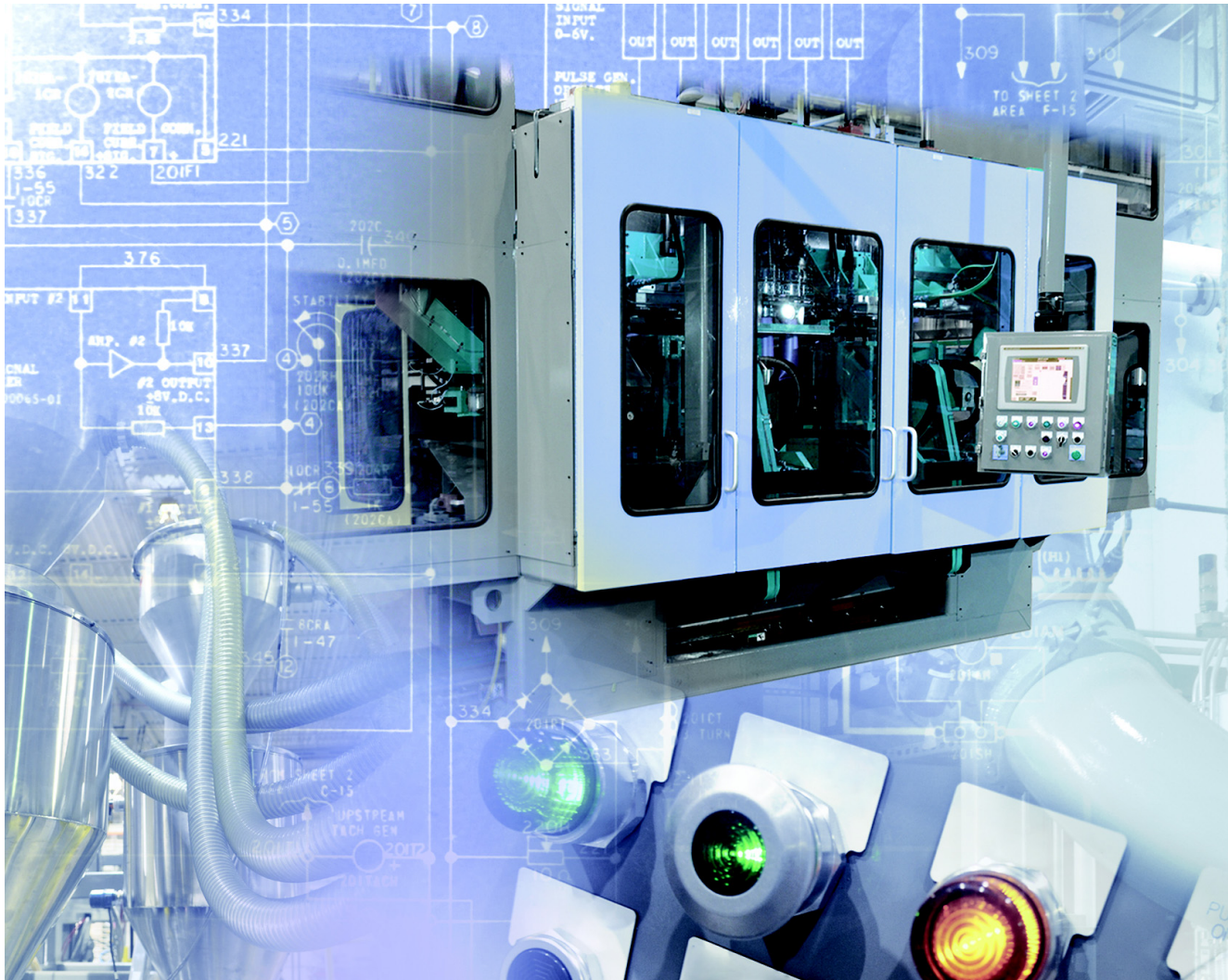


ArmorStart ST Motor Controllers: Safety and Standard Versions

Bulletins 281E and 284E (With RRG Gland)



LISTEN.
THINK.
SOLVE.®

What's Inside

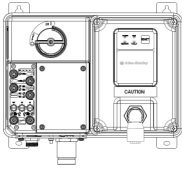
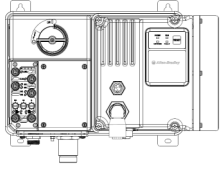
Topic	Page
Overview	3
Product Selection — Bulletin 281E	9
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Summary of Changes

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

Topic	Page
Changed short circuit protection value for max. fuse.	39
Changed short circuit protection value for max. fuse.	47

Overview

		
Bulletin	281E (with RRG Gland)	284E (with RRG Gland)
EtherNet/IP™ Network Communication		✓
Standard and Safety Versions		✓
Horsepower Range:		
0.5...10 Hp (0.37...7.5 kW)	✓	—
1...5 Hp (0.4...3.0 kW)	—	✓
Start Method:		
Full-voltage and Reverse	✓	—
VFD Sensorless Vector Control or V/Hz	—	✓
Environmental Rating	IP67/NEMA Type 4/12	
Control Voltage	24V DC	
Operational Voltage Ratings:		
200...480V AC	✓	—
380...480V AC	—	✓
DeviceLogix™		✓
Field Input Devices	4 inputs (24V DC)	
Field Output Devices	2 outputs (24V DC)	
Light-emitting Diode Status Indication		✓
ArmorConnect® Quick Disconnects		✓
I/O and Communications Quick Disconnects		✓
Safety Output Contactor		✓
CE - EMI Filter		✓
Motor Connector		✓
Source Brake Connector		✓
Dynamic Brake Connector		✓ ⁽¹⁾
Power Cables		✓ ⁽²⁾
UL Listed for Group Motor Installations		✓
Safety Performance	PLe and Category 4 (when used with specified Bulletin 1732ES)	
Standards Compliance and Certifications	cULus, CCC, KCC, CE, C-Tick	

(1) Resistor sold separately. See [Accessories](#).

(2) Cable assemblies sold separately. See [Accessories](#).

Product Description

ArmorStart® Bulletin 281E and 284E products are integrated, pre-engineered distributed motor control solutions that have quick disconnect connectivity, to satisfy automotive and material handling needs. They are available in full-voltage reversing or variable-speed motor control types. The ArmorStart product offers a standard IP67/Type 4/12 enclosure design, which is suitable for water wash-down environments. The modular design offers simplicity in wiring by applying quick disconnects for power, I/O, communications, and motor connection. The hardware machine stop version, when used with the recommended Bulletin 1732ES Safety I/O block, achieves Category 4 Performance Level e (PLe), SIL 3.

The ArmorStart product provides a standard local at-motor disconnect. It is UL Listed as suitable for Group Motor installation. This Listing can eliminate the need for additional components that would otherwise be required in each motor branch circuit.

The ArmorStart Bulletin 281E and 284E motor controllers natively support EtherNet/IP™, Device Level Ring, and IEEE 1588 transparent clock (Precision Time Protocol). Configuration is done using Studio 5000® Add-On Profile (AOP) capability. The AOP provides easy-to-navigate setup wizards and automatically creates descriptive producer and consumer tags in the Logix controller. An embedded web server allows you to easily retrieve status and diagnostic information when the AOP is not accessible. The ArmorStart product includes externally accessible node address switches and a comprehensive cluster of status and diagnostics light-emitting diodes for easy setup.

Included Features

Standard Features for ArmorStart ST Bulletin 281E and 284E Motor Controllers:

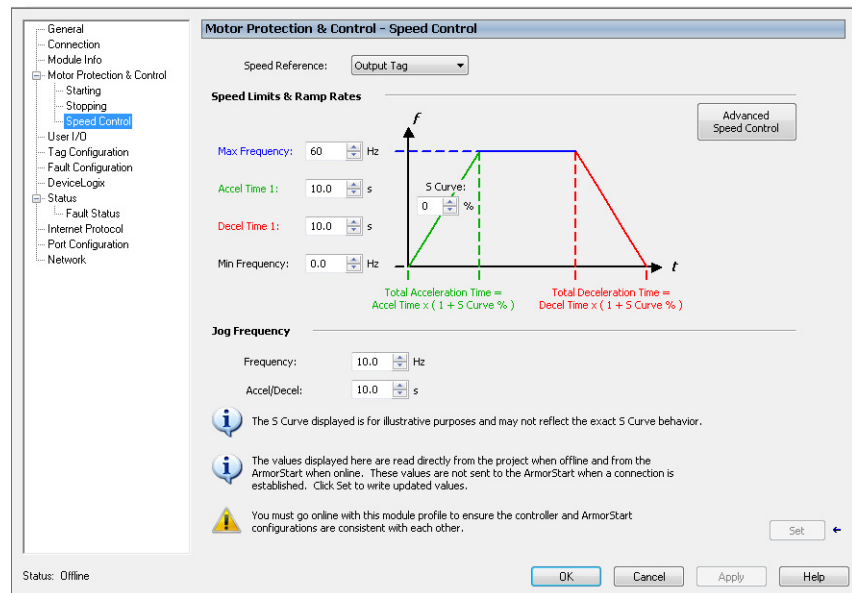
UL Listed "Suitable for Group Motor Applications" — Where NFPA 70 (National Electrical Code) or NFPA 79 are required installation standards, this Listing allows two or more motors to be connected to the same branch circuit without individual motor branch short-circuit or ground-fault protection.

At-motor disconnect switch — ArmorStart motor controllers offer a local ON/Off motor disconnect means with lockout-tag out provision. Industrial standards require a local at-motor disconnect to be within eye sight of the motor for maintenance or other shutdown reasons.

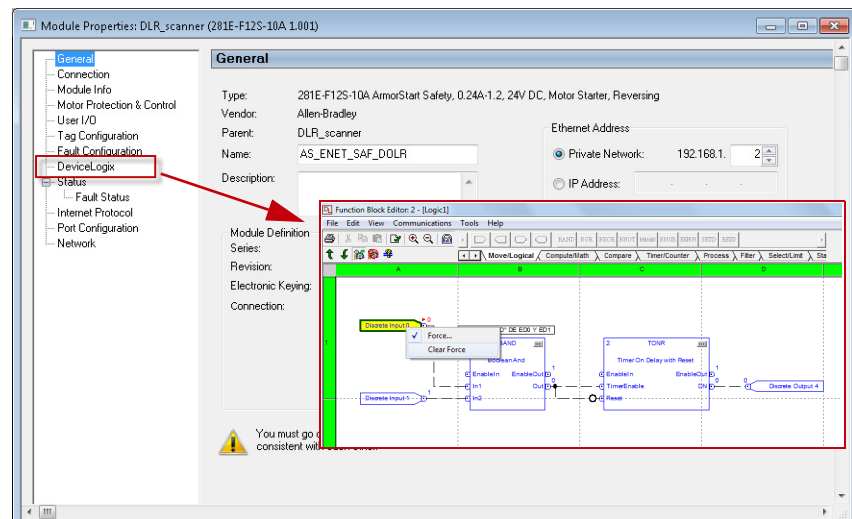
User I/O (field devices) — ArmorStart motor controllers offer four user-configurable inputs and two (sourcing) 24V DC outputs. You can select any point as a sourcing 24V DC output.

Light-emitting Diode Status Indication — The light-emitting diode indication provides a comprehensive number of status light-emitting diodes with indication for the following: POWER, RUN, NETWORK STATUS, FAULT, AND I/O.

Studio 5000 Add-on Profile (AOP) — ArmorStart motor controllers offer an Add-on Profile (AOP) for Allen-Bradley® ControlLogix® or CompactLogix™ Programmable Logic Controllers (PLCs). The AOP simplifies setup and commissioning via predefined tags and a setup wizard. The AOP allows copy and paste functionality for quick setup and configuration of multiple controllers.



DeviceLogix™ — ArmorStart motor controllers offer local programmable logic via DeviceLogix. DeviceLogix is a standalone program that resides within the ArmorStart motor controller and implements operations such as, AND, OR, NOT, Timers, Counters, and Latches.



Motor Connector — A common motor connector is used for ArmorStart 281E and 284E motor controllers when the RRG gland is selected. It is available as a single-ended, double-ended, shielded, or non-shielded cable assembly that meets UL 2237 for distributed three-phase power for machinery applications. The motor brake cable must be purchased separately. See [Accessories](#) for details.

Standard Features for Bulletin 284E (with RRG Gland):

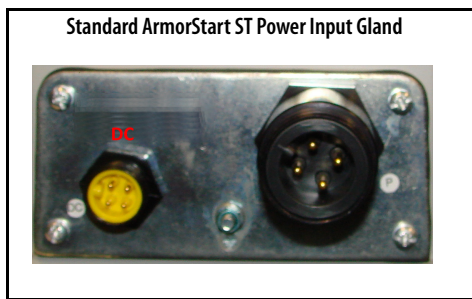
Electro Magnetic Interference (EMI) filter — An internal EMI filter is provided for CE compliance. CE requires that a shielded motor cable is used per product specifications.

Electromechanical Brake Connector — An internal mechanical contactor is used to switch an electromechanical motor brake On/Off. The motor brake contactor is powered from two phases of the main power circuit that is referred to as the Source Brake. The configuration of the R1 relay controls the operation of the brake. A customer accessible 2.5 A fuse is provided to protect the brake cable. The motor brake cable or sealing cap must be purchased separately. See [Accessories](#) for details.

Dynamic Brake Connector — The dynamic brake feature is used when decelerating high inertia loads that can cause over bus voltage faults. This feature is exclusively used with the IP67 Dynamic Brake Resistor. See [Accessories](#) for additional details regarding the IP67 Dynamic Brake Resistor or sealing cap.

Hardware Machine Stop (Category 0 Stop Function) Category 4 PLe

ArmorStart 281E and 284E motor controllers with Safety achieve hardware machine stop of Category 4 functionality by using redundant internal contactors. The 1732ES-IB12XOBV2 (two bipolar outputs) or 1732ES-IB8XOBV4 (four bipolar outputs) safety I/O module is used to achieve PLe performance. The 1732ES monitors [S0] and controls [S1] the internal contactors. See [Accessories](#) for safety I/O block section details.



ArmorConnect 3-Phase Power Media

ArmorConnect® power media offers both three-phase and control power cable systems of cordsets, patchcords, receptacles, tees, reducers and accessories, to be used with the ArmorStart distributed motor controller. These cable system components allow quick connection of ArmorStart distributed motor controllers, which reduces installation time. They allow for repeatable, consistent connection of the three-phase and control power to the ArmorStart distributed motor controller and motor. They provide a plug and play environment that also helps to avoid mis-wiring of the system. See [Accessories](#) for additional details.



Through-panel receptacles



Trunk cable assemblies



Tee, reducer adapter, and field attachable connector

Auxiliary Power Media

Auxiliary power media offers a mini style quick disconnect cable that provides a secure connection to the ArmorStart ST motor controller. The auxiliary power media components are based on a 4-pin, mini connector to avoid mis-wires. The connectors can be straight or right angled and are physically keyed to avoid wiring mishaps. See [Accessories](#) for additional details.



Through-panel receptacles



4-pin mini auxiliary power cables



Tees

I/O and Network Media

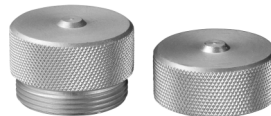
Connection Devices include Network Media for Ethernet, Input and Output devices, and Safety Connection Systems. Rockwell Automation offers many product solutions in cordsets, patchcords, V- and Y-cables, splitters, field-attachable connectors, and receptacles. See [Accessories](#) for additional details.



I/O cordset and patchcord



Ethernet cordset and patchcord



Sealing caps

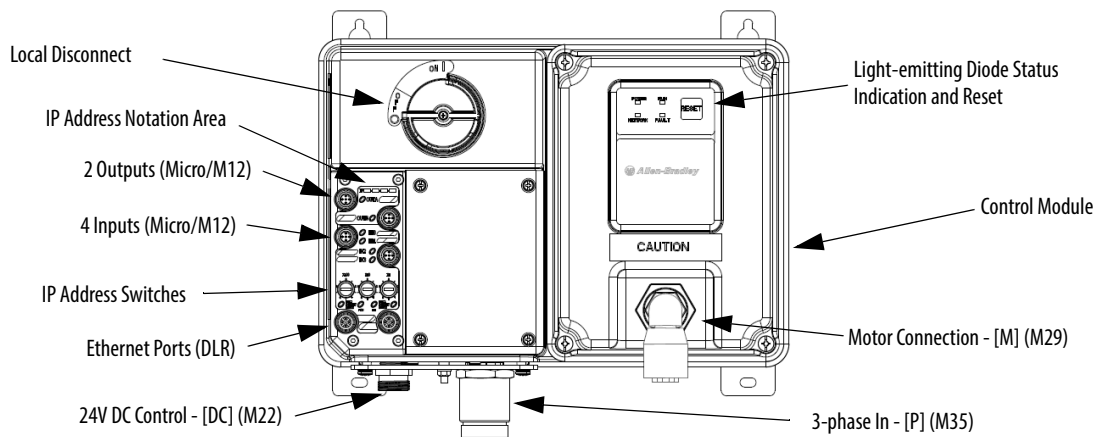
Notes:

Bulletin 281E ArmorStart ST Distributed Motor Controller with RRG Gland

Full-voltage Reversing Standard Starter

The ArmorStart catalog number 281E-...Z-RRG is the standard version motor controller and is used in applications that require across-the-line starting. It has full in-rush current and locked-rotor torque.

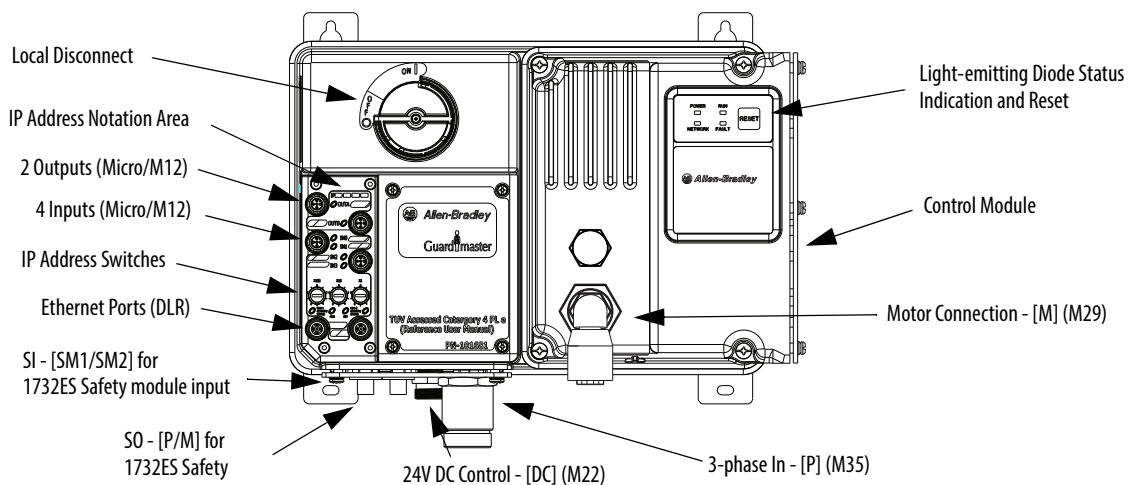
Standard Version



Hardware Machine Off Safety Starter (Category 0 Stop)

The ArmorStart catalog number 281E...S-RRG is the safety version motor controller and is used in applications that require across-the-line starting and is also key to the overall machine safety compliance based on the risk assessment. This safety system solution can achieve a maximum of Category 4 PLe Safety.

