Ascent® DMS Power Supply

AP15 and AP30

User Manual

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TRADEMARKS

PATENTS

This product is covered by US Patent No. 5,917,286 (issued June 29, 1999).

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- tech.writing@aei.com

To order a manual, please contact Technical Support:

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Safety and Product Compliance Guidelines

IMPORTANT SAFETY INFORMATION

To ensure safe installation and operation of the Advanced Energy Ascent DMS unit, read and understand this manual before attempting to install and operate this unit. At a minimum, read and follow the safety guidelines, instructions, and practices.

DANGER, WARNING, AND CAUTION BOXES

This symbol represents important notes concerning potential harm to people, this unit, or associated equipment. Advanced Energy includes this symbol in Danger, Warning, and Caution boxes to identify specific levels of hazard seriousness.

DANGER:

DANGER indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury. DANGER is limited to the most extreme situations.

WARNING:

WARNING indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury, and/or property damage.

CAUTION:

CAUTION indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate injury, and/or property damage. CAUTION is also used for property-damage-only accidents.

SAFETY GUIDELINES

Review the following information before attempting to install and operate the product.

Rules for Safe Installation and Operation

Please note the following rules:

- Do not attempt to install or operate this equipment without proper training.
- Ensure that this unit is properly grounded.
- Ensure that all cables are properly connected.
- Verify that input voltage and current capacity are within specifications before turning on the power supplies.
- Use proper electrostatic discharge (ESD) precautions.
- Maintenance and service must be performed only by AE-trained service personnel.
- Do not clean the unit.

INTERPRETING PRODUCT LABELS

The following labels may appear on your unit:

Hazardous voltage

Voltage > 30 V_{rms}, 42.4 V peak, or 60 VDC

Protective conductor terminal

This terminal must be connected first and be of proper type and size for the circuit with the highest voltage and current carrying capacity. Note that other connections may have higher requirements than that of the MAINS connection.

Environmentally Friendly Use Period of 25 years per China RoHS—recycle responsibly at end of life

European Union RoHS compliant

Refer to manual for more information

Heavy object—can cause muscle strain or back injury

Short-circuit protected

CE label

Complies with applicable European directives.

No user-serviceable parts

Alternating current

Direct current

PRODUCT COMPLIANCE

The following sections include information about unit compliance and certification, including the conditions of use required to be in compliance with the standards and directives.

Product Certification

Certain options of this product may be certified according to the list below.

For more information, refer to the Certificate or Letter of Conformity (US) or Declaration of Conformity (EU) accompanying the product.

- NRTL – Safety certified by CSA International, a Nationally Recognized Testing Laboratory
- CE Marking – Self-declaration, assessed by AE Corporate Compliance
- EMC measurements – Verified by AE Corporate Compliance

Safety and EMC Directives and Standards

For information concerning compliance to applicable EU requirements, refer to the EU Declaration of Conformity for this unit. The Declaration of Conformity may also include a supplementary section covering compliance to non-EU regulatory requirements and/or industry standards or guidelines.

Conditions of Use

To comply with the stated directives and standards, you must meet the following conditions of use:

- Before making any other connection to this device, connect the secondary Protective Earth (ground) terminal to a local earth (ground) terminal. To meet EMC requirements, the secondary ground should be a copper strap or braid sized to a cross-sectional area equivalent to the AC mains supply wires. See local electrical codes for minimum cross sectional area requirements.
- Install and operate this unit in an overvoltage category according to environmental specifications.
- Install and operate this unit in a pollution degree environment according to environmental specifications.
- Operate this device within the ambient temperature and water specifications declared in the specifications.
- To prevent condensation, install and operate this device with an external water solenoid valve so that water flow is interrupted when the device is not operating.
- Use only clean, well-conditioned water with low conductivity. See the cooling specifications.
- Use only a shielded cable for the output process power connections.
- Use only a shielded cable for communications and/or control connections.
- Install this device so that the input power connection is inaccessible to the user.
- Install this device so that the output power connection is inaccessible to the user.
- Dispose of this product as directed by applicable laws and regulations.
- For the input and output power connections, use wires that are suitable for at least 90°C (194°F).
- The air filter housing must be installed for operation.

Environmental Compliance

- **EU RoHS – European Union Directive 2011/65/EU (RoHS 2)**

  Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment

  This product is outside the scope of this Directive, because it is installed in a large-scale fixed installation or large-scale stationary industrial tool. Therefore, conformity is not required and conformance to this Directive is not declared on the CE Declaration of Conformity for this product.

However, this product is EU RoHS compliant. This product has been designed per specification to meet this Directive to contain no more than the maximum concentration of hazardous substances listed in Annex II, but may utilize application exemptions in Annex III or IV.

- **EU REACH – European Union Regulation (EC) No. 1907/2006**

  Registration, Evaluation, Authorization and Restriction of Chemicals

  Advanced Energy manufactures articles subject to Article 33 of REACH and, upon request, will provide information regarding Substances of Very High Concern (SVHC) currently identified by the European Chemical Agency (ECHA) that are contained in this product, at concentrations greater than 0.1% by weight.

- **China RoHS - People's Republic of China (PRC) Ministry of Industry and Information Technology (MIIT) Order #32 (China RoHS 2)**

  Management Methods for the Restriction of the Use of Hazardous Substances Electrical and Electronic Products

  This product contains hazardous substances listed in PRC Standard GB/T 26572, above the maximum concentration limits stipulated. In compliance to PRC Standard SJ/T 11364, AE provides a disclosure of hazardous substance content and this product is marked with an Environmentally Friendly Use Period (EFUP) of 25 years.

INTERLOCKS AND LIMITING CONDITIONS

WARNING:

Advanced Energy products only include interlocks when required by product specification. Interlocks in Advanced Energy products are not intended to meet or satisfy safety requirements. Where interlocks exist, you must still meet and satisfy safety requirements. The presence of interlocks does not imply operator protection.

The Ascent DMS power supply provides the following interlocks:

- Output cover interlock
- Rear panel 9-pin subminiature-D **INTERLOCK** port—Pins 3 and 4 of this connector must be shorted together to satisfy the system interlock

The Ascent DMS power supply ships with one dummy plug that will satisfy the **INTERLOCK** port if you do not need to use it.

An open interlock opens the internal interlock relay and disables gate drive power, thereby keeping the power section off and disabling output.

Figure 1-1 illustrates the interlock circuit on the **INTERLOCK** port.

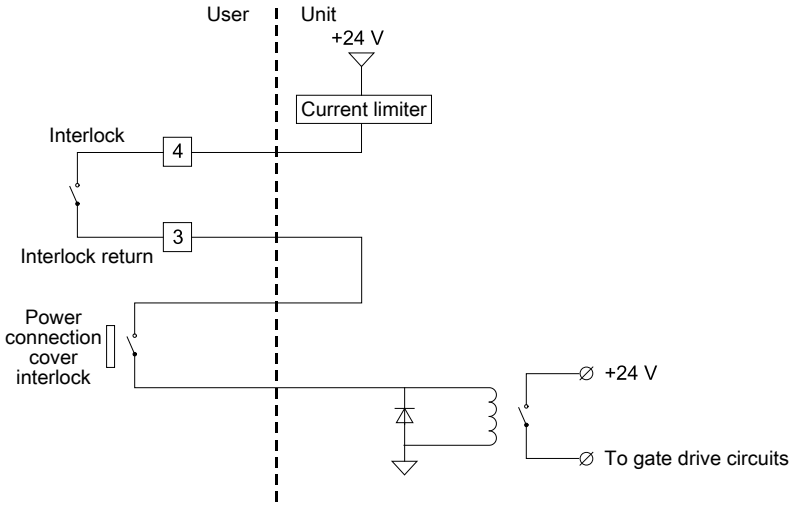


Figure 1-1. *Interlock circuit for the* ***INTERLOCK*** *port*

Product Overview

GENERAL DESCRIPTION

The Ascent DMS power supply, models AP15 and AP30 (Advanced Pulsing Dual Magnetron Sputtering), is a DC and pulsed DC power supply designed for superior performance with features such as a wide voltage range, low arc energy, flexible communication, and controllable output waveform. The Ascent DMS power supply offers power-delivery control for dual-magnetron sputtering, enabling precise tuning of film characteristics. The unit creates bipolar variable frequency and duty cycle square wave output. Units can also be combined to scale up power as needed, which enhances manufacturing deposition flexibility. The Ascent DMS unit has bipolar arc detection for superior dual magnetron sputtering arc handling.

Control Interfaces

You can control the Ascent DMS power supply from the following (your unit will include one or more of these options):

- An analog/digital connector that you can control using your Programmable Logic Control (PLC) device. This port (labeled **USER**) provides limited access to operating parameters and control functions. The **USER** port is included on some units.
- A digital communications port. Digital communications ports provide access to all operating parameters and control functions. Your unit includes one or more of the following communications interfaces:
  - Ethernet (**ETHERNET** port – all units)
  - Serial (**HOST** port – all units)
  - PROFIBUS (**PROFIBUS** port – some units)

You can use the Advanced Energy Virtual Front Panel (VFP) software to communicate with the Ascent DMS power supply through the following ports:

- **HOST** port
- **ETHERNET** port

Ascent DMS power supply control interfaces are described in the communication controls chapter of the user manual.

Microprocessor Capabilities

The internal microprocessor performs these tasks:

- Runs system diagnostics when you initially power up the unit
- Checks for proper circuit operation while supervising all operating parameters
- Manages interfaces (serial, Ethernet, master/slave, intersystem synchronization)
- Processes AE Host commands, including unit configuration and parameter management
- Monitors faults/sensors
- Manages nonvolatile memory

  The unit retains its most recent power settings and conditions in nonvolatile memory.

Arc Management

The Ascent DMS power supply arc management feature ensures a short arc detection and recovery time. The activation time for the arc suppression behavior is less than 1 µs, and delivered arc energy can be less than 0.5 mJ/kW.

The Ascent DMS power supply can detect arcs to ground (chamber wall) in a dual cathode system.

Fault Handling

If the Ascent DMS power supply detects an internal fault, it will turn off the unit and will report the fault code. Fault conditions that cause the unit to turn off power or prevent output from being turned on include:

- Open interlock loops
- Input power failure
- Overtemperature

Specifications

PHYSICAL SPECIFICATIONS

Table 3-1. Physical specifications

Description	Specification
General Physical Specifications	
Size	261 mm (H) x 483 mm (W) x 633 mm (D) 10.3″ (H) x 19.0″ (W) x 24.9″ (D) Dimensions include front panel mounting extensions. Dimensions do not include the power connection cover, handles, or connectors.
Weight	• 15 kW unit: 56 kg (123 lb) • 30 kW unit: 60.3 kg (133 lb)
Mounting	48.26 cm (19″), rack mountable, 6U height
Connectors (Located on Rear of Unit)	
AC input power	• 15 kW units: AWG4 input terminal block; 3-phase; 35 A circuit breaker • 30 kW units: AWG4 input terminal block; 3-phase; 63 A circuit breaker
DC output process power	4x 10 mm studs with cable cord grip fasteners
Cooling water (**Water In**, **Water Out**)	Water fittings 1/2″ NPT, female
Solenoid (**WATER CONTROL**)	24 V, 0.5 A maximum current, 5.5 mm (0.22″) quick-connect connector (male) to control the solenoid User supplies solenoid, valve, mating connector (for example, Switchcraft® 761K), and wire harness.
Protective Earth ground	M10 ground stud
Arc-Sync™ (**SYNC PWR IN/OUT**)	RJ-45
Arc-Sync (**ARC IN/OUT**)	SMA
FREQ IN/OUT	SMA
Master/slave (**M/S**)	**M/S OUT**: HDMI

Table 3-1. Physical specifications (Continued)

Description	Specification
	M/S IN: mini HDMI
Communication Ports (Communication Ports Vary From Unit to Unit)	
ETHERNET	RJ-45
HOST	9-pin, female, subminiature-D
INTERLOCK	9-pin, male, subminiature-D
PROFIBUS	(Optional) 9-pin, female, shielded, subminiature-D connector, and associated 8-switch dual in-line package (DIP) to set the address
USER	(Optional) One of the following: • 37-pin, male, subminiature-D • 37-pin, female, subminiature-D • 37-pin, male, subminiature-D, for use with the PE II adapter kit, 25-pin (available with select models)
REMOTE MONITOR	9-pin, female, subminiature-D
SERVICE	USB micro B, female
SERVICE PORT (on front panel of unit)	USB micro B, female
EXTERNAL TABLET (on front panel of unit)	USB Type A, female

ELECTRICAL SPECIFICATIONS

For fixed-frequency unit electrical specifications, see "Electrical Specifications (Fixed Frequency Units)"

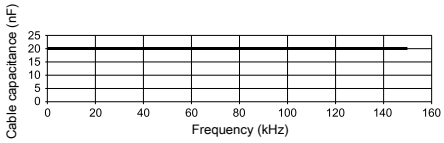
Table 3-2. Electrical specifications (full featured units)

Description	Specification
Input Power	
AC input voltage	400 VAC ± 10% (360 VAC – 440 VAC), 3-phase Wye, no neutral required or 3 phase delta unearthed
AC line frequency	50/60 Hz, 98% – 102% of the nominal range
AC input current	• 15 kW units: 27 A nominal (maximum 30 A_{rms}) at 360 VAC

Table 3-2. Electrical specifications (full featured units) (Continued)

Description	Specification
	• 30 kW units: 53 A nominal (maximum 59 A_{rms}) at 360 VAC
Inrush current	< 150 A peak for 1 ms at maximum input line voltage
Power factor	> 0.9 at full power and nominal voltage
Efficiency	> 90% at full power and nominal voltage
Maximum leakage current	< 3.5 mA Wye configured power distribution system
External overcurrent protection	Install overcurrent protection in accordance with local regulations and codes
Ground connection	Required: Chassis ground near AC connector suitable for ring lug connection
Output Power	
Output power (DC mode)	One of the following (see your unit label for the maximum output power): • 30 kW, maximum • 15 kW, maximum
Output voltage	1000 VDC, maximum
Output current	15 kW units: 40 A (average); 50 A (peak); 42.5 A (rms), maximum 30 kW units: 80 A (average); 100 A (peak); 85 A (rms), maximum
Operating frequency	5 kHz – 150 kHz selectable in 1 kHz steps (DC mode is valid)
Duty cycle	5% – 95% limited to a minimum conduction time of 2 µs (15 kW and 30 kW)
Boost voltage	0 V – 600 V Maximum, one of the following: • 95% of process voltage • $V_{boost} + V_{process}$ up to a maximum total of 1200 V
$T_{deadtime}$	0 µs – 1 µs User-settable off time between forward and reverse time
Accuracy	The accuracy of the output value to setpoint at 25°C (77°F) is the greater of one of the following: • ± 1% of the actual value (V, kW, or A) • ± 0.2% of the full rated output This applies to setpoints from 10% to 100% of rated power. Below setpoints of 10% rated power accuracy is indeterminate.

Table 3-2. Electrical specifications (full featured units) (Continued)

<table>
<tr><th>Description</th><th>Specification</th></tr>
<tr><td>Open circuit voltage (ignition capability)</td><td>1200 VDC at 60 mA, 0.5 s on, 5 s off, until plasma ignites
Strike voltage profiles:
<table><tr><th>Profile</th><th>Ignition On</th><th>Ignition Off</th></tr><tr><td>High</td><td>1200 V</td><td>1000 V</td></tr><tr><td>Medium</td><td>900 V</td><td>750 V</td></tr><tr><td>Low</td><td>600 V</td><td>500 V</td></tr><tr><td>No profile</td><td>N/A</td><td>N/A</td></tr></table>For example, using the medium strike voltage profile, the unit is repeatedly at 900 V for 0.5 s then 750 V for 5 s, until plasma ignites.</td></tr>
<tr><td>Output cable inductance</td><td>< 3 µH, maximum, at 1 kHz, cable end shorted</td></tr>
<tr><td>Output cable capacitance</td><td>< 50 nF, maximum, at 50 kHz derating to 20 nF at 150 kHz
Maximum cable capacitance (15 kW units):
 

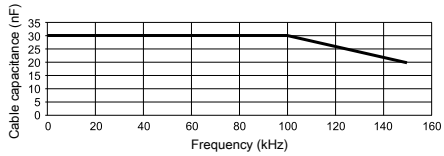
Maximum cable capacitance (30 kW units):
 
</td></tr>
<tr><td>Output ripple</td><td>Total line frequency related ripple is less than 2% RMS into a resistive load</td></tr>
</table>

Table 3-3. Operational limits specifications

Description	Specification
Regulation modes	Power, voltage, or current (30 kW units) Regulation mode ranges: • Voltage: 50 V – 1000 V • Average current: 2 A – 80 A

Table 3-3. Operational limits specifications (Continued)

Description	Specification
	• Power: 300 W – 30 kW (15 kW units) Regulation mode ranges: • Voltage: 50 V – 1000 V • Average current: 2 A – 40 A • Power: 150 W – 15 kW
Line regulation	No accuracy derating for line voltages within the specified input voltage range
Load regulation	No accuracy derating for impedances within the specified output impedance range
Repeatability	Output power repeatability from run to run at a constant setpoint is 0.1% from 10% – 100% of rated power
Temperature regulation	< 0.05% / °C variation in the regulated output parameter over 20°C to 40°C (68°F to 104°F) ambient temperature range, at 10% to 90% of power range

Table 3-4. Arc handling specifications

Description	Specification
Arc detection	Arcs will be sensed in less than 1 µs using a combination of voltage- and current-sensing parameters. There are different arc quenching blocks depending of the severity of the arc.
Detection modes	Voltage / Current
Arc energy	≤ 0.5 mJ/kW
Arc rate	Maximum 2 kHz continuous or 10000 arcs/5 s window

Output Power Range (15 kW units)

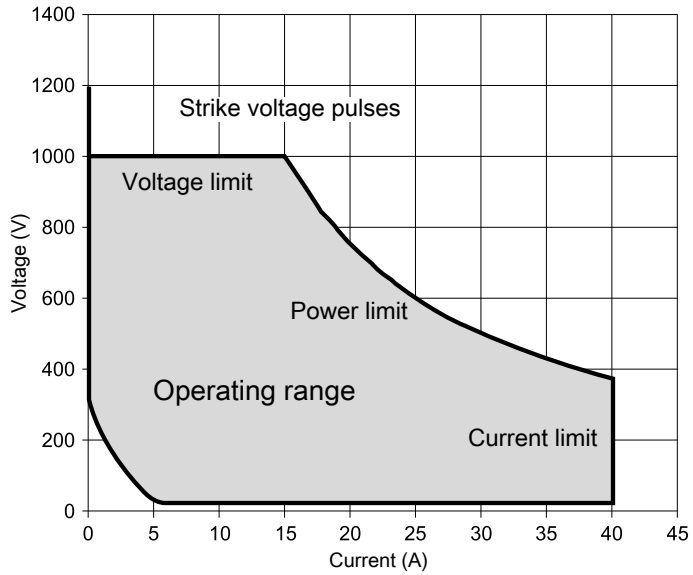


Figure 3-1. *Operating area (15 kW units)*

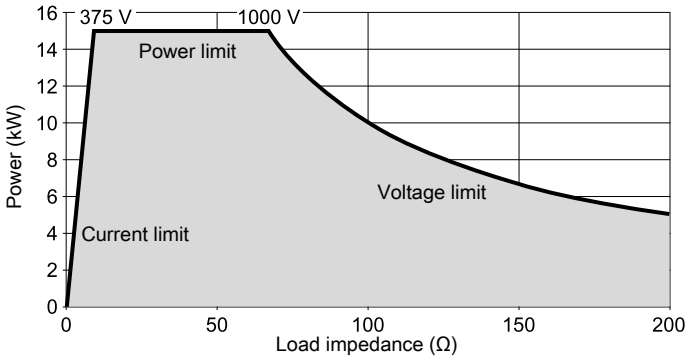


Figure 3-2. *Output impedance range (15 kW units)*

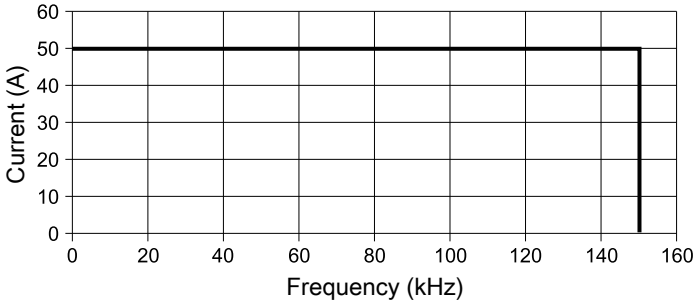


Figure 3-3. *Peak current versus frequency (15 kW units)*

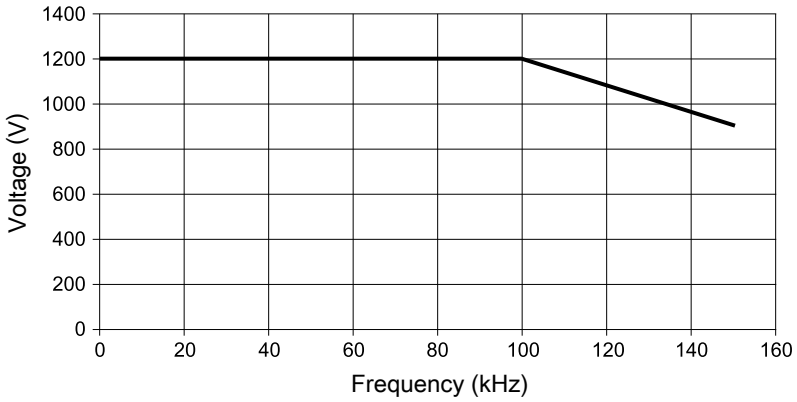


Figure 3-4. *Maximum output voltage (boost voltage + process voltage) (15 kW units)*

Output Power Range (30 kW units)

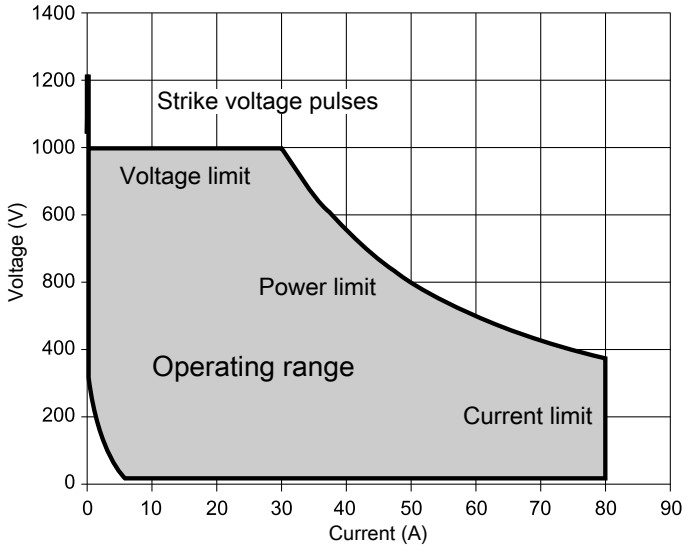


Figure 3-5. *Operating area (30 kW units)*

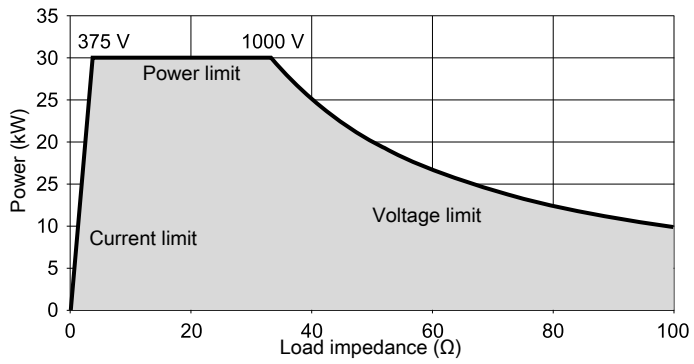


Figure 3-6. *Output impedance range (30 kW units)*

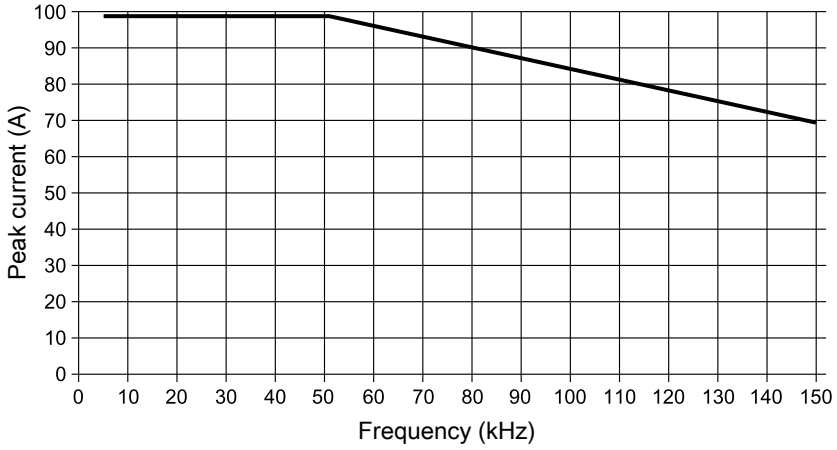


Figure 3-7. Peak current versus frequency (30 kW units)

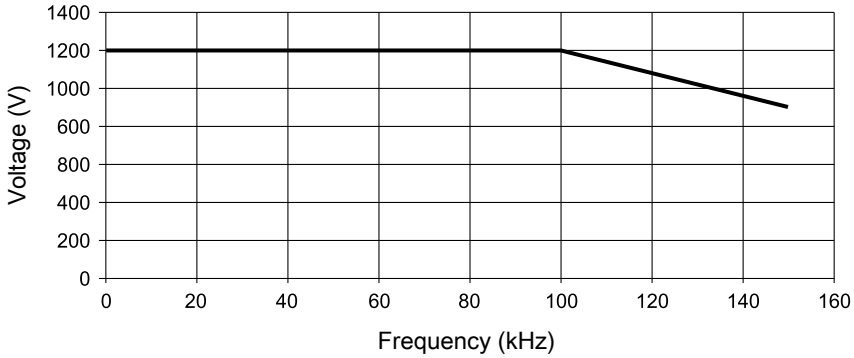


Figure 3-8. Maximum output voltage (boost voltage + process voltage) (30 kW units)

Electrical Specifications (Fixed Frequency Units)

These specifications apply to fixed frequency units. To see if your unit is fixed frequency, please contact AE Global Services.

Table 3-5. Electrical specifications (fixed frequency units)

Description	Specification
Input Power	
AC input voltage	400 VAC ± 10% (360 VAC – 440 VAC), 3-phase Wye, no neutral required or 3 phase delta unearthed
AC line frequency	50/60 Hz, 98% – 102% of the nominal range
AC input current	27 A nominal (maximum 30 A_{rms}) at 360 VAC Circuit breaker size minimum 40 A
Inrush current	< 150 A peak for 1 ms at maximum input line voltage
Power factor	> 0.9 at full power and nominal voltage

Table 3-5. Electrical specifications (fixed frequency units) (Continued)

Description	Specification
Efficiency	> 90% at full power and nominal voltage
Maximum leakage current	< 3.5 mA Wye configured power distribution system
External overcurrent protection	Install overcurrent protection in accordance with local regulations and codes
Ground connection	Required: Chassis ground near AC connector suitable for ring lug connection
Output Power	
Output power (DC section)	15 kW, maximum
Output voltage	150 VDC – 1000 VDC
Output current	40 A (average); 50 A (peak); 42.5 A (rms), maximum
Operating frequency	40 kHz, fixed
Duty cycle	50%, fixed
$T_{deadtime}$	0 µs The time between forward and reverse time
Accuracy	The accuracy of the output value to setpoint at 25°C (77°F) is the greater of one of the following: • ± 1% of the actual value (V, kW, or A) • ± 0.2% of the full rated output This applies to setpoints from 10% to 100% of rated power. Below setpoints of 10% rated power accuracy is indeterminate.
Open circuit voltage (ignition capability)	1200 VDC at 60 mA, 0.5 s on, 5 s off, until plasma ignites Strike voltage profiles: Profile / Ignition On / Ignition Off High / 1200 V / 1000 V Medium / 900 V / 750 V Low / 600 V / 500 V No profile / N/A / N/A For example, using the medium strike voltage profile, the unit is repeatedly at 900 V for 0.5 s then 750 V for 5 s, until plasma ignites.
Output cable inductance	< 3 µH, maximum, at 1 kHz, cable end shorted
Output cable capacitance	< 20 nF, maximum
Output ripple	Total line frequency related ripple is less than 2% RMS into a resistive load

Table 3-6. Operational limits specifications

Description	Specification
Regulation modes	Power, voltage, or current Regulation mode ranges: • Voltage: 150 V – 1000 V • Average current: 2 A – 40 A • Power: 150 W – 15 kW
Line regulation	No accuracy derating for line voltages within the specified input voltage range
Load regulation	No accuracy derating for impedances within the specified output impedance range
Repeatability	Output power repeatability from run to run at a constant setpoint is 0.1% from 10% – 100% of rated power
Temperature regulation	< 0.05% / °C variation in the regulated output parameter over 20°C to 40°C (68°F to 104°F) ambient temperature range, at 10% to 90% of power range

Table 3-7. Arc handling specifications

Description	Specification
Arc detection	Arcs will be sensed in less than 1 µs using a combination of voltage- and current-sensing parameters. There are different arc quenching blocks depending of the severity of the arc.
Detection modes	Voltage / Current
Arc energy	≤ 0.5 mJ/kW
Arc rate	Maximum 2 kHz continuous or 10000 arcs/5 s window

OUTPUT POWER RANGE (FIXED FREQUENCY UNITS)

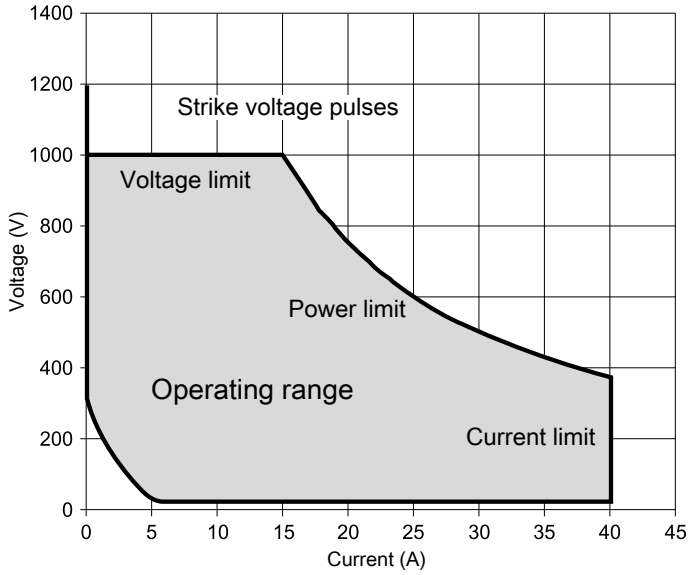


Figure 3-9. Operating area

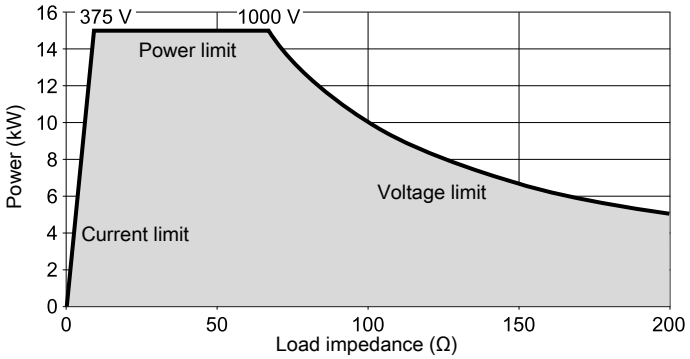


Figure 3-10. Output impedance range

ENVIRONMENTAL SPECIFICATIONS

The two following tables describe the environmental specifications for the Ascent DMS unit.

Table 3-8. Environmental standard specifications

Description	Specification
Overvoltage category	III
Pollution degree	2

Table 3-9. Climatic specifications

	Temperature	Relative Humidity	Air Pressure
Operating	+5°C to +40°C +41°F to +104°F	5% to 85% [1] 1 g/m^3 to 25 g/m^3	78.8 kPa to 106 kPa 788 mbar to 1060 mbar Equivalent altitude: +2000 m to -500 m (+6562′ to -1640′)
Storage	-25°C to +55°C -13°F to +131°F	5% to 95% 1 g/m^3 to 29 g/m^3	78.8 kPa to 106 kPa 788 mbar to 1060 mbar Equivalent altitude: +2000 m to -500 m (+6562′ to -1640′)
Transportation	-25°C to +70°C -13°F to +158°F	95% [2] 60 g/m^3 [3]	65.6 kPa to 106 kPa 656 mbar to 1060 mbar Equivalent altitude: +3500 m to -500 m (+11483′ to -1640′)

[1] Non-condensing, no formation of ice

[2] Maximum relative humidity when the unit temperature slowly increases, or when the unit temperature directly increases from -25°C to +30°C (-13°F to +86°F)

[3] Maximum absolute humidity when the unit temperature directly decreases from +70°C to +15°C (+158°F to +59°F)

COOLING SPECIFICATIONS

CAUTION:

Do not use deionized water for cooling purposes. Deionized water causes both corrosion and erosion of cooling manifolds.

Table 3-10. Cooling specifications

Description	Specification
Cooling medium	Water and air
Air Cooling	
Required spacing	• Minimum clearance between either side of the Ascent DMS power supply and the enclosure: 51 mm (2″). • Minimum clearance between the top of the Ascent DMS power supply and the top of the enclosure: 25 mm (1″).

Table 3-10. Cooling specifications (Continued)

Description	Specification
	• Minimum clearance between the front and back of the Ascent DMS power supply and the enclosure: 102 mm (4″), with adequate ventilation. • Minimum clearance between power supplies in the 19″ rack: 1U height [44 mm (1.7″)].
Cooling air temperature	Air (gas) minimum 5°C (41°F), maximum 40°C (104°F)
Water Cooling	
Temperature	Water (fluid) maximum: 35°C (95°F) To prevent condensation, the temperature of the cooling water must be higher than the dew point.
Water flow	Minimum (15 kW units): 7.5 lpm (2 gpm) Minimum (30 kW units): 10 lpm (2.5 gpm)
Water pressure	Maximum (15 kW and 30 kW units): 10 bar (145 PSI or 1000 kPa) above atmospheric pressure
Differential water pressure	Minimum (15 kW units): 0.6 bar (8.7 PSI or 60 kPa) input-to-output at minimum water flow rate Minimum (30 kW units): 0.7 bar (10 PSI or 69 kPa) input-to-output at minimum water flow rate Do not serially connect units.
Contaminants	Cooling water quality recommended: • pH between 6.0 and 9.0 • Total chlorine < 10 ppm • Total chlorides < 100 ppm • Total nitrate < 10 ppm • Total nitrite < 1 ppm • Total sulfate < 100 ppm • Total ammonium/ammonia < 1 ppm • Total dissolved solids < 250 ppm • Total hardness expressed as calcium carbonate equivalent less than 150 ppm • Specific resistivity of 2500 Ω-cm or higher at 25°C • Total dissolved solids (TDS) as estimated by the following: ◦ TDS ≤ 640,000/ specific resistivity (Ω-cm)

Table 3-10. Cooling specifications (Continued)

Description	Specification
	• All surfaces in contact with water must be copper, brass, bronze, or superior materials (aluminum with or without coatings is expressly forbidden).

