ASPYRE® AT

Power Controller

User's Guide

WATLOW®

Powered by Possibility

TOTAL CUSTOMER SATISFACTION 3 Year Warranty

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Safety Information

Symbol	Explanation
“NOTE”	An important detail or recommendation
	CAUTION - Warning or Hazard that needs further explanation than the label on unit can provide. Consult User’s Guide for further information.
	Electrical Shock Hazard - Symbol (a lightning bolt in a triangle) precedes an electric shock hazard CAUTION or WARNING safety statement.
	ESD Sensitive product, use proper grounding and handling techniques when installing or servicing product.
	Do not throw in trash, use proper recycling techniques or consult manufacturer for proper disposal.
	Unit is a Listed device per Underwriters Laboratories. It has been investigated to ANSI/UL® 508 standards for Industrial Control Switches and equivalent to CSA C22.2 #14. For more detail search for File E73741 on www.ul.com.
 	Unit is compliant with European Union directives and the United Kingdom's Statutory Regulations. See "Agency Approval and Regulatory" on page 134. for further details on Directives and Standards used for Compliance.

WARNING! To avoid damage to property or equipment, injury, and loss of life, adhere to applicable electrical codes and standard wiring practices when installing and operating this product. Failure to do so could result in damage, injury and death.

WARNING! All service including inspection, installation, wiring, maintenance, and troubleshooting must be performed only by properly qualified personnel. Service personnel must read this manual before proceeding with work. While service is being performed other, unqualified personnel should not work on the unit or be allowed in the immediate vicinity.

WARNING! When in use the power controller is connected to dangerous voltages. Do not service controller without first disconnecting and preventing power from being restored while servicing the power controller.

WARNING! Do not use in aerospace or nuclear applications.

WARNING! The power controller’s protection rating is IP20. It must be installed in an enclosure that provides all the necessary additional protections appropriate for the environment and application.

WARNING! Ground the power controller via the provided protective earth grounding terminal. Verify ground is within impedance specifications of UL 508A 0.1 ohm. This should be verified periodically.

WARNING! The installation must be protected by electromagnetic circuit breakers or by fuses.

WARNING! When making live voltage or current measurements, use proper personal protective equipment for the voltages and arc-flash potentials involved.

⚠**WARNING!** Verify the voltage and current ratings of the power controller are correct for the application.

⚠**CAUTION:** To avoid compromising the insulation, do not bend wire or other components beyond their bend radius specifications.

⚠**CAUTION:** Protect the power controller from high temperature, humidity and vibrations.

⚠**CAUTION:** Install an appropriately sized RC filter across contactor coils, relays and other inductive loads.

⚠**NOTE!** Provide a local disconnect to isolate the power controller for servicing.

⚠**NOTE!** The nominal current is specified for ambient temperatures at or below 40° C. Ensure the application design allows for adequate cooling of each power controller. The power controller must be mounted vertically. The cooling design must prevent air heated by one power controller from causing power controllers mounted above to exceed the ambient operating temperature limit.

⚠**NOTE!** Use only copper cables and wires rated for use at 90°C or greater, unless otherwise noted.

⚠**AVERTISSEMENT!** Pour éviter d'endommager la propriété et l'équipement, les blessures et la perte de vie, respecter les codes électriques en vigueur et les pratiques de câblage standard au moment de l'installation et de l'utilisation de ce produit. Dans le cas contraire, cela peut entraîner la mort, des blessures graves ou des dommages.

⚠**AVERTISSEMENT!** Lorsqu'il est utilisé, le contrôleur de puissance est connecté à des tensions dangereuses. Ne réparez pas le contrôleur sans d'abord déconnecter et empêcher le rétablissement de l'alimentation lors de l'entretien du contrôleur de puissance.

⚠**AVERTISSEMENT!** Tous les services, y compris l'inspection, l'installation, le câblage, l'entretien, le dépannage, le remplacement de fusibles ou d'autres composants pouvant être réparés par l'utilisateur, doivent être effectués uniquement par un personnel dûment qualifié. Le personnel de service doit lire ce manuel avant d'effectuer tout travail. Pendant que l'entretien est exécuté, tout personnel non qualifié ne doit effectuer de travail sur l'appareil ni se trouver à proximité.

⚠**AVERTISSEMENT!** Ne pas utiliser pour les applications aérospatiales ou nucléaires.

⚠**AVERTISSEMENT!** L'indice de protection du régulateur de puissance est de IP20 lorsque les couvercles sont installés et fermés. L'appareil doit être installé dans une enceinte qui assure toute la protection supplémentaire nécessaire pour l'environnement et l'application.

⚠**AVERTISSEMENT!** Mise à la terre du régulateur de puissance par le biais de la borne de prise de terre de protection fournie. Vérifier que la prise de terre est conforme aux spécifications de l'impédance UL 508A 0.1 ohm. Cela doit être vérifié périodiquement.

⚠**AVERTISSEMENT!** L'installation doit être protégée par des disjoncteurs électromagnétiques ou des fusibles.

⚠**AVERTISSEMENT!** Au moment de relever des mesures de tension ou de courant en direct, utiliser un équipement de protection individuelle approprié pour les tensions et les potentiels d'arc électrique concernés.

⚠**AVERTISSEMENT!** Vérifier que les valeurs de tension et de courant du régulateur de puissance sont correctes pour l'application.

⚠**ATTENTION**: Pour éviter de compromettre l'isolation, ne pas plier le fil ou tout autre composant au-delà de ses spécifications en matière de rayon de courbure.

⚠**ATTENTION**: Protéger le régulateur de puissance contre les températures élevées, l'humidité et les vibrations.

⚠**ATTENTION**: Installer un filtre RC de dimensions appropriées sur les bobines du contacteur, les relais et autres charges par induction.

⚠**REMARQUE**: Fournir une déconnexion locale afin d'isoler le régulateur de puissance pour l'entretien.

⚠**REMARQUE**: Le courant nominal est précisé pour des températures ambiantes égales ou inférieures à 40 °C. S'assurer que la conception de l'application permette le refroidissement adéquat de chaque régulateur de puissance. Le régulateur de puissance doit être monté verticalement. La conception de refroidissement doit empêcher l'air chauffé par le régulateur de puissance de dépasser la limite de température de fonctionnement ambiante de la part des régulateurs de puissance montés au-dessus.

⚠**REMARQUE**: N'utiliser que des câbles et des fils en cuivre pour l'utilisation à 90 °C ou plus, sauf indication contraire.

Technical Assistance

If you encounter a problem with your Watlow® controller, review your configuration information to verify that your selections are consistent with your application: inputs, outputs, alarms, limits, etc. If the problem persists, you can get technical assistance from your local Watlow representative "How to Reach Us" on page 135, by e-mailing your questions to wintechsupport@watlow.com or by dialing +1 (507) 494-5656 between 7 a.m. and 5 p.m. Central Time USA & Canada. Ask for an Applications Engineer. Please have the complete model number available when calling.

Return Material Authorization (RMA)

1. If you purchased the Watlow product you wish to return from a distributor or as part of a larger assembly from a third party, please contact that company for repair service. If you purchased the product directly from Watlow please go to www.watlow.com/rma to start the RMA process. Watlow Customer Service will then respond back with the RMA number via an email.
2. Goods returned for credit must comply with Watlow's standard terms, found at www.watlow.com/terms.
3. A return merchandise authorization (RMA) number issued by Watlow is required when returning any product for credit, repair or evaluation. Make sure the RMA number is on the outside of the carton and on all paperwork returned. Ship on a Freight Prepaid basis.
4. After we receive your return, we will examine it to verify the reason for the failure. Unless otherwise agreed to in writing, Watlow's standard warranty provisions, found at www.watlow.com/terms, apply to any failed product.
5. In the event that the product is not subject to an applicable warranty, we will quote repair costs to you and request a purchase order from you prior to proceeding with the repair work.
6. Watlow reserves the right to charge for no trouble found (NTF) returns.

Warranty

The ASPYRE AT power controller is warranted by Watlow in accordance with the terms and conditions set forth on Watlow's website at www.watlow.com/terms.

TC Contents

1 Overview

This chapter describes how to locate the model number of the ASPYRE® AT power controller, explains how to determine which ordering options are present, identifies its physical features, lists its main functional features and benefits and provides a functional overview in the form of a block diagram.

Identifying the Product

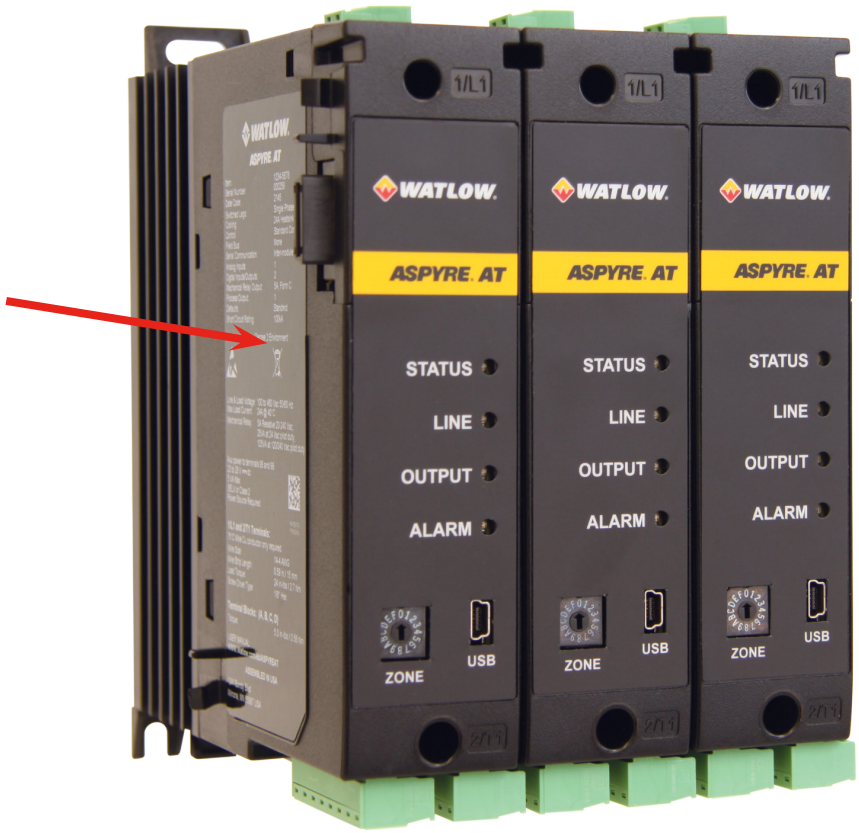
Refer to product label for the features installed in your ASPYRE AT power controller.

The product identification label indicates the voltage and current ratings and auxiliary power requirements and other information needed to set up the power controller. See "Features and Benefits" on page 10 for details.

Product Selection

The product label on the side of the controller shows the features/options installed in the unit.

Product identification label on left side of each ASPYRE AT power controller



Order Options

This chart below lists the features and ordering options for the ASPYRE AT power controller.

✓	Switched Legs
	Single-phase

✓	Maximum Load Current
	12A
	24A
	48A

✓	Cooling
	Base plate (customer supplied heat sink)
	Up to 24A convection cooled, DIN-rail mounted heat sink
	Up to 48A convection cooled, DIN-rail mounted heat sink

✓	Control and Measurement
	Standard precision closed-loop power control with current limit

✓	Serial Communications
	High-speed inter-module bus via backplane and screw terminal connection
	Modbus® RTU via screw terminal connection, high-speed inter-module bus via backplane only

✓	Analog Input
	None
	1 process input (volts and milliamps)

✓	Digital Inputs/Outputs
	None
	2 digital I/O points

✓	Mechanical Relay Output
	None
	Mechanical relay 5A, Form C

✓	Universal Process/Retransmit Output
	None
	1 universal process output

✓	Firmware
	Standard (current revision)
	Locked revisions

✓	Defaults
	Standard
	Custom - consult factory

Features and Benefits

Watlow's new ASPYRE AT power controller is flexible and scalable, and available with a variety of options allowing one platform to be re-used across a wide range of applications, which can help save time and money. ASPYRE AT models available include sizes from 12 to 48 amps. This smart power controller features multiple advanced firing and control mode algorithms.

RM connectivity

- High speed backplane interface with Watlow® RM family of controllers eliminates discrete wiring between temperature controllers and power controllers for each heater
- Enables data collection and diagnostics from the power controllers

High accuracy current and voltage measurement

- Characterizes process performance
- Supports comparing (fingerprinting) equipment operation

Wide range of communication protocols (future option)

- Modbus® RTU, Modbus® TCP, EtherNet/IP™, USB device, ProfiNet, EtherCAT® (configuration and data file transfers). With the use of a high speed watbus backplane, all of these are already available when linked with appropriate RM

Industry-leading design and serviceability

- Offers a robust SCR design to meet a rugged industrial environment's high quality and reliability needs
- Enables fast troubleshooting by providing helpful thermal system diagnostics

100KA short circuit current rating (SCCR)

- Enables greater protection in the event of a short circuit

c-UL® 508 Listed

- Shortens project schedules, agency testing and expenses

Control modes: contactor, voltage, current, power or energy

- Compensates for component thermal tolerances (e.g. heater wattage, insulation variation etc.)

Load firing modes: zero-cross, burst fire, phase angle, soft start

- Handles a wide range of load types
- Protects and extends the life of connected loads

Open heater and shorted SCR indication

- Minimizes production downtime with easy to understand, intelligent, troubleshooting diagnostics

Integrated USB for configuration

- Easily and safely program configuration settings as the user interface can be powered through USB connection
- Eliminates a user from having to work in a high voltage hazard environment. High voltage to controller or system panel can be turned off while setting controller configuration

Heater Bakeout

- Protects heater on startup
- Eliminates labor and time associated with checking for wet heaters

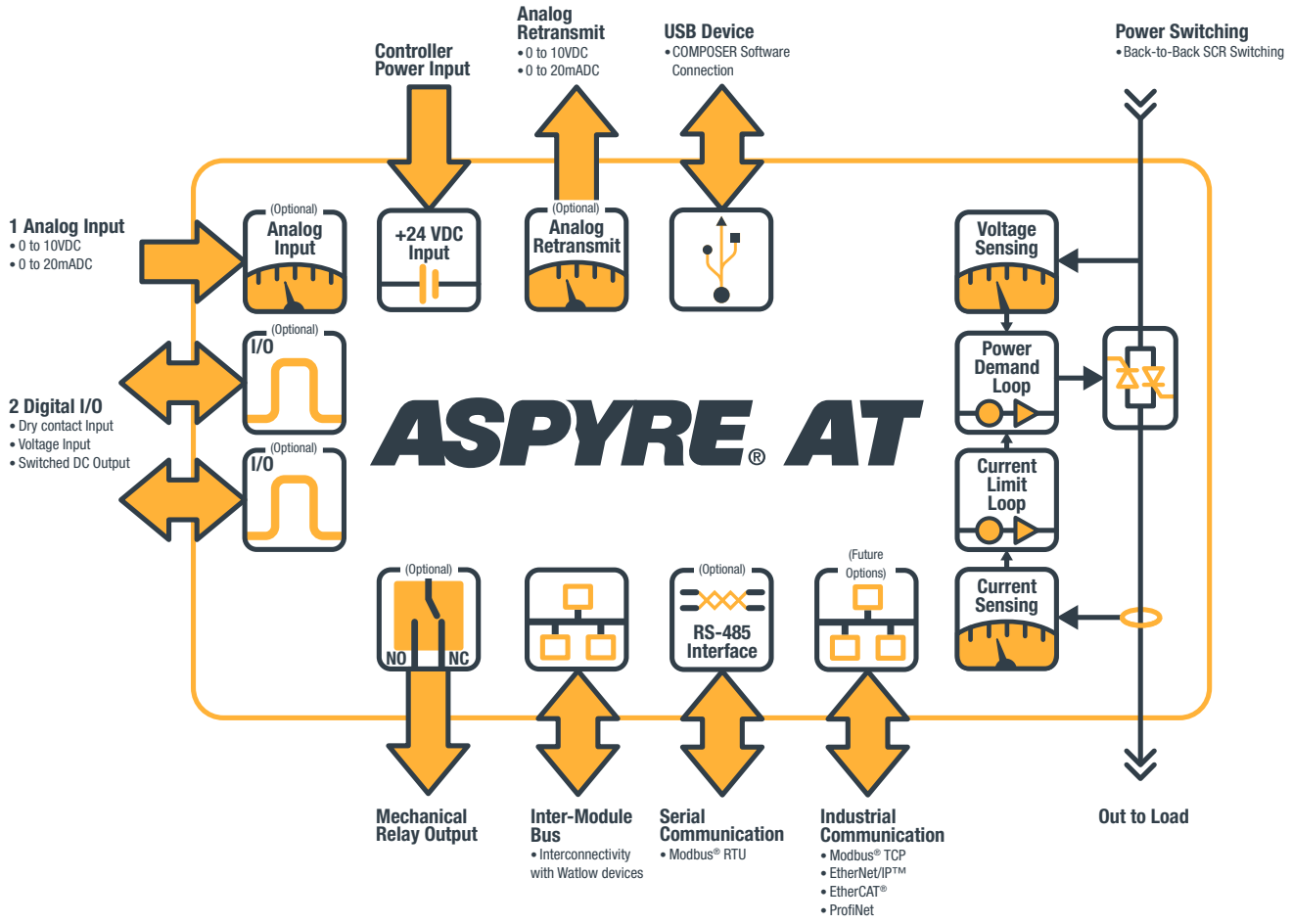
Cooling options

- Integrated DIN-rail mountable heat sink option simplifies implementation
- Base plate option for flexibility in removing heat from the electrical box

Product Block Diagram

This diagram represents the features and functions of the ASPYRE AT power controller in a graphical format showing the relationships between various functions. Optional features are indicated.

Product block diagram for ASPYRE AT power controller



Introduction to ASPYRE AT Power Controller Integration

⚠NOTE: It's highly recommended to review this section before operating your ASPYRE AT power controller.

The ASPYRE AT power controller can be operated in any one of several ways depending on features the power controller includes. This chapter introduces you to the various ways you can integrate the power controller into your system. The cross references throughout the chapter direct you to other sections where the operation is explained in greater detail.

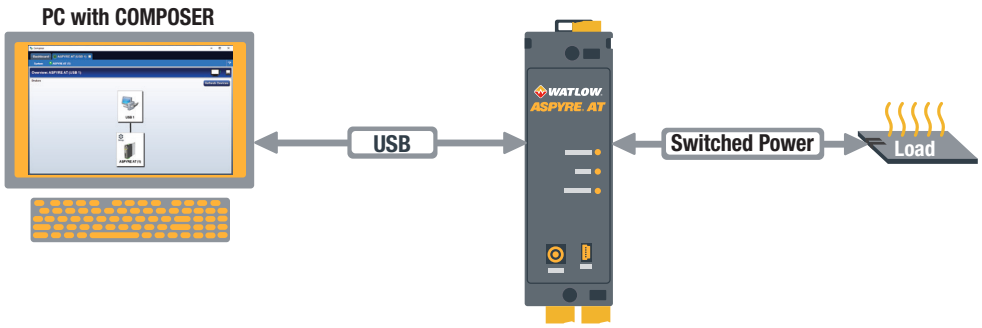
Ways to Integrate the ASPYRE AT Power Controller into Your System

These are the main ways to integrate the ASPYRE AT power controller:

- Test bench operation—to try out and learn the features
- Connect a temperature controller via discrete & analog signals
- Connect via a standard industrial communication protocol
- Watlow temperature controllers connected via Watlow's inter-module bus

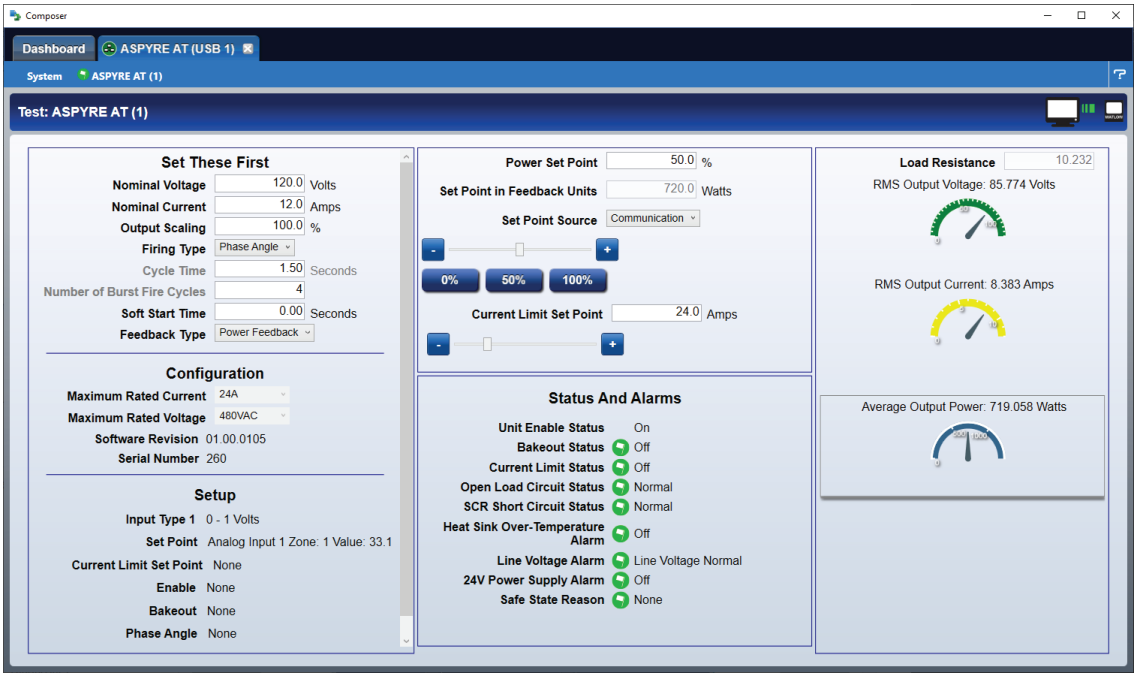
Test Bench Operation

For first time user this may be the simplest and fastest way to learn how to use the ASPYRE AT power controller. Connect the COMPOSER® software to the ASPYRE AT power controller via the USB cable. See "Connect PC (COMPOSER Software)" on page 29.

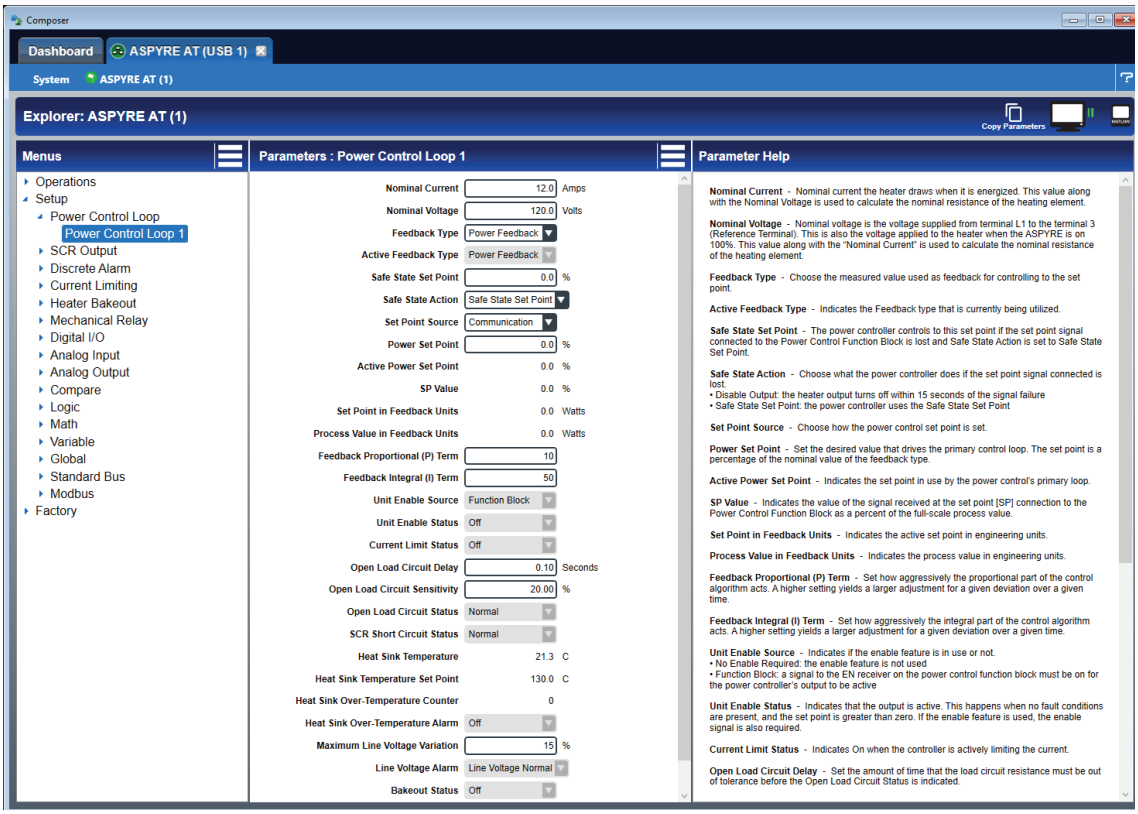


Use this approach to set up and monitor basic parameters and to test how the product works without fully installing it. Use COMPOSER's **Test** and **Explorer** views to set parameters and see the results. For detailed instruction see "Set Up the ASPYRE AT Using the Test View" on page 31.

COMPOSER Test View



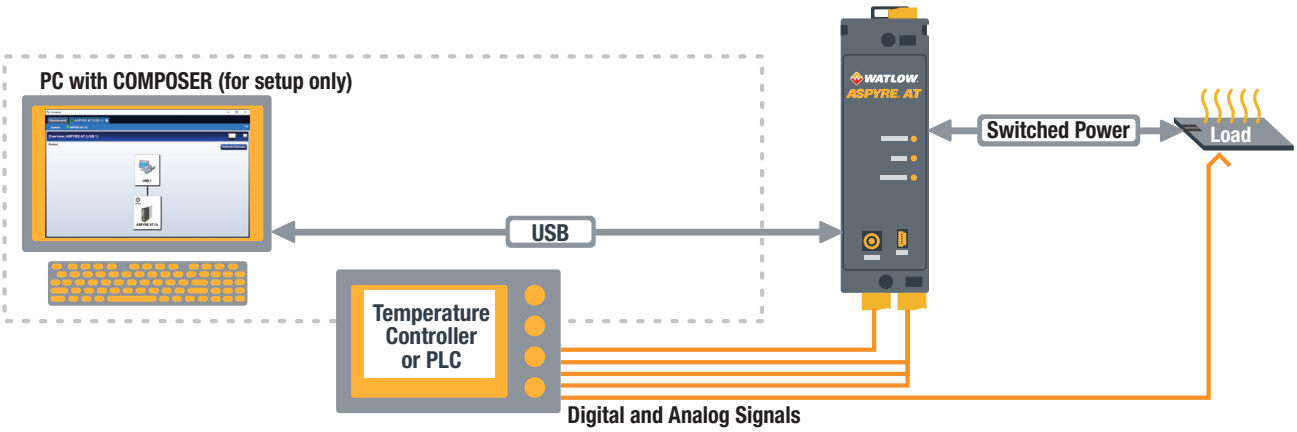
COMPOSER Explorer View



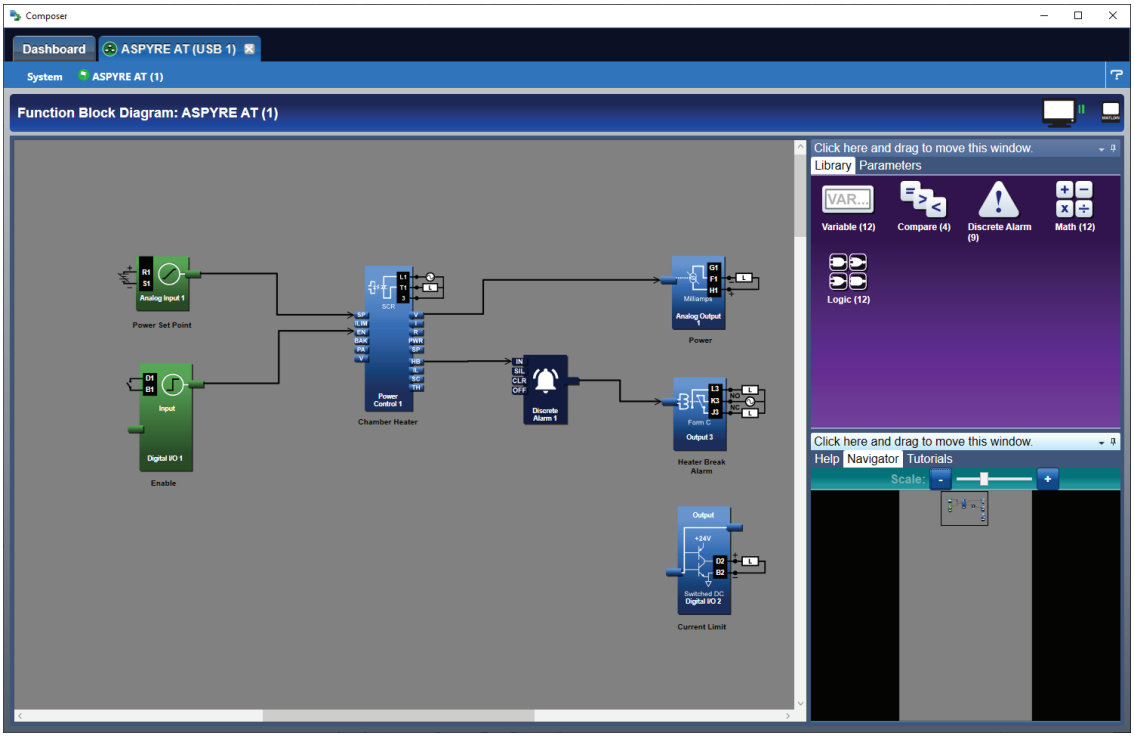
Connect a Temperature Controller via Discrete and Analog Signals

This approach uses the Function Block Diagram view in COMPOSER to configure the ASPYRE AT power controller to use a discrete signal to switch the output or an analog signal as the set point for power in the application. Use the power control function block to connect the power controller's optional inputs and outputs so that digital and analog signals from other automation equipment can, for example, enable the output and supply the set point.

Connect the COMPOSER software to the ASPYRE AT power controller via the USB cable. See "Connect PC (COMPOSER Software)" on page 29 and "Using COMPOSER" on page 33.

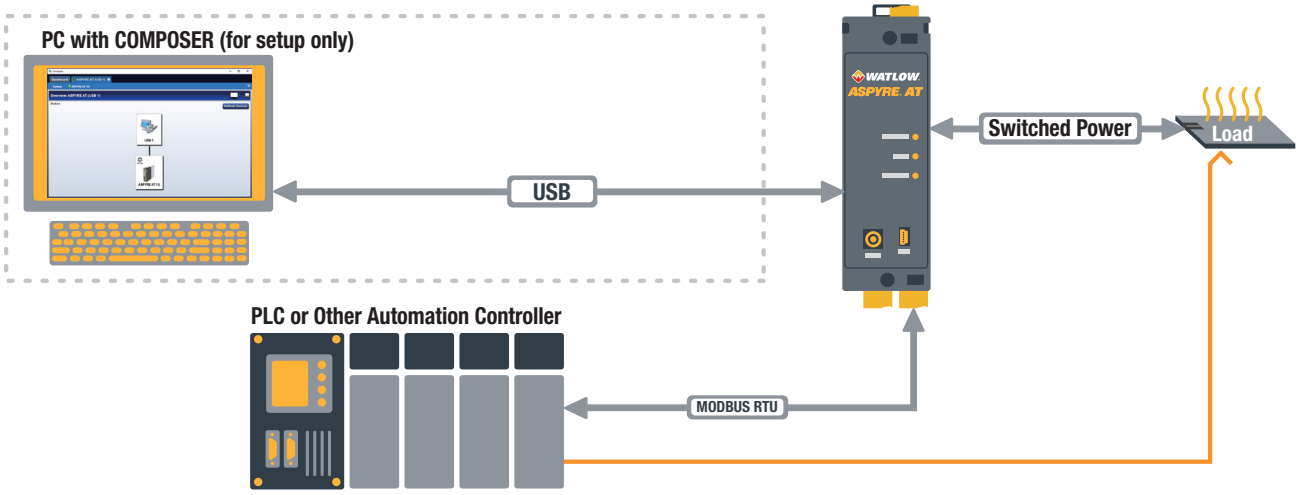


Function Block Diagram



Connect via a Standard Industrial Protocol

This approach connects another piece of automation equipment such as a PLC via a communication protocol such as Modbus® RTU. See the diagram below. COMPOSER is used for initial setup only. In this example the application uses Modbus® RTU to communicate between the power controller and a PLC, HMI or other controller. For further details see "Communication" on page 119 and "Modbus® RTU Holding Registers" on page 120.

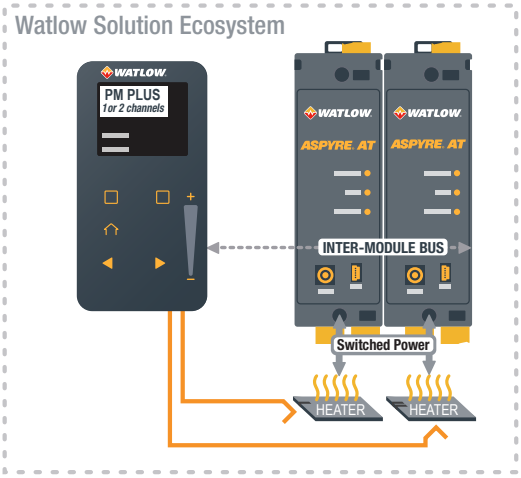


Watlow Solution Ecosystem

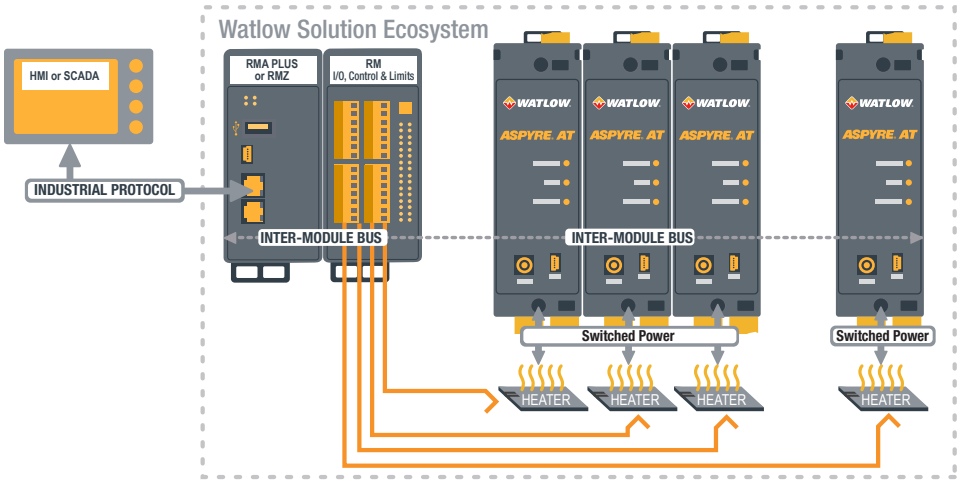
Use a control loop or other feature in a Watlow product such as the PM PLUS or EZ-ZONE® RM controller to drive the set point in the ASPYRE AT power controller.

