User Manual

Allen-Bradley

ArmorStart® LT Distributed Motor Controller

Catalog Numbers 290E, 291E, 294E

EtherNet/IP™ CONFORMANCE TESTED

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

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

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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

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

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

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

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

General Precautions

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

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

WARNING: The National Electrical Code (NEC), NFPA79, and any other governing regional or local code will overrule the information in this manual. Rockwell Automation cannot assume responsibility for the compliance or proper installation of the ArmorStart LT or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.

ATTENTION: The controller contains ESD (electrostatic discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing, or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, refer to Publication 8000-4.5.2, Guarding against Electrostatic Discharge, or any other applicable ESD protection handbooks.

ATTENTION: Only personnel familiar with the controller and associated machinery should plan or implement the installation, startup, and subsequent maintenance of the system. Failure to do this may result in personal injury and/or equipment damage.

Precautions for Bulletin 294E Applications

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

Software Requirements

The table lists the versions of software that are required.

Software	Version
RSLinx Classic	2.56 or later
RSLogix 5000	17.01 or later Download the most current version of the Add-On Profile from http://www.rockwellautomation.com/support/downloads.html.
BOOTP/DHCP	Version 2.3 or later

Additional Resources

These documents and websites contain additional information concerning related Rockwell Automation products.

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

Table 1 - Rockwell Automation Industrial Network Resources

Resource	Description
http://ab.rockwellautomation.com/Networks-and-Communications	Rockwell Automation networks and communication website
http://ab.rockwellautomation.com/Networks-and-Communications/Ethernet-IP-Network	Rockwell Automation EtherNet/IP website
http://www.rockwellautomation.com/services/networks/ http://www.rockwellautomation.com/services/security/	Rockwell Automation network and security services websites
http://www.ab.com/networks/architectures.html	Education series webcasts for IT and controls professionals
EtherNet/IP Embedded Switch Technology Application Guide, Publication ENET-AP005	Describes how to install, configure, and maintain linear and device-level Ring (DLR) networks using Rockwell Automation EtherNet/IP devices with embedded switch technology.
EtherNet/IP Network Configuration User Manual, Publication ENET-UM001	Describes how to configure and use EtherNet/IP communication modules with a Logix5000 controller and communicate with various devices on the Ethernet network.
EtherNet Design Consideration, Publication ENET-RM002A-EN-P	Provides details on ethernet design and infrastructure.
EtherNet/IP Modules in Logix5000 Control Systems User Manual, Publication ENET-UM001	Provides details about how to configure your module.
EtherNet/IP Embedded Switch Technology Application Guide, Publication ENET-AP005	Provides information about using products with embedded switch technology to construct networks with linear and ring topologies.
EtherNet/IP Industrial Protocol White Paper, Publication ENET-WP001	Describes how to implement services and data objects on a TCP/UDP/IP based Ethernet network.
Industrial Automation Wiring and Grounding Guidelines, Publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Wiring and Grounding Guidelines, (PWM) AC Drives, Publication DRIVES-IN001	Describes wiring and grounding guidelines for Pulse Width Modulated (PWM) AC Drives
Product Certifications website, http://www.rockwellautomation.com/products/certification/	Provides declarations of conformity, certificates, and other certification details.

Table 2 - ODVA Resources

Resource	Description
http://www.odva.org/	Open DeviceNet Vendors Association (ODVA) website
http://www.odva.org/default.aspx?tabid=54	The CIP Advantage website • CIP features and benefits • How to get started
Ethernet Media Planning and Installation Manual, ODVA publication http://www.odva.org/Portals/0/Library/Publications_Numbered/PUB00148R0_EtherNetIP_Media_Planning_and_Installation_Manual.pdf	Describes the required media components and how to plan for, install, verify, troubleshoot, and certify an Ethernet network.
Network Infrastructure for EtherNet/IP: Introduction and Considerations, ODVA publication http://www.odva.org/Portals/0/Library/Publications_Numbered/PUB00035R0_Infrastructure_Guide.pdf	Provides an overview of the technologies used in EtherNet/IP networks and provides guidelines for deploying infrastructure devices in EtherNet/IP networks.

Table 3 - Product Selection Resources

Resource	Description
Industrial Controls catalog website, http://www.ab.com/catalogs/	Industrial Controls catalog website
ArmorStart LT Distributed Motor Controller Selection Guide, Publication 290-SG001	Product selection guide

Table 4 - Cisco and Rockwell Automation Alliance Resources

Resource	Description
http://www.ab.com/networks/architectures.html	Rockwell Automation and Cisco Systems reference architecture website
Converged Plantwide Ethernet (CPwE) Design and Implementation Guide, Publication ENET-TD001	Represents a collaborative development effort from Rockwell Automation and Cisco Systems. The design guide is built on, and adds to, design guidelines from the Cisco Ethernet-to-the-Factory (EttF) solution and the Rockwell Automation Integrated Architecture. The design guide focuses on the manufacturing industry.

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support/, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

Installation Assistance

If you experience a problem within the first 24 hours of installation, contact Customer Support.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

New and Updated Information

This table contains the changes made to this revision.

Topic	Page
Added source brake and IPS specifications	Various

Notes:

European Communities (EC) Directive Compliance

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

Low Voltage and EMC Directives

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

- Bulletin 290E_/291E_: EN 60947-4-1 — Low-voltage switchgear and controlgear — Part 4-1: Contactors and motor-starters — Electromechanical contactors and motor-starters.

- Bulletin 294E_: EN 61800-3 — Adjustable speed electronic power drive systems — Part 3: EMC product standard including specific test methods EN 61800-5-1:2003 — Adjustable speed electrical power drive systems — Part 5-1: Safety requirements — Electrical, thermal and energy.

This product is intended for use in an industrial environment.

Introduction

The ArmorStart LT is an integrated, pre-engineered, motor starting solution designed for use in material handling applications. ArmorStart LT is the latest addition to the ArmorStart portfolio. ArmorStart LT is a leader in the market place given its compact size and high performance features in network, I/O, and motor control. This manual will guide you through the features and functionality when installing the product. Thank you for choosing ArmorStart LT for your distributed motor control needs. If you have any questions please refer to the "Support Section" for contact information.

Chapter 2

Installation and Wiring

Chapter 3

Product Commissioning

Chapter 4

Bulletin 290E/291E/294E Programmable Parameters

Using DeviceLogix

Appendix C

Product Overview

Description

ArmorStart LT is available with Full Voltage, Full Voltage Reversing, or Variable Speed motor control performance. It comes equipped with a UL Listed At-motor disconnect that supports a lock-out tag-out (LOTO) provision. ArmorStart LT is listed as suitable for group installations per UL and can be applied with either branch circuit breaker protection or fuse protection. It provides a robust IP66/ UL Type 4/12❶ enclosure suitable for water washdown environments in a single box construction that will minimize inventory needs. All external connections are made from the bottom of the unit minimizing accidental contact by moving equipment. ArmorStart LT as a standard will come with quick disconnect receptacles for the I/O and network connections. And finally, ArmorStart LT will include DeviceLogix, a high-performing local logic engine when a fast I/O response is critical to the application.

ArmorStart LT leverages the capabilities of the Rockwell Automation® Integrated Architecture so you can achieve an unmatched level of integration and ease of use. The architecture of ArmorStart LT allows Premiere Integration with Allen-Bradley® ControlLogix® or CompactLogix™ line of Automation Controllers and PLCs. RSLogix™ 5000 is the only programming tool needed which consolidates controller programming, device configuration, and maintenance into a single, integrated environment. ArmorStart LT includes tools such as an Add-on Profile that will automatically generate PLC tag names for quick and efficient configuration and programming.

The ArmorStart LT is available with options that can further reduce installation and commissioning time and cost, such as:

- Quick disconnect receptacles for power, control, and motor connections
- Local Hand-Off-Auto keypad for manual control
- Internal power supply (IPS) eliminating the need to run additional control power to each unit
- Bulletin 294 can be ordered with an electromechanical brake connection (source brake)
- EDS Tag Generator tool with RS Logix 5000

❶ The G2 gland option is rated IP66/ UL Type 4

Features

The ArmorStart LT provides many features and benefits that are unsurpassed in the market place:

- Robust IP66, UL Type 4/12 enclosure
- UL Listed, Suitable for Group Motor Applications
- UL Listed, At-motor disconnect switch
- Native support for EtherNet/IP
- Embedded dual port ethernet switch
- Device Level Ring (DLR) with Beacon frame performance
- IEEE 1588 Transparent Clock
- RSLogix 5000 Add-On Profile
- 6 user configurable I/O points
- DeviceLogix
- Embedded web server support
- Configurable e-mail response for fault or alarm events
- Optional internal power supply
- Optional electromechanical brake contactor
- Optional local control via Hand-Off-Auto keypad
- Optional quick disconnect for power and motor connections

IMPORTANT Not all options are available for Bulletin 290E/291E/294E. Refer to the catalog configurator for details.

Feature Description

Standard Features Across Product Family

UL Listed "Suitable for Group Motor Applications" — Where NFPA 70 (NEC) or 79 are required installation standards, this Listing allows two or more motors to be connected to the same branch circuit without individual motor branch short circuit or ground fault protection. Refer to Appendix A for details.

At-motor disconnect switch — ArmorStart LT offers a local ON/OFF motor disconnecting means with lockout-tagout provision. Industrial standards require a local at-motor disconnect to be within eye sight of the motor for maintenance or other shutdown reasons. Refer to your installation code for details.

User configurable I/O — ArmorStart LT offers 6 user configurable I/O points to be used with sensors and actuators. By default all 6 points are configured as sinking 24V DC inputs. The user has the option to select any point as a sourcing 24V DC output.

RSLogix 5000 Add-On Profile (AOP) — ArmorStart LT offers for Allen-Bradley ControlLogix or CompactLogix PLCs a downloadable Add-On Profile. The AOP simplifies setup and commissioning via predefined tags and commissioning wizards. The AOP also allows copy and paste functionality for quick setup and configuration of multiple ArmorStart LTs.

IMPORTANT AOP support for EtherNet/IP network **only** and requires RSLogix 5000 revision 17.01 or later. There is a known compatibility issue with revision 20.0. Update RSLogix 5000 to 20.1 or greater.

DeviceLogix — ArmorStart LT offers local programmable logic via DeviceLogix. DeviceLogix is a stand-alone program that resides within the ArmorStart LT. It is programmed locally using the Add-On-Profile and implements operations such as, AND, OR, NOT, Timers, Counters, Latches, and Analog operations. DeviceLogix can run as a stand-alone application, independent of the network or collaboratively with the PLC. However, unswitched control power must be maintained for DeviceLogix to operate.

Quick disconnect for I/O and network — ArmorStart LT offers quick disconnect connectors for I/O and communications.

EtherNet/IP node address — ArmorStart LT offers external accessible address switches for device node address configuration. The address can be set statically or dynamically.

EMI filter — ArmorStart LT for VFD application (Bulletin 294) provides an internal EMI filter and is CE compliant. For CE compliant installations refer to the recommended EMI/RFI cord grip accessory. For availability of the quick disconnect shielded motor cable contact your local sales representative for details.

Local and remote status and diagnostics — ArmorStart LT offers comprehensive status and diagnostics for I/O, Network, and device health via 12

LEDs found on the electronic control module (ECM). If a fault occurs a local fault reset button allows the user to quickly get the process started after corrective action is taken. The user can also configure the embedded webserver to send an e-mail when a fault or warning occurs.

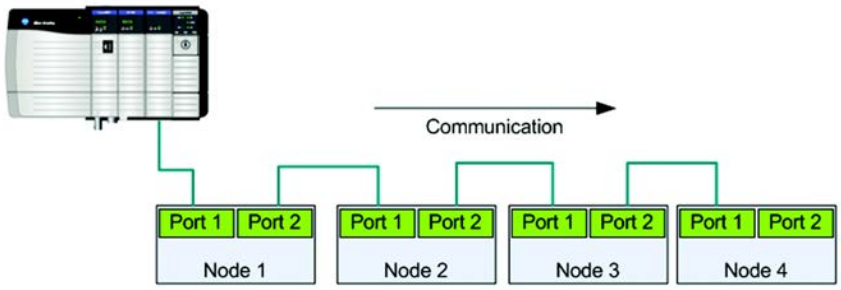
Gland plate entrance — ArmorStart LT offers different methods of connecting three-phase, control power, and motor. ArmorStart LT has conduit entrance openings, as standard.

Network Options

Native EtherNet/IP — ArmorStart LT supports native EtherNet/IP without additional modules or adapters. EtherNet/IP allows complete integration of control with information across multiple Common Industrial Protocol (CIP™) networks. EtherNet/IP allows users to integrate I/O control, device configuration, and data collection across multiple networks enabling internet connectivity and information.

Embedded dual port switch — ArmorStart LT EtherNet/IP version includes a dual port 10/100 mb/s ethernet switch that supports linear or Device Level Ring (DLR) topology.

Figure 1 - Linear Topology



Device Level Ring (DLR) - ArmorStart LT EtherNet/IP version offers DLR support with beacon frame performance. DLR provides a single fault tolerant network solution for EtherNet/IP.

Figure 2 - DLR with Beacon Performance — No Fault

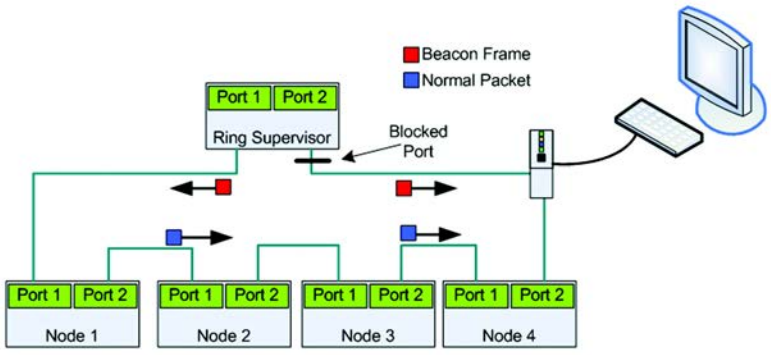
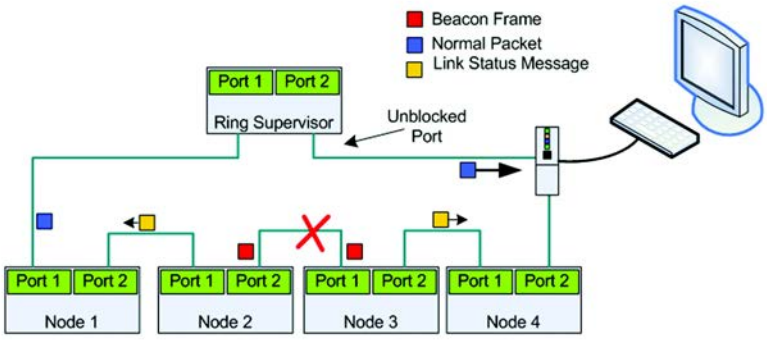


Figure 3 - DLR with Beacon Performance — Fault



In this example the fault is precisely identified by the link status message and the supervisor opens the blocked port to allow network traffic to continue normally.

IEEE 1588 transparent clock —ArmorStart LT EtherNet/IP version supports the IEEE 1588 transparent clock when used with precision time protocols (PTP). A transparent clock measures and adjusts for packet delays, therefore removing the negative effects that these variations can cause within a synchronized distributed network of devices.

Embedded web server — ArmorStart LT EtherNet/IP version offers a web server that can be accessed via a standard internet browser. The web server provides status, diagnostics, and configuration capabilities.

E-mail notification — ArmorStart LT via the embedded web server, supports configuration of the Simple Mail Transfer Protocol (SMTP). Once properly configured, the motor controller will e-mail the user with specific fault/trip messages.

Factory-Installed Options

Internal power supply (IPS) — ArmorStart LT offers the user an optional 24V DC internal power supply. The internal power supply provides all control and I/O power needs and is sourced from the incoming 3-phase power. This eliminates the need to run separate control power to each unit, reducing installation time and cost. The local at-motor disconnect will remove power from the motor terminals and outputs when in the OFF condition.

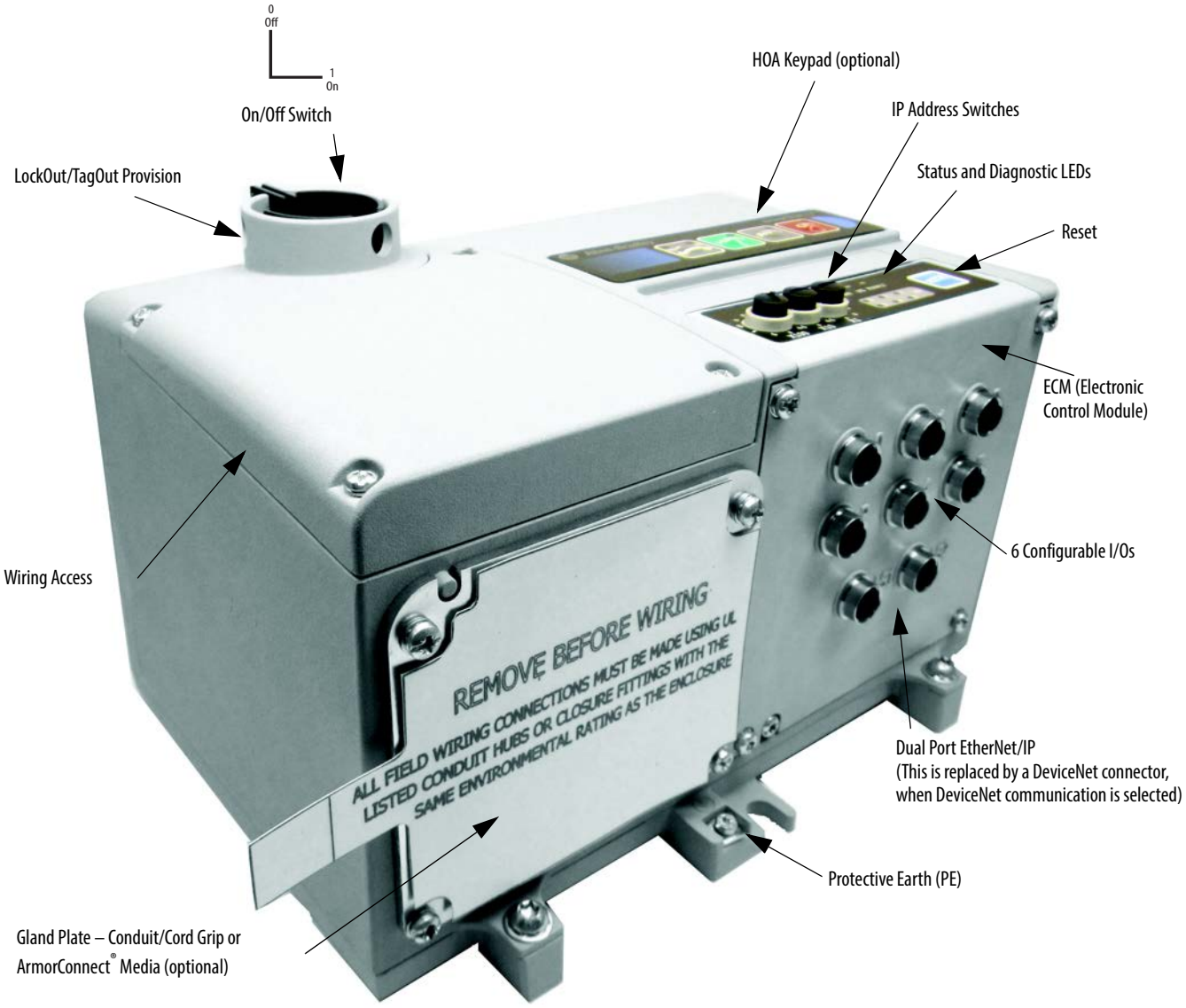
Hand/Off/Auto (HOA) keypad — ArmorStart LT offers an optional local Hand-Off-Auto keypad. This key pad allows local start/stop motor control regardless of PLC status. This option can be used for troubleshooting or maintenance operations. The HOA can also be disabled when local control is not allowed, using parameter 67.

Source brake — ArmorStart LT provides an optional, internally-controlled electromechanical motor brake contactor. The motor brake power is sourced from 3-phase power, L1 and L2.

Quick disconnect gland — ArmorStart LT offers a plug -n- play solution that simplifies wiring and installation. These factory installed quick disconnect receptacles provide connectivity to ArmorConnect® media for three-phase, control, and motor connections. The cables are ordered separately.

ArmorStart LT Characteristics

Figure 4 - Bulletin 290E/291E ArmorStart LT



Catalog Number Explanation

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

290	E	-	F	A	Z	-	G1	-	Option 1	-	Option 2
a	*b*		*c*	*d*	*e*		*f*		*g*		*h*

a

Bulletin Number	
Code	Description
290	Full-Voltage Starter
291	Reversing Starter

b

Communications	
Code	Description
E	EtherNet/IP
D	DeviceNet

c

Enclosure Type	
Code	Description
F	UL Type 4/12 ❶

d

Overload Selection	
Code	Description
A	0.25…3.5 A
B	1.1…7.6 A

e

Control Voltage	
Code	Description
Z	External 24V DC control power
P	Internal power supply

f

Gland Plate Options (Power and Motor)	
Code	Description
G1	Conduit entry
G2	ArmorConnect
G3	Gland Kits ❷

g

Option 1	
Code	Description
3	Hand/Off/Auto selector keypad
3FR	Hand/Off/Auto selector keypad with Forward/Reverse

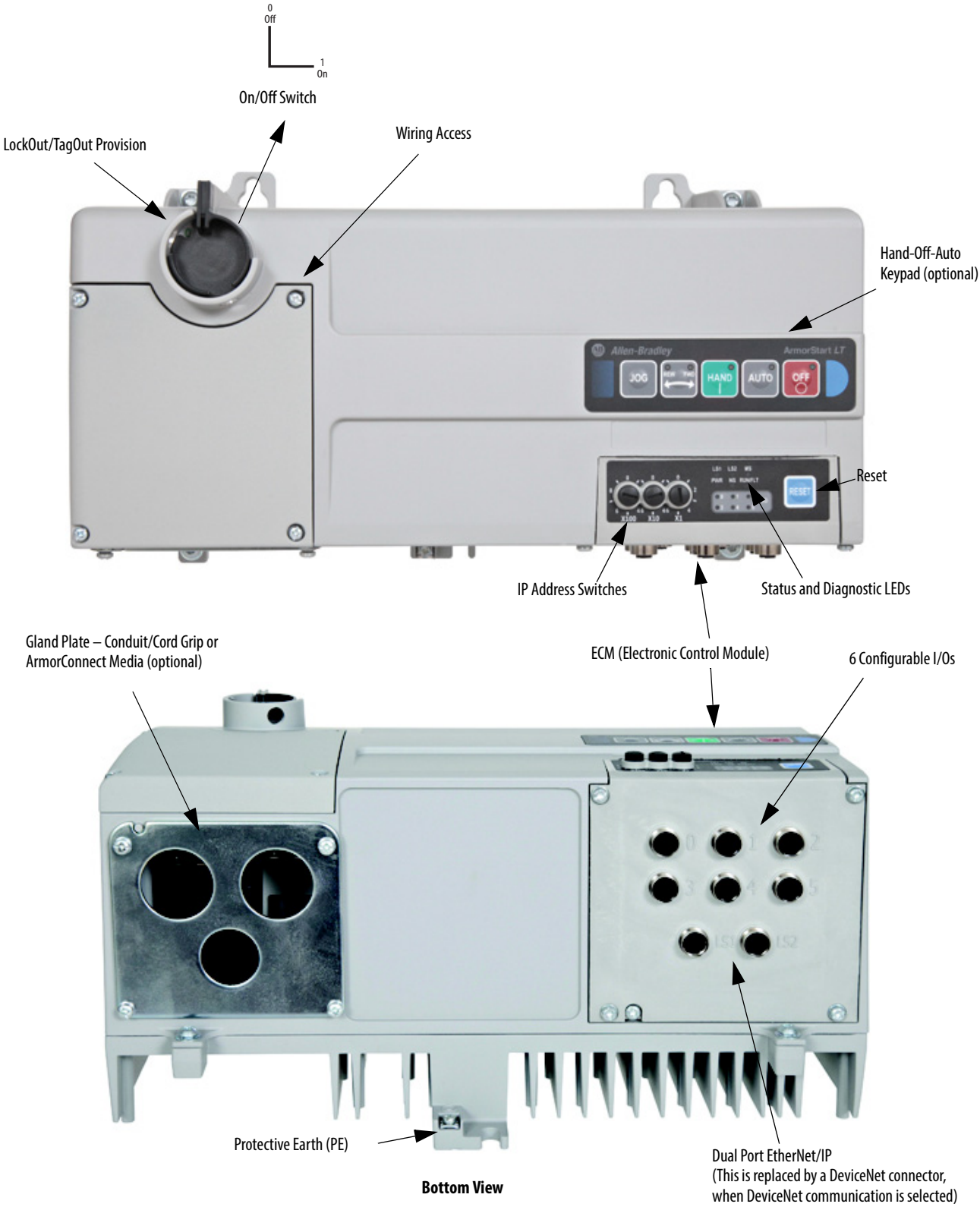
h

Option 2	
Code	Description
blank ❸	No option

❶ IP66/UL Type 4 is available with all gland options. UL Type 4/12 is available with G1 and G3 gland option.
❷ See selection guide 290-SG001_-EN-P Accessories section for gland configurations and ordering.
❸ Leave blank unless there is a customer-specific option defined by the factory.

ArmorStart LT Characteristics

Figure 5 - Bulletin 294E ArmorStart LT



Bottom View

Catalog Number Explanation

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

294	E	-	F	D1P5	Z	-	G1	-	Option 1	-	Option 2
a	*b*		*c*	*d*	*e*		*f*		*g*		*h*

a

Bulletin Number	
Code	Description
294	VFD Starter

b

Communications	
Code	Description
E	EtherNet/IP
D	DeviceNet

c

Enclosure Type	
Code	Description
F	UL Type 4/12 ❶

d

Output Current	
Code	Description
D1P5	1.5 A (0.4 kW), 0.5 Hp
D2P5	2.5 A (0.75 kW), 1.0Hp
D4P2	3.6 A (1.5 kW), 2.0Hp

e

Control Voltage	
Code	Description
Z	External 24V DC control power
P	Internal power supply

f

Gland Plate Options (Power and Motor)	
Code	Description
G1	Conduit entry
G2	ArmorConnect
G3	Gland kits ❷

g

Option 1	
Code	Description
3	Hand/Off/Auto selector keypad with Jog function

h

Option 2	
Code	Description
SB	Source Brake
blank ❸	No option

❶ IP66/UL Type 4 is available with all gland options. UL Type 4/12 is available with G1 and G3 gland option.
❷ See selection guide 290-SG001_-EN-P Accessories section for gland configurations and ordering.
❸ Leave blank unless there is a customer-specific option defined by the factory.

Basic Operation

Group Motor Installations for USA and Canada Markets

The ArmorStart LT Distributed Motor controllers are listed for use with each other in group installations per NFPA 79, Electrical Standard for Industrial Machinery and NFPA 70, the National Electrical Code. When applied according to the group motor installation requirements, two or more motors 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 regarding group motor installations with the ArmorStart LT Distributed Motor Controller, see Appendix A.

Control Circuit

ArmorStart LT accepts a 24V DC Class 2 input power supply for switched and unswitched power. The control voltage provides power to the inputs (unswitched) and outputs (switched). Unswitched control voltage is used to ensure no loss of network connectivity, sensor, or other field input status under normal operation. The control power terminal connections are labeled A1, A2, and A3. Switched power is identified as (+A1) (-A2). Unswitched power is identified as (+A3) (-A2).

As an option, ArmorStart LT can be supplied with an internal power supply (IPS) eliminating the need for an external control power. The IPS is sourced from the line side of 3-phase power and is not impacted by the status of the local at-motor disconnect switch.

Figure 6 - Control Circuit Wiring Diagram — Single External Power Supply

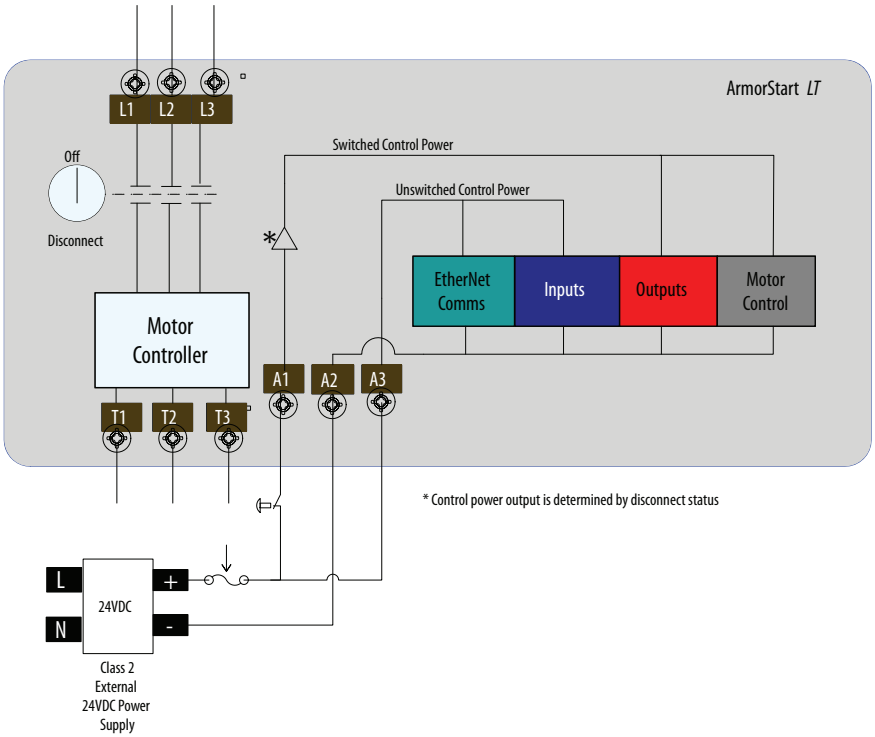


Figure 7 - Control Circuit Wiring Diagram — Multiple External Power Supplies

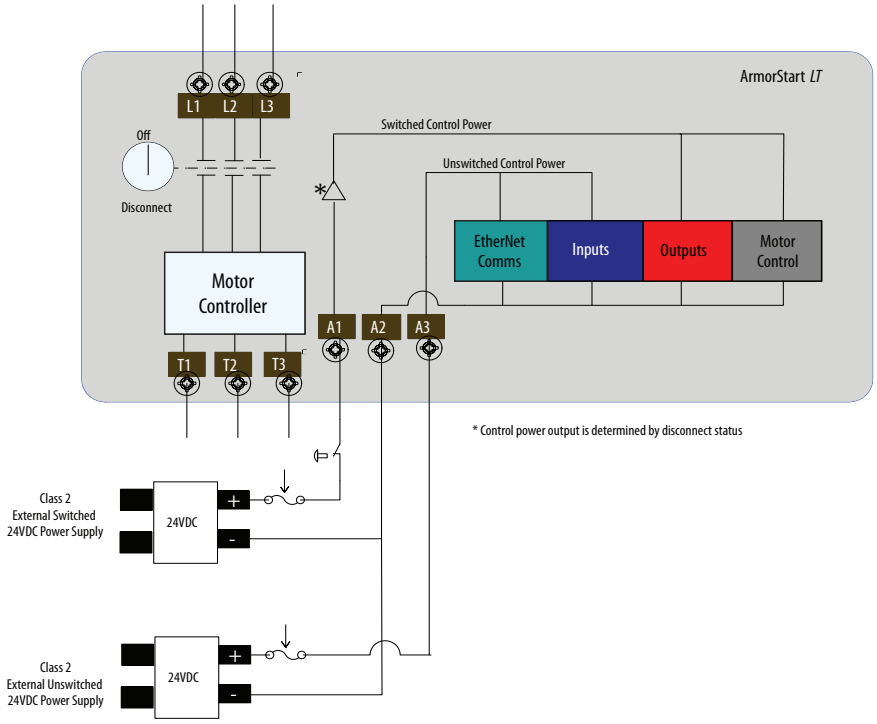
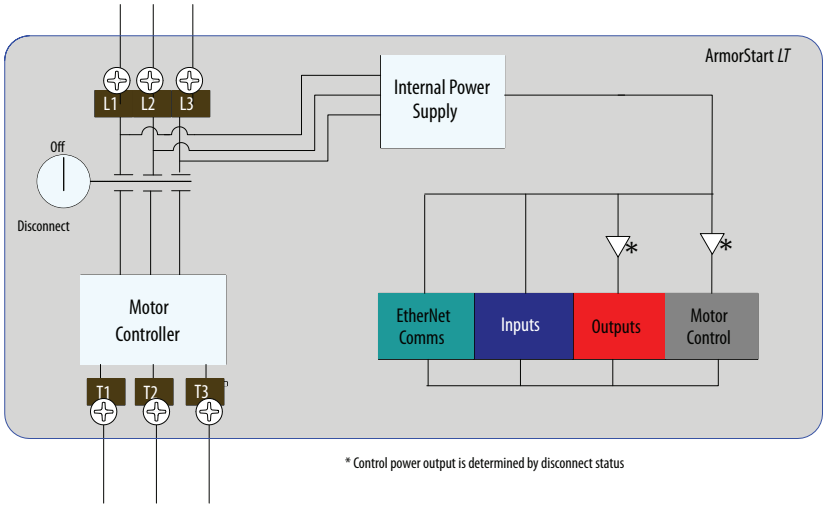


Figure 8 - Control Circuit Wiring Diagram — Internal Power Supply (optional)



Motor Circuit

The ArmorStart LT Distributed Motor Controllers are rated to operate the following types of three-phase squirrel-cage induction motors:

Bulletin 290E/291E:
0.5 Hp (0.37 kW) to 5 Hp (3 kW) @ 480/277V AC
Bulletin 294E:
0.5 Hp (0.37 kW) to 2 Hp (1.5 kW) @ 480/277V AC

Local I/O

The ArmorStart LT provides as standard, 6 user configurable I/O points. By default, all points are configured as an Input. When not using the AOP, the user will need to refer to parameter 49 [IOPointConfiguration], to define an output point.

When using the AOP, the I/O point is configured from the General screen in the Module Definition section by clicking the "Change" button, see Figure 9. This allows user to view and configure the I/O mix, refer to Figure 10.

Figure 9 - Defining I/O Point

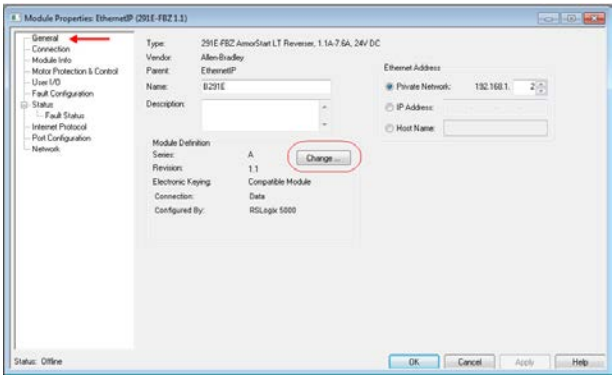
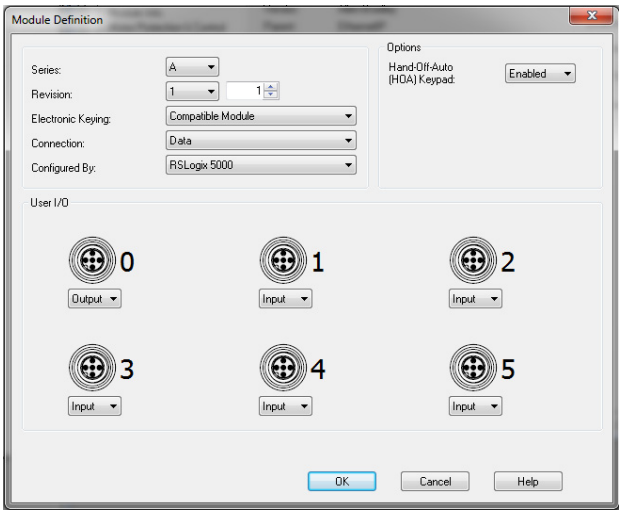


Figure 10 - Current I/O Point Configuration



Overload Protection

The ArmorStart LT Distributed Motor Controller incorporates, as standard, electronic motor overload protection. This overload protection is accomplished electronically with an I^2t algorithm. The ArmorStart LT's overload protection is programmable via the communication network, providing the user with greater flexibility.

The Bulletin 290E/291E includes programmable overload Class 10, 15, and 20 protection. The Bulletin 294E provides overload protection: 150% for 60s and 200% for 3s.

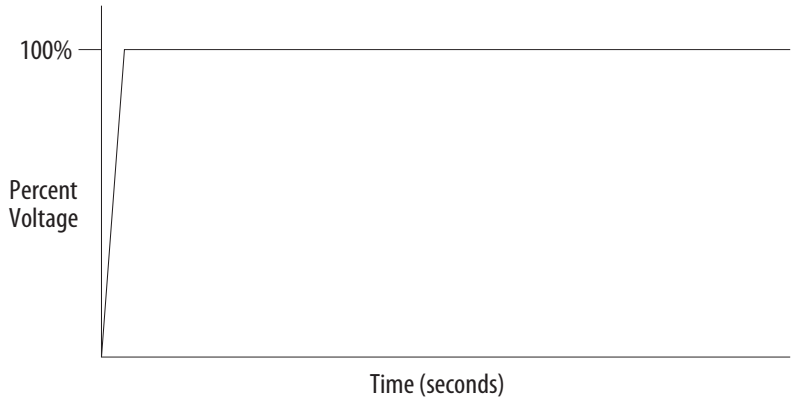
Refer to Chapter 6, Specifications, for additional information.

Mode of Operation Bulletin 290E/291E

Full-Voltage Start

This method is used in applications requiring across-the-line starting, in which full inrush current and locked-rotor torque are realized. The ArmorStart LT Bulletin 290E offers full-voltage starting and Bulletin 291E offers full-voltage starting for reversing applications, from 0.5 Hp (0.37 kW) to 5 Hp (3 kW) at 480Y/277V AC, 3-phase power.

Figure 11 - Full-Voltage Start

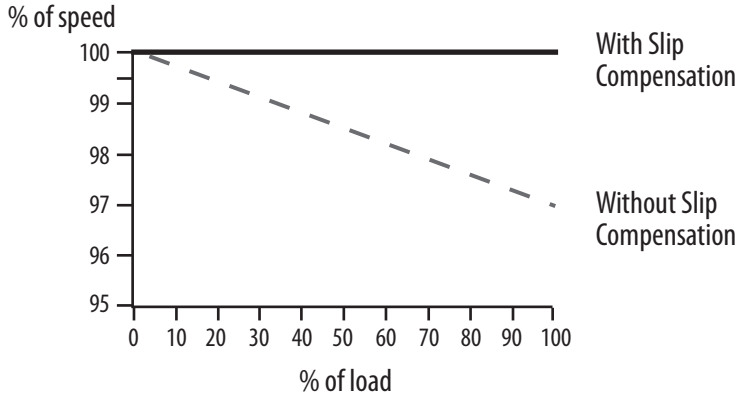


Mode of Operation Bulletin 294E

Sensorless Vector Performance

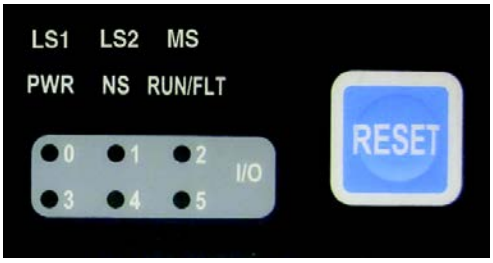
Using a distributed AC drive to operate mechanical equipment at optimum speed helps reduce energy costs and eliminates mechanical wear and tear that can occur in the mechanical parts. The advance monitoring found in ArmorStart LT protects critical equipment against unplanned downtime with advanced diagnostics and notification of irregular operating parameters. ArmorStart LT provides open-loop speed regulation (V/Hz) with slip compensation. This provides excellent speed regulation and high levels of torque across the entire speed range of the drive, and improved speed regulation as loading increases.

Open Loop Speed Regulation with Slip Compensation allows the VFD to automatically adjust the output frequency to compensate for speed changes due to motor loading. This feature utilizes an open loop, current feedback, slip compensation circuit. Slip Compensation works as an open loop speed regulator that increases the output frequency of the drive as the load is increased, or decreases the frequency as the load drops. This feature is used where the motor must run at a relatively constant speed regardless of torque output.



Status LEDs and Reset

Figure 12 - Status, Diagnostic LEDs, and Reset



ArmorStart LT provides comprehensive status and diagnostics via 12 individually marked LEDs shown in Figure 12, located on the ECM module. In addition, a local reset is provide for clearing of faults. Table 5 details the diagnostic and status LEDs.

Table 5 - ArmorStart LT Status and Diagnostics Indicators

Indicator	Description	Color_1	Color_2
PWR LED	The bicolor (green/yellow) LED shows the state of the control voltage. When LED is off, switched and/or unswitched power is not present.	Solid green is illuminated when switched and unswitched control power is within its specified limits and has the proper polarity.	Solid yellow is illuminated when switched or unswitched control power is outside its specified limits or has incorrect polarity.
RUN/FLT LED	The bicolor (green/red) LED combines the functions of the Run and Fault LEDs.	Solid green is illuminated when a Run command is present.	The LED will blink red in a prescribed fault pattern when a protection fault (trip) condition is present. See Table 6 for fault blink patterns.
NS – Network Status LED	The bicolor (green/red) LED indicates the status of the CIP network connection. See Network Status Indicator for further information. Flashing bicolor (red/green) indicates a self-test on power up.	Flashing green indicates an IP address is configured, no CIP connections are established, and an Exclusive Owner connection has not timed out. Steady green indicates at least one CIP connection is established and an Exclusive Owner connection has not timed out.	Flashing red indicates the connection has timed out. Steady Red indicates a duplicate IP Address detected.
LS1 and LS2 – Link Status LEDs	The bicolor (green/yellow) LED shows the activity/link status of each EtherNet/IP port.	Solid green is illuminated when a link has been established at 100 Mbps.	Solid yellow is illuminated when a link has been established at 10 Mbps.
MS – Module Status LED	The bicolor (green/red) LED indicates the status of the module. Flashing bicolor (red/green) indicates a self-test on power up.	Flashing green indicates the device has not been configured. Steady green indicates the device is configured and operational.	Flashing red indicates a resettable protection fault exists or the node address switches have been changed without a power cycle and do not match the in-use configuration. Steady red indicates a non-resettable protection fault exists.
I/O Status Enunciators 0…5 LEDs	Six yellow LEDs are numbered 0…5 and indicate the status of the input/output connectors. One LED for each I/O point.	Yellow is illuminated when input is valid or output is on.	Off when input is not valid or the output is not turned on.
Reset Button	The blue reset button will cause a protection fault reset to occur.	—	—

Electronic Data Sheet (EDS)

ArmorStart LT EtherNet/IP has an embedded electronic data sheet. An EDS consists of specially formatted text files, as defined by the CIP™. EDS files contain details about the readable and configurable parameters of the EtherNet/IP device. They also provide information about the I/O connections that the device supports and the content of the associated data structures. EDS 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 LT EtherNet/IP devices can be uploaded directly from the device via the web server interface. Rockwell Automation product EDS files are also available on the internet at: http://www.ab.com/networks/eds.

Fault Diagnostics

Fault diagnostics capabilities built in the ArmorStart LT Distributed Motor Controller are designed to help you pinpoint a problem for easy troubleshooting and quick re-starting.

Protection Faults

Protection faults will be generated when potentially dangerous or damaging conditions are detected. Protection faults are also known as “trips” or “faults”. These faults will be reported in multiple formats, including:

- Bit enumeration in the TripStatus parameter 16 in DeviceLogix
- In the ArmorStart LT web server for ArmorStart EtherNet/IP version
- As a sequence of LED flashes on the ECM

Table 6 - Protection Faults

LED Flash	Bit Enumeration	Bulletin 290E/291E Trip Status Bits	Bulletin 294E Trip Status Bits
1	0	OverloadTrip ❶	OverloadTrip ❶
2	1	PhaseLossTrip	PhaseLShortTrip
3	2	UnderPowerTrip ❶	UnderPowerTrip ❶
4	3	SensorShortTrip ❶	SensorShortTrip ❶
5	4	PhaseImbalTrip	OverCurrentTrip
6	5	NonVolMemoryTrip ❶	NonVolMemoryTrip ❶
7	6	reserved	ParamSyncTrip ❶
8	7	JamTrip	DCBusOrDiscnnct ❶
9	8	StallTrip	StallTrip ❶
10	9	UnderloadTrip	OverTemperature ❶
11	10	reserved	GroundFault ❶
12	11	reserved	RestartRetries
13	12	reserved	DriveHdwFault ❶
14	13	OutputShortTrip ❶	OutputShortTrip ❶
15	14	UserDefinedTrip	UserDefinedTrip
16	15	HardwareFltTrip ❶	HardwareFltTrip ❶

❶ Cannot be disabled.

Optional HOA Selector Keypad

Keypad Local Control

The HOA Selector Keypad allows for local start/stop/jog control in forward/reverse motor direction. If two buttons are pressed simultaneously, this action is ignored by the device unless one of the buttons is the OFF button. If the OFF button is pressed at any time, the unit will go to the off state. When local Hand mode is entered, speed reference is switched to Internal Frequency. When in "Auto" mode the unit the speed reference is switched to the mode specified in parameter 33 "SpeedReference".

	**HAND**	The Hand key will initiate starter operation
	**AUTO**	The Auto key allows for Start/Stop control via the communications network
	**OFF**	If the starter is running, pressing the OFF key will cause the starter to stop.
	**DIR Arrow**	The Dir arrow selects the direction of the motor, either forward or reverse.
	**JOG**	When pressed, JOG will be initiated if no other control devices are sending a stop command. Releasing the key will cause the drive to stop, using selected stop mode.

Optional HOA Keypad Configuration (Bulletin 290E/291E only)

The ArmorStart LT offers optional factory-installed Hand/OFF/Auto (HOA) configurations: Standard (Bulletin 290E) and Forward/Reverse (Bulletin 291E).

Figure 13 - Bulletin 290E Standard HOA

Figure 14 - Bulletin 291 Forward/Reverse HOA

Bulletin 290E

With the KeypadMode parameter (parameter 66) set to 1 = Maintained, pressing the buttons reacts like a maintained switch.

Key Press	Current Mode		
	OFF	**HAND**	**AUTO**
AUTO	Auto Mode — Motor Off	—	—
HAND	If no fault, Motor On	—	—
OFF	—	Motor turns Off	Motor turns Off
FAULT PRESENT	—	Motor turns Off	Motor turns Off

With the KeypadMode parameter (parameter 66) set to 0 = Momentary, pressing the buttons reacts like a momentary switch.

Key Press	Current Mode		
	OFF Key	**HAND**	**AUTO Key**
NO KEY PRESSED	—	Motor Off	—
AUTO	Auto Mode — Motor Off	—	—
HAND	If no fault, Motor On	—	—
OFF	—	Motor Off	Motor Off
PROTECTION FAULT PRESENT	—	Motor Off	—

Bulletin 291E

With the KeypadMode parameter (parameter 66) set to 1 = Maintained, pressing the buttons reacts like a maintained switch.

Key Press	Current Mode		
	OFF	**HAND**	**AUTO**
FWD/REV	FWD LED Set REV LED REV LED Set FWD LED	—	—
AUTO	Auto Mode — Motor Off	—	—
HAND	If no fault, Motor On	—	—
OFF	Ignore	Motor Off	Motor Off
PROTECTION FAULT PRESENT	Ignore	Motor Off	—

With the KeypadMode parameter (parameter 66) set to 0 = Momentary, pressing the buttons reacts like a momentary switch.

Key Press	Current Mode		
	OFF	**HAND**	**AUTO**
NO KEY PRESSED	—	Motor Off	—
FWD/REV	FWD LED Set REV LED REV LED Set FWD LED	—	—
AUTO	Auto Mode — Motor Off	—	—
HAND	If no fault, Motor On	—	—
OFF	—	Motor Off	Motor Off
PROTECTION FAULT PRESENT	—	Motor Off	—

Optional HOA Selector Keypad with Jog Function (Bulletin 294E only)

The HOA Selector Keypad with Jog function allows for local start/stop control with capabilities to jog in forward/reverse motor directions.

Figure 15 - Bulletin 294E Jog/Forward/Reverse HOA

Keypad Local Control

With the KeypadMode parameter (parameter 66) set to 1 = Maintained, pressing the buttons reacts like a maintained switch.

Key Press	Current Mode			
	OFF	**HAND**	**JOG**	**AUTO**
NO KEY PRESSED	—	—	Motor Off	—
FWD/REV	FWD LED Set REV LED REV LED Set FWD LED	FWD LED Set REV LED REV LED Set FWD LED	—	—
JOG	If no fault, Jog Motor	—	—	—
AUTO	Auto Mode — Motor Off	—	—	—
HAND	If no fault, Motor On	—	—	—
OFF	—	Motor Off	Motor Off	Motor Off
PROTECTION FAULT PRESENT	—	Motor Off	Motor Off	—

With the KeypadMode parameter (parameter 66) set to 0 = Momentary, pressing the buttons reacts like a momentary switch.

Key Press	Current Mode			
	OFF	**HAND**	**JOG**	**AUTO**
NO KEY PRESSED	—	Motor Off	Motor Off	—
FWD/REV	FWD LED Set REV LED REV LED Set FWD LED	FWD LED Set REV LED REV LED Set FWD LED	—	—
JOG	If no fault, Jog Motor	—	—	—
AUTO	Auto Mode — Motor Off	—	—	—
HAND	If no fault, Motor On	—	—	—
OFF	—	Motor Off	Motor Off	Motor Off
PROTECTION FAULT PRESENT	—	Motor Off	Motor Off	—

IMPORTANT If multiple buttons are pressed at the same time, the software interprets this as a “no button pressed” condition. The only exception to this rule is if multiple buttons are pressed and one of them is the OFF button. If the OFF button is pressed in combination with any combination of other buttons, the processor will behave as if the OFF button were pressed by itself.

Keypad Disable Parameter

"Keypad Disable", parameter 67, only inhibits the "HAND", "FWD", "REV" and "JOG" buttons on the HOA keypad. The "OFF" and "AUTO" buttons are always enabled, even if parameter 67 is set to "1=Disable". The keypad OFF button can not be disabled.

Source Brake Contactor and Connector (Bulletin 294E only)

An internal contactor is used to switch the electromechanical motor brake On/Off. The motor brake contactor is actuated via the internal power which supplies L1 and L2 voltage to the mechanical brake in the motor. The source brake can be configured for independent control via parameter configuration.

The internal contactor, electromechanical motor brake, and associated motor branch cable are protected by the branch circuit protective device. There is no resettable or replaceable protective device in ArmorStart LT.

WARNING: If the branch circuit protective device trips, the user must ensure that the Source Brake function is still operational prior to putting the equipment back in service. If the source brake function is not working properly, loss of brake function or motor damage can occur.

Installation and Wiring

Receiving

It is the responsibility of the user to thoroughly inspect the equipment before accepting the shipment from the freight company. Check the item(s) received against the purchase order. If any items are damaged, it is the responsibility of the user not to accept delivery until the freight agent has noted the damage on the freight bill. Should any concealed damage be found during unpacking, it is also the responsibility of the user to notify the freight agent. The shipping container must be left intact and the freight agent should be requested to make a visual inspection of the equipment.

Unpacking

Remove all packing material, wedges, or braces from within and around the ArmorStart LT distributed motor controller and other device(s). Check the contents of the package to see if all contents are included. 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 (i.e. loose parts, wires, connections, packing materials, etc.) must be made.

Inspecting

After unpacking, check nameplate catalog number(s) of the item(s) against the purchase order. See Chapter 1 for an explanation of the catalog numbering system which will aid in nameplate interpretation.

Storing

The controller should remain in the shipping container prior to installation. If the equipment is not to be used for a period of time, it must be stored according to the following instructions in order 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 could be exposed to a corrosive atmosphere.
- Do not store equipment in a construction area.

Installation Precautions

The following statements must be read and understood.

ATTENTION: The earth ground terminal shall be connected to a solid earth ground via a low-impedance connection.

ATTENTION: Copper ground conductors are recommended. The ArmorStart LT external protective earth (PE) pad is aluminum. Refer to your local electrical installation standard for proper bonding and protection when dissimilar metals are used.

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 out of range ambient temperatures, may result in malfunction of the system.

Precautions for Bulletin 290E/291E Applications

SHOCK HAZARD: To prevent electrical shock, open appropriate machine disconnect switch prior to connecting and disconnecting cables. Risk of shock — environment rating may not be maintained with open receptacles.

Precautions for Bulletin 294E Applications

SHOCK HAZARD: The drive contains high voltage capacitors which take time to discharge after removal of mains supply. Before working on drive, ensure isolation of mains supply from line inputs (L1, L2, L3). Wait three minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death.

