | |
| | Input On-State Current | 3.0 mA @ 10V DC | |
| | | 7.2 mA @ 24V DC | |
| | Input Off-State Voltage Range | 0…5V DC | |
| | Input Off-State Current | <1.5 mA | |
| | Maximum Input Frequency Response | 200 Hz<br>(DeviceLogix response is greater than 200 Hz. Network response depends on control system network performance.) | |
| | **Input Filter – Software Selectable** | | |
| | Off to On | Settable from 0…64 ms in 1 ms increments | |
| | On to Off | Settable from 0…64 ms in 1 ms increments | |
| | Input Compatibility | — | IEC 1133 Type 1+ |
| | Number of Inputs | 4 | |
| | **Sensor Source** | | |
| | Voltage Status Only | 11…26.4V DC from unswitched power (A3-A2) | |
| | Current Available | 50 mA max. per input, 200 mA for any single point | |
| **SI - SM1 and SM2 (24V DC)** | Contact Rating | DC-12 L/R, 1 ms resistive, 6 A | |
| | Contact Type | IEC 60947-5-1 Annex L - mechanically | |
| **SO - P/M** | | 3 W/0.125 A per contactor (Two safety contactors) | |

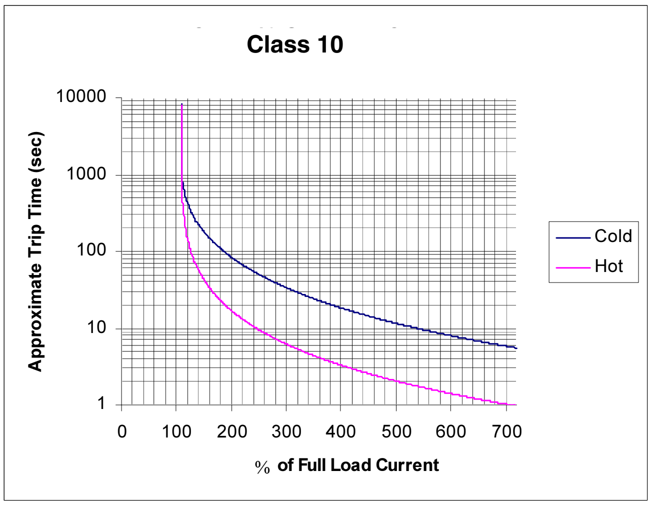
| | | UL/NEMA | IEC |
|---|---|---|---|
| **Output Ratings – Sourced from Control Circuit (A1/A2) (Do not use as a power supply source to other devices)** | Rated Operation Voltage | 26.4V DC | |
| | Rate Insulation Voltage | 250V | |
| | Dielectric Withstand | 1500V AC (UL) | 2000V AC (IEC) |
| | Operating Frequency | Solid-state sourcing output | |
| | Type of Current | 24V DC | |
| | Conventional Thermal Current Ith | 0.5 A each, 1 A, max combined | |
| | Peak Output Current | Current limited 2…8 amps (5 amps, nom) @ 24V DC | |
| | Type of Contacts | Normally open (N.O.) | |
| | Number of Contacts | 2 | |
| | Load Types | Resistive or light inductive | |
| | Surge Suppression | Integrated diode, clamps @ 35V DC | |
| | Thermo-Protection | Integrated short circuit and over current protection | |
| | Maximum Cycle Rate | 30 operations/minute capacitive and inductive loads | |
| | Maximum Blocking Voltage | 35V DC | |
| | Maximum On-State Voltage @ Maximum Output | 1.5V DC | |
| | Maximum Off-State Leakage Current | 10 µA | |
| **Device Level Ring (DLR)** | | Beacon-based performance including IEEE 1588 end to end transparent clock | |
| | Fault Recovery | Ring recovery time is less than 3 ms for a 50 node network | |
| **Ethernet Port** | Ethernet Receptacles | 2 D-coded, 4-pin female M12 connectors | |
| | Ports | Embedded switch with 2 ports | |
| | IP Address | DHCP enabled by default | |
| | DHCP Timeout | 30 s | |
| | Communication Rate | 10/100 Mbps with auto negotiate half duplex and full duplex | |
| | Data | • Transported over both TCP and UDP<br>• Min. of 500 I/O packets/second (pps)<br>• Supports up to 150 concurrent TCP sockets | |
| **Web Server** | | Embedded web server | |
| | Security | Login and password configurable | |
| | Email | Support Simple Mail Transfer Protocol (SMTP) | |
| | Configuration | Status, diagnostics, and configuration tabs | |
| **Device Connections** | Supports scheduled (Class 1) and unscheduled (Class 3 and UCMM) connections | | |
| | 6 - Class 3 connections are supported simultaneously | | |
| | Supports up to 2 Class 1 CIP connections [Exclusive owner (data) or listen-only]. One connection per PLC. Listen-only connection requires a data connection to be established. | | |
| | Class 1 Connection API: 2…3200 ms, Class 3 Connection API: 100…10 000 ms | | |
| | 20 ms Request Packet Interval (RPI) default | | |
| | 3 concurrent Encapsulation sessions | | |
| | TCP port supports 5 concurrent incoming connections | | |
| **Component Response Time** | 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 | See ArmorBlock Guard I/O DeviceNet Installation Instructions, publication 1732DS-IN001 | |
| | Bulletin 281 | 20…40 ms | |
| **Probability of Dangerous Failure per hour and $MTTF_d$ for Uncontrolled Stop(1)p** | $MTTF_d$ | 100 years | |
| | Average probability of dangerous failure per hour | 6.0E-9 (1/h) | |

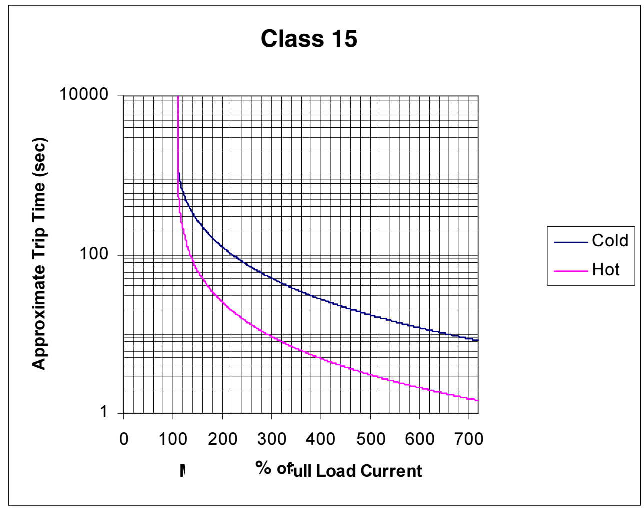
(1) ArmorStart safety controller used in combination with ArmorStart safety-related parts.

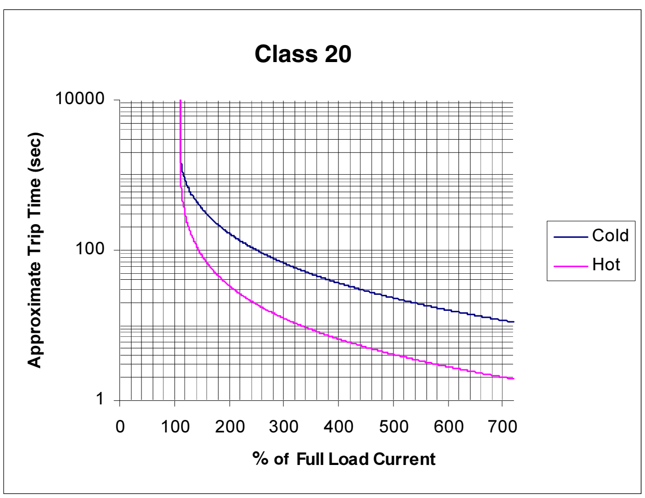
## Motor Overload Trip Curves

Motor overload current parameter provides class 10, 15, and 20 overload protection. Ambient insensitivity is inherent in the electronic design of the overload.

**Figure 87 - Bulletin 281E Overload Trip Curves**




**Note:** If an overload fault occurs, it can require 60 s or more before a fault reset is allowed. See Overload Class Parameter 107, Thermo-Utilization parameter 105, and OL Reset Level parameter 108 to adjust the reset time.

**Note:** When the mechanical motor brake voltage is applied by using power from the load side of the ArmorStart controller, the added load current can result in a phase imbalance or overload, if the FLA of the motor and the brake current are similar in scale.

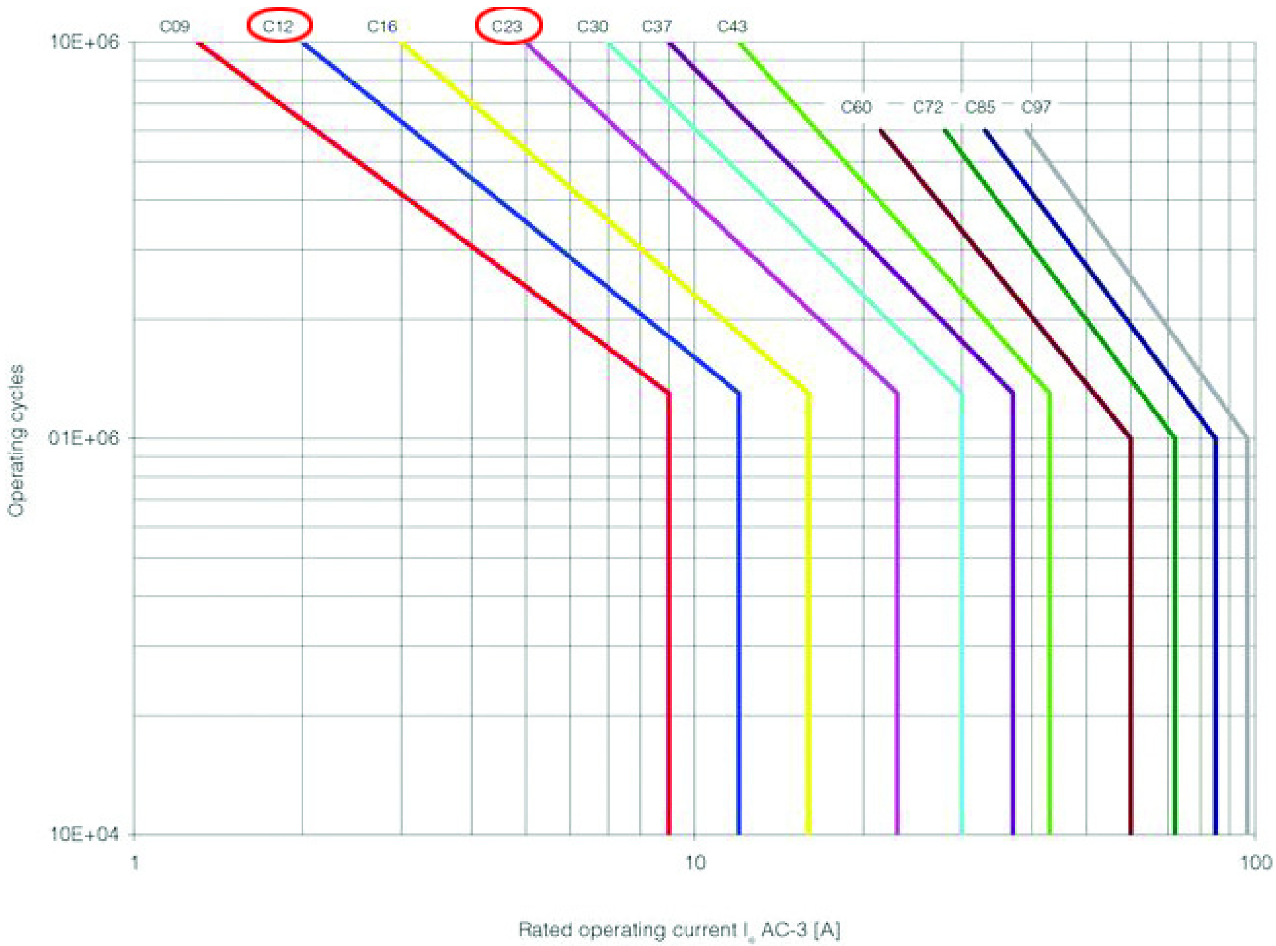
## Contactor Life Load Curves

| | |
|---|---|
| 280/1_-_12* | = 100-C12* |
| 280/1_-_23* | = 100-C23* |

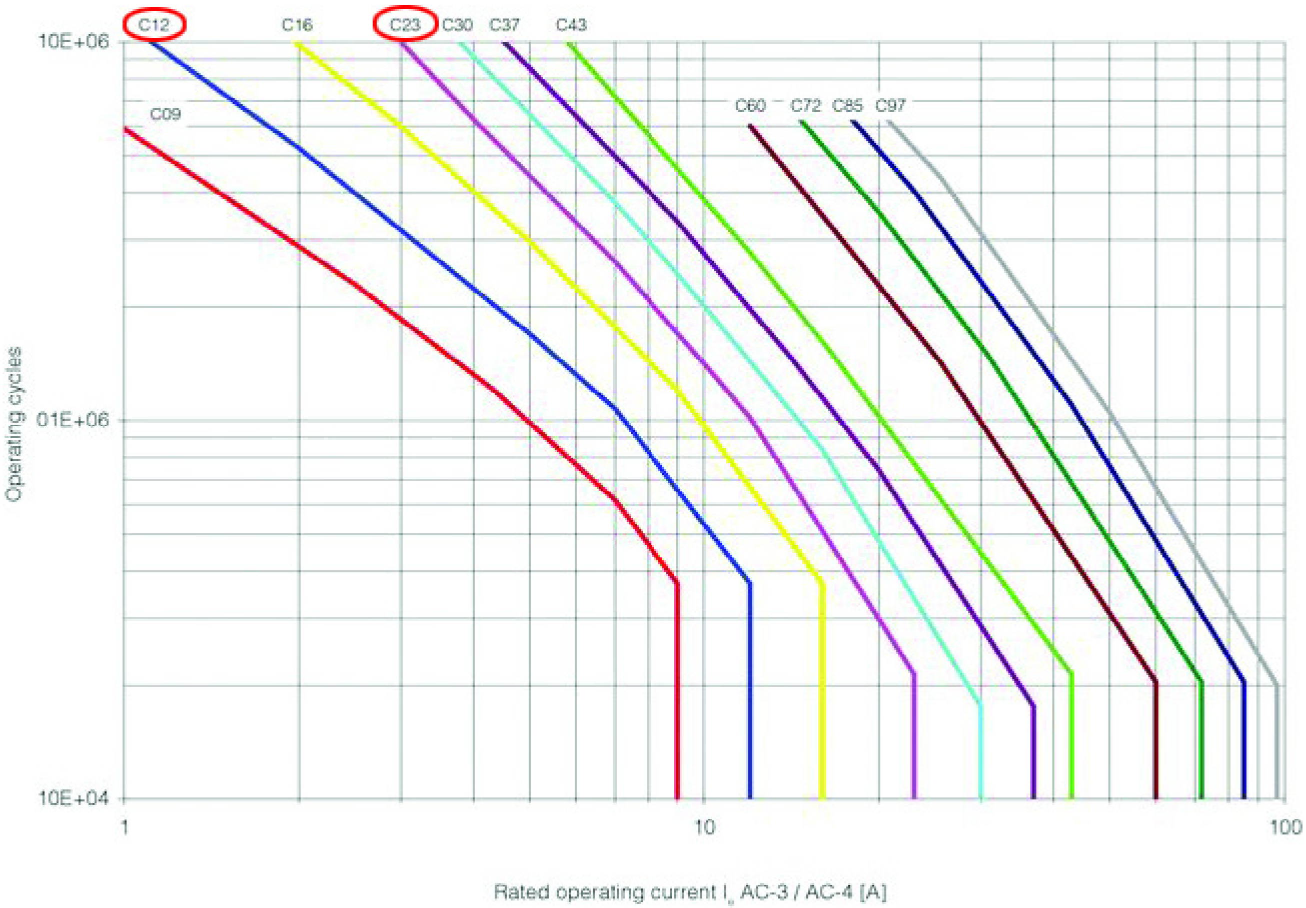
*Life Load Curves:*

AC-3 Switching of squirrel-cage motors while starting

$U_e$ = 230…400…460V

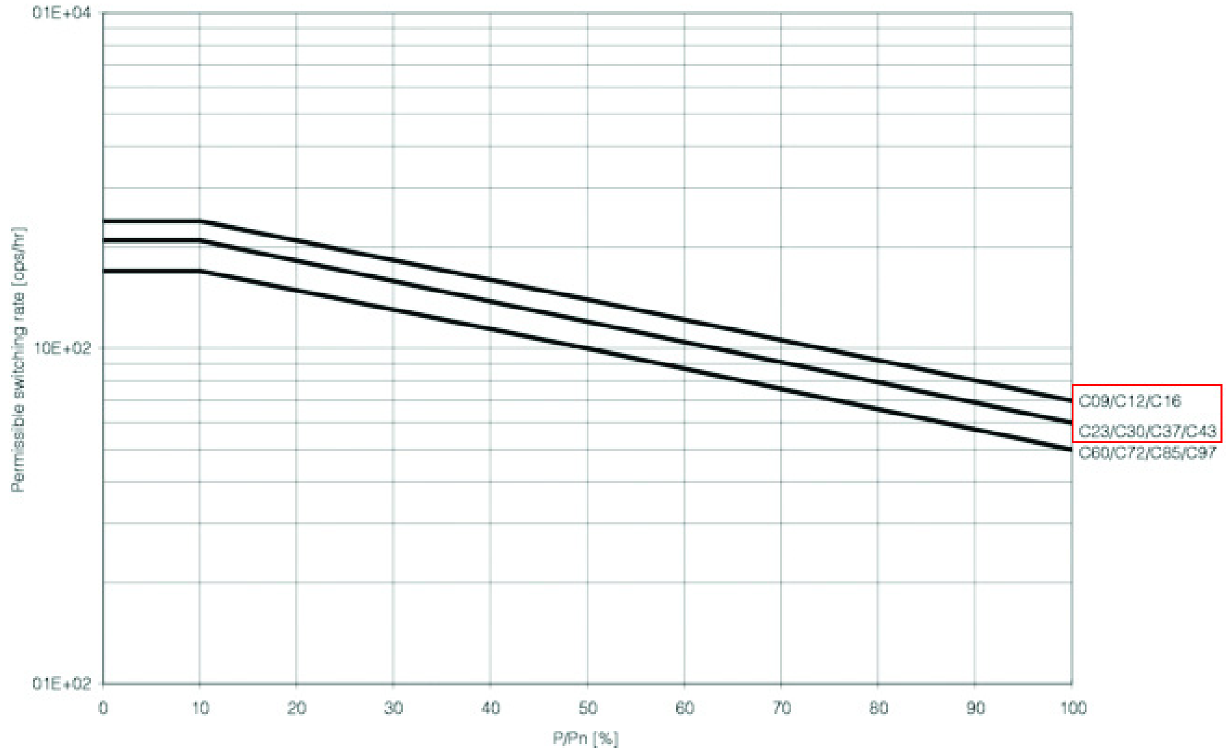


AC-3 & AC-4 10% AC-4 Mixed operation of squirrel-cage motors
$U_e$ = 400…460V

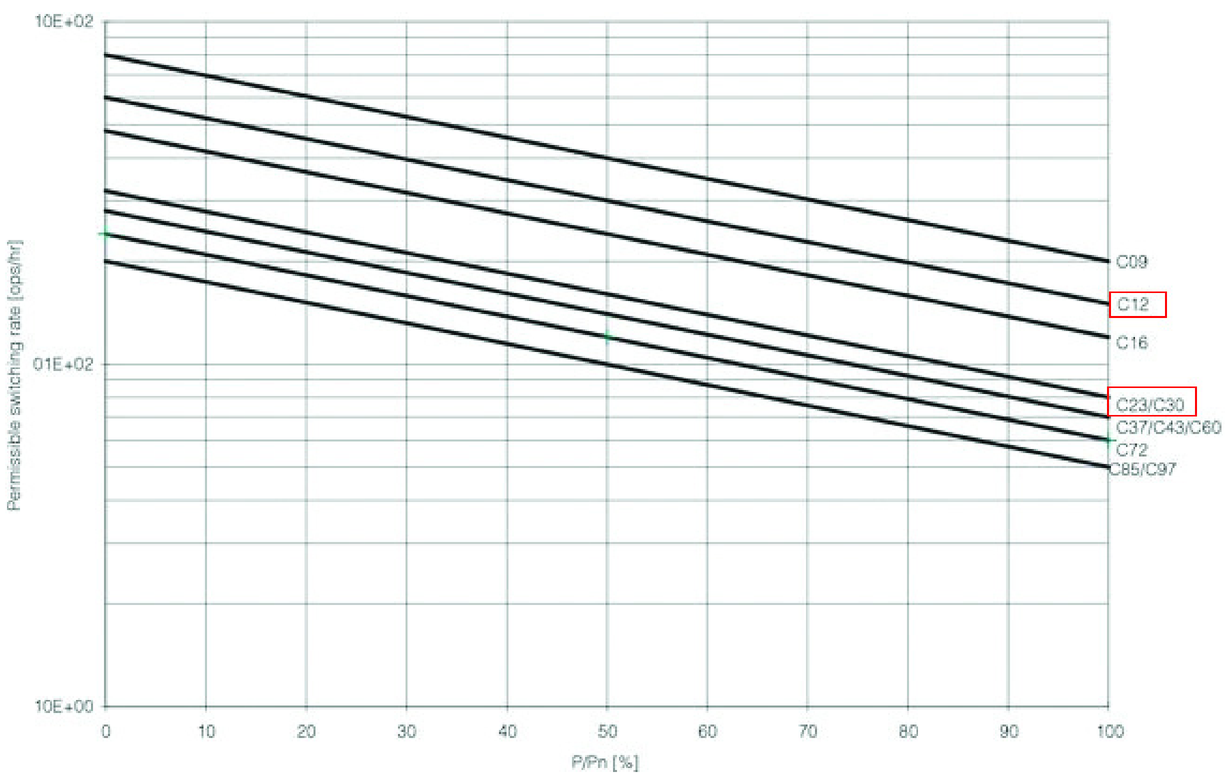


### *Maximum Operating Rates:*

AC-3 Switching of squirrel-cage motors while starting
$U_e$ = 230…460V, Relative operating time 40%, Starting time tA = 0.25 s




AC-4 Inching of squirrel-cage motors
Ue = 230…460V, Starting time tA = 0.25 s



# Bulletin 284E Controller

| Electrical Ratings | | UL/NEMA | | IEC |
|---|---|---|---|---|
| Power Circuit | Rated Operation Voltage | 380/220…480/277V AC | | 380/220…480/277V AC |
| | Rate Insulation Voltage | 600V | | 600V |
| | Rated Impulse Voltage | 6 kV | | 6 kV |
| | Dielectric Withstand | 2200V AC | | 2500V AC |
| | Operating Frequency | 50/60 Hz | | 50/60 Hz |
| | Utilization Category | — | | AC-3 |
| | Protection Against Shock | — | | IP0 |
| | Rated Max. Output Operating Current | **SVC - Performance** | | |
| | | | **3-phase Hp Rating** | **Output Current [A]** |
| | | 284E-FVD1P4Z* | 0.5 | 1.4 |
| | | 284E-FVD2P3Z* | 1 | 2.3 |
| | | 284E-FVD4P0Z* | 2 | 4 |
| | | 284E-FVD6P0Z* | 3 | 6 |
| | | 284E-FVD7P6Z* | 5 | 7.6 |
| Control Circuit | Rated Operation Voltage | 24V DC (+10%, –15%), SELV or PELV, (A2 must be grounded at voltage source) | | |
| | Rate Insulation Voltage | 30V | | 30V |
| | Rated Impulse Voltage | — | | 1.5 kV |
| | Dielectric Withstand | 1500V AC | | 2000V AC |
| | Overvoltage Category | — | | III |
| | Operating Frequency | DC | | DC |
| Short Circuit Protection | Short Circuit Protection Device (SCPD) Performance Type 1 | **Short Circuit Protection** | | **480Y/277V** |
| | | -10 or -25 | **Sym. Amps rms** | 65 kA |
| | | | **Max. Fuse(1)** | 30 A |
| | | -10 or -25 | **Sym. Amps rms** | 30 kA |
| | | | **Max. Circuit Breaker(2)** | 60 A |

(1) Class J, CC, and T fuses only.