Communication Controls

OVERVIEW OF THE ASCENT DMS UNIT CONNECTORS

This chapter provides information on the communication and auxiliary interfaces for the Ascent DMS unit, including:

- Communication and auxiliary ports on the front and rear panel
- Communication interface information (protocol, commands)

For information on how to make the connections and how to use the connections, see the installation and operation chapter.

I/O and Auxiliary Ports

Figure 4-1 and Figure 4-2 show the Ascent DMS unit ports. Table 4-1 describes each of the ports. For detailed connector information, see the connector section in the communication chapter. For installation information, see the installation chapter.

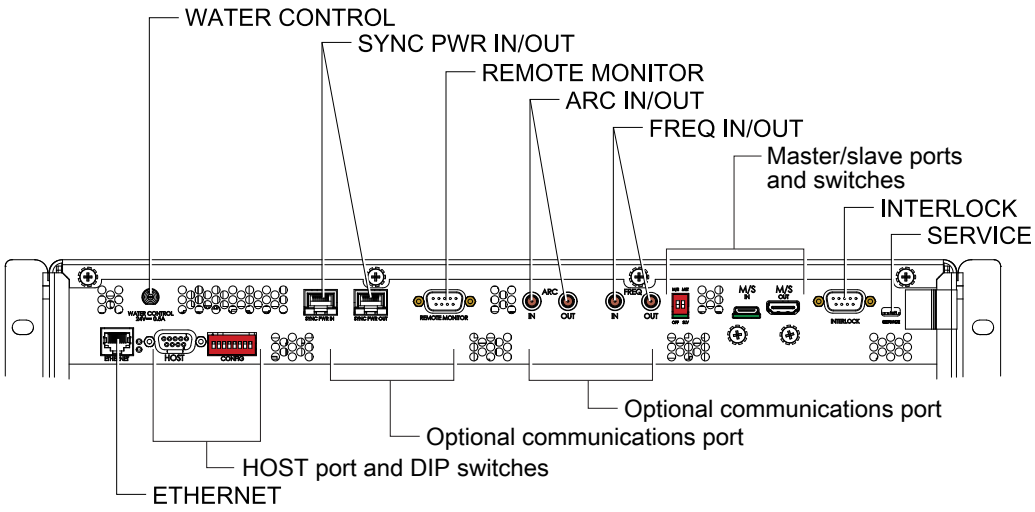


Figure 4-1. Rear panel connectors

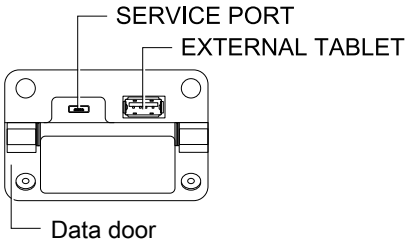


Figure 4-2. Front panel connectors

Table 4-1. I/O and auxiliary ports

Port	Description
Back panel	
ETHERNET	Allows digital communication with a host computer using the Ethernet protocol. Used primarily for monitoring the system and service. Can also be used for configuration if using the factory default IP address.
HOST	Allows serial communications (RS-232/RS-485) with a host computer using AE Bus communications protocol.
Optional communications ports	The Ascent DMS power supply can have up to two optional communications ports. The optional communications ports vary by unit and can include: • **PROFIBUS** • **USER**
SYNC PWR IN/OUT	Allows synchronization between multiple Ascent DMS units.
REMOTE MONITOR	Reserved for future use.
ARC IN/OUT	Reserved for future use.
FREQ IN/OUT	Reserved for future use.
M/S IN/OUT	Master/slave connectors.
INTERLOCK	Required connections used in the system interlock.
SERVICE	Allows communication using the USB protocol. Used primarily for service.
Front panel, optional connections	
SERVICE PORT	Allows communication using the USB protocol. Used primarily for service.
EXTERNAL TABLET	Reserved for future use.

STANDARD 24 V 37-PIN USER PORT

For this **USER** port, inputs and reference signals are 0 VDC to 10 VDC analog. The output signals are 0 VDC to 24 VDC digital. In addition, the unit incorporates:

- A fast response setpoint input (0 VDC to 10 VDC); the unit shall respond to the setpoint signal and adjust the output of the power supply in 50 ms or less
- Regulation mode selection (voltage, current, power)
- User reference signals for voltage, current, and power (0 VDC to 10 VDC)
- Arc counter
- Outputs
- **USER** port compatibility with Allen Bradley®, Siemens®, and Mitsubishi® PLCs

Standard 24 V 37-Pin USER Port Connector

The **USER** port is an analog interface that allows the use of a remote controller. It is a 24 V interface card with a 37-pin, subminiature-D connector. This connector will be male or female, depending on which options you specified at the time you ordered your unit.

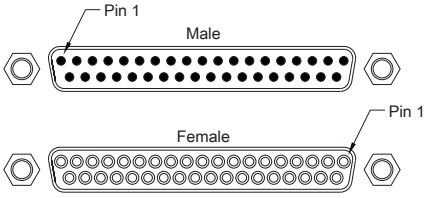


Figure 4-3. 37-pin subminiature-D, male and female connectors

Standard 24 V 37-Pin USER Port Installation

DANGER:

RISK OF DEATH OR BODILY INJURY. Disconnect and lockout/tagout all sources of input power before working on this unit or anything connected to it.

If you have an isolated 24 V user interface card, your card provides isolation of 500 V_{RMS} (maximum) from the logic and control circuitry to all 37 pins on the connector.

Signals at the **USER** port can be sensitive to noise. We recommend that you take standard preventive measures against electromagnetic interference (EMI), including using shielded cabling on the **USER** port.

Grounding the shield of the user interface cable at the power supply reduces noise interference. To avoid ground loop problems, you should typically ground only one end.

Connect your system 24 V supply to pin 18 on the Ascent DMS supply **USER** port.

☞ **Important**
Pin 18 must be connected to pin 11 (*AUX.D INTLK*) to satisfy the interlock. A pull-up resistor is not necessary.

Your 24 V supply must meet the following requirements:

- Voltage (nominal): 24 VDC
- Ripple: 3.6 VAC maximum
- Permissible voltage range: 20 V to 30 V
- V surge (t < 0.5 s): 35 V
- Current (depends on loading of outputs): 5.0 A maximum

Standard 24 V 37-Pin USER Port Signal and Pin Descriptions

This section provides general information about the **USER** port analog and digital signals as well as specific information about each pin.

ANALOG SIGNALS

A "*.A*" suffix appended to a pin name indicates an analog signal. Analog common lines are denoted by the "*COM.A*" suffix.

Analog outputs can source or sink up to 3.0 mA. The input impedance of the analog inputs is > 200 kΩ.

DIGITAL SIGNALS

A "*.D*" appended to a pin name indicates a digital signal. Digital commons are denoted by the "*COM.D*" suffix. Digital outputs are short-circuit protected.

The signal levels for digital outputs are as follows:

- Logical "0": +3 V maximum with 1.0 mA maximum leakage

- Logical "1": Vpos less 1.5 V minimum (Vpos refers to the 24 V supply). Output current can range from 0.5 mA to 0.5 A.

The signal levels for digital inputs are as follows:

- Logical "0": -30 V to +5 V with 0.5 mA maximum leakage
- Logical "1": +13 V to +30 V, and 8.5 mA typical

All digital input lines incorporate a low pass filter that rejects signals less than 10 ms.

PIN DESCRIPTION TABLE

*Table 4-2. Standard 24 V 37-pin **USER** port pin descriptions*

Signal Pin	Related Pin	Name	Signal Type	Description
1	37	Reserved	Output	N/A
2	37	*OUTPUT.D*	Output	When high, this signal indicates that the interlock is closed and output power is on.
3	37	*SETPOINT.D*	Output	When high, this signal indicates that the output is equal to the requested setpoint. In a master/slave configuration, this pin signal goes high on the master unit when the system has reached the system setpoint. Slave units do not track the setpoint levels in a master/slave configuration.
4	36	Reserved	Input	N/A
5	36	*IREG.D*	Input	This signal is used with *PREG.D* (pin 6) to set the regulation mode. See "Setting the Regulation Mode" on page 4-8 for a list of signal conditions for each regulation mode.
6	36	*PREG.D*	Input	This signal is used with *IREG.D* (pin 5) to set the regulation mode. See the description of pin 5 for the logic table associated with this signal.
7	36	*ON.D*	Input	A high on this pin turns on output power. A low signal turns output power off.
8	N/A	Unassigned	N/A	N/A
9	N/A	*OUTCOM.A*	N/A	This pin is a dedicated return for analog outputs.

*Table 4-2. Standard 24 V 37-pin **USER** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
				Reference pins 23, 24, 25, and 31 to this pin.
10	N/A	*INCOM.A*	N/A	This signal is a dedicated return for analog inputs. Reference pin 27 to this pin.
11	19	*AUX.D INTLK*	Input	This signal monitors the system interlock string. A high on this pin will satisfy the interlock.
12	N/A	Unassigned	N/A	N/A
13	N/A	Unassigned	N/A	N/A
14	36	*RESET.D*	Input	A high on this pin will reset active explicit-clear faults, provided that the fault conditions are no longer present. This pin must be returned to the inactive state (low) to enable the unit output.
15	N/A	Unassigned	N/A	N/A
16	N/A	Unassigned	N/A	N/A
17	N/A	Unassigned	N/A	N/A
18	37	*+24 V*	Input	Connect your system +24 V power supply to this pin. Pin 37 is the 0 V reference.
19	N/A	*INTLKCOM.D*	N/A	This pin is the dedicated return for the *AUX.D INTLK* pin (pin 11).
20	37	Reserved	Output	Reserved
21	37	*ARC.D*	Output	A pulse of a predetermined width (normally 20 ms) will be seen on this pin for every hard arc seen by the unit. If another hard arc is seen before the last pulse is complete, the pulse width will be refreshed to the full width.
22	37	Reserved	Output	Reserved
23	9	*VOUT.A*	Output	This signal represents median output voltage (average rectified output waveform). Full scale (10 V) represents 1200 V.
24	9	*POUT.A*	Output	This signal represents average output power. 15 kW units: Full scale (10 V) represents 15 kW.

*Table 4-2. Standard 24 V 37-pin **USER** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
				30 kW units: Full scale (10 V) represents 30 kW.
25	9	*IOUT.A*	Output	This signal represents median output current (average rectified output waveform). 15 kW units: Full scale (10 V) represents 50 A. 30 kW units: Full scale (10 V) represents 100 A.
26	N/A	Unassigned	N/A	N/A
27	10	*LEVELIN.A*	Input	This signal represents the desired output power, voltage, or current. Regulation mode is set using pins 5 and 6. Full scale (10 V) is the same as *POUT.A*, *VOUT.A*, and *IOUT.A*.
28	N/A	Unassigned	N/A	N/A
29	N/A	Unassigned	N/A	N/A
30	N/A	Unassigned	N/A	N/A
31	9	*LEVELOUT.A*	Output	This signal represents the programmed setpoint level. Full scale (10 V) is the same as *POUT.A*, *VOUT.A*, and *IOUT.A*.
32	N/A	Unassigned	N/A	N/A
33	N/A	Unassigned	N/A	N/A
34	36	Reserved	Input	N/A
35	36	Reserved	Input	N/A
36	N/A	*INCOM.D*	N/A	This pin is a dedicated return for digital inputs. Pins 4, 5, 6, 7, 14, 34, and 35 should be referenced to this pin.
37	N/A	*OUTCOM.D*	N/A	This signal is a dedicated return for digital outputs. Pins 1, 2, 3, 20, 21, and 22 should be referenced to this pin.

SETTING THE REGULATION MODE

The following table shows the pin state for pins 5 and 6 to select a specific regulation mode.

Table 4-3. Regulation mode (pin 5 and pin 6)

Regulation Mode	*IREG.D* (Pin 5)	*PREG.D* (Pin 6)
Voltage	Low	Low
Power	Low	High
Current	High	Low
Not valid	High	High

24 V 37-PIN USER PORT FOR PE II ADAPTER KIT, 25-PIN (AVAILABLE WITH SELECT MODELS)

This interface emulates the AE PE II 25-pin user interface and is available with select models. This section applies to the 24 V 37-pin **USER** port when the following is true:

- The **USER** port on the unit is a 37-pin, female, subminiature-D port
- The unit shipped with the PE II adapter kit, 37-pin to 25-pin cable

For this **USER** port, inputs and reference signals are 0 VDC to 10 VDC analog. The output signals are 0 VDC to 24 VDC digital. In addition, the unit incorporates:

- A fast response setpoint input (0 VDC to 10 VDC); the unit shall respond to the setpoint signal and adjust the output of the power supply in 50 ms or less
- Regulation mode selection (voltage, current, power)
- User reference signals for voltage, current, and power (0 VDC to 10 VDC)
- Arc counter
- Outputs
- **USER** port compatibility with Allen Bradley, Siemens, and Mitsubishi PLCs

24 V 37-Pin USER Port Connector and PE II Adapter Kit Cable

The **USER** port is an analog interface that allows the use of a remote controller. It is a 24 V interface with a 37-pin, male, subminiature-D connector. To use this interface

for PE II 25-pin emulation, attach the supplied 37-pin to 25-pin cable. The connector on the end of the cable is a 25-pin, female, subminiature-D connector.

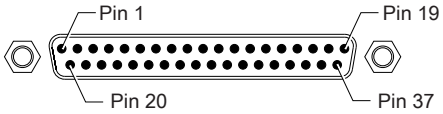


Figure 4-4. 37-pin subminiature-D connector on the unit

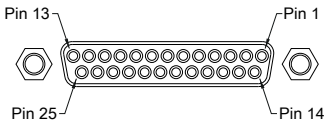


Figure 4-5. 25-pin subminiature-D connector on the 37-pin to 25-pin cable

24 V 37-Pin to 25-Pin USER Port Installation

DANGER:

RISK OF DEATH OR BODILY INJURY. Disconnect and lockout/tagout all sources of input power before working on this unit or anything connected to it.

If you have an isolated 24 V user interface card, your card provides isolation of ≤ 500 V_{RMS} from the logic and control circuitry to all pins on the connector.

Signals at the **USER** port can be sensitive to noise. We recommend that you take standard preventive measures against electromagnetic interference (EMI), including using shielded cabling on the **USER** port.

Grounding the shield of the user interface cable at the power supply reduces noise interference. To avoid ground loop problems, you should typically ground only one end.

To use this port with PE II units, connect the 25-pin adapter kit cable to the unit 37-pin **USER** port. The rest of this section describes the 25-pin cable connector.

Connect your system 24 V supply to pin 6 on the **USER** port 25-pin cable connector.

Important

Pin 10 must be connected to pin 23 (*AUX.D INTLK*) to satisfy the interlock. A pull-up resistor is not necessary.

Your 24 V supply must meet the following requirements:

- Voltage (nominal): 24 VDC
- Ripple: 3.6 VAC maximum
- Permissible voltage range: 20 V to 30 V
- V surge (t < 0.5 s): 35 V

- Current (depends on loading of outputs): 5.0 A maximum

24 V 25-Pin USER Port Signal and Pin Descriptions on PE II Adapter Kit Cable Connector

This section provides general information about the **USER** port analog and digital signals as well as specific information about each pin.

ANALOG SIGNALS

A "*.A*" suffix appended to a pin name indicates an analog signal. Analog common lines are denoted by the "*COM.A*" suffix.

Analog outputs can source or sink up to 3.0 mA. The input impedance of the analog inputs is > 200 kΩ.

DIGITAL SIGNALS

A "*.D*" appended to a pin name indicates a digital signal. Digital commons are denoted by the "*COM.D*" suffix. Digital outputs are short-circuit protected.

The signal levels for digital outputs are as follows:

- Logical "0": +3 V maximum with 1.0 mA maximum leakage
- Logical "1": Vpos less 1.5 V minimum (Vpos refers to the 24 V supply). Output current can range from 0.5 mA to 0.5 A.

The signal levels for digital inputs are as follows:

- Logical "0": -30 V to +5 V with 0.5 mA maximum leakage
- Logical "1": +13 V to +30 V, and 8.5 mA typical

PIN DESCRIPTION TABLE

Table 4-4. *24 V 25-pin **USER** port pin descriptions for PE II adapter kit cable*

Signal Pin	Related Pin	Name (PE II Name)	Signal Type	Description
1	15	*IOUT.A (CURRENT)*	Output	This signal represents median output current (average rectified output waveform). Full scale (10 V) represents 50 A (15 kW units) or 100 A (30 kW units). Corresponding pin on 37-pin connector: 25.

*Table 4-4. 24 V 25-pin **USER** port pin descriptions for PE II adapter kit cable (Continued)*

Signal Pin	Related Pin	Name (PE II Name)	Signal Type	Description
2	15	*VOUT.A (VOLTAGE)*	Output	This signal represents median output voltage (average rectified output waveform). Full scale (10 V) represents 1200 V. Corresponding pin on 37-pin connector: 23.
3	15	*POUT.A (POWER)*	Output	This signal represents average output power. Full scale (10 V) represents 15 kW (15 kW units) or 30 kW (30 kW units). Corresponding pin on 37-pin connector: 24.
4	19	*ON.D (OUTPUT ON)*	Input	A high on this pin turns on output power. A low signal turns output power off. Corresponding pin on 37-pin connector: 7.
5	18	*LEVELIN.A (SETPOINT)*	Input	This signal represents the desired output power, voltage, or current. Regulation mode is set using pins 11 and 24. Full scale (10 V) is the same as *POUT.A*, *VOUT.A*, and *IOUT.A*. Corresponding pin on 37-pin connector: 27
6	19	*+24 V INPUT*	Input	Input voltage for digital inputs and outputs. Connect your system 24 V power supply to this pin. Pin 19 is the 0 V reference. Corresponding pin on 37-pin connector: 18.
7	19	*PULSE_OFF_FEEDBACK.D*	Output	High steady state when in power-pulsing mode and power output is set on. Corresponding pin on 37-pin connector: 20.
8	19	*IARC.D (CURRENT ARC)*	Output	A high signal confirms that a current arc (IArc) has occurred; typical signal time is 20 ms ± 2 ms. Corresponding pin on 37-pin connector: 21.

*Table 4-4. 24 V 25-pin **USER** port pin descriptions for PE II adapter kit cable (Continued)*

Signal Pin	Related Pin	Name (PE II Name)	Signal Type	Description
9	19	*VARC.D* *(VOLTAGE ARC)*	Output	A high signal confirms that a voltage arc (VArc) has occurred; typical signal time is 20 ms ± 2 ms. Corresponding pin on 37-pin connector: 22.
10	23	*24 V OUTPUT FOR +INTERLOCK* *(INTERLOCK)*	Output	Connect pin 23 to pin 10 with a contact closure to satisfy *AUX.D INTLK*. If the conditions are not all satisfied, the power supply interlock is opened, preventing the output from enabling. A high on this pin will satisfy the interlock. Corresponding pin on 37-pin connector: 18.
11	19	*REG1.D*	Input	Used with *REG2.D* (pin 24) to set the regulation mode. See "Setting the Regulation Mode" on page 4-14 for the logic table associated with this signal. Corresponding pin on 37-pin connector: 5.
12	N/A	Unassigned	N/A	PE II tap 1 not used. Corresponding pin on 37-pin connector: N/C (no connect).
13	N/A	Unassigned	N/A	PE II tap 3 not used. Corresponding pin on 37-pin connector: N/C.
14	19	*SETPOINT.D*	Output	When high, this signal indicates that the output is equal to the requested setpoint. Corresponding pin on 37-pin connector: 3.
15	N/A	*OUTCOM.A* *(ANALOG OUTPUT REFERENCE)*	N/A	This pin is a dedicated return for analog outputs. Reference pins 1, 2, and 3 to this pin. Corresponding pin on 37-pin connector: 9.
16	N/A	Unassigned	N/A	Not used. The PE II unit master/slave functionality is not supported using this pin. Use the Ascent DMS unit master/slave functionality.

*Table 4-4. 24 V 25-pin **USER** port pin descriptions for PE II adapter kit cable (Continued)*

Signal Pin	Related Pin	Name (PE II Name)	Signal Type	Description
				Corresponding pin on 37-pin connector: N/C.
17	19	*PULSE_OFF.D*	Input	A high on this pin will pulse off the output. The pulsing signal is limited to the following: an off time from 1 ms to 500 ms and a repetition rate of 1 to 500 times per second. On time is limited to a minimum of 1 ms. Corresponding pin on 37-pin connector: 4.
18	N/A	*INCOM.A* *(SETPOINT REFERENCE)*	N/A	This signal is a dedicated return for analog inputs. Reference pin 5 to this pin. Corresponding pin on 37-pin connector: 10.
19	N/A	*COM.D* *(DIGITAL COMMON)*	Common reference	This pin is the dedicated return for digital inputs and outputs. Reference pins 4, 6, 7, 8, 9, 11,14, 17, 20, 22, and 24 to this pin. Corresponding pins on 37-pin connector: 19, 36, 37.
20	19	*OUTPUT.D*	Output	When high, this signal indicates that the interlock is closed and output power is on. Corresponding pin on 37-pin connector: 2.
21	N/A	Unassigned	N/A	Not used. Corresponding pin on 37-pin connector: N/C.
22	19	*FAULT.D* *(OVERTEMP)*	Output	When high this signal indicates a fault or an overtemperature condition. Corresponding pin on 37-pin connector: 1.
23	10	*AUX.D INTLK* *(INTERLOCK)*	Input	See pin 10 for the signal description. Corresponding pin on 37-pin connector: 11.

*Table 4-4. 24 V 25-pin **USER** port pin descriptions for PE II adapter kit cable (Continued)*

Signal Pin	Related Pin	Name (PE II Name)	Signal Type	Description
24	19	*REG2.D*	Input	This signal is used with *REG1.D* (pin 11) to set the regulation mode. See "Setting the Regulation Mode" on page 4-14 for the logic table associated with this signal. Corresponding pin on 37-pin connector: 6.
25	N/A	Unassigned	N/A	PE II unit tap 2 not used. Corresponding pin on 37-pin connector: N/C.

SETTING THE REGULATION MODE

The following table shows the pin state for pins 5 and 6 to select a specific regulation mode.

Table 4-5. Regulation mode

Regulation Mode	*REG2.D* (Pin 24)	*REG1.D* (Pin 11)
Power	Low	Low
Voltage	Low	High
Current	High	Low
Power	High	High

INTERLOCK PORT

INTERLOCK Port Connector

The **INTERLOCK** port, located on the rear panel of the Ascent DMS unit, is a 9-pin, male, subminiature-D connector.

To enable the Ascent DMS unit to function, pins 3 and 4 of this connector must be shorted together (through a cheater plug, external switch, or relay). Pin 4 supplies the signal with 24 V, and it can source 60 mA.

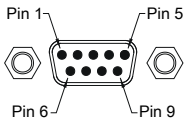


*Figure 4-6. **INTERLOCK** port connector*

INTERLOCK PORT SIGNAL AND PIN DESCRIPTIONS

CAUTION:
Grounding either interlock connection does not satisfy the system interlock.

The following table provides the connector pin descriptions for the **INTERLOCK** port interfaces.

*Table 4-6. **INTERLOCK** port pin descriptions*

Signal Pin	Related Pin	Name	Signal Type	Description
1	N/A	Unassigned	N/A	N/A
2	N/A	Unassigned	N/A	N/A
3	4	*UNIT ENABLE RETURN*		To enable the Ascent DMS power supply, pins 3 and 4 of this connector must be shorted together (through a cheater plug, external switch, or relay). Pin 4 supplies the signal with 24 V, and it can source 60 mA.
4	3	*UNIT ENABLE SIGNAL*		
5	8	*RESERVED*	N/A	N/A
6	8	*RESERVED*	N/A	N/A
7	8	*RESERVED*	N/A	N/A
8	5, 6, 7, and 9	*RETURN*		Common return and reference signal for pins 5, 6, 7, and 9.
9	8	*RESERVED*	N/A	N/A

INTERLOCK Cabling Requirements

To connect the **INTERLOCK** port, use a shielded, 9-wire, 22 AWG, jacketed cable (type UL® 2343) or an equivalent cable. You can use twisted-pair wiring, but this is not mandatory.

To minimize signal losses, keep the cable length as short as possible.

DANGER:

RISK OF DEATH OR BODILY INJURY. Disconnect and lockout/tagout all sources of input power before working on this unit or anything connected to it.

CAUTION:

Signals at the I/O port can be sensitive to noise. Take standard preventative measures against electromagnetic interference (EMI), including using shielded cabling on this port.

To minimize interference from adjacent electrical equipment, the EMI shield in the cable must be terminated to the metal shells of the cable connectors. Additionally, you must connect the unit chassis to a local earth ground through an adequately sized, copper grounding strap.

Advanced Energy does not include the **INTERLOCK** port cable with the Ascent DMS unit.

ETHERNET INTERFACE

The Ascent DMS unit provides an Ethernet communications interface that allows the unit to communicate with a host computer. The interface consists of a shielded RJ-45 port (labeled **ETHERNET** on your unit) and the AE TCP protocol, which uses function code (FC) 100.

ETHERNET Connector and Indicators

You can control the Ascent DMS unit through a network using an Ethernet Modbus®/TCP connection.

Important

The Ascent DMS unit supports a Modbus/TCP connection to port 502. For more information about the Modbus/TCP protocol, visit the Modbus Users website at: http://www.modbus.org.

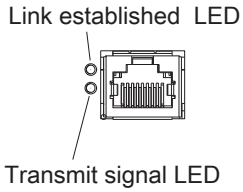


Figure 4-7. Ethernet connector and indicators

The two LEDs next to the Ethernet connector communicate when the unit is transmitting data and if the Ethernet link has been established.

- The Transmit Signal (yellow) LED lights and flashes when the unit is actively transmitting. The LED is off (not lit) when no data is being transmitted.
- The Link Established (green) LED is on (is lit and steady) when the Ethernet link has been established with the unit. The LED is off when no link has been established with the unit.

ETHERNET Port Pin and Signal Descriptions

Table 4-7. ETHERNET port pin and signal descriptions

Signal Pin	Pin Name	Description
1	*TX*+	Transmit data +
2	*TX*–	Transmit data –
3	*RX*+	Receive data +
4	Unassigned	Not connected
5	Unassigned	Not connected
6	*RX*–	Receive data –
7	Unassigned	Not connected
8	Unassigned	Not connected

AE TCP Protocol (FC100)

The AE TCP protocol is a method for communicating with an AE product using a network connection. It uses Modbus/TCP as a transport for AE Host commands. The Ascent DMS unit acts as a server while the host or tool program communicating with the unit acts as a client. The unit listens for requests for TCP connections on registered port 502. Port 502 is assigned to Modbus/TCP protocol. The unit can support up to six simultaneous TCP connections.

Modbus user-defined function code FC100 encapsulates AE Host commands and data into Modbus/TCP packets. FC100 functions according to the Modbus/TCP standard (visit http://www.modbus.org for more information). You can use FC100 to run all common commands.

ESTABLISHING A CONNECTION

To establish a TCP connection, the host or tool program (client) connects to TCP port 502. If the number of already established connections exceeds the predefined limit for the given equipment, the connection is rejected.

Once the connection is established, the client may perform multiple transactions consisting of the following two steps:

1. The client sends a request containing an AE Host command to be executed by the Ascent DMS unit (server).
2. The server executes the AE Host command and returns a packet containing the unit's reply to the command (CSR and data).

☞ **Important**
For optimum performance, keep the TCP connection open during continuous operation. Opening and closing a connection for each command transaction will result in poor communication performance.

DATA ENCODING

Each Modbus/TCP message packet consists of two sections: A Modbus Application Protocol (MBAP) header and a protocol data unit (PDU).

The MBAP header contains the following information:

- Transaction ID (2 bytes)
- Protocol ID (2 bytes)
- Length (2 bytes)
- Unit ID (1 byte)

Following the MBAP header, the PDU consists of the following information:

- Function code (1 byte)
- Command number (1 byte)
- Command status response (CSR; 1 byte)

  All commands and responses include a CSR byte.
- Data length (2 bytes)
- Data bytes (as many as 248)

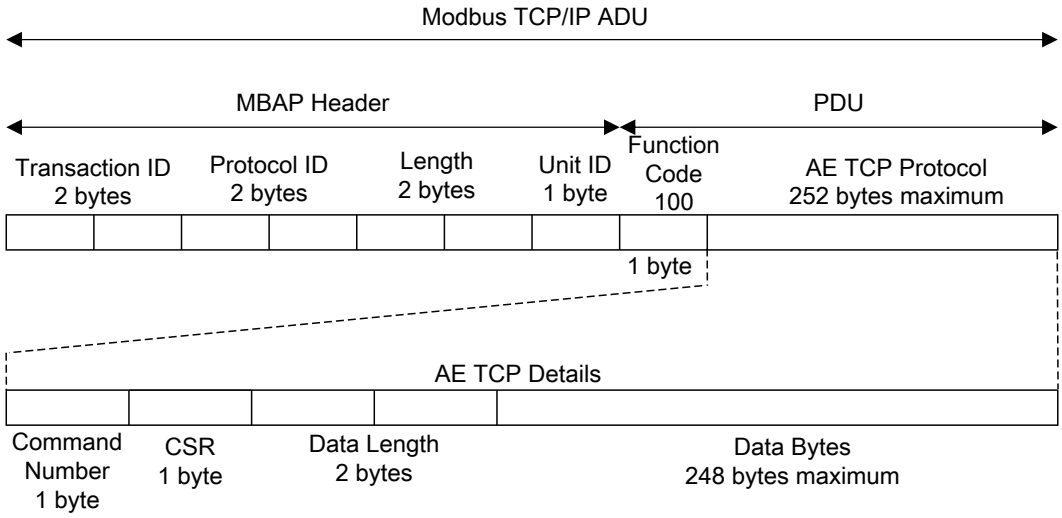


Figure 4-8. Data encoding for AE TCP using FC100

The Modbus/TCP protocol uses big endian (most significant byte first) architecture. The AE TCP portion of each packet uses little endian (least significant byte first) architecture.

To remain compliant with Modbus/TCP protocol, the PDU size must be no larger than 253 bytes.

Using AE FC100

FC100 allows you to send any AE Host command through the Ethernet interface, providing complete control of the system.

FC100 SEND PACKET FORMAT

Table 4-8. Format for FC100 send packet

Byte Numbers	Purpose	Value To Send
MBAP		
0 and 1	Transaction ID	Not used (value is copied into reply)
2 and 3	Protocol ID	0
4 and 5	Number of bytes following	Count of bytes in packet (starting with byte 6)
6	Unit ID	Address of unit • Unit ID ◦ 0 or 1 = Normal operation

Table 4-8. Format for FC100 send packet (Continued)

Byte Numbers	Purpose	Value To Send
		◦ 2 to 254 = Reserved ◦ 255 = Broadcast (command is received and processed, but no response)
PDU		
7	Function code	100 = 0x64
8	AE Host command number	AE Host command number
9	CSR	Send packets Do not use the CSR byte; it can be set to 0.
10 and 11	Data length	Number of TCP data bytes in the packet
12 and up	Data bytes	Data bytes contained in the command packet ☞ **Important** All bytes in the PDU (byte 8 to end of packet) are in little endian order (least significant bytes first).

FC100 RESPONSE PACKET

Table 4-9. Format for FC100 response packet

Byte Numbers	Purpose	Value To Send
MBAP		
0 and 1	Transaction ID	Not used (value is copied from send packet)
2 and 3	Protocol ID	0
4 and 5	Number of bytes following	Count of bytes in packet (starting with byte 6)
6	Unit ID	Identity of unit: • Unit ID ◦ 1 = Normal operation ◦ 2 to 255 = Reserved
PDU		
7	Function code (100)	0x64

Table 4-9. Format for FC100 response packet (Continued)

Byte Numbers	Purpose	Value To Send
8	AE command number	AE Host command number
9	CSR	CSR byte (always returned)
10 and 11	Data length	Total number of data bytes in the packet
12 and up	Data bytes	Data bytes contained in the command packet ☞ **Important** All bytes in the PDU (byte 8 to end of packet) are in little endian order (least significant bytes first).

FC100 ERROR PACKETS

If the communication from the host to the Ascent DMS unit encounters no problems, the unit sends CSR 0 (command accepted). If something goes wrong in the communication to the unit, you receive one of these two notifications:

- Modbus/TCP error packet: The Modbus/TCP protocol issues an exception error packet
- CSR packet: The Ascent DMS unit replies to commands with a CSR packet.

Table 4-10. Format for FC100 Modbus/TCP exception error packet

Byte Numbers	Purpose	Response Value
0 and 1	Transaction ID	Not used (value is copied from send packet)
2 and 3	Protocol ID	0
4 and 5	Number of bytes following	Count of bytes in packet (starting with byte 6)
6	Unit ID	Unit identifier
7	Function code	228 = 0xE4
8	Exception code	One of many available exception codes

Table 4-11. Format for FC100 CSR packet

Byte Numbers	Purpose	Response Value
0 and 1	Transaction ID	Not used (value is copied from send packet)

Table 4-11. Format for FC100 CSR packet (Continued)

Byte Numbers	Purpose	Response Value
2 and 3	Protocol ID	0
4 and 5	Number of bytes following	Count of bytes in packet (starting with byte 6)
6	Unit ID	Unit identifier
7	Function code	100 = 0x64
8	Command	AE Host command number
9	CSR	One of many CSR codes
10 and 11	Data length	0

FC100 EXAMPLE

Refer to the following information for an example that illustrates using AE Host command 14 to read back power, voltage, and current from the unit using the AE TCP connection with FC100.

*Table 4-12. Packet format for command **14** send*

Byte Numbers	Send Value	Purpose
0 and 1	0x00, 0x00	Transaction ID (any value)
2 and 3	0x00, 0x00	Protocol ID
4 and 5	0x00, 0x07	Number of bytes following (count of bytes in packet starting with byte 6)
6	0x01	Unit ID
7	0x64	Function code (100 = 0x64)
8	0x0E	AE Host command number = **14**
9	0x00	CSR = Reserved
10 and 11	0x01, 0x00	Data length = 1 End of packet—no data bytes exist in this command
12	0x04	Data byte: 2 = **HOST** port

This table illustrates the response packet for command 14.

*Table 4-13. Packet format for command **14** response*

Byte Numbers	Send Value	Purpose
0 and 1	0x00, 0x00	Transaction ID (any value)
2 and 3	0x00, 0x00	Protocol ID
4 and 5	0x00, 0x06	Number of bytes following (count of bytes in packet starting with byte 6)
6	0x01	Unit ID
7	0x64	Function code (100 = 0x64)
8	0x0E	AE Host command number = **14**
9	0x00	Command status response = CSR value
10 and 11	0x00, 0x00	Number of data bytes in response

AE BUS INTERFACE (HOST PORT)

The Ascent DMS unit provides a serial communications interface through the **HOST** port. This interface allows the Ascent DMS unit to interface with a host computer using the AE Bus protocol.

HOST Connector

The serial **HOST** port connector is a 9-pin, female, shielded, subminiature-D connector for interfacing with a host computer.

*Figure 4-9. **HOST** port connector*

HOST Port Pin Descriptions

*Table 4-14. **HOST** port pin descriptions*

Signal Pin	Name	Description
1	RESERVED	Reserved for future use
2	tx RS232	RS-232 transmit data

Table 4-14. HOST port pin descriptions (Continued)

Signal Pin	Name	Description
3	rx RS232	RS-232 receive data
4	RESERVED	Reserved for future use
5	Digital Ground	This pin connects to the digital ground of the controller
6	RS485 -	RS-485 LOW
7	RS485 +	RS-485 HIGH
8	RESERVED	Reserved for future use
9 [1]	RESERVED (FACTORY)	Reserved for future use

[1] Do not connect pins marked *RESERVED*. Do not ground this factory reserved pin. Grounding this pin disrupts the operation of the unit.