The ASPYRE AT power controller, PM PLUS controllers and the RM family of products interoperate via the Watlow inter-module bus interface. Connect the COMPOSER software to the ASPYRE AT power controller via the USB cable. See "Connect PC (COMPOSER Software)" on page 29 and "Using COMPOSER" on page 33.

Integration with PM PLUS



Integration with EZ-ZONE RM



Front Panel

This section describes the items on the front panel of the power controller.

Backplane Connector

Connect the inter-module bus to other ASPYRE AT power conrollers. Depending on the ordering option, the inter-module bus may also be available via terminal block "C" at the bottom. See "Watlow Solution Ecosystem" on page 26.

Indicators

See "Indicator Descriptions" on page 16.

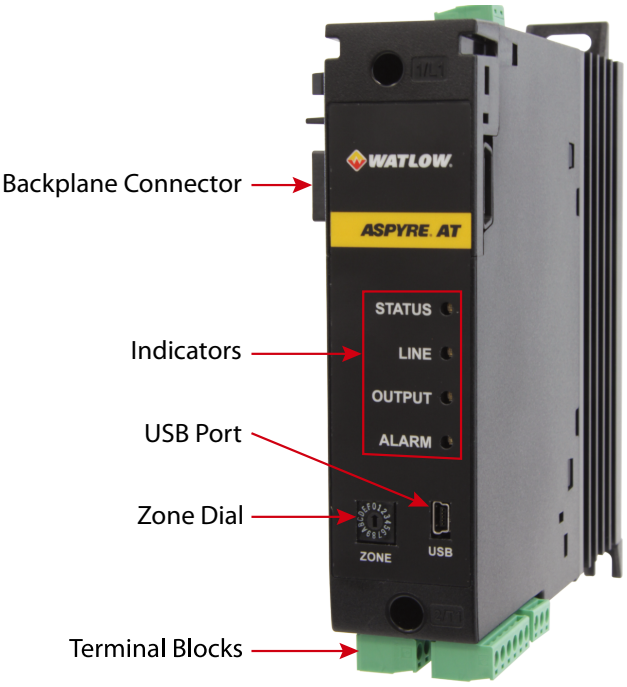
USB Connection Port

Use to connect the power controller for configuration using COMPOSER on your computer.

Zone Dial

The zone dial sets the address.

Front Panel Components



Indicator Descriptions

Indicator	Color	State	Description	Normal Operation
Status	Green	Off	Indicating electronics not powered: no 24VDC power or USB connected	Status LED off
	Green	On	Indicating electronics is powered by USB, but 24VDC is not connected. Settings can be configured, but the output cannot be enabled, and line voltage is not measured	Status LED blinking green
	Green	Flashing (1Hz)	Indicating electronics is powered by 24 VDC	Status LED on-blinking green
Line	Green	Off	Indicating no line voltage is detected	Line LED off
	Green	On	Indicating line voltage is detected	Line LED on-steady green
Output	Green	Off	Indicating no power is being delivered	Output LED off
	Green	On	Indicating power is called for and being delivered	Output LED on-steady green
Alarm	Red	Off	Indicating there are no alarms currrently, though there may be a latched alarm	Alarm LED off
	Red	Blinking (1Hz)	Indicating an alarm condition exits	Line LED on-blinking red
	Red	Fast blinking (5Hz)	Indicating an internal fault has occurred	Line LED on-blinking red

⚠ **NOTE!** When all four indicators flash in sequence, there is a firmware update in progress. Allow the update to complete before attempting to configure or operate the power controller.

⚠ **NOTE!** When the Line and Output indicators flash in an alternating pattern at power-up, this indicates pre-runtime preparation in the firmware. This process should complete in a few seconds time, and the power controller will not be ready to communicate until this process completes.

2 Installation

WARNING: To avoid damage to property and equipment, injury and loss of life, adhere to applicable electrical codes and standard wiring practices when installing and operating this product. Failure to do so could result in damage, injury and death.

AVERTISSEMENT! Pour éviter d'endommager la propriété et l'équipement, les blessures et la perte de vie, respecter les codes électriques en vigueur et les pratiques de câblage standard au moment de l'installation et de l'utilisation de ce produit. Dans le cas contraire, cela peut entraîner la mort, des blessures graves ou des dommages.

Installing the ASPYRE AT Power Controller

This chapter provides the information necessary to select and prepare a location and to mount one or more ASPYRE AT power controllers.

Consider the spacing required for power, load, and control signal wiring before mounting the power controller. Take into account the controller dimensions, wire bending radius, and cooling requirements. Use good wiring practices to minimize electrical noise problems.

Mounting Orientation

Device amperage ratings are with vertical mounting. For mounting in other orientations consult Watlow.

Bend Radius

Allow adequate space to route cables without requiring bending more than permitted for the type of cable.

Applications with High Vibration or Mechanical Shocks

For applications in environments or when transportation of the assembly will experience more than nominal vibration or where there is opportunity for mechanical shock, fasten the power controller directly to the chassis. For these applications DIN-rail mounting is not sufficient.

Environmental Conditions

Mount ASPYRE AT power controllers in a suitable electrical enclosure. Allow adequate wire bending space and cooling. 48A unit had derating at 30°C ambient in order to show full 48 Amps. 12 and 24A units have current ratings at 40°C. For ambient temperatures see "Derating Curve" on page 131.

Ambient Temperature	0° to 60°C (32° to 104°F) see "Derating Curve" on page 131
Storage Temperature	-13° to 158°F (-25°to 70°C)
Installation Location	Install away from direct sun light, conductive dust, corrosive gas, vibration, water and corrosive salts
Altitude	Up to 6560 feet (2000m) above sea level At altitudes above 3280 feet (1000m) reduce the nominal current by 2% for each 328 feet (100m)
Humidity	From 5 to 95% relative humidity, non-condensing and without ice
Pollution degree	Installation Category III, Pollution degree 2

Cooling Requirements

To maintain the ambient temperature in the enclosure in which the power controller, circuit breakers, fuses and other components are installed, there must be adequate cooling to remove the heat generated by all the devices. The power controllers are designed to be cooled by drawing cool air in from the bottom and expelling heated air at the top. Typically cabinets are designed with one or more fans on the front door or on the top of the enclosure. The designer will need to know the heat generated by the power controller. See the table below.

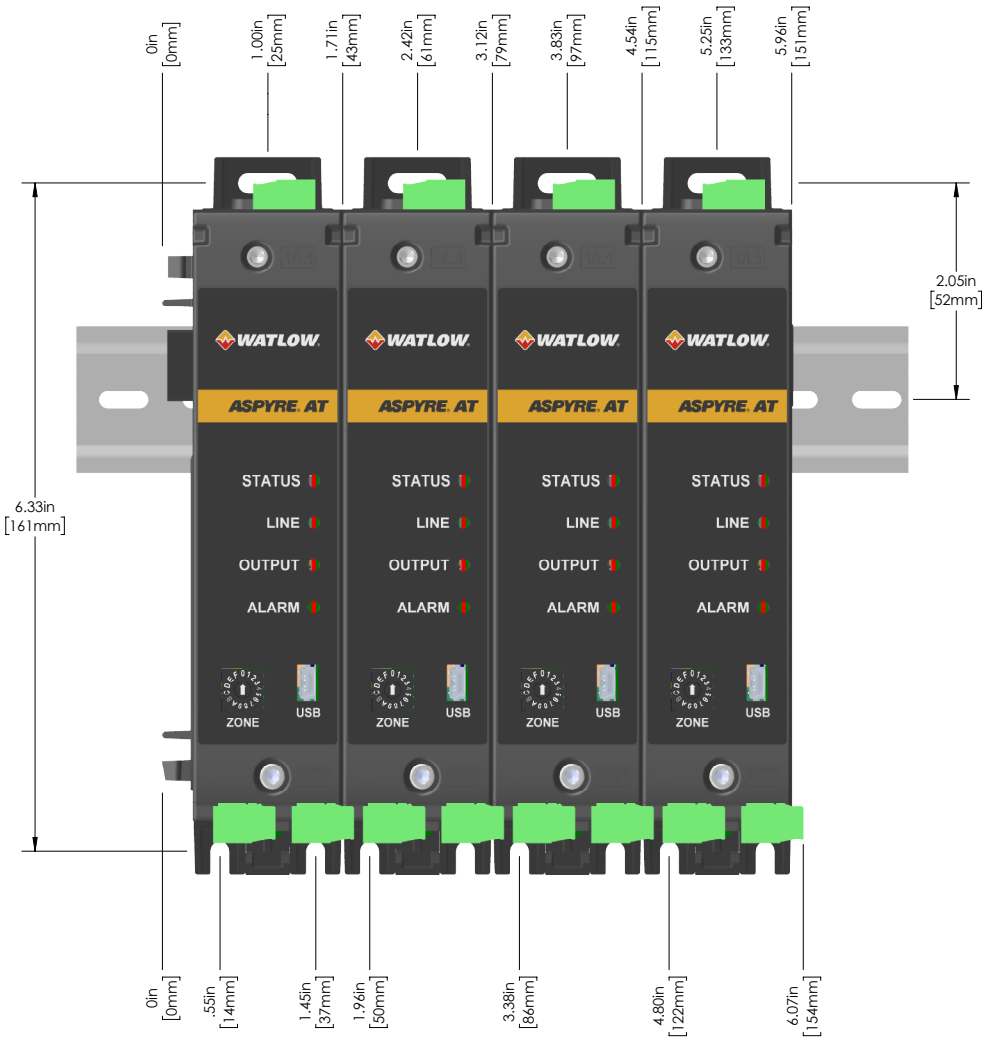
Total Heat Generated by the ASPYRE AT power controller

Current (A)	Heat Loss (W)
12	20
24	28
48	52

Spacing for Multiple Power Controllers

The ASPYRE AT power controller is designed to be clipped together to form multi-zone power controller systems. When this installation technique is used, the amperage derating tables for multiple units applies. When multiple power controllers are mounted side-by-side they may be placed as close together as is practical for installation and service. See the illustration below and illustrations on the following page for the product dimensions, spacing, weight and mounting locations. "Snapping" units together allows for use of the inter-module bus between units. Connect to the communication port of any one of the units and to communicate with all the units.

Overall Dimentions



Mounting Dimensions

The power controller may be mounted on a DIN rail or with screws. See the tables and Illustrations below and the illustration on the preceding page for the product dimensions, spacing, weight and mounting locations.

Dimensions Key

Dimensions and Weight

Model	W	H	D	Weight
12A/24A DIN-Rail Heat Sink Option	Unit Width 1.42in (36mm) Overall Width 1.82 in. (46mm)	6.79 in. (172 mm)	5.88 in. (149 mm)	1.61 lb. (0.73 kg)
48A DIN-Rail Heat Sink Option			7.07 in. (180 mm)	1.89 lb. (0.86 kg)
Cooling Plate Option		7.29 in. (185 mm)	3.97 in. (101 mm)	1.15 lb. (.52 kg)

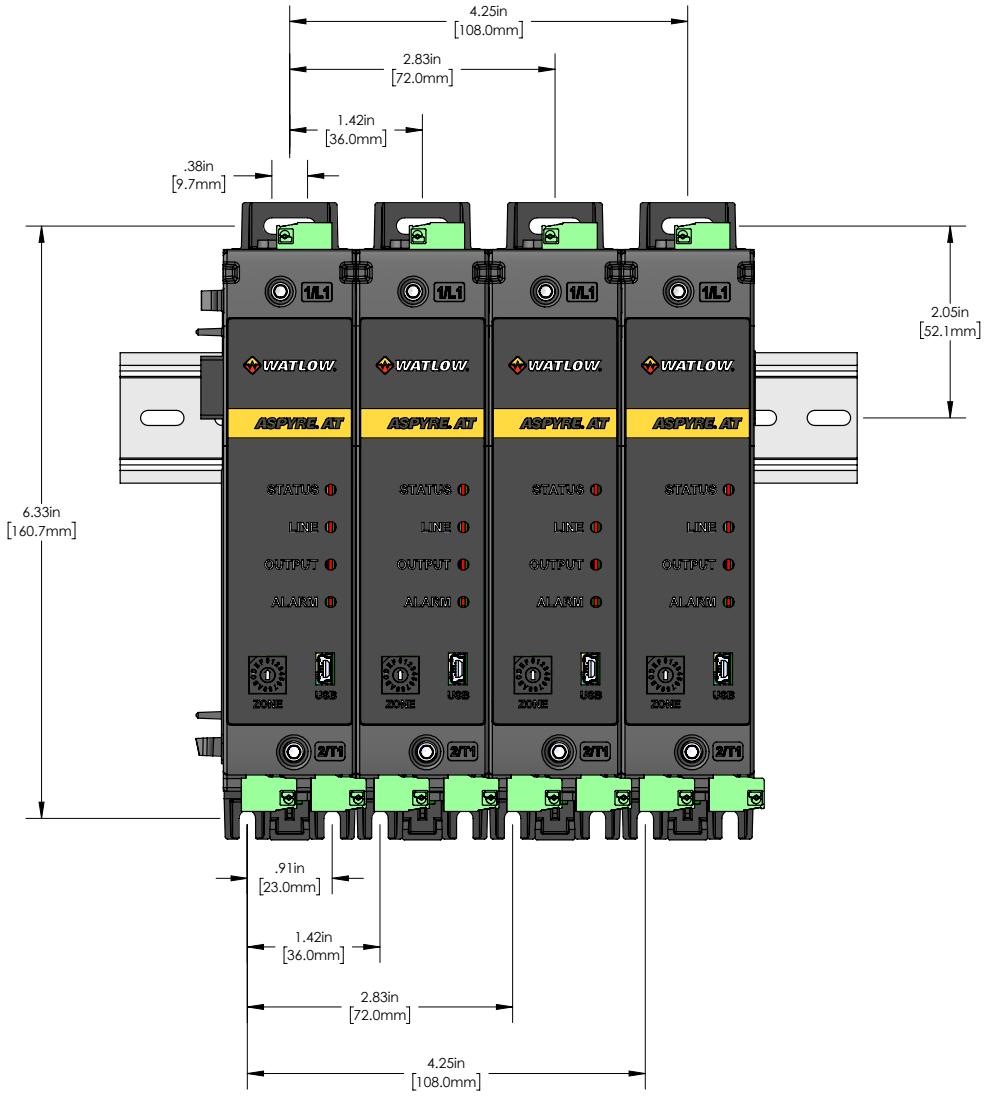
Mounting Hole Size

Mounting hole diameter	0.177 in. (4.50 mm)

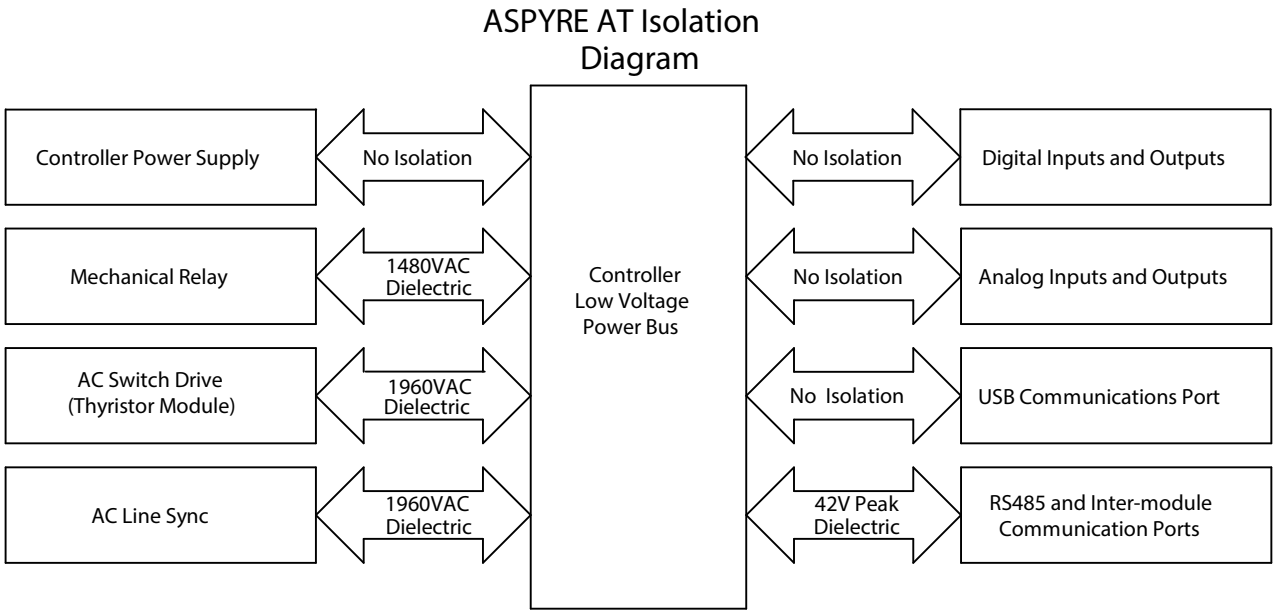
Recommended fastener: No 8-32 (M5)

⚠ **Note!** The maximum thickness for the DIN rail is 1mm.

Mounting Dimensions



Isolation Diagram



3 Wiring

WARNING: To avoid damage to property and equipment, injury and loss of life, adhere to applicable electrical codes and standard wiring practices when installing and operating this product. Failure to do so could result in damage, injury and death.

WARNING: The installation must be protected by electromagnetic circuit breakers or by fuses.

AVERTISSEMENT! Pour éviter d'endommager la propriété et l'équipement, les blessures et la perte de vie, respecter les codes électriques en vigueur et les pratiques de câblage standard au moment de l'installation et de l'utilisation de ce produit. Dans le cas contraire, cela peut entraîner la mort, des blessures graves ou des dommages.

AVERTISSEMENT! L'installation doit être protégée par des disjoncteurs électromagnétiques ou des fusibles.

Wiring the ASPYRE® AT Power Controller

This chapter describes how to select, prepare and attach power and signal wires to the power controller.

Good Wiring Practices

Follow good wiring practices to minimize the effects of interference from nearby equipment and the line power on the operation of the power controller:

- Install an appropriately sized RC filter across contactor coils, relays and other inductive loads
- Use shielded, twisted-pair cables for input, output and communication signals
- Route control and signal cables away from motors and other sources of electromagnetic interference and not parallel to power cables
- Follow all local regulations applicable to electrical installations

NOTE: Use only copper cables and wires rated for use at 90°C or greater unless otherwise noted.

REMARQUE : N'utiliser que des câbles et des fils en cuivre pour l'utilisation à 90 °C ou plus, sauf indication contraire.

Wire Selection, Prep and Torque

This section lists the recommended wire sizes for line power, load, earth ground and control signal connections. There are also recommendations for insulation stripping and termination torque.

Line Power and Load Wire Size and Termination

Stranded Wire Size	Wire Termination	Temperature Rating
14 to 10 AWG solid (1.5 to 6 mm^2)	Wire compression clamp	90°C or greater
14 to 6 AWG Stranded (1.5 to 16 mm^2)	Wire compression clamp	90°C or greater

Ground Wire Size and Termination

Wire Size	Wire Termination	Temperature Rating
10 AWG (6 mm^2)	UL Listed (ZMVV) ring or spade crimp lug	75°C or greater

Control and Signal Wire Size

- Range: 22 to 14 AWG (0.50 to 1.5 mm^2)
- Recommended: 18 AWG (0.75 mm^2)
- Temperature Rating: 75°C or greater

Insulation Stripping and Torque

To insure proper connections, but minimize hazardous exposure of conductors, strip the correct amount of insulation from each cable.

Insulation Stripping

Load & Line Power	Bare wire connection: 0.59 in. (15 mm) Connection with crimp lug: per lug manufacturer
Ground	Per crimp lug requirements
Control and Signal	0.24 in. (6mm)

Control Signal and Ground Torque

Control & Signal	5 in.-lbs. (0.56 Nm)
Ground Screw	15 to 17 in.-lbs. (1.7 to 1.9 Nm)

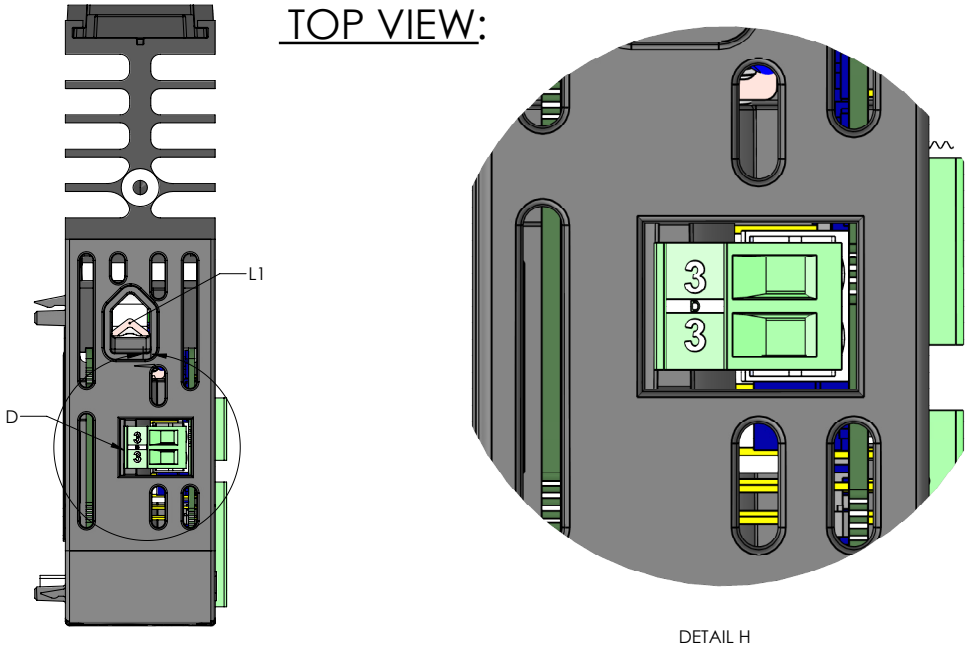
Line Power and Load Torque

Recommended Tool	1/8 in. Hex Driver
Proper Torque	24 in.-lbs. (2.7 Nm)

Wiring Overview

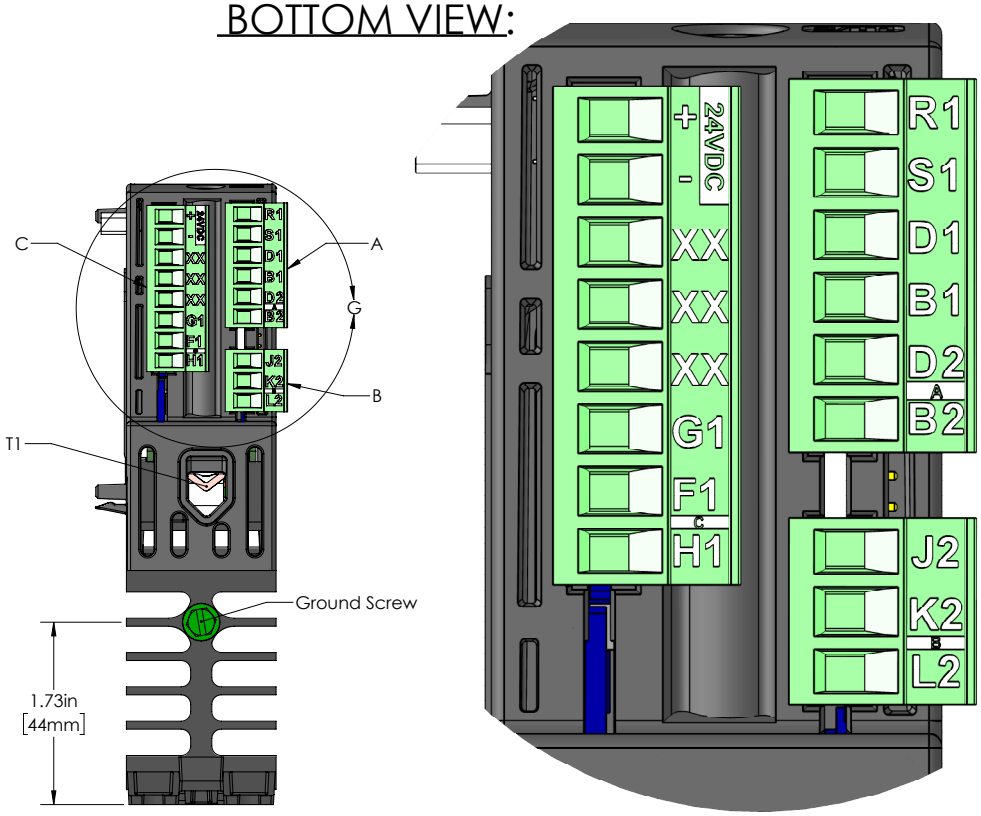
This section indicates the locations of the line power, load, earth ground and control signal terminal blocks on the power controller. Refer to the two drawings below, the tables on the next page and the wiring diagram on the following page to determine the correct wiring connections. Terminals are labeled according to the features present. See the product identification label on the side of the unit for which optional features are present. The earth ground screw location depends on the cooling option.

TOP VIEW:



DETAIL H
SCALE 3 : 1

BOTTOM VIEW:



DETAIL G
SCALE 3 : 1

Terminal Block A

Position	Function	Description
R1	Analog Input+	0-10V or 4-20mA analog input referenced to pin S1. Can be configured as 0-10V or 4-20mA via the software interface
S1	Analog Input Reference	
D1	Digital I/O1	Digital I/O 1 referenced to pin B1. Can be configured as a 24V input, output, or dry contact input via the software interface
B1	Digital I/O 1 Reference	
D2	Digital I/O 2	Digital I/O 2 referenced to pin B2. Can be configured as a 24V input, output, or dry contact input via the software interface
B2	Digital I/O 2 Reference	

Terminal Block B

Position	Function	Description
J2	Relay NC	Normally closed relay contact
K2	Relay Reference	Relay connections rated for 240VAC at 5A maximum
L2	Relay NO	Normally open relay contact

Terminal Block C

Position	Function	Description
98 +	+24VDC Auxiliary Power	Auxiliary power input
99 -		
CC/CZ	Modbus® Common/inter-module bus common	CC: Modbus® RTU common CZ: Watlow inter-module bus connection
CA/CX	Modbus® A(-)/inter-module bus	CA: Modbus® RTU A(-) CX: Watlow inter-models bus connection
CB/CY	Modbus® B(+)/inter-module bus	CB: Modbus® RTU B(+) CY: Watlow inter-models bus connection
G1	Retransmit 0-10V	0-10V retransmit output referenced to pin F1
F1	Retransmit Reference	Retransmit ground reference
H1	Retransmit 4-20mA	4-20mA retransmit output referenced to pin F1

Terminal Block D

Position	Function	Description
3	Reference	Connect to the unswitched phase of the heater
3	Reference	Connect to the unswitched phase of the heater

Power and Ground Connections

Position	Function	Description
L1	Line Connection	Line power connection. Torque= 24 (in.-lbs)
T1	Switched Leg	Switched power connection. Torque= 24 (in.-lbs)
Ground Screw	Earth Ground	#8-32. Screw head diameter: 0.341" Torque= 15-17 (in.-lbs)

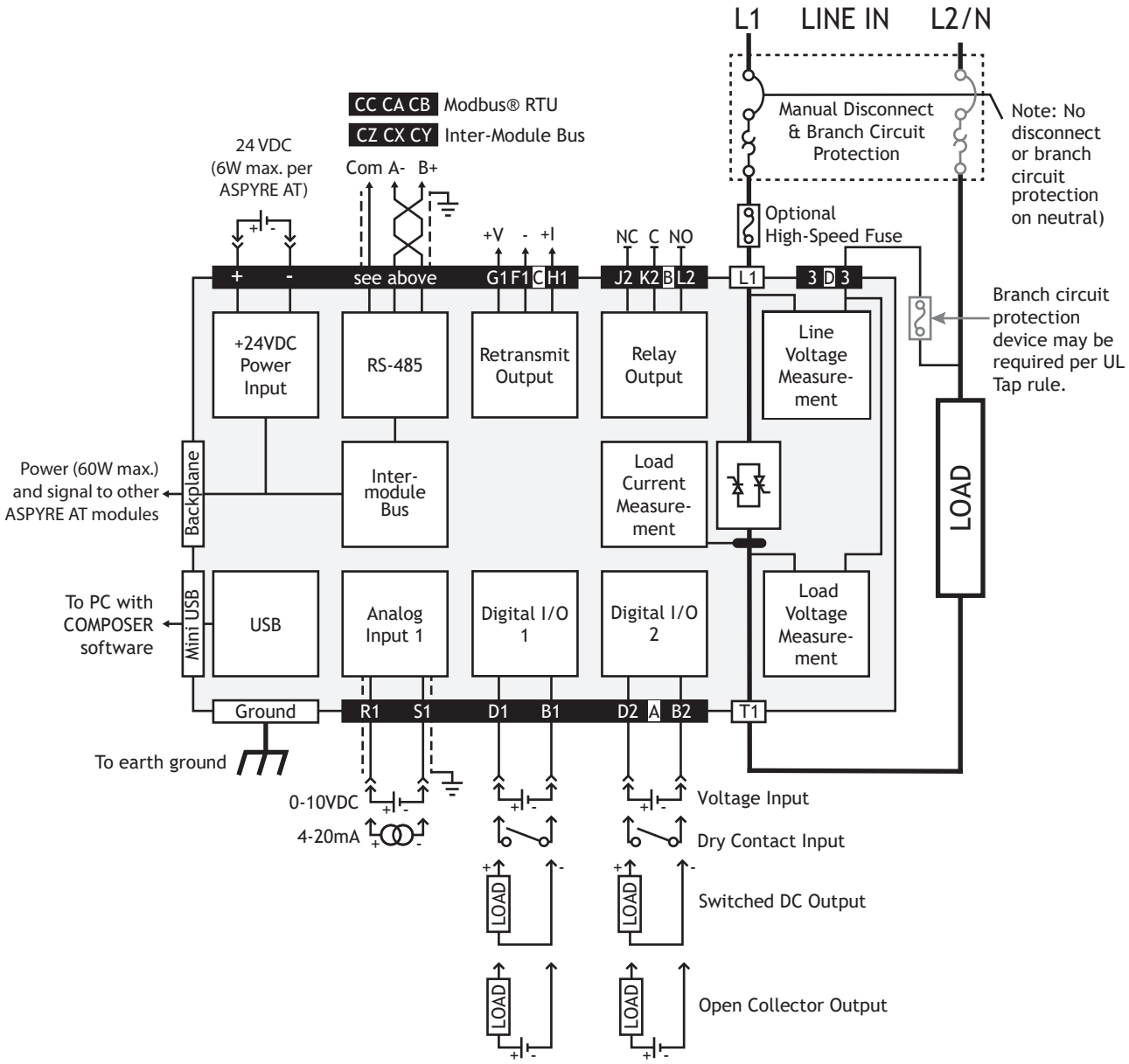
⚠**NOTE!** For terminal blocks (A, B, C, D), the recommended torque is 5.0 in.-lbs.

Wiring Connections

The wiring diagram below shows how to connect control signals, line power, earth ground and the load to the ASPYRE AT power controller. Refer to the wiring diagram below and the two drawings on the previous pages to determine the correct wiring connections.

See "Coordinated Fuses and Circuit Breakers" on page 134 for options for both branch circuit protection and high-speed fusing.

Wiring Schematic



Watlow Solution Ecosystem

The Watlow Solution Ecosystem is comprised of Watlow products working together in an application utilizing the inter-module bus. ASPYRE AT power controllers can share data with each other and with other Watlow products such as EZ-ZONE RM modules and PM PLUS controllers via the inter-module bus.

The key features of the Watlow Solution Ecosystem and inter-module bus:

- **Share data**—signals produced by inputs and function blocks in any device can connect to function blocks and outputs in any other device in the ecosystem
- **Display parameters**—the PM PLUS home page can display parameters from any ecosystem device
- **Log data**—the RMA PLUS is available with data logging onboard
- **Read and set parameters**—SCADA software such as SpecView, HMI panels such as the Silver Series OIT and other automation equipment can connect via the RMA PLUS module's gateway
- **Integrate**—with power control and control loops via the EtherCAT® protocol with an EZ-ZONE RMZ module

Setting Up a Watlow Solution Ecosystem

There are three fundamental steps to setting up an application in the Watlow Solution Ecosystem:

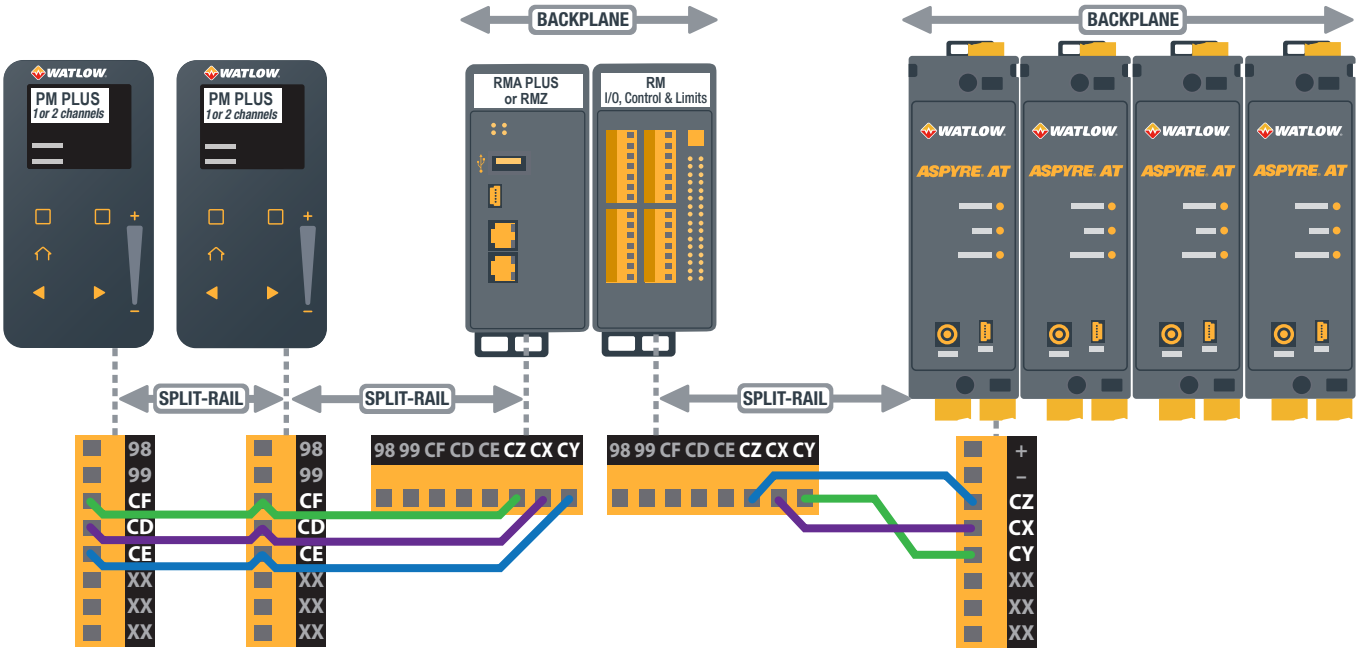
1. Connect up to 16 devices or 17 with an RMA PLUS via their inter-module bus connections
2. Set each device's zone (inter-module bus node address) to a unique value
3. Use COMPOSER software to make the signal connections between inputs, functions and outputs

Connecting Devices

See the diagram for the essentials of connecting ecosystem devices together via the inter-module bus. See each device's user guide for the specifics of connecting to the inter-module bus. Generally, ASPYRE AT power controllers connect to one another via their backplane connector. RM modules connect via their backplane as well.