(2) Only when used with Cat. No. 140G-H6C3-C60.

| | | UL/NEMA | IEC |
|---|---|---|---|
| Environmental | Operating Temperature Range | −20…+40 °C (−4…+104 °F) | |
| | Storage and Transportation Temperature Range | −25….+85 °C (−13…+185 °F) | |
| | Altitude(1) | 1000 m | |
| | Humidity | 5…95% (on-condensing) | |
| | Pollution Degree | 3 | |
| | Enclosure Ratings | NEMA Type 4/12 | IP67 |
| | Approximate Shipping Weight | 13.6 kg (30 lb) | |
| Mechanical | **Resistance to Shock** | | |
| | Operational | 15 G | |
| | Non-Operational | 30 G | |
| | **Resistance to Vibration** | | |
| | Operational | 1 G, 0.15 mm (0.006 in.) Displacement | |
| | Non-Operational | 2.5 G, 0.38 mm (0.015 in.) Displacement | |
| | **Power and Ground Terminals** | | |
| | Wire Size | Primary/Secondary Terminal: #16…#10 AWG | Primary/Secondary Terminal: 1.0…4.0 $mm^2$ |
| | Tightening Torque | Primary Terminal: 10.8 lb·in.<br>Secondary Terminal: 4.5 lb·in. | Primary Terminal: 1.2 N·m<br>Secondary Terminal: 0.5 N·m |
| | Wire Strip Length | 9 mm (0.35 in.) | |
| | **Control** | | |
| | Terminal Wire Size | #18…#10 AWG | 1.0…4.0 mm2 |
| | Tightening Torque | 6.2 lb·in. | 0.7 N·m |
| | Wire Strip Length | 9 mm (0.35 in.) | |
| | Disconnect Lock Out | Recommend 8 mm (5/16 in.) lock shackle or hasp.<br>The hasp must not exceed 8 mm (5/16 in.) when closed. | |
| Other Rating | **EMC Emission Levels** | | |
| | Conducted Radio Frequency Emissions | 10V rms Communications Cables<br>10V rms (PE)<br>150 kHz…80 MHz | |
| | Radiated Emissions | Class A, Group 1, equivalent to C2 emissions | |
| | **EMC Immunity Levels** | | |
| | Electrostatic Discharge | 4 kV contact and 8 kV Air | |
| | Radio Frequency Electromagnetic Field | 10V/m, 80 KHz…1 GHz<br>3V/m, 1.4 GHz…2 GHz<br>1V/m, 2.0 GHz …2.7 GHz | |
| | Fast Transient | 2 kV (Power)<br>2 kV (PE)<br>1 kV (Communications and Control) | |
| | Surge Transient | 1 kV (12) L-L, 2 kV (2) L-N (Earth) | |
| | Internal Fan for 284 | Fan L10 Operation data: 80K hr at 40 °C (104 °F) | |
| SI - SM1 and SM2 (24V DC) | Contact Rating | DC-12 L/R , 1 ms resistive, 6 A | |
| | Contact Type | IEC 60947-5-1 Annex L - mechanically | |
| SO - P/M | | 3 W/0.125 A per contactor (Two safety contactors) | |

(1) See Altitude Derating on page 259 for derating guide.

| | UL/NEMA | IEC |
|---|---|---|
| **Standards Compliance** | UL 508C<br>CSA C22.2, No. 14<br>EN50178<br>EN61800-3<br>EN/IEC 60947-4-2<br>CE Marked per Low Voltage 2006/95/EC<br>EMC Directive 2004/108/EC<br>ODVA for EtherNet/IP | |
| **Certifications** | UL, TÜV | |

| Control and I/O Power Requirements | | | | | | |
|---|---|---|---|---|---|---|
| | **Units** | **A1/A2(2)** | **A3/A2(3)** | **A1/A2(2)** | **A3/A2(3)** | **A3/A2(4)** |
| | | **W/O HOA** | | **W/ HOA** | | |
| Control Voltage | Volts | 24V DC | | | | |
| Module Inrush(1) | Amps | 0.92 | 0.30 | 1.09 | 0.125 | 0.295 |
| Module Steady | Amps | 0.06 | 0.30 | 0.23 | 0.125 | 0.295 |
| Total Control Power (Pick Up) | Watts | 22.08 | 7.20 | 26.16 | 3.00 | 7.08 |
| Total Control Power (Running) | Watts | 1.44 | 7.20 | 5.52 | 3.00 | 7.08 |
| Total Control Power (with Dynamic Brake or Output Contactor option) | Watts | — | — | 12 | 3 | 8.4 |
| Total Control Power (with Dynamic Brake and Output Contactor option) | Watts | — | — | 15 | 3 | 8.4 |

(1) Instantaneous capacitive inrush exists for less than 10 ms, which can exceed 20 A. The power supply must have sufficient capacity to support this amount of instant power demand when multiple units are turned ON simultaneously. If supplies are weaker, we recommend applying unswitched power (A3-A2) first and after a 2…4 second delay, apply switched power.

(2) Add power requirements for outputs (1 A max.) to A1/A2.

(3) Add power requirements for inputs (200 mA max.) to A3/A2.

(4) If A1 power is disconnected.

| Drive Ratings – VFD Output Current vs. Input Current | | | | | |
|---|---|---|---|---|---|
| **Line Voltage [V]** | **Frequency [Hz]** | **3-Phase kW Rating** | **3-Phase Hp Rating** | **Output Current [A]** | **Input Current [A]** |
| | | | | **Sensorless Vector Control** | **Sensorless Vector Control** |
| 380 | 50 | 0.4 | — | 1.4 | 2.15 |
| | | 0.75 | — | 2.3 | 3.80 |
| | | 1.5 | — | 4.0 | 6.40 |
| | | 2.2 | — | 6.0 | 9.00 |
| | | 3.0 | — | 7.6 | 12.40 |
| 460 | 60 | — | 0.5 | 1.4 | 1.85 |
| | | — | 1 | 2.3 | 3.45 |
| | | — | 2 | 4.0 | 5.57 |
| | | — | 3 | 6.0 | 8.20 |
| | | — | 5 | 7.6 | 12.5 |

| Drive Characteristics | |
|---|---|
| Output Frequency | 0…400 Hz (Programmable) |
| Efficiency | 97.5% (Typical) |
| Sensorless Vector Control | |
| Maximum (kW) Hp Rating/Input Voltage | 5 Hp (3.3 kW)/480V AC |
| Preset Speeds | 8 |
| Skip Frequency | ✓ |
| StepLogic® Functionality | ✓ |
| Timer/Counter Functions | ✓ |

## Sensorless Vector Control (SVC)

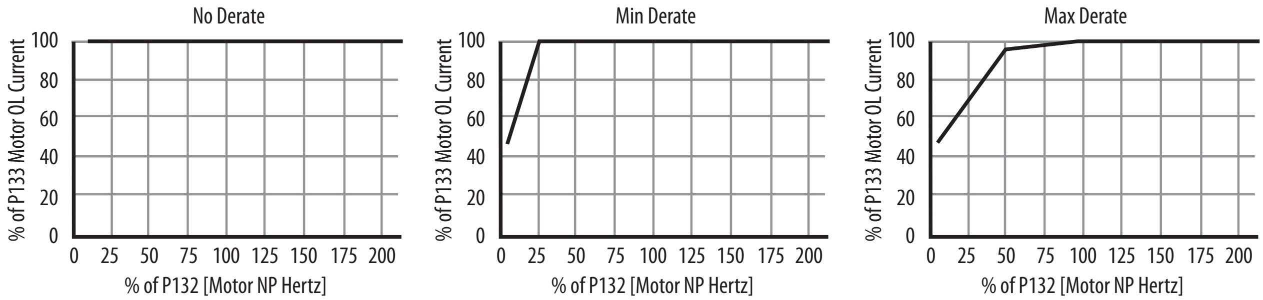
| Protective Specifications – Sensorless Vector Control | |
|---|---|
| Motor Overload Protection | $I^2t$ overload protection – 150% for 60 seconds, 200% for 3 seconds (provides Class 10 protection) |
| Overcurrent | 200% hardware limit, 300% instantaneous fault |
| Over Voltage | 380…460V AC Input – Trip occurs @ 810V DC bus voltage (equivalent to 575V AC incoming line) |
| Under Voltage | 380…480V AC Input – Trip occurs @ 390V DC bus voltage (equivalent to 275V AC incoming line) |
| Faultless Power Ride Through | 100 milliseconds |

| Control Specifications – Sensorless Vector Control | |
|---|---|
| Carrier Frequency | 2…16 kHz. Drive rating is based on 4 kHz. |
| Frequency Accuracy – Digital Input | Within ±0.05% of set output frequency. |
| Speed Regulation – Open Loop with Slip Compensation | ±1% of base speed across a 60:1 speed range |
| Stop Modes | Multiple programmable stop modes including – Ramp, Coast, DC-Brake, Ramp-to-Hold, and S Curve. |
| Accel/Decel | Two independently programmable accel and decel times. Each time can be programmed from 0…600 s in 0.1 s increments. |
| Electronic Motor Overload Protection | Class 10 protection with speed sensitive response |

## Motor Overload Trip Curves

Motor OL Current parameter provides Class 10 overload protection. Ambient insensitivity is inherent in the electronic design of the overload.

**Figure 88 - 284E Overload Trip Curves**



| | | UL/NEMA | IEC |
|---|---|---|---|
| **Input Ratings – Sourced from Control Circuit (A3/A2)** | Rated Operation Voltage | 24V DC | |
| | Input On-State Voltage Range | 10…26V DC | |
| | Input On-State Current | 3.0 mA @ 10V DC | |
| | | 7.2 mA @ 24V DC | |
| | Input Off-State Voltage Range | 0…5V DC | |
| | Input Off-State Current | <1.5 mA | |
| | Maximum Input Frequency Response | 200 Hz<br>(DeviceLogix response is greater than 200 Hz. Network response depends on control system network performance.) | |
| | **Input Filter – Software Selectable** | | |
| | Off to On | Settable from 0…64 ms in 1 ms increments | |
| | On to Off | Settable from 0…64 ms in 1 ms increments | |
| | Input Compatibility | — | IEC 1+ |
| | Number of Inputs | 4 | |
| | **Sensor Source** | | |
| | Voltage Status Only | 11…26.4V DC from unswitched power | |
| | Current Available | 50 mA, max per input, 200 mA, any single point | |
| **Output Ratings – Sourced from Control Circuit (A1/A2)** | Rated Operation Voltage | 26.4V DC | |
| | Rate Insulation Voltage | 250V | |
| | Dielectric Withstand | 1500V AC (UL) | 2000V AC (IEC) |
| | Type of Control Circuit | Solid-state sourcing output | |
| | Type of Current | 24V DC | |
| | Conventional Thermal Current Ith | 0.5 A each, 1 A, max combined | |
| | Peak Output Current | Current limited 2…8 amps (5 amps, nom) @ 24V DC | |
| | Type of Contacts | Normally open (N.O.) | |
| | Number of Contacts | 2 | |
| | Load Types | Resistive or light inductive | |
| | Surge Suppression | Integrated diode, clamps @ 35V DC | |
| | Thermo-Protection | Integrated short circuit and over current protection | |
| | Maximum Cycle Rate | 30 operations/minute capacitive and inductive loads | |
| | Maximum Blocking Voltage | 35V DC | |
| | Maximum On-State Voltage @ Maximum Output | 1.5V DC | |
| | Maximum Off-State Leakage Current | 10 μA | |
| **Device Level Ring (DLR)** | — | Beacon-based performance including IEEE 1588 end to end transparent clock | |
| | Fault Recovery | Ring recovery time is less than 3 ms for a 50 node network | |
| **Ethernet Port** | — | 2 D-coded, 4-pin female M12 connectors | |
| | Ports | Embedded switch with 2 ports | |
| | IP Address | DHCP enabled by default | |
| | DHCP Timeout | 30 s | |
| | Communication Rate | 10/100 Mbps with auto negotiate half duplex and full duplex | |
| | Data | •Transported over both TCP and UDP<br>• Min. of 500 I/O packets/second (pps)<br>• Supports up to 150 concurrent TCP sockets | |
| **Web Server** | — | Embedded web server | |
| | Security | Login and password configurable | |
| | Email | Support Simple Mail Transfer Protocol (SMTP) | |
| | Configuration | Status, diagnostics, and configuration tabs | |

| | | UL/NEMA | IEC |
|---|---|---|---|
| **Device Connections** | Supports scheduled (Class 1) and unscheduled (Class 3 and UCMM) connections<br>6 - Class 3 connections are supported simultaneously<br>Supports up to 2 Class 1 CIP connections [Exclusive owner (data) or listen-only]. One connection per PLC. Listen only connection requires a data connection to be established. | | |
| | Class 1 Connection API: 2…3200 ms<br>Class 3 Connection API: 100…10 000 ms | | |
| | 20 ms Request Packet Interval (RPI) default | | |
| | 3 concurrent Encapsulation sessions | | |
| | TCP port supports 5 concurrent incoming connections | | |
| **Component Response Time** | 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 | | See ArmorBlock Guard I/O DeviceNet Installation Instructions, publication 1732DS-IN001 |
| | Bulletin 284 | | 8…12 ms |
| **Probability of Dangerous Failure per hour and $MTTF_d$ for Uncontrolled Stop**(1) | $MTTF_d$ | | 100 years |
| | Average probability of dangerous failure per hour | | 6.0E-9 (1/h) |

(1) ArmorStart safety controller used in combination with ArmorStart safety-related parts.

# Altitude Derating

## Altitude Rating for Bulletin 281

- No altitude derating up to 2000 m (6562 ft)

## Altitude Rating for Bulletin 284

- **0.5 Hp:** No Derating up to 3000 m (9843 ft)
- **1 Hp:** No Derating up to 3000 m (9843 ft)
- **2 Hp:** Derate 1% per 100 m (328 ft) above 1000 m (3281 ft)
- **3 Hp:** No Derating up to 3000 m (9843 ft)
- **5 Hp:** Derate 1% per 100 m (328 ft) above 1000 m

**Example:** Application requires 2600 m for a 5 Hp ArmorStart controller

- 2600 m-1000 m= 1600 m
- 1600/100 = 16
- 16 * 1%= 16%. Derate output amps by 16%
- (1-.16)*7.6 amp = 6.4 amp

It is possible to extend the operational range of the units if the ambient temperature is lower than 40 °C (104 °F), or if line reactors are used.

# Notes:

# Accessories

## Industrial Ethernet Media

### D Code Connectivity (M12) – 1585D

| Patchcords and Cordsets IP67 | | |
|---|---|---|
| M12 D Code | Connector Type | Cat. No. Unshielded |
|  | Male Straight to Male Straight | 1585D-M4TBDM-(1) |
|  | Male Straight to Male Right Angle | 1585D-M4TBDE-(1) |
|  | Male Right Angle to Male Right Angle | 1585D-E4TBDE-(1) |
|  | Male Straight to Female Straight | 1585D-M4TBDF-(1) |

(1) Available in 0.3, 0.6, 1, 2, 5, 10, 15, and increments of 5 meters up to 75 meters.

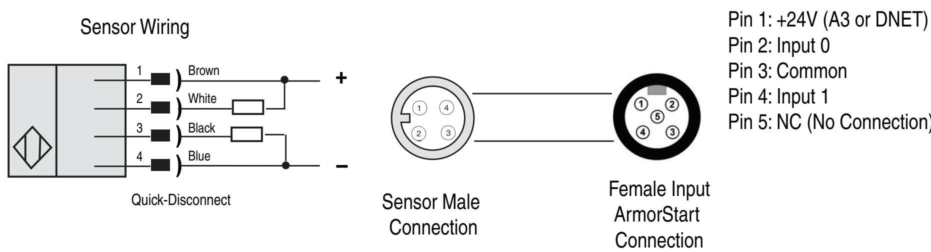
**Note:** See www.ab.com/networks/media/ethernet to learn more about Industrial Ethernet Media.

# Sensor Media

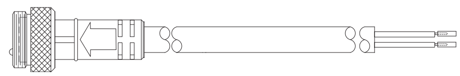
| Description | Description | I/O Connection | Pin Count | Connector | Cat. No. |
|---|---|---|---|---|---|
|  | DC Micro Patchcord | Input/Output | 4-Pin | Straight Female<br>Straight Male | 889D-F4ACDM-(1) |
| | | | | Straight Female<br>Right Angle Male | 889D-F4ACDE-(1) |
|  | DC Micro V-Cable | Input | | Straight Female | 879D-F4ACDM-(1) |
| | | | | Right Angle Female | 879D-R4ACM-(1) |

(1) Replace symbol with desired length in meters (for example, **Cat. No. 889D-F4ACDM-1** for a 1 m cable). Standard cable lengths: 1 m, 2 m, 5 m, and 10 m.

## Sensor Wiring



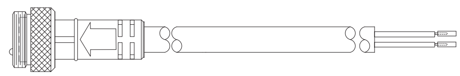
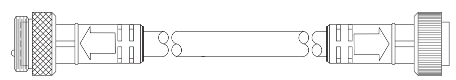
# Motor and Brake Cables

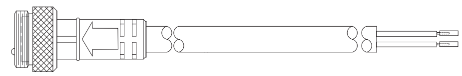
| Description | Rating | Length m (ft) | Cat. No. |
|---|---|---|---|
| **Single-ended, Non-shielded Motor Cable** | | | |
|  | | | |
| Non-shielded cordset cable assembly with straight male / flying leads, 29 mm shell, 4 Pin, 12 AWG Conductors | IP67, NEMA 4/12, TC-ER<br><br>Bend radius not to exceed 10x the cable diameter<br><br>Cable diameter 0.657 in. +/- 0.12 in. (16.71 mm +/- 0.5 mm) with four 12 AWG conductors | 0.5 | 280-PWRM29G-M05 |
| | | 1 | 280-PWRM29G-M1 |
| | | 1.5 | 280-PWRM29G-M015 |
| | | 2 | 280-PWRM29G-M2 |
| | | 3 | 280-PWRM29G-M3 |
| | | 4 | 280-PWRM29G-M4 |
| | | 6 | 280-PWRM29G-M6 |
| | | 8 | 280-PWRM29G-M8 |
| | | 10 | 280-PWRM29G-M10 |
| | | 12 | 280-PWRM29G-M12 |
| | | 14 | 280-PWRM29G-M14 |
| Non-shielded cordset cable assembly with 90 deg male / Flying leads, 29 mm shell, 4 Pin, 12 AWG Conductors(1) | IP67, NEMA 4/12, TC-ER<br><br>Bend radius not to exceed 10x the cable diameter<br><br>Cable diameter 0.657 in. +/- 0.12 in. (16.71 mm +/- 0.5 mm) with four 12 AWG conductors | 0.5 | 280-PWRM29H-M05 |
| | | 1 | 280-PWRM29H-M1 |
| | | 1.5 | 280-PWRM29H-M015 |
| | | 2 | 280-PWRM29H-M2 |
| | | 3 | 280-PWRM29H-M3 |
| | | 4 | 280-PWRM29H-M4 |
| | | 6 | 280-PWRM29H-M6 |
| | | 8 | 280-PWRM29H-M8 |
| | | 10 | 280-PWRM29H-M10 |
| | | 12 | 280-PWRM29H-M12 |
| | | 14 | 280-PWRM29H-M14 |

(1) Check for product availability. Contact your local Rockwell Automation sales office or Allen-Bradley distributor.

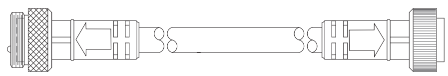
| Description | Rating | Length m (ft) | Cat. No. |
|---|---|---|---|
|  | | | |
| Non-shielded patch cable assembly with straight male / female receptacle, 29 mm shell, 4 Pin, 12 AWG Conductors | IP67, NEMA 4/12, TC-ER<br><br>Bend radius not to exceed 10x the cable diameter<br><br>Cable diameter 0.657 in. +/- 0.12 in. (16.71 mm +/- 0.5 mm) with four 12 AWG conductors | 0.5 | 280-PWRM29A-M05 |
| | | 1 | 280-PWRM29A-M1 |
| | | 1.5 | 280-PWRM29A-M015 |
| | | 2 | 280-PWRM29A-M2 |
| | | 3 | 280-PWRM29A-M3 |
| | | 4 | 280-PWRM29A-M4 |
| | | 6 | 280-PWRM29A-M6 |
| | | 8 | 280-PWRM29A-M8 |
| | | 10 | 280-PWRM29A-M10 |
| | | 12 | 280-PWRM29A-M12 |
| | | 14 | 280-PWRM29A-M14 |
| Non-shielded patch cable assembly with 90 deg male / 90 deg female receptacle, 29 mm shell, 4 Pin, 12 AWG Conductors(1) | IP67, NEMA 4/12, TC-ER<br><br>Bend radius not to exceed 10x the cable diameter<br><br>Cable diameter 0.657 in. +/- 0.12 in. (16.71 mm +/- 0.5 mm) with four 12 AWG conductors | 0.5 | 280-PWRM29D-M05 |
| | | 1 | 280-PWRM29D-M1 |
| | | 1.5 | 280-PWRM29D-M015 |
| | | 2 | 280-PWRM29D-M2 |
| | | 3 | 280-PWRM29D-M3 |
| | | 4 | 280-PWRM29D-M4 |
| | | 6 | 280-PWRM29D-M6 |
| | | 8 | 280-PWRM29D-M8 |
| | | 10 | 280-PWRM29D-M10 |
| | | 12 | 280-PWRM29D-M12 |
| | | 14 | 280-PWRM29D-M14 |

(1) Check for product availability. Contact your local Rockwell Automation sales office or Allen-Bradley distributor.

| Description | Rating | Length m (ft) | Cat. No. |
|---|---|---|---|
| **Single-ended, Shielded Motor Cable** | | | |
|  | | | |
| Shielded cordset cable assembly with straight male / flying leads, 29 mm shell, 4 Pin, 12 AWG Conductors | IP67, NEMA 4/12, TC-ER<br><br>Bend radius not to exceed 10x the cable diameter<br><br>Cable diameter 0.657 in. +/- 0.12 in. (16.71 mm +/- 0.5 mm) with four 12 AWG conductors | 0.5 | 284-PWRM29G-M05 |
| | | 1 | 284-PWRM29G-M1 |
| | | 1.5 | 284-PWRM29G-M015 |
| | | 2 | 284-PWRM29G-M2 |
| | | 3 | 284-PWRM29G-M3 |
| | | 4 | 284-PWRM29G-M4 |
| | | 6 | 284-PWRM29G-M6 |
| | | 8 | 284-PWRM29G-M8 |
| | | 10 | 284-PWRM29G-M10 |
| | | 12 | 284-PWRM29G-M12 |
| | | 14 | 284-PWRM29G-M14 |
| **Double-ended, Shielded Motor Cable** | | | |
|  | | | |
| Shielded patch cable assembly with straight male / female receptacle with leads, 29 mm shell, 4 Pin, 12 AWG Conductors | IP67, NEMA 4/12, TC-ER<br><br>Bend radius not to exceed 10x the cable diameter<br><br>Cable diameter 0.657 in. +/- 0.12 in. (16.71 mm +/- 0.5 mm) with four 12 AWG conductors | 0.5 | 284-PWRM29A-M05 |
| | | 1 | 284-PWRM29A-M1 |
| | | 1.5 | 284-PWRM29A-M015 |
| | | 2 | 284-PWRM29A-M2 |
| | | 3 | 284-PWRM29A-M3 |
| | | 4 | 284-PWRM29A-M4 |
| | | 6 | 284-PWRM29A-M6 |
| | | 8 | 284-PWRM29A-M8 |
| | | 10 | 284-PWRM29A-M10 |
| | | 12 | 284-PWRM29A-M12 |
| | | 14 | 284-PWRM29A-M14 |
| **Receptacles** | | | |
| Shielded straight male receptacle with 4 wires, 29 mm shell, 4 Pin, 12 AWG Conductors | | 0.3 | 284-M29M-M03 |
| Shielded straight female receptacle with 4 wires, 29 mm shell, 4 Pin, 12 AWG Conductors | | 0.3 | 284-M29F-M03 |

| Description | Rating | Length m (ft) | Cat. No. |
|---|---|---|---|
| **Single-ended, Non-shielded, Source Brake Cable** | | | |
|  | | | |
| Non-shielded cord assembly with straight male receptacle with leads, 22 mm shell, 3 Pin, 16 AWG Conductors | | 0.5 | 285-BRC22-M05 |
| | | 1 | 285-BRC22-M1 |
| | | 1.5 | 285-BRC22-M015 |
| | | 2 | 285-BRC22-M2 |
| | | 3 | 285-BRC22-M3 |
| | | 4 | 285-BRC22-M4 |
| | | 6 | 285-BRC22-M6 |
| | | 8 | 285-BRC22-M8 |
| | | 10 | 285-BRC22-M10 |
| | | 12 | 285-BRC22-M12 |
| | | 14 | 285-BRC22-M14 |
| Non-shielded cordset cable assembly with 90° male/ Flying leads 22 mm shell, 3 Pin, 16 AWG Conductors(1) | | 0.5 | 285-BRC22H-M05 |
| | | 1 | 285-BRC22H-M1 |
| | | 1.5 | 285-BRC22H-M015 |
| | | 2 | 285-BRC22H-M2 |
| | | 3 | 285-BRC22H-M3 |
| | | 4 | 285-BRC22H-M4 |
| | | 6 | 285-BRC22H-M6 |
| | | 8 | 285-BRC22H-M8 |
| | | 10 | 285-BRC22H-M10 |
| | | 12 | 285-BRC22H-M12 |
| | | 14 | 285-BRC22H-M14 |

(1) Check for product availability. Contact your local Rockwell Automation sales office or Allen-Bradley distributor.

| Description | Rating | Length m (ft) | Cat. No. |
|---|---|---|---|
| **Double-ended, Non-shielded, Source Brake Cable** | | | |
|  | | | |
| Non-shielded patch cable assembly with straight male / straight female receptacle with leads, 22 mm shell, 3 Pin, 16 AWG Conductors | | 0.5 | 285-BRC22-M05D |
| | | 1 | 285-BRC22-M1D |
| | | 1.5 | 285-BRC22-M015D |
| | | 2 | 285-BRC22-M2D |
| | | 3 | 285-BRC22-M3D |
| | | 4 | 285-BRC22-M4D |
| | | 6 | 285-BRC22-M6D |
| | | 8 | 285-BRC22-M8D |
| | | 10 | 285-BRC22-M10D |
| | | 12 | 285-BRC22-M12D |
| | | 14 | 285-BRC22-M14D |
| Non-shielded patch cable assembly with 90° male / 90° female receptacle with leads, 22 mm shell, 3 Pin, 16 AWG Conductors | | 0.5 | 285-BRC22D-M05 |
| | | 1 | 285-BRC22D-M1 |
| | | 1.5 | 285-BRC22D-M015 |
| | | 2 | 285-BRC22D-M2 |
| | | 3 | 285-BRC22D-M3 |
| | | 4 | 285-BRC22D-M4 |
| | | 6 | 285-BRC22D-M6 |
| | | 8 | 285-BRC22D-M8 |
| | | 10 | 285-BRC22D-M10 |
| | | 12 | 285-BRC22D-M12 |
| | | 14 | 285-BRC22D-M14 |
| **Receptacle** | | | |
| Non-shielded receptacle straight male with flying leads 22 mm shell, 3 Pin, 14 AWG Conductors | IP67/NEMA Type 4 /12 | 0.5 (1.6) | 285-M24M-M05 |
| Non-shielded receptacle straight female with flying leads 22 mm shell, 3 Pin, 14 AWG Conductors | IP67/NEMA Type 4 /12 | 0.25 (0.8) | 285-M24F-M025 |

# Three-phase Power

| Description[1] | Cat. No. | |
|---|---|---|
| Power cable - straight female to straight male | 280-PWRM35A-M[2] | |
| Power tee - 3-phase, 4-pole | 280-T35 | |
| Power tee - 3-phase, 4-pole, reducing drop<br>(when using ArmorStart EtherNet/IP version 0.5…2 Hp) | 280-RT35 | |
| Field-attachable M35 connector - 10 AWG, 600V, 32 A | 280-FAM35F (female) | 280-FAM35M (male) |

(1) UL Listed - UL 2237 (File No. E318496, Guide PVVA)

(2) See ArmorConnect Power and Control Media Selection Guide, publication 280PWR-SG001, for available lengths.