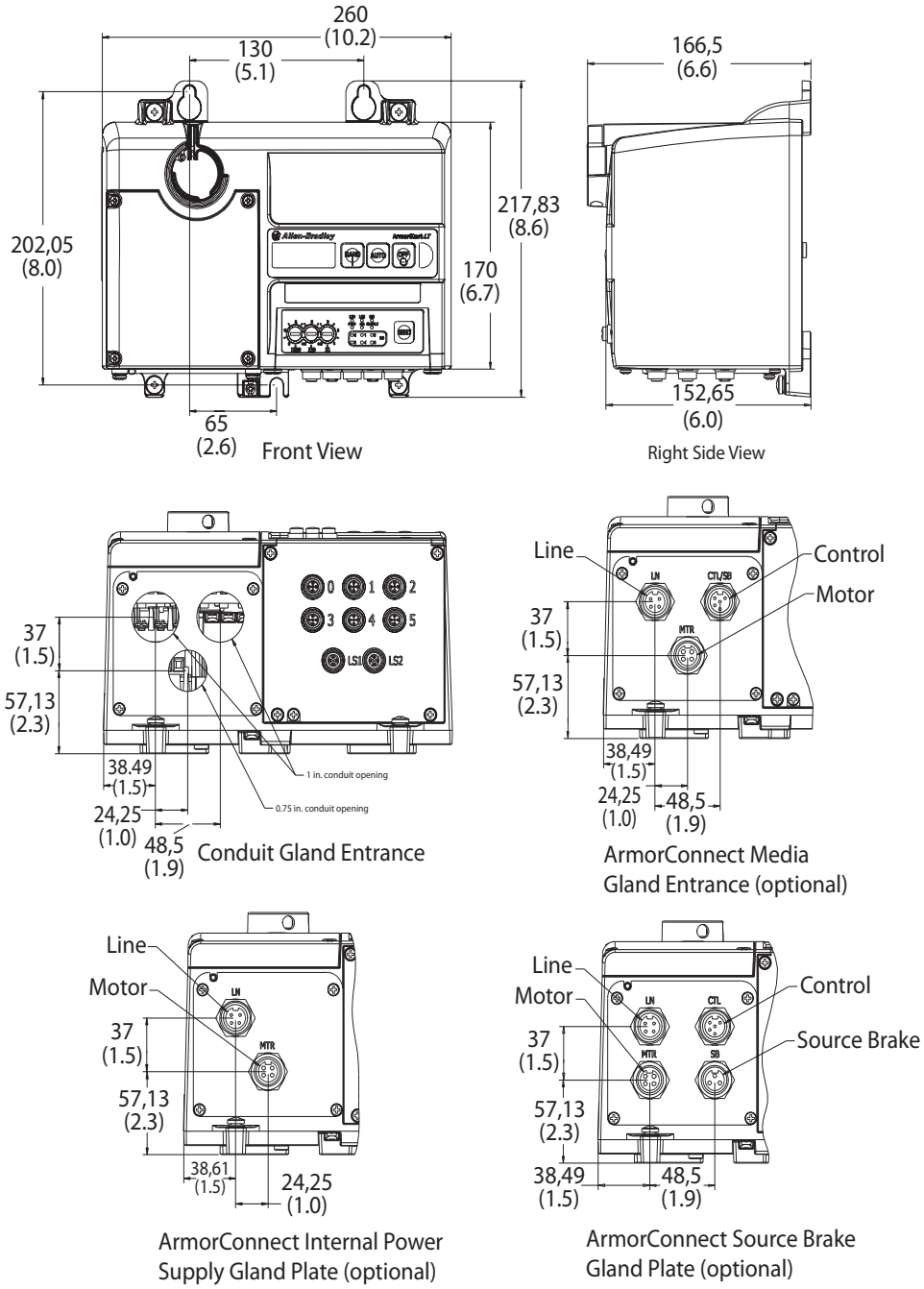
Dimensions

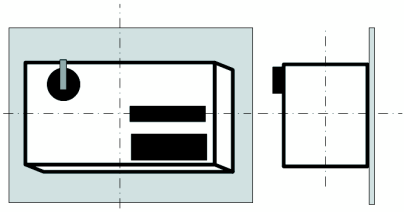
ArmorStart LT consists of three components that are non-replaceable. The Electronic Control Module (ECM); a gland plate for wire entry; and the aluminum alloy enclosure which makes up the back cover, top housing, and wiring access door. The ECM includes communications, discrete I/O, status and diagnostic LEDs, and the node address switches. All mating surfaces are sealed using foam in place gasket or o-ring.

Dimensions

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

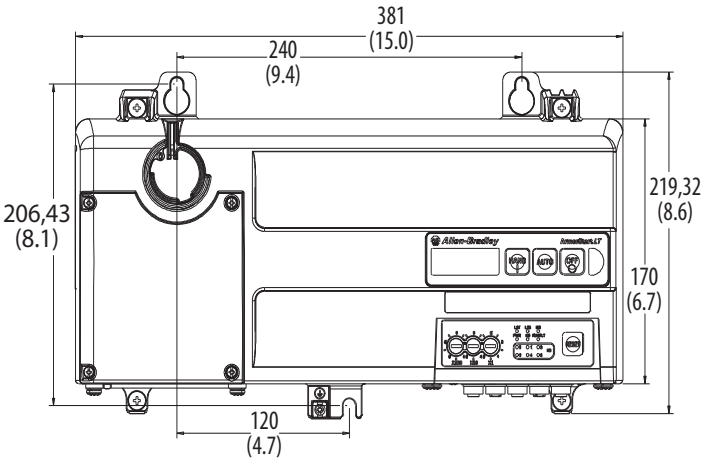
Figure 16 - Dimensions for Bulletin 290E/291E



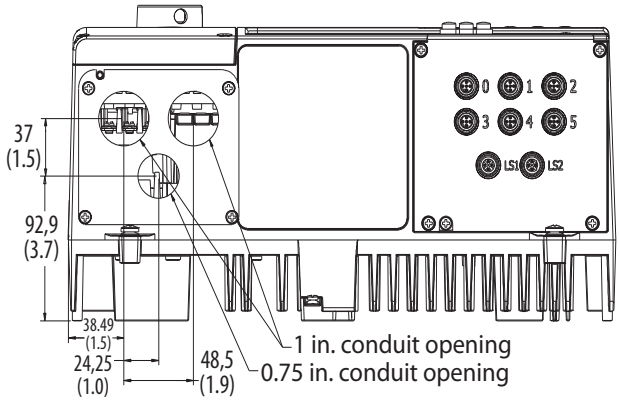


IMPORTANT For proper heat dissipation and product operation, mount the ArmorStart LT in the vertical orientation as shown.

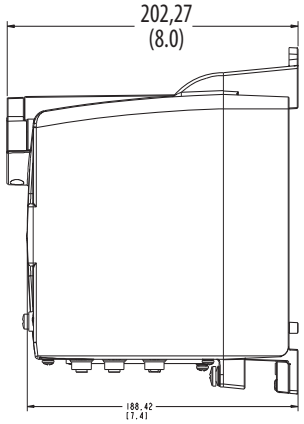
Figure 17 - Dimensions for Bulletin 294E



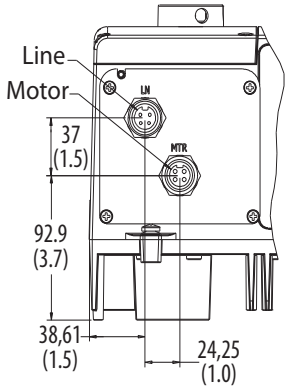
Front View



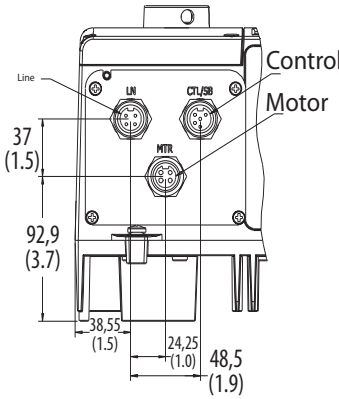
Conduit Gland Entrance - Bottom View



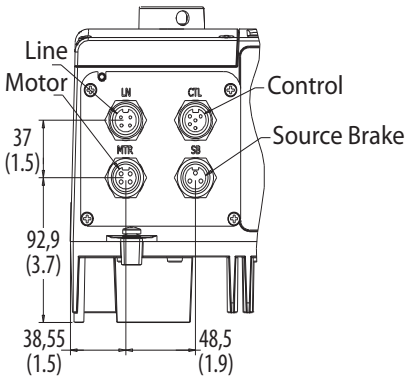
Right Side View



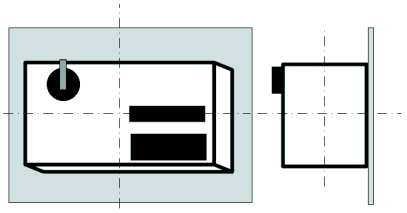
ArmorConnect Internal Power Supply Gland Plate (optional)



ArmorConnect Media Gland Entrance (optional)



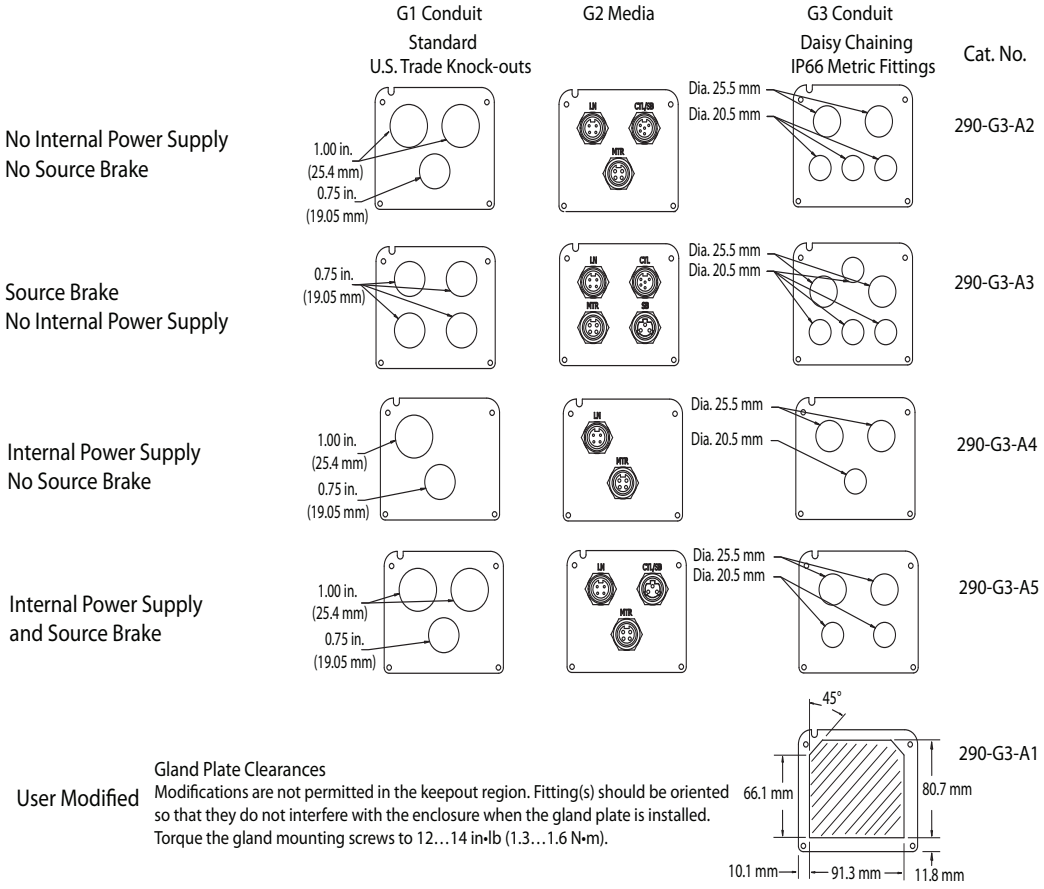
ArmorConnect Gland Entrance with Source Brake (optional)



IMPORTANT For proper heat dissipation and product operation, mount the ArmorStart LT in the vertical orientation as shown.

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

Figure 18 - ArmorStart LT Gland Plate Matrix



Connection Locations

Figure 19 - Internal Power, Control, and Ground Locations

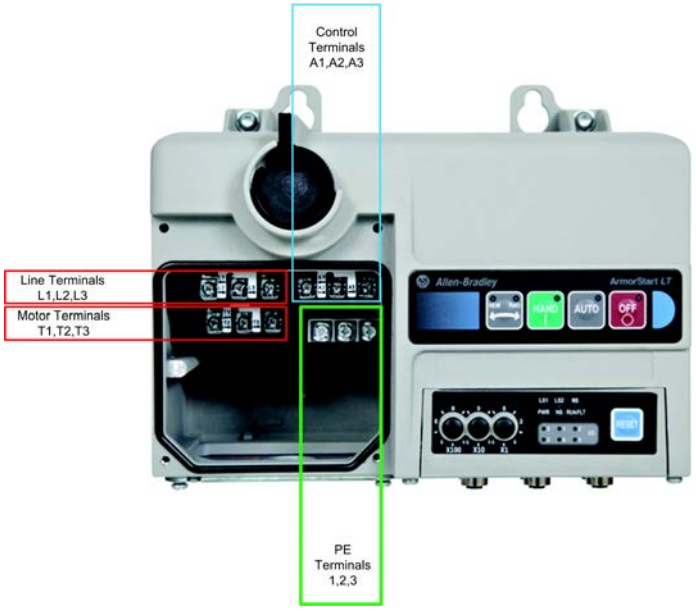
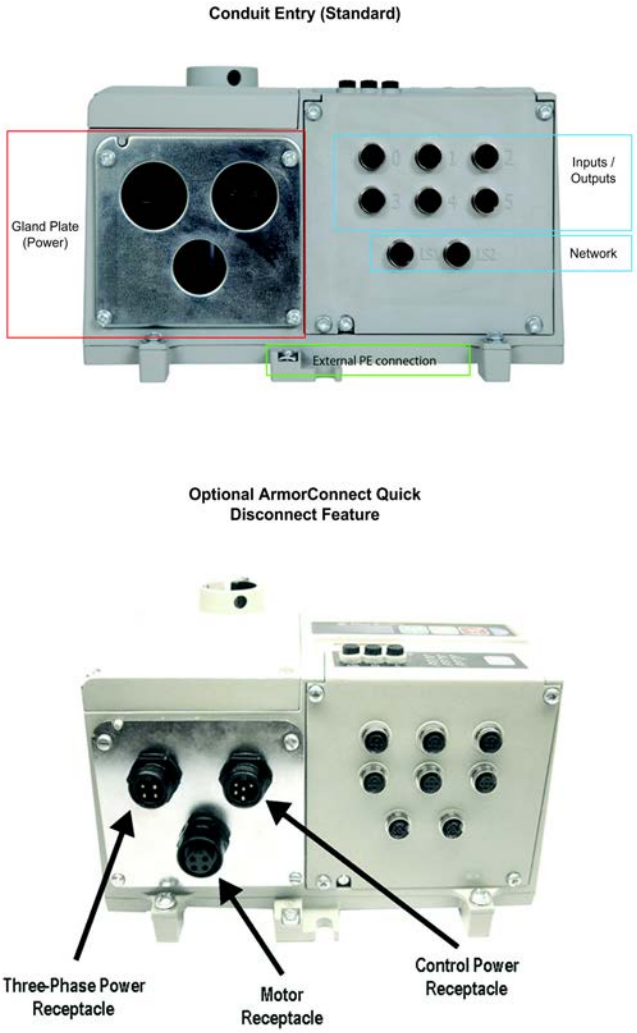


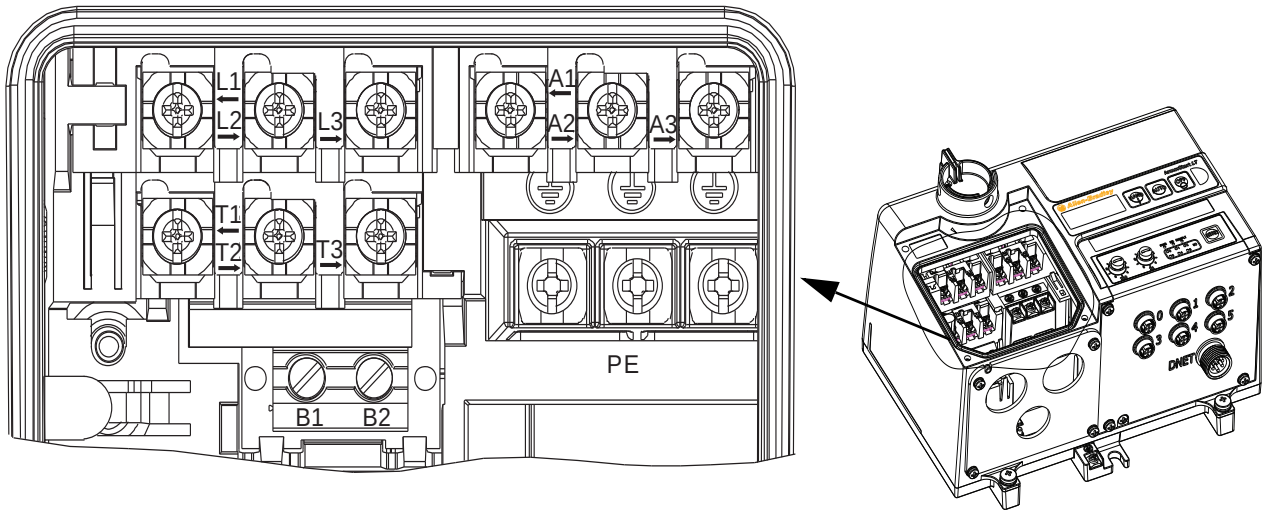
Figure 20 - Gland Connection

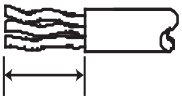


Wiring Terminal Detail

The power, control, and ground wire capacity and the tightening torque requirements are shown in Table 8. The maximum number of connections per terminal are shown in Table 7. As shown in Figure 21 all the terminals are found in the wiring area. Access can be gained by removing the terminal access cover plate.

Figure 21 - ArmorStart LT Power and Control Terminals





Wire Strip Length
0.35 ± 0.01 in.
(9 ± 0.2 mm)

Table 7 - Power, Control, and Ground Terminal Designations

Terminal Designations	Wires/Connections	Description
A1	2	Switched 24V DC Control Power (+) ❶
A2	2	Control Power Common (–) ❶
A3	2	Unswitched 24V DC Control Power (+) ❶
PE	2	Ground
L1	2	Line Power – Phase A
L2	2	Line Power – Phase B
L3	2	Line Power – Phase C
T1	1	Motor Connection – Phase A
T2	1	Motor Connection – Phase B
T3	1	Motor Connection – Phase C
B1	1	Source Brake Connection – B1 ❷
B2	1	Source Brake Connection – B2 ❷

❶ When internal power supply option is selected, no connection is made here.
❷ Available only with Bulletin 294E.

Table 8 - Power, Control, and Ground Wire Capacity and the Tightening Torque Requirements

Power Terminals	Wire Size	(2) #18…#10 AWG (0.8…5.2 mm^2) per terminal
	Tightening Torque	10.6 +/– 2 lb•in (1.2 +/– 0.2 N•m)
Motor Terminals	Wire Size	#18…#10 AWG (0.8…5.2 mm^2) per terminal
	Tightening Torque	10.6 +/– 2 lb•in (1.2 +/– 0.2 N•m)
Control Terminals	Wire Size	(2) #18…#10 AWG (0.8…5.2 mm^2) per terminal
	Tightening Torque	10.6 +/– 2 lb•in (1.2 +/– 0.2 N•m)
PE/Ground	Wire Size	(2) #16…#10 AWG (1.3…5.2 mm^2) per terminal
	Tightening Torque	18 +/– 2 lb•in (2 +/– 0.2 N•m)
Source Brake (Bulletin 294)	Wire Size	#16 …#10 AWG (1.0…4.0 mm^2) per terminal
	Tightening Torque	4.8 ± 2 lb•in (0.5 ± 0.2 N•m)

IMPORTANT ArmorStart LT is UL Listed for use with 14 AWG wire or preassemble power cable. Refer to your local electrical code(s) when applying 16 AWG wire or cable in a motor circuit.

Branch Circuit Protection

ATTENTION: Select the motor branch circuit protection that complies with the NFPA79/ or NFPA70 (NEC) and any other governing regional or local codes.

The ArmorStart LT is Underwriters Laboratory (UL) Group Motor listed. Refer to the product Specifications, Chapter 6 for maximum branch fuse and circuit breaker ratings. Select the motor branch circuit protection device that complies with NFPA70 (NEC) or NFPA79, and any other governing regional or local codes. The installer shall observe the product nameplate markings and not apply the ArmorStart LT where the maximum perspective short circuit current is exceeded. The ArmorStart LT shall be applied to a solidly grounded WYE power distribution system that does not exceed 480V AC, 60 Hz or 400V AC, 50 Hz.

WARNING: Do not install the ArmorStart LT where the maximum available fault current exceeds the product rating.

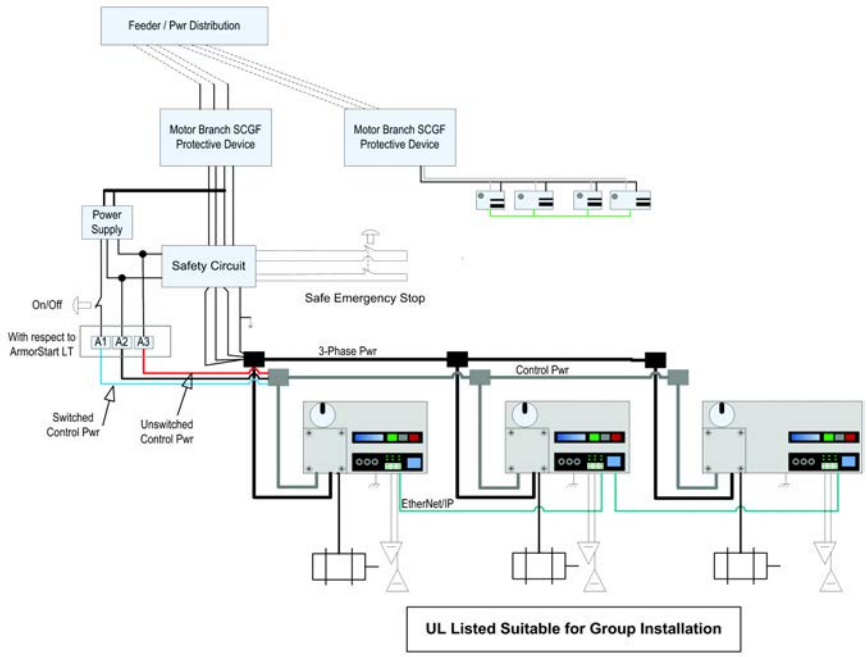
Typical System Example

The primary function of ArmorStart LT is to control and protect a three-phase squirrel cage induction motor. Three-phase power enters through terminals that are connected to a manually operated disconnect switch. The three-phase power may also connect internally to an optional three-phase to 24V DC power supply (IPS). Wired in series with the disconnect is an electrically operated contactor or a variable frequency drive. For Bulletin 294E an optional source brake contactor may also be connected to the disconnect output terminals. The source brake contactor is used to control an electromechanical brake physically attached to the motor. The microcontroller and interface circuits are contained in the ECM. The ECM also houses 6 user configurable I/O points. These six I/O points are used for system level control and are accessible via by the communication network or DeviceLogix.

The user has the flexibility to coordinate the appropriate safety function for their application. ArmorStart LT does not provide a safe torque-off input. Therefore, the safety function is configured externally from the controller and based upon the risk assessment.

For example, the risk assessment may require a safety circuit with a high level of performance. In this example, a safety relay with redundant safety contactors and emergency stop function can be integrated into the machine controls. Figure 22 below is an example of this configuration. Contact your local Rockwell Automation supplier for additional support regarding the safety circuit or for a risk assessment of your machinery.

Figure 22 -



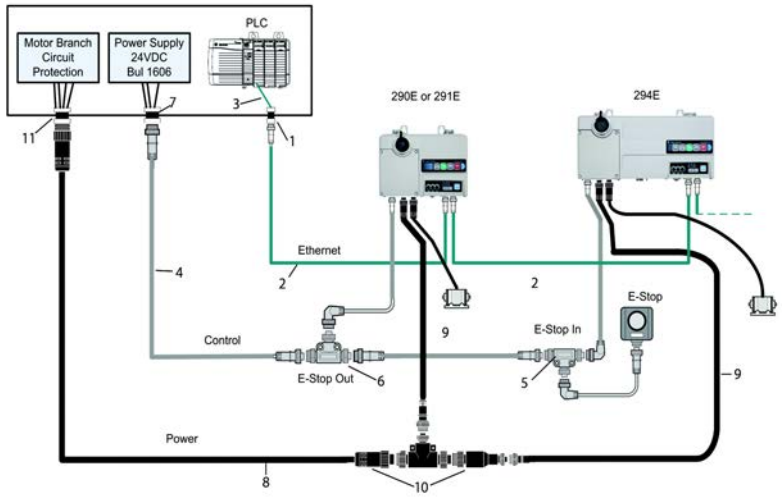
ArmorConnect Media

For greater flexibility and faster installations the user may also use ArmorConnect media for a complete plug-n-play solution. This solution provides plug-in style stop stations, as shown in Figure 23. The ArmorConnect power media offers both three-phase and control power cable cord set systems. These include patchcords, receptacles, tees, reducers and accessories to be utilized with the ArmorStart LT Distributed Motor Controller. This cable system allows quick connections and reduced installation time by utilizing pre-manufactured cable assemblies for more reliable connection of the three phase and control power.

IMPORTANT When specifying power media for use with the ArmorStart LT Distributed Motor Controllers (Bulletin 290E/291E and Bulletin 294E) use only ArmorConnect power media. The use of any other power media will void the UL Listing of the motor controller.

IMPORTANT Refer to your local electrical code for proper application and protection of long length power cable to minimize physical damage and appropriate short-circuit and ground-fault protection for the assembly.

Figure 23 - ArmorConnect Configuration Example



IMPORTANT A single channel Stop is pictured. It is necessary to perform a risk assessment and determine specific application requirements.

1. CAT5e Bulkhead Connector and Receptacle (Example Cat. No.:1585A-DD4JD)
2. CAT5e Patch Cord, IP67, M12 D-Code, Male Straight, Male Right Angle (Example Cat. No.: 1585D-M4TBDE-*)
3. CAT5e, Patch Cable, IP20, RJ45 Male to RJ45 Male (Example Cat. No. 1585J-M4TB-*)
4. Control Power Media Patchcords – PatchCord cable with integral female or male connector on each end (Example Cat. No.: 889N-F65GFNM-*)
5. Control Power Tees – The E-stop In Tee (Cat. No.: 898N-653ST-NKF) is used to connect to the Bulletin 800F On-Machine Stop station using a control power media patchcord.

6. The E-stop Out tee (Cat. No.: 898N-653ES-NKF) is used with cordset or patchcord to connect to the ArmorStart Distributed Motor Controller.

7. Control Power Receptacles – Female receptacles are a panel mount connector with flying leads (Cat. No.: 888N-D65AF1-*)

8. Three-Phase Power Trunk – Patchcord cable with integral female or male connector on each end (Example Cat. No.:280-PWRM35A-M*)

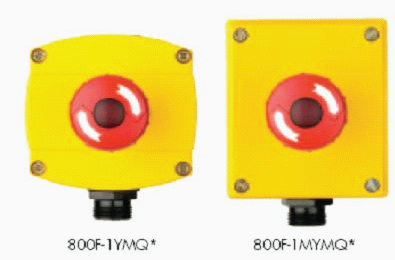
9. Three-Phase Drop Cable – PatchCord cable with integral female or male connector on each end (Example Cat. No.:280-PWRM22A-M*)

10. Three-Phase Power Tees and Reducer – Tee connects to a single drop line to trunk with quick change connectors (Cat. No.: 280-T35)
    Reducing Tee connects to a single drop line (Mini) to trunk (Quick change) connector (Cat. No.: 280-RT35)
    Reducer connects from quick change male connector to mini female connector (Cat. No.: 280-RA35)

11. Three-Phase Power Receptacles – Female receptacles are a panel mount connector with flying leads (Cat. No.: 280-M35F-M1)

IMPORTANT See the On-Machine Connectivity catalog for specific Ethernet media components

Figure 24 - On-Machine Stop Stations



Enclosure Type	Quick Connect	Knockout Type	Operator	Illumination Voltage	Contact Configuration	Cat. No.
Plastic	Mini Receptacle	Metric	Twist to Release	24V AC/DC	1 N.C./1 N.O.	800F-1YMQ4
Metal				24V AC/DC		800F-1MYMQ4

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 refer to ArmorStart LT selection guide, publication 290-SG001_-EN-P.

Branch Circuit Protection Requirements for ArmorConnect Three-Phase Power Media

When using ArmorConnect Three-Phase Power Media, fuses or circuit breakers may be used for the motor branch circuit ground fault protection if properly sized and allowed by product labeling.

Circuit Breaker:

Where ArmorStart LT is used with ArmorConnect — suitable for use on a circuit capable of delivering not more than 10000 RMS Symmetrical Amperes

at 480Y/277 VAC maximum when protected by Cat. No.140U-D6D3-C30 circuit breaker, refer to the Specifications, Chapter 6.

WARNING: The total circuit impedance including each cable assembly's own impedance, must be low enough to ensure any short-circuit or ground fault current that can flow through any assembly, will be large enough to operate the magnetic trip of the Cat. No. 140U-D63-C* circuit breaker. Refer to NFPA 70 and NFPA 79 or your local electrical code for guidance in coordinating over current protective devices and the circuit being protected.

Fusing:

Where ArmorStart LT is used with ArmorConnect — suitable for use on a circuit capable of delivering not more than 10000 RMS Symmetrical Amperes (SCCR) at 480/277 V AC maximum when protected by 40 A CC, J, and T class fuses, refer to the Specifications, Chapter 6.

Electrical Wiring

ArmorStart LT EtherNet/IP utilizes 24V DC control power for communications and I/O. The control power terminal connections are labeled A1, A2, and A3. Switched power (A1) will supply outputs and motor control. Unswitched power (A3) will supply logic power, communications, and sensor inputs.

IMPORTANT EtherNet/IP is an unpowered network, therefore if device status is important, the A3 terminal must have an unswitched power source.

Figure 25 - Bulletin 290E Full Voltage

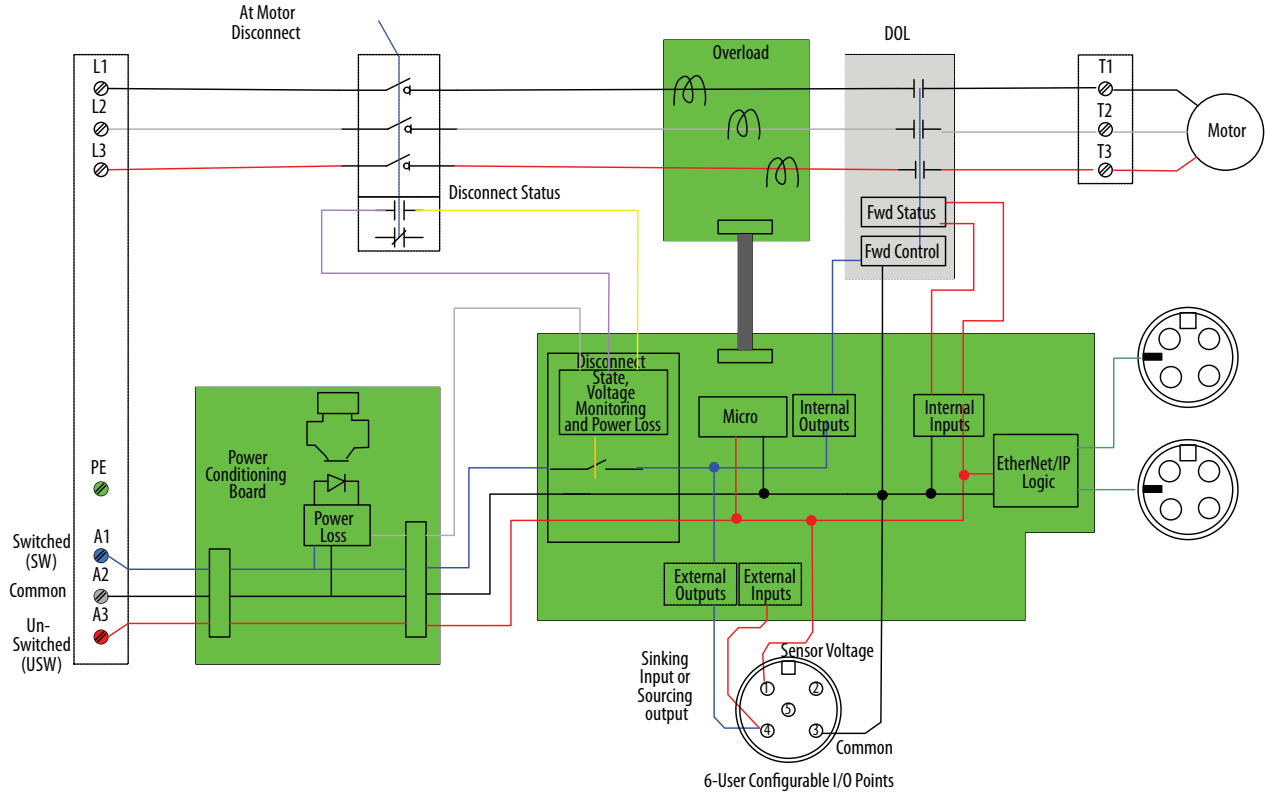


Figure 26 - Bulletin 291E Full Voltage Reversing

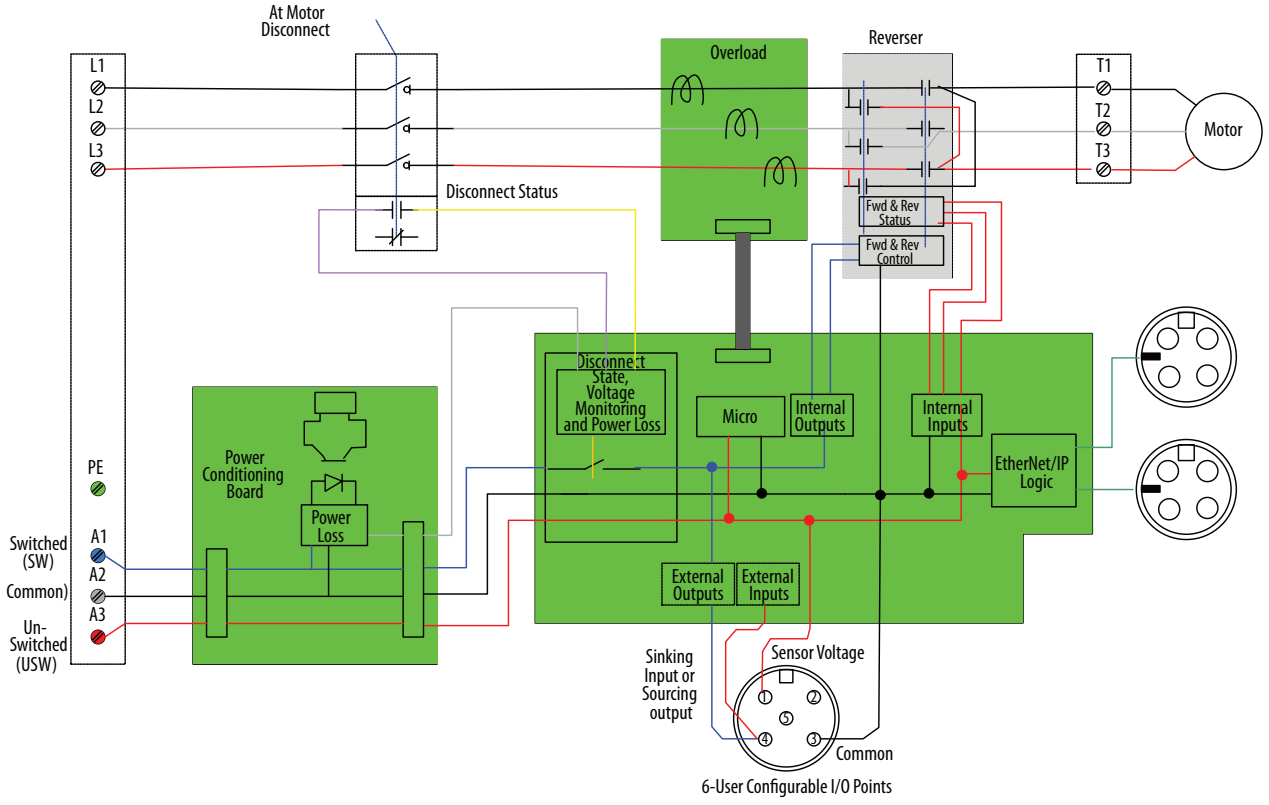


Figure 27 - Bulletin 294E VFD

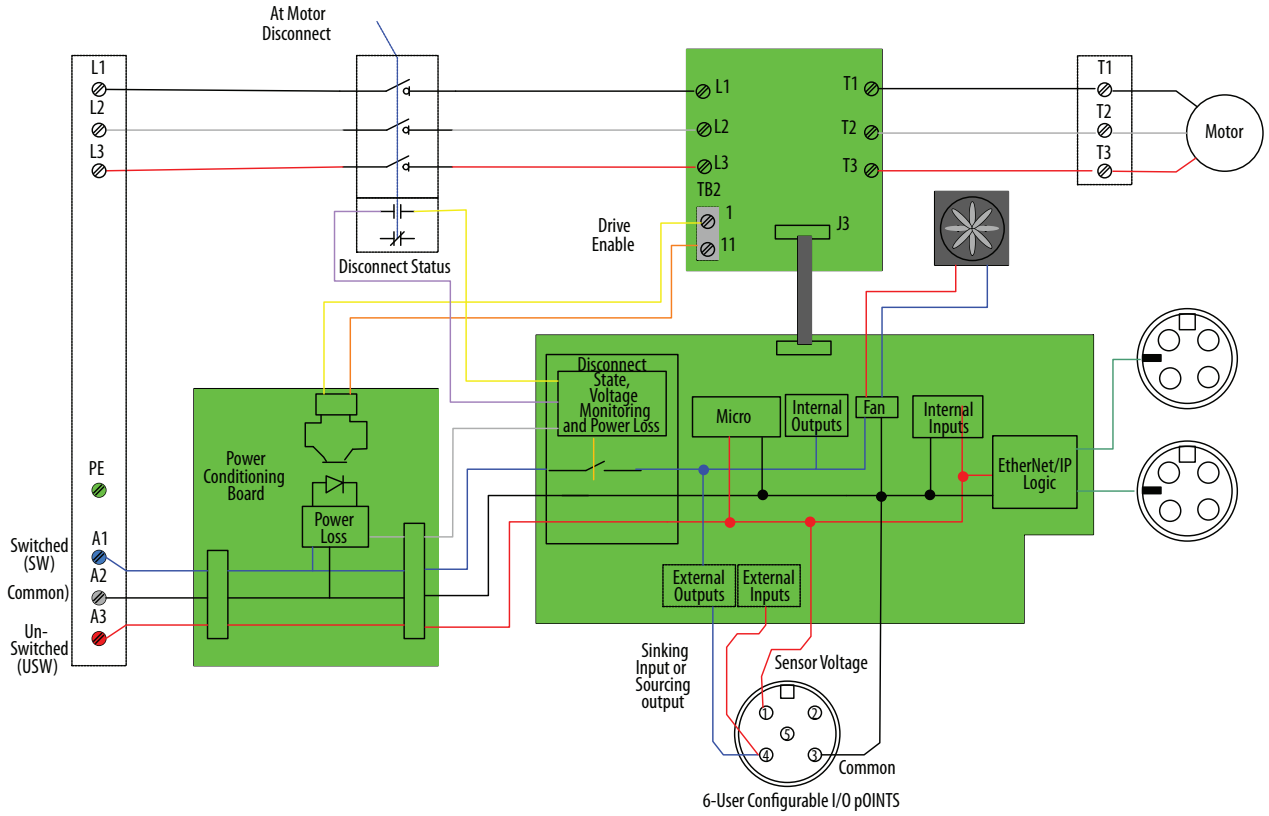


Figure 28 - Bulletin 294E VFD with -SB

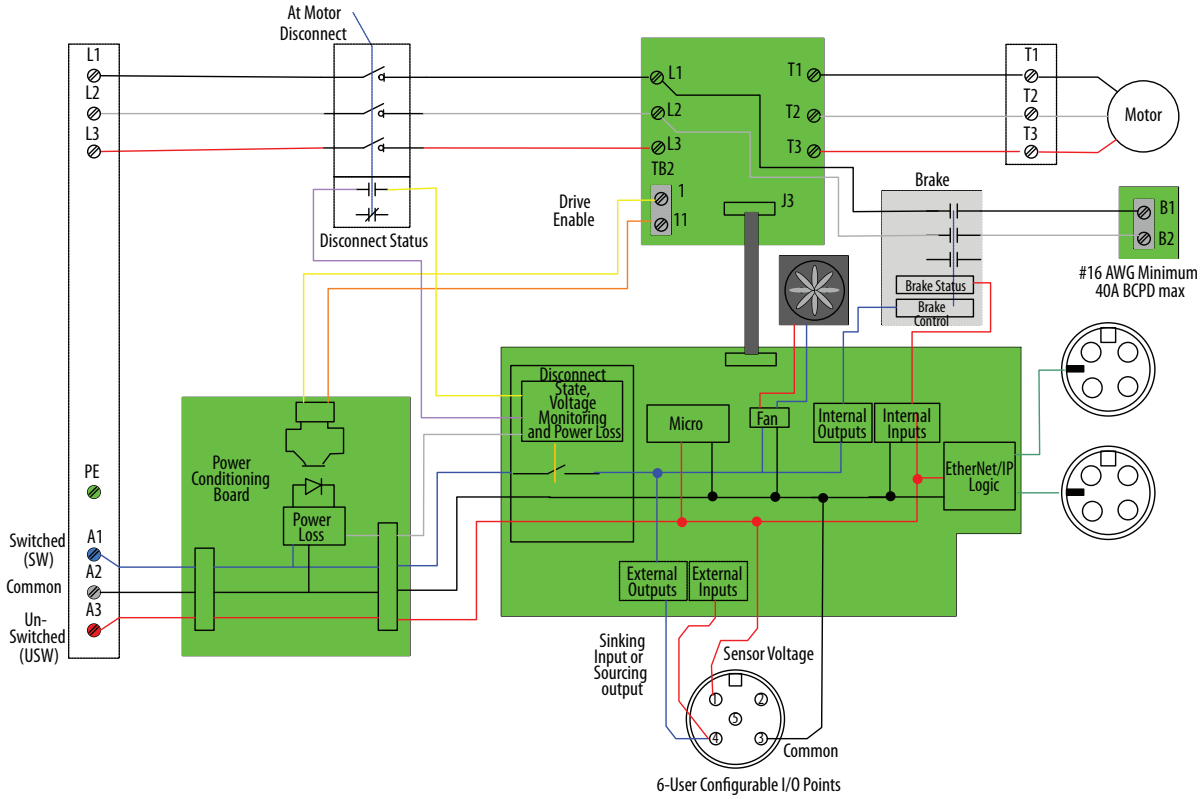


Figure 29 - Bulletin 290E Full Voltage with -IPS

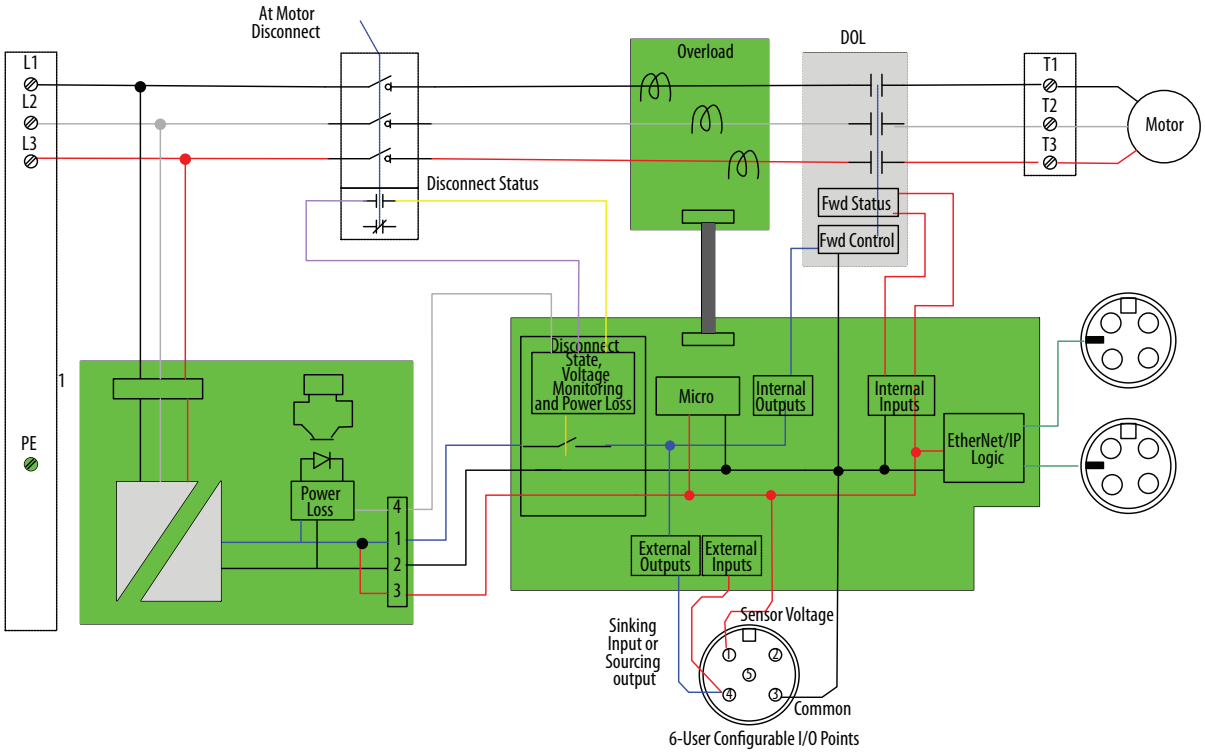


Figure 30 - Bulletin 291E Full Voltage Reversing with -IPS

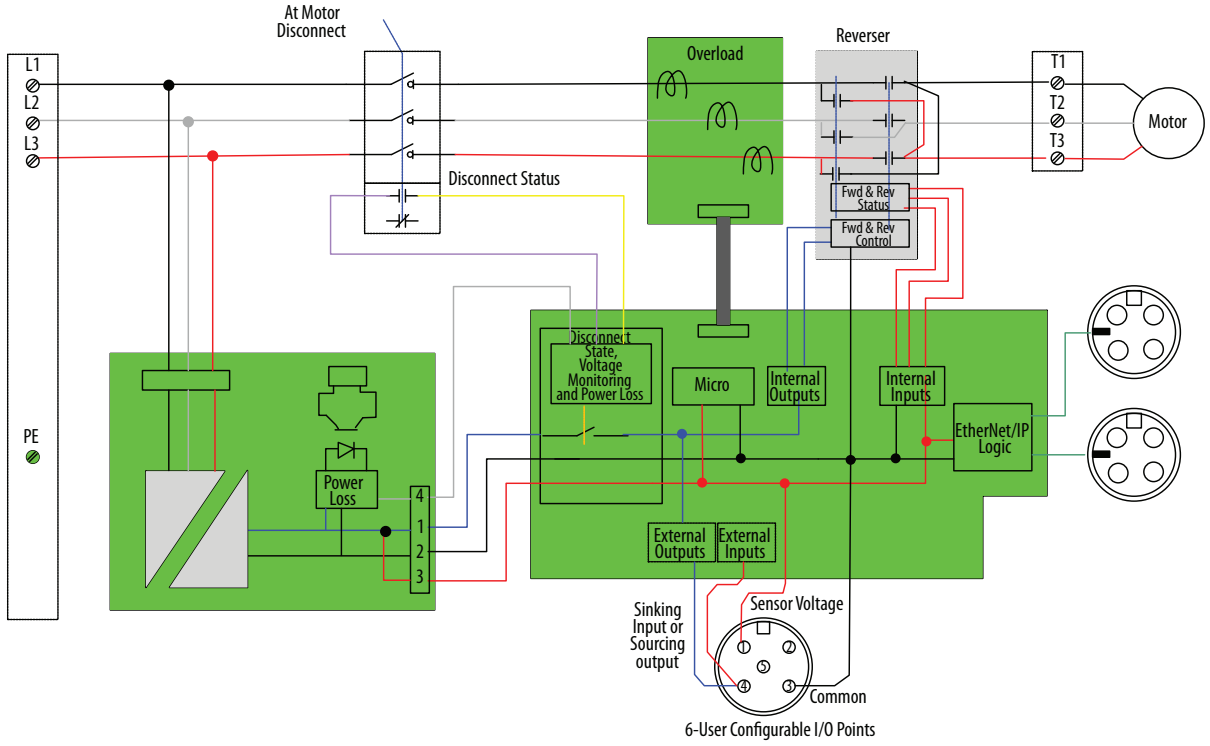


Figure 31 - Bulletin 294E VFD with -IPS

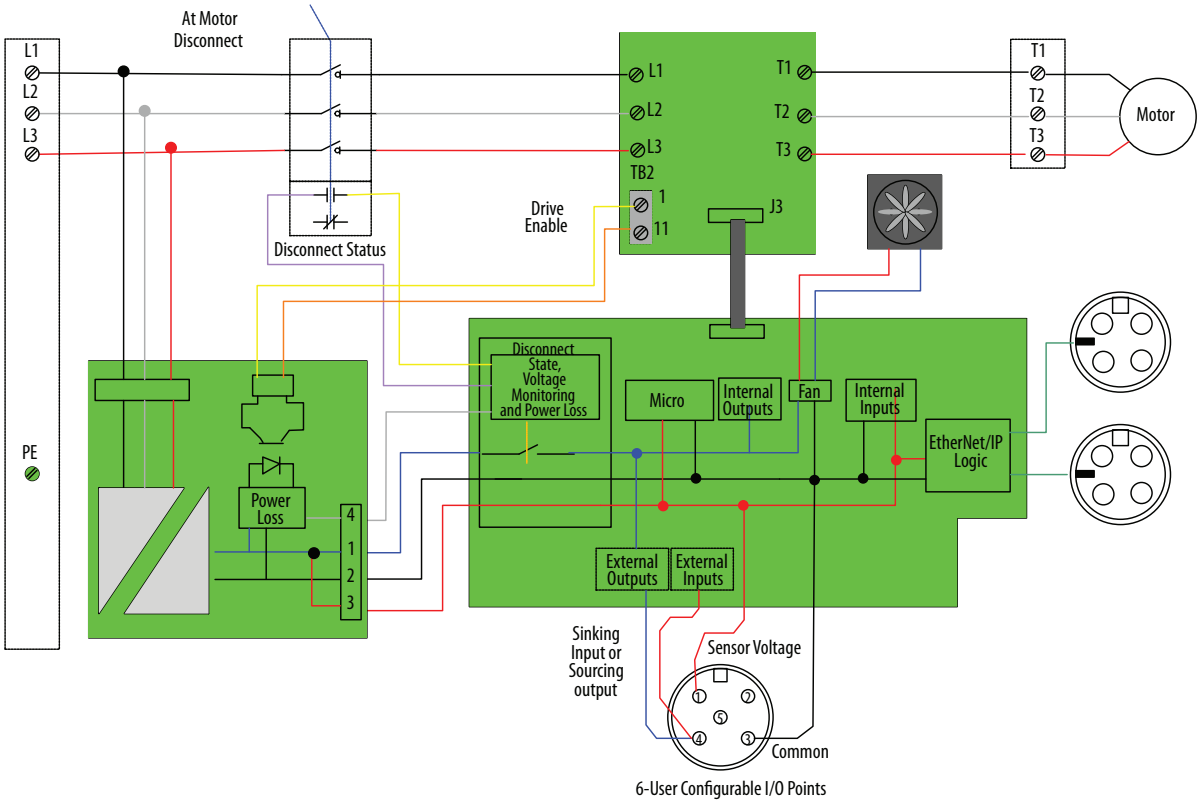
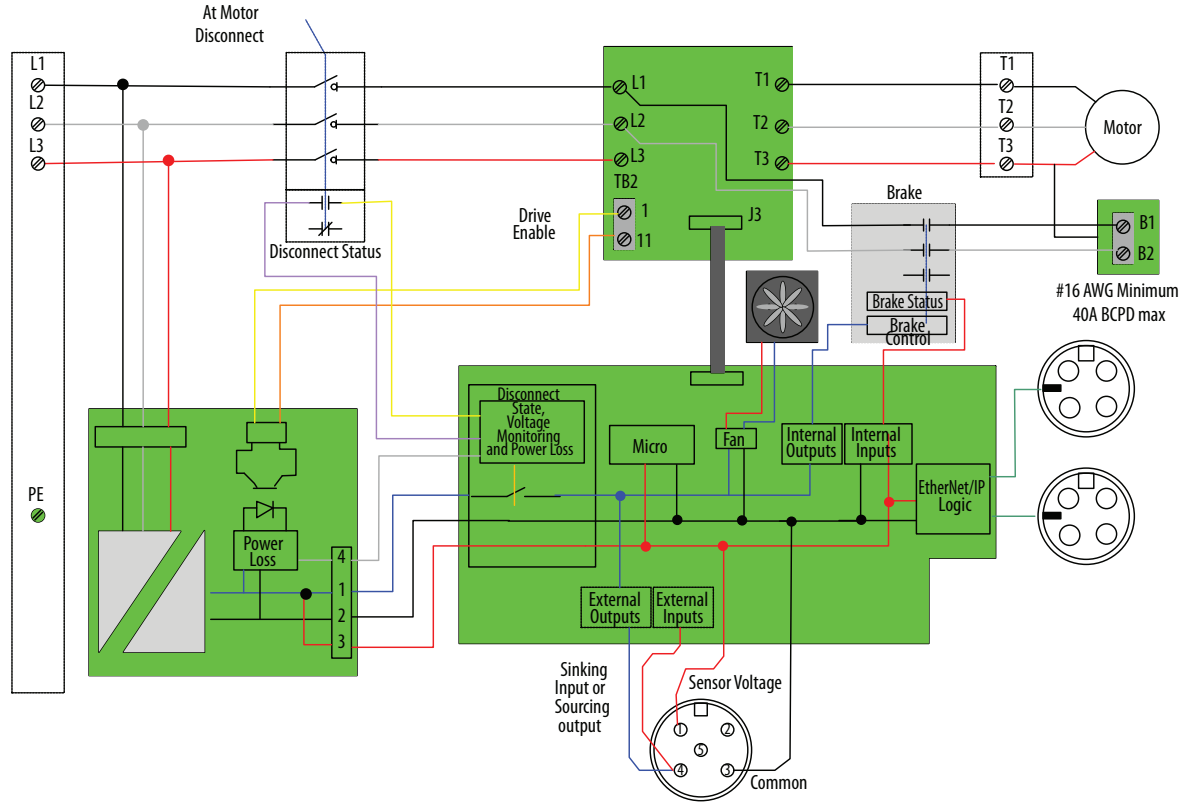


Figure 32 - Bulletin 294E VFD with -IPS, -SB



Group Motor Installations for USA and Canada Markets

When ArmorStart LT is applied according to 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.

IMPORTANT For additional information regarding group motor installations with the ArmorStart LT Distributed Motor Controller, see Appendix A

Wiring

Cable Workmanship Guidelines

In addition to conduit and seal-tite raceway, it is acceptable to utilize cable that is dual rated Tray Cable Exposed Runs (TC-ER) and Cord, STOOW, for power and control wiring on ArmorStart LT installations. In the USA and Canada installations, the following guidance is outlined by the National Electrical Code (NEC) and National Fire Protection Association (NFPA) 79.

In industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation, and where the exposed cable is continuously supported and protected against physical damage 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)❶ 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 6 ft (1.8 m) and installed in a "good workman-like" manner. Equipment grounding for the utilization equipment shall be provided by an equipment grounding conductor within the cable.