Safety Version



Features

On-Machine™ motor starting solution from 0.5...10 Hp (0.37...7.5 kW). Includes:

- Native dual-port Ethernet switch and supports DLR over EtherNet/IP
- Four digital inputs and two digital outputs
- IP67/Type 4/12 enclosure rating
- Quick disconnect connections for I/O, communications, motor, three-phase, and control power.
- ArmorConnect power media is the only UL recommended solution
- Comprehensive local light-emitting diode status indication
- Local logic technology using DeviceLogix
- TÜV certified Category 4 PLe Safety performance

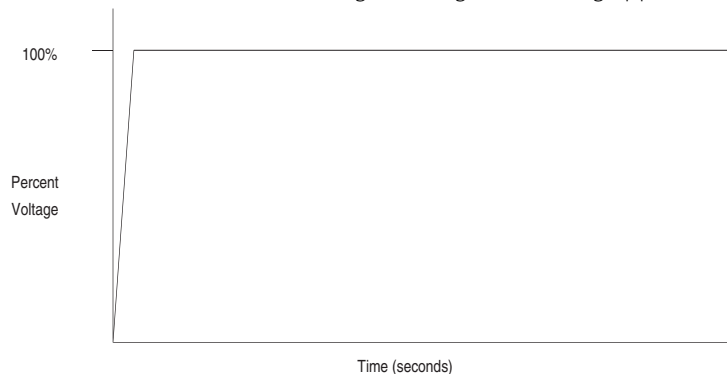
Standards Compliance and Certifications

• UL 508	• EN/IEC 60947-4-1	• CCC
• CSA C22.2, No. 14	• CE Marked per Low Voltage 2006/95/EC	• ODVA for EtherNet/IP
• EN/IEC 60947-4	• EMC Directive 2004/108/EC	• TÜV

Mode of Operation

Full-voltage Start

This method is used in applications that require across-the-line starting. It has full in-rush current and locked-rotor torque. The ArmorStart Bulletin 281E motor controller offers full-voltage starting for reversing applications.



Overload Protection

The Bulletin 281E ArmorStart distributed motor controller incorporates, as standard, electronic motor overload protection. This overload protection is accomplished electronically with an I^2t algorithm. The overload protection is programmable via the communication network providing you with flexibility. The overload trip class can be selected for class 10, 15, or 20 protection. Ambient insensitivity is inherent in the electronic design of the overload.

Fault Diagnostics

Fault diagnostics capabilities that are built into the Bulletin 281E ArmorStart Distributed Motor Controller:

• Short Circuit	• Control Power Fuse Detection	• Phase Imbalance
• Overload	• I/O Fault	• EEPROM Fault
• Phase Loss	• Output Power Fuse Detection	• Hardware Fault
• Control Power Loss	• Overtemperature	

Catalog Number Explanation

Examples that are 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.

281
E - F
12
Z - 10
C - RRG

a
b
c
d
e
f
g
h

a

Bulletin Number	
Code	Description
281	Reversing Starter

b

Code	Description
E	EtherNet/IP

c

Enclosure Type	
Code	Description
F	IP67/Type 4/12

d

Contactor Size	
12	
23	

e

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

f

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

g

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

h

Control and 3-Phase Power Connections/Motor Cable Connection			
Code	Description		
	Control Power	3-Phase Power	Motor Cable
RRG	Round Media (Male Receptacle)	Round Media (Male Receptacle)	Round Media (Female Receptacle)

Cables are sold separately.

Product Selection Tables

EtherNet/IP Network Communication

Standard Reversing Starters — IP67/Type 4/12 with ArmorConnect power media connections, Up to 480V AC

Current Rating [A]	kW		Hp			24V DC Control Voltage
	230V AC, 50 Hz	400V AC, 50 Hz	200V AC, 60 Hz	230V AC, 60 Hz	480V AC, 60 Hz	Cat. No.
0.24...1.2	0.18	0.37	—	—	0.5	281E-F12Z-10A-RRG
0.5...2.5	0.37	0.75	0.5	0.5	1	281E-F12Z-10B-RRG
1.1...5.5	1.1	2.2	1	1	3	281E-F12Z-10C-RRG
3.2...16	4	7.5	3	5	10	281E-F23Z-25D-RRG

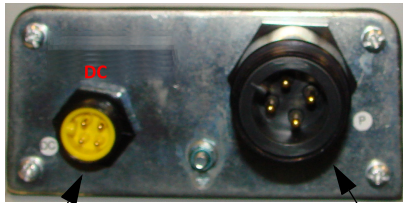
Safety Reversing Starters — IP67/Type 4/12 with ArmorConnect power media connections, Up to 480V AC

Current Rating [A]	kW		Hp			24V DC Control Voltage
	230V AC, 50 Hz	400V AC, 50 Hz	200V AC, 60 Hz	230V AC, 60 Hz	480V AC, 60 Hz	Cat. No.
0.24...1.2	0.18	0.37	—	—	0.5	281E-F12S-10A-RRG
0.5...2.5	0.37	0.75	0.5	0.5	1	281E-F12S-10B-RRG
1.1...5.5	1.1	2.2	1	1	3	281E-F12S-10C-RRG
3.2...16	4	7.5	3	5	10	281E-F23S-25D-RRG

Connections

ArmorConnect Receptacles

Standard Version



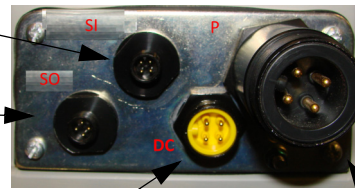
24V DC Control Power Receptacle

Three-phase Power Receptacle

Safety Version

Safety Monitor (SM1, SM2) Input to 1732S Safety I/O Module Input

Safety Contactor Control - 24V DC
1732S Safety Output to ArmorStart
Contactor Control (P&M)



24V DC Control Power Receptacle

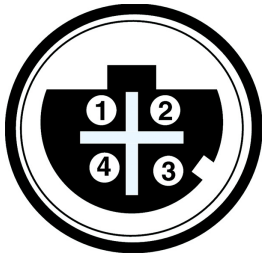
Three-phase Power Receptacle

Receptacle Pinouts

Note: Pinouts are based on view into the connector.

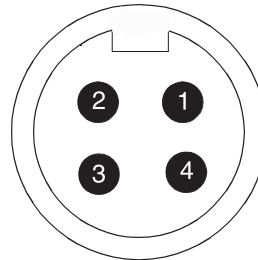
The ArmorStart ST motor controller uses a sealed D-coded M12 (micro) style Ethernet connector.

EtherNet/IP Connector (M12) - Female



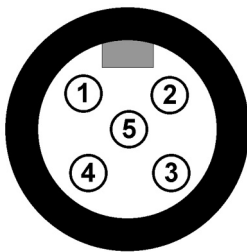
Pin 1 - TxData+ (white/orange)
 Pin 2 - RecV Data+ (white/green)
 Pin 3 - TxData- (orange)
 Pin 4 - RecV Data- (green)

Safety Output Power (P/M) - Male



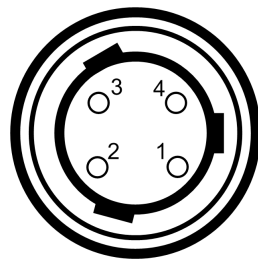
Pin 1 - NC (no connection) (brown)
 Pin 2 - M (white)
 Pin 3 - NC (no connection) (blue)
 Pin 4 - P (black)

I/O Receptacle Input Pinout (M12) - Female



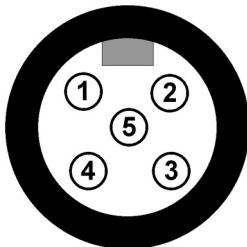
Pin 1 - +24V (A3 pwr)
 Pin 2 - Input 1
 Pin 3 - Common
 Pin 4 - Input 2
 Pin 5 - NC (no connection)

Motor Connector Pinout (M29) - Female



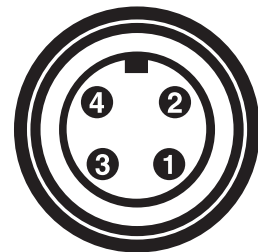
Pin 1 - T1 (black)
 Pin 2 - T2 (white)
 Pin 3 - T3 (red)
 Pin 4 - Ground (green/yellow)

I/O Receptacle Output Pinout (M12) - Female



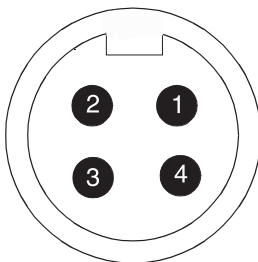
Pin 1 - NC (no connection)
 Pin 2 - NC (no connection)
 Pin 3 - Common
 Pin 4 - Output +24V DC (A1 pwr)
 Pin 5 - NC (no connection)

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



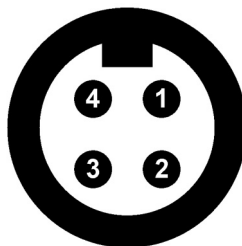
Pin 1 - 24V DC switched (brown)
 Pin 2 - 24V DC unswitched (white)
 Pin 3 - Common unswitched (blue)
 Pin 4 - Common switched (blue)

Safety Monitor (SM1/SM2) - Male



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

Incoming Three-phase Power (M35) - Male



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

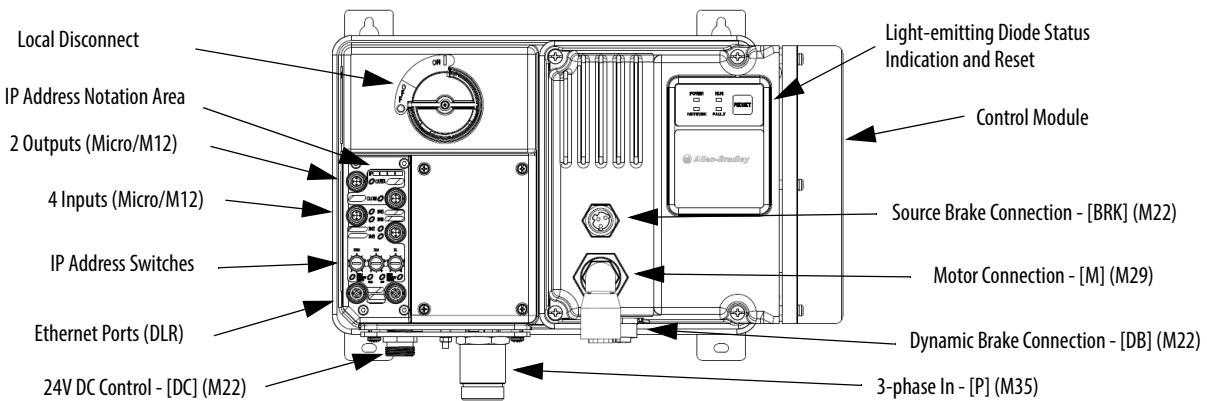
Notes:

Bulletin 284E ArmorStart ST Distributed Motor Controller with RRG Gland

Standard Variable Frequency Drive, Sensorless Vector Control Performance (SVC) Starter

The ArmorStart catalog number 284E-...Z-RRG... is the standard version motor controller and is used in applications that require regulated speed control of AC Motors. Variable speed and control are accomplished through selectable V/Hz or SVC control.

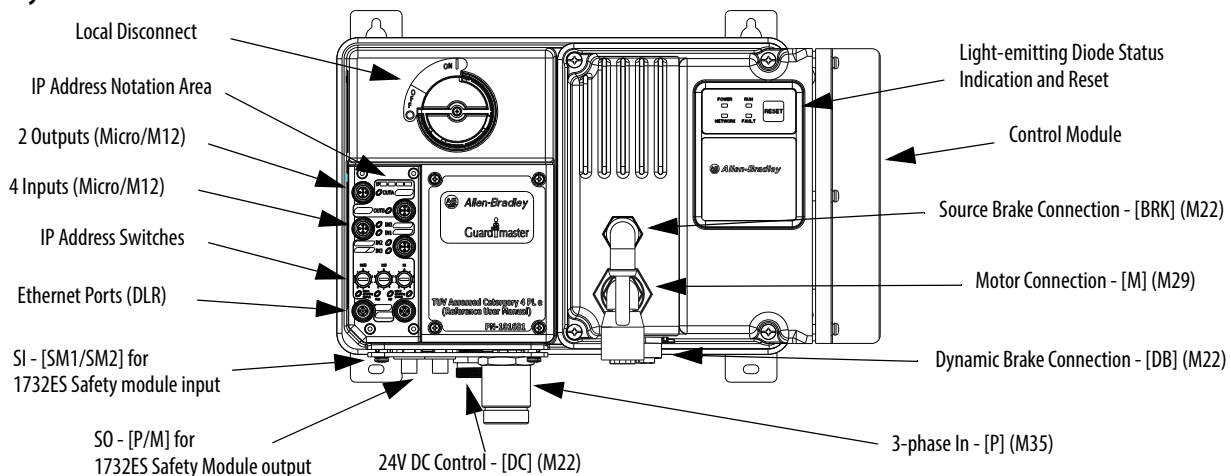
Standard Version



Hardware Machine Off Safety VFD Starter

The ArmorStart catalog number 284E-...S-RRG... is the safety version motor controller and used in applications that require regulated speed control of AC Motors. Variable speed and control are accomplished through selectable V/Hz or SVC control. This is key to the overall machine safety compliance based on the risk assessment. This safety system solution can achieve a maximum of Category 4 PLe Safety.

Safety Version



Features

On-Machine motor starting solution from 1...5 Hp (0.75...3.0 kW). Includes:

- Variable frequency AC drive using PowerFlex® Technology
- Native dual-port Ethernet switch and supports DLR over EtherNet/IP
- Four digital inputs and two digital outputs
- IP67/Type 4/12 enclosure rating
- Quick disconnect connections for I/O, communications, motor, three-phase, and control power.
- ArmorConnect power media is the only UL recommended solution for distribution of 3-phase power.
- Comprehensive local light-emitting diode status indication
- Local logic technology using DeviceLogix
- TÜV certified Category 4 PLc Safety performance
- Electromechanical Source Motor Brake Connector
- Dynamic Brake Connector (IP67 Resistor sold separately)
- Internal EMI Filter

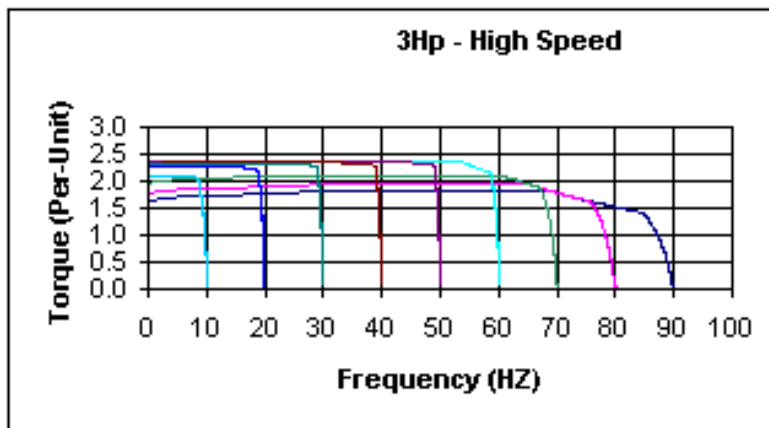
Standards Compliance and Certifications

• UL 508	• EN 61800-3	• EMC Directive 2004/108/EC
• CSA C22.2, No. 14	• EN/IEC 60947-4-2	• ODVA for EtherNet/IP
• EN 50178	• CE Marked per Low Voltage 2006/95/EC	• TÜV

Mode of Operation

Sensorless Vector Control (SVC)

This method provides exceptional speed regulation and high levels of torque across the entire speed range of the drive.



- The Autotune feature allows the Bulletin 284E SVC to adapt to individual motor characteristics.
- Develops high torque over a wide speed range and adapts to individual motor characteristics.

Overload Protection

The Bulletin 284E ArmorStart distributed motor controller incorporates a standard electronic motor overload protection. This overload protection is accomplished electronically with an I^2t algorithm. The overload protection is programmable via the communication network providing you with flexibility. The overload trip class allows for class 10 overload protection. Ambient insensitivity is inherent in the electronic design of the overload.

Fault Diagnostics

Fault diagnostics capabilities that are built into the Bulletin 284E ArmorStart Distributed Motor Controller:

• Short Circuit	• Control Power Loss	• Output Fuse Protection	• Hardware Fault
• Overload	• Control Power Fuse Detection	• Brake Fuse Protection	• Restart Retries
• Phase Short	• I/O Fault	• Internal Communication Fault	• Miscellaneous Fault
• Ground Fault	• Overcurrent	• DC Bus Fault	
• Stall	• Overtemperature	• EEPROM Fault	

Catalog Number Explanation

Examples that are 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.

284 E – F V D2P3 Z – 10 – RRG – SBG – DB1 – EMI

a b c d e f g h i j

a

Bulletin Number	
Code	Description
284	VFD Starter

d

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

f

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

i

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

b

Communications	
Code	Description
E	EtherNet/IP

e

Output Current	
380...480V	
Code	Description
D2P3	2.3 A, 0.75 kW, 1.0 Hp
D4P0	4.0 A, 1.5 kW, 2.0 Hp
D6P0	6.0 A, 2.2 kW, 3.0 Hp
D7P6	7.6 A, 3.3 kW, 5.0 Hp

g

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

j

Filter	
Code	Description
EMI	EMI Filter

c

Enclosure Type	
Code	Description
F	IP67/Type 4/12

h

Control and 3-Phase Power Connections / Motor Cable Connection			
Code	Description		
	Control Power	3-Phase Power	Motor Cable
RRG	Round Media (Male Receptacle)	Round Media (Male Receptacle)	Round Media (Female Receptacle)

Cables are sold separately.

Product Selection Tables

EtherNet/IP Network Communication

Standard VFD Starters — IP67/Type 4/12 with ArmorConnect power media connections, Up to 480V AC

Input Voltage	Output Current [A]	kW	Hp	Cat. No.
380...480V, 50/60 Hz	2.3	0.75	1	284E-FVD2P3Z-10-RRG-SBG-DB1-EMI
	4	1.5	2	284E-FVD4P0Z-10-RRG-SBG-DB1-EMI
	6	2.2	3	284E-FVD6P0Z-25-RRG-SBG-DB1-EMI
	7.6	3	5	284E-FVD7P6Z-25-RRG-SBG-DB1-EMI

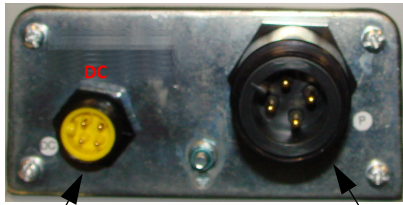
Safety VFD Starters — IP67/Type 4/12 with ArmorConnect power media connections, Up to 480V AC

Input Voltage	Output Current [A]	kW	Hp	Cat. No.
380...480V, 50/60 Hz	2.3	0.75	1	284E-FVD2P3S-10-RRG-SBG-DB1-EMI
	4	1.5	2	284E-FVD4P0S-10-RRG-SBG-DB1-EMI
	6	2.2	3	284E-FVD6P0S-25-RRG-SBG-DB1-EMI
	7.6	3	5	284E-FVD7P6S-25-RRG-SBG-DB1-EMI

Connections

ArmorConnect Receptacles

Standard Version



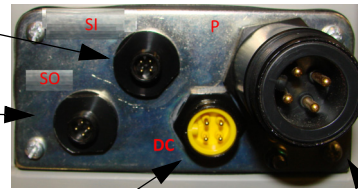
24V DC Control Power Receptacle

Three-phase Power Receptacle

Safety Version

Safety Monitor (SM1, SM2) Input to
1732S Safety I/O Module Input

Safety Contactor Control - 24V DC
1732S Safety Output to ArmorStart
Contactor Control (P&M)



24V DC Control Power Receptacle

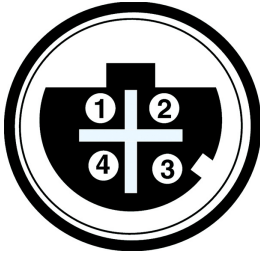
Three-phase Power Receptacle

Receptacle Pinouts

Note: Pinouts are based on view into the connector.