**Note:** See ArmorConnect Power and Control Media Selection Guide, publication 280PWR-SG001, for additional 3-phase media options.

# 24V DC Auxiliary Power

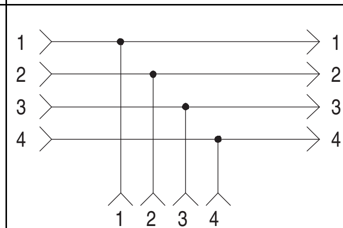
| Description | Cat. No. |
|---|---|
| Cordset - mini straight female to flying leads | 889N-F4AFC-[1] |
| Cordset - mini straight male to flying leads | 889N-M4AFC-[1] |
| Patchcord - mini straight male to straight female | 889N-F4AFNM-[2] |
| Control power tee - 24V DC, 4-pole | 898N-43PB-N-4KF |
| Auxiliary device T-port | 898N-43PB-N4KT |
| ArmorStart auxiliary T-port<br>(ArmorStart adapter tee when using ArmorStart EtherNet/IP version with quick disconnects) | 898N-543ES-NKF |
| Patchcord - 5/6 pin mini (for use with ArmorStart auxiliary T-port drop)<br>(ArmorStart drop from Tee when using ArmorStart EtherNet/IP version with quick disconnects) | 889N-F65[1] |

(1) Replace symbol with 6F (1.8 m [6 ft]), 5 (5 m [16.4 ft]), or 10 (10 m [32.8 ft]) for standard cable length.

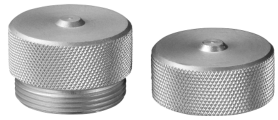
(2) Replace symbol with 2 (2 m [6.6 ft]), 5 (5 m [16.4 ft]), or 10 (10 m [32.8 ft]) for standard cable length.

**Note:** See http://ab.rockwellautomation.com/connection-devices/cables-and-cordsets for additional auxiliary power cable options.

# Control Power Tee

| Pin Count | Assembly Rating | Wiring Diagram | Cat. No. |
|---|---|---|---|
| 4-pin | 250V, 4 A, 4-pole |  | 898N-43PB-N4KF |

# Sealing Caps



| Description | EtherNet/IP | |
|---|---|---|
| | Input | Output |
| Plastic Sealing Cap (M12)(1) | 1485A-M12 | 1485A-M12 |
| Connector Aluminum Sealing Cap (M22)* | — | 1485A-C1 |
| Motor Connector Aluminum Sealing Cap (M35) for 25 A protection | — | 889A-QMCAP |
| Dynamic Brake and Source Brake Connector (M22) | — | 1485A-C1 |

(1) To achieve IP67 rating, sealing caps must be installed on all unused connections.

# Handle Accessory

| Description | | Cat. No. |
|---|---|---|
|  | Locking Tag<br>Padlock attachment to the lockable handles<br>Up to three padlocks 4…8 mm (5/16 in. diameter) shackle | 140M-C-M3 |

## Dynamic Brake Resistors Recommended Dynamic Brake Modules for Option DB1 (IP67 Resistor)

| Drive and Motor Size kW | Cat. No.(1) | Resistance Ohms ± 5% | Continuous Power kW | Max Energy kJ | Max Braking Torque % of Motor | Application Type 1 | | Application Type 2 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Braking Torque % of Motor | Duty Cycle % | Braking Torque % of Motor | Duty Cycle % |
| 380…480 Volt AC Input Drives | | | | | | | | | |
| 0.37 (0.5) | 284R-360P500-M(2) | 360 | 0.086 | 17 | 305% | 100% | 47% | 150% | 31% |
| 0.75 (1) | 284R-360P500-M(2) | 360 | 0.086 | 17 | 220% | 100% | 23% | 150% | 15% |
| 1.5 (2) | 284R-360P500-M(2) | 360 | 0.086 | 17 | 110% | 100% | 12% | 110% | 11% |
| 2.2 (3) | 284R-120P1K2-M(2) | 120 | 0.26 | 52 | 197% | 100% | 24% | 150% | 16% |
| 4 (5) | 284R-120P1K2-M(2) | 120 | 0.26 | 52 | 124% | 100% | 13% | 124% | 10% |

(1) Drive rating and DB part numbers are not interchangeable. Only use specified resistor. Customer is responsible to evaluate if performance meets application requirement.

(2) Length is user-selectable based on a suffix added to the catalog number. For a length of 500±10 mm, add **-M05** to the end of the catalog number. For a length of 1000±10 mm, add **-M1** to the end of the catalog number.

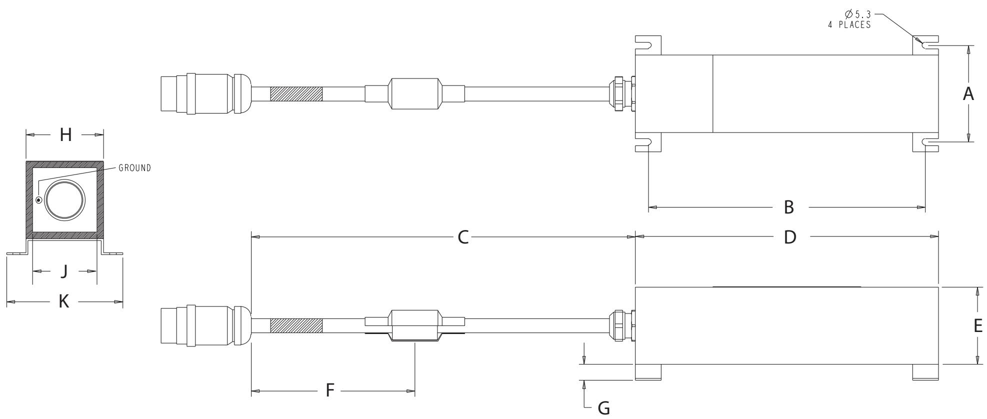
**Note:** Duty Cycle that is listed, is based on full speed to zero speed deceleration. For constant regen at full speed, duty cycle capability is half of what is listed.

Application Type 1 represents maximum capability up to 100% braking torque where possible.

Application Type 2 represents more than 100% braking torque where possible, up to a maximum of 150%.

**Figure 89 - Bulletin 284 Dynamic Brake Resistor Approximate Dimensions**

Dimensions are not intended to be used for manufacturing purposes.




<table>
<tr><th>Cat. No.</th><th>A<br>mm (in.)</th><th>B<br>mm (in.)</th><th>C<br>mm (in.)</th><th>D<br>mm (in.)</th><th>E<br>mm (in.)</th><th>F<br>mm (in.)</th><th>G<br>mm (in.)</th><th>H<br>mm (in.)</th><th>J<br>mm (in.)</th><th>K<br>mm (in.)</th></tr>
<tr><td>284R-091P500</td><td rowspan="3">89 ± 3<br>(3.5 ± 0.12)</td><td rowspan="2">215 ± 5<br>(8.46 ± 0.2)</td><td rowspan="3">M05 = 0.5 m<br>M1 = 1 m (1)</td><td rowspan="2">235 ± 5<br>(9.25 ± 0.2)</td><td rowspan="3">60 ± 2<br>(2.36 ± 0.08)</td><td rowspan="3">127<br>(5)</td><td rowspan="3">12.54<br>(0.49)</td><td rowspan="3">60 ± 2<br>(2.36 ± 0.08)</td><td rowspan="3">50 ± 1.5<br>(1.97 ± 0.06)</td><td rowspan="3">106 ± 3<br>(4.17 ± 0.12)</td></tr>
<tr><td>284R-120P1K2</td></tr>
<tr><td>284R-120P1K2</td><td>420 ± 5<br>(16.54 ± 0.2)</td><td>440 ± 5<br>(17.32 ± 0.2)</td></tr>
</table>

(1) Length is user-selectable based on the suffix added to the catalog number. For a length of 500 ±10 mm, add **-M05** to the end of the catalog number. For a length of 1000 ±10 mm, add **-M1** to the end of the catalog number.

**Note:** The customer must help to protect the resistor if a shorted switch occurs in the VFD. This protection is done via PLC control. An example ControlLogix program can be downloaded from http://samplecode.rockwellautomation.com.

# Applying More Than One ArmorStart Motor Controller in a Single Branch Circuit on Industrial Machinery

## Introduction

In the general multiple-motor branch circuit case, installation of a motor controller that is not listed for group installation, violates the NEC® and NFPA® 79.

Each ArmorStart motor controller is listed for group installation. This appendix explains how to use this listing to apply ArmorStart motor controllers in multiple-motor branch circuits.

## Background

The NEC® (*National Electrical Code*®) is NFPA® 70. NFPA 79 is the *Electrical Standard for Industrial Machinery*®. The 2014 version of the NEC refers to NFPA 79 in the first informational note of Article 670.

Group installation means that a single set of fuses or a single circuit breaker protects a branch circuit that supplies two or more motors and their controllers. Both the NEC and NFPA 79 have rules for installation of controllers in these multiple-motor branch circuits. Both also have special rules for controllers that are not Listed for group installation and general rules for controllers that are.

The special rules for controllers that are not Listed for group installation restrict some variable. These rules are found in the NEC 430.53(A), 430.53(B), and 430.53(C)(2)(b) and NFPA 79 7.2.10.2, 7.2.10.3, and the 7.2.10.4(1) condition "...does not exceed that permitted by 7.2.10.1...". For example, for 480V motors, NEC 430.53(A) limits each rating of the motor to 1 Hp or less and the protective device rating to 15 A or less.

The following addresses this **general** case: If a motor controller is Listed for group installation, the NEC and NFPA 79 permit the following:

1. It can be installed in a branch circuit with other motors having any mix of horsepower ratings
2. Protection of all of the wiring and controllers with a single set of fuses or a single circuit breaker large enough to operate this mix of motors.

The rules for this general case are found in the NEC 430.53(C) and 450.53(D) and in NFPA 79 7.2.10.4 and 7.2.10.5.

For this general case, the following conclusions apply:

## Importance of a Motor Controller Being Listed for Group Installation

- Unless a motor controller is listed for group installation, its listing covers only individual motor circuit installation, and installation of it in a general multiple-motor circuit violates the NEC and NFPA 79.
- This listing is physically important because it verifies that the short circuit current rating of the controller is valid with the larger fuses and circuit breakers necessary to operate the multiple-motor circuit.
- If a motor controller is not listed for group installation, the installer must add fuses or a circuit breaker in each input circuit of the motor controller.
- So, the group installation listing is important because it verifies that the short circuit current rating of the controller applies to the multiple-motor branch circuit and removes the requirement for the additional input circuit protective device or devices.

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. This appendix refers to this type of branch circuit as a multiple-motor branch circuit. The circuit topology that is shown in Figure 90, is one configuration, but not the only possible configuration, of a multiple-motor branch circuit. In these circuits, a single set of fuses (or a single circuit breaker) protects multiple motors, their controllers, and the circuit conductors. The motors can be any mixture of power ratings and the controllers can be any mixture of motor controller technologies (magnetic motor controllers and variable-frequency AC drive controllers).

This appendix addresses only NFPA 79 applications. This limitation is not because these products are only suitable for industrial machinery, but because industrial machinery is their primary market. In fact, while all versions of the ArmorStart products can be applied on industrial machinery, the versions that have the Conduit Entrance Gland Plate Option can also be used in applications governed by NFPA 70, National Electrical Code (NEC), (see “ArmorStart Product Family”).

## Listing Requirements for a "Factory Assembly" and "Separate Assemblies"

- The first sentence of NEC 430.53(C) relies on two terms that the NEC does not define: ""factory assembly" and "separate assemblies". But the text also requires both to be "listed": "listed factory assembly" or "separate assemblies listed for such use". 45A of UL 508C, "Power Conversion Equipment", contains the 430.53(C) listing requirements for drives. 52A of UL 508, "Industrial Control Equipment", contains the 430.53(C) listing requirements for contactor-based motor controllers. Neither standard contains the term "factory assembly" or the term "separate assemblies" and each requires this marking: "Suitable for motor group installation…".
- Therefore, the terms "factory assembly" and "separate assemblies" do not change the listing requirements. All drives and contactor-based motor controllers that are listed for 430.53(C) installation are marked "Suitable for motor group installation…".

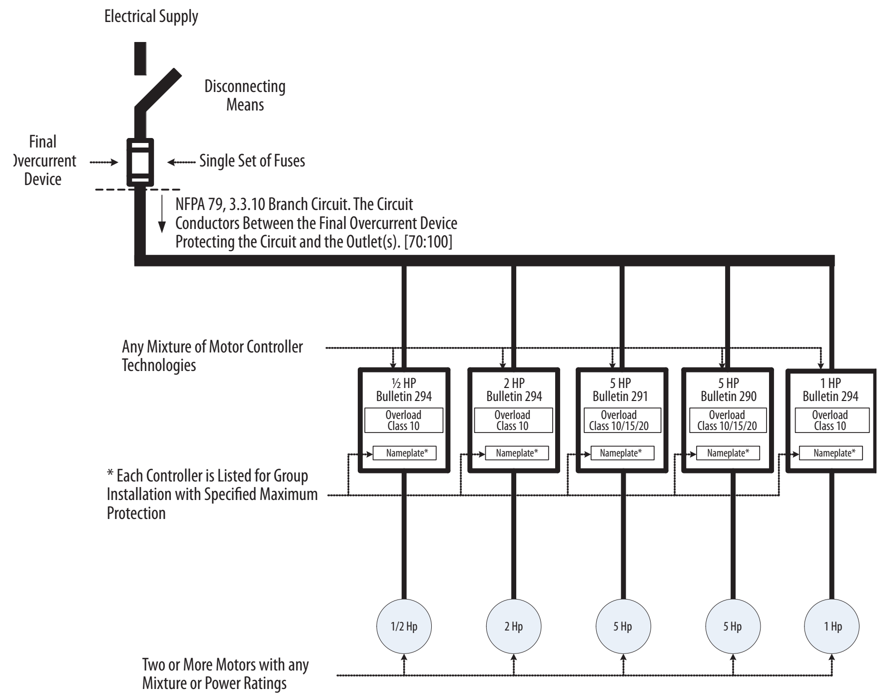
In the 2012 Edition of NFPA 79, motor controllers that are listed for group installation can be installed in multiple-motor branch circuits according to either of two alternative sets of requirements. The first is found in 7.2.10.4(2), the second in 7.2.10.4(3). The requirements of 7.2.10.4(3) are similar to those requirements in 430.53(C) of NFPA 70, while the requirements of 7.2.10.4(2) are found only in NFPA 79. This appendix explains the requirements of 7.2.10.4(2), rather than those requirements of 7.2.10.4(3), because it is the simpler method to use for application of the ArmorStart family of motor controllers.

You must determine the requirements – NFPA 79 or NFPA 70 – to use for the application. When making this determination, it is necessary to understand the ArmorStart product characteristics and useful to understand the definition of industrial machinery. The section of this appendix, "ArmorStart Product Family", specifies whether a motor controller is suitable for installation according to NFPA 79 or NFPA 70 (or both). The definition of industrial machinery is found in 3.3.56 of NFPA 79 and 670.2 of Article 670, Industrial Machinery, in NFPA 70.

These conventions are used throughout this appendix. First, although all equipment is connected to a three-phase electrical supply, all figures are shown as one-line diagrams. Second, although all ArmorStart motor controllers are listed for group installation with both fuses and a specific family of inverse time circuit breakers, this appendix considers only fuses. This limitation is done to avoid repetitive explanations with minor, but necessary qualifications, for circuit breakers. Generally, the principles for fuse selection also apply to inverse time circuit breaker selection. Third, all references, unless indicated otherwise, are to NFPA 79 – 2012.

**Note:** The following example uses an ArmorStart LT circuit. The ArmorStart LT provides a more comprehensive example,

**Figure 90 - ArmorStart LT NFPA 79 Multi-motor Branch Circuit**




## ArmorStart Product Family

This section contains a brief description of the attributes of the ArmorStart LT motor controllers that are relevant to application of them in multiple-motor branch circuits. These same relative attributes can be assumed for ArmorStart controllers.

The term motor controller refers to the device that stops and starts the motor. The ArmorStart product family consists of two types of motor controllers. The Bulletin 290 and 291 controllers are magnetic motor controllers that use an electromechanical contactor to stop and start the motor. The Bulletin 294 motor controllers use a variable-frequency AC drive to stop, start, and vary the speed of the motor. This appendix refers to the Bulletin 290, 291 and 294 products as either motor controllers or just controllers.

Each ArmorStart motor controller uses an integrated overload relay and motor disconnecting means. The Underwriters Laboratories' (UL) listing for each motor controller confirms that the motor controller – including its integral overload relay and motor disconnecting means — is suitable for motor group installation.

The suitability of each ArmorStart LT motor controller for installation according to either NFPA 79 or NFPA 70 depends on the means of connecting the power circuit wiring. All controllers are suitable for installation in multiple-motor branch circuits on industrial machinery according to 7.2.10.4 of NFPA 79. The controllers that have the Conduit Entrance Gland Plate Option are also suitable for installation in multiple-motor branch circuits according to 430.53(C) and 430.53(D) of NFPA 70 (NEC). The controllers that have the Power Media Gland Plate Option are suitable for installation only on industrial machinery. These versions are limited to industrial machinery because the UL listing for the power media connectors themselves and their matching cable assemblies covers installation only on industrial machinery.

## Multiple-motor Branch Circuits and Motor Controllers Listed for Group Installation – General

Multiple-motor branch circuits, like that shown in Figure 90, have this fundamental tradeoff: protecting more than one controller with a single set of fuses requires more electrical and mechanical robustness in each controller.

In exchange for the elimination of the cost and space necessary for a dedicated set of fuses in front of each controller, the construction of each controller itself must be more robust. For the circuit configuration shown in Figure 90 to be practical, the ampere rating of the fuse must be large enough to operate all motors, without opening, under normal start and run conditions. This rating of fuse must be larger than the rating permitted to protect a circuit that supplies only a single motor and its controller. In general, as the rating of the fuse increases, so does the magnitude of fault currents that flow until the fuse opens. This higher magnitude of fault current results in more damage to the controller. Therefore, the additional controller robustness is necessary to withstand these higher fault currents, without controller damage that can result in a shock or fire hazard.

Consequently to the controller, being Listed for group installation mostly means that the UL testing is performed with fuses that have this practical and higher, ampere rating. This testing verifies that it is reasonable to apply this controller in a multiple-motor branch circuit, provided the fuse is of the same class and does not have a rating that exceeds the marked rating on the controller.

The example in Figure 91, illustrates this increase in the maximum ampere rating of fuse that is permitted to protect a controller. This example compares the rating of the fuse that is used in the UL testing of two variable-frequency AC drive-based motor controllers. Both controllers have a rated power of 0.5 Hp and a rated output current of 1.5 A. The controller that is shown on the left is intended for installation in individual-motor branch circuits. The controller that is shown on the right is the ArmorStart LT Bulletin 294 controller that must be listed for group installation to be installed, as intended, in multiple-motor branch circuits. For this example, assume that all testing is done with fuses of the same class.

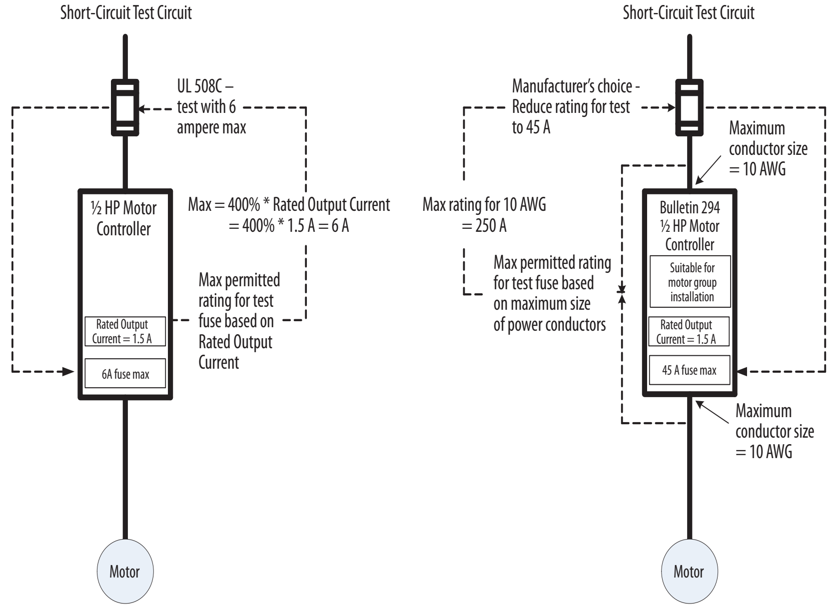
The UL investigation of both controllers is done according to UL 508C, Power Conversion Equipment. The controllers are connected to the test supply through the three-phase conductors and equipment grounding conductor and then covered with cotton in areas that are likely to vent hot gases and sparks during the tests. During the test, electrical faults are impressed on the output of, and internal to, these variable-frequency AC drive-based controllers. An increase of the ampere rating of the fuses increases the magnitude of the fault currents that flow through, and damage, the controller before the fuses open. Afterwards, the damage to the controller is evaluated to determine whether a potential shock or fire hazard exists when protected by fuses having this ampere rating. One criterion of the evaluation is the examination of the equipment grounding conductor that must not open during the test. If the conductor opens, it can leave exposed conductive parts in an energized state (shock hazard). Another criterion is that the cotton must not ignite as this ignition indicates the expulsion from the controller of hot gases or molten metal fragments (fire hazard).

For the controller that is displayed on the left, UL 508C permits the individual-motor testing to be performed with the maximum rating of fuse that can be used to protect an individual-motor branch circuit. According to both NFPA 70 and NFPA 79, this rating is 400 percent of the full-load current rating of the largest motor that the controller can supply. In UL 508C, this rating is taken to be 400 percent of the rated output current of the controller, or 6 A.