While the ArmorStart LT is intended for installation in factory floor environments of industrial establishments, the following must be taken into consideration when locating the ArmorStart LT in the application:

- Cables, including those for control voltage including 24V DC and communications, are not to be exposed to an operator or building traffic on a continuous basis.
- Location of the ArmorStart LT 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 should be considered.
- Routing cables should be done in such a manner to minimize inadvertent exposure and/or damage.
- If conduit or other raceways are not used, it is recommended that strain relief fittings be utilized when installing the cables for the control and power wiring through the conduit openings.

❶ Historically cable meeting 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.

Service Space

The working space around the ArmorStart LT can be minimized as the ArmorStart LT does not require examination, adjustment, servicing or maintenance while energized. In lieu of this service, the ArmorStart LT is meant to be unplugged and replaced after proper lock-out/tag-out procedures have been employed.

Hand Operation (HOA) Considerations

The Hand/Off/Auto (HOA) is a factory-installed option that the user may select. The HOA keypad may require the ArmorStart LT to be installed as follows, if the application requires frequent use of the hand operated interface by the equipment operator:

1. Install not less than 2 ft (0.6 m) above the servicing level and within easy reach of the operator, who is in a normal working position.
2. Install where the operator is not placed in a hazardous situation when operating the equipment.
3. Install where the possibility of inadvertent operation is minimized.

Where inadvertent operation may cause adverse effects the HOA can be disabled via parameter 67.

General Wiring Considerations

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 is provided to reduce the coupling effect:

- Minimum spacing between different wire groups in the same tray should be 6 in. (16 cm).
- Wire runs outside an enclosure should be run in conduit or have shielding/armor with equivalent attenuation.
- Different wire groups should be run in separate conduits.
- Minimum spacing between conduits containing different wire groups should be 3 in. (8 cm).
- Minimum spacing between 3-phase power cabling and Ethernet or I/O cabling should be at least 6 in. (16 cm) to avoid noise issues, unless properly shielded.

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 which may 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 may sometimes share the same path and components, they should be considered different circuits with different requirements.

Grounding Safety Grounds

The object of safety grounding is to ensure 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 will 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 point must be connected to an adjacent building steel (girder, joist), a floor ground rod, a bus bar or a building ground grid. Grounding points must comply with national and local industrial safety regulations or electrical codes. Some codes may require redundant ground paths and periodic examination of connection integrity.

IMPORTANT To avoid electrolytic corrosion on the external earth terminal, avoid spraying 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.x Ground connections should be inspected on a regular basis.

Grounding Motors

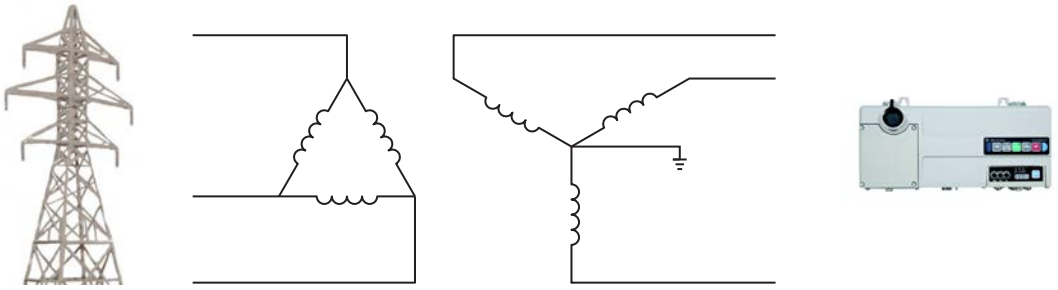
The motor frame or stator core must be connected directly to the PE connection with a separate ground conductor. It is recommended that each motor frame be grounded to building steel at the motor.

Power Distribution

The type of transformer and the connection configuration feeding an ArmorStart LT Bulletin 294E plays an important role in its performance and safety.

Delta/Wye with Grounded Wye Neutral

Figure 33 -



Delta/Wye with Grounded Wye Neutral is the most common type of distribution system. The grounded neutral provides a direct path for common mode current caused by the drive output.

SHOCK HAZARD: ArmorStart LT requires the use of grounded Wye power systems.

AC Line Voltage

Incoming voltage imbalances greater than 2% can cause large unequal currents in a drive. An input line reactor may be necessary when line voltage imbalances are greater than 2%.

Line Reactor

In general, ArmorStart LT does not require line reactors. In most applications, the ArmorStart LT is further away from the power distribution panel, therefore the length of cable provides additional impedance as compared to an in-panel solution.

Therefore, ArmorStart LT does not define a minimum line impedance specification, and does not require a line reactor. Its design trades the external reactor supplied by the customer for an internal fan integral to the controller. This improves the overall life of the product. To achieve maximum electrical life of Bulletin 294, a minimum 800 uH line reactor for the group can be applied to extend total service life.

In addition, if line disturbance mitigation is also necessary, the ArmorStart LT is equipped with an EMI filter and when used with a shielded motor cable reduces the impact of the power switching components. For CE compliant installations

refer to the recommended EMI/RFI cord grip accessory or quick disconnect shielded motor cable. Contact your local sales representative for details.

If however, the customer specifications require input line reactors or transformers, the recommendation is to group the ArmorStarts at the distribution panel under one line reactor (not individual reactors or transformers). Keep in mind where full voltage ArmorStarts are included with VFD ArmorStarts, the starting currents of the full voltage ArmorStarts can be significant. The current must be accounted for in the selection of the line reactor or you run the risk of nuisance undervoltage faults of the VFD ArmorStarts while the full voltage ArmorStarts are starting their motors.

ATTENTION: For 50°C ambients ArmorStart LT must be derated and applied with a minimum of 800 uH to1200 uH line reactor. Failure to follow this application requirement will result in premature product failure. Contact your local Rockwell Automation representative for assistance.

Bulletin 294 Motor Cable Considerations

The majority of recommendations regarding drive cable address issues are caused by 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 noise caused by the drive output
3. The amount of cable charging current available from the drive
4. Possible voltage drop (and subsequent loss of torque) for long wire runs

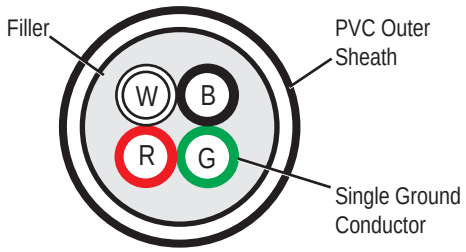
Keep the motor cable lengths less than 45 ft from the ArmorStart LT.

Unshielded Cable

Properly designed multi-conductor cable can provide superior performance in wet applications, significantly reduce voltage stress on wire insulation and reduce cross coupling between drives.

The use of cables without shielding is generally acceptable for installations where electrical noise created by the drive does not interfere with the operation of other devices such as: communications 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.

Figure 34 - Unshielded Multi-Conductor Cable

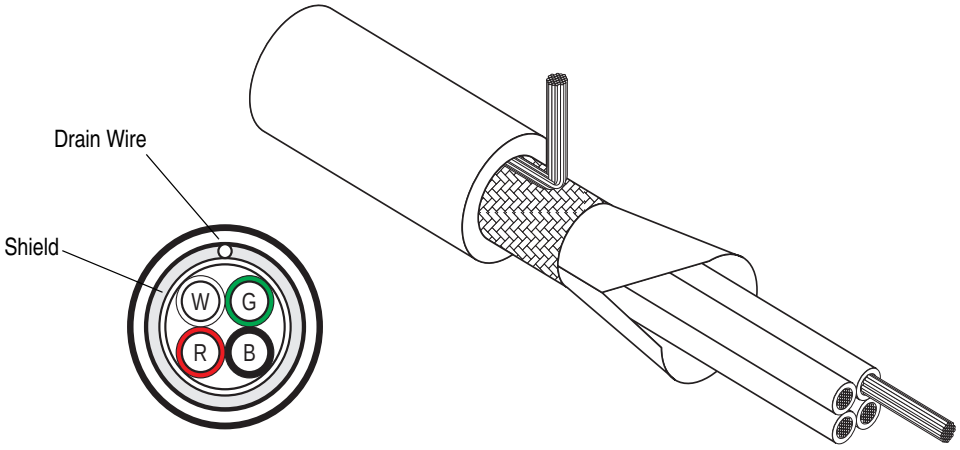


Shielded Cable

Shielded cable contains all of the general benefits of multi-conductor cable with the added benefit of a copper braided shield that can contain much of the noise generated by a typical AC Drive. Strong consideration for shielded cable should be given for installations with sensitive equipment such as weigh scales, capacitive proximity switches, and other devices that may be affected by electrical noise in the distribution system. Applications with large numbers of drives in a similar location, imposed EMC regulations, or a high degree of communications/networking are also good candidates for shielded cable.

An acceptable shielded cable will have 4 XLPE insulated conductors with a 100% coverage foil and an 85% coverage copper braided shield (with drain wire) surrounded by a PVC jacket.

Figure 35 - Shielded Cable with Four Conductors



Recommended Cable Connectors/Glands

Choose cable connectors or glands that offer the best cable protection, shield termination, and ground contact.

Recommended Cord Grips

The following are recommended cord grips to be used for ArmorStart LT installations.

Table 9 - Cord grip for Motor, Power, and Control
Recommended Thomas and Betts Cord Grips for G1 and G3 Glands.

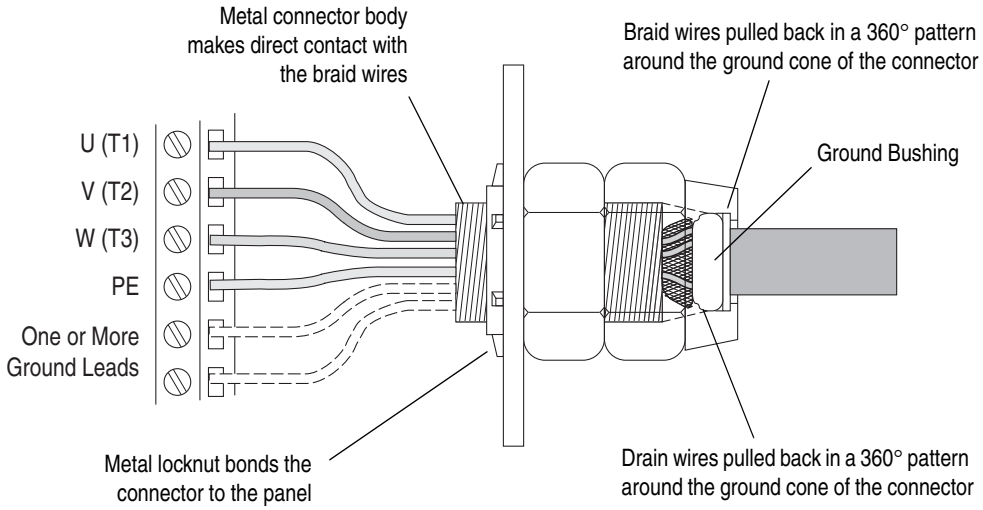
Description	Gland	Knockout Size	Cable Diameter Range (in.^{2})	Thomas and Betts Part Nos.		
				Cord Grip	Sealing Ring	Lock Nut
Motor/Source Brake	G1	0.75 in.	0.500…0.750	2932NM	5263	142TB
Motor/Source Brake	G1	0.75 in.	0.660…0.780	2675	5263	142TB
Power	G1	1.0 in.	0.660…0.780	2676	5264	143
Power	G1	1.0 in.	0.770…0.895	2677	5264	143
Control Power, Motor/Source Brake	G3	M20	0.236…0.473	CC-ISO20-G	❶	GMN-M20
3-Phase Power	G3	M25	0.512…0.709	CC-ISO25-G	❶	GMN-M25

❶ Contact Thomas and Betts for product selection details

Shield Terminating Connectors

The cable connector selected must provide good 360º contact and low transfer impedance from the shield or armor of the cable to the conduit entry plate at both the motor and the ArmorStart LT for electrical bonding. SKINTOP® MS-SC/MS-SCL cable grounding connectors and NPT/PG adapters from LAPPUSA are good examples of this type of shield terminating gland.

Figure 36 - Terminating the Shield with a Connector



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

Electromagnetic Compatibility (EMC)

The following guidelines are provided for EMC installation compliance.

General Notes (Bulletin 294E only)

- The motor cable should be kept as short as possible in order to avoid electromagnetic emissions as well as capacitive currents. CE conformity of ArmorStart LT with EMC directive does not guarantee the entire machine installation complies with CE EMC requirements. Many factors can influence total machine/installation compliance.
- The EMI filter may result in relatively high ground leakage currents. Therefore, ArmorStart LT must only be applied in installations that are solidly grounded (bonded) to the building power distribution ground.

ATTENTION: RFI Filter Grounding. Due to the presence of an integral EMI filter, this product may draw more that 3.5 mA of leakage current. The controller must only be used in installations with grounded AC supply systems and be permanently installed and solidly grounded (bonded) to the building power distribution ground. Grounding should not include any form of plug or socket that would permit inadvertent disconnection. Consult your local codes regarding redundant ground connections and/or size of protective earthing conductor. The integrity of all connections should be periodically checked.

Ethernet, DeviceNet, and I/O Connections

DeviceNet Connector (M18)

Pin 1 – Drain (no connection)
Pin 2 – +VDNET
Pin 3 – -VDNET
Pin 4 – CAN_H
Pin 5– CAN_L

Ethernet/IP Connector D-coded (M12)

M12 Female Ethernet Connector
Pin 1 – Tx+
Pin 2 – Rx+
Pin 3 – Tx–
Pin 4 – Rx–

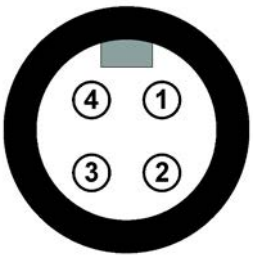
I/O Connector (M12)

Pin 1 – Sensor Source Voltage
Pin 2 – Not Used
Pin 3 – Common
Pin 4 – Input or Output
Pin 5 – Not Used

ArmorConnect Power Media Receptacles

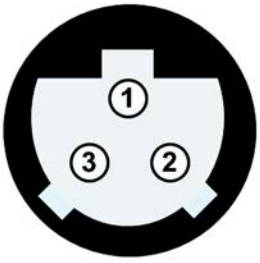
ArmorStart LT utilizes a M22 male receptacle for power inputs and a M22 female receptacle for motor or motor brake output.

Motor Connector (optional)



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

Source Brake Connector (optional)



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

Incoming Control Power (optional) – 24V DC Only

Pin 1 – (+V) Unswitched (A3/red)
Pin 2 – (–V) Common (A2/black)
Pin 3 – Not used (green)
Pin 4 – Not used (blank)
Pin 5 – (+V) Switched (A1/blue)
Pin 6 – Not used (white)

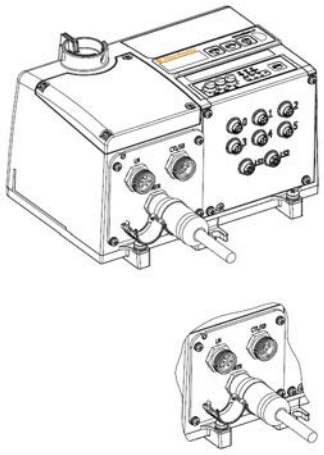
Incoming Three-Phase Power (optional)

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

Optional Locking Clip

The locking clip is an optional device that can be used, if desired. The clam shell design clips over power quick disconnect connections to limit customer access to disconnection.

Figure 37 -



SHOCK HAZARD: DO NOT connect or disconnect power or motor connections while power is applied to ArmorStart LT. Proper Lock-Out Tag-Out procedures should be followed to reduced the risk of severe injury.

SHOCK HAZARD: The ArmorStart LT local disconnect will only isolate the motor power and remove switched power when turned OFF. Power inputs must be switched OFF properly from their respective sources before connection or disconnection of incoming power. Proper Lock-Out Tag-Out procedures should be followed to reduced the risk of severe injury.

Notes:

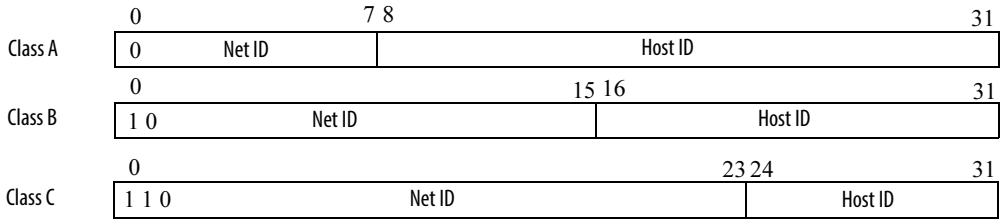
Product Commissioning

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 38 - 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

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 giving it a unique IP address.

Gateway Address

The Gateway Address is the default address of a network. It provides a single domain name and point of entry to the site. Gateways connect individual physical networks into a system of networks.

Subnet Mask

The subnet mask is used for splitting IP networks into a series of subgroups, or subnets. The mask is a binary pattern that is matched up with the IP address to turn part of the Host ID address field into a field for subnets.

Configuring EtherNet/IP Address

Before using the ArmorStart LT, you may need to configure an IP address, subnet mask, and optional Gateway address. The rotary network address switches found on the front of the ECM, are set to 999 and DHCP is enabled as the factory default. The network Internet Protocol (IP) address can be set one of three ways:

- Use the switches located on the module
- Use a Dynamic Host Configuration Protocol (DHCP) server, such as Rockwell Automation BootP/DHCP
- Retrieve a static IP address from nonvolatile memory

The ArmorStart LT reads these switches first at power up or after a reset to determine if they are set to a valid IP address between 1...254. When switches are set to a valid number the IP address will be 192.168.1._ _ _ [switch setting].

If the switches are set to an invalid number (for example, 000 or a value greater than 254 excluding 888), DHCP is enabled. The DHCP server will assign the IP address and the Transport Control Protocol (TCP) parameters.

The RS Logix 5000 installation provides a BootP/DHCP server found in the Rockwell Software Program folder. Use Rockwell Automation BootP/DHCP server utility, version 2.3 or later, that ships with RSLogix™ 5000 or RSLinx software.

A third party DHCP server can also be used.

Manually Configure the Network Address Switches

Remove the protective caps from the rotary switches.

Figure 39 - Switches on the I/O module

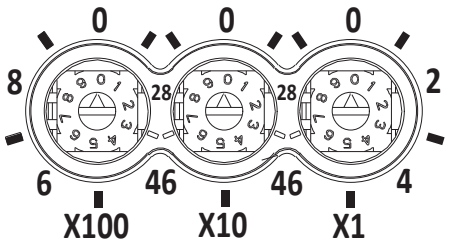
Set the network address by adjusting the three rotary switches on the front of the ECM. When the IP address switches are valid, the subnet mask will be

255.255.255.0 and the gateway address is set to 0.0.0.0. A power cycle is required for any new IP address to take effect when the switches are used.

ATTENTION: To avoid unintended operation, the ArmorStart LT must be assigned a fixed IP address. If a DHCP server is used, it must be configured to assign a fixed IP address for ArmorStart LT.

Failure to observe this precaution may result in unintended machine motion or loss of process control.

Figure 40 - Network Address Example



This example shows the IP address set to 000 (DHCP).

Static Address Alternative

If the manual address configuration of 192.168.1.xxx is not acceptable, a static address can be configured using the embedded web page. First configure the switches to a valid address to access the web page. Using a common web browser enter the address 192.168.1._ _ _ (switches). From the Administrative Settings window select Network Configuration. Change the Ethernet Interface Configuration to “Static” and enter the IP Address, Subnet Mask, and Default Gateway and apply. Change the ArmorStart LT address switches to 999. The unit will now accept the new IP address. To access the web page you will need to use the new address in the web browser.

The switch value of 888 allows the user to reset to factory default configuration including configuration parameters. This setting is useful in situations where the user wishes to decommission a module or when the user wishes 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 LT will return to factory default settings and cease all communications. The Module Status LED shall transition to blinking red and the Network Status LED shall transition to OFF.

After reset, the user will then need to change the IP address to a valid setting and power cycle. The purpose of this is to prevent the user from resetting the module and then never changing the switch setting from 888.

IMPORTANT Setting the IP address to “888” followed by a power cycle will reset the device 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.

Using the Rockwell Automation BootP/DHCP Utility

The Rockwell Automation BootP/DHCP utility is a stand alone 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 LT must have DHCP enabled (factory default) to use the utility.

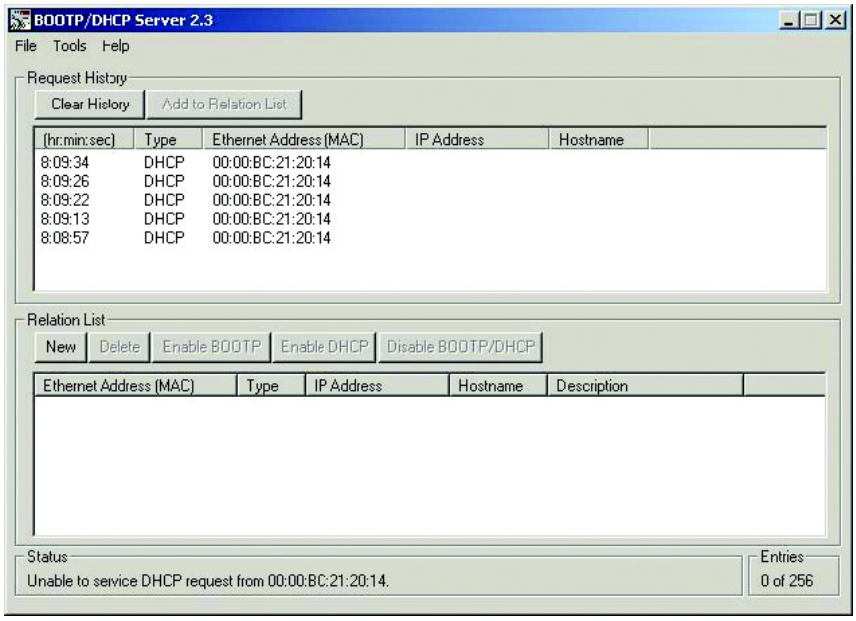
To configure your adapter using the BootP/DHCP utility, perform the following steps:

1. Run the BootP/DHCP software.

   In the BOOTP/DHCP Request History panel you will see the Ethernet (Mac) addresses of the devices issuing requests.

   Note: the Ethernet (Mac) address for a device can be found on the product label.

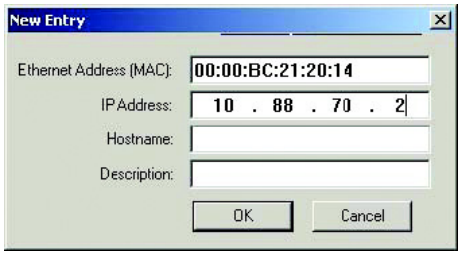
Figure 41 - BOOTP/DHCP Request History Panel



2. Double-click the Ethernet (Mac) address of the device you want to configure.

   You will see the New Entry dialog with the device's Ethernet Address (MAC).

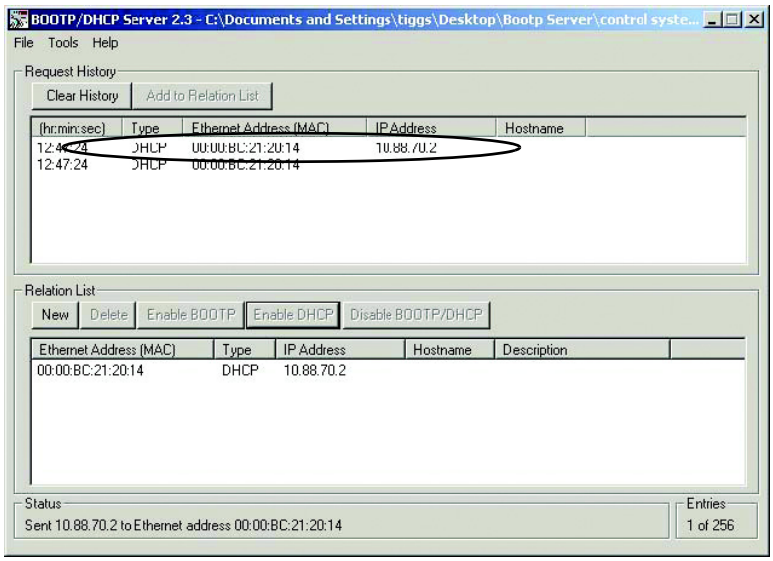
Figure 42 - New Entry Dialog Box



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

   The device is added to the Relation List, displaying the Ethernet Address (MAC) and corresponding IP Address, Hostname, and Description (if applicable).

Figure 43 - 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.

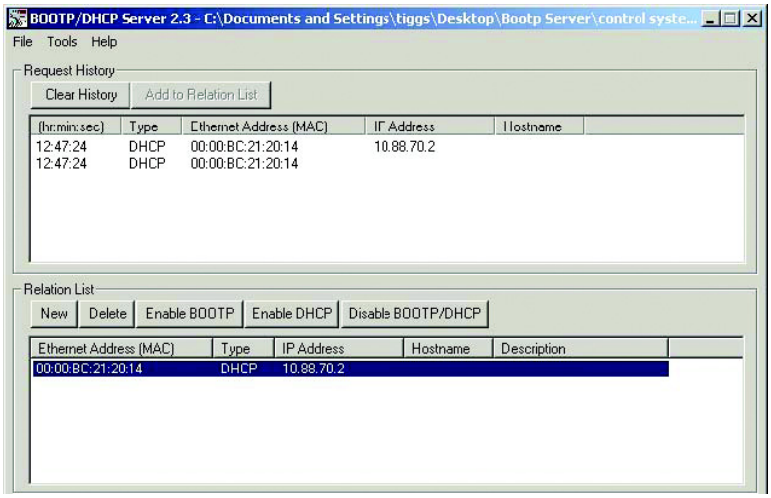
4. To assign this configuration to the device, highlight the device in the Relation List panel, and click the Disable BOOTP/DHCP button.

   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 44 - Enable DHCP Button

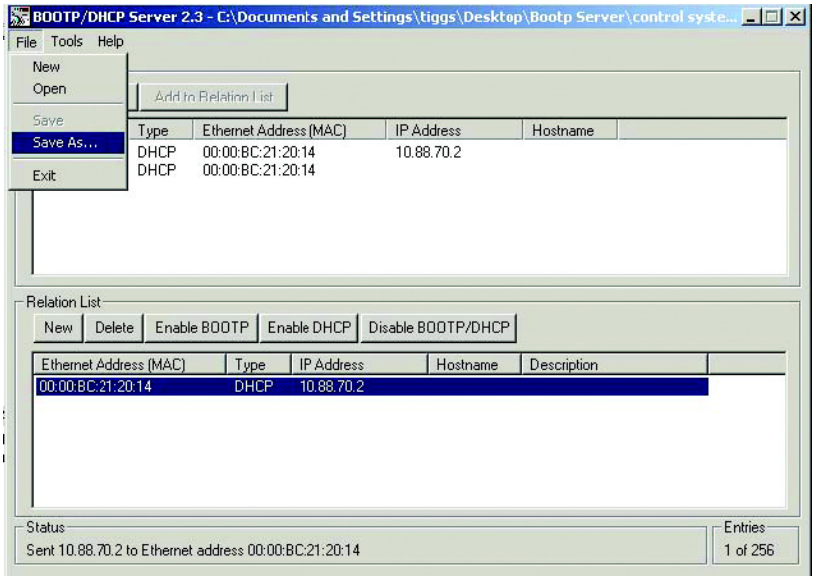


Save the Relation List

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

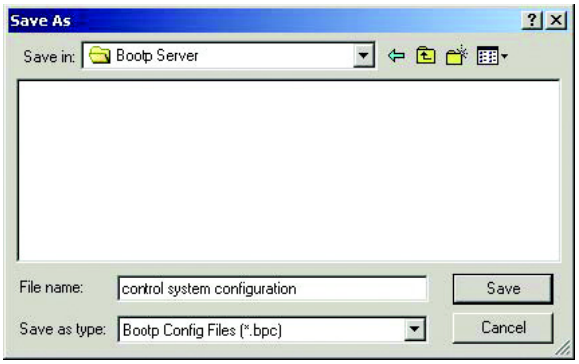
1. Select Save As... from the File menu.

Figure 45 - Save Relation List



You will see the Save As Dialog.

Figure 46 - Save As Dialog Box



2. Select the folder 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 containing the Relation List at a later session.

When DHCP is enabled (factory default Enabled), the unit will request its network configuration from a DHCP/BOOTP server. Any configuration received from a DHCP server will be stored in non-volatile memory.

The unit will try to obtain the same IP address from the DHCP server. If the server is not present (e.g., server fails to power up), the unit will use the IP address it previously received from the server. The DHCP timeout = 30 s.

Be cautious about using an unmanaged switch to assign the IP address. A DHCP server typically assigns a finite lease time to the offered IP address. The possibility exists that the ArmorStart LT would be assigned a different IP address which would cause a stop in communication with the controller.

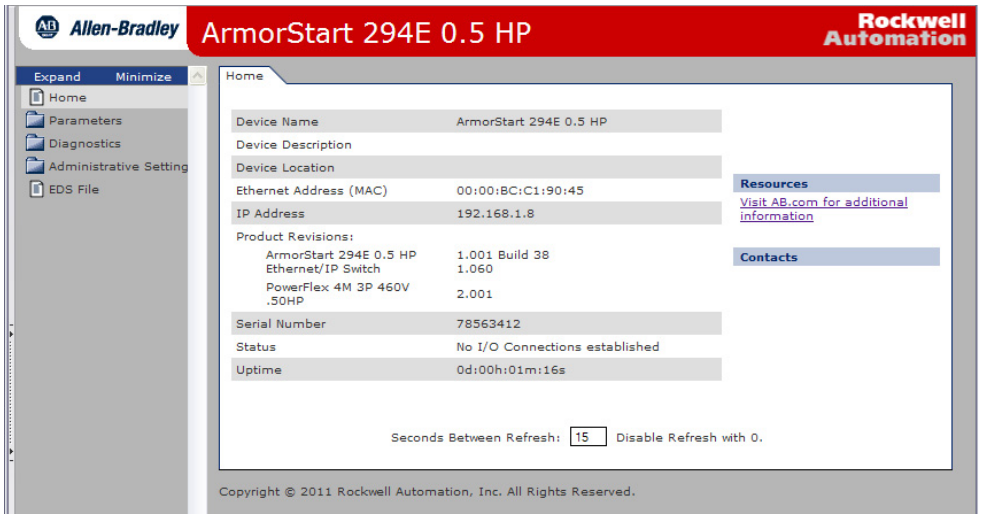
Embedded Web Server

The embedded web server is used to access configuration and status data.

IMPORTANT	The user should set the password to a unique value for authorized personnel. If the login and password are lost you will need to reset the device to the factory defaults, which results in losing its configuration.

To access the internal web browser, open your computer's internet browser and enter the IP address of the desired ArmorStart LT (for example, 192.168.1.1).

Figure 47 - Internal Web Browser

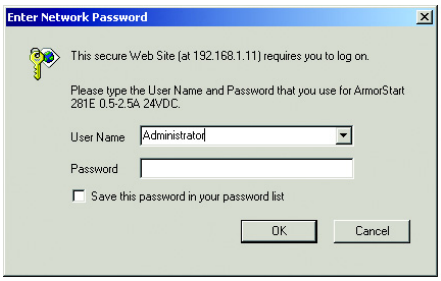


From here you are able to view parameter settings, device status, and diagnostics from multiple tab views.

Network Configuration

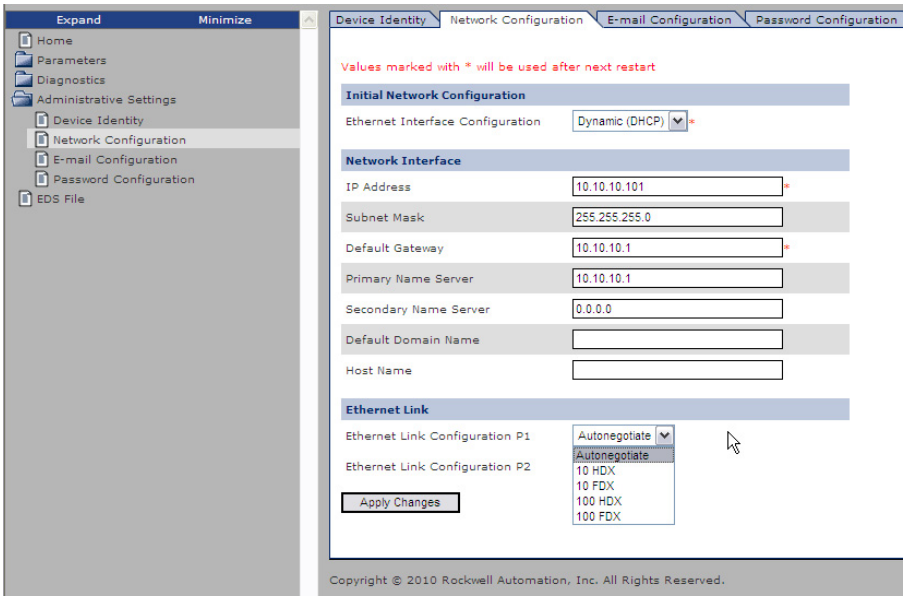
To access the network configuration, you will be prompted to login to the Administrative Setting.

Figure 48 - Enter Network Password



The user will be prompted to enter the default User Name (Administrator). The factory default password is blank. The user is expected to change the password to avoid unauthorized access.

Figure 49 - Network Configurations

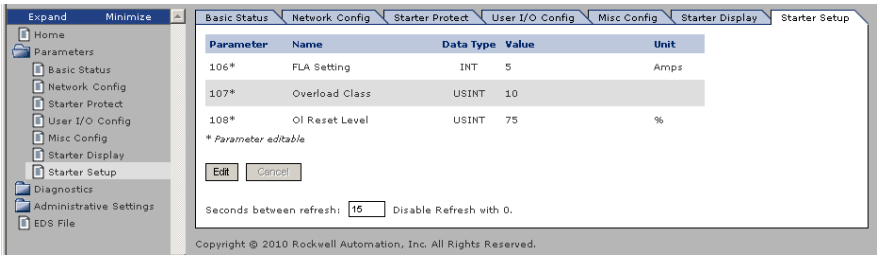


From this screen you can change the Ethernet Configuration. For example in the above image the IP address will be changed to 10.10.10.101. Choose “APPLY Changes” for new settings to take effect.

Parameter Configuration

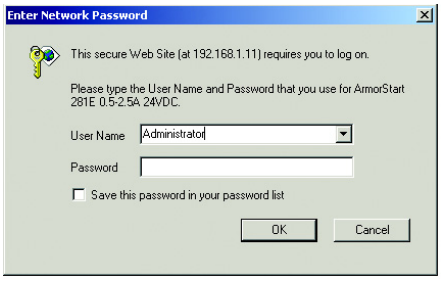
ArmorStart LT embedded web server provides the user the ability to view and modify the device configuration without having to access RSLogix 5000. To view the device configuration from the web server, select the parameters folder.

Figure 50 -



In the figure above, the Starter Setup parameters are viewed. To modify a parameter the user will click the “Edit” button.

Figure 51 - Enter Network Password

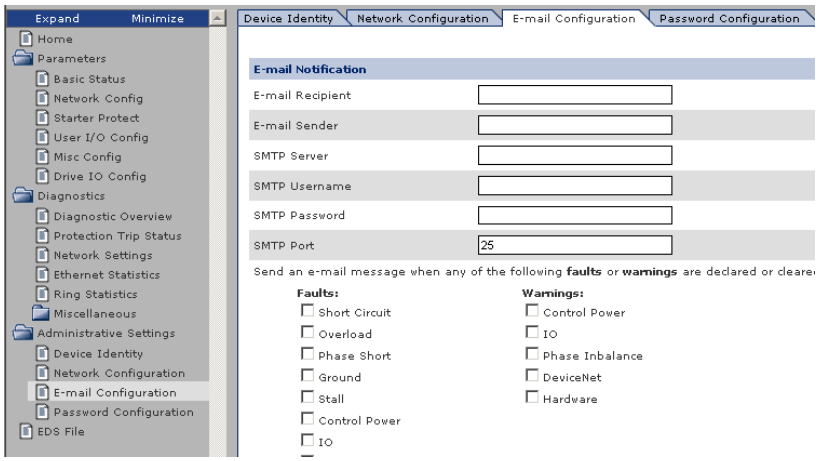


The user will be prompted to enter the default User Name (Administrator). The factory default password is blank. The user is expected to change the Password to avoid unauthorized access.

E-mail Notification Configuration

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

Figure 52 - E-mail Notification Configuration



E-mail triggers:

- when a trip occurs
- when a trip is cleared
- when a warning occurs
- when a warning is cleared

IMPORTANT "Cleared Event" e-mails will only be sent when all events have been cleared and if a trip event e-mail has previously been sent.

The following is an example trip e-mail:

Subject: ArmorStart LT 291E 1.1-7.6A has detected an Overload Trip

Body: Trip Snapshot:
SnapShotL1Amps: 1.11 Amps
SnapShotL2Amps: 2.22 Amps
SnapShotL3Amps: 3.33 Amps
SnapShotAveAmps: 2.22 Amps
SnapShot%Thermal: 55%

Trip Type: Overload Trip

Trip Info: Load has drawn excessive current based on the trip class selected.

Device Name: ArmorStart LT 291E Test Unit

Device Description: Latest AB On-Machine Offering

Device Location: Sixth Floor Comms Lab

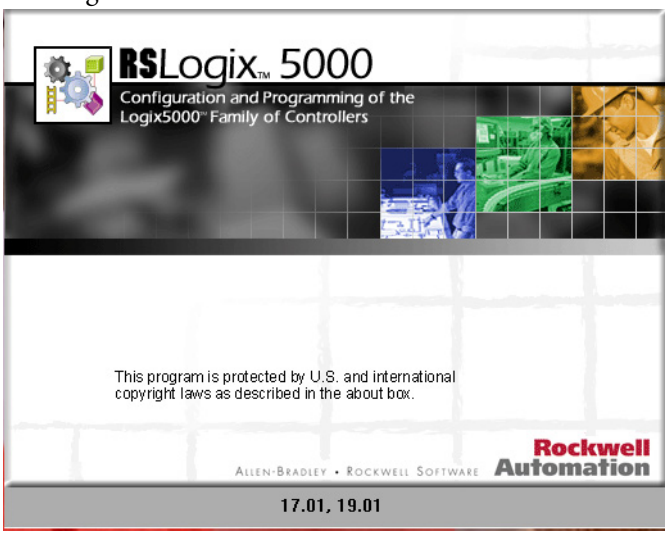
Contact Info: Contact 1 Info: Slicia Turnbull in California
Contact 2 Info: Steve Plummer on Friday

How to Add a New Module Using the Add-On Profile

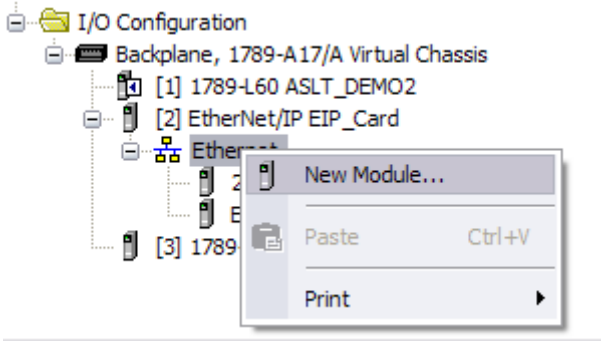
ArmorStart LT is provided with an Add-On Profile (AOP). An Add-on profile streamlines the programming and installation by eliminating the task of individually configuring the device tags and providing an easy to use configuration interface. In addition, the copy and paste function allows easy configuration of multiple ArmorStart LTs with RSLogix™ 5000 revision 17.01 or later. There is a known compatibility issue with revision 20.0. Update RSLogix 5000 to 20.1 or greater.

IMPORTANT If your version of RSLogix 5000 does not include the AOP for ArmorStart LT, it can be installed from http://support.rockwellautomation.com/controlflash/LogixProfiler.asp

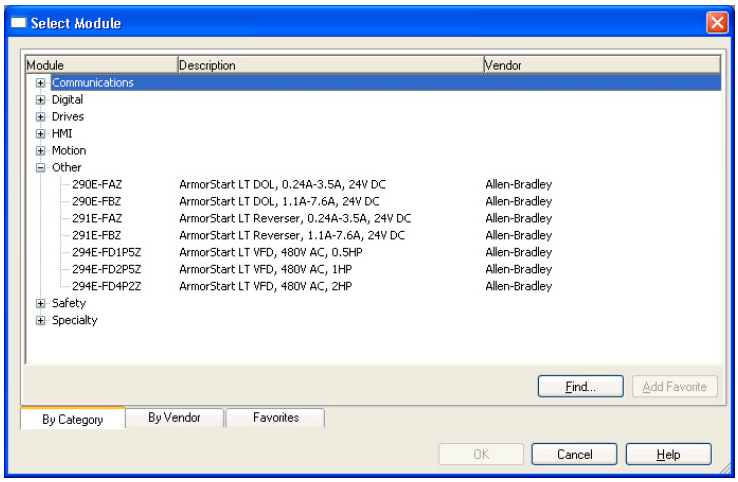
1. Launch RS Logix 5000



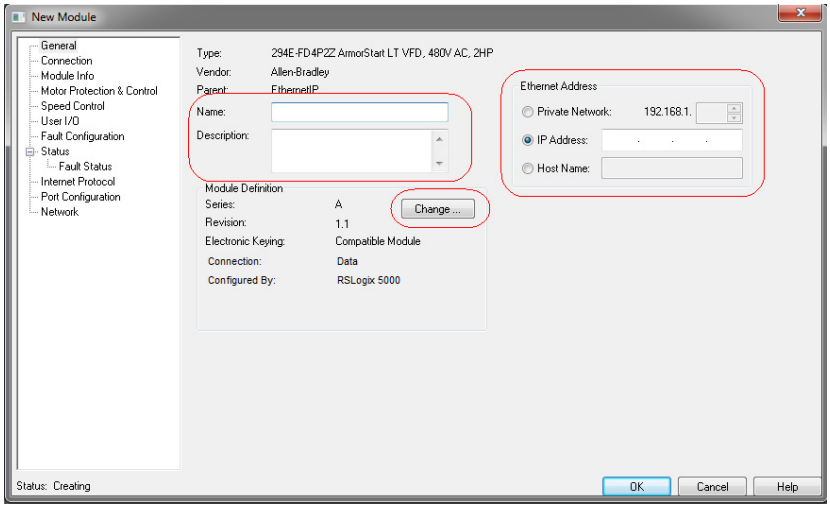
2. From the "I/O Configuration" tree add a "New Module"



3. From the list of modules find the ArmorStart LT using the catalog number. The AOP will include all options therefore the list will only display the base catalog number.



4. The “General” page is displayed. Enter a descriptive name for the ArmorStart LT.



5. In the “General” page enter the ArmorStart LT IP address. The “Private Address” corresponds to the local IP address configurations using the switches. The “IP Address” is a static address but configured from the webpage. This allows more flexibility in defining the address. If the address is served up, use “Host Name” field.

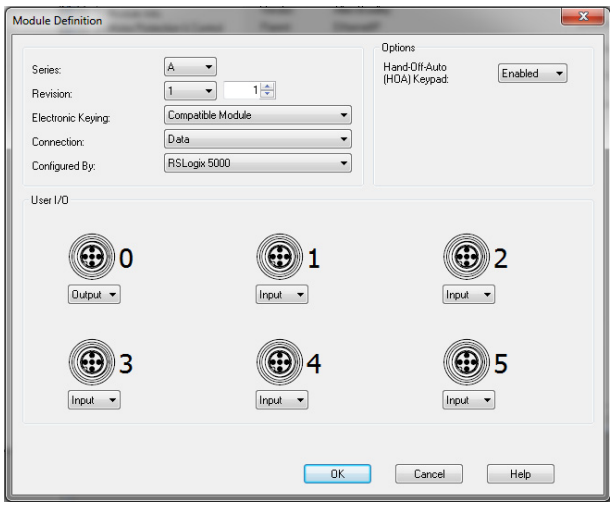
6. In the “General” page, select the “Change” button. From here, define what options are available and what discrete point, if any, will need to be defined as an output.

The “General” page of the ArmorStart LT AOP differs from many other product AOPs. The Module definition allows the user to specify the following items:

- Electronic Keying: Module Compatibility
- Configured By: RSLogix 5000 or ArmorStart LT Embedded Web Page
- Connection Type: Data or Listen Only

- User I/O Configuration: Specify the Input or Output use for each I/O point
- Keypad Option: Is product supplied with this option
- Electro-Mechanical Brake Option: Is product supplied with this option

The figure below is an example of the Module Definition page.



Electronic Keying

The electronic keying feature automatically compares the expected module, as shown in the RSLogix 5000 I/O Configuration tree, to the physical module before I/O communication begins. You can use electronic keying to help prevent communication to a module that does not match the type and revision expected. Typically, three keying options are available:

- Exact Match
  Exact Match keying requires all keying attributes, that is, Vendor, Product Type, Product Code (catalog number), Major Revision, and Minor Revision, of the physical module and the module created in the software to match precisely to establish communication.
- Compatible Keying
  Compatible Keying indicates that the module determines whether to accept or reject communication. Compatible Keying is the default setting.
- Disable Keying
  Disabled Keying indicates the keying attributes are not considered when attempting to communicate with a module.

ATTENTION: Be extremely cautious when using Disabled Keying; if used incorrectly, this option can lead to personal injury or death, property damage, or economic loss.

IMPORTANT Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

Connections

Two Class 1 connections for I/O transfer will be supported and six Class 3 explicit connections will be supported. The Class 1 connections are:

- Data
- Listen Only

Only one Data connection is allowed. A maximum of two Listen Only connections are supported (shared with the Data connection). This connection type is dependent on another connection to exist. If that connection (Data) is closed, the listen only connection shall be closed as well.

The connection sizes are:

ArmorStart	Connection Type	Connection Size (in bytes)
Bulletin290E/291E	Input	16
	Output	3
Bulletin 294E	Input	18
	Output	6

Configured by

The ArmorStart LT may be configured via the ArmorStart LT's web page or RS Logix 5000. Often times, customers utilize the web interface to configure the unit before it is ever connected to the PLC. The AOP will require the user to specify how the ArmorStart LT is configured, once added to RS Logix 5000. The valid options are:

- "Web Page" — The unit is configured by the ArmorStart LT's web pages. The AOP will NOT display any page or content of a page that allows configuration of the unit. In this mode Connection Type will include a "Backup" and "Restore" feature. The Backup selection will store parameter data in the RSLogix 5000 programming file and in the PLC. The Restore selection will allow the user to manually re-configure a replacement unit.
- "RSLogix 5000" — The unit is configured by RSLogix 5000. The AOP controls all parameter configurations. Any change made using the webpage will be over written by the PLC configuration. When the user changes the "Configured By" field from "Web Page" to "RSLogix 5000", the values stored by the "Backup" function will be copied to the configuration in the PLC. The "Backup/Restore" will no longer be displayed.

HOA Keypad Option

ArmorStart LT units are available with or without an HOA Keypad. The user will specify either “Installed” or “Not Installed”. When a unit is provided without the HOA keypad this setting should be set to “Not Installed” which removes the keypad parameters.

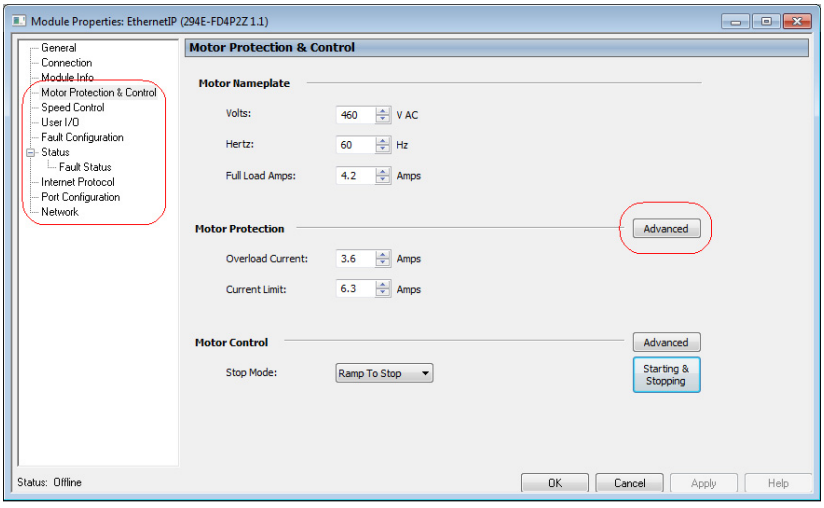
Source Brake, Electro-Mechanical Brake Option

ArmorStart LT units are available with or without an electromechanical (EM) brake. The user will select either “Installed” or “Not Installed”. When a unit is provided without an EM brake the setting should be set to Not Installed which removes the associated parameters.

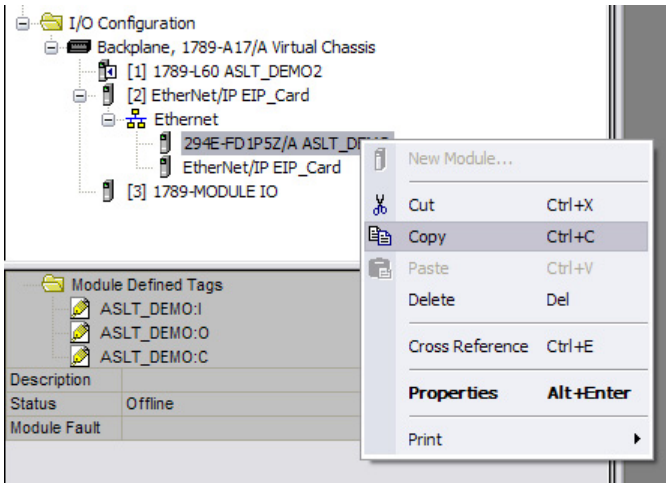
User Configurable I/O

The ArmorStart LT I/O points may be used as either an input or an output. The ArmorStart LT hardware does not require the user to specify a point’s actual use as an input or output, but the AOP requires the user to specify it to assign the correct tag name for the I/O point. When a point is configured as an input or output the corresponding tag name is “Pt0_Data”. If a point is configured as an output the corresponding feedback tag name is “Pt0_ReadBack”.

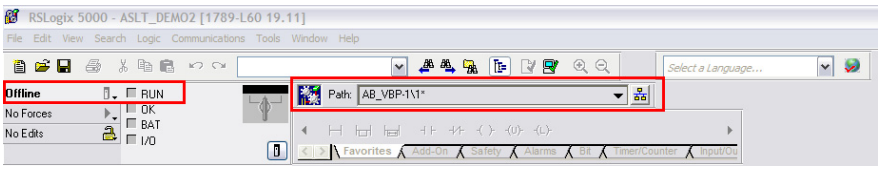
Using the navigation tree on the left, start configuring the ArmorStart LT with the simplified wizard. The minimum configuration is displayed on each page. Review each field to determine if the default setting is acceptable or modify as appropriate for your application. Note that more advanced properties are available using the “Advance” buttons on the screen.



Once complete the new ArmorStart LT will appear in the Ethernet tree. If there are multiple ArmorStart LTs with similar configurations, utilize the copy-paste function and update only those parameters that change between units.



The final step is to download your project to the controller and the ArmorStart LT. Define the path to the PLC and then download.



RSLogix 5000 Add-On Profile

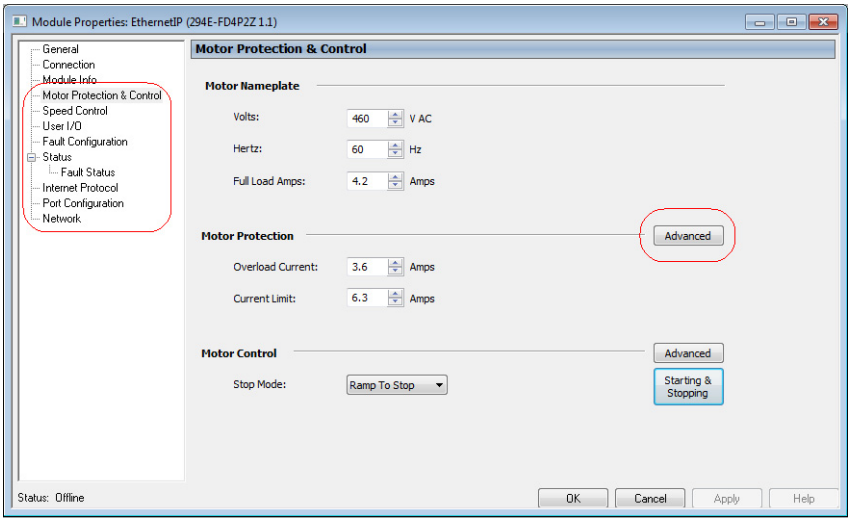
The Add-On Profile (AOP) for ArmorStart LT consists of several standard pages and multiple product specific pages for configuration within RS Logix 5000. In addition the AOP will automatically create descriptive tag names for the input and output assemblies.

The following table lists the available AOPs for ArmorStart LT when adding a new module in RS Logix 5000.

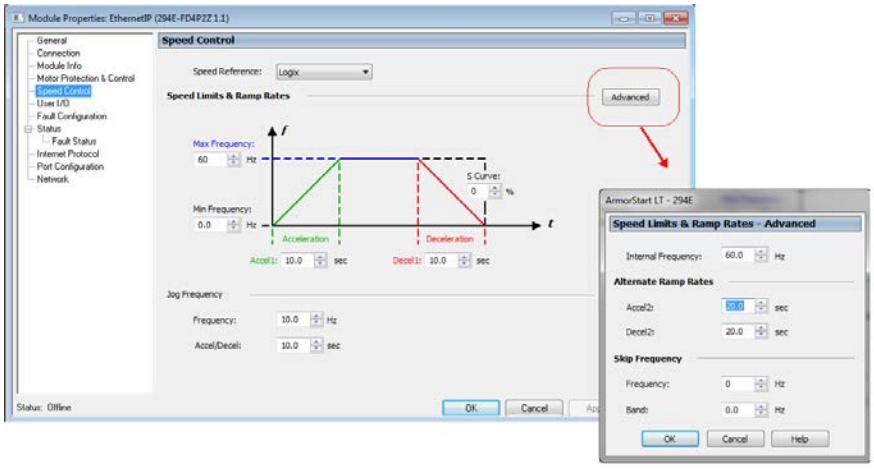
Catalog Number	AOP Description
290E-FAZ	ArmorStart LT DOL, 0.24…3.5 A, 24V DC
290E-FBZ	ArmorStart LT DOL, 1.1…7.6 A, 24V DC
291E-FAZ	ArmorStart LT Reverser, 0.24…3.5 A, 24V DC
291E-FBZ	ArmorStart LT Reverser, 1.1…7.6 A, 24V DC
294E-FVD1P5Z	ArmorStart LT VFD, 480V AC, 0.5 Hp
294E-FVD2P5Z	ArmorStart LT VFD, 480V AC, 1 Hp
294E-FVD4P2Z	ArmorStart LT VFD, 480V AC, 2 Hp
290E-FAP	ArmorStart LT DOL, 0.24…3.5 A, IPS
290E-FBP	ArmorStart LT DOL, 1.1…7.6 A, IPS
291E-FAP	ArmorStart LT Reverser, 0.24…3.5 A, IPS
291E-FBP	ArmorStart LT Reverser, 1.1…7.6 A, IPS

Catalog Number	AOP Description
294E-FVD1P5P	ArmorStart LT VFD, 480V AC, 0.5 Hp, IPS
294E-FVD2P5P	ArmorStart LT VFD, 480V AC, 1 Hp, IPS
294E-FVD4P2P	ArmorStart LT VFD, 480V AC, 2 Hp, IPS

The AOP presents an organized view of parameters within groups and specific functional pages. All of the parameters are distributed within the AOP pages. Each page includes basic information that must be reviewed by the user. In addition, within each page there are capabilities that can be accessed using the advance buttons.