However, the ASPYRE AT and RMs cannot be connected together this way because their backplane connectors do not align due to dimensional differences and the power controller's heat sink location. PM PLUS controllers do not have backplane connectors. Use "split-rail: connection to connect between different types of ecosystem devices.

Sample Watlow Solution Ecosystem System



Tips for Watlow Solution Ecosystem systems using the inter-module bus:

- Up to 16 ASPYRE AT and EZ-ZONE RM modules can be connected in one inter-module bus network
- An RMA PLUS module can also be connected to the network as a 17th device
- Each power controller. PM PLUS and EZ-ZONE RM module on the bus must have a unique address
- Set the ASPYRE AT inter-module bus address with the rotary switch
- Set EZ-ZONE RM addresses with the push button beneath the address display or rotary switch (depending on the model)
- Set the PM PLUS protocol to Inter-module Bus (formerly "Backplane Bus") and its address on its Communications menu
- Connect network wires daisy-chain fashion when connecting multiple devices via terminal blocks
- Route network wires away from power wires
- Ensure that the total inter-module bus system does not exceed 200 feet.

“Split-Rail” Connections

A split-rail connection is used to span the gap between ecosystem devices than cannot connect via a backplane. The split-rail connection consists of three wires between corresponding screw terminals.

Use split-rail connections to connect:

- RM modules or ASPYRE AT power controllers that are mounted apart from each other such as on different DIN rails
- ASPYRE AT power controllers with different heat sink options
- Groups of one or more RM modules to one or more ASPYRE AT power controllers
- PM PLUS controllers to each other or to other ecosystem devices (see the diagram for terminals)

ASPYRE AT Heat Sinks

ASPYRE AT power controllers are available with various heat sink options. Units with the same heat sink option can be connected to each other via their backplanes. If a mix of heat sink options are used, connect the units using the split-rail method.

For simplicity consider using the same heat sink option for all ASPYRE AT modules. That means each must be ordered with the largest heat sink required for any of the power controls. That way they can be mounted side-by-side and utilize their backplane connectors for interconnection.

Modbus® RTU

The ASPYRE AT is available with either the inter-module bus or Modbus® RTU on terminal block “C” at the bottom of the power contoller. An ASPYRE AT power controller with the Modbus® RTU option can only be connected to the inter-module bus via its backplane. To connect to other ecosystem devices you must connect another ASPYRE AT module ordered with the inter-module bus option which can be connected to other ecosystem devices. The gateway function in the Modbus® RTU equipped unit can be configured to read and set parameters from any ecosystem device on the inter-module bus.

Connecting to Other Networks

A Watalow Solution Ecosystem can connect to other industrial networks such as EtherNet/IP™, EtherCAT® and Modbus® TCP by including in the system an EZ-ZONE RMZ or RMA PLUS module equiped with the desired protocol.

4 Initial Setup

This chapter provides the information necessary to setup and begin using your ASPYRE® AT power controller.

Controller Configuration Initial Setup

Zone Setting

Each ASPYRE AT power controller and EZ-ZONE RM module connected on the inter-module bus must have a unique zone address. Use the rotary switch on the ASPYRE AT power controller to set the zone address. The zero setting corresponds to zone 16. Settings 1 to 9 and A to F correspond to zones 1 to 9 and 10 to 15 respectively. The zone addresses of some types of EZ-ZONE RM modules are set with the push button under the zone display. Not all EZ-ZONE RM modules have the same address range. See the user guides for the other devices.

Wiring Connections

This chapter assumes that all wiring connections have been correctly installed. See "Wiring" on page 21.

Install COMPOSER® Software

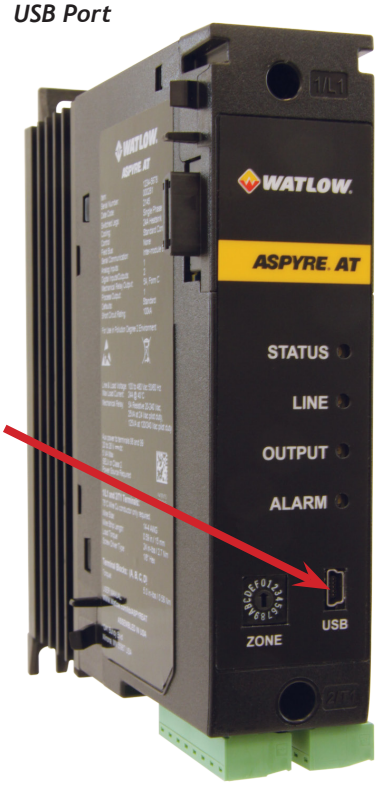
Locating the Software and System Requirements

Download COMPOSER at www.watlow.com/products/controllers/software/composer-software.

The system requirements and installation instructions are listed there.

⚠Note: If experiencing difficulties installing or using COMPOSER software, prior to contacting Watlow technical support, be prepared to send the user log file to the tech support team.

USB Port



Connect PC (COMPOSER Software)

Connect the PC to the system with a USB cable between the PC and the ASPYRE AT power controller's USB port.

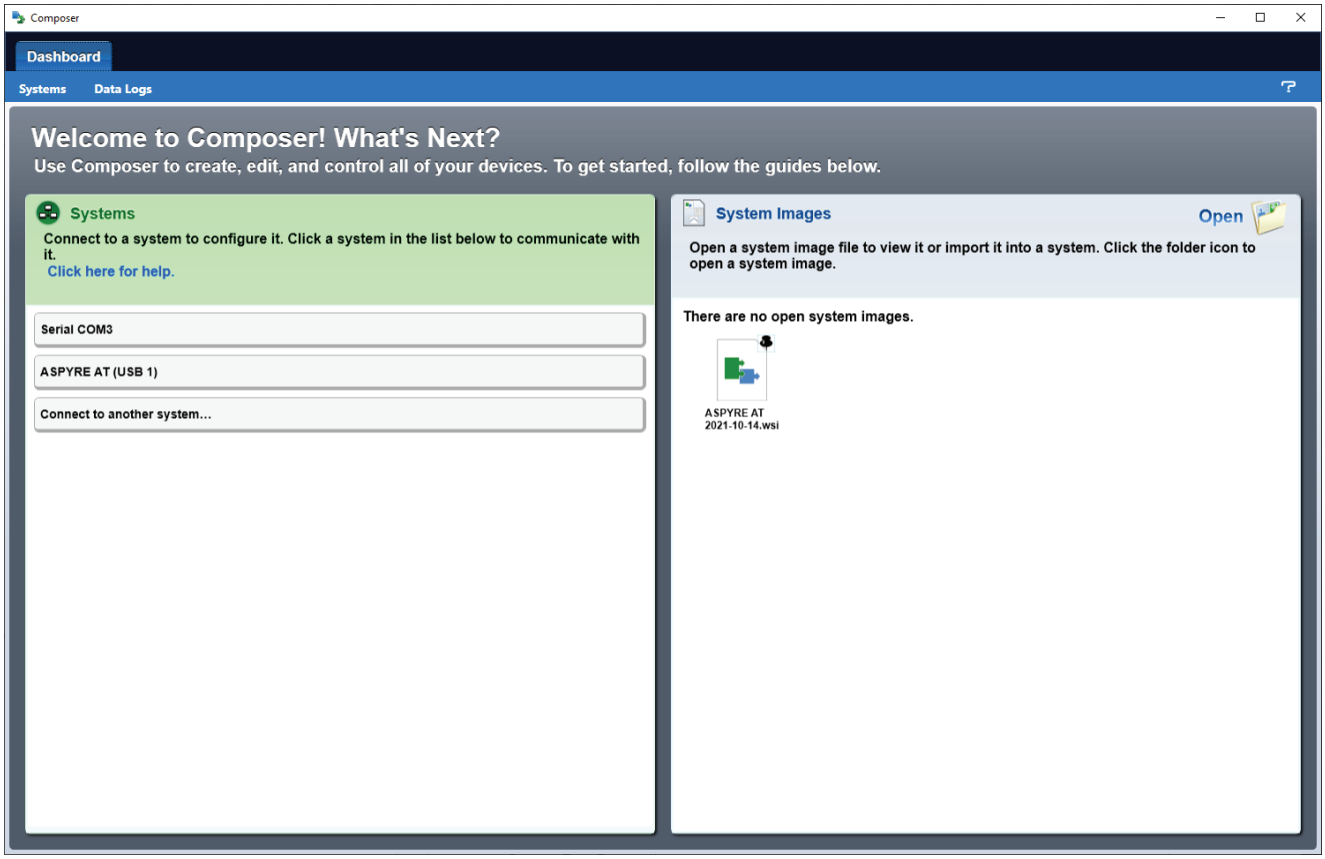
Set Up the ASPYRE AT with COMPOSER Software

The simplest way to configure the ASPYRE AT power conroller is to connect to it with COMPOSER and use the guided setup feature. Alternatively, use the Test view in COMPOSER to set up and test the ASPYRE AT power controller. Either way start by connecting the ASPYRE AT and COMPOSER

Connect Using COMPOSER:

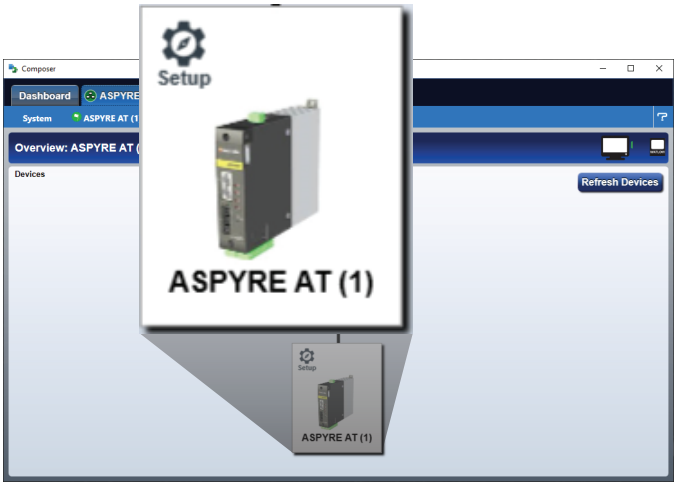
1. Open COMPOSER on your PC
2. In the Systems list double-click the ASPYRE AT
3. Continue setting up the ASPYRE AT power controller with the guided setup feature or test view.

COMPOSER Dashboard Screen



Set Up the ASPYRE AT Using the Guided Setup

Open the guided setup by clicking the gear icon on the ASPYRE AT portrait in the system map on the system overview and follow the on-screen instructions.



Set Up the ASPYRE AT Using the Test View

The following procedures guide you through using the Test View in COMPOSER to set up the ASPYRE AT.

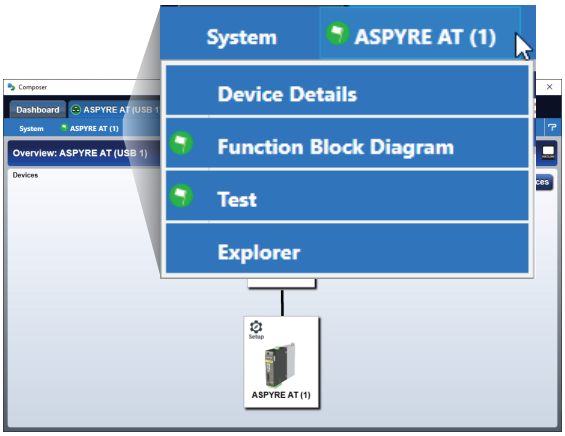
In the Set These First group on the Test view:

1. From the ASPYRE AT device menu, choose **Test**.
2. Enter the **Nominal Voltage** for the load.
3. Enter the **Nominal Current** for the load.
4. Set the **Firing Type**.
5. Select the **Feedback Type**.

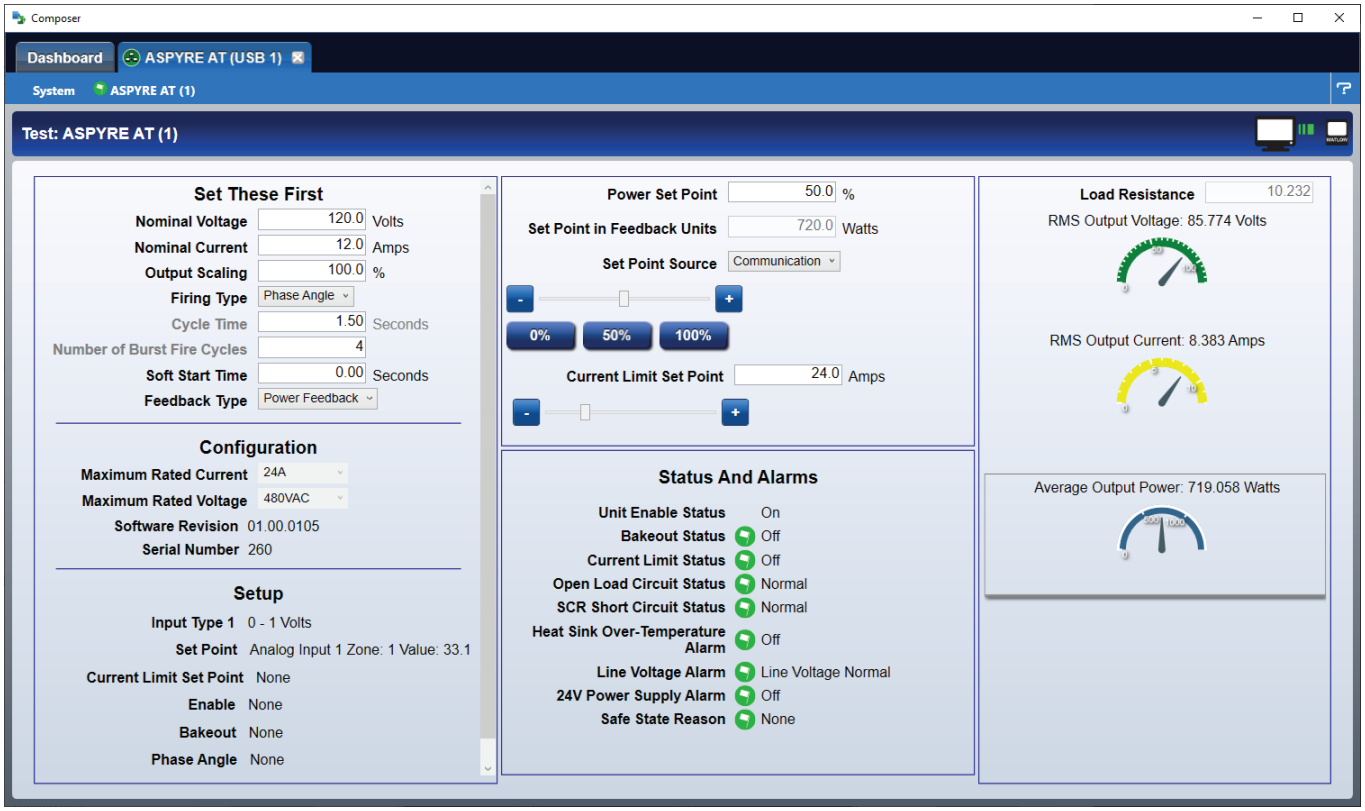
To test the output using COMPOSER's Test view:

1. Enter a **Setpoint**.
2. Set the **Setpoint Source** too **Communications**
3. Check to see if the output, voltage, current and power are as expected.

System Overview in COMPOSER



COMPOSER Test View



5 Using COMPOSER

Overview

This section describes the scope and intent of the COMPOSER software.

Typical Uses

The software may be used during commissioning to set and make a record of settings that determine how the power controller operates and performs; to copy or clone the setup of one power controller to another; on a day-to-day basis to monitor operation and power usage; if necessary, to examine performance in more detail to determine if any corrective actions are needed; or to restore the setup of the power controller.

Communicating with Power Controllers

COMPOSER software communicates with ASPYRE AT power controllers via a Mini-b USB. The power controller's electronics are powered by the computer via the USB connection when the auxiliary line power is turned off, also through connections with other Watlow products (RM's for example). This makes it possible to examine and configure the power controller's settings prior to applying power to the panel.

System Image Files

A system image is a computer file which contains a setting for each user adjustable parameter in each power controller. An image file can be used to configure a power controller for a particular application or job. An image file can be used to copy the settings of one power controller to another. An image file can be created by reading the settings from a power controller to using COMPOSER software and saving it as a file on the computer. A power controller can be configured by importing a saved image file into the power controller using COMPOSER software.

How To

This section provides step-by-step procedures for common tasks.

Connect to a System

To connect to a system:

1. Connect the PC with COMPOSER to the ASPYRE AT power controller with a mini-b-USB cable.
2. Launch COMPOSER.
3. On the Dashboard screen double-click the ASPYRE AT power controller system.

System Image File Procedures

To save a system image the first time:

1. From the System menu, choose Save Image As.
2. Use the save as dialog to select the destination folder for the image.
3. Enter the desired filename.
4. Click Save.

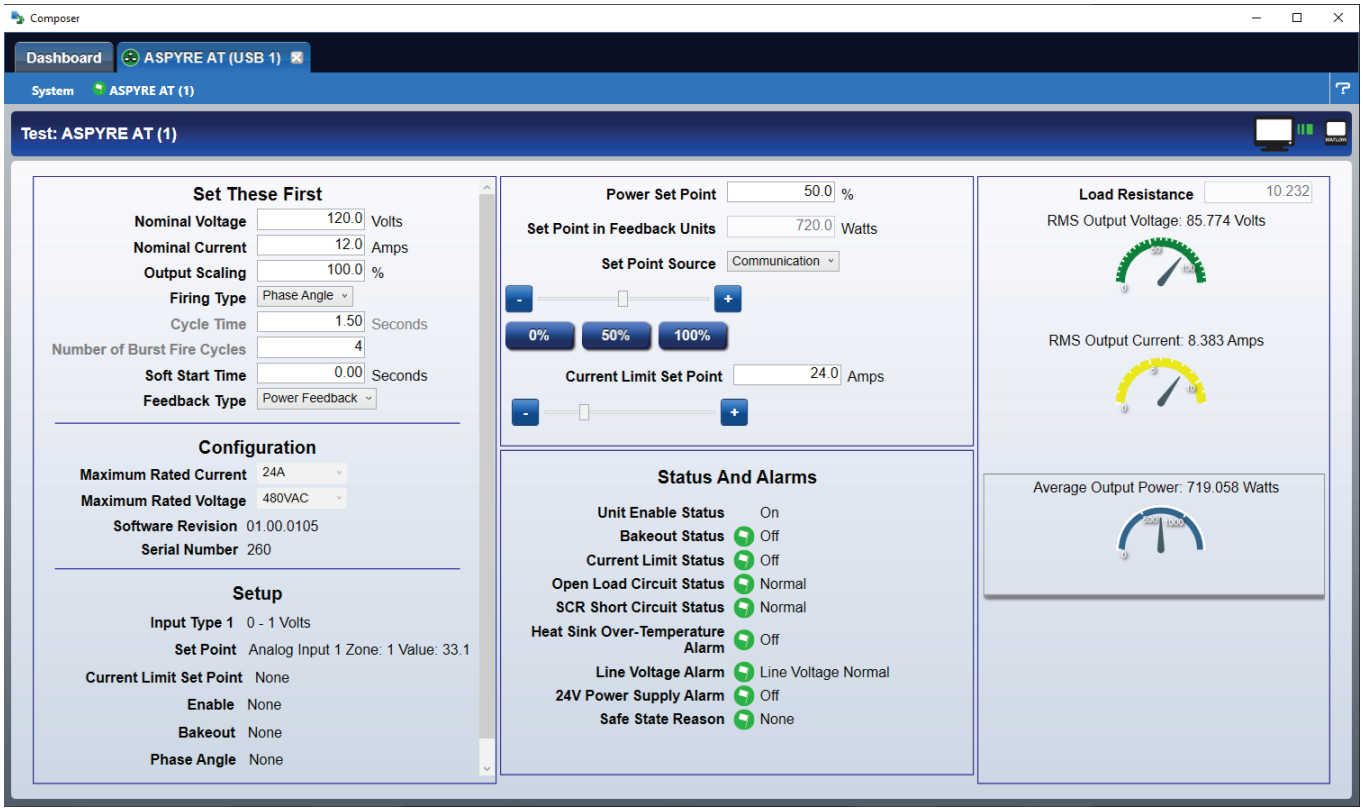
To import settings into the system from a system image file:

1. From the System menu choose Import Image.
2. In the Open dialog locate and select the desired system image file.
3. Click Open.

Monitor Operation with the Test View

Use the Test view to monitor the operation.

COMPOSER Test View



Function Block Diagram Procedures

These procedures describe how to use the Function Block Diagram view to customize the power controller's operation for your application.

To Open the Function Block View

- From the device menu choose Function Block Diagram

Working with Function Blocks

These procedures describe how to use, place and move function blocks on the canvas and access the parameters that control what they do.

To place a function block on the canvas:

- Find the desired function block within the library.
- Click-and-drag the Function Block to the canvas.

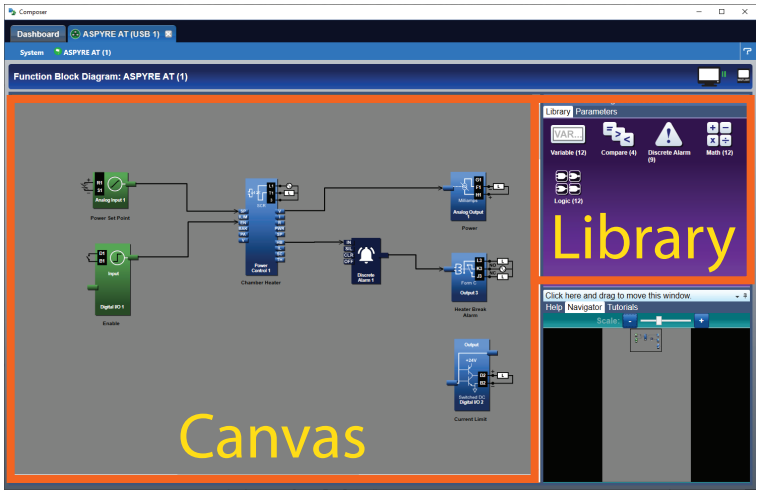
To move a function block:

- Click-and-drag the Function Block to the desired location on the canvas.
- Hint: click the main body of the block, not one of its transmitters or receivers.

To connect a transmitter to a receiver:

- Click and drag a signal from a transmitter to a receiver on another Function Block.

Function Block Diagram: Canvas and Library Window



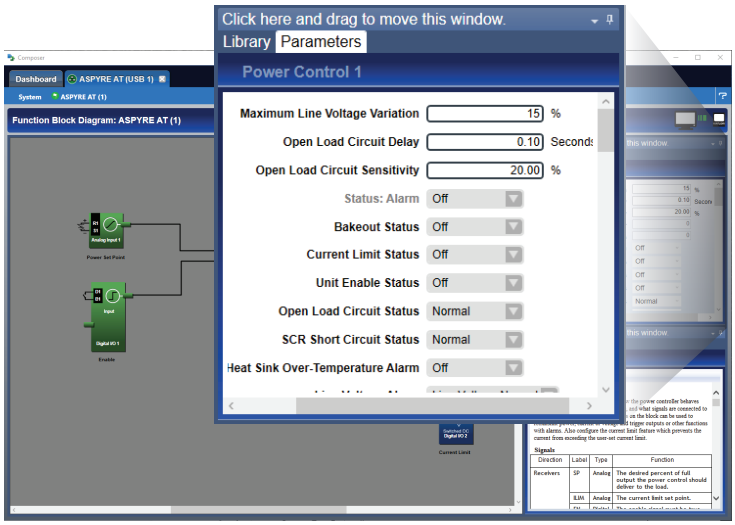
NOTE: Function blocks use the data from the signals connected to the recievers on their right sides. The connection points on the left of the function blocks transmit processed signals to other function blocks.

WARNING: Once an output function block receiver is connected to another block, the output turns on or off according to the received signal. Do not connect outputs until it is safe to do so.

To view or adjust a parameter:

1. Double-click on the Function Block.
2. In the Parameters window, locate the desired parameter.
3. Change the parameter setting as needed.

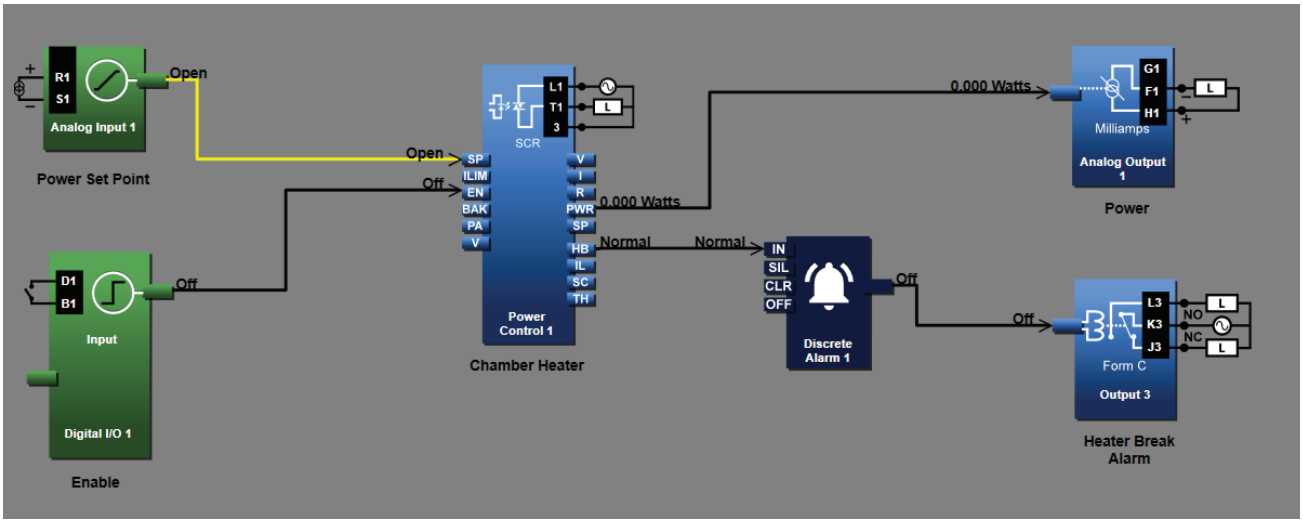
Function Block Diagram: Parameter Window



Working with Signals

These procedures describe how to connect and work with the signals that connect Function Blocks.

Function Blocks and Signals



To momentarily display a signal's value:

- Point the mouse over the signal.

To display a signal's value continuously:

1. Right-click the signal.
2. Click Show/Hide Data.

To cancel (turn off) the signal display:

1. Right-click the signal.
2. Click Show/Hide Data.

To evaluate the cause of a yellow signal:

1. Trace the yellow signal back to the source (first occurrence of a yellow link).
2. Place the mouse over the signal to read the error.
3. Click the Function Block to view the Help window for information on how to correct the error.
4. Correct the cause of the problem.

To delete a signal:

1. Click the signal to select it.
2. Press the Delete key on the keyboard.

To move a signal:

1. Delete the signal.
2. Make the desired connection.

To remove a function block from the canvas:

1. Delete all signals connected to the Function Block.
2. Click the Function Block to select it.
3. Press the Delete key on the keyboard.

Arrange Function Block Windows

These procedures describe how to use the options associated with the Function Block Diagram windows.

To toggle the auto-hide option for a window or a group of windows:

- Click the pin (auto hide) icon to pin or un pin in the window

To use a window that is hidden:

- Click the window name

To float a window or a group of windows:

- Click-and-drag the window's title bar to the desired location

To separate a window from a group:

- Click-and-drag the window name to the desired location

To return a floating window or a group of windows to its previous docking location:

- Double-click the title bar

To change where a window or a group of windows is docked:

1. Click-and-drag the window's title bar until the anchor points appear.
2. Drag the window until the mouse pointer is at the desired anchor point.
3. Release the mouse.

To turn floating windows off:

- Right-click anywhere on the canvas and choose Turn off float in the pop-up menu.

To turn floating windows on:

- Right-click anywhere on the canvas and choose Turn on float in the pop-up menu.

Reference

This section provides explanations of the features found in the COMPOSER Software.

Program Window

The COMPOSER window presents one or more tabs, a menu bar and a view. The default view is the dashboard.

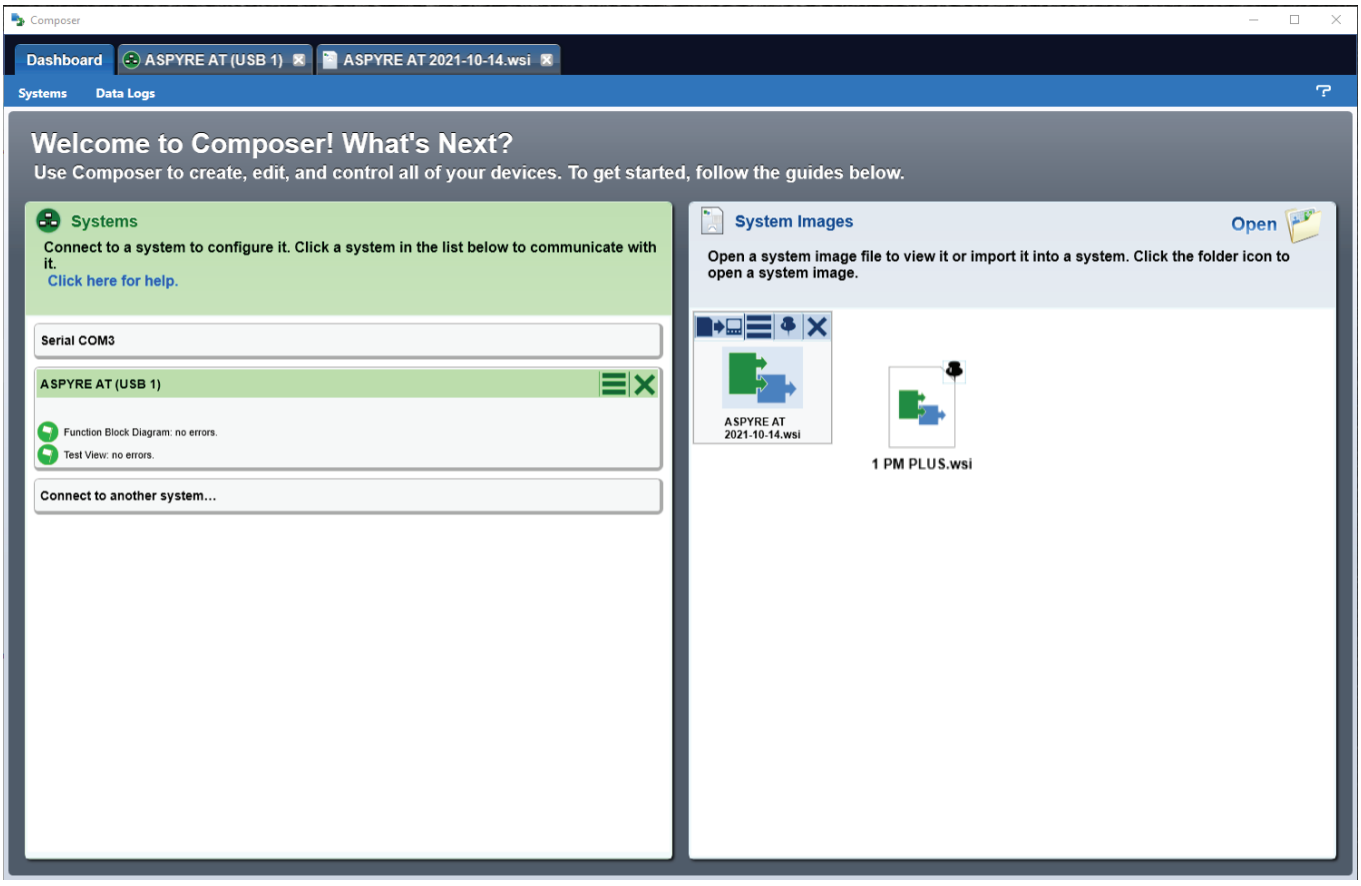
Tabs

Click a tab to view the Dashboard, a connected system or an open system image file.

Dashboard View

Use this view to connect to systems and open system image files to view.

Dashboard View



Systems Menu

Open—open a system image file to view.

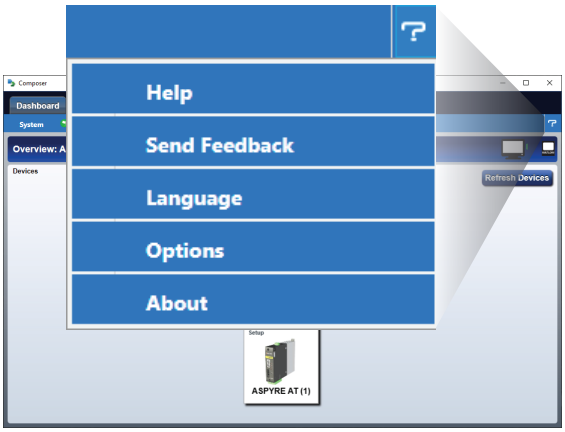
Data Logs Menu

This menu has options for log files created with F4T controllers and D4T data loggers:

- Decrypt—create a decrypted copy of a log file
- View—open a log file

Dashboard "?" Menu

- Help—open help for this view
- Send Feedback—open email to send feedback to Watlow about COMPOSER
- Language—choose the language option for COMPOSER
- Update Settings—set options for automatically checking for software updates
- Check for Updates—check for software updates
- About—display support contact and s software version



Systems List

Lists systems connected to COMPOSER, systems that are detected and can be connected and serial ports and methods to connect to other systems. Click a system to connect.

Connected System

The item in the systems list for a connected system includes:

- **System name**—includes the name of a device in the system and indicates how the system is connected to the computer. The same

name appears on the corresponding tab at the top of the program window
- **Options menu**—view the system, save the system's settings in an image file or import settings from an image file
- **Close button**—click disconnect from the system
- **Status information**—displays information about the system

System Images

Includes open and pinned system image files.

