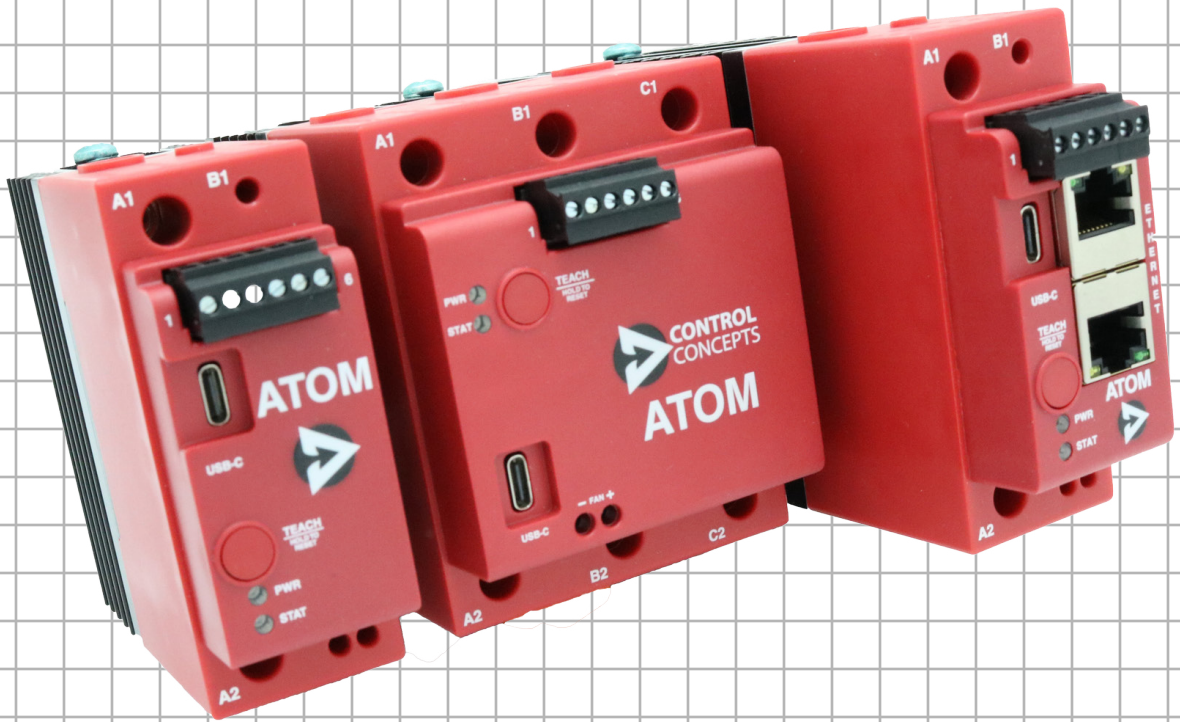
CONTROL CONCEPTS

ATOM

SCR POWER CONTROLLERS

USER'S MANUAL



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WARNING: The Control Concepts, Inc. power controllers use power thyristors to switch voltage to the connected load. Line voltage must be assumed at the output terminals at all times, even when the control signal has been removed and the load voltage appears to be off. It has been mandated by the National Electrical Code and the Occupational Safety and Heath Act of 1970 that a physical disconnect be opened ahead of all remotely actuated controls before performing any maintenance work on the controller or its connected load.

PROPRIETARY DATA
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www.ccipower.com

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Listed 3L32 - Industrial Control Equipment
100kA Short Circuit Current Rating
File Number E136219



EN60947-4-3
IP 20
See CE Declaration of Conformity



Part 15 Subpart B
Class A Device



See RoHS Certificate of Compliance

DECLARATION OF CONFORMITY

Manufacturer: Control Concepts, Inc.
8077 Century Blvd
Chanhassen, MN 55317 USA

Product Family: ATOM Series Power Controller
Classification: Solid State Power Controller, Class I, CE Pollution Degree II
Rated Voltage / Frequency: 24 - 690 VAC / 45 - 65 Hz
Model Numbers: Model A or AS, *followed by any combination of numbers and/or letters*

We, as the manufacturer, declare under our sole responsibility of the product family described above, meets the essential requirements of the following European Union Directive(s) using the relevant section(s) of the normalized standards and related documents shown:

Low Voltage Directive (LVD) 2014/35/EU
Harmonized Standard(s)
IEC 60947 - 4 - 3: 2020 Semiconductor controllers and semiconductor contactors for non-motor loads
IEC 60947 – 1: 2020 General rules

IEC 61000-4-2:2008	Electrostatic discharge immunity test
IEC 61000-4-3:2020	Radiated, radio-frequency, electromagnetic field immunity test
IEC 61000-4-4:2012	Electrical fast transient/burst immunity test
IEC 61000-4-5:2014+AMD1:2017	Surge immunity test
IEC 61000-4-6:2013	Immunity to conducted disturbances, induced by radio-frequency fields
IEC 61000-4-8:2009	Power frequency magnetic field immunity test
IEC 61000-4-11:2020	Voltage Dips and interruptions for levels less than 16 Amps
IEC 61000-4-34:2005+AMD1:2009	Voltage Dips and interruptions for levels higher than 16 Amps

Electromagnetic Compatibility Directive (EMCD) 2014/30/EU
Harmonized Standard(s)
EUROPEAN STANDARD EN 55011: 2016 / A11: 2020 - Group 1 Class B Limit
FCC Part 15 Subpart B - Class B Limit

RoHS Directive 2011/65/EU, as amended, including Commission Delegated Directive (EU) 2015/863.

Notes:	1: All power terminals must be populated as to keep the controller touch safe to comply with EN 60947-4-3.
	2: Controller must be mounted in a shielded enclosure to comply with EMC Directive 2014/30/EU.
	3: Controller must have appropriate line and control power filter to comply with EN61000-6-2.

Third party conformance testing conducted by TÜV America.
TÜV SÜD America Inc.
141 14th ST NW
New Brighton, MN 55112 - 1891

Name of Authorized Representative: Cory Watkins
Title of Authorized Representative: President
Place of Issue: Chanhassen, Minnesota, USA
Date of Issue: April, 2023



Signature of Authorized Representative

10/28/2026
Date

External EMI filters must be used in conjunction with the ATOM series power controllers to maintain CE immunity* approval. The following filters were used during the immunity testing:

Universal input power:

Schaffner filter

P/N: FN 2030-3-06

Line input power:

Schaffner filter

P/N: FN 3270H-35-33

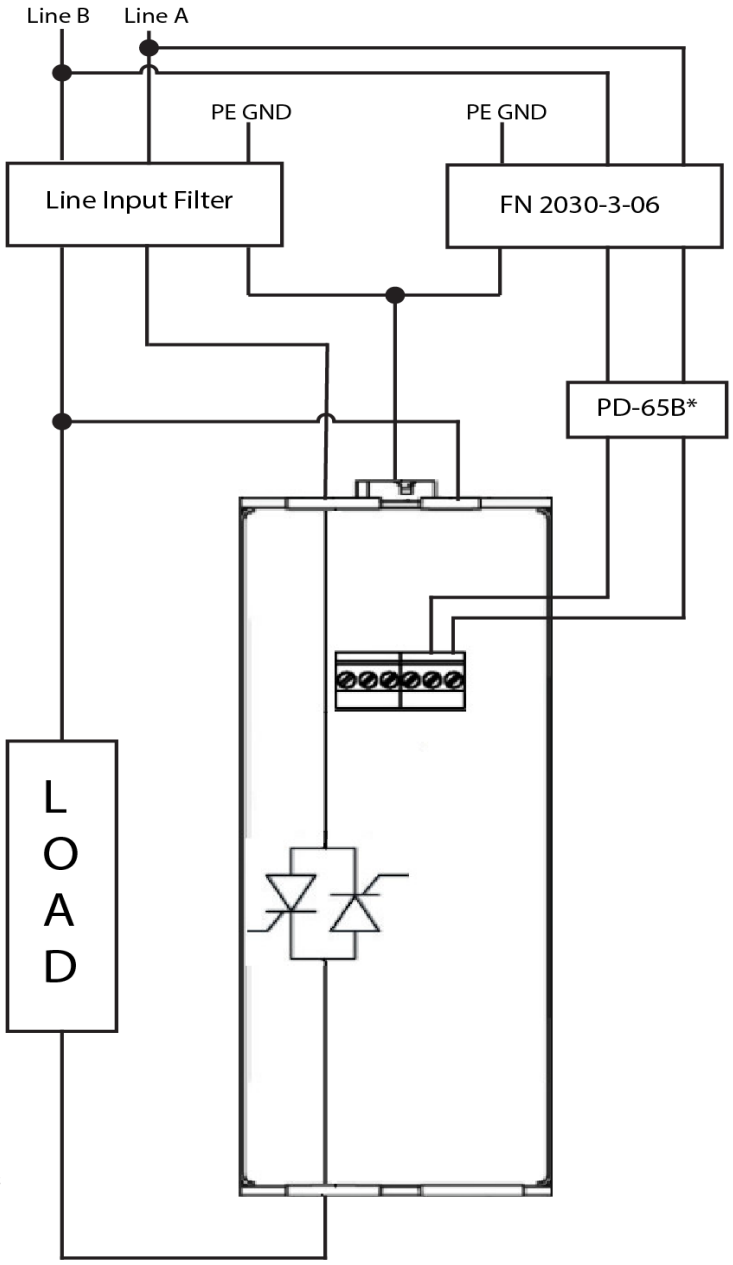
*No filtering is required for emissions.

The Schaffner filter for universal input power, or it's equivalent, may be used as listed above. The line input power filter however, will need to be sized accordingly for your load. Please contact Schaffner EMC Inc. for help finding the appropriate filter.

Schaffner EMC Inc.
52 Mayfield Avenue | Edison, New Jersey 08837 / USA
T 1-800-367-5566 | T 732-225-9533 | F 732-225-4789
usasales@schaffner.com | http://www.schaffner.com/us

1-Phase Controller

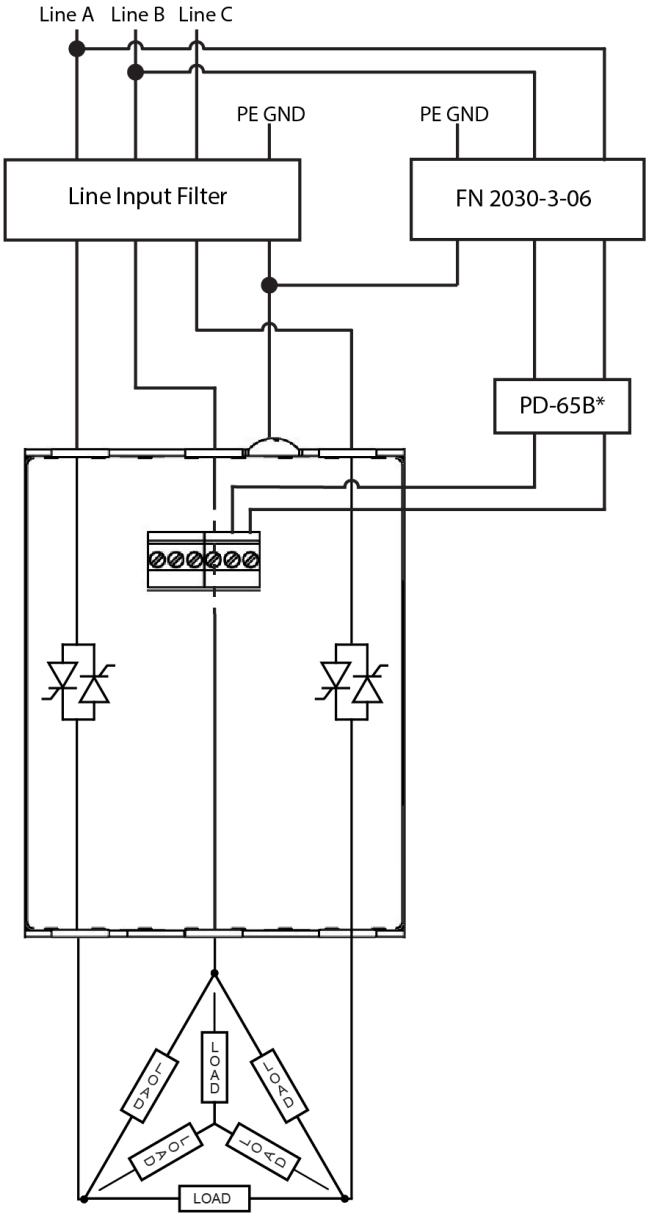
Wire filters as shown:



* Tests were conducted with a Mean Well, Inc 24 Vdc Power Supply. Model # PD-65B

3-Phase Controller

Wire filters as shown:



* Tests were conducted with a Mean Well, Inc 24 Vdc Power Supply. Model # PD-65B

ATTENTION

This product has been designed for class A equipment. Use of this product in domestic environments may cause radio interference, in which case the user may be required to employ additional mitigation methods.

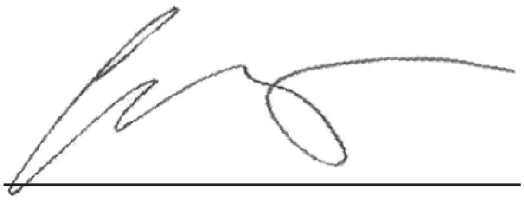
NOTICE

This product has been designed for environment A. Use of the product in environment B may cause unwanted electromagnetic disturbances, in which case the user may be required to take adequate mitigation methods.

CERTIFICATE OF COMPLIANCE

This document certifies that Control Concepts, Inc's products listed in the table are fully RoHS compliant as of July 21, 2011 in accordance with EU RoHS Directive 2011/65/EU, as amended, including Commission Delegated Directive (EU) 2015/863. The products listed in the table below have been identified as RoHS compliant and do not exceed the maximum limit for the six substances: Lead, Mercury, Cadmium, Hexavalent chromium, Polybrominated biphenyls and Polybrominated diphenyl ether.

PRODUCT FAMILY	PART NUMBERS	DATE ADDED
ATOM	A□□□□□□-□□□□□-□□□-□□-□□□-□□□□	6/1/2024
ATOM SEMI	AS□□□□□□□-□□□□	6/1/1024



6/1/2024

Authorized Signature
Cory Watkins, President

Date Last Updated

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www.ccipower.com

1. OVERVIEW

ATOM 1-phase



ATOM 3-phase



1.1. Description

ATOM is an ultra-compact low cost microprocessor-based power controller to assist with control of AC loads.

Available in both single phase and three phase two leg (4 SCR) models. All with options of analog or digital fieldbus communications. Resistive or transformer connected loads can be controlled in either Zero-cross, Fast Zero-cross,and On/Off Random Relay mode (Zero-cross). Single phase ATOM controllers add the capability of control with Phase angle, On/Off Random Relay mode (Phase Angle), and Half-cycle DC modes.

ATOM Series power controllers are available in current ratings from 16 to 80 amps depending on model. Auto-ranging voltage circuitry enables main line voltage from 24 - 600 Vac (45 - 65 Hz) eliminating the need for hardware jumpers or stocking multiple controllers for international voltages. A separate 24 Vdc power source supplies the control electronics and maintains critical communications to your control system when the mains are absent.

Status LEDs make operation and troubleshooting simple. A plug-n-play USB interface and free Control Panel app for your Windows PC or Android device further simplifies installing and configuring the controller to its designated application. For multiple controllers, controller settings can be duplicated by simply loading a configuration file saved from a previous unit.

Depending on the ATOM model, setpoints can be controlled through either the analog or digital fieldbus interface. The factory-configured analog setpoint signal range is 0 - 5 Vdc, setpoints are field scalable from 0 - 32 Vdc or 4 - 20 mA.

Available fieldbus communications interfaces: EtherNet/IP, ModbusTCP, PROFINET, or EtherCAT.

This manual will provide an overview of all ATOM model features, considerations for installation, wiring diagrams, explanation of device operation and settings, and basic troubleshooting tips.

1.2. Certifications / Markings

In addition to certification markings, the controllers will also be marked with:

Model Number	Serial Number
Voltage Range (24-600VAC)	Frame Current Size
Frequency (50-60Hz)	Control Concepts contact information

1.3. Features

Feature	ATOM 1 Ø 16A	ATOM 1 Ø 32A	ATOM 1 Ø 50A	ATOM 1 Ø 65A	ATOM 3 Ø 16A	ATOM 3 Ø 32A	ATOM 3 Ø 50A	ATOM 3 Ø 80A
Max Amps @50 °C [122 °F]	16	32	50	65	16	32	50	80
Universal Line Voltage Input (24-600 VAC)	✓	✓	✓	✓	✓	✓	✓	✓
Max AC Line Voltage	600	600	600	600	600	600	600	600
VDC Contactor Input (4.5-32 VDC)	✓	✓	✓	✓	✓	✓	✓	✓
4-20mA DC Input	✓	✓	✓	✓	✓	✓	✓	✓
Pot / 0-5 / 1-5 / 0-10 VDC Control	✓	✓	✓	✓	✓	✓	✓	✓
Adjustable Analog Input	✓	✓	✓	✓	✓	✓	✓	✓
Voltage Feedforward Control	✓	✓	✓	✓	✓	✓	✓	✓
Current Control	✓	✓	✓	✓	✓[1]	✓[1]	✓[1]	✓[1]
Adjustable Control Response	✓	✓	✓	✓	n/a	n/a	n/a	n/a
Proportional Control (Variable Time Based)	✓	✓	✓	✓	✓	✓	✓	✓
Phase Angle Output	✓	✓	✓	✓	n/a	n/a	n/a	n/a
Fast Zero Cross Mode	✓	✓	✓	✓	✓	✓	✓	✓
SSR Contactor Mode	✓	✓	✓	✓	✓	✓	✓	✓
1/2 Cycle DC Output	✓	✓	✓	✓	n/a	n/a	n/a	n/a
Load Current Monitor	✓	✓	✓	✓	✓[1]	✓[1]	✓[1]	✓[1]
Line Voltage Compensation	✓	✓	✓	✓	✓	✓	✓	✓
Trans-Guard	✓	✓	✓	✓	✓	✓	✓	✓
Voltage Limit	✓	✓	✓	✓	✓	✓	✓	✓
Current Limit	✓	✓	✓	✓	✓[1]	✓[1]	✓[1]	✓[1]
Over-Current Trip	✓	✓	✓	✓	✓[1]	✓[1]	✓[1]	✓[1]
Over Temperature Alarm	✓	✓	✓	✓	✓	✓	✓	✓
Shorted SCR Alarm	✓	✓	✓	✓	✓	✓	✓	✓
Open Load/Heater Alarm	✓	✓	✓	✓	✓	✓	✓	✓
Partial Load Fault / Teach Button	✓	✓	✓	✓	✓	✓	✓	✓
SSR Alarm Output	✓	✓	✓	✓	✓	✓	✓	✓
Digital Sync Guard	✓	✓	✓	✓	✓	✓	✓	✓
Ethernet/IP, Modbus TCP, PROFINET	✓	✓	✓	✓	✓	✓	✓	✓
EtherCAT	✓	✓	✓	✓	✓	✓	✓	✓
DIN Rail Mount	✓	✓	✓	✓	✓	✓	✓	✓
Panel Mount	✓	✓	✓	✓	✓	✓	✓	✓
Side-by-Side Clearance	0" [0mm]	0" [0mm]	0" [0mm]	0" [0mm]	0" [0mm]	0.25" [6.35mm]	0" [0mm]	0" [0mm]
24 VDC Control Powered	✓	✓	✓	✓	✓	✓	✓	✓
Electrically Touch-Safe	✓	✓	✓	✓	✓	✓	✓	✓
SCCR	✓	✓	✓	✓	✓	✓	✓	✓
UL / cUL / RoHS / CE w/ filter	✓	✓	✓	✓	✓	✓	✓	✓

[1] Operates on a single phase of the three phase controller only

1.4. Options / Upgrades

ATOM is available in analog and digital models with additional options that can be added at time of manufacture.

● = Included ○ = Purchase option available at time of manufacture x = Not available on that model

Purchase Option Packages; when purchased all items in that column are included on the Controller.

PA w/ CL: Phase Angle with Current Limit; includes additional firing modes and adjustable current limit.

Alarms: System Relay Alarms; provides solid state relay output for alarms, Partial Load Fault and Shorted-SCR Detection.

ATOM Model:	1 Ø Analog			1 Ø Digital			3 Ø Analog			3 Ø Digital		
	Base	PA w/ CL	Alarms	Base	PA w/ CL	Alarms	Base	CL	Alarms	Base	CL	Alarms
Operation												
Phase Angle		○			○		x	x	x	x	x	x
Zero Cross	●			●			●			●		
SSR-Random Relay mode	●			●			●			●		
Half-cycle DC		○			○		x	x	x	x	x	x
Feedback												
Current	●			●			●			●		
Voltage	●			●			●			●		
Options												
Alarm Output (SSR)			○			○			○			○
Adjustable Current Limit		○			○			○			○	
Digital Monitoring												
Line Voltage				●						●		
Feed-Forward Voltage				●						●		
Current					○						○	
Temperature						○						○
Alarms												
Memory Error	LED		○	●			LED		○	●		
Communication Error				●						●		
Voltage Limit	LED		○	●			LED		○	●		
Current Limit	LED		○	●			LED		○	●		
Shorted SCR			○			○			○		○	
Partial Load Fault/Open Load			○			○			○		○	
Over-Temperature	LED		○	●			LED		○	●		
Overcurrent Trip	LED		○	●			LED		○	●		

Modbus EtherNet/IP PROFINET EtherCAT

1.5. Frame Sizes

1-Phase ATOM		
Frame Rating	Mounting	Cooling
16 to 50 amps	DIN rail or Panel Mount	Natural convection
65 amps		Forced air (Fan)

Frame Rating	Mounting	Cooling
16 to 32 amps	DIN rail or Panel Mount	Natural convection
50 to 80 amps		Forced air (Fan)

1.6. Connections and Controls

1. Line/Load/Reference Connections

Lug connections for Line and Load. 1-Phase models also include a B1 reference connection.
See Chapter 3 - Wiring

2. 6-Pin Command Connector

Provides for wiring external 24VDC power input, and alarm relay output to an external device.
See Chapter 3 - Wiring

Analog models also provide an analog setpoint input.
See Chapter 7 - Basic Operation & Settings

3. USB-C Interface

All models include a high speed USB-C connection to allow for configuration and monitoring of all critical functions and alarms using the free Control Concepts Control Panel Application.
See Chapter 5 - USB Interface

4. Reset/Teach Button *(Teach not available on EtherCAT models)*

A multifunction button used for hardware processor reset and on models with teach functionality, to learn the connected load resistance.
See Chapter 7 - Basic Operation & Settings

5. Indicator LEDs

Provide real time visual indication of power and status during operation. Additionally, EtherCAT models have a discrete error LED for fieldbus error state.
See Chapter 4 - Indicator LEDs

6. Fan Connection

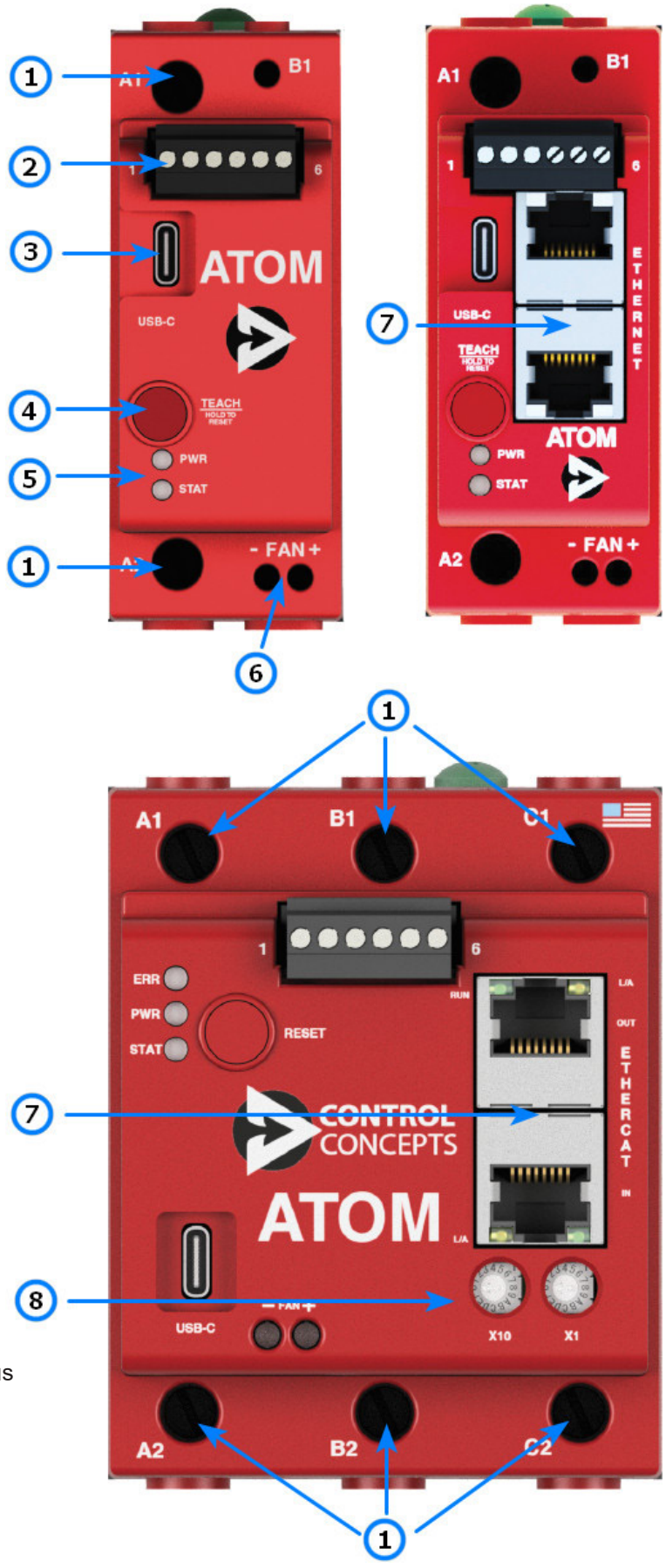
Some ATOM models are equipped with forced air cooling provided by an external fan. This connection is wired at the factory and should not be serviced in the field.