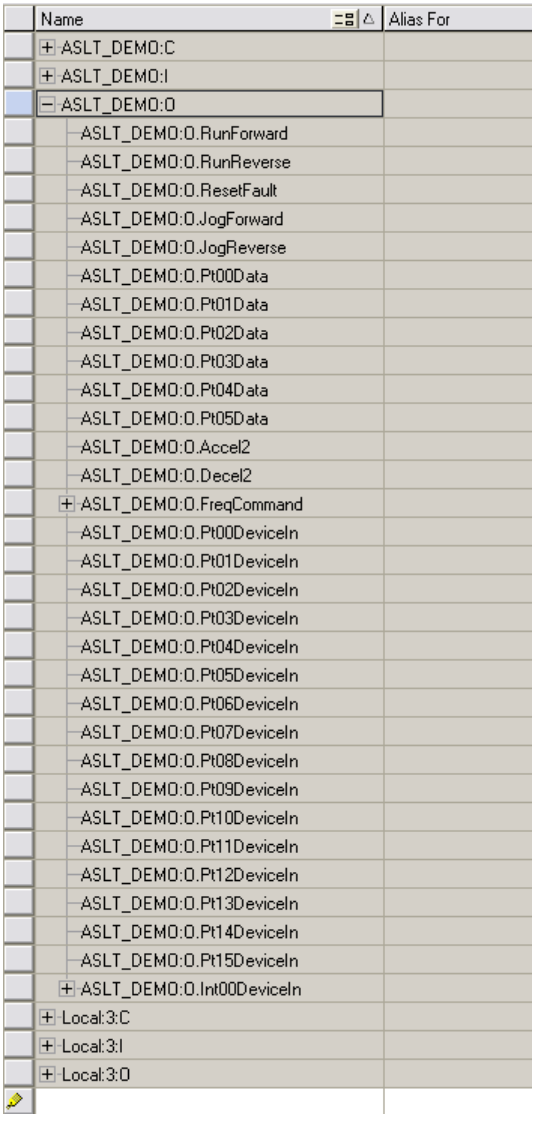


The AOP page below is an example of the “Advanced” button that provides the user additional functionality.



Auto-Generated Tags

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



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

Table 10 - Default Consume Assembly for Bulletin 294E

Instance 154 "Drive Cmd" – Default Consumed Assembly for Bulletin 294 Starters								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0				JogReverse	JogForward	ResetFault	RunReverse	**RunForward**
1	Decel2	Accel2	**Out05**	**Out04**	**Out03**	**Out02**	**Out01**	**Out00**
2	**CommandFreq (Low) (xxx.x Hz)**							
3	**CommandFreq (High) (xxx.x Hz)**							
4	Pt07DeviceIn	Pt06DeviceIn	Pt05DeviceIn	Pt04DeviceIn	Pt03DeviceIn	Pt02DeviceIn	Pt01DeviceIn	Pt00DeviceIn
5	Pt15DeviceIn	Pt14DeviceIn	Pt13DeviceIn	Pt12DeviceIn	Pt11DeviceIn	Pt10DeviceIn	Pt09DeviceIn	Pt08DeviceIn
6	AnalogDeviceIn (low byte)							
7	AnalogDeviceIn (high byte)							

Table 11 - Bulletin 294E Consume Assembly Command Tags

Device Name	Name	Logix Tag Name	Data Type	Style
ASLT_DEM0	**RunForward**	**ASLT_DEM0:0.RunForward**	BOOL	Decimal
ASLT_DEM0	RunReverse	ASLT_DEM0:0.RunReverse	BOOL	Decimal
ASLT_DEM0	ResetFault	ASLT_DEM0:0.ResetFault	BOOL	Decimal
ASLT_DEM0	JogForward	ASLT_DEM0:0.JogForward	BOOL	Decimal
ASLT_DEM0	JogReverse	ASLT_DEM0:0.JogReverse	BOOL	Decimal
ASLT_DEM0	**Pt00Data**	**ASLT_DEM0:0.Pt00Data**	BOOL	Decimal
ASLT_DEM0	**Pt01Data**	**ASLT_DEM0:0.Pt01Data**	BOOL	Decimal
ASLT_DEM0	**Pt02Data**	**ASLT_DEM0:0.Pt02Data**	BOOL	Decimal
ASLT_DEM0	**Pt03Data**	**ASLT_DEM0:0.Pt03Data**	BOOL	Decimal
ASLT_DEM0	**Pt04Data**	**ASLT_DEM0:0.Pt04Data**	BOOL	Decimal
ASLT_DEM0	**Pt05Data**	**ASLT_DEM0:0.Pt05Data**	BOOL	Decimal
ASLT_DEM0	Accel2	ASLT_DEM0:0.Accel2	BOOL	Decimal
ASLT_DEM0	Decel2	ASLT_DEM0:0.Decel2	BOOL	Decimal
ASLT_DEM0	**FreqCommand**	**ASLT_DEM0:0.FreqCommand**	INT	Decimal
ASLT_DEM0	Pt00DeviceIn	ASLT_DEM0:0.Pt00DeviceIn	BOOL	Decimal
ASLT_DEM0	Pt01DeviceIn	ASLT_DEM0:0.Pt01DeviceIn	BOOL	Decimal
ASLT_DEM0	Pt02DeviceIn	ASLT_DEM0:0.Pt02DeviceIn	BOOL	Decimal
ASLT_DEM0	Pt03DeviceIn	ASLT_DEM0:0.Pt03DeviceIn	BOOL	Decimal
ASLT_DEM0	Pt04DeviceIn	ASLT_DEM0:0.Pt04DeviceIn	BOOL	Decimal
ASLT_DEM0	Pt05DeviceIn	ASLT_DEM0:0.Pt05DeviceIn	BOOL	Decimal
ASLT_DEM0	Pt06DeviceIn	ASLT_DEM0:0.Pt06DeviceIn	BOOL	Decimal
ASLT_DEM0	Pt07DeviceIn	ASLT_DEM0:0.Pt07DeviceIn	BOOL	Decimal
ASLT_DEM0	Pt08DeviceIn	ASLT_DEM0:0.Pt08DeviceIn	BOOL	Decimal
ASLT_DEM0	Pt09DeviceIn	ASLT_DEM0:0.Pt09DeviceIn	BOOL	Decimal
ASLT_DEM0	Pt10DeviceIn	ASLT_DEM0:0.Pt10DeviceIn	BOOL	Decimal
ASLT_DEM0	Pt11DeviceIn	ASLT_DEM0:0.Pt11DeviceIn	BOOL	Decimal
ASLT_DEM0	Pt12DeviceIn	ASLT_DEM0:0.Pt12DeviceIn	BOOL	Decimal
ASLT_DEM0	Pt13DeviceIn	ASLT_DEM0:0.Pt13DeviceIn	BOOL	Decimal

Device Name	Name	Logix Tag Name	Data Type	Style
ASLT_DEM0	Pt14DeviceIn	ASLT_DEM0:O.Pt14DeviceIn	BOOL	Decimal
ASLT_DEM0	Pt15DeviceIn	ASLT_DEM0:O.Pt15DeviceIn	BOOL	Decimal
ASLT_DEM0	Int00DeviceIn	ASLT_DEM0:O.Int00DeviceIn	BOOL	Decimal

Table 12 - Default Produce Assembly for Bulletin 294E

Instance 156 "Drive Status" - Produced Assembly for Bulletin 294 Starters								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	**Reserved - (name):I.ConnectionFault ❶**							
1	**Reserved - (name):I.ConnectionFault ❶**							
2	**Reserved - (name):I.ConnectionFault ❶**							
3	**Reserved - (name):I.ConnectionFault ❶**							
4	AtReference	NetRefStatus	NetControlStatus	Ready	RunningReverse	**RunningForward**	WarningPresent	TripPresent
5	BrakeStatus	DisconnectClosed		KeyPadJogging	KeyPadHand	KeyPadOff	KeyPadAuto	DLXEnabled
6	OutputFrequency (Low) (xxx.x Hz)							
7	OutputFrequency (High) (xxx.x Hz)							
8			**Pt05**	**Pt04**	**Pt03**	**Pt02**	**Pt01**	**Pt00**
9								
10	Pt07DeviceOut	Pt06DeviceOut	Pt05DeviceOut	Pt04DeviceOut	Pt03DeviceOut	Pt02DeviceOut	Pt01DeviceOut	Pt00DeviceOut
11	Pt15DeviceOut	Pt14DeviceOut	Pt13DeviceOut	Pt12DeviceOut	Pt11DeviceOut	Pt10DeviceOut	Pt09DeviceOut	Pt08DeviceOut
12	AnalogDeviceOut (low byte)							
13	AnalogDeviceOut (high byte)							
14	Param3 — OutputCurrent							
15								
16	Param 4 — OutputVoltage							
17								
18	Param 5 — DCBusVoltage							
19								
20	Param 11 — SwitchedVolts (OutputSourceV, IPS units)							
21								
22	Param 12 — UnswitchedVolts (SensorSourceV, IPS units)							
23								
24	Param 13 — InternalFanRPM							
25								
26	Param 14 — ElapesedRunTime							
27								
28	Param 15 — DriveTemperature							
29								
30	Param 16 — TripStatus							
31								
32	Param 17 — WarningStatus							
33								

❶ PLC Communication Fault Only

Table 13 - Bulletin 294E Produced Assembly Status Tags

Device Name	Name	Logix Tag Name	Data Type	Style
ASLT_DEM0	**Fault**	**ASLT_DEM0:I.Fault**	DINT	Binary
ASLT_DEM0	TripPresent	ASLT_DEM0:I.TripPresent	BOOL	Decimal
ASLT_DEM0	WarningPresent	ASLT_DEM0:I.WarningPresent	BOOL	Decimal
ASLT_DEM0	**RunningForward**	**ASLT_DEM0:I.RunningForward**	BOOL	Decimal
ASLT_DEM0	RunningReverse	ASLT_DEM0:I.RunningReverse	BOOL	Decimal
ASLT_DEM0	Ready	ASLT_DEM0:I.Ready	BOOL	Decimal
ASLT_DEM0	NetworkControlStatus	ASLT_DEM0:I.NetworkControlStatus	BOOL	Decimal
ASLT_DEM0	NetworkReferenceStatus	ASLT_DEM0:I.NetworkReferenceStatus	BOOL	Decimal
ASLT_DEM0	AtReference	ASLT_DEM0:I.AtReference	BOOL	Decimal
ASLT_DEM0	DeviceLogixEnabled	ASLT_DEM0:I.DeviceLogixEnabled	BOOL	Decimal
ASLT_DEM0	KeypadAuto	ASLT_DEM0:I.KeypadAuto	BOOL	Decimal
ASLT_DEM0	KeypadOff	ASLT_DEM0:I.KeypadOff	BOOL	Decimal
ASLT_DEM0	KeypadHand	ASLT_DEM0:I.KeypadHand	BOOL	Decimal
ASLT_DEM0	KeypadJogging	ASLT_DEM0:I.KeypadJogging	BOOL	Decimal
ASLT_DEM0	DisconnectClosed	ASLT_DEM0:I.DisconnectClosed	BOOL	Decimal
ASLT_DEM0	BrakeContactorStatus	ASLT_DEM0:I.BrakeContactorStatus	BOOL	Decimal
ASLT_DEM0	OutputFrequency	ASLT_DEM0:I.OutputFrequency	INT	Decimal
ASLT_DEM0	**Pt00Data**	**ASLT_DEM0:I.Pt00Data**	BOOL	Decimal
ASLT_DEM0	**Pt01Data**	**ASLT_DEM0:I.Pt01Data**	BOOL	Decimal
ASLT_DEM0	**Pt02Data**	**ASLT_DEM0:I.Pt02Data**	BOOL	Decimal
ASLT_DEM0	**Pt03Data**	**ASLT_DEM0:I.Pt03Data**	BOOL	Decimal
ASLT_DEM0	**Pt04Data**	**ASLT_DEM0:I.Pt04Data**	BOOL	Decimal
ASLT_DEM0	**Pt05Data**	**ASLT_DEM0:I.Pt05Data**	BOOL	Decimal
ASLT_DEM0	Pt00DeviceOut	ASLT_DEM0:I.Pt00DeviceOut	BOOL	Decimal
ASLT_DEM0	Pt01DeviceOut	ASLT_DEM0:I.Pt01DeviceOut	BOOL	Decimal
ASLT_DEM0	Pt02DeviceOut	ASLT_DEM0:I.Pt02DeviceOut	BOOL	Decimal
ASLT_DEM0	Pt03DeviceOut	ASLT_DEM0:I.Pt03DeviceOut	BOOL	Decimal
ASLT_DEM0	Pt04DeviceOut	ASLT_DEM0:I.Pt04DeviceOut	BOOL	Decimal
ASLT_DEM0	Pt05DeviceOut	ASLT_DEM0:I.Pt05DeviceOut	BOOL	Decimal
ASLT_DEM0	Pt06DeviceOut	ASLT_DEM0:I.Pt06DeviceOut	BOOL	Decimal
ASLT_DEM0	Pt07DeviceOut	ASLT_DEM0:I.Pt07DeviceOut	BOOL	Decimal
ASLT_DEM0	Pt08DeviceOut	ASLT_DEM0:I.Pt08DeviceOut	BOOL	Decimal
ASLT_DEM0	Pt09DeviceOut	ASLT_DEM0:I.Pt09DeviceOut	BOOL	Decimal
ASLT_DEM0	Pt10DeviceOut	ASLT_DEM0:I.Pt10DeviceOut	BOOL	Decimal
ASLT_DEM0	Pt11DeviceOut	ASLT_DEM0:I.Pt11DeviceOut	BOOL	Decimal
ASLT_DEM0	Pt12DeviceOut	ASLT_DEM0:I.Pt12DeviceOut	BOOL	Decimal
ASLT_DEM0	Pt13DeviceOut	ASLT_DEM0:I.Pt13DeviceOut	BOOL	Decimal
ASLT_DEM0	Pt14DeviceOut	ASLT_DEM0:I.Pt14DeviceOut	BOOL	Decimal
ASLT_DEM0	Pt15DeviceOut	ASLT_DEM0:I.Pt15DeviceOut	BOOL	Decimal
ASLT_DEM0	Int00DeviceOut	ASLT_DEM0:I.Int00DeviceOut	INT	Decimal
ASLT_DEM0	OutputCurrent	ASLT_DEM0:I.OutputCurrent	INT	Decimal
ASLT_DEM0	OutputVoltage	ASLT_DEM0:I.OutputVoltage	INT	Decimal

Device Name	Name	Logix Tag Name	Data Type	Style
ASLT_DEMO	DCBusVoltage	ASLT_DEMO:I.DCBusVoltage	INT	Decimal
ASLT_DEMO	SwitchedVoltageLevel	ASLT_DEMO:I.SwitchedVoltageLevel	INT	Decimal
ASLT_DEMO	UnswitchedVoltageLevel	ASLT_DEMO:I.UnswitchedVoltageLevel	INT	Decimal
ASLT_DEMO	InternalFanRPM	ASLT_DEMO:I.InternalFanRPM	INT	Decimal
ASLT_DEMO	OperatingHours	ASLT_DEMO:I.OperatingHours	INT	Decimal
ASLT_DEMO	DriveTemperature	ASLT_DEMO:I.DriveTemperature	INT	Decimal
ASLT_DEMO	TripStatus	ASLT_DEMO:I.TripStatus	INT	Binary
ASLT_DEMO	WarningStatus	ASLT_DEMO:I.WarningStatus	INT	Binary

Table 14 - Bulletin 294E Consume Assembly/Command Tag Explanation

Device 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
Pt00Data	If user defined as output, commnd output ON
Pt01Data	If user defined as output, commnd output ON
Pt02Data	If user defined as output, commnd output ON
Pt03Data	If user defined as output, commnd output ON
Pt04Data	If user defined as output, commnd output ON
Pt05Data	If user defined as output, commnd output ON
Accel2	VFD acceleration ramp 2
Decel2	VFD deceleration ramp 2
FreqCommand	Logix command 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
Int00DeviceIn	Network analog input to DeviceLogix engine

Table 15 - Bulletin 294E Produced Assembly/Status Tag Explanation

Device Input Status Tags	Tag Description/Use
Fault	Communication fault between PLC and device (all 1s = fault, all 0s = normal)
TripPresent	Fault exists within unit
WarningPresent	Warning of potential fault
RunningForward	Motor commanded to run forward
RunningReverse	Motor commanded to run reverse
Ready	Control and 3-phase power 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
DeviceLogixEnabled	DeviceLogix is enabled
KeypadAuto	HOA is in Auto mode
KeypadOff	HOA is in Off mode
KeypadHand	HOA is in Hand mode
KeypadJogging	HOA is in Jog mode
DisconnectClosed	Disconnect is closed
BrakeContactorStatus	Source brake contactor status (1 = close, 0 = open)
OutputFrequency	VFD frequency
Pt00Data	User-configured I/O status
Pt01Data	User-configured I/O status
Pt02Data	User-configured I/O status
Pt03Data	User-configured I/O status
Pt04Data	ASLT_DEMO:I.Pt04Data
Pt05Data	User-configured I/O status
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
Pt15DeviceOut	DeviceLogix network output status
Int00DeviceOut	DeviceLogix network analog output
OutputCurrent	VFD output current — Parameter 3
OutputVoltage	VFD output voltage — Parameter 4

Device Input Status Tags	Tag Description/Use
DCBusVoltage	VFD DC bus voltage — Parameter 5
SwitchedVoltageLevel	Switched control power voltage — Parameter 11
UnswitchedVoltageLevel	Unswitched control power voltage — Parameter 12
InternalFanRPM	VFD fan speed — Parameter 13
OperatingHours	Elapse run hours — Parameter 14
DriveTemperature	VFD internal temperature — Parameter 15
TripStatus	Bit enumerate trip status — Parameter 16
WarningStatus	Bit enumerate warning status — Parameter 17

Table 16 - Default Consume Assembly for Bulletin 290E/291E

Instance 150 "Starter Cmd" - DeviceLogix Consumed Assembly for Bulletin 290 / 291 Starters								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0						**ResetFault**	RunReverse	RunForward
1			**Out05**	Out04	Out03	Out02	Out01	Out00
2	Pt07DeviceIn	Pt06DeviceIn	Pt05DeviceIn	Pt04DeviceIn	Pt03DeviceIn	Pt02DeviceIn	Pt01DeviceIn	Pt00DeviceIn
3	Pt15DeviceIn	Pt14DeviceIn	Pt13DeviceIn	Pt12DeviceIn	Pt11DeviceIn	Pt10DeviceIn	Pt09DeviceIn	Pt08DeviceIn
4	AnalogDeviceIn (low byte)							
5	AnalogDeviceIn (high byte)							

Table 17 - Bulletin 290E/291E Consume Assembly Command Tags

Device Name	Name	Logix Tag Name	Data Type	Style
DEMO_REV	RunForward	DEMO_REV:O.RunForward	BOOL	Decimal
DEMO_REV	RunReverse	DEMO_REV:O.RunReverse	BOOL	Decimal
DEMO_REV	**ResetFault**	**DEMO_REV:O.ResetFault**	BOOL	Decimal
DEMO_REV	Pt00Data	DEMO_REV:O.Pt00Data	BOOL	Decimal
DEMO_REV	Pt01Data	DEMO_REV:O.Pt01Data	BOOL	Decimal
DEMO_REV	Pt02Data	DEMO_REV:O.Pt02Data	BOOL	Decimal
DEMO_REV	Pt03Data	DEMO_REV:O.Pt03Data	BOOL	Decimal
DEMO_REV	Pt04Data	DEMO_REV:O.Pt04Data	BOOL	Decimal
DEMO_REV	**Pt05Data**	**DEMO_REV:O.Pt05Data**	BOOL	Decimal
DEMO_REV	Pt00DeviceIn	DEMO_REV:O.Pt00DeviceIn	BOOL	Decimal
DEMO_REV	Pt01DeviceIn	DEMO_REV:O.Pt01DeviceIn	BOOL	Decimal
DEMO_REV	Pt02DeviceIn	DEMO_REV:O.Pt02DeviceIn	BOOL	Decimal
DEMO_REV	Pt03DeviceIn	DEMO_REV:O.Pt03DeviceIn	BOOL	Decimal
DEMO_REV	Pt04DeviceIn	DEMO_REV:O.Pt04DeviceIn	BOOL	Decimal
DEMO_REV	Pt05DeviceIn	DEMO_REV:O.Pt05DeviceIn	BOOL	Decimal
DEMO_REV	Pt06DeviceIn	DEMO_REV:O.Pt06DeviceIn	BOOL	Decimal
DEMO_REV	Pt07DeviceIn	DEMO_REV:O.Pt07DeviceIn	BOOL	Decimal
DEMO_REV	Pt08DeviceIn	DEMO_REV:O.Pt08DeviceIn	BOOL	Decimal
DEMO_REV	Pt09DeviceIn	DEMO_REV:O.Pt09DeviceIn	BOOL	Decimal
DEMO_REV	Pt10DeviceIn	DEMO_REV:O.Pt10DeviceIn	BOOL	Decimal
DEMO_REV	Pt11DeviceIn	DEMO_REV:O.Pt11DeviceIn	BOOL	Decimal
DEMO_REV	Pt12DeviceIn	DEMO_REV:O.Pt12DeviceIn	BOOL	Decimal
DEMO_REV	Pt13DeviceIn	DEMO_REV:O.Pt13DeviceIn	BOOL	Decimal
DEMO_REV	Pt14DeviceIn	DEMO_REV:O.Pt14DeviceIn	BOOL	Decimal
DEMO_REV	Pt15DeviceIn	DEMO_REV:O.Pt15DeviceIn	BOOL	Decimal
DEMO_REV	Int00DeviceIn	DEMO_REV:O.Int00DeviceIn	INT	Decimal

Table 18 - Bulletin 290E/291E Starters Starter Stat Produced Assembly

Instance 152 "Starter Stat" - Produced Assembly for Bulletin 290E / 291E Starters								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved - (name):I.ConnectionFault ❶							
1	Reserved - (name):I.ConnectionFault ❶							
2	Reserved - (name):I.ConnectionFault ❶							
3	Reserved - (name):I.ConnectionFault ❶							
4	**CurrentFlowing**		NetControlStatus	Ready	RunningReverse	RunningForward	WarningPresent	TripPresent
5		DisconnectClosed			KeyPadHand	KeyPadOff	KeyPadAuto	DLXEnabled
6			Pt05	Pt04	Pt03	Pt02	Pt01	Pt00
7								
8	Pt07DeviceOut	Pt06DeviceOut	Pt05DeviceOut	Pt04DeviceOut	Pt03DeviceOut	Pt02DeviceOut	Pt01DeviceOut	Pt00DeviceOut
9	Pt15DeviceOut	Pt14DeviceOut	Pt13DeviceOut	Pt12DeviceOut	Pt11DeviceOut	Pt10DeviceOut	Pt09DeviceOut	Pt08DeviceOut
10	AnalogDeviceOut (low byte)							
11	AnalogDeviceOut (high byte)							
12	Param 1— PhaseL1Current							
13								
14	Param 2— PhaseL2Current							
15								
16	Param 3— PhaseL3Current							
17								
18	Param 4— AverageCurrent							
19								
20	**Param 5—%ThermalUtilized**							
21								
22	Param 11 — SwitchedVolts (OutputSourceV, IPS units)							
23								
24	Param 12 — UnswitchedVolts (SensorSourceV, IPS units)							
25								
26	Param 16 — TripStatus							
27								
28	Param 17 — WarningStatus							
29								

❶ PLC Communication Fault Only

Table 19 - Bulletin 290E/291E Produced Assembly Status Tags

Device Name	Name	Logix Tag Name	Data Type	Style
DEMO_REV	Fault	DEMO_REV:I.Fault	DINT	Binary
DEMO_REV	TripPresent	DEMO_REV:I.TripPresent	BOOL	Decimal
DEMO_REV	WarningPresent	DEMO_REV:I.WarningPresent	BOOL	Decimal
DEMO_REV	RunningForward	DEMO_REV:I.RunningForward	BOOL	Decimal
DEMO_REV	RunningReverse	DEMO_REV:I.RunningReverse	BOOL	Decimal
DEMO_REV	Ready	DEMO_REV:I.Ready	BOOL	Decimal
DEMO_REV	**CurrentFlowing**	**DEMO_REV:I.CurrentFlowing**	BOOL	Decimal

Device Name	Name	Logix Tag Name	Data Type	Style
DEMO_REV	DeviceLogixEnabled	DEMO_REV:I.DeviceLogixEnabled	BOOL	Decimal
DEMO_REV	KeypadAuto	DEMO_REV:I.KeypadAuto	BOOL	Decimal
DEMO_REV	KeypadOff	DEMO_REV:I.KeypadOff	BOOL	Decimal
DEMO_REV	KeypadHand	DEMO_REV:I.KeypadHand	BOOL	Decimal
DEMO_REV	DisconnectClosed	DEMO_REV:I.DisconnectClosed	BOOL	Decimal
DEMO_REV	Pt00Data	DEMO_REV:I.Pt00Data	BOOL	Decimal
DEMO_REV	Pt01Data	DEMO_REV:I.Pt01Data	BOOL	Decimal
DEMO_REV	Pt02Data	DEMO_REV:I.Pt02Data	BOOL	Decimal
DEMO_REV	Pt03Data	DEMO_REV:I.Pt03Data	BOOL	Decimal
DEMO_REV	Pt04Data	DEMO_REV:I.Pt04Data	BOOL	Decimal
DEMO_REV	Pt05Data	DEMO_REV:I.Pt05Data	BOOL	Decimal
DEMO_REV	Pt00DeviceOut	DEMO_REV:I.Pt00DeviceOut	BOOL	Decimal
DEMO_REV	Pt01DeviceOut	DEMO_REV:I.Pt01DeviceOut	BOOL	Decimal
DEMO_REV	Pt02DeviceOut	DEMO_REV:I.Pt02DeviceOut	BOOL	Decimal
DEMO_REV	Pt03DeviceOut	DEMO_REV:I.Pt03DeviceOut	BOOL	Decimal
DEMO_REV	Pt04DeviceOut	DEMO_REV:I.Pt04DeviceOut	BOOL	Decimal
DEMO_REV	Pt05DeviceOut	DEMO_REV:I.Pt05DeviceOut	BOOL	Decimal
DEMO_REV	Pt06DeviceOut	DEMO_REV:I.Pt06DeviceOut	BOOL	Decimal
DEMO_REV	Pt07DeviceOut	DEMO_REV:I.Pt07DeviceOut	BOOL	Decimal
DEMO_REV	Pt08DeviceOut	DEMO_REV:I.Pt08DeviceOut	BOOL	Decimal
DEMO_REV	Pt09DeviceOut	DEMO_REV:I.Pt09DeviceOut	BOOL	Decimal
DEMO_REV	Pt10DeviceOut	DEMO_REV:I.Pt10DeviceOut	BOOL	Decimal
DEMO_REV	Pt11DeviceOut	DEMO_REV:I.Pt11DeviceOut	BOOL	Decimal
DEMO_REV	Pt12DeviceOut	DEMO_REV:I.Pt12DeviceOut	BOOL	Decimal
DEMO_REV	Pt13DeviceOut	DEMO_REV:I.Pt13DeviceOut	BOOL	Decimal
DEMO_REV	Pt14DeviceOut	DEMO_REV:I.Pt14DeviceOut	BOOL	Decimal
DEMO_REV	Pt15DeviceOut	DEMO_REV:I.Pt15DeviceOut	BOOL	Decimal
DEMO_REV	Int00DeviceOut	DEMO_REV:I.Int00DeviceOut	INT	Decimal
DEMO_REV	L1Current	DEMO_REV:I.L1Current	INT	Decimal
DEMO_REV	L2Current	DEMO_REV:I.L2Current	INT	Decimal
DEMO_REV	L3Current	DEMO_REV:I.L3Current	INT	Decimal
DEMO_REV	AvgCurrent	DEMO_REV:I.AvgCurrent	INT	Decimal
DEMO_REV	**PercentTCU**	**DEMO_REV:I.PercentTCU**	INT	Decimal
DEMO_REV	SwitchedVoltageLevel	DEMO_REV:I.SwitchedVoltageLevel	INT	Decimal
DEMO_REV	UnswitchedVoltageLevel	DEMO_REV:I.UnswitchedVoltageLevel	INT	Decimal
DEMO_REV	TripStatus	DEMO_REV:I.TripStatus	INT	Binary
DEMO_REV	WarningStatus	DEMO_REV:I.WarningStatus	INT	Binary

The following table provides a brief explanation for the tag function:

Table 20 - Bulletin 290E/291E Consume Assembly Command Tag Explanation

Device Output Command Tags	Tag Description/Use
RunForward	Command VFD forward
RunReverse	Command VFD reverse
ResetFault	Fault reset
Pt00Data	If user defined as output, commnd output ON
Pt01Data	If user defined as output, commnd output ON
Pt02Data	If user defined as output, commnd output ON
Pt03Data	If user defined as output, commnd output ON
Pt04Data	If user defined as output, commnd output ON
Pt05Data	If user defined as output, commnd output ON
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
Int00DeviceIn	Network analog input to DeviceLogix engine

Table 21 - Bulletin 290E/291E Produced Assembly Status Tag Explanation

Device Input Status Tags	Tag Description/Use
Fault	Communication fault between PLC and device (all 1s = fault, all 0s = normal)
TripPresent	Fault exists within unit
WarningPresent	Warning of potential fault
RunningForward	Motor commanded to run forward
RunningReverse	Motor commanded to run reverse
Ready	Control and 3-phase power present
CurrentFlowing	Current is passing to motor
DeviceLogixEnabled	DeviceLogix is enabled
KeypadAuto	HOA is in Auto mode
KeypadOff	HOA is in Off mode
KeypadHand	HOA is in Hand mode
DisconnectClosed	Disconnect is closed
Pt00Data	User-configured I/O status
Pt01Data	User-configured I/O status
Pt02Data	User-configured I/O status
Pt03Data	User-configured I/O status
Pt04Data	ASLT_DEMO:I.Pt04Data
Pt05Data	User-configured I/O status
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
Pt15DeviceOut	DeviceLogix network output status
Int00DeviceOut	DeviceLogix network analog output
L1Current	Phase A current
L2Current	Phase B current
L3Current	Phase C current
AvgCurrent	Average phase A, B, and C current
PercentTCU	Overload percentage thermal utilization (100% = overload trip)
SwitchedVoltageLevel	Switched control power voltage — Parameter 11

Device Input Status Tags	Tag Description/Use
UnswitchedVoltageLevel	Unswitched control power voltage — Parameter 12
TripStatus	Bit enumerate trip status — Parameter 16
WarningStatus	Bit enumerate warning status — Parameter 17

Notes:

Bulletin 290E/291E/294E Programmable Parameters

Electronic Data Sheet (EDS)

When a 3rd party PLC is used, an embedded EDS file can be uploaded directly from the ArmorStart LT. This allows device configuration through 3rd party tools. EDS files are also available on the internet at: http://www.ab.com/networks/eds.

Basic Setup Parameters

When the RSLogix AOP is not used, Table 22 lists the minimum setup configurations required for Bulletin 290E/291E or Bulletin 294E. Basic parameter configuration, status, and diagnostic information can be accessed from the embedded web browser.

RSLogix 5000 is the recommended commissioning software. Download the Add-On-Profile (AOP) from http://support.rockwellautomation.com/controlflash/LogixProfiler.asp for additional functionality. There are additional capabilities that are not enabled or left at their default values.

Table 22 - Quick Parameter Setup

Bulletin 290E/291E	Bulletin 294E
28 FLASetting **29** OLResetLevel **30** OverloadClass **49** IOPointConfiguration	**28** MotorNPVolts **29** MotorNPHertz **30** MotorOLCurrent **32** StopMode **34** MinimumFreq **35** MaximumFreq **36** AccelTime1 **37** DecelTime1 **49** IOPointConfiguration❶

❶ When using the AOP this parameter is configured during module definition on the "General" page.

IMPORTANT All I/O points are configured as inputs, by default. Identify which points are outputs, when needed for proper operation, using parameter 49 [IOPointConfiguration].

Parameter Groups

<table>
<tr><th>Bulletin
290E/291E Units</th><th>Bulletin 294E Units</th><th colspan="2">Common to Bulletin 290E/291E
and Bulletin 294E Units</th><th>Bulletin
290E/291E Units</th></tr>
<tr><th colspan="2">Basic Status</th><th colspan="2">Trip Status</th><th>Basic Config</th></tr>
<tr><td rowspan="4">1 PhaseL1Current
2 PhaseL2Current
3 PhaseL3Current
4 AverageCurrent
5%ThermalUtilized
6 StarterStatus
7 StarterCommand
8 AuxIOStatus
9 NetworkStatus
10 DLXControlStatus
11 OutputSourceV
12 SensorSourceV
13 Reserved
14 Reserved
15 Reserved</td><td rowspan="4">1 OutputFreq
2 CommandFreq
3 OutputCurrent
4 OutputVoltage
5 DCBusVoltage
6 StarterStatus
7 StarterCommand
8 AuxIOStatus
9 NetworkStatus
10 DLXControlStatus
11 OutputSourceV
12 SensorSourceV
13 InternalFanRPM
14 ElapsedRunTime
15 DriveTemperature</td><td>16 TripStatus
17 WarningStatus
18 TripLog0
19 TripLog1</td><td>20 TripLog2
21 TripLog3
22 TripLog4</td><td rowspan="4">28 FLASetting
29 OLResetLevel
30 OverloadClass
31…40 Reserved</td></tr>
<tr><td>Bulletin
290E/291E Units</td><td>Bulletin 294E Units</td></tr>
<tr><td colspan="2">Trip Status</td></tr>
<tr><td>23 SnapShotL1Amps
24 SnapShotL2Amps
25 SnapShotL3Amps
26 SnapShotAvgAmps
27 SnapShot%Thermal</td><td>23 SnapShotOutFreq
24 SnapShotOutAmps
25 SnapShotOutVolts
26 SnapShotBusVolts
27 SnapShotDrvTemp</td></tr>
</table>

Bulletin 294E Units		Common to Bulletin 290E/291E and Bulletin 294E Units		
Motor and Control	**Speed Control**	**Starter Protection**	**User I/O Config.**	**Miscellaneous Config.**
28 MotorNPVolts **29** MotorNPHertz **30** MotorOLCurrent **31** CurrentLimit **32** StopMode	**33** SpeedReference **34** MinimumFreq **35** MaximumFreq **36** AccelTime1 **37** DecelTime1 **38** SCurvePercent **39** JogFrequency **40** JogAccelDecel	**41** ProtFltResetMode **42** ProtectFltEnable **43** WarningEnable **44** ProtectFltReset **45** RunNetFltAction **46** RunNetFaultValue **47** RunNetIdleAction **48** RunNetIdleValue	**49** IOPointConfigure **50** FilterOffOn **51** FilterOnOff **52** OutProtFltState **53** OutProtFltValue **54** OutNetFaultState **55** OutNetFaultValue **56** OutNetIdleState **57** OutNetIdleValue **58** Input00Function **59** Input01Function **60** Input02Function **61** Input03Function **62** Input04Function **63** Input05Function	**64** NetworkOverride **65** CommsOverride **66** KeypadMode **67** KeypadDisable **68** SetToDefaults

Bulletin 290E/291E Units	Bulletin 294E Units
Advanced Config.	
69 OLWarningLevel **70** JamInhibitTime **71** JamTripDelay **72** JamTripLevel **73** JamWarningLevel **74** StallEnabledTime **75** StallTripLevel **76** ULInhibitTime **77** ULTripDelay **78** ULTripLevel **79** ULWarningLevel	**69** AccelTime2 **70** DecelTime2 **71** MotorOLRetention **72** InternalFreq **73** SkipFrequency **74** SkipFreqBand **75** DCBrakeTime **76** DCBrakeLevel **77** ReverseDisable **78** FlyingStartEna **79** Compensation **80** SlipHertzAtFLA **81** BusRegulateMode **82** MotorOLSelect **83** SWCurrentTrip **84** AutoRestartTries **85** AutoRestartDelay **86** BoostSelect **87** MaximumVoltage **88** MotorNamPlateFLA **89** BrakeMode **90** BrakeFreqThresh **91** BrakeCurrThresh

ArmorStart LT EtherNet/IP Parameters

Introduction

This chapter describes each programmable parameter and its function.

Parameter Programming

Each Distributed Motor Controller type will have a common set of parameters and a set of parameters that pertain to the individual starter type. Parameters 41…68 are common to all ArmorStart LTs.

IMPORTANT Parameter setting changes take effect immediately unless otherwise noted in the parameter listing. These changes maybe immediate even during the "running" status.

Bulletin 290E/291E

Basic Status Group

PhaseL1Current This parameter determines the actual Phase L1 current.	Parameter Number	1
	Access Rule	GET
	Data Type	INT
	Group	Basic Status
	Units	x.xx Amps
	Minimum Value	0
	Maximum Value	32767
	Default Value	0

PhaseL2Current This parameter determines the actual Phase L2 current.	Parameter Number	2
	Access Rule	GET
	Data Type	INT
	Group	Basic Status
	Units	x.xx Amps
	Minimum Value	0
	Maximum Value	32767
	Default Value	0

PhaseL3Current This parameter determines the actual Phase L3 current.	Parameter Number	3
	Access Rule	GET
	Data Type	INT
	Group	Basic Status
	Units	x.xx Amps
	Minimum Value	0
	Maximum Value	32767
	Default Value	0

AverageCurrent This parameter determines the average of 3 Phase currents.	Parameter Number	4
	Access Rule	GET
	Data Type	INT
	Group	Basic Status
	Units	x.xx Amps
	Minimum Value	0
	Maximum Value	32767
	Default Value	0

%ThermalUtilized This parameter determines the percent of Thermal Capacity used.	Parameter Number	5
	Access Rule	GET
	Data Type	USINT
	Group	Basic Status
	Units	Percent
	Minimum Value	0
	Maximum Value	100
	Default Value	0

StarterStatus This parameter provides the status of the starter.	Parameter Number	6
	Access Rule	GET
	Data Type	WORD
	Group	Basic Status
	Units	—
	Minimum Value	0
	Maximum Value	0x4FBF
	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	—	—	—	—	—	NetControlStatus
—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	Reserved
—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	CurrentFlowing
—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	DLXEnabled
—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	KeyPadAuto
—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	KeyPadOff
—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	KeyPadHand
—	—	X	X	—	—	—	—	—	—	—	—	—	—	—	—	Reserved
—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	DisconnectClosed
X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Reserved

StarterCommand The parameter provides the Run Command status to the starter.	Parameter Number	7
	Access Rule	GET
	Data Type	WORD
	Group	Basic Status
	Units	—
	Minimum Value	0
	Maximum Value	0x3F07
	Default Value	0

Bit																Function
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	RunForward
—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	RunReverse
—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	ResetFault
—	—	—	—	—	—	—	—	X	X	X	X	X	—	—	—	Reserved
—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	Out00
—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	Out01
—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	Out02
—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	Out03
—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	Out04
—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	Out05
X	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Reserved

AuxIOStatus The parameter provides the status of hardware input/output points.	Parameter Number	8
	Access Rule	GET
	Data Type	WORD
	Group	Basic Status
	Units	—
	Minimum Value	0
	Maximum Value	0x3F
	Default Value	0

Bit																Function
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	Pt00
—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	Pt01
—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	Pt02
—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	Pt03
—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	Pt04
—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	Pt05
X	X	X	X	X	X	X	X	X	X	—	—	—	—	—	—	Reserved

NetworkStatus The parameter provides the status of the network connections.	Parameter Number	9
	Access Rule	GET
	Data Type	WORD
	Group	Basic Status
	Units	—
	Minimum Value	0
	Maximum Value	0xDF
	Default Value	0

Bit																**Function:**
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	ExplicitCnxn
—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	I/OConnection
—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	ExplicitCnxnFlt
—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	IOCnxnFault
—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	IOCnxnIdle
—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	Reserve
—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	DLREnabled
—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	DLRFault
X	X	X	X	X	X	X	X	—	—	—	—	—	—	—	—	Reserved

DLXControlStatus The parameter provides the DeviceLogix Control Status. 0 = Controlled in Logix programs. 1 = Controlled in local DLX programs.	Parameter Number	10
	Access Rule	GET
	Data Type	UINT
	Group	Basic Status
	Units	—
	Minimum Value	0
	Maximum Value	OXFF
	Default Value	0

Bit								**Function:**
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
—	—	—	—	—	—	—	X	RunForward
—	—	—	—	—	—	X	—	RunReverse
—	—	—	—	—	X	—	—	Out00
—	—	—	—	X	—	—	—	Out01
—	—	—	X	—	—	—	—	Out02
—	—	X	—	—	—	—	—	Out03
—	X	—	—	—	—	—	—	Out04
X	—	—	—	—	—	—	—	Out05

OutputSourceV (IPS) [SwitchedVolts] This parameter determines the incoming switched control voltage across terminals A1…A2. (IPS) Available voltage on User Output Pin 4 for all I/O points	Parameter Number	11
	Access Rule	GET
	Data Type	UINT
	Group	Basic Status
	Units	x.xx Volts
	Minimum Value	0
	Maximum Value	65535
	Default Value	0

SensorSourceV (IPS) [UnswitchedVolts] This parameter determines the incoming unswitched control voltage across terminals A2…A3. (IPS) Available voltage on Input Sensor Source Pin 1 for all I/O points	Parameter Number	12
	Access Rule	GET
	Data Type	UINT
	Group	Basic Status
	Units	x.xx Volts
	Minimum Value	0
	Maximum Value	65535
	Default Value	0

Trip Status Group

TripStatus This parameter provides the fault condition that caused any current trip.	Parameter Number	16
	Access Rule	GET
	Data Type	WORD
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	0xE3BF
	Default Value	0

Bit																Function
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	OverloadTrip
—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	PhaseLossTrip
—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	UnderPowerTrip
—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	SensorShortTrip
—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	PhaseImbalanceTrip
—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	NonVolMemoryTrip
—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	Reserved
—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	JamTrip
—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	StallTrip
—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	UnderloadTrip
—	—	—	X	X	X	—	—	—	—	—	—	—	—	—	—	Reserved
—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	OutputShortTrip
—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	UserDefinedTrip
X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	HardwareFltTrip

WarningStatus	Parameter Number	17
This parameter provides the current warning condition.	Access Rule	GET
	Data Type	WORD
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	0xC295
	Default Value	

Bit																Function
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	OverloadWarning
—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	Reserved
—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	UnderPowerWarn
—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	Reserved
—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	PhaseImbalanceWarn
—	—	—	—	—	—	—	—	—	X	X	—	—	—	—	—	Reserved
—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	JamWarning
—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	Reserved
—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	UnderloadWarning
—	—	X	X	X	X	—	—	—	—	—	—	—	—	—	—	Reserved
—	**X**	—	—	—	—	—	—	—	—	—	—	—	—	—	—	UnswitchedPwrWarn
X	—	—	—	—	—	—	—	—	—	—	—	—	—	—		ConfigWarning

TripLog1 This parameter provides the last trip to occur.	Parameter Number	18
	Access Rule	GET
	Data Type	UINT
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	75
	Default Value	0

TripLog2 This parameter provides the second last trip to occur.	Parameter Number	19
	Access Rule	GET
	Data Type	UINT
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	75
	Default Value	0

TripLog3 This parameter provides the third last trip to occur.	Parameter Number	20
	Access Rule	GET
	Data Type	UINT
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	75
	Default Value	0

TripLog4 This parameter provides the fourth last trip to occur.	Parameter Number	21
	Access Rule	GET
	Data Type	UINT
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	75
	Default Value	0

TripLog5 This parameter provides the fifth last trip to occur.	Parameter Number	22
	Access Rule	GET
	Data Type	UINT
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	75
	Default Value	0

SnapShotL1Amps This parameter provides a snapshot of actual Phase L1 current at time of last trip.	Parameter Number	23
	Access Rule	GET
	Data Type	INT
	Group	Trip Status
	Units	x.xx Amps
	Minimum Value	0
	Maximum Value	32767
	Default Value	

SnapShotL2Amps This parameter provides a snapshot of actual Phase L2 current at time of last trip.	Parameter Number	24
	Access Rule	GET
	Data Type	INT
	Group	Trip Status
	Units	x.xx Amps
	Minimum Value	0
	Maximum Value	32767
	Default Value	0

SnapShotL3Amps This parameter provides a snapshot of actual Phase L3 current at time of last trip.	Parameter Number	25
	Access Rule	GET
	Data Type	INT
	Group	Trip Status
	Units	x.xx Amps
	Minimum Value	0
	Maximum Value	32767
	Default Value	0

SnapShotLAvgAmps This parameter provides a snapshot of average of 3 Phase currents at time of last trip.	Parameter Number	26
	Access Rule	GET
	Data Type	INT
	Group	Trip Status
	Units	x.xx Amps
	Minimum Value	0
	Maximum Value	32767
	Default Value	0

SnapShot%Thermal This parameter provides a snapshot of the percentage of Thermal Capacity used at time of last trip.	Parameter Number	27
	Access Rule	GET
	Data Type	USINT
	Group	Trip Status
	Units	Percent
	Minimum Value	0
	Maximum Value	100
	Default Value	0

Basic Configuration Group

FLASetting The motor's full load current rating is programmed in this parameter.	Parameter Number	28
	Access Rule	GET/SET
	Data Type	INT
	Group	Basic Configuration
	Units	x.xx Amps
	Minimum Value	See Table 23.
	Maximum Value	See Table 23.
	Default Value	See Table 23.

Table 23 - FLA Setting Ranges and Default Values (with indicated setting precision)

FLA Current Range (A)				Default Value
CatNo	**460V AC**	**Minimum Value**	**Maximum Value**	
290E/1_-FA_*	3 Hp	0.24	3.5	0.24
290E/1_-FB_*	5 Hp	1.1	7.6	1.1

OLResetLevel This parameter determines the % Thermal Capacity which an overload can be cleared.	Parameter Number	29
	Access Rule	GET/SET
	Data Type	BYTE
	Group	Basic Configuration
	Units	% TCU
	Minimum Value	75
	Maximum Value	100
	Default Value	75

OverloadClass This parameter provides the overload trip classification. 1 = 10 2 = 15 3 = 20	Parameter Number	30
	Access Rule	GET
	Data Type	USINT
	Group	Basic Configuration
	Units	—
	Minimum Value	1
	Maximum Value	3
	Default Value	1

Starter Protection Group

ProtFltResetMode This parameter configures the Protection Fault reset mode. 0 = Manual 1 = Automatic	Parameter Number	41
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Starter Protection
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

TripStatus This parameter provides the fault condition that caused any current trip.	Parameter Number	42
	Access Rule	GET
	Data Type	WORD
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	0xE3BF
	Default Value	0

Bit																Function
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	OverloadTrip
—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	PhaseLossTrip
—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	UnderPowerTrip
—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	SensorShortTrip
—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	PhaseImbalanceTrip
—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	NonVolMemoryTrip
—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	Reserved
—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	JamTrip
—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	StallTrip
—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	UnderloadTrip
—	—	—	X	X	X	—	—	—	—	—	—	—	—	—	—	Reserved
—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	OutputShortTrip
—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	UserDefinedTrip
X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	HardwareFltTrip

The highlighted functions are enabled by default.