Units using RS-485: Termination resistors are not installed in the unit. If your configuration requires termination, then install termination resistors across the RS-485 network per your controller requirements.

AE Bus Transmission Parameters

The communications capability of the **HOST** port is limited to the following parameters:

- RS-232 or RS-485 transmission standard
- Baud rates:
  - 9600
  - 19,200
  - 57,600
  - 115,200
- Ascent DMS unit addresses 1 to 31
- Odd parity
- One start bit, eight data bits, one stop bit
- Low-order bytes transmitted before high-order bytes (little endian)

The timeout period for the Ascent DMS unit is factory set at 0.75 seconds (that is, no more than 0.75 seconds can elapse between bytes, or the unit will reset and begin searching for a new message packet). Use command **40** to change this value.

The host computer must finish one transaction with the Ascent DMS unit before it initiates another one, either with the same unit or any other unit.

HOST Port DIP Switches

Use the DIP switch to set the unit AE Bus address, the baud rate, and the communication mode for your unit.

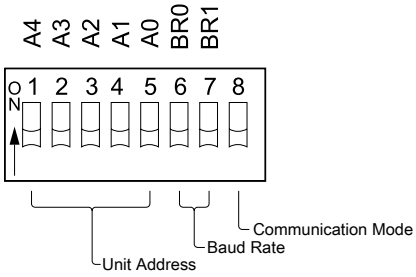


Figure 4-10. DIP switch

The DIP switch contains eight individual switches. Setting a switch to the on position means sliding the switch toward the numbers on the DIP, and setting a switch to the off position means sliding it away from the numbers.

SWITCHES

The first five switches (A4 to A0) specify the address of the Ascent DMS unit, which a host computer must include in the message packet it sends. Each Ascent DMS unit in a network must have a unique address.

The next two switches (6 and 7) specify the AE Bus port's baud rate. Switch 8 sets communication mode, either RS-232 or RS-485.

SETTING THE BAUD RATE

Use DIP switches 6 and 7 to set the serial AE Bus port baud rate. Use switch 8 to select communication mode, either RS-232 or RS-485.

Table 4-15. DIP switch settings for variable baud rate, switches 6 and 7

Baud	Switch 6	Switch 7
9600	on	on
19,200	on	off
57,600	off	on
115,200	off	off

SETTING THE COMMUNICATION MODE

Table 4-16. DIP switch settings for communication mode, switch 8

Switch Position	Communication Mode
on	RS-232
off	RS-485

SETTING THE UNIT AE BUS ADDRESS

Use the DIP switch to set the unit AE Bus address.

Table 4-17. AE Bus address settings

Address	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5
0	Do not assign this address to a unit; it is the AE Bus broadcast address. All AE Bus units receive a message sent to this address by the host, but will not reply. If you set the address to 0, the unit automatically re-assigns the address to 1				
1	on	on	on	on	off
2	on	on	on	off	on
3	on	on	on	off	off
4	on	on	off	on	on
5	on	on	off	on	off
6	on	on	off	off	on
7	on	on	off	off	off
8	on	off	on	on	on
9	on	off	on	on	off
10	on	off	on	off	on
11	on	off	on	off	off
12	on	off	off	on	on
13	on	off	off	on	off
14	on	off	off	off	on
15	on	off	off	off	off
16	off	on	on	on	on
17	off	on	on	on	off
18	off	on	on	off	on
19	off	on	on	off	off
20	off	on	off	on	on
21	off	on	off	on	off

Table 4-17. AE Bus address settings (Continued)

Address	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5
22	off	on	off	off	on
23	off	on	off	off	off
24	off	off	on	on	on
25	off	off	on	on	off
26	off	off	on	off	on
27	off	off	on	off	off
28	off	off	off	on	on
29	off	off	off	on	off
30	off	off	off	off	on
31	off	off	off	off	off

AE Bus Protocol

The AE Bus protocol uses pure binary data (nothing is coded in ASCII) and is designed to facilitate direct communications between a host computer and the Ascent DMS unit. The AE Bus message packet combines a set quantity of bits and bytes in such a way that groups of information can be sent over communications lines at one time. Five types of information (fields) make up a communications message packet.

- Header (address and the length of Data field)
- Command Number
- Optional Length byte
- Data
- Checksum

Figure 4-11 shows the organization of these fields in the AE Bus message packet. The subsequent paragraphs describe each field in detail.

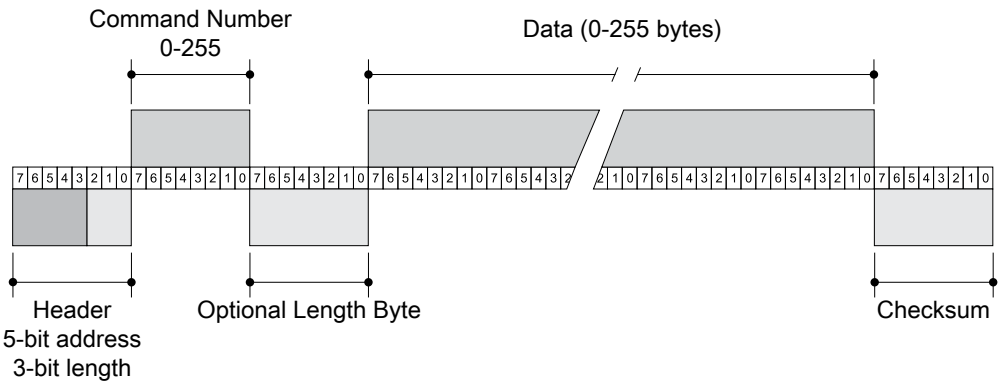


Figure 4-11. Graphic representation of a message packet

AE BUS HEADER BYTE

The first byte in each packet contains two pieces of information: five bits contain the packet address, and three bits contain the data byte count. If the message packet originates with the host computer, the address specifies the packet destination (to the Ascent DMS unit, for example). If the packet is going to the host, the address specifies the packet origin (from the Ascent DMS unit). The address section of the Header field is five bits long (bits 3-7), which allows a total of 32 distinct addresses. Address 0 (zero) is reserved for the network broadcast address, which the Ascent DMS unit does not support.

The remaining three bits (bits 0, 1, and 2) are the length bits. These bits tell the receiving unit how long the Data field is so that the unit can determine when it has received the entire message. If the Data field contains more than six bytes, the value of these three bits will be set to 7 (07h), and the Optional length byte field will contain a value indicating the number of data bytes in the Data field.

☞ **Important**

The value of these bits refers only to the number of actual data bytes in the Data field. Do not include the checksum byte when calculating the value for these bits.

AE BUS COMMAND NUMBER BYTE

This one-byte field contains an 8-bit value from 0 to 255 (00h to ffh) representing the command number. If the message packet originates with the host computer, this value specifies the purpose of the message packet. If the message originates with the Ascent DMS unit, the value specifies the command to which it is responding.

AE BUS OPTIONAL LENGTH BYTE

This field supplements the Header field and exists only when the length bits (bits 0, 1, and 2) in the Header field contain a value of 7 (07h). If the number of data bytes in the Data field is six or less, then the three length bits in the Header field are sufficient to represent this amount 0 to 6 (00h to 06h). Since the Data field may contain up to 255 bytes of information, the Optional Length byte is required when the Data field is larger than six bytes.

When the Data field is larger than six bytes, the length bits in the header (bits 0, 1, and 2) equals 7 (07h), and the Optional Length byte contains a one-byte value, from 7 to 255 (07h to ffh), representing the number of data bytes in the Data field.

AE BUS DATA BYTES

The Data field may contain from 0 to 255 bytes of binary data. This field contains command-related data or a command status response (CSR). Since some commands do not require data, sometimes the Data field is not present.

If the value specified in the length bits (bits 0, 1, and 2) of the Header field is 0 to 6, the Ascent DMS unit expects zero to six data bytes. However, if the value in the Header field is 7 (07h), the Ascent DMS unit looks for the Optional Length byte after the Command field and reads this value to calculate the data byte count.

Unless otherwise specified for individual commands, AE Bus protocol is little endian, which means that all values greater than 1 byte are sent in little endian order. For example, a command with 7 data bytes that included one 8-bit value, one 16-bit value, and one 32-bit value, would be sent as shown in Table 4-18.

Table 4-18. AE Bus byte structure

Value to send	Byte configuration
8-bit value = 15	Byte 1 = 0x0F
16-bit value = 23450	Bytes 2 and 3 = 0x9A 0x5B
32-bit value = 147679	Bytes 4 through 7 = 0xDF 0x40 0x02 0x00

AE BUS CHECKSUM BYTE

This one-byte field is the last byte in the packet. The value of this byte depends upon the number of bytes in each of the preceding fields. The transmitting unit determines this value by accumulating the exclusive-or (XOR) of all bytes of the packet up to, but not including, the checksum value. The receiving unit accumulates the XOR of all bytes of the packet, including the checksum. If the result is zero, the unit has received the packet intact.

The unit will act on the message only if the address is valid and the checksum is validated.

Creating an Ideal Communications Transaction

Figure 4-12 illustrates the steps in an ideal communications transaction between a host computer and the Ascent DMS unit.

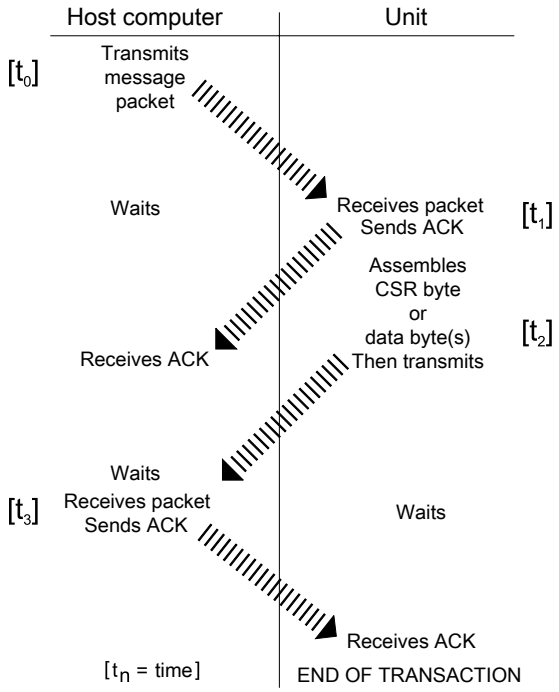


Figure 4-12. AE Bus communications transaction

T_0: HOST TRANSMITS MESSAGE PACKET

The host computer sends a message packet to the Ascent DMS unit. The packet contains one of the following:

- A command that requests data or status information
- A command and data that change a parameter setting
- An executable command

T_1: UNIT VERIFIES HOST TRANSMISSION PACKET

Once the Ascent DMS unit receives the host computer transmission message packet, the Ascent DMS unit verifies that the message is intended for it and not for another unit on the network. At this time, the Ascent DMS unit also analyzes the checksum to verify that the message was received correctly.

- If the address does not match, the Ascent DMS unit does not respond to the host computer; the Ascent DMS unit resets and resumes waiting for a message addressed to it. If the address matches but the exclusive-or (XOR) sum of the bytes in the packet (including the checksum) is not zero, the Ascent DMS unit sends a negative acknowledgment (NAK), hexadecimal 15h, to the host computer.
- If the address matches and the message is intact, the Ascent DMS unit sends an acknowledgment (ACK), hexadecimal 06h, to the host computer.

If the Ascent DMS unit receives a request for data or status information, it gathers and sends the requested information. Otherwise, it evaluates the incoming command and sends a message packet that contains a one-byte data value (CSR code) to the host. The power supply sends CSR code 0 when it has accepted the command.

If the host computer receives a NAK from the Ascent DMS unit, the host computer either retransmits the packet or does whatever else it has been programmed to do in this situation. If the host computer receives an ACK, it waits for the requested data or status information, or it waits for the CSR code telling it whether or not the new parameter was accepted. If the host computer receives no response within a reasonable period, it takes whatever action it has been programmed to take.

T_2: UNIT TRANSMITS RESPONSE TO HOST

The Ascent DMS unit prepares a response packet with the requested information or appropriate CSR code, which it then transmits to the host computer. The host computer then determines, by means of the checksum, if the response packet is complete. If the host computer detects an error in the transmission (the checksum is not validated), it can request the packet be sent again by transmitting a NAK.

T_3: HOST ACKNOWLEDGES UNIT RESPONSE

If the Ascent DMS unit receives an ACK from the host computer, it returns to the normal waiting state. If the Ascent DMS unit receives a NAK from the host computer, the unit retransmits the response packet. The Ascent DMS unit continues to retransmit in response to NAK transmissions until the host computer stops the cycle. If the Ascent DMS unit receives no response, it assumes an ACK and returns to the waiting state.

AE BUS COMMUNICATIONS TRANSACTION EXAMPLE

Figure 4-13 illustrates the steps in an example communications transaction between a host computer and the Ascent DMS unit.

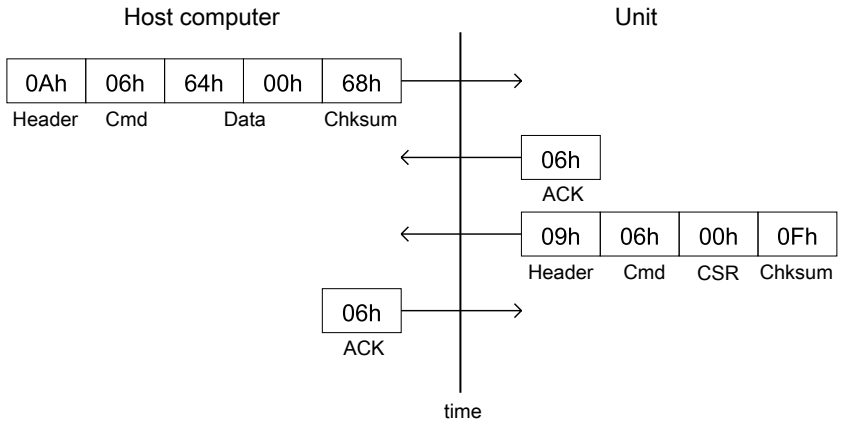


Figure 4-13. Communications transaction example

PROFIBUS INTERFACE

The Ascent DMS unit provides a serial communications interface through the **PROFIBUS** (Process Field Bus) port. This interface allows the Ascent DMS unit to interface with a PROFIBUS Master, which resides in a programmable logic controller (PLC).

PROFIBUS Connector

The serial **PROFIBUS** port connector is a 9-pin, female, shielded, subminiature-D connector for interfacing with a programmable logic controller (PLC). An eight-switch DIP (dual in-line package) is adjacent to the connector for setting the PROFIBUS address.

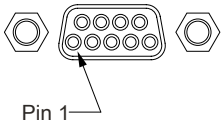


*Figure 4-14. **PROFIBUS** port connector*

PROFIBUS Port Pin and Signal Descriptions

*Table 4-19. **PROFIBUS** port pin and signal descriptions*

Signal Pin	Return Pin	Pin Name	Signal Type	Description
1	n/a	Unassigned	n/a	n/a
2	n/a	Unassigned	n/a	n/a
3	n/a	PROFI_RS485A	Digital I/O	RS-485A, PROFIBUS differential data A
4	n/a	Unassigned or PROFI_RTS_ISO	n/a or Digital I/O	One of the following: • n/a • PROFIBUS RTS (this pin must be left open if not used)
5	n/a	PROFI_DGND	0 V isolated	Isolated returns of the PROFIBUS 5 V supply for line impedance termination
6	5	+5 V	+5 VDC	Isolated PROFIBUS 5 V supply for line impedance termination

Table 4-19. PROFIBUS port pin and signal descriptions (Continued)

Signal Pin	Return Pin	Pin Name	Signal Type	Description
7	n/a	Unassigned	n/a	n/a
8	n/a	PROFI_RS485B	Digital I/O	RS-485B, PROFIBUS differential data B
9	n/a	Unassigned	n/a	n/a

PROFIBUS Cabling and Termination

The cable used for the **PROFIBUS** interface must be RS-485 shielded twisted pair compatible with PROFIBUS standard communication requirements. Maximum segment lengths depend on the baud rate.

Table 4-20. Baud rate and cable lengths

Baud Rate	Length
1.5 M	200 meters
12 M	100 meters

Terminate each segment at both ends, and power the termination at all times. If a segment has more than 31 devices, then you must use a repeater. The termination resistors should be on the connector housing of the PROFIBUS cable (not included). Ensure that you follow proper termination procedures if your generator is the last slave on the PROFIBUS cable.

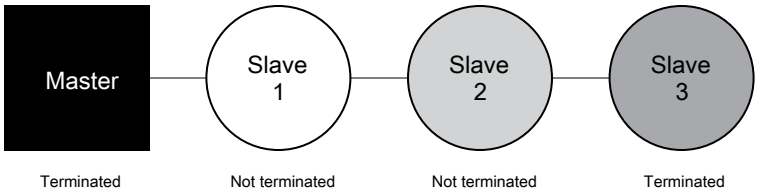


Figure 4-15. Example of a segment

AE PROFIBUS Protocol

The **PROFIBUS** port provides an interface that lets you communicate with the Ascent DMS unit from a PROFIBUS master. AE manufactures a PROFIBUS interface compliant with PROFIBUS masters described in the DIN 19245 PROFIBUS Standard DP, part III. Any PROFIBUS master that complies with this standard can communicate with the AE PROFIBUS interface.

☞ **Important**
The AE PROFIBUS protocol does not support the following functions: address changing, freeze/unfreeze modes, or sync modes.

PROFIBUS GSD FILES

GSD files are computer files that most programmable logic controllers (PLCs) use to configure PROFIBUS slaves. These files are device-specific and contain information on features found in that device.

The GSD file for your unit PROFIBUS interface is available from Advanced Energy. For general PROFIBUS information and specific information about GSD files, visit the following website:

http://www.profibus.com

SETTING THE UNIT PROFIBUS NETWORK ADDRESS

You can set the Ascent DMS unit PROFIBUS address to an even-numbered address from 2 through 126.

To set the unit PROFIBUS address, use the external DIP switch next to the **PROFIBUS** port.

Depending on the unit you have, the Ascent DMS unit provides at least one of these methods of setting the PROFIBUS address:

- External DIP switch
- AE Bus or software command

☞ **Important**
You cannot change the unit address from the PROFIBUS master.

If your unit has a DIP switch adjacent to the **PROFIBUS** port, you can change the unit address with that switch. If there is no DIP switch or rotary dial, you must change the address through the AE Bus interface.

TO SET THE UNIT PROFIBUS ADDRESS THROUGH AN EXTERNAL DIP SWITCH

The following graphic shows a **PROFIBUS** port and DIP switch. As shown in the illustration, the DIP switch has numbered switch labels (1 through 8).

One side of the DIP switch shows the switch numbers (1 through 8). Switch 8 is the msb. Positioning a switch toward the number indicates a “1” binary. To enter the unit address, set the DIP switch positions for binary representation of the desired address, with switch 8 as the msb. For example, to set an address of 4, set the switches to 00000100.

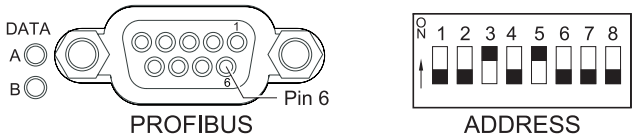


*Figure 4-16. **PROFIBUS** port, LEDs, and DIP switch*

PROFIBUS STATUS LED

The PROFIBUS LEDs (light-emitting diodes) on the rear panel indicate the following:

- **DATA A** = Lights when the device is recognized on the network
- **DATA B** = Reserved

PROFIBUS MASTER RESET COMMAND

Send the master reset command, PROFIBUS command **119**, when the Ascent DMS unit experiences an explicit clear fault (such as a PROFIBUS error fault). AE also recommends sending this command at the startup of PROFIBUS communications to clear any existing fault indications.

BAUD RATE

The auto-baud feature of the AE PROFIBUS interface adjusts automatically to the rate of the PROFIBUS master system. Baud rates are available in discrete steps from 9600 bits (9.6 kbits) to 12 Mbits.

WATCH DOG TIMER

As a safety feature, the PROFIBUS maintains a watch dog timer that shuts off the Ascent DMS unit output and shows an error (**PROFIBUS WATCHDOG EXPIRED**) if the PROFIBUS master stops communicating. The watch dog timer maintains a value for time (between 10 ms and 10 minutes) that the Ascent DMS unit waits between commands from the master. The timer counts down this time in 10 ms increments.

If your PROFIBUS system does not calculate the watch dog timer value for you or if you want to modify the existing watch dog timer value, then you may enter a timer value by using the PROFIBUS **Set_Prm** function call (see DIN 19245 PROFIBUS Standard Part III).

To get the actual wait time value, the unit's microprocessor uses the numbers you enter to octet 2 and 3 of **Set_Prm**, multiplies them together, and then multiplies the result by 10 ms. Therefore, when using the **Set_Prm** function call, calculate the numbers for octet 2 and 3 accordingly. The values for octet 2 and 3 must not equal or be zero.

You can disable the watch dog timer through the PROFIBUS master.

PROFIBUS-SPECIFIC ERRORS

In the event of a PROFIBUS error, the Ascent DMS unit turns off output power and sets the PROFIBUS fault status bit. All PROFIBUS errors are treated as explicit clear faults, which means that you must send PROFIBUS command **119** (the master reset command) or the Off command in the next download packet to clear the faults and resume operation.

PROFIBUS DATA CONSISTENCY

Some PLCs have a problem with data consistency, that is, the ability to complete the message packet construction before sending the packet to the Ascent DMS unit. Data inconsistency most often results in inappropriate value changes at the Ascent DMS unit.

This problem occurs because most PLCs share a memory block with the PROFIBUS interface. The PLC places data/packet information in the memory block, and the PROFIBUS interface reads the memory block for the next data/packet to transmit. Data inconsistency problems occur when the PLC updates the data from high to low memory locations without signaling the PROFIBUS interface that the update is complete. (If the PLC were to notify the PROFIBUS interface, then there would be data consistency.) As a result, the PROFIBUS interface sends the memory block regardless of where the PLC is in its update of that memory block.

You can create a workaround to this problem with a command sequence that ensures the data for a command will not be changed before the next download packet is received. Here is an example procedure:

1. Send the null command (command **0**). The Ascent DMS unit ignores this command.
2. Update the download packet with data for the desired command.
3. Update the packet with the desired command.
4. Send the download packet.
5. Repeat step 1, and continue as needed.

See your PLC documentation for additional information.

TRANSMISSION RATES AND THE HANDSHAKE FEATURE

It is possible for PLCs to send commands faster than the Ascent DMS unit can respond. This situation can cause the Ascent DMS unit to have intermittent failures in responding to or executing commands.

In response to this issue, AE has developed a handshake feature, which echoes back the last sent command in the last byte of the upload packet. This feature allows you to send a command and wait for verification that the command was accepted before sending the next command. Using the handshake feature has the following benefits:

- It simplifies the programming of PLCs that interact with AE products.

- It increases the bandwidth of the PROFIBUS channel by eliminating wasted time.
- It provides immediate feedback regarding command execution.
- It increases the reliability of PROFIBUS communications.

☞ **Important**
You can choose not to use the handshake feature, but if you do so, do not send commands to the Ascent DMS unit at a rate faster than one command per 20 milliseconds.

Expanded PROFIBUS Command Structure

This unit uses the AE expanded PROFIBUS format, which supports a larger data size.

The number command-based AE PROFIBUS protocol is designed to take advantage of the high transmission rates provided by the PROFIBUS standard. The download packet (outbytes) and the upload packet (inbytes) as well as the AE PROFIBUS "handshake" feature are described in the sections that follow.

The execution time of all PROFIBUS commands is less than 400 µs.

EXPANDED PROFIBUS DOWNLOAD PACKET

The download packet for PROFIBUS contains 16 bytes.

Table 4-21. Configuration of PROFIBUS download packet bytes

Byte	Description
0	Command
1	Data byte (LSB)
2 to 14	Data byte
15	Data byte (MSB)

In the download packet, bytes 1 through 15 make up the data field and contain information defined by the command.

When the data exceeds one byte, the packet sends the least significant byte (LSB) before the most significant byte (MSB).

EXPANDED PROFIBUS UPLOAD PACKET

During every PROFIBUS data exchange, the Ascent DMS unit supplies a 32-byte upload packet. This table defines the bytes contained in the upload packet.

Table 4-22. PROFIBUS upload packet structure

Byte	Description
0	Status flags–first byte
1	Status flags–second byte
2 and 3	Power in W (for example, 1 = 1 W)
4 and 5	Voltage in V (for example, 1 = 1 V)
6 and 7	Current in hundredths of A (for example, 1000 = 10 A)
8	Data byte (LSB) or CSR code when applicable
9 through 29	Data byte
30	Data byte (MSB)
31	Command number (echo of command sent)

PROFIBUS UPLOAD PACKET DATA BYTES 0 AND 1

Bytes 0 and 1 of the upload packet contain information (in the form of status bit flags) about the status of the Ascent DMS unit.

Table 4-23. PROFIBUS upload packet status bit flags

Byte	Description
Byte 0—first status byte	Bits 0 and 1 = Reserved Bit 2 = Reserved Bit 3 = Reserved Bit 4 = Reserved Bit 5 = Active toggle bit (see Note 1) Bit 6 = Reserved Bit 7 = At setpoint
Byte 1—second status byte	Bit 0 = Reserved Bit 1 = Reserved Bit 2 = Interlock mechanism open Bit 3 = Reserved Bit 4 = Reserved Bit 5 = Reserved Bit 6 = Reserved Bit 7 = Output is on
Note 1: Byte 0, bit 5 indicates the status of the PROFIBUS interface. After the Ascent DMS unit has powered on, this bit toggles to indicate that the PROFIBUS interface is ready. If this bit stops toggling during operation, it indicates a communication problem.	

EXPANDED PROFIBUS UPLOAD PACKET DATA BYTES 8 THROUGH 31

In the upload packet, bytes 8 through 30 make up the data field and contain information defined by byte 31 (echo of the command number).

When the reply data extends over more than one byte, the PROFIBUS sends the least significant byte (LSB) before the most significant byte (MSB).

SERVICE CONNECTOR

The **SERVICE** connector is a USB micro B female connector. The interface is used primarily for servicing the unit.

This connection is not required.

Figure 4-17. SERVICE connector

SYNC PWR IN AND SYNC PWR OUT CONNECTORS

The **SYNC PWR IN** and **SYNC PWR OUT** connectors are RJ-45 connectors used to synchronize frequency and arcs between multiple devices.

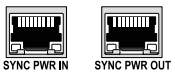


Figure 4-18. SYNC PWR IN and SYNC PWR OUT connectors

ARC IN/OUT CONNECTORS

These connectors are reserved for future use.

The **ARC IN/OUT** connectors are SMA connectors used to synchronize arcs between multiple devices.

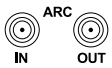


Figure 4-19. ARC IN/OUT connectors

FREQ IN/OUT CONNECTORS

These connectors are reserved for future use.

The **FREQ IN/OUT** connectors are SMA connectors used to synchronize between multiple devices.

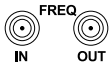


Figure 4-20. FREQ IN/OUT connectors

M/S IN/OUT CONNECTORS AND MASTER/ SLAVE PANEL

The master/slave connectors allow Ascent DMS units to operate in a master/slave configuration.

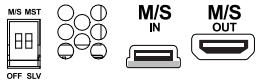


Figure 4-21. Master/slave connectors and switches

See the installation chapter for details on the master/slave connectors, switches, and installation.

Related Links

- "Connecting for Master/Slave Operation" on page 5-25

EXTERNAL TABLET CONNECTOR

This connector is reserved for future use.

The **EXTERNAL TABLET** is a USB type A female connector. This interface is used primarily for unit configuration and service. You can connect this port to a tablet running the Ascent DMS app. This USB interface is located on the front panel.

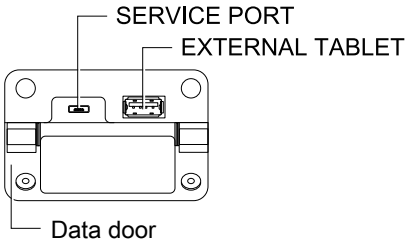


Figure 4-22. EXTERNAL TABLET connector

SERVICE PORT CONNECTOR

The **SERVICE PORT** is a USB micro B female connector. This interface is used primarily for servicing the unit. This interface is located on the front panel.

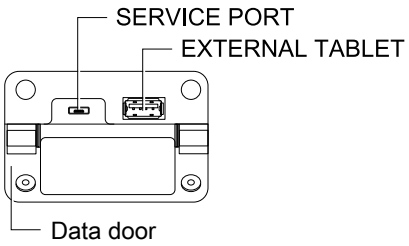


Figure 4-23. SERVICE PORT connector

AE HOST COMMANDS

The following sections describe the command status response (CSR) codes returned by the Ascent DMS unit in response to an AE Host command, as well as the AE Host commands. You can use these commands with one or more of the following interfaces (depending on your unit's configuration):

- AE Bus (serial)
- PROFIBUS
- Ethernet

AE Host Command Status Response (CSR) Codes

When the Ascent DMS unit receives a command requesting a change in unit operation (command numbers 1 through 127), or when the Ascent DMS unit receives any command that it rejects (command numbers 1 through 255), it responds with a command status response (CSR) code. The CSR is a single-byte number that

indicates whether the unit accepted or rejected the command and, in the case of rejection, the reason the unit could not respond to the command.

Table 4-24. AE Host command status response (CSR) codes

Code	Meaning
0	Command accepted
The following CSR codes are sent in response to a command that was not accepted and provide an indication of why the command was not accepted	
1	Control mode incorrect
2	Output on (change not allowed)
3	Output off (change not allowed)
4	Data out of range
5	Invalid parameter
6	Program source incorrect
7	Active fault(s) exist
8	Ramping active (change not allowed)
9	Data byte count incorrect
10	**USER** port has priority
11	Bus not ready (change not allowed)
12	This feature is not available on your unit
14	Regulation mode invalid
15	Ramp invalid (reset ramp start setpoint parameter to valid setting)
16	Target life expired
17	Output off timer active (minimum off time is 50 ms)
18	Limited duty cycle time active (change not allowed)
19	Recipe active (change not allowed)
21	Joule setpoint not reached
22	Process voltage fault has occurred
23	Inverter low fault active
24	Bus fault has occurred
25	Unit is configured as a slave
27	Output off timer active (minimum off time is 50 ms)
28	Setpoint exceeds user limit
29	Regulation mode not selectable (because it is locked)
31	The **USER** port reset active (you must deassert the reset line on the **USER** port)

Table 4-24. AE Host command status response (CSR) codes (Continued)

Code	Meaning
33	Timer out of range
34	Arc count limit out of range
37	Ramp/recipe inactive
38	Ramp and recipe hold already active
39	Ramp and recipe hold not active
40	The **USER** port standby line active. You must deassert it.
41	VArc sense level out of range
42	Current threshold for VArc out of range
47	Ignition setpoint out of range
48	Invalid target selection
49	Target life out of range
50	Invalid recipe step
51	Ramp start point out of range
52	Ramp time out of range
53	Run time out of range
54	Joule setpoint out of range
55	Joule threshold out of range
56	Invalid joule type
57	Invalid recipe type
58	Clock data out of range
59	RTC clock busy
62	Rev request out of range
63	Slave address out of range
64	System size out of range
65	Arc profile index out of range
67	Setpoint compensation limit out of range
68	Pulsing parameter out of range
69	Parameter cannot be changed while pulsing is enabled
79	Arc mask time out of range
80	Master/slave fault
81	Conflicts with enabled DHCP
82	Master/slave system diagnostic failure
83	Master/slave system not at steady state

Table 4-24. AE Host command status response (CSR) codes (Continued)

Code	Meaning
84	Master/slave system size (in kilowatts) does not match input parameter
85	Master/slave system size (in units) does not match input parameter
92	IArc sense level out of range
94	Arc persistence time out of range
95	Cannot enable both anode low and high
96	Anode high threshold out of range
97	Anode low threshold out of range
99	Command not accepted (there is no such command)
100	Arc shutdown time out of range
101	Arc window out of range
119	PROFIBUS fault was cleared
131	Specified interface is not installed
132	**USER** port not installed
135	Invalid parameter
150	EEPROM read/write error
151	One or more warnings active
152	DHCP enabled
153	Pulsing frequency out of range
155	Pulsing on/off time violated
156	Flash mode active

AE Host Command Set

The Ascent DMS unit communication interfaces use two types of AE Host commands:

- Commands **1** through **127** request a change to the Ascent DMS unit, such as changing a setting in the unit. The unit responds to these commands by sending a command status response (CSR). This single-byte response indicates whether the unit has accepted or rejected the command and, in the case of rejection, the reason the unit could not respond to the command.
- Command numbers **128** through **255** request information from the unit, such as unit settings. The unit responds to these commands by sending the data requested if the command was successful, and a CSR if the command was not successful.

Unless otherwise specified for individual commands, AE Bus protocol is little endian, which means that all values greater than 1 byte are sent least significant byte first.