7. Fieldbus Interface *(optional)*

Digital controllers provide one of four industry standard network interfaces. In addition the fieldbus interface includes additional status LEDs on the connector itself.
See Chapter 6 - Fieldbus Communications

8. EtherCAT Address Dials *(EtherCAT models only)*

Hardware address dials to configure the EtherCAT fieldbus address for the controller.
See Chapter 6 - Fieldbus Communications - EtherCAT



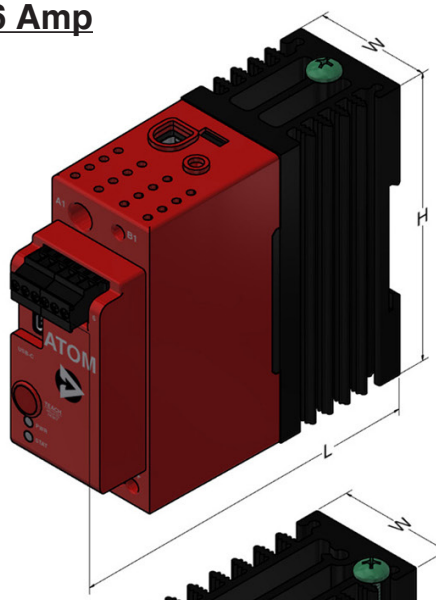
2. INSTALLATION

2.1. 1-Phase Dimensions

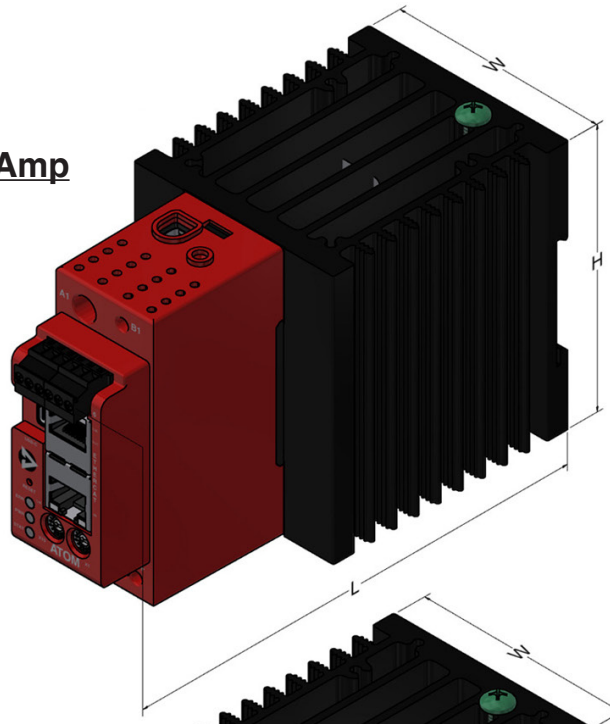
Dimensions: Inches [mm]

16 A	H: 3.50 [88.9]	W: 1.40 [35.5]	L: 4.37 [110.9]
32 A	H: 3.50 [88.9]	W: 1.40 [35.5]	L: 5.97 [151.6]
50 A	H: 3.50 [88.9]	W: 2.80 [71.1]	L: 5.97 [151.6]
65 A	H: 5.00 [127.0]	W: 2.80 [71.1]	L: 5.97 [151.6]

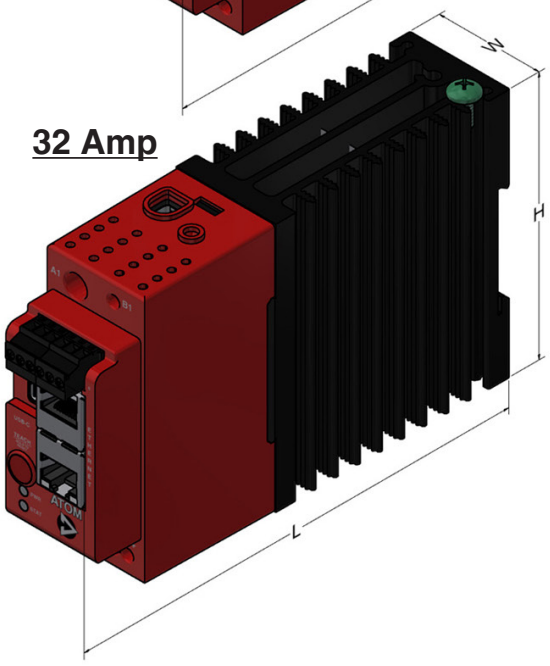
16 Amp



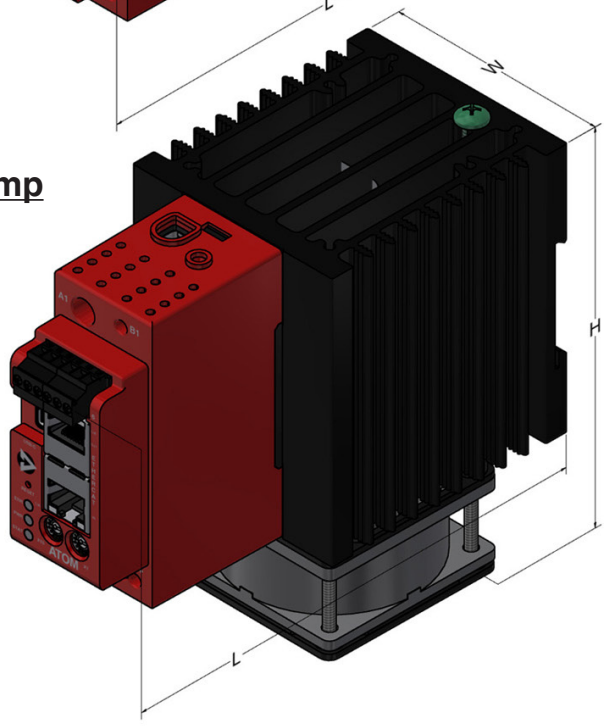
50 Amp



32 Amp



65 Amp

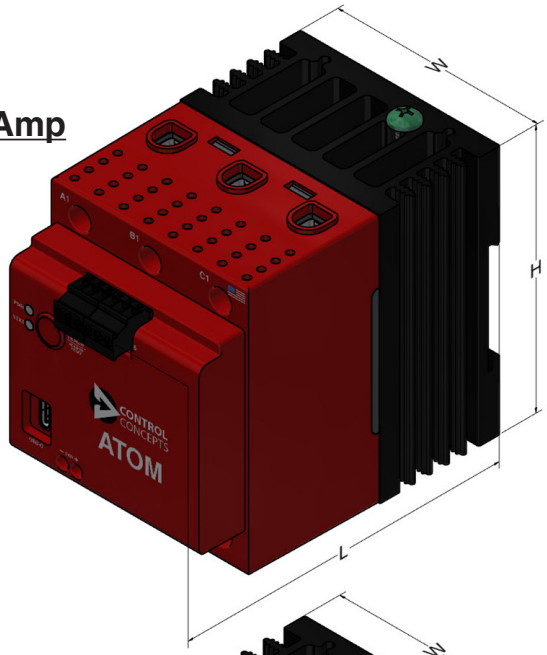


2.2. 3-Phase Dimensions

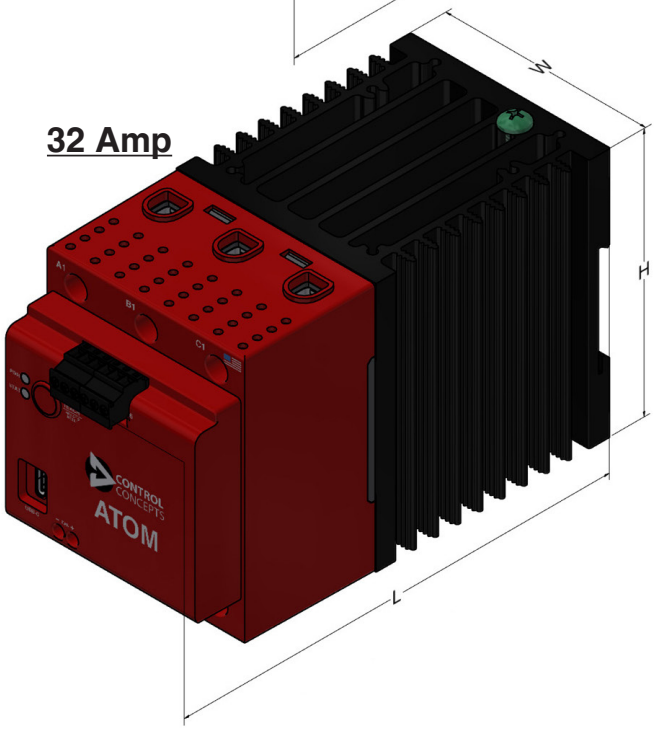
Dimensions:
Inches [mm]

16 A	H: 3.50 [88.9]	W: 2.80 [71.1]	L: 4.37 [110.9]
32 A	H: 3.50 [88.9]	W: 2.80 [71.1]	L: 5.97 [151.6]
50 & 80 A	H: 5.00 [127.0]	W: 2.80 [71.1]	L: 5.97 [151.6]

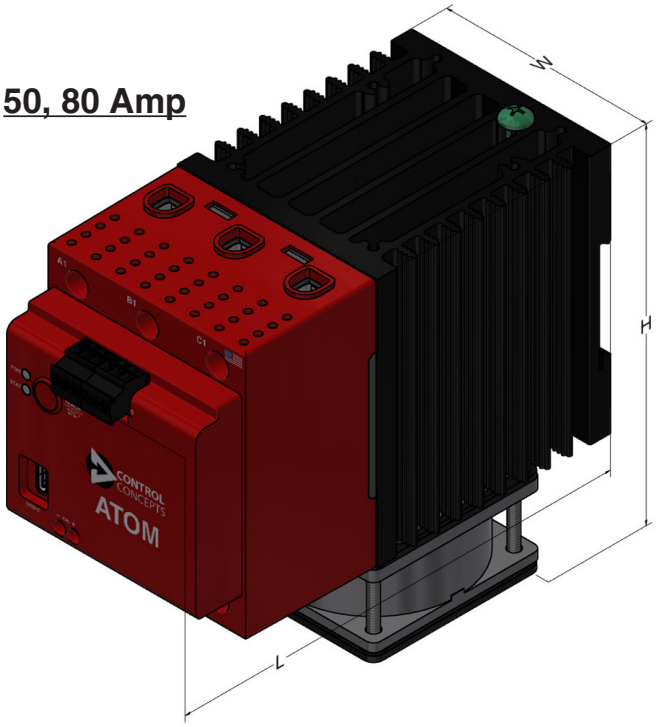
16 Amp



32 Amp

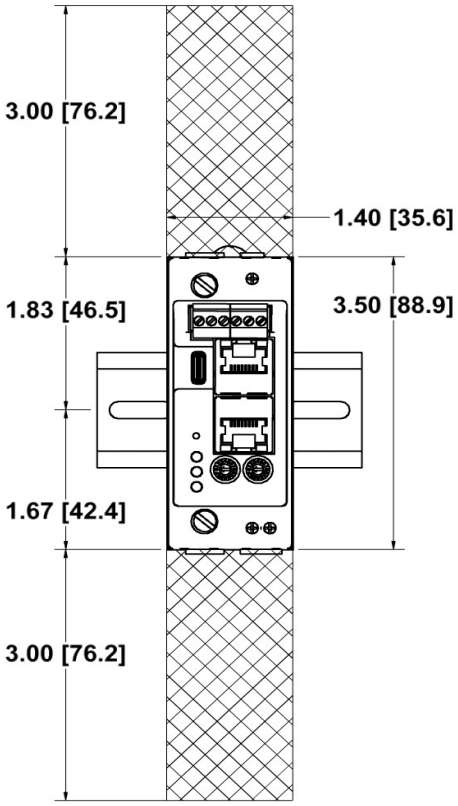


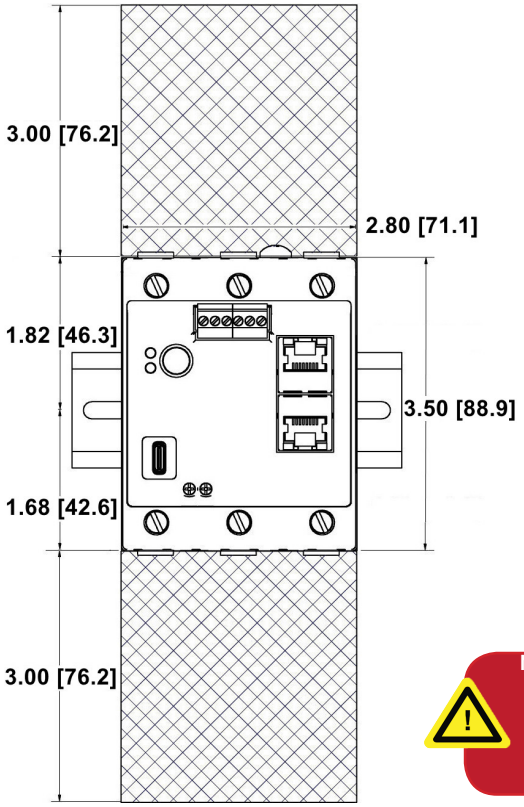
50, 80 Amp

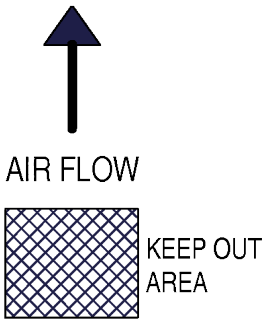


2.3. Mounting Considerations

Dimensions: Inches [mm]







NOTE
Do not remove DIN spring screw.

To remove or install on a DIN rail, push the controller up and tilt out.

Mount controllers vertically.

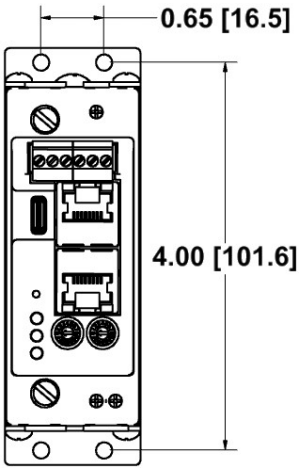
The cross-hatched area on the top and bottom of the pictured controllers designates a keep out area for air circulation. ***All controllers must have a minimum of 3.0" [76.2mm] vertical clearance***, above and below, free of obstructions as measured from the edge of the heatsink outwards.

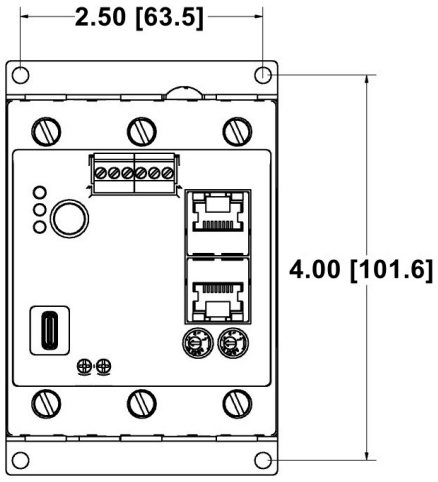
Controllers can be mounted side-by-side with the exception of 3-phase 32 amp models.
This frame size must have a minimum side clearance of 0.5" [12.7mm] between controllers.

Panel Mounting:

When installing without a DIN rail (panel mounted), attach the included mounting hardware with the provided screws to the heatsink base.

To mount to a panel use #6 or M2.5 screws with star washers (not included).





3. WIRING

Control Concepts configures and tests each controller before shipping. Once received,the controller is ready to install. The following sections will describe how to properly wire the unit with the recommended protection.

NOTE
Wire controllers to conform with the National Electric Code (NEC) and/or all local wiring codes.

The following applies to all line/load connections on the controller:

- Use copper conductors rated 75° C minimum.
- Only 1 conductor allowed per terminal.
- Bare wire or ferrules may be used.
- A ground wire is required for proper controller operation.

WARNING
Ensure Line and Load wires are fully inserted and seated. Improper installation may cause connection overheating or controller damage.

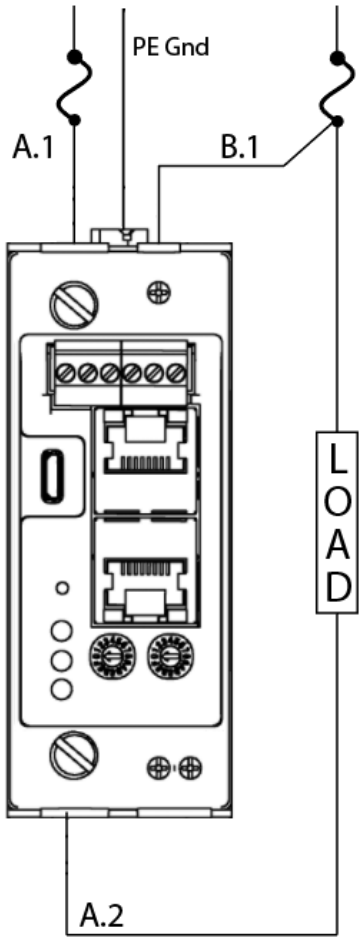
3.1. 1-Phase Wiring Diagram

A.1, A.2

- Use #2 - 14 AWG wire.
- Wire strip length: 0.65” minimum

B.1

- Use #14 - 22 AWG wire.
- Wire strip length: 0.23” minimum
- Maximum current of 0.2 mA at 480 VAC through the B1 reference connection.



3.1.1. 1-Phase Line/Load Torque

Tightening Torque - A1,A2,B1		
	Wire Size (AWG)	Torque
A1, A2	10 - 14	35 Inch lbs [3.9 Nm]
	8	40 Inch lbs [4.5 Nm]
	4 - 6	45 Inch lbs [5.0 Nm]
	2 - 3	50 Inch lbs [5.6 Nm]
B1	14 - 22	2.6 Inch lbs [0.3 Nm]

3.2. 3-Phase Wiring Diagram

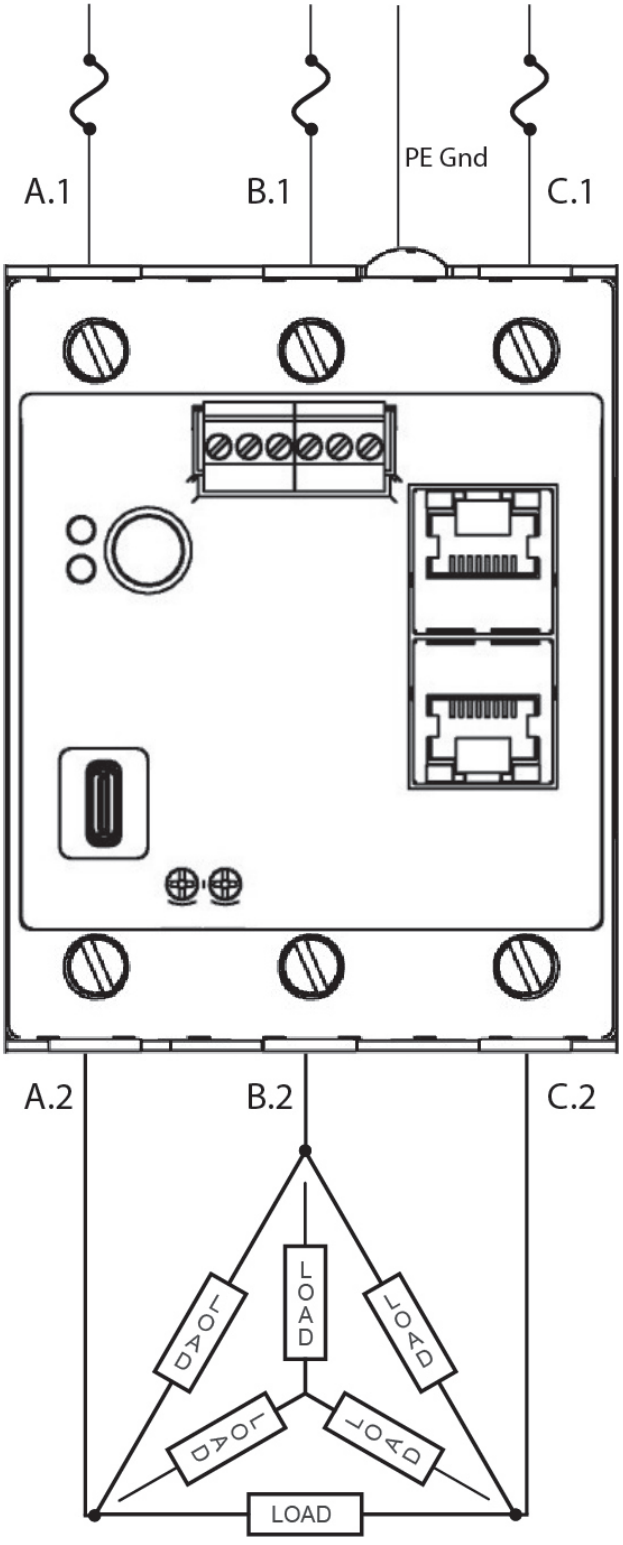
WARNING
Ensure Line and Load wires are fully inserted and seated. Improper installation may cause connection overheating or controller damage.

A.1, B.1, A.2, B.2, A.3, B.3

- Use #2 - 14 AWG wire.
- Wire strip length: 0.65” minimum

3.2.1. 3-Phase Line/Load Torque

Tightening Torque - A1 / A2 / A3 / B1 / B2 / B3		
	Wire Size (AWG)	Torque
A1, A2, A3 B1, B2, B3	10 - 14	35 Inch lbs [3.9 Nm]
	8	40 Inch lbs [4.5 Nm]
	4 - 6	45 Inch lbs [5.0 Nm]
	2 - 3	50 Inch lbs [5.6 Nm]



3.3. Command Connector

The provided 6-pin command connector allows for wiring an external 24 VDC power supply required to power the controller processor and I/O electronics. All models also include connections to the normally open alarm relay. See the I/O section for alarm relay settings and options.

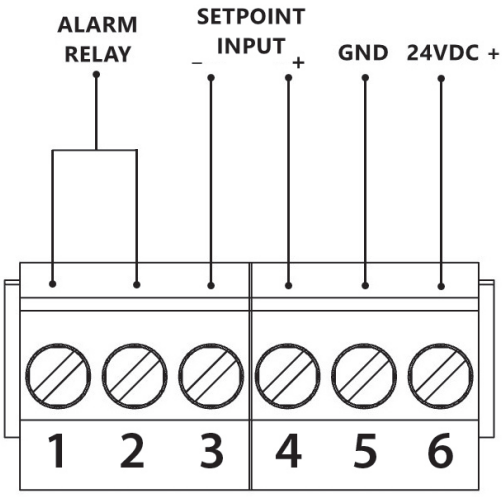
3.3.1. Connector Torque

Tightening Torque - 6-pin Connector	
Wire Size (AWG)	Torque
16 - 26	3 Inch lbs [0.34 Nm]

3.3.2. Analog Connector

Analog 1-phase and 3-phase also include connections to wire an analog setpoint input. See the Basic operation and Settings section, Analog control, for additional information on control via the setpoint input.

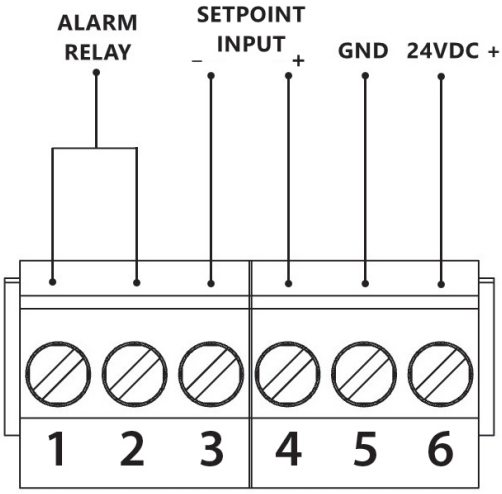
Command Connector	
Pin	
1, 2	Alarm Relay
3	Analog Setpoint -
4	Analog Setpoint +
5	Common/GND
6	24VDC +



3.3.3. Digital Connector

Digital models also include the ability to wire an analog setpoint input. By default, the setpoint select (SP-26) is set to use the Fieldbus setpoint (Setpoint value is stored in RAM).

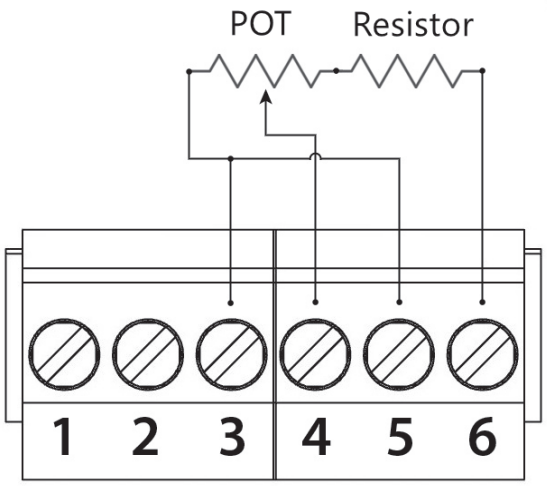
Command Connector	
Pin	
1, 2	Alarm Relay
3	Analog Setpoint -
4	Analog Setpoint +
5	Common/GND
6	24VDC +



3.3.4. Analog POT kit

POT kits are available for ATOM Analog and Digital models. This allows for wiring an setpoint input signal to the controller on pins 4 and 5.

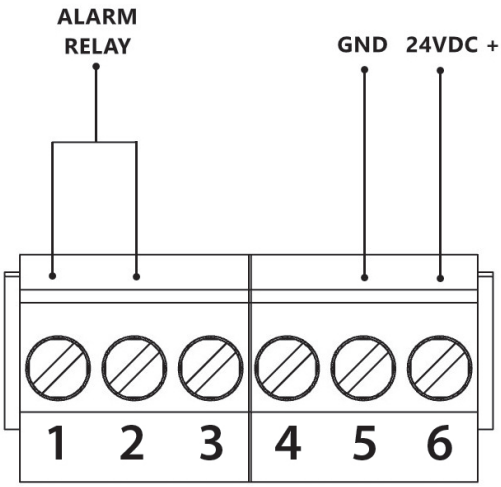
Wire the POT kit as shown below.



3.3.5. EtherCAT Connector

Digital models provide 24 VDC input and alarm relay output. Firing control is done via digital fieldbus settings.

Command Connector	
Pin	
1, 2	Alarm Relay
3	unused
4	unused
5	Common/GND
6	24VDC +



4. INDICATOR LEDS

4.1. LEDs (All Models)

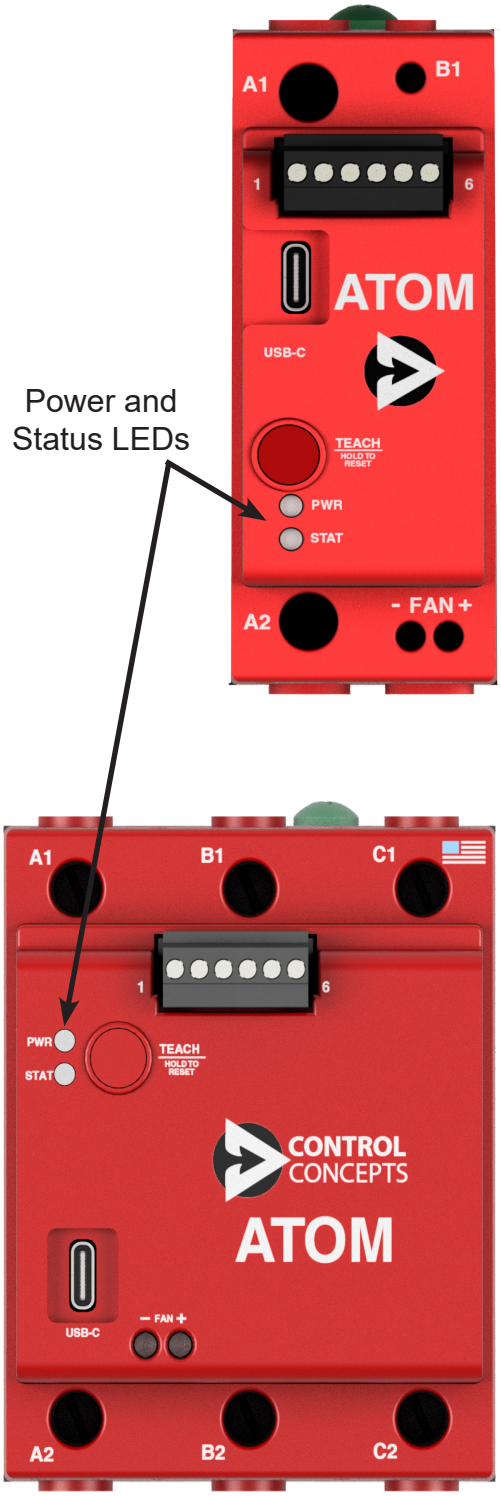
All 1-Phase and 3-Phase ATOM controllers have Power and Status multicolor LEDs. These LED's indicate condition of line input, alarms, and controller output state.