WarningStatus		
This parameter provides the current warning condition.	Parameter Number	43
	Access Rule	GET
	Data Type	WORD
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	0xC295
	Default Value	

Bit																Function
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	OverloadWarning
—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	Reserved
—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	UnderPowerWarn
—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	Reserved
—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	PhasImbalanceWarn
—	—	—	—	—	—	—	—	—	X	X	—	—	—	—	—	Reserved
—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	JamWarning
—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	Reserved
—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	UnderloadWarning
—	—	X	X	X	X	—	—	—	—	—	—	—	—	—	—	Reserved
—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	UnswitchedPwrWarn
X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	ConfigWarning

ProtectFltReset	Parameter Number	44
This parameter resets a Protection Fault by setting the bit to 1. 0 = NoAction 0 > 1 = ResetFault	Access Rule	GET/SET
	Data Type	BOOL
	Group	Starter Protection
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

RunNetFltAction	Parameter Number	45
This parameter in conjunction with Parameter 46 (RunNetFltValue) defines how the starter will respond when a fault occurs. 0 = GoToFaultValue 1 = HoldLastState	Access Rule	GET/SET
	Data Type	BOOL
	Group	Starter Protection
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

RunNetFltValue This parameter determines how the starter will be commanded in the event of a fault. State the starter will go to on a NetFlt if Parameter 45 (RunNetFltAction) = 1 (GotoFault-Value). 0 = OFF 1 = ON	Parameter Number	46
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Starter Protection
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

RunNetIdlAction This parameter in conjunction with Parameter 48 (RunNetIdlValue) defines how the starter will respond when a network is idle as determined by Parameter 48. 0 = GoToIdleValue 1 = HoldLastState	Parameter Number	47
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Starter Protection
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

RunNetIdlValue This parameter determines the state that starter assumes when the network is idle and Parameter 47 (RunNetIdlAction) is set to 1. 0 = OFF 1 = ON	Parameter Number	48
	Access Rule	GET
	Data Type	BOOL
	Group	Starter Protection
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

User I/O Configuration Group

IOPointConfigure This parameter determines the point that is configured: 0 = Input 1 = Output	Parameter Number	49
	Access Rule	GET/SET
	Data Type	WORD
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	0x3F
	Default Value	0

Bit						Function
5	4	3	2	1	0	
—	—	—	—	—	X	Pt00
—	—	—	—	X	—	Pt01
—	—	—	X	—	—	Pt02
—	—	X	—	—	—	Pt03
—	X	—	—	—	—	Pt04
X	—	—	—	—	—	Pt05

FilterOffOn This parameter determines the input (which must be present for this time) before being reported ON.	Parameter Number	50
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	msecs
	Minimum Value	0
	Maximum Value	64
	Default Value	0

FilterOnOff This parameter determines the input (which must be absent for this time) before being reported OFF.	Parameter Number	51
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	msecs
	Minimum Value	0
	Maximum Value	64
	Default Value	0

OutProtFltState This parameter in conjunction with Parameter 53 (OutProtFltValue) defines how the starter outputs will respond when a fault occurs. 0 = GoToPrFltValue 1 = IgnorePrFlt	Parameter Number	52
	Access Rule	GET/SET
	Data Type	BOOL
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

OutProtFltValue This parameter determines how the starter outputs will be commanded in the event of a protection fault if Parameter 52 (OutProtFltState) = 0. 0 = OFF 1 = ON	Parameter Number	53
	Access Rule	GET/SET
	Data Type	BOOL
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

OutNetFaultState This parameter in conjunction with Parameter 55 (OutNetFaultValue) defines how the starter outputs will respond on an Ethernet fault. 0 = GoToFaultValue 1 = HoldLastState	Parameter Number	54
	Access Rule	GET/SET
	Data Type	BOOL
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

OutNetFaultValue This parameter determines the state of the starter outputs when an Ethernet fault occurs and Parameter 54 (OutNetFaultState) is set to 0. 0 = OFF 1 = ON	Parameter Number	55
	Access Rule	GET
	Data Type	BOOL
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

OutNetIdleState This parameter in conjunction with Parameter 57 (OutNetIdleValue) defines how the starter outputs will respond when a network is idle. 0 = GoToIdleValue 1 = HoldLastState	Parameter Number	56
	Access Rule	GET/SET
	Data Type	BOOL
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

OutNetIdleValue This parameter determines the state that starter outputs assumes when the network is idle and Parameter 56 (OutNetIdleState) is set to 0. 0 = OFF 1 = ON	Parameter Number	57
	Access Rule	GET
	Data Type	BOOL
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

Input00Function This parameter determines the special function for User Input 0: 0 = NoFunction 1 = FaultReset 2 = MotionDisable❶ 3 = ForceSnapShot 4 = UserFault 5 = BrakeRelease❶ ❶ These choices are level sensitive. All others are edge sensitive	Parameter Number	58
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	4
	Default Value	0

Input01Function This parameter determines the special function for User Input 1: 0 = NoFunction 1 = FaultReset 2 = MotionDisable❶ 3 = ForceSnapShot 4 = UserFault 5 = BrakeRelease❶ ❶ These choices are level sensitive. All others are edge sensitive	Parameter Number	59
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	4
	Default Value	0

Input02Function This parameter determines the special function for User Input 2: 0 = NoFunction 1 = FaultReset 2 = MotionDisable❶ 3 = ForceSnapShot 4 = UserFault 5 = BrakeRelease❶ ❶ These choices are level sensitive. All others are edge sensitive	Parameter Number	60
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	4
	Default Value	0

Input03Function This parameter determines the special function for User Input 3: 0 = NoFunction 1 = FaultReset 2 = MotionDisable❶ 3 = ForceSnapShot 4 = UserFault 5 = BrakeRelease❶ ❶ These choices are level sensitive. All others are edge sensitive	Parameter Number	61
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	4
	Default Value	0

Input04Function This parameter determines the special function for User Input 4: 0 = NoFunction 1 = FaultReset 2 = MotionDisable❶ 3 = ForceSnapShot 4 = UserFault 5 = BrakeRelease❶ ❶ These choices are level sensitive. All others are edge sensitive	Parameter Number	62
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	4
	Default Value	0

Input05Function This parameter determines the special function for User Input 5: 0 = NoFunction 1 = FaultReset 2 = MotionDisable❶ 3 = ForceSnapShot 4 = UserFault 5 = BrakeRelease❶ ❶ These choices are level sensitive. All others are edge sensitive	Parameter Number	63
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	4
	Default Value	0

Miscellaneous Configuration Group

NetworkOverride This parameter allows for the local logic to override a Network fault. 0 = Disable 1 = Enable	Parameter Number	64
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Misc. Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

CommsOverride This parameter allows for local logic to override an I/O connection timeout. 0 = Disable 1 = Enable	Parameter Number	65
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Misc. Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

KeypadMode This parameter selects if the keypad operation is maintained or momentary. 0 = Momentary 1 = Maintained	Parameter Number	66
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Misc. Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

KeypadDisable This parameter disables all keypad function except for the “OFF” and “RESET” buttons. 0 = KeypadEnabled 1 = KeypadDisabled	Parameter Number	67
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Misc. Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

SetToDefaults This parameter if set to “1” will set the device to the factory defaults. 0 = NoAction 1 = SetToDefaults	Parameter Number	68
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Misc. Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

Advanced Configuration

OLWarningLevel This parameter determines the Overload Warning Level in % Thermal Capacity Used (%TCU).	Parameter Number	69
	Access Rule	GET
	Data Type	USINT
	Group	Advanced Config.
	Units	%TCU
	Minimum Value	0
	Maximum Value	100
	Default Value	85

JamInhibitTime This parameter determines the time during motor starting that Jam detection is inhibited.	Parameter Number	70
	Access Rule	GET
	Data Type	USINT
	Group	Advanced Config.
	Units	secs.
	Minimum Value	0
	Maximum Value	250
	Default Value	10

JamTripDelay This parameter determines how much time above the Jam Level before the unit will trip.	Parameter Number	71
	Access Rule	GET
	Data Type	USINT
	Group	Advanced Config.
	Units	x.x secs
	Minimum Value	1
	Maximum Value	25.0
	Default Value	5.0

JamTripLevel This parameter determines the Jam Trip Level as a percentage of Full Load Amps.	Parameter Number	72
	Access Rule	GET
	Data Type	UINT
	Group	Advanced Config.
	Units	%FLA
	Minimum Value	50
	Maximum Value	600
	Default Value	250

JamWarningLevel This parameter determines the Jam Warning Level as a percentage of Full Load Amps.	Parameter Number	73
	Access Rule	GET
	Data Type	UINT
	Group	Advanced Config.
	Units	%FLA
	Minimum Value	50
	Maximum Value	600
	Default Value	150

StallEnabledTime This parameter determines the time that stall detection is enabled during motor starting.	Parameter Number	74
	Access Rule	GET
	Data Type	USINT
	Group	Advanced Config.
	Units	secs
	Minimum Value	0
	Maximum Value	250
	Default Value	10

StallTripLevel This parameter determines the Stall Trip Level as a percentage of Full Load Amps.	Parameter Number	75
	Access Rule	GET
	Data Type	UINT
	Group	Advanced Config.
	Units	%FLA
	Minimum Value	100
	Maximum Value	600
	Default Value	600

ULInhibitTime This parameter determines the time during motor starting that Underload detection is inhibited.	Parameter Number	76
	Access Rule	GET
	Data Type	USINT
	Group	Advanced Config.
	Units	secs
	Minimum Value	0
	Maximum Value	250
	Default Value	10

ULTripDelay This parameter determines the time below Underload Level before the unit will trip.	Parameter Number	77
	Access Rule	GET
	Data Type	USINT
	Group	Advanced Config.
	Units	x.x secs
	Minimum Value	1
	Maximum Value	25.0
	Default Value	5.0

ULTripLevel This parameter determines the Underload Trip Level as a percentage of Full Load Amps.	Parameter Number	78
	Access Rule	GET
	Data Type	USINT
	Group	Advanced Config.
	Units	%FLA
	Minimum Value	10
	Maximum Value	100
	Default Value	50

ULWarningLevel This parameter determines the Underload Warning Level as a percentage of Full Load Amps.	Parameter Number	79
	Access Rule	GET
	Data Type	USINT
	Group	Advanced Config.
	Units	%FLA
	Minimum Value	10
	Maximum Value	100
	Default Value	70

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Basic Status Group

OutputFreq This parameter provides the output frequency at motor terminals T1, T2, T3.	Parameter Number	1
	Access Rule	GET
	Data Type	UINT
	Group	Basic Status
	Units	x.x Hz
	Minimum Value	0
	Maximum Value	999.9
	Default Value	0

CommandFreq This parameter provides the commanded frequency even if the starter is not running.	Parameter Number	2
	Access Rule	GET
	Data Type	UINT
	Group	Basic Status
	Units	x.x Hz
	Minimum Value	0
	Maximum Value	999.9
	Default Value	0

OutputCurrent This parameter provides the output current at motor terminals T1, T2, T3.	Parameter Number	3
	Access Rule	GET
	Data Type	UINT
	Group	Basic Status
	Units	x.xx Amps
	Minimum Value	0
	Maximum Value	8.00
	Default Value	0

OutputVoltage This parameter provides the output voltage at motor terminals T1, T2, T3.	Parameter Number	4
	Access Rule	GET
	Data Type	UINT
	Group	Basic Status
	Units	x.xV AC
	Minimum Value	0
	Maximum Value	999.9
	Default Value	0

DCBusVoltage This parameter provides the present DC bus voltage level.	Parameter Number	5
	Access Rule	GET
	Data Type	UINT
	Group	Basic Status
	Units	V DC
	Minimum Value	0
	Maximum Value	1200
	Default Value	0

Starter Status This parameter provides the status of the starter.	Parameter Number	6
	Access Rule	GET
	Data Type	WORD
	Group	Basic Status
	Units	—
	Minimum Value	0
	Maximum Value	0xDFFF
	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	—	—	—	—	—	NetControlStatus
—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	NetRefStatus
—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	AtReference
—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	DLXEnabled
—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	KeyPadAuto
—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	KeyPadOff
—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	KeyPadHand
—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	KeyPadJogging
—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	Reserved
—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	DisconnectClosed
X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	BrakeStatus

StarterCommand The parameter provides the command status of the starter.	Parameter Number	7
	Access Rule	GET
	Data Type	WORD
	Group	Basic Status
	Units	—
	Minimum Value	0
	Maximum Value	0xFF1F
	Default Value	0

Bit																Function
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	RunningForward
—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	RunningReverse
—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	ResetFault
—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	JogForward
—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	JogReverse
—	—	—	—	—	—	—	—	X	X	X	—	—	—	—	—	Reserved
—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	Out00
—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	Out01
—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	Out02
—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	Out03
—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	Out04
—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	Out05
—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Accel2
X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Decel2

AuxIOStatus Status of the hardware input/output points.	Parameter Number	8
	Access Rule	GET
	Data Type	WORD
	Group	Basic Status
	Units	—
	Minimum Value	0
	Maximum Value	0x3F
	Default Value	0

Bit																Function:
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	Pt00
—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	Pt01
—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	Pt02
—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	Pt03
—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	Pt04
—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	Pt05
X	X	X	X	X	X	X	X	X	X	—	—	—	—	—	—	Reserved

NetworkStatus		
The parameter provides the status of the network connections.	Parameter Number	9
	Access Rule	GET
	Data Type	WORD
	Group	Basic Status
	Units	—
	Minimum Value	0
	Maximum Value	0xDF
	Default Value	0

Bit																Function:
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	ExplicitCnxn
—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	IOConnection
—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	ExplicitCnxnFlt
—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	IOCnxnFault
—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	IOCnxnIdle
—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	Reserve
—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	DLREnabled
—	—	—	—	—	—	—		X	—	—	—	—	—	—	—	DLRFlt
X	X	X	X	X	X	X	X	—	—	—	—	—	—	—	—	Reserved

DLXControlStatus		
The parameter provides the DeviceLogix Control Status. 0 = Controlled in Logix Programs 1 = Controlled in local DLX programs.	Parameter Number	10
	Access Rule	GET
	Data Type	UINT
	Group	Basic Status
	Units	—
	Minimum Value	0
	Maximum Value	0x1FFF
	Default Value	0

Bit																Function:
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	RunForward
—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	RunReverse
—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	Out00
—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	Out01
—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	Out02
—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	Out03
—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	Out04
—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	Out05
—	—	—	—	—	—	—	X		—	—	—	—	—	—	—	JogForward
—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	JogReverse
—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	Accel2
—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	Decel2
—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	Command Freq
X	X	X	—	—	—	—	—	—	—	—	—	—	—	—	—	Reserved

OutputSourceV (IPS) [SwitchedVolts] This parameter determines the incoming switched control voltage across terminals A1…A2. (IPS) available voltage on User Output Pin 4 for all I/O points.	Parameter Number	11
	Access Rule	GET
	Data Type	UINT
	Group	Basic Status
	Units	x.xx Volts
	Minimum Value	0
	Maximum Value	65535
	Default Value	0

SensorSourceV (IPS) [UnswitchedVolts] This parameter determines the incoming unswitched control voltage across terminals A2…A3. (IPS) available voltage on input Sensor Source Pin 1 for all I/O points.	Parameter Number	12
	Access Rule	GET
	Data Type	UINT
	Group	Basic Status
	Units	x.xx Volts
	Minimum Value	0
	Maximum Value	65535
	Default Value	0

InternalFanRPM This parameter determines the Revolutions Per Minute (RPM) of the internal cooling fan.	Parameter Number	13
	Access Rule	GET
	Data Type	UINT
	Group	Basic Status
	Units	RPM
	Minimum Value	0
	Maximum Value	65535
	Default Value	0

ElapsedRunTime This parameter determines the accumulated run time displayed in 10 hour increments. 1 = 10 Hrs	Parameter Number	14
	Access Rule	GET
	Data Type	UINT
	Group	Basic Status
	Units	—
	Minimum Value	0
	Maximum Value	9999
	Default Value	0

DriveTemperature This parameter determines the present operating temperature of the power section.	Parameter Number	15
	Access Rule	GET
	Data Type	UINT
	Group	Basic Status
	Units	°C
	Minimum Value	0
	Maximum Value	9999
	Default Value	0

Trip Status Group

TripStatus This parameter provides the fault condition that caused any current trip.	Parameter Number	16
	Access Rule	GET
	Data Type	WORD
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	0xFFFF
	Default Value	0

Bit																Function
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	OverloadTrip
—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	PhaseShortTrip
—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	UnderPowerTrip
—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	SensorShortTrip
—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	OverCurrentTrip
—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	NonVolMemoryTrip
—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	ParamSyncTrip
—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	DCBusTrip/ OpenDisconnect
—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	StallTrip
—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	OverTemperature
—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	GroundFault
—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	RestartRetries
—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	DriveHdwFault
—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	OutputShortTrip
—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	UserDefinedTrip
X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	HardwareFltTrip

WarningStatus		
This parameter provides the current warning condition.	Parameter Number	17
	Access Rule	GET
	Data Type	WORD
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	0xC044
	Default Value	0

Bit																Function
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	Reserved
—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	UnderPowerWarn
—	—	—	—	—	—	—	—	—	—	X	X	X	—	—	—	Reserved
—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	DriveParamInit
—	—	X	X	X	X	X	X	X	—	—	—	—	—	—	—	Reserved
—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	UnswitchedPwrWarn
X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	ConfigWarning

TripLog0 This parameter provides the last trip to occur.	Parameter Number	18
	Access Rule	GET
	Data Type	UINT
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	75
	Default Value	0

TripLog1 This parameter provides the second last trip to occur.	Parameter Number	19
	Access Rule	GET
	Data Type	UINT
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	75
	Default Value	0

TripLog2 This parameter provides the third last trip to occur.	Parameter Number	20
	Access Rule	GET
	Data Type	UINT
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	75
	Default Value	0

TripLog3 This parameter provides the fourth last trip to occur.	Parameter Number	21
	Access Rule	GET
	Data Type	UINT
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	75
	Default Value	0

TripLog4 This parameter provides the fifth last trip to occur.	Parameter Number	22
	Access Rule	GET
	Data Type	UINT
	Group	Trip Status
	Units	—
	Minimum Value	0
	Maximum Value	75
	Default Value	0

SnapShotOutFreq This parameter provides a snapshot of output frequency at time of last trip.	Parameter Number	23
	Access Rule	GET
	Data Type	UINT
	Group	Trip Status
	Units	x.x Hz
	Minimum Value	0
	Maximum Value	999.9
	Default Value	0

SnapShotOutAmps This parameter provides a snapshot of output current at time of last trip.	Parameter Number	24
	Access Rule	GET
	Data Type	UINT
	Group	Trip Status
	Units	x.xx Amps
	Minimum Value	0
	Maximum Value	4.60
	Default Value	0

SnapShotOutVolts This parameter provides a snapshot of output voltage at time of last trip.	Parameter Number	25
	Access Rule	GET
	Data Type	UINT
	Group	Trip Status
	Units	x.x V AC
	Minimum Value	0
	Maximum Value	999.9
	Default Value	0

SnapShotBusVolts This parameter provides a snapshot of DC bus voltage level at time of last trip.	Parameter Number	26
	Access Rule	GET
	Data Type	UINT
	Group	Trip Status
	Units	V DC
	Minimum Value	0
	Maximum Value	1200
	Default Value	0

SnapShotDrvTemp This parameter provides a snapshot of operating temperature at time of last trip.	Parameter Number	27
	Access Rule	GET
	Data Type	UINT
	Group	Trip Status
	Units	°C
	Minimum Value	0
	Maximum Value	9999
	Default Value	0

Motor and Control Group

MotorNPVolts O Stop drive before changing this parameter. Set to the motor nameplate rated voltage.	Parameter Number	28
	Access Rule	GET/SET
	Data Type	UINT
	Group	Motor and Control
	Units	V AC
	Minimum Value	35
	Maximum Value	460
	Default Value	460

MotorNPHertz O Stop drive before changing this parameter. Set to the motor nameplate rated frequency.	Parameter Number	29
	Access Rule	GET/SET
	Data Type	UINT
	Group	Motor and Control
	Units	Hz
	Minimum Value	10
	Maximum Value	400
	Default Value	60

MotorOLCurrent

Set to the maximum allowable motor current.

Parameter Number	30
Related Parameter	31, 80, 82…83
Access Rule	GET/SET
Data Type	UINT
Group	Motor and Control
Units	x.x Amps
Minimum Value	0
Maximum Value	Cat. No. Dependent
Default Value	Cat. No. Max Output

Cat. No.	Hp (kW)	Min Amps	Default Amps
294_FD1P5	0.5 (0.4)	0	1.5
294_FD2P5	1.0 (0.75)	0	2.5
294_FD4P2	2.0 (1.5)	0	3.6

CurrentLimit

Maximum output current allowed before current limiting occurs

Parameter Number	31
Related Parameters	
Access Rule	GET/SET
Data Type	UINT
Group	Motor and Control
Units	x.x Amps
Minimum Value	0
Maximum Value	Cat. No. Dependent
Default Value	Cat. No. Dependent

Cat. No.	Hp (kW)	
294_FD1P5	0.5 Hp	Min = 0; Max = 2.7; Default = 2.2
294_FD2P5	1.0 Hp	Min = 0; Max = 4.5; Default = 3.7
294_FD4P2	2.0 Hp	Min = 0; Max = 7.5; Default = 6.3

StopMode

Valid Stop Mode for the Bulletin 294E ArmorStart LT are the following:
0 = **RampToStop,** "Stop" command clears active fault
1 = **Coast to Stop,** "Stop" command clears active fault
2 = **DCBrake,** DC Injection Braking Stop, "Stop" command clears active fault
3 = **DCBrakeAuto,** DC Injection Stop with Auto Shutoff
Standard DC Injection Braking for value set in Parameter 75 (DC Brake Time)
or
Drive shuts off if current limit is exceeded.

Parameter Number	32
Related Parameters	
Access Rule	GET/SET
Data Type	UINT
Group	Motor and Control
Units	—
Minimum Value	0
Maximum Value	3
Default Value	0

Speed Control Group

SpeedReference Sets the source of the speed reference: 0 = Logix (Network or DeviceLogix) 1 = InternalFreq	Parameter Number	33
	Related Parameters	1, 2, 36, 37, 72
	Access Rule	GET/SET
	Data Type	UINT
	Group	Speed Control
	Units	—
	Minimum Value	0
	Maximum Value	2
	Default Value	0

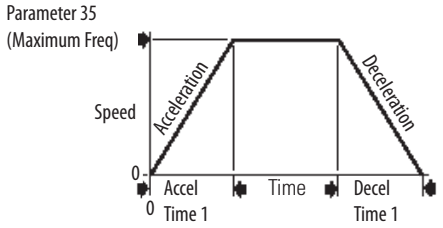
MinimumFreq Sets the lowest frequency the drive will output continuously.	Parameter Number	34
	Related Parameter	1, 2, 35
	Access Rule	GET/SET
	Data Type	UINT
	Group	Speed Control
	Units	x.x Hz
	Minimum Value	0.0
	Maximum Value	400.0
	Default Value	0.0

MaximumFreq O Stop drive before changing this parameter. Sets the highest frequency the drive will output.	Parameter Number	35
	Related Parameter	1, 2, 34, 35, 139
	Access Rule	GET/SET
	Data Type	UINT
	Group	Speed Control
	Units	Hz
	Minimum Value	0.0
	Maximum Value	400
	Default Value	60

AccelTime1

Sets the rate of acceleration for all speed increases.

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

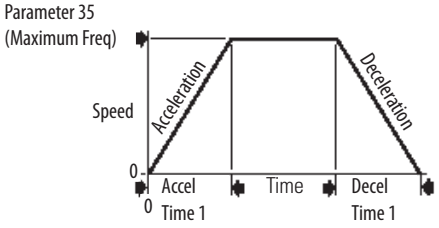


Parameter Number	36
Related Parameters	33, 37
Access Rule	GET/SET
Data Type	UINT
Group	Speed Control
Units	x.x secs
Minimum Value	0.0
Maximum Value	600.0
Default Value	10.0

DecelTime1

Sets the rate of deceleration for all speed decreases.

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



Parameter Number	37
Related Parameters	33, 36
Access Rule	GET/SET
Data Type	UINT
Group	Speed Control
Units	x.x secs
Minimum Value	0.1
Maximum Value	600.0
Default Value	10.0

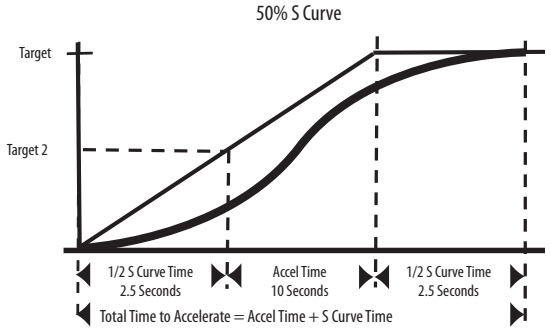
SCurvePercent

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	38
Access Rule	GET/SET
Data Type	UINT
Group	Speed Control
Units	Percentage
Minimum Value	0
Maximum Value	100
Default Value	0

Figure 53 - 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



JogFrequency Sets the output frequency when the jog command is issued.	Parameter Number	39
	Related Parameters	35, 40
	Access Rule	GET/SET
	Data Type	UINT
	Group	Drive Advanced Setup
	Units	x.x Hz
	Minimum Value	0.0
	Maximum Value	400.0
	Default Value	10.0

JogAccelDecel Sets the acceleration and deceleration time when a jog command is issued.	Parameter Number	40
	Related Parameters	39
	Access Rule	GET/SET
	Data Type	UINT
	Group	Drive Advanced Setup
	Units	x.x secs
	Minimum Value	0.1
	Maximum Value	600.0
	Default Value	10.0

Starter Protection Group

ProtFltResetMode This parameter configures the Protection Fault reset mode. 0 = Manual 1 = Automatic	Parameter Number	41
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Starter Protection
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

ProtectFltEnable This parameter enables the Protection Fault by setting the bit to 1.	Parameter Number	42
	Access Rule	GET/SET
	Data Type	WORD
	Group	Starter Protection
	Units	—
	Minimum Value	0
	Maximum Value	0xFFFF
	Default Value	0xBFFF

Bit																Function
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	OverloadTrip
—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	PhaseShortTrip
—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	UnderPowerTrip
—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	SensorShortTrip
—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	OverCurrentTrip
—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	NonVolMemoryTrip
—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	ParamSyncTrip
—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	DCBusTrip/ OpenDisconnect
—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	StallTrip
—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	OverTemperature
—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	GroundFault
—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	RestartRetries
—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	DriveHdwFault
—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	OutputShortTrip
—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	UserDefinedTrip
X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	HardwareFltTrip

The functions highlighted are enabled by default

WarningEnable This parameter enables a warning by setting the bit to 1.	Parameter Number	43
	Access Rule	GET/SET
	Data Type	WORD
	Group	Starter Protection
	Units	—
	Minimum Value	0
	Maximum Value	0xC044
	Default Value	0

Bit																Function
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	X	Reserved
—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	UnderPowerWarn
—	—	—	—	—	—	—	—	—	—	X	X	X	—	—	—	Reserved
—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	DriveParamInit
—	—	X	X	X	X	X	X	X	—	—	—	—	—	—	—	Reserved
—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	UnswitchedPwrWarn
X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	ConfigWarning

ProtectFltReset This parameter resets a Protection Fault by setting the bit to 1. 0 = NoAction 0 > 1 = ResetFault	Parameter Number	44
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Starter Protection
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

RunNetFltAction This parameter in conjunction with Parameter 46 (RunNetFltValue) defines how the starter will respond when a network fault occurs as determined. 0 = GoToFaultValue 1 = HoldLastState	Parameter Number	45
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Starter Protection
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

RunNetFltValue This parameter determines how the starter will be commanded in the event of a fault. State the starter will go to on a NetFlt if Parameter 45 (RunNetFltAction) = 1 (GotoFault-Value). 0 = OFF 1 = ON	Parameter Number	46
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Starter Protection
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

RunNetIdlAction This parameter in conjunction with Parameter 48 (RunNetIdlValue) defines how the starter will respond when a network is idle as determined by Parameter 48. 0 = GoToIdleValue 1 = HoldLastState	Parameter Number	47
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Starter Protection
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

RunNetIdlValue This parameter determines the state that starter assumes when the network is idle and Parameter 47 (RunNetIdlAction) is set to 1. 0 = OFF 1 = ON	Parameter Number	48
	Access Rule	GET
	Data Type	BOOL
	Group	Starter Protection
	Units	—
	Minimum Value	0
	Maximum Value	0x3F
	Default Value	0

User I/O Configuration Group

IOPointConfigure This parameter determines the point that is configured: 0 = Input 1 = Output	Parameter Number	49
	Access Rule	GET/SET
	Data Type	WORD
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	0x3F
	Default Value	0

Bit						Function
5	4	3	2	1	0	
—	—	—	—	—	X	Pt00
—	—	—	—	X	—	Pt01
—	—	—	X	—	—	Pt02
—	—	X	—	—	—	Pt03
—	X	—	—	—	—	Pt04
X	—	—	—	—	—	Pt05

FilterOffOn This parameter determines the input (which must be present for this time) before being reported ON.	Parameter Number	50
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	msecs
	Minimum Value	0
	Maximum Value	64
	Default Value	0

FilterOnOff This parameter determines the input (which must be absent for this time) before being reported OFF.	Parameter Number	51
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	msecs
	Minimum Value	0
	Maximum Value	64
	Default Value	0

OutProtFltState This parameter in conjunction with Parameter 53 (OutProtFltValue) defines how the starter outputs will respond when a fault occurs. 0 = GoToPrFltValue 1 = IgnorePrFlt	Parameter Number	52
	Access Rule	GET/SET
	Data Type	BOOL
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

OutProtFltValue This parameter determines how the starter outputs will be commanded in the event of a protection fault if Parameter 52 (OutProtFltState) = 0. 0 = OFF 1 = ON	Parameter Number	53
	Access Rule	GET/SET
	Data Type	BOOL
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

OutNetFaultState This parameter in conjunction with Parameter 55 (OutNetFaultValue) defines how the starter outputs will respond on an Ethernet fault. 0 = GoToFaultValue 1 = HoldLastState	Parameter Number	54
	Access Rule	GET/SET
	Data Type	BOOL
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

OutNetFaultValue This parameter determines the state that starter outputs when an Ethernet fault occurs and Parameter 54 (OutNetFaultState) is set to 0. 0 = OFF 1 = ON	Parameter Number	55
	Access Rule	GET
	Data Type	BOOL
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

OutNetIdleState This parameter in conjunction with Parameter 57 (OutNetIdleValue) defines how the starter outputs will respond when a network is idle. 0 = GoToIdleValue 1 = HoldLastState	Parameter Number	56
	Access Rule	GET/SET
	Data Type	BOOL
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

OutNetIdleValue This parameter determines the state that starter outputs assumes when the network is idle and Parameter 56 (OutNetIdleState) is set to 0. 0 = OFF 1 = ON	Parameter Number	57
	Access Rule	GET
	Data Type	BOOL
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

Input00Function This parameter determines the special function for User Input 0: 0 = NoFunction 1 = FaultReset 2 = MotionDisable❶ 3 = ForceSnapShot 4 = UserFault 5 = BrakeRelease❶ ❶ These choices are level sensitive. All others are edge sensitive	Parameter Number	58
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	5
	Default Value	0

Input01Function This parameter determines the special function for User Input 1: 0 = NoFunction 1 = FaultReset 2 = MotionDisable❶ 3 = ForceSnapShot 4 = UserFault 5 = BrakeRelease❶ ❶ These choices are level sensitive. All others are edge sensitive	Parameter Number	59
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	5
	Default Value	0

Input02Function This parameter determines the special function for User Input 2: 0 = NoFunction 1 = FaultReset 2 = MotionDisable❶ 3 = ForceSnapShot 4 = UserFault 5 = BrakeRelease❶ ❶ These choices are level sensitive. All others are edge sensitive	Parameter Number	60
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	5
	Default Value	0

Input03Function This parameter determines the special function for User Input 3: 0 = NoFunction 1 = FaultReset 2 = MotionDisable❶ 3 = ForceSnapShot 4 = UserFault 5 = BrakeRelease*❶ ❶ These choices are level sensitive. All others are edge sensitive	Parameter Number	61
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	5
	Default Value	0

Input04Function This parameter determines the special function for User Input 4: 0 = NoFunction 1 = FaultReset 2 = MotionDisable❶ 3 = ForceSnapShot 4 = UserFault 5 = BrakeRelease❶ ❶ These choices are level sensitive. All others are edge sensitive	Parameter Number	62
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	5
	Default Value	0

Input05Function This parameter determines the special function for User Input 5: 0 = NoFunction 1 = FaultReset 2 = MotionDisable❶ 3 = ForceSnapShot 4 = UserFault 5 = BrakeRelease❶ ❶ These choices are level sensitive. All others are edge sensitive	Parameter Number	63
	Access Rule	GET/SET
	Data Type	USINT
	Group	User I/O Config.
	Units	—
	Minimum Value	0
	Maximum Value	5
	Default Value	0

Miscellaneous Configuration Group

NetworkOverride This parameter allows for the local logic to override a Network fault. 0 = Disable 1 = Enable	Parameter Number	64
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Misc. Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

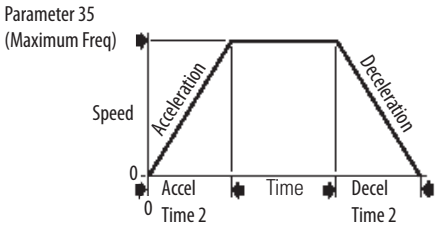
CommsOverride This parameter allows for local logic to override an I/O connection timeout. 0 = Disable 1 = Enable	Parameter Number	65
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Misc. Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

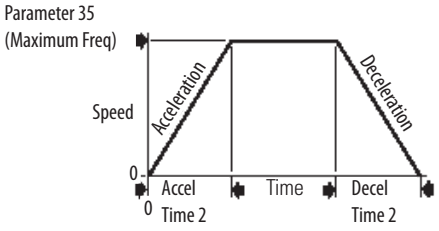
KeypadMode This parameter selects if the keypad operation is maintained or momentary. 0 = Momentary 1 = Maintained	Parameter Number	66
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Misc. Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

KeypadDisable This parameter disables all keypad function except for the “OFF” and “RESET” buttons. 0 = KeypadEnabled 1 = KeypadDisabled	Parameter Number	67
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Misc. Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

SetToDefaults This parameter if set to "1" will set the device to the factory defaults. 0 = NoAction 1 = SetToDefaults	Parameter Number	68
	Access Rule	GET/SET
	Data Type	BOOL
	Group	Misc. Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

Advanced Configuration

AccelTime2 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	69
	Related Parameters	36
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	x.x secs
	Minimum Value	0.0
	Maximum Value	600.0
	Default Value	20.0

DecelTime2 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	70
	Related Parameters	37
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	x.x secs
	Minimum Value	0.0
	Maximum Value	600.0
	Default Value	20.0

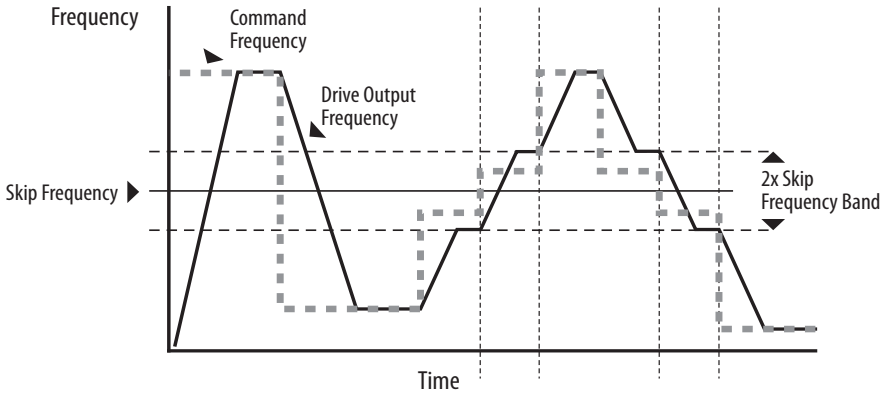
MotorOLRetention Enables/disables the Motor overload Retention function. When Enabled, the value held in the motor overload counter is saved at power-down and restored at power-up. A change to this parameter setting resets the counter. 0 = Disabled (Default) 1 = Enabled	Parameter Number	71
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

InternalFreq Provide the frequency command to drive when Parameter 33 (Speed-Reference) = 1 (InternalFreq). When enabled, this parameter will change the frequency command in real time.	Parameter Number	72
	Related Parameters	33
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	x.x Hz
	Minimum Value	0.0
	Maximum Value	400.0
	Default Value	60.0

SkipFrequency Sets the frequency at which the drive will not operate.	Parameter Number	73
	Related Parameters	74
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	Hz
	Minimum Value	0
	Maximum Value	400 Hz
	Default Value	0 Hz

SkipFrqBand Determines the band width around Parameter 73 (SkipFrequency). Parameter 74 (SkipFreqBand) is split applying 1/2 above and 1/2 below the actual skip frequency. A setting of 0.0 disables this parameter.	Parameter Number	74
	Related Parameters	73
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	x.x Hz
	Minimum Value	0.0 Hz
	Maximum Value	30.0 Hz
	Default Value	0.0 Hz

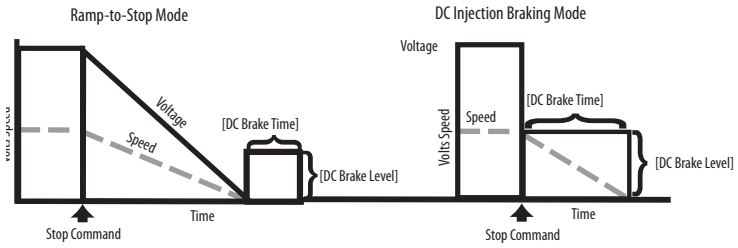
Figure 54 - Skip Frequency Band



DCBrakeTime Sets the length of time that DC brake current is injected into the motor. Refer to Parameter 76 (DCBrakeLevel).	Parameter Number	75
	Related Parameters	32, 76
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	x.x secs
	Minimum Value	0.0
	Maximum Value	99.9 (Setting of 99.9 = Continuous)
	Default Value	0.0

DCBrakeLevel Defines the maximum DC brake current, in amps, applied to the motor when Parameter 32 (StopMode) is set to either 0 = RAMP or 2 = DC BRAKE. For 0.5 Hp units – Min = 0; Max = 2.7; Default = .1 For 1.0 Hp units – Min = 0; Max = 4.5; Default = .1 For 2.0Hp units – Min = 0; Max = 7.5; Default = .2	Parameter Number	76
	Related Parameters	32, 75
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	x.x Amps
	Minimum Value	0.0
	Maximum Value	Hp Dependant
	Default Value	Hp Dependant

ATTENTION:



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

ReverseDisable		
O Stop drive before changing this parameter. Enables/disables the function that allows the direction of the motor rotation to be changed. 0 = Enabled 1 = Disabled	Parameter Number	77
	Related Parameters	—
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

FlyingStartEn		
Sets the condition that allows the drive to reconnect to a spinning motor at actual RPM. 0 = Disabled 1 = Enabled	Parameter Number	78
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

Compensation Enables/disables correction options that may improve problems with motor instability, 0 = Disabled 1 = Electrical (Default) Some drive/motor combinations have inherent instabilities which are exhibited as non-sinusoidal motor currents. This setting attempts to correct this condition 2 = Mechanical Some motor/load combinations have mechanical resonances which can be excited by the drive current regulator. This setting slows down the current regulator response and attempts to correct this condition. 3 = Both	Parameter Number	79
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	—
	Minimum Value	0
	Maximum Value	3
	Default Value	1

SlipHertzAtFLA Compensates for the inherent slip in an induction motor. This frequency is added to the commanded output frequency based on motor current.	Parameter Number	80
	Related Parameters	30
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	x.x Hz
	Minimum Value	0.0 Hz
	Maximum Value	10.0 Hz
	Default Value	2.0 Hz

BusRegulateMode Controls the operation of the drive voltage regulation, which is normally operational at deceleration or when the bus voltage rises. 0 = Disable 1 = Enabled	Parameter Number	81
	Related Parameters	—
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	—
	Minimum Value	0
	Maximum Value	1
	Default Value	0

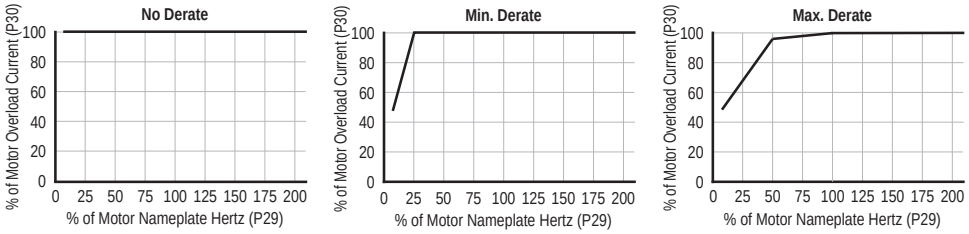
ATTENTION: The bus regulator mode function is extremely useful for preventing nuisance overvoltage faults resulting from aggressive decelerations, overhauling loads, and eccentric loads. However, it can also cause either of the following two conditions to occur.

1. Fast positive changes in input voltage or imbalanced input voltages can cause uncommanded positive speed changes;

2. Actual deceleration times can be longer than commanded deceleration times. However, a "Stall Fault" is generated if the drive remains in this state for 1 minute. If this condition is unacceptable, the bus regulator must be disabled.

MotorOLSelect		
Drive provides Class 10 motor overload protection. Sets the derating factor for I^2T motor overload function. 0 = NoDerating 1 = MinDerating 2 = MaxDerating	Parameter Number	82
	Related Parameters	29, 30
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	—
	Minimum Value	0
	Maximum Value	2
	Default Value	0

Figure 55 - Overload Trip Curves



SWCurrentTrip		
Enables/disables a software instantaneous (within 100 ms) current trip.	Parameter Number	83
	Related Parameter	30
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	x.x Amps
	Minimum Value	0.0
For 0.5 Hp units – Min = 0; Max = 3.0; Default = 0 For 1.0 Hp units – Min = 0; Max = 5.0; Default = 0 For 2.0Hp units – Min = 0; Max = 8.4; Default = 0	Maximum Value	Hp Dependent
	Default Value	0.0 (Disabled)

AutoRstrtTries Set the maximum number of times the drive attempts to reset a fault and restart.		
	Parameter Number	84
	Related Parameter	85
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	—
	Minimum Value	0
	Maximum Value	9
	Default Value	0

Clear a Type 1 Fault and Restart the Drive

1. Set Parameter 84 (AutoRestartTries) to a value other than 0.
2. Set Parameter 85 (AutoRestartDelay) to a value other than 0.

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

1. Set Parameter 84 (AutoRestartTries) to a value other than 0.
2. Set Parameter 85 (AutoRestartDelay) to 0.

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.

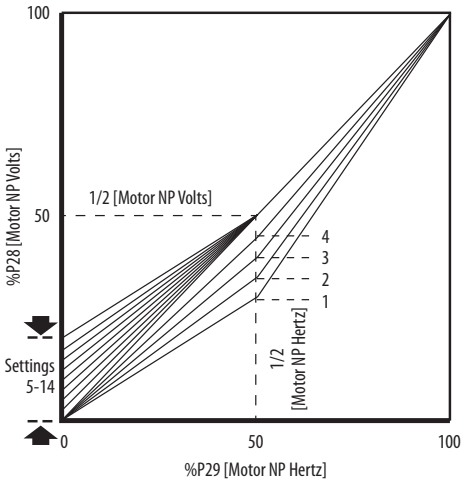
AutoRstrtDelay Sets time between restart attempts when Parameter 84(Auto Rstrt Tries) is set to a value other than zero.	Parameter Number	85
	Related Parameter	84
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	x.x secs
	Minimum Value	0.0
	Maximum Value	120.0
	Default Value	1.0

BoostSelect Sets the boost voltage (% of Parameter 28 [MotorNPVolts]) and redefines the Volts per Hz curve. See Table 24 for details.	Parameter Number	86
	Related Parameters	28, 29
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	—
	Minimum Value	1
	Maximum Value	14
	Default Value	8

Table 24 - Boost Select Options

Options	Description	
	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	
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 56 - Boost Select



MaximumVoltage Sets the highest voltage the drive will output.	Parameter Number	87
	Related Parameters	—
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	V AC
	Minimum Value	20V AC
	Maximum Value	460V AC
	Default Value	2V AC

MotorNamePlateFLA Set to the motor nameplate Full Load Amps.	Parameter Number	88
	Related Parameters	—
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	x.x Amps
	Minimum Value	0.0
For 0.5 Hp units – Min = 0; Max = 3.0; Default = 1.5 For 1.0 Hp units – Min = 0; Max = 5.0; Default = 2.5 For 2.0Hp units – Min = 0; Max = 8.4; Default = 3.6	Maximum Value	Hp Dependent
	Default Value	Hp Dependent

BrakeMode This parameter determines the source brake control mode. 0 = NoBrakeControl 1 = AboveFrequency 2 = AboveCurrent	Parameter Number	89
	Related Parameters	—
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	—
	Minimum Value	0
	Maximum Value	2
	Default Value	1

BrakeFreqThresh This parameter determines the frequency above which the source brake is released.	Parameter Number	90
	Related Parameters	—
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	x.x Hz
	Minimum Value	0.0
	Maximum Value	999.9
	Default Value	0.0

BrakeCurrThresh This parameter determines the motor current above which the source brake is released.	Parameter Number	91
	Related Parameters	—
	Access Rule	GET/SET
	Data Type	UINT
	Group	Advanced Config.
	Units	x.xx Amps
	Minimum Value	0.0
	Maximum Value	8.0
	Default Value	0.0

IMPORTANT For parameter 90 and 91 the value of the threshold can be set beyond the operational maximum limit of the product, or at a level which may cause multiple transitions during operation. Threshold values near the operational levels should be avoided.

Notes:

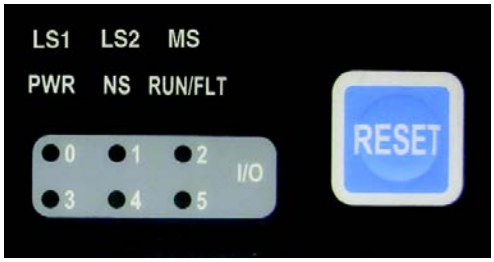
Diagnostics

Overview

This chapter describes the fault diagnostics of the ArmorStart LT Distributed Motor Controller and the conditions that cause various faults to occur.

Status LEDs and Reset

Figure 57 - Status and Diagnostic LEDs and Reset



ArmorStart LT provides comprehensive status and diagnostics via 12 individually marked LEDs shown in Figure 57, located on the ECM module. In addition, a local reset is provide for clearing of faults. Table 25 details the diagnostic and status LEDs.

Table 25 - ArmorStart LT Status and Diagnostics Indicators

Indicator	Description	Color_1	Color_2
PWR LED	The bicolor (green/yellow) LED shows the state of the control voltage. When LED is off, switched and/or unswitched power is not present.	Solid green is illuminated when switched and unswitched control power is within its specified limits and has the proper polarity.	Solid yellow is illuminated when switched or unswitched control power is outside its specified limits or has incorrect polarity. Flashing yellow indicates line voltage is not present (Bulletin 294 units only).
RUN/FLT LED	The bicolor (green/red) LED combines the functions of the Run and Fault LEDs.	Solid green is illuminated when a Run command is present.	The LED will blink red in a prescribed fault pattern when a protection fault (trip) condition is present. See table for fault blink patterns.
NS – Network Status LED	The bicolor (green/red) LED indicates the status of the CIP network connection. See Network Status Indicator for further information. Flashing bicolor (red/green) indicates a self-test on power up.	Flashing green indicates an IP address is configured, no CIP connections are established, and an Exclusive Owner connection has not timed out. Steady green indicates at least one CIP connection is established and an Exclusive Owner connection has not timed out.	Flashing red indicates the connection has timed out. Steady Red indicates a duplicate IP Address detected.
LS1 and LS2 – Link Status LEDs	The bicolor (green/yellow) LED shows the activity/link status of each EtherNet/IP port.	Solid green is illuminated when a link has been established at 100 Mbps.	Solid yellow is illuminated when a link has been established at 10 Mbps.

Table 25 - ArmorStart LT Status and Diagnostics Indicators

Indicator	Description	Color_1	Color_2
MS – Module Status LED	The bicolor (green/red) LED indicates the status of the module. Flashing bicolor (red/green) indicates a self-test on power up.	Flashing green indicates the device has not been assigned an IP address. Steady green indicates the device is configured and operational.	Flashing red indicates a resettable protection fault exists or the node address switches have been changed without a power cycle and do not match the in-use configuration. Steady red indicates a non-resettable protection fault exists.
I/O Status Enunciators 0…5 LEDs	Six yellow LEDs are numbered 0…5 and indicate the status of the input/output connectors. One LED for each I/O point.	Yellow is illuminated when input is valid or output is on.	Off when input is not valid or the output is not turned on.
Reset Button	The blue reset button will cause a protection fault reset to occur.	—	—

Fault Diagnostics

Fault diagnostics capabilities built in the ArmorStart LT Distributed Motor Controller are designed to help you pinpoint a problem for easy troubleshooting and quick restarting.

Protection Faults

Protection faults will be generated when potentially dangerous or damaging conditions are detected. Protection faults are also known as “trips” or “faults”. These faults will be reported in multiple formats, including:

- Bit enumeration in the TripStatus parameter (parameter 16) used as discrete bits or in DeviceLogix
- In the ArmorStart LT web server for ArmorStart EtherNet/IP version
- As a sequence of LED flashes on the ECM

LED Flash	Bit Enumeration	Bulletin 290E/291E Trip Status Bits	Bulletin 294E Trip Status Bits
1	0	OverloadTrip ❶	OverloadTrip ❶
2	1	PhaseLossTrip	PhaseLShortTrip
3	2	UnderPowerTrip ❶	UnderPowerTrip ❶
4	3	SensorShortTrip ❶	SensorShortTrip ❶
5	4	PhaseImbalTrip	OverCurrentTrip
6	5	NonVolMemoryTrip ❶	NonVolMemoryTrip ❶
7	6	reserved	ParamSyncTrip ❶
8	7	JamTrip	DCBusOrOpenDiscnnct ❶
9	8	StallTrip	StallTrip ❶
10	9	UnderloadTrip	OverTemperature ❶
11	10	reserved	GroundFault ❶
12	11	reserved	RestartRetries
13	12	reserved	DriveHdwFault ❶

LED Flash	Bit Enumeration	Bulletin 290E/291E Trip Status Bits	Bulletin 294E Trip Status Bits
14	13	OutputShortTrip ❶	OutputShortTrip ❶
15	14	UserDefinedTrip	UserDefinedTrip
16	15	HardwareFltTrip ❶	HardwareFltTrip ❶

❶ Can not be disabled.

A “ProtectFltEnable” parameter (param 42) is used to enable and disable individual protection faults. This parameter will be a bit enumerated parameter with each “disable fault” bit enumerated. Not all Faults can be disabled. Setting a bit to the value “1” enables the corresponding protection fault. Clearing a bit disables the protection fault. For protection faults that can not be disabled the value is always “1”.

There are two Protection Fault Reset modes: manual and automatic. When parameter 41 “ProtFltResetMode” is set to the value 0=Manual mode, a manual fault reset must occur before the fault is reset. When manual reset mode faults are latched until a fault reset command has been detected either locally or remotely. A Manual reset operation is either remotely via the network, locally via the “Reset” button on the front keypad, or via a DeviceLogix program. A rising edge (0 to 1 transition) of the “ResetFault” tag will attempt a reset. A rising edge of the parameter 44 “ProtectFltReset” will attempt a reset. A press of the local blue “Reset” button on the front keypad will attempt a reset. A rising edge of the “ResetFault” DeviceLogix tag will attempt a reset. When “ProtFltResetMode” is set to the value 1=Automatic, “auto-reset” faults are cleared automatically when the fault condition goes away.

Quick Reference Troubleshooting

The LEDs on the front of the ArmorStart LT provide an indication as to the health of the device and network. The following is a brief troubleshooting guide.

Table 26 - LED Status Indication

Status LED	Description	Recommended Action
PWR (Control) Status Indicator		
Off	The PWR LED is not illuminated at all.	Verify power is connected and with proper polarity.
Green	Voltage is present.	No action
Flashing Yellow	Power has fallen below minimum acceptable level.	Verify that the control power is between 19.2 and 26V DC.
RUN/FLT Status Indicator		
Off	The RUN/FLT LED is not illuminated when a Run command has been issued.	Verify that PLC is in Run mode. Verify that the correct run bit is being controlled. Verify that a stop condition does not exist.
Green	Valid start command	No action
Flashing Red	Protection fault	Count flashes and refer to Table 27 and 28.
MS – Module Status Indicator		
Off	The MS LED is not illuminated.	Check to make sure the product is properly wired and configured on the network.
Steady Green	Device configured and operational	No action
Flashing Green	Device IP Address has not been configured. .	Configure IP Address
Flashing Red	Resettable protection fault exists.	Verify fault by reviewing [TripStatus] Parameter 16 and [TripLog0…4] Parameters 18…22. Correct and press the blue reset button.
Solid Red	Non-resettable protection fault exists.	Verify fault by reviewing [TripStatus] Parameter 16 and [TripLog0…4] Parameters 18…22. Correct and cycle control power (switched and unswitched).
Flashes Green-Red	Self-test on power up	No action
NS – Network Status Indicator		
Off	The NS LED is not illuminated.	Check to make sure the product is properly wired and configured on the network.
Steady Green	CIP connection is established.	No action
Flashing Green	An IP address is configured, but no CIP connections are established, and an Exclusive Owner connection has not timed out.	Check to make sure the product is properly wired and configured on the network.
Flashing Red	Connection has timed out.	Check to make sure the PLC is operating correctly and that there are no media/cabling issues. Check to see if other network devices are in a similar state.
Solid Red	Duplicate IP address detected	Check for node address conflict and resolve.
Flashes Green-Red	The device has not completed the initialization, is not on an active network, or has not finished self test at power up.	Remove or change the IP address of the conflicting device.
LS1 and LS2 Port Activity/Status		
Off	No link established.	Verify network connection.
Green	Link established at 100 Mbps.	No action
Flashing Green	Transmit or receive activity present at 100 Mbps.	No action
Yellow	Link established at 10 Mbps.	No action

Table 26 - LED Status Indication

Status LED	Description	Recommended Action
Flashing Yellow	Transmit or receive activity present at 10 Mbps.	No action
I/O Status Indicators		
Off	The user has plugged into the I/O, but the indicator did not illuminate, once initiated.	Verify the wiring of Input or Output is correct. When used as an output point, ensure the corresponding bit in parameter 49 [IOPointConfiguration] is set to Output.

Fault LED Indications

The RUN/FLT LED will blink red in a prescribed fault pattern when a protection fault (trip) condition is present. The LED will blink in 0.5 second intervals when indicating a fault code. Once the pattern is finished, there will be a 2 second pause after which the pattern will be repeated.

Bulletin 290E/291E Faults

Bulletin 290E/291E faults are detected by the main control board. When the [ProtFltResetMode] Parameter 41 is set to the value 1=Automatic, the auto resettable faults in the table will reset automatically when the fault condition is no longer present.

Table 27 - Fault LED Indicator for Bulletin 290E/291E

Blink Pattern	Auto-Reset	Disable	Default	Bulletin 290E/291E Trip Status	Description	Action
1	Yes	No	On	Overload Trip	The load has drawn excessive current and based on the trip class selected, the device has tripped.	Verify that the load is operating correctly and is properly set-up, [FLASetting] Parameter 28, [OLResetLevel] Parameter 29. The fault may be reset only after the motor has sufficiently cooled.
2	Yes	Yes	Off	Phase Loss Trip	The ArmorStart LT has detected a missing phase.	This fault is generated by monitoring the relative levels of the 3-phase currents. Correct phase imbalance or disable fault using [ProtectFltEnable] Parameter 42.
3	Yes	No	On	Under Power Trip	The ArmorStart LT detected switched or unswitched power dip below 19.2 V for greater than 50 ms, or 13 V for greater than 4 ms.	Check control voltage, wiring, and proper polarity (A1/A2/A3 terminal).
4	No	No	On	Sensor Short Trip	This error indicates a shorted sensor, shorted input device, wiring input mistakes.	Correct, isolated or remove wiring error prior to restarting the system.
5	Yes	Yes	Off	Phase Imbalance Trip	The ArmorStart LT has detected a current imbalance in one of the phases.	Check the power system for current imbalance and correct. Correct phase imbalance or disable fault using [ProtectFltEnable] Parameter 42.
6	No	No	On	Non-Volatile Memory Trip	This is a major fault, which renders the ArmorStart LT inoperable. Possible causes of this fault are transients induced during Non-Volatile Storage (NVS) routines.	1. If the fault was initiated by a transient, power cycling may clear the problem. 2. This fault may be reset by a [SetToDefaults] Parameter 68. 3. Replacement of the ArmorStart LT may be required.
7	—	—	—	Reserved	—	—

Table 27 - Fault LED Indicator for Bulletin 290E/291E

Blink Pattern	Auto-Reset	Disable	Default	Bulletin 290E/291E Trip Status	Description	Action
8	No	Yes	Off	Jam Trip	During normal running (after starting period), the RMS current draw exceeds the prescribed fault level. This fault is generated when current is greater than the Jam Trip Level for longer than the Jam Delay time after the Jam Inhibit time has expired.	1. Check for the source of the jam (for example, excessive load or mechanical transmission component failure). 2. Check [JamInhibitTime] Parameter 70, [JamTripDelay] Parameter 71, and [JamTripLevel] Parameter 72 setting.
9	No	Yes	Off	Stall Trip	During starting, the motor did not reach running speed within the prescribed period. This fault is generated when the RMS current is greater than [StallTripLevel] Parameter 75 or longer than [StallEnbldTime] Parameter 74 during motor starting.	1. Check for source of stall (for example, excessive load, or mechanical transmission component failure). 2. Check [StallEnabledTime] Parameter 74 and [StallTripLevel] Parameter 75. 3. Check if [FLASetting] Parameter 28 is set correctly.
10	No	Yes	Off	Underload Trip	Underload protection is for undercurrent monitoring. A trip occurs when the motor current drops below the trip level.	Check motor and mechanical system for broken shaft, belts, or gear box. Check [ULInhibitTime] Parameter 76, [ULTripDelay] Parameter 77, [ULTripLevel] Parameter 78, and [ULWarningLevel] Parameter 79.
11	—	—	—	Reserved	—	—
12	—	—	—	Reserved	—	—
13	—	—	—	Reserved	—	—
14	No	No	On	Output Short Trip	This fault is generated when a hardware output short circuit condition is detected.	Correct, isolate or remove wiring error prior to restarting the system.
15	Yes	Yes	Off	User Defined Trip	This fault is generated either in response to the rising edge of user input 0...5, [Input00Function...Input- 05Function] Parameter 58...63, or by DeviceLogix.	This fault is generated based on user configuration. This fault may be reset after the condition that caused it is removed. For example, the Auxiliary Input goes low or the DeviceLogix logic drives the bit low.
16	No	No	On	Hardware Fault Trip	This fault indicates that a serious hardware problem exists.	Power cycle to correct. If fault persists the ArmorStart LT requires replacement.

Bulletin 294E Faults

Bulletin 294E faults are detected by the main control board and/or the internal drive. When there is an internal drive fault, the main control board simply polls the drive for the existence of faults and reports the fault state. Writing a value to [ProtFltResetMode] Parameter 41 determines auto-reset ability for some faults. The auto-reset ability of faults that are generated on the drive are controlled by [AutoRestartTries] Parameter 84 and [AutoRestar Delay] Parameter 85.

Auto Reset

Table 28 - Auto Reset Ability

Auto Reset	Function	Description
Drive Control	Auto-Reset/Run	When this type of fault occurs, and [AutoRestartTries] Parameter 84 is set to a value greater than "0," a user-configurable timer, [AutoRestartDelay] Parameter 85, begins. When the timer reaches zero, the drive attempts to automatically reset the fault. If the condition that caused the fault is no longer present, the fault will be reset and the drive will be restarted.
No	User Action Needed	This type of fault requires drive or motor repair, or is caused by wiring or programing errors. The cause of the fault must be corrected before the fault can be cleared via manual or network reset. A rising edge of the "Fault Reset" DeviceLogix bit will also clear the fault.
Yes	[ProtFltResetMode] Parameter 41 = 1 which is automatic	Faults are cleared automatically when the fault condition goes away.