Table 4-25. AE Host Commands

Command	Description	Data Bytes Sent	Data Bytes Returned
0 **NULL**	NULL command. For AE Bus: The Ascent DMS unit will ignore this command. For PROFIBUS: The Ascent DMS unit will ignore this command, unless your unit has the feature to allow command 0 to turn output off.	0	CSR only
1 **output off**	Turns DC output off. This request is always honored, regardless of which interface has control. This command clears all latched faults, but does not clear currently active faults.	0	CSR only
2 **output on**	Turns DC output on if there are no active or latched faults. Command **161** reports the status of the last output on event.	0	CSR only
3 **regulation mode**	Sets the regulation mode to power, current, or voltage. You cannot change the regulation mode if output is on. Send 1 data byte (8-bit value) = Regulation mode: • 6 = Power • 7 = Voltage • 8 = Current Command **154** reports this value.	1	CSR only
6 **setpoint**	Sets the output setpoint level for the active regulation mode (set with command **3**). The setpoint must not be greater than the unit maximum limit or the user limit in corresponding regulation mode. Send 2 data bytes (16-bit value) using the following guidelines: • For power regulation mode, setpoint increments represent 10 W. For example, for a system with a power limit of 15 kW, the allowed values are 0 – 1500.	2	CSR only

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• For current regulation mode, setpoint increments represent 0.01 A. For example, for a unit that has a maximum current limit of 15 A, the allowed values are 0 – 1500. • For voltage regulation mode, setpoint increments represent 1 V. For example, for a unit that has a maximum voltage limit of 800 V, the allowed values are 0 – 800. See command **78** to set a 4-byte setpoint. Command **164** reports this value.		
14 **control mode**	Sets the mode of control for the Ascent DMS supply. ☞ **Important** You can change the control mode only when output is turned off. The command returns a CSR if output is turned on. Send 1 data byte: • 2 = Host control mode (using one of the digital communications ports) • 4 = User control mode (using the **USER** port, if applicable) Command **155** reports this value.	1	CSR only
17 **program source**	Sets whether the power supply will receive setpoint, regulation mode, and power pulse signals from an internal digital source or from the **USER** port. The source can be set independently for each of the control modes. Send 3 data bytes, where each byte specifies the program source for one control mode: • Byte 0 = Host control program source: ◦ 0 = Internal program source ◦ Nonzero value = **USER** port • Byte 1 = Reserved • Byte 2 = User control mode program source: ◦ 0 = Internal program source	3	CSR only

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	◦ Nonzero value = **USER** port Command **163** reports these values.		
39 **set comm watchdog timer**	Sets the communications watchdog timer value in ms. Each serial digital communications interface has a unique watchdog timer that operates independently of all other interfaces. Any combination of enable, disable, or timeout values between interfaces is allowed. Send 2 data bytes. A value of 0 disables the watchdog timer. This parameter is volatile and defaults to a value of 0 each time the unit is turned on. The maximum value accepted is 65535. The watchdog timer value is stored internally in 10 ms increments, with any fractional remainder being truncated. Values from 1 to 9 are accepted and result in a timeout period of 10 ms. Command **139** reports this value.	2	CSR only
40 **set host port timeout value**	Specifies the timeout value for AE Bus port receiving this command. This is the maximum time allowed between bytes received from the host. Send 2 data bytes (16-bit value). The value represents increments of 10 ms. Two decimal places are implied (enter 500 for 5.00). Range: The value must be at least 2 but no greater than 500 (20 ms to 5 s). Default: 75 (750 ms). Command **140** reports this value.	2	CSR only
49 **user power limit**	Kept for backwards compatibility only. AE recommends using command **71** (subcommand 11) instead of this command. Sets a maximum limit for output power in tens of watts. For example, a value of 1500 = 15000 W. Commands **49**, **50**, and **51** all set output limits. The power supply responds to the first limit that it reaches. Send 2 data bytes (16-bit value); the acceptable range of values is from 0 to the maximum rated output power of the supply.	2	CSR only

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	See command **71** to set a 4-byte output power limit. ☞ **Important** Master/slave units will refresh to the maximum limit for power on power up, after explicit slave faults, or after connecting or disconnecting slaves. Command **141** reports this value.		
50 **user voltage limit**	Kept for backwards compatibility only. AE recommends using command **71** (subcommand 12) instead of this command. Sets a maximum limit for output voltage in volts. Commands **49**, **50**, and **51** all set output limits. The power supply responds to the first limit that it reaches. Send 2 data bytes (16-bit value); the acceptable range of values is from 0 to the maximum rated output of the supply. See command **71** to set a 4-byte output voltage limit. Command **142** reports this value.	2	CSR only
51 **user current limit**	Kept for backwards compatibility only. AE recommends using command **71** (subcommand 13) instead of this command. Sets a maximum limit for output current. Commands **49**, **50**, and **51** all set output limits. The power supply responds to the first limit that it reaches. Send 2 data bytes (16-bit value). The value to send depends on the current scaling option for which the unit is set. The scaling option for the unit is reported by command **204** (subcommand 27). • If the unit is set for 0.1 A scaling (this is the standard setting), send a value representing tenths of amperes. For example, a value of 1000 = 100.0 A.	2	CSR only

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• If the unit is set for 0.01 A scaling, send a value representing hundredths of amperes. For example, a value of 10,000 = 100.00 A. See command **71** to set a 4-byte output current limit. ☞ **Important** Master/slave units will refresh to the maximum limit for current on power up, after explicit slave faults, or after connecting or disconnecting slaves. Command **143** reports this value.		
52 **ignition setpoint**	Sets the ignition setpoint index value. See the ignition voltage section of the installation chapter for the setpoint values. Send either 1 or 3 data bytes. Expanded PROFIBUS: Use the 3-byte version of the command; the 1-byte version is not supported. Send 1 data byte: • 0 = Low setpoint • 1 = Medium setpoint • 2 = High setpoint Send 3 data bytes: • Byte 0 = 0 (reserved) • Byte 1 = Setpoint index: ◦ 0 = Low setpoint ◦ 1 = Medium setpoint ◦ 2 = High setpoint • Byte 2 = 0 (reserved) Command **118** (subcommand 99) enables/ disables ignition. Command **144** reports this value.	1 or 3	1 (CSR code)

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
69 **set serial port address and baud rate**	Sets AE Bus address, baud rate, and RS-485 mode for system serial ports. This command configures ports that have the appropriate PIN setting, and must be issued from the Ethernet port. Default serial port values are: • AE Bus address = 1 • Baud rate = 19200 • RS-485 mode = Off Send 4 data bytes: • Byte 0 = Serial port selection (send a value of 1) • Byte 1 = AE Bus address (values 0 – 31) AE Bus broadcast mode is not supported, so if the AE Bus address is set to 0, the unit uses default address 1. • Byte 2 = Baud rate (values 0 – 6) ◦ 0 = 2400 ◦ 1 = 4800 ◦ 2 = 9600 ◦ 3 = 19200 ◦ 4 = 38400 ◦ 5 = 57600 ◦ 6 = 115200 • Byte 3 = RS-485 mode (values 0 = Off; 1 = On)	4	CSR only
70 **set real time clock**	Sets the real time clock on the CPU module to the time/date specified. The data transmitted must be encoded in BCD (Binary Coded Decimal) format. (Example: To set the seconds to 48, the data value transmitted must be 0x48.) The real time clock features automatic leap year compensation for years up to 2100. Send 7 data bytes: • Byte 0 = Seconds (values 0 – 59)	7	CSR only

Table 4-25. AE Host Commands (Continued)

<table>
<tr><th>Command</th><th>Description</th><th>Data Bytes Sent</th><th>Data Bytes Returned</th></tr>
<tr><td></td><td>• Byte 1 = Minutes (values 0 – 59)
• Byte 2 = Hours (values 0 – 23)
• Byte 3 = Day of week (values 1 – 7, 1 = Sunday)
• Byte 4 = Date (values 1 – 31)
• Byte 5 = Month (values 1 – 12)
• Byte 6 = Year (values 00 – 99)
Command 205 reports this value.</td><td></td><td></td></tr>
<tr><td>71
set system control</td><td>This command is implemented for commands that must maintain strict compatibility with other AE product platforms.
Set the Ethernet IP address, default gateway, subnet mask, DHCP/BootP client control, and various other system settings.
This command allows you to send subcommands. The name and function of a subcommand depend on the value of the first byte.
The number of data bytes to send varies by subcommand. The first data byte specifies the requested action; the following data bytes specify values. For example, if byte 0 = 1, the command sets the default gateway.
Each subcommand is described in a separate row of this table.
<table>
<tr><th>Byte 0 =</th><th>Subcommand</th></tr>
<tr><td>0</td><td>set IP address</td></tr>
<tr><td>1</td><td>set default gateway</td></tr>
<tr><td>2</td><td>set subnet mask</td></tr>
<tr><td>5</td><td>enable/disable DHCP client enable</td></tr>
<tr><td>11</td><td>set user power limit</td></tr>
<tr><td>12</td><td>set user voltage limit</td></tr>
<tr><td>13</td><td>set user current limit</td></tr>
<tr><td>40</td><td>set setpoint compensation limit</td></tr>
<tr><td>200</td><td>set domain name</td></tr>
</table></td><td>Varies</td><td>CSR only</td></tr>
</table>

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	<table><tr><th>Byte 0 =</th><th>Subcommand</th></tr><tr><td>202</td><td>set DNS server IP address</td></tr><tr><td>203</td><td>set DNS configuration</td></tr></table>		
71 **set IP address** subcommand 0	Sets the Ethernet IP address. The unit stores the address in nonvolatile memory and restores it each time you cycle power. Make sure to check with your network administrator before setting any IP address on an established network. Once you set the parameters, you must cycle power to the unit for the new parameters to take effect. This command affects the unit only if DHCP client mode is disabled. Send the value LSB first. That is, byte 1 = least significant octet of the value. Send 5 data bytes: • Byte 0 = 0 (set IP address) • Bytes 1 to 4 = IP address (four 8-bit values) Default value: 192.168.254.30 (set at the factory). Command **204** (subcommand 0) reports this value.	5	1 (CSR code)
71 **set default gateway** subcommand 1	Sets the unit network default gateway address. The unit stores the address in nonvolatile memory and restores it each time you cycle power. Once you set the parameters, you must cycle power to the unit for the new parameters to take effect. This command affects the unit only if DHCP client mode is disabled. Send the value LSB first. That is, byte 1 = least significant octet of the value. Send 5 data bytes: • Byte 0 = 1 (set default gateway) • Bytes 1 to 4 = Default gateway (4 bytes) Default value: 192.168.254.254 (set at the factory) Command **204** (subcommand 1) reports this value.	5	1 (CSR code)

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
71 **set subnet mask** subcommand 2	Sets the unit subnet mask. The unit stores the value in nonvolatile memory and restores it each time you cycle power. Once you set the parameters, you must cycle power to the unit for the new parameters to take effect. This command affects the unit only if DHCP client mode is disabled. Send the value LSB first. That is, byte 1 = least significant octet of the value. Send 5 data bytes: • Byte 0 = 1 (set subnet mask) • Bytes 1 to 4 = Subnet mask (4 bytes) Default value: 255.255.255.0 (set at the factory) Command **204** (subcommand 2) reports this value.	5	1 (CSR code)
71 **enable/disable DHCP client** subcommand 5	Sets the unit network DHCP client enable mode. Once you set the parameters, you must cycle power to the unit for the new parameters to take effect. Send 2 data bytes: • Byte 0 = 5 (enable/disable DHCP client) • Byte 1 = (0 = Disable client; 1 = Enable client) Default value: Set at the factory. Command **204** (subcommand 5) reports this value.	2	1 (CSR code)
71 **set user power limit** subcommand 11	Sets the unit user power limit, which can be nonvolatile depending on configuration. Send 2 data bytes: • Byte 0 = 11 (set user power limit) • Bytes 1 to 4 (32-bit value) = Power limit in W Default value: Set at the factory. Command **204** (subcommand 12) reports this value.	5	1 (CSR code)

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
71 **set user voltage limit** subcommand 12	Sets the unit user voltage limit. It can be nonvolatile depending on configuration. Send 2 data bytes: • Byte 0 = 12 (set user voltage limit) • Bytes 1 to 4 (32-bit value) = Voltage limit in V Default value: Set at the factory. Command **204** (subcommand 12) reports this value.	5	1 (CSR code)
71 **set user current limit** subcommand 13	Sets the unit user current limit. It can be nonvolatile depending on configuration. Send 2 data bytes: • Byte 0 = 13 (set user current limit) • Bytes 1 to 4 (32-bit value) = Current limit in 0.1 A increments Default value: Set at the factory. Command **204** (subcommand 12) reports this value.	5	1 (CSR code)
71 **set setpoint compensation limit** subcommand 40	Sets the setpoint compensation limit as a percent increase above power setpoint. It can be nonvolatile depending on configuration. Send 3 data bytes: • Byte 0 = 40 (set setpoint compensation limit) • Bytes 1 to 2 = Setpoint compensation limit (%) Command **204** (subcommand 41) reports the allowed range. Command **204** (subcommand 40) reports this value.	3	1 (CSR code)
71 **set domain name** subcommand 200	Sets the network domain name. The domain name is stored in nonvolatile memory and is restored each time the unit is powered on. The length of the domain name is from 0 to 64 ASCII characters. Valid characters for the domain name are letters, digits, hyphens, and dots.	Varies	1 (CSR code)

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	Expanded PROFIBUS: The command is not supported. Send a variable number of data bytes based on the length of the domain name: • Byte 0 = 200 (set domain name) • Variable number of bytes (0 to 64) = Domain name in ASCII characters The factory default value is NULL. Command **204** (subcommand 200) reports this value.		
71 **set DNS server IP address** subcommand 202	Sets the IP address for the DNS server. The DNS server IP address is stored in nonvolatile memory and is restored each time the unit is powered on. This value should be sent LSB first. That is, data byte 1 = the least significant octet of the DNS server IP address. This command will only be accepted if DHCP client mode is disabled. Send 5 data bytes: • Byte 0 = 202 (set DNS server IP address) • Bytes 1 to 4 = DNS server IP address The factory default value is equal to the value of the default gateway address. Command **204** (subcommand 202) reports this value.	5	1 (CSR code)
71 **set DNS configuration** subcommand 203	Sets the DNS configuration mode. This setting is stored in nonvolatile memory and is restored each time the unit is powered on. Send 3 data bytes: • Byte 0 = 203 (set DNS configuration) • Bytes 1 to 2 = DNS configuration mode: ◦ 0 = Do not perform DNS server updates ◦ 1 = Enable DHCP server updates Default value: Set at the factory. Command **204** (subcommand 203) reports this value.	3	1 (CSR code)

Table 4-25. AE Host Commands (Continued)

<table>
<tr><th>Command</th><th>Description</th><th>Data Bytes Sent</th><th>Data Bytes Returned</th></tr>
<tr><td>78
set 32-bit setpoint</td><td>Sets the output setpoint level for the active regulation mode (set with command 3). This 4-byte setpoint command allows larger values than the 2-byte limit of command 6.
Sets power setpoint in watts, current setpoint in hundredths of amps increments, and voltage setpoint in volts.
Send 4 bytes:
• Bytes 0 to 3 (32-bit value) = Setpoint value
Command 238 reports this value.</td><td>4</td><td>1 (CSR code)</td></tr>
<tr><td>86
set arc parameters</td><td>Sets arc management parameters.
This command allows you to send subcommands. The name and function of a subcommand depend on the value of the first byte.
The number of data bytes to send varies by subcommand. The first data byte specifies the requested action; the following data bytes specify values. For example, if byte 0 = 2, the command allows you to enable and disable external Arc-Sync functionality.
Each subcommand is described in a separate row of this table.
<table>
<tr><th>Byte 0 =</th><th>Description</th></tr>
<tr><td>2</td><td>enable/disable external Arc-Sync</td></tr>
<tr><td>16</td><td>set arc profile index</td></tr>
<tr><td>201</td><td>clear arc counter</td></tr>
<tr><td>202</td><td>set arc threshold</td></tr>
<tr><td>203</td><td>set arc to ground persistence</td></tr>
<tr><td>204</td><td>set arc persistence</td></tr>
<tr><td>205</td><td>set arc timer</td></tr>
<tr><td>208</td><td>Set arc suppression routine</td></tr>
<tr><td>210</td><td>set pulse transition arc mask time</td></tr>
</table>
Command 236 reports the values set with this command.</td><td>Varies</td><td>1 (CSR code)</td></tr>
</table>

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
86 **enable/disable external Arc-Sync** subcommand 2	Enables and disables the external Arc-Sync feature on the unit. The external Arc-Sync feature is valid when the units are connected via the **SYNC PWR** ports. These Arc-Sync ports allow you to synchronize arc shutdown between multiple standalone power supplies. Master/slave systems: allows you to synchronize arc shutdown across multiple master/slave systems. Send 2 bytes: • Byte 0 = 2 (enable/disable external Arc-Sync) • Byte 1 = Enable/disable: ◦ 0 = External Arc-Sync disabled ◦ Nonzero value = External Arc-Sync enabled Command **236** (subcommand 2) reports this value.	2	1 (CSR code)
86 **set arc profile index** subcommand 16	Sets the arc profile index. This index specifies the active arc management profile in the power supply. Send 2 bytes: • Byte 0 = 16 (set arc profile index) • Byte 1 = Arc profile index value: ◦ 0 = Standard arc recovery Command **236** (subcommand 16) reports this value.	2	1 (CSR code)
86 **clear arc counter** subcommand 201	Clears the selected arc counter, resetting it to 0. Send 2 bytes: • Byte 0 = 201 (clear arc counter) • Byte 1 = Arc counter to clear: ◦ 0 = Clear micro arc counter for cathode A ◦ 1 = Clear hard arc counter for cathode A ◦ 2 = Clear micro arc counter for cathode B ◦ 3 = Clear hard arc counter for cathode B	2	1 (CSR code)

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	◦ 4 = Clear intersystem micro arc counter ◦ 5 = Clear intersystem hard arc counter Command **236** (subcommand 201) reports this value.		
86 **set arc threshold** subcommand 202	Select the arc threshold and set the value for the selected threshold. The threshold is a signed value. Send 4 bytes: • Byte 0 = 202 (set arc threshold) • Byte 1 = Threshold to set: ◦ 0 = VArc threshold (in V) ◦ 1 = Current threshold for VArc enable (in 0.01 A) ◦ 2 = Current threshold for VArc enable during recovery (in 0.01 A) ◦ 3 = VArc-to-ground threshold (in V) ◦ 4 = IArc threshold (in 0.01 A) • Bytes 2 to 3 (LSB first) = Threshold value Command **236** (subcommand 252) reports the range. Command **236** (subcommand 202) reports this value.	4	1 (CSR code)
86 **set arc-to-ground persistence** subcommand 203	Sets the arc-to-ground persistence in ns. An arc condition must be present for the amount of time programmed before unit begins suppression. Send 5 bytes: • Byte 0 = 203 (arc-to-ground persistence) • Bytes 1 to 4 (LSB first) = Arc-to-ground persistence (in ns) Command **236** (subcommand 252) reports the range. Command **236** (subcommand 203) reports this value.	5	1 (CSR code)

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
86 **set arc persistence** subcommand 204	Sets the arc persistence in ns. An arc condition must be present for the amount of time programmed before unit begins suppression. Send 4 bytes: • Byte 0 = 204 set arc persistence) • Bytes 1 to 3 (LSB first) = Arc persistence (in ns) Command **236** (subcommand 252) reports the range. Command **236** (subcommand 204) reports this value.	4	1 (CSR code)
86 **set arc timer** subcommand 205	Sets the arc timer in ns. Send 6 bytes: • Byte 0 = 205 (set arc timer) • Byte 1 = Timer value to set: ◦ 128 = Arc reaction time for micro arc 1 ◦ 129 = Arc shutdown time for micro arc 1 ◦ 130 = Arc mask time for micro arc 1 ◦ 132 = Arc reaction time for micro arc 2 ◦ 133 = Arc shutdown time for micro arc 2 ◦ 134 = Arc mask time for micro arc 2 ◦ 136 = Arc reaction time for micro arc 3 ◦ 137 = Arc shutdown time for micro arc 3 ◦ 138 = Arc mask time for micro arc 3 ◦ 140 = Arc reaction time for hard arc ◦ 141 = Arc shutdown time for hard arc ◦ 142 = Arc mask time for hard arc • Bytes 2 to 5 (LSB first) = Timer value (in ns) Command **236** (subcommand 252) reports the range. Command **236** (subcommand 205) reports this value.	6	1 (CSR code)

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
86 **set arc suppression routine** subcommand 208	This command is activated on units with a user interface (**USER** port). Selects an arc suppression routine (micro arc 1, micro arc 2, micro arc 3, or hard arc). The unit will send a signal to the user interface for the selected arc suppression routine(s). The same value is used for V_{arc} and I_{arc}. The number of each arc suppression routine is counted internally. Use this command to select from which arc suppression routines a signal is output on the user card when its counter value increases. For example: If you send bytes 1 to 2 = 2, a signal is output on the user card only if micro arc 3 or hard arc counters change. Micro arc 1 and micro arc 2 are ignored. On the standard 37-pin user interface, the signal is output to *ARC.D* for V_{arc} and I_{arc}. On the user interface for the PE II adapter kit, 25-pin (available with select models), the signal is output to *I_ARC.D* and *U_ARC.D* as applicable. Send 3 bytes: • Byte 0 = 208 (set arc suppression routine) • Bytes 1 to 2 = Arc suppression routine selection: ◦ 0 = Micro arc 1, micro arc 2, micro arc 3, and hard arc ◦ 1 = Micro arc 2, micro arc 3, and hard arc ◦ 2 = Micro arc 3 and hard arc ◦ 3 = Hard arc Command **236** (subcommand 252) reports the range. Command **236** (subcommand 208) reports this value.	3	1 (CSR code)

Table 4-25. AE Host Commands (Continued)

<table>
<tr><th>Command</th><th>Description</th><th>Data Bytes Sent</th><th>Data Bytes Returned</th></tr>
<tr><td>86
set pulse transition arc mask time
subcommand 210</td><td>Set the selected pulse transition arc mask time in ns. The unit starts to count the mask time when it toggles the output.
Send 4 bytes:
Byte 0 = 210 (set pulse transition arc mask time)
Byte 1 = Pulse transition arc mask:
0 = Forward arc mask (off-to-on)
1 = Reverse arc mask (on-to-off)
Bytes 2 to 3 = Time (in ns)
Command 236 (subcommand 252) reports the range.
Command 236 (subcommand 210) reports this value.</td><td>4</td><td>1 (CSR code)</td></tr>
<tr><td>92
set pulsing parameters</td><td>Set pulsing parameters.
This command allows you to send subcommands. The name and function of a subcommand depend on the value of the first byte (the subcommand number).
The number of data bytes to send varies by subcommand. The first data byte specifies the requested action; the following data bytes specify values. For example, if byte 0 = 0, the command allows you to set the pulse mode.
Each subcommand is described in a separate row of this table.
<table>
<tr><th>Byte 0 =</th><th>Description</th></tr>
<tr><td>0</td><td>enable/disable pulsing</td></tr>
<tr><td>1</td><td>set output frequency</td></tr>
<tr><td>3</td><td>set output deadtime 1</td></tr>
<tr><td>4</td><td>set output deadtime 2</td></tr>
<tr><td>10</td><td>set boost voltage setpoint</td></tr>
<tr><td>13</td><td>set pulse duty cycle</td></tr>
<tr><td>15</td><td>set DC polarity</td></tr>
<tr><td>19</td><td>enable/disable power pulsing</td></tr>
</table></td><td>Varies</td><td>1 (CSR only)</td></tr>
</table>

Table 4-25. AE Host Commands (Continued)

<table>
<tr><th>Command</th><th>Description</th><th>Data Bytes Sent</th><th>Data Bytes Returned</th></tr>
<tr><td></td><td><table><tr><th>Byte 0 =</th><th>Description</th></tr><tr><td>20</td><td>set power pulsing on time</td></tr><tr><td>21</td><td>set power pulsing off time</td></tr></table></td><td></td><td></td></tr>
<tr><td>92
enable/disable pulsing
subcommand 0</td><td>Enable or disable pulse mode. When pulse mode is disabled, the unit is in DC mode.
Send 4 bytes:
• Bytes 0 to 1 = 0 (enable/disable pulsing)
• Bytes 2 to 3 = Enable/disable:
◦ 0 = Disable pulse mode (unit goes in to DC mode)
◦ 1 = Enable pulse mode
Command 146 (subcommand 0) reports this value.</td><td>4</td><td>1 (CSR only)</td></tr>
<tr><td>92
set output frequency
subcommand 1</td><td>Sets the output frequency value (in kHz).
Send 4 bytes:
• Bytes 0 to 1 = 1 (set output frequency)
• Bytes 2 to 4 = Output frequency (in kHz)
Command 146 (subcommand 252) reports the range.
Command 146 (subcommand 1) reports this value.</td><td>4</td><td>1 (CSR only)</td></tr>
<tr><td>92
set output deadtime 1
subcommand 3</td><td>Sets the output deadtime 1 in ns.
Send 4 bytes:
• Bytes 0 to 1 = 3 (set output deadtime 1)
• Bytes 2 to 4 = Time (in ns)
Command 146 (subcommand 252) reports the range.
Command 146 (subcommand 3) reports this value.</td><td>4</td><td>1 (CSR only)</td></tr>
<tr><td>92
set output deadtime 2
subcommand 4</td><td>Sets the output deadtime 2 in ns.
Send 4 bytes:
• Bytes 0 to 1 = 4 (set output deadtime 2)</td><td>4</td><td>1 (CSR only)</td></tr>
</table>

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• Bytes 2 to 4 = Time (in ns) Command **146** (subcommand 252) reports the range. Command **146** (subcommand 4) reports this value.		
92 **set boost voltage setpoint** subcommand 10	Sets the boost voltage (V_{boost}) setpoint value in V. The value to send is the additional voltage for boost. For example, to specify the total voltage (with boost) of 15 V, and the sputter voltage is 10 V, then send a value of 5 with this command. Send 4 bytes: • Bytes 0 to 1 = 10 (set boost voltage setpoint) • Bytes 2 to 4 = Boost voltage setpoint (in V) Default: 0 Command **146** (subcommand 252) reports the range. Command **146** (subcommand 10) reports this value.	4	1 (CSR only)
92 **set pulse duty cycle** subcommand 13	Sets the pulse duty cycle on value in 0.1% of the period. Send 4 bytes: • Bytes 0 to 1 = 13 (set pulse duty cycle) • Bytes 2 to 4 = Pulse duty cycle (in 0.1%) Command **146** (subcommand 252) reports the range. Command **146** (subcommand 13) reports this value.	4	1 (CSR only)
92 **set DC polarity** subcommand 15	Sets the DC polarity when the unit is in DC mode. Send 4 bytes: • Bytes 0 to 1 = 15 (set DC polarity) • Bytes 2 to 4 = Polarity ◦ 0 = Reverse	4	1 (CSR only)

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	◦ 1 = Forward Command **146** (subcommand 15) reports this value.		
92 **enable/disable power pulsing** subcommand 19	Enable or disable the power pulsing feature. Send 4 bytes: • Bytes 0 to 1 = 19 (enable/disable power pulsing) • Bytes 2 to 4 = Enable/disable: ◦ 0 = Disable ◦ 1 = Enable Command **146** (subcommand 19) reports this value.	4	1 (CSR only)
92 **set power pulsing on time** subcommand 20	Set the power pulsing on time in 0.1 ms increments. Send 4 bytes: • Bytes 0 to 1 = 20 (set power pulsing on time) • Bytes 2 to 4 = Power pulsing on time (in 0.1 ms increments) Command **146** (subcommand 252) reports the range. Command **146** (subcommand 20) reports this value.	4	1 (CSR only)
92 **set power pulsing off time** subcommand 21	Set the power pulsing off time in 0.1 ms increments. Send 4 bytes: • Bytes 0 to 1 = 21 (set power pulsing off time) • Bytes 2 to 4 = Power pulsing off time (in 0.1 ms increments) Command **146** (subcommand 252) reports the range. Command **146** (subcommand 21) reports this value.	4	1 (CSR only)

Table 4-25. AE Host Commands (Continued)

<table>
<tr><th>Command</th><th>Description</th><th>Data Bytes Sent</th><th>Data Bytes Returned</th></tr>
<tr><td>118
set intersystem frequency sync and other parameters</td><td>Sets intersystem frequency synchronization and other parameters.
This command allows you to send subcommands. The name and function of a subcommand depend on the value of the first two data bytes (the subcommand number).
The number of data bytes to send varies by subcommand. The first two data bytes specify the requested action; the following data bytes specify values. For example, if bytes 0 and 1 = 101, the command allows you to enable or disable intersystem frequency synchronization.
Each subcommand is described in a separate row of this table.
<table>
<tr><th>Byte 0 to 1 =</th><th>Description</th></tr>
<tr><td>99</td><td>enable/disable ignition</td></tr>
<tr><td>101</td><td>set intersystem frequency sync state</td></tr>
<tr><td>102</td><td>set intersystem frequency sync delay</td></tr>
<tr><td>104</td><td>set intersystem frequency sync phase shift</td></tr>
<tr><td>107</td><td>set output short circuit voltage threshold</td></tr>
<tr><td>108</td><td>set output short circuit current threshold</td></tr>
</table></td><td>Varies</td><td>1 (CSR only)</td></tr>
<tr><td>118
enable/disable ignition
subcommand 99</td><td>Enables and disables ignition.
Send 4 bytes:
Bytes 0 to 1 = 99 (enable/disable ignition)
Bytes 2 to 3 = Enable/disable:
0 = Ignition disabled
1 = Ignition enabled
Command 52 sets the ignition voltage setpoint.
Command 248 (subcommand 99) reports this value.</td><td>4</td><td>1 (CSR only)</td></tr>
</table>

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
118 **set intersystem frequency sync state** subcommand 101	Sets the unit intersystem frequency synchronization state. This command controls the intersystem frequency synchronization signal on the cable connected to the **SYNC PWR** connectors. The unit can be set to transmit or receive intersystem frequency synchronization signals, or set to disable the intersystem frequency synchronization feature. Send 4 bytes: • Bytes 0 to 1 = 101 (set intersystem frequency sync mode) • Bytes 2 to 3 = State to set: ◦ 0 = Disables unit intersystem frequency synchronization ◦ 1 = Enables intersystem frequency synchronization and sets the unit to be a receiver ◦ 2 = Enables intersystem frequency synchronization and sets the unit to be a transmitter Command **248** (subcommand 101) reports this value.	4	1 (CSR only)
118 **set intersystem frequency sync delay** subcommand 102	Sets the delay when using the intersystem frequency synchronization feature. Send 4 bytes: • Bytes 0 to 1 = 102 (set intersystem frequency sync delay) • Bytes 2 to 3 = Delay (in ns) Command **248** (subcommand 103) reports the allowed range. Command **248** (subcommand 102) reports this value.	4	1 (CSR only)

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
118 **set intersystem frequency phase shift** subcommand 104	Sets the phase shift (in °) when using the intersystem frequency synchronization feature. Send 4 bytes: • Bytes 0 to 1 = 104 (set intersystem frequency phase shift) • Bytes 2 to 3 = Phase shift (in °) Command **248** (subcommand 103) reports the allowed range. Command **248** (subcommand 104) reports this value.	4	1 (CSR only)
118 **set output short circuit voltage threshold** subcommand 107	Sets the voltage threshold at which the unit detects a short circuit. A value of 0 V disables the short circuit detection. This command is used in conjunction with command **118** (subcommand 108). Send 4 bytes: • Bytes 0 to 1 = 107 (set output short circuit voltage threshold) • Bytes 2 to 3 = Voltage (in V) Command **248** (subcommand 109) reports the allowed range. Command **248** (subcommand 107) reports this value.	4	1 (CSR only)
118 **set output short circuit current threshold** subcommand 108	Sets the current threshold at which the unit detects a short circuit. This command is used in conjunction with command **118** (subcommand 107). Send 4 bytes: • Bytes 0 to 1 = 108 (set output short circuit current threshold) • Bytes 2 to 3 = Current (in 0.01 A) Command **248** (subcommand 109) reports the allowed range. Command **248** (subcommand 108) reports this value.	4	1 (CSR only)

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
119 **master reset**	Send this command to clear the fault indication when the Ascent DMS supply has experienced a non-recoverable (explicit clear) fault. ☞ **Important** Output will be turned off. This request is always honored, regardless of which interface has control.	0	1
126 **reset default settings**	Resets all user-defined values to their defaults and stores them in nonvolatile memory. Send 1 data byte: • 0 = Retains network settings • 1 = Restores network settings to factory default	1	CSR only
128 **report supply type**	Report the power supply type. Send either 0 or 1 byte. Expanded PROFIBUS: Use the 1-byte version of the command; the 0-byte version of the command is not supported. If you send 0 bytes, the returning packet contains 4 ASCII characters representing the power supply type. If you send 1 byte, the value sent determines the return value. • If byte 0 = 0: Returns 2 bytes. Bytes 0 to 1 = Returns a 1 to indicate single output. • If byte 0 = 1: Returns 10 bytes. Bytes 0 to 9 = A non-terminated ASCII string that represents the power supply type. • If byte 0 = 3: Returns 14 bytes. Bytes 0 to 13 = A non-terminated ASCII string that represents the power supply name. The name is composed of a unique string based on the product platform, concatenated with the 6-digit ASCII representation of the three least significant bytes of the unit MAC ID. • If byte 0 = 6: Returns 4 bytes. Bytes 0 to 3 = Four-character unit type formatted to ASCII digits, right justified.	0 or 1	Varies

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
129 **report supply size**	Reports the output capacity of the power supply. Sending a data byte is optional. Expanded PROFIBUS: Use the 0-byte version of the command; the 1-byte version of the command is not supported. When sending no data byte, or byte 0 = 0, the returning packet contains 6 ASCII digits, right justified within the six-digit field, representing power size in watts. When byte 0 = 1: • A standalone unit reports the power supply size in watts. • A master unit reports the master/slave system size in tens of watts. • A slave unit reports its unit size in tens of watts.	0 or 1	6
130 **report setpoint limits**	Reports the maximum setpoint limits. Expanded PROFIBUS: The command is not supported. Returns 6 data bytes: • Bytes 0 to 1 = Maximum power setpoint (in W) • Bytes 2 to 3 = Maximum voltage setpoint (in V) • Bytes 4 to 5 = Maximum current (in hundredths of A)	0	6
139 **report comm watchdog timer**	Reports the communications watchdog timer value in ms. Since each serial digital communications interface has a unique watchdog timer, the value reported is the value of the watchdog timer associated with that specific interface. Returns 2 bytes. A value of 0 indicates that the watchdog timer for that interface is disabled. This parameter is volatile and defaults to a value of 0 each time the unit is turned on. The maximum value reported is 65530.	0	2

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	The watchdog timer value is stored internally in 10 ms increments, and all reported values are multiples of 10 ms. Command **39** sets this value.		
140 **report host timeout value**	Reports the communications port timeout value. The returning packet contains 2 data bytes (16-bit value) indicating the time in ms (a value of 2 indicates 20 ms). Command **40** sets this value.	0	2
141 **report user power limit**	For backwards compatibility only. Reports the user-specified limit for output power in kilowatts. Assume two decimals (for example, 5000 = 50.00 kW). ☞ **Important** Commands **141**, **142**, and **143** all report output limits. The power supply responds to the first limit that it reaches. Returns 2 data bytes (16-bit value) representing kilowatts; the acceptable range of values is from 0 to the maximum rated output of the supply. ☞ **Important** Master/slave units will refresh to the maximum limit for power on power up, after explicit slave faults, or after connecting or disconnecting slaves. Command **204** (subcommand 12) reports limits with 4 bytes. Command **49** sets this value.	0	2
142 **report user voltage limit**	For backwards compatibility only. Reports the user-specified limit for output voltage in volts. ☞ **Important** Commands **141**, **142**, and **143** all report output limits. The power supply responds to the first limit that it reaches. Returns 2 data bytes (16-bit value) representing volts; the acceptable range of values is from 0 to the maximum rated output voltage of the supply. Command **204** (subcommand 12) reports limits with 4 bytes.	0	2

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	Command **50** sets this value.		
143 **report user current limit**	For backwards compatibility only. Reports the user-specified limit for output current. Assume two decimal places (500 = 5.00 A). ☞ **Important** Commands **141**, **142**, and **143** all report output limits. The power supply responds to the first limit that it reaches. Returns 2 data bytes (16-bit value). The scaling of the returned value depends on the current scaling option for which the unit is set. The scaling option for the unit is reported by command **204** (subcommand 27). • If the unit is set for 0.1 A scaling (this is the standard setting), the value represents tenths of amperes. For example, a value of 1000 = 100.0 A. • If the unit is set for 0.01 A scaling, the value represents hundredths of amperes. For example, a value of 10,000 = 100.00 A. ☞ **Important** Master/slave units will refresh to the maximum limit for current on power up, after explicit slave faults, or after connecting or disconnecting slaves. Command **204** (subcommand 12) reports limits with 4 bytes. Command **51** sets this value.	0	2
144 **report user strike voltage limit**	Reports the strike voltage limit index. Send either 0 or 1 data byte. If you issue this command with no data bytes, it will return 1 byte indicating the strike voltage. If you issue this command with 1 data byte, send a value of 0 and the command will return 2 bytes indicating the strike voltage. Expanded PROFIBUS: Use the 1-byte version of the command; the 0-byte version is not supported.	0 or 1	1 or 2

Table 4-25. AE Host Commands (Continued)