PWR (Power)	
OFF	Controller is off / No 24 VDC Power
GREEN	AC Line Locked in sync
ORANGE	Phase Loss, AC Line voltage is present but too low, or attempting to achieve line lock status
RED	No AC Line Lock, AC Line Lock loss, or no AC Line voltage detected

STAT (Status)	
OFF	None of the states below are active
GREEN	In RUN State, Controller is Outputting[1]
ORANGE	Active Warning Alarm or power-up initialization in progress.
FLASHING ORANGE	Active Partial Load Fault Alarm
RED	Controller in FAULT State
Flashing RED	Error encountered during initialization
Alternating GREEN/ORANGE	In Partial Load Fault Teach Mode[2]
Alternating RED/GREEN	In Flash Programming Mode

[1] Controller is outputting (setpoint > 0%), the brightness of the green LED is proportional to the output duty cycle. (Brighter = higher output duty cycle percent)

[2] Partial Load Fault Teach Mode automatically cancels after 5 seconds have elapsed.
PLF Teach Mode not available on EtherCAT models



The ATOM Controller can also be partially powered by the USB-C connection. If using the Control Panel Software, the dashboard in the software will say 'USB Powered'.

The controller will not output without 24 VDC power applied.

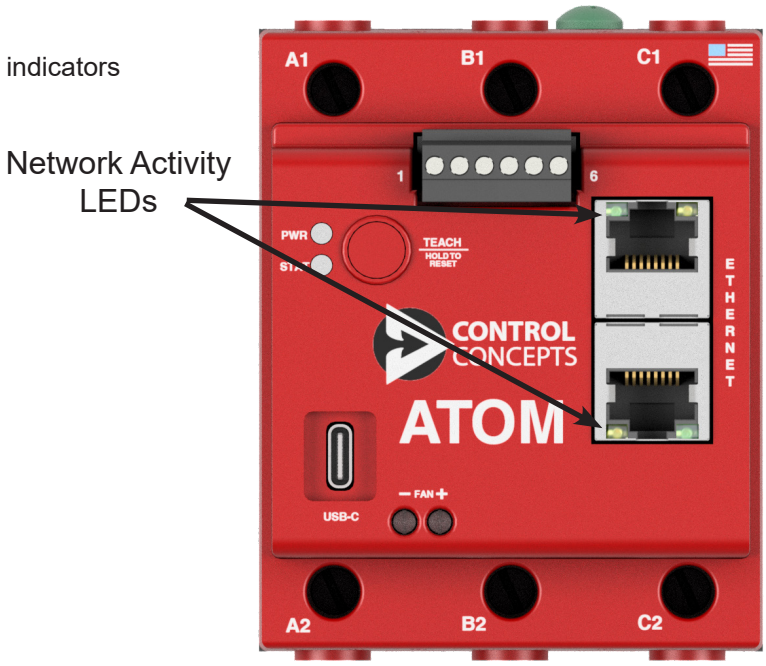
If the 24VDC power supply cannot deliver sufficient current to power the controller and USB is connected, the controller may appear to be powered on but not respond to command signals.

Ensure a 24VDC power supply capable of supplying a minimum of 1 amp is used to power the controller.

4.2. Digital LEDs

Ethernet/IP and PROFINET models have additional LED indicators on the RJ-45 connectors[1] (connection state/activity)

[1] PROFINET is restricted to only 1 active RJ-45 connection.

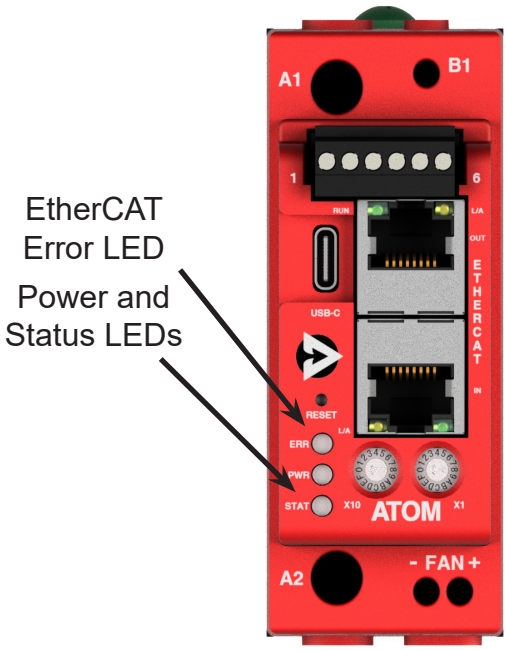


Green (Connection State)	
OFF	No connection state/Not connected
ON	Connected
Flashing	Connection OK and data is transferring

Yellow (Connection Speed)	
OFF	No connection state/Not connected
ON	Negotiated connection speed, 100 Mbps

4.3. EtherCAT LEDs

Along with the standard power and status LEDs, EtherCAT models also have indicators on the RJ-45 jacks and a discrete Error LED. This is used to indicate an error has occured in communication or control on the EtherCAT network.



RUN (EtherCAT State)	
OFF	Init
Blinking	Pre-Operational
Single Flash	Safe-Operational
Flashes	Initialization or Bootstrap
ON	Operational

ERR (Error/EtherCAT State)	
OFF	No Error
Blinking	Invalid Configuration
Single Flash	Unsolicited State Change
Double Flash	Application Watchdog Timeout
Flickering	Booting Error
ON	PDI Watchdog Timeout

EtherCAT® Technology Group

ATOM EtherCAT activity and error LEDs follows the ETG 1300 EtherCAT Indicator and Labeling specification for definition of communication state, errors, and link status.

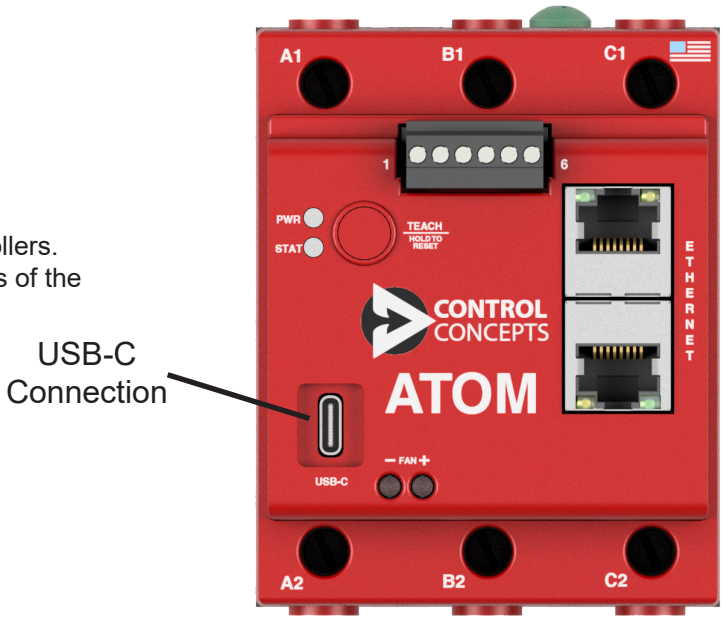
For additional information refer to the EtherCAT Technology group document:
ETG.1300 EtherCAT Indicator and Labeling Specification available on the EtherCAT Technology group website.

5. USB INTERFACE

5.1. USB-C Connection

A high speed USB-C interface is standard on all ATOM controllers. This connection allows configuration and control of all aspects of the power controller.

Control Concepts recommends using high quality, branded USB cables. If connection issues occur with the Control Panel software, try a different cable to see if communication is restored.



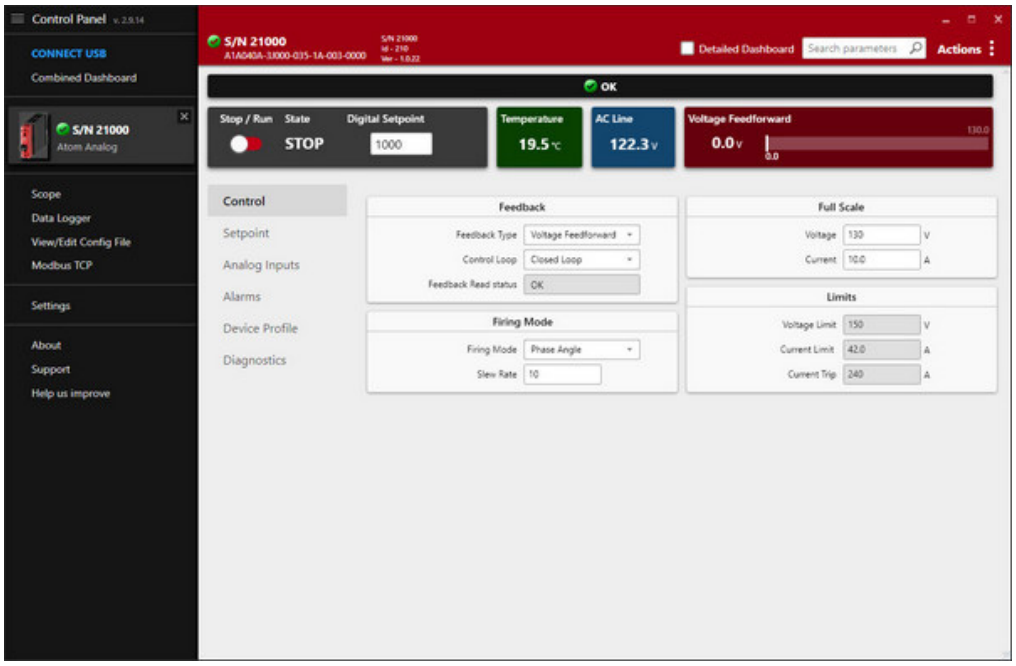
5.2. Control Panel Software

Control Concepts provides a free Control Panel application compatible with Microsoft Windows and Android devices.

The Control Panel app assists with the installation, parameter setup, operation, and troubleshooting of Control Concepts, Inc. devices. Download the Control Panel software on our website at www.ccipower.com.

Refer to the Control Panel User's Manual available on the Control Concepts, Inc. website for additional information. The Control Panel User's Manual describes controller features that are not included in this manual.

- Real-time control, monitoring, and alarms
- Trap and Fault History
- Diagnostics tests
- Save / Restore manufacturing and user default settings
- Load / Save Device configuration files
- Update device firmware
- Data Logging



6. BASIC OPERATION & SETTINGS

The free Control Panel software can be downloaded at
https://ccipower.com/software

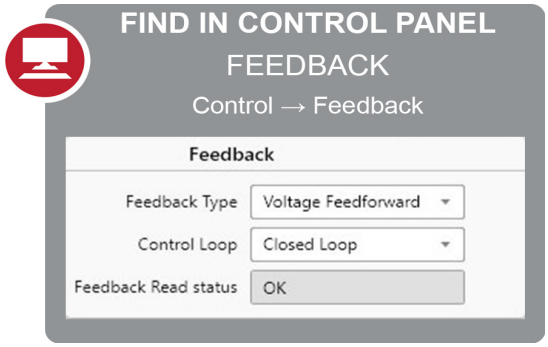
6.1. Overview

The ATOM power controller is easily deployed with the following steps:

1. Install the controller in the desired location with appropriate clearance as shown in the *Installation* section.
2. Wire line, load, and external connector as shown in the *Wiring* section.
3. Apply 24 Vdc power to the command connector (pins 5 and 6) to initiate controller startup.
4. Apply line voltage (voltage range: 24-600 VAC).
5. Apply a setpoint command to adjust controller output.
6. Check the controller LEDS for proper controller operation, see the *Indicator LED* section. (when the controller is outputing the 'STAT' LED will illuminate green.)

Parameters can be modified and operational states monitored using the Control Panel software over a USB connection to the controller. Optionally on models with digital fieldbus communications, settings and monitor parameters can be accessed over a local network using the appropriate protocol. See the *Digital Fieldbus* section for additional information. For expected default and available parameter values see the *Parameter Lists* section of this manual.

6.2. Feedback



6.2.1. Feedback Type [SP-1]

The selected Feedback Type determines the control loop feedback used to control voltage or current to the attached load.

Voltage Feedforward	The control loop makes adjustments to the controller's output according to the setpoint and the controller's AC line supply voltage.
Load Current RMS	The control loop monitors the RMS load current and adjusts the output to supply the desired RMS current to the load according to the setpoint.

6.2.2. Control Loop [SP-4]

The Control Loop offers both closed loop and proportional settings. When in closed loop the controller adjusts output based on the feedback type selected. Proportional mode does not use feedback, therefore in this mode the output duty cycle percentage is directly proportional to the setpoint.

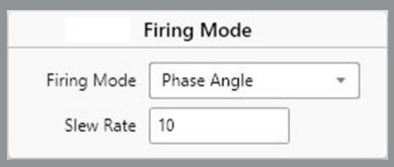
6.2.3. Feedback Read Status [MP-334]

The Feedback Read status displays the state of the internal feedback control circuit. When feedback is functioning normally this value will be (0), displayed as 'OK' in Control Panel. If this parameter reports 'Loss of feedback' (parameter value 1)there has been a failure in the feedback circuit and it is not functioning. An internal hardware failure or malfunction has occured and the controller will need to be replaced.

6.3. Firing Modes

ATOM controllers provide up to six different firing modes depending on configuration and purchased options.
It is critical to choose the correct mode of operation based on the application and type of load you are trying to control.

FIND IN CONTROL PANEL
FIRING MODES
Control → Firing Mode



6.3.1. Firing Mode [SP-2]

Available firing modes by model:

1 - Phase	3 Phase
Zero Cross	Zero Cross
Fast Zero Cross	Fast Zero Cross
SSR - Zero Cross (ON/OFF, proportional)	SSR - Zero Cross (ON/OFF, proportional)
SSR - Phase Angle (ON/OFF, proportional)	
Phase Angle [1]	
Half-Cycle DC (Phase Angle) [1]	

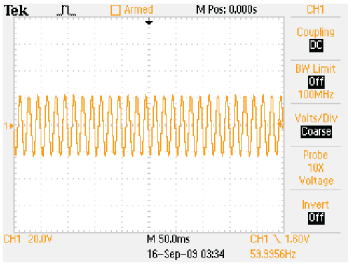
[1] Buy-up option available at time of purchase

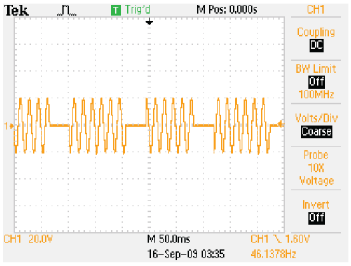
Zero Cross

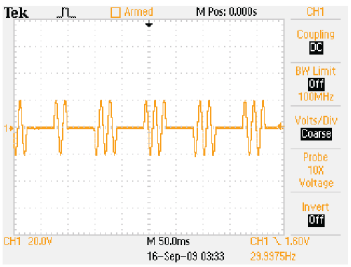
In zero-cross control, load power is turned ON and OFF only when the instantaneous value of the sinusoidal waveform is zero. Load power is controlled by switching the SCR's "ON" for a number of complete electrical half-cycles, and then "OFF" for additional number of complete half-cycles.

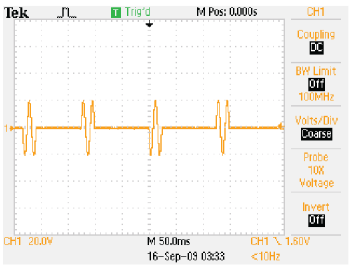
The waveform in the top left of the diagram below shows the 1-phase AC waveform into the controller. This would also be the representation of the output if the setpoint command is at 100%. The remaining waveforms show the "ON" and "OFF" cycles of the output at various setpoints.

The Load Power Timing tabulation shows the sequence of "ON" and "OFF" half-cycles that are applied to the load to achieve the percentage of load power indicated. The percentage of load power is equal to the ratio of the number of half-cycles that power is applied, to the total number of half-cycles.









Load Power Timing				
10%	25%	50%	75%	85%
5 ON	5 ON	9 ON	17 ON	23 ON
46 OFF	14 OFF	8 OFF	6 OFF	4 OFF
5 ON	5 ON	7 ON	19 ON	23 ON
44 OFF	16 OFF	8 OFF	6 OFF	4 OFF
				23 ON
				4 OFF
				23 ON
				4 OFF
				23 ON
				4 OFF
				21 ON
				4 OFF

Fast Zero Cross

In standard Zero Cross firing the applied power is ON for 3 half-cycles and OFF for 2 half-cycles. In Fast Zero Cross firing mode applied power is ON for 2 half-cycles and OFF 2 half-cycles. The quick change in applied power cycles allows the controller to provide a smoother output at a lower power value.

For a temperature dependant system, the Fast Zero Cross firing mode allows for a more controlled heating over time at a lower input power level. Because the power is on a 2-ON/2-OFF half-cycle routine the output will have a decrease in temperature dips and spikes, which are often found in a simple Zero Cross firing mode.

NOTE: Due to the decrease in time between cycles, the Sync-Guard feature is unable to be utilized in Fast Zero Cross mode.

SSR - Zero Cross and Phase Angle (Random Relay Mode)

About SSR firing:

The control output is either full ON or OFF. The setpoint must be 100% to turn the output ON, and 0% to turn the output OFF. Setpoint values between 0% and 100% will not change the state of the output.

SSR - Zero Cross
The output will turn ON at the point where the AC Line crosses zero.

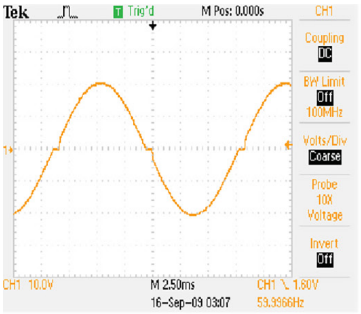
SSR - Phase Angle (Random)
The output will turn ON as soon as the setpoint reaches 100%. This can happen at any point during the AC Line half cycle.

Phase Angle

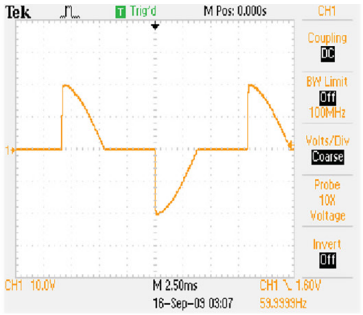
In Phase Angle control each SCR of the back-to-back pair is turned on for a variable portion of the AC half-cycle that it conducts. Power is regulated by advancing or delaying the point at which the SCR is turned ON within each half cycle. Light dimmers are an example of Phase Angle control.

Phase Angle provides a very fine resolution of power and is used to control fast responding loads such as tungsten filament lamps or loads in which the resistance changes as a function of temperature.

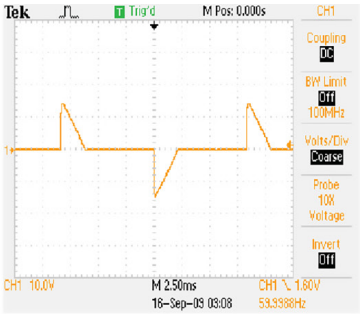
Single Phase Operation



100% Load Power



50% Load Power



25% Load Power

Slew rate setting [SP-3] is used when in phase angle firing mode. The slew rate parameter is adjustable with the Control Panel software when 'Phase Angle' is selected.

Half-Cycle DC

The controller will fire one SCR during the positive half-cycles of the AC Line voltage. The controller will not fire during the negative AC Line half-cycles. The output will phase angle fire during the ON/positive half-cycles in order to vary the output according to the setpoint to provide the desired DC power to the load.

6.3.2. Slew Rate [SP-3] (1-Phase ATOM only)

To reduce errors and increase control loop stability ATOM single phase uses the concept of Slew Rate. Slew rate adjustment is available in phase angle and half-cycle DC firing modes. The Slew Rate is used to adjust the time the control loop takes to respond to a change in feedback signal or setpoint. This value is dependent upon accurately setting Full Scale Voltage [SP-5] and Full Scale Current [SP-6] for the actual load.

Failure to properly set the full scale settings will result in either an overly aggressive or sluggish control loop, see section 6.4 Full Scale Settings for more information.

The following table lists the time constants relative to the value of this parameter.

NOTE: The default value used by the controller from the manufacturer is 10

Slew Rate	T (msec)	5 T (sec)
1	50	0.25
5	100	0.5
10	200	1.0
20	300	1.5
30	400	2.0
40	500	2.5
50	600	3.0
60	675	3.4
70	750	3.75
80	850	4.25
90	900	4.5
100	1000	5

Slew Rate time constants

Time Constant T (63.2% of final value) and 5T (99.3% of final value) for the vairous Rate entries.

A smaller number represents a faster responding system, the larger the slew value, the slower the controller will respond to feedback.

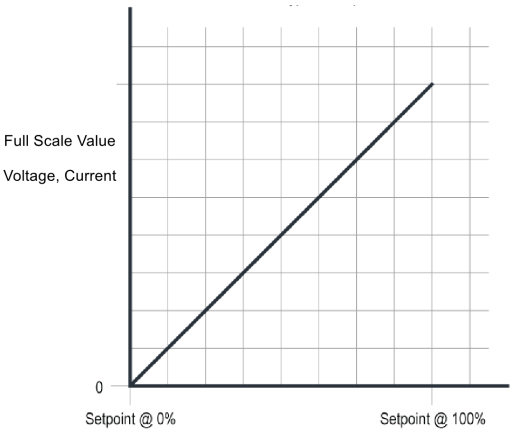
NOTE
These times are for reference only. Actual times may vary depending on the source, the load, as well as the accuracy of the full scale settings.

6.4. Full Scale Settings

Feedback type selects the signal you want to control. These settings deal directly with the full scale settings (Full Scale Voltage and Full Scale Current). When using the voltage feedforward setting, the feedback will be proportional to the full scale voltage. When using load current the feedback will correspond to the full scale current value.

The Full Scale settings are an important factor in calculations for command input, scaling, limits, and control loop response.

It is recommended that Full Scale settings should not be set to more than 2X the actual full load operating value.



How the setpoint corresponds to the full scale value

6.4.1. Full Scale Voltage [SP-5]

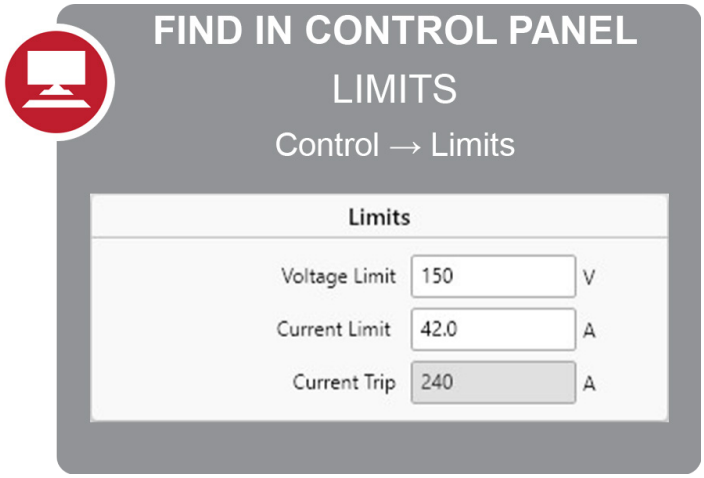
The Full Scale Voltage is the voltage that will be applied when the controller is at 100% output duty cycle. The closer the Full Scale Voltage is to the actual line voltage the more accurate the controller will be in response and control of the output. Setting this slightly higher than the actual voltage is common, but typically set to expected AC line voltage. The factory default setting for this value is 480 V.

6.4.2. Full Scale Current [SP-6]

The Full Scale Current is the current that the load will draw with the controller output 100% on. The closer this is set to the actual current, the more accurate the controller will be.
The factory default setting for this value is equal to the frame rating of the controller.

6.5. Limit Parameters

These parameters are safety features designed to help protect the load from excessive voltage and/or current.



6.5.1. Voltage Limit [SP-7]

Limits the load voltage to prevent the controller from exceeding this value. If the voltage reaches this value a warning alarm will be triggered indicating that the voltage limit has been reached. Optionally a Relay Alarm Mask may be selected to enable the alarm relay to activate when this value has been reached.

The recommended setting for the voltage limit is 105% of the full scale voltage [SP-5]. The default value is 700 volts.

6.5.2. Current Limit [SP-8]

Available as a purchased upgrade at time of order.
The Current Limit setting limits the load current to prevent the controller from exceeding this value. If the current reaches this value a warning alarm will be triggered indicating that the current limit has been reached. Optionally a Relay Alarm Mask may be selected to enable the alarm relay to activate when this value has been reached.

The valid value range of this parameter is 20% to 105% of the frame current rating.
The default value is 105% of the frame current rating.

6.5.3. Overcurrent Trip [SP-09]

This feature is designed to protect the controller from surge currents that could cause controller malfunction or failure. If the load current exceeds the overcurrent trip value the controller will shut down. The response is faster than current limit. When an over-current trip occurs the controller will disable the output, display the condition on the LED indicators, and activate an inhibit alarm. An overcurrent trip will occur if the load current exceeds 240 amps.

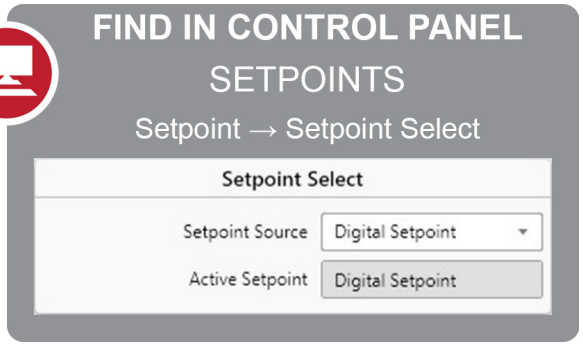
6.6. Setpoints

Depending on the model, there are 3 possible setpoint sources: Analog, Digital, and Fieldbus.

Analog and Digital controllers provide both a wired analog setpoint signal input (wired to pins 3 & 4 of the 6 pin connector), and a digital setpoint that can be set by modifying the associated parameter [SP-23] within the Control Panel software. The digital setpoint is stored in non-volatile/EEPROM memory and will be retained across controller restarts.
See *Analog Input* for additional information regarding this control method.

Digital models share the same digital setpoint as the analog models but also include a Fieldbus Setpoint [SP-24] that can be controlled over fieldbus communication. This value is stored in RAM and will be set to 0 on any controller restart.

6.6.1. Setpoint Source [SP-26]



This will select the setpoint to use for control.

Analog Setpoint

On models with an analog setpoint input, selecting 'Analog Setpoint' will use the analog input for control. The live analog input value and RUN state will be shown in the Control Panel dashboard.

In all firing modes except SSR[1], any setpoint input value above 0% will cause the controller to start outputting and a 0% input will turn the output off.

[1] In SSR modes only an input value of 0% will turn output off, and 100% will start outputting. Any other value will not change its current state.



For additional information on configuring the Analog Input see section 6.8.

Digital Setpoint



Selecting 'Digital Setpoint' sets the controller to use the digital setpoint value entered in Control Panel that is stored in [SP-23].

A value of 0 = 0% of full scale, 10000 = 100% of full scale.
So for example a digital setpoint of 5000 would set the controller to 50% of full scale.

NOTE: This value is stored in non-volatile/EEPROM memory and is restored to the parameter value on a controller restart.

Fieldbus Setpoint

The setpoint is controlled over the fieldbus interface.
See the appropriate protocol in the *Digital Fieldbus* section of this manual.

NOTE: This value is stored in RAM memory and will be set to zero on a controller restart.

6.7. Run / Stop

NOTE: ATOM Analog does not use Digital RUN Enable and will always be in RUN state unless an inhibit alarm is triggered.

The Digital RUN Enable [SP-25] puts the controller into RUN or STOP state. The Run/Stop state indicates if the controller can output. When in RUN state, the controller is able to output, however, RUN states does not mean the controller is outputting - the command setpoint must be set to a non-zero value or input percent[1]. When in STOP state the controller doesn't output regardless of setpoint value.