- Open (file icon) button—open a system image file to view

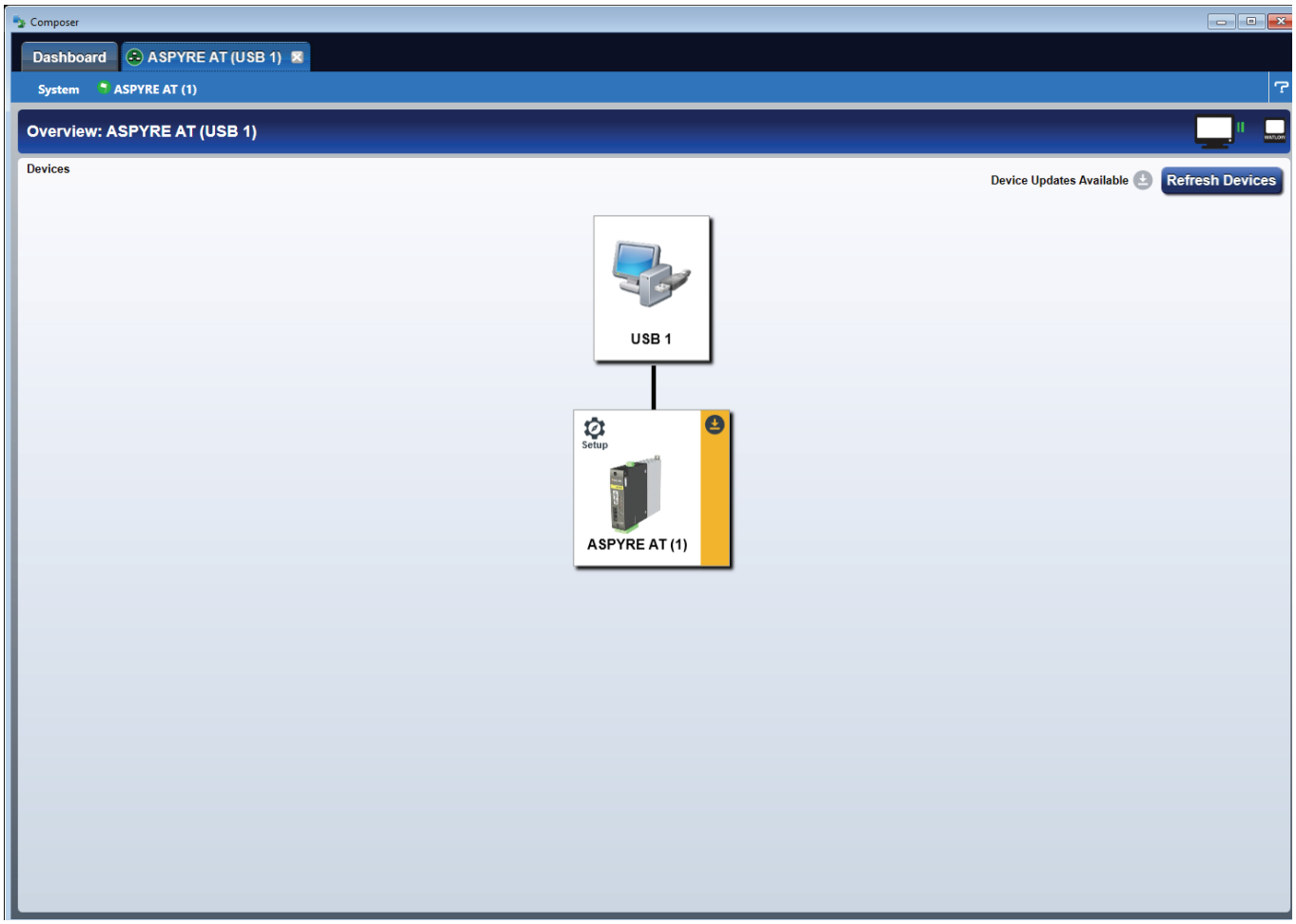
Open System Images

The item for an open system image file includes:

- **Import button**—import settings from this file into a connected system
- **Options menu**—import settings from this file into a connected system, unpin the file from the list or close the file
- **Close button**—click disconnect from the system
- **Pin information**—pin or unpin the system image file. Pin an image files to keep it on the dashboard even when closed
- **File name**—the name of the file also appears on the corresponding tab at the top of the program window

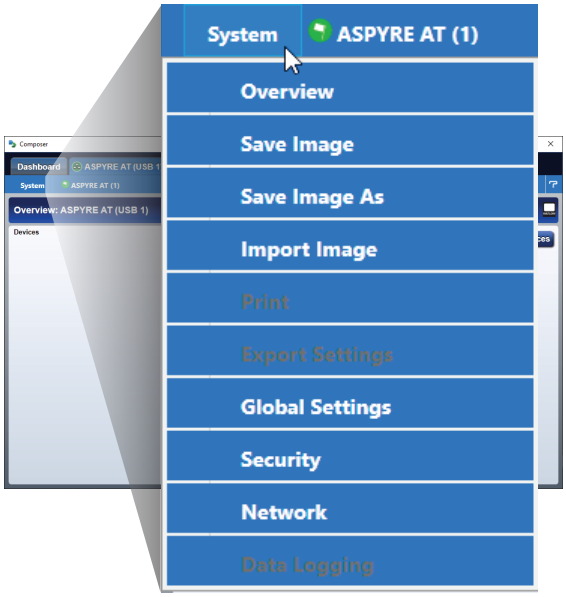
System Tab

A system tab appears for each open system and open system image file.



System Menu

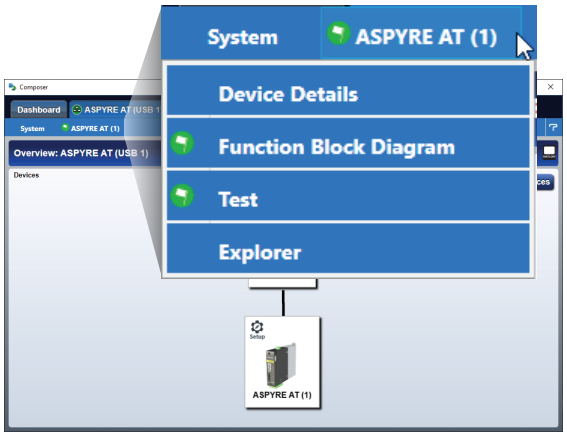
Use the items on this menu to view and set up features that apply to all the devices in the system:



- Overview—opens the Overview screen
- Save Image—saves the settings in a system image file. Prompts user for save location and file name for first save for a system in a session then overwrites file on subsequent uses
- Save Image As—prompts the user for save location and file name and saves settings in a system image file
- Import Image—prompts user to choose a system image file and overwrites the settings in the system with the settings from the file
- Print—prints the contents of the current view. Not available for all views
- Export Settings—exports the settings from current view to a file. Not available for all views
- Global Settings—opens the global settings dialog
- Security—opens the security view
- Network—opens the network view
- Data Logging—not available for ASPYRE AT power controllers

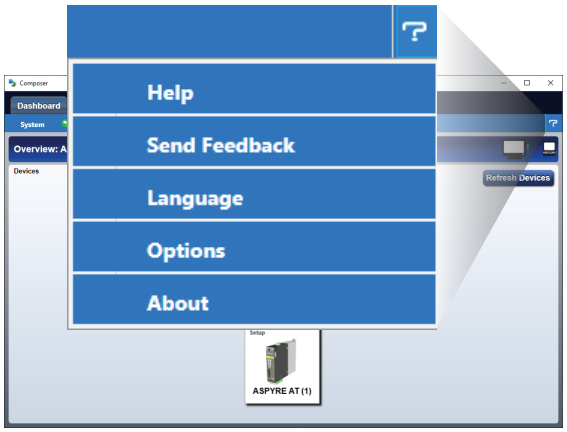
Device Menus

Each device in the system has a corresponding menu named for the device and its address. The items on the menu depend on the type of device. Badges next to the menu and menu items indicate a view that has an issue that needs resolving.



- Device Details—opens the device details view.
- Function Block Diagram—opens the function block diagram view.
- Test—opens the test view.
- Explorer—opens the explorer view.

Help Menu



- Help—open help for this view
- Send Feedback—open email to send feedback to Watlow about COMPOSER
- Language—choose the language option for COMPOSER
- Options—choose the write import option for COMPOSER
- About—display support contact and software version

View Bar

Indicates the name of the view and the name of the system or device shown in the view. The animation indicates active communication. The views selected with the system and device menus are displayed below the view bar.

Overview Screen

The Overview screen appears for each open system and open system image file.

Refresh Devices Button

Click to check the system for devices that have powered up after you connected.

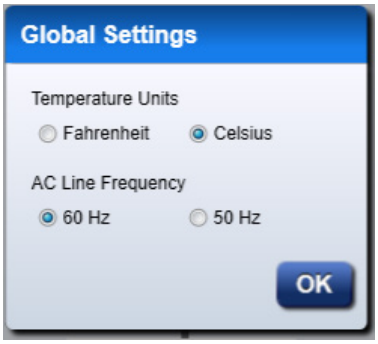
Devices Map

The following may display for one or more device:

- Device Update Available - indicates a newer version of firmware is available. Click to install the update.
- Setup - indicates guided setup is available for the device. Click to start the guided setup.

Global Settings Dialog

Use this dialog to view and set the Temperature Units and AC Line Frequency. These settings apply to the whole system. If you change the temperature units COMPOSER changes that setting in each device in the system.



Security View

Not applicable to ASPYRE AT power controllers.

Network View

Use this view to set up communication ports and communications gateways in the devices in the system to communicate with other automation equipment.

Options Menu

Show Legacy Assemblies—shows the assemblies used by the RUI and RMA gateway features for devices that support them.

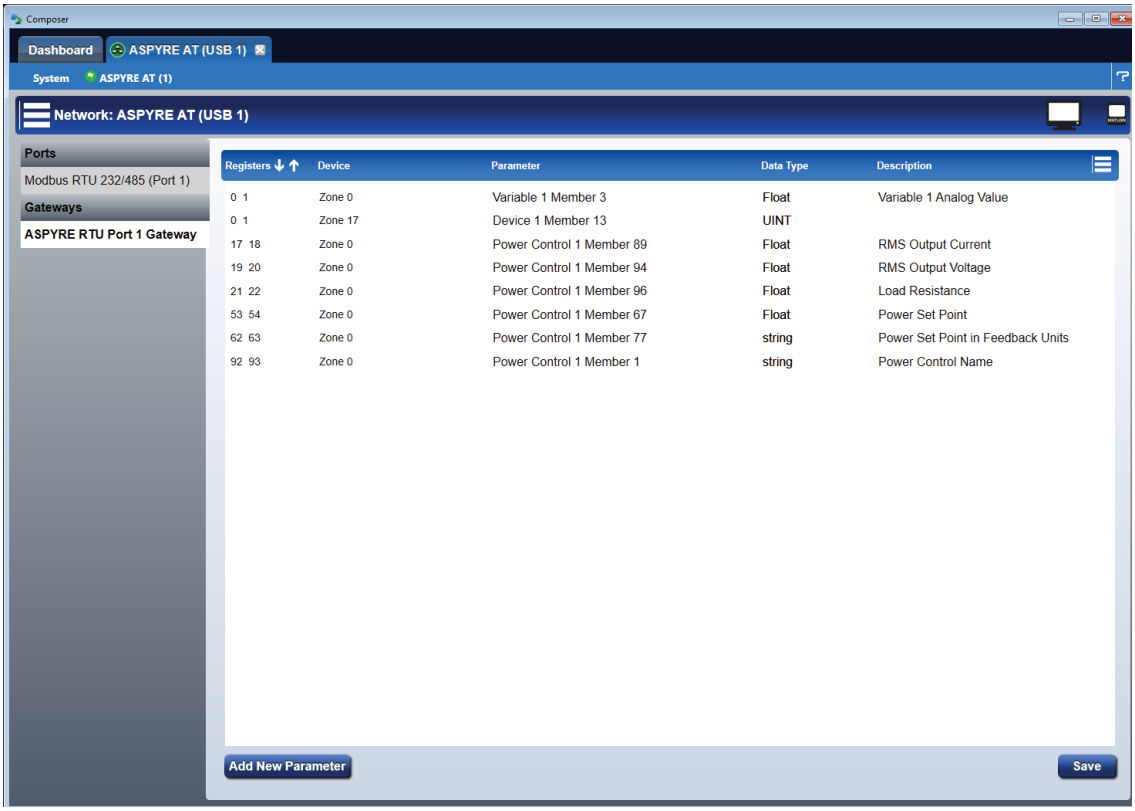
Ports Tab(s)

Set communication parameters such as baud rate for ports and protocols supported by the devices in the system. For parameter descriptions see "Modbus®" on page 84.

Gateway Tab

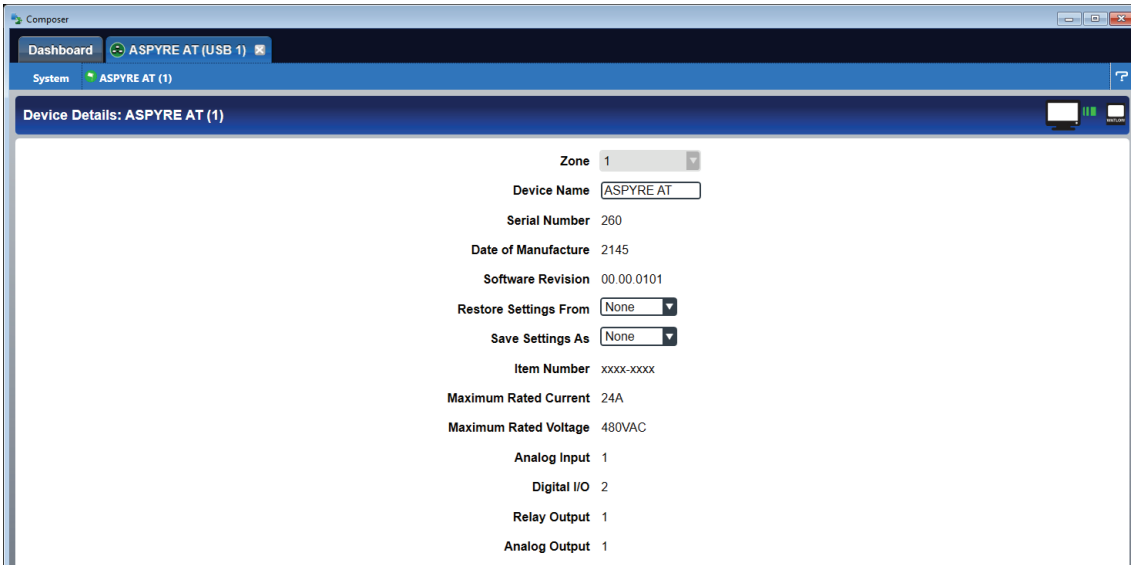
Create and maintain the list of parameters to make available via the communication gateway associated with port 1.

- **Parameter list**—each row represents a parameter available via the gateway. Click a row to change the addressing, parameter choice or other options. See "Communication" on page 119 for specifics on the protocol
- **Options menu**—use to export a file with the gateway setup
- **Add New Parameter**—add a row to the parameter list
- **Save**—save the communications gateway settings



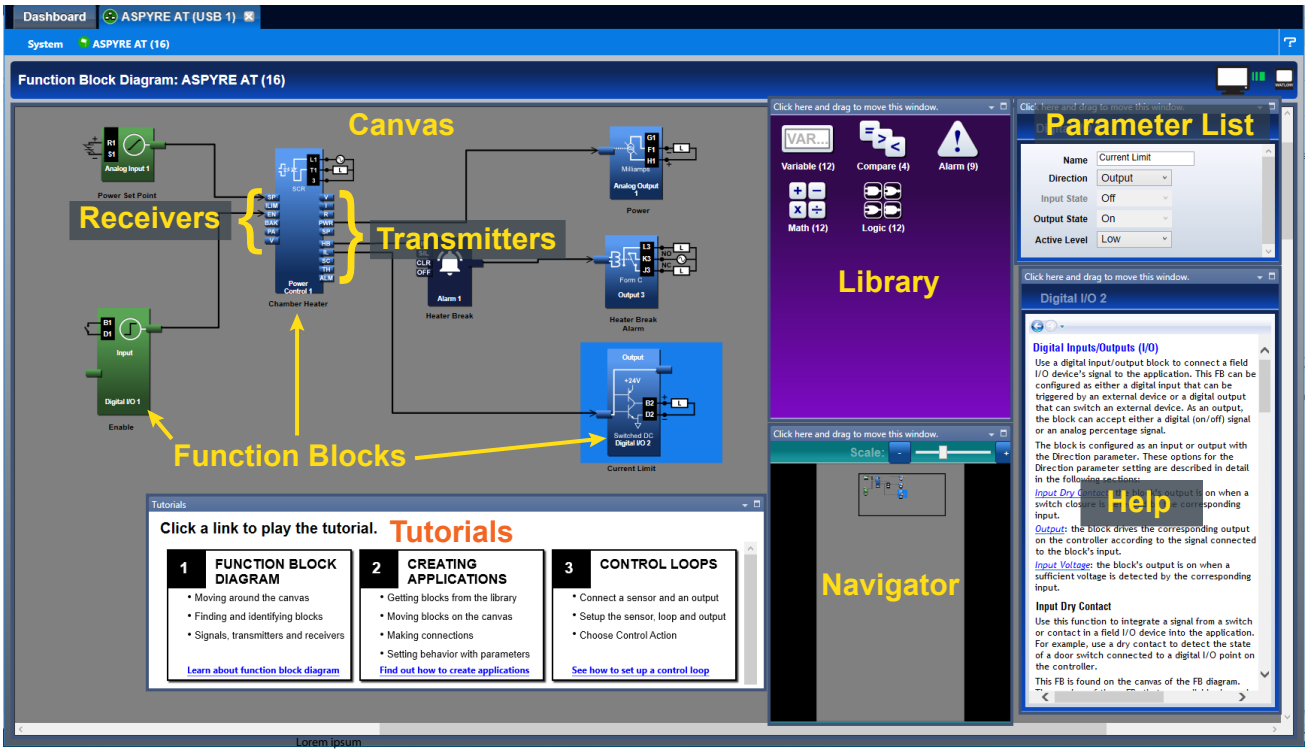
Device Details View

Use this view to view and set parameters for the device. See the descriptions in "Function Block and Parameter Reference" on page 47.



Function Block Diagram View

Use this view to customize the power controller's operation for your application by connecting and configuring Function Blocks.



Function Block Diagram View Windows

- Canvas—place function blocks here and connect them to customize the application. Blocks representing input and output hardware are always here.
- Library—find additional function blocks here. The number next to the name indicates how many blocks of the type remain available. This window is movable and dockable.
- Parameter List—view and set function block parameters to customize their behavior for the application. This window is movable and dockable.
- Navigator—Use to adjust the view of the canvas. Drag the box to reposition the view. Use the slide bar or the plus and minus buttons to adjust the zoom level. This window is movable and dockable.
- Help—displays detailed information for the selected function block. This window is movable and dockable.
- Tutorials—use to open video help files for the Function Block diagram.

Function Blocks and Signals

- Function blocks—connect blocls to customize the functionality of the controller for a specific application. Some Function Blocks are interfaces to real-world I/O devices and some serve as the interface to internal functions such as, the compare, logic and math blocks.
- Receiver (signal input)—the part of a function block to which a signal can be connected to supply data to the block.
- Transmitter (signal output)—the part of a function block from which a signal can be connected to carry data to another block.
- Signal—a line that represents the connection of data between blocks. Signals normally appear as black lines in the diagram, but when the block that transmits the signal cannot determine what the correct value should be, the signal changes to yellow indicating the error. Each Function Block's response to errors received is explained in the description of the Function Block. See "Working with Function Blocks" on page 34.

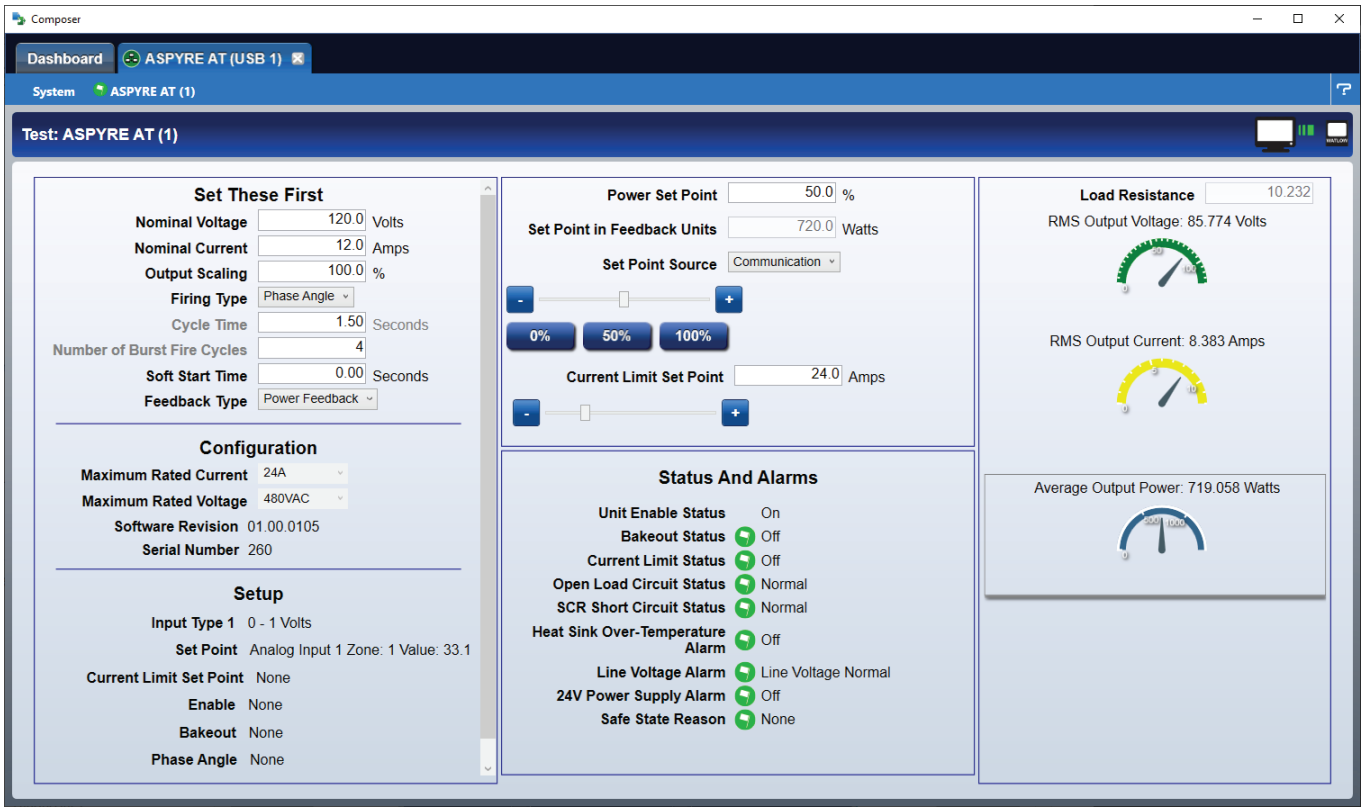
Notable facts about the function block diagram:

- How a function block responds to its inputs and drives its output is dependent on its parameter settings. Set the parameters for each function block as needed for the application
- Signals cannot be moved after they are created; to change where a signal gets data or where it delivers it,

delete the signal and create the desired connection
- There are several ways to do many things. Try right-clicking to see options or short cuts
- Function blocks from the library that have no signals connected are returned to the library when COMPOSER is closed
- The location of dockable windows is not saved; windows return to their default locations when the system is closed
- The selection of signal values displayed in the diagram is not saved; all signal value displays are turned off

Test View

Use to configure the basic parameters and get an overview of how the ASPYRE AT power controller is operating. See "Set Up the ASPYRE AT Using the Test View" on page 31 and Chapter 6 "Function Block and Parameter Reference chapter" starting on page 48 for descriptions of the parameters on this view.



Set These First

Set the basic parameters to scale the power control setpoint and measurements for the load in your application and configure the output.

Configuration

Indicates the basic properties of the power controller.

Setup

Indicates how the power controller's function has been customized with connections on the function block diagram.

Power Control and Current Limit Controls

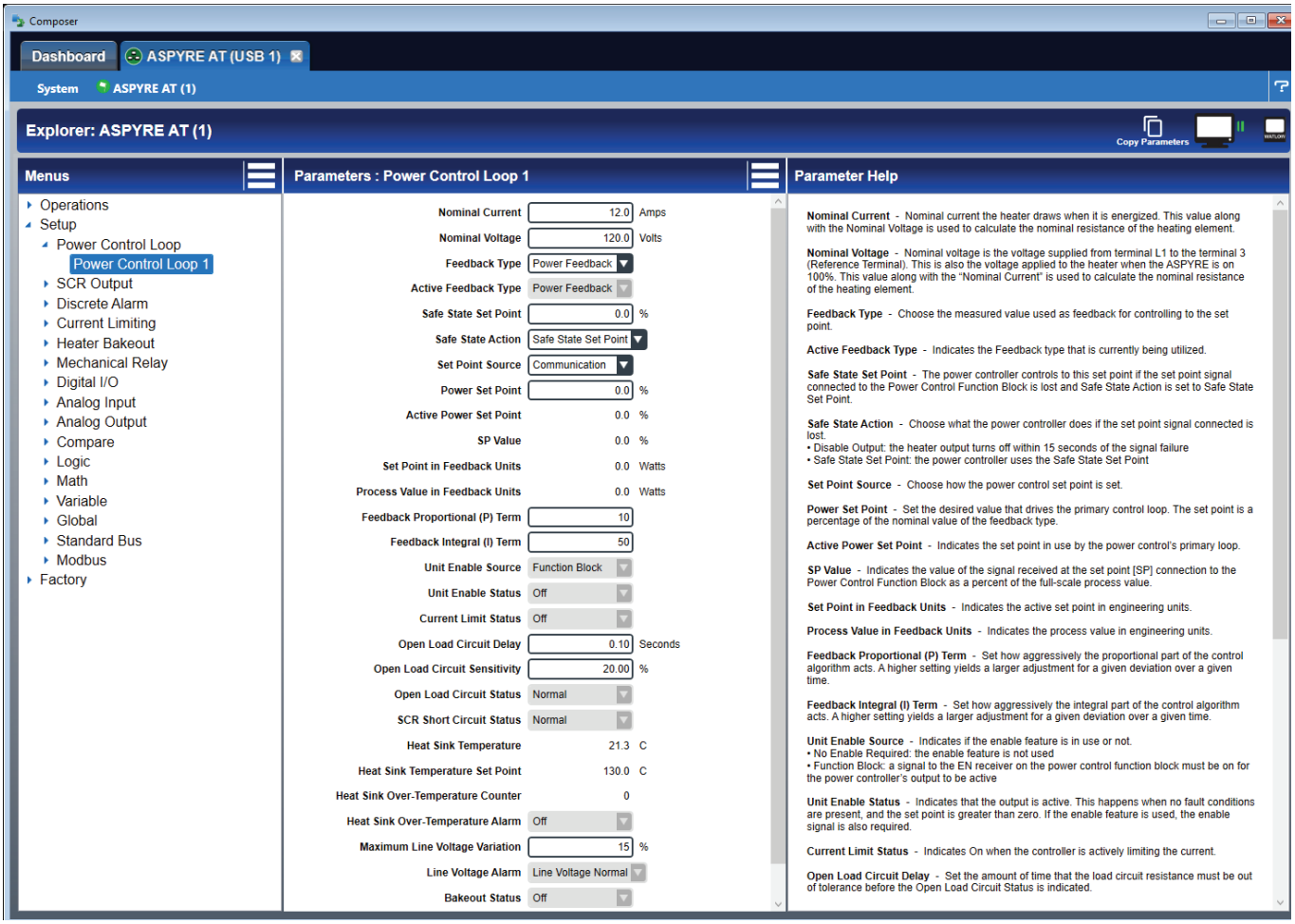
Adjust the set point using the **Power Set Point** field, slider or percent power buttons. Adjust the current limit set point using the **Current Limit Set Point** field or the slider.

Voltage, Current and Power Gauges

Indicate the **Load Resistance**, **RMS Output Voltage**, RMS Output Current and **Average Output Power**.

Explorer View

View and adjust parameter settings.



Menus Options

- Find—search for a page, menu or parameter name

Menu Tree

Lists parameters for the device in pages and menus. Click the arrows to expand or collapse the page and menu structure. Click an instance of a menu to view the parameters and settings.

Parameters Options

- Show Only Active Parameters—hides inactive parameters
- List Alphabetically—sorts the parameter lists by name

Parameter List

Lists the parameter that are on the selected menu. Parameters names are black for active parameters and gray for inactive parameters. Inactive parameters do not affect the operation and performance of the device. Parameter values are black for read-write parameters and gray for read-only parameters.

Parameter Help

Brief explanations are provided for the listed parameters. See the descriptions in Chapter 6 "Function Block and Parameter Reference" on page 47 for more detail.

6 Function Block and Parameter Reference

Function Block and Parameter Reference

Introduction

This section describes the Function Blocks available for customizing the ASPYRE AT power controller for your application. Use the Function Block Diagram view to connect inputs, functions and outputs to make the power controller work the way you want it to.

Each of the subsections listed below corresponds to the either a function block in the Function Block Diagram view or a menu in the Explorer view or both.

Chapter Table of Contents

Analog Input

Use this block to condition an analog process signal. A block is found on the Function Block Diagram's canvas for any analog input available for the device.

Function Block Signals

Connect signals from this block on the Function Block Diagram to customize the power controller for your application.

Direction	Label	Type	Function
Transmitter	- - - -	Analog	The scaled electrical signal or process value with filter and offset applied

Parameters

View and adjust this block's settings in the Parameters window in the Function Block Diagram and in the Explorer view.

Name

Uniquely identify this FB using up to 20 alphanumeric characters.

Range: 20 ASCII characters (letters, numbers and symbols) or 20 bytes other characters

Data Type: String

Access: Read-Write

Class: 4

Parameter Number: 48

Sensor Type

Configure the electronics to measure the type of electrical signal.

Options:

- *Off* (62): no signal is expected
- *Volts* (104): the analog input is set to measure DC voltage
- *Milliamps* (112): the analog input is set to measure DC current in the milliamp range

Default: Off

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 4

Parameter Number: 5

Units

Set the units for the function's output.

Options:

- *Absolute Temperature* (1540): the output is in units of degrees Fahrenheit or degrees Celsius
- *Power* (73): the output is a percentage with 100% representing full power and 0% representing no power
- *Process* (75): the output is in units of measure other than degrees Fahrenheit, degrees Celsius or relative humidity
- *Relative Humidity* (1538): the output is a measurement of percent relative humidity (%RH)

Default: Process

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 4

Parameter Number: 42

Scale Low
Set the electrical signal level at which the Range Low setting is the desired indicated process value. Scale Low and Range Low are the coordinates of a point on the line that relates the electrical signal to the conditioned process value produced by this block. Consult the hardware specifications for the signal range supported by the specific hardware. Use to set the minimum value of the process range in electrical units.

Range: -100.00 to 1,000.00

Units: Volts DC or mADC according to the Sensor Type setting

Default: 0.00

Data Type: IEEE Float

Access: Read-Write

Class: 4

Parameter Number: 15

Scale High
Set the electrical signal level at which the Range High setting is the desired indicated process value. Scale High and Range High are the coordinates of a point on the line that relates the electrical signal to the conditioned process value produced by this block. Consult the hardware specifications for the signal range supported by the specific hardware. Use to set maximum value of the process range in electrical units.

Range: -100.00 to 1,000.00

Units: Volts DC or mADC according to the Sensor Type setting

Default: 10.00

Data Type: IEEE Float

Access: Read-Write

Class: 4

Parameter Number: 16

Range Low
Set the process value to be indicated when the electrical signal is equal to the Scale Low setting. Scale Low and Range Low are the coordinates of a point on the line that relates the electrical signal to the conditioned process value produced by this block.

Range: -99,999 to 99,999

Units: °C, °F, %, Process or %RH according to the Units parameter setting

Default: 0

Data Type: IEEE Float

Access: Read-Write

Class: 4

Parameter Number: 17

Range High
Set the process value to be indicated when the electrical signal is equal to the Scale High set¬ting. Scale High and Range High are the coordinates of a point on the line that relates the electrical signal to the conditioned process value produced by this block.

Range: -99,999 to 99,999

Units: °C, °F, %, Process or %RH according to the Units parameter setting

Default: 100

Data Type: IEEE Float

Access: Read-Write

Class: 4

Parameter Number: 18

Process Error Enable
Set this parameter to enable low scale input error detection and response. Process inputs do not have intrinsic open/short detection. To enable detection of process errors set this parameter to Low.

Options:

- *Off* (62): any measured value is considered good
- *Low* (53): an error is indicated when the measured value is below the Process Error Low Value setting

Default: Off

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 4

Parameter Number: 30

Process Error Low Value
When Process Error Enable is set to Low, set the minimum electrical signal level that is considered a good measurement. If the signal level to the hardware drops below this value, an error will be triggered.

Range: -100.00 to 1,000.00

Units: Volts DC or mADC according to the Sensor Type setting

Default: 0.00

Data Type: IEEE Float

Access: Read-Write

Class: 4

Parameter Number: 31

Filter
Set the amount of filtering to apply to the analog input value. Filtering smooths signal fluctuations. Increase the time to increase filtering. Excessive filtering slows the function's response.

Range: 0.0 to 60.0 seconds

Units: Seconds

Default: 0.5 seconds

Data Type: IEEE Float

Access: Read-Write

Class: 4

Parameter Number: 14

Input Error Latching
Set whether an input error persists until it is cleared or clears automatically when the sensor signal returns to a normal level.

Options:

- *Off* (62): error clears automatically once the input returns to normal
- *On* (63): error remains active until the input returns to normal and the error is cleared by the Clear Error parameter

Default: Off

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 4

Parameter Number: 28

Display Precision
Set how many decimal places are displayed for the analog input value and associated parameters such as Range Low and Range High.

Options: *Whole* (105), *Tenths* (94), *Hundredths* (40), *Thousandths* (96)

Default: Tenths

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 4

Parameter Number: 20

Calibration Offset
Set a value to add to the measured input to compensate for sensor placement, lead-wire resistance or other factors that cause the input to vary from actual process value.

Range: -99,999 to 99,999

Units: °C, °F, %, Process or %RH according to the Units parameter setting

Data Type: IEEE Float

Access: Read-Write

Class: 4

Parameter Number: 12

Analog Input Value
Indicates the scaled process value.

Range: -99,999 to 99,999

Units: °C, °F, %, Process or %RH according to the Units parameter setting

Data Type: IEEE Float

Access: Read-Only

Class: 4

Parameter Number: 1

Input Error
Indicates an input error when there is a problem with the measurement or sensor signal.

Options: *None* (61), *Open* (65), *Shorted* (127), *Measurement Error* (140), *Bad Calibration Data* (139), *Fail* (32), *Not Sourced* (246)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 4

Parameter Number: 2

Clear Error
Set this parameter to Clear to reset the input error after correcting the condition that caused it.