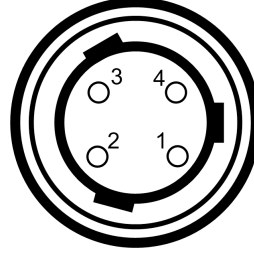
The ArmorStart ST motor controller uses a sealed D-coded M12 (micro) style Ethernet connector.

EtherNet/IP Connector (M12) - Female



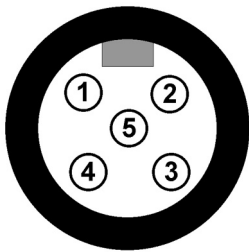
- Pin 1 - TxData+ (white/orange)
- Pin 2 - RecV Data+ (white/green)
- Pin 3 - TxData- (orange)
- Pin 4 - RecV Data- (green)

Motor Connector Pinout (M29) - Female



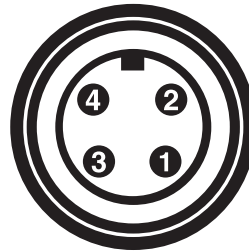
- Pin 1 - T1 (black)
- Pin 2 - T2 (white)
- Pin 3 - T3 (red)
- Pin 4 - Ground (green/yellow)

I/O Receptacle Input Pinout (M12) - Female



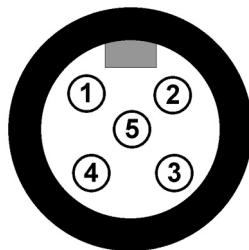
- Pin 1 - +24V (A3 pwr)
- Pin 2 - Input 1
- Pin 3 - Common
- Pin 4 - Input 2
- Pin 5 - NC (no connection)

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



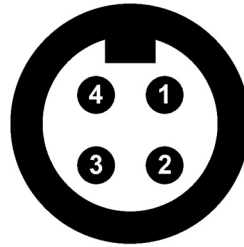
- Pin 1 - 24V DC switched (brown)
- Pin 2 - 24V DC unswitched (white)
- Pin 3 - Common unswitched (blue)
- Pin 4 - Common switched (blue)

I/O Receptacle Output Pinout (M12) - Female



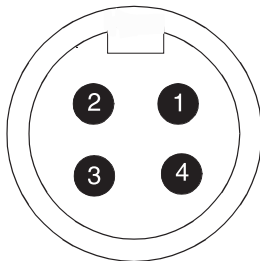
- Pin 1 - NC (no connection)
- Pin 2 - NC (no connection)
- Pin 3 - Common
- Pin 4 - Output +24V DC (A1 pwr)
- Pin 5 - NC (no connection)

Incoming Three-phase Power (M35) - Male



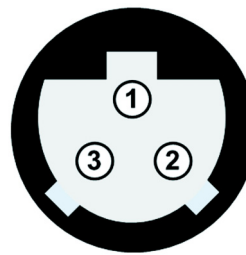
- Pin 1 - L1 (black)
- Pin 2 - Ground (green/yellow)
- Pin 3 - L3 (red)
- Pin 4 - L2 (white)

Safety Monitor (SM1/SM2) - Male



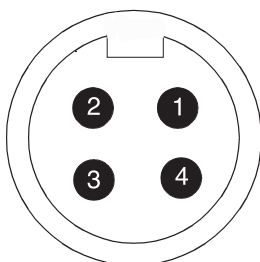
- Pin 1 - SM1 (brown)
- Pin 2 - SM2 (white)
- Pin 3 - NC (no connection) (blue)
- Pin 4 - NC (no connection) (black)

EM Brake Contactor Connector (M22) - Female



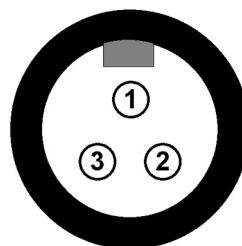
- Pin 1 - Ground (green/yellow)
- Pin 2 - B1 (black)
- Pin 3 - B2 (white)

Safety Output Power (P/M) - Male



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

Dynamic Brake Connection (M22) - Female



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

Safety Information and TÜV Requirements


ArmorStart Safety-related Parts

Each ArmorStart Safety distributed motor controller is intended to be combined with the catalog number 1732ES-IB12XOBV2 or 1732ES-IB8XOBV4 safety I/O module to form a subsystem that is part of the overall machine stop function. The motor controllers are connected to the safety I/O module through specified cable assemblies. The combination of one of these controllers, the safety module, and the specified interconnecting cables are referred to as the ArmorStart safety-related parts. The catalog numbers and specific combinations for these safety-related components are shown in the following tables. The safety I/O module and PLC program must be configured appropriately to meet TÜV CAT4 PLe certification. See Publication [280ES-UM001](#), ArmorStart ST Motor Controller User Manual, for details.

Safety-related Parts



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

ArmorBlock Guard I/O Modules

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

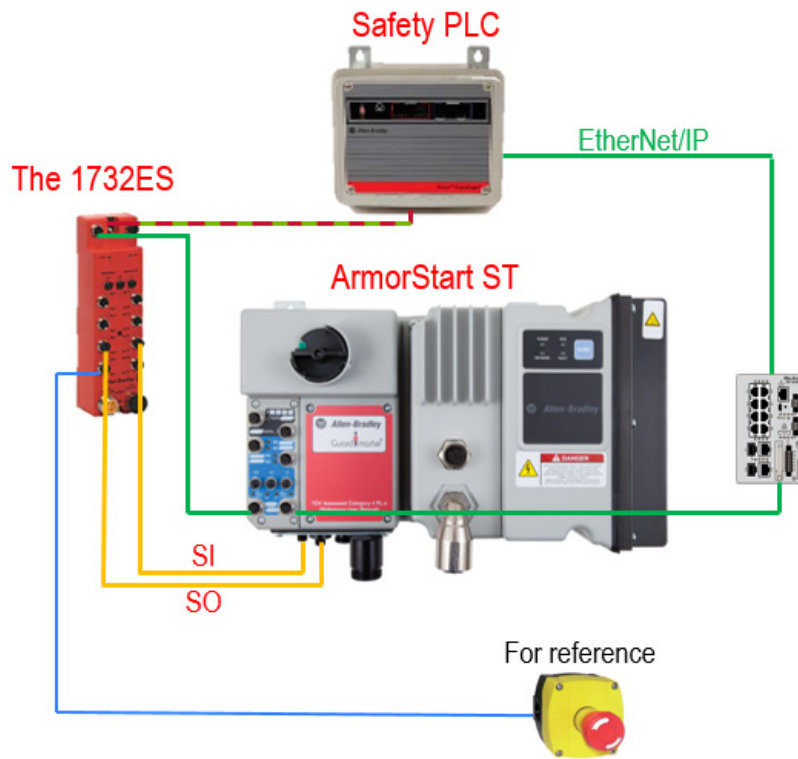
ArmorBlock Guard I/O Recommended Cables and Connectors

Micro Cables

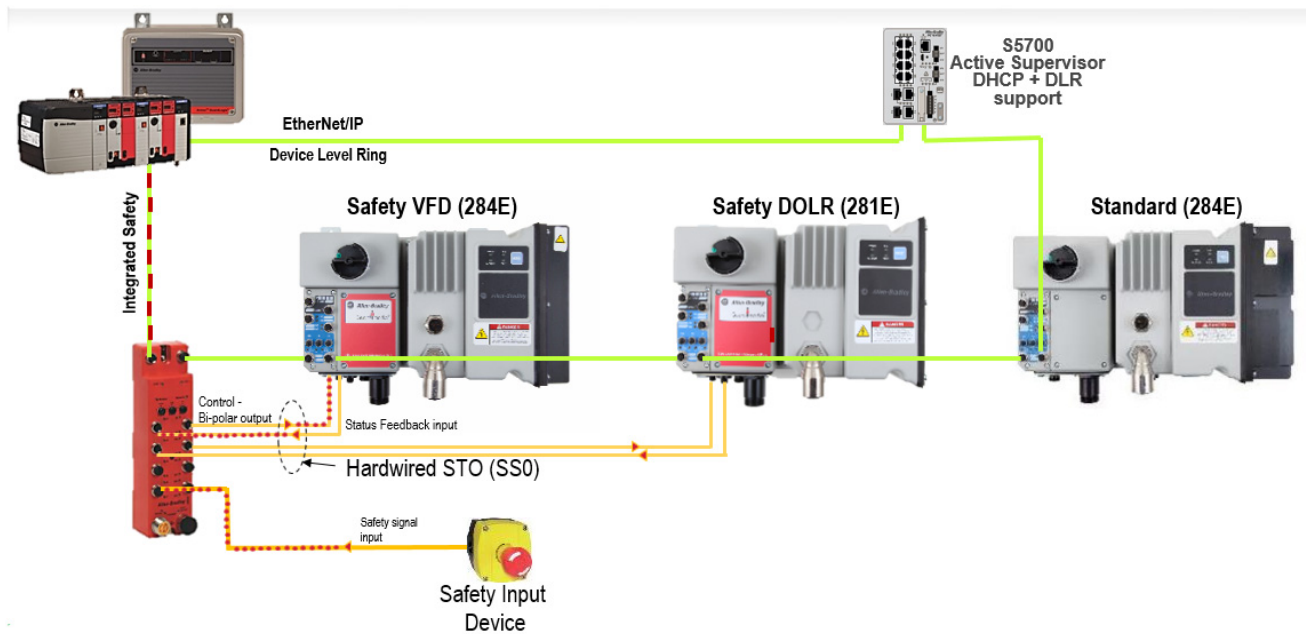
	Description	Cat. No.
	DC Micro (M12) Male Cordset	889D-F4HJ-(1)
	DC Micro Style Patchcord	889D-F4HJDM-(1)

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

Example of Safety System Connections Required

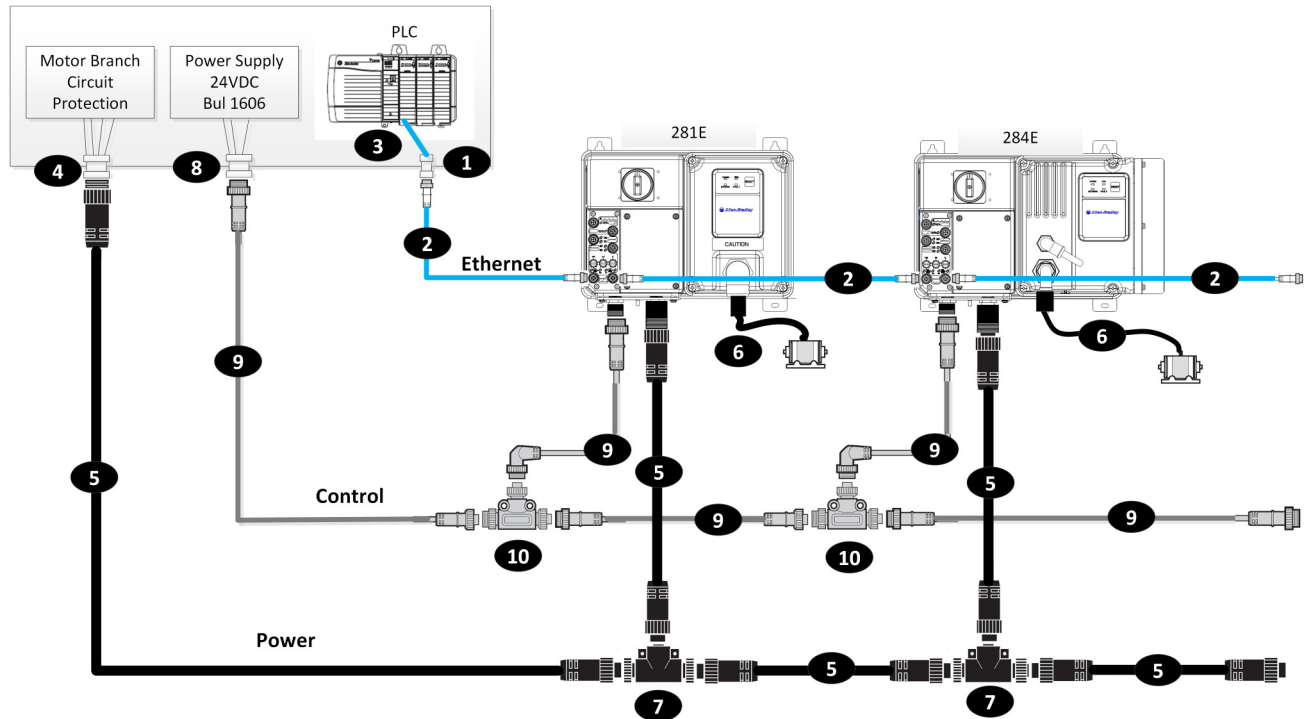


System View Example



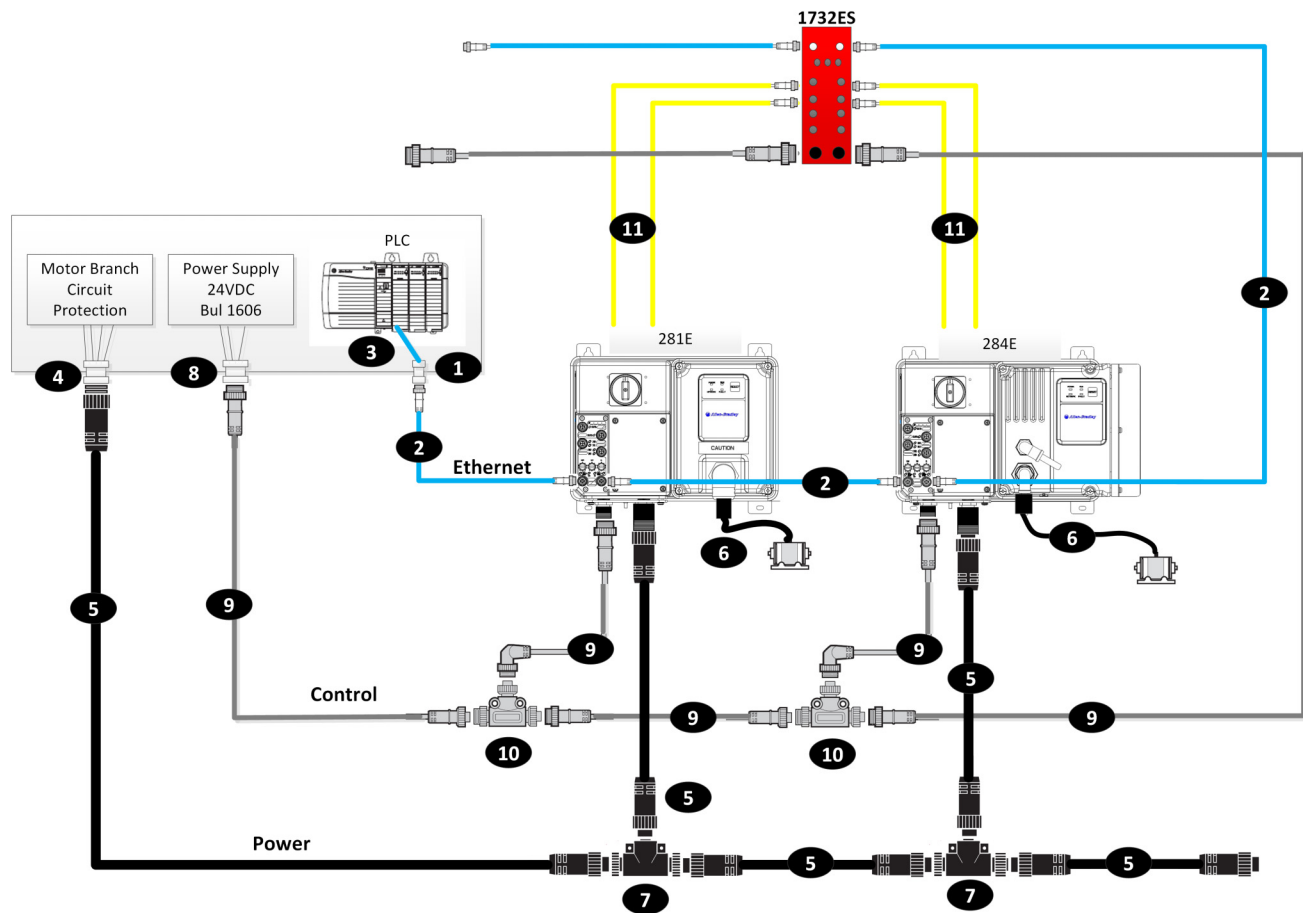
Power Media, Network, and I/O Connections

Standard Version Connector and Cable Requirement Overview



- ① CAT5e Bulkhead Connector and Receptacle – Example **Cat.No. 1585A-DD4JD**
- ② CAT5e Patchcord, 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 Three-phase Power Receptacles - Female receptacles are a panel mount connector with flying leads – Example **Cat. No. 280-M35F-M1**
- ⑤ Three-phase Power Trunk- Patchcord cable with integral female or male connector on each end – Example **Cat. No. 280-PWR35A-M***
- ⑥ Three-Phase Motor Cable – Example **Cat. Nos. 284-PWRM29A-M3 or 280-PWRM29A-M3**
- ⑦ Three-phase Power Tee connects to a single M35 drop line to trunk connectors – **Cat. No. 280-T35**
- ⑧ Control Power Receptacles - Female receptacles are a panel mount connector with flying leads – **Cat. No. 888N-D4AF1-1F**
- ⑨ Control/Auxiliary Power Media Patchcords – Patchcord cable with integral female or male connector on each end – Example **Cat. No. 889N-F4AFNM-***
- ⑩ Control/Auxiliary Power Tees - The Tee is used with cordset or patchcord to connect several ArmorStart ST controllers to the same control power source.– Example **Cat. No. 898N-43PB-N4KT**





Safety Version Connector and Cable Requirement Overview



- ❶ CAT5e Bulkhead Connector and Receptacle – Example **Cat.No. 1585A-DD4JD**
- ❷ CAT5e Patchcord, IP67, M12 D-Code, Male Straight, Male Right Angle – Example **Cat.No. 1585D-M4TBDE-***
- ❸ CAT5e, Patch Cable, IP20, RJ45 Male to RJ45 Male – Example **Cat.No. 1585J-M4TB-***
- ❹ Three-phase Power Receptacles - Female receptacles are a panel mount connector with flying leads – Example **Cat. No. 280-M35F-M1**
- ❺ Three-phase Power Trunk- Patchcord cable with integral female or male connector on each end – Example **Cat. No. 280-PWR35A-M***
- ❻ Three-Phase Motor Cable – Example **Cat. Nos. 284-PWRM29A-M3 or 280-PWRM29A-M3**
- ❼ Three-phase Power Tee connects to a single M35 drop line to trunk connectors – **Cat. No. 280-T35**
- ❽ Control Power Receptacles - Female receptacles are a panel mount connector with flying leads – **Cat. No. 888N-D4AF1-1F**
- ❾ Control/Auxiliary Power Media Patchcords – Patchcord cable with integral female or male connector on each end – Example **Cat. No. 889N-F4AFNM-***
- ❿ Control/Auxiliary Power Tees - The Tee is used with cordset or patchcord to connect several ArmorStart ST controllers to the same control power source.– Example **Cat. No. 898N-43PB-N4KT**
- ⓫ Patch cable between Safety I/O module input and ArmorStart connector labeled "SM" and "P/M". This cable provides status and control feedback to the safety system. – Example **Cat. No. 889D-F4AEDM-***

Industrial Ethernet Media



D Code Connectivity (M12) – 1585D

IP67 Patchcords and Cordsets		
M12 D Code	Connector Type	Cat. No. Unshielded
	Male Straight to Male Straight	1585D-M4TBDM ⁽¹⁾
	Male Straight to Male Right Angle	1585D-M4TBDE ⁽¹⁾
	Male Right Angle to Male Right Angle	1585D-E4TBDE ⁽¹⁾
	Male Straight to Female Straight	1585D-M4TBDF ⁽¹⁾

(1) Available in 0.3, 0.6, 1, 2, 5, 10, 15, and increments of 5 meters up to 75 meters.