[1] In SSR modes only an input value of 0% will turn output off, and 100% will start outputting. Any other value will not change its current state.

If the controller is firing (outputing) the status LED will turn green. The luminosity of the light will indicate the percentage of output to where the brighter the green light, the higher the output. The status LED will be off when the controller is not outputting. This does not represent the state of the Run/Stop, the controller could be in run, but with a 0% setpoint and the LED will be off (no output).

6.7.1. Controller State [SP-212]

The controller state monitor parameter shows whether the controller is in RUN, STOP, FAULT, or FAULT RESET.

STOP

Stop is the default state, the controller will be in stop state when AC Line voltage is not present. The controller can also be placed in stop state with AC line present by setting the Digital RUN Enable [SP-25] to STOP (0).

RUN

RUN state may be enabled when AC line is present and no inhibit alarms are active by setting Digital Run Enable to RUN (1). If there is a setpoint greater than 0 set, the controller will start outputting.

FAULT

Fault state is a latching state that indicates an inhibit alarm or critical event has occured while the controller was outputting. To recover the controller from fault state, set Digital RUN Enable [SP-25] to STOP (0). This will put the controller into Fault Reset state. If the cause of the fault is no longer present then the controller may be set back to RUN (1) and it will resume outputting if a setpoint value above zero is set.
For an overview of inhibit alarms see the *ALARMS* section of this manual.

NOTE: Analog controllers cannot be fault reset and must be power cycled or manually reset using the hardware switch to resume from a fault state.

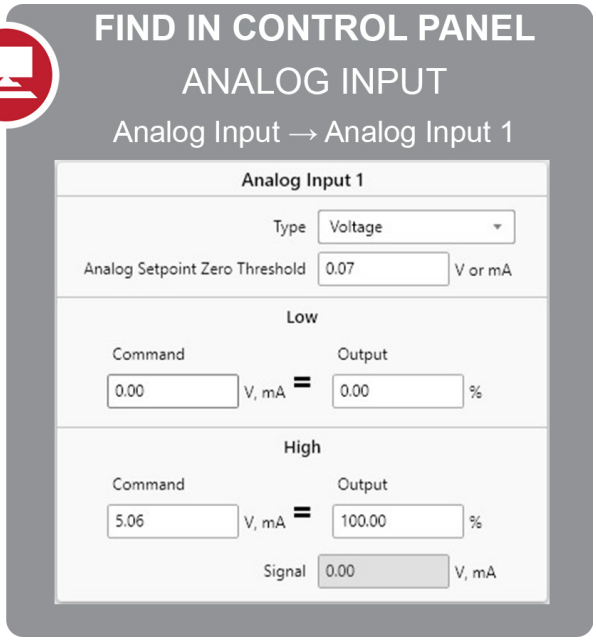
FAULT RESET

The controller state parameter will contain this value if the controller has been in a Fault state and then the Digital RUN Enable has been set to the STOP state.

6.8. Analog Input

Analog input is available on the Analog and Digital models.

The analog input is wired to the command connector and can be configured for voltage or current via the Control Panel software and provides a setpoint signal for controller output.



6.8.1. Analog Setpoint Type [SP-11]

Select ‘Voltage’ when connecting to a voltage source. Input range is 0-10Vdc (0-32Vdc when in Relay firing mode). Select ‘Current’ when connected to a current source. Input range is 4 to 20mA.

6.8.2. Analog Setpoint Zero Threshold [SP-10]

When the command signal [MP-203] is below the Zero Threshold the controller output setpoint becomes 0. The default value is 0.05

6.8.3. High and Low Command Settings

Set the low and high command and output values to set the span of the input value to setpoint command output.

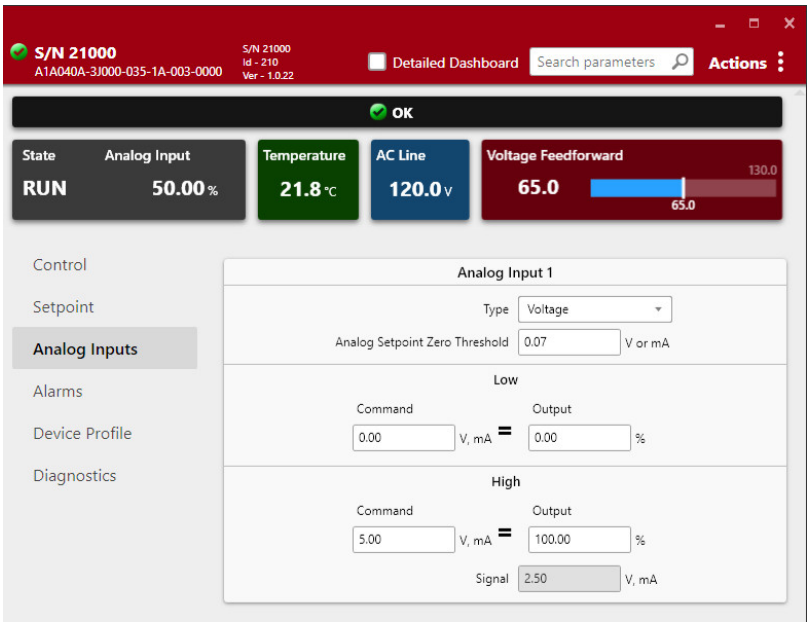
Example: Map 0 to 5Vdc input signal to 0 to 100% setpoint:

1. Set the Analog Input Type [SP-11] to 'Voltage'
2. Set the Analog Setpoint Low Command parameter [SP-12] to 0.00
3. Set the Analog Setpoint Low Output parameter [SP-13] to 0.00
4. Set the Analog Setpoint High Command [SP-14] to 5.00
5. Set the Analog Setpoint High Output parameter [SP-15] to 100.00

The controller will then output on any signal above the low command value with a setpoint command that follows the input linearly as the input command value changes.

In the image below we see a 0-5Vdc command signal mapped to 0 to 100% setpoint.

The analog input signal is reading 2.50v resulting in the controller at 50% output. The feedback circuit is reporting 65.0 volts, in this example the full scale voltage is set to 130V, the voltage feedback is reports 50% of the full scale voltage setting for a result of 65V.



Example showing a 0 to 5 Vdc analog input command mapped to a 0 to 100% setpoint. A 2.5v input signal results in a 50% setpoint output.

6.8.4. Analog Input with SSR Firing mode

In SSR firing mode the controller is either off (no output) or on (100% output) with changes > 0 and < 100 causing no change to the controller output. The input command can be mapped to a 4 to 32VDC (or 4-20mA) input range.

Example: Map a 4 to 32Vdc input signal to 0 and 100% setpoint:

1. Set the Analog Input Type [SP-11] to 'Voltage'
2. Set the Analog Setpoint Low Command parameter [SP-12] to 4.00
3. Set the Analog Setpoint Low Output parameter [SP-13] to 0.00
4. Set the Analog Setpoint High Command [SP-14] to 32.00
5. Set the Analog Setpoint High Output parameter [SP-15] to 100.00

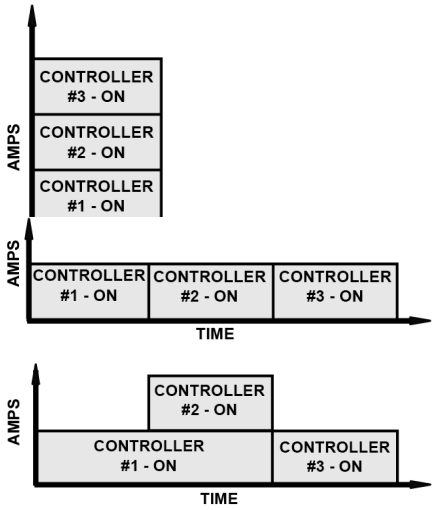
In the example above the controller would turn on with a voltage signal of 32 Vdc and would turn off (stop outputting) when the voltage signal is 4 Vdc.

6.9. SYNC-GUARD™

NOTE:
SYNC-GUARD is available on all Digital Ethernet Controllers in Zero-cross firing mode when the controllers are connected together on an Ethernet network. This feature is not compatible with Fast Zero Cross or SSR random relay modes.

SYNC-GUARD is useful whenever there are two or more power controllers connected to the same power source with zero-cross firing mode selected. SYNC-GUARD can significantly reduce the peak current required from a source that is supplying AC power to multiple power controllers while all are zero-cross firing.

Without SYNC-GUARD, multiple zero cross controllers could potentially be ON and OFF at the same time. This would require much greater current drawn from the source while the controllers are ON, and no current when they are OFF. The SYNC-GUARD feature works to reduce peak current draw required from the source by allowing each controller to attempt to find a time to turn ON when fewer, or no other, controllers are firing.



When enabled, SYNC-GUARD reduces the possibility of synchronous firing of two or more controllers. This feature does not alter the power applied to the load, but adjusts the time when power is applied in such a manner as to reduce the chance of multiple controllers simultaneously being ON or OFF.

Limitations:

SYNC-GUARD works to reduce the peak current draw from a source powering multiple controllers. Each controller cannot predict when another controller is going to fire. The probability of multiple controllers firing at the same time still exists when SYNC-GUARD is enabled. This most commonly occurs if many controllers transition to the RUN state and begin outputing at the same time.

SYNC-GUARD is compatible with up to 10 controllers on the same network.

6.9.1. SYNC-GUARD Enable [SP-50]

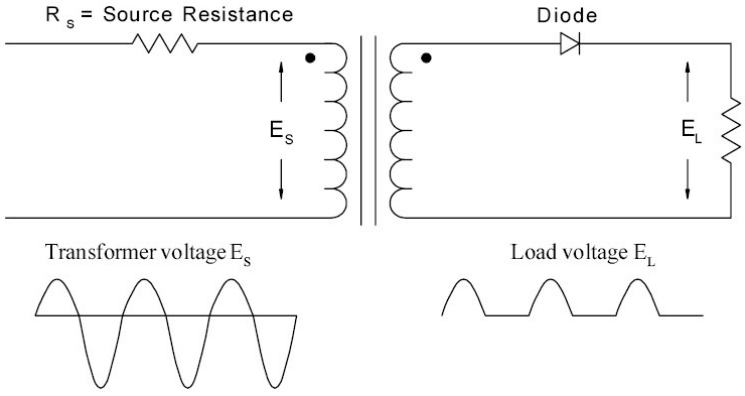
Sets the state of the SYNC-GUARD feature.
When a compatible zero-cross firing mode is selected, this parameter is able to be enabled/disabled through fieldbus communications or within Control Panel under the Firing Mode selections.



6.10. TRANS-GUARD™

The use of zero-cross controllers on the secondary of a transformer can cause saturation of the transformer resulting in excess transformer temperatures and early transformer failure.
A power controller firing in zero-cross with TRANS-GUARD eliminates this problem by always supplying the same number of positive ON half-cycles as negative OFF half-cycles. This technique guarantees that no DC will occur independent of the source impedance or the load configuration.

TRANS-GUARD is always enabled and active on ATOM controllers when in Zero-Cross/Fast Zero cross firing modes.



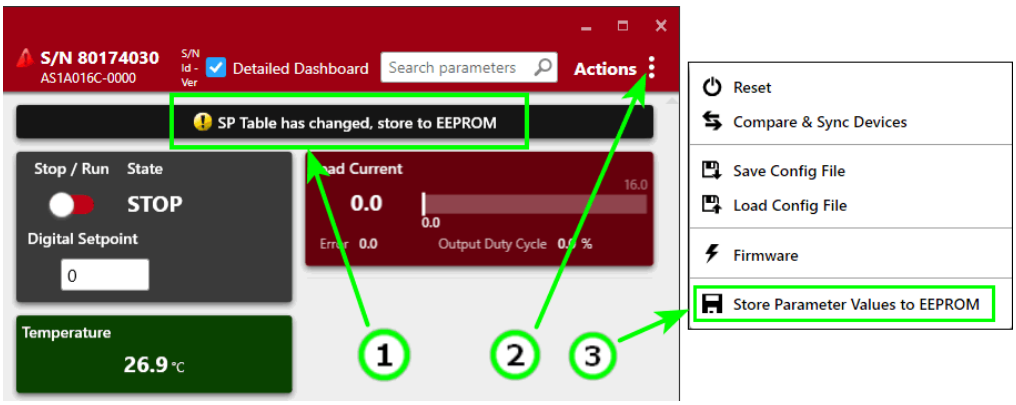
Transformer saturation due to secondary DC current

6.11.EtherCAT EEPROM

ATOM EtherCAT models store SP parameters in RAM. Changes made to any SP values that want to be saved across a controller restart need to be written to EEPROM either with the Control Panel Application or an EtherCAT SDO message.

Saving parameters with Control Panel

Control Panel will show a notice when parameters have changed and have not been saved to the controller.



1. Control Panel Indicates there are unsaved SP parameter changes
2. Click the 3 dot Actions button
3. Click ‘Store Parameter Values to EEPROM’ to save current values to non-volatile memory

7. ALARMS & MONITORS

ATOM power controllers offer numerous monitors and internal systems that continuously oversee and audit critical processes. Reporting consists of LED indicators on the controller. Diagnostic and status data available is also accessible through the fieldbus interface on digital models. The Control Panel software when connected over USB to the controller displays all live data and configuration options and can access additional resources available on the controller.

Additionally all models include a solid state relay that can be mapped to the various alarms allowing signaling or response of external hardware in the event of abnormal system operation.

7.1. Warning Alarms

Warning alarms are unexpected events that require alerting the operator to unusual or dangerous conditions that should be investigated or monitored, but controller output will be allowed to continue while the alarm is active. Controller output may be limited as with the case of Voltage or Current Limit alarms.

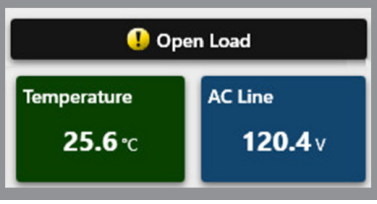
Warning alarms will be displayed in the Control Panel status bar and the Status LED on the controller will turn orange.

NOTE: When a condition that triggered the warning alarm returns to its normal range the warning alarm will clear automatically.

FIND IN CONTROL PANEL

WARNING ALARMS

Active Warning alarms are displayed with a yellow icon in the “Status” section of the Control Panel dashboard



7.1.1. Voltage Limit

The controller voltage output has reached the value set in the Voltage Limit [SP-7] parameter. When this occurs the controller will restrict voltage output to the voltage parameter value regardless of an increase in setpoint passed the output duty-cycle percent where the voltage limit was reached.

7.1.2. Current Limit

The controller current output has reached the value set in the Current Limit [SP-8] parameter. When this occurs the controller will restrict current output to the current limit parameter value regardless of an increase in setpoint passed the output duty-cycle percent where the current limit was reached.

7.1.3. Partial Load Fault

Partial Load Fault is enabled and the controller has detected a variation in load resistance that is outside the tolerance value of the target resistance. For additional information and settings see the *Partial Load Fault Detection* section.

7.1.4. Open Load

Open Load Detection is enabled and the controller detects a change in load current outside of the expected range. For additional information and settings see the *Open Load Detection* section.

7.1.5. Shorted SCR

Shorted SCR Check is enabled and the controller has detected the SCR has become shorted. It is important to note that when the SCR is shorted and the controller is outputing, it will continue to output regardless of the run/stop/fault and setpoint states. For settings and additional information see the *Shorted SCR Detection* section.

7.1.6. High Temperature

The controller has exceeded the high temperature threshold of 100° C. The controller will continue to operate but a high temperature warning will be displayed on the Control Panel dashboard until the temperature returns to the normal range.

7.2. Inhibit Alarms

Inhibit alarms are detected conditions that are considered serious enough that controller output should be stopped until the condition causing the alarm returned to a normal state or is corrected.
When an inhibit alarm occurs the controller status [SP-212] will be set to FAULT (2) and controller output will be disabled. The status LED on the controller lid will turn red to indicate the output is in inhibit state.

To resume operation after an inhibit alarm is active on a digital model ATOM the controller RUN Enable [SP-25] must be set to STOP (0) which will put the controller FAULT RESET, then if the RUN Enable is set back to the RUN (1) setting and the condition has cleared, output will resume according to the commanded setpoint.

On the Analog ATOM model the only way to resume output after an inhibit alarm is to power cycle or reset the controller using the hardware switch.

7.2.1. AC Line Lock Loss

If there is an interruption or loss of AC line voltage to the controller during operation this inhibit alarm will trigger.
The Power LED will turn red to indicate the loss of AC Line Lock and the Status LED will turn red to indicate the controller is in Fault state.

7.2.2. Over Current Trip

Current through the load has exceeded the value of the Current Trip parameter [SP-9].
The over-current limit is set to 240 amps from the factory and cannot be changed.

7.2.3. Over Temperature

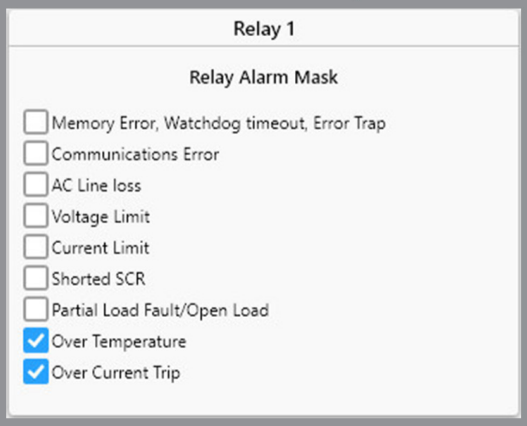
The controller has exceeded the maximum safe operating temperature. If this condition occurs check all mounting clearances and airflow for the controller. If the ATOM controller is equipped with a fan, ensure it is unobstructed and operating normally. The over temperature limit is set to 105° C.

7.2.4. Feedback Loss

A malfunction has occured in the internal feedback circuit in the controller. If the Feedback Read Status [MP-334] indicated a fault the controller has sustained an internal malfunction or unexpected condition. If this alarm does not reset after a power cycle the controller has failed and will need to be replaced.

7.3. Relay Alarm Mask

FIND IN CONTROL PANEL
RELAY ALARM MASK
Alarms → Relay 1



ATOM controllers are equipped with one normally open relay accessible on pins 1 and 2 of the 6-pin command connector.

When a relay alarm mask is set for an alarm the relay will close any time that alarm is triggered. All alarms mapped to the relay are OR'ed together so any or all alarm states can control the relay simultaneously. The relay will open when an existing alarm clears unless another triggered relay mask alarm has also closed the relay.

Alarm	Description
Memory Error Watchdog Timeout Error Trap	An internal processor error has occured during initialization or operation.
Communications Error	A fieldbus network error occured
AC Line Loss	AC phase loss has been detected
Voltage Limit	Load voltage has reached the Load Voltage Limit parameter value
Current Limit	Load current has reached the Load Current Limit parameter value
Shorted SCR	The controller has detected that the SCR is shorted.
PLF/Open Load	A partial load fault or open load condition has been detected
Over Temperature	Controller operating temperature has exceeded the over temperature rating
Over-current Trip	Load current has exceeded the Current Trip parameter value

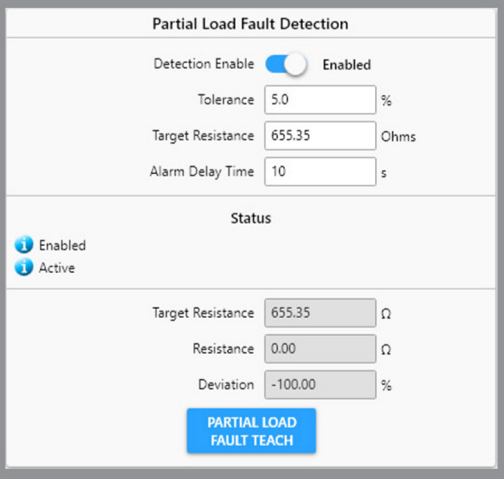
Alarm Relay Specifications:

Normally open, Solid State, Form A
60 Vdc 100 mA / 42 Vac 100 mA RMS

The relay alarm mask is enabled for Over Temperature and Over-current Trip by default.

7.4. Partial Load Fault Detection

FIND IN CONTROL PANEL
PARTIAL LOAD FAULT DETECT
Alarms → Partial Load Fault Detection



The Partial Load Fault (PLF) Detection is a "watch-dog" feature that monitors the load for changes in resistance. This is useful for detecting an element failure in loads with multiple parallel elements. The detection circuit reads the actual load resistance and compares it against the saved target resistance. If it falls outside the tolerance value percent the system will trigger the partial load fault warning alarm. The controller status LED will flash orange while this alarm is active. A warning will also be displayed on the Control Panel dashboard status bar and in the PLF status frame under Alarms.

PLF Detection is only active when the controller is outputting.

NOTE: Partial Load Fault Detection will not work properly with transformer-coupled loads or resistive loads whose resistance varies greater than 10%. PLF should never be enabled in those instances.

Partial Load Fault Status

The status frame in Control Panel displays the current state of the detection circuit. The status values are as follows:

Status	Description
OK	PLF Detection is disabled
Enabled	PLF Detection is enabled
Active	The PLF circuit is monitoring the load for resistance changes
Partial Load Fault A	A load fault has been detected (warning alarm is active)

Changing Target Resistance / Teach Mode

In Control Panel the target resistance can be set manually by changing the value in the Target Resistance parameter [SP-18] or set from the current load resistance by pressing the Partial Load Fault Teach button in the PLF frame.

Using the Teach Button on the Controller

The live calculated load resistance can be saved by using the Teach button[1] on the ATOM controller.

To set the Target Resistance with the Teach Button:

Momentary press the Teach/Reset button on the controller - The Status LED should begin flashing orange
Press the Teach button again within 5 seconds to save the resistance to the controller
If the button is not pressed a second time the teach mode will cancel and the controller will resume normal operation.

Partial Load Fault Detection will not be active when in teach mode.

[1] Manual Teach button is not available on EtherCAT models.

7.4.1. Tolerance [SP-17]

The value of this parameter is the percentage of deviation allowed between the expected target resistance and the actual resistance of the attached load before a partial load fault alarm is triggered.

7.4.2. Target Resistance [SP-18]

This value is the expected resistance of the attached load, either manually entered, or learned via the teach function.

7.4.3. Alarm Delay Time [SP-19]

The time in seconds the Partial Load Fault circuit should wait before triggering a warning alarm after a load fault has been detected. The time is configurable by the operator and is defaulted to 10 seconds.

7.5. Shorted SCR Detection

Shorted SCR detection is always performed when AC Line is ON and the controller's output is OFF. Due to feedback signal delay, the output must be off for at least 8 half cycles (4 line cycles) before the shorted SCR check can be performed.



Firing modes Zero-cross & Fast Zero-cross may be checked during off periods, between firing, or if the off periods are less than 4 cycles the output will be turned off every 30 seconds for 4 cycles in order to check for a shorted SCR.

This is performed when the controller's output duty cycle% is less than 95%.

Shorted SCR load current threshold for detection: ¼ Full Scale Current setting (SP-6) with a minimum = 1 A
If the Load current, while the output is OFF, is greater than the threshold it is determined to be a shorted SCR.

The Shorted SCR Detection Enable parameter [SP-21] enables or disables this monitor.

7.6. Open Load Detection

The controller detects an open load by monitoring its output duty-cycle and load current while outputing.

When the output duty cycle is at least 10% and the load current is less than 5% of the Full Scale Current [SP-6] setting (or 250 mA minimum) the controller will trigger an open load warning alarm.
This alarm has a 5 second delay after detection before the alarm is set or cleared.

The Open Load Detection Enable parameter [SP-22] enables or disables this monitor.

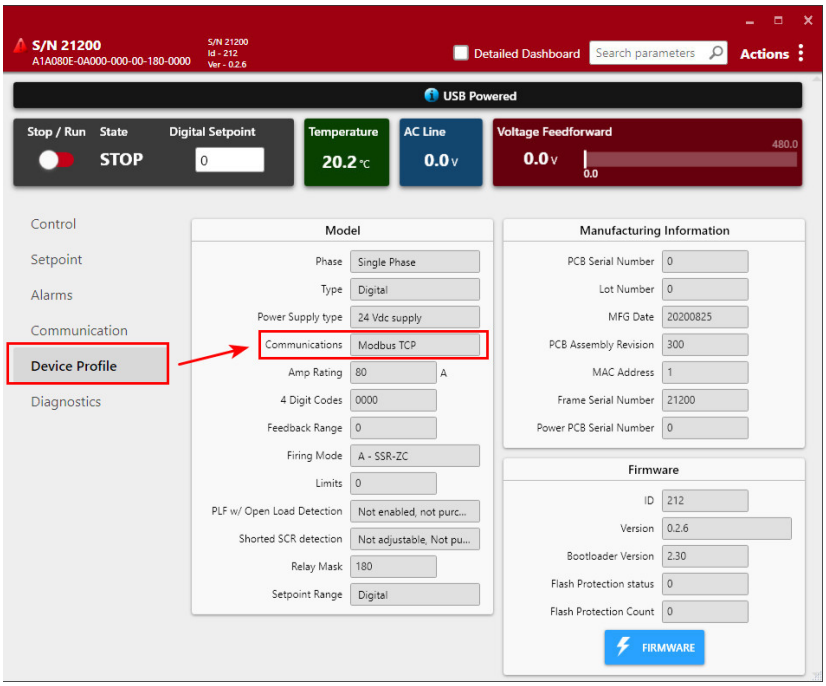
8. FIELDBUS COMMUNICATIONS

ATOM implements the most popular industry standard fieldbus protocols to allow you to connect and integrate ATOM into your power control systems quickly and easily. ATOM can be configured with EtherNet/IP, ModbusTCP, PROFINET, or EtherCAT.

If you are unsure of the fieldbus type installed on the controller you can refer to the model number printed on the frame label.
See Model Numbers Appendix at the end of this manual for the comms option serial # format.

Alternatively you can connect with the Control Concepts Control Panel Application using a USB cable and look at the Device Profile tab. No external power source is required for basic Control Panel operation as the controller can be powered for diagnostics using the USB cable.

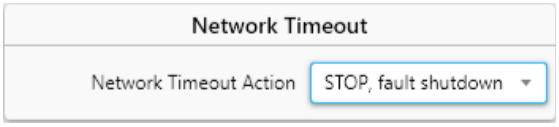
In the example on the right the Device Profile Communications value indicates the attached ATOM controller is equipped with Modbus TCP.



8.1. Common Settings

All ATOM controllers allow for a Network timeout action if communications is lost to the controller. Modbus TCP and EtherNET/IP have an internal adjustable timer (SP-29 Communications Heartbeat) PROFINET timers would be provided by control devices on the network while EtherCAT models would have a watchdog timer value provided by the EtherCAT Master that would determine the time before a Network Timeout Action would be executed.

8.1.1. Network Timeout Action



When the hearbeat timer expires, or loss of communication with the controller after X amount time, an EtherCAT Watchdog timeout occurs. The controller will then execute the network timeout action.

The following actions are available when a timeout occurs:

NONE, continue

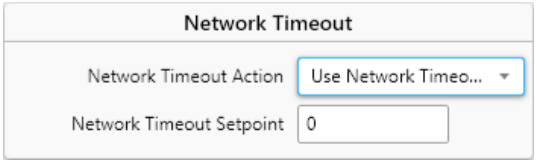
The controller will ignore the timeout and continue operation in its current state and setpoint.

STOP, fault shutdown

The controller will enter STOP state (no output) and also enter FAULT state. (Requires a fault reset to resume operation)

Use Network Timeout Setpoint

The commanded setpoint will change to the Network Setpoint Value (SP-29). The desired network setpoint is set in the dialog that is visible in the Network Timeout Action panel when “Use Network Timeout Setpoint” is selected.