Options:

- *Ignore* (204): do nothing
- *Clear* (129): attempt to clear the input error

Default: Ignore

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 4

Parameter Number: 29

Analog Output

Use this block to operate an external device that takes an analog or process signal such as 4 to 20 mADC or 0 to 10 VDC. A block is found on the Function Block Diagram's canvas for any analog output available for the device.

Function Block Signals

Connect signals to and/or from this block on the Function Block Diagram to customize the power controller for your application.

Direction	Label	Type	Function
Receiver	- - - -	Analog	Drives the physical output associated with the block

Parameters

View and adjust this block's settings in the Parameters window in the Function Block Diagram and in the Explorer view.

Name

Uniquely identify this FB using up to 20 alphanumeric characters.

Range: 20 ASCII characters (letters, numbers and symbols)

Data Type: String

Access: Read-Write

Class: 18

Parameter Number: 24

Output Type

Configure the electronics to transmit the specified electrical signal.

Options:

- *Off* (62): the output is off
- *Volts* (104): the output supplies a voltage signal
- *Milliamps* (112): the output supplies a current signal in the milliamp DC range

Default: Off

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 18

Parameter Number: 1

Scale Low

Set the desired value for the output in electrical units (mA DC or VDC) when the input to the block equals the Range Low setting. Scale Low and Range Low are the coordinates of a point on the line that relates the input to the scaled output. Consult the hardware specifications for the signal range supported by the specific hardware. Use to set the minimum value of the process range in electrical units.

Range: -100.0 to 100.0 mA DC (typically 0 mA DC or 4 mA DC)
-100.0 to 100.0 VDC (typically 0 VDC)

Units: Volts DC or mADC according to the Sensor Type setting

Default: 0.00

Data Type: IEEE Float

Access: Read-Write

Class: 18

Parameter Number: 9

Scale High

Set the desired value for the output in electrical units (mA DC or VDC) when the input to the block equals the Range High setting. Scale High and Range High are the coordinates of a point on the line that relates the input to the scaled output. Consult the hardware specifications for the signal range supported by the specific hardware.

Range: -100.0 to 100.0 mA DC (typically 20 mA DC)

-100.0 to 100.0 VDC (typically 1, 5, or 10 VDC)

Units: Volts DC or mADC according to the Sensor Type setting

Default: 10.00

Data Type: IEEE Float

Access: Read-Write

Class: 18

Parameter Number: 10

Range Low

Set the process value to be indicated when the electrical signal is equal to the Scale Low setting. Scale Low and Range Low are the coordinates of a point on the line that relates the electrical signal to the conditioned process value produced by this block.

Range: -99,999 to 99,999

Units: V, A, W, °C, °F, %, Process or %RH according to the signal received by the Function Block

Default: 0

Data Type: IEEE Float

Access: Read-Write

Class: 18

Parameter Number: 11

Range High

Set the process value to be indicated when the electrical signal is equal to the Scale High setting. Scale High and Range High are the coordinates of a point on the line that relates the electrical signal to the conditioned process value produced by this block.

Range: -99,999 to 99,999

Units: V, A, W, °C, °F, %, Process or %RH according to the signal received by the Function Block

Default: 100

Data Type: IEEE Float

Access: Read-Write

Class: 18

Parameter Number: 12

Filtered Process Value

Indicates the scaled output value in percent of full scale.

Range: -99,999 to 99,999

Units: %

Data Type: IEEE Float

Access: Read-Only

Class: 18

Parameter Number: 26

Calibration

Use these parameters to adjust the calibration of the load current, load voltage, line voltage, analog input measurements and the analog output value.

Parameters

These parameters are found on the Factory page in the Explorer view.

Load Current User Calibration Gain

The power controller is calibrated by Watlow. Adjust this setting to change the RMS Output Current indication to match a user-supplied meter reading.

Range: 0.9 to 1.1

Default: 1

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 198

Load Current User Calibration Offset

The power controller is calibrated by Watlow. Adjust this setting to change the RMS Output Current indication to match a user-supplied meter reading.

Range: ±5% of the units Max Rated Current

Units: Amperes

Default: 0

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 199

Load Voltage User Calibration Gain

The power controller is calibrated by Watlow. Adjust this setting to change the RMS Output Voltage indication to match a user-supplied meter reading.

Range: 0.9 to 1.1

Default: 1

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 200

Load Voltage User Calibration Offset

The power controller is calibrated by Watlow. Adjust this setting to change the RMS Output Voltage indication to match a user-supplied meter reading.

Range: ±5% of the units Max Rated Voltage

Units: Volts

Default: 0

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 201

Line Voltage User Calibration Gain

The power controller is calibrated by Watlow. Adjust this setting to change the Measured Line Voltage indication to match a user-supplied meter reading.

Range: 0.9 to 1.1

Default: 1

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 204

Line Voltage User Calibration Offset

The power controller is calibrated by Watlow. Adjust this setting to change the Measured Line Voltage indication to match a user-supplied meter reading.

Range: ±5% of the units Max Rated Voltage

Units: Volts

Default: 0

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 205

Reset User Calibrations

Choose On to return the line and load voltage and current measurements to factory calibration by setting the user gains/offsets to their default values.

Options:

- *Off* (62): do nothing
- *On* (63): restores line and load voltage to factory calibration

Default: Off

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 207

Analog In (V) User Gain

The power controller is calibrated by Watlow. When the Sensor Type is Volts, adjust this setting to change the analog input indication to match a user-supplied meter reading.

Range: -3.4E+38 to 3.4E+38

Units: none

Default: 1

Data Type: IEEE Float

Access: Read-Write

Class: 211

Parameter Number: 82

Analog In (V) User Offset

The power controller is calibrated by Watlow. When the Sensor Type is Volts, adjust this setting to change the analog input indication to match a user-supplied meter reading.

Range: -3.4E+38 to 3.4E+38

Units: Volts

Default: 0

Data Type: IEEE Float

Access: Read-Write

Class: 211

Parameter Number: 83

Analog In (mA) User Gain

The power controller is calibrated by Watlow. When the Sensor Type is Milliamps, adjust this setting to change the analog input indication to match a user-supplied meter reading.

Range: -3.4E+38 to 3.4E+38

Units: none

Default: 1

Data Type: IEEE Float

Access: Read-Write

Class: 211

Parameter Number: 86

Analog In (mA) User Offset

The power controller is calibrated by Watlow. When the Sensor Type is Milliamps, adjust this setting to change the analog input indication to match a user-supplied meter reading.

Range: -3.4E+38 to 3.4E+38

Units: Amperes

Default: 0

Data Type: IEEE Float

Access: Read-Write

Class: 211

Parameter Number: 87

Analog Out (V) User Gain

The power controller is calibrated by Watlow. When the Output Type is Volts, adjust this setting to change the analog output signal to match a user-supplied meter reading.

Range: -3.4E+38 to 3.4E+38

Units: none

Default: 1

Data Type: IEEE Float

Access: Read-Write

Class: 211

Parameter Number: 90

Analog Out (V) User Offset

The power controller is calibrated by Watlow. When the Output Type is Volts, adjust this setting to change the analog output signal to match a user-supplied meter reading.

Range: -3.4E+38 to 3.4E+38

Units: Volts

Default: 0

Data Type: IEEE Float

Access: Read-Write

Class: 211

Parameter Number: 91

Analog Out (mA) User Gain

The power controller is calibrated by Watlow. When the Output Type is Milliamps, adjust this setting to change the analog output signal to match a user-supplied meter reading.

Range: -3.4E+38 to 3.4E+38

Units: none

Default: 1

Data Type: IEEE Float

Access: Read-Write

Class: 211

Parameter Number: 94

Analog Out (mA) User Offset

The power controller is calibrated by Watlow. When the Output Type is Milliamps, adjust this setting to change the analog output signal to match a user-supplied meter reading.

Range: -3.4E+38 to 3.4E+38

Units: Amperes

Default: 0

Data Type: IEEE Float

Access: Read-Write

Class: 211

Parameter Number: 95

Compare

Use a compare Function Block to set an output based on comparing two analog signals. The block is found in the Function Block Diagram's Library.

Function Block Signals

Connect signals to and/or from this block on the Function Block Diagram to customize the power controller for your application.

Direction	Label	Type	Function
Receivers	A	Analog	Signal to compare to B
	B	Analog	Signal to compare to A
Transmitter	T/F	Digital	On when compare condition is true, otherwise off

Parameters

View and adjust function and air handling in the Parameters window in the Function Block Diagram and in the Explorer view.

Function

Choose the type of comparison with the Function parameter.

Options:

- *Off* (62): the block's output is off
- *Greater Than* (1435): the block's output is on when input A is greater than input B
- *Less Than* (1436): the block's output is on when input A is less than input B
- *Equal To* (1437): the block's output is on when the two inputs are equal
- *Not Equal To* (1438): the block's output is on when the two inputs are not equal to each other
- *Greater or Equal* (1439): the block's output is on when input A is greater than or equal input B
- *Less or Equal* (1440): the block's output is on when input A is less than or equal to input B

Default: Off

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 28

Parameter Number: 9

Tolerance

Use Tolerance to set how precisely A and B must match to be considered equal. For example, with Tolerance set to 2, the values 10 and 12 are considered equal, but 10 and 12.5 are not.

Range: 0.000 to 99,999.000

Units: same as the source A signal

Default: 0.100

Data Type: IEEE Float

Access: Read-Write

Class: 28

Parameter Number: 11

Error Handling

When an error exists on any receiver, the function cannot definitively determine the result of the comparison and an error will be generated. Use Error Handling to select the output's value and error status.

Options:

- *True Good* (1476): outputs value is true (on) with no error
- *True Bad* (1477): outputs value is true (on) and has an error
- *False Good* (1478): outputs value is false (off) with no error
- *False Bad* (1479): outputs value is false (off) and has an error

Default: False Bad

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 28

Parameter Number: 12

Source Value A

Indicates the value received at A.

Range: -99,999 to 99,999

Units: same as the source A signal

Data Type: IEEE Float

Access: Read-Only

Class: 28

Parameter Number: 7

Source Value B

Indicates the value received at B.

Range: -99,999 to 99,999

Units: same as the source B signal

Data Type: IEEE Float

Access: Read-Only

Class: 28

Parameter Number: 8

Output Value

Indicates the state of the block’s transmitter.

Options:

- *Off* (62): the block’s output is off
- *On* (63): the block’s output is on

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 28

Parameter Number: 10

Current Limiting (Power Control)

Use these parameters to enable or disable current limiting and to set the current limit value. This feature is not fast enough to prevent damaging a wet or cold (high tcr) heater.

Parameters

View and adjust these parameters in the Parameters list for the Power Control Function Block on the Function Block Diagram and on the Setup page in the Explorer view.

Enable Current Limiting

When On, the power controller attempts to prevent the current from exceeding the user set current limit. See Current Limit Set Point.

Options:

- *Off* (62): the unit will allow the output to exceed the CLSP
- *On* (63): the unit will attempt to prevent the output from exceeding the CLSP

Default: On

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 51

Current Limit Set Point

Set point for the current limiting loop. While a signal is connected to the current limit receiver [ILIM] on the Power Control Function Block, this parameter's value is not used.

Range: 12A Aspyre AT Range = 0 to 12
24A Aspyre AT Range = 0 to 24
48A Aspyre AT Range = 0 to 48

Units: Amperes

Default: maximum rated current for the power controller

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 84

Active Current Limit Set Point

Indicates the active current limit set point.

Range: 12A Aspyre AT Range = 0 to 12
24A Aspyre AT Range = 0 to 24
48A Aspyre AT Range = 0 to 48

Units: Amperes

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 85

ILIM Value
Indicates the signal received at the current limit set point (ILIM) receiver on the Power Control Function Block.

Range: -99,999 to 99,999

Units: Amperes

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 149

Current Limit Proportional (P) Term
Set how aggressively the proportional part of the current limit algorithm acts. A higher setting yields a larger adjustment for a given deviation over a given time.

Range: 0 to 65535

Default: 10

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 52

Current Limit Integral (I) Term
Set how aggressively the integral part of the current limit algorithm acts. A higher setting yields a larger adjustment for a given deviation over a given time.

Range: 0 to 65535

Default: 50

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 53

Current Limit Status
Indicates On when the controller is actively limiting the current.

Options: *Off* (62), *On* (63), *Error* (28)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 114

Diagnostics

Use these parameters to set up and view the most basic attributes of your ASPYRE AT power controller.

Parameters

View and set these parameters on the Factory page in the Explorer view. Some are also listed in the Parameters list for the Power Control Function Block on the Function Block Diagram.

Device Name

Uniquely identify this device using up to 20 alphanumeric characters.

Range: 20 ASCII characters (letters, numbers and symbols) or 20 bytes other characters

Data Type: String

Access: Read-Write

Class: 1

Parameter Number: 11

Standard Bus Address

View the network address. Each device on the network must have a unique address. The address is set with the rotary switch on the front of the controller.

Range: 1 to 16 (on the switch 0 = 16)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 68

Parameter Number: 3

Item Number

Indicates the part number for the ASPYRE AT power controller.

Data Type: String (9 ASCII characters)

Access: Read-Only

Class: 1

Parameter Number: 60

Software Revision

Indicates the version of software in the ASPYRE AT power controller.

Data Type: String (17 ASCII characters)

Access: Read-Only

Class: 1

Parameter Number: 17

Serial Number

Indicates the serial number of the ASPYRE AT power controller.

Data Type: Unit 32 - max value is 4,294,967,295

Access: Read-Only

Class: 1

Parameter Number: 32

Unit Type
Indicates the number of controlled legs.

Options: *Single Phase* (3067), *Invalid* (10192)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 2

Maximum Rated Current
Indicates the maximum continuous load current that can be carried L1 to T1.

Options: *12A* (3178), *24A* (3179), *48A* (3180), *Invalid* (10192)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 8

Maximum Rated Voltage
Indicates the maximum nominal line voltage that be connected to the L1 connection.

Range: *480VAC* (3176), *600VAC* (3177), *Invalid* (10192)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 9

Digital Inputs/Outputs (I/O)

Use a digital input/output block to connect a field I/O device's signal to the application. This block can be configured as either a digital input that can be triggered by an external device or a digital output that can switch an external device. As an output, the block can accept either a digital (on/off) signal or an analog percentage signal. A block is found on the Function Block Diagram's canvas for each digital I/O point available for the device.

Function Block Signals

Connect signals to and/or from this block on the Function Block Diagram to customize the power controller for your application.

Direction	Label	Type	Function
Receiver	- - - -	Analog (%) or Digital	Drives the physical output associated with the block. See Active Level.
Transmitter	- - - -	Digital	Transmitter is off when digital signal not detected and on when signal is detected. See Active Level. The receiver is only used when the block is an output and the transmitter is only used when the block is an input.

Parameters

View and adjust this block's settings in the Parameters window in the Function Block Diagram and in the Explorer view.

Name

Uniquely identify this FB using up to 20 alphanumeric characters.

Range: 20 ASCII characters (letters, numbers and symbols)

Data Type: String

Access: Read-Write

Class: 61

Parameter Number: 19

Direction

Set the digital I/O point to operate as an input or output.

Options:

- *Output* (68): switch an external device
- *Input Voltage* (193): input signal is from a field I/O device that provides a high or low voltage signal indicating its state
- *Dry Contact* (44): input signal is from a switch or contact in a field I/O device

Default: Output

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 61

Parameter Number: 1

Output Type

Set how the load is wired.

Options: *Switched DC* (10033), *Open Collector* (3311)

Default: Switched DC

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 61

Parameter Number: 25

Input State
Indicates the state of the input.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 61

Parameter Number: 11

Output State
Indicates the state of the output.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 61

Parameter Number: 7

Source Value A
Indicates the value received at A.

Range: -99,999 to 99,999

Units: same as the source A signal

Data Type: IEEE Float

Access: Read-Only

Class: 61

Parameter Number: 13

Active Level
Select which signal level corresponds to the *On* state. For a digital input set whether a high or low measured input results in the block transmitting an *On* signal. For a digital output set whether a received *On* signal results in the digital output being set high or low. See tables below.

Options: *High* (37), *Low* (53)

Default: Low

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 61

Parameter Number: 21

Output

Active State	Signal at Receiver	Output
Low	Off or 0 to 99	On
Low	On or 100	Off
High	Off or 0 to 99	Off
High	On or 100	On

Input Dry Contact

Active State	Detected Switch State at Input	Transmitter
Low	Closed Circuit	On
Low	Open Circuit	Off
High	Closed Circuit	Off
High	Open Circuit	Off

Input Voltage

Active State	Detected Electrical Signal at Input	Transmitter
Low	≤ 1VDC	On
Low	≥ 4 volts	Off
High	≤ 1VDC	Off
High	≥ 4VDC	On

⚠**NOTE:** Once the input is >= 4V it is considered 'on' by the controller. The output state depends on the other settings. After the signal is seen as 'on', it will not be seen as 'off' until the voltage drops below 1V.

Discrete Alarm

Use an alarm Function Block for alarm annunciation with silencing, latching and/or logic behaviors based on a digital signal. Most simply the Alarm sets its output when the receiver (IN) is true. However, the alarm's behavior can be customized with Logic, Latching, Silencing and Delay Time parameters. The block is found in the Function Block Diagram's library.

Function Block Signals

Connect signals to and/or from this block on the Function Block Diagram to customize the power controller for your application.

Direction	Label	Type	Function
Receivers	IN	Digital	True indicates an alarm condition
	SIL	Digital	True (leading-edge triggered) silences the alarm (see Silencing)
	CLR	Digital	True (leading-edge triggered) clears the alarm latch if IN is false (See Latching)
	OFF	Digital	True makes the function act as if it were disabled
Transmitter	- - - -	Digital	Indicates the alarm state (see Logic)

Parameters

View and adjust this block's settings in the Parameters window in the Function Block Diagram and in the Explorer view.

Name

Uniquely identify this FB using up to 20 alphanumeric characters.

Range: 20 ASCII characters (letters, numbers and symbols) or 20 bytes other characters

Data Type: String

Access: Read-Write

Class: 155

Parameter Number: 35

Enable

Set whether the block performs its function.

Options:

- *Off* (62): the block's output is off
- *On* (63): the block sets its output according to the received signals and user-set settings

Default: Off

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 155

Parameter Number: 1

Silencing

Set whether the output can be returned to the non-alarm state (silenced) before the input returns to the false state. Silencing an alarm returns the alarm's output to its inactive state without requiring the alarm state to be cleared. Once the alarm is silenced, the output remains inactive until the alarm is cleared, and the alarm condition reoccurs.

Options:

- *Off* (62): alarm cannot be silenced. After an alarm occurs, the function’s output returns to its non-alarm state only when the alarm is cleared
- *On* (63): alarm can be silenced with a digital signal to SIL or by using the Silence Alarm parameter

Default: Off

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 155

Parameter Number: 2

Latching

Set whether an alarm state is maintained (latched) or (non-latching) clears automatically when the input to the discrete alarm block is a digital only signal.

Options:

- *Latching* (49): alarm remains active until the condition that caused it no longer exists and the alarm is reset by the CLR receiver or the Clear Alarm parameter
- *Non-latching* (60): alarm clears automatically once the condition that caused it no longer exists

Default: Non-latching

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 155

Parameter Number: 3

Logic

Set which state (on or off) of the alarm function's transmitter indicates there is an alarm.

Options:

- *Close on Alarm* (17): the alarm function's transmitter is off when there is no alarm and on when there is an alarm
- *Open on Alarm* (66): the alarm function's transmitter is on when there is no alarm and off when there is an alarm

Default: Close on Alarm

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 155

Parameter Number: 4

Delay Time

Set a length of time, in seconds, that an alarm condition must be present before the alarm state and output are triggered. This setting determines the minimum time that the signal at *IN* must be continuously true before the alarm state and alarm function's output indicate an alarm. If the signal at *IN* becomes false before this time, no alarm occurs. This feature can be used to minimize nuisance alarms.

Range: 0 to 9,999 seconds

Units: Seconds

Default: 0 seconds

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 155

Parameter Number: 5

Alarm State

Indicates the alarm state.

Options:

- *Startup* (88): the initial state and the state if the alarm is not enabled
- *None* (61): the signal at the *IN* receiver is true and there is no latched alarm
- *Active* (5): a signal at the *IN* receiver is true or was true and latched, but has not been cleared
- *Error* (28) : Indicates there is an error associated with the alarm block.(Currently this is not used)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 155

Parameter Number: 9

Clear Alarm

Use this parameter to clear a latched alarm.

Options:

- *Ignore* (204): do nothing
- *Clear* (129): attempt to clear the alarm

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 155

Parameter Number: 7

Silence Alarm

Use this parameter to silence an alarm. Silencing required to be *ON*.

Options:

- *Ignore* (204): do nothing
- *Silence Alarms* (108): silence the alarm

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 155

Parameter Number: 8

IN Value
Indicates the value received at *IN*.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 155

Parameter Number: 16

SIL Value
Indicates the alarm is silenced if alarm is present when SIL Value = *ON*

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 155

Parameter Number: 20

CLR Value
Indicates the value received at CLR. Will clear the latched alarm if the fault is no longer present and latched is still set.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 155

Parameter Number: 25

OFF Value
Indicates the value received at *OFF*. Will prevent the alarm to be set if the OFF Value is *ON*.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 155

Parameter Number: 30

Output Value
Indicates the state of the block's transmitter.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 155

Parameter Number: 6

Global

Use these parameters to adjust settings that apply to the entire power controller.

Parameters

These parameters are found on the Setup page, Global menu in the Explorer view.

Display Units

Choose which scale to use for temperature.

Options: *F* (30), *C* (15)

Default: C

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 3

Parameter Number: 5

Save Settings As

Save this controller's settings in the selected memory location.

Options:

- *None* (61): do nothing
- *User Set 1* (101): save settings in set 1 memory
- *User Set 2* (102): save settings in set 2 memory

Default: None

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 1

Parameter Number: 14

Restore Settings From

Replace this controller's settings with values stored in the selected memory location.

Options:

- *None* (61): do nothing
- *User Set 1* (101): restore settings from set 1 memory
- *User Set 2* (102): restore settings from set 2 memory
- *Factory* (31): restore settings as shipped from Watlow

Default: None

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 1

Parameter Number: 13

Heater Bakeout (Power Control)

Use these parameters to set up the heater bakeout functionality of the power controller.

Parameters

View and adjust these parameters in the Parameters list for the Power Control Function Block on the Function Block Diagram and on the Setup page in the Explorer view.

Heater Bakeout Off Time

Set the minimum time the output must be disabled before a bakeout cycle is triggered by enabling the output.

Range: 0 to 65,535 minutes

Units: Minutes

Default: 64,800 minutes (45 days)

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 135

Heater Bakeout Ramp Time

Set the total time for the bakeout ramp in minutes.

Range: 0 to 65,535 minutes

Units: Minutes

Default: 120 minutes

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 136

Heater Bakeout Target Current

Set the heater current to be reached at the end of the Heater Bakeout Ramp Time.

Range: 12A Aspyre AT Range = 0 to 12
24A Aspyre AT Range = 0 to 24
48A Aspyre AT Range = 0 to 48

Units: Amperes

Default: 12A Aspyre AT Range = 0 to 12
24A Aspyre AT Range = 0 to 24
48A Aspyre AT Range = 0 to 48

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 137

Enable Heater Bakeout
Set to *On* to start a heater bakeout sequence. (As long as the unit is not currently enabled, or it has been off for the specified off time).

Range: *Off* (62), *On* (63)

Default: Off

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 134

BAK Value
Indicates the value of the signal received at the heater bakeout enable [BAK] connection to the power control Function Block.

Options: *Off* (63), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 157

Active Heater Bakeout Current Limit Set Point
Indicates the current limit set point when the heater bakeout feature is active.

Range: 0.0 to Heater Bakeout Target Current

Units: Amperes

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 138

Bakeout Status
Indicates *On* when the controller is actively in a bakeout cycle.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 113

Logic

Use a logic block to set an output based on one or more digital signals. The logic block performs logic operations on one or more inputs and sets its output based on the result. This block is found in the Function Block Diagram editor's library when working with a controller that offers the logic block.

Function Block Signals

Connect signals to and/or from this block on the Function Block Diagram to customize the power controller for your application.

Direction	Label	Type	Function
Receivers	*	Digital	Input to logic function
	*	Digital	Input to logic function
	- - - -	Digital	Input to logic function
	- - - -	Digital	Input to logic function
	- - - -	Digital	Input to logic function
	- - - -	Digital	Input to logic function
	- - - -	Digital	Input to logic function
	- - - -	Digital	Input to logic function
Transmitter	- - - -	Digital	On when logic function evaluates as true, otherwise false

*Labeled IN and HOLD for Latch function and SET and RST for RS Flip Flop function, otherwise no labels.
Note: Only connected inputs are considered by the logic operation; inputs that are not connected are ignored.

Parameters

View and adjust this block's settings in the Parameters window in the Function Block Diagram and in the Explorer view.

Function

Choose the type of comparison with the Function parameter.

Options:

- *Off* (62): the block's output is off
- *And* (1426): when all inputs all are on, the output is on. When any input is off, the output is off
- *Nand* (1427): when any input is on, the output is on. When all inputs are on the output is off
- *Equal To* (1437): when all inputs are the same, the output is on otherwise the output is off
- *Not Equal To* (1438): when all inputs are the same, the output is off otherwise the output is on
- *Or* (1442): when any input is on, the output is on. When all inputs are off, the output is off
- *Nor* (1443): when any input is on, the output is off. When all inputs are off, the output is on
- *Latch* (1444): see Latch Behavior below
- *RS Flip Flop* (1639): see RS Flip Flop Behavior below

Default: Off

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 27

Parameter Number: 33

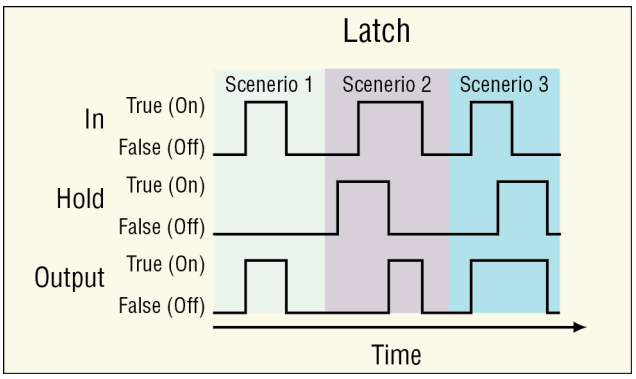
Truth Table: Results of the Logic Function with Three Received Signals

Received Signals	And	Nand	Equal To	Not Equal To	Or	Nor
FFF	F	T	T	F	F	T
FFT	F	T	F	T	T	F
FTF	F	T	F	T	T	F
FTT	F	T	F	T	T	F
TFF	F	T	F	T	T	F
TFT	F	T	F	T	T	F
TTF	F	T	F	T	T	F
TTT	T	F	T	F	T	F
F = False (0%, off) T – True (100%, on)						

Latch Behavior

The latch function uses only the top two receivers. The top is labeled IN and the second from the top is labeled HOLD.

When the HOLD input is off, the output follows the IN value. When HOLD is on, the output does not change; it is held (latched) at the value that was present at IN when HOLD turned on.



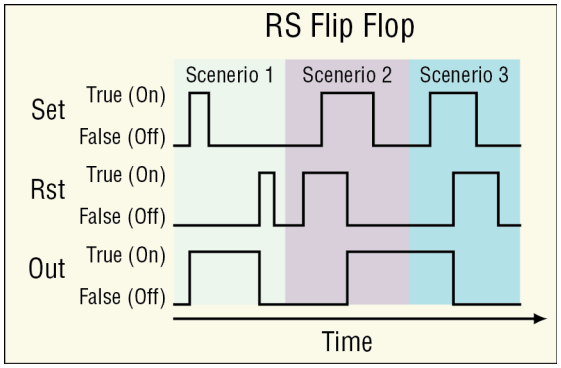
To understand the Latch's behavior consider these scenarios illustrated in the timing diagram below:

1. When Hold is off, the output follows IN.
2. If IN turns on after Hold turns on, the output remains off until Hold turns off.
3. If Hold turns on after IN turns on, the output remains on as long as Hold is on even after IN turns off.

RS Flip Flop Behavior

The flip flop function uses only the top two receivers. The top is labeled SET and the second from the top is labeled RST (reset).

When SET is on the output is on unless RST is on. Whenever RST is on, the output is off.



To understand the RS Flip Flop's behavior consider these scenarios illustrated in the timing diagram below:

1. SET turns the output on, RST turns it off.
2. If RST is on when SET turns on, the output remains off until RST turns off.
3. SET has no effect when the output is already on.

Error Handling

When an error exists on any receiver, the function cannot definitively determine the result of the comparison and an error will be generated. Use Error Handling to select the output's value and error status.

Options:

- *True Good* (1476): outputs value is true (on) with no error
- *True Bad* (1477): outputs value is true (on) and has an error
- *False Good* (1478): outputs value is false (off) with no error
- *False Bad* (1479): outputs value is false (off) and has an error

Default: False Bad

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 27

Parameter Number: 35

When the input has an error the signals connected to the output have the same error.

Function	Error Condition	Result
Off	One or more inputs has an error	The output is false with no error
Latch	IN has an error HOLD is off with no error	The output's value and error follow the input
	IN has an error HOLD is on with no error	The output's value and error are the same as the input was at the time the Hold signal turned on
	HOLD has an error	The output's value and error follow the input
RS Flip Flop	SET input gets an error while the output is false	The output stays false with no error
	SET input gets an error while the output is true	The output stays true with no error until the RST input resets the output to false
	RST input gets an error while the output is false	The output stays false with no error until the SET input sets the output to true
	RST input gets an error while the output is true	The output stays true with no error
All Others	One or more inputs has an error	If there is enough information to determine the output, all errors are ignored. Otherwise, the output value and error are determined by the setting of the Error Handling parameter

Source Value A

Indicates the value received at A.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 27

Parameter Number: 25

Source Value B

Indicates the value received at B.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 27

Parameter Number: 26

Source Value C

Indicates the value received at C.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 27

Parameter Number: 27

Source Value D
Indicates the value received at D.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 27

Parameter Number: 28

Source Value E
Indicates the value received at E.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 27

Parameter Number: 29

Source Value F
Indicates the value received at F.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 27

Parameter Number: 30

Source Value G
Indicates the value received at G.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 27

Parameter Number: 31

Source Value H
Indicates the value received at H.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 27

Parameter Number: 32

Output Value
Indicates the state of the block's transmitter.

Options:

- *Off* (62): the block's output is off
- *On* (63): the block's output is on

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 27

Parameter Number: 34

Math

Use a Math block to set an output based on performing the selected math function on up to four inputs. A filter and offset may be applied to the calculated value. A digital input enables or disables some of the math functions. This block is found in the Function Block Diagram editor's library.

Function Block Signals

Connect signals to and/or from this block on the Function Block Diagram to customize the power controller for your application.

Direction	Label*	Type	Function
Receivers		Analog	Input to math function
		Analog	Input to math function
		Analog	Input to math function
		Analog	Input to math function
		Digital	Input to math function
Transmitter		Analog	The result of the calculation

*Label depends on the function . See below.

⚠**NOTE!** Only connected inputs are considered by the math operation; inputs that are not connected are ignored.

Parameters

View and adjust this block's settings in the Parameters window in the Function Block Diagram and in the Explorer view.

Function

Choose the math operation with the Function Parameter.

Options:

- *Off* (62): the block's output follows the top input. A filter and offset may be applied to the output value. The output has the units of the signal connected to the first receiver.
- *Average* (1367): calculates the mean average of up to four inputs. Only inputs connected to a source are used in the calculation. A filter and offset may be applied to the calculated value. The output has the units of the signal connected to the first receiver.
- *Switch Over* (1370): one of the top two analog signals is retransmitted on the output based on the state of the digital signal. See Switch Over Behavior below.
- *Process Scale* (1371): linearly scales the top analog input or retransmits the second input based on the state of the digital signal. See Process Scale Behavior below.
- *Deviation Scale* (1372): linearly scales the top analog input and adds the second input as an offset or retransmits the second input based on the state of the digital signal. See Deviation Scale Behavior below.
- *Differential* (1373): outputs the difference (X – Y) between X the top input and Y the second input. A filter and offset may be applied to the calculated value. The output has the units of input X.
- *Ratio* (1374): calculates the quotient: top input X divided by second input Y. A filter and offset may be applied to the calculated value. If both inputs have the same units, the output has no units, otherwise the output has the units of input X.
- *Add* (1375): outputs the sum of the values of up to four inputs. Only inputs connected to a source are used in the calculation. A filter and offset may be applied to the calculated value. If any input is an absolute temperature, the output is also an absolute temperature; otherwise the output's units are those of the signal connected to the first receiver.
- *Multiply* (1376): outputs the product of the values of up to four inputs. Only inputs connected to a source are used in the calculation. A filter and offset may be applied to the calculated value. If any input is an absolute temperature, the output is also an absolute temperature; otherwise the output's units are those of the signal connected to the first receiver.
- *Absolute Difference* (1377): calculates the absolute value of X the top input minus Y the second input. A

filter and offset may be applied to the calculated value. The output has the units of input x.

- *Minimum* (1378): outputs the minimum of up to four inputs. Only inputs connected to a source are considered. A filter and offset may be applied to the output. The output has the units of the signal with the minimum value.
- *Maximum* (1379): outputs the maximum of up to four inputs. Only inputs connected to a source are considered. A filter and offset may be applied to the output. The output has the units of the signal with the minimum value.
- *Square Root* (1380): calculates the square root of X, the top input. A filter and offset may be applied to the calculated value. The output has the same units as X.
- *Sample and Hold* (1381): When the digital HOLD input is off, the output follows IN, the top analog value. When HOLD is on, the output stops changing; the output stays at the value it had at the time HOLD turned on. A filter and offset may be applied to the output value. Filtering holds when the HOLD input is on. Changes to the offset are applied without filtering and are not affected by the HOLD input. The output has the same units as IN.
- *Pressure to Altitude* (1649): outputs the altitude based on the atmospheric pressure. A filter and offset may be applied to the calculated value. The output has the units selected with the Altitude Units parameter. The calculation is based on the International Standard Atmosphere 1976 and is accurate from sea level to 90,000 feet. It can be used beyond this range in both directions, but with loss of accuracy. The standard is based on an altitude of 0 feet (sea level) pressure of 14.6967 PSI and a temperature of 59 °F.
- *Dew Point* (1650): outputs the dew point based on temperature and relative humidity. A filter and offset may be applied to the calculated value. The output is an absolute temperature.

Default: Off

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 25

Parameter Number: 21

Switch Over Behavior

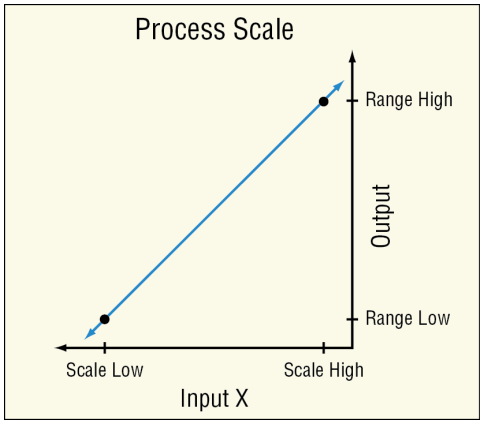
When SW is off, the output equals input 1. When SW is on, the output equals input 2. A filter and offset may be applied to the output. The output has the same units as the selected input.