Table 29 - Fault LED Indicator for Bulletin 294E

Blink Pattern	Auto-Reset Capable	Disable	Default	Bulletin 294E Trip Status	Description	Action
1	Drive Controlled	No	On	Overload Trip *(PF 4M Codes 7 and 64)*	This fault is a result of the drive's Motor Overload fault or the Drive Overload fault. Exceeding the Drive overload rating of 150% for 1 minute or 200% for 3 seconds caused the device to trip.	The fault may be reset only after the overload algorithm determines that the motor has sufficiently cooled or that the Drive heatsink temperature falls to an acceptable level. Check the following: 1. Excessive motor load. Reduce load so drive output current does not exceed the current set by [MotorOLCurrent] Parameter 30. 2. Verify [BoostSelect] Parameter 86 setting.
2	No	No	On	Phase Short *(PF 4M Codes 38…43)*	This fault is a result of the drive's Phase to Ground Short faults *(Codes 38…40)* or Phase to Phase Short faults *(Codes 41…43)*.	1. Check the wiring between the drive and motor. 2. Check motor for grounded phase. 3. Replace ArmorStart LT if fault cannot be cleared.
3	Yes	No	On	Under Power Trip	The ArmorStart LT detected switched or unswitched power dip below 19.2 V for greater than 50 ms, or 13 V for greater than 4 ms.	Check control voltage, wiring, and proper polarity (A1/A2 terminal). Correct power loss or disable fault using [ProtectFltEnable] Parameter 42.
4	No	No	On	Sensor Short Trip	This error indicates a shorted sensor, shorted input device, wiring input mistakes.	Correct, isolated or remove wiring error prior to restarting the system.
5	Drive Controlled	No	On	Over Current *(PF 4M Codes 12 and 63)*	This fault is a result of the drive's HW OverCurrent fault or it's SW OverCurrent fault.	1. Check for excess load, improper [BoostSelect] Parameter 86 setting or other causes of excess current or 2. Check load requirements and [SWCurrentTrip] Parameter 83 setting.
6	No	No	On	Non-Volatile Memory Trip *(PF 4M Code 100)*	This is a major fault, which renders the ArmorStart LT inoperable. Possible causes of this fault are transients induced during Non-Volatile Storage (NVS) routines.	1. If the fault was initiated by a transient, power cycling may clear the problem. 2. This fault may be reset by a [SetToDefaults] Parameter 68. 3. Replacement of the ArmorStart LT may be required.

Table 29 - Fault LED Indicator for Bulletin 294E

Blink Pattern	Auto-Reset Capable	Disable	Default	Bulletin 294E Trip Status	Description	Action
7	Yes	No	On	Parameter Sync *(PF 4M Codes 48, 71 and 81)*	This fault is generated during the parameter synchronization procedure between the Control Module and the internal drive when the syncing process fails resulting in the drive configuration not matching the Control Module configuration.	1. The most common cause of this fault is that the disconnect has been opened, or that power has been removed from the drive. To clear the fault, repower the drive and activate a reset. 2. The drive may have been commanded to default values. Clear the fault or cycle power to the drive.
8	Drive Controlled	No	On	DCBusOrDiscnnct ❶ *(PF 4M Codes 3, 4 and 5)*	This fault is a result of the drive's Power Loss *(PF 4M Code 3)*, UnderVoltage *(PF 4M Code 4)* and OverVoltage *(PF 4M Code 5)* faults. When an Undervoltage occurs because the Disconnect has been opened, the condition will be diagnosed as an "Open Disconnect" trip	1. The most common cause of this fault is that the disconnect has been opened, or that power has been removed from the drive. To Clear the fault, repower the drive and activate a reset. 2. Monitor the incoming line for phase loss or line imbalance, low voltage or line power interruption. high line voltage or transient conditions. Bus OverVoltage can also be caused by motor regeneration. 3. Extending the [DecelTime1] Parameter 37 or [DecelTime2] Parameter 70 may also help with this fault.
9	Drive Controlled	No	On	Stall Trip *(PF 4M Code 6)*	During starting the motor did not reach running speed within the prescribed period. This fault occurs when the drive detects a motor stall condition during acceleration.	1. Check for source of stall (for example, excessive load, or mechanical transmission component failure). 2. Increase [AccelTime1] Parameter 36 or [AccelTime2] Parameter 69 or reduce load so drive output current does not exceed the current set by [CurrentLimit] Parameter 31.
10	Drive Controlled	No	On	Over Temperature *(PF 4M Code 8)*	This fault occurs when the drive detects a heat sink over temperature condition.	Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 40° C (104° F).
11	No	No	On	Ground Fault *(PF 4M Code 13)*	This fault occurs 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.
12	No	No	On	Restart Retries *(PF 4M Code 33)*	Drive unsuccessfully attempted to reset a fault and resume running for the programmed number of auto retries.	Correct the cause of the fault and manually clear. Check [AutoRestartTries] Parameter 84 and [AutoRestartDelay] Parameter 85 meets application needs.
13	No	No	On	Drive Hardware Fault	Failure has been detected in the drive power section.	1. Cycle power. 2. Replace unit if failure can not be cleared.
14	No	No	On	Output Short	This fault is generated when a hardware output short circuit condition is detected.	Correct, isolate or remove wiring error prior to restarting the system.
15	Yes	Yes	Off	User Defined	This fault is generated either in response to the rising edge of user input 0...5, [Input00Function...Input- 05Function] Parameter 58...63.	This fault is generated based on user configuration. This fault may be reset after the condition that caused it is removed. For example, the Auxiliary Input goes low or the DeviceLogix logic drives the bit low.
16	No	No	On	Hardware Fault Trip	This fault indicates that a serious hardware problem exists. This fault is generated when either the PF 4M drive is not detected or an invalid factory configuration setting is detected.	Power cycle to correct. If fault persists the ArmorStart LT requires replacement.

❶ In the case of a Disconnect open fault, reclosing the disconnect will cause a reset to be issued.

Specifications

Bulletin 290E/291E

Electrical Ratings				
Power Circuit	Application	Three-phase		
	Number of Poles	3		
	Input Power Terminals	L1, L2, L3		
	Motor Power Terminals	T1, T2, T3		
	PE (Earth Ground) Terminal	4 PE terminals		
	Maximum Rated Operating Voltage	400Y/230…480Y/277 (-15%, +10%)		
	Rated Impulsed Voltage (U_{imp})	4 kV		
	Dielectric Withstand	**UL**: 1960V AC, **IEC**: 2500V AC		
	Operating Frequency	50/60 Hz (±10%)		
	Maximum Rated Operating Current	**Cat. No.**	**Hp (kW)**	**Overload Range**
		290_-____-A-* 291_-____-A-*	2 (1.5)	0.24…3.5 A
		290_-____-B-* 291_-____-B-*	5 (3)	1.1…7.6 A
	Overload Type	Solid-state I^2T		
	Trip Class	**[10]**, 15, 20 with thermal memory retention (see Motor Overload Trip Curves)		
	Trip Rating — Full Load Current (FLC)	120% of FLC		
	Reset Mode	Automatic or manual		
	Overload Reset Level	1…100% TCU		
	Overvoltage Category	III		

Electrical Ratings				
Control Circuit (External Source)	Power Supply	NEC Class 2		
	Rated Operating Voltage	24V DC (+10%, -20%)		
	Overvoltage Protection	Reverse-polarity protected		
	Unswitched Power Supply Requirements	Voltage	19.2…26.4V DC	
		Nominal Current	150 mA	
		Power	3.6 W	
		Input Current (each) ❶	50 mA	
		Maximum Current	450 mA	
		Maximum Power	14.4 W	
		Peak Inrush ❷	<5 A for 35 ms	
	Switched Power Supply Requirements	Voltage	19.2…26.4V DC	
		Nominal Current	125 mA	
		Power	3 W	
		Output Current (each) ❶	500 mA	
		Maximum Current	1.625 A	
		Maximum Power	42 W	
		Peak Inrush ❷	<5 A for 35 ms	
	Switched and Unswitched Power Supply Requirements	Voltage	19.2…26.4V DC	
		Nominal Current	275 mA	
		Power	6.6 W	
		Number of Inputs (x 50 mA)	user defined	
		Number of Outputs (x 500 mA)	user defined	
		Maximum Current	275 mA + user defined	
		Maximum Power	6.6 W + (24V DC x user defined)	
		Peak Inrush ❷	<10 for 35 ms	
Control Circuit (Internal Source)	An internal 50 W power supply sources 24V DC for input, outputs, and logic control.			

	Cat. No.	**Sym. Amps RMS**	**Circuit Breaker**	**Fuse**
Short Circuit Current Rating (SCCR)	290/1_-*-G1 (or G3)	10 kA @ 480Y/277	When used with Allen Bradley Cat. No. 140U-D6D3-C30	CC, J, or T fuse (maximum 45 A)
	290/1_-*-G1 (or G3)	5 kA @ 480Y/277		UL Class fuse (maximum 45 A)
	290/1_-*-G2	10 kA @ 480Y/277		CC, J, or T fuse (maximum 40 A)
Short Circuit Coordination	Type 1			
	Size per NFPA 70 (NEC) or NFPA 79 for Group Motor Applications			

❶ I/O is configurable to either input or output.

❷ Assumes zero wire resistance. Wire impedance will reduce current inrush.

Input and Output Ratings		
Input	Supply Voltage	Unswitched power A3/A2
	Type of Inputs	24V DC current sinking
	Connection Type	Single keyed M12, quick disconnect
	Input per Connection	1/each
	Rated Operating Voltage	24V DC
	On-State Input Voltage (pin 4)	10…26.4V DC, nominal 24V DC
	Off-State Input Voltage	5V DC
	On-State Input Current (pin 4)	1…3.7 mA, 2.6 mA @ 24V DC
	Off-State Input Current	<1.5 mA
	Maximum Sensor Leakage Current	<2.5 mA
	Maximum Number of Input Devices	6
	Maximum Sensor Sourcing Current (pin 1)	50 mA per point (max 300 mA total for sourcing one device)
	Sensor Operating Voltage Range	19.2…26V DC
	Input Bounce Filter ❶ (Software Configurable)	Off-On or On-Off: 0.5 ms + 64 ms
	Filtering	100 µs
	DeviceLogix I/O Response	2 ms (500 Hz)
Output	Supply Voltage (Switched Power)	A1/A2
	Type of Outputs	DC sourcing
	Load Types	Resistive or light inductive
	Utilization Category (IEC)	DC-1, DC-13
	Output State	Normally Open (N.O.)
	Connection Type	Single keyed M12, quick disconnect
	Output per Connection	1/each
	Overcurrent Protection ❷	1.5 A (the sum of all outputs cannot exceed this value)
	Rated Insulation Voltage (U_i)	**UL:** 1500V AC, **IEC:** 2000V AC
	Rated Operating Voltage (U_e)	19.2…26.4V DC
	Maximum Blocking Voltage	35V DC
	Nominal Operating Current (I_e)	500 mA per point
	Maximum Thermal Current (I_{the})	500 mA per point
	Maximum Off-state Leakage Current	1 µA
	Maximum Number of Outputs	6
	Surge Suppression	Integrated diode to protect against switching loads

❶ Input ON-to-OFF delay time is the time from a valid input signal to recognition by the module.

❷ If an output exceeds 1.5 A for greater than 7 ms, a fault is generated.

Environmental Ratings	
Operating Temperature Range	-20…+50 °C (-4…+122 °F)
Storage and Transportation Temperature Range	-25...+85 °C (-13…+185 °F)
Altitude	2000 m
Humidity	5…95% (non-condensing)
Pollution Degree	3
Enclosure Ratings	IP66/UL Type 4/12 ❶
Approximate Shipping Weight	4.6 kg (10 lb)

Mechanical Ratings				
Resistance to Shock	Operational	30 G, exceeds IEC 60947-1		
	Non-Operational	50 G, exceeds IEC 60947-1		
Resistance to Vibration	Operational	2.5 G, tested to MIL-STD-810G, exceeds IEC 60947-1		
	Non-Operational	5 G, tested to MIL-STD-810G, exceeds IEC 60947-1		
Disconnect Lock Out	Maximum of 3/8 in. (9.5 mm) diameter lock shackle or hasp			
Disconnect LOTO Locks	Up to 2 locks or hasps are supported			
Disconnect Mechanical Life	200 000 operations			
Contractor Utilization Category (IEC)	AC-1, AC-3, AC-4 (refer to Life Load Curves)			
Contactor Opening Delay	8…12 ms			
Contactor Closing Delay	18…40 ms			
Minimum Off Time	200 ms			
Contactor Mechanical Life	15 million operations			
	Power Terminals	**Motor Terminals**	**Control Terminals**	**PE/Ground**
Wire Size❷	(2) #18 …#10 AWG (0.8…5.2 mm^2) per terminal	#18…#10 AWG (0.8…5.2 mm^2) per terminal	(2) #18 …#10 AWG (0.8…5.2 mm^2) per terminal	(2) #16 …#10 AWG (1.3…5.2 mm^2) per terminal
Wire Type	Multi-strand copper wire			
Tightening Torque	10.6 ± 2 lb•in (1.2 ± 0.2 N•m)			18 ± 2 lb•in (2 ± 0.2 N•m)
Wire Strip Length	0.35 ± 0.01 in. (9 ± 2 mm)			
Power Rating	600V AC/25 Amp	600 V AC/10 Amp	600 V AC/10 Amp	—

Emission and Immunity Ratings		
Emission	Conducted	EN 60947-4-1 Class A
	Radiated	
	Electrostatic Discharge	4 kV contact, 8 kV air
	Radio Frequency Electromagnetic Field	EN 60947-4-1 10V/m, 80 MHz…1 GHz 10V/m, 1.4 GHz…2 GHz
Immunity	Fast Transient	2 kV (Power) 2 kV (PE) 1 kV (Communication and control)
	Surge Transient	1 kV (12) $_{L-L}$, 2 kV (2) $_{L-N}$ (earth)
	Radio Frequency Conducted Disturbance	10V, 150 kHz…80 MHz

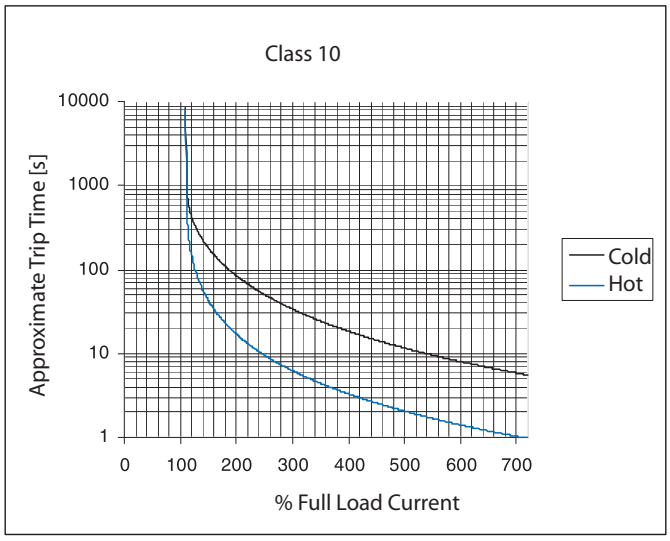
❶ IP66/UL Type 4 is available with gland options G1-3. IP66/UL Type 4/12 available with G1 and G3 gland option

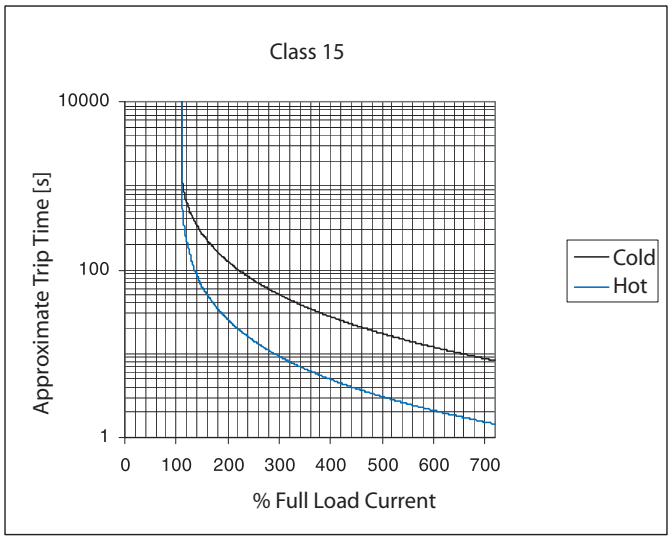
❷ When two wires used in terminal block both wires are to be of same wire AWG.

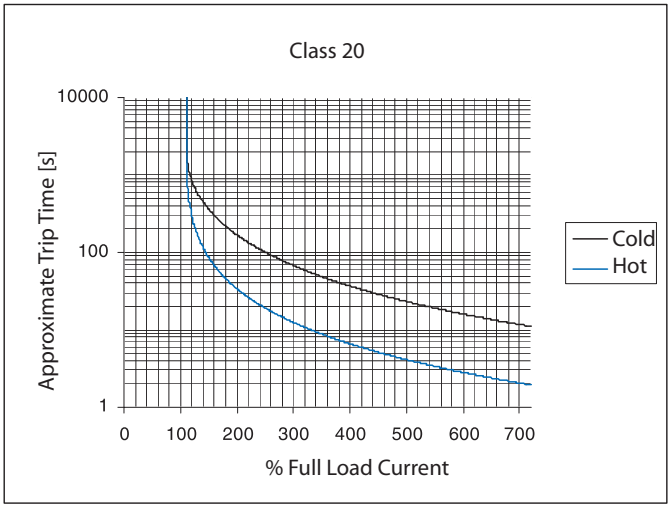
Standards Compliance and Certifications			
	UL/CSA	**EN/IEC**	**Other Agencies**
Standards Compliance	UL 508 Industrial Control Equipment – Suitable for Group Installation CSA C22.2, No. 14	EN 60947-4-1 Low Voltage Switchgear CE Marked per Low Voltage Directive 2006/95/EC and EMC Directive 2004/108/EC	CCC (Pending) KCC C-Tick ODVA for EtherNet/IP and DeviceNet
Certifications	cULus (File No. E3125, Guide NLDX, NLDX7)		

Communication Ratings		
	Rated Insulation Voltage	250V
	Operating Dielectric Withstand	**UL/NEMA**: 1500V AC, **IEC**: 2000V AC
EtherNet/IP	EtherNet/IP ODVA – Conformance Testing	EtherNet/IP Interoperability Performance – Per A9 PF 2.1
	Ethernet Communication Rate	10/100 Mbps, half or full-duplex
	Ethernet Ports	2 (embedded switch)
	Ethernet Network Topologies Supported	Star, Tree, Linear, and Ring
	Device Level Ring Support	Beacon Performance, IEEE 1588 Transparent Clock
	Ethernet Connector	M12, D code, female, with Ethernet keying, 4 Pin
	Ethernet Cable	Category 5e: Shielded or unshielded
	IP Configuration	Static, DHCP, or BootP
	DHCP Timeout	30 s
	Data	Transported over both TCP and UDP
	Packet Rate (pps)	500 packets-per-second (2000 µs), Tx 500 packets-per-second (2000 µs), Rx
	Consume Instance (Command)	Default of 3 words (Instance 150)
	Produce Instance (Status)	Default of 14 words (Instance 152)
	Message Support	Unicast or Multicast
	Address Conflict Detection (ACD)	IP v4 Address Conflict Detection for EtherNet/IP devices
	Sockets	150 maximum
Web Server	Security	Login and password configurable
	E-mail	Support Simple Mail Transfer Protocol (SMTP)
	Webpage Features	Status, diagnostics, configuration
	Concurrent Sessions	20
	Web Server	HTTP 1.1
Network Connections	Concurrent TCP Connections	Maximum of 15 encapsulated messages over both TCP and UDP
	Maximum I/O Connections (CIP Class 1)	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.
	Maximum Concurrent Explicit Messages (CIP Class 3)	6
	Class 1 Connection API	2…3200 ms
	Class 3 Connection API	100…10 000 ms
	Request Packet Interval (RPI)	20 ms default (2 ms minimum)

Motor Overload Trip Curves

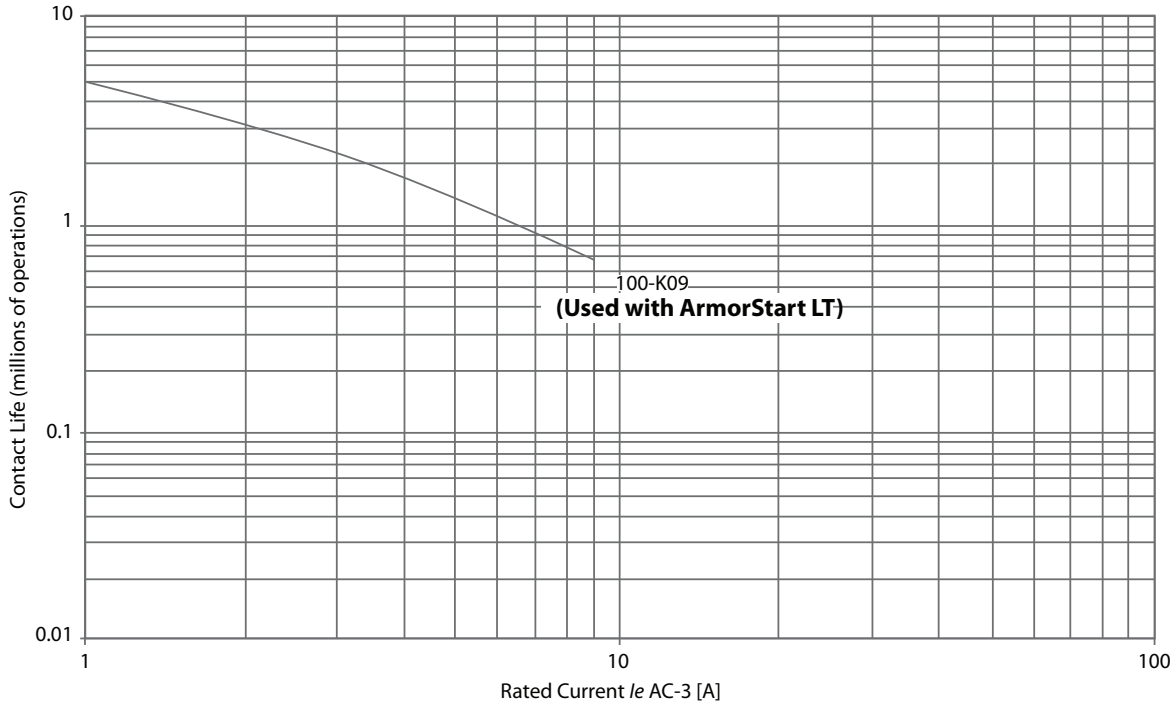




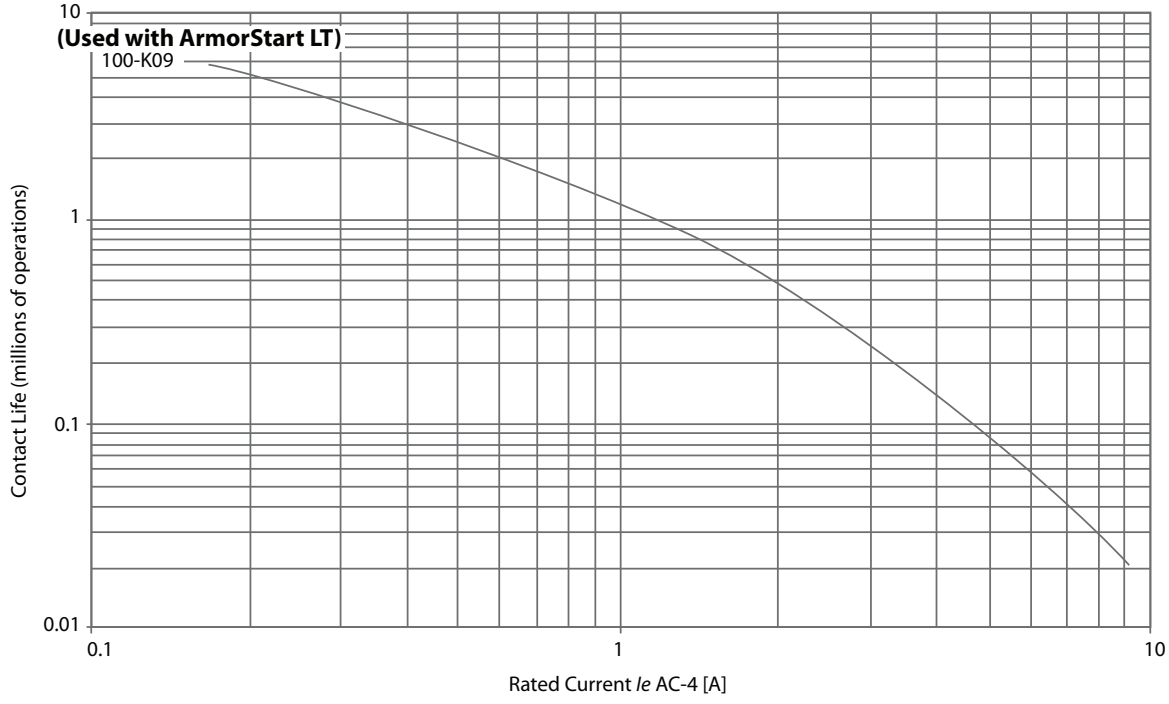


Bulletin 100-K/104-K Life-Load Curves

Electrical life; Ue = 400…460V AC
AC-3: Switching of squirrel-cage motors



Electrical life; Ue = 400…460V AC
AC-4: Stepping of squirrel-cage motors



Bulletin 294E

Electrical Ratings		
Power Circuit	Application	Three-phase
	Number of Poles	3
	Input Power Terminals	L1, L2, L3
	Motor Power Terminals	T1, T2, T3
	PE (Earth Ground) Terminal	4 PE terminals
	Maximum Rated Operating Voltage	400Y/230…480Y/277 (-15%, +10%)
	Rated Impulsed Voltage (U_{imp})	4 kV
	Dielectric Withstand	**UL:** 1960V AC, **IEC:** 2500V AC
	Operating Frequency	50/60 Hz (±10%)

Electrical Ratings — Variable Frequency Drive						
		Cat. No.	**Hp (kW)**	**Input Amps 400V AC, 50 Hz**	**Input Amps 480V AC, 60 Hz**	**Output Amps**
Power Circuit	Maximum Rated Operating Current	294_-FD1P5*	0.5 (0.37)	2.0	1.8	1.5
		294_-FD2P5*	1.0 (0.75)	3.7	3.0	2.5
		294_-FD4P2*	2.0 (1.5)	6.5	5.5	3.6
	Overload Protection	Solid-state I^2T type	150% for 60 s or 200% for 3 s			
		Trip Class	Class 10 protection with speed sensitive response and power-down overload retention function			
		Overcurrent Protection	200% hardware limit, 300% instantaneous fault			
	Overvoltage Category		III			
	Reset Mode		Automatic or manual			
	Output Frequency		0…400 Hz (programmable)			
	Efficiency		97.5% typical			
	Overvoltage		380…480V AC Input – Trip occurs at 810V DC bus voltage (equivalent to 575V AC incoming line)			
	Undervoltage		380…480V AC Input – Trip occurs at 390V DC bus voltage (equivalent to 275V AC incoming line)			
	Control Ride Through		Minimum ride through is 0.5 s — typical value is 2 s			
	Faultless Power Ride Through		10 ms			
	Carrier Frequency		2…10 kHz, drive rating based on 4 kHz			
	Speed Regulation — Open Loop with Slip Compensation		±2% of base speed across a 40:1 speed range			
	Acceleration/Deceleration		Two independently programmable acceleration and deceleration times. Each time may be programmed from 0…600 s, in 0.1 s increments.			
	Maximum Motor Cable Lengths (Reflected Wave Protection) ❶		10 m (32 ft)(CE application)❷ 14 m (45.9 ft) (non-CE application)			
	Source Brake (EM Brake) Current		Maximum load current of 3 A			

❶ The reflected wave data applies to all frequencies 2…10 kHz.

❷ For CE compliant installations refer to the recommended EMI/RFI cord grip accessory. For availability of the quick disconnect three-phase shielded power and motor cable contact your local sales representative for details.

Electrical Ratings				
Control Circuit (External Source)	Power Supply	NEC Class 2		
	Rated Operating Voltage	24V DC (+10%, -20%)		
	Overvoltage Protection	Reverse-polarity protected		
	Unswitched Power Supply Requirements	Voltage	19.2…26.4V DC	
		Nominal Current	150 mA	
		Power	3.6 W	
		Input Current (each) ❶	50 mA	
		Maximum Current	450 mA	
		Maximum Power	14.4 W	
		Peak Inrush ❷	<5 A for 35 ms	
	Switched Power Supply Requirements	Voltage	19.2…26.4V DC	
		Nominal Current	125 mA	
		Power	3 W	
		Output Current (each) ❶	500 mA	
		Maximum Current	1.625 A	
		Maximum Power	42 W	
		Peak Inrush ❷	<5 A for 35 ms	
	Switched and Unswitched Power Supply Requirements	Voltage	19.2…26.4V DC	
		Nominal Current	275 mA	
		Power	6.6 W	
		Number of Inputs (x 50 mA)	user defined	
		Number of Outputs (x 500 mA)	user defined	
		Maximum Current	275 mA + user defined	
		Maximum Power	6.6 W + (24 x user defined), (60 W max.)	
		Peak Inrush ❷	<10 A for 35 ms	
Control Circuit (Internal Source)	An internal 50 W power supply sources 24V DC for input, outputs, and logic control.			

Short Circuit Current Rating (SCCR)	**Cat. No.**	**Sym. Amps RMS**	**Circuit Breaker**	**Fuse**
	294_-*-G1 or (-G3)	10 kA @ 480Y/277	When used with Allen-Bradley Cat. No. 140U-D6D3-C30	CC, J, or T fuse (maximum 45 A)
	294_-*-G1 or (-G3)	5 kA @ 480Y/277		UL Class fuse (maximum 45 A)
	294_-*-G1-SB	10 kA @ 480Y/277		CC, J, or T fuse (maximum 40 A)
	294_-*-G1-SB	5 kA @ 480Y/277		UL Class fuse (maximum 40 A)
	294_-*-G2*	10 kA @ 480Y/277		CC, J, or T fuse (maximum 40 A)

Short Circuit Coordination	Type 1
	Size per NFPA 70 (NEC) or NFPA 79 for Group Motor Applications

❶ I/O is configurable to either input or output.

❷ Assumes zero wire resistance. Wire impedance will reduce current inrush.

Input and Output Ratings		
Input	Supply Voltage	Unswitched power A3/A2
	Type of Inputs	24V DC current sinking
	Connection Type	Single keyed M12, quick disconnect
	Input per Connection	1/each
	Rated Operating Voltage	24V DC
	On-State Input Voltage (pin 4)	10…26.4V DC, nominal 24V DC
	Off-State Input Voltage	5V DC
	On-State Input Current (pin 4)	1…3.7 mA, nominal 2.6 mA @ 24V DC
	Off-State Input Current	<1.5 mA
	Maximum Sensor Leakage Current	<2.5 mA
	Maximum Number of Input Devices	6
	Maximum Sensor Sourcing Current (pin 1)	50mA per point (max 300mA total for sourcing one device)
	Sensor Operating Voltage Range	19.2…26V DC
	Input Bounce Filter ❶ (Software Configurable)	Off-On or On-Off: 0.5 ms + 64 ms
	Filtering	100 µs
	DeviceLogix I/O Response	2 ms (500 Hz)
Output	Supply Voltage (Switched Power)	A1/A2
	Type of Outputs	DC sourcing
	Load Types	Resistive or light inductive
	Utilization Category (IEC)	DC-1, DC-13
	Output State	Normally Open (N.O.)
	Connection Type	Single keyed M12, quick disconnect
	Output per Connection	1/each
	Overcurrent Protection ❷	1.5 A (the sum of all outputs cannot exceed this value)
	Rated Insulation Voltage (U_i)	**UL**: 1500V AC, **IEC**: 2000V AC
	Rated Operating Voltage (U_e)	19.2…26.4V DC
	Maximum Blocking Voltage	35V DC
	Nominal Operating Current (I_e)	500 mA per point
	Maximum Thermal Current (I_{the})	500 mA per point
	Maximum Off-state Leakage Current	1 µA
	Maximum Number of Outputs	6
	Surge Suppression	Integrated diode to protect against switching loads

❶ Input ON-to-OFF delay time is the time from a valid input signal to recognition by the module.

❷ If an output exceeds 1.5 A for greater than 7 ms, a fault is generated

Environmental Ratings	
Operating Temperature Range	-20…+40°C (-4…+104°F) 50 °C (122 °F) without derating, when properly rated line reactors are installed in branch circuit.
Storage and Transportation Temperature Range	–25...+85 °C (–13…+185 °F)
Altitude	1000 m
Humidity	5…95% (non-condensing)
Pollution Degree	3
Enclosure Ratings	IP66/UL Type 4/12 ❶
Approximate Shipping Weight	7.3 kg (16 lb)

❶ IP66/UL Type 4 is available with gland options G1-3. IP66/ UL Type 4/12 available with G1 and G3 gland option.

Mechanical Ratings					
Resistance to Shock	Operational	30 G (exceeds IEC 61800-5-1)			
	Non-Operational	50 G (exceeds IEC 61800-5-1)			
Resistance to Vibration	Operational	2.5 G, MIL-STD-810G, (exceeds IEC 61800-5-1)			
	Non-Operational	5 G, MIL-STD-810G, (exceeds IEC 61800-5-1)			
Disconnect Lock Out	Maximum of 3/8 in. (9.5 mm) diameter lock shackle or hasp				
Disconnect LOTO Locks	Up to 2 locks or hasps are supported				
Disconnect Mechanical Life	200 000 operations				
	Power Terminals	**Motor Terminals**	**Control Terminals**	**PE/Ground**	**Source Brake**
Wire Size ❶	(2) #18 …#10 AWG (0.8…5.2 mm^2) per terminal	#18…#10 AWG (0.8…5.2 mm^2) per terminal	(2) #18 …#10 AWG (0.8…5.2 mm^2) per terminal	(2) #16 …#10 AWG (1.3…5.2 mm^2) per terminal	#16 …#10 AWG (1.0…4.0 mm^2) per terminal
Wire Type	Multi-strand copper wire				
Tightening Torque	10.6 ± 2 lb•in (1.2 ± 0.2 N•m)			18 ± 2 lb•in (2 ± 0.2 N•m)	4.8 ± 2 lb•in (0.5 ± 0.2 N•m)
Wire Strip Length	0.35 ± 0.01 in. (9 ± 2 mm)				
Power Rating	600V AC/25 Amp	600V AC/10 Amp	600V AC/10 Amp	—	600V AC/10 Amp

Emission and Immunity Ratings		
Emission	Conducted	EN 55011 Class Group 2
	Radiated	
	Electrostatic Discharge	4 kV contact, 8 kV air
	Radio Frequency Electromagnetic Field	EN 61800-3 10V/m, 80 MHz…1 GHz
Immunity	Fast Transient	2 kV (Power) 2 kV (PE) 1 kV (Communication and control)
	Surge Transient	1 kV (12) $_{L-L}$, 2 kV (2) $_{L-N}$ (earth)
	Radio Frequency Conducted Disturbance	10V, 150 kHz…80 MHz

❶ When two wires used in terminal block both wires are to be of same wire AWG

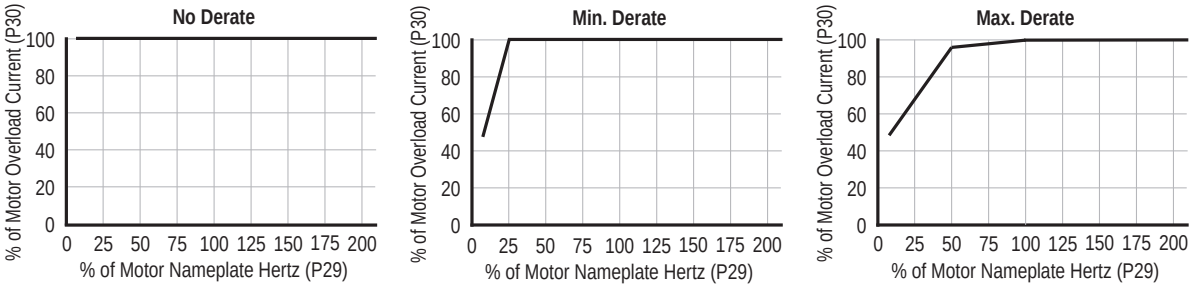
Standards Compliance and Certifications			
	UL/CSA	**EN/IEC**	**Other Agencies**
Standards Compliance	UL 508C Power Conversion Equipment – Suitable for Group Installation CSA C22.2, No. 14	EN 61800 - Adjustable Speed Electrical Power Drive Systems, Part 3: EMC Requirements and Specific Test Methods, CE Marked per EMC Directive 2004/108/EC, Part 5-1: Safety Requirements – Electrical, Thermal and Energy, CE Marked per Low Voltage Directive 2005/95/EC	CCC (Pending) KCC C-Tick ODVA for EtherNet/IP and DeviceNet
Certifications	cULus (File No. E207834, Guides NMMS, NMMS7)		

Communication Ratings		
	Rated Insulation Voltage	250V
	Operating Dielectric Withstand	**UL/NEMA**: 1500V AC, **IEC**: 2000V AC
DeviceNet	DeviceNet Supply Voltage Rating	Range 11…25V DC, 24V DC nominal
	DeviceNet Input Current	50 mA @ 24V DC
	DeviceNet Input Current Surge	500 mA peak inrush
	Baud Rates	125, 250, 500 kbps
	Distance Maximum	500 m (1630 ft) @ 125 kbps 200 m (656 ft) @ 250 kbps 100 m (328 ft) @ 500 kbps
	Auto-Baud Rate Identification	Yes
	"Group 2 - Slave Only" Device Type	Yes
	Polled I/O Messaging	Yes
	Change of State Messaging	Yes
	Cyclic Messaging	Yes
	Explicit Messaging	Yes
	Full Parameter Object Support	Yes
	Group 4 - Off-Line Node Recovery Messaging	Yes
	Configuring Consistency Value	Yes
	Unconnected Messaging Manager (UCMN)	Yes

Communication Ratings		
EtherNet/IP	EtherNet/IP ODVA - Conformance Testing	EtherNet/IP Interoperability Performance – Per A9 PF 2.1
	Ethernet Communication Rate	10/100 Mbps, half or full-duplex
	Ethernet Ports	2 (embedded switch)
	Ethernet Network Topologies Supported	Star, Tree, Linear, and Ring
	Device Level Ring Support	Beacon Performance, IEEE 1583 Transparent Clock
	Ethernet Connector	M12, D code, female, with Ethernet keying, 4 Pin
	Ethernet Cable	Category 5e: Shielded or unshielded
	IP Configuration	Static, DHCP, or BootP
	DHCP Timeout	30 s
	Data	Transported over both TCP and UDP
	Packet Rate (pps)	500 packets-per-second (2000 µs), Tx 500 packets-per-second (2000 µs), Rx
	Consume Instance (Command)	Default of 4 words (Instance 154)
	Produce Instance (Status)	Default of 16 words (Instance 156)
	Message Support	Unicast or Multicast
	Address Conflict Detection (ACD)	IP v4 Address Conflict Detection for EtherNet/IP devices
	Sockets	150 maximum
Web Server	Security	Login and password configurable
	E-mail	Support Simple Mail Transfer Protocol (SMTP)
	Webpage Features	Status, diagnostics, configuration
	Concurrent Sessions	20
	Web Server	HTTP 1.1
Network Connections	Concurrent TCP Connections	Maximum of 5 encapsulated messages over both TCP and UDP
	Maximum I/O Connections (CIP Class 1)	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.
	Maximum Concurrent Explicit Messages (CIP Class 3)	6
	Class 1 Connection API	2…3200 ms
	Class 3 Connection API	100…10 000 ms
	Request Packet Interval (RPI)	20 ms default (2 ms minimum)

Motor Overload Trip Curves

Motor overload current parameter provides class 10 overload protection. Ambient insensitivity is inherent in the electronic design of the overload.



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

Introduction

Each ArmorStart LT motor controller is listed for group installation. This appendix explains how to use this listing to apply ArmorStart LT motor controllers in multiple-motor branch circuits according to 7.2.10.4(1) and 7.2.10.4(2) of NFPA 79, Electrical Standard for Industrial Machinery.

From the perspective of the ArmorStart LT product family, being listed for group installation means one set of fuses or one circuit breaker may protect a branch circuit that has two or more of these motor controllers connected to it. This appendix refers to this type of branch circuit as a multiple-motor branch circuit. The circuit topology shown in Figure 58, 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 may be any mixture of power ratings and the controllers may be any mixture of motor controller technologies (magnetic motor controllers and variable-frequency AC drive controllers).

This appendix addresses only NFPA 79 applications. This 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 LT products may be applied on industrial machinery, the versions that have the Conduit Entrance Gland Plate Option may also be used in applications governed by NFPA 70, National Electrical Code (NEC), (see "ArmorStart LT Product Family").

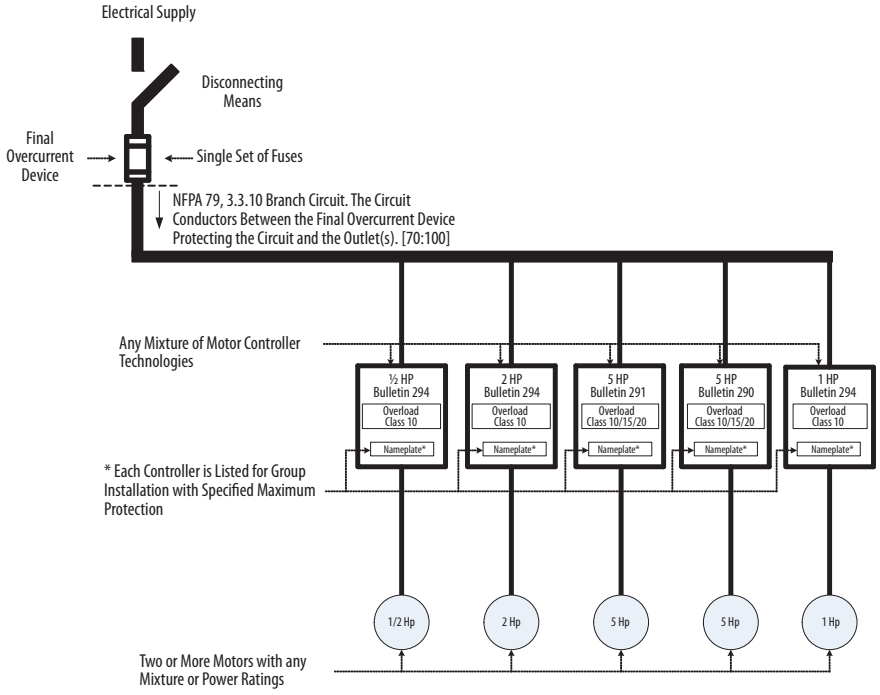
In the 2012 Edition of NFPA 79, motor controllers that are listed for group installation may be installed in multiple-motor branch circuits according to either of two alternative sets of requirements. The first is found in 7.2.10.4(2), the second in 7.2.10.4(3). The requirements of 7.2.10.4(3) are similar to those 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 of 7.2.10.4(3), because this is the simpler method to use when applying the ArmorStart LT family of motor controllers.

The user 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 LT product characteristics and useful to understand the definition of industrial machinery. The section of this appendix, "ArmorStart LT 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 of the equipment is connected to a three-phase electrical supply, all of the figures are shown as one-line diagrams. Second, although all of the ArmorStart LT 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 is done to avoid repetitive explanations with minor, but necessary qualifications, for circuit breakers. Generally, the principles for selecting the fuses also apply to selecting inverse time circuit breakers. Third, all references unless indicated otherwise, are to NFPA 79 – 2012.

Figure 58 - ArmorStart LT NFPA 79 Multi-Motor Branch Circuit



ArmorStart LT Product Family

This section contains a brief description of the attributes of the ArmorStart LT motor controllers that are relevant to applying them in multiple-motor branch circuits.

The term motor controller refers to the device that stops and starts the motor. The ArmorStart LT 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 LT motor controller incorporates 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 of the 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 58, 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 eliminating 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 58 to be practical, the ampere rating of the fuse must be large enough to operate all of the motors, without opening, under normal starting and running 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 could result in a shock or fire hazard.

Consequently, to the controller, being listed for group installation mostly means the UL testing is performed with fuses that have this practical, and higher, ampere rating. This testing verifies that it is safe to apply this controller in a multiple-motor branch circuit, provided the fuse is of the same class and does not have a rating exceeding that marked on the controller.

The example in Figure 59, 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 used in the UL testing of two variable-frequency AC drive-based motor controllers. Both controllers have a rated power of ½ horsepower and a rated output current of 1.5 amperes. The controller shown on the left is intended for installation in individual-motor branch circuits. The controller 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 all testing is done with fuses of the same class.

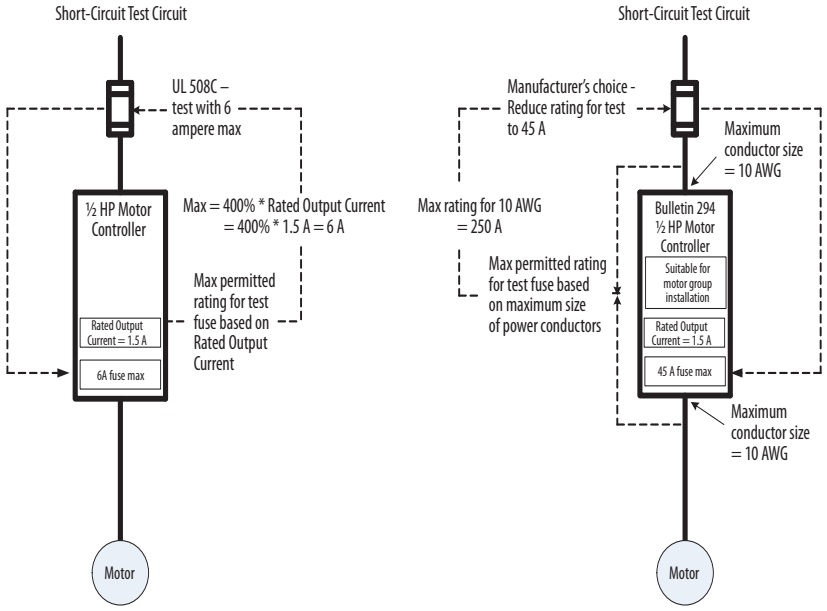
The UL investigation of both controllers is done according to UL 508C, Power Conversion Equipment. The controllers are connected to the test supply through the three-phase conductors and equipment grounding conductor and then covered with cotton in areas that are likely to vent hot gases and sparks during the tests. During the test, electrical faults are impressed on the output of, and internal to, these variable-frequency AC drive-based controllers. Increasing 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, as this could leave exposed conductive parts in an energized state (shock hazard). Another criterion is that the cotton must not ignite, as this indicates the expulsion from the controller of hot gases or molten metal fragments (fire hazard).

Referring to the controller 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 is 400 percent of the full-load current rating of the largest motor that the controller can supply. In UL 508C, this is taken to be 400 percent of the rated output current of the controller, or 6 amperes.

Referring to the controller 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 is 250 amperes. This value, derived from the installation requirements of 430.53(C) and 430.53(D) of NFPA 70, is determined by the largest size of power conductor that the ArmorStart LT controller can accept, 10 AWG. Because the UL 508C test covers all possibilities in NFPA 70 and NFPA 79, it permits the maximum value of 250 amperes. This 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 amperes. 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 engineered into each controller.

Therefore, to make its use in the multiple-motor branch circuit of Figure 58 practical, the ½ horsepower Bulletin 294 controller was engineered to be robust enough to safely contain the damage when protected by a fuse having a rating of 45 amperes, rather than just 6 amperes.

Figure 59 - 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 60 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 58.

The following is the complete text of 7.2.10.4(1) and 7.2.10.4(2) and an abbreviated version of Table 30 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 30 for the smallest conductor in the circuit."

(3) ...(not considered in this appendix)

Table 30 - 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 60 provide an explanation of 7.2.10.4(1) and (2). In the following, the text not relevant to Figure 58 is replaced by ellipsis points (...). 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 60.

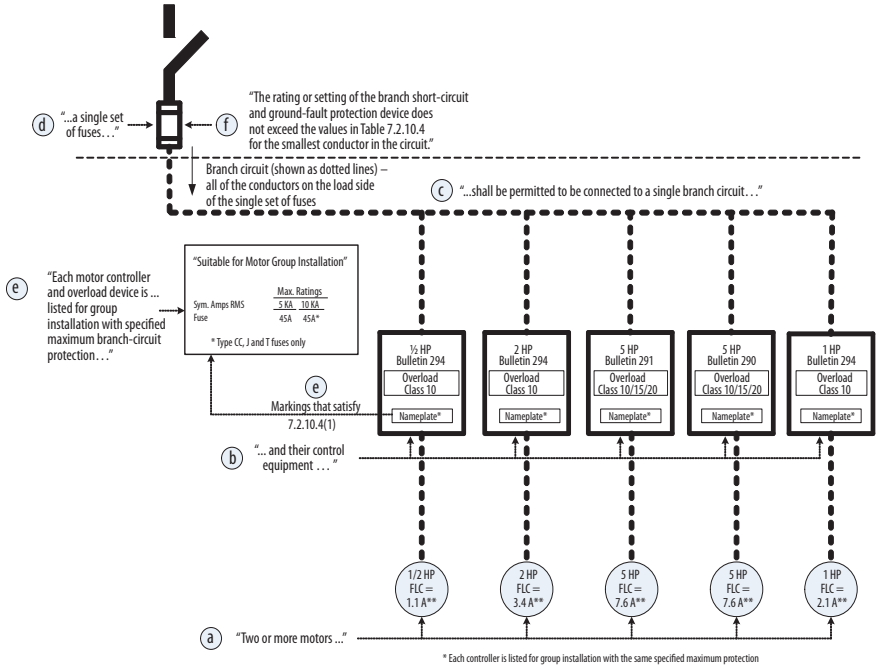
"7.2.10.4 Two or more motors (a)...and their control equipment (b) shall be permitted to be connected to a single branch circuit (c) where short-circuit and ground-fault protection is provided by a single inverse time circuit breaker or a single set of fuses (d), provided the following conditions under (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 58: 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 the motor controllers are listed for group installation, (2) the fuse does not exceed the maximum rating that Table 30 permits to protect the smallest conductor and (3) the fuse complies with the maximum fuse ratings of all of the controllers.

Figure 60 - 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 61. 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 given by 12.5.3 and 12.5.4. The method for determining this minimum ampacity is explained in Requirement 5 and Figure 62.

The example branch circuit is shown in Figure 61 and Figure 62. 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 of the 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 61 and Figure 62 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 shown in Figure 61 and Figure 62. Unless indicated, all text is from NFPA 79.

Figure 61 - ArmorStart LT NFPA 79 Multi-Motor Branch Circuit — Conductor and Controller Protection

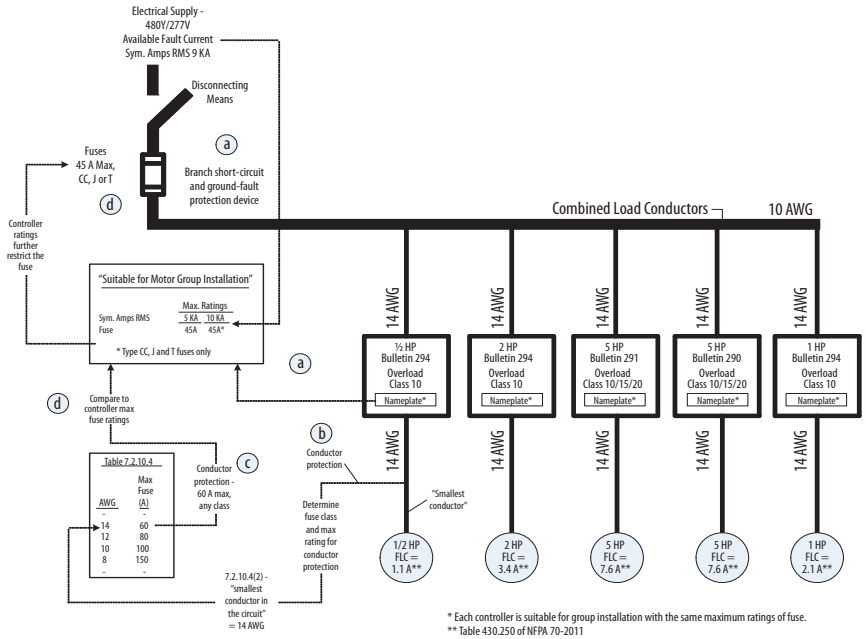
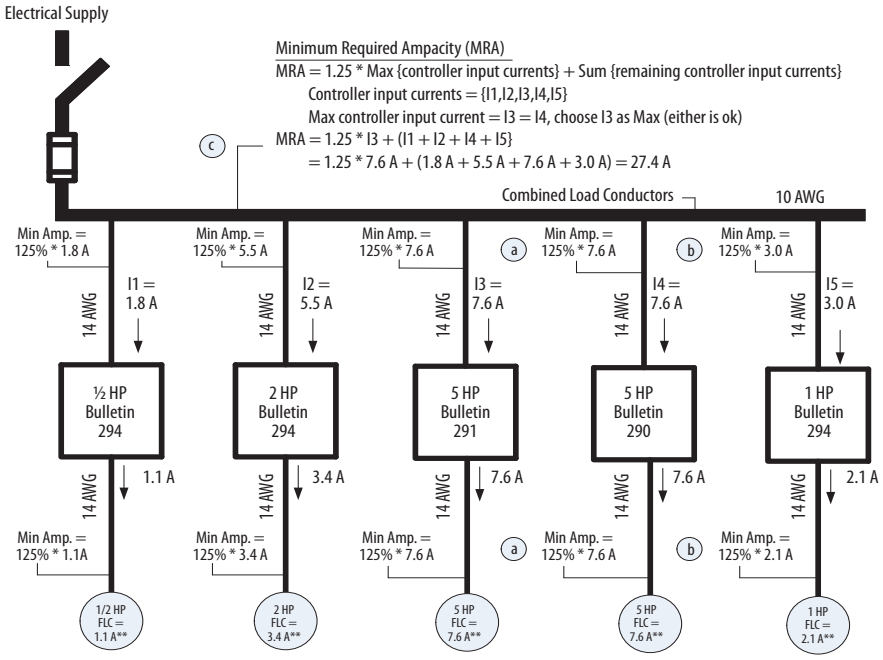


Figure 62 - ArmorStart LT NFPA 79 Multi-Motor Branch Circuit Minimum Conductor Ampacity



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 shown in Figure 61, 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.

Referring to Figure 62 (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 located beneath the description "Max. Ratings" are the specified maximum branch circuit protection. The (a) beside the fuse(s) indicates that the maximum protection specified on the nameplate applies to these fuse(s).

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 30 for the smallest conductor in the circuit."