Note: See www.ab.com/networks/media/ethernet to learn more about Industrial Ethernet Media.



Sensor Media

Description	Description	I/O Connection	Pin Count	Connector	Cat. No.
	DC Micro Patchcord	Input/Output	4-Pin	Straight Female Straight Male	889D-F4ACDM- ⁽¹⁾
				Straight Female Right Angle Male	889D-F4ACDE- ⁽¹⁾
	DC Micro V-Cable	Input		Straight Female	879D-F4ACDM- ⁽¹⁾
				Right Angle Female	879D-R4ACM- ⁽¹⁾

(1) Replace symbol with desired length in meters (for example, **Cat. No. 889D-F4ACDM-1** for a 1 m cable). Standard cable lengths: 1 m, 2 m, 5 m, and 10 m.


Safety I/O Cables and Connectors

Micro Cables

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

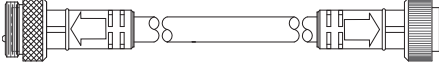
(1) Replace symbol with 1 (1 m [3.3 ft]), 2 (2 m [6.6 ft]), 5 (5 m [16.4 ft]), or 10 (10 m [32.8 ft]) for standard cable length.

Motor and Brake Cables

Description	Rating	Length m (ft)	Cat. No.
Single-ended, Non-shielded Motor Cable			
			
Non-shielded cordset cable assembly with straight male / flying leads, 29 mm shell, 4 -pin, 12 AWG Conductors	IP67, NEMA 4/12, TC-ER Bending radius not to exceed 10x the cable diameter Cable diameter 0.657 in. +/- 0.12 in. (16.71 mm +/- 0.5 mm) with four 12 AWG conductors	0.5	280-PWRM29G-M05
		1	280-PWRM29G-M1
		1.5	280-PWRM29G-M015
		2	280-PWRM29G-M2
		3	280-PWRM29G-M3
		4	280-PWRM29G-M4
		6	280-PWRM29G-M6
		8	280-PWRM29G-M8
		10	280-PWRM29G-M10
		12	280-PWRM29G-M12
		14	280-PWRM29G-M14
Non-shielded cordset cable assembly with 90 deg male / Flying leads, 29 mm shell, 4 -pin, 12 AWG Conductors ⁽¹⁾	IP67, NEMA 4/12, TC-ER Bending radius not to exceed 10x the cable diameter Cable diameter 0.657 in. +/- 0.12 in. (16.71 mm +/- 0.5 mm) with four 12 AWG conductors	0.5	280-PWRM29H-M05
		1	280-PWRM29H-M1
		1.5	280-PWRM29H-M015
		2	280-PWRM29H-M2
		3	280-PWRM29H-M3
		4	280-PWRM29H-M4
		6	280-PWRM29H-M6
		8	280-PWRM29H-M8
		10	280-PWRM29H-M10
		12	280-PWRM29H-M12
		14	280-PWRM29H-M14

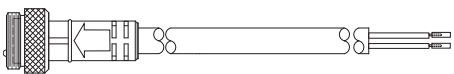
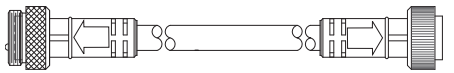
(1) Check for product availability. Contact your local Rockwell Automation sales office or Allen-Bradley distributor.

Motor and Brake Cables (continued)


Description	Rating	Length m (ft)	Cat. No.		
Double-ended, Non-shielded Motor Cable					
					
Non-shielded patch cable assembly with straight male / female receptacle, 29 mm shell, 4 -pin, 12 AWG Conductors	IP67, NEMA 4/12, TC-ER Bending radius not to exceed 10x the cable diameter Cable diameter 0.657 in. +/- 0.12 in. (16.71 mm +/- 0.5 mm) with four 12 AWG conductors	0.5	280-PWRM29A-M05		
		1	280-PWRM29A-M1		
		1.5	280-PWRM29A-M015		
		2	280-PWRM29A-M2		
		3	280-PWRM29A-M3		
		4	280-PWRM29A-M4		
		6	280-PWRM29A-M6		
		8	280-PWRM29A-M8		
		10	280-PWRM29A-M10		
		12	280-PWRM29A-M12		
		14	280-PWRM29A-M14		
		Non-shielded patch cable assembly with 90 deg male / 90 deg female receptacle, 29 mm shell, 4 -pin, 12 AWG Conductors ⁽¹⁾	IP67, NEMA 4/12, TC-ER Bending radius not to exceed 10x the cable diameter Cable diameter 0.657 in. +/- 0.12 in. (16.71 mm +/- 0.5 mm) with four 12 AWG conductors	0.5	280-PWRM29D-M05
				1	280-PWRM29D-M1
				1.5	280-PWRM29D-M015
2	280-PWRM29D-M2				
3	280-PWRM29D-M3				
4	280-PWRM29D-M4				
6	280-PWRM29D-M6				
8	280-PWRM29D-M8				
10	280-PWRM29D-M10				
12	280-PWRM29D-M12				
14	280-PWRM29D-M14				

(1) Check for product availability. Contact your local Rockwell Automation sales office or Allen-Bradley distributor.

Motor and Brake Cables (continued)

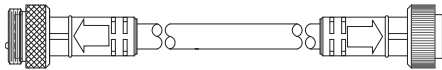
Description	Rating	Length m (ft)	Cat. No.
Single-ended, Shielded Motor Cable			
			
Shielded cordset cable assembly with straight male / flying leads, 29 mm shell, 4 -pin, 12 AWG Conductors	IP67, NEMA 4/12, TC-ER Bending radius not to exceed 10x the cable diameter Cable diameter 0.657 in. +/- 0.12 in. (16.71 mm +/- 0.5 mm) with four 12 AWG conductors	0.5	284-PWRM29G-M05
		1	284-PWRM29G-M1
		1.5	284-PWRM29G-M015
		2	284-PWRM29G-M2
		3	284-PWRM29G-M3
		4	284-PWRM29G-M4
		6	284-PWRM29G-M6
		8	284-PWRM29G-M8
		10	284-PWRM29G-M10
		12	284-PWRM29G-M12
14	284-PWRM29G-M14		
Double-ended, Shielded Motor Cable			
			
Shielded patch cable assembly with straight male / female receptacle with leads, 29 mm shell, 4 -pin, 12 AWG Conductors	IP67, NEMA 4/12, TC-ER Bending radius not to exceed 10x the cable diameter Cable diameter 0.657 in. +/- 0.12 in. (16.71 mm +/- 0.5 mm) with four 12 AWG conductors	0.5	284-PWRM29A-M05
		1	284-PWRM29A-M1
		1.5	284-PWRM29A-M015
		2	284-PWRM29A-M2
		3	284-PWRM29A-M3
		4	284-PWRM29A-M4
		6	284-PWRM29A-M6
		8	284-PWRM29A-M8
		10	284-PWRM29A-M10
		12	284-PWRM29A-M12
14	284-PWRM29A-M14		
Receptacles			
Shielded straight male receptacle with 4 wires, 29 mm shell, 4 -pin, 12 AWG Conductors		0.3	284-M29M-M03
Shielded straight female receptacle with 4 wires, 29 mm shell, 4 -pin, 12 AWG Conductors		0.3	284-M29F-M03

Motor and Brake Cables (continued)

Description	Rating	Length m (ft)	Cat. No.
Single-ended, Non-shielded, Source Brake Cable			
			
Non-shielded cord assembly with straight male receptacle with leads, 22 mm shell, 3 -pin, 16 AWG Conductors		0.5	285-BRC22-M05
		1	285-BRC22-M1
		1.5	285-BRC22-M015
		2	285-BRC22-M2
		3	285-BRC22-M3
		4	285-BRC22-M4
		6	285-BRC22-M6
		8	285-BRC22-M8
		10	285-BRC22-M10
		12	285-BRC22-M12
14	285-BRC22-M14		
Non-shielded cordset cable assembly with 90° male/ Flying leads 22 mm shell, 3 -pin, 16 AWG Conductors ⁽¹⁾		0.5	285-BRC22H-M05
		1	285-BRC22H-M1
		1.5	285-BRC22H-M015
		2	285-BRC22H-M2
		3	285-BRC22H-M3
		4	285-BRC22H-M4
		6	285-BRC22H-M6
		8	285-BRC22H-M8
		10	285-BRC22H-M10
		12	285-BRC22H-M12
14	285-BRC22H-M14		

(1) Check for product availability. Contact your local Rockwell Automation sales office or Allen-Bradley distributor.

Motor and Brake Cables (continued)

Description	Rating	Length m (ft)	Cat. No.
Double-ended, Non-shielded, Source Brake Cable			
			
Non-shielded patch cable assembly with straight male / straight female receptacle with leads, 22 mm shell, 3 -pin, 16 AWG Conductors		0.5	285-BRC22-M05D
		1	285-BRC22-M1D
		1.5	285-BRC22-M015D
		2	285-BRC22-M2D
		3	285-BRC22-M3D
		4	285-BRC22-M4D
		6	285-BRC22-M6D
		8	285-BRC22-M8D
		10	285-BRC22-M10D
		12	285-BRC22-M12D
		14	285-BRC22-M14D
Non-shielded patch cable assembly with 90° male / 90° female receptacle with leads, 22 mm shell, 3 -pin, 16 AWG Conductors		0.5	285-BRC22D-M05
		1	285-BRC22D-M1
		1.5	285-BRC22D-M015
		2	285-BRC22D-M2
		3	285-BRC22D-M3
		4	285-BRC22D-M4
		6	285-BRC22D-M6
		8	285-BRC22D-M8
		10	285-BRC22D-M10
		12	285-BRC22D-M12
	14	285-BRC22D-M14	
Receptacle			
Non-shielded receptacle straight male with flying leads 22 mm shell, 3 -pin, 14 AWG Conductors	IP67/NEMA Type 4 /12	0.5 (1.6)	285-M24M-M05
Non-shielded receptacle straight female with flying leads 22 mm shell, 3 -pin, 14 AWG Conductors	IP67/NEMA Type 4/12	0.25 (0.8)	285-M24F-M025

Three-phase Power

Description ⁽¹⁾	Cat. No.	
Power cable - straight female to straight male	280-PWRM35A-M ⁽²⁾	
Power tee - 3-phase, 4-pole	280-T35	
Power tee - 3-phase, 4-pole, reducing drop (when using ArmorStart EtherNet/IP version 0.5...2 Hp)	280-RT35	
Field-attachable M35 connector - 10 AWG, 600V, 32 A	280-FAM35F (female)	280-FAM35M (male)

(1) UL Listed - UL 2237 (File No. E318496, Guide PVVA)

(2) See Publication [280PWR-SG001](#), ArmorConnect Power and Control Media Selection Guide, for available lengths.

Note: See Publication [280PWR-SG001](#), ArmorConnect Power and Control Media Selection Guide, for additional three-phase media options.

24V DC Auxiliary Power

Description	Cat. No.
Cordset - mini straight female to flying leads	889N-F4AFC ⁽¹⁾
Cordset - mini straight male to flying leads	889N-M4AFC ⁽¹⁾
Patchcord - mini straight male to straight female	889N-F4AFNM ⁽²⁾
Control power tee - 24V DC, 4-pole	898N-43PB-N-4KF
Auxiliary device T-port	898N-43PB-N4KT
ArmorStart auxiliary T-port (ArmorStart adapter tee when using ArmorStart EtherNet/IP version with quick disconnects)	898N-543ES-NKF
Patchcord - 5/6 -pin mini (for use with ArmorStart auxiliary T-port drop) (ArmorStart drop from Tee when using ArmorStart EtherNet/IP version with quick disconnects)	889N-F65 ⁽¹⁾

(1) Replace symbol with 6F (1.8 m [6 ft]), 5 (5 m [16.4 ft]), or 10 (10 m [32.8 ft]) for standard cable length.

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

Note: See <http://ab.rockwellautomation.com/connection-devices/cables-and-cordsets> for additional auxiliary power cable options.

Control Power Tee (898N-43PB-N-4KF) Internal Wiring

Pin Count	Assembly Rating	Wiring Diagram	Cat. No.
4-pin	250V, 4 A, 4-pole		898N-43PB-N4KF

Dynamic Brake Resistors Recommended Dynamic Brake Modules for Option DB1 (IP67 Resistor)

Drive and Motor Size kW	Cat. No. ⁽¹⁾	Resistance $\Omega \pm 5\%$	Continuous Power kW	Max Energy kJ	Max Braking Torque % of Motor	Application Type 1		Application Type 2	
						Braking Torque % of Motor	Duty Cycle %	Braking Torque % of Motor	Duty Cycle %
380...480 Volt AC Input Drives									
0.37 (0.5)	284R-360P500-M ⁽²⁾	360	0.086	17	305%	100%	47%	150%	31%
0.75 (1)	284R-360P500-M ⁽²⁾	360	0.086	17	220%	100%	23%	150%	15%
1.5 (2)	284R-360P500-M ⁽²⁾	360	0.086	17	110%	100%	12%	110%	11%
2.2 (3)	284R-120P1K2-M ⁽²⁾	120	0.26	52	197%	100%	24%	150%	16%
4 (5)	284R-120P1K2-M ⁽²⁾	120	0.26	52	124%	100%	13%	124%	10%

(1) Drive rating and DB part numbers are not interchangeable. Only use specified resistor. Customer is responsible to evaluate if performance meets application requirement.

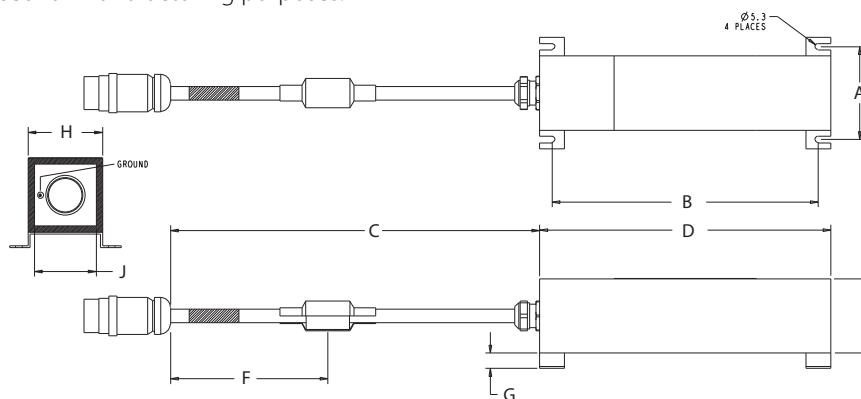
(2) Length is user-selectable based on a suffix added to the catalog number. For a length of 500±10 mm, add **-M05** to the end of the catalog number. For a length of 1000±10 mm, add **-M1** to the end of the catalog number.

Notes: Duty Cycle that is listed, is based on full speed to zero speed deceleration. For constant regen at full speed, duty cycle capability is half of what is listed.

- Application Type 1 represents maximum capability up to 100% braking torque where possible.
- Application Type 2 represents more than 100% braking torque where possible, up to a maximum of 150%.

Bulletin 284 Dynamic Brake Resistor Approximate Dimensions

Dimensions are not intended to be used for manufacturing purposes.

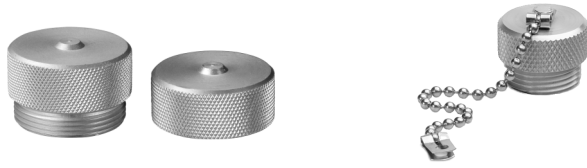


Cat. No.	A mm (in.)	B mm (in.)	C mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)	G mm (in.)	H mm (in.)	J mm (in.)
284R-091P500	89 ± 3 (3.5 ± 0.12)	215 ± 5 (8.46 ± 0.2)	M05 = 0.5 m M1 = 1 m ⁽¹⁾	235 ± 5 (9.25 ± 0.2)	60 ± 2 (2.36 ± 0.08)	127 (5)	12.54 (0.49)	60 ± 2 (2.36 ± 0.08)	50 ± 1.5 (1.97 ± 0.06)
284R-120P1K2		420 ± 5 (16.54 ± 0.2)		440 ± 5 (17.32 ± 0.2)					
284R-120P1K2									

(1) Length is user-selectable based on the suffix added to the catalog number. For a length of 500±10 mm, add **-M05** to the end of the catalog number. For a length of 1000±10 mm, add **-M1** to the end of the catalog number.

Note: The customer must protect the resistor in the event of a shorted switch in the VFD, which is done via PLC control. An example ControlLogix program can be downloaded from <http://samplecode.rockwellautomation.com>


Sealing Caps



Description	Cat. No. EtherNet/IP	
	Input	Output
Plastic Sealing Cap (M12) ⁽¹⁾	1485A-M12	1485A-M12
Aluminum Sealing Cap (M22) ⁽¹⁾	—	1485A-C1
Aluminum Sealing Cap (M35) ⁽¹⁾	—	889A-QMCAP

(1) To achieve IP67 rating, sealing caps must be installed on all unused I/O connections.