The receivers are as follows:

Direction	Label	Type	Function
Receivers	1	Analog	Selected as the output when SW is off
	2	Analog	Selected as the output when SW is on
	- - - -	Analog	Not used
	- - - -	Analog	Not used
	SW	Digital	Off selects input 1, on selects input 2
Transmitter	- - - -	Analog	The filtered value of the selected input plus the offset

Process Scale Behavior

When SW is off, the output equals the filtered, scaled value of input X plus the offset. When SW is on, the output equals the filtered value of input B plus the offset.



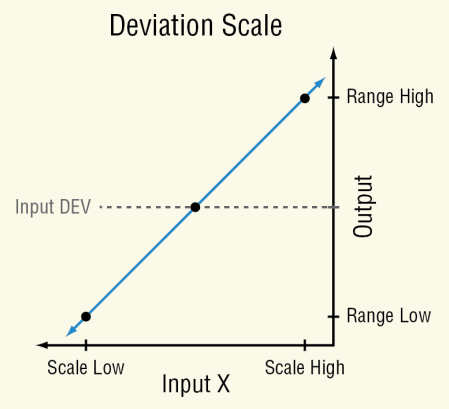
The receivers are as follows:

Direction	Label	Type	Function
Receivers	X	Analog	Signal to scale when SW is off
	B	Analog	Signal used without scaling when SW is on
	- - - -	Analog	Not used
	- - - -	Analog	Not used
	SW	Digital	When off, the output is based on the scaled value of input X, when on the output is based on input B (not scaled)
Transmitter	- - - -	Analog	The filtered value of the selected input plus the offset

Scaling converts input X proportionally from the input scale to the output range according to the line defined by the Scale Low, Scale High, Range Low and Range High settings as shown in the illustration.

Deviation Scale Behavior

When SW is off, the output equals the filtered, scaled value of input X plus DEV plus the offset. When SW is on, the output equals the filtered value of DEV plus the offset.



The receivers are as follows:

Direction	Label	Type	Function
Receivers	X	Analog	Signal to scale when SW is off
	DEV	Analog	Signal added to the scaled value of X when SW is off, signal used without scaling when SW is on
	- - - -	Analog	Not used
	- - - -	Analog	Not used
	SW	Digital	When off, the output is based on DEV plus the scaled value of input X, when on the output is based on DEV (not scaled)
Transmitter	- - - -	Analog	The filtered value of the selected input plus the offset

Scaling converts input X proportionally from the input scale to the output range according to the line defined by the Scale Low, Scale High, Range Low and Range High settings as shown in the illustration.

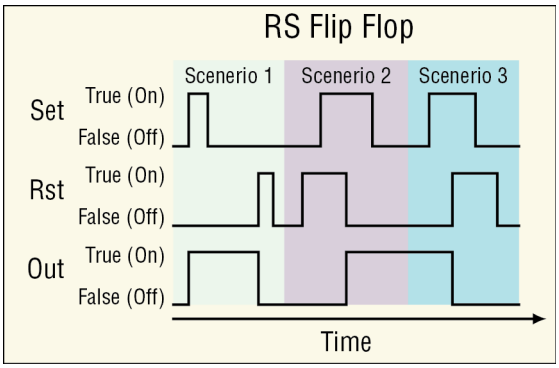
RS Flip Flop Behavior

The flip flop function uses only the top two receivers. The top is labeled SET and the second from the top is labeled RST (reset).

When SET is on the output is on unless RST is on. Whenever RST is on, the output is off.

To understand the RS Flip Flop's behavior consider these scenarios illustrated in the timing diagram below:

1. SET turns the output on, RST turns it off.
2. If RST is on when SET turns on, the output remains off until RST turns off.
3. SET has no effect when the output is already on.



Source Value A
Indicates the value received at A.

Range: -99,999.00 to 99,999.00

Data Type: IEEE Float

Access: Read-Only

Class: 25

Parameter Number: 16

Source Value B
Indicates the value received at B.

Range: -99,999.00 to 99,999.00

Data Type: IEEE Float

Access: Read-Only

Class: 25

Parameter Number: 17

Source Value C
Indicates the value received at C.

Range: -99,999.00 to 99,999.00

Data Type: IEEE Float

Access: Read-Only

Class: 25

Parameter Number: 18

Source Value D
Indicates the value received at D.

Range: -99,999.00 to 99,999.00

Data Type: IEEE Float

Access: Read-Only

Class: 25

Parameter Number: 19

Source Value E
Indicates the value received at E.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 25

Parameter Number: 20

Scale Low
Set the value of the input at which the Low Range setting is the desired output. Scale Low and Range Low are the coordinates of a point on the line that relates the input to the output.

Range: -99,999.00 to 99,999.00

Units: none

Default: 1.0

Data Type: IEEE Float

Access: Read-Write

Class: 25

Parameter Number: 24

Scale High

Set the value of the input at which the High Range setting is the desired output. Scale High and Range High are the coordinates of a point on the line that relates input to the output.

Range: -99,999.00 to 99,999.00

Units: none

Default: 1.0

Data Type: IEEE Float

Access: Read-Write

Class: 25

Parameter Number: 25

Units

Set the units for the function's output. Applied only for Deviation Scale.

Options:

- *Source* (1539): when SW is on, the output has the same units as input X. When SW is off, the output has the same units as input B
- *None* (61): the output value is a pure number without units. When function is deviation scale: input A is labeled 'X', input B is labeled 'DEV', either use A/B or X/DEV notation
- *Absolute Temperature* (1540): the output value is a temperature in Celsius or Fahrenheit
- Relative Temperature (1541): the output value is a relative number of degrees Celsius or Fahrenheit such as when subtract two absolute temperatures to compare them
- *Power* (73): the output is a percentage with 100% representing full power and 0% representing no power
- *Process* (75): the output is in units of measure other than degrees Fahrenheit, degrees Celsius or relative humidity
- *Relative Humidity* (1538): the output is a measurement of percent relative humidity (%RH)

Default: Source

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 25

Parameter Number: 32

Range Low

Set the desired result of scaling at the point where the input equals the Scale Low setting. Scale Low and Range Low are the coordinates of a point on the line that relates the input to the scaled output.

Range: -99,999.00 to 99,999.00

Units: °C, °F, %, Process or %RH according to the Units parameter setting

Default: 0

Data Type: IEEE Float

Access: Read-Write

Class: 25

Parameter Number: 17

Range High

Set the desired result of scaling at the point where the input equals the Scale High setting. Scale High and Range High are the coordinates of a point on the line that relates the input to the scaled output.

Range: -99,999.00 to 99,999.00

Units: °C, °F, %, Process or %RH according to the Units parameter setting

Default: 1

Data Type: IEEE Float

Access: Read-Write

Class: 25

Parameter Number: 18

Pressure Units
Set the units of pressure input. Applies only when the function is set to Pressure to Altitude.

Options: *PSI* (1671), *mbar* (1672), *Torr* (1673), *Pascal* (1674), *Atmosphere* (1675)

Default: PSI

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 25

Parameter Number: 30

Altitude Units
Set the units for altitude. Applies only when the function is set to Pressure to Altitude.

Options: *Feet* (1676), *Kilofeet* (1677)

Default: Kilofeet

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 25

Parameter Number: 31

Offset
Set an amount to add at the end of the math function's calculation.

Range: -99,999.00 to 99,999.00

Units: same as the units determined for the output by the function and other settings

Default: 0

Data Type: IEEE Float

Access: Read-Write

Class: 25

Parameter Number: 23

Filter
Set the amount of filtering to apply to the result of the math function's calculation. Filtering smooths signal fluctuations. Increase the time to increase filtering. Excessive filtering slows the function's response.

Range: 0.0 to 60.0 seconds

Units: Seconds

Default: 0

Data Type: IEEE Float

Access: Read-Write

Class: 25

Parameter Number: 28

Output Value
View the result of the math function's calculation.

Range: -99,999.00 to 99,999.00

Units: as determined by the Function and other settings

Default: 0

Data Type: IEEE Float

Access: Read-Write

Class: 25

Parameter Number: 22

Math Errors

Inputs that are not connected are ignored. Otherwise, error behavior is specific to the function.

Function	Error Condition	Result
Off	Any or none	The output value and error follow the first input
Average	One or more, but not all inputs have errors	The output value is the average of the inputs that have no errors and the output has no error
	All inputs have errors	The output has the last good value and has an error
Switch Over	When SW has no error	The output's value and error follow the input selected by the digital input
	When SW has an error	The output value and error follow input 1
Deviation Scale	X or DEV or both have errors	The output is equal to the offset and has an error
	SW has an error	The function considers the switch to be off
Process Scale	X has an error	The output is equal to the offset and has an error
	SW has an error	The function considers the switch to be off
Differential	X or Y or both have errors	The output is equal to the offset and has an error
Ratio	X or Y or both have errors	The output is equal to the offset and has an error
	Y equals zero	The output is equal to the offset and has an error
Add	Any or all inputs have errors	The output is equal to the offset and has an error
Multiply	Any or all inputs have errors	The output is equal to the offset and has an error
Absolute Difference	X or Y or both have errors	The output is equal to the offset and has an error

Mechanical Relay / Output 3

Use a digital output block to drive an external device. Output blocks can accept either a digital (on/off) signal or an analog percentage signal. This block is found on the Function Block Diagram's canvas.

Use a digital input/output block to connect a field I/O device's signal to the application. This block can be configured as either a digital input that can be triggered by an external device or a digital output that can switch an external device. As an output, the block can accept either a digital (on/off) signal or an analog percentage signal.

Function Block Signals

Connect signals to and/or from this block on the Function Block Diagram to customize the power controller for your application.

Direction	Label	Type	Function
Receiver	- - - -	Analog (%) or Digital	Drives the physical output associated with the block <50% is received: the output is off >50% is received: the output is on

Parameters

View and adjust this block's settings in the Parameters window for the Output block in the Function Block Diagram and on the Setup page, Mechanical Relay menu in the Explorer view.

Name

Uniquely identify this FB using up to 20 alphanumeric characters.

Range: 20 ASCII characters (letters, numbers and symbols) or 20 bytes other characters

Data Type: String

Access: Read-Write

Class: 64

Parameter Number: 19

Source Value A
Indicates the value received at A.
Range: -99,999.00 to 99,999.00
Units: same as the source A signal
Data Type: IEEE Float
Access: Read-Only
Class: 64
Parameter Number: 13

Output State
Indicates the state of the output.
Options: *Off* (62), *On* (63)
Data Type: Unsigned 16-bit Integer
Access: Read-Only
Class: 64
Parameter Number: 7

Modbus®
Use these parameters to adjust the settings for the Modbus® RTU port.

Parameters
These parameters are found on the Setup page in the Explorer view.

Comms Gateway Enable
Enable or disable the Modbus® RTU communications gateway feature.
Options: *Off* (62), *On* (63)
Default: Off
Data Type: Unsigned 16-bit Integer
Access: Read-Write
Class: 69
Parameter Number: 29

485 Client / Server
Indicates the port's role.

Options: *Server* (3205), *Client* (3204)
Default: Server
Data Type: Unsigned 16-bit Integer
Access: Read-Only
Class: 69
Parameter Number: 9

Modbus® Address
Set server node address (also known as station number) for the port on the 485 network.
Range: 1 to 247
Default: 1
Data Type: Unsigned 16-bit Integer
Access: Read-Write
Class: 69
Parameter Number: 5

Baud Rate
Set speed to match the serial network.

Options: *9600* (188), *19200* (189), *38400* (190), *115200* (10283)

Default: 19200

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 69

Parameter Number: 3

Parity
Set parity to match the serial network.

Options: *None* (61), *Even* (191), *Odd* (192)

Default: None

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 69

Parameter Number: 4

Modbus® Word Order
Select the word order for floating-point values.

Options: *High Low* (1330), *Low High* (1331)

Default: Low High

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 69

Parameter Number: 7

Display Units
Choose the scale for temperatures communicated via Modbus®.

Options: *F* (30), *C* (15)

Default: C

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 69

Parameter Number: 1

Non-Volatile Save
Set whether to save all values written via the port in the non-volatile memory.

Note: Any value that is changed via the communication port initiates a write to the EEPROM. Life of EEPROM is approximately one million writes.

Options: *No* (59), *Yes* (106)

Default: Yes

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 69

Parameter Number: 2

Comms Watchdog Enable

Enable this feature when the power output is controlled via communication to automatically respond with the Safe State Action in the event communication is lost. See "Safe State Action" on page 89.

Options: *No* (59), *Yes* (106)

Default: No

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 69

Parameter Number: 27

Comms Watchdog Timeout

Set how long the power controller should wait between messages from the host before assuming communication has been lost.

Range: 1 to 255 seconds

Units: Seconds

Default: 5 seconds

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 69

Parameter Number: 28

Power Control Loop (Power Control)

Use the power control Function Block to integrate the operation of power control with other controllers and automation equipment. This block is found on the Function Block Diagram's canvas. Connect signals from analog and digital inputs or logic to the power control's receivers to control its operation. The transmitters on the block can be used to retransmit power, current or voltage and trigger outputs or other functions with alarms.

Parameters

Use the parameters below to configure how the power controller behaves including the firing type, feedback type and to configure fault detection. View and adjust these parameters in the Parameters list for the Power Control Function Block on the Function Block Diagram and on the Setup page in the Explorer view. See also the parameters listed for "Current Limiting (Power Control)" on page 60, "Heater Bakeout (Power Control)" on page 71, and "SCR Output (Power Control)" on page 95.

Function Block Signals

Connect signals to and/or from this block on the Function Block Diagram to customize the power controller for your application.

Direction	Label	Type	Function
Receivers	SP	Analog	The desired percent of full output the power control should deliver to the load see "Set Point Source" on page 89
	ILIM	Analog	Current limit set point see "Current Limit Set Point" on page 60
	EN	Digital	When a signal is connected, *On* enables the power control output and *Off* disables the output. With no signal connected the output is always enabled. See "Enable" on page 107
	BAK	Digital	On enables the heater bakeout feature
	PA	Digital	Forces the firing type to phase angle while on
	V	Digital	Forces the feedback type to voltage while on
Transmitters	V	Analog	Retransmits the measured load voltage in volts, see "RMS Output Voltage" on page 98
	I	Analog	Retransmits the measured load current in amperes, see "RMS Output Current" on page 97
	R	Analog	Retransmits the measured load resistance in ohms, see "Load Resistance" on page 98
	PWR	Analog	Retransmits the average output power in watts, see "Average Output Power" on page 98
	SP	Analog	Retransmits the power control set point value in percent, see "Power Set Point" on page 90
	OL	Digital	On indicates heater break / open load circuit is detected, see "Open Load Circuit Status" on page 93
	IL	Digital	On indicates the output is being reduced by current limit feature, see "Current Limit Status" on page 61
	SC	Digital	On indicates the SCR is shorted, see "SCR Short Circuit Status" on page 93
	TH	Digital	On indicates the heat sink is over temperature or that it has not cooled down below the re-enable point (which is defined as 20 degrees C below the heat sink over temp setpoint,) see "Heat Sink Over-Temperature Alarm" on page 94

Parameters

View and adjust this block's settings in the Parameters window in the Function Block Diagram and in Explorer view.

Name

Uniquely identify this FB using up to 20 alphanumeric characters.

Range: 20 ASCII characters (letters, numbers and symbols) or 20 bytes other characters

Data Type: String

Access: Read-Write

Class: 153

Parameter Number: 1

Nominal Current

Nominal current the heater draws when it is energized. This value along with the Nominal Voltage is used to calculate the nominal resistance of the heating element.

Range: 12A Aspyre AT Range = 0 to 12
24A Aspyre AT Range = 0 to 24
48A Aspyre AT Range = 0 to 48

Units: Amperes

Default: Maximum rated current for the power controller

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 15

Nominal Voltage

Nominal voltage is the voltage supplied from terminal L1 to the terminal 3 (Reference Terminal). This is also the voltage applied to the heater when the ASPYRE is on 100%. This value along with the "Nominal Current" is used to calculate the nominal resistance of the heating element.

Range: 0.1 to the max rated voltage (either 480.0 or 600.0)

Units: Volts

Default: 480V

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 16

Feedback Type

Choose the measured value used as feedback for controlling to the set point. See "Feedback" on page 104 in Chapter 7 Features.

Options: *No Feedback* (3078), *No Feedback Linear Power* (3312), *V2 Feedback* (3079), *V Feedback* (3080), *I2 Feedback* (3081), *I Feedback* (3082), *Power Feedback* (3083)

Default: Power Feedback

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 41

Active Feedback Type
Indicates the Feedback type that is currently being utilized.

Options: *No Feedback* (3078), *V2 Feedback* (3079), *V Feedback* (3080), *I2 Feedback* (3081), *I Feedback* (3082), *Power Feedback* (3083)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 42

Safe State Set Point
The power controller controls to this set point if the set point signal connected to the Power Control Function Block is lost and Safe State Action is set to Safe State Set Point.

Range: 0.0 to 100.0%

Units: Percent

Default: 0%

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 57

Safe State Action
Choose what the power controller does if the set point signal connected to the Power Control Function Block is lost or when the communication watchdog indicates loss of communication with a device sending the set point. This can happen when, for example, the set point signal is sourced from a control loop in an RM module and the RM is powered off. Things that trigger a safe state: Error on Function Block Diagram SP, ILIM or EN signal, communications watchdog trips, or the SP source is Function Block Diagram but nothing is connected.

Options:

- *Disable Output* (3197): the heater output turns off within 15 seconds of the signal failure
- *Safe State Set Point* (3198): the power controller will use the Safe State Set Point when the signal fails

Default: Safe State Set Point

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 69

Set Point Source
Choose how the power control set point is set.

Options:

- *Function Block* (3196): the power control set point is the signal connected to the set point [SP] receiver on the Power Control Function Block
- *Communication* (3195): the power control set point is set with the *Power Set Point* parameter

Default: Communication

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 68

Power Set Point

Set the desired value that drives the primary control loop. The set point is a percentage of the nominal value of the feedback type.

For example if:

- Nominal Voltage = 208 Volts
- Nominal Current = 10 Amps
- Set Point = 10%

With Feedback Type...	...the set point in Engineering Units is...
V Feedback	208V x 10% = 20.8 V
I Feedback	10A x 10% = 1 A
Power Feedback	208V x 10A x 10% = 208 W

Range: 0.0 to 100.0%

Units: Percent

Default: 0%

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 67

Note that the Set Point Source parameter determines if this parameter or the value received at the set point receiver [SP] on the power control Function Block is used for control.

Active Power Set Point

Indicates the set point in use by the power control's primary loop.

Range: 0.0 to 100.0%

Units: Percent

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 70

SP Value

Indicates the value of the signal received at the set point [SP] connection to the Power Control Function Block. This set point is a percent of the full-scale process value according to the Feedback Type setting and the Nominal Current and Nominal Voltage values. For example, if Feedback Type is set to Power Feedback, this is percent of nominal power (Nominal Current x Nominal Voltage). When Feedback Type is set to No Feedback this is percent on-time.

Range: 0 to 100%.

Units: Percent

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 145

Set Point in Feedback Units

Indicates the active set point in engineering units according to the Feedback Type. For example, if the Feedback Type setting is Power Feedback, this parameter indicates the set point in Watts.

Range: 0 to full-scale process value

With Feedback Type...	...the range is...
No Feedback	0% to 100% on-time
V2 Feedback	0V2 to (Nominal Voltage)^2
V Feedback	0V to Nominal Voltage
I2 Feedback	0A2 to (Nominal Current)^2
I Feedback	0A to Nominal Current
Power Feedback	0W to (Nominal Voltage x Nominal Current)

Units: Volts, Volts Squared, Amperes, Amperes Squared or Watts according to the Feedback Type setting or percent on-time when Feedback Type is set to No Feedback.

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 72

Process Value in Feedback Units

Indicates the process value in engineering units according to the Feedback Type. For example, if the Feedback Type setting is Power Feedback, this member indicates power delivered to the heater in Watts.

Range: 0 to full-scale process value

With Feedback Type...	...the range is...
No Feedback	0% to 100% on-time
V2 Feedback	0V2 to (Nominal Voltage)^2
V Feedback	0V to Nominal Voltage
I2 Feedback	0A2 to (Nominal Current) ^{2}
I Feedback	0A to Nominal Current
Power Feedback	0W to (Nominal Voltage x Nominal Current)

Units: Volts, Volts Squared, Amperes, Amperes Squared or Watts according to the Feedback Type setting or percent on-time when Feedback Type is set to No Feedback.

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 86

Feedback Proportional (P) Term

Set how aggressively the proportional part of the control algorithm acts. A higher setting yields a larger adjustment for a given deviation over a given time.

Range: 0 to 65535

Units: none

Default: 10

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 43

Feedback Integral (I) Term

Set how aggressively the intragral part of the control algorithm acts. A higher setting yields a larger adjustment for a given deviation over a given time.

Range: 0 to 65535

Units: none

Default: 50

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 44

Unit Enable Source

Indicates if the enable feature is in use or not. See "Enable" on page 107 {Features chapter}.

Options:

- *No Enable Required* (3223): No signal is connected to the EN receiver on the power control Function Block; the enable feature is not used.
- *Function Block* (3196): A signal is connected to the EN receiver on the power control Function Block; the enable signal must be on for the power controller's output to be active.

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 56

Unit Enable Status

Indicates that the output is active. This happens when no fault conditions are present and the set point is greater than zero. If the enable feature is used, the enable signal is also required. See "Enable" on page 107 Chapter 7 Features.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 115

Open Load Circuit Delay

Set the amount of time that the load circuit resistance must be out of tolerance before the Open Load Circuit Status is indicated.

Range: 0.05 to 12.00 seconds

Units: Seconds

Default: 2.50 seconds

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 60

Open Load Circuit Sensitivity
Set the sensitivity of the Open Load Circuit detection. The value entered is a percentage of the nominal heater resistance as calculated from the Nominal Load Voltage and Nominal Load Current settings.

Range: 0 to 100%

Units: Percent

Default: 20%

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 61

Open Load Circuit Status
Indicates Open when the measured load resistance is higher than expected by more than the Open Load Circuit Sensitivity for more than the Open Load Circuit Delay time.

Options: *Normal* (3280), *Open* (65), *Error* (28)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 116

SCR Short Circuit Status
Indicates Shorted when the SCR is stuck on and the output is on continuously.

Options: *Normal* (3280), *Shorted* (127), *Error* (28)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 117

Heat Sink Temperature
Indicates the temperature of the SCR module.

Range: -17.8 to 150.0° C (0 to 302.0° F)

Units: Celsius or Fahrenheit according to the display units setting

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 139

Heat Sink Temperature Set Point
Indicates the temperature at which the Heat Sink Over-Temperature Alarm occurs.

Range: 130.0° C (266.0° F)

Units: Celsius or Fahrenheit according to the display units setting

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 140

Heat Sink Over-Temperature Counter
Indicates the number of times the Heat Sink Temperature has exceeded the Heat Sink Temperature Set Point. Or the unit has not cooled past the hysteresis point (20C below the SP) after the over temperature has tripped.

Range: 0 to 65,535

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 141

Heat Sink Over-Temperature Alarm
Indicates *On* when the Heat Sink Temperature exceeds the Heat Sink Temperature Set Point.

Options: *Off* (62), *On* (63), *Error* (28)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 118

Maximum Line Voltage Variation
Set the threshold for the Line Voltage Status to indicate high or low voltage.

Range: 10 to 100%

Units: Percent

Default: 15%

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 58

Line Voltage Alarm
Indicates whether the measured line voltage is above (high) or below (low) the Nominal Voltage setting by more than the Maximum Line Voltage Variation or if the line voltage is absent altogether (lost).

Options: *Line Voltage Normal* (3169), *Line Voltage High* (3170), *Line Voltage Low* (3171), *Line Voltage Lost* (3181), *Line Voltage Phase Loss* (3172), *Disabled* (20021)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 119

24V Power Supply Alarm
Indicates *On* when 24VDC is out of range.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 129

SCR Output (Power Control)

Use these parameters to set up and monitor the power control's output.

Parameters

View and adjust these parameters in the Parameters list for the Power Control Function Block on the Function Block Diagram and on the Setup page in the Explorer view.

Firing Type

Choose how the output turns on and off to deliver the requested percent power. See "Firing Types" on page 108.

Options: *Zero Cross* (1701), *Burst Firing* (3074), *Phase Angle* (1702)

Default: Burst Firing

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 24

Active Firing Type

Indicates the firing algorithm that is currently active.

Options: *Zero Cross* (1701), *Burst Firing* (3074), *Phase Angle* (1702)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 66

Cycle Time

The period for fixed time base firing. Applies to the zero cross firing type.

Range: 1.00 to 300.00 seconds

Units: Seconds

Default: 1.5 seconds

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 25

Number of Burst Fire Cycles

The minimum number of cycles the load is energized per modulation period when variable time base firing is selected (Burst Fire).

Range: 4 to 16 cycles, for 0-50%, from 50%-99.9% this is the minimum number of off cycles per modulation period

Units: Cycles

Default: 4 cycles

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 27

Soft Start Time
Soft start acts as a filter on the set point. A value greater than zero will enable soft start.

Range: 0.00 to 10.00 seconds

Units: Seconds

Default: 0 seconds

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 31

Start Ramp (Half-Cycle Counts) (Not available at this time)
Start ramp causes the output to be phase-angle fired for a user-specified time each time the output is turned on.

Range: 0 to 1000 half-cycles

Units: Number of half line cycles

Default: 0 half-cycles

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 33

Safety Ramp Off Time
The minimum amount of time the output must be "off". See "Safety Ramp" on page 110

Range: 0.00 to 3600.00 seconds

Units: Seconds

Default: 0.0 seconds

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 34

Safety Ramp Duration
Enable the safety ramp feature and set how long the ramp takes by writing a value greater than zero. See "Safety Ramp" on page 111.

Range: 0.00 to 3600.00 seconds

Units: Seconds

Default: 0.00 seconds

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 35

EN Value
Indicates the value of the signal received at the output enable [EN] connection to the Power Control Function Block.

Options: *Off* (62), *On* (63)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 153

Parameter Number: 153

Output Scaling
Set the percentage by which the set point is scaled. For example, if set point is 50% and Output Scaling is 80%, then the effective set point is 40%.

Range: 0.0 to 100.0%

Units: Percent

Default: 100.0%

Data Type: IEEE Float

Access: Read-Write

Class: 153

Parameter Number: 71

Line Voltage
Line voltage measured between terminal L1 and 3 (Reference Connection).

Range: 0.0 to 1000.0V

Units: Volts

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 87

AC Line Frequency
Line frequency measured between terminal L1 and 3 (Reference Connection).

Range: 40.0 to 70.0 Hz

Units: Hertz

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 88

RMS Output Current
Indicates the effective RMS output current applied the heater.

Range: 0.000 to 200.000 A

Units: Amperes

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 89

Instantaneous Output Current
Indicates the RMS current drawn by the heater when the output is on.

Range: 0.000 to 200.000 A

Units: Amperes

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 90

RMS Output Voltage
Indicates the effective RMS output voltage applied the heater.
Range: 0.0 to 1000.0V
Units: Volts
Data Type: IEEE Float
Access: Read-Only
Class: 153
Parameter Number: 94

Instantaneous Output Voltage
Indicates the RMS voltage across the heater when the output is on.
Range: 0.0 to 1000.0V
Units: Volts
Data Type: IEEE Float
Access: Read-Only
Class: 153
Parameter Number: 95

Load Resistance
Indicates the measured resistance.
Range: 0.000 to 3.4E+38 Ω
Units: Ohms
Data Type: IEEE Float
Access: Read-Only
Class: 153
Parameter Number: 96

Average Output Power
Indicates the average true power delivered to the heater.
Range: 0.000 to 3.4E+38 W
Units: Watts
Data Type: IEEE Float
Access: Read-Only
Class: 153
Parameter Number: 97

Apparent Power
Indicates the average apparent power.
Range: 0.000 to 3.4E+38 W
Units: Watts
Data Type: IEEE Float
Access: Read-Only
Class: 153
Parameter Number: 102

Reactive Power
Indicates the average reactive power.

Range: 0.000 to 3.4E+38 W

Units: Watts

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 103

Power Factor
The ratio of the real power absorbed by the load to the apparent power flowing in the circuit.

Range: 0.000 to 1.000

Units: unitless ratio

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 104

Watt-Second Totalizer
Total Watt Seconds (Joules) of energy consumed by the load since the totalizer was last reset.

Range: 0.000 to 3.4E+38 W-s. The totalizer is presented as a 0-41 character string.

Units: Watt-Seconds (Joules)

Data Type: IEEE Float

Access: Read-Only

Class: 153

Parameter Number: 105

Reset Watt-Second Totalizer Command
Resets the Watt-Second Totalizer to zero.

Options:

- *Off* (62): do nothing
- *On* (63): resets the totalizer to zero

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 153

Parameter Number: 106

Standard Bus

Use these parameters to view the settings for the standard bus port.

Parameters

These parameters are found on the Setup page in the Explorer view.

Standard Bus Address

View the network address. Each device on the network must have a unique address. The address is set with the rotary switch on the front of the controller. See "Zone Dial" on page 15.

Range: 1 to 16 (on the switch 0 = 16)

Data Type: Unsigned 16-bit Integer

Access: Read-Only

Class: 68

Parameter Number: 3

Variable

Use a variable to allow a user to set and modify an analog or digital signal value that is an input to another block. This block is found in the Function Block Diagram editor's library when working with a controller that offers the Variable block.

Function Block Signals

Connect signals to and/or from this block on the Function Block Diagram to customize the power controller for your application.

Direction	Label	Type	Function
Transmitter	- - - -	Digital or Analog	The value set by the user with the Digital or Analog parameter depending on the Data Type setting

Parameters

View and adjust this block's settings in the Parameters window in the Function Block Diagram and in the Explorer view.

Name

Uniquely identify this FB using up to 20 alphanumeric characters.

Range: 20 ASCII characters (letters, numbers and symbols) or 20 bytes other characters

Data Type: String

Access: Read-Write

Class: 2

Parameter Number: 10

Data Type
Choose what the block produces.

Options:

- *Analog* (1215): the block outputs the user-set value from the Analog parameter in the units specified with the Units parameter
- *Digital* (1220): the block outputs the user-set value from the Digital parameter

Default: Analog

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 2

Parameter Number: 1

Units
Set the units for the function's analog value.

Options:

- *None* (61): the analog value is a pure number without units
- *Absolute Temperature* (1540): the analog value is a temperature in Celsius or Fahrenheit
- *Relative Temperature* (1541): the analog value is a relative number of degrees Celsius or Fahrenheit such as when subtract two absolute temperatures to compare them
- *Power* (73): the analog value is a percentage with 100% representing full power and 0% representing no power
- *Process* (75): the analog value is in units of measure other than degrees Fahrenheit, degrees Celsius or relative humidity
- *Relative Humidity* (1538): the analog value is a measurement of percent relative humidity (%RH)

Default: None

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 2

Parameter Number: 7

Digital
Set the variable's digital value.

Options: *Off* (62), *On* (63)

Default: Off

Data Type: Unsigned 16-bit Integer

Access: Read-Write

Class: 2

Parameter Number: 2

Analog
Set the variable's analog value.

Range: -99,999.00 to 99,999.00

Units: according to the Units parameter

Default: 0

Data Type: IEEE Float

Access: Read-Write

Class: 2

Parameter Number: 6

7 Features

This chapter describes the programmable features of the ASPYRE® AT power controller.

⚠ CAUTION: All parameter settings should only be determined by qualified personnel.

⚠ ATTENTION : Tous les réglages de paramètres ne doivent être effectués que par du personnel qualifié.

Features

Closed Loop Control

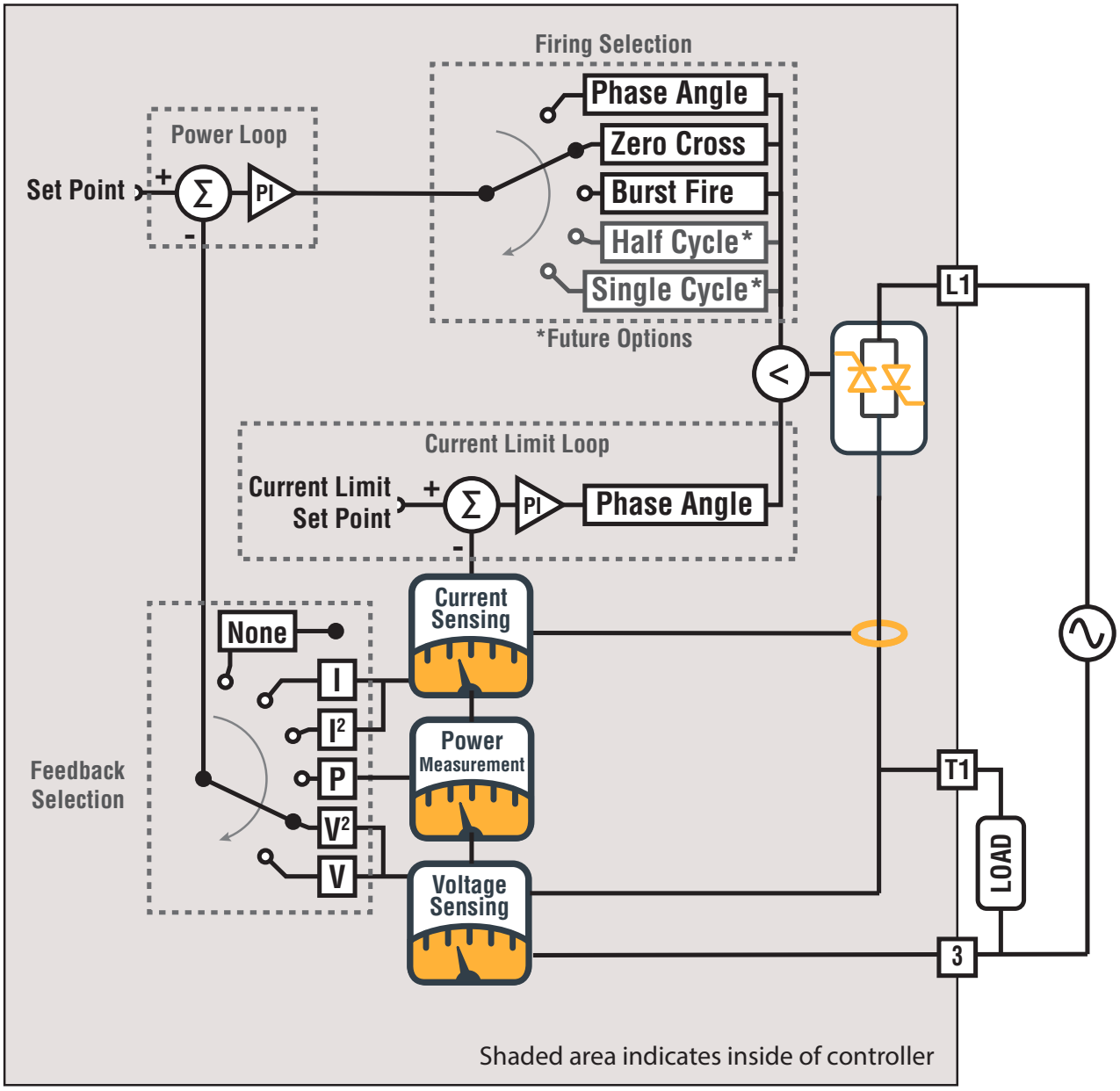
The ASPYRE AT power controller measures the voltage and current delivered to the load, and depending on how it is configured, corrects for, among other things, variations in line voltage and load resistance. See diagram on the next page.