Analysis: Referring to Figure 61, 7.2.10.4(2) must be satisfied. The fuse, as indicated by the description in Figure 61 (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 the conductor protection is based on the smallest conductor, 14 AWG. Referring to Table 30 a 14 AWG conductor may 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 specified in Table 30 is the maximum rating of fuse that 7.2.10.4(2) permits to protect that size of conductor. The rating of the fuse may be set to the maximum value given by Table 30 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 30 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 may be necessary to protect the motor controller within its ratings because its specified maximum protection is less than the rating that Table 30 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 ensure the ampere rating is sufficient to start and operate the motors without nuisance opening of the fuse(s).

Supplementary Note 2: The note at (b) points to the conductor on the output of the ½ Hp Bulletin 294E controller in order 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 may be made without this fuse, in some cases, through the use of 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 neither applicable nor necessary. In Figure 61, the smaller 14 AWG conductors may 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 30 protects the smallest conductor directly by specifying the maximum rating of fuse that may 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 61. The characteristics of the fuse(s) permitted to protect the conductors (see Requirement 2) must now be compared to those in the controller's ratings. To comply with the listing of each motor controller and overload relay, the fuse(s) must comply with the maximum branch-circuit protection specified in the controller markings. Therefore, the fuse(s) must be of a class marked on all of the controllers and the rating of the fuse(s) must not exceed the rating marked on any of the controllers. The markings of each controller specify that a fuse having a maximum rating of 45 A may protect the motor controller. When connecting to an electrical supply having an available fault current of 5000 amperes or less, the class of the fuse is not specified and may be any class. When connecting to an electrical supply having an available fault

current between 5000 and 10000 amperes, the class of the fuse must be CC, J or T. Since the electrical supply has an available fault current of 9000 amperes, selecting a Class CC, J or T fuse with a rating of 45 A or less ensures each motor controller is applied within its own ratings.

Supplementary Note 1: The rating of the fuse must not exceed the rating 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 amperes, being less than 60 amperes, also protects the conductors (see Requirement 2). Although the ArmorStart LT products presently have a maximum fuse rating of 45 A, future controllers may 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 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 an 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 the 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 reduce the fault current available at the controllers, this reduction is neglected by assuming the first controller, the ½ horsepower 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) ensures 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 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, which remove(s) the overloaded motor(s) 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: Referring to Figure 62, (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 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 exceeding 30 °C or more than three current-carrying conductors in a cable or raceway. In a particular application, these conditions of use may require derating of the ampacity 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 of Bulletin 290E and 291E Controllers (a)

For Bulletin 290E and 291E controllers, which 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).

Referring to Figure 62, the full-load current rating of a three-phase, 460 V, 5 Hp induction motor is 7.6 amperes. 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 of Bulletin 294E Controllers (b)

The Bulletin 294E controllers use a variable-frequency AC drive 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 that of the output conductors must be 125% of the motor full-load current rating.

Referring to Figure 62, the 1 Hp Bulletin 294E controller has a rated input current of 3.0 amperes. 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 62, 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. Referring to the explanatory text (c) in Figure 62, 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 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 may be less than the specified value.

CIP Information

High Level Product Description

The ArmorStart LT EtherNet/IP is an extension of the ArmorStart LT DeviceNet. Three product types offered:

Table 31 - ArmorStart LT Distributed Starter Type

Bulletin Number	Distributed Starter Type
290E	DOL
291E	Reversing
294E	V/Hz

Product Codes and Name Strings

The following table lists the product codes and name strings that will be added to the ArmorStart LT product family for EtherNet/IP.

Table 32 - Product Codes and Name Strings

Product Code	Current Rating	Identity Object Name String	Integrated Power Supply
0x301	0.24…3.5 amps	ArmorStart 290E 0.24…3.5 A	No
0x302	1.1…7.6 amps	ArmorStart 290E 1.1…7.6 A	No
0x311	0.24…3.5 amps	ArmorStart 290EP 0.24…3.5 A	Yes
0x312	1.1…7.6 amps	ArmorStart 290EP 1.1…7.6 A	Yes
0x341	0.24…3.5 amps	ArmorStart 291E 0.24…3.5 A	No
0x342	1.1…7.6 amps	ArmorStart 291E 1.1…7.6 A	No
0x351	0.24…3.5 amps	ArmorStart 291EP 0.24…3.5 A	Yes
0x352	1.1…7.6 amps	ArmorStart 291EP 1.1…7.6 A	Yes
0x3C2	0.5…2.5 amps	ArmorStart 294E 0.5 Hp	No
0x3C4	1.1…5.5 amps	ArmorStart 294E 1.0 Hp	No
0x3C6	3.2…16 amps	ArmorStart 294E 2.0 Hp	No
0x3D2	0.5…2.5 amps	ArmorStart 294EP 0.5 Hp	Yes
0x3D4	1.1…5.5 amps	ArmorStart 294EP 1.0 Hp	Yes
0x3D6	3.2…16 amps	ArmorStart 294EP 2.0 Hp	Yes

CIP Explicit Connection Behavior

The ArmorStart LT allows run, jog and user outputs to be driven by connected explicit messages when no I/O connection exists, or when a I/O connection exists in the idle state. a single EtherNet/IP Class 3 explicit connection will be 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 Discrete Output Point (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

The information contained in the EDS (Electronic Data Sheet) files for ArmorStart LT EtherNet/IP can be extracted via the network.

CIP Object Requirements

The following CIP objects will be covered in the following subsections:

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

Class	Object
0x0001	Identity Object
0x0002	Message Router
0x0004	Assembly Object
0x0006	Connection Manager Object
0x0008	Discrete Input Point Object
0x0009	Discrete Output Point Object
0x000A	Analog Input Point
0x000B	Analog Output Point
0x000F	Parameter Object
0x0010	Parameter Group Object
0x001D	Discrete Input Group Object
0x001E	Discrete Output Group Object
0x0029	Control Supervisor
0x002C	Overload Object
0x0047	Device Level Ring Object
0x0097	DPI Fault Object
0x098	Alarm Object

Class	Object
0x00F5	TCP/IP Interface Object
0x00F6	Ethernet Link Object
0x0376	Trip and Warning Email Object
0x032F	Email Object

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	2 for Bulletin 290E/291E and 3 for Bulletin 294E

Two instances of the Identity Object will be supported for Bulletin 290E and Bulletin 291E; 3 for Bulletin 294E. The following table shows what each instance will represent.

Instance	Name	Revision Attribute
1	Main Control Board	The firmware rev of the main control board operating system
3	PowerFlex 4M (Bulletin 294E only)	The firmware revision of the PowerFlex 4M

Each instance of the Identity Object will contain the following attributes:

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Vendor	UINT	1
2	Get	Device Type	UINT	22
3❶	Get	Product Code	UINT	Product Code specific.
4	Get	Revision Major Revision Minor Revision	Structure of: USINT USINT	
5	Get	Status	WORD	Bit 0 - 0 = Not Owned; 1 = Owned by Master Bit 2 - 0 = Factory Defaulted; 1 = Configured Bits 4-7 – Extended Status (see table below) Bit 8 - Minor Recoverable fault Bit 9 - Minor Unrecoverable fault Bit 10 - Major Recoverable fault Bit 11 - Major Unrecoverable fault
6	Get	Serial Number	UDINT	Unique number for each device
7❶	Get	Product Name String Length ASCII String	Structure of: USINT STRING	Product Code specific
8	Get	State	USINT	Returns the value 3 = Operational
9	Get	Configuration Consistency Value	UINT	Unique value depending on output of the parameter checksum algorithm.
102	Get	Build	UDINT	Firmware Build Number

❶ See product code definitions in Table 32, Product Codes and Name Strings.

Extended Device Status Field (bits 4-7) in "Status" Instance Attribute 5 on previous page

Value	Description
0	Self-testing or unknown
1	Firmware update in progress
2	At least one faulted I/O connection
3	No I/O connections established
4	Non-volatile configuration bad
5	Major fault – either bit 10 or bit 11 is true (1)
6	At least one I/O connection in run mode
7	At least one I/O connection established, all in idle mode

The following common services will be implemented for the Identity Object:

Service Code	Implemented for:		Service Name
	Class	Instance	
0x01	Yes	Yes	Get_Attributes_All
0x05	No	Yes	Reset
0x0E	Yes	Yes	Get_Attributes_Single

Message Router

CLASS CODE 0x0002

No class or instance attributes will be supported. The message router object exists only to route explicit messages to other objects.

Assembly Object

CLASS CODE 0x0004

The following class attribute is supported for the Assembly Object:

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	2

The following static Assembly instance attributes will be 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 Path in bytes
		Member Path	Packed EPATH	Member EPATHs for each assembly instance

Attribute ID	Access Rule	Name	Data Type	Value
3	Conditional	Data	Array of BYTE	—
4	Get	Size	UINT	Number of bytes in attribute 3
100	Get	Name String	STRING	—

The following services will be implemented for the Assembly Object:

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single

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
100	Config	Configuration Assembly for Bulletin 290E/291E Starters
101	Config	Configuration Assembly for Bulletin 294E Starters
150	Consumed	Default Consumed Instance for Bulletin 290E/291E units
152	Produced	Exhaustive Produced Status Assembly Instance
154	Consumed	Default Consumed Instance for Inverter type (Bulletin 294E) units
156	Produced	Exhaustive Produced Drive Status Assembly Instance

Instance 3

Instance 3 is the required output (consumed) assembly.

Instance 3 "ODVA Cmd"								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	—	—	—	—	—	—	—	Run Forward

Instance 52

Instance 52 is the required input (produced) assembly.

Instance 52 "ODVA Status"								
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
—	—	—	—	—	—	RunningForward	—	TripPresent

Instance 100

Instance 100 is the Configuration Assembly for Bulletin 290E and 291E units.

Instance 100 for Bulletin 290E/291E Starters			
Member Index	**Byte Offset**	**Name**	**Parameter Instance**
0	0	Reserved for Logix	N/A
1	2	AssemblyRevision	N/A
2	4	FLASetting	28
3	6	OLResetLevel	29
4	8	OverloadClass	30
5	10	ProtFltResetMode	41
6	12	ProtectFltEnable	42
7	14	WarningEnable	43
8	16	RunNetFltAction	45
9	18	RunNetFltValue	46
10	20	RunNetIdleAction	47
11	22	RunNetIdleValue	48
12	24	IOPointConfigure	49
13	26	FilterOffOn	50
14	28	FilterOnOff	51
15	30	OutProtFltState	52
16	32	OutProtFltValue	53
17	34	OutNetFltState	54
18	36	OutNetFltValue	55
19	38	OutNetIdleState	56
20	40	OutNetIdleValue	57
21	42	Input00Function	58
22	44	Input01Function	59
23	46	Input02Function	60
24	48	Input03Function	61
25	50	Input04Function	62
26	52	Input05Function	63
27	54	NetworkOverride	64
28	56	CommOverride	65
29	58	KeypadMode	66
30	60	KeypadDisable	67
31	62	OLWarningLevel	69
32	64	JamInhibitTime	70
33	66	JamTripDeley	71
34	68	JamTripLevel	72
35	70	JamWarningLevel	73

Instance 100 for Bulletin 290E/291E Starters			
Member Index	**Byte Offset**	**Name**	**Parameter Instance**
36	72	StallEnableTime	74
37	74	StallTripLevel	75
38	76	ULInhibitTime	76
39	78	ULTripDelay	77
40	80	ULTripLevel	78
41	82	ULWarnLevel	79

Instance 101

Instance 101 is the Configuration Assembly for Bulletin 294E units.

Instance 101 for Bulletin 294E Starters			
Member Index	**Byte Offset**	**Name**	**Parameter Instance**
0	0	AssemblyRevision	N/A
1	2	AssemblyRevision	N/A
2	4	MotorNPVolts	28
3	6	MotorNPHertz	29
4	8	MotorOLCurrent	30
5	10	CurrentLimit	31
6	12	StopMode	32
7	14	SpeedReference	33
8	16	MinimumFreq	34
9	18	MaximumFreq	35
10	20	AccelTime1	36
11	22	DecelTime1	37
12	24	SCurvePercent	38
13	26	JogFrequency	39
14	28	JogAccelDecel	40
15	30	ProtFltResetMode	41
16	32	ProtectFltEnable	42
17	34	WarningEnable	43
18	36	RunNetFltAction	45
19	38	RunNetFaultValue	46
20	40	RunNetIdleAction	47
21	42	RunNetIdleValue	48
22	44	IOPointConfigure	49
23	46	FilterOffOn	50
24	48	FilterOnOff	51
25	50	OutProtFltState	52
26	52	OutProtFltValue	53

Instance 101 for Bulletin 294E Starters			
Member Index	**Byte Offset**	**Name**	**Parameter Instance**
27	54	OutNetFaultState	54
28	56	OutNetFaultValue	55
29	58	OutNetIdleState	56
30	60	OutNetIdleValue	57
31	62	Input00Function	58
32	64	Input01Function	59
33	66	Input02Function	60
34	68	Input03Function	61
35	70	Input04Function	62
36	72	Input05Function	63
37	74	NetworkOverride	64
38	76	CommOverride	65
39	78	KeypadMode	66
40	80	KeypadDisable	67
41	82	AccelTime2	69
42	84	DecelTime2	70
43	86	MotorOLRetention	71
44	88	InternalFreq	72
45	90	SkipFrequency	73
46	92	SkipFreqBand	74
47	94	DCBrakeTime	75
48	96	DCBrakeLevel	76
49	98	ReverseDisable	77
50	100	FlytingStartEna	78
51	102	Compensation	79
52	104	SlipHertzAtFLA	80
53	106	BusRegulateMode	81
54	108	MotorOLSelect	82
55	110	SWCurrentTrip	83
56	112	AutoRestartTries	84
57	114	AutoRestartDelay	85
58	116	BoostSelect	86
59	118	MaximumVoltage	87
60	120	MotorNamPlateFLA	88
61	122	BrakeMode	89
62	124	BrkFreqThresh	90
63	126	BrkCurrThresh	91

Instance 150

Instance 150 is the default Output (Consumed) Assembly for Bulletin 290E/291E starters.

Instance 150 "Starter Cmd" – DeviceLogix Consumed Assembly for Bulletin 290E/291E Starters								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	—	—	—	—	—	ResetFault	RunReverse	RunForward
1	—	—	Out05	Out04	Out03	Out02	Out01	Out00
2	Pt07DeviceIn	Pt06DeviceIn	Pt05DeviceIn	Pt04DeviceIn	Pt03DeviceIn	Pt02DeviceIn	Pt01DeviceIn	Pt00DeviceIn
3	Pt15DeviceIn	Pt14DeviceIn	Pt13DeviceIn	Pt12DeviceIn	Pt11DeviceIn	Pt10DeviceIn	Pt09DeviceIn	Pt08DeviceIn
4	AnalogDeviceIn (low byte)							
5	AnalogDeviceIn (high Byte)							

Instance 152

Instance 152 is the Exhaustive Starter Status Assembly for Bulletin 290E/291E starters.

Instance 152 "Starter Stat" – DeviceLogix Produced Assembly for Bulletin 290E/291E Starters								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Reserved							
1	Reserved							
2	Reserved							
3	Reserved							
4	CurrentFlowing		NetControlStatus	Ready	RunningReverse	RunningForward	WarningPresent	TripPresent
5		DisconnectClosed			KeyPadHand	KeyPadOff	KeyPadAuto	DLXEnabled
6			Pt05	Pt04	Pt03	Pt02	Pt01	Pt00
7								
8	Pt07DeviceOut	Pt06DeviceOut	Pt05DeviceOut	Pt04DeviceOut	Pt03DeviceOut	Pt02DeviceOut	Pt01DeviceOut	Pt00DeviceOut
9	Pt15DeviceOut	Pt14DeviceOut	Pt13DeviceOut	Pt12DeviceOut	Pt11DeviceOut	Pt10DeviceOut	Pt09DeviceOut	Pt08DeviceOut
10	An00DeviceOut (low byte)							
11	An00DeviceOut (high byte)							
12	Parameter 1 – PhaseL1Current							
13								
14	Parameter 2 – PhaseL2Current							
15								
16	Parameter 3 – PhaseL3Current							
17								
18	Parameter 4 – AverageCurrent							
19								
20	Parameter 5 – %ThermalUtilized							
21								

Instance 152 "Starter Stat" – DeviceLogix Produced Assembly for Bulletin 290E/291E Starters	
22	Parameter 11 – SwitchedVolts OutputSourceV (IPS units)
23	
24	Parameter 12 – UnswitchedVolts SensorSourceV (IPS units)
25	
26	Parameter 16 – TripStatus
27	
28	Parameter 17 – WarningStstus
29	

Instance 154

Instance 154 is the default Output (Consumed) Assembly for Inverter type (Bulletin 294E) Distributed Starters.

Instance 154 "Drive Cmd" – DeviceLogix Consumed Assembly for Bulletin 294E Starters								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0				JogReverse	JogForward	ResetFault	RunReverse	RunFoward
1	Decel2	Accel2	Out05	Out04	Out03	Out02	Out01	Out00
2	CommandFreq (Low) (xxx.x Hz)							
3	CommandFreq (High) (xxx.x Hz)							
4	Pt07DeviceIn	Pt06DeviceIn	Pt05DeviceIn	Pt04DeviceIn	Pt03DeviceIn	Pt02DeviceIn	Pt01DeviceIn	Pt00DeviceIn
5	Pt15DeviceIn	Pt14DeviceIn	Pt13DeviceIn	Pt12DeviceIn	Pt11DeviceIn	Pt10DeviceIn	Pt09DeviceIn	Pt08DeviceIn
6	An00DeviceIn (lowbyte)							
7	An00DeviceIn (highbyte)							

Instance 156

Instance 156 is the Exhaustive Drive Status Assembly Instance

Instance 156 "Drive Status" – Produced Assembly for Bulletin 294E Starters								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Reserved							
1	Reserved							
2	Reserved							
3	Reserved							
4	AtReference	NetRefStatus	NetControlStatus	Ready	RunningReverse	RunningForward	WarningPresent	TripPresent
5	BrakeStatus	DisconnectClosed		KeyPadJogging	KeyPadHand	KeyPadOff	KeyPadAuto	DLXEnabled
6	Output Frequency (Low) (xxx.x Hz)							
7	Output Frequency (High) (xxx.x Hz)							
8			Pt05	Pt04	Pt03	Pt02	Pt01	Pt00
9								
10	Pt07DeviceOut	Pt06DeviceOut	Pt05DeviceOut	Pt04DeviceOut	Pt03DeviceOut	Pt02DeviceOut	Pt01DeviceOut	Pt00DeviceOut

Instance 156 "Drive Status" – Produced Assembly for Bulletin 294E Starters								
11	Pt15DeviceOut	Pt14DeviceOut	Pt13DeviceOut	Pt12DeviceOut	Pt11DeviceOut	Pt10DeviceOut	Pt09DeviceOut	Pt08DeviceOut
12	An00DeviceOut (low byte)							
13	An00DeviceOut (high byte)							
14	Parameter 3 – OutputCurrent							
15								
16	Parameter 4 – OutputVoltage							
17								
18	Parameter 5 – DCBusVoltage							
19								
20	Parameter 11 – SwitchedVolts OutputSourceV (IPS units)							
21								
22	Parameter 12 – UnswitchedVolts SensorSourceV (IPS units)							
23								
24	Parameter 13 – InternalFanRPM							
25								
26	Parameter 14 – ElaspedRunTime							
27								
28	Parameter 15 – DriveTemperature							
29								
30	Parameter 16 – TripStatus							
31								
32	Parameter 17 – WarningStatus							
33								

Connection Manager Object

CLASS CODE 0x0006

No class attributes will be supported for the Connection Manager Object.

One Instance of the Connection Manager Object will be supported. It has the following attributes:

Attribute ID	Access Rule	Name	Data Type	Value
1	Set	Open Requests	UINT	Number of Forward Open service requests received
2	Set	Open Format Rejects	UINT	Number of Forward Open service requests which were rejected due to bad format
3	Set	Open Resource Rejects	UINT	Number of Forward Open service requests which were rejected due to lack of resources
4	Set	Open Other Rejects	UINT	Number of Forward Open service requests rejected for reasons other than bad format or lack of resources.
5	Set	Close Requests	UINT	Number of Forward Close service requests received
6	Set	Close Format Requests	UINT	Number of Forward Close service requests which were rejected due to bad format

Attribute ID	Access Rule	Name	Data Type	Value
7	Set	Close Other Requests	UINT	Number of Forward Close service requests which were rejected for reasons other than bad format
8	Set	Connection Timeouts	UINT	Total number of connection timeouts that have occurred
9	Get	Connection Entry Lists	Struct of	
		NumConnEntries	UINT	Number of connection entries. This attribute, divided by 8 and rounded up for any remainder, gives the length of the array (in bytes) of the ConnOpenBits field of this structure.
		ConnOpenBits	Array of BOOL	List of connections. Each bit represents a possible connection.
11	Get	CPU_Utilization	UINT	CPU Utilization in tenths of a percent
12	Get	MaxBuffSize	UDINT	Amount of buffer space (in bytes) originally available
13	Get	BufSize Remaining	UDINT	Amount of buffer space (in bytes) available at this time

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 shall access only inputs. Class 1 uses UDP transport.

- Total numbers of supported Class 1 connections equals 4 (Total for: exclusive owner + input only + listen only)
- Supported API: 2…3200 ms
- T->O Connection type: Point-to-point, multicast
- O->T Connection type: Point-to-point
- Supported trigger type: Cyclic, Change-of-state

When all supported connections are used the error code “Connection Manager cannot support any more connections” shall be returned.

Exclusive Owner Connection

This connection type is used for controlling the outputs of the module and shall not be dependent on any other connection. 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) shall be returned an error code.

- Connection point O -> T shall be Assembly object, Instance 3, 150, or 154
- Connection point T -> O shall be Assembly object, Instance 52, 152, or 156

Input Only Connection

This connection is used to read data from the module without controlling the outputs. This connection type shall not be dependent on any other connection. It is recommended that the originator sets the data size in the O->T direction of the Forward_Open be zero, there are however no check that this is actually the case.

IMPORTANT If an exclusive owner connection has been opened against the module and times out, the input only connection shall time out as well. If the exclusive owner connection is properly closed, the input only connection shall not be affected.

- Number of supported input only connections equals four (shared with exclusive owner and listen only connection).

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 shall be closed as well.

It is recommended that the originator sets the data size in the O->T direction of the Forward_Open be zero, there are however no checks that this is actually the case.

If no other connection exists when listen only tries to be opened, a "Controlling connection not open (general status = 0x01, extend status = 0x0119)" error message shall be sent.

- Number of supported listen only connections equals four (shared with exclusive owner and input only connection).

Class 3 Connections

Explicit Message Connection

Class 3 connections are used to establish connections to the message router. Thereafter the connection is used for explicit messaging. Class 3 connections use TCP connections.

- 16 concurrent Class 3 connections will be supported

Service Code	Implemented for:		Service Name
	Class	Instance	
0x01	No	Yes	Get_Attribute_All
0x0e	No	Yes	Get_Attribute_Single

Service Code	Implemented for:		Service Name
	Class	Instance	
0x10	No	Yes	Set_Attribute_Single
0x4E	No	Yes	Forward_Close
0x54	No	Yes	Forward_Open

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	6

Six instances of the Discrete Input Point Object are supported. All instances contain the following attributes:

Attribute ID	Access Rule	Name	Data Type	Value
3	Get	Value	BOOL	0 = OFF, 1 = ON
4	Get	Fault Status	BOOL	0 = OK, 1 = Fault
115	Get/Set	Force Enable	BOOL	0 = Disable, 1 = Enable
116	Get/Set	Force Value	BOOL	0 = OFF, 1 = ON

The following common services will be 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	8 for Bulletin 290E/291E, 10 for Bulletin 294E

Eight instances of the Discrete Output Point Object are supported for DOL/Reverser (Bulletin 290E/291E) units. Ten instances are supported for Drive (Bulletin 294E) units. The following table summarizes the DOP (Bulletin 290E/291E) instances:

Instance	Name	Alternate Mapping	Description
1	Run Fwd Output	0029-01-03	Run Forward output.
2	Run Rev Output	0029-01-04	Run Reverse output.
3	User Output A	None	These are the six ArmorStart LT user outputs for all starter types. Their fault/idle behavior is defined in DOP Instance 3.
4	User Output B	None	
5	User Output C	None	
6	User Output D	None	
7	User Output E	None	
8	User Output F	None	
9	Drive Jog Fwd	None	This instances exists for Inverter (Bulletin 294E) units only.
10	Drive Jog Rev	None	

All instances contain the following attribute:

Attribute ID	Access Rule	Name	Data Type	Value
3	Get	Value	BOOL	0 = OFF, 1 = ON

The following common services will be implemented for the Discrete Output Point Object:

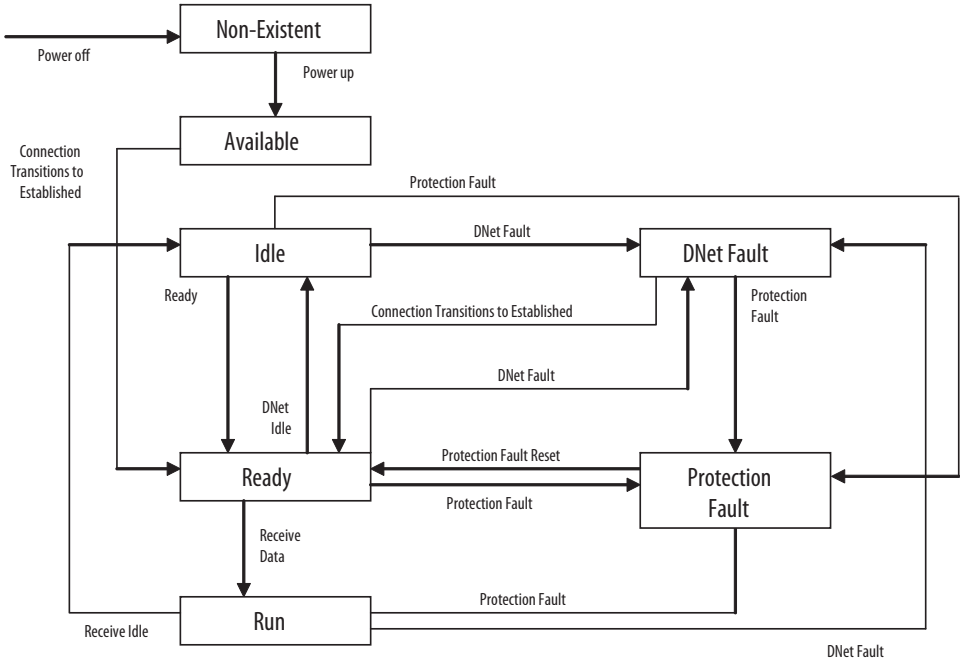
Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single

Discrete Output Point Object Special Requirements

There are many sources that can affect an output point's value: an I/O message, an explicit message, local logic, network fault and idle conditions, and protection fault conditions. An output point must know how to select which source of data to use to drive its value attribute.

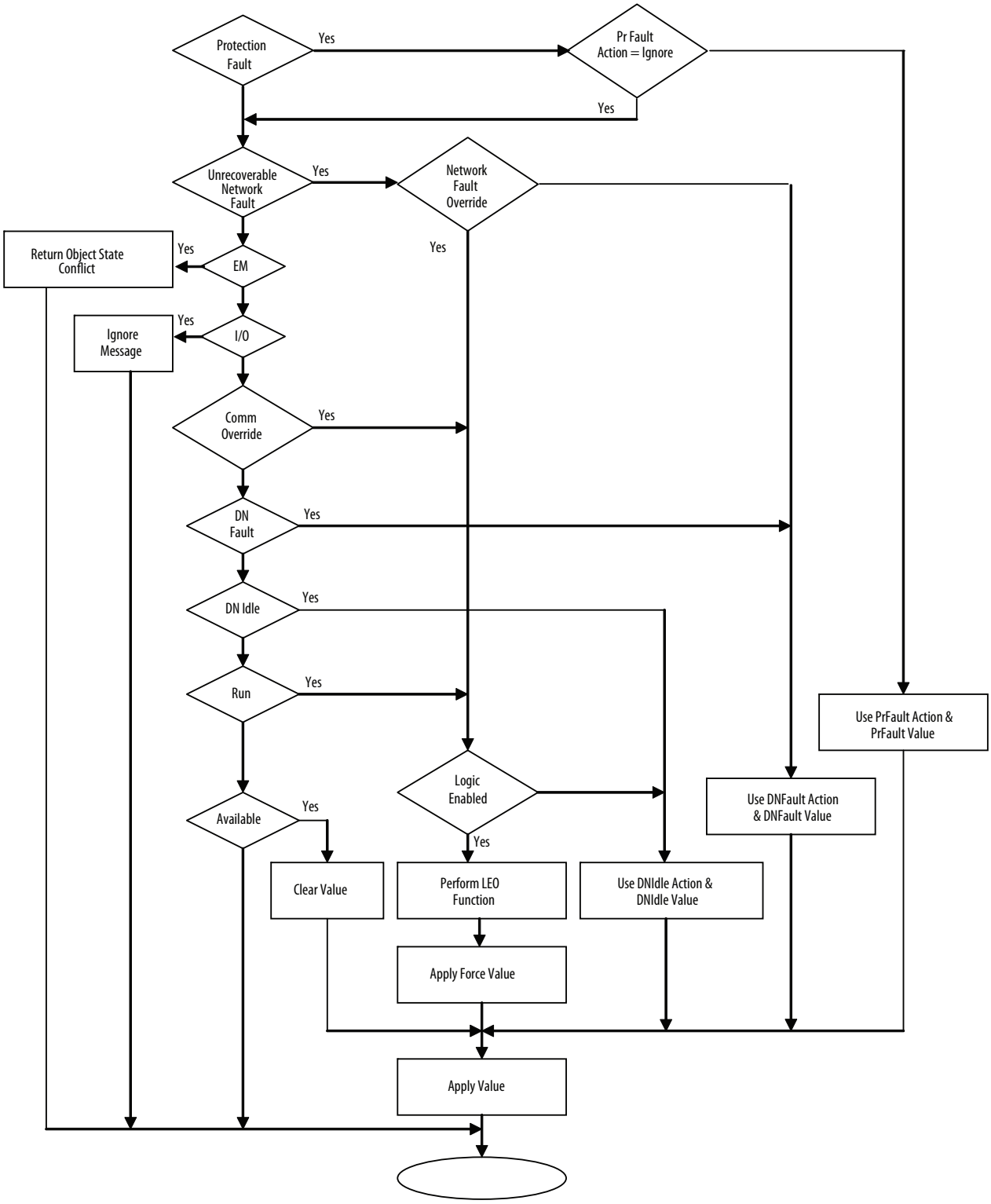
The following state transition diagram is used for an unbound Bulletin 290E

Figure 63 - State Transition for Unbound Bulletin 290E



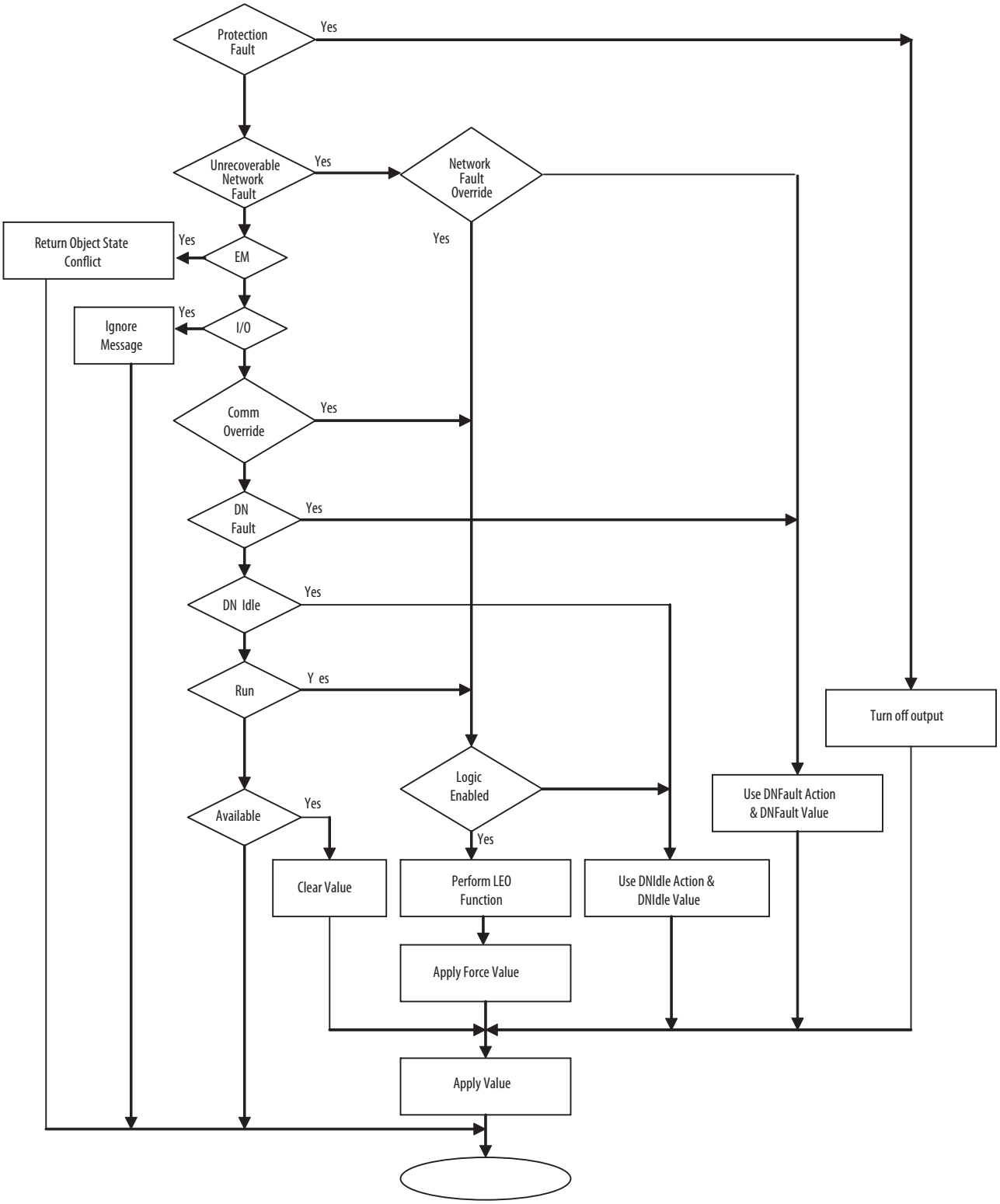
The following flow chart illustrates the behavior of **Bound DOPs**

Figure 64 - State Transition for Bound Bulletin 290E



The following flow chart illustrates the behavior of **Bound DOP Instances**.

Figure 65 - State Transition for Bound Bulletin 290E



Analog Input Point Object

CLASS CODE 0x000A (Implemented in Bulletin 294E units only)

The following class attributes will be supported for the Analog Input Point Object:

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	2
2	Get	Max Instance	UINT	1

One instance of the Analog Input Point Object will supported. CommandFreq from Assembly 154 is placed in the value attribute when it is consumed.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Value	INT	0 = Default

The following common services will be implemented for the Analog Input Point Object:

	Implemented for:		
Service Code	Class	Instance	Service Name
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single

Analog Output Point Object

CLASS CODE 0x000B (Implemented in Bulletin 294E units only)

The following class attributes will be supported for the Analog Output Point Object:

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	2
2	Get	Max Instance	UINT	1

One instance of the Analog Output Point object will supported. It will represent the Frequency command sent to the PF40 via the DSI link. CommandFreq from Assembly 154 is placed in the Value Attribute when it is consumed. The Value Attribute can then be overwritten by DeviceLogix.

Attribute ID	Access Rule	Name	Data Type	Value
3	Get/Set	Value	INT	0 = Default
129	Get/Set	Input Binding	STRUCT: USINT Array of USINT	Size of Appendix I encoded path Appendix I encoded path NULL path means attribute 3 drives the output. Otherwise, this is a path to a bit in the Bit Table.

The following common services will be implemented for the Analog 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 will be 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	—
9	Get	Configuration Assembly Instance	UINT	100 for Bulletin 290E/291E units 101 for Bulletin 294E units

The number of instances of the parameter object will depend upon the type of Distributed Starter that the control board is connected to.

The following instance attributes will be 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: BYTE 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 Divisor	UINT	—
15	Get	Scaling Base	UINT	—
16	Get	Scaling Offset	INT	—

Attribute ID	Access Rule	Name	Data Type	Value
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 will be 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 will be supported for the Parameter Group Object:

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	—
2	Get	Max Instance	UINT	—

The following instance attributes will be 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 will be 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 will be supported for the Discrete Input Group (DIP) 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	6
4	Get	Binding	Array of UINT	List of DIP Instances
6	Get/Set	Off_On_Delay	UINT	—
7	Get/Set	On_Off_Delay	UINT	—

The following common services will be 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 will be supported for the Discrete Output Group (DOP) object.

Instance 1…3 exists for all ArmorStart LT units.

Instance 1 exists for the sole purpose of providing a place holder for the Comm Override and Network Override parameters. Instance 1 will contain the following attributes:

Attribute ID	Access Rule	Name	Data Type	Value
3	Get	Number of Instances	USINT	8 for DOL/Soft Starter (Bulletin 290E/291E) 12 for Inverters (Bulletin 294E)
4	Get	Binding	Array of UINT	List of DOP Instances
6	Get/Set	Command	BOOL	0 = Idle, 1 = Run
104	Get/Set	Network Status Overrride	BOOL	0 = No override (go to safe state) 1 = Override (run local logic)
105	Get/Set	Comm Status Overrride	BOOL	0 = No Override (go to safe state) 1 = Override (run local logic)

Instance 2 controls the communication fault and idle behaviors for run/jog outputs. Instance 2 contains the following instance attributes:

Attribute ID	Access Rule	Name	Data Type	Value
3	Get	Number of Instances	USINT	2 for DOLs (Bulletin 290E/291E) 4 for Drives (Bulletin 294E)
4	Get	Binding	Array of UINT	1, 2 for DOLs (Bulletin 290E/291E) 1, 2, 9, 10 for Drives (Bulletin 294E)
6	Get/Set	Command	BOOL	0 = Idle, 1 = Run
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

Note: There are no protection fault attributes. Behavior for protection faults is go to OFF.

Instance 3 will drive protection fault and communication fault/idle behaviors for user outputs. Instance 3 will have the following attributes.

Attribute ID	Access Rule	Name	Data Type	Value
3	Get	Number of Instances	USINT	6
4	Get	Binding	Array of UINT	3, 4, 5, 6, 7, 8
6	Get/Set	Command	BOOL	0 = Idle, 1 = Run
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 Input 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 Instances 1 and 2
4❶	Get/Set	Run 2	BOOL	
7	Get	Running 1	BOOL	—
8❶	Get	Running 2	BOOL	—
9	Get	Ready	BOOL	—
10	Get	Tripped	BOOL	—
12	Get/Set	Fault Reset	BOOL	0 > 1 = Trip Reset

❶ Reversing Starters (291E) and Inverter (294E) Starters only

The following common services will be 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 will be supported for the Overload Object.

A single instance (Instance 1) of the Overload Object is supported for DOL (Bulletin 290E/291E) and Reversing (Bulletin 294E) 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	
193	Get	Current L1 Times 10	UINT	
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	
0x01	No	Yes	Get_Attribute_All
0x0E	No	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single

Device Level Ring (DLR) Object

CLASS CODE 0x0047

The following class attribute will be supported for the DLR Object.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	2

A single instance (instance 1) will be supported.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Network Topology	USINT	0 = Linear 1 = Ring
2	Get	Network Status	USINT	0 = Normal 1 = Ring Fault 2 = Unexpected Loop Detect 3 = Partial Network Fault 4 = Rapid Fault/Restore Cycle
10	Get	Active Supervisor Address	Struct of: UDINT Array of 6 USINT	Ring Supervisor
12	Get	Capability Flags	DWORD	0x00000002

The following common services will be implemented for the DLR Object.

Service Code	Implemented for:		Service Name
	Class	Instance	
0x01	No	Yes	Get_Attribute_All
0x0E	No	Yes	Get_Attribute_Single

Extended Device Object

CLASS CODE 0x0064

The following class attributes will be supported for the Extended Device Object.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	2

A single instance (instance 1) will be supported.

Attribute ID	Access Rule	Name	Data Type	Value
1	Set	Name	STRING	User Assigned Name – Defaults to a null. 32 chars max
2	Set	Description	STRING	User Assigned Description – Defaults to a null. 64 chars max
3	Set	Geographic Location	STRING	User Assigned Geographic Loc. – Defaults to null. 32 chars max
101	Set	Contacxts 1	STRING	Contacts String – Defaults to a null. – 80 chars max.
102	Set	Contacts 2	STRING	Contacts String – Defaults to a null. – 80 chars max.

The following common services will be implemented for the Extended Device 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

DPI Fault Object

CLASS CODE 0x0097

This object provides access to fault information within the device.

The following class attributes will be supported for the DPI Fault Object.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Class Revision	UINT	1
2	Get	Number of Instances	UINT	4
3	Get/Set	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 containing information about the fault that tripped the device.
5	Get	Fault into parameter instance array	Struct of: UINT Array [5] of UINT	Array of SnapShot parameter instance numbers Array Size = 5 Array of Instance Numbers = 23,24,25,26,27
6	Get	Number of Recorded Faults	UINT	The number of faults recorded in the fault queue.

Four instances of the DPI Fault Object will be supported.

Attribute ID	Access Rule	Name	Data Type	Value
0	Get	Full/All Info Fault Code Fault Source DPI Port Number Device Object Instance Fault Text Fault Time Stamp Timer Value Timer Descriptor Help Object Instance Fault Data	Struct of: UINT Struct of: USINT USINT BYTE [16] Struct of: ULDINT WORD USINT Array [5] of 32 bit fault data values	 See Tables below 0 See Tables below Snapshot data
1	Get	Basic Info Fault Code Fault Source DPI Port Number Device Object Instance Fault Time Stamp Timer Value Timer Descriptor	Struct of: UINT Struct of: USINT USINT Struct of: ULINT WORD	 See Tables below 0
3	Get	Help Text	STRING	See Tables below

The following common services will be implemented for the DPI Fault Object.

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	Yes	No	Set_Attribute_Single

The table below lists Fault Codes, Fault Text, and Fault Help Strings for DOL and Reversers.

Table 33 - Fault Codes, Fault Text, and Fault Help Strings for DOL and Reversers

Fault Code	Fault Text	Help Text
1	Fault 1	—
2	User Defined	User defined trip has occurred.
3	Overload Trip	Load has drawn excessive current based on trip class selected.
4	Fault 4	—
5	Phase Loss Trip	Indicates missing supply phase. This fault can be disabled.
6	Jam Trip	Motor current above jam level for more than jam trip delay time.
7	Underload Trip	Motor current below UL level for more than UL trip delay time.
8	Fault 8	—
9	Fault 9	—
10	Fault 10	—
11	Fault 11	—
12	Stall Trip	Motor current above stall trip level during motor starting.
13	Switched Power	Indicates the loss of switched control power. *Not available in units with Integrated Power Supply.*

Table 33 - Fault Codes, Fault Text, and Fault Help Strings for DOL and Reversers

Fault Code	Fault Text	Help Text
14	Under Power Trip	Indicates the internal power supply is below its working level. *Available in units with Integrated Power Supply only*
15	Sensor Short	Flags a miswired hardware input point.
16	Output Short	Flags a miswired hardware output point.
17	Fault 17	—
18	Fault 18	—
19	Phase Imbalance	Indicates an imbalanced phase current.
20	Fault 20	—
21	Aux Power Loss	Auxiliary Power was lost or dipped below the minimum threshold. *Not available in units with Integrated Power Supply*
22	Fault 22	—
23	Fault 23	—
24	Fault 24	—
25	Fault 25	—
26	Fault 26	—
27	NonVol Memory	This is a major fault which renders the unit inoperable.
28	Fault 28	—
29	Fault 29	—
30	Hardware Fault	This is a major fault which renders the unit inoperable.
31	Fault 31	—
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	—

The table below lists Fault Codes, Fault Text, and Fault Help Strings for Drive units.

Table 34 - Fault Codes, Fault Text, and Fault Help Strings for Drive Units

Fault Code	Fault Text	Help Text	PF4M Fault Code
1	Fault 1	—	
2	User Defined	User defined trip has occurred.	
3	Motor Overload	The load has drawn excessive current.	7
4	Drive Overload	150% load for 1 min. or 200% load for 3 sec. exceeded.	64

Table 34 - Fault Codes, Fault Text, and Fault Help Strings for Drive Units

Fault Code	Fault Text	Help Text	PF4M Fault Code
5	Phase U to Gnd	A Phase U to Ground fault detected between drive and motor.	38
6	Phase V to Gnd	A Phase V to Ground fault detected between drive and motor.	39
7	Phase W to Gnd	A Phase W to Ground fault detected between drive and motor.	40
8	Phase UV Short	Excessive current detected between phases U and V.	41
9	Phase UW Short	Excessive current detected between phases U and W.	42
10	Phase VW Short	Excessive current detected between phases V and W.	43
11	Ground Fault	A current path to earth ground at one or more output terminals.	13
12	Stall Trip	The drive is unable to accelerate the motor.	6
13	Switched Power	Indicates the loss of switched control power. *Not available in units with Integrated Power Supply*	
14	Under Power Trip	Indicates the internal power supply is below its working level. *Available in units with Integrated Power Supply only.*	
15	Sensor Short	Flags a miswired hardware input point.	
16	Output Short	Flags a miswired hardware output point.	
17	Fault 17		
18	Heatsink Temp	The Heatsink temperature exceeds a predefined value.	8
19	HW Over Current	The drive output current has exceeded the hardware limit.	12
20	SW OverCurrent	Programmed parameter 83 (SW Current Trip) has been exceeded.	63
21	Aux Power Loss	Auxiliary Power was lost or dipped below the minimum threshold. *Not available in units with Integrated Power Supply.*	
22	Internal Comm	Communication with the internal Power Flex drive has been lost.	71
23	Drive Comm Loss	The RS485 port on the internal Power Flex stopped communicating.	81
24	Power Loss	Drive DC Bus Voltage remained below 85% of nominal bus voltage.	3
25	Under Voltage	DC Bus Voltage fell below the minimum value.	4
26	Over Voltage	DC Bus Voltage exceeded the maximum value.	5
27	MCB EEPROM	This is a major fault which renders the ArmorStart inoperable.	
28	Param Sync	The drive and Main Control Board EEPROMS are not in sync.	
29	Drive EEPROM	The drive EEPROM checksum checks have failed.	100
30	Hardware Fault	This is a major fault which renders the unit inoperable	
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.	70
33	Drive I/O Brd	A failure has been detected in the drive control and I/O section.	122
34	Restart Retries	Automatic fault reset and run retries exceeded.	33
35	Drive Aux In Flt	The drive auxiliary input interlock is open inside the ArmorStart.	2
36	Fault 36	—	
37	Drv Param Reset	Internal Drive Parameters (Parameters > 100) have been defaulted.	48
38	Fault 38	—	
39	Fault 39	—	
40	Unknown Fault	—	

DPI Alarm Object

CLASS CODE 0x0098

This object provides access to warning information within the device.

The following class attributes will be supported.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Class Revision	UINT	1
2	Get	Number of Instances	UINT	1
3	Set	Alarm Cmd Write	USINT	0=NOP; 1=Clear Alarm; 2=Clear Queue
74	Get	Alarm Instance Read	UINT	The instance of the Fault Queue Entry containing information about the fault that tripped the device.
6	Get	Number of Recorded Alarms	UINT	The number of faults recorded in the fault queue.

A single instance of the DPI Alarm Object will be supported.

Attribute ID	Access Rule	Name	Data Type	Value
0	Get	Full/All Info Alarm Code Alarm Source DPI Port Number Device Object Instance Alarm Text Alarm Time Stamp Timer Value Timer Descriptor Help Object Interface Alarm Data	Struct of: UINT Struct of: USINT USINT STRING Struct of: ULINT WORD USINT	 See Tables below 0 See Tables below
1	Get	Basic Info Alarm Code Alarm Source DPI Port Number Device Object Instance Alarm Time Stamp Timer Value Timer Descriptor	Struct of: UINT Struct of: USINT USINT Struct of: ULINT WORD	 See Tables below 0
3	Get	Help Text	STRING	See Tables below

The following common services will be implemented for the DPI Fault Object.

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	Yes	No	Set_Attribute_Single

The table below lists Fault Codes, Fault Text, and Fault Help Strings.

Table 35 - Fault Codes, Fault Text, and Fault Help Strings for ArmorStart LT

Warning Code	Warning Text	Help Text
1	Warning 1	—
2	Warning 2	—
3	Motor Overload	Overload warning level has been exceeded.

Table 35 - Fault Codes, Fault Text, and Fault Help Strings for ArmorStart LT

Warning Code	Warning Text	Help Text
4	Warning 4	—
5	Warning 5	Indicates missing supply phase. This fault can be disabled.
6	Jam Warning	Motor current has exceeded jam warning level.
7	Underload Warning	Motor current dropped below Underload Warning level.
8	Warning 8	—
9	Warning 9	—
10	Warning 10	—
11	Warning 11	—
12	Warning 12	—
13	Switched Pwr Warn	Indicates the control power has dipped below 19 Volts. *Not available in units with Integrated Power Supply.*
14	Under Power Warn	Indicates the internal power supply is below its optimal level. *Available in units with Integrated Power Supply only.*
15	Warning 15	—
16	Warning 16	—
17	Warning 17	—
18	Warning 18	—
19	Warning 19	—
20	Warning 20	—
21	Aux Power Warn	Indicates auxiliary Power was has dipped below 19 Volts. *Not available in units with Integrated Power Supply.*

TCP/IP Interface Object

CLASS CODE 0x00F5

The following class attributes will be supported.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	2

One Instance of the TCP/IP Interface Object will be supported.

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Status	DWORD	
2	Get	Configuration Capability	DWORD	0x000000F4
3	Get/Set	Configuration Control	DWORD	0 = Configuration from NVS 2 = Configuration from DHCP
4	Get	Physical Link Object	Struct of: UINT Padded EPATH	 2 words 20 F6 24 01 (Enet Link Object Instance 1)

Attribute ID	Access Rule	Name	Data Type	Value
5	Get/Set	Interface Configuration	Struct of: UDINT UDINT UDINT UDINT UDINT STRING	 IP Address Network Mask Gateway Address Primary DNS Secondary DNS Default Domain Name for not fully qualified host names
6	Get/Set	Host Name	STRING	
8	Get/Set	TTL Value	USINT	Time to Live value for EtherNet/IP multicast packets
9	Get/Set	Multicast Config	Structure of USINT USINT UINT UDINT	 Allocation Control Reserved Number of multicast addresses to allocate (1-4) Multicast starting address.
10	Get/Set	SelectAcd	BOOL	Activates the use of ACD
11		LastConflictDetected	Structure of USINT USINT(6) USINT(28)	 AcdActivity RemoteMAC ArpPdu

The following common services will be implemented for the TCP/IP Interface Object.

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single
0x4C	No	Yes	Get_And_Clear

Ethernet Link Object

CLASS CODE 0x00F6

The following class attributes will be 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

Two instances of the Ethernet Link Object will be supported.

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 Specification
3	Get	Physical Address	ARRAY of 6 USINTs	MAC Address

Attribute ID	Access Rule	Name	Data Type	Value
4	Get	Interface Counters	Struct of: In Octets In Ucast packets In NUcast packets In Discards In Errors In Unknown Protos Out Octets Out Ucast packets Out NUcast packets Out Discards Out Errors	
5	Get	Media Counters	Struct of: Alignment Errors FCS Errors Single Collisions SQE Test Errors Deferred Transmits Late Collisions Excessive Collisions MAC Transmit Errors Carrier Sense Errors Frame Too Long MAC Receive Errors	
6	Get/Set	Interface Control	Struct of: Control Bits Forced Interface Speed	
7	Get	Interface Type	USINT	
8	Get	Inteface State	USINT	
9	Get/Set	Admin State	USINT	
10	Get	Interface Label	SHORT_STRING	Instance 1:LS 1 Instance 2:LS 2

The following common services will be implemented for the Ethernet Link Object.

Service Code	Implemented for:		Service Name
	Class	Instance	
0x0E	Yes	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single

Trip and Warning Email Object

CLASS CODE 0x0376

No class attributes will be supported.

Attribute ID	Need in Implementation	Access Rule	NV	Name	Data Type	Description of Attribute	Semantics of Values
2	Required	Set	NV	To	Struct of	Email address of the recipient of Trip and Warning Emails	The default value of this string is the null string.
				To Length	UDINT	Length of string in bytes	
				To Data	Array of USINT	ASCII characters	Example: user1@ra.rockwell.com
3	Required	Set	NV	From	Struct of	Email address of this device	The default value of this string is the null string.
				From Length	UDINT	Length of string in bytes	
				From Data	Array of USINT	ASCII characters	Example: user1@ra.rockwell.com
5	Required	Set	NV	SMTP Server Address	Struct of	SMTP Server Address String	The default value of this string is the null string.
				Addr Length	UDINT	Length of string in bytes	
				Addr Data	Array of USINT	ASCII characters	
6	Required	Set	NV	SMTP User Name	Struct of	SMTP User Name String	The default value of this string is the null string.
				To Length	UDINT	Length of string in bytes	
				To Data	Array of USINT	ASCII characters	
7	Required	Set	NV	SMTP Password	Struct of	SMTP Password String	The default value of this string is the null string.
				To Length	UDINT	Length of string in bytes	
				To Data	Array of USINT	ASCII characters	
8	Required	Set	NV	SMTP Port	UINT	The SMTP Port	The Default Value is 0.
9	Optional	Set	NV	Trip Email Mask	WORD	Mask to enable emails for individual trip conditions	
10	Optional	Set	NV	Warning Email Mask	WORD	Mask to enable emails for individual warning conditions	
11	Optional	Set	NV	Trip Reset Email Mask	WORD	Mask to enable emails when trip conditions are cleared	
12	Optional	Set	NV	Warning Reset Email Mask	WORD	Mask to enable emails when warning conditions are cleared	
13	Optional	Get	V	Trip Email Count	UINT	Number of emails sent in response to a trip condition	Defaults to the value 0
14	Optional	Get	V	Trip Cleared Emails	UINT	Number of emails sent in response to clearing a trip	Defaults to the value 0
15	Optional	Get	V	Warning Email Count	UINT	Number of emails sent in response to a warningcondition	Defaults to the value 0
16	Optional	Get	V	Warning Cleared Emails	UINT	Number of emails sent in response toclearing a trip	Defaults to the value 0
17	Optional	Get	V	Email Send Features	UINT	Number of email failures detected	Defaults to the value 0
18	Optional	Get	V	Trip Email Count	UINT	Number of emails sent in response to a trip condition	

The following common services will be implemented for the TCP/IP Interface Object.