Disconnect Accessory

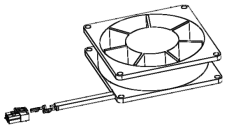
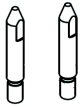
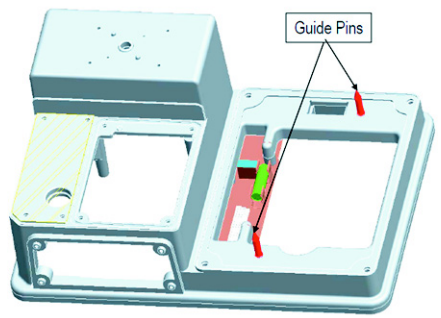
Description	Cat. No.
 <p>Locking Tag Padlock attachment to the lockable handles Up to three padlocks 4...8 mm (5/16 in. diameter) shackle</p>	140M-C-M3

Replacement Parts

Replacement Fuses

Description	Part No.
Output Fuse	
Fast acting, high-interrupting capacity, tubular fuse Rating: 2.5 A, 250V Dimension [mm (in.)]: 20 (0.787) x 5 (0.197)	Littlefuse PN 021602.5
Control Fuse	
UL Listed Class CC, CSA HRC-1 Rating: 7 A, 600V Dimensions [in.]: 1.5 x 0.405	Cooper Bussman PN KTK-R-7 or Littlefuse PN KLKR007.T
Source Brake Fuse (For use with Bulletins 284)	
UL Listed Class CC, CSA HRC-1 Rating: 3 A, 600V Dimensions [in.]: 1.5 x 0.405	Cooper Bussman PN KTK-R-3 or Littlefuse PN KLKR003.T

Fan and Guide Pins

Description		Cat. No.
	Replacement Fan for 284 Control Module	284-FAN
	Replacement Guide Pins (2 pins per package) ⁽¹⁾	284-PIN
		

(1) These pins are replacement parts for factory-installed alignment pins. They cannot be retrofitted in the field.

Bulletin 281E— Standard Version

Full Voltage and Reversing Control Replacement Module

Current Rating [A]	kW		Hp			Cat. No. 24V DC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	
0.24...1.2	0.18	0.37	—	—	0.5	281E-F12Z-NA-RG
0.5...2.5	0.37	0.75	0.5	0.5	1	281E-F12Z-NB-RG
1.1...5.5	1.1	2.2	1	1	3	281E-F12Z-NC-RG
3.2...16	4	7.5	3	5	10	281E-F23Z-ND-RG

Full Voltage and Reversing Base Replacement Module

Current Rating [A]	kW		Hp			Cat. No. 24V DC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	
0.24...1.2	0.18	0.37	—	—	0.5	280E-FN-10-RG
0.5...2.5	0.37	0.75	0.5	0.5	1	280E-FN-10-RG
1.1...5.5	1.1	2.2	1	1	3	280E-FN-10-RG
3.2...16	4	7.5	3	5	10	280E-FN-25-RG

Bulletin 284E — Standard Version

VFD Control Replacement Module

Input Voltage	kW	Hp	Cat. No. 24V DC Control Voltage
380...480V 50/60 Hz 3-Phase	0.75	1.0	284E-FVD2P3Z-N-RG-SBG-DB1-EMI
	1.5	2.0	284E-FVD4P0Z-N-RG-SBG-DB1-EMI
	2.2	3.0	284E-FVD6P0Z-N-RG-SBG-DB1-EMI
	3.0	5.0	284E-FVD7P6Z-N-RG-SBG-DB1-EMI

VFD Base Replacement Module

Input Voltage	kW	Hp	Cat. No. 24V DC Control Voltage
380...480V 50/60 Hz 3-Phase	0.75	1.0	280E-FN-10-RG
	1.5	2.0	280E-FN-10-RG
	2.2	3.0	280E-FN-25-RG
	3.0	5.0	280E-FN-25-RG

Bulletin 281E — Safety Version

Full Voltage and Reversing Safety Control Replacement Module

Current Rating [A]	kW		Hp			Cat. No. 24V DC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	
0.24...1.2	0.18	0.37	—	—	0.5	281E-F12S-NA-RG
0.5...2.5	0.37	0.75	0.5	0.5	1	281E-F12S-NB-RG
1.1...5.5	1.1	2.2	1	1	3	281E-F12S-NC-RG
3.2...16	4	7.5	3	5	10	281E-F23S-ND-RG

Full Voltage and Reversing Safety Base Replacement Module

Current Rating [A]	kW		Hp			Cat. No. 24V DC Control Voltage
	230V AC 50 Hz	400V AC 50 Hz	200V AC 60 Hz	230V AC 60 Hz	460V AC 60 Hz	
0.24...1.2	0.18	0.37	—	—	0.5	280E-FNS-10-RG
0.5...2.5	0.37	0.75	0.5	0.5	1	280E-FNS-10-RG
1.1...5.5	1.1	2.2	1	1	3	280E-FNS-10-RG
3.2...16	4	7.5	3	5	10	280E-FNS-25-RG

Bulletin 284E — Safety Version

VFD Safety Control Replacement Module

Input Voltage	kW	Hp	Cat. No. 24V DC Control Voltage
380...480V 50/60 Hz 3-Phase	0.75	1.0	284E-FVD2P3S-N-RG-SBG-DB1-EMI
	1.5	2.0	284E-FVD4P0S-N-RG-SBG-DB1-EMI
	2.2	3.0	284E-FVD6P0S-N-RG-SBG-DB1-EMI
	3.0	5.0	284E-FVD7P6S-N-RG-SBG-DB1-EMI

VFD Safety Base Replacement Module

Input Voltage	kW	Hp	Cat. No. 24V DC Control Voltage
380...480V 50/60 Hz 3-Phase	0.75	1.0	280E-FNS-10-RG
	1.5	2.0	280E-FNS-10-RG
	2.2	3.0	280E-FNS-25-RG
	3.0	5.0	280E-FNS-25-RG

Notes:

Specifications — Bulletin 281E

Electrical Ratings		UL/NEMA		IEC	
Power Circuit	Rated Operation Voltage	200...575V		200...575V	
	Rate Insulation Voltage	600V		600V	
	Rated Impulse Voltage	6 kV		6 kV	
	Dielectric Withstand	2200V AC		2500V AC	
	Operating Frequency	50/60 Hz		50/60 Hz	
	Utilization Category	Not applicable		AC-3	
	Protection Against Shock	Not applicable		IP2X	
	Rated Operating Current Max.	281E_ - ____ -10A-*(1)	1.2 A		
281E_ - ____ -10B-*(1)		2.5 A			
281E_ - ____ -10C-*(1)		5.5 A			
281E_ - ____ -25D-*(1)		16 A			
Control Circuit	Rated Operation Voltage	24V DC (+10%, -15%), SELV or PELV, (A2 should be grounded at voltage source)			
	Rate Insulation Voltage	30V		30V	
	Rated Impulse Voltage	—		1.5 kV	
	Dielectric Withstand	1500V AC		2000V AC	
	Oversoltage Category	—		III	
	Operating Frequency	DC		DC	
Short Circuit Protection	Short Circuit Protection Device (SCPD) Performance Type 1	Short Circuit Protection		480Y/277V	
		10A, 10B, 10C, and 10D	Sym. Amps rms		65 kA
			Max. Fuse ⁽²⁾		30 A
		10A, 10B, 10C, and 10D	Sym. Amps rms		30 kA
Max. Circuit Breaker ⁽³⁾			60 A		

(1) See [Contactor Life Load Curves](#).

(2) Class J, CC, and T fuses only.

(3) Only when used with Cat. No. 140G-H6C3-C60.

		UL/NEMA		IEC	
Environmental	Operating Temperature Range	-20...+40 °C (-4...+104 °F)			
	Storage and Transportation Temperature Range	-25...+85 °C (-13...+185 °F)			
	Altitude ⁽¹⁾	2000 m			
	Humidity	5...95% (on-condensing)			
	Pollution Degree	3			
	Enclosure Ratings	NEMA Type 4/12	IP67		
	Approximate Shipping Weight	10.4 kg (23 lbs)			
Mechanical	Resistance to Shock				
	Operational	15 G			
	Non-Operational	30 G			
	Resistance to Vibration				
	Operational	1 G, 0.15 mm (0.006 in.) Displacement			
	Non-Operational	2.5 G, 0.38 mm (0.015 in.) Displacement			
	Power and Ground Terminals				
	Wire Size	Primary/Secondary Terminal: #16...#10 AWG	Primary/Secondary Terminal: 1.0...4.0 mm ²		
	Tightening Torque	Primary Terminal: 10.8 lb-in. Secondary Terminal: 4.5 lb-in.	Primary Terminal: 1.2 N-m Secondary Terminal: 0.5 N-m		
	Wire Strip Length	0.35 in. (9 mm)			
	Control Terminals				
	Wire Size	#18...#10 AWG	1.0...4.0 mm ²		
	Tightening Torque	6.2 lb-in.	0.7 N-m		
	Wire Strip Length	0.35 in. (9 mm)			
	Disconnect Lock Out	Recommend 8 mm (5/16 in.) lock shackle or hasp. The hasp should not exceed 8 mm (5/16 in.) when closed.			
	Contactor Mechanical Life	Cat. No. 100-	Ops	C12 (AC3)	C23 (AC3)
		280/1__-12*	Mil	13	—
280/1__-23*		Mil	—	13	
Other Rating	EMC Emission Levels				
	Conducted Radio Frequency Emissions	10V rms Communications Cables 10V rms (PE) 150 kHz...80 MHz			
	Radiated Emissions	Class A, Group 1, Equivalent to C2 emissions			
	EMC Immunity Levels				
	Electrostatic Discharge	4 kV contact and 8 kV Air			
	Radio Frequency Electromagnetic Field	10V/m, 80 MHz...1 GHz 3V/m, 1.4 GHz...2 GHz 1V/m, 2.0 GHz...2.7 GHz			
	Fast Transient	2 kV (Power) 2 kV (PE) 1 kV (Communications and Control)			
	Surge Transient	1 kV (12) L-L, 2 kV (2) L-N (Earth)			
	Overload Current Range	280__-___-10A-*	0.24...1.2 A		
		280__-___-10B-*	0.5...2.5 A		
		280__-___-10C-*	1.1...5.5 A		
		280__-___-25D-*	3.2...16 A		
	Trip Classes ⁽²⁾	10, 15, 20			
Trip Rating	120% of Full Load current (FLC) setting				
Number of poles	3				

(1) See [Altitude Derating](#) for derating guide.

(2) See [Motor Overload Trip Curves](#).

	UL/NEMA	IEC
Standards Compliance	UL 508C CSA C22.2, No. 14 EN50178 EN61800-3 EN/IEC 60947-4-2 CE Marked per Low Voltage 2006/95/EC EMC Directive 2004/108/EC ODVA for EtherNet/IP	
Certifications	UL, TÜV	

Control and I/O Power Requirements

	Units	A1/A2 ⁽²⁾	A3/A2 ⁽³⁾	A1/A2 ⁽²⁾	A3/A2 ⁽³⁾	A3/A2 ⁽⁴⁾	
		W/O HOA		W/ HOA			
Control Voltage	Volts	24V DC					
Module Inrush ⁽¹⁾	Amps	0.92	0.30	1.09	0.125	0.295	
Module Steady	Amps	0.06	0.30	0.23	0.125	0.295	
Total Control Power (Pick Up)	Watts	22.08	7.20	26.16	3.00	7.08	
Total Control Power (Running)	Watts	1.44	7.20	5.52	3.00	7.08	
Total Control Power (with Dynamic Brake or Output Contactor option)	Watts	—	—	12	3	8.4	
Total Control Power (with Dynamic Brake and Output Contactor option)	Watts	—	—	15	3	8.4	

- (1) Instantaneous capacitive inrush exists for less than 10 ms, which can exceed 20 A. The power supply must be capable of supporting this amount of instant power demand when multiple units are turned ON simultaneously. If supplies are weaker, it is recommended to apply unswitched power (A3-A2) first and after a 2 . . . 4 second delay, apply switched power.
- (2) Add power requirements for outputs (1 A max.) to A1/A2.
- (3) Add power requirements for inputs (200 mA max.) to A3/A2.
- (4) If A1 power is disconnected.

	UL/NEMA	IEC	
Input Ratings – Sourced from Control Circuit (A3/A2)	Rated Operation Voltage	24V DC	
	Input On-State Voltage Range	10 . . . 26V DC	
	Input On-State Current	3.0 mA @ 10V DC	
		7.2 mA @ 24V DC	
	Input Off-State Voltage Range	0 . . . 5V DC	
	Input Off-State Current	<1.5 mA	
	Maximum Input Frequency Response	200 Hz (DeviceLogix response is greater than 200 Hz. Network response depends on control system network performance.)	
	Input Filter – Software Selectable		
	Off to On	Settable from 0 . . . 64 ms in 1 ms increments	
	On to Off	Settable from 0 . . . 64 ms in 1 ms increments	
	Input Compatibility	Not applicable	IEC 1133 Type 1+
	Number of Inputs	4	
	Sensor Source		
	Voltage Status Only	11 . . . 26.4V DC from unswitched power (A3-A2)	
Current Available	50 mA max. per input, 200 mA for any single point		
SI - SM1 and SM2 (24V DC)	Contact Rating	DC-12 L/R, 1 ms resistive, 6 A	
	Contact Type	IEC 60947-5-1 Annex L - mechanically	
SO - P/M	3 W/0.125 A per contactor (Two safety contactors)		

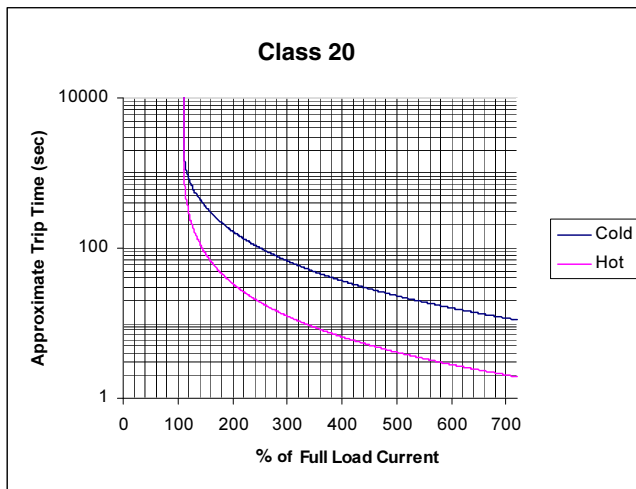
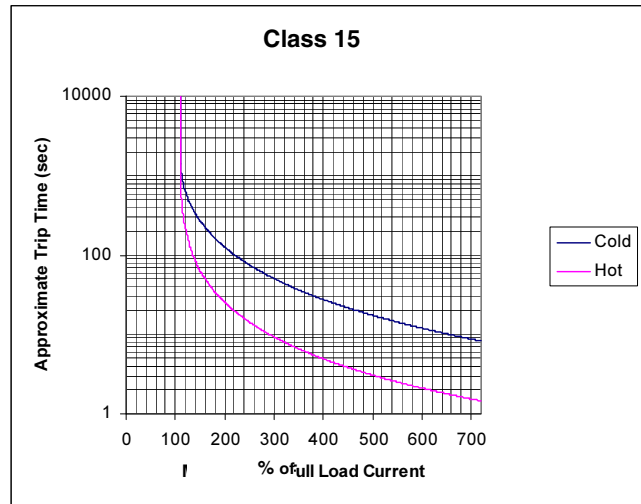
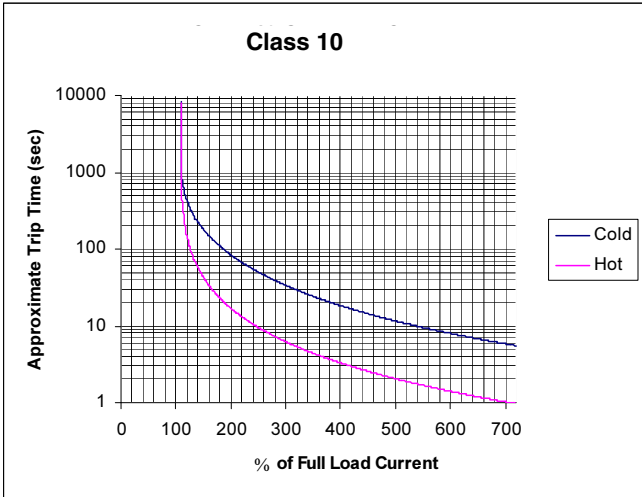
		UL/NEMA	IEC
Output Ratings – Sourced from Control Circuit (A1/A2) (Do not use as a power supply source to other devices)	Rated Operation Voltage	26.4V DC	
	Rate Insulation Voltage	250V	
	Dielectric Withstand	1500V AC (UL)	2000V AC (IEC)
	Operating Frequency	Solid-state sourcing output	
	Type of Current	24V DC	
	Conventional Thermal Current Ith	0.5 A each, 1 A max. combined	
	Peak Output Current	Current limited 2...8 amps (5 amps nominal) @ 24V DC	
	Type of Contacts	Normally open (N.O.)	
	Number of Contacts	2	
	Load Types	Resistive or light inductive	
	Surge Suppression	Integrated diode, clamps @ 35V DC	
	Thermo-Protection	Integrated short circuit and over current protection	
	Maximum Cycle Rate	30 operations/minute capacitive and inductive loads	
	Maximum Blocking Voltage	35V DC	
	Maximum On-State Voltage @ Maximum Output	1.5V DC	
Maximum Off-State Leakage Current	10 µA		
Device Level Ring (DLR)		Beacon-based performance including IEEE 1588 end to end transparent clock	
	Fault Recovery	Ring recovery time is less than 3 ms for a 50 node network	
Ethernet Port	Ethernet Receptacles	2 D-coded, 4-pin female M12 connectors	
	Ports	Embedded switch with 2 ports	
	IP Address	DHCP enabled by default	
	DHCP Timeout	30 s	
	Communication Rate	10/100 Mbps with auto negotiate half-duplex and full-duplex	
	Data	<ul style="list-style-type: none"> Transported over both TCP and UDP Min. of 500 I/O packets/second (pps) Supports up to 150 concurrent TCP sockets 	
Web Server		Embedded web server	
	Security	Login and password configurable	
	Email	Support Simple Mail Transfer Protocol (SMTP)	
	Configuration	Status, diagnostics, and configuration tabs	
Device Connections		Supports scheduled (Class 1) and unscheduled (Class 3 and UCMM) connections	
		6 - Class 3 connections are supported simultaneously	
		Supports up to 2 Class 1 CIP connections [Exclusive owner (data) or listen-only]. One connection per PLC. Listen-only connection requires a data connection to be established.	
		Class 1 Connection API: 2...3200 ms, Class 3 Connection API: 100...10 000 ms	
		20 ms Request Packet Interval (RPI) default	
		3 concurrent Encapsulation sessions	
		TCP port supports 5 concurrent incoming connections	
Component Response Time	1732ES-IB12X0BV2 or 1732ES-IB8X0BV4	See Publication 1732DS-IN001	
	Bulletin 281	20...40 ms	
Probability of Dangerous Failure per Hour and MTTF_d for Uncontrolled Stop⁽¹⁾	MTTF _d	100 years	
	Average probability of dangerous failure per hour	6.0E-9 (1/h)	

(1) ArmorStart safety controller used in combination with ArmorStart safety-related parts.

Motor Overload Trip Curves

Motor overload current parameter provides class 10, 15, and 20 overload protection. Ambient insensitivity is inherent in the electronic design of the overload.

Bulletin 281E Overload Trip Curves



Note: For Bulletin 281E, if an overload fault occurs it can require 60 s or more before a fault reset is allowed. See Overload Class Parameter 107, Thermo-Utilization parameter 105, and OL Reset Level parameter 108 to adjust the reset time.

Note: For Bulletin 281E, when the mechanical motor brake voltage is applied using power from the load side of the ArmorStart controller, this current adds to the load and can result in a phase imbalance or overload if the FLA of the motor and the brake current are similar in scale.