For the controller that is displayed on the right, UL 508C permits the group installation testing to be performed with the maximum rating of fuse that can be used to protect a multiple-motor branch circuit. According to both NFPA 70 (430.53(C)) and NFPA 79 (7.2.10.4(3)), this rating is 250 amperes. The largest size of power conductor that the ArmorStart LT controller can accept, 10 AWG, determines this value, which is derived from the installation requirements of 430.53(C) and 430.53(D) of NFPA 70. Because the UL 508C test covers all possibilities in NFPA 70 and NFPA 79, it permits the maximum value of 250 amperes. This value covers 7.2.10.4(2), which permits only 100 amperes. However in this case, the manufacturer, Rockwell Automation, chose to test and mark with the lower value of 45 A. This value was chosen as the tradeoff between the maximum number and type of controllers in the branch circuit – limited by the maximum fuse rating - and the electrical and mechanical robustness that is engineered into each controller.

Therefore, to make its use in the multiple-motor branch circuit of Figure 90 practical, the 0.5 Hp, Bulletin 294 controller was engineered to be robust enough to contain the damage safely, when protected by a fuse having a rating of 45 A, rather than just 6 A.

**Figure 91 - UL508C Variable-frequency AC Drive Motor Controller Evaluation**




## Maximum Fuse Ampere Rating according to 7.2.10.4(1) and 7.2.10.4(2)

This section uses Figure 92 to explain the requirements from 7.2.10.4(1) and 7.2.10.4(2) that are relevant to, and permit, the multiple-motor branch circuit of Figure 90.

The following is the complete text of 7.2.10.4(1) and 7.2.10.4(2) and an abbreviated version of Table 48 from the 2012 Edition of NFPA 79. The table is abbreviated to cover the size of conductors that are generally relevant to the ArmorStart LT motor controllers.

### Complete Text

"7.2.10.4 Two or more motors or one or more motor(s) and other load(s), and their control equipment shall be permitted to be connected to a single branch circuit where short-circuit and ground-fault protection is provided by a single inverse time circuit breaker or a single set of fuses, provided the following conditions under (1) and either (2) or (3) are met:

(1) Each motor controller and overload device is either listed for group installation with specified maximum branch-circuit protection or selected such that the ampere rating of the motor branch short-circuit and ground-fault protective device does not exceed that permitted by 7.2.10.1 for that individual motor controller or overload device and corresponding motor load.

(2) The rating or setting of the branch short-circuit and ground-fault protection device does not exceed the values in Table 48 for the smallest conductor in the circuit."

(3) …(not considered in this appendix)

**Table 48 - Abbreviated Table 7.2.10.4**

| **Table 7.2.10.4 Relationship Between Conductor Size and Maximum Rating or Setting of Short-Circuit Protective Device for Power Circuits Group Installations** | |
|---|---|
| Conductor Size (AWG) | Maximum Rating Fuse or Inverse Time* Circuit Breaker (amperes) |
| … | … |
| … | … |
| 14 | 60 |
| 12 | 80 |
| 10 | 100 |
| 8 | 150 |
| 6 | 200 |
| … | … |

The following text and Figure 92 provide an explanation of 7.2.10.4(1) and (2). In the following, ellipsis points (…) replace the text not relevant to Figure 90. Then each individual requirement is underlined and followed by an underlined letter in parentheses. This underlined letter in the following text corresponds to the letter in Figure 92.

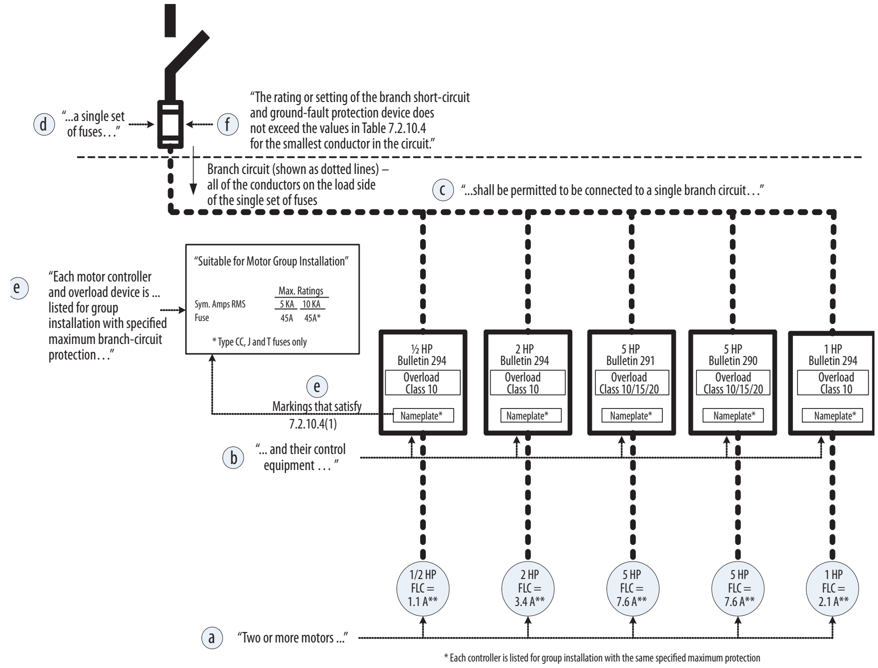
"7.2.10.4 Two or more motors (a)…and their control equipment (b) shall be permitted to be connected to a single branch circuit (c) where short-circuit and ground-fault protection is provided by a single inverse time circuit breaker or a single set of fuses (d), provided the following conditions under (1) and…(2)…are met:

(1) Each motor controller and overload device is… listed for group installation with specified maximum branch-circuit protection (e) …

(2) The rating or setting of the branch short-circuit and ground-fault protection device does not exceed the values in Table 7.2.10.4 for the smallest conductor in the circuit." (f)

Summarizing the requirements relevant to Figure 90: 7.2.10.4(1) and 7.2.10.4(2) permit two or more ArmorStart LT motor controllers to be installed in a single branch circuit provided (1) all motor controllers are listed for group installation, (2) the fuse does not exceed the maximum rating that Table 48 permits to protect the smallest conductor and (3) the fuse complies with the maximum fuse ratings of all controllers.

**Figure 92 - ArmorStart LT NFPA 79 Multi-motor Branch Circuit**



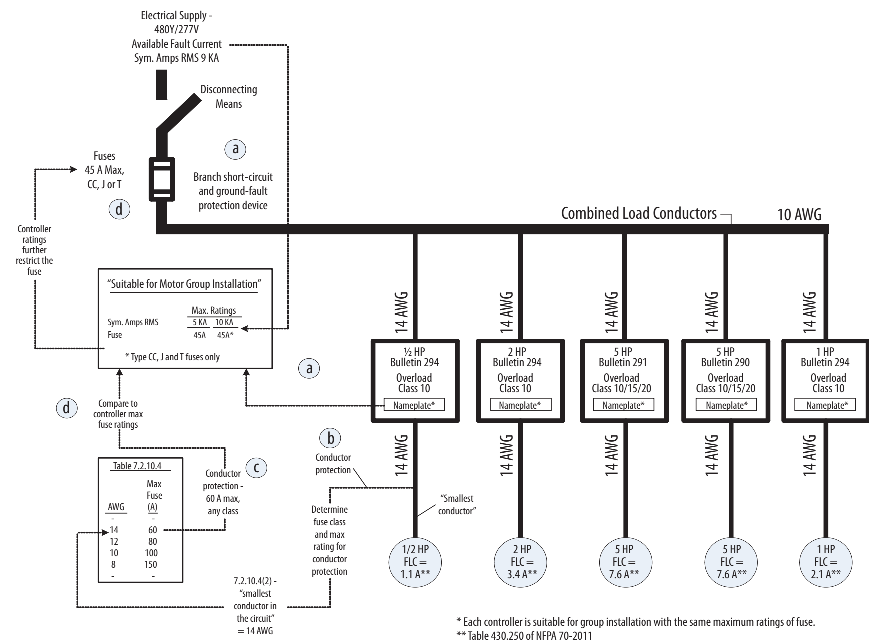

## Explanatory Example

The example addresses the overcurrent protection of the conductors, controllers, and motors. Protection for three overcurrent conditions is considered: motor running overloads, short-circuit (line-to-line) faults, and ground-faults (line-to-ground). The short-circuit fault and ground-fault protection is governed by 7.2.10.4(1) and 7.2.10.4(2) and explained in Requirements 1, 2, and 3 and Figure 93. The overload protection, explained in Requirement 4, is governed by 7.3.1 and 7.3.1.1. Overload coordination depends on each conductor having the minimum ampacity that is given by 12.5.3 and 12.5.4. The method for determining this minimum ampacity is explained in Requirement 5 and Figure 94.

The example branch circuit is shown in Figure 93 and Figure 94. The circuit topology consists of a set of 10 AWG conductors that supply multiple sets of 14 AWG conductors. Each set of 14 AWG conductors supply a controller and motor. These conductor sizes are chosen to be the smallest conductors that have sufficient ampacity, without derating, for the loads each must carry. All wiring is customer-supplied, rather than the ArmorConnect power media, because all controllers have the Conduit Entrance Gland Plate Option. Fuses protect the branch circuit.

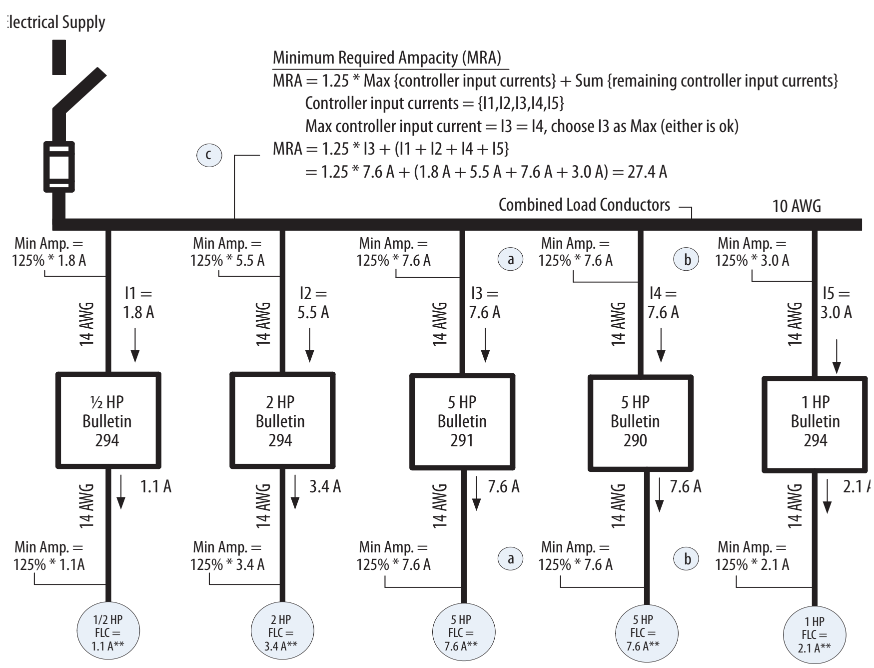
The example addresses five basic requirements that the motor controllers, fuses, and conductors must satisfy. The letters in the circles on Figure 93 and Figure 94 are referenced in the explanations as letters in parentheses. Ellipses points (...) are used to replace NFPA 79 text that is not applicable to the multiple-motor branch circuit that is shown in Figure 93 and Figure 94. Unless indicated, all text is from NFPA 79.

**Figure 93 - ArmorStart LT NFPA 79 Multi-motor Branch Circuit — Conductor and Controller Protection**




* Each controller is suitable for group installation with the same maximum ratings of fuse.
** Table 430.250 of NFPA 70-2011

**Figure 94 - ArmorStart LT NFPA 79 Multi-motor Branch Circuit Minimum Conductor Ampacity**




** Table 430.250 of NFPA 70-2011

**1. Requirement One: Controller Ratings** — The motor controllers and overload relays must be listed for group installation with specified maximum branch-circuit protection.

**Text:** "7.2.10.4(1) Each motor controller and overload device is... listed for group installation with specified maximum branch-circuit protection..."

**Analysis:** To apply the ArmorStart LT motor controllers in the multiple-motor branch circuit that is shown in Figure 93, 7.2.10.4(1) must be satisfied; each controller must be listed for group installation with specified maximum branch-circuit protection. The UL listing for each ArmorStart LT motor controller confirms that it – including its integral overload relay and motor disconnecting means — is suitable for motor group installation with specified fuses, satisfying 7.2.10.4(1). The Bulletin 290E and 291E controllers are listed for group installation according to UL 508, Industrial Control Equipment. The Bulletin 294E controllers are listed for group installation according to UL 508C, Power Conversion Equipment.

As shown in Figure 94 (a) indicates the markings on the nameplate that satisfy 7.2.10.4(1). The marking "Suitable for Motor Group Installation" satisfies the requirement to be listed for group installation. The ratings that are located beneath the description "Max. Ratings" are the specified maximum branch circuit protection. The (a) beside the fuse or fuses indicates that the maximum protection that is specified on the nameplate applies to these fuses.

**2. Requirement Two: Conductor Short-circuit and Ground-Fault Protection** — The fuse must protect the conductors for short-circuit faults and ground faults.

**Text:** "7.2.10.4(2) The rating or setting of the branch short-circuit and ground-fault protection device does not exceed the values in Table 48 for the smallest conductor in the circuit."

**Analysis:** As shown in Figure 93, 7.2.10.4(2) must be satisfied. The fuse, as indicated by the description in Figure 93 (a), is the branch short-circuit and ground-fault protection device. The word circuit means the branch circuit. The conductors of the branch circuit start at the load side of the fuses and end at the input to the motor, including the conductors between the motor controllers and the motor. The smallest conductor in the circuit is any one of the 14 AWG conductors that supply each controller and motor. The note at (b) indicates that the conductor protection is based on the smallest conductor, 14 AWG. As shown in Table 48, a 14 AWG conductor can be used in a circuit that is protected by a fuse of any class having a rating of 60 amperes or less (c). Therefore, selecting a fuse of any class with a maximum rating of 60 amperes satisfies the conductor protection requirement of 7.2.10.4(2).

**Supplementary Note 1:** The value that is specified in Table 48 is the maximum rating of fuse that 7.2.10.4(2) permits to protect that size of conductor. The rating of the fuse can be set to the maximum value given by Table 48 for the smallest conductor without further justification. However, if any controller, or other component, has a maximum rating of fuse that is less than the Table 48 value, the maximum rating of the fuse protecting the branch circuit must be reduced to the lower value so that all components are applied according to their ratings. For example, as shown in Requirement Three, a lower value can be necessary to protect the motor controller within its ratings because its specified maximum protection is less than the rating that Table 48 permits for the smallest circuit conductor. Another reason to use a lower rating of fuse is to provide more conservative conductor and controller protection. However, in all cases it is important to make sure that the ampere rating is sufficient to start and operate the motors without nuisance opening of the fuses.

**Supplementary Note 2:** The note at (b) points to the conductor on the output of the 0.5 Hp Bulletin 294E controller to emphasize that the smallest conductor in the circuit includes the conductors between each controller and motor. This includes the output of the variable-frequency AC drive-based Bulletin 294E controllers; even though these drives have electronic short-circuit protection. According to NFPA 79, the fuse, and not the drive's electronic short-circuit protection, provides the short-circuit fault and ground-fault protection for these output conductors.

**Supplementary Note 3:** Generally, connecting a smaller conductor to a larger conductor requires the installation of fuses at the connection. This connection can be made without this fuse, in some cases, by using a tap rule that indirectly protects the smaller conductor by limiting two things: the ratio of the ampacity of the larger conductor to the ampacity of the smaller conductor and the maximum length of the smaller conductor (see, for example, 7.2.8.2). When applying 7.2.10.4(2), such a tap rule is not applicable or necessary. In Figure 93, the smaller 14 AWG conductors can be connected to combined load conductors of any size because 7.2.10.4 does not indirectly protect the smaller conductor by limiting the ratio of the larger to smaller conductor ampacities and the conductor length. Instead, Table 48 protects the smallest conductor directly by specifying the maximum rating of fuse that can protect a branch circuit that contains a conductor of that size.

**3. Requirement Three: Controller Short-Circuit and Ground-Fault Protection** — Each motor controller must be protected according to its own ratings, that is, applied in accordance with its listing.

**Text:** "(1) Each motor controller and overload device is… listed for group installation with specified maximum branch-circuit protection…"

**Analysis:** See (d) in Figure 93. The characteristics of the fuse or fuses permitted to protect the conductors (see Requirement 2) must now be compared to those in the ratings of the controller. To comply with the listing of each motor controller and overload relay, the fuse or fuses must comply with the maximum branch-circuit protection that is specified in the controller markings. Therefore, the fuse or fuses must be of a class that is marked on all controllers and the rating of the fuse or fuses must not exceed the rating that is marked on any of the controllers. The markings of each controller specify that a fuse having a maximum rating of 45 A can protect the motor controller. When connecting to an electrical supply having an available fault current of 5000 A or less, the class of the fuse is not specified and can be any class. When connecting to an electrical supply having an available fault current from 5000 to 10000 A, the class of the fuse must be CC, J, or T. Since the electrical supply has an available fault current of 9000 A, selecting a Class CC, J, or T fuse with a rating of 45 A or less, verifies that each motor controller is applied within its own ratings.

**Supplementary Note 1:** The rating of the fuse must not exceed the rating that is permitted by 7.2.10.4(2) to protect the smallest conductor in the circuit. Selecting a Class CC, J or T fuse with a rating of 45 A, being less than 60 A, also protects the conductors (see Requirement 2). Although the ArmorStart LT products presently have a maximum fuse rating of 45 A, future controllers can have maximum fuse ratings that exceed 60 A. In this case, the maximum rating of fuse is limited by the rating to protect the 14 AWG conductors, 60 A. The maximum rating that is permitted for the controller, 45 A, is a maximum rating and can be reduced, for more conservative protection, provided nuisance opening of the fuses do not occur.

**Supplementary Note 2:** In this appendix, a fuse having a rating of any class means a fuse having the let-through characteristics of a Class RK-5 fuse. Class RK-5 fuses are assumed to have the maximum let-through of any class of fuse. For this reason, the ArmorStart LT motor controllers that are marked for use with fuses, without a restriction to a particular class, have been tested with and are intended to be used with fuses having a class of RK-5. Of course, fuses of a class that have lower let-throughs than Class RK-5, such as Class CC, J, or T, are also acceptable. A fuse having a rating of any class also restricts the fuse to those that have been evaluated for use as branch-circuit protection devices. This means that semiconductor fuses, used to protect power electronic equipment, or supplemental fuses cannot be used to protect the multiple-motor branch circuit.

**Supplementary Note 3:** There are four complementary ratings relevant to the "specified maximum branch-circuit protection" of 7.2.10.4(1). They are: the fuse class, the maximum fuse rating, the voltage rating and connection of the source (480Y/277 V), and the available fault current of the source. Applying the controllers according to these four ratings means that a fault on the output of all controllers, and internal faults for Bulletin 294 controllers, will not result in a shock or fire hazard.

**Supplementary Note 4:** In this example, the assumption is made that the available fault current at the controller is that of the source on the line side of the fuses. Although it is true that the wiring impedance between the fuses and the first controller, reduces the fault current available at the controllers, this reduction is neglected by assuming the first controller, the 0.5 Hp, Bulletin 294 controller, is very close to the fuses.

**4. Requirement Four: Overload Protection** — The motors, conductors, and controllers must be protected against motor overload conditions.

**Text:**

"7.3.1 General. Overload devices shall be provided to protect each motor, motor controller, and branch-circuit conductor against excessive heating due to motor overloads or failure to start."

"7.3.1.1 Motors. Motor overload protection shall be provided in accordance with Article 430, Part III, of NFPA 70."

**Analysis:** Each ArmorStart LT motor controller incorporates an integral overload relay. This overload function must be set in accordance with Article 430, Part III of NFPA 70. Selecting the ampacity of the circuit conductors appropriately (see Requirement 5) makes sure that the overload relays, when set according to 7.3.1.1, will protect the conductors against overheating due to motor overloads.

**Supplementary Note:** Each individual controller overload relay directly protects the conductors that are connected to the input and output of that controller and the motor that the controller supplies. The combined load conductor is protected by the tripping of one or more of the controller overload relays, that removes the overloaded motor or motors before the combined load conductor overheats.

**5. Requirement: Conductor Ampacity** —The minimum ampacity of conductors.

**Text:**

"12.5.3 Motor circuit conductors supplying a single motor shall have an ampacity not less than 125 percent of the motor full-load current rating."

"12.5.4 Combined load conductors shall have an ampacity not less than … 125 percent of the full-load current rating of the highest rated motor plus the sum of the full-load current ratings of all other connected motors…"

**Analysis:** As shown in Figure 94, (a), (b), and (c) explain the method for calculating the minimum required conductor ampacity for each of these conductors: input and output conductors of Bulletin 290E and 291E controllers (a), input and output conductors of Bulletin 294E controllers (b), and combined load conductors that supply Bulletin 290E, 291E, and 294E controllers (c). The currents I1 through I5 are the input currents to the controllers. For the Bulletin 290E and 291E controllers, these currents are the same as the output motor currents. For the Bulletin 294E controllers, these currents are the rated input currents.

The example does not address conditions of use such as an ambient temperature that exceeds 30 °C or more than three current-carrying conductors in a cable or raceway. In a particular application, these conditions of use can require derating of the ampacity that is given in Table 12.5.1. This example assumes that, under the conditions of use, both conductors have sufficient ampacity for the application. This means the 14 AWG conductors have an ampacity of no less than 9.5 A and the 10 AWG conductors have an ampacity of no less than 27.4 A.

## Input and Output Conductors for Mechanical Controllers (a)

AmorStart models that use an electromechanical contactor to control the motor, the input current like the output current, is just the current to the motor. Therefore, the minimum conductor ampacity for both input and output conductors is 125 percent of the motor full-load current rating, as specified in the text of 12.5.3 (a).

As shown in Figure 94, the full-load current rating of a three-phase, 460 V, 5 Hp induction motor is 7.6 A. By using this value, both the input and output conductors must have an ampacity that is not less than 125% of 7.6 A or 9.5 A.

## Input and Output Conductors for Variable Frequency Drives (b)

ArmorStart models that are a variable-frequency AC drive, are used to control the motor. These drives use a power conversion method that generates input currents that are larger than the output currents. The input currents are larger because, unlike the output currents to the motor, they are not sinusoidal. Consequently, when determining the minimum ampacity of the input conductors, the requirement of 12.5.3 must be based on the rated input current of the controller, rather than the full-load current rating of the motor. Therefore, the minimum ampacity of the input conductors must be 125% of the controller rated input current, while the ampacity of the output conductors must be 125% of the motor full-load current rating.

As shown in Figure 94, the 1 Hp Bulletin 294E controller has a rated input current of 3.0 A. By using the rated input current, the conductors from the combined load conductors to the controllers must have an ampacity of 125% of 3.0 A or 3.75 A. The output conductors must have an ampacity of 125% of 2.1 A or 2.6 A.

## Combined Load Conductors (c)

The requirement for the minimum ampacity of the combined load conductors is given by 12.5.4. When the combined load conductors supply one or more Bulletin 294E controllers, the minimum ampacity calculation of 12.5.4 must be made by substituting the rated input current of the Bulletin 294E controllers for the full-load current rating of the motors that these controllers supply.

In Figure 94, the currents I1, I2, I3, I4, and I5 are the input currents to each controller. I3 and I4 are the full-load current ratings of the 5 Hp motors. I1, I2, and I5 are the rated input currents of the Bulletin 294E controllers. As shown in the explanatory text (c) in Figure 94, the method for calculating the minimum ampacity of the combined load conductors follows: first, multiply the largest input current to any controller – Bulletin 290E, 291E, or 294E - by 125%. In this case, the input currents to the Bulletin 290E and 291E controllers, I3 and I4, are the largest, 7.6 A. Because they are the same, either can be used. Choose I3 to calculate 125% of the maximum. 125% of 7.6 A is 9.5 A. Second, sum the remaining input currents (I1, I2, I4, I5) for a total of 17.9 A. Third, add the result from the first step to the result from the second for a total of 27.4 A. Finally, the minimum ampacity of the combined load conductors is 27.4 A.

**Supplementary Note 1:** The input currents to the Bulletin 294E motor controllers are larger than the output currents to the motor because the input currents contain harmonics resulting from the power conversion process. This harmonic content and the magnitude of the resulting non-sinusoidal input currents depend on the impedance of the electrical supply. The value that is specified for the rated input current is the maximum value over the range of possible supply impedances. For this reason, the magnitude of current measured on a particular electrical system can be less than the specified value.