8.2. Modbus TCP / EtherNet/IP / PROFINET

8.3. Overview

Modbus TCP

ATOM Modbus TCP implements the Modbus RTU protocol with a TCP interface that runs on Ethernet.

In general, ATOM parameters are all 16-bit integer values. Some values may have digits to the right of the decimal point. The decimal point, or resolution, is not part of the message. Rather, a parameter with one decimal place will be scaled x10, while two decimal places will be scaled x100.

EtherNet/IP

ATOM is ODVA Ethernet/IP CT19 Conformant. See https://marketplace.odva.org/products/2567-atom
Control Concepts provdes a profile document describing the EtherNET/IP implementation on the ATOM controllers.

An electronic data sheet file (EDS) for ATOM is available. This file can be imported into most PLC software to easily interface with ATOM power controllers.

ATOM EtherNET EDS download link

PROFINET

ATOM PROFINET exposes the same parameters as the EtherNET/IP protocol. A general station description markup language file (gsdml) for ATOM is available for download that defines these parameteres.. This file can be imported into most PLC software to easily interface with ATOM power controllers.

PROFINET GSDML download link

> **NOTE:**
> EtherNET/IP, ModbusTCP and PROFINET can be remotely upgraded or switched if you would like to change the fieldbus protocol on your controller(s). Contact your distributor or manufacturer for assistance.

8.3.1. Wiring

ATOM uses the standard Ethernet pin-out. Control Concepts recommends using a minimum rating of CAT5e shielded cables between the controller and other devices on the same network.

Daisy Chaining ATOM

ATOM digital units include an onboard dual-port network switch that can be used to easily daisy chain multiple ATOMs together. Daisy chaining is especially useful when you have SyncGuard® enabled or want to quickly connect multiple ATOMs to your Fieldbus network.

Recommendation #1: Avoid using ATOM as a network switch

ATOM's built in network switch is not intended for use as a high-performance network switch. We recommend only using it to daisy chain ATOMs - do not use it as a network switch to connect portions of your network or process other network traffic. ATOMs can quickly become overloaded with network traffic, especially when SyncGuard® is enabled.

Recommendation #2: Avoid circular network connections - ONLY use line topology

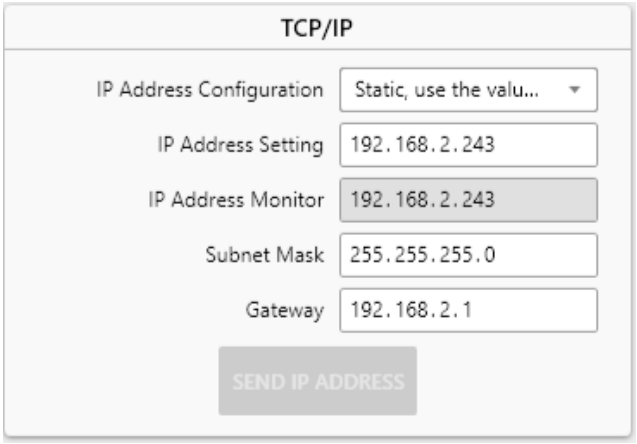
Avoid circular daisy chaining - creating a ring network can cause network traffic to explode and continually forward around the ring, causing ATOMs to get overloaded - especially when SyncGuard® is enabled.

NOTE:
PROFINET models disable Link Port #1 (RJ-45 jack closest to the 6-pin connector).
Only 1 network connection is allowed when configured with the PROFINET protocol.

8.3.2. Connection Settings

TCP/IP settings are configurable using the Control Panel software. Connect to the controller using a USB cable and select the 'Communication' tab to access the network settings.

Static IP addressing is recommended for industrial control systems. Use of DHCP may prevent reliable connection to the target controller from your factory controller.



IP Address Configuration
Static: User sets the IP Address, Subnet Mask, and Gateway.
DHCP: Address, Subnet, and Gateway are assigned by an external server.

IP Address Setting
Set your desired IP address in this field, this address will be automatically assigned if using DHCP.
Default: 192.168.2.243

IP Address Monitor
The actual IP address saved in the device. If this field is blank, no IP address has been issued or written to the controller.

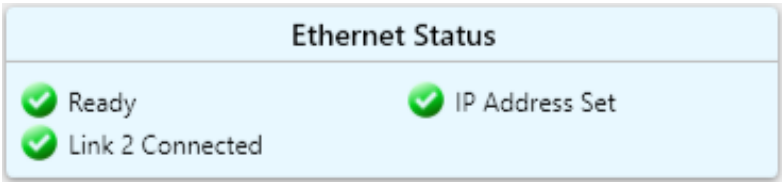
Subnet Mask
Subnet mask determines the host and network portion of the IP Address. This will be auto-assigned in using DHCP. Otherwise set this value according to your network configuration.
Default: 255.255.255.0

Gateway
Set this address to the gateway server used on your network.
Default: 192.168.2.1

Send IP Address
Used to write IP address, subnet, and/or Gateway addresses to the controller. A change to the IP Address Setting should be reflected in the IP Address Monitor after the settings are written to the controller with this button.

8.3.3. Ethernet Status

The Ethernet Status in the Control Panel Software will dynamically display the state of the network connection(s).



A green check box indicates a good condition, while a yellow exclamation icon indicates a fault or configuration issue.

Ethernet Status Messages [MP-340]	
Ready / Not Ready	Internal hardware test for communication with the on-board Ethernet switch. If this reports not ready there is an internal issue with the controller. Contact technical support or your distributor.
Link 1 / 2 Connected	A physical Ethernet cable connection is detected on one or both of the Ethernet ports. This does not indicate whether the port(s) are correctly configured.
TCP Connection Established	TCP/IP traffic is detected and active.
IP Address Set / Not Set	Informs the user as to whether the IP Address is configured correctly.
Heatbeat Timer Active	The Heartbeat timer is monitoring the connection(s) for any timeouts.
Heartbeat Timer Timeout	The Heatbeat timer has expired and is in timeout. If configured, the controller is the state set by the Network Timeout Action (SP-30)
Packet Transmission / Reception Error	Network error(s) are occuring during transmit or receive. Check cables and connections for loss or signal issues.
IP Address Conflict	The configured IP address already exists on the network. (Check the IP Address Setting.)

8.3.4. ModbusTCP Registers

All ATOM parameters are available over ModbusTCP. Refer to the Parameter List in the Appendix section of this manual for a full listing of all available parameters (registers). SP-61 to SP-90 contain the mapping of fieldbus link parameters.

ATOM supports the following ModbusTCP register operations:

NOTE:
For a list of all available ModbusTCP registers refer to the 1 and 3-phase Parameter lists in the appendix of this manual, parameters [SP-61 to SP-90]

Parameter Read

Modbus function 0x03 “Read Holding Registers”

- Allows reading of multiple parameters
- Parameter limit of 24 registers per message

Parameter Write

Modbus function 0x06 “Preset Single Register” (Write Single)

- Write limited to one parameter

Modbus Function 0.10 “Preset Multiple Parameters” (Write Multiple)

- Allows setting multiple parameters with a one message
- Parameter limit of 24 registers per message

Read Alarm Status, or Read System Status

Modbus function 0x07 “Read Exception Status”

- The response contains a single byte field that may be used to return 8 status flags to indicate the state of a connection ATOM controller.

8.3.5. EtherNet/IP & PROFINET Parameters

ATOM makes 30 parameters accessible to Ethernet/IP and PROFINET. These parameters are made available through the CIP Assembly Object (code 0x04) and a custom ParameterLink object (code 0x64). The assembly object is most commonly used to read and write parameters from a PLC. The ParameterLink object is a custom object defined by Control Concepts that can be used to individually control parameters and is less commonly used.

#	Name	Type	Description	Read / Write
1	Digital Setpoint	DINT	A value between 0 and 10,000 indicating the desired output current. The value is scaled to the output range of ATOM. For example, if the output range is 0-100A, a value of 5000 would set the output to 50A.	Read/Write
2	Digital Run Enable	BOOL	Enables or disables the output current. When disabled, the output current is set to 0A.	Read/Write
3	Inhibit Alarm Status	BYTE	Bitfield indicating alarms that are preventing controller operation. *See Appendix: Parameters MP-204*	Read
4	Warning Alarm Status	BYTE	Bitfield indicating warning alarms. *See Appendix: Parameters MP-217*	Read
5	Feedback Read Status	BOOL	Bitfield indicating if controller has acquired feedback. *See Appendix: Parameters MP-334*	Read
6	AC Line Frequency	REAL	The AC line frequency in Hz.	Read
7	AC Line Voltage	REAL	The AC line voltage in volts.	Read
8	Load Voltage	REAL	The load voltage in volts.	Read
9	Load Current	REAL	The load current in amps.	Read
10	Load Resistance	REAL	The load resistance in ohms.	Read
11	Heatsink Temperature	REAL	Heatsink temperature, in degrees celsius.	Read
12	Output Duty Cycle %	REAL	Indicates the amount, in percent, that the output of the controller is ON.	Read
13	Setpoint Reference	REAL	Reference input to control compensation loop in units determined by “feedback type”	Read
14	Feedback	REAL	The control output supplied to the load in units determined by “feedback type”.	Read
15	Partial Load Fault Target Resistance	REAL	Expected nominal resistance, in Ohms, of the load. Used for partial load fault detection.	Read
16	Partial Load Fault Resistance	REAL	The actual load resistance in Ohms. Compared with parameter #15 to determine if a partial load fault has occurred.	Read
17	Partial Load Fault Resistance Deviation	REAL	The tolerable percentage that parameters #15 and #16 may differ by until a partial load fault will be triggered.	Read
18	Firmware ID	DINT	Indicates the version of firmware that is loaded, dictating which features are available.	Read
19	Firmware major revision	DINT	Indicates which revision of the firmware is loaded. Major revisions fix critical bugs or add significant new features.	Read
20	Firmware minor revision	DINT	Indicates which minor revision of the firmware is loaded. Minor revisions fix minor issues and/or add minor improvements.	Read
21	Full Scale Voltage	DINT	The expected output voltage when the controller output is fully on.	Read
22	Full Scale Current	REAL	The expected current when the controller output is fully on.	Read
23	AC Line Status	BYTE	Bitfield indicating the status of the connected AC Line.	Read
24	Load Status	BYTE	Bitfield indicating the load status. *See Appendix: Parameters MP-338*	Read
25	Controller Status	BYTE	A value indicating the operational status of the controller. *See Appendix: Parameters MP-205*	Read
26	Controller State	BYTE	A value indicating the controller state. *See Appendix: Parameters MP-212*	Read
27	EEPROM Status	WORD	Bitfield indicating the EEPROM status. *See Appendix: Parameters MP-336*	Read
28	EEPROM Status 2	WORD	Indentical to parameter #27.	Read
29	Error Latch	BYTE	Bitfield used for diagnostic troubleshooting. *See Appendix: Parameters MP-339*	Read
30	Miscellaneous Status	BYTE	Bitfield indicating miscellaneous status information. *See Appendix: Parameters MP-335*	Read

The data types listed above are defined in the CIP standard as:

Type	Size	Description		Type	Size	Description
BOOL	1 byte	Boolean value		DINT	4 bytes	Signed 32-bit integer
BYTE	1 byte	8-bit bitmap		REAL	4 bytes	32-bit floating point number
WORD	2 bytes	16-bit bitmap				

INFO

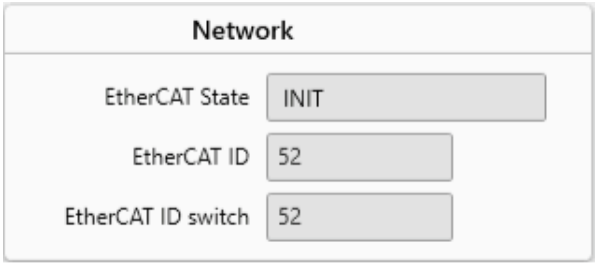
Rockwell's RSLogix Studio 5000 does not support unsigned integers. Any EDS file that contains unsigned integers will cause issues when it is imported into Studio 5000. To avoid this issue, ATOM uses signed integers for all integer types, regardless of whether the value may be negative or not. For example, parameter #1, Digital setpoint is represented as a signed 32-bit integer, but it may never be negative.

8.4. EtherCAT

ATOM EtherCAT conforms to the IEC61158 standard. Refer to the documents provided by the EtherCAT Technology group for network topology configuration.

8.4.1. Configuration & Operation

The Control Panel software application provides live status and ID configuration. Under the Communications tab you'll find the 'Network' panel. The Network panel exposes the folliwing parameters:



EtherCAT State [MP-348]

The current status of the EtherCAT connection.

EtherCAT States	
NOT Initialized	PreOP
INIT	SafeOP
BOOT	OP

EtherCAT ID [MP-346]

The ID currently assigned to the controller.

IMPORTANT:
If the EtherCAT ID is not set correctly in the controller or master assignment, the controller will not be seen by the master.

EtherCAT ID Switch [MP-347]

This is the live/current position of the EtherCAT address dials on the controller. To change the ID of the controller, adjust the address dials to the desired ID (displayed in this field), then reset or power-cycle the controller save the ID. Upon restart the EtherCAT ID value (MP-346) should reflect the new switch setting.

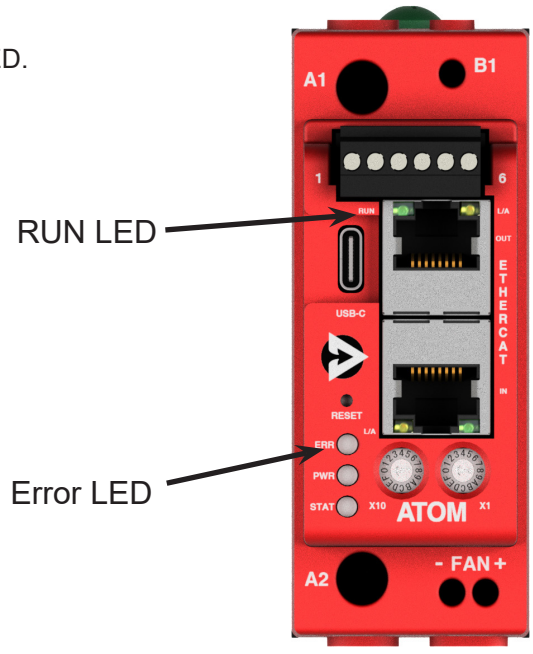
8.4.2. EtherCAT LEDs

ATOM EtherCAT models indicate their operational status with the RUN LED.

RUN (EtherCAT State)	
OFF	Init
Blinking	Pre-Operational
Single Flash	Safe-Operational
Flashes	Initialization or Bootstrap
ON	Operational

In addtion they also have a dedicated error LED to indicate error states.

ERR (Error/EtherCAT State)	
OFF	No Error
Blinking	Invalid Configuration
Single Flash	Unsolicited State Change
Double Flash	Application Watchdog Timeout
Flickering	Booting Error
ON	PDI Watchdog Timeout



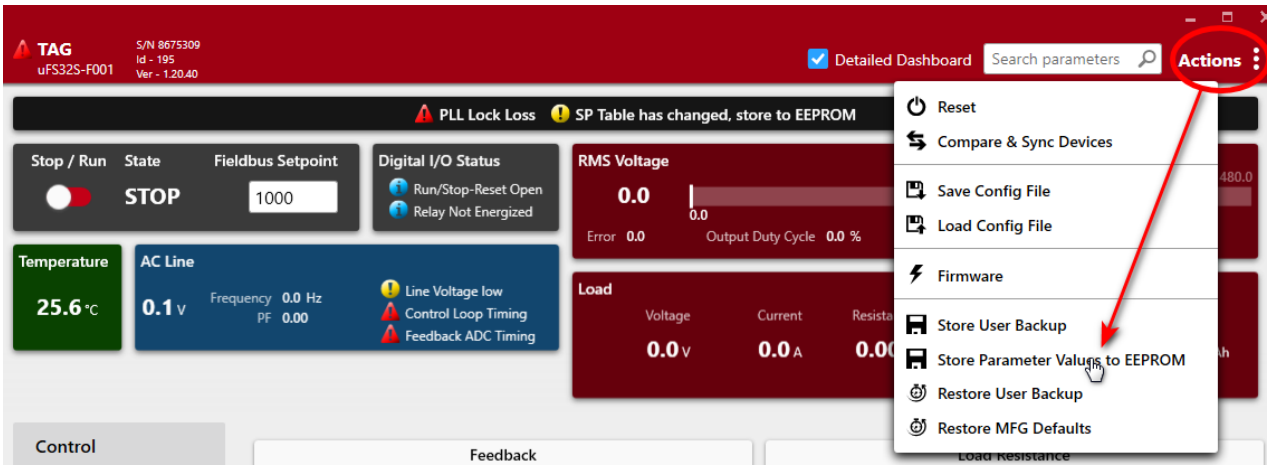
8.4.3. EtherCAT Parameters

When parameters are changed in a power controller with EtherCAT, the parameters are volatile. This means any altered parameters values will revert back to what value is currently saved in the controller EEPROM.

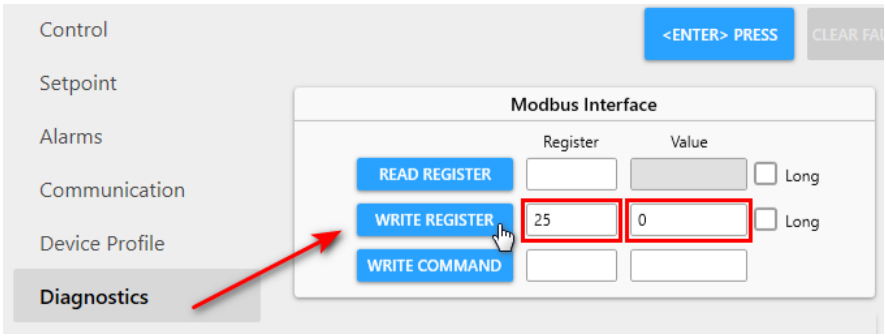
There are 3 methods to save parameter values to an EtherCAT unit.

Using Control Panel software:

1. Use the Action menu to write parameters to EEPROM.



2. In the Diagnostic tab, issue a write command 25 with a value of 0



Over EtherCAT:

3. Issue the EtherCAT save command: write 0x73 0x61 0x76 0x65 to address 0xFBF2

9. TROUBLESHOOTING

When determining a malfunction with a controller the following resources are available to diagnose the issue:

1. The Control Panel Software running on a PC or Android device connected using a USB-C cable.
2. On Digital and EtherCAT, parameters can be monitored or controlled over their respective fieldbus protocols.
3. Physical LED's on the controller. See the *Indicator LED section* for information on all LED conditions.

PWR (Power LED)	
OFF	No 24 VDC power
RED	Powered on, No AC Line Voltage
GREEN	Powered on, AC Line Lock OK
ORANGE	Phase Loss, or low or unstable AC Line Voltage

STAT (Status LED)	
OFF	None, not in any of the following states
RED	in FAULT State (Inhibit Alarm is active)
GREEN	in RUN State, Outputting
ORANGE	Active Warning Alarm *Controller will still output in this state*
Flashing RED	Initialization Error, in Wait for Enter State
Flashing ORANGE	Partial Load Fault Alarm is active

CAUTION: Do not attach or remove wiring while AC power is applied.

9.1. No Controller Output

ATOM power controllers will output when all the following conditions are met:

1. 24VDC is wired to command connector and capable of supplying at least 500mA of current to the controller.

Check that the power supply is wired correctly to pins 5 (-V) and 6 (+V) on the 6-pin connector. Ensure the power supply is on. The controller PWR (power) LED should be illuminated when 24VDC is present.

If the controller is connected via USB the power LED will be illuminated but will not output unless 24VDC is present.

2. AC Line is wired to the Line and Load connections and supplying between 24 - 600VAC to the controller.

The PWR LED will be green with AC line applied and phase lock has been achieved. If the PWR LED is red or orange, there is an issue with the AC Line voltage input.

3. The Controller is in RUN state

The Digital RUN Enable parameter [SP-25] is set to RUN (1).

Analog controllers do not use Digital RUN Enable and are always in RUN state unless there is a condition that places the controller in FAULT state.

4. A command setpoint is set greater than zero

The Digital Setpoint [SP-23] controls the setpoint command, additionally Digital/EtherCAT models provide a Fieldbus Setpoint [SP-24]. Analog controllers are equipped with an analog setpoint control wired to pins 3 and 4 of the 6-pin connector. If using the analog input, ensure the setpoint input type, low, high, and threshold settings are correct for the input signal type (voltage/current) and range.

A controller in SSR firing mode requires a setpoint of 100% to enable output.

5. The controller is not in Fault State

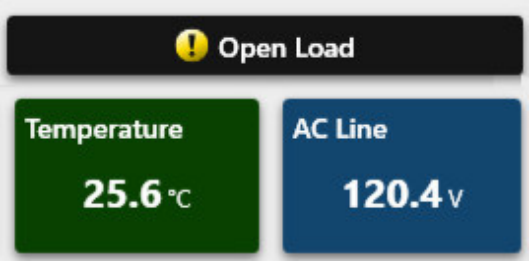
Any active inhibit alarm will put the controller in Fault state. Parameter [SP-212] will indicate any active inhibit alarm. The STAT LED will be red when an inhibit alarm has been triggered, output will be disabled and the Controller State parameter [SP-212] will be set to FAULT (2).

9.2. Alarms and Error Messages

The on-board LEDs on the ATOM Controller will indicate when a warning or inhibit alarm is active. The Control Panel software will show detailed information on what alarm(s) are active and allow additional diagnostics to determine the cause. Additionally Digital and EtherCAT models can access alarm states over their fieldbus protocol.
See the *Alarms* section of this manual for descriptions and conditions for alarm triggers.

9.2.1. Warning Alarms

Example Control Panel Dashboard showing an Open Load Warning Alarm



Status LED is orange during operation when a warning alarm is triggered.

The controller will continue to output with an active warning alarm.

The Warning Alarm Status parameter [MP-217] contains the binary mask of active warning alarms. The Control Panel will display all active warning alarms in the dashboard status bar.

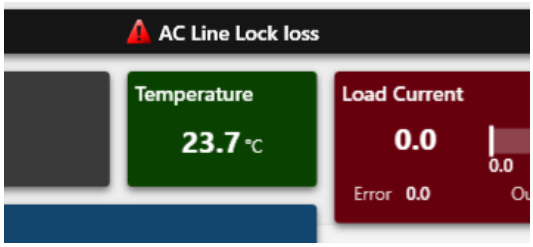
Any of the following conditions will trigger a Warning Alarm:

Warning Alarm	Condition
Voltage/Current Limiting	The current or voltage supplied to the load is at the configured limit parameter values. Check actual current/voltage readings from the source and load vs parameter values.
Partial Load Fault	Detected load resistance has changed and exceeded the tolerance value defined in the PLF Tolerance parameter. An open or short may have occured in one or more load elements.
Open Load	Infinite resistance Check wiring, check load for open circuit.
Shorted SCR	Controller has detected current flow while output is off. Check for short across Line/Load plugs.
High Temperature	Operating temp is high, check airflow around controller, check cooling fan operation (if equipped)

Warning alarms will automatically clear if the condition that triggered them falls within normal operating range.

9.2.2. Inhibit Alarms

Example Control Panel Dashboard showing an AC Line Loss Inhibit Alarm



Status LED is illuminated red during operation with an active inhibit alarm.

Controller output will be disabled with an active inhibit alarm.

The Inhibit Alarm Status parameter [MP-204] contains the binary mask of active inhibit alarms. The Control Panel will display all active inhibit alarms in the dashboard status bar.

Any of the following conditions will trigger an Inhibit Alarm:

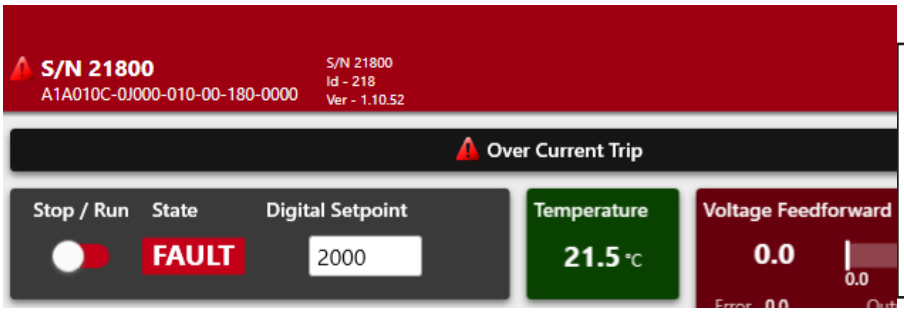
Inhibit Alarm	Condition
AC Line Lock Loss	Lost AC input phase lock, check AC line voltage and signal quality.
Overcurrent Trip[1]	Output current exceeded 240 amps, check for short in load circuit.
Over Temperature[1]	Controller temp exceeded safe operating range. (> 105 °C). Check airflow around controller, ensure mounting clearances are correct, check cooling fan operation. (if equipped)
Loss of Feedback[1]	Lost internal feedback signal to the processor. Reset the controller, if alarm re-occurs the controller has experienced a hardware failure.

[1] An overcurrent trip, over temperature, or loss of feedback alarm will place the controller in FAULT state.

Inhibit alarms that do not place the controller in FAULT state will automatically clear if the condition that triggered them falls within normal operating range. Controllers in FAULT state will not resume output until the FAULT state has been cleared.

9.2.3. Clearing Inhibit Alarms/Fault Reset

When an inhibit alarm is active, the controller will go into FAULT State and stop outputting.
The controller will not go into RUN and resume output until the FAULT state is cleared.



Example Controller in Fault State with an 'Over Current Trip' inhibit alarm is active preventing controller output.

The STAT LED on the Controller will also be illuminated RED indicating the Controller is in Fault state.

Clearing FAULT State on Digital/EtherCAT models:

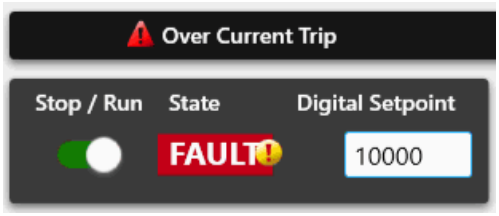
1. Set RUN Enable [SP-25] to STOP (0)
   This will put the controller into FAULT RESET.
2. Set RUN Enable [SP-25] set back to the RUN (1)

Clearing FAULT State on Analog models:

1. Press the Reset switch (press for a minimum of 3 seconds), or power cycle the controller to clear FAULT state.

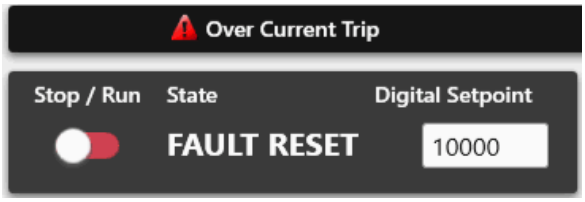
Analog models are always in RUN state and try to return to RUN state after a FAULT on any controller restart.

FAULT Reset example (Digital/EtherCAT models only)



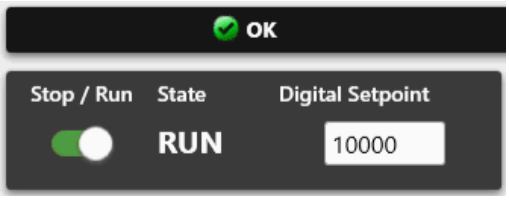
This controller was outputting and experienced an overcurrent trip and entered FAULT state.

Output has been disabled due to the overcurrent inhibit alarm. Although the switch position shows Run, the FAULT state overrides the Run/Stop control until the fault condition is corrected.