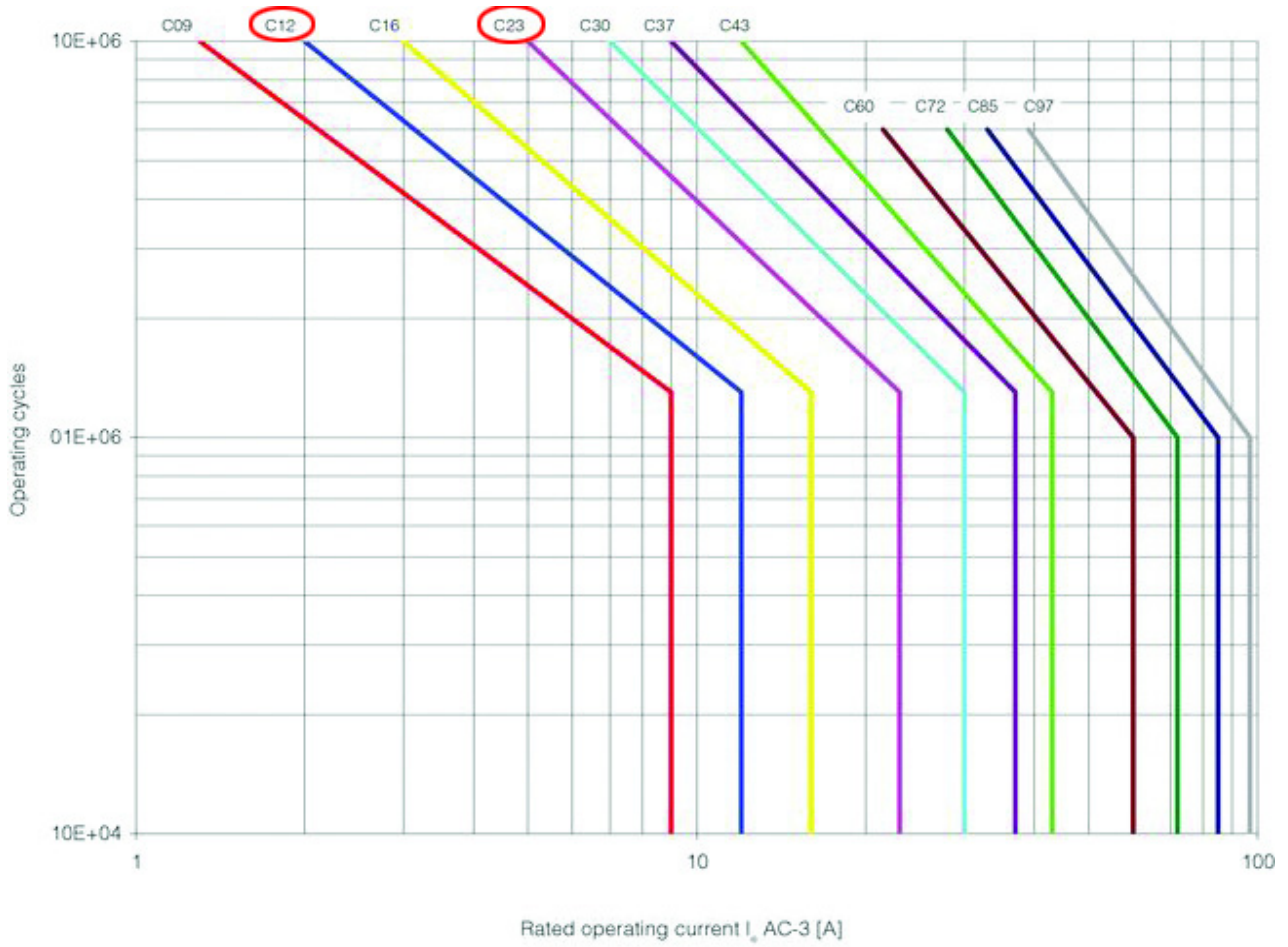
Contactors Life Load Curves

280/1_-_12* = 100-C12*
 280/1_-_23* = 100-C23*

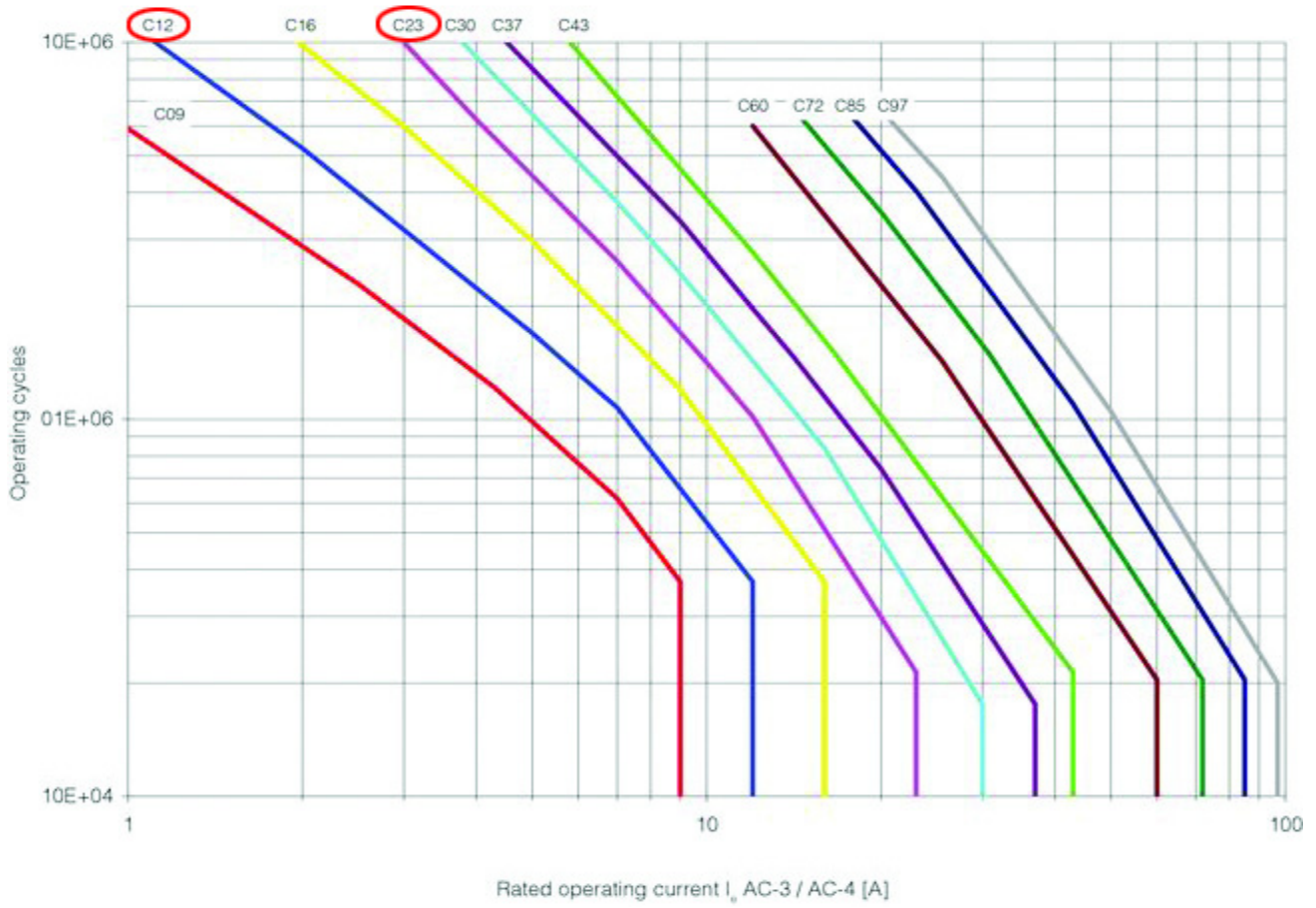
Life Load Curves:

AC-3 Switching of squirrel-cage motors while starting

$U_e = 230 \dots 400 \dots 460V$

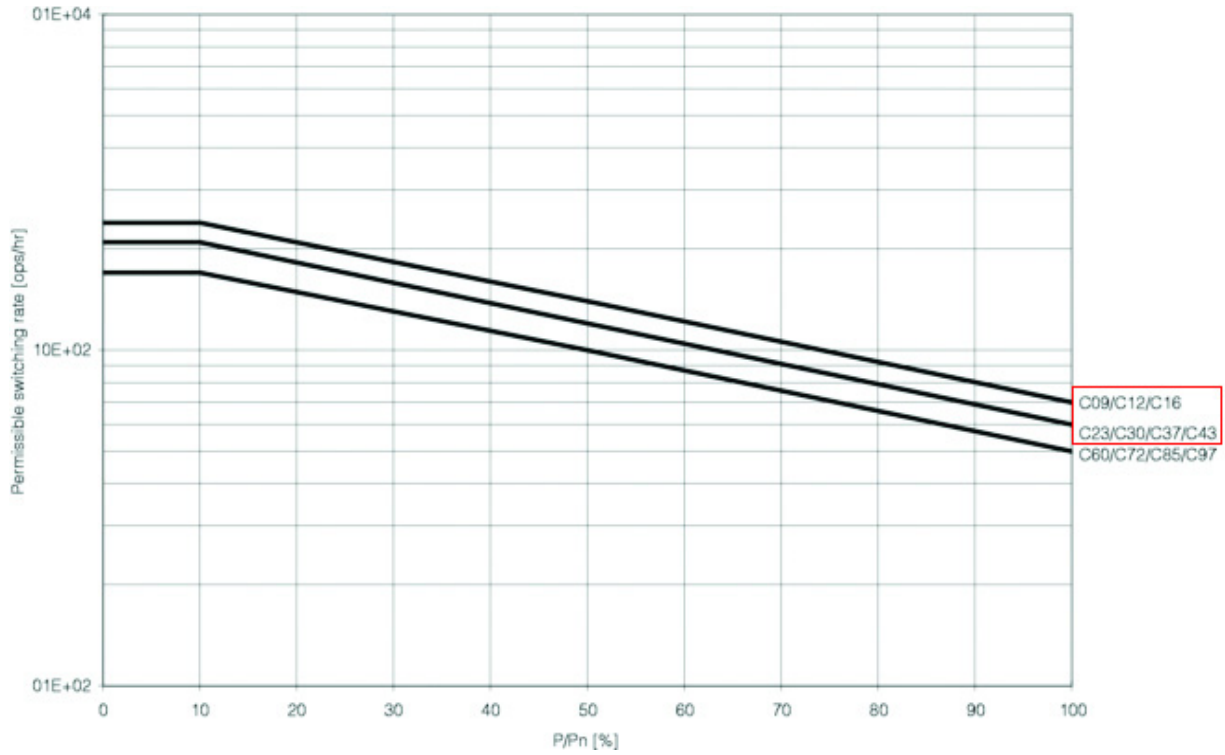


AC-3 & AC-4 10% AC-4 Mixed operation of squirrel-cage motors
 $U_e = 400 \dots 460V$

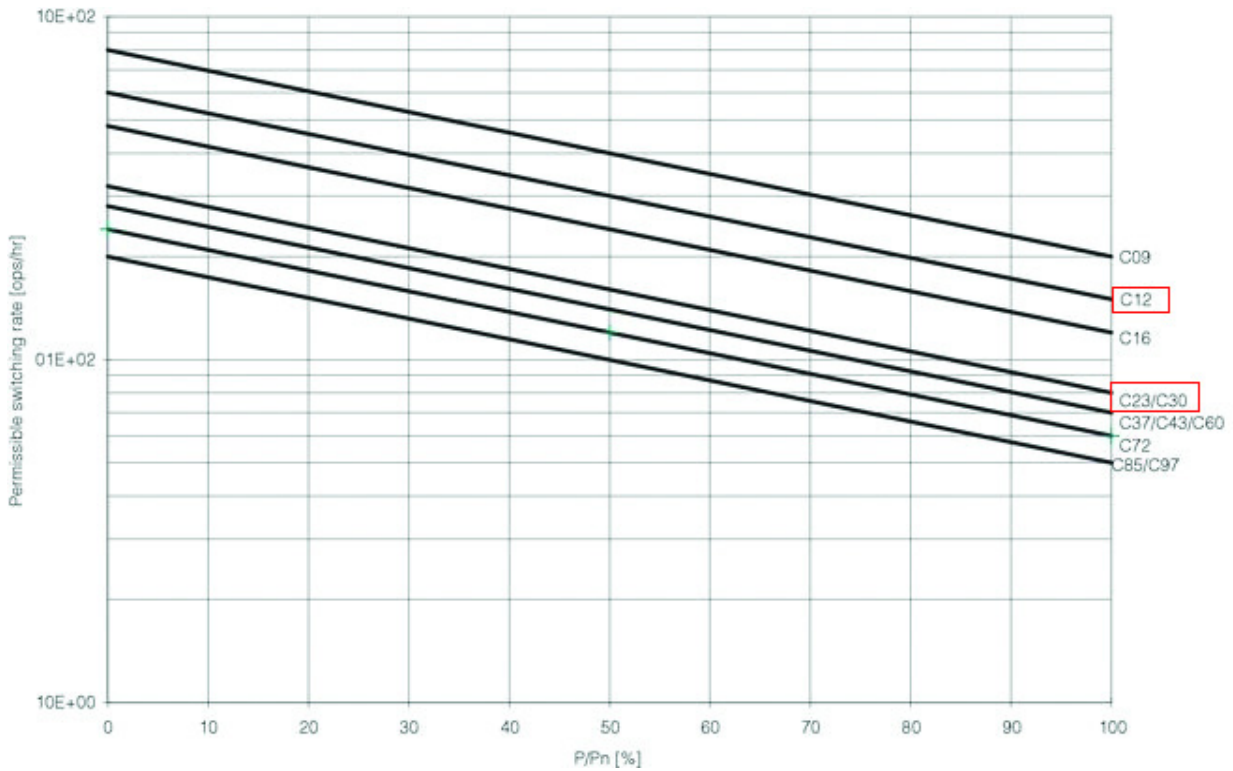


Maximum Operating Rates:

AC-3 Switching of squirrel-cage motors while starting
 $U_e = 230 \dots 460V$, Relative operating time 40%, Starting time $t_A = 0.25 s$



AC-4 Inching of squirrel-cage motors
 $U_e = 230 \dots 460V$, Starting time $t_A = 0.25 s$



Specifications — Bulletin 284E

Electrical Ratings		UL/NEMA		IEC	
Power Circuit	Rated Operation Voltage	380/220...480/277V AC		380/220...480/277V AC	
	Rate Insulation Voltage	600V		600V	
	Rated Impulse Voltage	6 kV		6 kV	
	Dielectric Withstand	2200V AC		2500V AC	
	Operating Frequency	50/60 Hz		50/60 Hz	
	Utilization Category	Not applicable		AC-3	
	Protection Against Shock	Not applicable		IPO	
	Rated Max. Output Operating Current	SVC - Performance			
			3-phase Hp Rating	Output Current [A]	
		284E-FVD1P4Z*	0.5	1.4	
284E-FVD2P3Z*		1	2.3		
284E-FVD4P0Z*		2	4		
284E-FVD6P0Z*		3	6		
284E-FVD7P6Z*	5	7.6			
Control Circuit	Rated Operation Voltage	24V DC (+10%, -15%), SELV or PELV, (A2 should be grounded at voltage source)			
	Rate Insulation Voltage	30V		30V	
	Rated Impulse Voltage	—		1.5 kV	
	Dielectric Withstand	1500V AC		2000V AC	
	Overvoltage Category	—		III	
	Operating Frequency	DC		DC	
Short Circuit Protection	Short Circuit Protection Device (SCPD) Performance Type 1	Short Circuit Protection		480Y/277V	
		-10 or -25	Sym. Amps rms	65 kA	
			Max. Fuse⁽¹⁾	30 A	
		-10 or -25	Sym. Amps rms	30 kA	
			Max. Circuit Breaker⁽²⁾	60 A	

(1) Class J, CC, and T fuses only.

(2) Only when used with Cat. No. 140G-H6C3-C60.

		UL/NEMA	IEC
Environmental	Operating Temperature Range	-20...+40 °C (-4...+104 °F)	
	Storage and Transportation Temperature Range	-25...+85 °C (-13...+185 °F)	
	Altitude ⁽¹⁾	1000 m	
	Humidity	5...95% (on-condensing)	
	Pollution Degree	3	
	Enclosure Ratings	NEMA Type 4/12	IP67
	Approximate Shipping Weight	13.6 kg (30 lb)	
Mechanical	Resistance to Shock		
	Operational	15 G	
	Non-Operational	30 G	
	Resistance to Vibration		
	Operational	1 G, 0.15 mm (0.006 in.) Displacement	
	Non-Operational	2.5 G, 0.38 mm (0.015 in.) Displacement	
	Power and Ground Terminals		
	Wire Size	Primary/Secondary Terminal: #16...#10 AWG	Primary/Secondary Terminal: 1.0...4.0 mm ²
	Tightening Torque	Primary Terminal: 10.8 lb-in. Secondary Terminal: 4.5 lb-in.	Primary Terminal: 1.2 N-m Secondary Terminal: 0.5 N-m
	Wire Strip Length	9 mm (0.35 in.)	
	Control		
	Terminal Wire Size	#18...#10 AWG	1.0...4.0 mm ²
	Tightening Torque	6.2 lb-in.	0.7 N-m
	Wire Strip Length	9 mm (0.35 in.)	
	Disconnect Lock Out	Recommend 8 mm (5/16 in.) lock shackle or hasp. The hasp should not exceed 8 mm (5/16 in.) when closed.	
Other Rating	EMC Emission Levels		
	Conducted Radio Frequency Emissions	10V rms Communications Cables 10V rms (PE) 150 kHz...80 MHz	
	Radiated Emissions	Class A, Group 1, equivalent to C2 emissions	
	EMC Immunity Levels		
	Electrostatic Discharge	4 kV contact and 8 kV Air	
	Radio Frequency Electromagnetic Field	10V/m, 80 KHz...1 GHz 3V/m, 1.4 GHz...2 GHz 1V/m, 2.0 GHz...2.7 GHz	
	Fast Transient	2 kV (Power) 2 kV (PE) 1 kV (Communications and Control)	
	Surge Transient	1 kV (12) L-L, 2 kV (2) L-N (Earth)	
	Internal Fan for 284	Fan L10 Operation data: 80K hr at 40 °C (104 °F)	
	SI - SM1 and SM2 (24V DC)	Contact Rating	DC-12 L/R, 1 ms resistive, 6 A
Contact Type		IEC 60947-5-1 Annex L - mechanically	
S0 - P/M	3 W/0.125 A per contactor (Two safety contactors)		

(1) See [Altitude Derating](#) for derating guide.

	UL/NEMA	IEC
Standards Compliance	UL 508C CSA C22.2, No. 14 EN50178 EN61800-3 EN/IEC 60947-4-2 CE Marked per Low Voltage 2006/95/EC EMC Directive 2004/108/EC ODVA for EtherNet/IP	
Certifications	UL, TÜV	

Control and I/O Power Requirements

	Units	A1/A2 ⁽²⁾	A3/A2 ⁽³⁾	A1/A2 ⁽²⁾	A3/A2 ⁽³⁾	A3/A2 ⁽⁴⁾
		W/O HOA		W/ HOA		
Control Voltage	Volts	24V DC				
Module Inrush ⁽¹⁾	Amps	0.92	0.30	1.09	0.125	0.295
Module Steady	Amps	0.06	0.30	0.23	0.125	0.295
Total Control Power (Pick Up)	Watts	22.08	7.20	26.16	3.00	7.08
Total Control Power (Running)	Watts	1.44	7.20	5.52	3.00	7.08
Total Control Power (with Dynamic Brake or Output Contactor option)	Watts	—	—	12	3	8.4
Total Control Power (with Dynamic Brake and Output Contactor option)	Watts	—	—	15	3	8.4

- (1) Instantaneous capacitive inrush exists for less than 10 ms, which can exceed 20 A. The power supply must be capable of supporting this amount of instant power demand when multiple units are turned ON simultaneously. If supplies are weaker, it is recommended to apply unswitched power (A3-A2) first and after a 2 . . . 4 second delay, apply switched power.
- (2) Add power requirements for outputs (1 A max.) to A1/A2.
- (3) Add power requirements for inputs (200 mA max.) to A3/A2.
- (4) If A1 power is disconnected.