<table>
<tr><th>Command</th><th>Description</th><th>Data Bytes Sent</th><th>Data Bytes Returned</th></tr>
<tr><td></td><td>Strike voltage:
• 0 = Low
• 1 = Medium
• 2 = High
Command 52 sets this value.</td><td></td><td></td></tr>
<tr><td>146
report pulsing parameters</td><td>Report pulsing parameters.
This command allows you to send subcommands. The name and function of a subcommand depend on the value of the first two bytes (the subcommand number).
The number of bytes to send and number of bytes returned varies by subcommand. The first two data bytes specifies the subcommand. The returned data bytes specify the parameter values. For example, if bytes 0 to 1 = 0, the command reports the pulse mode.
Each subcommand is described in a separate row of this table.
<table>
<tr><th>Bytes 0 to 1 =</th><th>Description</th></tr>
<tr><td>0</td><td>report pulsing enable/disable</td></tr>
<tr><td>1</td><td>report output frequency</td></tr>
<tr><td>3</td><td>report output deadtime 1</td></tr>
<tr><td>4</td><td>report output deadtime 2</td></tr>
<tr><td>5</td><td>report pulse output power forward</td></tr>
<tr><td>6</td><td>report pulse output voltage forward</td></tr>
<tr><td>7</td><td>report pulse output current forward</td></tr>
<tr><td>10</td><td>report boost voltage setpoint</td></tr>
<tr><td>11</td><td>report boost voltage output</td></tr>
<tr><td>13</td><td>report pulse duty cycle</td></tr>
<tr><td>15</td><td>report DC polarity</td></tr>
<tr><td>16</td><td>report pulse output power reverse</td></tr>
</table></td><td>Varies</td><td>Varies</td></tr>
</table>

Table 4-25. AE Host Commands (Continued)

<table>
<tr><th>Command</th><th>Description</th><th>Data Bytes Sent</th><th>Data Bytes Returned</th></tr>
<tr><td></td><td><table><tr><th>Bytes 0 to 1 =</th><th>Description</th></tr><tr><td>17</td><td>report pulse output voltage reverse</td></tr><tr><td>18</td><td>report pulse output current reverse</td></tr><tr><td>19</td><td>report power pulsing enable</td></tr><tr><td>20</td><td>report power pulsing on time</td></tr><tr><td>21</td><td>report power pulsing off time</td></tr><tr><td>252</td><td>report pulse parameters range</td></tr></table></td><td></td><td></td></tr>
<tr><td>146
report pulsing enable/disable
subcommand 0</td><td>Reports whether pulse mode is enabled or disabled.
Send 2 bytes:
• Bytes 0 to 1 = 0 (report pulsing enable/ disable)
Returns 2 bytes:
• Bytes 0 to 1 = Pulse mode
◦ 0 = Pulse mode disabled (unit is in DC mode)
◦ 1 = Pulse mode enabled
Command 92 (subcommand 0) sets this value.</td><td>2</td><td>2</td></tr>
<tr><td>146
report output frequency
subcommand 1</td><td>Reports output frequency in kHz.
Send 2 bytes:
• Bytes 0 to 1 = 1 (report output frequency)
Returns 2 bytes:
• Bytes 0 to 1 = Output frequency (in kHz)
Command 92 (subcommand 1) sets this value.</td><td>2</td><td>2</td></tr>
<tr><td>146
report output deadtime 1
subcommand 3</td><td>Reports output deadtime 1 in ns.</td><td>2</td><td>2</td></tr>
</table>

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	Send 2 bytes: • Bytes 0 to 1 = 3 (report output deadtime 1) Returns 2 bytes: • Bytes 0 to 1 = Time (in ns) Command **92** (subcommand 3) sets this value.		
146 **report output deadtime 2** subcommand 4	Reports output deadtime 2 in ns. Send 2 bytes: • Bytes 0 to 1 = 4 (report output deadtime 2) Returns 2 bytes: • Bytes 0 to 1 = Time (in ns) Command **92** (subcommand 4) sets this value.	2	2
146 **report pulse output power forward** subcommand 5	Reports average process power in W. The value can be positive or negative. Send 2 bytes: • Bytes 0 to 1 = 5 (report average process power) Returns 4 bytes: • Bytes 0 to 3 (32-bit signed) = Process power (in W)	2	4
146 **report pulse output voltage forward** subcommand 6	Reports average process voltage in V: • In pulse mode: returns average process voltage • In DC mode: returns average output voltage The value can be positive or negative. Send 2 bytes: • Bytes 0 to 1 = 6 (report average process voltage) Returns 4 bytes: • Bytes 0 to 3 (32-bit signed) = Process voltage (in V)	2	4

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
146 **report pulse output current forward** subcommand 7	Reports average output current in 0.01 A: • In pulse mode: returns average output current at the end of the forward period • In DC mode: returns average output current The value can be positive or negative. Send 2 bytes: • Bytes 0 to 1 = 7 (report output current) Returns 4 bytes: • Bytes 0 to 3 (32-bit signed) = Output current (in 0.01 A)	2	4
146 **report boost voltage setpoint** subcommand 10	Reports boost voltage (V_{boost}) setpoint. Send 2 bytes: • Bytes 0 to 1 = 10 (report boost voltage setpoint) Returns 2 bytes: • Bytes 0 to 1 = Boost voltage setpoint (in V) Command **92** (subcommand 10) sets this value.	2	2
146 **report boost voltage output** subcommand 11	Reports average boost voltage output. Send 2 bytes: • Bytes 0 to 1 = 11 (report boost voltage output) Returns 2 bytes: • Bytes 0 to 1 = Boost voltage output (in V)	2	2
146 **report pulse duty cycle** subcommand 13	Reports pulse duty cycle on value in 0.1%. Send 2 bytes: • Bytes 0 to 1 = 13 (report pulse duty cycle) Returns 2 bytes: • Bytes 0 to 1 = Pulse duty cycle (in 0.1%) Command **92** (subcommand 13) sets this value.	2	2

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
146 **report DC polarity** subcommand 15	Reports the DC polarity (forward or reverse). Send 2 bytes: • Bytes 0 to 1 = 15 (report DC polarity) Returns 2 bytes: • Bytes 0 to 1 = DC polarity: ◦ 0 = Reverse ◦ 1 = Forward Command **92** (subcommand 15) sets this value.	2	2
146 **report pulse output power reverse** subcommand 16	Reports the average pulse output power reverse in W. The value can be positive or negative. Send 2 bytes: • Bytes 0 to 1 = 16 (report pulse output power reverse) Returns 4 bytes: • Bytes 0 to 3 (32-bit signed) = Pulse output power reverse (in W) Command **92** (subcommand 16) sets this value.	2	4
146 **report pulse output voltage reverse** subcommand 17	Reports the average pulse output voltage reverse in V: • Pulse mode: Average process voltage reverse • DC mode: Average output voltage The value can be positive or negative Send 2 bytes: • Bytes 0 to 1 = 17 (report pulse output voltage reverse) Returns 4 bytes: • Bytes 0 to 3 (32-bit signed) = Pulse output voltage reverse (in V) Command **92** (subcommand 17) sets this value.	2	4

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
146 **report pulse output current reverse** subcommand 18	Reports the average pulse output current reverse in 0.01 A: • Pulse mode: Average process current reverse • DC mode: Average output current The value can be positive or negative Send 2 bytes: • Bytes 0 to 1 = 18 (report pulse output current reverse) Returns 4 bytes: • Bytes 0 to 3 (32-bit signed) = Pulse output current reverse (in 0.01 A) Command **92** (subcommand 18) sets this value.	2	4
146 **report power pulsing enable/ disable** subcommand 19	Reports whether power pulsing is enabled or disabled. Send 2 bytes: • Bytes 0 to 1 = 19 (report power pulsing enable/disable) Returns 2 bytes: • Bytes 0 to 1 = Power pulsing state: ◦ 0 = Disabled ◦ 1 = Enabled Command **92** (subcommand 19) sets this value.	2	2
146 **report power pulsing on time** subcommand 20	Reports power pulsing on time in 0.1 ms. Send 2 bytes: • Bytes 0 to 1 = 20 (report power pulsing on time) Returns 2 bytes: • Bytes 0 to 1 = Power pulsing on time (in 0.1 ms) Command **92** (subcommand 20) sets this value.	2	2

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
146 **report power pulsing off time** subcommand 21	Reports power pulsing off time in 0.1 ms. Send 2 bytes: • Bytes 0 to 1 = 21 (report power pulsing off time) Returns 2 bytes: • Bytes 0 to 1 = Power pulsing off time (in 0.1 ms) Command **92** (subcommand 21) sets this value.	2	2
146 **report pulse parameter range** subcommand 252	Reports the valid range for the selected pulse parameter. Send 4 bytes: • Bytes 0 to 1 = 252 (report pulse parameter range) • Bytes 2 to 3 = Pulse parameter selection: ◦ 0 = Output frequency range (in kHz) ◦ 2 = Output deadtime 1 (in ns) ◦ 3 = Output deadtime 2 (in ns) ◦ 5 = Boost voltage setpoint range (in V) ◦ 6 = Pulse duty cycle range (in 0.1%) ◦ 7 = Power pulsing on time range (in 0.1 ms) ◦ 8 = Power pulsing off time range (in 0.1 ms) Returns 4 bytes: • Bytes 0 to 3 = Minimum value • Bytes 4 to 7 = Maximum value	4	8
154 **report regulation mode**	Reports the output regulation mode. Send either 0 or 1 byte. If you issue this command with no data bytes, the returning packet contains 1 data byte (8-bit value) indicating the unit regulation mode. If you issue this command with 1 data byte, send a value of 0. The returning packet contains 2 data bytes indicating the regulation mode.	0 or 1	1 or 2

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	Expanded PROFIBUS: Send the command with zero data bytes. The return packet (1 or 2 bytes) indicates the regulation mode of the unit: • 6 = Power • 7 = Voltage • 8 = Current Command **3** sets this value.		
155 **report active control mode**	Reports the active control mode. Send either 0 or 1 data byte. Expanded PROFIBUS: Use the 1-byte version of the command; the 0-byte version is not supported. If you issue this command with no data bytes, the returning packet contains 1 data byte (8-bit value) indicating the control mode. If the unit is in any control mode other than the following, the unit returns 2, indicating host control mode. • Byte 0 = Control mode: ◦ 2 = Host control mode (using one of the digital communications ports) ◦ 4 = User control mode (using the **USER** port) If you issue this command with 1 data byte, send a value of 1. The returning packet contains 2 data bytes indicating the control mode. • Bytes 0 to 1 = Control mode: ◦ 2 = Host control mode (using one of the digital communications ports) ◦ 4 = User control mode (using the **USER** port) ◦ 21 = Slave control mode (control mode of slaves in a master/slave system) Command **14** sets this value.	0 or 1	1 or 2

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
161 **report output on status**	Reports the status of the most recent output request, since the last power up event of the unit. The returning packet contains 1 data byte (8-bit value): • 0 = Output on sequence OK • 1 = Control mode invalid • 2 = Unit is already on • 7 = Active fault exists • 11 = Bus is not ready • 44 = The Ascent DMS unit has not received a request to turn output on since power up	0	1
162 **report process status**	Reports on process status. In the status definitions, unless otherwise noted a value of 1 means the status is true, 0 means the status is false. Bits not listed are reserved or unassigned. Sending byte 0 is optional. If you send byte 0, send a value of 0. Expanded PROFIBUS: Use the 0-byte version of the command; the 1-byte version is not supported. The returning packet contains 4 bytes. 1st status byte (Byte 0): • 0 = Power fold-back active Units in a master/slave system: Applies to the master or slave unit, not the master/slave system. • 3 = Output power (0 = Off; 1 = On) • 4 = Invalid regulation mode • 5 = Internal interlock open • 7 = Setpoint status (0 = Within tolerance; 1 = Out of tolerance) Units in a master/slave system: Master unit, this bit applies to the entire master/slave	0 or 1	4

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	system; Slave unit, this bit applies to only the slave unit. 2nd status byte (Byte 1): • 0 = Overvoltage condition • 1 = Overcurrent condition • 2 = Warning active • 3 = Fault active • 4 = Overtemperature fault • 5 = User interlock open • 6 = **USER** port reset active • 7 = External interlock open 3rd status byte (Byte 2): • 0 = Power fault • 1 = Master/slave fault • 2 = Process voltage low • 3 = Arc limit fault • 4 = Inverter low • 6 = Plasma ignited • 7 = PROFIBUS error 4th status byte (Byte 3): • 0 = Bus fault or bus high fault • 1 = Bus low fault • 5 = Ground fault		
163 **report configuration status**	Reports the system configuration status. In the status definitions, unless otherwise noted a value of 1 means the status is true, 0 means the status is false. Bits not listed are reserved or unassigned. Sending byte 0 is optional. Expanded PROFIBUS: Use the 0-byte version of the command; the 1-byte version is not supported.	0 or 1	2

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	If you send byte 0, send a value of 0. Returns 4 bytes. 1st status byte (Byte 0): • 0 = Host program source (0 = Internal; 1 = External) • 2 = User (analog) program source (0 = Internal, 1 = External) • 3 = Master unit (0 = Standalone; 1 = Master) • 4 = Slave unit (0 = Standalone; 1 = Slave) • 5 = Arc handling (0 = Disabled; 1 = Enabled) • 6 = Program source (0 = Internal; 1 = External) 2nd status byte (Byte 1): • 1 = Pulsing mode (0 = Disabled; 1 = Enabled) • 4 = Process voltage limit (0 = Disabled; 1 = Enabled) • 7 = Ripple Level (0 = Low; 1 = High) 3rd status byte (Byte 2): • 0 = Intersystem frequency synchronization transmitter/receiver (0 = Receiver; 1 = Transmitter) 4th status byte (Byte 3): • 3 = Intersystem frequency synchronization (0 = Disabled; 1 = Enabled) • 7 = Arc limit fault feature (0 = Disabled; 1 = Enabled)		
164 **report setpoint and regulation mode**	Reports the setpoint level and the regulation mode for the power supply. Returns 3 data bytes. Bytes 0 to 1 (16-bit value):	0	3

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• When reporting a power setpoint, returns a value indicating hundredths of kilowatts (for example, a value of 1000 = 10.00 kW). • When reporting a current setpoint, returns a value indicating hundredths of amperes. For example, a value of 10,000 = 100.00 A. • When reporting a voltage setpoint, returns a value indicating volts (for example, a value of 800 = 800 V). Byte 2 (8-bit value) = Regulation mode: • 6 = Power • 7 = Voltage • 8 = Current Command **6** sets the setpoint value. Command **3** sets the regulation mode.		
165 **report actual output power**	Reports a snapshot of the output power level at that instant. The returning packet contains 2 data bytes (16-bit value), indicating output power level in tens of W. For example, a value of 1500 = 15000 W.	0	2
166 **report actual output voltage**	Reports a snapshot of the output voltage level at that instant. The returning packet contains 2 data bytes (16-bit value), indicating the voltage level in V. For example, a value of 800 = 800 V (no implied decimal).	0	2
167 **report actual output current**	Reports a snapshot of the output current level at that instant. The returning packet contains 2 data bytes (16-bit value), indicating the output current in hundredths of A. For example, a value of 1500 = 15.00 A.	0	2
168 **report actual output power, voltage, current**	Reports a snapshot of the output power, voltage, and current at that instant. The returning packet contains 6 data bytes (three 16-bit values): • Bytes 0 to 1 = Power level (tens of W)	0	6

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• Bytes 2 to 3 = Voltage level (V) • Bytes 4 to 5 = Current level (hundredths of A) See commands **165**, **166**, and **167** for the format of the reported output values.		
169 **report setpoints: power, voltage, and current**	Reports the setpoint levels for power, voltage, and current. The returning packet contains 6 data bytes (three 16-bit values): • Bytes 0 to 1 = Power setpoint (tens of W) • Bytes 2 to 3 = Voltage setpoint (V) • Bytes 4 to 5 = Current setpoint (hundredths of A) See commands **165**, **166**, and **167** for the format of the reported setpoint values.	0	6
175 **report time output on**	Reports how much time has elapsed since output power was turned on. The returning packet contains 3 data bytes: • Byte 0 = Number of hours • Byte 1 = Number of minutes • Byte 2 = Number of seconds	0	3
198 **report software revision level**	Reports the revision level of the software. Send 0 bytes. The command returns 12 ASCII characters indicating the firmware part number and revision. PROFIBUS: This command is not supported.	0	12
204 **report system control**	Reports the Ethernet IP address, default gateway, subnet mask, DHCP/BootP client control, and various other system settings. This command allows you to send subcommands. The name and function of a subcommand depend on the value of the first byte. The send data byte (Byte 0) specifies the requested parameter; the returned data bytes specify the parameter values. For example, if	Varies	Varies

Table 4-25. AE Host Commands (Continued)

<table>
<tr><th>Command</th><th>Description</th><th>Data Bytes Sent</th><th>Data Bytes Returned</th></tr>
<tr><td></td><td>byte 0 = 1, the returned data gives the value for the Ethernet default gateway.<table><tr><th>Byte 0 =</th><th>Description</th></tr><tr><td>0</td><td>report IP address</td></tr><tr><td>1</td><td>report default gateway</td></tr><tr><td>2</td><td>report subnet mask</td></tr><tr><td>3</td><td>report MAC ID</td></tr><tr><td>4</td><td>report Phy initialization status</td></tr><tr><td>5</td><td>report DHCP/BootP enable status (1-byte)</td></tr><tr><td>8</td><td>report DHCP/BootP enable status (2-byte)</td></tr><tr><td>11</td><td>report output limits as 32-bit values</td></tr><tr><td>12</td><td>report user limits as 32-bit values</td></tr><tr><td>27</td><td>report current scaling information</td></tr><tr><td>40</td><td>report setpoint compensation limit</td></tr><tr><td>41</td><td>Report setpoint compensation limit range</td></tr><tr><td>92</td><td>report warning or fault description</td></tr><tr><td>97</td><td>report CSR description</td></tr><tr><td>200</td><td>report domain name</td></tr><tr><td>202</td><td>report DNS server IP address</td></tr><tr><td>203</td><td>report DNS configuration</td></tr></table></td><td></td><td></td></tr>
<tr><td>204
report IP address
subcommand 0</td><td>Reports the Ethernet IP address for the power supply.
Send 1 data byte:
Byte 0 = 0 (report IP address)
Returns 4 data bytes:
Bytes 0 to 3 = IP address (LSB first)</td><td>1</td><td>4</td></tr>
</table>

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	Command **71** (subcommand 0) sets this value.		
204 **report default gateway** subcommand 1	Reports the Ethernet default gateway. Send 1 data byte: • Byte 0 = 1 (report Ethernet default gateway) Returns 4 data bytes: • Bytes 0 to 3 = Default gateway (LSB first) Command **71** (subcommand 1) sets this value.	1	4
204 **report subnet mask** subcommand 2	Reports the Ethernet subnet mask. Send 1 data byte: • Byte 0 = 2 (report Ethernet subnet mask) Returns 4 data bytes: • Bytes 0 to 3 = Subnet mask (LSB first) Command **71** (subcommand 2) sets this value.	1	4
204 **report MAC ID** subcommand 3	Reports the MAC ID for the power supply. Send 1 data byte: • Byte 0 = 3 (report MAC ID) Returns 6 data bytes: • Bytes 0 to 5 = MAC ID (LSB first)	1	6
204 **report Phy initialization status** subcommand 4	Reports Phy initialization status. When the cable is disconnected, all status bits return a 0. Send 1 data byte: • Byte 0 = 4 (report Phy initialization status) Returns 4 data bytes: • Byte 0 = Status ◦ Bit 0 = Phy read fail (0 = OK; 1 = Phy read fail) ◦ Bit 1 = Auto negotiate results (0 = OK; 1 = Timeout fail)	1	4

Table 4-25. AE Host Commands (Continued)

<table>
<tr><th>Command</th><th>Description</th><th>Data Bytes Sent</th><th>Data Bytes Returned</th></tr>
<tr><td></td><td>◦ Bit 2 = Link status (0 = Link up OK; 1 = Link down fail)
◦ Bit 3 = Remote fault (0 = OK; 1 = Remote fault)
◦ Bits 4 to 5 = Speed
<table><tr><th>Bit 5</th><th>Bit 4</th><th>Speed value</th></tr><tr><td>0</td><td>0</td><td>10 Mbit</td></tr><tr><td>0</td><td>1</td><td>100 Mbit</td></tr><tr><td>1</td><td>0</td><td>Reserved</td></tr><tr><td>1</td><td>1</td><td>Reserved</td></tr></table>◦ Bit 6 = Link duplex (0 = Half duplex; 1 = Full duplex)
◦ Bit 7 = 0 (Reserved)
• Bytes 1 to 3 = (Reserved)</td><td></td><td></td></tr>
<tr><td>204
report DHCP client enable status (1-byte response)
subcommand 5</td><td>Reports the enabled/disabled status of the DHCP client.
Send 1 data byte:
• Byte 0 = 5 (report DHCP enable status)
Returns 1 data byte:
• Byte 0 = Enable/disable status
◦ 0 = DHCP client disabled
◦ 1 = DHCP client enabled
Command 71 (subcommand 5) sets this value.</td><td>1</td><td>1</td></tr>
<tr><td>204
report DHCP client enable status (2-byte response)
subcommand 8</td><td>Reports the enabled/disabled status of the DHCP client.
Send 1 data byte:
• Byte 0 = 8 (report DHCP enable status)
Returns 2 data bytes:
• Bytes 0 to 1 = Enable/disable status
◦ 0 = DHCP client disabled
◦ 1 = DHCP client enabled</td><td>1</td><td>2</td></tr>
</table>

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	Command **71** (subcommand 5) sets this value.		
204 **report output limits as 32-bit values** subcommand 11	Report the unit output limits as 32-bit values. Send 1 byte. Byte 0 = 11 (report output limits as 32-bit values) Returns 12 bytes: • Bytes 0 to 3 = 32-bit power limit (in W) • Bytes 4 to 7 = 32-bit voltage limit (in V) • Bytes 8 to 11 = 32-bit current limit (in 0.01 A) Command **71** (subcommands 11, 12, and 13) set these values.	1	12
204 **report user limits as 32-bit values** subcommand 12	Report the user limits as 32-bit values. Send 1 byte. Byte 0 = 12 (report user limits as 32-bit values) Returns 12 bytes: • Bytes 0 to 3 = 32-bit power limit (in W) • Bytes 4 to 7 = 32-bit voltage limit (in V) • Bytes 8 to 11 = 32-bit current limit (in 0.01 A)	1	12
204 **report current scaling information** subcommand 27	Reports the current scaling. Send 1 data byte: • Byte 0 = 27 (report current scaling information) Returns 2 data bytes: • Bytes 0 to 1 = Current scaling (1 = 0.01 A increments; 10 = 0.1 A increments)	1	2
204 **report setpoint compensation limit** subcommand 40	Reports the setpoint compensation limit as a percent increase above power setpoint.	1	2

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	Send 1 data byte: • Byte 0 = 40 (report setpoint compensation limit) Returns 2 data bytes: • Bytes 0 to 1 = Setpoint compensation limit (in %) Set with command **71** (subcommand 40).		
204 **report setpoint compensation limit range** subcommand 41	Reports the setpoint compensation limit as a percent increase above power setpoint. Send 1 data byte: • Byte 0 = 41 (report setpoint compensation limit range) Returns 4 data bytes: • Bytes 0 to 1 = Minimum setpoint compensation limit (in %) • Bytes 2 to 3 = Maximum setpoint compensation limit (in %)	1	4
204 **report warning or fault description** subcommand 92	Returns the exact length of the description string up to 250 characters and is not NULL terminated. Expanded PROFIBUS: The command is not supported. Send 3 data bytes: • Byte 0 = 92 (report warning or fault description) • Byte 1 = Type (1 or 3 = Fault; 2 or 4 = Warning) • Byte 2 = Fault or warning code Returns a variable number of data bytes depending on the type sent. The first part of the return data is the length.	3	Varies

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	When type = 1 or 2, returns the fault description, up to 250 characters: • LEN = Length of the description, up to 250 characters • Bytes 0 to *LEN–1* = Fault description When type = 3 or 4, returns the 80-character fault description: • LEN = 80 (length of the description) • Bytes 0 to 79 = Fault description Command **223** reports the fault and warning codes. See the troubleshooting chapter for descriptions of fault and warning codes.		
204 **report CSR description** subcommand 97	Returns the exact length of the description string up to 250 characters and is not NULL terminated. Expanded PROFIBUS: The command is not supported. Send 3 data bytes: • Byte 0 = 94 (report CSR description) • Byte 1 = CSR code • Byte 2 = Reserved (always send 0) Returns a variable number of data bytes. The first part of the return data is the length. • LEN = Length of the description, up to 250 characters • Byte 0 to *LEN–1* = CSR description	4	Varies
204 **report domain name** subcommand 200	Reports the network domain name. Expanded PROFIBUS: The command is not supported. Send 1 data byte: • Byte 0 = 200 (report domain name) Returns a variable number of data bytes. The first part of the return data is the length.	1	Varies

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• LEN = Length of the domain name, up to 64 characters • Byte 0 to *LEN–1* = Domain name Valid characters for the domain name are letters, digits, hyphens, and dots. The factory default value is NULL. Set the domain name with command **71** (subcommand 200).		
204 **report DNS server IP address** subcommand 202	Reports the IP address for the DNS server. Send 1 data byte: • Byte 0 = 202 (report IP address) Returns 4 data bytes: • Bytes 0 to 3 = DNS server IP address (LSB first) Set the domain name with command **71** (subcommand 202).	1	4
204 **report DNS configuration** subcommand 203	Reports the IP address for the DNS server. Send 1 data byte: • Byte 0 = 203 (report DNS configuration) Returns 2 data bytes: • Bytes 0 to 1 = Enable/Disable DNS server updates (0 = Disable; 1 = Enable)	1	2
205 **report real-time clock**	Reports the time and date in the microprocessor module real-time clock. Returns 7 bytes: • Byte 0 = Seconds (00 – 59) • Byte 1 = Minutes (00 – 59) • Byte 2 = Hours (00 – 23) • Byte 3 = Day in week (01 – 07) • Byte 4 = Day in month (01 – 31) • Byte 5 = Month (01 – 12) • Byte 6 = Year (00 – 99) Command **70** sets this value.	0	7

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
209 **report 32-bit outputs**	Reports the unit output power, voltage, and current. Returns 12 bytes: • Bytes 0 to 3 = Power (in W) • Bytes 4 to 7 = Voltage (in V) • Bytes 8 to 11 = Current (in 0.01 A)	0	12
221 **report PIN number**	Returns a NULL-terminated ASCII string that represents the generator PIN number. Returns 32 bytes: • Bytes 0 to 31 = Unit PIN (ASCII characters)	0	32
223 **report fault or warning code list**	Returns a variable number of data bytes containing up to 20 fault codes. If no fault exists, returns CSR code 0. If there are active faults, returns 2 data bytes for each fault code. For example, if a single fault is active, the packet contains 2 data bytes; if two faults are active, the packet data length is 4 data bytes; and so on. If no faults are active, the packet data length is 1 (value = 0, indicating no faults). Send 1 data byte to request either faults or warnings: • If byte 0 = 1 or 3, report faults: ◦ 1 = Returns a variable length list of up to 20 2-byte faults. ◦ 3 = Returns 40 bytes with up to 20 2-byte faults. • If byte 0 = 2 or 4, report warnings: ◦ 2 = Returns a variable length list of up to 20 2-byte warnings. ◦ 4 = Returns 40 bytes with up to 20 2-byte warnings. The return packet for this command always starts with LEN (2 times the number of faults or	0	Varies, or CSR code 0 if no fault exists

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	warnings present). If you send byte 0 = 3 or 4, then: • LEN will always = 40. • If there are fewer than 20 active or latched faults or warnings, the remainder of the response packet following nonzero fault and warning codes will be set to 0. See the troubleshooting chapter for a list of the fault codes.		
231 **report unit information**	Reports unit information, such as part number and serial number. Send either 0 or 1 data byte. Expanded PROFIBUS: Use the 1-byte version of the command; the 0-byte version is not supported. If you issue this command with no data bytes, it will report the unit serial number. To specify the data to report, send 1 data byte (8-bit value) requesting the desired information: • Byte 0 = Information to report: ◦ 0 = Serial number ◦ 1 = Unit part number ◦ 6 = Part number revision Returns a variable number of data bytes, depending on the information requested: • If send byte 0 = 0, or if issued with no data byte: Returns 4 data bytes. Bytes 0 to 3 = 32-bit integer representing the unit serial number. • If send byte 0 = 1: Returns 12 data bytes. Bytes 0 to 11 = Unit part number as a 12-byte string. • If send byte 0 = 6: Returns 3 data bytes: ◦ Byte 0 = Revision character ◦ Bytes 1 to 2 = 0	0 or 1	3, 4, or 12

Table 4-25. AE Host Commands (Continued)

<table>
<tr><th>Command</th><th>Description</th><th>Data Bytes Sent</th><th>Data Bytes Returned</th></tr>
<tr><td>236
report arc parameters and counts</td><td>Reports arc management parameters and arc counts.
This command allows you to send subcommands. The name and function of a subcommand depend on the value of the first byte (the subcommand number).
The number of bytes to send and number of bytes returned varies by subcommand. The first data byte specifies the subcommand. The returned data bytes specify the parameter values. For example, if byte 0 = 2, the returned data reports the external Arc-Sync enabled state.
Each subcommand is described in a separate row of this table.
<table>
<tr><th>Byte 0 =</th><th>Description</th></tr>
<tr><td>2</td><td>report external Arc-Sync enable state</td></tr>
<tr><td>16</td><td>report arc profile index</td></tr>
<tr><td>17</td><td>report active arc profile name</td></tr>
<tr><td>18</td><td>report arc profile name</td></tr>
<tr><td>200</td><td>report arc density</td></tr>
<tr><td>201</td><td>report arc count</td></tr>
<tr><td>202</td><td>report arc threshold</td></tr>
<tr><td>203</td><td>report arc to ground persistence</td></tr>
<tr><td>204</td><td>report arc persistence</td></tr>
<tr><td>205</td><td>report arc timer</td></tr>
<tr><td>207</td><td>report arc density distribution</td></tr>
<tr><td>208</td><td>report arc suppression</td></tr>
<tr><td>210</td><td>report pulse transition arc mask time</td></tr>
<tr><td>252</td><td>report arc parameters range</td></tr>
</table></td><td>1</td><td>Varies</td></tr>
<tr><td>236
report external Arc-Sync enabled state
subcommand 2</td><td>Reports whether the external Arc-Sync function on the unit is enabled or disabled (SYNC PWR ports on the power supply). The external Arc-Sync feature allows you to synchronize arc</td><td>1</td><td>2</td></tr>
</table>

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	shutdown between multiple standalone power supplies and across master/slave systems. Send 1 data byte: • Byte 0 = 2 (report external Arc-Sync enable state) Returns 2 data bytes: • Byte 0 = Enabled state ◦ 0 = External Arc-Sync disabled ◦ 1 = External Arc-Sync enabled • Byte 1 = 0 Command **86** (subcommand 2) sets this value.		
236 **report arc profile index** subcommand 16	Reports the index number of the active arc management profile. Send 1 data byte: • Byte 0 = 16 (report arc profile index) Returns 2 data bytes: • Byte 0 = Arc profile index ◦ 0 = Standard arc recovery • Byte 1 = Reserved Command **236** (subcommand 17) reports the name of the active profile. Command **236** (subcommand 18) reports the name of the profile by index number. Command **86** (subcommand 16) sets this value.	1	2
236 **report active arc profile name** subcommand 17	Reports the name string that identifies the active arc profile. Send 1 data byte: • Byte 0 = 17 (report active arc profile name) Returns 32 bytes plus one byte NULL termination: • Bytes 0 to 31 = Arc profile name in ASCII • Byte 32 = 0 (NULL termination)	1	33

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
236 **report arc profile name** subcommand 18	Reports the name of the arc profile by index number. The name string (ASCII) could have as many as 32 bytes. Send 2 data bytes: • Byte 0 = 18 (report arc profile name) • Byte 1 = Profile index (always send 0) Returns 32 data bytes plus 1 NULL termination byte: • Bytes 0 to 31 = Arc profile name in ASCII • Byte 32 = 0 (NULL termination)	2	33
236 **report arc density** subcommand 200	Reports the arc density. Send 1 data byte: • Byte 0 = 200 (report arc density) • Byte 1 = Arc density selection: ◦ 0 = Micro arc density for cathode A ◦ 1 = Hard arc density for cathode A ◦ 2 = Micro arc density for cathode B ◦ 3 = Hard arc density for cathode B ◦ 4 = Intersystem micro arc density ◦ 5 = Intersystem hard arc density Returns 4 data bytes: • Bytes 0 to 3 = Arc density value (in arc/s)	2	4
236 **report arc count** subcommand 201	Reports the arc count for the selected counter. All arc counters are reset when you cycle power to the unit. Send 2 data bytes: • Byte 0 = 201 (report arc counter) • Byte 1 = Arc counter selection: ◦ 0 = Micro arc counter for cathode A ◦ 1 = Hard arc counter for cathode A ◦ 2 = Micro arc counter for cathode B	2	4

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	◦ 3 = Hard arc counter for cathode B ◦ 4 = Intersystem micro arc counter ◦ 5 = Intersystem hard arc counter Returns 4 data bytes: • Bytes 0 to 3 = Arc count for the selected counter Command **86** (subcommand 201) clears the selected counter. All counters are reset each time you cycle power to the unit.		
236 **report arc threshold** subcommand 202	Reports the selected arc threshold. Send 2 data bytes: • Byte 0 = 202 (report arc threshold) • Byte 1 = Arc threshold to report: ◦ 0 = VArc threshold (in V) ◦ 1 = Current threshold for VArc enable (in 0.01 A) ◦ 2 = Current threshold for VArc enable during recovery (in 0.01 A) ◦ 3 = VArc to ground threshold (in V) ◦ 4 = IArc threshold (in 0.01 A) Returns 2 data bytes: • Bytes 0 to 1 = Threshold value Command **86** (subcommand 202) sets this value.	2	2
236 **report arc-to-ground persistence** subcommand 203	Reports the arc-to-ground persistence. Send 1 data byte: • Byte 0 = 203 (report arc-to-ground persistence) Returns 4 data bytes: • Bytes 0 to 3 = Arc-to-ground persistence value (in ns) Command **86** (subcommand 203) sets this value.	1	4

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
236 **report arc persistence** subcommand 204	Reports the arc persistence. Send 1 data byte: • Byte 0 = 204 (report arc persistence) Returns 4 data bytes: • Bytes 0 to 3 = Arc persistence value (in ns) Command **86** (subcommand 204) sets this value.	1	4
236 **report arc timer** subcommand 205	Reports the selected arc timer value. Send 2 data bytes: • Byte 0 = 205 (report arc timer) • Byte 1 = Arc timer selection: ◦ 128 = Arc reaction time for micro arc 1 ◦ 129 = Arc shutdown time for micro arc 1 ◦ 130 = Arc mask time for micro arc 1 ◦ 132 = Arc reaction time for micro arc 2 ◦ 133 = Arc shutdown time for micro arc 2 ◦ 134 = Arc mask time for micro arc 2 ◦ 136 = Arc reaction time for micro arc 3 ◦ 137 = Arc shutdown time for micro arc 3 ◦ 138 = Arc mask time for micro arc 3 ◦ 140 = Arc reaction time for hard arc ◦ 141 = Arc shutdown time for hard arc ◦ 142 = Arc mask time for hard arc Returns 2 data bytes: • Bytes 0 to 1 = Arc timer (in ns) Command **86** (subcommand 205) sets this value.	2	2
236 **report arc density distribution** subcommand 207	Reports the selected arc density distribution in 0.1%. Send 2 data bytes: • Byte 0 = 207 (report arc density distribution) • Byte 1 = Arc density distribution selection:	2	2