The Fault Reset is performed by setting the Stop/Run state to STOP (Using Control Panel this is equivalent to setting SP-25 to 0). This sets the controller in Fault Reset State.

The source of the current trip was then identified and corrected.



The controller can then be set back to RUN (SP-25 set to 1) to resume output. If the alarm that caused the FAULT state re-occurs, safely recheck all related components and connections to ensure normal operations can be resumed [1].

[1] In the event of an over-temperature alarm, the controller must return to a safe operating temperature (< 105 °C) before this inhibit alarm will clear.

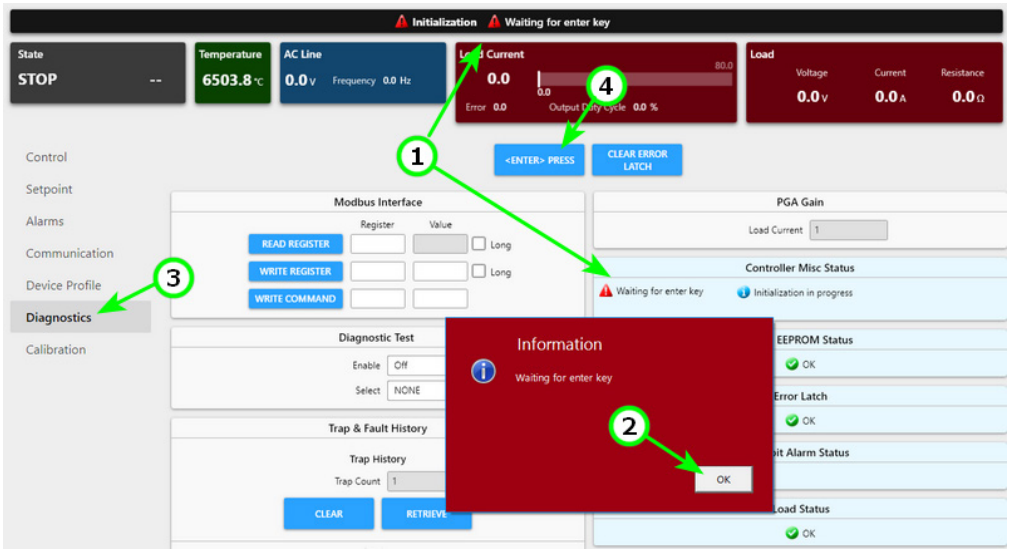
If this had been an Analog controller the FAULT state can be reset using the hardware reset button, use the Control Panel software, or power cycle the controller be removing and re-applying 24VDC power. Any of the above actions will clear the FAULT state and the controller will return to RUN state.

9.3. Waiting for 'ENTER'

The Controller is not responding, STAT LED is Flashing RED.

If the controller encounters an unexpected condition or error during initialization the processor will halt and enter a 'Wait for Enter' state. The Control Panel software must be used to clear this state and will provide additional information on what caused this condition.

Controller in Wait for Enter State, stopped during initialization



Clearing a 'Wait for Enter' State:

1. Connect to the controller via USB with the Control Panel software.
   The dashboard will display the active inhibit alarm and a wait for enter dialog.
2. Press the OK button in the dialog.
3. Select the Diagnostics TAB.
4. Click the '<ENTER> PRESS' button.
   This will clear the Initialization stop and if there is no further error(s) the Controller will start normally.

To view the reason for the startup failure check the Trap History in Control Panel.

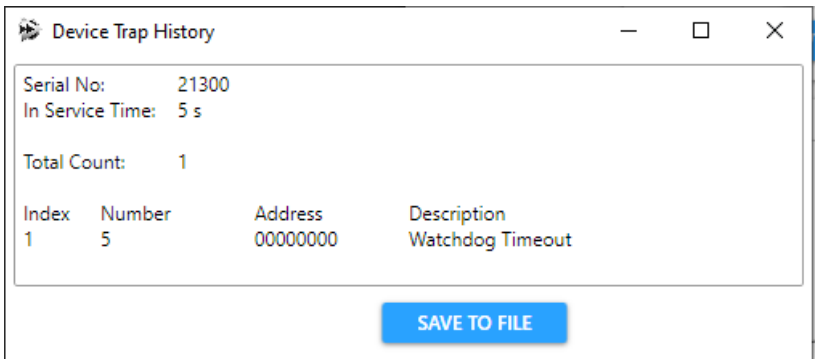


Check Trap History for initialization error:

1. Select the Diagnostic tab in Control Panel.
2. Press the 'RETRIEVE' button in the Trap History panel.

A report will be displayed of current and past processor trap errors.

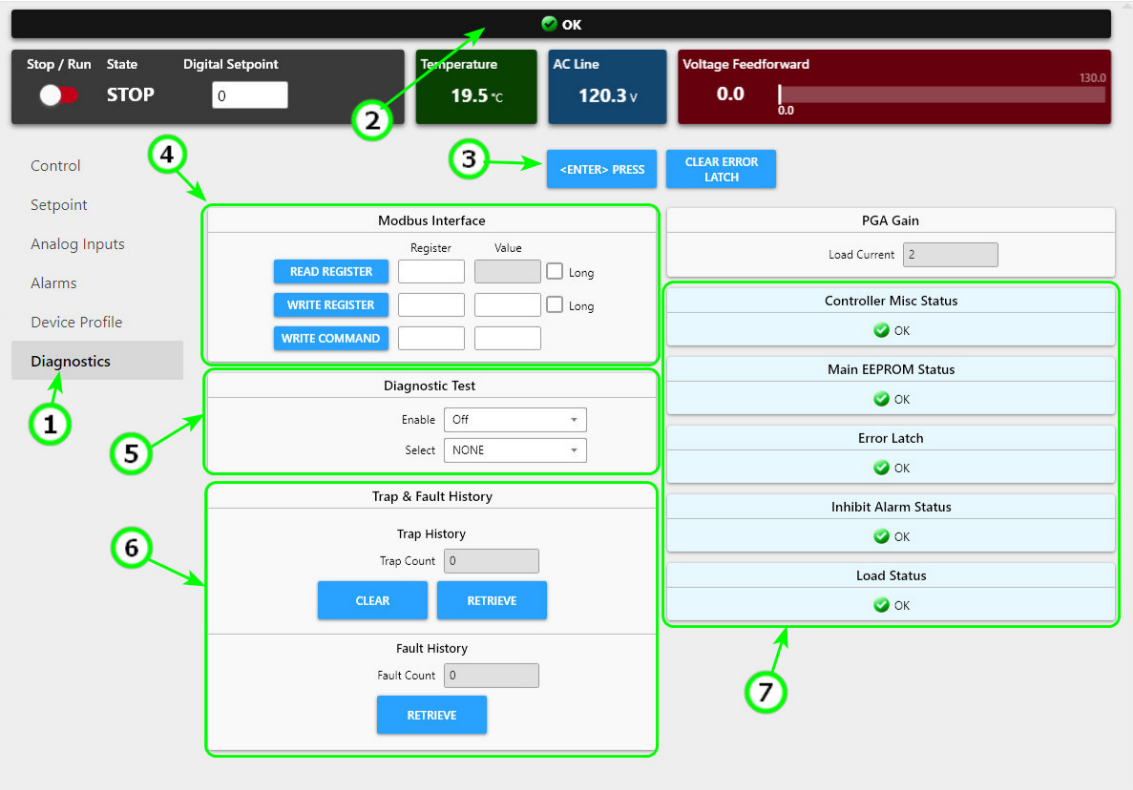
In the example on the right, a Watchdog Timeout has caused an initialization error. These history reports are useful to diagnose Controller errors when contacting technical support.



If an initialization error continuously re-occurs during controller start contact your distributor or the factory for further instruction on addressing the controller fault.

9.4. Diagnostics with Control Panel

The Control Panel Software Diagnostics tab provides real-time active states of the Controller.



<u>The Diagnostic tab is broken up into several panels:</u>

1. Diagnostic tab button; select this to display the diagnostic panels.
2. Dashboard status bar; displays active alarms and controller status.
3. ENTER button; clears 'Wait for Enter' error state to resume controller initialization.
   CLEAR ERROR LATCH button; resets any error latch conditions displayed in the Error Latch status panel.
4. Modbus Interface; read and write Modbus register values, the Write Command is often reserved for factory tests.
5. Diagnostic Test; allows toggling states of the LEDs, Gates and Relay (if equipped).
6. Trap and Fault History; retrieve and clear error records.
7. Status panels; displays active processor, memory, alarms, and load states.

Consult the Control Panel User's Manual for additional information on using the Control Panel with the ATOM controller. The User's Manual is available as a PDF download on the Control Panel software web page.

The Control Concepts Control Panel software is available as a free download from our website at:

https://ccipower.com/products/accessories/control-panel-software

9.4.1. No USB Communication

If when connecting the ATOM controller via USB-C cable to a PC or Android device, Control Panel reports no communication or a time-out connecting to the controller:

1. Check the USB-C cable and connections.
2. Try a different USB-C cable.
3. Cable lengths greater than 15 feet (4.57 meters) may cause signal lose over long distances causing communication errors between Control Panel and the ATOM Controller.
4. Try a different USB port on the PC.

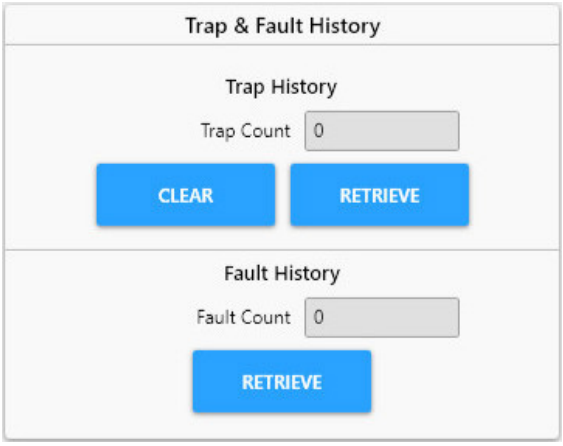
If none of the above steps resolves the communication issue, if available, try to connect to another ATOM controller to determine if the communication issue is particular to a single controller.

9.4.2. Trap and Fault History

Faults and Errors that might occur during controller operation are logged and can be viewed and exported to a file for reference. Any faults or trap errors are visible on the Diagnostic tab.

Trap and Fault History events are timestamped in the log as they occur. The event time is relative to the controller in-service time.

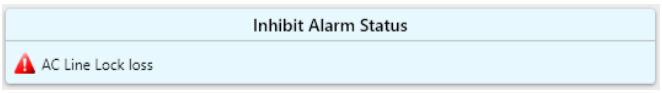
On Digital and EtherCAT models Fault History may include logged network timeout events which may be useful for network diagnostics in the event of communication errors.

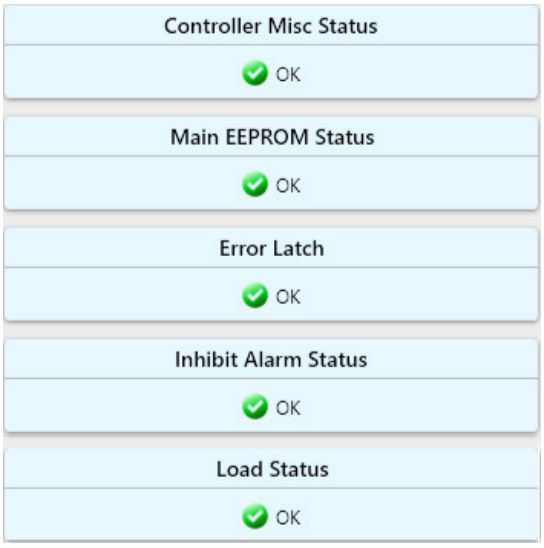


9.4.3. Diagnostic Status Panels

Displays live states of controller status. It is recommended to check this panel for any warnings or errors when troubleshooting issues with controller operation.

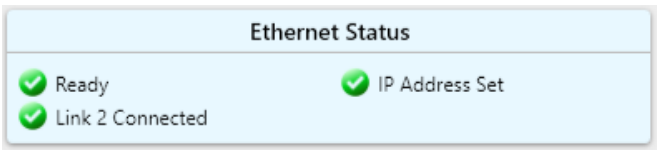
In the example below an Inhibit Alarm is active and in this case would disable the controller from operating.





In addition, the Control Panel provides a ‘Communication’ tab that has a Network status panel that shows the current state of the fieldbus communication hardware.

When diagnosing network issues it is useful to check this panel for any network state information.



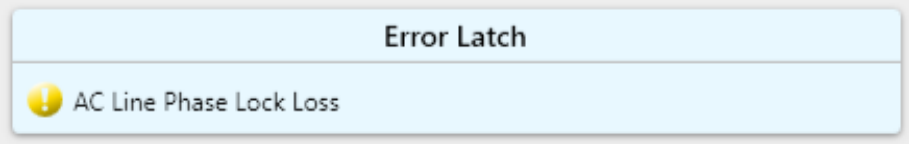
Network status information is unique to each fieldbus type.

See the Digital Fieldbus section of this manual for additional information on network status.

9.4.4. Error Latch

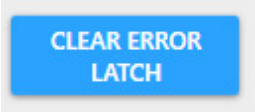
On the Diagnostic tab, one of the status panels is the Error Latch status.
The Error Latch will display events that negatively effect controller operation but may not be currently present while the controller is in operation. This is useful to catch intermittent issues or troubleshoot inconsistent errors or faults that cannot be reliably repeated.

In the example below an AC Line Phase Lock Loss event has occurred since the last time the Error Latch was reset.



Clearing the Error Latch

To clear the Error Latch events, press the 'CLEAR ERROR LATCH' button.
The Error Latch information is also cleared if the controller is reset or power cycled.



9.5. Fieldbus / Network Issues

Due to the complex protocols and differing network topologies no generalized troubleshooting guide will be applicable to all fieldbus issues. Refer to the *Digital Fieldbus* section of this manual for configuration settings for the fieldbus option that your controller shipped with.

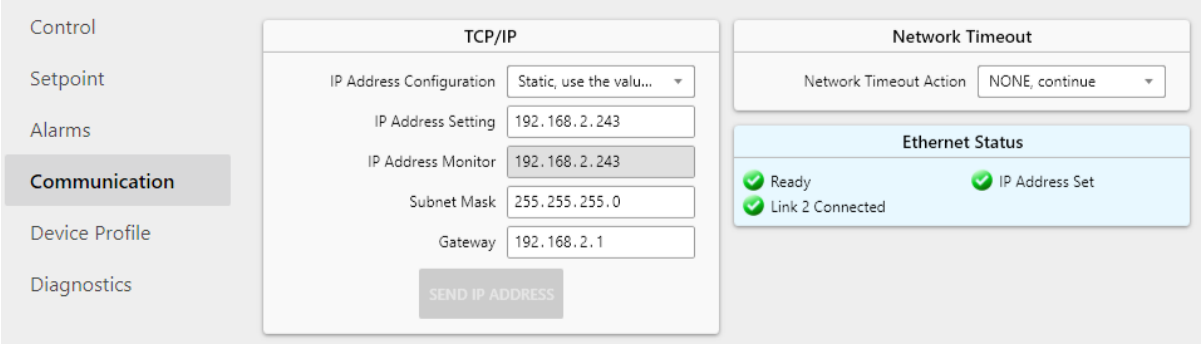
Control Concepts recommends using a minimum of CAT5e shielded cable between the controller(s) and other devices connected on the same network.

9.5.1. Network Hardware

1. Ensure all wiring and connections are properly seated.
2. All networking hardware power supplies should be grounded and wired according to local electrical codes.
3. External sources of spurious emissions should be evaluated and isolated from network cables and components.
4. Check the hardware configuration of any managed network devices to ensure proper connection routing.

9.5.2. Fieldbus Configuration Verification

The Control Panel software will display the configuration of the fieldbus and the current state of any network connections. The provided example shows an Ethernet/IP configured device. Available network options and status messages will vary with the fieldbus installed in the controller see the *Digital Fieldbus* section of this manual for details.



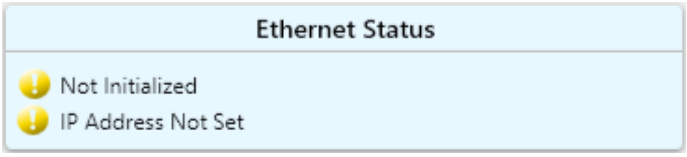
Example: Properly configured and connected Ethernet/IP Controller

9.5.3. ModbusTCP & Ethernet/IP Issues

If no network connection can be established, first check the green LED on the Ethernet RJ-45 jack.

Green RJ-45 LED state (Link Status)	
OFF	No network connection detected (Check cables and connections)
ON	Physical connection is good, no data is transferring
Flashing	Connected and data is transferring

Ethernet Status messages:



Not Initialized

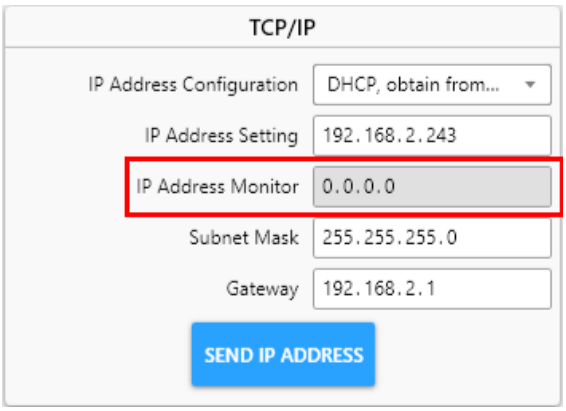
There is no hardware/wired connection detected.

1. Check cables and connections at the controller.
2. Check wiring to all endpoints on the network to the controller.

IP Address Not Set

The controller IP address has not been assigned or is invalid.

1. Check the IP Address Monitor in the Control Panel TCP/IP configuration panel. In the example to the right, the IP address monitor reads 0.0.0.0 with the controller set for DHCP. Therefore the controller cannot communicate with the DHCP server on the network.
2. If using a Static IP address, ensure the IP Address Setting, and Subnet Mask are correct for the LAN segment the controller should be operating on.
   If incorrect, enter the proper addresses and press the 'SEND IP ADDRESS' button to update the controller.



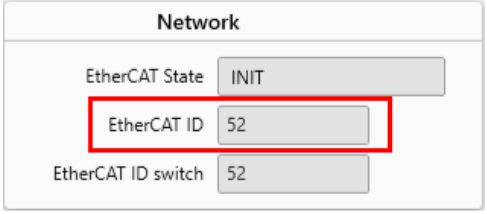
9.5.4. Profinet Issues

Profinet relies on external device discovery to assign its IP address. While the Control Panel allows for configuration of a static IP address the controller should be configured via the TIA portal, PRONETA, or other PLC software.

If using a third-party device ensure you have the GSD file provided by Control Concepts and have correctly imported the file into your PLC software.

9.5.5. EtherCAT Issues

1. Check the EtherCAT discrete Error (ERR) LED for an indication of a network issue.
2. If there is no indication of an error state but the controller is not recognized by the EtherCAT master device, check the station alias set in the ATOM controller.



ERR (Error/EtherCAT State)	
OFF	No Error
Blinking	Invalid Configuration
Single Flash	Unsolicited State Change
Double Flash	Application Watchdog Timeout
Flickering	Booting Error
ON	PDI Watchdog Timeout

Refer to the EtherCAT Technology group document: ETG.1300 EtherCAT Indicator and Labeling Specification for additional error information.

APPENDIX: 1-PHASE SPECIFICATIONS

POWER	
Line Voltage	24 - 600V Vac +10% / -15%
Line Frequency	45 - 65 Hz
Frame Current Ratings	16 | 32 | 50 | 65 Continuous RMS (AC)
Current Rating Peak Surge	15x continuous rating
Minimum Hold/Latch Current	500 mA RMS
SCR Rating (PIV)	1600 V peak forward and reverse
SCR Protection	DV/DT Protection 1000 V MOV
Device Load Protection	External load protection required
Fusing	Optional external Class T, branch-rated, touch-safe fusing
Device Protection	PCB mount integrated thermistor monitoring bus bar temperature
Power Dissipation	1.3 W per amp of load current
Controller Power Supply	24 Vdc

DC POWER CONSUMPTION		
Model	**Frame Size**	**Power (watts)**
Analog	< 50 A	2 W
	> 50 A	4 W
Digital and EtherCAT	< 50 A	3 W
	> 50 A	6 W

CONTROL FUNCTIONS	
Control Modes (set via USB or Fieldbus)	**Description**
Zero-cross	Standard algorithm
Fast Zero-cross	1 cycle on 1 cycle off
Phase Angle	Variable firing angle of line voltage cycle
Half-cycle DC	Variable phase angle firing for 1/2 cycle
On/Off Relay mode Zero-cross	Replacement for Zero-cross relay
On/Off Relay mode Phase Angle	Replacement for Random Relay
Load Configurations	Single Phase

CONTROL LOOP	
Feedback Types	Feed Forward Voltage RMS Current Proportional (Open Loop) On/Off (Relay mode)
Line Compensation	Yes (not in Proportional or Relay mode)
Set Point Sources	**Description**
Analog version	Analog Voltage Input • Selectable voltage range 0-10V • 200k Ohm impedance • Max 32 VDC input for relay mode Analog Current Input • Selectable current range 0-20mA • 249 Ohm impedance USB
Digital version	USB Certified EtherNet/IP with Add-on Profile (AOP) Certified Profinet Modbus TCP EtherCAT

PERFORMANCE	
Setpoint Resolution	10k
Internal Control Loop Resolution	32k
Output Resolution	30k @ 50 Hz, 25k @ 60 Hz
Response Time	Adjustable from 50 ms to 1 s
Accuracy (Full Conduction)	
Voltage	5.0% of line voltage
Current	5.0% of frame rating
Output Linearity	4.0% from (5 - 100%) output range
Accuracy	(+10% / -15%) line voltage change will result in a max output change of 2% (5 - 100% output range.)
Temperature Drift	Output shall not change greater than 1% per degree °C max over the operating temperature range from (5 - 100%) output range.

CONTROL FEATURES	
Reset/Teach	Dual purpose button • Hold for processor reset • Momentary press to learn load resistance *(Not available on EtherCAT models)*
Soft Start	Slew rate USB settable, factory default ~ 200ms
TRANS-GUARD	Yes *(Not available in Fast Zero-cross mode)*
Missing Cycle Detection	Ramps from zero to setpoint when a missing power cycle is detected.
SYNC-GUARD	Yes, up to 8 units with sufficient bandwidth *(Only available on Digital models)*
Over Current Trip	Fixed at 240 amps
Current/Voltage Limit (*Buy up*)	IL adjustable from 20-105% of frame rating If not purchased, IL default = 105% of frame rating.
Shorted SCR (*Buy up*)	Detects if SCR is shorted
Partial Load Fault/ Open Load (*Buy up*)	Parameter settings • Tolerance in 5% increments Teach/Learn initiation • USB or ModbusTCP fieldbus • Momentary button on Analog and Digital

ALARM RELAY	
Solid State, Form A	60 Vdc 100 mA / 42 Vac 100 mA RMS Relay mask via USB or Fieldbus setting

RELIABILITY	
Mean Time Between Failure (MTBF)	~ 50,000 Hours

ISOLATION	
Signal to Line/Load	3750 Vac minimum
Line/Load to Ground	2500 Vac minimum
Line to Load	1000 Vac minimum limited by MOV
Network	500 Vac minimum

ENCLOSURE PROTECTIVE RATING	
International	IP 20

ENVIRONMENTAL	
Surrounding Air Operating Temp	Integrated heatsink: 0 to 50 °C
Humidity	20% to 90% RH Non-Condensing
Rated Operating Altitude	Up to 1750m (6000ft) at rated current.
Contaminates	ROHS Compliant CE Pollution Degree 2
Storage Temperature	-20 to 80 °C

MECHANICAL	
Mounting	DIN Rail or Panel Mount
Cooling	Natural convection: 16, 32, 50 amp frames Forced air cooling: 65 amp frames
Insulation Protection Rating	CE & UL Protective Class I
EN 50178 Installation Category	Installation CAT II
IEC	IEC 60950-VDE0805 IEC60335-1-VDE0700-1 IEC62314
SCCR	100KA

1-PHASE SCCR - TYPE 1 COORDINATION		
Frame Rating	**Recommended Fusing ***	**SCCR Rating ****
16	20A Fast Acting J or T	100 kA
32	40A Fast Acting J or T	100 kA
50	60A Fast Acting J or T	100 kA
65	80A Fast Acting J or T	100 kA

* Maximum fuse amps shown, fuses with lower amp ratings can also be used.
** To meet SCCR rating, fast acting J or T type fuses must be used.

APPENDIX: 3-PHASE SPECIFICATIONS

POWER	
Line Voltage	24 - 600V Vac +10% / -15%
Line Frequency	45 - 65 Hz
Frame Current Ratings	16 | 32 | 50 | 80 Continuous RMS (AC)
Current Rating Peak Surge	15x continuous rating
Minimum Hold/Latch Current	500 mA RMS
SCR Rating (PIV)	1600 V peak forward and reverse
SCR Protection	DV/DT Protection 1000 V MOV
Device Load Protection	External load protection required
Fusing	Optional external Class T, branch-rated, touch-safe fusing
Device Protection	PCB mount integrated thermistor monitoring bus bar temperature
Power Dissipation	1.3 W per amp of load current
Controller Power Supply	24 Vdc

DC POWER CONSUMPTION		
Model	**Frame Size**	**Power (watts)**
Analog	< 50 A	2 W
	> 50 A	4 W
Digital and EtherCAT	< 50 A	3 W
	> 50 A	6 W

CONTROL FUNCTIONS	
Control Modes (set via USB or Fieldbus)	**Description**
Zero-cross	standard algorithm
Fast Zero-cross	1 cycle on 1 cycle off
On/Off Relay mode Zero-cross	Replacement for Zero-cross relay
Load Configurations	Three Phase 2 leg (4 SCR)

CONTROL LOOP	
Feedback Types	Feed Forward Voltage RMS Current Proportional (Open Loop) On/Off (Relay mode)
Line Compensation	Yes (not in Proportional or Relay mode)
Set Point Sources	**Description**
Analog version	Analog Voltage Input • Selectable voltage range 0-10V • 200k Ohm impedance • Max 32 VDC input for relay mode Analog Current Input • Selectable current range 0-20mA • 249 Ohms impedance USB
Digital version	USB Certified EtherNet/IP with Add-on Profile (AOP) Certified Profinet Modbus TCP EtherCAT

PERFORMACE	
Setpoint Resolution	10k
Internal Control Loop Resolution	32k
Output Resolution	30k @ 50 Hz, 25k @ 60 Hz
Accuracy (Full Conduction)	
Voltage	5.0% of line voltage
Current	5.0% of frame rating
Output Linearity	4.0% from (5 - 100%) output range
Accuracy	(+10% / -15%) line voltage change will result in a max output change of 2% (5 - 100% output range.)
Temperature Drift	Output shall not change geater than 1% per degree °C max over the operating temperature range from (5 - 100%) output range.