Drive Ratings – VFD Output Current vs. Input Current

Line Voltage [V]	Frequency [Hz]	3-Phase kW Rating	3-Phase Hp Rating	Sensorless Vector Control	
				Output Current [A]	Input Current [A]
380	50	0.4	—	1.4	2.15
		0.75	—	2.3	3.80
		1.5	—	4.0	6.40
		2.2	—	6.0	9.00
		3.0	—	7.6	12.40
460	60	—	0.5	1.4	1.85
		—	1	2.3	3.45
		—	2	4.0	5.57
		—	3	6.0	8.20
		—	5	7.6	12.5

Drive Characteristics	
Output Frequency	0...400 Hz (Programmable)
Efficiency	97.5% (Typical)
Sensorless Vector Control	
Maximum (kW) Hp Rating/Input Voltage	5 Hp (3.3 kW)/480V AC
Preset Speeds	8
Skip Frequency	3
StepLogic® Functionality	3
Timer/Counter Functions	3

Sensorless Vector Control (SVC)

Protective Specifications – Sensorless Vector Control	
Motor Overload Protection	I^2t overload protection – 150% for 60 seconds, 200% for 3 seconds (provides Class 10 protection)
Overcurrent	200% hardware limit, 300% instantaneous fault
Over Voltage	380...460V AC Input – Trip occurs @ 810V DC bus voltage (equivalent to 575V AC incoming line)
Under Voltage	380...480V AC Input – Trip occurs @ 390V DC bus voltage (equivalent to 275V AC incoming line)
Faultless Power Ride Through	100 milliseconds

Control Specifications – Sensorless Vector Control	
Carrier Frequency	2...16 kHz. Drive rating is based on 4 kHz.
Frequency Accuracy – Digital Input	Within ±0.05% of set output frequency.
Speed Regulation – Open Loop with Slip Compensation	±1% of base speed across a 60:1 speed range
Stop Modes	Multiple programmable stop modes including – Ramp, Coast, DC-Brake, Ramp-to-Hold, and S Curve.
Accel/Decel	Two independently programmable accel and decel times. Each time can be programmed from 0...600 s in 0.1 s increments.
Electronic Motor Overload Protection	Class 10 protection with speed sensitive response

		UL/NEMA	IEC	
Input Ratings – Sourced from Control Circuit (A3/A2)	Rated Operation Voltage	24V DC		
	Input On-State Voltage Range	10...26V DC		
	Input On-State Current	3.0 mA @ 10V DC		
		7.2 mA @ 24V DC		
	Input Off-State Voltage Range	0...5V DC		
	Input Off-State Current	<1.5 mA		
	Maximum Input Frequency Response	200 Hz (DeviceLogix response is greater than 200 Hz. Network response depends on control system network performance.)		
	Input Filter – Software Selectable			
	Off to On	Settable from 0...64 ms in 1 ms increments		
	On to Off	Settable from 0...64 ms in 1 ms increments		
	Input Compatibility	Not applicable	IEC 1+	
	Number of Inputs	4		
	Sensor Source			
	Voltage Status Only	11...26.4V DC from unswitched power		
Current Available	50 mA max. per input, 200 mA, any single point			

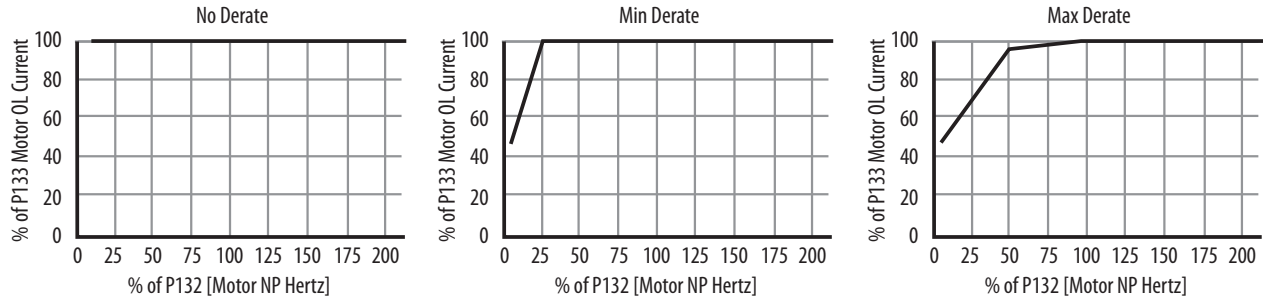
		UL/NEMA	IEC
Output Ratings – Sourced from Control Circuit (A1/A2)	Rated Operation Voltage	26.4V DC	
	Rate Insulation Voltage	250V	
	Dielectric Withstand	1500V AC (UL)	2000V AC (IEC)
	Type of Control Circuit	Solid-state sourcing output	
	Type of Current	24V DC	
	Conventional Thermal Current I _{th}	0.5 A each, 1 A max. combined	
	Peak Output Current	Current limited 2...8 amps (5 amps nominal) @ 24V DC	
	Type of Contacts	Normally open (N.O.)	
	Number of Contacts	2	
	Load Types	Resistive or light inductive	
	Surge Suppression	Integrated diode, clamps @ 35V DC	
	Thermo-Protection	Integrated short circuit and over current protection	
	Maximum Cycle Rate	30 operations/minute capacitive and inductive loads	
	Maximum Blocking Voltage	35V DC	
	Maximum On-State Voltage @ Maximum Output	1.5V DC	
Maximum Off-State Leakage Current	10 μA		
Device Level Ring (DLR)	—	Beacon-based performance including IEEE 1588 end to end transparent clock	
	Fault Recovery	Ring recovery time is less than 3 ms for a 50 node network	
Ethernet Port	—	2 D-coded, 4-pin female M12 connectors	
	Ports	Embedded switch with 2 ports	
	IP Address	DHCP enabled by default	
	DHCP Timeout	30 s	
	Communication Rate	10/100 Mbps with auto negotiate half-duplex and full-duplex	
	Data	<ul style="list-style-type: none"> •Transported over both TCP and UDP • Min. of 500 I/O packets/second (pps) • Supports up to 150 concurrent TCP sockets 	
Web Server	—	Embedded web server	
	Security	Login and password configurable	
	Email	Support Simple Mail Transfer Protocol (SMTP)	
	Configuration	Status, diagnostics, and configuration tabs	
Device Connections	Supports scheduled (Class 1) and unscheduled (Class 3 and UCMM) connections		
	6 - Class 3 connections are supported simultaneously		
	Supports up to 2 Class 1 CIP connections [Exclusive owner (data) or listen-only]. One connection per PLC. Listen only connection requires a data connection to be established.		
	Class 1 Connection API: 2...3200 ms Class 3 Connection API: 100...10 000 ms		
	20 ms Request Packet Interval (RPI) default		
Component Response Time	3 concurrent Encapsulation sessions		
	TCP port supports 5 concurrent incoming connections		
	1732ES-IB12X0BV2 or 1732ES-IB8X0BV4	See Publication 1732DS-IN001	
	Bulletin 284	8...12 ms	
Probability of Dangerous Failure per Hour and MTTF_d for Uncontrolled Stop⁽¹⁾	MTTF _d		100 years
	Average probability of dangerous failure per hour		6.0E-9 (1/h)

(1) ArmorStart safety controller used in combination with ArmorStart safety-related parts.

Motor Overload Trip Curves

Motor OL Current parameter provides Class 10 overload protection. Ambient insensitivity is inherent in the electronic design of the overload.

284E Overload Trip Curves



Altitude Derating

Altitude Rating for Bulletin 281E

- No altitude derating up to 2000 m (6562 ft)

Altitude Rating for Bulletin 284E

- **0.5 Hp:** No Derating up to 3000 m (9843 ft)
- **1 Hp:** No Derating up to 3000 m (9843 ft)
- **2 Hp:** Derate 1% per 100 m (328 ft) above 1000 m (3281 ft)
- **3 Hp:** No Derating up to 3000 m (9843 ft)
- **5 Hp:** Derate 1% per 100 m (328 ft) above 1000 m

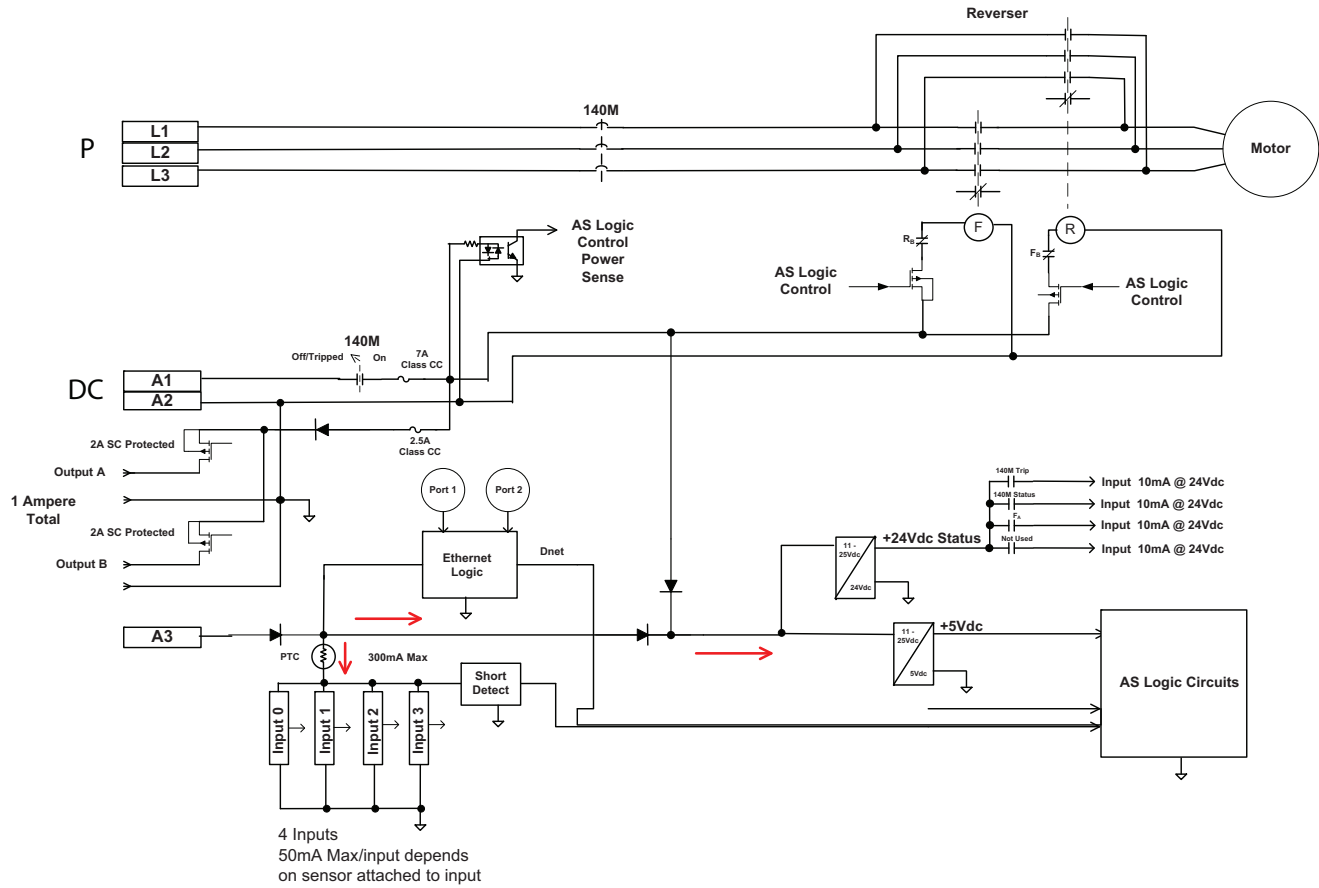
Example: Application requires 2600 m for a 5 Hp ArmorStart

- 2600 m-1000 m= 1600 m
- 1600/100 = 16
- 16 * 1%= 16%. Derate output amps by 16%
- (1-.16)*7.6 A = 6.4 A

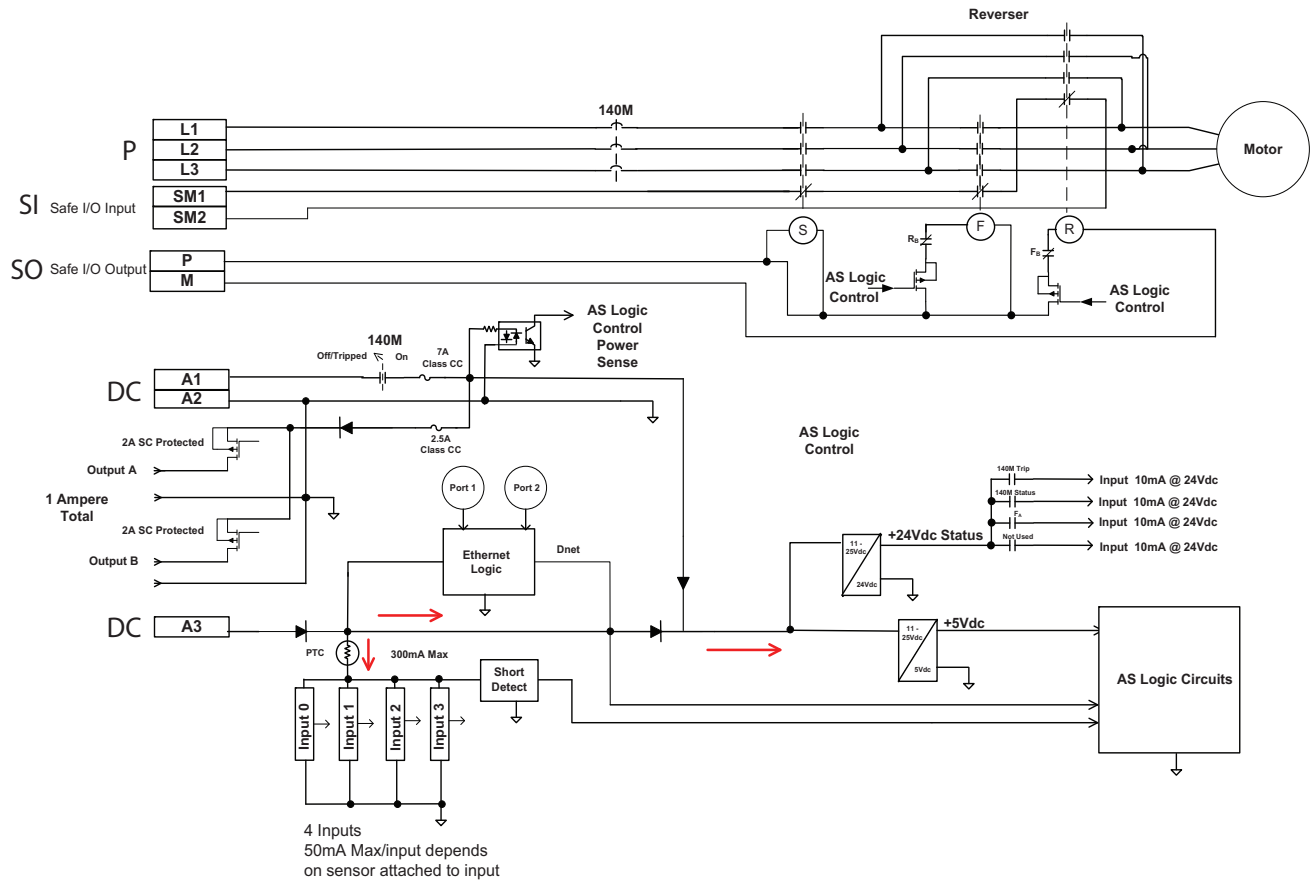
It is possible to extend the operational range of the units if the ambient temperature is lower than 40 °C (104 °F), or if line reactors are used.