Service Code	Implemented for:		Service Name
	Class	Instance	
0x01	No	Yes	Get_Attribute_All
0x0E	No	Yes	Get_Attribute_Single
0x10	No	Yes	Set_Attribute_Single

Notes:

Using DeviceLogix™

Introduction

DeviceLogix is a stand-alone Boolean program that resides within the ArmorStart LT. The program is embedded in the product so that there is no additional module required to use this technology; DeviceLogix is programmed using the Add-On Profile for RS Logix 5000.

In addition to the actual programming, DeviceLogix can be configured to operate under specific situations. It is important to note that the DeviceLogix program will only run if the logic has been enabled and unswitched power is present. This can be done within the "Logic Editor." The operation configuration is accomplished by setting the "Network Override" and "Communication Override" parameter. The following information describes the varying levels of operation:

- If both overrides are disabled and the logic is enabled, the ONLY time DeviceLogix will run is if there is an active I/O connection with a master, i.e. the master is in Run mode. At all other times DeviceLogix will be running the logic, but will NOT control the state of the outputs.
- If the Network Override is enabled and the logic is enabled then DeviceLogix controls the state of the outputs when the PLC is in Run mode and if a network fault 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 are switched and unswitched power sources connected to the device, the logic will control the state of the outputs.

DeviceLogix Local Control Mode

In local control mode, the embedded DeviceLogix logic engine drives the local outputs and motor run/jog commands from a local DeviceLogix program. Local Control is completely independent of the any or all CIP connections. I/O and/or Explicit Message connections can exist in any state and they do not affect the user outputs or the run/jog commands for the motor. Local control mode is chosen by when the keypad "Auto LED" is on, "Network Override" is set "Communication Override" is set, and DeviceLogix is enabled.

I/O Networked Control Mode

In I/O networked control mode, local outputs and motor run/jog commands are received over a CIP I/O connection in the established state. I/O networked control mode is chosen when DeviceLogix is disabled, or when DeviceLogix is enabled and no user outputs or run commands are being driven in the DeviceLogix program.

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 using simple Boolean math operators, such as AND, OR, NOT, timers, counters, latches, and analog values. Decision making is done by combining these Boolean operations with any of the available I/O. The inputs and outputs 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 located on the device such as push buttons and pilot lights that are connected to the ArmotStart LT. Refer to Table 36 - for complete list of DeviceLogix I/O functions.

There are many reasons to use the DeviceLogix functionality, but some of the most common are listed below:

- 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 in the event of network interruptions
- Critical operations can be safely shutdown through local logic

DeviceLogix Programming Example

The following example will show how to program a simple logic routine to interface the ArmorStart with a remote hard-wired startstop station. In this case the I/O is wired as shown in the table below.

Input/Output Table

Bit	Description
Pt00	Start Button
Pt01	Stop Button
Out02	Run Forward

IMPORTANT Before programming logic, it is important to decide on the conditions under which the logic will run. The conditions can be defined by setting CommsOverride and NetworkOverride to the value that you want.

1. Refer to section “How to Add a New Module, Using the Add-On Profile” to configure the I/O. Then select the DeviceLogix section and create a program.

2. Click on the "**DeviceLogix**" tab. If you are on-line with a device, a dialog box will appear asking you to upload or download. Click on "**Upload**."

3. Click the "Start Logic Editor**"** button.

4. If programming off-line continue to step 5, otherwise click on the "**Edit**" button. Click "**Yes**" when asked if you want to Enter Edit Mode. Once in edit mode the entire list of Function Blocks will be displayed in the toolbar.

5. Left Click on the "**RSL**" function block. This is a reset dominate latch.

6. Move the cursor into the grid, and left click to drop the function onto the grid.

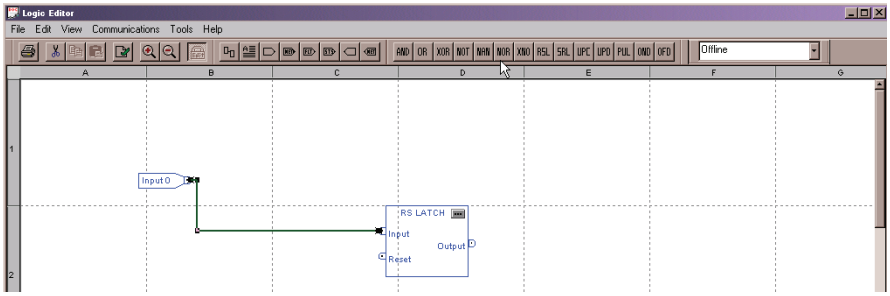
7. From the toolbar, Click on the "**Discrete Input**" button and select **Pt00** from the pull-down menu. This is the remote start button based on the example I/O table.

8. Place the input to the left of the RSL function. To drop the input on the page, left click on the desired position.

9. Place the mouse cursor over the tip of Pt00. The tip will turn green. Click on the tip when it turns green.

10. Move the mouse cursor toward the input of the RSL function. A line will follow the cursor. When a connection can be made, the tip of the RSL function will also turn green. Click the on Input and the line will be drawn from Pt00 to the Set Input of the RSL function.

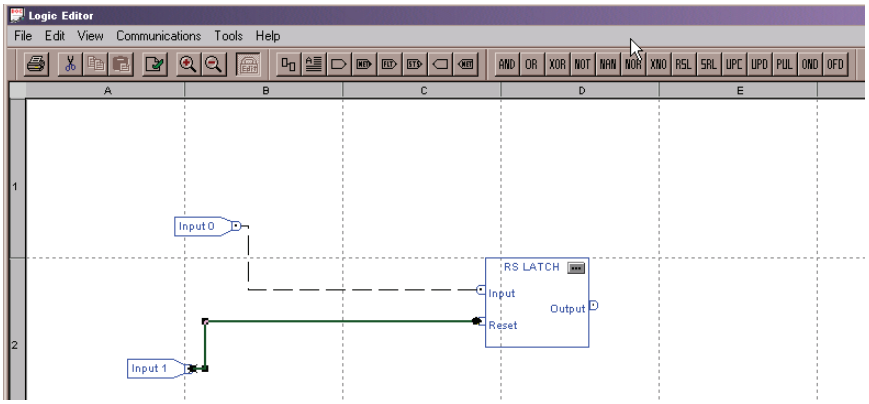
Note: If this was not a valid connection, one of the pin tips would have turned red rather than green. Left double clicking on the unused portion of the grid or pressing the "**Esc**" key at any time will cancel the connection process.



11. From the toolbar, Click on the "**Discrete Input**" button and select **Pt01** from the pull-down menu. This is the remote stop button based on the example I/O table.

12. Place the input to the left of the RSL function.

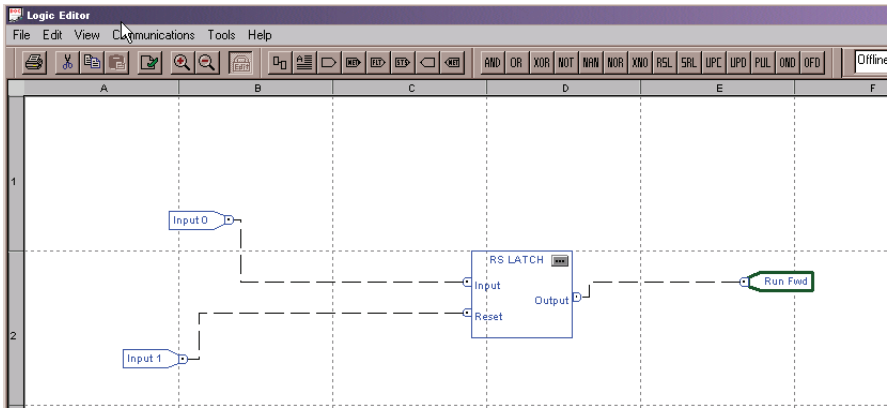
13. Connect the input to the reset input of the RSL latch.



14. From the toolbar, Click on the "**Discrete Output**" button and select "**RunForward"** from the pull-down menu. RunForward is the relay controlling the coil of the contactor. Click OK.

15. Move the cursor into the grid and place the Output to the right of the RSL function block.

16. Connect the output of the "**RSL**" function block to **Run Fwd.**



17. Click on the "**Verify**" button located in the toolbar or select "Logic Verify" from the "Tools" pull-down menu.

18. Click on the "**Edit**" button to toggle out of edit mode if online with a device.

19. Go to the pull-down menu in the right corner of the toolbar and select "**Download**".

Note: Ensure that the PLC key switch is in the Program position. If in any other position, the download will not occur and an error will be generated.

20. Press "**OK**" when told the download was successful.

21. Now from the same pull-down menu select "**Logic Enable On**."

22. The ArmorStart is now programmed and the logic is Active.

Table 36 - DeviceLogix Input and Output Variables

Element Type	Bulletin 290E	Bulletin 291E	Bulletin 294E
Consumed Network Data	PT00DeviceIn	PT00DeviceIn	PT00DeviceIn
	…	…	…
	PT15DeviceIn	PT15DeviceIn	PT15DeviceIn
Discrete Input Points	PT00	PT00	PT00
	…	…	…
	PT00	PT00	PT00
Discrete Output Points	RunForward	RunForward	RunForward
	…	RunReverse	RunReverse
	Out00	Out00	Out00
	…	…	…
	Out05	Out05	Out05
			JogForward
			JogReverse
Produced Network Data	Pt00DeviceOut	Pt00DeviceOut	Pt00DeviceOut
	…	…	…
	Pt15DeviceOut	Pt15DeviceOut	Pt15DeviceOut
	ResetFault	ResetFault	ResetFault
	MotionDisable	MotionDisable	MotionDisable
	ForceSnapshot	ForceSnapshot	ForceSnapshot
	UserDefinedFault	UserDefinedFault	UserDefinedFault
	KeypadDisable	KeypadDisable	KeypadDisable
			Accel2
			Decel2
			BrakeRelease

Element Type	Bulletin 290E	Bulletin 291E	Bulletin 294E
Faults	OverloadTrip	OverloadTrip	OverloadTrip
	PhaseShortTrip	PhaseShortTrip	PhaseShortTrip
	UnderPowerTrip	UnderPowerTrip	UnderPowerTrip
	SensorShortTrip	SensorShortTrip	SensorShortTrip
	PhaseImbalTrip	PhaseImbalTrip	PhaseImbalTrip
	NonVolMemooryTrip	NonVolMemooryTrip	NonVolMemooryTrip
			ParamSyncTrip
	JamTrip	JamTrip	DCBusFaults
	StallTrip	StallTrip	StallTrip
	UnderloadTrip	UnderloadTrip	UnderloadTrip
			GroundFault
			RestartRetries
			DriveHdwFault
	OutputShortTrip	OutputShortTrip	OutputShortTrip
	UserDefinedTrip	UserDefinedTrip	UserDefinedTrip
	HardwareFltTrip	HardwareFltTrip	HardwareFltTrip
Warnings	OverloadWarning	OverloadWarning	OverloadWarning
	UnderPowerWarn	UnderPowerWarn	UnderPowerWarn
	PhaseImbalWarn	PhaseImbalWarn	
	JamWarning	JamWarning	
	UnderLoadWarn	UnderLoadWarn	
	UnswitchedPwrWarn	UnswitchedPwrWarn	UnswitchedPwrWarn

Element Type	Bulletin 290E	Bulletin 291E	Bulletin 294E
Misc Data	TripPresent	TripPresent	TripPresent
	WarningPresent	WarningPresent	WarningPresent
	RunningForward	RunningForward	RunningForward
	RunningReverse	RunningReverse	RunningReverse
	Ready	Ready	Ready
	NetControlStatus	NetControlStatus	NetControlStatus
			NetRefStatus
	CurrentFlowing	CurrentFlowing	AtReference
	KeyPadAuto	KeyPadAuto	KeyPadAuto
	KeyPadOff	KeyPadOff	KeyPadOff
	KeyPadHand	KeyPadHand	KeyPadHand
			KeyPadJogging
	DisconnectStatus	DisconnectStatus	DisconnectStatus
			BrakeStatus
	ExplicitCnxn	ExplicitCnxn	ExplicitCnxn
	IOConnection	IOConnection	IOConnection
	ExplicitCnxnFault	ExplicitCnxnFault	ExplicitCnxnFault
	IOCnxnFault	IOCnxnFault	IOCnxnFault
	IOCnxnIdle	IOCnxnIdle	IOCnxnIdle
	DLREnabled	DLREnabled	DLREnabled
	DLRFault	DLRFault	DLRFault
Analog Input Point			NetInputFreq
Analog Output Point			CommandFreq
Misc Analog Input Data	PhaseL1Current	PhaseL1Current	OutputFreq
	PhaseL2Current	PhaseL2Current	OutputCurrent
	PhaseL3Current	PhaseL3Current	OutputVoltage
	AverageCurrent	AverageCurrent	DCBusVoltage
	%ThermalUtilized	%ThermalUtilized	DriveTemperature
	SwitchedVolts OutputSourceV ❶	SwitchedVolts OutputSourceV ❶	SwitchedVolts OutputSourceV ❶
	UnswitchedVolts SensorSourceV ❶	UnswitchedVolts SensorSourceV ❶	UnswitchedVolts SensorSourceV ❶
Analog Consumed Network Data	AnalogDeviceIn	AnalogDeviceIn	AnalogDeviceIn
Analog Produced Network Data	AnalogDeviceOut	AnalogDeviceOut	AnalogDeviceOut

❶ IPS Units

ArmorStart LT Bulletin 294E Example Configuration

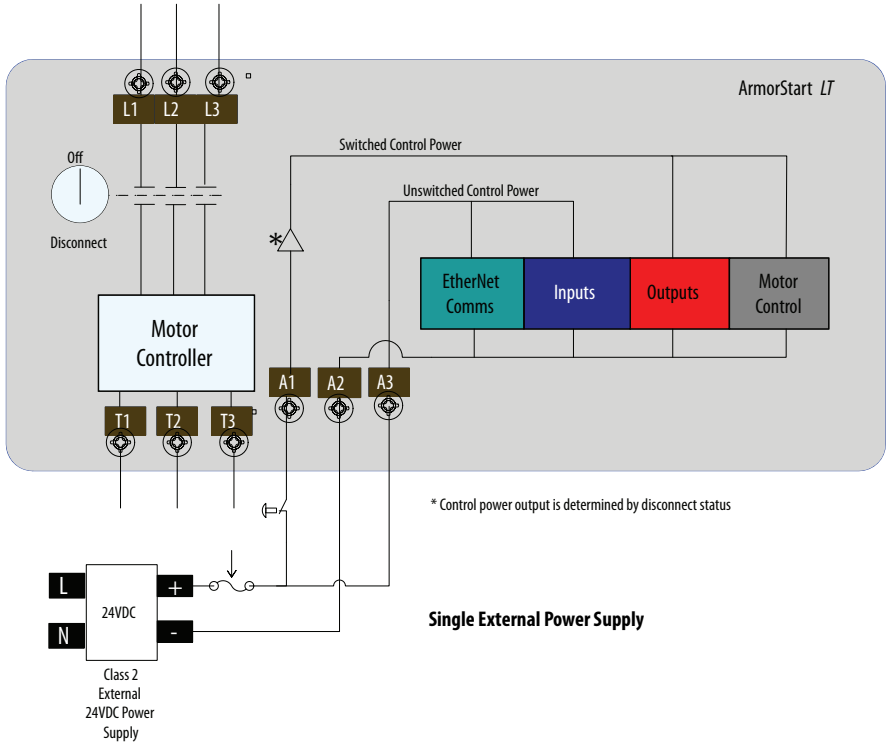
Hardware & Software Versions Used in this example

- RSLogix 5000 Revision 19
- Download AOP from the Support website:
- http://support.rockwellautomation.com/controlflash/LogixProfiler.asp
- Hardware:
  - 294E-FD2P5Z-G1 — ArmorStart LT
  - 1606-XLP72E — Power Supply
  - 1783-EMS08TA — Stratix Ethernet switch
  - 1756-L63 system set — Control Logix
  - 1756-EN2TR — EtherNet/IP module for Control Logix
- The IP address of the Hardware will be preset to as followed:

Item	Description	IP Address
1	ArmorStart LT	192.168.1.36
2	1756-EN2TR	192.168.1.32
3	PC	192.168.1.89

- The Armorstart LT control power wiring example used

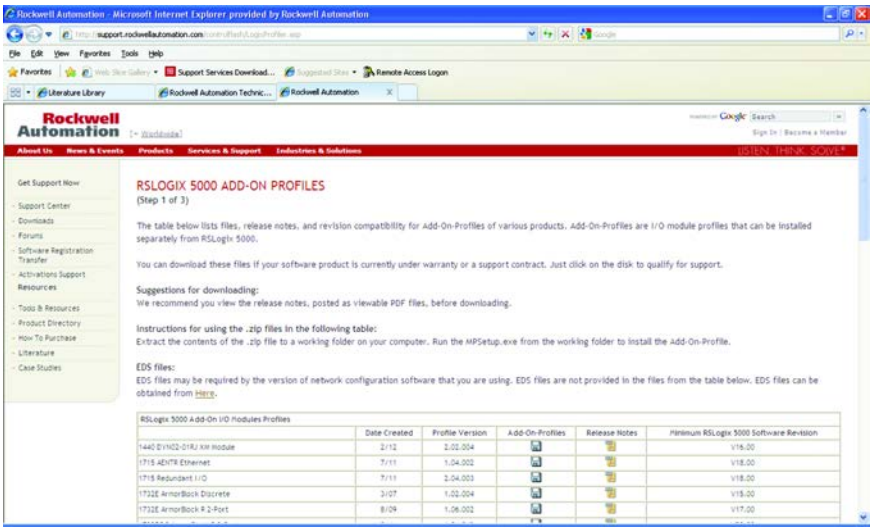
Figure 1: Control Power Wiring Example



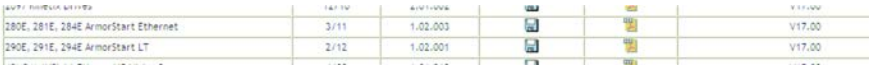
Download the AOP

Download and install the AOP for RSLOGIX5000 from the Service and Support website.

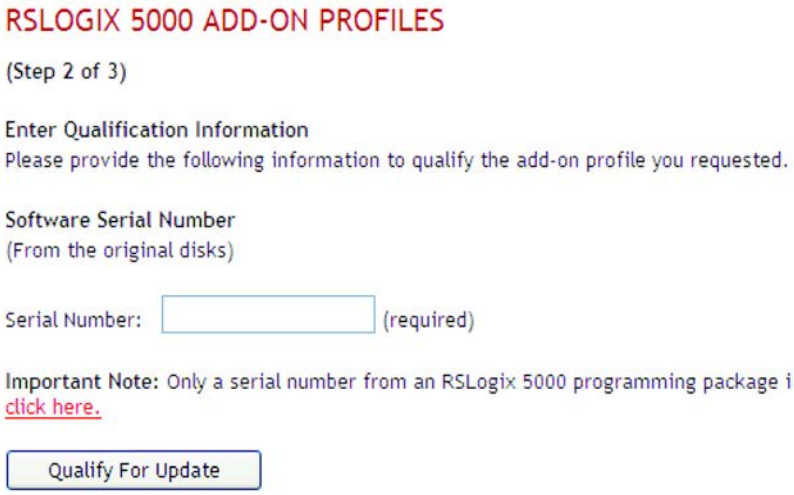
1. Open an Internet Explorer and enter the following URL: http://support.rockwellautomation.com/controlflash/LogixProfiler.asp



2. From the list of the Add-On I/O Modules Profiles, scroll down and select Bulletin 290E, 291E, 294E ArmorStart LT from the list and download the file.

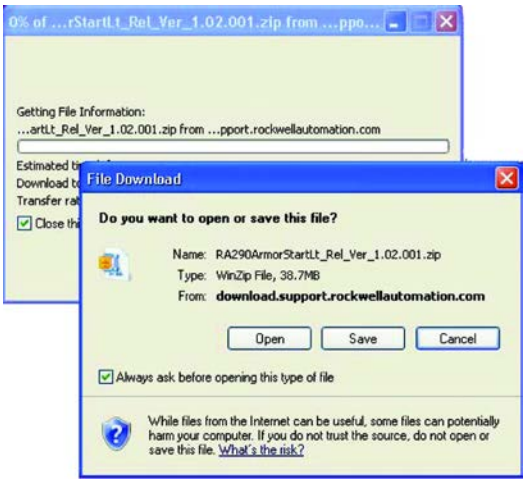


3. To download the file, your RSLOGIX 5000 Serial Number will be prompted. Enter the Serial Number and click on the 'Qualify For Update' button to proceed.

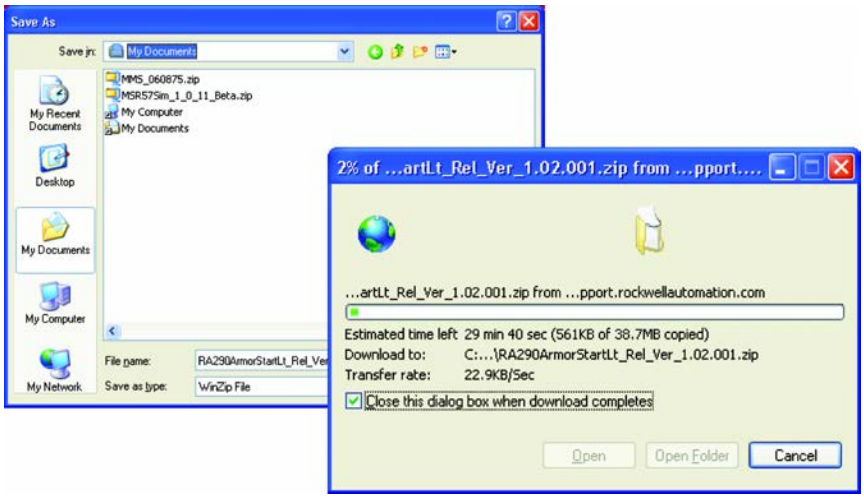


4. Upon verification, the following screen will appear. Click on the link to download the file.

5. At the pop-up dialogue box, select 'Save' to save the file.

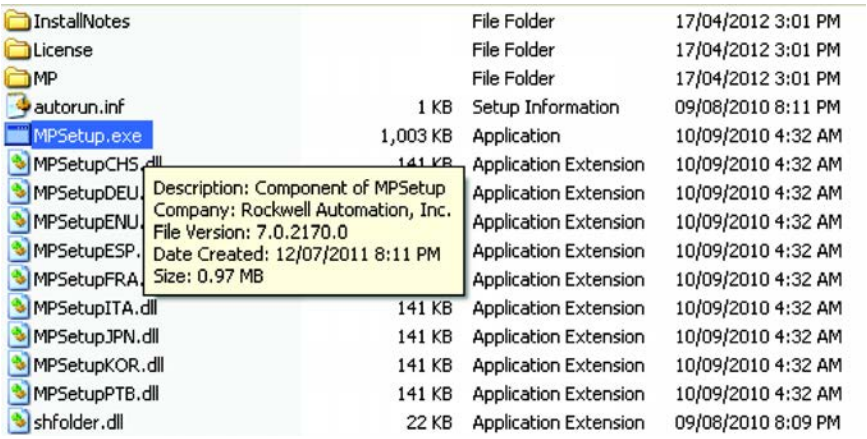


6. Select the folder to save the file and click 'Save'. The downloading will start.



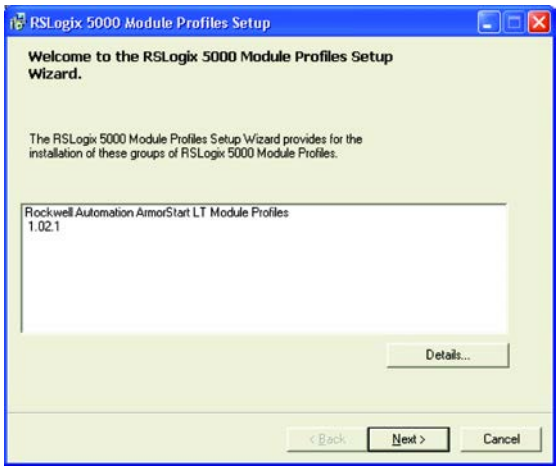
7. Upon the completion of downloading, unzip the files to the folder.

8. Run the MPSetup.exe from the folder and start installation.



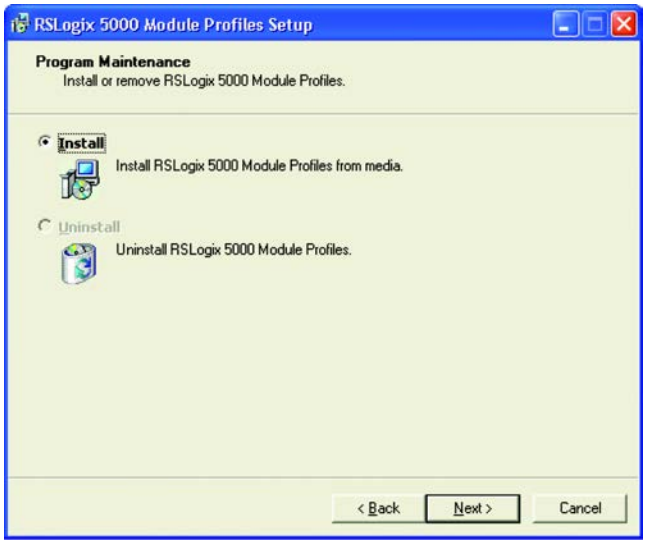
9. The following dialog box will appear.

10. The RSLogix 5000 Module Profiles Setup window will be shown. Click 'Next' to continue.

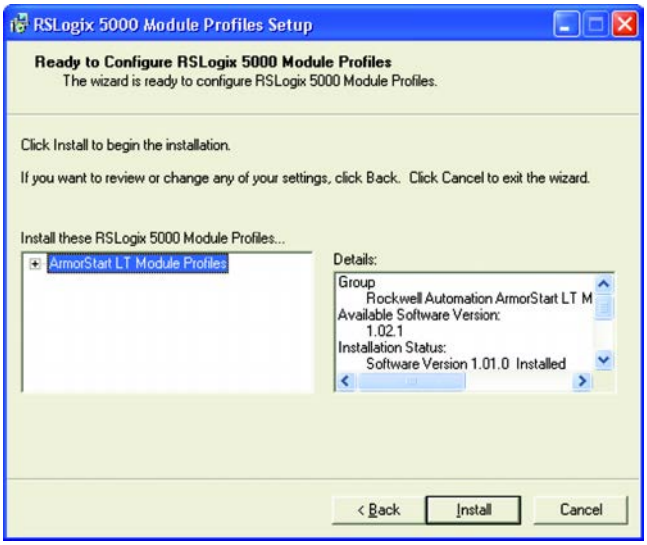


11. Select 'I accept the terms in the license agreement' and click on 'Next'

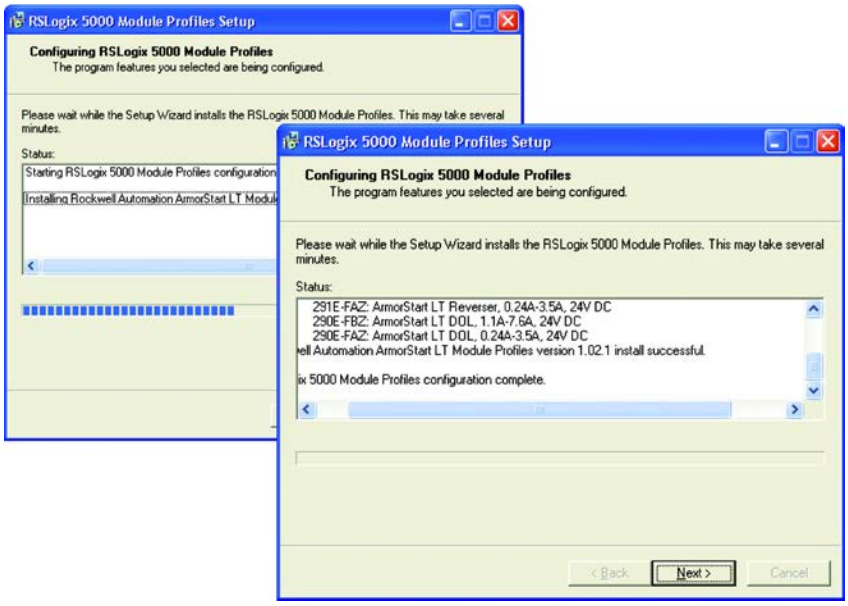
12. Then click on 'Next' to proceed to installation



13. Select 'Install' to start installation



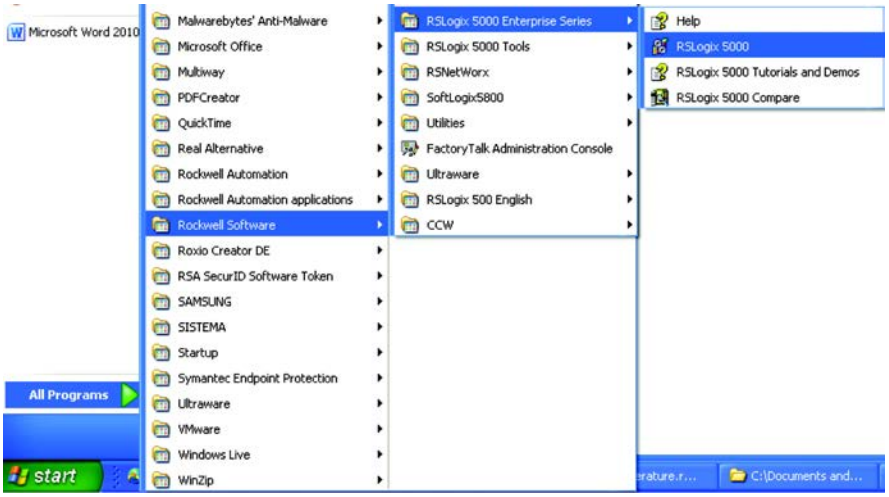
14. The profiles will be installed, upon completion, click on 'Next' to proceed



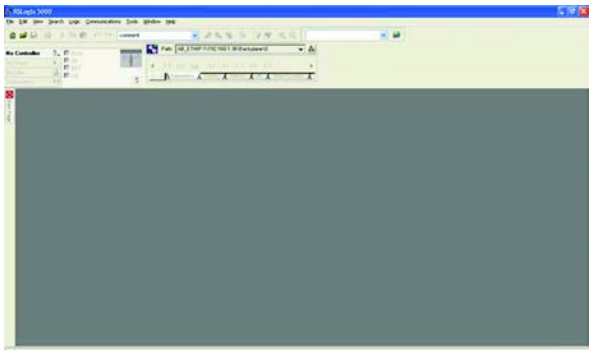
15. To complete, click on 'Finish'

Use of the AOP in RSLogix 5000

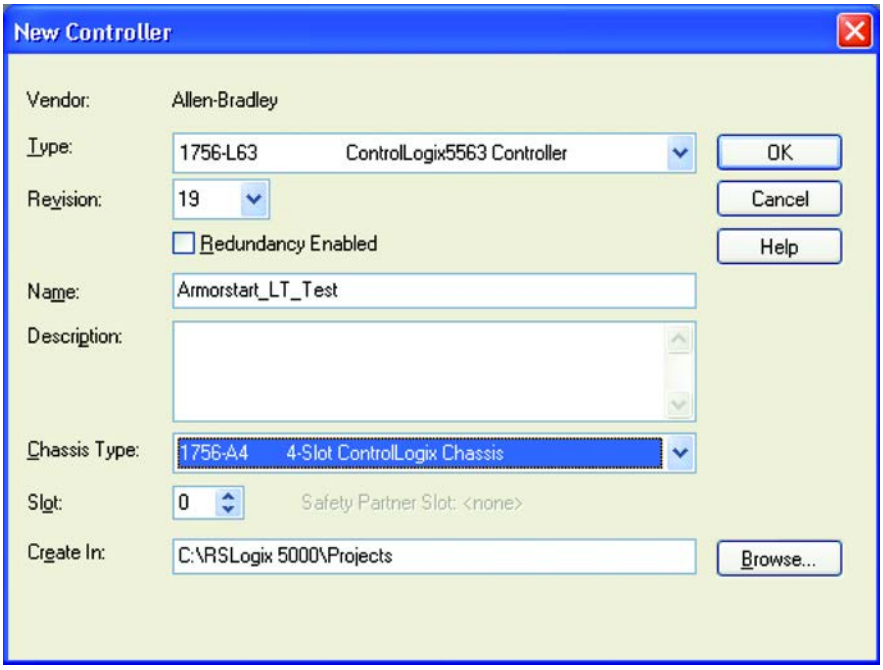
1. Start the RSLogix5000 from Start ➔ Rockwell Software ➔ RSLogix 5000 Enterprise Series ➔ RSLogix 5000



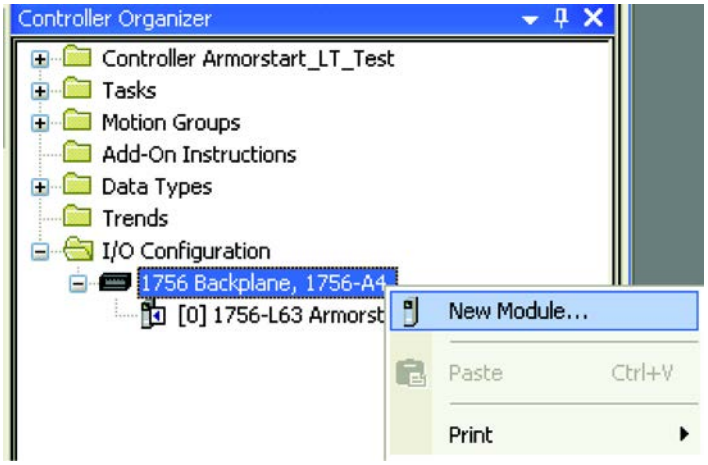
2. Start a new project, by clicking on the icon



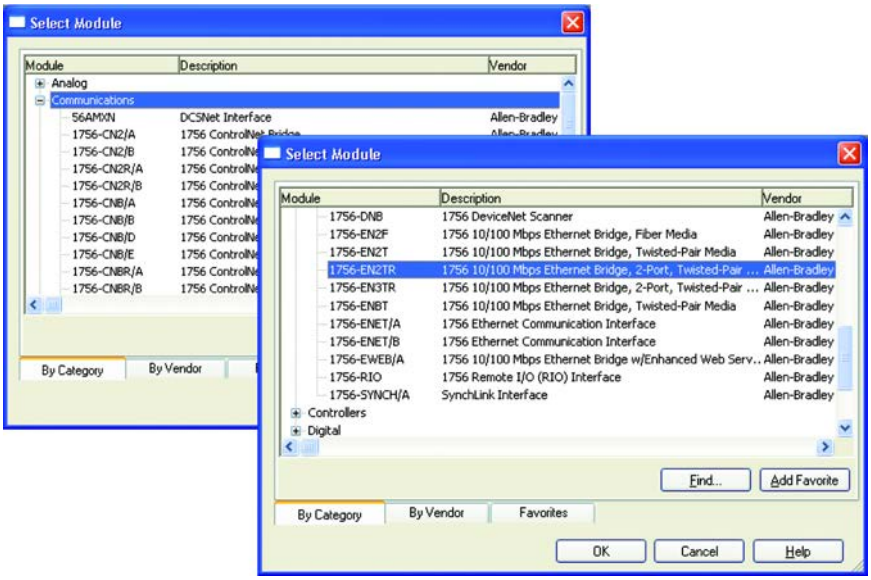
3. In the controller dialog box, enter the appropriate information of the controller. Then click 'OK' to proceed



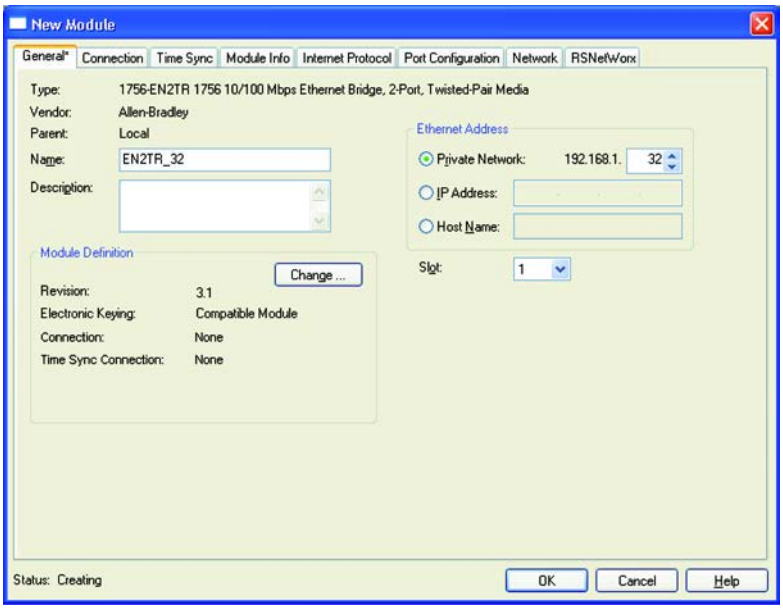
4. In the Controller Organizer window find "I/O Configuration" and right click on the 1756 Backplane and select New module



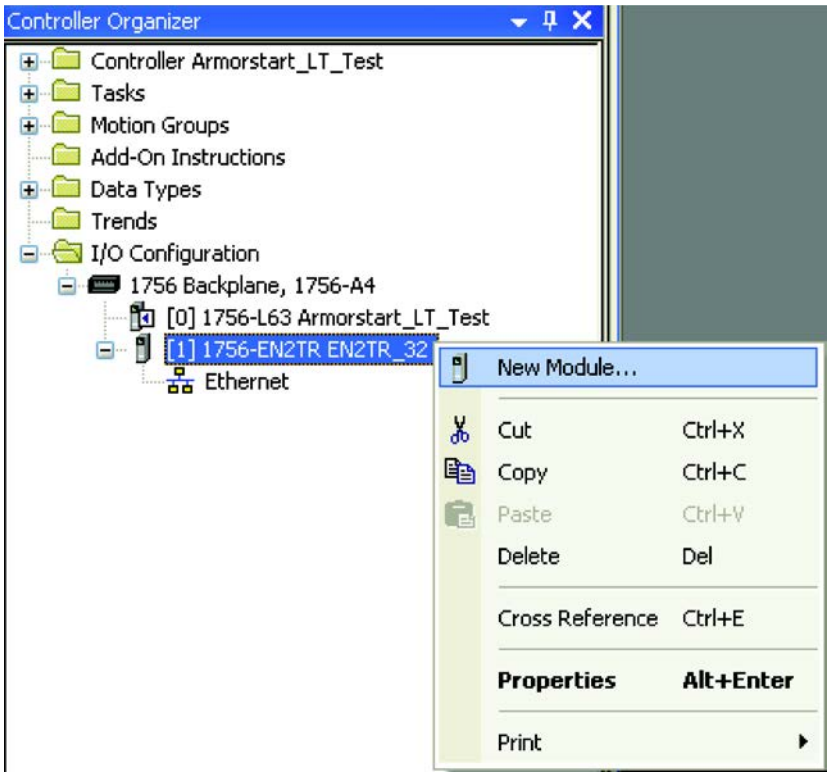
5. Select Module Dialog box followed by “Communications” and then select 1756-EN2TR and click OK



6. In the New module dialog box enter the Unit name, IP address, and slot then click OK

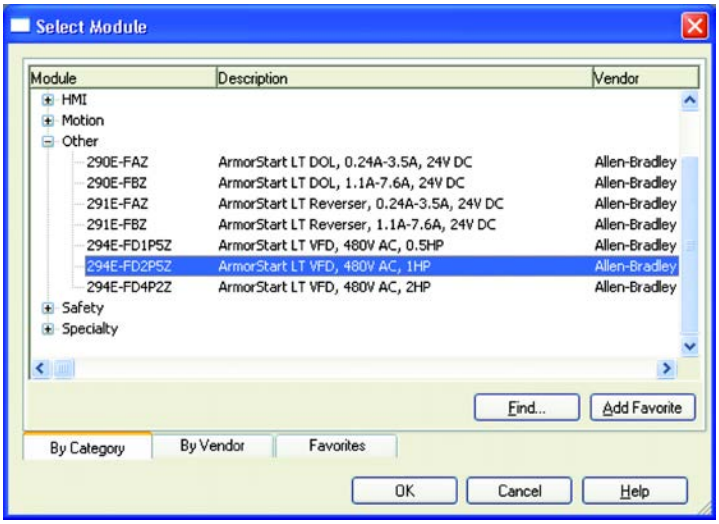


7. Right click on the EN2TR-32, in the Controller Organizer at the I/O Configuration ➔ 1756-Backplane ➔ 1756-EN2TR, select 'New Module...'

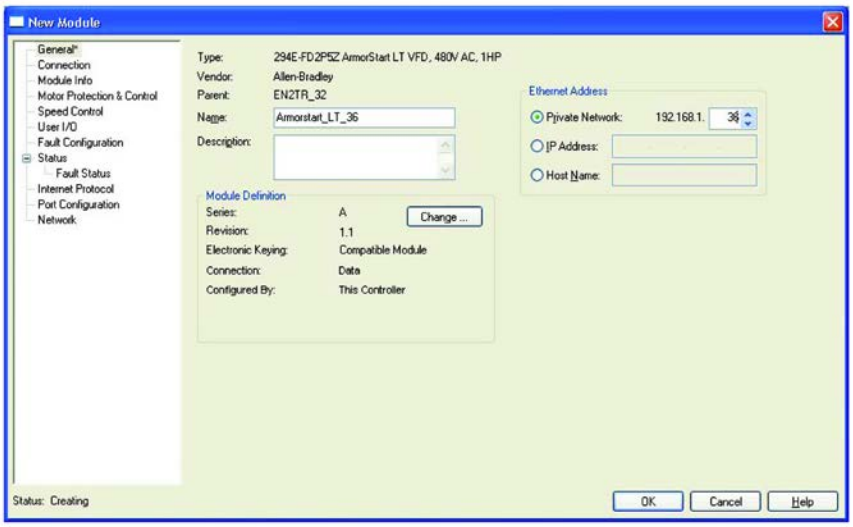


8. In the Select Module window select "Other" and choose the 294E-FD2P5Z and click on OK

Note: Please select the appropriate module. If the wrong module is selected once RSLOGIX 5000 is in Online with the controller a yellow triangle will appear next to the module indicating an I/O error has occurred.



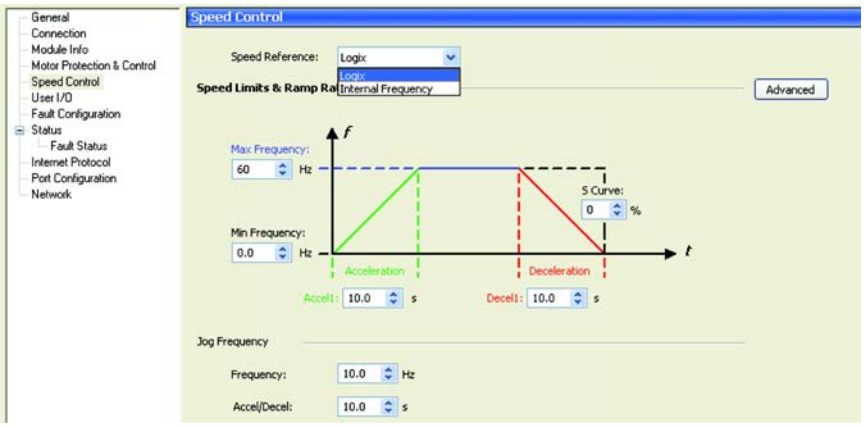
9. In the New Module window, enter the Name of the Armorstart LT and the IP address assigned to it. You can now start to configure the ArmorStart LT. Begin with "Motor Protection & Control"



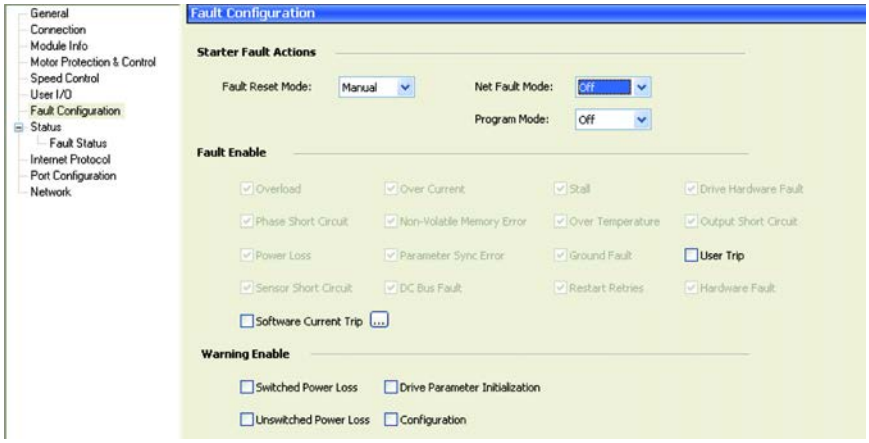
10. At the Motor Protection & Control, enter the motor information.

Note: Please refer to the motor nameplate for the information.

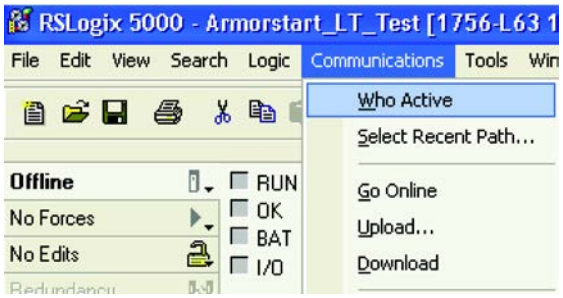
11. Next select “Speed Control”. By default “Speed Reference” is set to select Logix. The speed of the motor will be control by the controller tag in the Contrologix. Configure the Acceleration/Deceleration and Jog Frequency here.



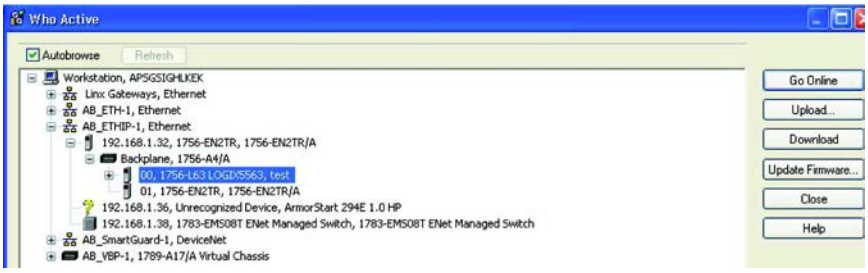
12. Then proceed to the “Fault Configuration” and configure the reset mode to Automatic or Manual. Then click OK to proceed.



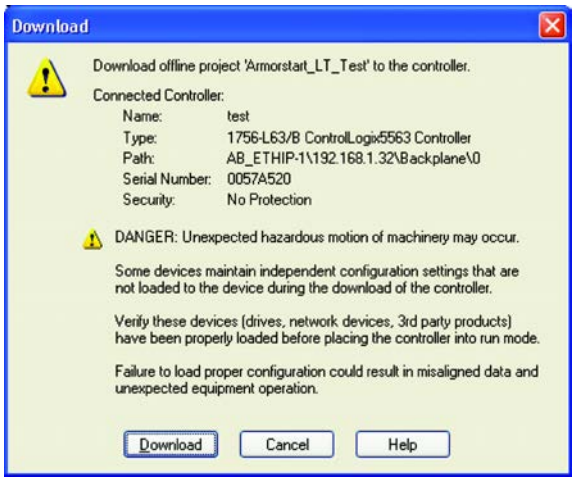
13. Download the configuration to the controller. To download, select Communication ➔ Who Active.



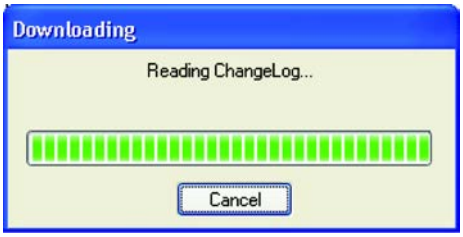
14. At the Who Active window select the 1756-EN2TR, then the controller, and click on the Download button



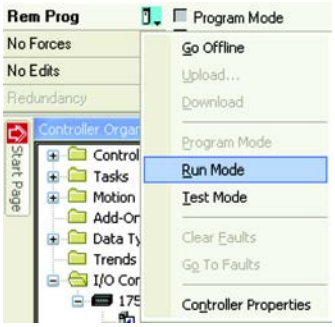
15. The Download dialog box will appear, click on Download to proceed



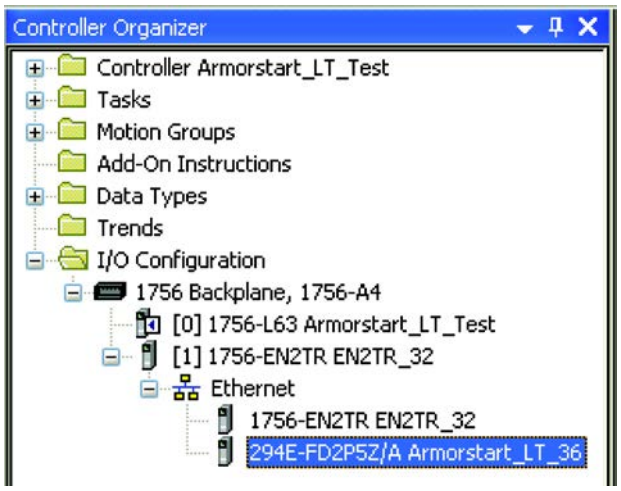
16. The configuration will be downloaded and the Downloading dialog box will show the progress



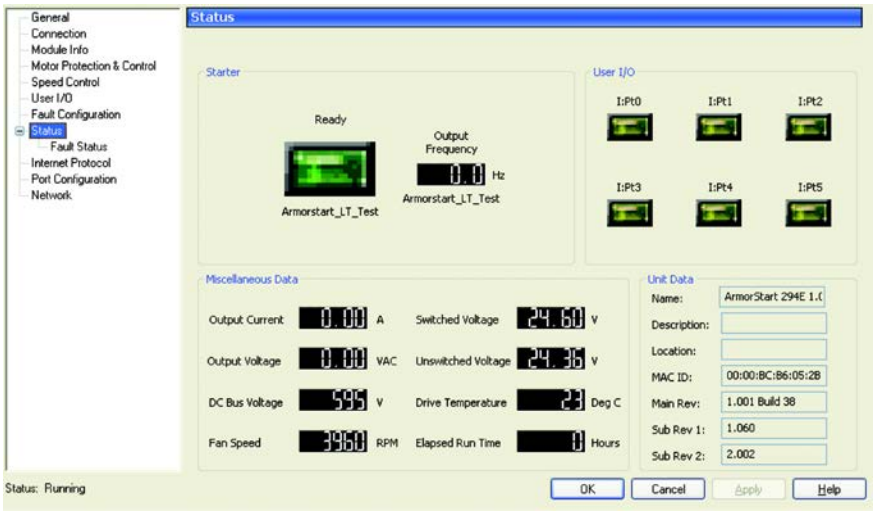
17. Upon completion, select Run Mode as per shown



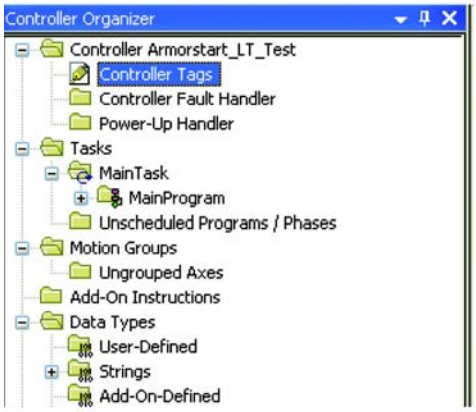
18. Double click on the Armorstart_LT at the Controller Organizer



19. Proceed to the Status to check the status of the ArmorStart LT



20. Double click on the Controller Tags at the Controller Organizer



21. Expand the output tag of the ArmorStart LT, i.e.: Armorstart_LT_36:O

+ Armorstart_LT_36:C	{...}
+ Armorstart_LT_36:I	{...}
− Armorstart_LT_36:O	{...}
Armorstart_LT_36:O.Accel2	0
Armorstart_LT_36:O.Decel2	0
+ Armorstart_LT_36:O.FreqCommand	300
+ Armorstart_LT_36:O.Int00DeviceIn	0
Armorstart_LT_36:O.JogForward	0

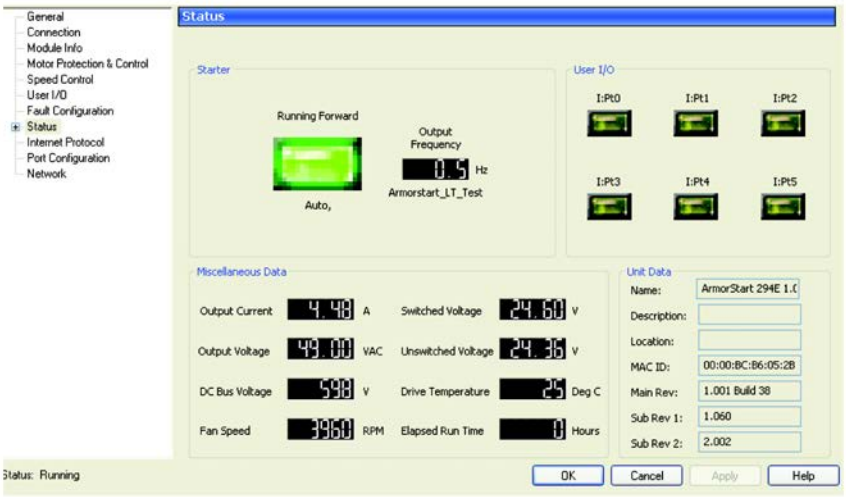
22. Enter the following value:

Name	Value	Description
Armorstart_LT_36:O.FreqCommand	300	30.0Hz, Setting Target Frequency
Armorstart_LT_36_O.RunForward	1	Start the RUNning in Forward Direction

23. Toggle the Armorstart_LT_36_O.RunForward to move the motor in the forward direction. Then toggle Armorstart_LT_36_O.RunReverse. The motor will run in the reverse direction.

24. Change the value of the FreqCommand to vary the speed.

Note: Setting the tag value to 500 instructs the drive to run at 50.0Hz



This example configuration is now complete. If additional help is needed, please contact your Rockwell Automation sales representative or technical support.

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support/, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect[SM] support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

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Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

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