Two control loops regulate power to the load. One loop attempts to drive the output to match the power set point. If the current limit feature is enabled, the second loop attempts to prevent the current through the load from exceeding the current limit set point. By using the lesser of the outputs from the two control loops, the output is controlled to the set point but prevented from exceeding the current limit. While the current limit loop overrides the power demand loop, the output is phase angle fired and the Current Limit Status parameter indicates the current limit alarm.

Each loop adjusts its output based on its measurement of error, the difference between the set point and the measured or calculated feedback. For the current limit loop, the error is the difference between the current limit set point and the measured current. For the power demand loop, the error is the difference between the set point and the user-selected feedback.

The two loops use Proportional and Integral (PI) control which allows them to compensate for both transient and long-term variations in conditions, including line voltage and load resistance. The performance of each loop can be tuned by adjusting the corresponding proportional term and integral term settings. The Feedback Proportional (P) Term and Feedback Integral (I) Term parameters determine how the power controller adjusts its output to match the set point. The Current Limit Proportional (P) Term and Current Limit Integral (I) Term parameters determine how the power controller adjusts the output to ensure that the current limit set point is enforced. These parameters are on the setup menu. See diagram on the next page.

The power demand set point can be set with the Power Set Point parameter on the Test view in COMPOSER or via Communication. Alternatively it can be set by an analog voltage or current signal from another piece of automation equipment such as a temperature controller or via another Watlow product on the backplane. See diagram on the next page.



Feedback

Selecting the feedback parameter determines what the power controller attempts to keep constant and therefore what variations are compensated.

Because closed-loop control reacts to the difference between the user-supplied set point and the measured feedback, the feedback selection also determines the meaning of the set point. For example, if Feedback Type is set to Voltage, the set point is interpreted as a percentage of the Nominal Load Voltage. In that case with a set point of 50%, the power controller adjusts the output to make the voltage drop across the load half the Nominal Load Voltage setting.

Keep in mind that the output can be limited by the current loop when that feature is enabled. Therefore, at times the actual output may be less than the the power loop demands.

These options are available for feedback type:

- **Voltage**—the power controller adjusts the output to make the measured load voltage divided by the nominal load voltage equal to the set point. This method of control compensates for line voltage fluctuations; the power remains constant as long as the load impedance does not change.

$$\text{Feedback} = \left(\frac{V_{rms}}{V_{nominal}}\right)100\% \qquad \text{Set Point is a percentage of } V_{nominal}$$

- **Voltage Squared**—the power controller adjusts the output to make the square of the measured load voltage divided by the square of the nominal load voltage equal to the set point. The output power responds linearly to changes in the set point for loads with constant resistance. This method of control compensates for line voltage fluctuations; the power remains constant as long as the load impedance does not change.

$$\text{Feedback} = \left(\frac{V_{rms}}{V_{nominal}}\right)^2 100\% \qquad \text{Set Point is a percentage of } V^2_{nominal}$$

- **Power**—the power controller adjusts the output to make the product of the measured load current and voltage divided by the product of the nominal load voltage and nominal load current equal to the set point. With this method of control the power remains constant even when the line voltage or load impedance varies.

$$\text{Feedback} = \left(\frac{V_{rms} I_{rms}}{V_{nominal} I_{nominal}}\right)100\%$$

Set Point is a percentage of $V_{nominal} \times I_{nominal}$

- **Current Squared**—the power controller adjusts the output to make the square of the measured load current divided by the square of the nominal load current equal to the set point. The set point is a percentage of the square of the nominal load current. With this method of control the power remains constant as long as the load impedance does not change.

$$\text{Feedback} = \left(\frac{I_{rms}}{I_{nominal}}\right)^2 100\%$$

Set Point is a percentage of $I^2_{nominal}$

- **Current**—the power controller adjusts the output to make the measured load current divided by the nominal load current equal to the set point. This method of control maintains constant current even when the line voltage or load impedance varies.

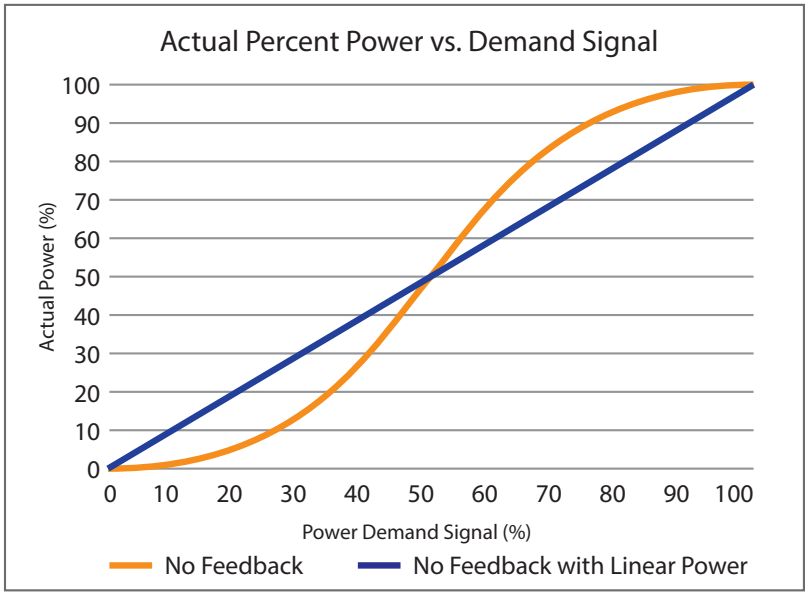
$$\text{Feedback} = \left(\frac{I_{rms}}{I_{nominal}}\right)100\%$$

Set Point is a percentage of $I_{nominal}$

- **No Feedback**—the power controller output is on for a percentage of time equal to the set point. The power demand loop does not adjust the output based on the measured voltage or current.

- **No Feedback Linear Power**—for use with phase angle firing. The power controller output is on for the amount of time necessary to deliver the percentage of power represented by the set point assuming the supplied voltage is a perfect sine wave at the nominal voltage specified by the user. The power demand loop does not adjust the output based on the measured voltage or current, but this feedback type delivers a more linear response to the demand signal than the straight *No Feedback* option. See "No Feedback and No Feedback Linear Power Response (with phase angle firing)" on page 106.

No Feedback and No Feedback Linear Power Response (with phase angle firing)



Current Limit

This feature is active when "Enable Current Limiting" is set to ON. It uses phase angle firing to limit the RMS load current by reducing the output whenever the power control loop would tend to drive current above the current limit set point. While the current limit loop overrides the power loop, the output is phase angle fired and the alarm LED flashes at 1 Hz (RED).

Configurable Inputs and Outputs

The ASPYRE AT power controller offers options for two digital inputs/outputs, an analog input, a relay output and an analog output. These inputs and outputs have many possible uses in an application. This section describes the typical ways they are used with the power controller.

Digital I/O

The digital I/O (input/output) points can be connected to control panel switches or other automation equipment such as a temperature controller or programmable logic controller. The Digital I/O can be used as general purpose I/O within the Watlow High Speed Buss architecture. To configure the I/O ,see Watlow Function Block Programming.

They are often used as inputs to interface external devices with these features of the power controller:

- **Enable**—allows the power control output to be enabled and disabled by an external device
- **Start Heater Bake Out Feature**
- **Force Phase Angle**—allows an external device to switch the firing type
- **Force Voltage Feedback**-this signal overrides the feedback parameter setting

One or both digital I/O points can be configured as outputs. Typical uses are to send signals to other automation equipment indicating states or alarms including:

- Open load circuit status
- Current limit status
- SCR short circuit status
- Heat Sink Over-Temperature Alarm

See "Wiring" on page 21 for information on connecting to the digital inputs.

Analog Input

The analog input can be connected to other automation equipment such as a temperature controller or programmable logic controller. See "Wiring Overview" on page 23 for information on connecting to the analog input. The input accepts current and voltage signals. It is often connected to the power control Function Block's Set Point (SP) receiver or the Current Limit Set Point receiver (ILIM).

Analog Output

The analog output can be configured to supply a current or voltage signal. It can be used to retransmit measured values to a data logger, chart recorder or other automation equipment by connecting it to one of these transmitters on the power control function block:

- RMS Load Voltage (V)
- RMS Load Current (I)
- Load Resistance (R)
- Load Power (PWR)
- Set Point (SP)

See "Wiring Overview" on page 23 for information on connecting to the analog output.

Relay Output

The relay output can be connected to other automation equipment such as a temperature controller or programmable logic controller. Typically, the relay is used to indicate a state or alarm.
See "Wiring" on page 21 for information on connecting to the relay output. Configure how the relay operates using the function block programming in Composer.

Enable

This features allows you to configure the power controller to disable its output unless an enabling signal is received. To use this feature, in COMPOSER's Function Block Diagram connect a signal to the enable (EN) receiver on the Power block. The power controller is enabled when the signal is on. The signal could come from an external device via a digital I/O point configured as an input or from another block in the function block diagram that transmits a digital signal.

If you do not connect a signal to the power control function block's enable (EN) receiver on the function block, the output is enabled by default and no enable signal is required and the output follows the set point.

Force Phase Angle

In some applications it is desirable to use phase angle firing sometimes, for example for a period of time while the load comes to temperature. You can use logic on the Function Block diagram or source an external signal via a digital I/O point connected to the force phase angle (PA) receiver on the power controller Function Block. While the PA receiver detects an *On* signal, the power controller's firing type parameter setting is ignored and the power controller uses phase angle firing.

Force Voltage Feedback

In some applications it is desirable to use voltage feedback sometimes, for example for a period of time while the load comes to temperature. You can use logic on the Function Block diagram or source an external signal via a digital I/O point connected to the force voltage feedback (V) receiver on the power controller function block. While the V receiver detects an On signal, the power controller's feedback type parameter setting is ignored and the power controller uses voltage feedback.

Firing Types

This section describes the options for the *Firing Type* parameter. Using the correct firing type ensures the optimum performance of the power controller with a particular type of load. You can set *Firing Type* on the Test view in COMPOSER.

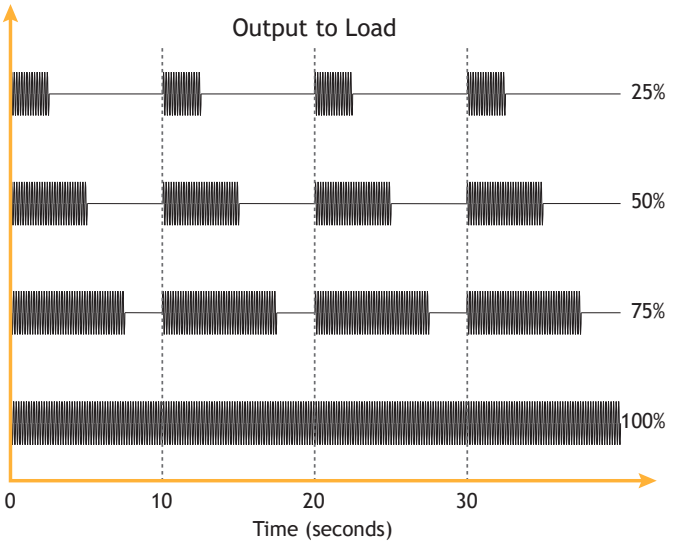
Zero-Crossing

This firing type is used with relatively slow loads and when it is desirable to minimize radio frequency emissions by switching only as the line voltage crosses zero volts. Power to the load is on for a percentage of the fixed time-base proportional to the required output percentage. The time base is defined by the Cycle Time parameter. For example, if the cycle time is ten seconds and 75% power is called for, the output turns on for 7.5 seconds and off for 2.5 seconds, and repeats.

The illustration shows examples of zero-cross firing with a cycle time of 10 seconds:

- 25%, the output is on for 2.5 out of every 10 seconds (150 out of 600 cycles at 60Hz)
- 50%, the output is on for 5 out of every 10 seconds (300 out of 600 cycles at 60Hz)
- 75%, the output is on for 7.5 out of every 10 seconds (450 out of 600 cycles at 60Hz)
- 100%, the output is on continuously

Zero-Cross Firing Examples



Burst Firing

Use this firing type when it is desirable for the power to the load to switch on and off frequently but not as frequently as every ac line cycle. Burst firing minimizes radio frequency emissions by switching only as the line voltage crosses zero.

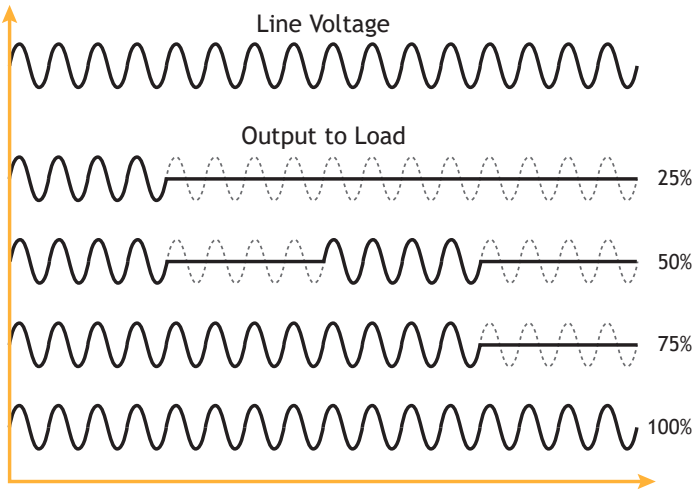
With burst firing, power to the load is on for a number cycles proportional to the required output percentage.

Burst firing is similar to single-cycle firing, but the output is on and off for a minimum number of cycles specified by the user with the *Number of Burst Fire Cycles* setting available on the Test view in COMPOSER.

The illustration shows examples of burst firing with four minimum cycles:

- 25%, the output is on for four out of every sixteen cycles
- 50%, the output is on for four out every eight cycles
- 75%, the output is on for twelve out of every sixteen cycles
- 100%, the output is on continuously

Burst Firing Examples



Phase Angle

This firing type is recommended for controlling inductive loads including the primary of transformer-coupled load and for loads with low resistances when cold such as heaters with silicon carbide, molybdenum and tungsten elements. The disadvantage is increased radio frequency emissions compared with zero-cross firing types.

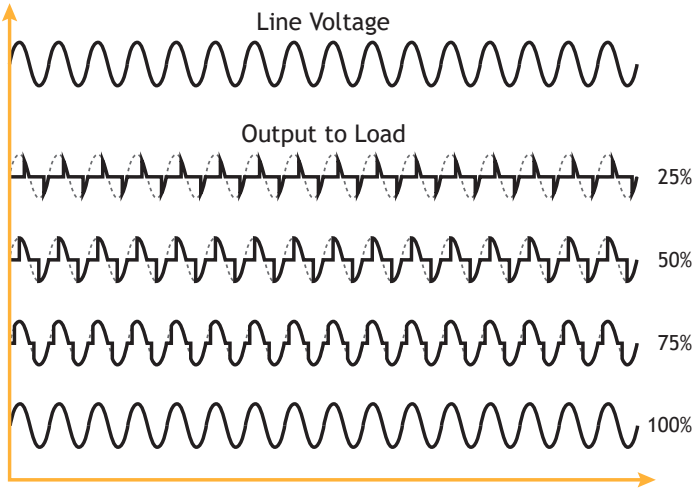
Note: Use of Phase Angle control mode will fail European CE EMC Directive conducted emissions and harmonics limits unless additional filtering is used.

The load switches on for a portion of each half line cycle. This limits the voltage applied across the load when the power is less than 50%.

The illustration shows examples of phase-angle firing:

- 25%, the output is on for a quarter of each half cycle (on at 135°, off at 180°, on at 315°, off at 360°)
- 50%, the output is on for one half of each half cycle (on at 90°, off at 180°, on at 270°, off at 360°)
- 75%, the output is on for three quarters of each half cycle (on at 45°, off at 180°, on at 225°, off at 360°)
- 100%, the output is on continuously

Phase Angle Firing Examples



Soft Start

Soft start acts as a filter on the set point gradually applying changes to the set point over the user-set Soft Start Time. Soft start does not change the firing type.

The soft start feature applies when the set point changes and when the enable signal changes state. For example, if the set point is 60% but the enable signal is off, when the enable signal turns on, the output gradually increases as if the set point was ramped up from 0% to 60% over the soft start time setting.

⚠**NOTE!** This is true for the state change of off to on, but not on to off - for example: if the enable is off and the SP is 50%, it will soft start from 0-50% when the enable is set on. When the enable is set to on and the SP is 50% it will go directly to 0 without a soft start when the enable is turned off.

Start Ramp

This feature is not currently available. Start ramp causes the output to be phase-angle fired for a user-specified number of half cycles each time the output is turned on. This intermittent phase-angle firing increases radio frequency emissions compared with purely zero-cross firing types. Set the duration of the ramp using the *Start Ramp* parameter on the advanced setup menu in increments of half cycles. This feature is not currently available.

Safety Ramp

This feature is not currently available. This feature is similar to start ramp but it is active only if the output is disabled for longer than a user-set time. Safety ramp requires burst fire with delay triggering or half cycle. Use it to ramp up the voltage applied to a heater or other load which has been off for more than a user-set time.

With this option enabled, after power to the load has been off for more than the user-set time, once power is called for, the firing type is temporarily changed to phase angle and the power is ramped up from zero to the set point over the safety ramp time. Once the ramp is complete, the firing type reverts to the user setting.

Because it uses phase-angle firing, safety ramp increases radio frequency emissions when active compared with purely zero-cross switching.

Enable the safety ramp feature and set how long the ramp takes by setting the Safety Ramp Time to a value greater than zero (also requires a supported firing mode). Set the minimum amount of time the unit is off before the ramp occurs with the Safety Ramp Off Time parameter.

Heater Bakeout

When a heater insulated with magnesium oxide (MgO) is powered off, not in use or in storage for a long period of time, it can absorb moisture. If full voltage is applied, excessive current can damage the heater or blow fuses. The heater bakeout feature limits the voltage and current applied as the heater is brought back in to service. This drives moisture out of the heater and prevents blown fuses and damage to the heater.

Using Heater Bakeout:

- While the Heater Bakeout feature is active, the ASPYRE AT power controller uses Phase Angle firing and current limiting to ramp the current according to the user-set target current and ramp time parameters for the Heater Bakeout function. The Heater Bakeout function does not ramp the output above the normal process set point. Once the function has run for the user-set time, the Bakeout function terminates and the power controller attempts to perform control to set point normally.

- Use Heater Bakeout Ramp Time to set the duration of the bakeout in minutes. Use Heater Bakeout Target Current to set the current to which the function attempts to ramp. Use Heater Bakeout Off Time to set how many minutes the heater must be off before the bakeout function runs the next time the heater is used. With Heater Bakeout enabled, the power controller will bakeout after a power cycle.

8 Maintenance & Troubleshooting

This chapter describes the routine maintenance that should be planned, provides information for troubleshooting and includes procedures for corrective actions.

⚠**NOTE!** To ensure proper and safe operation of the equipment all investigation, adjustments and replacement procedures must be performed by qualified individuals.

⚠**REMARQUE:** Pour assurer un fonctionnement approprié et sécuritaire de l'équipement, toutes les recherches, les réglages et les procédures de remplacement doivent être effectués par le personnel qualifié.

Routine Maintenance

With very little maintenance you can expect the ASPYRE® AT power controller to provide years of trouble-free operation.

1. To prevent overheating, periodically clean the heat-sink and protective grill. Depending on the environment, this cleaning may be necessary more or less frequently.
2. Periodically verify the torque on the bolts for the line, power and safety earth ground connections.

Indicators

The table below describes the functions of the indicators on the front of the power controller.

Indicator	Color	State	Indicated Fun
Status	Green	Off	Electronics not powered: no 24VDC power or USB connected
		On	Electronics is powered by USB, but 24VDC is not connected. Settings can be configured, but the output cannot be enabled, and line voltage is not measured
		Flashing (1Hz)	Electronics is powered by 24 VDC
Line	Green	Off	No line voltage is detected
		On	Line voltage is detected
Output	Green	Off	No power is being delivered
		On	Power is called for and being delivered
Alarm	Red	Off	There are no alarms currrently, though there may be a latched alarm
		Flashing (1Hz)	An alarm condition exits
		Fast Flash (5Hz)	An internal fault has occurred

Normal Operation

Normal operation is indicated by:

- Status: blinking
- Line: on
- Output: on (power is called for and being delivered)
- Alarm: off

All Indicators Flashing in Sequence

When all four indicators flash in sequence, there is a firmware update in progress. Allow the update to complete before attempting to configure or operate the power controller.

Alarms

This section describes the alarms that can occur and what can cause them.

24V Power Supply

The 24VDC power voltage is too high or too low for reliable operation of the power controller. Power to the load is turned off and the alarm indicator blinks whenever the 24V supply is too high or too low.

Current Limit

This alarm occurs when the current loop overrides the power loop to prevent the load current from exceeding the current limit set point. The alarm indicator blinks while the current limit feature is reducing the output.

Line Voltage Alarm

Power to the load is turned off and the alarm indicator blinks whenever the line voltage is not within the range set with the Maximum Line Voltage Variation parameter.

Open Load Circuit

This alarm occurs when the measured load resistance is higher than expected. This is detected only when the power controller is attempting to deliver power. The problem could be an open heater, a blown fuse, an open circuit breaker or any other condition that prevents the power controller from closing the circuit and delivering power to the load. You can adjust the sensitivity of this alarm. The alarm indicator blinks while the open load circuit is detected.

SCR Short Circuit

The SCR is stuck on and the output is on continuously. The power controller must be replaced. The alarm indicator blinks while the open load circuit is detected.

Heat Sink Over - Temperature

The temperature sensor on the heat sink indicates it is too hot. Until the temperature is reduced, power to the load is turned off. Wait for the power controller to cool down to resume operation. Increase cooling air flow or otherwise correct the environmental conditions that caused the over temperature and / or reduce the load current to prevent recurrences. Operating the unit at temperatures outside the specified range can void the warranty. The alarm indicator blinks while the heat sink temperature is too high.

Unit Enable Status

The Unit Enable Status parameter is on when the power to the load is enabled and the set point is greater than zero. This parameter is off whenever any condition is present (over-temperature alarm, 24 volt alarm, line voltage not normal) or when the set point is zero. Also, if the enable feature is used, the enable signal must be received for power to the load to be on.

Using Alarms

The ASPYRE AT power controller monitors for alarm conditions when the power controller is powered by 24VDC. When only powered by a USB connection from a computer, the power controller is not able to measure voltage, current or the heat sink temperature and alarms do not function.

Alarm Indication

When one or more alarms occur, the red alarm indicator on the front of the power controller blinks. Alarm states can be seen on the Test view in Watlow's COMPOSER® software. Also alarm states can be read using a communication protocol such as Modbus® RTU. See "Communication" on page 119.

Alarm Annunciation

The alarm indicator on the front of the power controller blinks when there is an abnormal condition. The alarm indicator turns off once the condition is corrected. Use the Discrete Alarm function blocks to provide silencing and latching behavior to an output for any or all of the alarm signals available from the Power Control function block.

Note the Discrete Alarm block does not affect the Alarm indicator on the front of the power controller, but it can control an output that you connect in the Function Block Diagram.

Calibration Procedures

The procedures in this section can be used to adjust the performance of the corresponding features.

Configure the Current Limit

The current limit feature acts to prevent the RMS current from exceeding the user-set current limit. As the current approaches the limit, the power controller decreases its output. The current limit setpoint can be set with the Current Limit Setpoint parameter or by an analog input.

⚠**CAUTION:** This procedure must be performed only by qualified persons.

⚠**CAUTION:** This procedure requires turning on full power to the load. This should only be performed once the installation is complete and when it is safe to provide full power.

⚠**ATTENTION**: Cette procédure ne doit être effectuée que par le personnel qualifié.

⚠**ATTENTION**: Cette procédure nécessite la mise sous tension totale de la charge. Cela ne doit être effectué qu'une fois l'installation terminée et lorsque la puissance maximale peut être fournie en toute sécurité.

To limit the current using the parameter setting:

1. On the COMPOSER Test view, set the Current Limit Setpoint to 0 Amps.
2. Enable the power controller and set the power setpoint to 100%.
3. Gradually increase the current limit setpoint until the RMS current is at the maximum desired value.
4. Disable the power controller.

To limit the current using the signal to analog input 2:

1. On the COMPOSER Function Block Diagram view connect Analog Input 1 to the ILIM receiver on Power 1.
2. Configure Analog Input 1 of signal (volts or milliamps).
3. Set the scaling parameters to scale the signal to current. See the table below for examples.

Signal	Sensor Type	Scale Low	Scale High	Range Low	Range High
0 to 10VDC	Volts	0.00	10.00	0 (A)	(the current represented by 10VDC)
4 to 20mADC	Milliamps	4.00	20.00	0 (A)	(the current represented by 10mADC)

4. Set the signal to the analog input to the minimum value (typically 0 V).
5. Enable the power controller and set the power set point to 100%.
6. Gradually increase the signal to the analog input until the RMS current is at the maximum desired value.
7. Disable the power controller.

⚠**NOTE!** This procedure assumes the analog input signal wiring, if used has been connected and that the signal can be set to various values as needed to perform the procedure. "Wiring Connections" on page 25.

Open Load Circuit and Partial Load Failure Calibration Procedure

The open load circuit alarm is automatically set when you set the nominal load current and nominal line voltage. If the load resistance increases due to a partial or total load failure, the Open Load Circuit alarm occurs.

You can adjust the resistance threshold at which the open load circuit alarm occurs with the Open Load Circuit Sensitivity parameter in the Power Control Loop Setup menu or Power Control function block. This parameter is set as a percent of the nominal load resistance (from 1% to 100%). A lower value causes the alarm to occur with less change to the resistance.

For example, if the nominal line voltage is 300V and the nominal load current is 3A, the nominal load resistance is 100Ω. With the open load circuit sensitivity set to 20%, the open load circuit alarm occurs if the measured load resistance rises above 120Ω.

If the open load circuit alarm occurs due to transient conditions, you can suppress these nuisance alarms by increasing the Open Load Circuit Alarm Delay parameter.

⚠**NOTE!** Partial load failure detection works best for stable resistance heaters. Variable resistance heaters such as tungsten lamps change resistance as they heat making it difficult to define a resistance that indicates a partial failure.

⚠**NOTE!** The minimum resistance change detectable is limited by how accurately the nominal resistance is set as well as the calibration accuracy of the ASPYRE AT. To improve the detection capacity use the guided setup in COMPOSER to calibrate the ASPYRE AT for the actual load see "Set Up the ASPYRE AT Using the Guided Setup" on page 30.

⚠**NOTE!** When using phase angle swithing, setting the open load sensitivty below 20% is more likely to lead to false alarms.

⚠**REMARQUE**: La détection de défaillance de charge partielle fonctionne mieux pour les radiateurs à résistance stable. Les radiateurs à résistance variable tels que les lampes au tungstène changent de résistance à mesure qu'ils chauffent, ce qui rend difficile la définition d'une résistance indiquant une défaillance partielle.

⚠**REMARQUE**: Le changement de résistance minimum détectable est limité par la précision avec laquelle la résistance nominale est réglée ainsi que par la précision d'étalonnage de l'ASPYRE AT. Pour améliorer la capacité de détection, utilisez la configuration guidée dans COMPOSER pour calibrer l'ASPYRE AT pour la charge réelle, voir « Configuration de l'ASPYRE AT à l'aide de la configuration guidée » à la page 30.

⚠**REMARQUE**: Lors de l'utilisation du réglage de commutation d'angle de phase, la sensibilité de la charge ouverte inférieure à 20 % est plus susceptible de conduire à de fausses alarmes.

Updating the Firmware

The firmware program that operates the ASPYRE AT power controller can be updated using Watlow's COMPOSER software on a Windows® computer via USB to the controller. COMPOSER software and firmware updates, when available, can be found on the Watlow website.

To update the firmware program:

1. Retrieve the firmware file from the Watlow website.
2. Use the Windows(R) file manager to create a folder under the COMPOSER called "Firmware Updates" and a second folder in that one named "ASPYRE".
3. Place the firmware update file *.e19 into the folder named ASPYRE.
4. Shut off the line power and auxiliary power to the power controller.
5. Connect the computer with the firmware update to the ASPYRE AT power controller with the USB cable.

6. Launch COMPOSER and connect to the ASPYRE AT power controller.
7. On the Overview view, click the update icon (need screen capture) and follow the on screen instructions.
8. Once COMPOSER completes the update, wait for the indicators on the front of the ASPYRE AT power controller to stop flashing in sequence.
9. Close COMPOSER.
10. Disconnect the USB cable.
11. Restore line power.

Check the Load

For heaters switched through a transformer or heaters with elements other than nichrome measure the resistance of each leg of the heater to determine if there has been a partial or complete failure and if it can be done safely measure the current through each leg of the heater.

⚠**WARNING**: To prevent injury and loss of life, shut off power and ensure it cannot be restored while performing work with the covers open or removed.

⚠**NOTE!** To ensure proper and safe operation of the equipment all investigation, adjustments and replacement procedures must be performed by qualified individuals.

⚠**AVERTISSEMENT**: Pour éviter les blessures et les pertes de vie, couper l'alimentation électrique et s'assurer qu'elle ne peut être restaurée pendant l'exécution du travail avec les couvercles ouverts ou enlevés.

⚠**REMARQUE**: Pour assurer un fonctionnement approprié et sécuritaire de l'équipement, toutes les recherches, les réglages et les procédures de remplacement doivent être effectués par le personnel qualifié.

Measure the Load Resistance:

1. Disconnect and lock out the line power.
2. Measure the load resistance:
   - For a single-phase load: measure the resistance between the load connection (T1) and L2 or neutral (depending on how the load is wired.)
   - For a three-phase load: measure the resistance between each load connection (T1 to T2, T2 to T3 and T3 to T1).
3. For each measured resistance, using Ohm's Law calculate the nominal wattage of the heater and compare to the expected wattage.
4. Restore line power:
   - If any leg of the load is open, the heater should be replaced.
   - If the resistance of any leg differs by more than 10% from another, or from the expected value, there is likely a partial failure of the heater. Contact your supplier for further assistance.

⚠**NOTE!** Watlow provides wattage calculators at:
Single-phase: https://www.watlow.com/resources-and-support/engineering-tools/wattage-calculator
Three-phase: https://www.watlow.com/resources-and-support/engineering-tools/3phase-delta-wye-calculator

To measure the load current if it can be done safely using a clamp-on current meter:

- For a single-phase load measure the current near the load connection and compare with the current returned at the L2 or neutral connection. For a three-phase load: measure and compare the current through each leg of the load.

If the current measurements differ by more than 10%, contact your supplier for further assistance. If the resistance and current measurements are good, but the open load error persists, check the nominal voltage and load current settings.

See "Nominal Voltage" on page 88. If the resistance is good but the current is not, contact your supplier. If both the resistance and current are not good replace or repair heater.

Baking the Moisture Out of a Heater

The Heater Bakeout Function can be set up using the Explorer view in the COMPOSER software. See "Initial Setup" on page 29 for instructions on installing the software, connecting to a controller, and navigating to the test view. To learn more, See "Heater Bakeout" on page 110 (in the Features chapter).

Heater Bakeout Setup Procedure:

1. Ensure that power is not applied to the heater. One way to ensure that no power is applied to the heater is to adjust the set point to 0%.
2. Set the heater bakeout ramp time to the number of minutes over which the power to the heater should be ramped to avoid damage to the heater. Set the heater bakeout target current to the maximum current, in Amperes, that should be allowed during the bakeout process. Typically this value should be no more than the maximum current rating for the heater plus ten percent, but you can set the heater to a lower value to be safe.
3. Set the heater bakeout off time to the maximum amount of time the heater should allowed to be off before the heater bakeout occurs. If the heater is off for more than this amount of time, the heater bakeout runs automatically the next time the heater is used.
4. Set enable heater bakeout to "On".
5. Adjust the setpoint or demand signal to call for heat to start the bakeout cycle.
6. While the heater bakeout function is active, the bakeout status parameter indicates "On".
7. When the bakeout cycle is complete, normal control resumes.

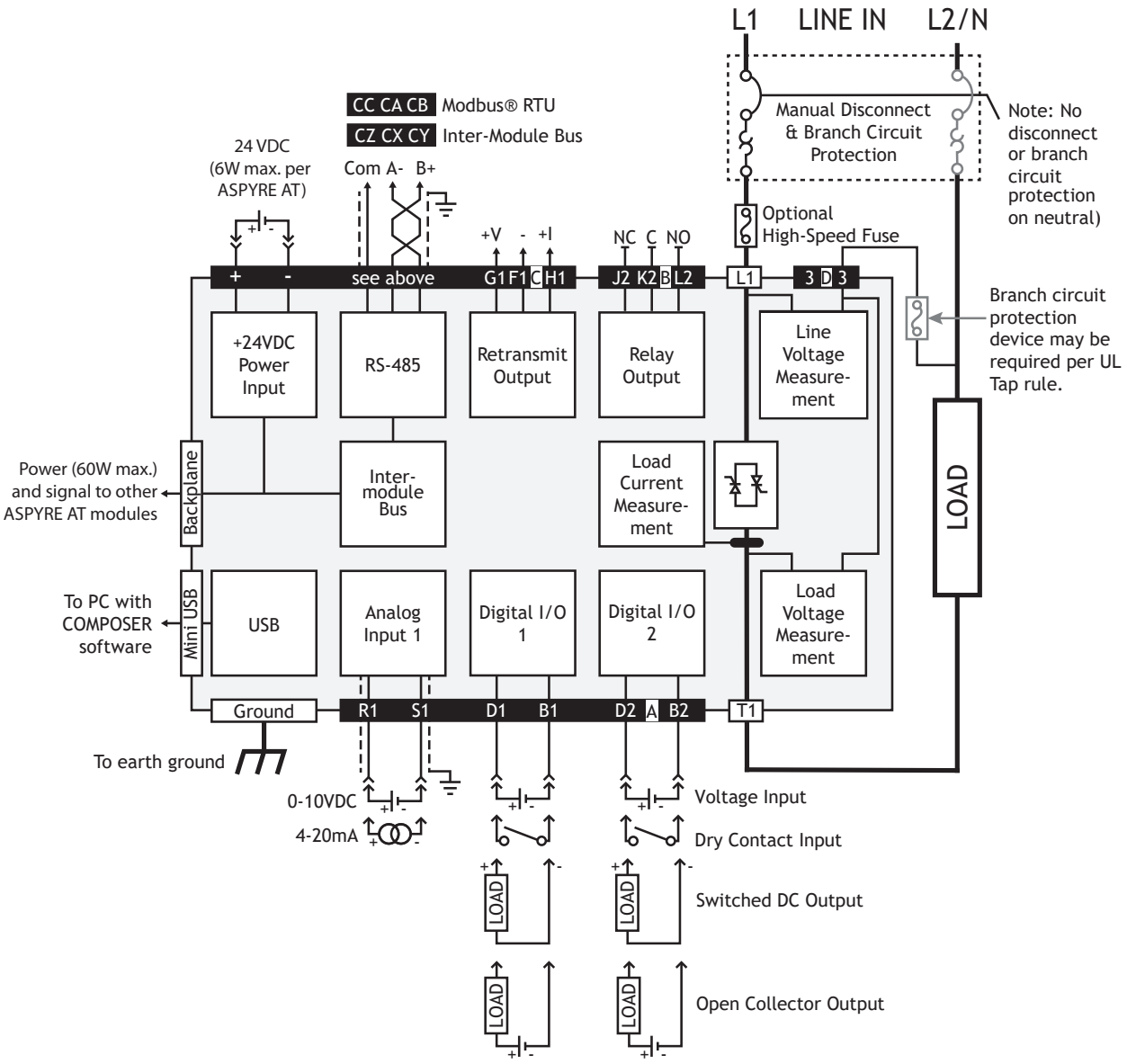
Troubleshooting Schematic

The wiring diagram below is provided to help you understand the ASPYRE AT power controller when troubleshooting its use in an application.