# Common Industrial Protocol (CIP) Information

## High-level Product Description

The ArmorStart EtherNet/IP controller is an extension of the ArmorStart DeviceNet controller. Three product types are offered:

| Bulletin Number | Distributed Starter Type |
|---|---|
| 281E | Reversing |
| 284E | Inverter |

### Product Codes and Name Strings

The following table lists the product codes and name strings that are added to the ArmorStart product family for EtherNet/IP.

| Product Code (hex) | Product Code (decimal) | Identity Object Name String |
|---|---|---|
| 0xD1 | 209 | ArmorStart Bulletin 281E 0.5…2.5 A 24V DC |
| 0xD2 | 210 | ArmorStart Bulletin 281E 1.1…5.5 A 24V DC |
| 0xD3 | 211 | ArmorStart Bulletin 281E 3.2…16 A 24V DC |
| 0xDA | 218 | ArmorStart Bulletin 281E 0.3…1.5 A 24V DC |
| 0x172 | 370 | ArmorStart Bulletin 284E PF40 480V 0.5 Hp |
| 0x174 | 372 | ArmorStart Bulletin 284E PF40 480V 1 Hp |
| 0x176 | 374 | ArmorStart Bulletin 284E PF40 480V 2 Hp |
| 0x177 | 375 | ArmorStart Bulletin 284E PF40 480V 3 Hp |
| 0x178 | 376 | ArmorStart Bulletin 284E PF40 480V 5 Hp |

## CIP Explicit Connection Behavior

The ArmorStart controller lets run, jog, and user outputs 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

Most of the information that is contained in the EDS (Electronic Data Sheet) files for the ArmorStart EtherNet/IP product line is able to be extracted via the network.

## CIP Object Requirements

The following CIP objects are covered in the following subsections.

| Class | Object |
|---|---|
| 0x0001 | Identity Object |
| 0x0004 | Assembly Object |
| 0x0006 | Connection Manager Object |
| 0x0008 | Discrete Input Point Object |
| 0x0009 | Discrete Output Point Object |
| 0x000F | Parameter Object |
| 0x0010 | Parameter Group Object |
| 0x001D | Discrete Input Group Object |
| 0x001E | Discrete Output Group Object |
| 0x0029 | Control Supervisor Object |
| 0x002C | Overload Object |
| 0x0047 | Device Level Ring Object |
| 0x0048 | QoS Object |
| 0x0097 | DPI Fault Object |
| 0x0098 | DPI Alarm Object |
| 0x00B4 | Interface Object |
| 0x00F5 | TCP/IP Interface Object |
| 0x00F6 | 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: 0SSSMMMM<br>• 0 = reserved by DeviceNet<br>• SSS = Revision of Soft-start or inverter. Initial release = 0; We will be limited to support for 8 major revisions.<br>• MMMM = Revision of Main ArmorStart board. Initial release = 1; We will be limited to support for 15 major revisions. |
| 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<br>Major Revision<br>Minor Revision | Structure of:<br>USINT<br>USINT | See table. |
| 5 | Get | Status | WORD | Bit 0…0 = Not Owned; 1 = Owned by Master<br>Bit 2…0 = Factory Defaulted; 1 = Configured<br>Bit 8 - Minor Recoverable fault<br>Bit 9 - Minor Unrecoverable fault<br>Bit 10 - Major Recoverable fault<br>Bit 11 - Major Unrecoverable fault |
| 6 | Get | Serial Number | UDINT | Unique number for each device |
| 7 | Get | Product Name<br>String Length<br>ASCII String | Structure of:<br>USINT<br>STRING | Product Code specific |
| 8 | Get | State | USINT | Returns the value "3 = Operational" |
| 9 | Get | Configuration Consistency Value | UINT | "Module FRS" |
| 102(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: Class | Implemented for: Instance | Service Name |
|---|---|---|---|
| 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 281E Produced Assembly |
| 151(1) | Produced | Default Bulletin 284E Produced Assembly |
| 162 | Consumed | Default Consumed Instance for DOL and Reversing Starters |
| 166(1) | Consumed | Default Consumed Instance for Inverter type Starters |
| 191 | Consumed | Empty assembly for Input Only I/O Connection |
| 192 | Consumed | Empty assembly for Listen Only I/O Connection |

(1) These assemblies are selectable on Inverter Type ArmorStart units only.

Instances 3 and 52 are required by the ODVA Motor Starter Profile. 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 281E starters.

**Instance 150 "Starter Stat" - Default Status Assembly for Bulletin 281E Starters**

| Byte | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Reserved (AOP Tag name: {name}:I.Fault) | | | | | | | |
| 1 | Reserved (AOP Tag name: {name}:I.Fault) | | | | | | | |
| 2 | Reserved (AOP Tag name: {name}:I.Fault) | | | | | | | |
| 3 | Reserved (AOP Tag name: {name}:I.Fault) | | | | | | | |
| 4 | — | — | — | Ready | RunningReverse | RunningForward | WarningPresent | TripPresent |
| 5 | — | — | DisconnectClosed | Hand | In3 | In2 | In1 | In0 |
| 6 | Pt07DeviceOut | Pt06DeviceOut | Pt05DeviceOut | Pt04DeviceOut | Pt03DeviceOut | Pt02DeviceOut | Pt01DeviceOut | Pt00DeviceOut |
| 7 | Logic Enable | Pt14DeviceOut | Pt13DeviceOut | Pt12DeviceOut | Pt11DeviceOut | Pt10DeviceOut | Pt09DeviceOut | Pt08DeviceOut |
| 8 | Value of the parameter pointed to by “Parameter Int00DeviceOut Cfg” (low byte) - ProducedWord0Param | | | | | | | |
| 9 | Value of the parameter pointed to by “Parameter Int00DeviceOut Cfg” (high byte) - ProducedWord0Param | | | | | | | |
| 10 | Value of the parameter pointed to by “Parameter Int01DeviceOut Cfg” (low byte) - ProducedWord1Param | | | | | | | |
| 11 | Value of the parameter pointed to by “Parameter Int01DeviceOut Cfg” (high byte) - ProducedWord1Param | | | | | | | |
| 12 | Value of the parameter pointed to by “Parameter Int02DeviceOut Cfg” (low byte) - ProducedWord2Param | | | | | | | |
| 13 | Value of the parameter pointed to by “Parameter Int02DeviceOut Cfg” (high byte) - ProducedWord2Param | | | | | | | |
| 14 | Value of the parameter pointed to by “Parameter Int03DeviceOut Cfg” (low byte) - ProducedWord3Param | | | | | | | |
| 15 | Value of the parameter pointed to by “Parameter Int03DeviceOut Cfg” (high byte) - ProducedWord3Param | | | | | | | |

**Note:** Byte 0 - 3 refers to PLC communication status. All 1s (bit high) indicates a connection fault (communication fault) exists or all 0s (bit low) connection is normal.

### *Instance 151*

Here is the default input (produced) assembly for Inverter Type Distributed Starters.

| Produce Assembly - Instance 151 "Drive Status" - 284E Starters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Byte** | **Bit 7** | **Bit 6** | **Bit 5** | **Bit 4** | **Bit 3** | **Bit 2** | **Bit 1** | **Bit 0** |
| 0 | Reserved - {name}:I.Fault | | | | | | | |
| 1 | Reserved - {name}:I.Fault | | | | | | | |
| 2 | Reserved - {name}:I.Fault | | | | | | | |
| 3 | Reserved - {name}:I.Fault | | | | | | | |
| 4 | AtReference | Network ReferenceStatus | NetControlStatus | Ready | RunningReverse | RunningForward | WarningPresent | TripPresent |
| 5 | OutputContactor Status | BrakeContactor Status | DisconnectClosed | Hand | In3 | In2 | In1 | In0 |
| 6 | OutputFrequency (Low) (xxx.x Hz) | | | | | | | |
| 7 | OutputFrequency (High) (xxx.x Hz) | | | | | | | |
| 8 | Pt07DeviceOut | Pt06DeviceOut | Pt05DeviceOut | Pt04DeviceOut | Pt03DeviceOut | Pt02DeviceOut | Pt01DeviceOut | Pt00DeviceOut |
| 9 | LogicEnable | Pt14DeviceOut | Pt14DeviceOut | Pt13DeviceOut | Pt11DeviceOut | P10DeviceOut | Pt09DeviceOut | Pt08DeviceOut |
| 10 | Value of the parameter pointed to by "Parameter 13 Prod Assy Word 0" (low byte)" - Int00DeviceOut | | | | | | | |
| 11 | Value of the parameter pointed to by "Parameter 13 Prod Assy Word 0" (high byte)" - Int00DeviceOut | | | | | | | |
| 12 | Value of the parameter pointed to by "Parameter 14 Prod Assy Word 1" (low byte)" - Int01DeviceOut | | | | | | | |
| 13 | Value of the parameter pointed to by "Parameter 14 Prod Assy Word 1" (high byte)" - Int01DeviceOut | | | | | | | |
| 14 | Value of the parameter pointed to by "Parameter 15 Prod Assy Word 2" (low byte)" - Int02DeviceOut | | | | | | | |
| 15 | Value of the parameter pointed to by "Parameter 15 Prod Assy Word 2" (high byte)" - Int02DeviceOut | | | | | | | |
| 16 | Value of the parameter pointed to by "Parameter 16 Prod Assy Word 3" (low byte)" - Int03DeviceOut | | | | | | | |
| 17 | Value of the parameter pointed to by "Parameter 16 Prod Assy Word 3" (high byte)" - Int03DeviceOut | | | | | | | |

**Note:** Byte 0 - 3 refers to PLC communication status. All 1s (bit high) indicates a connection fault (communication fault) exists or all 0s (bit low) connection is normal.

| ** Contactor | Reference |
|---|---|
| Contactor 1 | Source Brake Contactor status |
| Contactor 2 | Output Contactor status |

*Instance 162*

Here is the standard output (consumed) assembly with Network Inputs.

**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 |

*Instance 166*

Here is the standard output (consumed) assembly for Inverter Type Distributed Starters with network inputs.

**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 | DriveInput3 | DriveInput2 | DriveInput1 | 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 | Pt9DeviceIn | Pt8DeviceIn |

## 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 numbers 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 shall not be 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 shall be Assembly object, Instance 3, 162 or 166 (162 for product codes <= 0x100 only, 166 for product codes > 0x100 only).

- Connection point T -> O shall be 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 be zero.

- Number of supported listen only connections equals two (shared with exclusive owner and listen only connection).
- Connection point O -> T shall be Assembly object, Instance 192 (Listen only heartbeat)
- Connection point T -> O shall be 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 |

Four 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 |
| 115 | Get/Set | Force Enable | BOOL | 0 = Disable, 1 = Enable |
| 116 | Get/Set | Force 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 | 4 or 10 |

Four instances of the Discrete Output Point Object are supported for DOL/ Reverser units. Ten instances are supported for Drive units. The following table summarizes the DOP instances.

| Instance | Name | Alternate Mapping | Description |
|---|---|---|---|
| 1 | Run Fwd Output | 0029-01-03 | Run Forward output. For all starter types, this output is hard wired from the ArmorStart CPU to the actuator. |
| 2 | Run Rev Output | 0029-01-04 | Run Reverse output. For all starter types, this output is hard wired from the ArmorStart CPU to the actuator. |
| 3 | User Output 1 | None | These are the two ArmorStart user outputs for all starter types. |
| 4 | User Output 2 | None | |
| 5 | Drive Input 1 | None | These four instances exist for Inverter units only. They are drive the outputs on the main control board that are connected to Drive Inputs 1…4. |
| 6 | Drive Input 2 | None | |
| 7 | Drive Input 3 | None | |
| 8 | Drive Input 4 | None | |
| 9 | Drive Jog Fwd | None | This instance exists for Inverter units only. |
| 10 | Drive Jog Rev | None | |

All instances contain the following attributes.

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 3 | Get | Value | BOOL | 0 = OFF, 1 = ON |
| 5 | Get/Set | Fault Action | BOOL | 0 = Fault Value attribute, 1 = Hold Last State |
| 6 | Get/Set | Fault Value | BOOL | 0 = OFF, 1 = ON |
| 7 | Get/Set | Idle Action | BOOL | 0 = Fault Value attribute, 1 = Hold Last State |
| 8 | Get/Set | Idle Value | BOOL | 0 = OFF, 1 = ON |
| 113 | Get/Set(1) | Pr Fault Action | BOOL | 0 = Pr Fault Value attribute, 1 = Ignore |
| 114 | Get/Set(1) | Pr Fault Value | BOOL | 0 = OFF, 1 = ON |
| 115 | Get/Set | Force Enable | BOOL | 0 = Disable, 1 = Enable |
| 116 | Get/Set | Force Value | BOOL | 0 = OFF, 1 = ON |
| 117 | Get/Set | Input Binding | STRUCT:<br>USINT<br>Array of USINT | Size of Appendix I encoded path<br>Appendix I encoded path<br>NULL path means Attribute 3 drives the output.<br>Otherwise, this is a path to a bit in the Bit Table. |

(1) For DOP Instances 1, 2, 9 and 10, Attributes 113 and 114 have “Get” only access, and their values are always 0.

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 |

## Parameter Object

### CLASS CODE 0x000F

The following class attributes are supported for the Parameter Object.

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 1 | Get | Revision | UINT | — |
| 2 | Get | Max Instance | UINT | — |
| 8 | Get | Parameter Class Descriptor | WORD | — |

The number of instances of the parameter object depend upon the type of Control Module that the EtherNet/IP board is connected to.

The following instance attributes are implemented for all parameter attributes.

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 1 | Get/Set | Value | Specified in Descriptor | — |
| 2 | Get | Link Path Size | USINT | — |
| 3 | Get | Link Path | Array of:<br>BYTE<br>EPATH | — |
| 4 | Get | Descriptor | WORD | — |
| 5 | Get | Data Type | EPATH | — |
| 6 | Get | Data Size | USINT | — |
| 7 | Get | Parameter Name String | SHORT_STRING | — |
| 8 | Get | Units String | SHORT_STRING | — |
| 9 | Get | Help String | SHORT_STRING | — |
| 10 | Get | Minimum Value | Specified in Descriptor | — |
| 11 | Get | Maximum Value | Specified in Descriptor | — |
| 12 | Get | Default Value | Specified in Descriptor | — |
| 13 | Get | Scaling Multiplier | UINT | — |
| 14 | Get | Scaling Devisor | UINT | — |
| 15 | Get | Scaling Base | UINT | — |
| 16 | Get | Scaling Offset | INT | — |
| 17 | Get | Multiplier Link | UINT | — |
| 18 | Get | Divisor Link | UINT | — |
| 19 | Get | Base Link | UINT | — |
| 20 | Get | Offset Link | UINT | — |
| 21 | Get | Decimal Precision | USINT | — |

The following services are implemented for the Parameter 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 |
| 0x4b | No | Yes | Get_Enum_String |

## Parameter Group Object

### CLASS CODE 0x0010

The following class attributes are supported for the Parameter Object.

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 1 | Get | Revision | UINT | — |
| 2 | Get | Max Instance | UINT | — |

The following instance attributes are supported for all parameter group instances.

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 1 | Get | Group Name String | SHORT_STRING | — |
| 2 | Get | Number of Members | UINT | — |
| 3 | Get | 1st Parameter | UINT | — |
| 4 | Get | 2nd Parameter | UINT | — |
| n | Get | Nth Parameter | UINT | — |

The following common services are implemented for the Parameter Group Object.

| Service Code | Implemented for: | | Service Name |
|---|---|---|---|
| | Class | Instance | |
| 0x01 | Yes | Yes | Get_Attribute_All |
| 0x0E | Yes | Yes | Get_Attribute_Single |

## Discrete Input Group Object

### CLASS CODE 0x001D

No class attributes are supported for the Discrete Input Group Object.

A single instance of the Discrete Input Group Object is supported and contains the following instance attributes.

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 3 | Get | Number of Instances | USINT | 4 |
| 4 | Get | Binding | Array of UINT | List of DIP Instances |
| 6 | Get/Set | Off_On_Delay | UINT | — |
| 7 | Get/Set | Off_On_Delay | UINT | — |

The following common services are implemented for the Discrete Input Group Object.

| Service Code | Implemented for: | | Service Name |
|---|---|---|---|
| | Class | Instance | |
| 0x0E | No | Yes | Get_Attribute_Single |
| 0x10 | No | Yes | Set_Attribute_Single |

## Discrete Output Group Object

### CLASS CODE 0x001E

No class attributes are supported for the Discrete Output Group Object.

Instance 1 exists for all ArmorStart units. Instance 2 exists for drive units only.

Instance 1 contains the following instance attributes.

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 3 | Get | Number of Instances | USINT | 4 for DOL/Soft Starter 10 for Inverters |
| 4 | Get | Binding | Array of UINT | List of DOP Instances |
| 6 | Get/Set | Command | BOOL | 0 = Idle, 1 = Run |
| 104 | Get/Set | Network Status Override | BOOL | 0 = No override (go to safe state)<br>1 = Override (run local logic) |
| 105 | Get/Set | Comm Status Override | BOOL | 0 = No override (go to safe state)<br>1 = Override (run local logic) |

Instance 2 contains the following instance attributes.

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 3 | Get | Number of Instances | USINT | 4 |
| 4 | Get | Binding | Array of UINT | 5, 6, 7, 8 |
| 7 | Get/Set | Fault Action | BOOL | 0 = Fault Value Attribute, 1 = Hold Last State |
| 8 | Get/Set | Fault Value | BOOL | 0 = OFF, 1 = On |
| 9 | Get/Set | Idle Action | BOOL | 0 = Idle Value Attribute, 1 = Hold Last State |
| 10 | Get/Set | Idle Value | BOOL | 0 = OFF, 1 = On |
| 113 | Get/Set | Pr Fault Action | BOOL | 0 = Pr Fault Value Attribute, 1 = Ignore |
| 114 | Get/Set | Pr Fault Value | BOOL | 0 = OFF, 1 = On |

The following common services are implemented for the Discrete Output Group Object.

| Service Code | Implemented for: | | Service Name |
|---|---|---|---|
| | Class | Instance | |
| 0x0E | No | Yes | Get_Attribute_Single |
| 0x10 | No | Yes | Set_Attribute_Single |

## Control Supervisor Object

### CLASS CODE 0x0029

No class attributes are supported.

A single instance (Instance 1) of the Control Supervisor Object is supported and contains the following instance attributes.

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 3 | Get/Set | Run 1 | BOOL | These Run outputs also map to DOP<br>Instances 1 and 2 |
| 4(1) | Get/Set | Run 2 | BOOL | — |
| 7 | Get | Running 1 | BOOL | — |
| 8(1) | Get | Running 2 | BOOL | — |
| 9 | Get | Ready | BOOL | — |
| 10 | Get | Tripped | BOOL | — |
| 12 | Get/Set | Fault Reset | BOOL | 0->1 = Trip Reset |
| 100 | Get/Set | Keypad Mode | BOOL | 0 = Maintained, 1 = Momentary |
| 101 | Get/Set | Keypad Disable | BOOL | 0 = Not Disabled, 1= Disabled |
| 115 | Get | Warning Status | WORD | Bits 0…1 = Reserved<br>Bit 2 = PL Warning (does not apply for Ethernet version)<br>Bit 3 = Reserved<br>Bit 4 = PR Warning (does not apply for Ethernet version)<br>Bit 5 = CP Warning<br>Bit 6 = I/O Warning<br>Bit 7 = Reserved<br>Bit 8 = PI Warning (does not apply for Ethernet version)<br>Bit 9 = DN Warning<br>Bits 10…12 = Reserved<br>Bit 13 = HW Warning<br>Bit 14 = Reserved<br>Bit 15 = DB Warning |
| 124 | Get/Set | Trip Enable | WORD | Bit enumerated trip enable word |
| 130 | Get/Set | Trip Reset Mode | BOOL | 0 = Manual, 1 = Auto |
| 131 | Get/Set | Trip Reset Level | USINT | 0 = 100%, Default = 75 |
| 150(2) | Get/Set | High Speed Ena | BOOL | 0 = Disable, 1 = Enable |
| 151 | Get | Base Enclosure | WORD | Bit 0 = IP67<br>Bit 2 = PLe Cat 4<br>Bits 3…15 Reserved |
| 152 | Get | Base Options | WORD | Bit 0 = Output Fuse<br>Bit 2 = CP Fuse Detect<br>Bits 3…7 = Reserved<br>Bit 8 = 10A Base<br>Bit 9 = 25A Base<br>Bit 10…15 = Reserved |
| 153 | Get | Wiring Options | WORD | Bit 0 = Conduit<br>Bit 1 = Round Media<br>Bit 2 = 28xG Gland<br>Bits 3…15 = Reserved |

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 154 | Get | Starter Enclosure | WORD | Bit 0 = IP67<br>Bit 1 = NEMA 4x<br>Bit 2 = 28xG Ple Cat4<br>Bits 3…15 Reserved |
| 155 | Get | Starter Options | WORD | Bit 0 = Full Keypad<br>Bit 1 = Safety Monitor<br>Bit 2 = Source Brake<br>Bit 3 = CP Brake<br>Bit 4 = Dynamic Brake<br>Bit 5 = Output Contactor<br>Bit 6 = EMI Filter<br>Bit 7 = 0…10V Analog In<br>Bit 8 = Fused Dyn Brake<br>Bits 9…15 = Reserved |
| 156 | Get | Last Pr Trip | UINT | — |
| 157(2) | Get | DB Status | WORD | Bit 0 = DB Faulted<br>Bit 1 = DB Overtemp Warning<br>Bit 2 = DB On<br>Bit 3 = DB Flt Reset Inhibit<br>Bits 4…15 = Reserved |
| 158(2) | Get | DB Fault | WORD | Bit 0 = DB Overtemp<br>Bit 1 = DB OverCurrent<br>Bit 2 = DB UnderCurrent<br>Bit 3 = DB Shorted Switch<br>Bit 4 = DB Open<br>Bit 5 = Reserved<br>Bit 6 = DB Bus Voltage Link Open<br>Bit 7 = Reserved<br>Bit 8 = DB Comms<br>Bits 9…15 = Reserved |

(1) Reversing Starters and Inverter Starters only.

(2) Inverter Starters only.

The following common services are implemented for the Control Supervisor Object.

| Service Code | Implemented for: | | Service Name |
|---|---|---|---|
| | Class | Instance | |
| 0x0E | No | Yes | Get_Attribute_Single |
| 0x10 | No | Yes | Set_Attribute_Single |

## Overload Object

### CLASS CODE 0x002C

No class attributes are supported for the Overload Object.

A single instance (Instance 1) of the Overload Object is supported for DOL and Reversing Starters. Instance 1 contains the following instance attributes.

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 3 | Get/Set | FLA Setting | BOOL | xxx.x amps |
| 4 | Get/Set | Trip Class | USINT | — |
| 5 | Get | Average Current | INT | xxx.x amps |
| 7 | Get | % Thermal Utilized | USINT | xxx% FLA |
| 8 | Get | Current L1 | INT | xxx.x amps |
| 9 | Get | Current L2 | INT | |
| 10 | Get | Current L3 | INT | |
| 190 | Get/Set | FLA Setting Times 10 | BOOL | xxx.xx amps |
| 192 | Get | Average Current Times 10 | UINT | xxx.xx amps |
| 193 | Get | Current L1 Times 10 | UINT | xxx.xx amps |
| 194 | Get | Current L2 Times 10 | UINT | |
| 195 | Get | Current L3 Times 10 | UINT | |

The following common services are implemented for the Overload Object.

| Service Code | Implemented for: | | Service Name |
|---|---|---|---|
| | Class | Instance | |
| 0x0E | No | 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<br>1 = Ring Fault<br>2 = Unexpected Loop Detect<br>3 = Partial Network Fault<br>4 = Rapid Fault/Restore Cycle |
| 10 | Get | Active Supervisor Address | Struct of<br>UDINT<br>Array of 6<br>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)<br>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 |

# DPI Fault Object

## CLASS CODE 0x0097

The DPI Fault Object is implemented in the DeviceNet Main Control Board.