CONTROL FEATURES	
Reset/Teach	Dual purpose button • Hold for processor reset • Momentary press to learn load resistance *(Not available on EtherCAT models)*
TRANS-GUARD	Yes *(Not available in Fast Zero-cross mode)*
Missing Cycle Detection	Restarts from zero to setpoint when a missing power cycle is detected.
SYNC-GUARD	Yes, up to 8 units with sufficient bandwith *(Not available in Analog or EtherCAT models)*
Over Current Trip	Fixed at 240 amps
Current/Voltage Limit (*Buy up)*	IL adjustable from 20-105% of frame rating If not purchased, IL default = 105% of frame rating.
Shorted SCR (*Buy up)*	Detects if SCR is shorted
Partial Load Fault/ Open Load (*Buy up)*	Parameter setings • Tolerance in 5% increments Teach initiation • USB or ModbusTCP fieldbus • Momentary button on Analog and Digital

ALARM RELAY	
Solid State, Form A	60 Vdc 100 mA / 42 Vac 100 mA RMS Relay mask via USB or Fieldbus setting

RELIABILITY	
Mean Time Between Failure (MTBF)	~ 50,000 Hours

ISOLATION	
Signal to Line/Load	3750 Vac minimum
Line/Load to Ground	2500 Vac minimum
Line to Load	1000 Vac minimum limited by MOV
Network	500 Vac minimum

ENCLOSURE PROTECTIVE RATING	
International	IP 20

ENVIRONMENTAL	
Surrounding Air Operating Temp	integrated heatsink: 0 to 50 °C
Humidity	20% to 90% RH Non-Condensing
Rated Operating Altitude	up to 1750m (6000ft) at rated current.
Contaminates	ROHS Compliant CE Pollution Degree 2
Storage Temperature	-20 to 80 °C

MECHANICAL	
Mounting	DIN Rail or Panel Mount
Cooling	Natural convection: 16, 32 amp frames Forced air cooling: 50, 80 amp frames
Insulation Protection Rating	CE & UL Protective Class I
EN 50178 Installation Category	Installation CAT II
IEC	IEC 60950-VDE0805 IEC60335-1-VDE0700-1 IEC62314
SCCR	100KA

3-PHASE SCCR - TYPE 1 COORDINATION		
Frame Rating	**Recommended Fusing ***	**SCCR Rating ****
16	20A Fast Acting J or T	100 kA
32	40A Fast Acting J or T	100 kA
50	60A Fast Acting J or T	100 kA
80	100A Fast Acting J or T	100 kA

* Maximum fuse amps shown, fuses with lower amp ratiings can also be used.
** To meet SCCR rating, fast acting J or T type fuses must be used.

1-PHASE PARAMETER LIST

SETUP PARAMETERS

[SP - 1] Feedback Type	
Units:	N/A
Minimum:	1
Maximum:	2
Default:	1
Selections:	1 = Voltage Feedforward 2 = Load Current

Sets the signal type used for feedback by the control loop. Voltage Feedforward is derived from AC Line voltage.

[SP - 2] Firing Mode	
Units:	N/A
Minimum:	1
Maximum:	6
Default:	3
Selections:	1 = Zero Cross 2 = Fast Zero Cross 3 = SSR – Zero Cross (ON/OFF, proportional) 4 = SSR – Phase Angle (ON/OFF, proportional) 5 = Phase Angle 6 = Half-Cycle DC (phase angle)

Selects the desired type of firing mode. Phase Angle and Half-Cycle DC include the ability to limit output voltage and current. All other firing modes do not include limits.
All firing modes include over current trip fault shutdown capability.
SSR firing modes (5 & 6) require a setpoint of 100% to turn ON and a setpoint of 0% to turn OFF.

[SP - 3] Slew Rate	
Units:	N/A
Minimum:	1
Maximum:	100
Default:	10

Sets the control loop response for Phase Angle and Half-Cycle DC firing modes. Higher value = slower response, Lower value = faster response.

[SP - 4] Control Loop	
Units:	N/A
Minimum:	0
Maximum:	1
Default:	1
Selections:	0 = Proportional (Open Loop) 1 = Closed Loop

Used for the first 4 firing modes to select closed or open loop. Closed loop compares the feedback with the setpoint to achieve the correct output. Open loop adjusts the output duty cycle of the controller directly without adjusting for feedback.

[SP - 5] Full Scale Voltage	
Units:	RMS Voltage = Volts
Minimum:	10
Maximum:	600
Default:	480

Set to the expected output voltage when the controller output is fully ON 100%. This equates to the voltage output command when feedback type is set to Voltage feedforward and the setpoint is at 100% (maximum).

[SP - 6] Full Scale Current	
Units:	RMS Current = Amps
Minimum:	2.0
Maximum:	100.0
Default:	80.0

Set to the expected output current when the controller output is fully ON 100%. This equates to the current output command when feedback type is set to Load Current and the setpoint is at 100% (maximum).

[SP - 7] Voltage Limit	
Units:	RMS Voltage = Volts
Minimum:	10
Maximum:	700
Default:	700

Sets the maximum output voltage allowed by the controller.

[SP - 8] Current Limit	
Units:	RMS Current = Amps
Minimum:	1.0
Maximum:	105.0
Default:	84.0

Sets the maximum output current allowed by the controller. The valid range for Current Limit is: minimum = 20% of the frame current rating, maximum = 105% of the frame current rating.

[SP - 9] Current Trip	
Units:	RMS Current = Amps
Default:	240

Output current fault shutdown threshold. The controller will shut off the output and transition to Fault state if the load current supplied by this controller exceeds this setting.

[SP - 10] Analog Setpoint Zero Threshold
ATOM Analog and Digital only

Units:	V, mA
Minimum:	0.00
Maximum:	20.00
Default:	0.05

The analog setpoint will be zero (0) when the analog signal is at or below this threshold. Set this value high enough to ensure that the setpoint will be zero when the input signal is at its lowest. Set this value low enough so that it does not affect normal operation.

[SP - 11] Analog Setpoint Type
ATOM Analog and Digital only

Units:	N/A
Minimum:	1
Maximum:	2
Default:	1
Selections:	1 = Voltage 2 = Current

Selection for the signal type connected to the analog setpoint input terminals. Select Voltage (1) when connecting a voltage source (0 to 10v). Select Current (2) when connecting a current source (4 to 20ma).

[SP - 12] Analog Setpoint Low Command
ATOM Analog and Digital only

Units:	V, mA
Minimum:	-5.00
Maximum:	25.00
Default:	0.00

Set to the analog setpoint input low signal value. This will provide an analog setpoint at the percent set in “Analog Setpoint Low Out” (SP-13).

[SP - 13] Analog Setpoint Low Out
ATOM Analog and Digital only

Units:	%
Minimum:	0.00
Maximum:	125.00
Default:	0.00

Set to the desired setpoint % when the analog setpoint signal is at the value set for “Analog Setpoint Low Command” (SP-12).

[SP - 14] Analog Setpoint High Command
ATOM Analog and Digital only

Units:	V, mA
Minimum:	-5.00
Maximum:	25.00
Default:	10.00

Set to the analog setpoint input high signal value. This will provide an analog setpoint at the percent set in “Analog Setpoint High Out” (SP-15).

[SP - 15] Analog Setpoint High Out
ATOM Analog and Digital only

Units:	%
Minimum:	0.00
Maximum:	125.00
Default:	100.00

Set to the desired setpoint % when the analog setpoint signal is at the value set for “Analog Setpoint High Command” (SP-14).

[SP - 16] Partial Load Fault Enable

Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = Disable 1 = Enable

Enables and disables partial load fault detection & alarm.

[SP - 17] Partial Load Fault Tolerance

Units:	%
Minimum:	0.0
Maximum:	100.0
Default:	8.0

Sets the maximum percent load resistance deviation from the “Partial Load Fault Resistance” (SP-18) value. Deviations outside this band will trigger a Partial Load Fault alarm.

[SP - 18] Partial Load Fault Resistance

Units:	Ohm
Minimum:	0.10
Maximum:	655.35
Default:	8.00

Sets the nominal resistance of the load. This is used for comparison in determination of a partial load fault alarm condition.

[SP - 19] Partial Load Fault Alarm Delay Time

Units:	Seconds
Minimum:	1
Maximum:	120
Default:	10

Sets the delay time, in seconds, after detection of a partial load fault until the alarm is indicated.

[SP - 20] Relay Alarm Mask

Units:	N/A, Binary Coded
Minimum:	000000000 = 0
Maximum:	111111111 = 511
Default:	110000000 = 384

Bit	Description
8 =	Over Current Trip
7 =	Over Temperature
6 =	Partial Load Fault/Open Load
5 =	Shorted SCR
4 =	Current Limit
3 =	Voltage Limit
2 =	AC Line Loss
1 =	Communications Error
0 =	Memory Error, Watchdog Timeout, Error Trap (Halted in initialization)

Selects the events that will cause the relay output to activate. More than one selection may be made.

[SP - 21] Shorted SCR Detection Enable

Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = Disable 1 = Enable

Enables and disables shorted SCR detection and alarm indication.
Shorted SCR detection is always performed when AC Line is ON and the controller's output is OFF.
Due to feedback signal delay, the output must be off for at least 8 half cycles (4 line cycles) before the shorted SCR check can be performed.
Firing modes Zero-cross & Fast Zero-cross may be checked during off periods, between firing, or if the off periods are less than 4 cycles the output will be turned off every 30 seconds for 4 cycles in order to check for a shorted SCR.
This is performed when the controller's output duty cycle% is less than 95%.
Shorted SCR load current threshold for detection:
¼ Full Scale Current setting (SP-6) with a minimum = 1 A
If the Load current, while the output is OFF, is greater than the threshold it is determined to be a shorted SCR.

[SP - 22] Open Load Detection Enable

Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = Disable 1 = Enable

Enables and disables open load detection and alarm indication.
Open Load detection criterion:
The controller's output duty cycle % is ≥ 10% and the Load Current is less than 5% of the Full Scale Current (SP-6) setting (or 250 ma minimum threshold).
There is a 5 second delay after open load is detected until the alarm is indicated.

[SP - 23] Digital Setpoint [non-volatile/EEPROM]

Units:	N/A
Minimum:	0
Maximum:	10000
Default:	0

This is provided as an alternate setpoint that can be used while connected via USB. This value will be set to zero (0) at power-up during initialization. "Setpoint Select" (SP-25) must be set to Digital Setpoint (2) in order to utilize this Digital Setpoint for control.

[SP - 24] Fieldbus Setpoint [RAM]

ATOM Digital and EtherCAT only

Units:	N/A
Minimum:	0
Maximum:	10000
Default:	0

This is the setpoint that is used for fieldbus communications. This value will be set to zero (0) at power-up during initialization.

[SP - 25] Digital Run Enable [RAM]

ATOM Digital and EtherCAT only

Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = STOP 1 = RUN

This is used to put the controller into RUN and STOP state.
The value of this parameter will be set to STOP (0) at power-up during initialization.

[SP - 26] Setpoint Source

Units:	N/A
Minimum:	1 (Analog and Digital models) 2 (EtherCAT model)
Maximum:	2 (Analog model) 3 (Digital and EtherCAT models)
Default:	1 (Analog model) 3 (Digital and EtherCAT models)
Selections:	1 = Analog Setpoint 2 = Digital Setpoint (non-volatile/EEPROM) 3 = Fieldbus Setpoint (RAM)

This will select the setpoint to use for control. Analog Setpoint (1) will use the analog setpoint input for control. Digital Setpoint (2) selects the "Digital Setpoint" (SP-23) for control.

[SP - 27] Digital RUN Enable Power-up Default
ATOM Digital and EtherCAT only

Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = STOP 1 = RUN

Sets the operating state of the controller on power up.
This is the value of SP-25 Digital RUN Enable set during initialization.

[SP - 28] Partial Load Fault Teach Enable [RAM]
ATOM Digital and EtherCAT only

Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = Disable 1 = Enable

When Partial Load Fault Teach Enable is set to “Enable” (1) the value of the load resistance (MP-210) is stored into Partial Load Fault Resistance (SP-18). After the load resistance value has been recorded, the value for this parameter returns to “Disable” (0).

[SP - 29] Communications Heartbeat Time
ATOM Digital only

Units:	Seconds
Minimum:	0
Maximum:	65535
Default:	0 [Disabled]

This timer is used to detect loss of communications over Ethernet, and take appropriate action when communications loss is detected. Communication loss is the result of the Heartbeat timer reaching the value set for this parameter without reception of a packet.
The Heartbeat timer is reset with the reception of a packet destined for this controller.
Setting this parameter to a value greater than zero enables the timer.
Setting the value to zero disables the timer.

[SP - 30] Network Timeout Action
ATOM Digital and EtherCAT only

Units:	N/A
Minimum:	0
Maximum:	2
Default:	0
Selections:	0 = NONE, continue 1 = STOP, fault shutdown 2 = Use Network Timeout Setpoint (SP-29)

Set this parameter for the desired action to take upon detection of network communication loss due to expiration of the Network Heartbeat timer (MP-341).

[SP - 31] Network Timeout Setpoint
ATOM Digital and EtherCAT only

Units:	N/A
Minimum:	0
Maximum:	10000
Default:	0

This is the setpoint that is used by the control loop after the Heartbeat timer expires, due to communication loss, when Network Timeout Action (SP-30) is set to Use Network Timeout setpoint (2).

[SP - 32] IP Address Configuration Method
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = Static (use the values in SP-33 thru SP-36 1 = DHCP

Use this parameter to select the method used for obtaining the IP Address to use for Ethernet communications.

[SP - 33] IP Address, Octet 1
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	255
Default:	192

The value of this parameter sets the value of the first octet of the static IP address.

[SP - 34] IP Address, Octet 2
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	255
Default:	168

The value of this parameter sets the value of the second octet of the static IP address.

[SP - 35] IP Address, Octet 3
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	255
Default:	2

The value of this parameter sets the value of the third octet of the static IP address.

[SP - 36] IP Address, Octet 4 ATOM Digital only	
Units:	N/A
Minimum:	0
Maximum:	255
Default:	243
The value of this parameter sets the value of the fourth octet of the static IP address.	

[SP - 37] Subnet Mask, Octet 1 ATOM Digital only	
Units:	N/A
Minimum:	0
Maximum:	255
Default:	255
The value of this parameter sets the value of the first octet of the Subnet Mask.	

[SP - 38] Subnet Mask, Octet 2 ATOM Digital only	
Units:	N/A
Minimum:	0
Maximum:	255
Default:	255
The value of this parameter sets the value of the second octet of the Subnet Mask.	

[SP - 39] Subnet Mask, Octet 3 ATOM Digital only	
Units:	N/A
Minimum:	0
Maximum:	255
Default:	255
The value of this parameter sets the value of the third octet of the Subnet Mask.	

[SP - 40] Subnet Mask, Octet 4 ATOM Digital only	
Units:	N/A
Minimum:	0
Maximum:	255
Default:	0
The value of this parameter sets the value of the fourth octet of the Subnet Mask.	

[SP - 41] Gateway IP Address, Octet 1 ATOM Digital only	
Units:	N/A
Minimum:	0
Maximum:	255
Default:	192
The value of this parameter sets the value of the first octet of the IP address used for the gateway.	

[SP - 42] Gateway IP Address, Octet 2 ATOM Digital only	
Units:	N/A
Minimum:	0
Maximum:	255
Default:	168
The value of this parameter sets the value of the second octet of the IP address used for the gateway.	

[SP - 43] Gateway IP Address, Octet 3 ATOM Digital only	
Units:	N/A
Minimum:	0
Maximum:	255
Default:	2
The value of this parameter sets the value of the third octet of the IP address used for the gateway.	

[SP - 44] Gateway IP Address, Octet 4 ATOM Digital only	
Units:	N/A
Minimum:	0
Maximum:	255
Default:	1
The value of this parameter sets the value of the fourth octet of the IP address used for the gateway.	

[SP - 45] Relay Normal State	
Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = OFF 1 = ON
Sets the normal, not energized, state of the relay output	

[SP - 46] EtherCAT Warning Mask HI [SP - 47] EtherCAT Warning Mask LO ATOM EtherCAT only	
Units:	N/A
Minimum:	0
Maximum:	65535
Default:	65535

[SP - 48] EtherCAT Error Mask HI [SP - 49] EtherCAT Error Mask LO ATOM EtherCAT only	
Units:	N/A
Minimum:	0
Maximum:	65535
Default:	65535

[SP - 50] Sync-Guard Enable
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	65535
Default:	65535
Selections:	0 = Disable 1 = Enable

[SP - 61 to 90] Fieldbus Link Parameters
ATOM Digital only

Parameters 61 and 62 are read/write, parameters 63 to 90 contain the read-only parameter values that can be read by fieldbus communications.

See the Digital Fieldbus section of the ATOM User's Manual for additional information on accessing these parameters.

Parameter	Name	State	Default
61	Fieldbus Setpoint	Read/Write	24
62	Digital RUN Enable	Read/Write	25
63	Inhibit Alarm Status	Read only	204
64	Warning Alarm Status	Read only	217
65	Feedback Read Status	Read only	334
66	AC Line Frequency	Read only	206
67	AC Line Voltage	Read only	207
68	Load Voltage	Read only	208
69	Load Current	Read only	209
70	Load Resistance	Read only	210
71	Heatsink Temperature	Read only	211
72	Output Duty Cycle %	Read only	213
73	Setpoint Reference	Read only	214
74	Feedback	Read only	215
75	Partial Load Fault Target Resistance	Read only	218
76	Partial Load Fault Resistance	Read only	219
77	Partial Load Fault Resistance Deviation	Read only	220
78	Firmware ID	Read only	331
79	Firmware Major Revision	Read only	332
80	Firmware Minor Revision	Read only	333
81	Full Scale Voltage	Read only	5
82	Full Scale Current	Read only	6
83	AC Line Status	Read only	337
84	Load Status	Read only	338
85	Controller Status	Read only	205
86	Controller State	Read only	212
87	EEPROM Status	Read only	336
88	EEPROM Status 2	Read only	336
89	Error Latch	Read only	339
90	Miscellaneous Status	Read only	335

MONITOR PARAMETERS

[MP - 200] Active Setpoint

Units:	N/A
Format:	X (always = 2 on EtherCAT models)
Representaion:	1 = Analog Setpoint (Analog and Digital models) 2 = Digital Setpoint

Indicates the setpoint in use by the control loop.

[MP - 204] Inhibit Alarm Status

Units:	N/A, Binary Coded
Format:	XXXXXXXX

Bit	Description
7 =	reserved
6 =	reserved
5 =	reserved
4 =	reserved
3 =	Feedback Loss
2 =	Over Temperature
1 =	Over Current Trip
0 =	AC Line Lock Loss

Indication of alarms that cause the controller to be shut OFF and not allowed to RUN.

[MP - 205] Controller Status

Units:	N/A
Format:	X
Representaion:	0 = Disabled 1 = Initialization 2 = Normal, operating 3 = Calibration 4 = Diagnostic

Indicates the operational status of the controller.

[MP - 206] AC Line Frequency

Units:	Hz
Format:	XX.X

[MP - 207] AC Line Voltage

Units:	Volts
Format:	XXX.X

[MP - 208] Feedforward Voltage

Units:	Volts
Format:	XXX.X

[MP - 209] Load Current

Units:	Amps
Format:	XXX.X

[MP - 210] Load Resistance

Units:	Ohms
Format:	XXX.X

[MP - 211] Temperature

Units:	° C
Format:	XXX.X

[MP - 212] Controller State

Units:	N/A
Format:	X
Representaion:	0 = STOP 1 = RUN 2 = FAULT 3 = FAULT RESET

STOP is the default, initialized, state.
The controller will be in STOP state when AC Line voltage is not present
The controller may be put into RUN state when AC Line is present by setting “Digital RUN Enable” (SP-24) to RUN (1)
The controller may be put into STOP state when AC Line is present by setting “Digital RUN Enable” (SP-24) to STOP (0)
FAULT state is a latching state of output shutdown. To get the controller out of Fault state: Set “Digital RUN Enable” (SP-24) to STOP (0) which will put the controller into FAULT RESET state. Then the controller is ready to be put back into RUN state when “Digital RUN Enable” (SP-24) is set back to RUN (1).

[MP - 213] Output Duty Cycle %

Units:	%
Format:	XXX.X

Indicates the amount, in percent, that the output of the controller is ON.

[MP - 214] Setpoint Reference

Units:	Volts, Amps
Format:	XXX.X

The command reference input to the control compensation loop in units determined by the “Feedback Type” (SP-1) selection.

[MP - 215] Feedback

Units:	Volts, Amps
Format:	XXX.X

The control output supplied to the load in units determined by the “Feedback Type” (SP-1) selection.

[MP - 216] Control Loop Error

Units:	Volts, Amps
Format:	± XXX.X

The difference between the “Setpoint Reference” (MP-214) and the “Feedback” (MP-215) as seen by the control compensation loop.

[MP - 217] Warning Alarm Status

Units:	N/A, Binary Coded
Format:	XXXXXXXX

Indication of conditions that cause specific warning alarms.

[MP - 217] Warning Alarm Status

Bit	Description
7 =	reserved
6 =	reserved
5 =	High Temperature
4 =	Shorted SCR
3 =	Open Load
2 =	Partial Load Fault
1 =	Current Limit
0 =	Voltage Limit

Indication of conditions that cause specific warning alarms.

[MP - 218] Partial Load Fault Target Resistance

Units:	Ohms
Format:	XXX.XX

Expected nominal resistance of the load used for comparison for partial load fault detection.

[MP - 219] Partial Load Fault Resistance

Units:	Ohms
Format:	XXX.XX

The load resistance used for comparison with the “Partial Load Fault Target Resistance” (MP-218) in detection of a partial load fault.

[MP - 220] Partial Load Fault Resistance Deviation

Units:	%
Format:	± XXX.XX

The “Load Resistance” (MP-219) deviation from the “Partial Load Fault Target Resistance” (MP-218).

[MP - 221] Partial Load Fault Status

Units:	N/A, Binary Coded
Format:	XXXXXXXX

Bit	Description
7 =	reserved
6 =	Partial Load Fault B
5 =	Partial Load Fault A
4 =	reserved
3 =	reserved
2 =	reserved
1 =	Active (1 = checking, 0 = not checking)
0 =	Enabled

The status of Partial Load Fault detection.

[MP - 307] Power-up Count

Units:	N/A
Format:	XXXXX

[MP - 309] In Service Time HI
[MP - 310] In Service Time LO

Units:	Hours
Format:	XXXXXXX

The time, in seconds, since the controller was powered up.

[MP - 311] Processor Temperature

Units:	° C
Format:	XXX.X

[MP - 331] Firmware ID

Units:	N/A
Format:	XXXXX

The firmware identification number.

[MP - 332] Firmware Revision

Units:	N/A
Format:	XX.XX

[MP - 333] Firmware Minor Revision

Units:	N/A
Format:	XX.XX

[MP - 334] Feedback Read Status

Units:	N/A
Format:	X
Representaion:	0 = OK 1 = Timeout (Loss of feedback)

Status of feedback acquisition.

[MP - 335] Miscellaneous Status

Units:	N/A, Binary Coded
Format:	XXXXXXXX

Bit	Description
7 =	reserved
6 =	Initialization in progress (0 = finished = Ready)
5 =	reserved
4 =	reserved
3 =	Waiting for ENTER key during initialization
2 =	reserved
1 =	reserved
0 =	reserved

[MP - 336] EEPROM Status

Units:	N/A, Binary Coded
Format:	XXXXXXXXXXXXXXXX

Bit	Description
13 - 15 =	reserved
12 =	EEPROM is Write protected
11 =	reserved
10 =	reserved
9 =	reserved
8 =	SP Definition table needs updating
7 =	reserved
6 =	Backup Calibration Table Error
5 =	reserved
4 =	reserved
3 =	Calibration Table Error
2 =	MFG CP Table Error
1 =	SP Table Error
0 =	EEPROM Initialization

Status of the non-volatile parameter EEPROM storage.
BITs 1 thru 6 indicate EE Table error status conditions.
Modbus Command 25 must be sent to the controller in order to retain the modified values through a power-cycle or processor reset.

[MP - 337] AC Line Status

Units:	N/A, Binary Coded
Format:	XXXXXXXX

Bit	Description
6 - 7 =	reserved
5 =	Sync-Locked (Synced to AC Line)
4 =	Pre-Lock 2
3 =	Pre-Lock 1
2 =	reserved
1 =	AC Line B ok
0 =	AC Line A ok

"BIT 5 = 1" is required before the controller can provide power to the load.

[MP - 338] Load Status

Units:	N/A, Binary Coded
Format:	XXXXXXXX

Bit	Description
5 - 7 =	reserved
4 =	Open Load
3 =	reserved
2 =	reserved
1 =	reserved
0 =	Shorted SCR

[MP - 339] Error Latch

Units:	N/A, Binary Coded
Format:	XXXXXXXX

Bit	Description
5 - 7 =	reserved
4 =	Feedback Loss
3 =	SCR Timing Loss
2 =	Line Frequency Failure
1 =	Phase Loss or Missing Cycle
0 =	Line Lock Loss

"Error Latch" is provided as a diagnostic troubleshooting aid. When one of the specific events indicated in Error Latch occurs, the indication bit for the event is set. The Error Latch bits can only be cleared by a power-cycle, processor reset, or by sending Modbus command 26 to the controller.

[MP - 340] Ethernet Status
ATOM Digital only

Units:	N/A, Binary Coded
Format:	XXXXXXXXXXXXXXXX

Bit	Description
11 - 15 =	reserved
10 =	IP Address conflict detected
9 =	Packet Transmission error detected
8 =	Packet reception error detected
7 =	Heartbeat Timer timeout
6 =	Heatbeat Timer active
5 =	IP Address is set = OK
4 =	not used
3 =	TCP Connection established
2 =	Link2 = Port 2 cable is connected
1 =	Link1 = Port 1 cable is connected
0 =	

Ethernet Status indicates the status of the Ethernet network interface.

[MP - 341] Network Heartbeat Timer

Units:	Seconds
Format:	XXXXX

[MP - 342] IP Address (in use) Octect 1
ATOM Digital only

Units:	N/A
Format:	XXX

[MP - 343] IP Address (in use) Octect 2
ATOM Digital only

Units:	N/A
Format:	XXX

[MP - 344] IP Address (in use) Octect 3
ATOM Digital only

Units:	N/A
Format:	XXX

[MP - 345] IP Address (in use) Octect 4 ATOM Digital only	
Units:	N/A
Format:	XXX

[MP - 346] EtherCAT ID ATOM EtherCAT only	
Units:	N/A
Format:	XXX
Reports the EtherCAT ID that is in use. The ID is read during power-up initialization.	

[MP - 347] EtherCAT ID Switches ATOM EtherCAT only	
Units:	N/A
Format:	XXX
Reports the setting of the EtherCAT ID switches “Live”.	

[MP - 348] EtherCAT State ATOM EtherCAT only	
Units:	N/A
Format:	X
Representaion:	0 = NOT Initialized 1 = INIT 2 = PreOP 3 = BOOT 4 = SafeOP 8 = OP

[MP - 349] Firmware Update Code	
Units:	N/A
Format:	XXXXX

[MP - 379] Bootloader Version	
Units:	N/A
Format:	XX.XX

[MP - 389] Load Current PGA Gain	
Units:	N/A
Format:	XX

DIAGNOSTIC PARAMETERS

[CAL - 395] Diagnostic Test Enable	
Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = Disabled 1 = Enabled

[CAL - 396] Diagnostic Test Select	
Units:	N/A
Minimum:	0
Maximum:	7
Default:	0
Selections:	0 = NONE 1 = Energize Relay 2 = Power LED Green 3 = Power LED Red 4 = Status LED Green 5 = Status LED Red 6 = Gate 1 ON 7 = Gate 2 ON

3-PHASE PARAMETER LIST

SETUP PARAMETERS

[SP - 1] Feedback Type

Units:	N/A
Minimum:	1
Maximum:	2
Default:	1
Selections:	1 = Voltage Feedforward 2 = Load Current

Sets the signal type used for feedback by the control loop. Voltage Feedforward is derived from AC Line voltage.