⚠**CAUTION:** Other than specifically listed in this manual, the internal components of the ASPYRE AT power controller are not user-serviceable. To avoid causing unsafe operation that can lead to property damage or loss of life, do not attempt to repair or alter the product.

⚠**ATTENTION**: Outre ce qui est spécifié dans le présent manuel, les composants internes du régulateur de puissance ASPYRE AT ne peuvent pas être réparés par l'utilisateur. Pour éviter un fonctionnement dangereux pouvant entraîner des dommages à la propriété ou la perte de vie, ne pas essayer de réparer ou de modifier le produit.

ASPYRE AT Schematic



9 Communication

Overview

This chapter describes communicating with an ASPYRE AT power controller via the Modbus® RTU communication protocol. The typical application for this protocol is using a programmable logic controller or other automation equipment to control the power controller.

Wiring

For information about wiring for the communication ports. See "Wiring" on page 21.

Modbus® RTU Gateway

The ASPYRE AT may be purchased with either Modbus RTU 485 or the inter-module bus connected to the screw terminals on connector "C" at the bottom of the power controller. For units with the Modbus® RTU option, you can simply connect to a host device and read and write data using the default gateway settings. See "Modbus® RTU Holding Registers" on page 120.

The default gateway settings provide access to the parameters you are most likely to want to access in an ASPYRE AT power controller. However, you can customize the gateway to access parameters in multiple ASPYRE AT units and other Watlow products connected via the inter-module bus.

The gateway feature is disabled by default, and you must enable it to view and edit the parmeter map using COMPOSER. If more than one ASPYRE AT is present in the application and connected via the back-plane or split-rail inter-module bus, enable the gateway in the ASPYRE AT to which the Modbus® RTU network is connected. See "Comms Gateway Enable" on page 84.

Use the Gateway tab in the Network view in COMPOSER to view and edit the gateway configuration. See "Network View" on page 41.

Communication Watchdog

When the power output is controlled via communication, use the watchdog feature to automatically set the output to the safe state in the event communication is lost with the controlling host device or software. Whenever the time between messages exceeds the reset time, the watchdog feature sets the output according to the safe state action see "Safe State Action" on page 89. The watchdog is disabled by default. See "Comms Watchdog Enable" on page 86 and "Comms Watchdog Timeout" on page 86.

Message Format

The transmission format is:

- 1 start bit
- 8 data bits
- 2 stop bits (no parity)
- Low-high word order

The default address is 1.

Broadcast Messages

The ASPYRE AT power controller supports Modbus® RTU broadcast messages. Send broadcast messages using station address 0. All ASPYRE AT power controllers on the local area network act on the message contents without sending back any reply.

Supported Functions

The ASPYRE AT power controller supports the Modbus® RTU functions listed below. Note the limits to the number of registers that can be read and written with a single message from the host for each function.

Function	Description	Maximum Registers
03	Read the holding registers (40,001 to 49,999)	125
06	Write a single holding register	1
16	Write multiple holding registers	25

Communication Errors

Messages contain CRC error checking. If a message from the host fails the CRC test, or if the received message contains a syntax error, for example, the number of bytes or words is not correct, then the power controller will ignore the message.

If the received message is correct but contains an invalid value, the power controller responds with an error code. The supported error codes are listed in the table below.

Error Code	Description
1	Function code not supported
2	Incorrect data address
3	Incorrect data value
4	Too many registers (parameters) requested
6	Device busy

Data Types

The ASPYRE AT stores parameter values as IEEE Floats, unsigned 16-bit integers, unsigned 32-bit integers and strings. Each Modbus® register contains a 16-bit value. IEEE floating point values are stored in two contiguous registers. The word order defaults to Low-High. For string type parameters, each character in the string occupies a register.

Enumerated Values

Some values represent data that is indicated by a word or short phrase. These enumerated values are listed in the table below. For more thorough explanations see the parameter descriptions in the "Function Block and Parameter Reference" chapter starting on page 48.

Modbus® RTU Holding Registers

The table below lists the parameters that may be read via Modbus® RTU.

For each parameter and the following information is listed:

- Parameter: the name of the parameter
- Register: the memory register that holds the parameter value
- Data Type: IEEE float, unsigned 16-bit integer, unsigned 32-bit integers or string
- Range: the values to which the parameter can be set. For strings it represents the number of characters
- Units: units of measurement
- Access: marked "R" for read-only and "RW" for parameters that can be read and written

Parameter	Register	Data Type	Enum/Range	Units	Access
Firmware Release Version	0	string	12 to 17 Characters		R
Serial Number	17	uint32	0 to 4294967295		RW
Date of Manufacture	19	uint32	0 to 4294967295		RW
Device Name	21	string	0 to 32 Characters		RW

Parameter	Register	Data Type	Enum/Range	Units	Access
Item Number	53	string	9 Characters		RW
Customer Part Number	62	string	0 to 30 Characters		RW
Power Control Name	92	string	0 to 21 Characters		RW
Save Settings As	113	uint16	61 = none 101 = user set 1 102 = user set 2 31 = factory		RW
Restore Settings From	114	uint16	61 = none 101 = user set 1 102 = user set 2 31 = factory 3193 = full default 3194 = communications default		RW
Variable 1 Digital Value	115	uint16	63 = on 62 = off		RW
Variable 1 Analog Value	116	float	-99999.0 to 99999.0		RW
Variable 2 Digital Value	118	uint16	63 = on 62 = off		RW
Variable 2 Analog Value	119	float	-99999.0 to 99999.0		RW
Variable 3 Digital Value	121	uint16	63 = on 62 = off		RW
Variable 3 Analog Value	122	float	-99999.0 to 99999.0		RW
Variable 4 Digital Value	124	uint16	63 = on 62 = off		RW
Variable 4 Analog Value	125	float	-99999.0 to 99999.0		RW
Variable 5 Digital Value	127	uint16	63 = on 62 = off		RW
Variable 5 Analog Value	128	float	-99999.0 to 99999.0		RW
Variable 6 Digital Value	130	uint16	63 = on 62 = off		RW
Variable 6 Analog Value	131	float	-99999.0 to 99999.0		RW
Variable 7 Digital Value	133	uint16	63 = on 62 = off		RW
Variable 7 Analog Value	134	float	-99999.0 to 99999.0		RW
Variable 8 Digital Value	136	uint16	63 = on 62 = off		RW
Variable 8 Analog Value	137	float	-99999.0 to 99999.0		RW
Variable 9 Digital Value	139	uint16	63 = on 62 = off		RW
Variable 9 Analog Value	140	float	-99999.0 to 99999.0		RW
Variable 10 Digital Value	142	uint16	63 = on 62 = off		RW
Variable 10 Analog Value	143	float	-99999.0 to 99999.0		RW
Variable 11 Digital Value	145	uint16	63 = on 62 = off		RW
Variable 11 Analog Value	146	float	-99999.0 to 99999.0		RW
Variable 12 Digital Value	148	uint16	63 = on 62 = off		RW

Parameter	Register	Data Type	Enum/Range	Units	Access
Variable 12 Analog Value	149	float	-99999.0 to 99999.0		RW
Analog Input 1 Value	151	float	-99999.0 to 99999.0		R
Analog Input 1 Error	153	uint16	61 = none 65 = open 127 = shorted 140 = measurement error 139 = bad cal data 32 = fail 246 = not sourced		R
Analog Input 2 Value	154	float	-99999.0 to 99999.0		R
Analog Input 2 Error	156	uint16	61 = none 65 = open 127 = shorted 140 = measurement error 139 = bad cal data 32 = fail 246 = not sourced		R
Analog Output Filtered Process Value	157	float	-99999.0 to 99999.0		R
Math 1 Output Value	159	float	-99999.0 to 99999.0		R
Math 2 Output Value	161	float	-99999.0 to 99999.0		R
Math 3 Output Value	163	float	-99999.0 to 99999.0		R
Math 4 Output Value	165	float	-99999.0 to 99999.0		R
Math 5 Output Value	167	float	-99999.0 to 99999.0		R
Math 6 Output Value	169	float	-99999.0 to 99999.0		R
Math 7 Output Value	171	float	-99999.0 to 99999.0		R
Math 8 Output Value	173	float	-99999.0 to 99999.0		R
Math 9 Output Value	175	float	-99999.0 to 99999.0		R
Math 10 Output Value	177	float	-99999.0 to 99999.0		R
Math 11 Output Value	179	float	-99999.0 to 99999.0		R
Math 12 Output Value	181	float	-99999.0 to 99999.0		R
Logic 1 Output Value	183	uint16	63 = on 62 = off		R
Logic 2 Output Value	184	uint16	63 = on 62 = off		R
Logic 3 Output Value	185	uint16	63 = on 62 = off		R
Logic 4 Output Value	186	uint16	63 = on 62 = off		R
Logic 5 Output Value	187	uint16	63 = on 62 = off		R
Logic 6 Output Value	188	uint16	63 = on 62 = off		R
Logic 7 Output Value	189	uint16	63 = on 62 = off		R
Logic 8 Output Value	190	uint16	63 = on 62 = off		R
Logic 9 Output Value	191	uint16	63 = on 62 = off		R

Parameter	Register	Data Type	Enum/Range	Units	Access
Logic 10 Output Value	192	uint16	63 = on 62 = off		R
Logic 11 Output Value	193	uint16	63 = on 62 = off		R
Logic 12 Output Value	194	uint16	63 = on 62 = off		R
Compare 1 Output Value	195	uint16	63 = on 62 = off		R
Compare 2 Output Value	196	uint16	63 = on 62 = off		R
Compare 3 Output Value	197	uint16	63 = on 62 = off		R
Compare 4 Output Value	198	uint16	63 = on 62 = off		R
Output 1 State	199	uint16	63 = on 62 = off		R
Input 1 State	200	uint16	63 = on 62 = off		R
Output 2 State	201	uint16	63 = on 62 = off		R
Input 2 State	202	uint16	63 = on 62 = off		R
Output 3 State	203	uint16	63 = on 62 = off		R
Analog 1 In Voltage Offset User	204	float	-3.4e+38 to 3.4e+38		RW
Analog 1 In Current Offset User	206	float	-3.4e+38 to 3.4e+38		RW
Analog Out Voltage Offset User	208	float	-3.4e+38 to 3.4e+38		RW
Analog Out Current Offset User	210	float	-3.4e+38 to 3.4e+38		RW
Reserved Offset User	212	float	-3.4e+38 to 3.4e+38		RW
Unit Type	214	uint16	3067 = 1 phase 1 leg 3068 = 3 phase 2 leg 3069 = 3 phase 3 leg 10192 = invalid		R
Maximum Rated Current	215	uint16	3178 = max rated curr 12a 3179 = max rated curr 24a 3180 = max rated curr 48a 10192 = invalid		R
Maximum Rated Voltage	216	uint16	3176 = max rated volt 480vac 3177 = max rated volt 600vac 10192 = invalid		R
Nominal Current	217	float	0.1 to [maximum rated current]	A	RW
Nominal Voltage	219	float	0.1 to [maximum rated voltage]	V	RW
Firing Type	221	uint16	1701 = zero cross 3074 = burst firing 1702 = phase angle		RW
Cycle Time	222	float	1.0 to 300.0	seconds	RW
Number of Burst Fire Cycles	224	uint16	4 to 16		RW
DT Half-cycles	225	uint16	0 to 255		R
DT Angle	226	uint16	0 to 100		R
Soft Start Time	227	float	0.0 to 10.0	seconds	RW

Parameter	Register	Data Type	Enum/Range	Units	Access
Start Ramp (Half-Cycle Counts)	229	uint16	0 to 1000	Half-Cycles	R
Safety Ramp Off Time Counts (seconds)	230	float	0.0 to 3600.0	seconds	RW
Safety Ramp Time Counts (seconds)	232	float	0.0 to 3600.0	seconds	RW
Feedback Type	234	uint16	3078 = no feedback 3312 = no feedback linear power 3079 = v2 feedback 3080 = v feedback 3081 = i2 feedback 3082 = i feedback 3083 = pwr feedback 310192 = invalid		RW
Active Feedback Type	235	uint16			R
Enable Current Limiting	236	uint16	62 = off 63 = on		RW
Unit Enable Source	237	uint16	3223 = normal on 3196 = function block		R
Safe State Set Point	238	float	0.0 to 100.0		RW
Maximum Line Voltage Variation	240	float	10.0 to 100.0	%	RW
Open Load Circuit Delay	242	float	0.05 to 12.0	seconds	RW
Open Load Circuit Sensitivity	244	float	0.0 to 100.0		RW
Enable Unit Command	246	uint16	62 = off 63 = on		R
Active Firing Type	247	uint16	1701 = zero cross 3074 = burst firing 1702 = phase angle 3214 = zero cross ss 3216 = burst firing ss 3071 = phase angle ss		R
Power Set Point	248	float	0.0 to 100.0		RW
Set Point Source	250	uint16	3195 = communication 3196 = function block		RW
Safe State Action	251	uint16	3197 = disable output 3198 = safe state setpoint		RW
Active Power Set Point	252	float	0.0 to 100.0		R
Output Scaling	254	float	0.0 to 100.0		RW
Set Point in Feedback Units	256	float	0.0 to 3.4e+38		R
Current Limit Set Point	258	float	0.0 to [maximum rated current]		RW
Active Current Limit Set Point	260	float	0.0 to 100.0		R
Process Value in Feedback Units	262	float	0.0 to 3.4e+38		R
Line Voltage	264	float	0.0 to 1000.0	V	R
AC Line Frequency	266	float	40.0 to 70.0	HZ	R
RMS Output Current	268	float	0.0 to 200.0	A	R
Instantaneous Output Current	270	float	0.0 to 200.0	A	R
RMS Output Voltage	272	float	0.0 to 1000.0	V	R
Instantaneous Output Voltage	274	float	0.0 to 1000.0	V	R

Parameter	Register	Data Type	Enum/Range	Units	Access
Load Resistance	276	float	0.0 to 3.4e+38	ohm	R
Average Output Power	278	float	0.0 to 3.4e+38	W	R
Apparent Power	280	float	0.0 to 3.4e+38	VA	R
Reactive Power	282	float	0.0 to 3.4e+38	VAR	R
Power Factor	284	float	0.0 to 1.65	W/VA	R
Watt-Second Totalizer	286	string	0 to 41 Characters	W-S	R
Reset Watt-Second Totalizer Command	327	uint16	62 = off 63 = on		RW
Bakeout Status	328	uint16	62 = off 63 = on		R
Current Limit Status	329	uint16	62 = off 63 = on 28 = error		R
Unit Enable Status	330	uint16	62 = off 63 = on		R
Open Load Circuit Status	331	uint16	3280 = normal 65 = open 28 = error		R
SCR Short Circuit Status	332	uint16	3280 = normal 127 = shorted 28 = error		R
Heat Sink Over-Temperature Alarm	333	uint16	62 = off 63 = on 28 = error		R
Line Voltage Alarm	334	uint16	3169 = line normal 3170 = line high 3171 = line low 3181 = line loss 3172 = phase loss 20021 = disabled		R
24V Power Supply Alarm	335	uint16	62 = off 63 = on		R
Enable Heater Bakeout	336	uint16	62 = off 63 = on		RW
Heater Bakeout Off Time (minutes)	337	uint16	1 to 65535	minutes	RW
Heater Bakeout Ramp Time (minutes)	338	uint16	1 to 65535	minutes	RW
Heater Bakeout Target Current	339	float	0.1 to [maximum rated current]	A	RW
Active Heater Bakeout Current Limit Set Point	341	float	0.0 to [nominal current]	A	R
Heat Sink Temperature	343	float	0.0 to 302.0		R
Heat Sink Temperature Setpoint	345	float	0.0 to 302.0		RW
Heat Sink Over-Temperature Counter	347	uint16	0 to 65535		R
Power Control Block SP Value	348	float	-99999.0 to 99999.0		R
Power Control Block ILIM Value	350	float	-99999.0 to 99999.0		R

Parameter	Register	Data Type	Enum/Range	Units	Access
Power Control Block EN Value	352	uint16	62 = off 63 = on		R
Power Control Block BAK Value	353	uint16	63 = on 62 = off		R
Power Control Block PA Value	354	uint16	63 = on 62 = off		R
Power Control Block V Value	355	uint16	63 = on 62 = off		R
Load Current User Calibration Gain	356	float	0.9 to 1.1		RW
Load Current User Calibration Offset	358	float	-3.0 to 3.0	A	RW
Load Voltage User Calibration Gain	360	float	0.9 to 1.1		RW
Load Voltage User Calibration Offset	362	float	-30.0 to 30.0	V	RW
Line Voltage User Calibration Gain	364	float	0.9 to 1.1		RW
Line Voltage User Calibration Offset	366	float	-30.0 to 30.0	V	RW
Alarm In 1 Value	368	uint16	63 = on 62 = off		R
Alarm 1 State	369	uint16	88 = startup 61 = none 5 = active 28 = error		R
Alarm Output 1 Value	370	uint16	63 = on 62 = off		R
Silence Alarm 1	371	uint16	204 = ignore 108 = silence		RW
Clear Alarm 1	372	uint16	204 = ignore 129 = clear		RW
Alarm 1 Latched	373	uint16	59 = no 106 = yes		R
Alarm 1 Silenced	374	uint16	59 = no 106 = yes		R
Alarm 1 Clearable	375	uint16	59 = no 106 = yes		R
Alarm In 2 Value	376	uint16	63 = on 62 = off		R
Alarm 2 State	377	uint16	88 = startup 61 = none 5 = active 28 = error		R
Alarm Output 2 Value	378	uint16	63 = on 62 = off		R
Silence Alarm 2	379	uint16	204 = ignore 108 = silence		RW
Clear Alarm 2	380	uint16	204 = ignore 129 = clear		RW

Parameter	Register	Data Type	Enum/Range	Units	Access
Alarm 2 Latched	381	uint16	59 = no 106 = yes		R
Alarm 2 Silenced	382	uint16	59 = no 106 = yes		R
Alarm 2 Clearable	383	uint16	59 = no 106 = yes		R
Alarm In 3 Value	384	uint16	63 = on 62 = off		R
Alarm 3 State	385	uint16	88 = startup 61 = none 5 = active 28 = error		R
Alarm Output 3 Value	386	uint16	63 = on 62 = off		R
Silence Alarm 3	387	uint16	204 = ignore 108 = silence		RW
Clear Alarm 3	388	uint16	204 = ignore 129 = clear		RW
Alarm 3 Latched	389	uint16	59 = no 106 = yes		R
Alarm 3 Silenced	390	uint16	59 = no 106 = yes		R
Alarm 3 Clearable	391	uint16	59 = no 106 = yes		R
Alarm In 4 Value	392	uint16	63 = on 62 = off		R
Alarm 4 State	393	uint16	88 = startup 61 = none 5 = active 28 = error		R
Alarm Output 4 Value	394	uint16	63 = on 62 = off		R
Silence Alarm 4	395	uint16	204 = ignore 108 = silence		RW
Clear Alarm 4	396	uint16	204 = ignore 129 = clear		RW
Alarm 4 Latched	397	uint16	59 = no 106 = yes		R
Alarm 4 Silenced	398	uint16	59 = no 106 = yes		R
Alarm 4 Clearable	399	uint16	59 = no 106 = yes		R
Alarm In 5 Value	400	uint16	63 = on 62 = off		R
Alarm 5 State	401	uint16	88 = startup 61 = none 5 = active 28 = error		R
Alarm Output 5 Value	402	uint16	63 = on 62 = off		R

Parameter	Register	Data Type	Enum/Range	Units	Access
Silence Alarm 5	403	uint16	204 = ignore 108 = silence		RW
Clear Alarm 5	404	uint16	204 = ignore 129 = clear		RW
Alarm 5 Latched	405	uint16	59 = no 106 = yes		R
Alarm 5 Silenced	406	uint16	59 = no 106 = yes		R
Alarm 5 Clearable	407	uint16	59 = no 106 = yes		R
Alarm In 6 Value	408	uint16	63 = on 62 = off		R
Alarm 6 State	409	uint16	88 = startup 61 = none 5 = active 28 = error		R
Alarm Output 6 Value	410	uint16	63 = on 62 = off		R
Silence Alarm 6	411	uint16	204 = ignore 108 = silence		RW
Clear Alarm 6	412	uint16	204 = ignore 129 = clear		RW
Alarm 6 Latched	413	uint16	59 = no 106 = yes		R
Alarm 6 Silenced	414	uint16	59 = no 106 = yes		R
Alarm 6 Clearable	415	uint16	59 = no 106 = yes		R
Alarm In 7 Value	416	uint16	63 = on 62 = off		R
Alarm 7 State	417	uint16	88 = startup 61 = none 5 = active 28 = error		R
Alarm Output 7 Value	418	uint16	63 = on 62 = off		R
Silence Alarm 7	419	uint16	204 = ignore 108 = silence		RW
Clear Alarm 7	420	uint16	204 = ignore 129 = clear		RW
Alarm 7 Latched	421	uint16	59 = no 106 = yes		R
Alarm 7 Silenced	422	uint16	59 = no 106 = yes		R
Alarm 7 Clearable	423	uint16	59 = no 106 = yes		R
Alarm In 8 Value	424	uint16	63 = on 62 = off		R

Parameter	Register	Data Type	Enum/Range	Units	Access
Alarm 8 State	425	uint16	88 = startup 61 = none 5 = active 28 = error		R
Alarm Output 8 Value	426	uint16	63 = on 62 = off		R
Silence Alarm 8	427	uint16	204 = ignore 108 = silence		RW
Clear Alarm 8	428	uint16	204 = ignore 129 = clear		RW
Alarm 8 Latched	429	uint16	59 = no 106 = yes		R
Alarm 8 Silenced	430	uint16	59 = no 106 = yes		R
Alarm 8 Clearable	431	uint16	59 = no 106 = yes		R
Alarm In 9 Value	432	uint16	63 = on 62 = off		R
Alarm 9 State	433	uint16	88 = startup 61 = none 5 = active 28 = error		R
Alarm Output 9 Value	434	uint16	63 = on 62 = off		R
Silence Alarm 9	435	uint16	204 = ignore 108 = silence		RW
Clear Alarm 9	436	uint16	204 = ignore 129 = clear		RW
Alarm 9 Latched	437	uint16	59 = no 106 = yes		R
Alarm 9 Silenced	438	uint16	59 = no 106 = yes		R
Alarm 9 Clearable	439	uint16	59 = no 106 = yes		R
Alarm In 10 Value	440	uint16	63 = on 62 = off		R
Alarm 10 State	441	uint16	88 = startup 61 = none 5 = active 28 = error		R
Alarm Output 10 Value	442	uint16	63 = on 62 = off		R
Silence Alarm 10	443	uint16	204 = ignore 108 = silence		RW
Clear Alarm 10	444	uint16	204 = ignore 129 = clear		RW
Alarm 10 Latched	445	uint16	59 = no 106 = yes		R
Alarm 10 Silenced	446	uint16	59 = no 106 = yes		R

Parameter	Register	Data Type	Enum/Range	Units	Access
Alarm 10 Clearable	447	uint16	59 = no 106 = yes		R
Modbus® Comms Watchdog Enable	448	uint16	59 = no 106 = yes		RW
Modbus® Comms Watchdog Timeout	449	uint8	1 to 255		RW

10 Specifications

Specifications

Power Bases

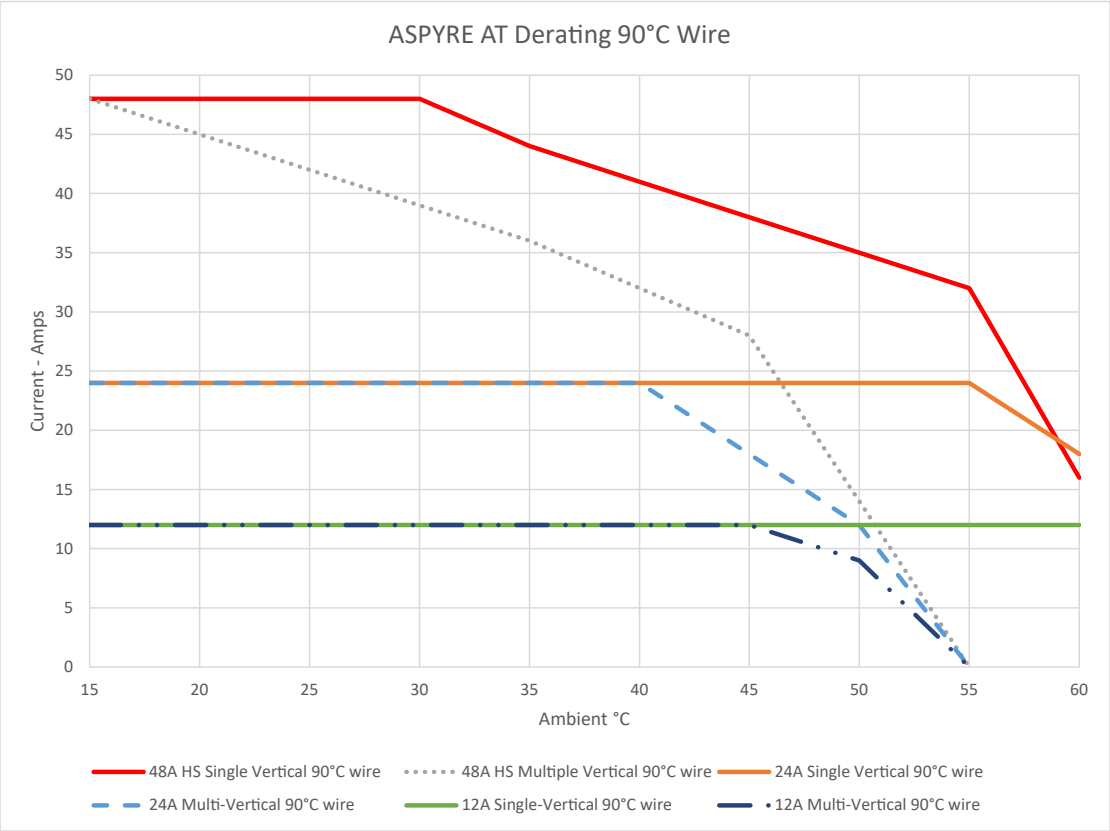
- Single-phase, 1 controlled leg.

Load Amp Range

- 12A, 24A and 48A options (see derating curves)

Derating Curve

Ambient (°C)	48A HS Single Vertical 90°C wire	48A HS Multiple Vertical 90°C wire	24A Single Vertical 90°C wire	24A Multi-Vertical 90°C wire	12A Single-Vertical 90°C wire	12A Multi-Vertical 90°C wire
15	48	48	24	24	12	12
20	48	45	24	24	12	12
25	48	42	24	24	12	12
30	48	39	24	24	12	12
35	44	36	24	24	12	12
40	41	32	24	24	12	12
45	38	28	24	18	12	12
50	35	14	24	12	12	9
55	32	0	24	0	12	0
60	16		18		12	



SCR and Amperage Rating
- SCCR rating 100,000A up to 480VAC with coordinated fusing
- SCCR rating 10,000A up to 240VAC with recommended circuit breaker
- Power dissipation: Approximately 1 to 1.2 watts per amp
- Leakage current: 1mA at maximum 25°C
- I^2T for fuse selection for all ASPYRE AT models: 9,100 A^2s
- See "Coordinated Fuses and Circuit Breakers" on page 134

Line and Load Voltage Range
- 100 to 480V

Voltage Frequency
- Automatically compensates for 47 to 63Hz

Controller Operating Supply Voltage
- 24VDC ±10%
- 6W 6VA per ASPYRE AT unit
- Maximum 10 units powered via terminal screw and backplane connector
- Use split-rail configuration when more units are required

Voltage and Current Measurement Accuracy
- ±2% of range

Control Modes
- Voltage, voltage squared, current, current squared, power

Output Control Firing Types
- Fixed time-base zero crossing
- Variable time-base zero crossing (burst firing)
- Phase angle

Digital Inputs and Outputs
- Independently user-configurable as input or switched DC output
- Update rate: 10Hz
- Input type: User-selectable, dc voltage or dry contact
- Input logic: On ≥ 4VDC, off ≤ 1VDC, 30VDC max
- Output voltage: 24V (based on the supply voltage)
- Output: 100mADC m Digital Inputs and max. per channel

Analog Input
- Voltage: 0-10VDC, 15kΩ impedance
- Current: 4 to 20mA, 0 to 20mADC, 100Ω impedance

Analog Output
- 0 to 20mADC ±120µA or 4 to 20mADC into 500Ω max. load with 30µA nominal resolution
- 0 to 10VDC ±60mV into a 500Ω min. load with 15mV nominal resolution

Backplane Connection
- Supplies power and inter-module bus connection between ASPYRE AT units mounted together
- Up to 10 total ASPYRE AT units can share power over the backplane connection

Split-Rail Connection
- Connects inter-module bus between groups of backplane connected ASPYRE AT and EZ-ZONE RM modules

- 16 maximum EZ-ZONE RM modules, PM PLUS controllers and/or ASPYRE AT controllers combined plus one RMA PLUS module
- Maximum overall network wire length 200m

Electromechanical Relay Output

- Form C, 5A resistive load
- 100,000 cycles at 24VDC, 120/240 VAC
- 125VA pilot duty 120/240VAC
- 25VA 24VAC/DC

Connectivity

- EIA 485, Modbus® RTU (standard)
- USB device
- EtherCAT® ETG (future option)
- Modbus® TCP (future option)
- EtherNet/IP™ (future option)
- ProfiNet (future option)

Diagnostics

- Open load circuit (including heater break) partial load failure, SCR short circuit, current limit, heat sink over-temperature Alarm, line voltage loss

Operator Interface

- 4 discrete LED indicators for status monitoring

COMPOSER® PC Configuration Software

- Connects via USB port
- Easy-to-use test drive screen
- Function Block diagram programming

Cooling Options

- DIN-rail heat sink for convection cooling
- Cooling plate for use with customer supplied heat sink

Control Terminals

- Terminal blocks are touch safe, removable, 22 to 12 AWG, 5 in.-lb. (0.6 Nm) torque, 1/8 in. (3.5 mm) flat blade screw driver

Line and Load Terminals

- Compatible with crimp lug terminals or bare wire, 14 to 6 AWG, 24 in.-lb. (2.7 Nm) torque, 1/8 in. hex driver

Ground Terminal

- Recommended 14 to 10 AWG with UL® Listed (ZMVV) #8 ring or spade crimp lug, 15 to 17 in.-lb. (1.7 to 1.9 Nm) torque, 1/4 in. (6.5 mm) flat blade screw driver

Mounting

- Panel mounting with screws or DIN rail
- No. 8 (M4) fastener
- DIN rail: 35 mm x 7.5 mm

Environment

- 0 to 60°C (single unit) or 55°C (multiple units) see derating curves
- 5 to 90% RH (relative humidity), non-condensing

Agency Approval and Regulatory

https://www.watlow.com/Resources-and-Support/Additional-Support/Agency-Approvals
Search keyword: “ASPYRE AT”

Accessories

COMPOSER® Configuration Software

- Download: www.watlow.com/products/controllers/software/composer-software

USB Cable

- USB Cable: 5ft USB 2.0 type A to mini device cable (p/n 0219-0382-0000), PC to ASPYRE AT for COMPOSER PC software

24VDC Power Supply

- Watlow power supply (p/n 0847-0299-0000) UL® Class 2, 90-263 VAC input, 24VDC output, 1.30A, 31W
- Watlow power supply (p/n 0847-0300-0000) UL® Class 2, 90-263 VAC input, 24VDC output, 2.50A, 60W
- Watlow power supply (p/n 0847-0301-0000) UL® Class 2, 90-263 VAC input, 24VDC output, 3.80A, 100W

Coordinated Fuses and Circuit Breakers

Select from these fuse and circuit breaker options to maintain the short circuit current rating and in some cases also provide branch circuit protection.

ASPYRE AT Amperage	Type	Protection	Watlow Item	Manufacturer Part	SCCR (A)	SCCR Max Voltage
12A	Type 1	Branch Circuit	N/A	Eaton FAZ-D15X-NA Circuit Breaker	10,000 A	240VAC
24A	Type 1	Branch Circuit	N/A	Eaton FAZ-D30X-NA Circuit Breaker	10,000 A	240VAC
12A	Type 2	Combination	N/A	Eaton Bussmann DFJ15	100,000 A	480VAC
12A	Type 2	Branch Circuit	N/A	Eaton Bussmann Class J/CC/CF/T 15 Amp	100,000 A	480VAC
24A	Type 2	Combination	0808-0325-0030	Eaton Bussmann DFJ30	100,000 A	480VAC
24A	Type 2	Branch Circuit	N/A	Eaton Bussmann Class J/CC/CF/T 30 Amp	100,000 A	480VAC
48A	Type 2	Combination	0808-0325-0060	Eaton Bussmann DFJ60	100,000 A	480VAC
48A	Type 2	Semiconductor	N/A	Eaton Bussmann FWP 60	100,000 A	480VAC
48A	Type 1	Branch Circuit	N/A	Eaton Bussmann Class J, CF, T 60A	100,000 A	480VAC

Type 1	Coordination requires that, under short-circuit conditions, the device shall cause no danger to persons or to the installation and may not be suitable for further service without repair and replacement of parts.
Type 2	Coordination requires that, under short-circuit conditions, the device shall cause no danger to persons or to the installation and shall be suitable for further use.
Branch Circuit	Fuse or circuit breaker intended to prevent circuit wiring from catching fire in the case of a short circuit
Semiconductor	Fuse intended to protect the power controller and prevent a dangerous arc flash in the event of a short circuit
Combination	Fuse that is intended to serve as both both branch circuit and semiconductor protection

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