The following class attributes are supported:

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 1 | Get | Class Revision | UINT | 1 |
| 2 | Get | Number of Instances | UINT | 4 |
| 3 | Get | Fault Cmd Write | USINT | 0 = NOP, 1 = Clear Fault, 2 = Clear Flt Queue |
| 4 | Get | Fault Instance Read | UINT | The instance of the Fault Queue Entry that contains information about the Fault that tripped the Device. |
| 6 | Get | Number of Recorded Faults | UINT | The number of Faults that are recorded in the Fault Queue. |

Four instances of the DPI Fault Object are supported. Instance 1 is the most recent fault while 4 is the oldest. They have the following instance attributes:

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 0 | Get | Full/All Info | Struct of: | — |
| — | — | Fault Code | UINT | See Table 49. |
| — | — | Fault Source | Struct of: | — |
| — | — | DPI Port Number | USINT | 0 |
| — | — | Device Object Instance | USINT | 0x2c |
| — | — | B Fault Text | BYTE[16] | See Table 49. |
| — | — | Fault Time Stamp | Struct of: | — |
| — | — | Timer Value | ULDINT | — |
| — | — | Timer Description | WORD | — |
| — | — | Help Object Instance | USINT | — |
| — | — | Fault Data | | — |
| 1 | Get | Basic Info | Struct of: | — |
| — | — | Fault Code | UINT | See Table 49. |
| — | — | Fault Source | Struct of: | — |
| — | — | DPI Port Number | USINT | 0 |
| — | — | Device Object Instance | USINT | 0x2C |
| — | — | Fault Time Stamp | Struct of: | — |
| — | — | Timer Value | ULINT | — |
| — | — | Timer Description | WORD | — |
| 3 | Get | Help Text | STRING | See Table 49. |

The following services are supported:

| Service Code | Implemented for: | | Service Name |
|---|---|---|---|
| | Class | Instance | |
| 0x0E | Yes | Yes | Get_Attribute_Single |
| 0x10 | Yes | No | Set_Attribute_Single |

The next table lists Fault Codes, Fault Text, and Fault Help Strings for DOL and Reversers.

**Table 49 - Bulletin 281E Faults**

| Fault Code | Fault Text | Help Text |
|---|---|---|
| 1 | Hdw Short Ckt | The built-in 140M Circuit Breaker has tripped. |
| 2 | Sfw Short Ckt | The wire protection algorithm detected an unsafe current surge. |
| 3 | Motor Overload | Load has drawn excessive current that is based on trip class selected. |
| 4 | Fault 4 | — |
| 5 | Phase Loss | Indicates missing supply phase. This fault can be disabled. |
| 6 | Fault 6 | — |
| 7 | Fault 7 | — |
| 8 | Fault 8 | — |
| 9 | Fault 9 | — |
| 10 | Fault 10 | — |
| 11 | Fault 11 | — |
| 12 | Fault 12 | — |
| 13 | Control Pwr Loss | Indicates the loss of control power. This fault can be disabled. |
| 14 | Control Pwr Fuse | The Control Power Fuse has blown. Remove power and replace fuse. |
| 15 | Input Short | Flags a shorted sensor, input device, or input wiring mistake. |
| 16 | Output Fuse | The Output Fuse has blown. Remove all power and replace the fuse. |
| 17 | Over Temp | Indicates that the operating temperature has been exceeded. |
| 18 | Fault 18 | — |
| 19 | Phase Imbalance | Indicates an imbalanced supply voltage. |
| 20 | Fault 20 | — |
| 21 | A3 Power Loss | Unswitched (A3) Power was lost or dipped below the 12V DC threshold. |
| 22 | Internal Comm | Communication with an internal component has been lost. |
| 23 | Fault 23 | — |
| 24 | Fault 24 | — |
| 25 | Fault 25 | — |
| 26 | Fault 26 | — |
| 27 | MCB EEPROM | This is a major fault that renders the ArmorStart controller inoperable. |
| 28 | Base EEPROM | This is a major fault that renders the ArmorStart controller inoperable. |
| 29 | Fault 29 | — |
| 30 | Wrong Base | The ArmorStart controller is connected to the wrong base type. |
| 31 | Wrong CTs | This is a major fault that renders the ArmorStart controller inoperable. |

**Table 49 - Bulletin 281E Faults**

| Fault Code | Fault Text | Help Text |
|---|---|---|
| 32 | Fault 32 | — |
| 33 | Fault 33 | — |
| 34 | Fault 34 | — |
| 35 | Fault 35 | — |
| 36 | Fault 36 | — |
| 37 | Fault 37 | — |
| 38 | Fault 38 | — |
| 39 | Fault 39 | — |
| 40 | Unknown Fault | — |
| 41 | Fault 41 | — |
| 42 | Fault 42 | — |
| 43 | Fault 43 | — |
| 44 | Fault 44 | — |
| 45 | Fault 45 | — |

The next table lists Fault Codes, Fault Text, and Fault Help Strings for VFD units.

**Table 50 Bulletin 284E**

| Fault Code | Fault Text | Help Text |
|---|---|---|
| 1 | Hdw Short Ckt | The built-in 140M Circuit Breaker has tripped. |
| 2 | Fault 2 | — |
| 3 | Motor Overload | The Load has drawn excessive current. |
| 4 | Drive Overload | 150% load for 1 min. or 200% load for 3 sec. exceeded |
| 5 | Phase U to Gnd | A Phase U to Ground fault is detected between drive and motor. |
| 6 | Phase V to Gnd | A Phase V to Ground fault is detected between drive and motor. |
| 7 | Phase W to Gnd | A Phase W to Ground fault is detected between drive and motor. |
| 8 | Phase UV Short | Excessive current is detected between phases U and V. |
| 9 | Phase UW Short | Excessive current is detected between phases U and W. |
| 10 | Phase VW Short | Excessive current is detected between phases V and W. |
| 11 | Ground Fault | A current path to earth ground at one or more output terminals. |
| 12 | Stall | The drive is unable to accelerate the motor. |
| 13 | Control Pwr Loss | Indicates the loss of control power. This fault can be disabled. |
| 14 | Control Pwr Fuse | The Control Power Fuse has blown. Remove power and replace fuse. |
| 15 | Input Short | Flags a shorted sensor, input device, or input wiring mistake. |
| 16 | Output Fuse | The Output Fuse has blown. Remove all power and replace the fuse. |
| 17 | Over Temp | Indicates that the operating temperature has been exceeded. |
| 18 | Heatsink OvrTmp | The Heatsink temperature exceeds a predefined value. |
| 19 | HW OverCurrent | The drive output current has exceeded the hardware limit. |
| 20 | SW OverCurrent | Programmed parameter 198 (SW Current Trip) has been exceeded. |

**Table 50 Bulletin 284E**

| Fault Code | Fault Text | Help Text |
|---|---|---|
| 21 | A3 Power Loss | Unswitched (A3) Power was lost or dipped below the 12V DC threshold. |
| 22 | Internal Comm | Communication with the internal Power Flex drive has been lost. |
| 23 | Drive Comm Loss | The RS-485 port on the internal Power Flex stopped communicating. |
| 24 | Power Loss | Drive DC Bus Voltage remained below 85% of nominal bus voltage. |
| 25 | Under Voltage | DC Bus Voltage fell below the minimum value. |
| 26 | Over Voltage | DC Bus Voltage exceeded the maximum value. |
| 27 | MCB EEPROM | This is a major fault that renders the ArmorStart controller inoperable. |
| 28 | Base EEPROM | This is a major fault that renders the ArmorStart controller inoperable. |
| 29 | Drive EEPROM | The drive EEPROM checksum checks have failed. |
| 30 | Wrong Base | The ArmorStart controller is connected to the wrong base type. |
| 31 | Fan RMP | The internal cooling fan is not running properly. |
| 32 | Power Unit | A major failure has been detected in the drive power section. |
| 33 | Drive I/O Brd | A failure has been detected in the drive control and I/O section. |
| 34 | Restart Retries | Automatic fault reset and run retries exceeded. |
| 35 | Drive Aux In Flt | The drive auxiliary input interlock is open inside the ArmorStart controller. |
| 36 | Analog Input | (PF Fault Code 29) |
| 37 | Drv Param Reset | Internal Drive Parameters (Parameters > 100) have been defaulted. |
| 38 | SCV Autotune | The drive automatic tuning function was either aborted or failed. |
| 39 | Source Brake | The source brake fuse has blown. Remove power and replace fuse. |
| 40 | Unknown Fault | — |
| 41 | DB1 Comm | Communication with an internal DB1 board has been lost. |
| 42 | DB1 Fault | A fault has been detected with the operation of the Dynamic Brake. |
| 43 | DB Switch Short | The Dynamic Brake switch is shorted. |
| 44 | Fault 44 | — |
| 45(1) | Incompatible COMM Device | The software version of the Drive is not compatible with the ArmorStart controller. |

(1) The Fault text for this error is not return by the device, and is only reported as “Fault 45”.

# DPI Alarm Object

## CLASS CODE 0x0098

The following class attributes are supported:

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 1 | Get | Class Revision | UINT | 1 |
| 2 | Get | Number of Instances | UINT | 4 |
| 3 | Set | Alarm Cmd Write | USINT | 0=NOP, 1=Clear Fault, 2=Clear Flt Queue |
| 74 | Get | Alarm Instance Read | UINT | The instance of the Fault Queue Entry that contains information about the Fault that tripped the Device. |
| 6 | Get | Number of Recorded Faults | UINT | The number of Faults that are recorded in the Fault Queue. |

Four instances of the DPI Alarm Object are supported with the following instance attributes. Instance 1 is the most recent fault while 4 is the oldest. See Table 49 on page 312 and Table 50 on page 313 for fault codes.

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 0 | Get | Full/All Info | Struct of: | — |
| — | — | Alarm Code | UINT | — |
| — | — | Alarm Source | Struct of: | — |
| — | — | DPI Port Number | USINT | — |
| — | — | Device Object Instance | USINT | — |
| — | — | Alarm Text | STRING | — |
| — | — | Alarm Time Stamp | Struct of: | — |
| — | — | Timer Value | ULINT | — |
| — | — | Timer Descriptor | WORD | — |
| — | — | Help Object Instance | USINT | — |
| — | — | Alarm Data | — | — |
| 1 | Get | Basic Info | Struct of: | — |
| — | — | 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 | — |
| 3 | Get | Help Text | STRING | — |

The following services are supported.

| Service Code | Implemented for: | | Service Name |
| --- | --- | --- | --- |
| | Class | Instance | |
| 0x0E | Yes | Yes | Get_Attribute_Single |
| 0x10 | Yes | No | Set_Attribute_Single |

The next table lists Warning Codes, Warning Text, and Warning Help Strings that do not match the fault text.

| Fault Code | Fault Text | Help Text |
| --- | --- | --- |
| 101 | IP67/4X Mismatch | The Base enclosure type does not match the Control Module enclosure type. |
| 102 | DB Terminal | A warning has been detected with the operation of the Dynamic Brake. |

# Interface Object

## CLASS CODE 0x00B4

The following class attributes are supported.

| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 1 | Get | Revision | UINT | 1 for DOL<br>2 for Inverters |

A single instance (Instance 1) of the Interface Object is supported with the following instance attributes.

| Attribute ID | Access Rule | Name | Data Type | Min/Max | Default | Description |
|---|---|---|---|---|---|---|
| 7 | Get/Set | Prod Assy Word 0 | USINT (rev 1)<br>UINT (rev 2) | — | 1 | Defines Word 0 of Assy 120 |
| 8 | Get/Set | Prod Assy Word 1 | USINT (rev 1)<br>UINT (rev 2) | — | 5 | Defines Word 1 of Assy 120 |
| 9 | Get/Set | Prod Assy Word 2 | USINT (rev 1)<br>UINT (rev 2) | — | 6 | Defines Word 2 of Assy 120 |
| 10 | Get/Set | Prod Assy Word 3 | USINT (rev 1)<br>UINT (rev 2) | — | 7 | Defines Word 3 of Assy 120 |
| 13 | Get/Set | Starter COS Mask | WORD | 0 to 0xFFFF | 0xFFFF | Change of state mask for starter bits |
| 15 | Get/Set | Autobaud Enable | BOOL | 0 to 1 | 1 | 1= enabled, 0 = disabled |
| 16 | Get/Set | Consumed Assy | USINT | 0 to 185 | 162 (VFD 166) | 3, 162 (also for drives 166, 191, and 192) |
| 17 | Get/Set | Produced Assy | USINT | 100 to 187 | 150 (VFD 151) | 52, 150, 161 (also for drive 151) |
| 19 | Get/Set | Set To Defaults | BOOL | 0 to 1 | 0 | 0 = No action, 1 = Reset |
| 23 | Get | I/O Produced Size | — | 0 t0 20 | — | — |
| 24 | Get | I/O Consumed Size | USINT | 0 to 16 | — | — |
| 30 | Get | DNet Voltage | UINT | — | — | DeviceNet Voltage |
| 50 | Get/Set | PNB COS Mask | WORD | 0 to 0x00FF | 0 | Change of state mask for PNBs |
| 64 | Get/Set | Unlock Identity | USINT | — | 0 | Multiple Identity Object instances are unlocked when this attribute is set to the value 0x99. |

The following common services are implemented for the Interface Object.

| Service Code | Implemented for: | | Service Name |
|---|---|---|---|
| | Class | Instance | |
| 0x0E | No | 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<br>2 = Configuration from DHCP |
| 4 | Get | Physical Link Object | Struct of<br>UINT<br>Padded EPATH | <br>2 words<br>NULL Enet Link Object Instance |
| 5 | Get/Set | Interface Configuration | Struct of<br>UDINT<br>UDINT<br>UDINT<br>UDINT<br>UDINT<br>STRING | <br>IP Address<br>Network Mask<br>Gateway Address<br>Primary DNS<br>Secondary DNS<br>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<br>USINT<br>USINT<br>UINT<br>UDINT | <br>Allocation Control<br>Reserved<br>Number of multicast addresses to allocate (1…4)<br>Multicast starting address. |
| 11 | Get/Set | LastConflictedDetected | Struct of | |
| | | AcdActivity | USINT | State of last ACD Activity when last conflicted detected.<br>Default = 0 |
| | | RemoteMAC | Array of 6<br>USINT | MAC address of a remote node from the ARP DPU in which a conflict was detected. Default = 0 |
| | | ArpPdu | Array of 28<br>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: Class | Implemented for: Instance | Service Name |
|---|---|---|---|
| | 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.

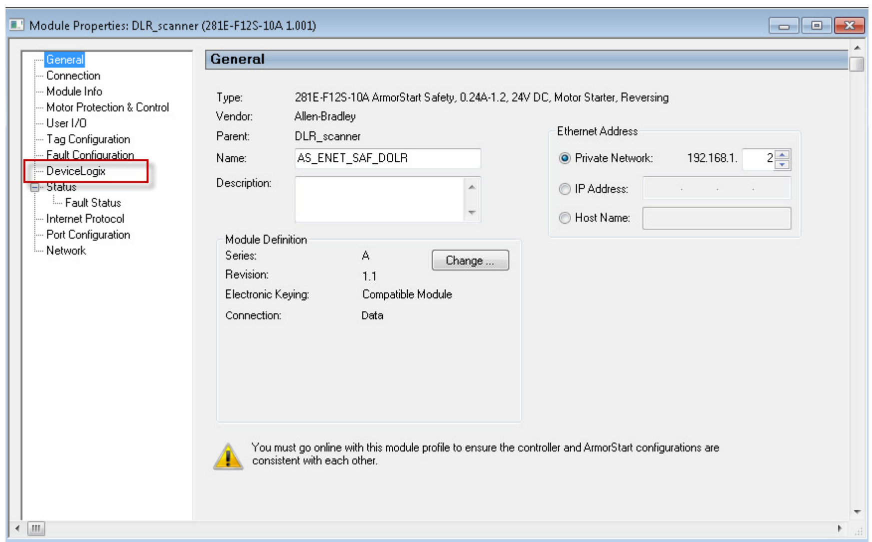
| Attribute ID | Access Rule | Name | Data Type | Value |
|---|---|---|---|---|
| 1 | Get | Interface Speed | UDINT | 10 or 100 Mbit/Sec |
| 2 | Get | Interface Flags | DWORD | See ENet/IP Spec |
| 3 | Get | Physical Address | ARRAY of 6 USINTs | MAC Address |
| 4 | Get | Interface Counters | Struct of:<br>In Octets<br>In Ucast packets<br>In NUcast packets<br>In Discards<br>In Errors<br>In Unknown Protos<br>Out Octets<br>Out Ucast packets<br>Out NUcast packets<br>Out Discards<br>Out Errors | — |
| 5 | Get | Media Counters | Struct of:<br>Alignment Errors<br>FCS Errors<br>Single Collisions<br>SQE Test Errors<br>Deferred Transmits<br>Late Collisions<br>Excessive Collisions<br>MAC Transmit Errors<br>Carrier Sense Errors<br>Frame Too Long<br>MAC Receive Errors | — |
| 6 | Get/Set | Interface Control | Struct of:<br>Control Bits<br>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<br>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 |

# 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 AOP for ArmorStart EtherNet/IP for ControlLogix or other Logix family PLCs.




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 PLC 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 control power and a DeviceNet 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 PLC or network status
- Continue to run process if network interruptions occur
- Critical operations can be safely shut down through local logic

## DeviceLogix Programming Example

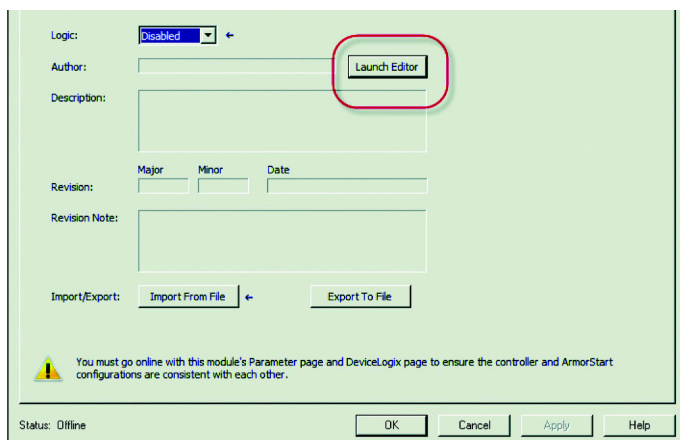
The following example shows how to program a simple logic routine to interface the ArmorStart ST controller with a remote hard-wired start/stop station. In this case, the I/O is wired as shown in Table 51.

**Table 51 - Hardware Bit Assignments and Description for the ArmorStart**

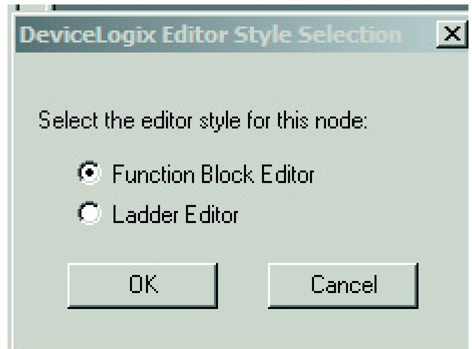
| Input Table | | Output Table | |
|---|---|---|---|
| **Bit** | **Description** | **Bit** | **Description** |
| In 0 | Start Button | Run Forward | Contactor Coil |
| In 1 | Stop Button | — | — |
| In 2 | — | — | — |
| In 3 | — | — | — |

**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 parameter 8 (Network Override) and parameter 9 (Comm. Override) to the desired value.

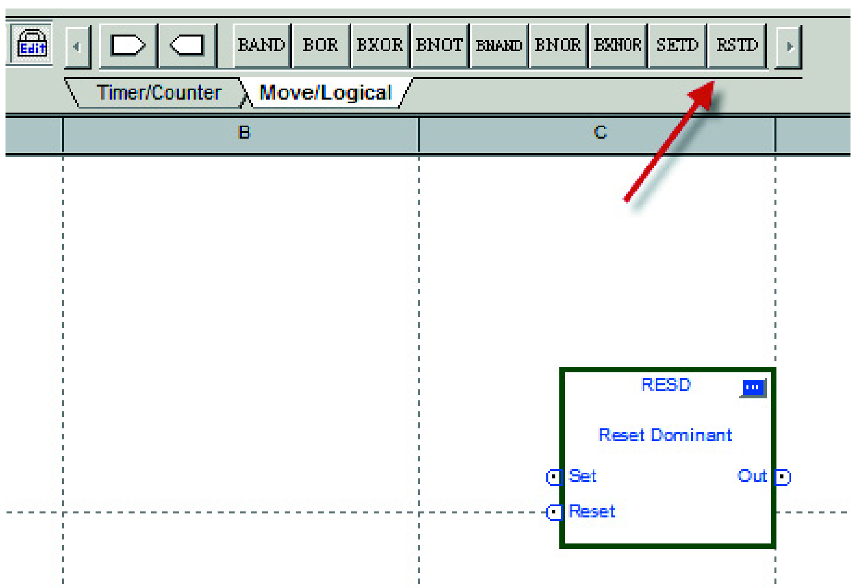
1. While in the AOP, click the DeviceLogix tab. Click the Launch Editor button.



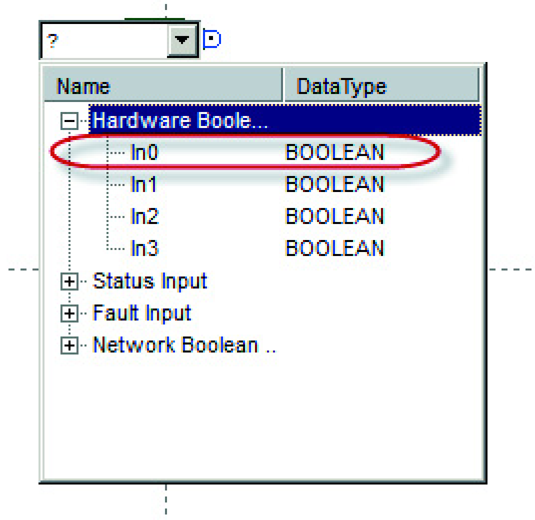
2. Select Function Block or Ladder editor.
   **Note:** Once selected, you are not able to switch back without recreating the logic.




3. Locate the tool bar 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.

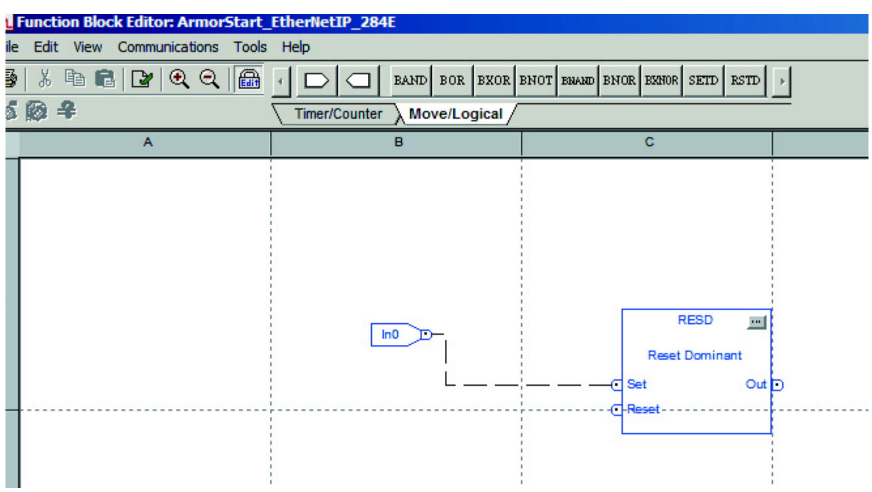


4. From the toolbar, Click the “**Bit Input**” button and select **In 0** from the Hardware Boolean tree. This selection is the remote start button that is based on the example I/O table.

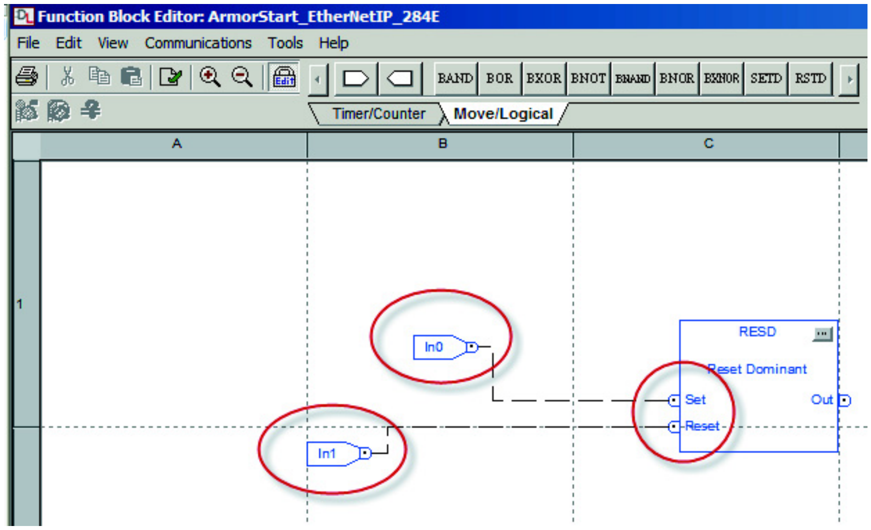



5. Place the input to the left of the reset function. To drop the input on the page, left click the desired position.
6. Place the mouse cursor over the tip of In 0. The tip turns green. Click the tip when it turns green.
7. Move the mouse cursor toward the Set input of the reset function. A line follows the cursor. When a connection can be made, the tip of the RSL function also turns green. Click the on Input and the line is drawn from In 0 to the Set Input of the reset function.