[SP - 2] Firing Mode

Units:	N/A
Minimum:	1
Maximum:	3
Default:	3
Selections:	1 = Zero Cross 2 = Fast Zero Cross 3 = SSR – Zero Cross (ON/OFF, proportional)

Selects the desired type of firing mode. Phase Angle and Half-Cycle DC include the ability to limit output voltage and current. All other firing modes do not include limits. All firing modes include over current trip fault shutdown capability.
SSR firing mode (3) requires a setpoint of 100% to turn ON and a setpoint of 0% to turn OFF. The analog setpoint scaling values (SP 12-15) may need to be adjusted in order to accomplish this

[SP - 4] Control Loop

Units:	N/A
Minimum:	0
Maximum:	1
Default:	1
Selections:	0 = Proportional (Open Loop) 1 = Closed Loop

Used for the first 4 firing modes to select closed or open loop. Closed loop compares the feedback with the setpoint to achieve the correct output. Open loop adjusts the output duty cycle of the controller directly without adjusting for feedback.

[SP - 5] Full Scale Voltage

Units:	RMS Voltage = Volts
Minimum:	10
Maximum:	600
Default:	480

Set to the expected output voltage when the controller output is fully ON 100%. This equates to the voltage output command when feedback type is set to Voltage feedforward and the setpoint is at 100% (maximum).

[SP - 6] Full Scale Current

Units:	RMS Current = Amps
Minimum:	2.0
Maximum:	80.0
Default:	80.0

Set to the expected output current when the controller output is fully ON 100%. This equates to the current output command when feedback type is set to Load Current and the setpoint is at 100% (maximum).

[SP - 7] Voltage Limit

Units:	RMS Voltage = Volts
Minimum:	10
Maximum:	700
Default:	700

Sets the maximum output voltage allowed by the controller.

[SP - 8] Current Limit

Units:	RMS Current = Amps
Minimum:	1.0
Maximum:	105.0
Default:	84.0

Sets the maximum output current allowed by the controller. The valid range for Current Limit is: minimum = 20% of the frame current rating, maximum = 105% of the frame current rating.

[SP - 9] Current Trip [read-only]

Units:	RMS Current = Amps
Default:	240

Output current fault shutdown threshold. The controller will shut off the output and transition to Fault state if the load current supplied by this controller exceeds this setting.

[SP - 10] Analog Setpoint Zero Threshold
ATOM Analog and Digital only

Units:	V, mA
Minimum:	0.00
Maximum:	20.00
Default:	0.05

The analog setpoint will be zero (0) when the analog signal is at or below this threshold. Set this value high enough to ensure that the setpoint will be zero when the input signal is at its lowest. Set this value low enough so that it does not affect normal operation.

[SP - 11] Analog Setpoint Type
ATOM Analog and Digital only

Units:	N/A
Minimum:	1
Maximum:	2
Default:	1
Selections:	1 = Voltage 2 = Current

Selection for the signal type connected to the analog setpoint input terminals. Select Voltage (1) when connecting a voltage source (0 to 10v). Select Current (2) when connecting a current source (4 to 20ma).

[SP - 12] Analog Setpoint Low Command
ATOM Analog and Digital only

Units:	V, mA
Minimum:	-5.00
Maximum:	25.00
Default:	0.00

Set to the analog setpoint input low signal value. This will provide an analog setpoint at the percent set in “Analog Setpoint Low Out” (SP-13).

[SP - 13] Analog Setpoint Low Out
ATOM Analog and Digital only

Units:	%
Minimum:	0.00
Maximum:	125.00
Default:	0.00

Set to the desired setpoint % when the analog setpoint signal is at the value set for “Analog Setpoint Low Command” (SP-12).

[SP - 14] Analog Setpoint High Command
ATOM Analog and Digital only

Units:	V, mA
Minimum:	-5.00
Maximum:	25.00
Default:	10.00

Set to the analog setpoint input high signal value. This will provide an analog setpoint at the percent set in “Analog Setpoint High Out” (SP-15).

[SP - 15] Analog Setpoint High Out
ATOM Analog and Digital only

Units:	%
Minimum:	0.00
Maximum:	125.00
Default:	100.00

Set to the desired setpoint % when the analog setpoint signal is at the value set for “Analog Setpoint High Command” (SP-14).

[SP - 16] Partial Load Fault Enable

Units:	N/A
Minimum:	0
Maximum:	1

Enables and disables partial load fault detection & alarm.

[SP - 16] Partial Load Fault Enable

Default:	0
Selections:	0 = Disable 1 = Enable

Enables and disables partial load fault detection & alarm.

[SP - 17] Partial Load Fault Tolerance

Units:	%
Minimum:	0.0
Maximum:	100.0
Default:	8.0

Sets the maximum percent load resistance deviation from the “Partial Load Fault Resistance” (SP-18) value. Deviations outside this band will trigger a Partial Load Fault alarm.

[SP - 18] Partial Load Fault Resistance

Units:	Ohm
Minimum:	0.10
Maximum:	655.35
Default:	8.00

Sets the nominal resistance of the load. This is used for comparison in determination of a partial load fault alarm condition.

[SP - 19] Partial Load Fault Alarm Delay Time

Units:	Seconds
Minimum:	1
Maximum:	120
Default:	10

Sets the delay time, in seconds, after detection of a partial load fault until the alarm is indicated.

[SP - 20] Relay Alarm Mask

Units:	N/A, Binary Coded
Minimum:	000000000 = 0
Maximum:	111111111 = 511
Default:	110000000 = 384

Bit	Description
8 =	Over Current Trip
7 =	Over Temperature
6 =	Partial Load Fault/Open Load
5 =	Shorted SCR
4 =	Current Limit
3 =	Voltage Limit
2 =	AC Line Loss
1 =	Communications Error
0 =	Memory Error, Watchdog Timeout, Error Trap (Halted in initialization)

Selects the events that will cause the relay output to activate. More than one selection may be made.

[SP - 21] Shorted SCR Detection Enable

Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = Disable 1 = Enable

Enables and disables shorted SCR detection and alarm indication.
Shorted SCR detection is always performed when AC Line is ON and the controller's output is OFF.
Due to feedback signal delay, the output must be off for at least 8 half cycles (4 line cycles) before the shorted SCR check can be performed.
Firing modes Zero-cross & Fast Zero-cross may be checked during off periods, between firing, or if the off periods are less than 4 cycles the output will be turned off every 30 seconds for 4 cycles in order to check for a shorted SCR.
This is performed when the controller's output duty cycle% is less than 95%.
Shorted SCR load current threshold for detection:
¼ Full Scale Current setting (SP-6) with a minimum = 1 A
If the Load current, while the output is OFF, is greater than the threshold it is determined to be a shorted SCR.

[SP - 22] Open Load Detection Enable

Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = Disable 1 = Enable

Enables and disables open load detection and alarm indication.
Open Load detection criterion:
The controller's output duty cycle % is ≥ 10% and the Load Current is less than 5% of the Full Scale Current (SP-6) setting (or 250 ma minimum threshold).
There is a 5 second delay after open load is detected until the alarm is indicated.

[SP - 23] Digital Setpoint [non-volatile/EEPROM]

Units:	N/A
Minimum:	0
Maximum:	10000
Default:	0

This is provided as an alternate setpoint that can be used while connected via USB. This value will be set to zero (0) at power-up during initialization. "Setpoint Select" (SP-25) must be set to Digital Setpoint (2) in order to utilize this Digital Setpoint for control.

[SP - 24] Fieldbus Setpoint [RAM]
ATOM Digital and EtherCAT only

Units:	N/A
Minimum:	0
Maximum:	10000
Default:	0

This is the setpoint that is used for fieldbus communications. This value will be set to zero (0) at power-up during initialization.

[SP - 25] Digital Run Enable [RAM]
ATOM Digital and EtherCAT only

Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = STOP 1 = RUN

This is used to put the controller into RUN and STOP state.
The value of this parameter will be set to STOP (0) at power-up during initialization.

[SP - 26] Setpoint Source
ATOM Digital and EtherCAT only

Units:	N/A
Minimum:	1
Maximum:	2
Default:	1
Selections:	1 = Analog Setpoint 2 = Digital Setpoint

This will select the setpoint to use for control. Analog Setpoint (1) will use the analog setpoint input for control. Digital Setpoint (2) selects the "Digital Setpoint" (SP-23) for control.

[SP - 26] Setpoint Source

Units:	N/A
Minimum:	1 (Analog and Digital models) 2 (EtherCAT model)
Maximum:	2 (Analog model) 3 (Digital and EtherCAT models)
Default:	1 (Analog model) 3 (Digital and EtherCAT models)
Selections:	1 = Analog Setpoint 2 = Digital Setpoint (non-volatile/EEPROM) 3 = Fieldbus Setpoint (RAM)

This will select the setpoint to use for control. Analog Setpoint (1) will use the analog setpoint input for control. Digital Setpoint (2) selects the "Digital Setpoint" (SP-23) for control.

[SP - 27] Digital RUN Enable Power-up Default
ATOM Digital and EtherCAT only

Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = STOP 1 = RUN

Sets the operating state of the controller on power up.
This is the value of SP-25 Digital RUN Enable set during initialization.

[SP - 28] Partial Load Fault Teach Enable [RAM]
ATOM Digital and EtherCAT only

Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = Disable 1 = Enable

When Partial Load Fault Teach Enable is set to “Enable” (1) the value of the load resistance (MP-210) is stored into Partial Load Fault Resistance (SP-18). After the load resistance value has been recorded, the value for this parameter returns to “Disable” (0).

[SP - 29] Communications Heartbeat Time
ATOM Digital and EtherCAT only

Units:	Seconds
Minimum:	0
Maximum:	65535
Default:	0 [Disabled]

This timer is used to detect loss of communications over Ethernet, and take appropriate action when communications loss is detected. Communication loss is the result of the Heartbeat timer reaching the value set for this parameter without reception of a packet.
The Heartbeat timer is reset with the reception of a packet destined for this controller.
Setting this parameter to a value greater than zero enables the timer. Setting the value to zero disables the timer.

[SP - 30] Network Timeout Action
ATOM Digital and EtherCAT only

Units:	N/A
Minimum:	0
Maximum:	2
Default:	0
Selections:	0 = NONE, continue 1 = STOP, fault shutdown 2 = Use Network Timeout Setpoint (SP-29)

Set this parameter for the desired action to take upon detection of network communication loss due to expiration of the Network Heartbeat timer (MP-341).

[SP - 31] Network Timeout Setpoint
ATOM Digital and EtherCAT only

Units:	N/A
Minimum:	0
Maximum:	10000
Default:	0

This is the setpoint that is used by the control loop after the Heartbeat timer expires, due to communication loss, when Network Timeout Action (SP-30) is set to Use Network Timeout setpoint (2).

[SP - 33] IP Address, Octet 1
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	255
Default:	192

The value of this parameter sets the value of the first octet of the static IP address.

[SP - 34] IP Address, Octet 2
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	255
Default:	168

The value of this parameter sets the value of the second octet of the static IP address.

[SP - 35] IP Address, Octet 3
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	255
Default:	2

The value of this parameter sets the value of the third octet of the static IP address.

[SP - 36] IP Address, Octet 4
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	255
Default:	243

The value of this parameter sets the value of the fourth octet of the static IP address.

[SP - 37] Subnet Mask, Octet 1
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	255
Default:	255

The value of this parameter sets the value of the first octet of the Subnet Mask.

[SP - 38] Subnet Mask, Octet 2
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	255
Default:	255

The value of this parameter sets the value of the second octet of the Subnet Mask.

[SP - 39] Subnet Mask, Octet 3
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	255
Default:	255

The value of this parameter sets the value of the third octet of the Subnet Mask.

[SP - 40] Subnet Mask, Octet 4
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	255
Default:	0

The value of this parameter sets the value of the fourth octet of the Subnet Mask.

[SP - 41] Gateway IP Address, Octet 1
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	255
Default:	192

The value of this parameter sets the value of the first octet of the IP address used for the gateway.

[SP - 42] Gateway IP Address, Octet 2
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	255
Default:	168

The value of this parameter sets the value of the second octet of the IP address used for the gateway.

[SP - 43] Gateway IP Address, Octet 3
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	255
Default:	2

The value of this parameter sets the value of the third octet of the IP address used for the gateway.

[SP - 44] Gateway IP Address, Octet 4
ATOM Digital and EtherCAT only

Units:	N/A
Minimum:	0
Maximum:	255
Default:	1

The value of this parameter sets the value of the fourth octet of the IP address used for the gateway.

[SP - 45] Relay Normal State

Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = OFF 1 = ON

Sets the normal, not energized, state of the relay output

[SP - 46] EtherCAT Warning Mask HI
[SP - 47] EtherCAT Warning Mask LO
ATOM EtherCAT only

Units:	N/A
Minimum:	0
Maximum:	65535
Default:	65535

[SP - 48] EtherCAT Error Mask HI
[SP - 49] EtherCAT Error Mask LO
ATOM EtherCAT only

Units:	N/A
Minimum:	0
Maximum:	65535
Default:	65535

[SP - 50] Sync-Guard Enable
ATOM Digital only

Units:	N/A
Minimum:	0
Maximum:	65535
Default:	65535
Selections:	0 = Disable 1 = Enable

[SP - 61 to 90] Fieldbus Link Parameters
ATOM Digital only

Parameters 61 and 62 are read/write, parameters 63 to 90 contain the read-only parameter values that can be read by fieldbus communications.

See the Digital Fieldbus section of the ATOM User's Manual for additional information on accessing these parameters.

Parameter	Name	State	Default
61	Fieldbus Setpoint	Read/Write	24
62	Digital RUN Enable	Read/Write	25
63	Inhibit Alarm Status	Read only	204
64	Warning Alarm Status	Read only	217
65	Feedback Read Status	Read only	334
66	AC Line Frequency	Read only	206
67	AC Line Voltage	Read only	207
68	Load Voltage	Read only	208
69	Load Current	Read only	209
70	Load Resistance	Read only	210
71	Heatsink Temperature	Read only	211
72	Output Duty Cycle %	Read only	213
73	Setpoint Reference	Read only	214
74	Feedback	Read only	215
75	Partial Load Fault Target Resistance	Read only	218
76	Partial Load Fault Resistance	Read only	219
77	Partial Load Fault Resistance Deviation	Read only	220
78	Firmware ID	Read only	331
79	Firmware Major Revision	Read only	332
80	Firmware Minor Revision	Read only	333
81	Full Scale Voltage	Read only	5
82	Full Scale Current	Read only	6
83	AC Line Status	Read only	337
84	Load Status	Read only	338
85	Controller Status	Read only	205
86	Controller State	Read only	212
87	EEPROM Status	Read only	336
88	EEPROM Status 2	Read only	336
89	Error Latch	Read only	339
90	Miscellaneous Status	Read only	335

MONITOR PARAMETERS

[MP - 200] Active Setpoint

Units:	N/A
Format:	X (always = 2 on ATOM Digital and EtherCAT)
Representaion:	1 = Analog Setpoint (ATOM Analog) 2 = Digital Setpoint

Indicates the setpoint in use by the control loop.

[MP - 204] Inhibit Alarm Status

Units:	N/A, Binary Coded
Format:	XXXXXXXX

Bit	Description
7 =	reserved
6 =	reserved
5 =	reserved
4 =	reserved
3 =	Feedback Loss
2 =	Over Temperature
1 =	Over Current Trip
0 =	AC Line Lock Loss

Indication of alarms that cause the controller to be shut OFF and not allowed to RUN.

[MP - 205] Controller Status

Units:	N/A
Format:	X
Representaion:	0 = Disabled 1 = Initialization 2 = Normal, operating 3 = Calibration 4 = Diagnostic

Indicates the operational status of the controller.

[MP - 206] AC Line Frequency

Units:	Hz
Format:	XX.X

[MP - 207] AC Line Voltage

Units:	Volts
Format:	XXX.X

[MP - 208] Feedforward Voltage

Units:	Volts
Format:	XXX.X

[MP - 209] Load Current

Units:	Amps
Format:	XXX.X

[MP - 210] Load Resistance

Units:	Ohms
Format:	XXX.X

[MP - 211] Temperature

Units:	° C
Format:	XXX.X

[MP - 212] Controller State

Units:	N/A
Format:	X
Representaion:	0 = STOP 1 = RUN 2 = FAULT 3 = FAULT RESET

STOP is the default, initialized, state.
The controller will be in STOP state when AC Line voltage is not present
The controller may be put into RUN state when AC Line is present by setting “Digital RUN Enable” (SP-24) to RUN (1)
The controller may be put into STOP state when AC Line is present by setting “Digital RUN Enable” (SP-24) to STOP (0)
FAULT state is a latching state of output shutdown. To get the controller out of Fault state: Set “Digital RUN Enable” (SP-24) to STOP (0) which will put the controller into FAULT RESET state. Then the controller is ready to be put back into RUN state when “Digital RUN Enable” (SP-24) is set back to RUN (1).

[MP - 213] Output Duty Cycle %

Units:	%
Format:	XXX.X

Indicates the amount, in percent, that the output of the controller is ON.

[MP - 214] Setpoint Reference

Units:	Volts, Amps
Format:	XXX.X

The command reference input to the control compensation loop in units determined by the “Feedback Type” (SP-1) selection.

[MP - 215] Feedback

Units:	Volts, Amps
Format:	XXX.X

The control output supplied to the load in units determined by the “Feedback Type” (SP-1) selection.

[MP - 216] Control Loop Error

Units:	Volts, Amps
Format:	± XXX.X

The difference between the “Setpoint Reference” (MP-214) and the “Feedback” (MP-215) as seen by the control compensation loop.

[MP - 217] Warning Alarm Status

Units:	N/A, Binary Coded
Format:	XXXXXXXX

Indication of conditions that cause specific warning alarms.

[MP - 217] Warning Alarm Status

Bit	Description
7 =	reserved
6 =	reserved
5 =	High Temperature
4 =	Shorted SCR
3 =	Open Load
2 =	Partial Load Fault
1 =	Current Limit
0 =	Voltage Limit

Indication of conditions that cause specific warning alarms.

[MP - 218] Partial Load Fault Target Resistance

Units:	Ohms
Format:	XXX.XX

Expected nominal resistance of the load used for comparison for partial load fault detection.

[MP - 219] Partial Load Fault Resistance

Units:	Ohms
Format:	XXX.XX

The load resistance used for comparison with the “Partial Load Fault Target Resistance” (MP-218) in detection of a partial load fault.

[MP - 220] Partial Load Fault Resistance Deviation

Units:	%
Format:	± XXX.XX

The “Load Resistance” (MP-219) deviation from the “Partial Load Fault Target Resistance” (MP-218).

[MP - 221] Partial Load Fault Status

Units:	N/A, Binary Coded
Format:	XXXXXXXX

Bit	Description
7 =	reserved
6 =	Partial Load Fault B
5 =	Partial Load Fault A
4 =	reserved
3 =	reserved
2 =	reserved
1 =	Active (1 = checking, 0 = not checking)
0 =	Enabled

The status of Partial Load Fault detection.

[MP - 307] Power-up Count

Units:	N/A
Format:	XXXXX

[MP - 309] In Service Time HI
[MP - 310] In Service Time LO

Units:	Hours
Format:	XXXXXXX

The time, in seconds, since the controller was powered up.

[MP - 311] Processor Temperature

Units:	° C
Format:	XXX.X

[MP - 331] Firmware ID

Units:	N/A
Format:	XXXXX

The firmware identification number.

[MP - 332] Firmware Revision

Units:	N/A
Format:	XX.XX

[MP - 333] Firmware Minor Revision

Units:	N/A
Format:	XX.XX

[MP - 334] Feedback Read Status

Units:	N/A
Format:	X
Representaion:	0 = OK 1 = Timeout (Loss of feedback)

Status of feedback acquisition.

[MP - 335] Miscellaneous Status

Units:	N/A, Binary Coded
Format:	XXXXXXXX

Bit	Description
7 =	reserved
6 =	Initialization in progress (0 = finished = Ready)
5 =	reserved
4 =	reserved
3 =	Waiting for ENTER key during initialization
2 =	reserved
1 =	reserved
0 =	reserved

[MP - 336] EEPROM Status

Units:	N/A, Binary Coded
Format:	XXXXXXXXXXXXXXXX

Bit	Description
15 =	reserved
14 =	reserved
13 =	reserved
12 =	EEPROM is Write protected
11 =	reserved
10 =	reserved
9 =	reserved
8 =	SP Definition table needs updating
7 =	reserved
6 =	Backup Calibration Table Error
5 =	reserved
4 =	reserved
3 =	Calibration Table Error
2 =	MFG CP Table Error
1 =	SP Table Error
0 =	EEPROM Initialization

Status of the non-volatile parameter EEPROM storage.
BITs 1 thru 6 indicate EE Table error status conditions.
Modbus Command 25 must be sent to the controller in order to retain the modified values through a power-cycle or processor reset.

[MP - 337] AC Line Status

Units:	N/A, Binary Coded
Format:	XXXXXXXX

Bit	Description
7 =	reserved
6 =	reserved
5 =	Sync-Locked (Synced to AC Line)
4 =	Pre-Lock 2
3 =	Pre-Lock 1
2 =	reserved
1 =	AC Line B ok
0 =	AC Line A ok

"BIT 5 = 1" is required before the controller can provide power to the load.

[MP - 338] Load Status

Units:	N/A, Binary Coded
Format:	XXXXXXXX

Bit	Description
7 =	reserved
6 =	reserved
5 =	reserved
4 =	Open Load
3 =	reserved
2 =	reserved
1 =	reserved
0 =	Shorted SCR

[MP - 339] Error Latch

Units:	N/A, Binary Coded
Format:	XXXXXXXX

Bit	Description
7 =	reserved
6 =	reserved
5 =	reserved
4 =	Feedback Loss
3 =	SCR Timing Loss
2 =	Line Frequency Failure
1 =	Phase Loss or Missing Cycle
0 =	Line Lock Loss

"Error Latch" is provided as a diagnostic troubleshooting aid. When one of the specific events indicated in Error Latch occurs, the indication bit for the event is set. The Error Latch bits can only be cleared by a power-cycle, processor reset, or by sending Modbus command 26 to the controller.

[MP - 346] EtherCAT ID

ATOM EtherCAT only

Units:	N/A
Format:	XXX

Reports the EtherCAT ID that is in use.
The ID is read during power-up initialization.

[MP - 347] EtherCAT ID Switches

ATOM EtherCAT only

Units:	N/A
Format:	XXX

Reports the setting of the EtherCAT ID switches "Live".

[MP - 348] EtherCAT State

ATOM EtherCAT only

Units:	N/A
Format:	X
Representaion:	0 = NOT Initialized 1 = INIT 2 = PreOP 3 = BOOT 4 = SafeOP 8 = OP

[MP - 349] Firmware Update Code

Units:	N/A
Format:	XXXXX

[MP - 379] Bootloader Version

Units:	N/A
Format:	XX.XX

[MP - 389] Load Current PGA Gain

Units:	N/A
Format:	XX

DIAGNOSTIC PARAMETERS

[CAL - 395] Diagnostic Test Enable	
Units:	N/A
Minimum:	0
Maximum:	1
Default:	0
Selections:	0 = Disabled 1 = Enabled

[CAL - 396] Diagnostic Test Select	
Units:	N/A
Minimum:	0
Maximum:	7
Default:	0
Selections:	0 = NONE 1 = Energize Relay 2 = Power LED Green 3 = Power LED Red 4 = Status LED Green 5 = Status LED Red 6 = Gate 1 ON 7 = Gate 2 ON

APPENDIX: MODEL NUMBERS

1-Phase Model Numbers

A 1 □ 0 □□□ – □□□□□ – □□□ – □□ – □□□ – □□□□

Phase

Circuit Power
A = 24vdc Digital

Frame Current
16, 32, 50, or 65

Comms
A = Analog or I = Ethernet/IP E = Modbus TCP C = EtherCAT N = Profinet

Setpoint Range

Digital	0	Analog	4 = 4 / 20mA
Analog	1 = 0 / 5V	Analog	5 = POT
Analog	2 = 1 / 5V	Analog	6 = SSR (3 / 4V)
Analog	3 = 0 / 10V		

Firing Mode

SSR	RMS Voltage	RMS Current	Proportional
A = Zero Cross	G = Zero Cross	M = Zero Cross	C = Zero Cross
B = Random	H = Fast Zero Cross	N = Fast Zero Cross	D = Fast Zero Cross
	J = Phase Angle	P = Phase Angle	E = Phase Angle
	K = 1/2 Cycle DC	Q = 1/2 Cycle DC	F = 1/2 Cycle DC

Full Scale

SSR or PROP	000
Voltage	001 - 600
Current	001 - 100

Limits
000 = Default - fixed 105% of frame rating
020 - 105 = Adjustable Limit - 20-105% of frame rating
The Limit value is entered as volts or amps

If the value is zero, then limit is not purchased, current is 105%.
If voltage feedback, limit is in current and has no voltage limit.
If current feedback, limit is in voltage, current limit is 105%.
If SSR or proportional, limit is in current.

Shorted SCR Enable
0 = Not Purchased 1 = Enabled

PLF/Open Load

0 = Not Purchased	B = 5%	E = 20%	H = 35%	K = 50%	N = 65%	(% Tolerance)
A = Purchase undetermined	C = 10%	F = 25%	I = 40%	L = 55%	O = 70%	
Z = Open Load	D = 15%	G = 30%	J = 45%	M = 60%	P = 75%	

Relay Mask

MSB										LSB
	1	1	0	0	0	0	0	0	0	
	OCT	Over Temp	PLF	SSCR	iL	VL	Line Loss	Comm Error	Mem Error Watchdog timeout Error trap	

Mask is binary selections represented as a hex value

Config Code
Reserved for manufacturer configuration



3-Phase Model Numbers

A 3 □ 0 □□□ – □□□□□ – □□□ – □□ – □□□ – □□□□

Phase

Circuit Power
A = 24VDC Digital

Frame Current
16, 32, 50, or 80

Comms
A = Analog or I = Ethernet/IP, E = Modbus TCP, C = EtherCAT, N = Profinet

Setpoint Range

Digital	0	Analog	4 = 4 / 20mA
Analog	1 = 0 / 5V	Analog	5 = POT
Analog	2 = 1 / 5V	Analog	6 = SSR (3 / 4V)
Analog	3 = 0 / 10V		

Firing Mode

SSR	RMS Voltage	RMS Current	Proportional
A = Zero Cross	G = Zero Cross	M = Zero Cross	C = Zero Cross
	H = Fast Zero Cross	N = Fast Zero Cross	D = Fast Zero Cross

Full Scale

SSR or PROP	000
Voltage	001 - 600
Current	001 - 100

Limits
000 = Default - fixed 105% of frame rating
020 - 105 = Adjustable Limit - 20-105% of frame rating
The Limit value is entered as volts or amps

If the value is zero, then limit is not purchased, current is 105%.
If voltage feedback, limit is in current and has no voltage limit.
If current feedback, limit is in voltage, current limit is 105%.
If SSR or proportional, limit is in current.

Shorted SCR Enable
0 = Not Purchased 1 = Enabled

PLF/Open Load

0 = Not Purchased	B = 5%	E = 20%	H = 35%	K = 50%	N = 65%	(% Tolerance)
A = Purchase undetermined	C = 10%	F = 25%	I = 40%	L = 55%	O = 70%	
Z = Open Load	D = 15%	G = 30%	J = 45%	M = 60%	P = 75%	

Relay Mask

MSB									LSB
1	1	0	0	0	0	0	0	0	
OCT	Over Temp	PLF	SSCR	iL	VL	Line Loss	Comm Error	Mem Error Watchdog timeout Error trap	

Mask is binary selections represented as a hex value

Config Code
Reserved for manufacturer configuration

Contact & Ordering Information

CONTACT / TECHNICAL SUPPORT

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CONTROL CONCEPTS