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	◦ 0 = VArc and IArc density in micro arc 1 ◦ 1 = VArc and IArc density in micro arc 2 ◦ 2 = VArc and IArc density in micro arc 3 ◦ 3 = VArc and IArc density in hard arc Returns 2 data bytes: • Bytes 0 to 1 = Arc density (in 0.1%)		
236 **report arc suppression** subcommand 208	Reports the arc suppression routine that is being reported to the user interface. Send 1 data byte: • Byte 0 = 208 (report arc suppression) Returns 2 data bytes. Bytes 0 to 1 (LSB first) = Arc suppression routines the unit is sending to the user interface: • 0 = Micro arc 1, micro arc 2, micro arc 3, and hard arc • 1 = Micro arc 2, micro arc 3, and hard arc • 2 = Micro arc 3 and hard arc • 3 = Hard arc Command **86** (subcommand 208) sets this value.	2	2
236 **report pulse transition arc mask time** subcommand 210	Reports the selected pulse transition arc mask time in ns. The unit starts to count the mask time when it toggles the output. Send 2 data bytes: • Byte 0 = 210 (report pulse transition arc mask time) • Byte 1 = Pulse transition arc mask selection: ◦ 0 = Forward arc mask (off-to-on) ◦ 1 = Reverse arc mask (on-to-off) Returns 2 data bytes: • Bytes 0 to 1 = Pulse transition arc mask time (in ns) Command **86** (subcommand 210) sets this value.	2	2

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
236 **report arc parameter ranges** subcommand 252	Reports the selected arc parameter range. Send 2 data bytes: • Byte 0 = 252 (report arc parameter ranges) • Byte 1 = Arc parameter range selection: ◦ 0 = Arc reaction time range for micro arc 1 (in ns) ◦ 1 = Arc shutdown time range for micro arc 1 (in ns) ◦ 2 = Arc mask time range for micro arc 1 (in ns) ◦ 4 = Arc reaction time range for micro arc 2 (in ns) ◦ 5 = Arc shutdown time range for micro arc 2 (in ns) ◦ 6 = Arc mask time range for micro arc 2 (in ns) ◦ 8 = Arc reaction time range for micro arc 3 (in ns) ◦ 9 = Arc shutdown time range for micro arc 3 (in ns) ◦ 10 = Arc mask time range for micro arc 3 (in ns) ◦ 12 = Arc reaction time range for hard arc (in ns) ◦ 13 = Arc shutdown time range for hard arc (in ns) ◦ 14 = Arc mask time range for hard arc (in ns) ◦ 17 = VArc threshold range for hard arc (in V) ◦ 18 = Current threshold for VArc enable range (in 0.01 A) ◦ 19 = Current threshold for VArc recovery range (in 0.01 A)	2	2

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	◦ 20 = VArc to ground threshold range (in V) ◦ 21 = IArc threshold range (in 0.01 A) ◦ 22 = Arc to ground persistence range (in ns) ◦ 23 = Forward pulse arc mask time range (in ns) ◦ 24 = Reverse pulse arc mask time range (in ns) Returns 2 data bytes: • Bytes 0 to 1 = Valid range: ◦ Bytes 0 to 3 = Minimum value ◦ Bytes 4 to 7 = Maximum value		
238 **report setpoint and regulation mode**	Reports the present setpoint and regulation mode in 32-bit format. Returns 5 data bytes: • Bytes 0 to 3 = Setpoint for the active regulation mode (in W, V, or 0.01 A) • Byte 4 = Regulation mode: ◦ 6 = Power ◦ 7 = Voltage ◦ 8 = Current Set these values with command **78**.	0	5
248 **report subcommands**	This command allows you to send subcommands. The name and function of a subcommand depend on the value of the first byte (the subcommand number). The number of bytes to send and number of bytes returned varies by subcommand. The first data byte specifies the subcommand. The returned data bytes specify the parameter values. For example, if byte 0 = 100, the command reports the value of the selected sensor. Each subcommand is described in a separate row of this table.	Varies	Varies

Table 4-25. AE Host Commands (Continued)

<table>
<tr><th>Command</th><th>Description</th><th>Data Bytes Sent</th><th>Data Bytes Returned</th></tr>
<tr><td></td><td>
<table>
<tr><th>Byte 0 to 1 =</th><th>Description</th></tr>
<tr><td>99</td><td>report ignition state</td></tr>
<tr><td>100</td><td>report sensor value</td></tr>
<tr><td>101</td><td>report intersystem frequency sync mode</td></tr>
<tr><td>102</td><td>report intersystem frequency sync delay</td></tr>
<tr><td>103</td><td>report valid intersystem frequency sync delay range</td></tr>
<tr><td>104</td><td>report intersystem frequency sync phase shift</td></tr>
<tr><td>105</td><td>report intersystem frequency sync phase shift range</td></tr>
<tr><td>107</td><td>report output short circuit voltage threshold</td></tr>
<tr><td>108</td><td>report output short circuit current threshold</td></tr>
<tr><td>109</td><td>report output short circuit threshold ranges</td></tr>
<tr><td>140</td><td>report customer snapshot</td></tr>
<tr><td>247</td><td>report rectified DC bus voltage</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>248
report ignition state
subcommand 99</td><td>Reports the ignition state.
Send 2 bytes:
• Bytes 0 to 1 = 99 (report ignition state)
Returns 2 bytes:
• Bytes 0 to 1 = Ignition state:
◦ 0 = Ignition disabled
◦ 1 = Ignition enabled
Command 118 (subcommand 99) sets this value.</td><td>2</td><td>2</td></tr>
</table>

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
248 **report sensor value** subcommand 100	Reports the value for the selected sensor. Send 4 bytes: • Bytes 0 to 1 = 100 (report sensor value) • Bytes 2 to 3 = Sensor selection: ◦ 1 = Inverter A bridge temperature (in °C) ◦ 2 = (30 kW units only) Inverter B bridge temperature (in °C) ◦ 3 = Pulse bridge temperature (in °C) ◦ 4 = IGBTs temperature (in °C) ◦ 5 = Ambient temperature at air intake (in °C) ◦ 6 = Water-in temperature (in °C) Returns 2 bytes: • Bytes 0 to 1 = Sensor value.	4	2
248 **report intersystem frequency sync state** subcommand 101	Reports the following intersystem frequency synchronization information for the unit. Send 2 bytes: • Bytes 0 to 1 = 101 (report intersystem frequency sync state) Returns 2 bytes: • Bytes 0 to 1 = State: ◦ 0 = Intersystem frequency synchronization disabled for the unit ◦ 1 = Intersystem frequency synchronization enabled and unit is a receiver ◦ 2 = Intersystem frequency synchronization enabled and unit is a transmitter Command **118** (subcommand 101) sets this value.	2	2
248 **report intersystem**	Sets the delay when using the intersystem frequency synchronization feature. Send 2 bytes:	2	2

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
frequency sync delay subcommand 102	• Bytes 0 to 1 = 102 (report intersystem frequency sync delay) Returns 2 bytes: • Bytes 0 to 1 = Intersystem frequency synchronization delay (in ns) Command **118** (subcommand 102) reports this value.		
248 **report intersystem frequency sync delay range** subcommand 103	Reports the allowed delay range when using the intersystem frequency synchronization feature. Send 2 bytes: • Bytes 0 to 1 = 103 (report intersystem frequency sync delay range) Returns 4 bytes: • Bytes 0 to 1 = Minimum delay value (in ns) • Bytes 2 to 3 = Maximum delay value (in ns)	2	4
248 **report intersystem frequency sync phase shift** subcommand 104	Reports the intersystem frequency synchronization phase shift in degrees. Send 2 bytes: • Bytes 0 to 1 = 104 (report intersystem frequency sync phase shift) Returns 2 bytes: • Bytes 0 to 1 = Phase shift (in degrees) Command **118** (subcommand 104) reports this value.	2	2
248 **report intersystem frequency sync phase shift range** subcommand 105	Reports the allowed phase shift range when using the intersystem frequency synchronization feature. Send 2 bytes: • Bytes 0 to 1 = 105 (report intersystem frequency phase shift range) Returns 4 bytes: • Bytes 0 to 1 = Minimum phase shift value (in degrees)	2	4

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• Bytes 2 to 3 = Maximum delay value (in degrees)		
248 **report output short circuit voltage threshold** subcommand 107	Reports the voltage threshold at which the unit detects a short circuit. A value of 0 V disables the short circuit detection. Send 2 bytes: • Bytes 0 to 1 = Voltage (in V) Returns 2 bytes: • Bytes 0 to 1 = Voltage (in V) Command **118** (subcommand 107) reports this value.	2	2
248 **report output short circuit current threshold** subcommand 108	Reports the current threshold at which the unit detects a short circuit. Send 2 bytes: • Bytes 0 to 1 = 108 (report output short circuit current threshold) Returns 2 bytes: • Bytes 0 to 1 = Current (in 0.01 A) Command **118** (subcommand 108) reports this value.	2	2
248 **report output short circuit parameters range** subcommand 109	Reports the selected parameter range. Send 4 bytes: • Bytes 0 to 1 = 109 (report output short circuit threshold ranges) • Bytes 2 to 3 = Range selection: ◦ 0 = Report voltage output short circuit threshold range (V) ◦ 1 = Report current output short circuit threshold range (0.01 A) Returns 4 bytes: • Bytes 0 to 1 (LSB first) = Minimum value • Bytes 2 to 3 (LSB first) = Maximum value Command **118** (subcommands 107 and 108) set these values.	4	4

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
248 **report customer snapshot** subcommand 140	Reports customer snapshot data. Sends 4 bytes: • Bytes 0 to 1 (LSB first) = 140 (report customer snapshot) • Bytes 2 to 3 = Always send 1 Returns 64 bytes: • Bytes 0 to 3 = Power • Bytes 4 to 7 = Voltage • Bytes 8 to 11 = Current • Bytes 12 to 15 = Intermediate setpoint • Bytes 16 to 19 = Final setpoint • Byte 20 = Regulation mode (6 = Power; 7 = Voltage; 8 = Current) • Byte 21 = Simplified program control mode (for backwards compatibility) (2 = Host; 4 = User) • Byte 22 = Expanded control mode (2 = Host; 4 = User; 21 = Slave) • Byte 23 = Reserved • Bytes 24 to 27 = Process status (same as command **162** with byte 0 = 0, extended format • Bytes 28 to 31 = Configuration status (same as command **163** with byte 0 = 0, extended format • Bytes 32 to 35 = Micro arc count A • Bytes 36 to 39 = Hard arc count A • Bytes 40 to 43 = Micro arc density A • Bytes 44 to 47 = Hard arc density A • Bytes 48 to 51 = Micro arc count B • Bytes 52 to 55 = Hard arc count B • Bytes 56 to 59 = Micro arc density B • Bytes 60 to 63 = Hard arc density B	4	64

Table 4-25. AE Host Commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
248 **report rectified DC bus voltage** subcommand 247	Reports the rectified DC bus voltage. DC bus voltage is an internal voltage used by the power supply. It is based on the AC input voltage. When in standby, the DC bus voltage equals approximately the AC input Vrms * 1.414. Send 2 bytes: • Bytes 0 to 1 = 247 (report rectified DC bus voltage) Returns 2 bytes: • Bytes 0 to 1 = Rectified DC bus voltage (in V)	2	2

Installation, Setup, and Operation

PREPARING TO INSTALL THE UNIT

Spacing Requirements

- Minimum clearance between either side of the Ascent DMS power supply and the enclosure: 51 mm (2″).
- Minimum clearance between the top of the Ascent DMS power supply and the top of the enclosure: 25 mm (1″).
- Minimum clearance between the front and back of the Ascent DMS power supply and the enclosure: 102 mm (4″), with adequate ventilation.
- Minimum clearance between power supplies in the 19″ rack: 1U height [44 mm (1.7″)].

Dimensional Drawings

The illustrations in this section show the Ascent DMS power supply dimensions. These drawings are representative. Your unit might differ from these drawings.

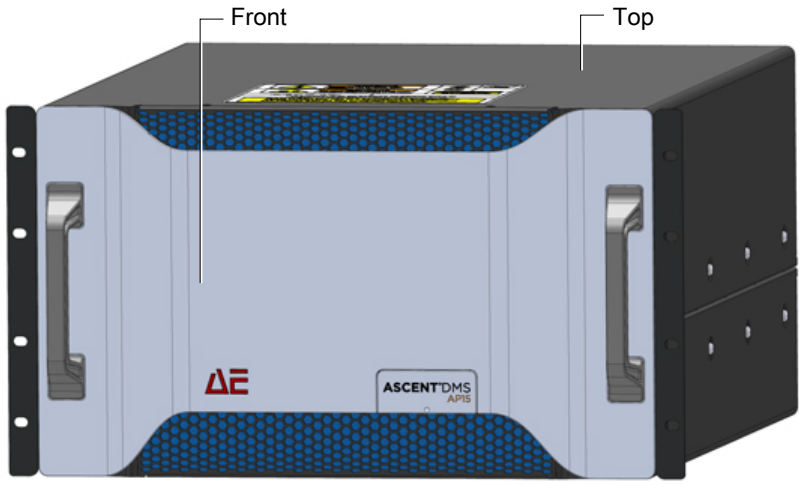


Figure 5-1. Isometric view, front

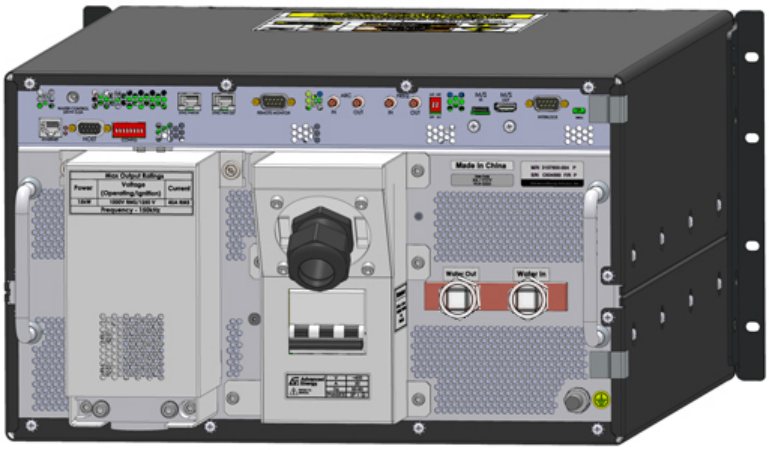


Figure 5-2. Isometric view, rear (15 kW units)

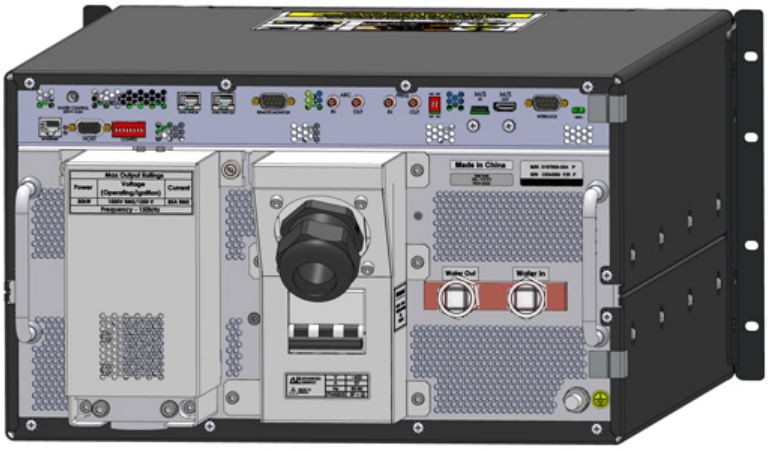


Figure 5-3. Isometric view, rear (30 kW units)

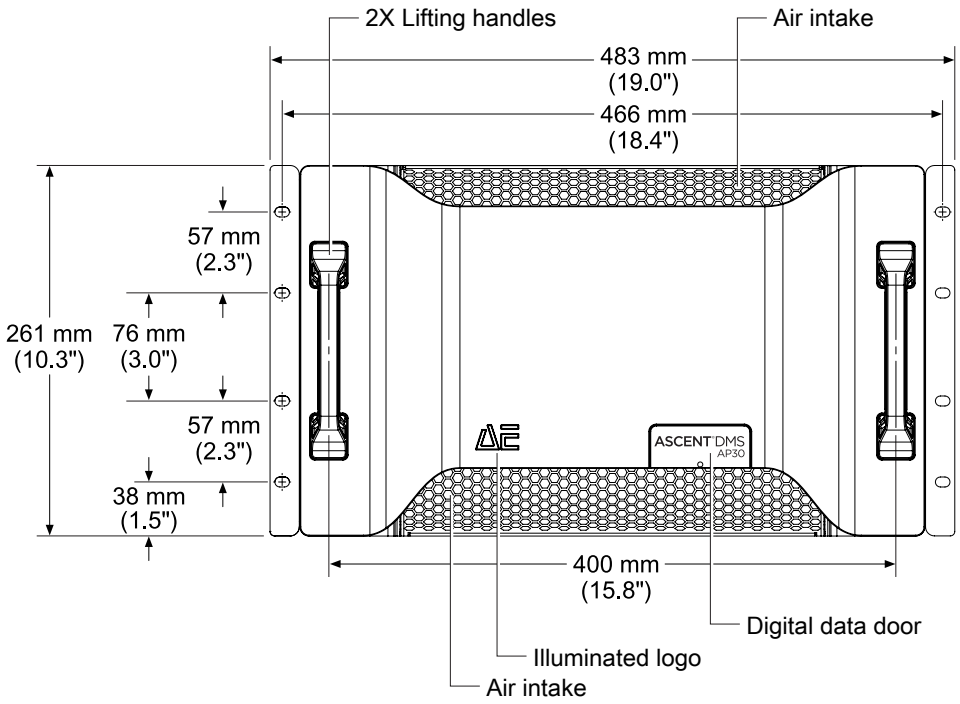


Figure 5-4. *Front view*

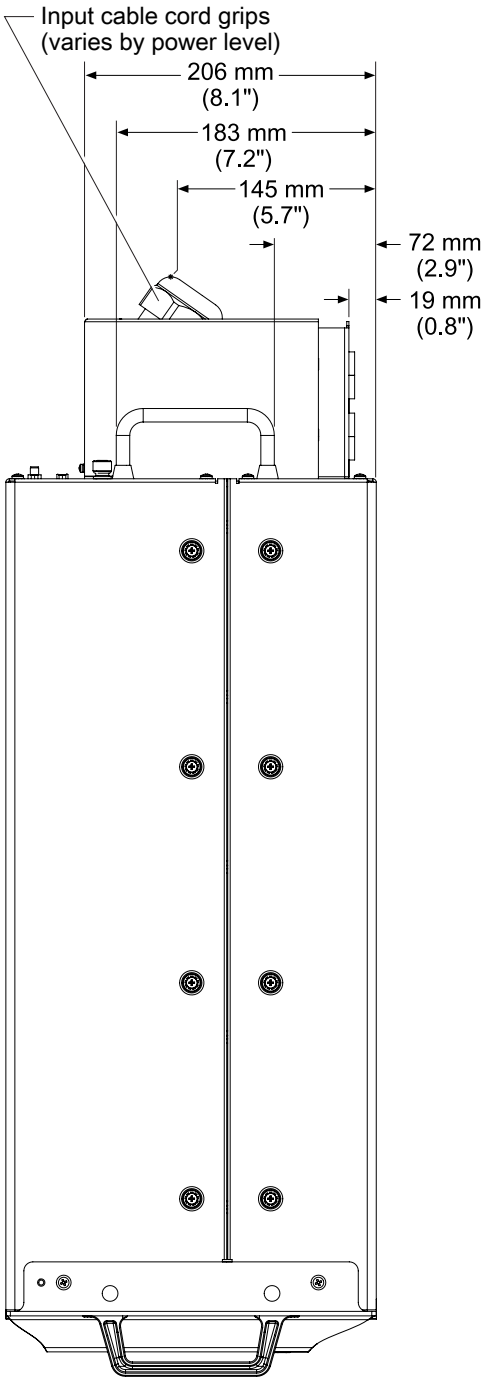


Figure 5-5. Right view

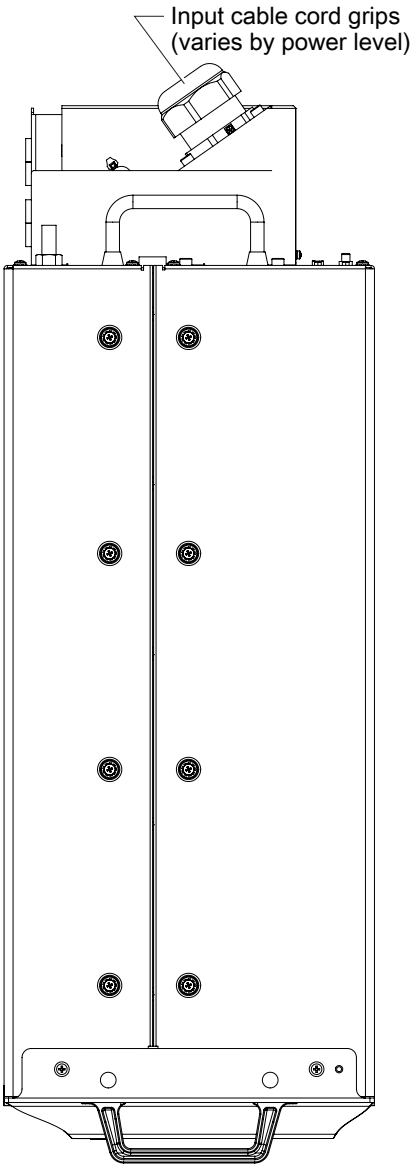


Figure 5-6. Left view

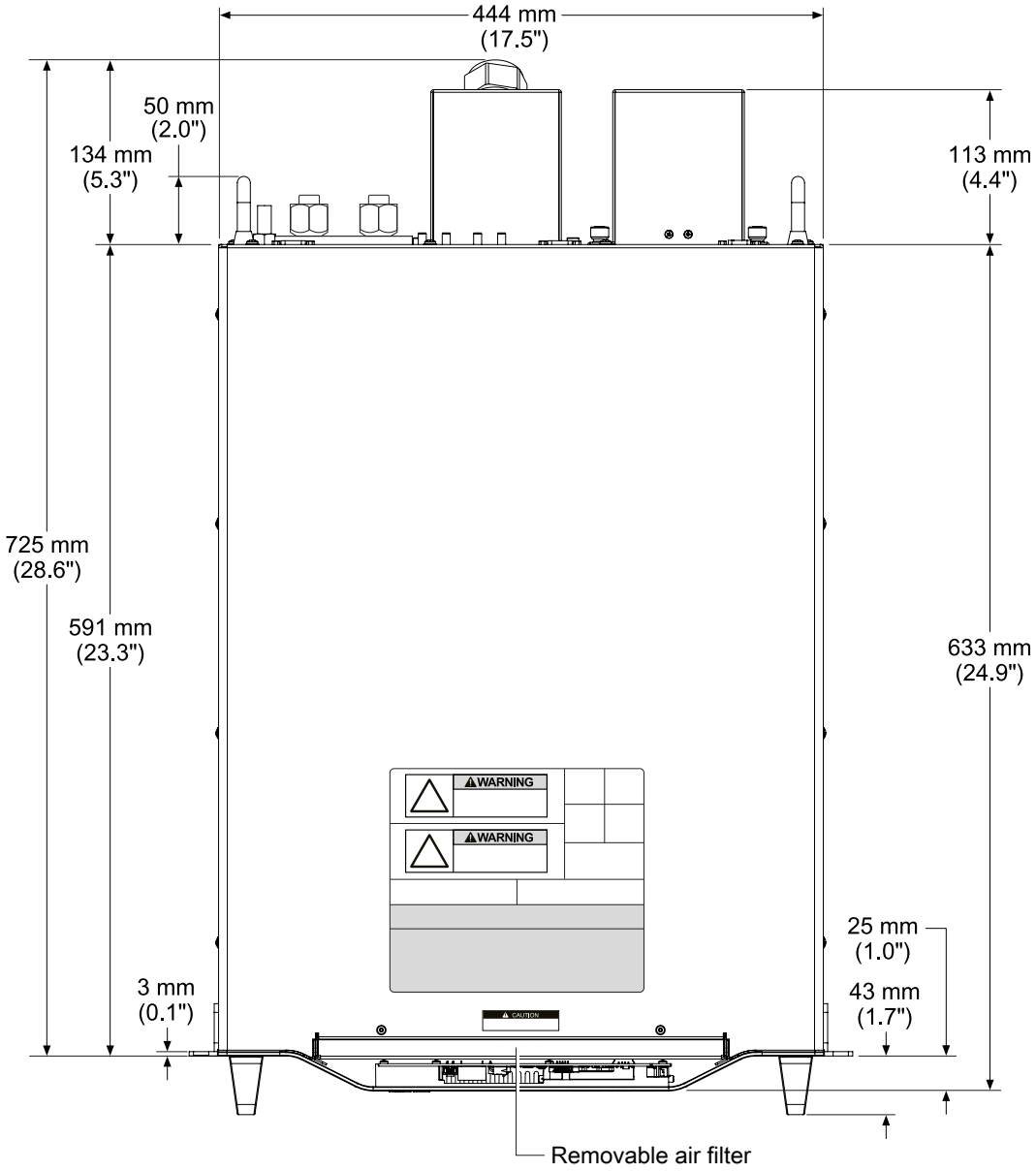


Figure 5-7. *Top view (15 kW units)*

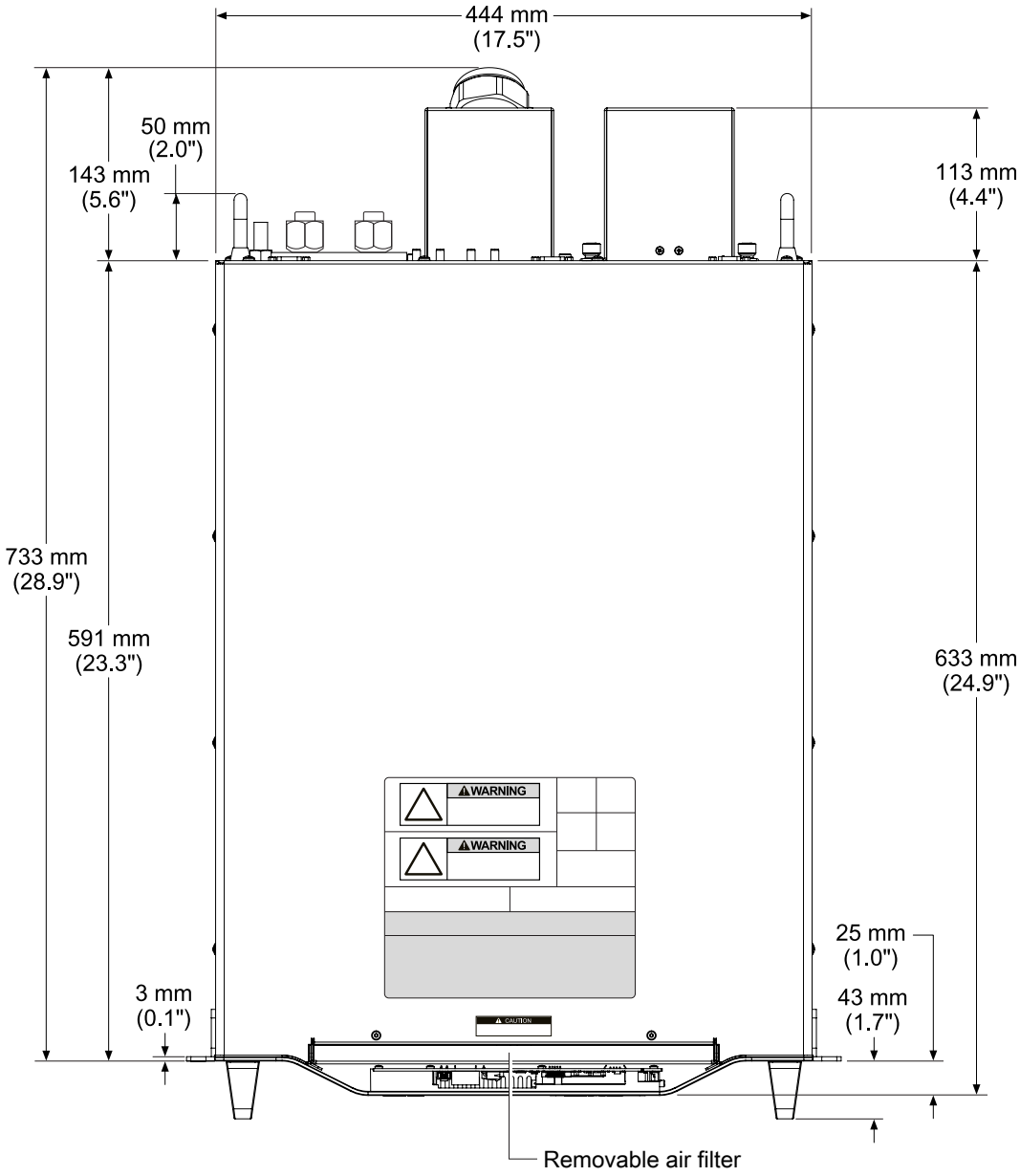


Figure 5-8. *Top view (30 kW units)*

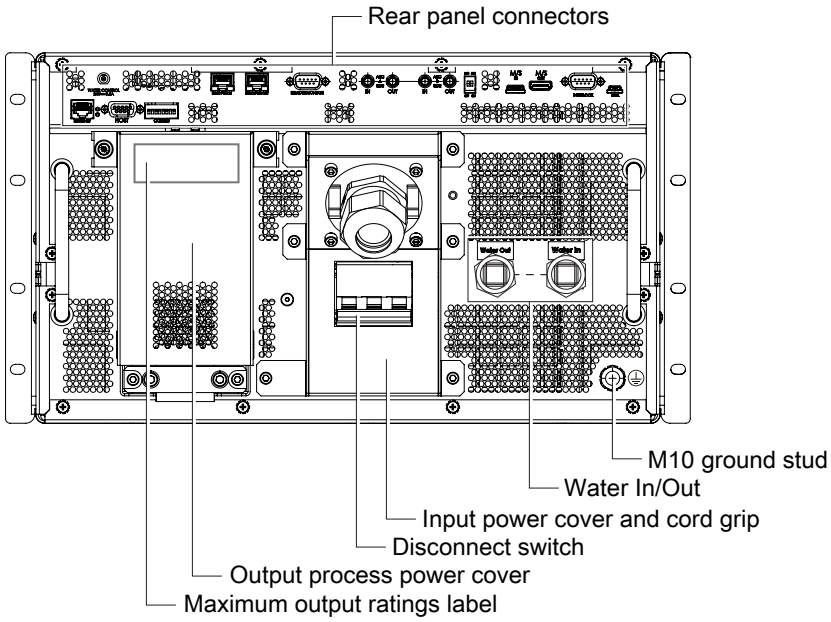


Figure 5-9. Rear view (15 kW)

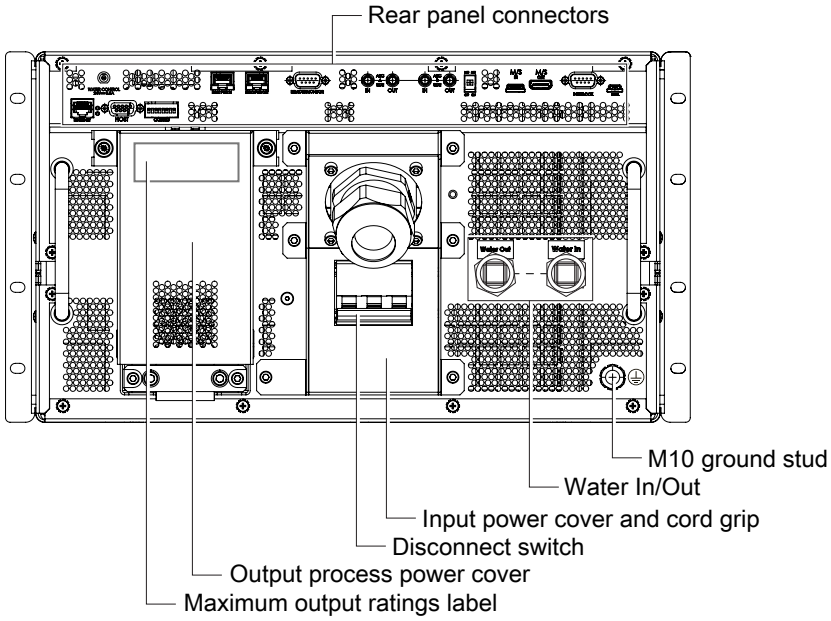


Figure 5-10. Rear view (30 kW)

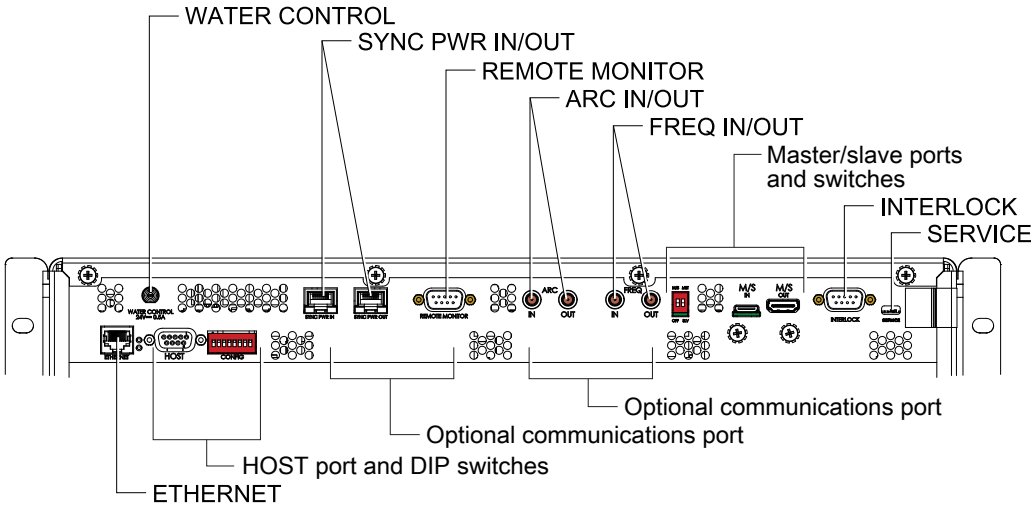


Figure 5-11. Control panel (rear)

Cooling Requirements

To provide sufficient cooling for the Ascent DMS power supply, you need to set up both air and water cooling.

AIR COOLING

CAUTION:

RISK OF BODILY INJURY OR DAMAGE TO UNIT. Turn off power supply before removing the air filter. If the air filter is not properly installed, fingers can come in contact with rotor or blades, resulting in bodily injury.

CAUTION:

Fan blades are accessible if air filter is not in place. Unit must be switched off before removing air filter. Unit must never be turned on without air filter.

To supply the Ascent DMS power supply with sufficient air cooling, set up the unit to ensure that it can do the following:

- Draw air through the front grill with no obstructions.
- Bring in coolant air of the temperature specified for the unit.
- Exhaust the hot air from the unit with minimal airflow restriction.
- Prevent air exhaust from the unit from circulating and becoming input air.

Important

Change the air filter as needed to maintain airflow.

If you are installing more than one unit in a rack, be sure that coolant air moves through each power supply.

WATER COOLING

The Ascent DMS power supply water cooling system does not include water solenoid, water flow meter, or humidity sensor. You must take external measures to protect the unit and the environment. The unit includes a 24 V water control to connect to a user-supplied water solenoid.

To supply the Ascent DMS power supply with sufficient water cooling, set up the water cooling to meet these criteria:

- Connect to the water supply without leaks.
- Water flow, pressure, and temperature must meet specifications (see cooling specifications).
- Water temperature must always be above dew point.
- You can use a solenoid and clean dry air to help ensure proper water cooling in a high humidity environment.