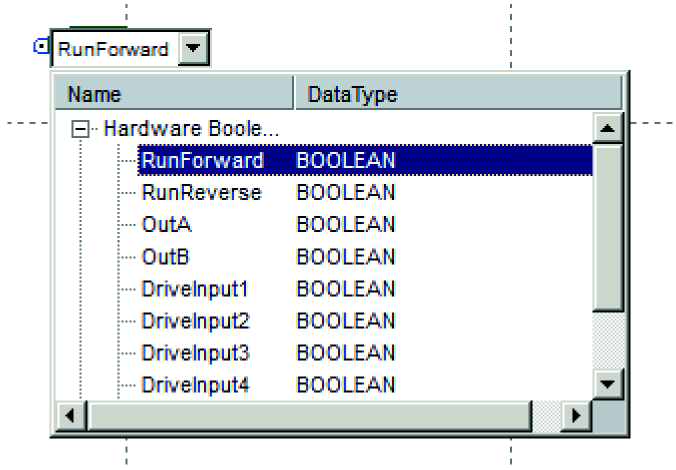
**Note:** If this connection was not valid, one of the pin tips would have turned red rather than green. Left double-clicking the unused portion of the grid or pressing the “**Esc**” key at any time cancels the connection process.



8. From the toolbar, Click the "**Bit Input**" button 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.
9. Place the input to the left of the reset function.
10. Connect the input to the reset input of the reset function.

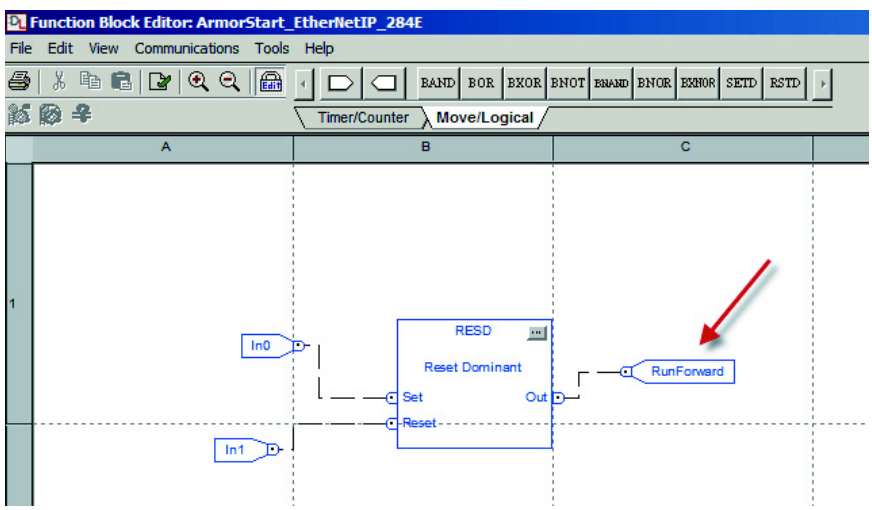


11. From the toolbar, Click the "**Bit Output**" button and select "**Run Forward"** from the hardware Boolean tree. Run Forward is the relay controlling the coil of the contactor.



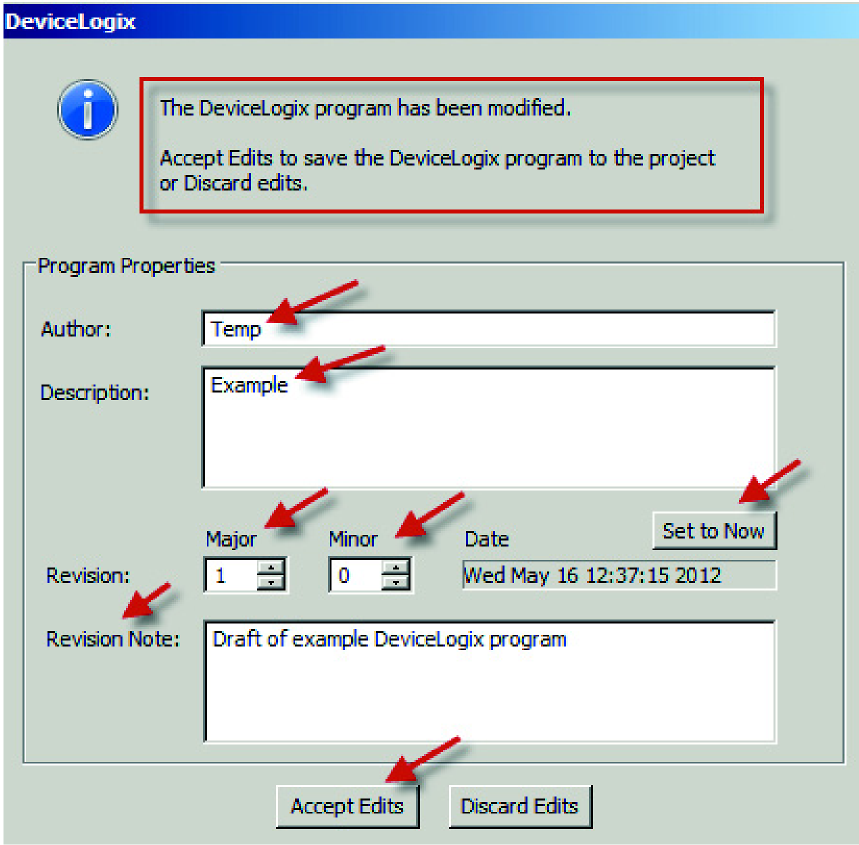

12. Move the cursor into the grid and place the Output to the right of the reset function block.

13. Connect the output of the reset function block to **Run Forward.**

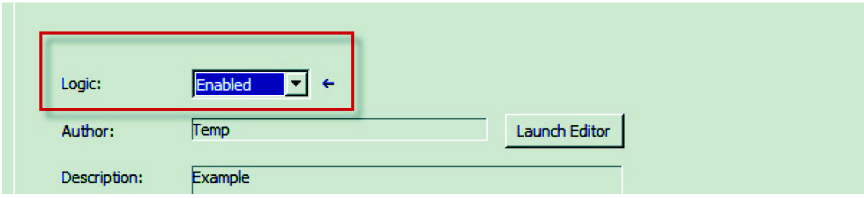



14. Click the "**Verify**" button that is located in the toolbar or select "Logic Verify" from the "Tools" pull-down menu.

15. 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.




16. The last step is to enable the logic via the pull-down menu.



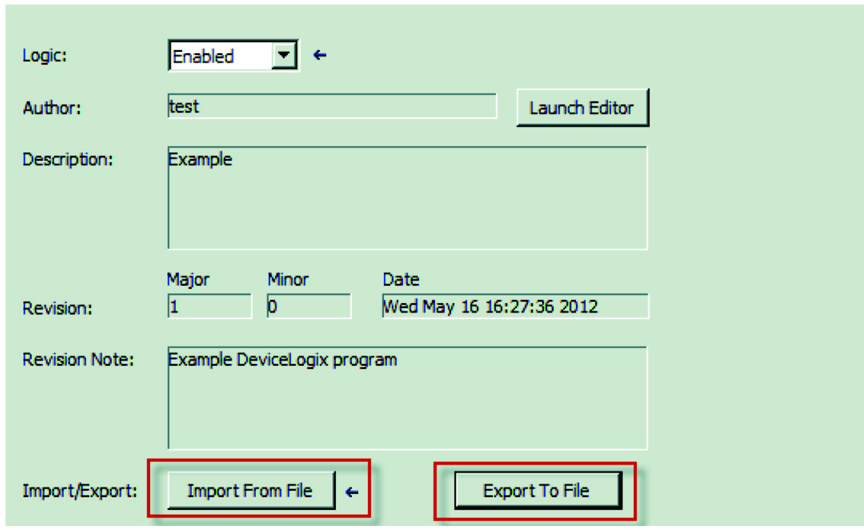

17. Click OK. To download the DeviceLogix program, you must go on-line with the PLC and allow the download. Verify that the PLC is in the Program position. If in any other position, the download does not occur and an error is generated.

18. The ArmorStart controller is now programmed and the logic is Active.

## Import and Export

The ArmorStart EtherNet/IP AOP provides you with an import or export function.

The export function lets the DeviceLogix program be saved to a file. This file can then be imported into a similar product of same function regardless of horsepower. You cannot import DeviceLogix between unlike products, for example Bulletin 284E and Bulletin 280E controllers.



# Notes:

# Replacement Parts

## Bulletin 281E Standard Version Controller

**Table 52 - Full Voltage and Reversing Control Replacement Module**

| Current Rating [A] | kW | | Hp | | | Cat. No. |
|---|---|---|---|---|---|---|
| | 230V AC 50 Hz | 400V AC 50 Hz | 200V AC 60 Hz | 230V AC 60 Hz | 460V AC 60 Hz | 24V DC |
| 0.24…1.2 | 0.18 | 0.37 | — | — | 0.5 | 281E-F12Z-NA-RG |
| 0.5…2.5 | 0.37 | 0.75 | 0.5 | 0.5 | 1 | 281E-F12Z-NB-RG |
| 1.1…5.5 | 1.1 | 2.2 | 1 | 1 | 3 | 281E-F12Z-NC-RG |
| 3.2…16 | 4 | 7.5 | 3 | 5 | 10 | 281E-F23Z-ND-RG |

**Table 53 - Full Voltage and Reversing Base Replacement Module**

| Current Rating [A] | kW | | Hp | | | Cat. No. |
|---|---|---|---|---|---|---|
| | 230V AC 50 Hz | 400V AC 50 Hz | 200V AC 60 Hz | 230V AC 60 Hz | 460V AC 60 Hz | |
| 0.24…1.2 | 0.18 | 0.37 | — | — | 0.5 | 280E-FN-10-RG |
| 0.5…2.5 | 0.37 | 0.75 | 0.5 | 0.5 | 1 | 280E-FN-10-RG |
| 1.1…5.5 | 1.1 | 2.2 | 1 | 1 | 3 | 280E-FN-10-RG |
| 3.2…16 | 4 | 7.5 | 3 | 5 | 10 | 280E-FN-25-RG |

For Motor and Brake Cables - See Motor and Brake Cables

## Bulletin 284E Standard Version Controller

**Table 54 - VFD Control Replacement Module**

| Input Voltage | kW | Hp | 24V DC Control Voltage |
|---|---|---|---|
| 380…480V 50/60 Hz 3-Phase | 0.75 | 1.0 | 284E-FVD2P3Z-N-RG-SBG-DB1-EMI |
| | 1.5 | 2.0 | 284E-FVD4P0Z-N -RG-SBG-DB1-EMI |
| | 2.2 | 3.0 | 284E-FVD6P0Z-N-RG-SBG-DB1-EMI |
| | 3.0 | 5.0 | 284E-FVD7P6Z-N-RG-SBG-DB1-EMI |

**Table 55 - VFD Base Replacement Module**

| Input Voltage | kW | Hp | 24V DC Control Voltage |
|---|---|---|---|
| 380…480V 50/60 Hz 3-Phase | 0.75 | 1.0 | 280E-FN-10-RG |
| | 1.5 | 2.0 | 280E-FN-10-RG |
| | 2.2 | 3.0 | 280E-FN-25-RG |
| | 3.0 | 5.0 | 280E-FN-25-RG |

## Bulletin 281E Safety Version Controller

**Table 56 - Full Voltage and Reversing Safety Control Replacement Module**

| Current Rating [A] | kW | | Hp | | | Cat. No. |
|---|---|---|---|---|---|---|
| | 230V AC 50 Hz | 400V AC 50 Hz | 200V AC 60 Hz | 230V AC 60 Hz | 460V AC 60 Hz | 24V DC |
| 0.24…1.2 | 0.18 | 0.37 | — | — | 0.5 | 281E-F12S-NA-RG |
| 0.5…2.5 | 0.37 | 0.75 | 0.5 | 0.5 | 1 | 281E-F12S-NB-RG |
| 1.1…5.5 | 1.1 | 2.2 | 1 | 1 | 3 | 281E-F12S-NC-RG |
| 3.2…16 | 4 | 7.5 | 3 | 5 | 10 | 281E-F23S-ND-RG |

**Table 57 - Full Voltage and Reversing Safety Base Replacement Module**

| Current Rating [A] | kW | | Hp | | | Cat. No. |
|---|---|---|---|---|---|---|
| | 230V AC 50 Hz | 400V AC 50 Hz | 200V AC 60 Hz | 230V AC 60 Hz | 460V AC 60 Hz | |
| 0.24…1.2 | 0.18 | 0.37 | — | — | 0.5 | 280E-FNS-10-RG |
| 0.5…2.5 | 0.37 | 0.75 | 0.5 | 0.5 | 1 | 280E-FNS-10-RG |
| 1.1…5.5 | 1.1 | 2.2 | 1 | 1 | 3 | 280E-FNS-10-RG |
| 3.2…16 | 4 | 7.5 | 3 | 5 | 10 | 280E-FNS-25-RG |

# Bulletin 284E Safety Version Controller

**Table 58 - VFD Safety Control Replacement Module**

| Input Voltage | kW | Hp | 24V DC Control Voltage |
|---|---|---|---|
| 380…480V 50/60 Hz 3-Phase | 0.75 | 1.0 | 284E-FVD2P3S-N-RG-SBG-DB1-EMI |
| | 1.5 | 2.0 | 284E-FVD4P0S-N -RG-SBG-DB1-EMI |
| | 2.2 | 3.0 | 284E-FVD6P0S-N-RG-SBG-DB1-EMI |
| | 3.0 | 5.0 | 284E-FVD7P6S-N-RG-SBG-DB1-EMI |

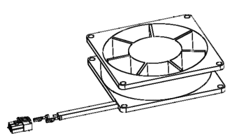
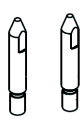
**Table 59 - VFD Safety Base Replacement Module**

| Input Voltage | kW | Hp | 24V DC Control Voltage |
|---|---|---|---|
| 380…480V 50/60 Hz 3-Phase | 0.75 | 1.0 | 280E-FNS-10-RG |
| | 1.5 | 2.0 | 280E-FNS-10-RG |
| | 2.2 | 3.0 | 280E-FNS-25-RG |
| | 3.0 | 5.0 | 280E-FNS-25-RG |

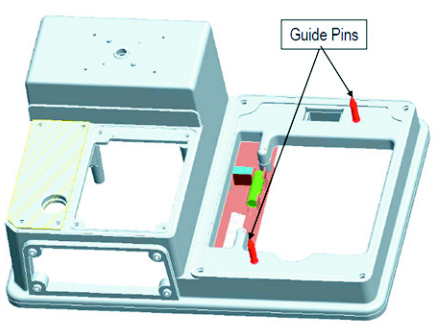
# Replacement Fuses

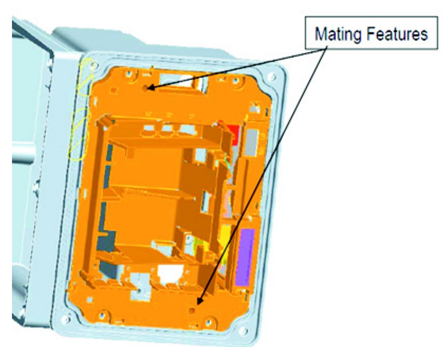
| Description | |
|---|---|
| Output Fuse | |
| Fast-acting, high-interrupting capacity, tubular fuse<br>Rating: 2.5 A, 250V<br>Dimension [mm (in.)]: 20 (0.787) x 5 (0.197) | Littlefuse PN 021602.5 |
| Control Fuse | |
| UL Listed Class CC, CSA HRC-1<br>Rating: 7 A, 600V<br>Dimensions [in.]: 1.5 x 0.405 | Cooper Bussman PN KTK-R-7<br>or<br>Littlefuse PN KLKR007.T |
| Source Brake Fuse (For use with Bulletin 284 with Brake option CB/SB) | |
| UL Listed Class CC, CSA HRC-1<br>Rating: 3 A, 600V<br>Dimensions [in.]: 1.5 x 0.405 | Cooper Bussman PN KTK-R-3<br>or<br>Littlefuse PN KLKR003.T |

# Replacement Parts

| Description | | Cat. No. |
|---|---|---|
|  | Replacement Fan for 284 Control Module | 284-FAN |
|  | Replacement Guide Pins (two pins per package)(1) | 284-PIN |

(1) These pins are replacement parts for factory-installed alignment pins. They cannot be retrofitted in the field. The base module and control module require mating features as indicated in the following diagrams.



# System Design Considerations When Using a Line Reactor

## General Rule

Generally a line reactor for an ArmorStart controller is not required. Customers familiar with Rockwell Automation PowerFlex® drives can ask this question when installing an ArmorStart controller.

## 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 assures 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.

# Application Examples

## Manual Brake Control

If you want to activate the mechanical brake (source brake option) of the ArmorStart Bulletin 284E controller, there are several parameters that need attention. The following configuration lets the brake operate normally while running and when the Bulletin 284 controller is not running, it lets a release of the brake for maintenance.

See the consume assembly (164 for DeviceNet or 166 for EtherNet/IP).

1. Select which Drive Input (1, 2, 3, 4) to trigger the release of the brake. Configure the corresponding parameter that references the Drive Input P151, P152, P153, or P154.

**Table 60 - Select Drive Input**

| Parameter Number | Parameter Name | Description | Factory Default | Group |
|---|---|---|---|---|
| 151…154 | Digital In 1 Sel | Selects the function for the digital inputs. | See Table 22 on page 175 | Drive Advanced Setup |
| | Digital In 2 Sel | | | |
| | Digital In 3 Sel | | | |
| | Digital In 4 Sel | | | |

- Set the Drive In you select to "27", Em Brk Release - If EM Brake function enabled, this input releases the brake manually.

| | | |
|---|---|---|
| 27(1) | Em Brk Rls | If EM Brake function is enabled, this input releases the brake. See parameter 155 and set to EM Brk Cntrol (22). |

(1) Provides programmable control of Em Brk via digital input (1...4).

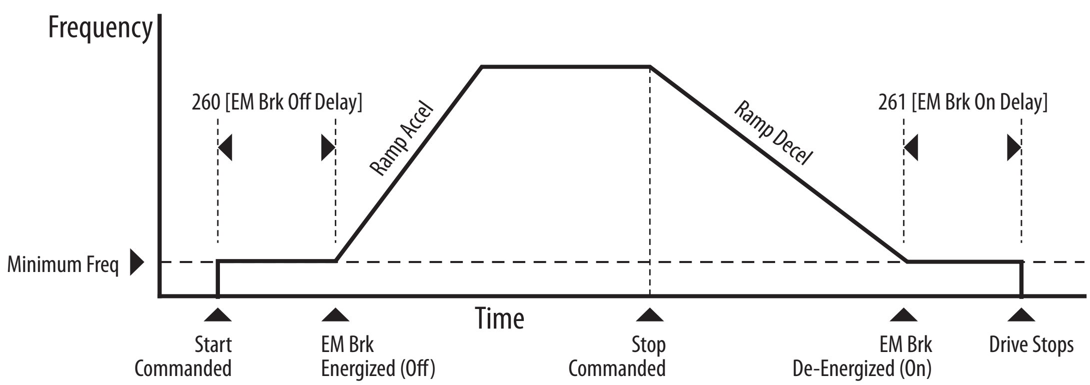
2. Set P137, Stop Mode to one of the following:
   - 8 = Ramp + EM B, CF Ramp to Stop with EM Brake Control. Stop command clears active fault.
   - 9 = Ramp + EM Brk Ramp to Stop with EM Brake Control.

3. Set P155, Relay Out Sel, to "22" EM Brk Cntrl EM Brake is energized.
   - Program Parameter 260 (EM Brk OFF Delay) for desired action.
   – Sets the time that the drive remains at minimum frequency (P134) before ramping to the commanded frequency.

| | | |
|---|---|---|
| **EM Brk OFF Delay**<br><br>Sets the time that the drive remains at minimum frequency before ramping to the commanded frequency. This action energizes the brake coil relay when Parameter 137 (Stop Mode) is set to Option 8 or 9. | Parameter Number | 260 |
| | Related Parameters | 134, 137 |
| | Access Rule | GET/SET |
| | Data Type | UNIT |
| | Group | Drive Advanced Setup |
| | Units | 0.01 sec |
| | Minimum Value | 0.01 sec |
| | Maximum Value | 10 sec |
| | Default Value | 0.0 sec |

- Program Parameter 261 (EM Brk On Delay) for desired action.
- (P137)

| | | |
|---|---|---|
| **EM Brk On Delay**<br><br>Sets the time that the drive remains at minimum frequency before stopping and de-energizing the brake coil relay when Parameter 137 (Stop Mode) is set to Option 8 or 9. | Parameter Number | 261 |
| | Related Parameters | 134, 137 |
| | Access Rule | GET/SET |
| | Data Type | UNIT |
| | Group | Drive Advanced Setup |
| | Units | 0.01 sec |
| | Minimum Value | 0.01 sec |
| | Maximum Value | 10.00 sec |
| | Default Value | 0.0 sec |



4. See the consume assembly next. The Drive Input that was configured in step #1, is used to control the mechanical brake.

| **Default Instance 166 Consumed Inverter Type Starter with Network Inputs** | | | | | **ArmorStart EtherNet/IP** | | | |
|---|---|---|---|---|---|---|---|---|
| **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** | **DriveInput3** | **DriveInput2** | **DriveInput1** | 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 | Pt9DeviceIn | Pt8DeviceIn |

## Bulletin 284 - 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 Chapter 5. 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 61.
**Note**: There are other capabilities that are shown in the table that are not reviewed in this example.

Figure 95 shows all available network outputs supported by Bulletin 284.Referring to Table 61 the preset frequencies are defined in parameter 170,171,172 and 173 of Bulletin 284. 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 Parameter 172 (Preset Freq 2).

**Figure 95 - Bulletin 284E Produced Network Bits in DeviceLogix Output**

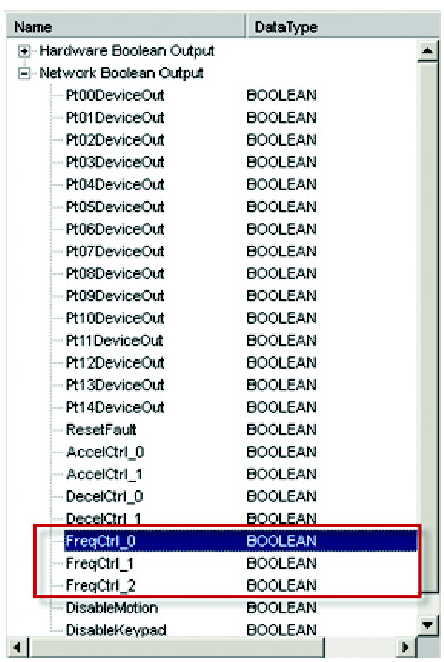


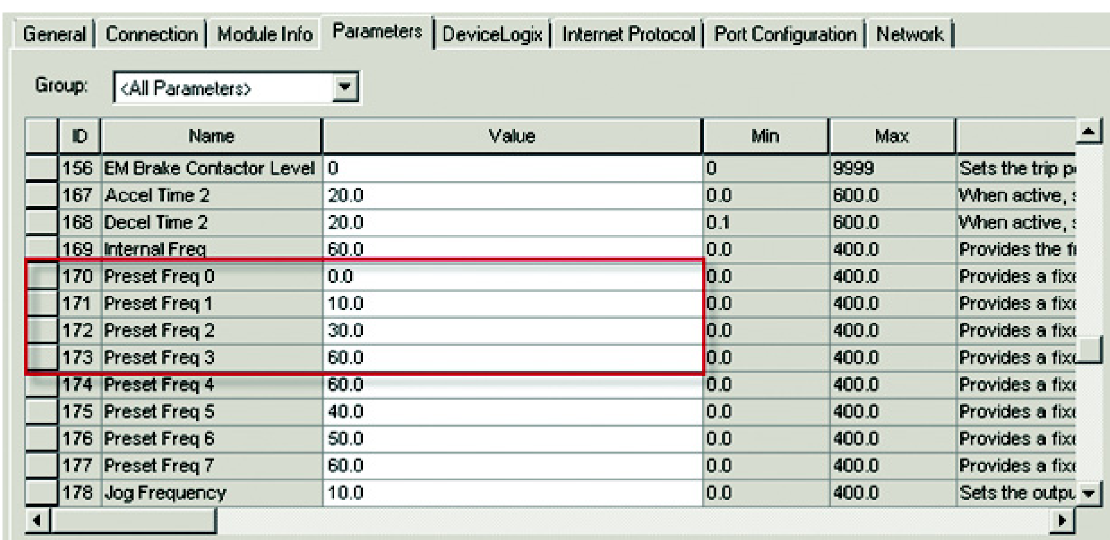
**Table 61 -**

**See table 22 - Parameters 170…177 Preset Freq Options for predefined accel and decel**

| 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** | **P170 (Preset Freq 0) (Accel/Decel 1)** |
| **1** | **0** | **1** | **P171 (Preset Freq 1) (Accel/Decel 1)** |
| **1** | **1** | **0** | **P172 (Preset Freq 2) (Accel/Decel 2)** |
| **1** | **1** | **1** | **P173 (Preset Freq 3) (Accel/Decel 2)** |

Use parameters 170…173, set them to 0, 10, 30, and 60 respectively. Figure 96 shows the preset frequencies 0…3.