Wiring Diagrams

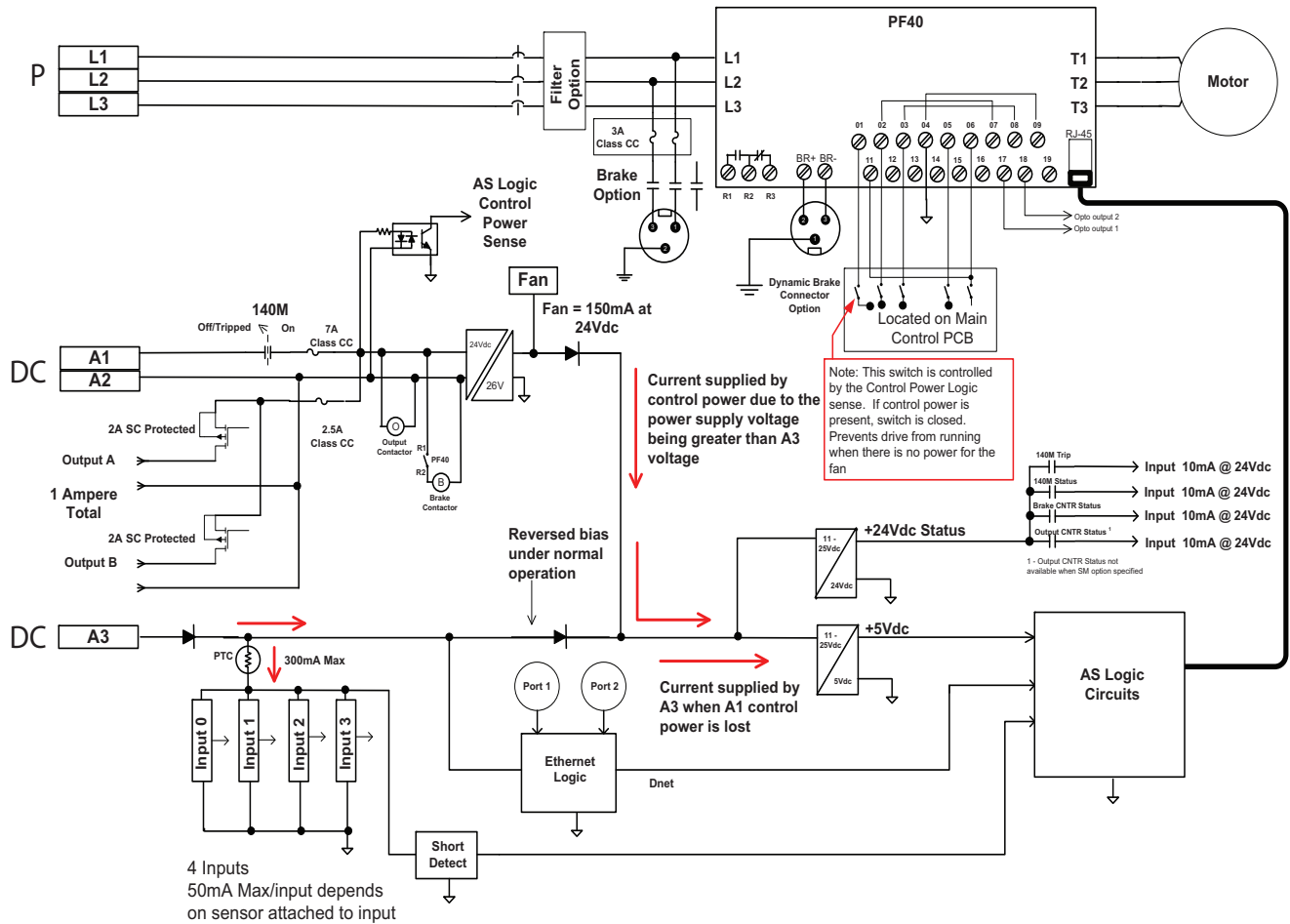
Bulletin 281E ArmorStart Standard Version Internal Wiring Diagram



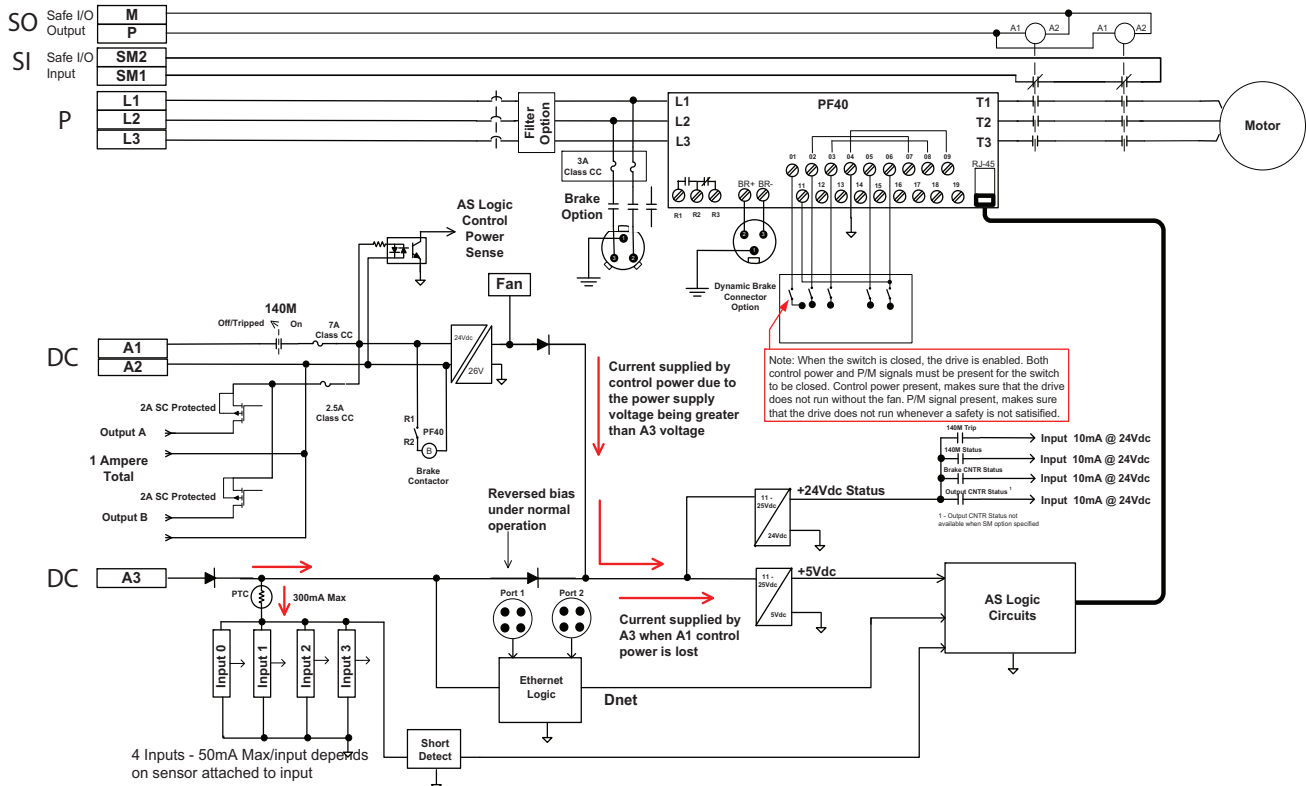
Bulletin 281E ArmorStart Safety Version Internal Wiring Diagram



Bulletin 284E ArmorStart Standard Version Internal Wiring Diagram



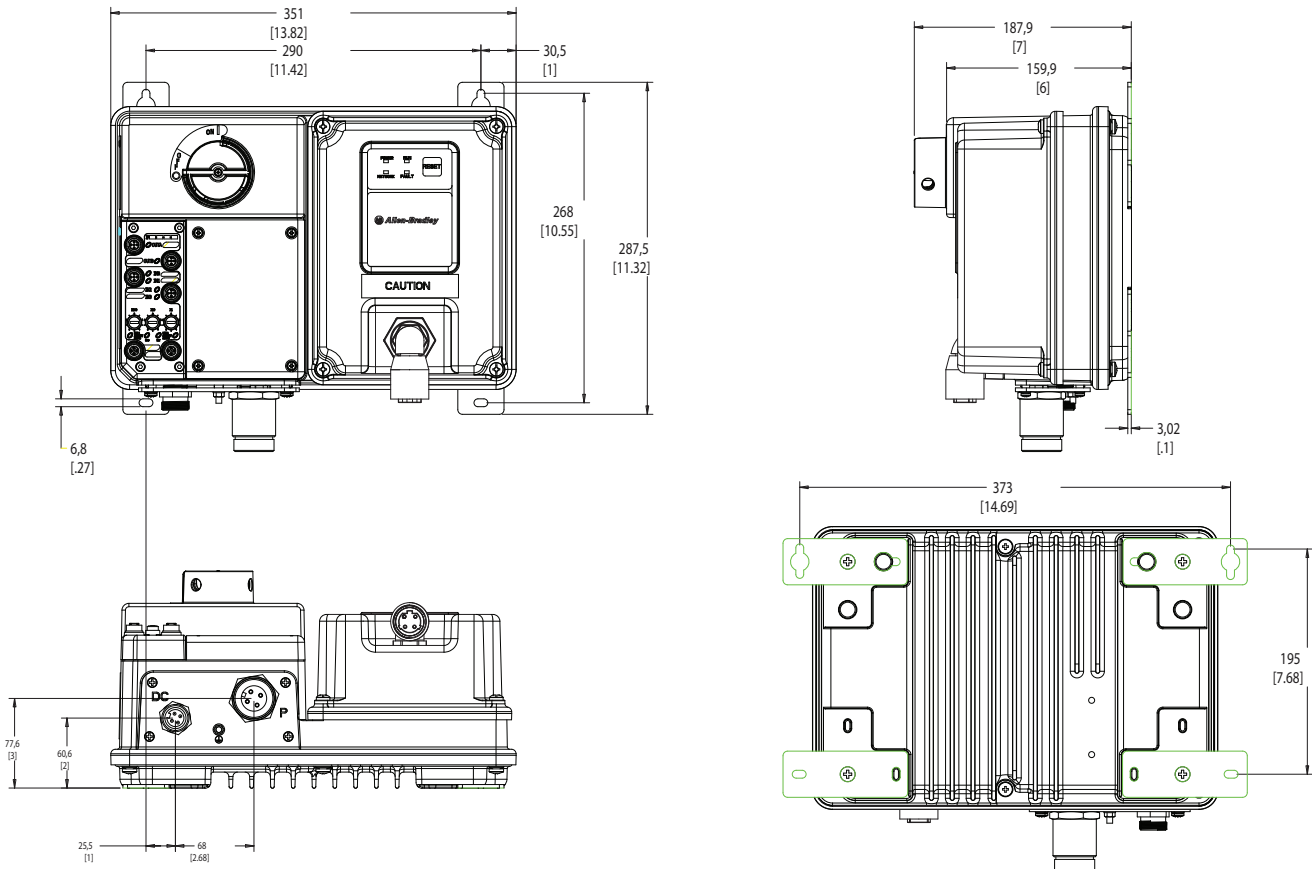
Bulletin 284E ArmorStart Safety Version Internal Wiring Diagram



Approximate Dimensions

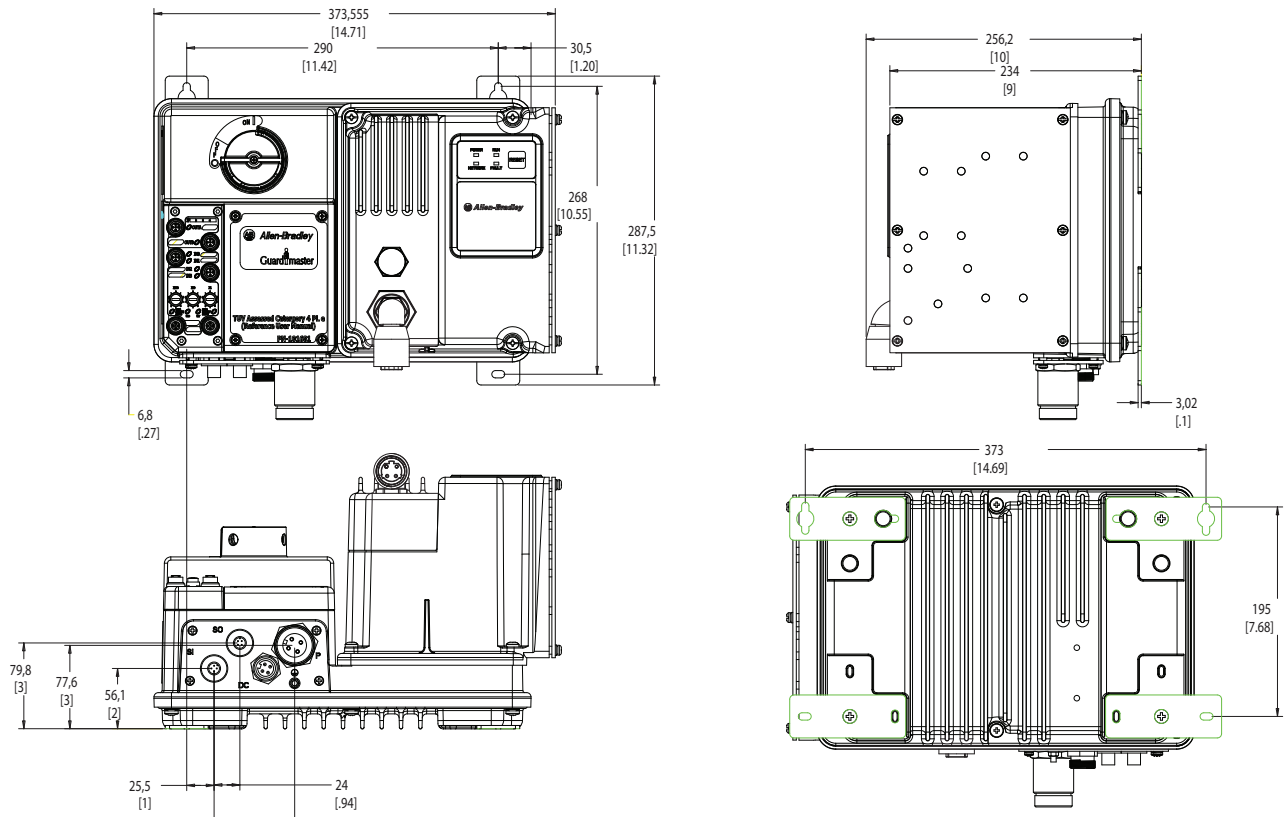
Bulletin 281E ArmorStart Standard Version with RRG Gland

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



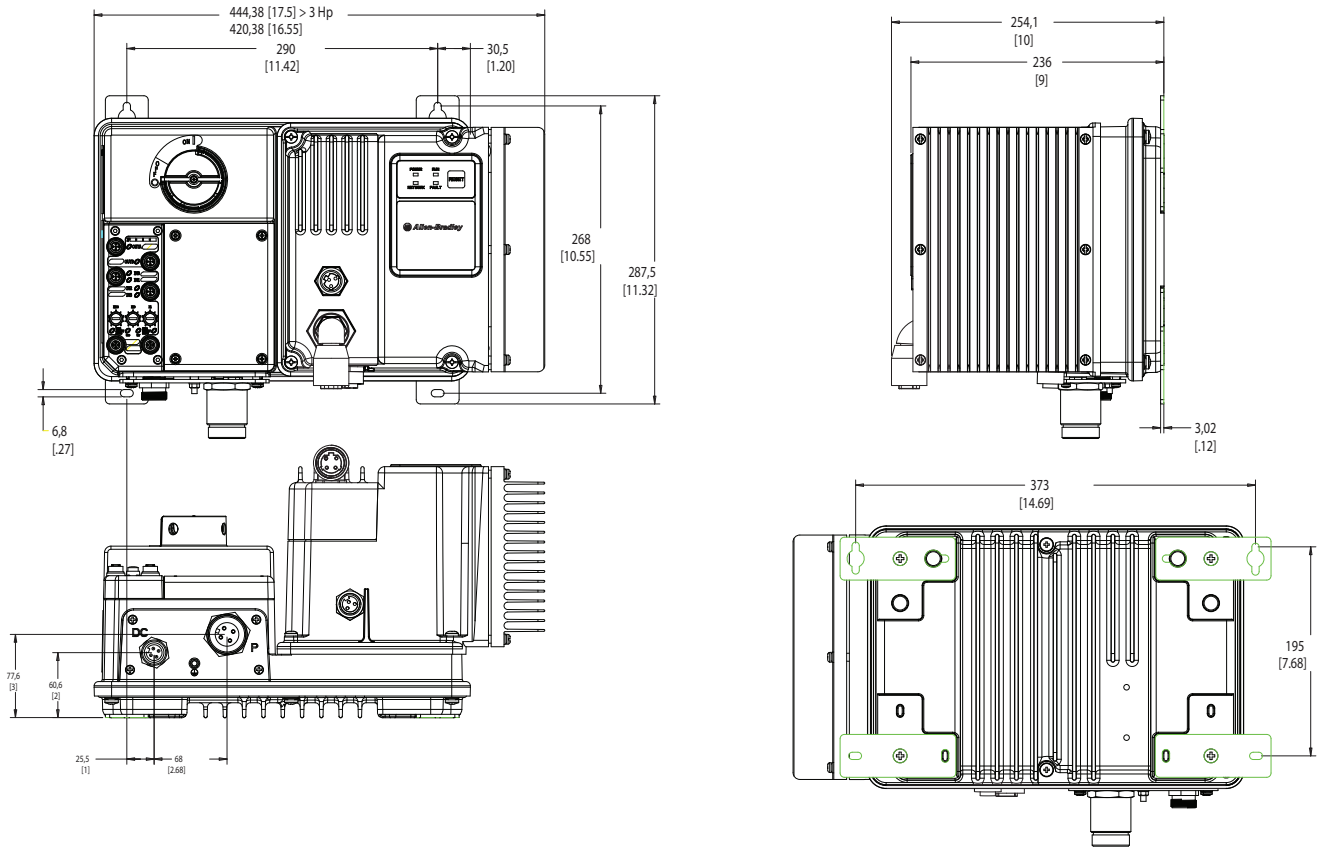
Bulletin 281E ArmorStart Safety Version with RRG Gland

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



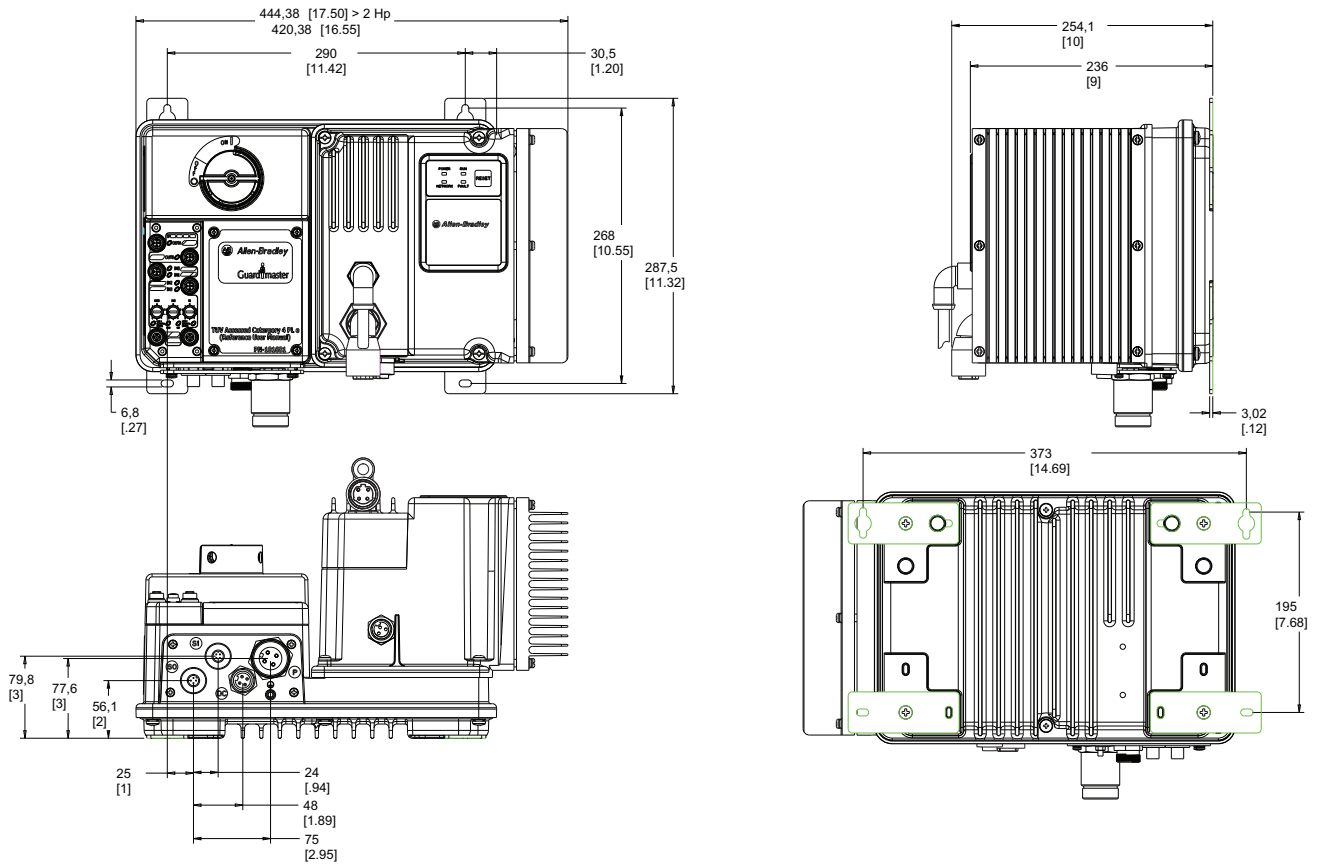
Bulletin 284E ArmorStart Standard Version with RRG Gland

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



Bulletin 284E ArmorStart Safety Version with RRG Gland

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



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Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 280ES-SG001B-EN-P - March 2017

Supersedes Publication 280ES-SG001A-EN-P - March 2017

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