SOLENOID WATER CONTROL

The cooling water temperature must be kept above the dew point, which can become an issue in high humidity environments. One way to ensure that the water temperature remains above the dew point is to use a solenoid to stop the water flow when the unit is not on.

The Ascent DMS power supply includes a 24 V, 0.5 A maximum current, connector (**WATER CONTROL**) that you can use to control a water solenoid. When the power supply is on, the **WATER CONTROL** connector provides 24 V to a connected solenoid.

RACK DESIGN

The following is a synopsis of the principles to follow when designing a rack containing a stack of Ascent DMS power supplies.

Coolant air must be drawn easily into the rack; exhaust air must be able to pass unrestricted out of the rack. If some physical constraint restricts the flow of exhaust air out of the rack, AE recommends mounting the fans or blowers so that the hot air is removed from the rack as quickly as possible.

Each Ascent DMS power supply dissipates up to 2.5% of its maximum power at full-rated output. The following table shows the minimum air flow in cubic feet per minute (CFM) required by individual Ascent DMS power supplies. The static pressure (inches of water) of the empty rack should not exceed 0.1 inches of water at the CFM level obtained by adding together the minimum CFM values for all the power supplies that will be placed in the rack.

Table 5-1. Minimum CFM required for an Ascent DMS power supply

Power Supply	CFM Required
30 kW	300 CFM / 8.5 M^3M
15 kW	300 CFM / 8.5 M^3M

Installation Requirements

Install this unit according to the following requirements.

DANGER:

RISK OF DEATH OR BODILY INJURY. Disconnect and lockout/tagout all sources of input power before working on this unit or anything connected to it.

DANGER:

Personnel must receive proper training before installing or troubleshooting high-energy electrical equipment. Potentially lethal voltages could cause death, serious personal injury, or damage to the equipment. Ensure that all appropriate safety precautions are taken.

CAUTION:

This equipment is intended for use with a single source of three-phase power with all phases vectored at 120° angles ± 5°. If the equipment is used with an uninterruptable power supply (UPS), or other type of power conditioner, the user is responsible to guarantee the safety and EMC performance of the entire system.

CAUTION:

You must never defeat an interlock by any means.

WARNING:

Advanced Energy products only include interlocks when required by product specification. Interlocks in Advanced Energy products are not intended to meet or satisfy safety requirements. Where interlocks exist, you must still meet and satisfy safety requirements. The presence of interlocks does not imply operator protection.

Unpacking the Unit

☞ **Important**
The labels on the packaging provide important handling information.

1. Unpack and inspect the unit carefully, looking for obvious physical damage.
2. If no damage is apparent, proceed with the unit installation and setup.
3. If you do see signs of shipping damage, contact Advanced Energy and the carrier immediately.

   Save the shipping container for submitting necessary claims to the carrier.

Lifting the Unit

⚠ **CAUTION:**
These units are heavy, and many jurisdictions require that you use at least two people to lift the unit or that you employ a mechanical lifting aid. Follow local and/or company regulations when lifting these units.

TO LIFT THE UNIT

1. Lift the unit following local regulations. When using two people, lift the unit with one at the front of the unit and one at the rear of the unit.

   You can use the unit handles to lift the unit; do not use rack ears to lift the unit.

INSTALLING THE UNIT

Related Links

- “Grounding” on page 5-13

Mounting the Unit in a Rack

You can mount the Ascent DMS power supply in a 482 mm (19″) rack. AE recommends mounting all units in a master/slave system in a common, electrically conductive rack to reduce electrical noise between units.

This section provides the recommended procedure for mounting the unit.

REQUIREMENTS

- Phillips screwdriver

- Mounting hardware
- Forklift

TO MOUNT THE UNIT IN A RACK

1. Make sure the rack is clear of obstructions.
2. Move the unit to the rack.
3. Carefully slide the unit into the rack.

   Use the unit handles; do not use rack ears.
4. Attach the mounting hardware.

When you have secured the unit to the rack, you can continue installing the unit.

Grounding

WARNING:

Do not attempt to turn on power until the chassis of the unit is tied to a local earth ground through a copper grounding strap that is sized in accordance with applicable requirements.

The rear panel of the Ascent DMS power supply features one M10 secondary Protective Earth (ground) stud, indicated on the rear panel by a ground symbol.

You must ground the power supply as specified by the conditions of use.

The grounding wire should be able to conduct the current of one phase (see the specifications in the user manual).

If connecting a master/slave system, see the master/slave information for the optimal grounding connection of the master and slave units.

Related Links

- "Conditions of Use" on page 1-4
- "Specifications" on page 3-1
- "Connecting for Master/Slave Operation" on page 5-25

Connecting Cooling Water

CAUTION:

A temporary conductivity caused by condensation may occur when the device is not operating. Operate only in noncondensing environments.

CAUTION:

Do not use deionized water for cooling purposes. Deionized water causes both corrosion and erosion of cooling manifolds.

CAUTION:

Avoid electrically conductive cooling water (such as salty or rusty water), which can compromise the isolation of electrically active components. See the cooling specification section of the user manual for maximum allowable contaminate specifications.

The **Water In** and **Water Out** connectors are located on the rear panel of the generator. You need the appropriate male water fittings to connect water to the unit. For information on the connector for your unit, see the physical specifications section.

Operate this unit under the ambient temperature and water specifications declared in the specification.

TO CONNECT COOLING WATER

1. Using standard NPT installation recommendations, prepare the male fitting as needed to ensure a proper connection and thread the fitting into the water manifold on the back of the unit.
2. Wrench-tighten the fitting as follows: 1.5 to 3 turns past finger tight.
3. Ensure that the water supply pressure does not exceed the maximum pressure specified in the cooling specifications in the user manual.
4. Turn the water on and examine the fittings and connections for any leaks.
   a. If leaks are not present, continue installing the unit.
   b. If leaks are present, remove the fittings, inspect and clean the threads, and then repeat this procedure.
   c. If leaks are still present after the second installation, contact AE Global Services.

CONNECTING TO A WATER SOLENOID

Figure 5-12. WATER CONTROL (solenoid)

To Connect to a Water Solenoid

- Connect the 24 V, 0.5 A maximum current, solenoid of a user-supplied water valve to the **WATER CONTROL** connector on the rear panel of the Ascent DMS power supply.

Connecting the INTERLOCK Port

DANGER:

RISK OF DEATH OR BODILY INJURY. Disconnect and lockout/tagout all sources of input power before working on this unit or anything connected to it.

CAUTION:

Turn off power to the system before connecting a cable to the I/O port connector. I/O port connectors are not hot pluggable.

CAUTION:

Signals at the I/O port can be sensitive to noise. Take standard preventative measures against electromagnetic interference (EMI), including using shielded cabling on this port.

The **INTERLOCK** port, located on the rear panel of the unit, is a 9-pin, male, subminiature-D connector.

Important

In addition to connecting the **INTERLOCK** port, the output cover interlock must be properly installed to allow the unit to run.

To enable the Ascent DMS power supply to function, pins 3 and 4 of this connector must be shorted together (through a cheater plug, external switch, or relay). Pin 4 supplies the signal with 24 V, and it can source 60 mA.

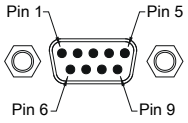


Figure 5-13. INTERLOCK port connector

The mating connector, connector shell, and post screws are included in the hardware kit that accompanied the Ascent DMS power supply.

Connecting Output Power

Be sure to heed the following safety information when making your output power connection. Improper connection to the output connector could affect operation of the Ascent DMS unit. To comply with EMI/EMC standards, use a shielded output cable and connect the shields to the two M6 Protective Earth ground studs on the Ascent DMS power supply output housing. In addition, see the conditions of use for more information about making the output connection. If you are unsure how to connect your output cable between the Ascent DMS unit and your chamber, please contact AE Global Services.

DANGER:

RISK OF DEATH OR BODILY INJURY. Disconnect and lockout/tagout all sources of input power before working on this unit or anything connected to it.

WARNING:

This device must be installed so that the output power connection is inaccessible to the user.

Related Links

- "Conditions of Use" on page 1-4

OUTPUT CONNECTOR

DANGER:

For safety compliance, when configuring for floating output do not allow the maximum voltage at either connection of the output connector terminals to exceed 1200 V with respect to ground.

The Ascent DMS power supply uses a two-terminal, ring lug output connector (with M10 bolts). The unit ships with a power connection cover that covers high voltage process power connections.

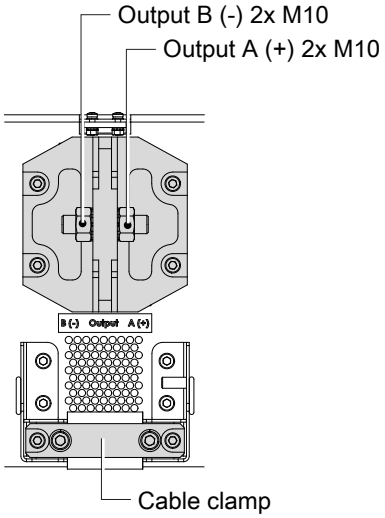


Figure 5-14. AC output connector, cover removed

OUTPUT POWER CABLE REQUIREMENTS

Important

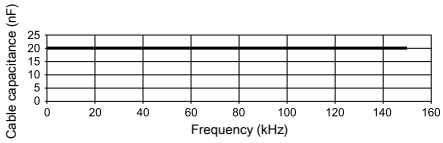
Advanced Energy does not include power output cables with the Ascent DMS power supply.

To meet EMC requirements, shielded output cables are required between the Ascent DMS power supply and your chamber. In addition to EMC compliance, using shielded output cables minimizes the system noise from chamber arcs and takes full advantage of the improved process rate of the Ascent DMS power supply. The output connections require output cables that meet the requirements of your local electrical code.

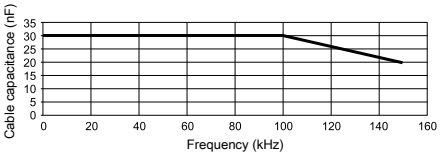
When selecting and preparing power output cables, keep the following in mind:

- Size cables according to your process. If the cables are sized less than the maximum capability of Ascent DMS power supply output, then use the I_{rms} limit to restrict the output of the Ascent DMS power supply. Either the A or the B terminal can be ± 1250 V (maximum) with respect to ground, or the terminals can have a maximum differential of 1250 V.
- The output cable clamps require that output cables have a maximum diameter of 31 mm (1.2″) and a minimum diameter of 25 mm (1.0″).
- For optimal performance, to provide maximum power to the cathodes, and to minimize arc energy, AE recommends cables that meet the following specifications: L < 3 µH, C < 50 nF.

  Maximum cable capacitance (15 kW units):



Maximum cable capacitance (30 kW units):



- The shield termination connection requires an M6 ring lug connector.
- Each terminal connection requires an M10 ring lug connector.
- Two strain reliefs are provided for the output cables.

TO CONNECT OUTPUT PROCESS POWER

WARNING:

This device must be installed so that the output power connection is inaccessible to the user.

When correctly installed, the output power connector cover provides an interlock closure.

1. Verify that all sources of input power are locked out/tagged out, including, but not limited to, AC input power and any power coupled from the load.
2. Cut the output cable to the desired length.
3. Remove the power connection cover by removing the cover screws.

   The cover is connected to the unit with 2x cross head screws mounted on springs. The screws stay with the cover even when loosened. Use a Phillips screwdriver to loosen the screws.
4. Prepare the cable with M10 ring lugs on the process power terminals and M6 ring lugs on the shield.

   Keep the following in mind:

   ◦ Ensure that the wire leads are properly insulated for 1250 V.

   ◦ Minimize the distance between strain relief and the M10 studs on the connector.

   ◦ Minimize the distance between the strain relief and the M6 ground studs.
5. Remove the screws holding the cable clamp on the bottom of the power connection cover.
6. Feed the cable through the cable clamp. Replace the screws.

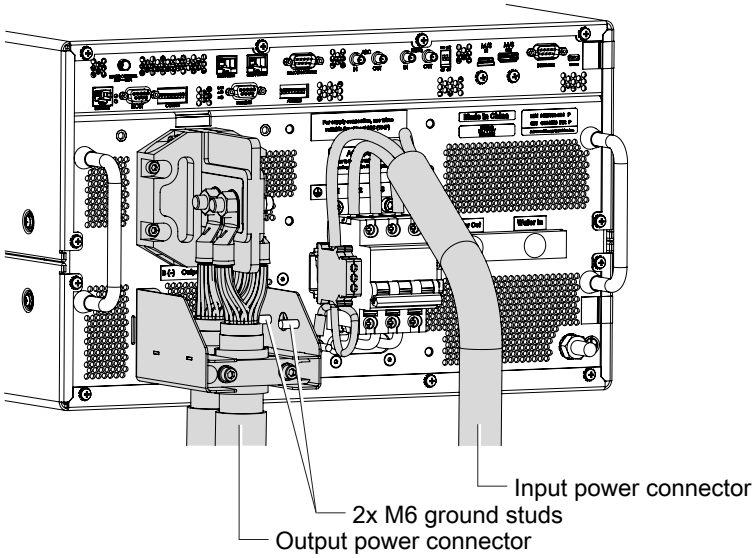
   The cable clamp must make contact with the cable shield.
7. To secure the cable connections to the terminal, do the following:

   a. Remove the M10 nuts from the terminal connections.

b. Secure one cable connection to the A terminal connection on the power supply. Torque each connection according to local electrical code up to a maximum of 32 Nm (280 in-lb).

c. Secure the other cable connection to the B terminal connection on the power supply. Torque each connection according to local electrical code up to a maximum of 32 Nm (280 in-lb).

d. Secure the cable shielding to the M6 ground studs on the floor of the power connection cover.



8. Replace the output connector cover.

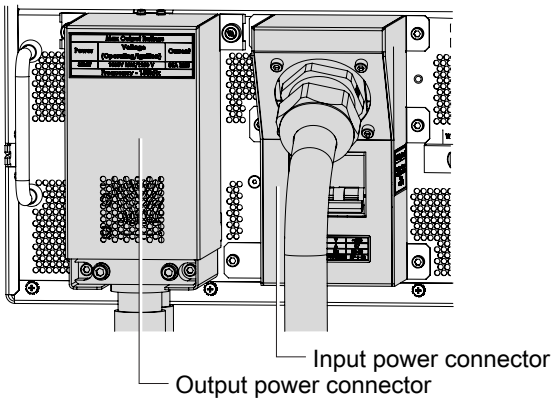


Figure 5-15. *Power connectors, cable installed, cover replaced*

Connecting Input Power

DANGER:

RISK OF DEATH OR BODILY INJURY. Disconnect and lockout/tagout all sources of input power before working on this unit or anything connected to it.

WARNING:

This device must be installed so that the input power connection is inaccessible to the user.

Important

Always follow regulations per local electrical codes for overcurrent protection and wire size used. Common practice is to use input conductors and overcurrent protection devices that can carry 125% of rated input current.

Related Links

- "Conditions of Use" on page 1-4

TOOLS AND EQUIPMENT REQUIRED TO INSTALL INPUT POWER

To install the input power connections, you need to supply the following tools and equipment:

- Hex key: #4, minimum length 120 mm (4.72″)
- Slotted screwdriver: Medium-sized blade
- POZIDRIV® screwdriver: PZ2
- Open-end wrench: 42 mm (1.65″)
- Wire stripper
- Stranded wire: See "Input Power Cable Requirements"

INPUT CONNECTOR

The AC input power connector is located on the rear panel of the Ascent DMS power supply. See the electrical specifications for AC voltage range, frequency, current, and other applicable specifications.

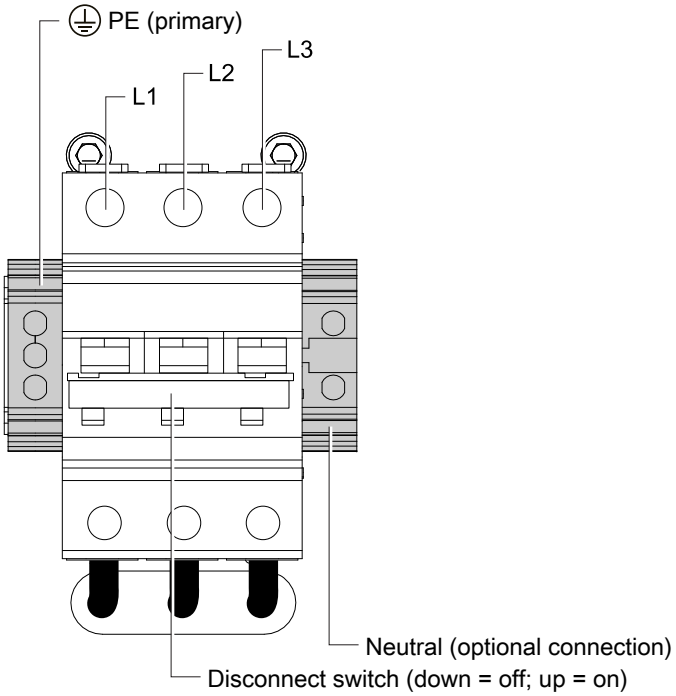


Figure 5-16. AC input power connector, cover removed

INPUT POWER CABLE REQUIREMENTS

Use a stranded wire of a gauge consistent with your application, applicable requirements, the input power specification, and the conditions of use for the product.

Always follow regulations per local electrical codes for overcurrent protection and wire size used.

CONNECTING INPUT POWER

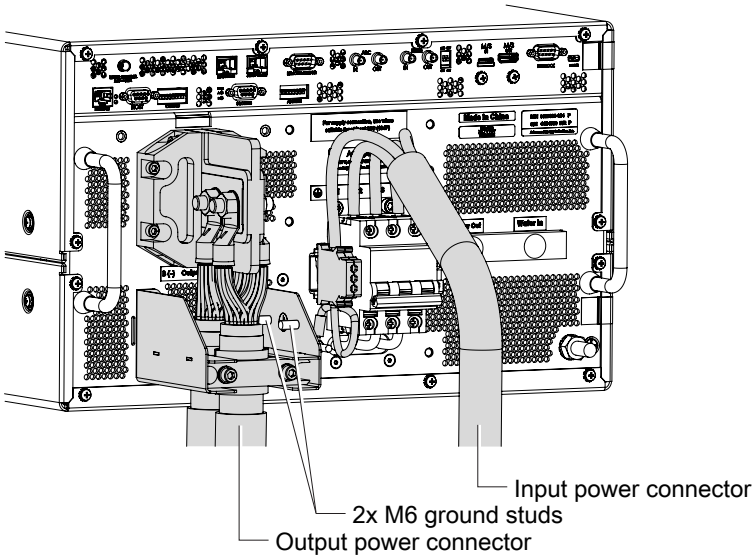
☞ **Important**
Always follow regulations per local electrical codes for overcurrent protection and wire size used. Common practice is to use input conductors and overcurrent protection devices that can carry 125% of rated input current.

To connect to the input power connector:

1. Remove the input power cover:
   a. Using the hex key, remove the 6x M5 screws.
   b. Remove the cover from the unit, keeping the screws and cover for reassembly.
2. Prepare the cable as needed.
   - L1, L2, L3: Strip the wire insulation to enable connection. Schneider Electric specifies a strip length of 14 mm (0.55″).

- Ground wire: Strip the wire insulation to enable connection to the ground terminal. Recommended strip length: 11 mm (0.43″).
- For all strands, AE recommends using wire ferrules to keep the wires from fraying too much during tightening. The recommended strip length is in addition to the wire needed to attach the wire ferrule.

3. Pass the cable through the strain relief.
4. Using the slotted screwdriver, connect the ground wire to the Protective Earth (PE) ground terminal (the green-and-yellow terminal) and tighten to 1.7 Nm (15 in-lbs).
5. Using the POZIDRIV screwdriver, connect the AC line input to the three-terminal, screw terminal connector and tighten to 3.5 Nm (31 in-lbs). Labels on the input terminal shield identify the line (**L3**, **L2**, and **L1**).
6. If your cable has a neutral wire, connect it to the neutral supply terminal (blue terminal).



7. Replace the input power cover. To do so:
   a. Slide the strain relief along the cable until the cover rests against the unit. Line up the cover screw holes to the unit screw holes.
   b. Insert the 6x M5 screws. Using the hex key, tighten each screw to 3.8 Nm (34 in-lbs).
   c. Using the open-ended wrench, tighten the cable glands to 5 Nm (44 in-lbs).

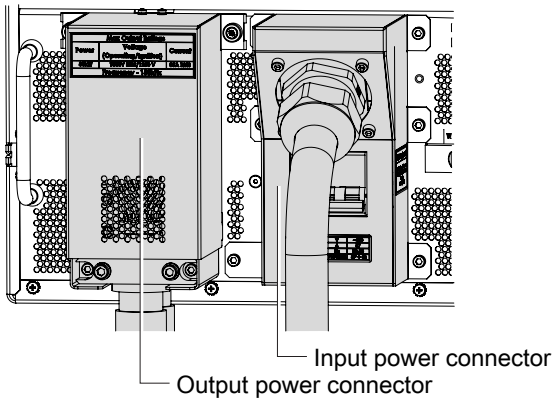


Figure 5-17. Power connectors, cable attached, cover installed

Making Communications Connections

CAUTION:

Turn off power to the system before connecting a cable to the I/O port connector. I/O port connectors are not hot pluggable.

CAUTION:

Signals at the I/O port can be sensitive to noise. Take standard preventative measures against electromagnetic interference (EMI), including using shielded cabling on this port.

Figure 5-18 shows typical connectors for the Ascent DMS power supply. The connectors vary by model and are described in the communications section in the user manual.

To reduce EMI interference:

- AE recommends using shielded cables when connecting to any communication port.

- Do not place communications cables near output power cabling.

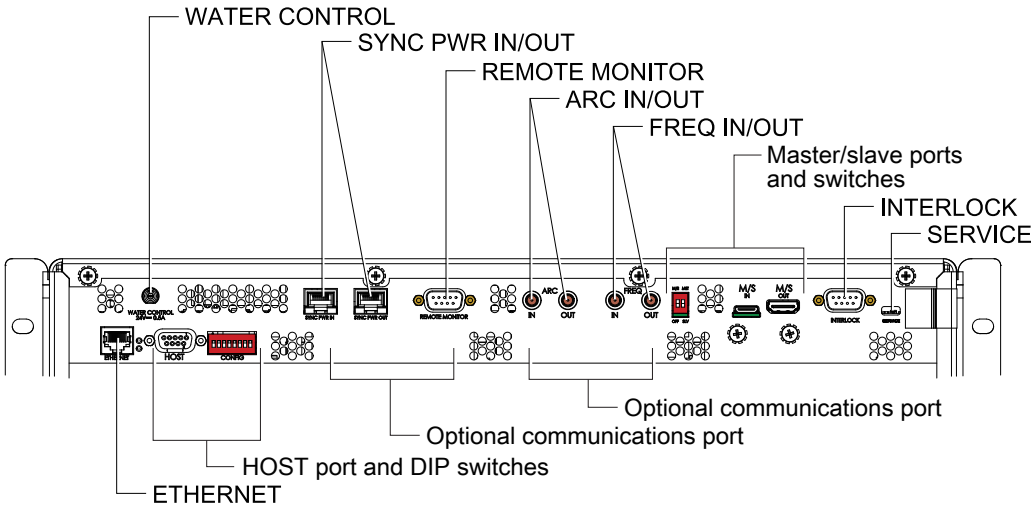


Figure 5-18. Rear panel (optional communication ports vary by unit)

CONTROL INTERFACES

You can control the Ascent DMS power supply from the following (your unit will include one or more of these options):

- An analog/digital connector that you can control using your Programmable Logic Control (PLC) device. This port (labeled **USER**) provides limited access to operating parameters and control functions. The **USER** port is included on some units.
- A digital communications port. Digital communications ports provide access to all operating parameters and control functions. Your unit includes one or more of the following communications interfaces:
  - Ethernet (**ETHERNET** port – all units)
  - Serial (**HOST** port – all units)
  - PROFIBUS (**PROFIBUS** port – some units)

You can use the Advanced Energy Virtual Front Panel (VFP) software to communicate with the Ascent DMS power supply through the following ports:

- **HOST** port
- **ETHERNET** port

Ascent DMS power supply control interfaces are described in the communication controls chapter of the user manual.

Connecting for Master/Slave Operation

☞ **Important**
Not all product options include this feature. Contact AE Global Services for specific product information. See "AE Global Services" on page 6-12.

The following sections explain how to connect your Ascent DMS power supplies in a master/slave configuration.

UNDERSTANDING MASTER/SLAVE OPERATION

Any Ascent DMS power supply can function as either a master unit or a slave unit.

☞ **Important**
Currently, master/slave systems can consist of one master plus one slave.

MASTER/SLAVE CONNECTORS AND SWITCHES

The master/slave connectors are located on the unit rear panel. The master/slave interface includes the following ports:

- **M/S IN** mini HDMI port to connect master and slave units
- **M/S OUT** HDMI port to connect (daisy-chain) a master unit to a slave unit and a slave unit to another slave unit

Both connectors must always be connected on a master or slave unit. Each cable includes a standard HDMI plug on one end, and a mini HDMI plug on the other.

The master/slave interface also includes two master/slave switches, which both set and indicate whether the power supply is functioning as a master, standalone, or slave unit. All units are shipped as standalone by default.

- Left switch:
  - Up (**M/S**): Unit is a master or slave
  - Down (**OFF**): Unit is a standalone system
- Right switch (setting does not matter if unit is set to standalone):
  - Up (**MST**): Unit is the master in a master/slave system
  - Down (**SLV**): Unit is a slave in a master/slave system

Figure 5-19 shows the master/slave connectors and switches on the rear panel of the unit.

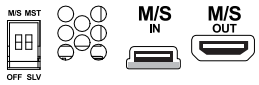


Figure 5-19. Master/slave connectors and switches

CONFIGURING A MASTER/SLAVE SYSTEM

The following sections provide information on configuring and connecting your power supplies for master/slave operation.

Master/Slave Configuration Example

The following figure illustrates how to configure your Ascent DMS power supplies for master/slave operation.

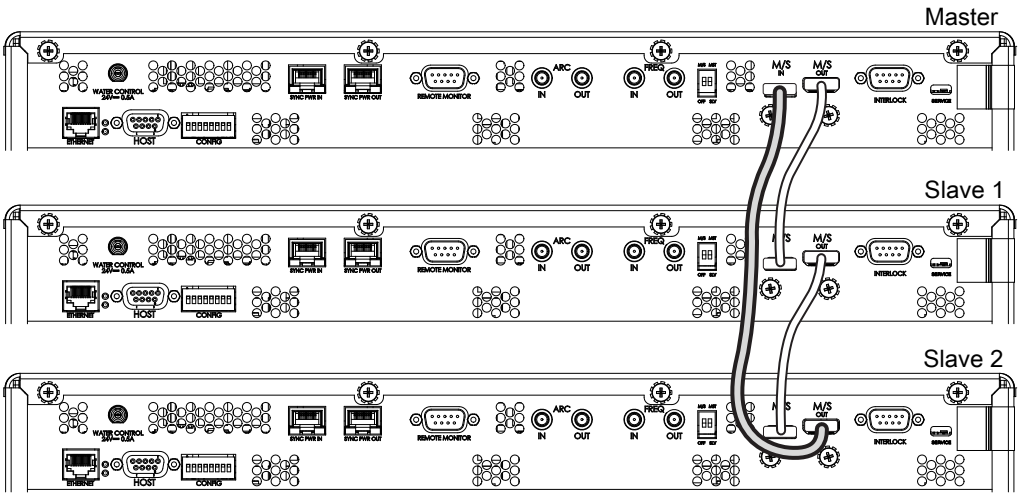
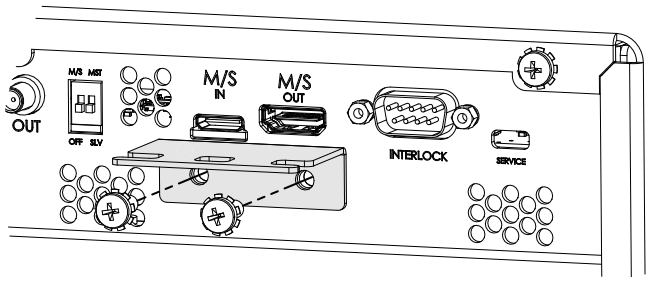


Figure 5-20. Master/slave system configuration example

To Configure the Master/Slave System

1. Remove all input power from the power supplies in your master/slave system.
2. Optional: Attach the supplied master/slave cable support bracket using the two fasteners.

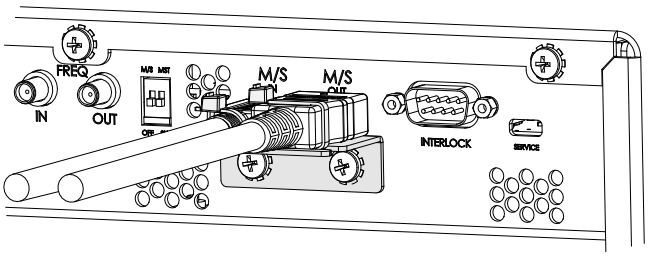


3. Connect the master unit and all the slave units in a daisy-chain configuration using the supplied master/slave interface cables (HDMI/mini HDMI). Make sure to complete the daisy chain by connecting the last slave **M/S OUT** to the master **M/S IN**.

   The master/slave interface cables are included with the power supplies.

   See "Master/Slave Configuration Example" for an example configuration.

4. Optional: Using user-supplied cable ties, secure the HDMI cables to the cable support bracket.



5. Set the master/slave switches on each unit as follows:
   a. All units: Set the **M/S OFF** switch to the up (**M/S**) position
   b. Master unit: Set the **MST SLV** switch to the up (**MST**) position.
   c. Each slave unit: Set the **MST SLV** switch to the down (**SLV**) position.
6. To satisfy the interlock, connect the system interlock cables on each unit as follows:
   a. Master unit: Connect the master unit (**INTERLOCK** connector) to the system interlock.

      This connection is required.
   b. Slave units: On each slave unit, either connect the interlock as described for the master, or use the dummy connectors to satisfy the interlock.
7. For each unit in the master/slave system, connect the process power output cable from the master or slave unit to the associated chamber.
8. Ground the units as follows:
   a. Use a grounding strap to connect an equipotential ground stud on the master unit to an equipotential ground stud on the first slave unit.
   b. Use a grounding strap to connect an equipotential ground stud on the first slave unit to an equipotential ground stud on the next slave unit. Continue connecting together subsequent slave unit chassis in this manner.

   AE recommends the following:

   ◦ Use a ground wire that can conduct the current of one phase, which is no longer than 91.44 cm (3′). For circuit breaker specification, see the specifications in the user manual.

   ◦ Connect the ground stud on the master unit to system ground.
9. For each unit in the master/slave system, connect AC input power.

☞ **Important**
A unit configured as a master unit faults if a slave is not detected. If no slave units are connected, the master unit must be reconfigured as a standalone unit. See “Reconfiguring the Power Supply as a Standalone Unit”.

For information on operating the master/slave system, see “Master/Slave System Operation”.

Reconfiguring the Power Supply as a Standalone Unit

As shipped from the factory, Ascent DMS power supplies are configured as standalone units. Follow these instructions if you previously configured a unit as a master or a slave, and now want to use the unit as a standalone unit.

TO RECONFIGURE THE POWER SUPPLY AS A STANDALONE UNIT

1. Remove all input power from the power supplies in your master/slave system.
2. Set the **M/S OFF** switch to the down (**OFF**) position, and the **MST SLV** switch to the up (**MST**) position.
3. Remove all master/slave interface cables from the unit.
4. Reconnect output power and set parameters as needed for a standalone unit.
5. For each unit changed, connect AC input power.

Connecting Units to Synchronize Arc Suppression and Frequency (SYNC PWR)

☞ **Important**
Not all product options include this feature. Contact AE Global Services for specific product information. See “AE Global Services” on page 6-12.

The Ascent DMS power supply supports the following types of intersystem synchronization through the **SYNC PWR** ports:

- Intersystem Arc-Sync between Ascent DMS units
- Intersystem frequency synchronization between Ascent DMS units

Nodes in an intersystem synchronization system can be a mixture of standalone Ascent DMS units and the masters in an Ascent DMS master/slave system. Do not connect the **SYNC PWR** ports on slave units in a master/slave system because the slaves are already synchronized to the master unit.

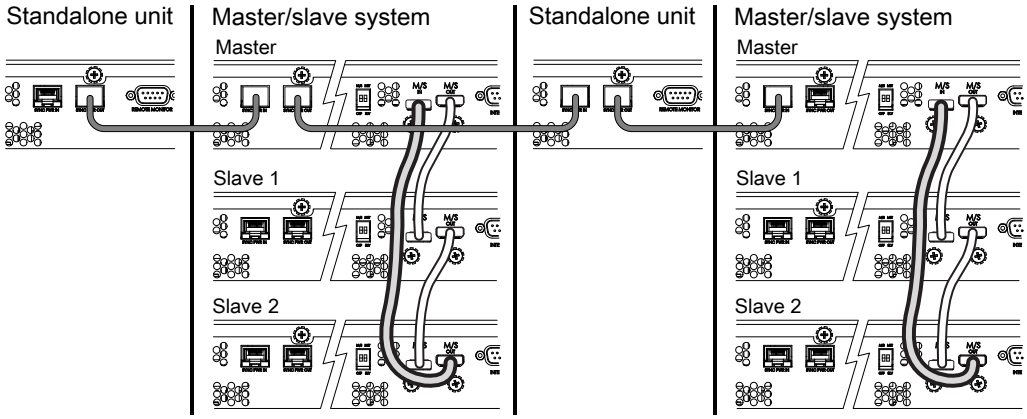


Figure 5-21. Intersystem synchronization configuration example

TO CONNECT UNITS TO SYNCHRONIZE ARC SUPPRESSION AND FREQUENCY (SYNC PWR)

1. Remove all input power from the power supplies that you will connect for intersystem synchronization.
2. Using the supplied Cat5e cables, connect the units in a daisy-chain configuration. Connect the **SYNC PWR OUT** port on one unit to the **SYNC PWR IN** port on the next unit.

   The **SYNC PWR OUT** port from one unit will transmit synchronization information to the **SYNC PWR IN** port of the next unit.

   - If connecting for frequency synchronization: One unit will be the transmitter, all others will be receivers. The transmitter must be at one end of the daisy chain.
   - If connecting for Arc-Sync: All units are transmitters. If any Ascent DMS unit detects an arc, it then starts the arc routine.

   You will enable intersystem Arc-Sync and intersystem frequency synchronization using commands, as described in the synchronizing arc suppression and frequency section in this manual.
3. For each unit in the system, connect AC input power.

Related Links

- “Synchronizing Arc Suppression and Frequency (SYNC PWR Connectors)” on page 5-44

NORMAL OPERATION

The following list provides a general description of how to operate the Ascent DMS power supply. Adapt this list to your power supply configuration and your

application, environment, and requirements. See "Making Communications Connections" for the digital communication ports you can use to set up the unit.

1. Supply power to the unit
2. You should see the AE logo illuminated on the front panel. If the logo is not lit, ensure that the unit is properly installed and is receiving AC input power.
3. Establish communications with one of the Ascent DMS power supply communication interfaces.
4. Select a regulation mode: power, current, or voltage.

   Output power must be off (that is, output must be de-energized) to switch between regulation modes.
5. Enter a setpoint value.
6. If necessary, enter the following parameters (available only through the communications port):
   - Enable arc management and enter appropriate arc management parameters for your normal process cycle and, if needed, for your target conditioning cycle.
   - Enable and set pulsing parameters as needed, such as frequency, off time, boost, reverse, and deadtimes.
7. If necessary, set limits for output power, output voltage, output current, and/or strike voltage.