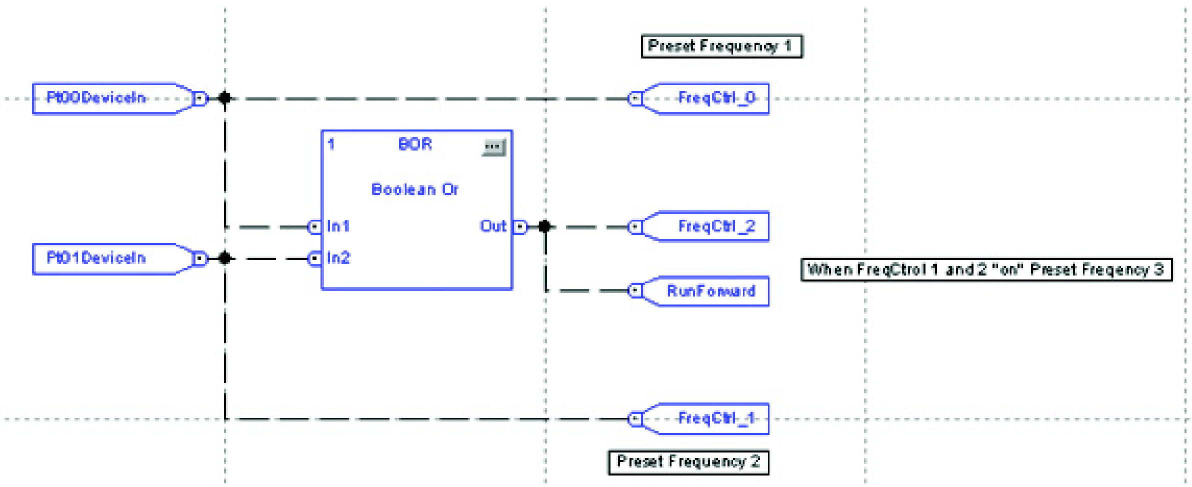
**Figure 96 - P170…173 Preset Frequency Settings**



In this example, DeviceLogix receives data from the PLC program. The communication and network overrides are disabled as shown next.

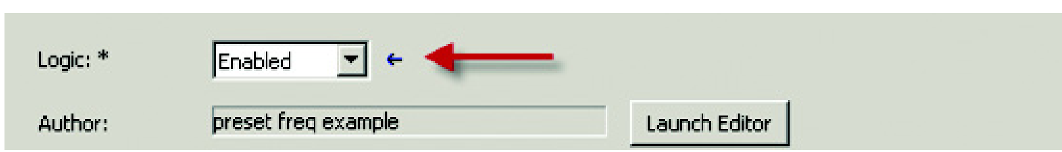

Figure 97 shows the DeviceLogix program. This program lets you select one of three predefined frequencies that are based on two network bits.

**Figure 97 - DeviceLogix Program**

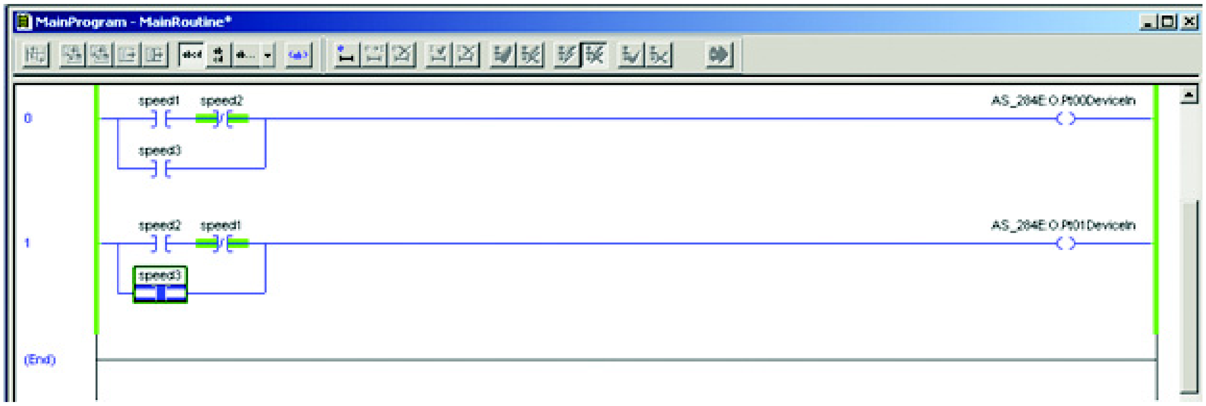



Once you exit the DeviceLogix editor, verify that the logic is "Enabled" otherwise the preset frequency control does not operate. See Figure 98.

**Figure 98 -**



This simple PLC 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 PLC. In order for the parameters and DeviceLogix program to update in the device, verify that the PLC is in program mode, and open the AOP for the Bulletin 284E controller.


Select the Parameters and DeviceLogix tab. This selection forces a correlation between the program file and the device. If a difference exists either upload from the device or download from the project to the device. In this example, choose to download.

Figure 99 is an example of the parameter correlation when a difference occurs between the project and the device.

**Figure 99 -**

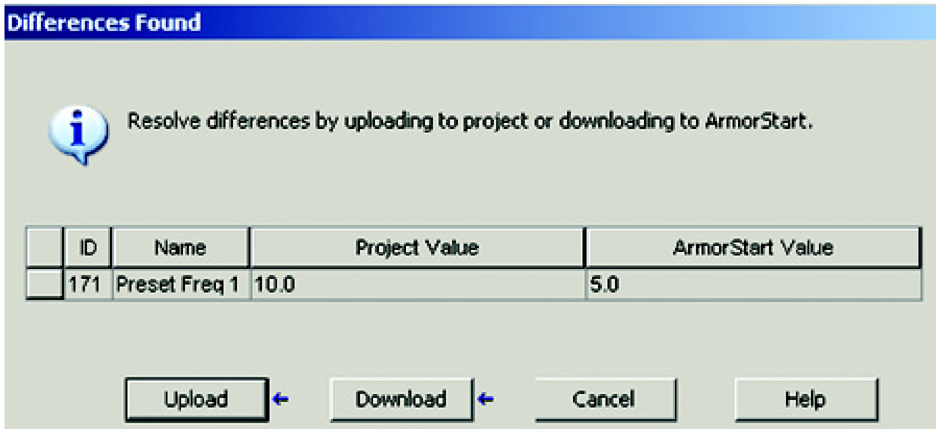
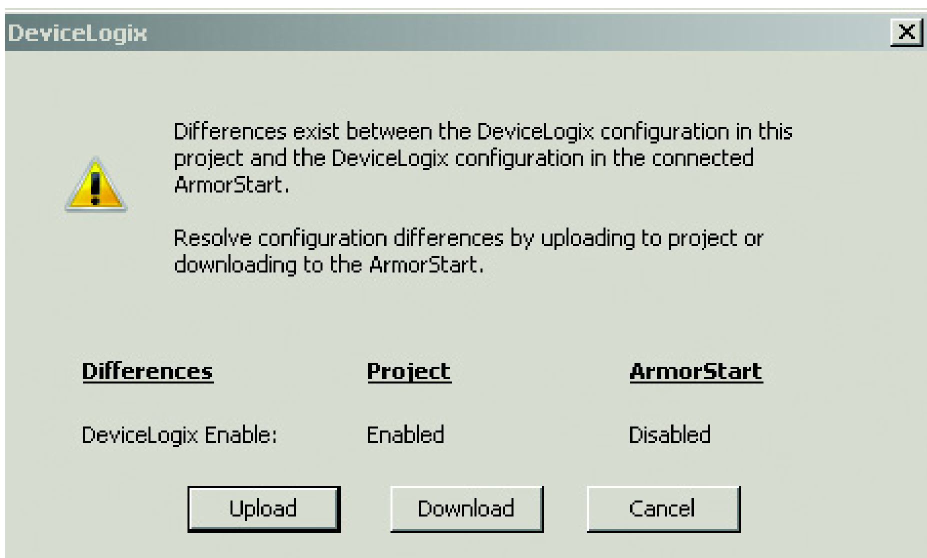
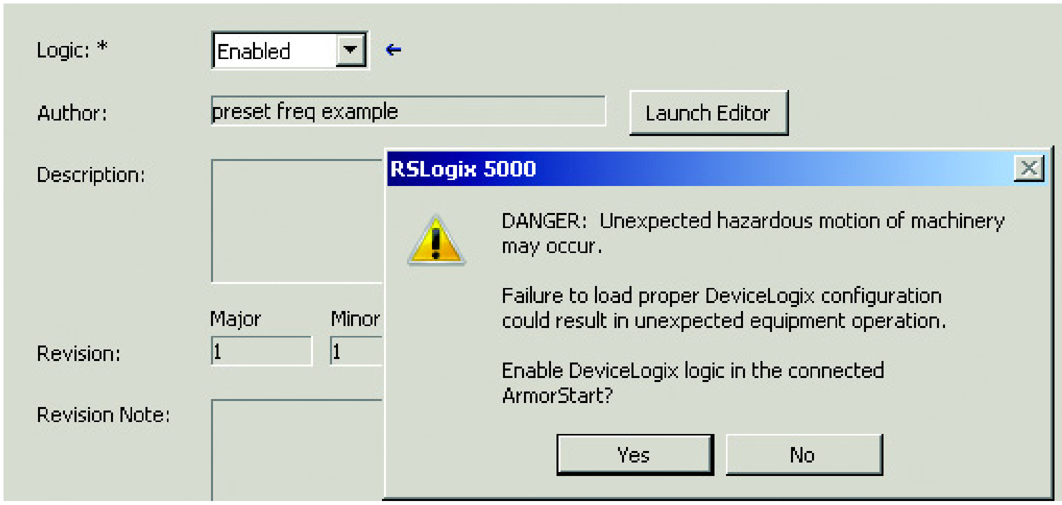



Figure 100 is an example of the DeviceLogix correlation when a difference occurs between the project and the device.

**Figure 100 - DeviceLogix Correlation**



Note the caution statement before download.




After the DeviceLogix correlation is successful, the following window is displayed.


After both correlations are complete place the PLC 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 PLC and stay in program mode. There can be no active I/O connections to the device or the download fails. Open the AOP 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 284E controller accelerates to 10 Hz or decelerate by using accel/decel Time 2.

When bit Speed_2 is ON, then the Bulletin 284E controller accelerates to 30 Hz or decelerate by using accel/decel Time 2.

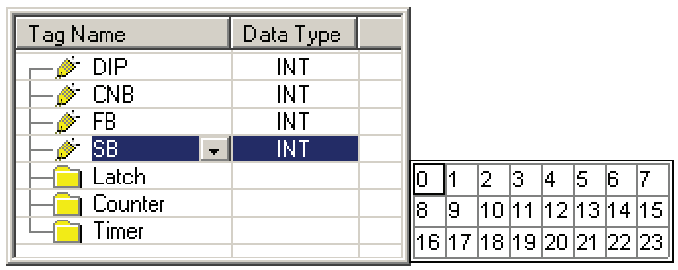
## DeviceLogix Ladder Editor Example

ArmorStart EtherNet/IP 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 PNB0, PNB1, and so on.

This document helps you interpret the naming conventions.

### ArmorStart Bulletin 281 Status Bits

The screen capture shows how to choose status bits in the ladder editor.

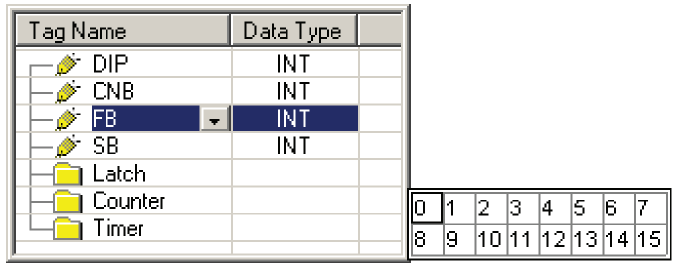



The following table contains the status bit definitions for ArmorStart Bulletin 281 units:

| 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 281 Fault Bits

The screen capture shows how to choose fault bits in the ladder editor.

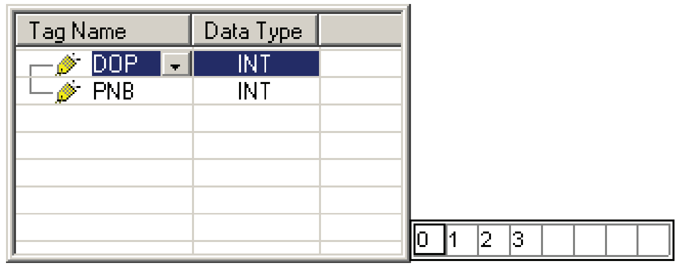



The following table contains the fault bit definitions for ArmorStart Bulletin 281 units:

| 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 281 Outputs

The screen capture shows how to choose outputs in the ladder editor.

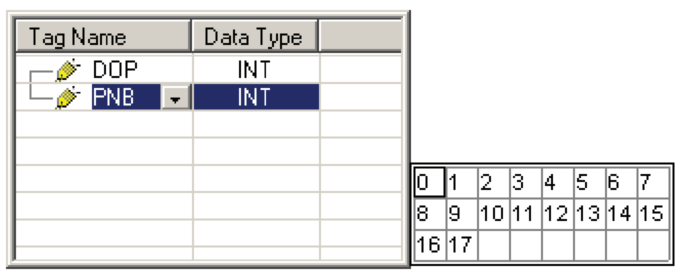



Bulletin 281 has the following bit definitions:

0 = Run Forward
1 = Run Reverse
2 = User Output A
3 = User Output B

## ArmorStart Bulletin 281 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 281 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 |

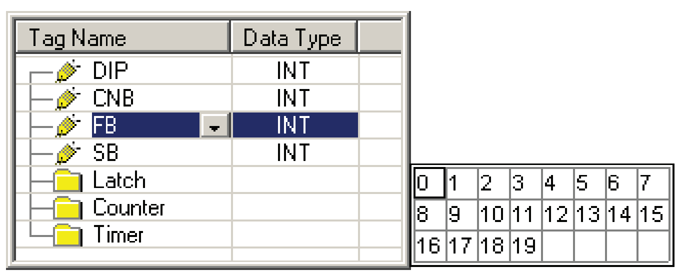
## ArmorStart Bulletin 284 Status Bits

The following table contains the status bit definitions for ArmorStart 284

| 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 284 Fault Bits

The screen capture shows how to choose Fault Bits in the ladder editor.

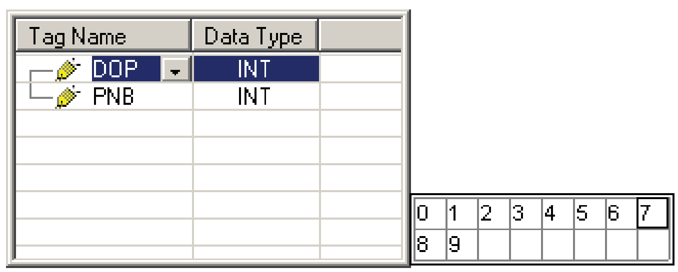


The following table contains the fault bit definitions for Bulletin 284:

| 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 284 Outputs

The screen capture shows how to choose outputs in the ladder editor.

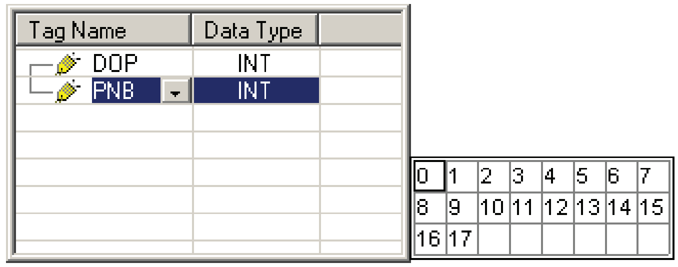



Bulletin 284 bit definitions:

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 284 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 284 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 284 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 284

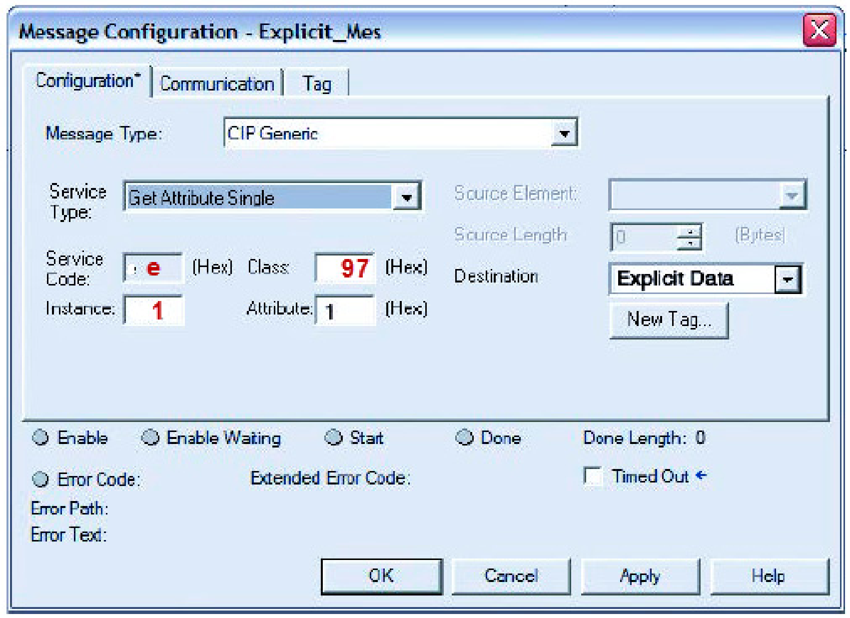
To get the heat sink temperature of the Bulletin 284, an explicit "get single" message instruction is needed.

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 PLC 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 Message instruction.

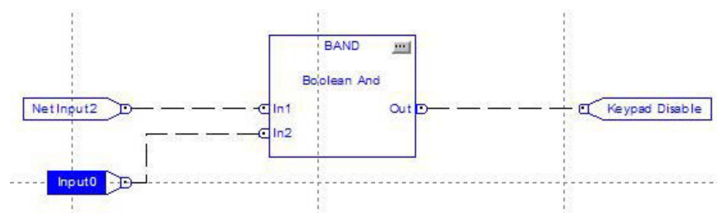
## Demand Torque Off Considerations

ArmorStart EtherNet/IP does not support "safety torque off" internally, therefore this capability must be implemented external to the ArmorStart controller within the safety circuit. To achieve a required safety performance without damage to the ArmorStart Bulletin 284 controller, some coordination between the safety circuit and the VFD enable is required. When there is a demand of the safety system, it is important that the ArmorStart VFD is disabled before any line side contactor opening. One way to accomplish this task, digitally, is to configure one of digital inputs via parameter 151…154 to option 9. Then use the consumed instance 166 and the previously defined digit input to disable the VFD before the safety contactor opens. This action disables the ArmorStart controller and lets the contactors open without damaging the VFD. Alternatively, if the safety circuit removes A1-A2 (switched control power) power before the safety contactors open, the same behavior results and helps stop damage to the VFD.

## Keypad Disable with DeviceLogix

HOA operation can be stopped dynamically without parameter modification, as follows:

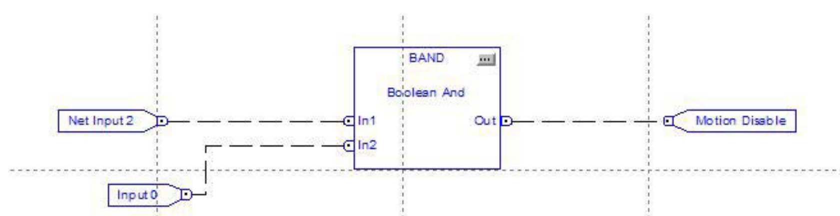
The DeviceLogix program that is shown, turns off the keypad if both inputs are true and the keypad is in either "OFF" or "AUTO" mode.




**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.

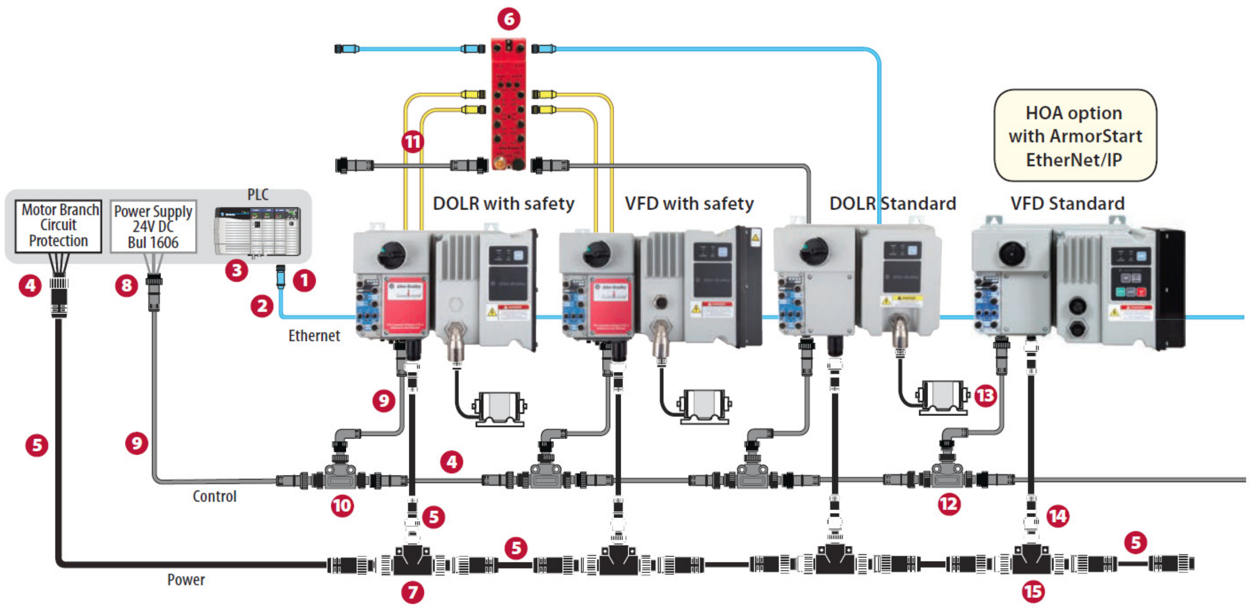
## Motion Disable

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.



# Cable System Quick Reference Diagram

This quick reference diagram shows the cordsets and connectors and an example of the minimum cables that are required to complete a system. It also shows how to integrate ArmorStart ST devices and ArmorStart EtherNet/IP when the HOA (hand-off-auto) option is required.




**1** CAT5e Bulkhead Connector – Cat. No. 1585A-*

**2** CAT5e Patchcord, – Cat. No. 1585D-*

**3** CAT5e, RJ45 to RJ45 – Cat. No. 1585J-*

**4** Three-Phase Power Receptacles – Cat. No. 280-M35F-*

**5** Three-Phase Power Cable (M35) – Cat. No. 280-PWRM35*

**6** ArmorBlock Guard I/O – Cat. No. 1732ES-IB8XOBV2

**7** Three-Phase Power Tee – Cat. No. 280-T35

**8** Control Power Receptacles – Cat. No. 888N-*

**9** Control/Auxiliary Power Cables – Cat. No. 889N-F4*

**10** Control/Auxiliary Power Tees – Cat. No. No. 898N-43PB-N4KT

**11** I/O Cable between Safety I/O Module and ArmorStart Controller – Cat. No. 889D-*

**12** ArmorStart Auxiliary T-Port – Cat. No. 898N-543ES-NKF

**13** Control Power Drop Cable – Cat. No. 889N-F65*

**14** Three-Phase Power Cable (M22) – Cat. No. 280-PWRM22-*

**15** Three-Phase Tee Reducing Drop – Cat. No. 280-RT35

# Notes:

## A



## C



## D



## E



## F

# Notes:

## Rockwell Automation Support

Use the following resources to access support information.

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

## Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete the How Are We Doing? form at http://literature.rockwellautomation.com/idc/groups/literature/documents/du/ra-du002_-en-e.pdf.



Rockwell Otomasyon Ticaret A.Ş., Kar Plaza İş Merkezi E Blok Kat:6 34752 İçerenköy, İstanbul, Tel: +90 (216) 5698400

**www.rockwellautomation.com**

**Power, Control and Information Solutions Headquarters**

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 280ES-UM001B-EN-P - June 2017
Supersedes Publication 280ES-UM001A-EN-P - November 2016