   The strike limit controls the level of the strike/ignition voltage, but also impacts the initial power overshoot experienced when requesting low setpoints. For example, with a strike voltage limit setting of high, you might observe a significant overshoot when requesting a low power. If ignition is not difficult, you can select medium or low to reduce the effects of overshoot.
8. Verify all output power load conditions and connections.
9. Enable the output.

ADVANCED PULSING (AP)

The Ascent DMS power supply provides advanced pulsing capability to allow enhanced plasma control, as compared with standard sine wave solutions. The power supply supports the classic dual-magnetron sputtering system configuration by alternating each target between anode and cathode (removing the disappearing anode phenomenon in reactive processes), while introducing adjustable frequency to optimize deposition rates and selectable duty cycle to maximize target utilization. The advanced controls are accessed using the user-settable parameters described in this section.

Figure 5-22 shows the general pulse waveform. Table 5-2 describes the pulsing parameters shown in the pulse waveform illustration.

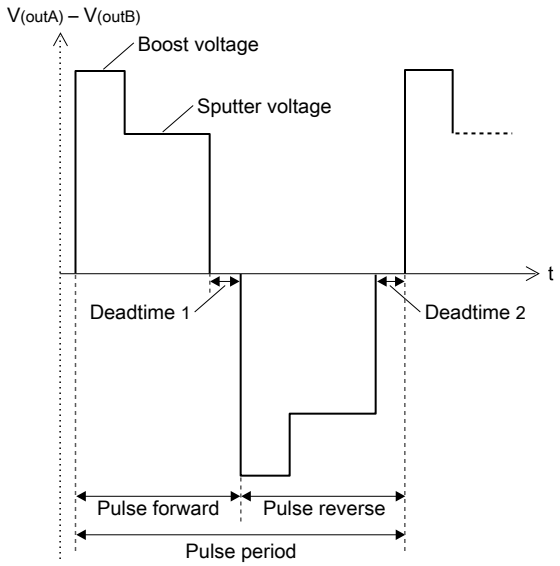


Figure 5-22. Pulse waveform

Table 5-2. Pulsing parameters

Parameter	Description
Enable/disable pulsing	When pulse mode is enabled, the unit can use the advanced pulsing features and pulse-related commands are available. When pulse mode is disabled, the unit reverts to DC mode. Enable/disable pulsing with AE Host command **92** (subcommand 0).
Boost voltage	Boost voltage (or boost pulse) is an output voltage higher than the sputter voltage. Boost voltage is used to quickly recover the process power in the pulse period. See "Boost Voltage" for additional information and applicable AE Host commands.
Sputter (or process) voltage	The voltage (sometimes called process voltage) where the plasma sputters. Not user settable.
Deadtime, pulse period, pulse forward time, pulse reverse time	User-settable times (when in pulse mode): • Deadtime is the time between pulse on time and pulse reverse time. Output voltage during deadtime is forced to 0. See "Pulse Deadtime" for

Table 5-2. Pulsing parameters (Continued)

Parameter	Description
	additional information and applicable AE Host commands. Pulse-related times that are not directly user settable: • Pulse reverse time = Pulse period – Pulse forward time • Pulse forward time = Pulse period * Duty cycle • Pulse period = 1/Frequency
Frequency	User settable when in pulse mode. Set with AE Host command **92** (subcommand 1).
Duty cycle	User settable when in pulse mode. Set with AE Host command **92** (subcommand 13). The duty cycle is limited by the minimum conduction time.

Minimum and Maximum Duty Cycle versus Output Frequency

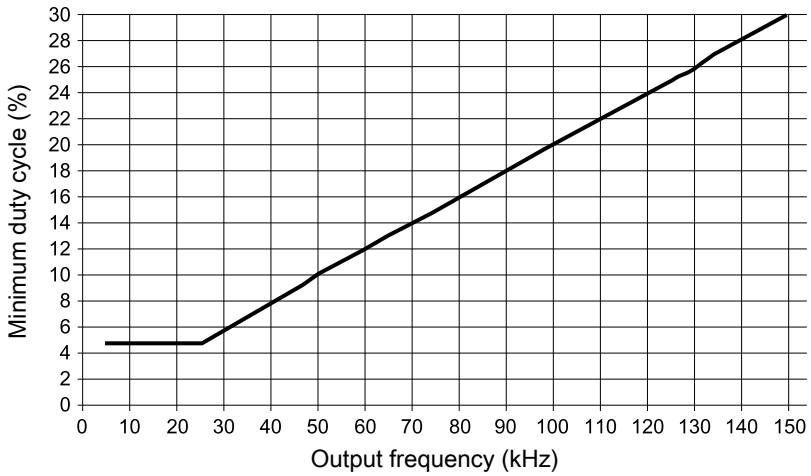


Figure 5-23. Minimum duty cycle versus output frequency

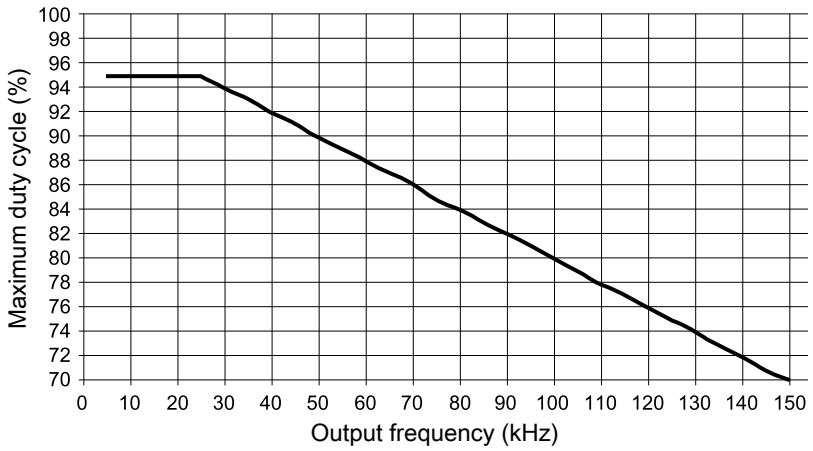


Figure 5-24. Maximum duty cycle versus output frequency

Pulse Deadtime

☞ **Important**
Not all product options include this feature. Contact AE Global Services for specific product information. See "AE Global Services" on page 6-12.

Deadtime is the time between pulse forward time ($T_{forward}$) and pulse reverse time ($T_{reverse}$), and between pulse reverse time and pulse forward time, where output is forced to 0. See the waveform illustration in "Advanced Pulsing (AP)".

Set these parameters through one of the digital communications ports. Applicable AE Host commands: **92** (subcommand 3 for deadtime 1, subcommand 4 for deadtime 2).

Boost Voltage

☞ **Important**
Not all product options include this feature. Contact AE Global Services for specific product information. See "AE Global Services" on page 6-12.

Boost voltage (or boost pulse) is a user-settable output voltage higher than the sputter voltage, and is used to quickly recover the process power at the beginning of the period (see the waveform illustration in "Advanced Pulsing (AP)").

Boost voltage is limited to a maximum of 95% of sputter voltage or a total maximum voltage of 1200 V ($V_{sputter} + V_{boost} \leq 1200$ V). Examples:

- If $V_{sputter} = 400$ V, then you can set the boost to a maximum of 380 V (95% of 400 V).

- If $V_{sputter}$ = 1000 V, then you can set the boost to a maximum of 200 V (unit maximum of 1200 V).

Typically, a higher boost voltage will force recovery of the process current faster and will lower the rms output current. A high boost voltage can cause overvoltage conditions in high discharge processes.

With any transition, the current will always lag the voltage and will have a peak current higher than the DC current from the DC section of the power supply (I_{DC}). By adding a higher voltage (boost) to the leading edge of the conduction cycle, the current lag is reduced and the output current will recover faster (see Figure 5-25).

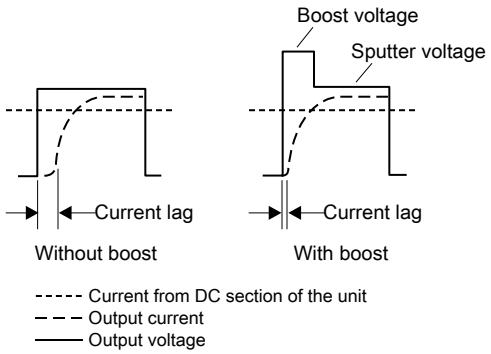


Figure 5-25. Pulse waveforms

Set this parameter through one of the digital communications ports. Applicable AE Host command: **92** (subcommand 10). The unit must be in pulse mode.

IGNITION VOLTAGE

To ignite a plasma, the Ascent DMS power supply can produce a higher-than-normal output voltage (called ignition voltage). Ignition voltage will be applied whether the unit is in pulse mode or in DC mode. During ignition the unit is always in DC mode. The difference between using ignition voltage in DC and pulse mode is:

- When in pulse mode the unit will start pulsing once the output current is above the ignition level.
- When in DC mode the unit will stay in DC mode.

Ignition works as follows:

1. The unit senses a load impedance higher than the factory-configured level.
   a. If in pulse mode, the unit temporarily switches to DC mode.
   b. The unit applies the ignition voltage.
2. When the output current rises above the factory-configured level:
   a. The unit stops applying ignition voltage.

b. If pulse mode is enabled, the unit switches from DC mode to pulse mode and the unit starts pulsing.

Specify the ignition voltage using one of the ignition profiles (see Figure 5-26):

- High
- Medium
- Low

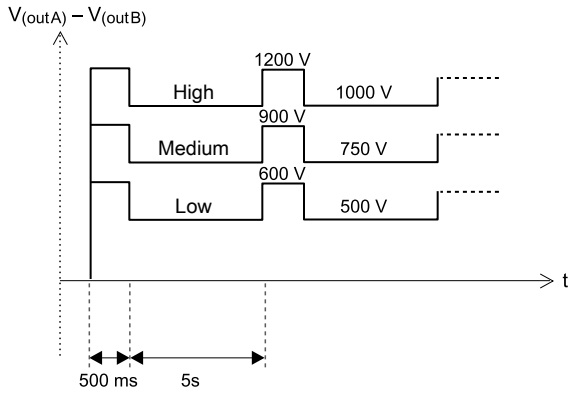


Figure 5-26. Ignition profiles

Set ignition parameters using one of the digital communications ports:

- Set the ignition profile. Applicable AE Host command: **52**.
- Enable or disable ignition voltage. Applicable AE Host command: **118** (subcommand 99).

POWER PULSING

The power pulsing feature allows you to specify short power pulses, which is useful for some applications.

Power pulsing is used in conjunction with the advanced pulsing feature:

- Advanced pulsing

  The advanced pulsing feature allows you to enable/disable pulsing and set pulsing parameters (for example, select DC or pulse mode, and set pulsing frequency). The advanced pulsing feature is described in "Advanced Pulsing (AP)".

- Power pulsing

  The power pulsing feature allows you to quickly turn the unit power on or off in regular pulse-like cycles. When the power pulsing signal is off, the unit output

power is off. When the power pulsing signal is on, all other features are enabled as usual. Power pulsing is described in this section.

With power pulsing, you can define an envelope of pulsing time. Each on and off envelope can be from 1 ms to 500 ms. See Figure 5-27.

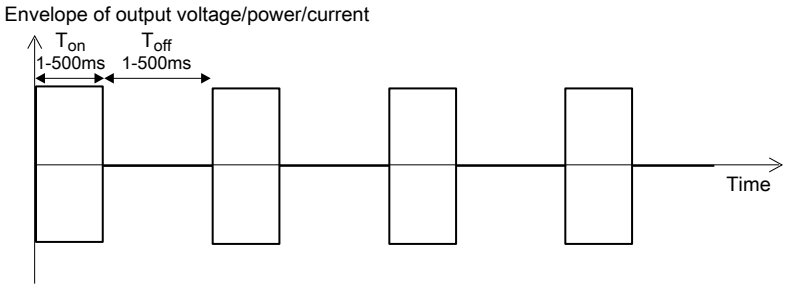


Figure 5-27. Power pulsing

You can use the advanced pulsing feature in either DC mode or in pulse mode.

When the unit pulses with the power pulsing feature, the output is turned off and then on with accelerated transition time. The power supply regulates the output during the on time (not the overage).

Power Pulsing Using a Digital Communication Interface

If power pulsing is enabled:

- During power pulsing on time (T_{on}), the unit will turn the output power on at the user-defined setpoint. The unit will pulse at the user-defined frequency and the user-defined duty cycle.
- During power pulsing off time (T_{off}), the unit output power is zero.

Set power pulsing parameters using one of the digital communications ports:

- Enable or disable power pulsing. Applicable AE Host command: **92** (subcommand 19).
- Set power pulsing on time (T_{on}) in 0.1 ms steps. Applicable AE Host command: **92** (subcommand 20).
- Set power pulsing off time (T_{off}) in 0.1 ms steps. Applicable AE Host command: **92** (subcommand 21).

Power Pulsing Using an Analog User Interface

Available on units with the 37-pin **USER** port for PE II adapter kit, 25-pin (available with select models).

When controlling the unit with the **USER** port, the power supply limits the pulsing signal in two ways:

- Off time is limited to a maximum of 500 ms
- On time is limited to a minimum of 1 ms

Use pin 17 to control the power pulsing on and off times, and pin 7 to read back power pulsing status.

For more information on setting power pulsing for the unit, see the section in the user manual that describes the user interface for the PE II adapter kit.

SHORT CIRCUIT DETECTION

The Ascent DMS unit integrates a short circuit detection feature that turns off the output and reports a fault (**129**, **Output Short Circuit Fault**) if the output is shorted.

When the output is on, the unit monitors the average output voltage and current to determine if the output is shorted. The following conditions must be satisfied to detect a short circuit:

- Average output voltage must be below a user-settable threshold
- Average output current must be above a user-settable threshold (you can set the current threshold to 0 A to depend on only the voltage)
- The time constant of the detection filter is 100 ms

This feature is disabled by default (both thresholds are set to 0). To enable this feature, set the voltage threshold above 0 V and, if needed, set the current threshold. If short circuit detection is needed, AE recommends that you:

- Set the voltage threshold to 50 V
- Set the current threshold to 0 A

☞ **Important**
Do not set the current threshold too high, If the current threshold is set too high, it could result in an undetected short circuit condition due to the arc management feature running in parallel to the short circuit detection feature.

Set short circuit detection parameters using one of the digital communications ports:

- Set short circuit voltage threshold. Applicable AE Host command: **118** (subcommand 207)

- Set short circuit current threshold. Applicable AE Host command: **118** (subcommand 208)

ARC MANAGEMENT

With the standard arc management feature enabled, the Ascent DMS unit hard arc detection time is less than 1 µs, and delivered arc energy is less than 0.5 mJ/kW.

The arc management system uses active circuitry to reverse the output voltage of the supply when an arc is sensed. To clear the arc, the active module drives the output current to zero faster than passive approaches, and thereby minimizes arc energy.

☞ **Important**
To optimize arc management performance, use a cable with a minimum amount of inductance. AE recommends using an output cable with inductance less than 3 µH when measured at 1 kHz with one end of the cable shorted.

Using a digital communications port, you can monitor arc density and arc counters for both micro and hard arcs. If you clear the arc counters, the unit can report the number of hard arcs and micro arcs during the previous run.

In this manual, sense level means the same as threshold (for example, VArc sense level means the same as VArc threshold).

Understanding Arc Management

The Ascent DMS power supply includes patented Arc Management System™ technology to ensure fast arc recovery time and increase system stability.

The unit uses an iterative approach to arc management, including four arc suppression time blocks: micro arc 1, micro arc 2, micro arc 3, and hard arc.

Arc management works using the following steps:

1. The unit monitors operation and initiates the suppression process when it detects one of the following conditions:
   - Output voltage is below the voltage sense level (VArc) and the output current is above the voltage arc handling enabling threshold.
   - Output current exceeds the current sense level (IArc).
2. The unit enters the first arc suppression routine (micro arc 1) by diverting power away from the plasma for a preset time and actively driving the output current to zero. The unit then enters the user-selectable shutdown time. Depending on the shutdown that is selected, the diversion of power can result in a lower average overall output power. At the end of the suppression time, the unit turns back on and attempts to return the output to setpoint.

3. If an arc is detected in any of the following scenarios, the unit will advance to the next arc suppression time (micro arc 2, micro arc 3, or hard arc):
   - Output voltage is below the VArc threshold and output current is above the recovery threshold (during the mask time).
   - Output current exceeds the IArc threshold (during the arc mask and arc guard times).
   - Output voltage is below the VArc threshold and output current is above the VArc threshold for enabling threshold during the arc guard time.
4. If the power supply enters the hard arc suppression routine, the power supply enters the user-selectable shutdown time. At the end of the suppression time, the unit turns back on, applies ignition voltage, and resets its control loop before attempting to return the output to setpoint.

Arc Waveform

The following illustration shows the general arc waveform.

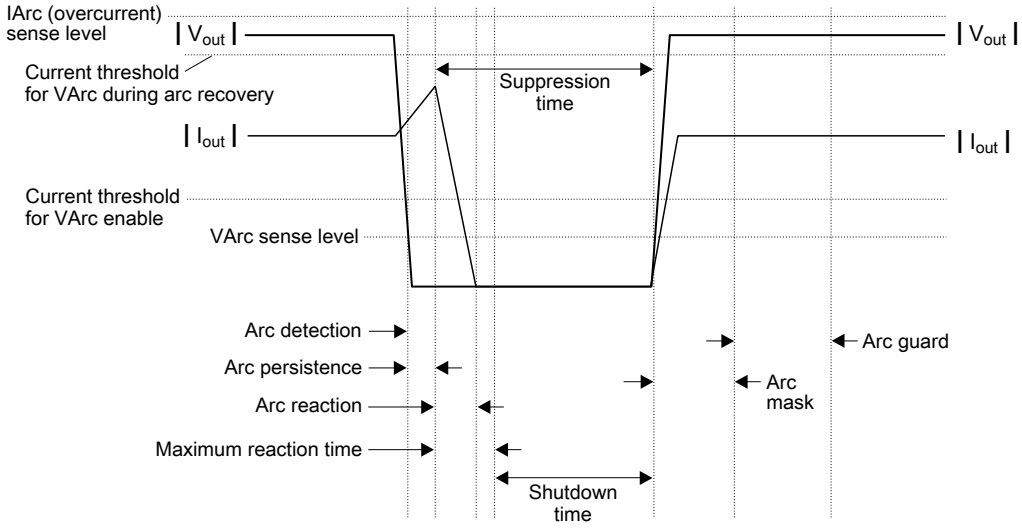


Figure 5-28. Arc waveform

The following table describes the arc suppression parameters shown in the arc waveform illustration. For applicable AE Host commands, see "Arc Suppression Parameters".

Table 5-3. Arc waveform descriptions

Arc Waveform Label	Behavior
Arc detection	Detection time (not user settable).
Arc persistence	Persistence time (user settable). Once an arc condition is detected, this is a wait time to see if the arc persists.

Table 5-3. Arc waveform descriptions (Continued)

Arc Waveform Label	Behavior
	When the arc persistence value is set to a nonzero value, an arc will be reacted upon only if the arc continuously persists for the timer value. The default arc persistence value is 0.0 µs.
Arc reaction	Reaction time (not user settable). Arc reaction time is 5 µs.
Shutdown time	Micro arc and hard arc shutdown times (user settable). Shutdown times can be set independently for micro arc and hard arc suppression routines.
Suppression time	Arc suppression time (not user settable). Sum of reaction time and shutdown time.
Arc mask	Mask time (user settable). The amount of time the unit output is allowed to recover after arc suppression. Mask times can be set independently for micro arc and hard arc suppression routines.
Arc guard	Guard time (not user settable). Set to 3 µs.
VArc and associated thresholds	All of these thresholds (also called sense levels) are user settable: • VArc sense level • Current threshold for VArc enable • Current threshold for VArc during recovery • VArc-to-ground sense level
IArc (overcurrent) sense level	IArc (overcurrent) sense level (user settable)
Arc-to-ground persistence	An arc condition must be present for the amount of time programmed before unit begins suppression.

STANDARD ARC SUPPRESSION PROFILE SETTINGS

Use command **236** to report the arc suppression profile settings.

User-settable arc suppression values in Table 5-4 are marked with an asterisk (*).

Table 5-4. Standard arc suppression times in µs

Routine	Reaction (t_r)	Shutdown Times (t_{shut})			Arc Mask Time (t_{mask})		
		Default	Max	Min	Default	Max	Min
Micro arc 1	5	20*	100000	1	2*	5	1
Micro arc 2	5	50*	100000	1	2*	5	1
Micro arc 3	5	200*	100000	1	2*	5	1
Hard arc	5	1000*	100000	1	2*	5	1

Arc Suppression Parameters

The arc suppression feature of the Ascent DMS power supply regulates on the parameters described in the following table.

Set these parameters through one of the digital communications ports.

Table 5-5. Arc suppression parameters

Parameter	Description	Related AE Host Commands
Voltage arc sense level (VArc and VArc-to-ground)	Sets the voltage threshold at which the Ascent DMS power supply determines that an arc is occurring. The arc management system also uses the following thresholds for voltage arc detection: • Current threshold for VArc enable • Current threshold for VArc recovery The best value for the VArc sense level and the VArc-to-ground sense level is between your process normal operating voltage and the typical low voltage that occurs when your system experiences an arc. The higher the sense level, the faster the unit can detect an arc. **CAUTION:** **Selecting a sense level that is lower than voltage during an arc could result in the unit not detecting arcs, and therefore could damage the system with high current.**	Set VArc, VArc-to-ground, and associated current sense levels: command **86** (subcommand 202) Report valid range for the VArc, VArc-to-ground, and associated current sense levels: command **236** (subcommand 252) Report VArc, VArc-to-ground, and associated current sense levels: command **236** (subcommand 202)

Table 5-5. Arc suppression parameters (Continued)

Parameter	Description	Related AE Host Commands
	Current threshold to enable voltage arc detection: Sets the current threshold at which the Ascent DMS power supply determines that an arc is occurring.	
Current arc sense (IArc)	Sets the current threshold at which the Ascent DMS power supply determines that an arc is occurring (independent of the voltage level).	Set IArc sense level: command **86** (subcommand 202) Report valid range for the IArc sense level: command **236** (subcommand 252) Report IArc sense level: command **236** (subcommand 202)
Arc shutdown and suppression time	Suppression time is the total amount of time that the unit responds to the detection of an arc. Suppression time = maximum reaction time + shutdown time. The Ascent DMS power supply design greatly reduces the stored energy of the power supply. However, occasions might exist when your Ascent DMS power supply can enhance your process by delivering more energy during arc events. With a longer micro arc suppression time, you increase the chance of a voltage overshoot when the plasma recovers. A longer micro arc suppression time might cause the ion density to decrease and the resultant plasma impedance might increase. The plasma might even extinguish. Thus, your process might require a higher voltage to reignite the plasma. Be sure to consider this possibility when setting the micro arc shutdown time.	Set micro arc shutdown times: command **86** (subcommand 205) Report valid ranges: command **236** (subcommand 252) Report micro arc shutdown times: command **236** (subcommand 205)
Hard arc shutdown and suppression time	Suppression time is the total amount of time that the unit responds to the detection of a hard arc. Suppression time = maximum reaction time + shutdown time. When the unit enters the hard arc suppression routine, output will remain off for the hard arc suppression time. To extinguish an arc properly, the power supply must divert power until the output current decays to a value near 0. The decay of output current depends on system cable inductance and the voltage of the arc.	Set hard arc shutdown time: command **86** (subcommand 205) Report valid range: command **236** (subcommand 252) Report hard arc shutdown time: command **236** (subcommand 205)

Table 5-5. Arc suppression parameters (Continued)

Parameter	Description	Related AE Host Commands
	At the end of hard arc suppression time, if the output voltage is above threshold, output will resume.	
Arc mask time	The amount of time the unit output is allowed to recover after arc suppression.	Set mask times: command **86** (subcommand 205) Report valid ranges: command **236** (subcommand 252) Report mask times: command **236** (subcommand 205)
Arc persistence time	The amount of time the arc condition has to be present to start arc handling.	Set persistence time: command **86** (subcommand 204) Report valid range: command **236** (subcommand 252) Report persistence time: command **236** (subcommand 204)
Arc-to-ground persistence time	The amount of time the arc-to-ground condition has to be present to start arc handling.	Set persistence time: command **86** (subcommand 203) Report valid range: command **236** (subcommand 252) Report persistence time: command **236** (subcommand 203)

UNDERSTANDING SETPOINT COMPENSATION

Setpoint compensation allows the Ascent DMS power supply to adjust its output to compensate for lower average power output due to heavy arc suppression conditions. As each arc is suppressed, the power supply output is shut off for a momentary programmed shutdown period. As the density of arc suppression events increases, the average output power begins to fall below the programmed setpoint. The setpoint

compensation feature causes the unit to internally increase output power as necessary to reduce the difference between programmed setpoint and average power readback during an increased rate of arc suppression events. This compensation helps to keep the deposition rate constant during periodic heavy arcing condition events, and is available only in power regulation mode.

The compensation limit is set as a percentage of programmed setpoint. The internal power cannot be higher than the full rated power of the unit. For example, if the programmed setpoint is 10 kW and the setpoint compensation limit is set to 20%, the power supply will internally increase the output power up to 2 kW above the 10 kW programmed value to minimize the difference between the programmed setpoint and the average power output.

Set the setpoint through one of the digital communications ports. Applicable AE Host command: **71** (subcommand 40).

SYNCHRONIZING ARC SUPPRESSION AND FREQUENCY (SYNC PWR CONNECTORS)

☞ **Important**
Not all product options include this feature. Contact AE Global Services for specific product information. See "AE Global Services" on page 6-12.

Intersystem synchronization allows you to synchronize across the plasma-facing portion of the process. Using intersystem synchronization, you can synchronize the following actions across multiple Ascent DMS power supplies:

- Arc suppression (intersystem Arc-Sync)
- Frequency (intersystem frequency synchronization)

In an intersystem synchronization configuration, you can connect any of the following:

- A standalone Ascent DMS unit
- The master of a master/slave Ascent DMS system

You will use the **SYNC PWR** connectors to set up intersystem synchronization. You can enable the intersystem synchronization in any of the following combinations:

- Only intersystem Arc-Sync is enabled
- Only intersystem frequency synchronization is enabled
- Both are enabled
- Both are disabled

By default, both intersystem Arc-Sync and intersystem frequency synchronization are disabled.

Related Links

- "Intersystem Arc-Sync" on page 5-45
- "Intersystem Frequency Synchronization" on page 5-45
- "Connecting Units to Synchronize Arc Suppression and Frequency (SYNC PWR)" on page 5-28

Intersystem Arc-Sync

The intersystem Arc-Sync feature allows you to synchronize arc suppression behavior across multiple Ascent DMS power supplies. In intersystem Arc-Sync operation, if the Ascent DMS unit detects an arc, it transmits an arc detection signal to the other units connected through the **SYNC PWR** ports. If the Ascent DMS unit receives an arc detection signal from another unit, it enters the arc management routine as if it had detected the arc itself.

You can connect up to 13 Ascent DMS power supplies through the **SYNC PWR** connectors. Each unit connected via these connectors is referred to as an intersystem synchronization node. Nodes in an intersystem synchronization system can be a mixture of standalone Ascent DMS units and the masters in a master/slave Ascent DMS system. Do not connect the **SYNC PWR** connectors on slave units in a master/slave system because the slaves are already synchronized to the master unit.

Every unit will transmit the arc notification to all other units connected via the **SYNC PWR** connectors. Each unit in the string needs to be enabled for intersystem Arc-Sync synchronization before it will listen and respond.

Enable or disable intersystem Arc-Sync through one of the digital communication ports. Applicable AE Host command: **86** (subcommand 2). AE recommends that you set all arc timing parameters the same on all units in the intersystem Arc-Sync system.

Intersystem Frequency Synchronization

The intersystem frequency synchronization (Sync-Pulse) feature allows you to synchronize frequency pulsing across multiple Ascent DMS power supplies. When intersystem frequency synchronization is enabled, the output switching frequency of the power supply is synchronized to another power supply.

You can connect multiple Ascent DMS power supplies for intersystem frequency synchronization using the **SYNC PWR** connectors. One Ascent DMS power supply is set up to be the frequency synchronization transmitter, and one or more additional units are set up to be frequency synchronization receivers. Each Ascent DMS power supply (standalone system or the master of a master/slave system) in the intersystem synchronization configuration is called a node.

For each unit connected via the **SYNC PWR** port, enable the unit to transmit or receive Arc-Sync information from other units.

For the node that will be the transmitter:

- Set the node to be a transmitter. The transmitter will be transmitting the signal and does not need to receive the signal.
- Set a delay.

For each node that will be a frequency synchronization receiver:

- Set the node to be a receiver. The receiver will lock to the connected transmitter.
- Set a delay.

Set these parameters through one of the digital communications ports. Applicable AE Host commands: **118** (subcommand 101), **118** (subcommand 102).

Related Links

• "Setting the Delay for Intersystem Frequency Synchronization" on page 5-46

SETTING THE DELAY FOR INTERSYSTEM FREQUENCY SYNCHRONIZATION

The first node in an intersystem synchronization configuration is the transmitter. All subsequent nodes are receivers.

Figure 5-29 shows a configuration of three nodes:

- Transmitter
- Receiver 1
- Receiver 2

Each node can be one of the following:

- Ascent DMS power supply (standalone unit)
- Ascent DMS master of a master/slave system

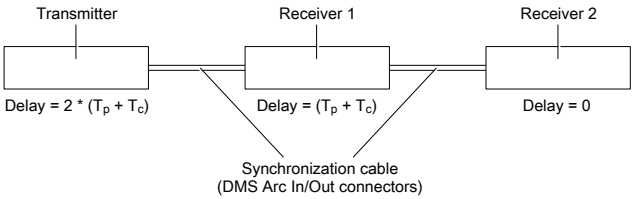


Figure 5-29. Intersystem frequency synchronization delay

To minimize the phase difference between nodes of an intersystem frequency synchronization system, you can compensate for the propagation delays.

If needed, you can set the delay value for each node in the configuration with command **118** (subcommand 102). To calculate the delay value for each node:

- Delay = (n – 1) * (T_p + T_c), where:
  - n = The number of nodes from the last receiver in the setup to the transmitter
  - T_p = 240 ns, the propagation delay of each synchronized node
  - T_c = Cable propagation delay, for example: a standard 2 m [6.6′] cable will have a worst case delay of 11 ns
- The last node in the setup should have the delay value set to 0 (default)

The delay value sent with command **118** (subcommand 102) is the calculated delay. Use command **248** (subcommand 103) to report the maximum delay value allowed.

For example:

- T_p = 240 ns
- T_c = 11 ns
- Transmitter delay = 2 * (240 + 11) = 502 ns

  The value to send with command **118** (subcommand 102) is 502.
- Receiver 1 delay = 1 * (240 + 11) = 251 ns.

  The value to send with command **118** (subcommand 102) is 251.
- Receiver 2 delay = 0

  The last node should always have a delay of 0, which is the default.

MASTER/SLAVE SYSTEM OPERATION

☞ **Important**
Not all product options include this feature. Contact AE Global Services for specific product information. See "AE Global Services" on page 6-12.

The following sections include information about operating and monitoring Ascent DMS power supplies in a master/slave configuration.

Arc management and synchronization is always enabled within a master/slave system.

To Power Up a Master/Slave System

1. Turn on AC power to all units. The order of power-up does not matter.
2. Once all units in the master/slave system are powered up, check to make sure that no unit indicates a fault.

A fault condition can indicate any of the following:

- Cables not connected, or connected incorrectly.
- Master/slave switches not set correctly.
- One or more units in the master/slave system are not powered up.

If all units are powered up and none indicate a fault condition, then the master/slave system is ready.

☞ **Important**
Powering up a master/slave system when the output power is on causes a fault.

Monitoring the Master/Slave System

Use one of the digital communications ports to monitor the output (power, current, or voltage) of your master/slave system and the output of each individual unit. Applicable AE Host commands: **165**, **166**, **167**, **168**.

MAINTENANCE

Consumable Parts

Some parts in the Ascent DMS are consumable and may wear out over time. For a current list of consumable and wear components in the Ascent DMS as well as for estimated lifetimes and recommended refurbishment schedules, please contact AE Global Services.

Replacing the Air Filter

⚠ **CAUTION:**
RISK OF BODILY INJURY OR DAMAGE TO UNIT. Turn off power supply before removing the air filter. If the air filter is not properly installed, fingers can come in contact with rotor or blades, resulting in bodily injury.

⚠ **CAUTION:**
Fan blades are accessible if air filter is not in place. Unit must be switched off before removing air filter. Unit must never be turned on without air filter.

☞ **Important**
The air filter housing must be installed for operation.

The air filter is located on the front of the Ascent DMS power supply. Replace the air filter as needed, depending on your environment.

Before replacing the air filter, obtain a replacement filter by contacting AE Global Services.

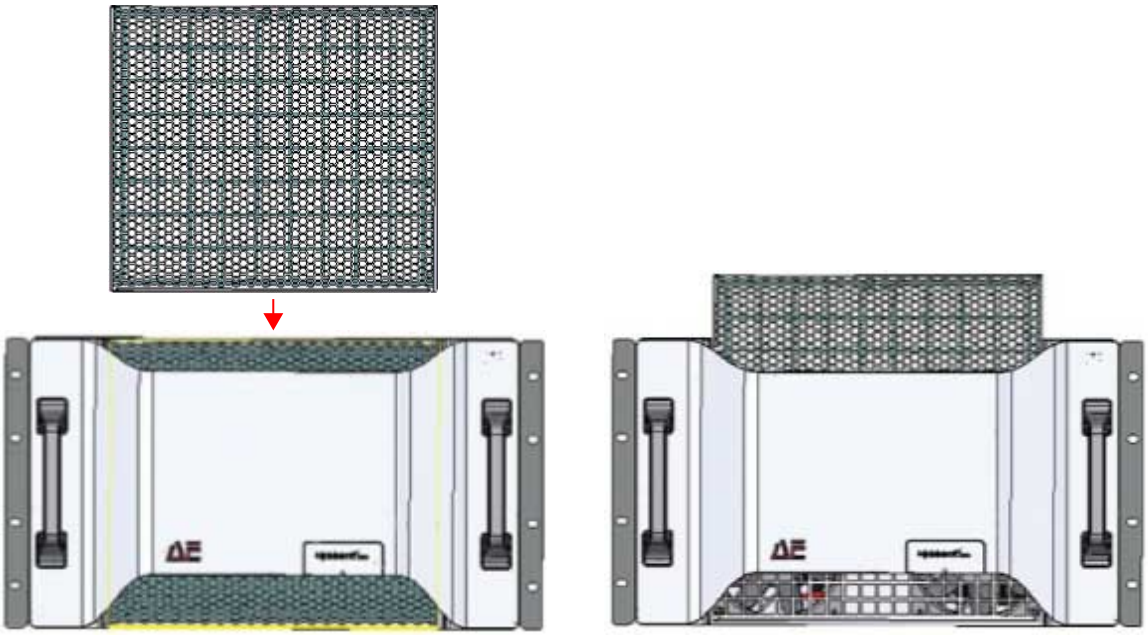


Figure 5-30. Air filter

TO REPLACE THE AIR FILTER

1. Turn off power to the unit.
2. Push up on the bottom of the air filter housing until it pops up.
3. Lift the air filter out of the containing slots.
4. Insert the new air filter into the housing.
5. Reinstall the filter and housing.
6. Turn power on to the unit.

Troubleshooting and Global Services

Before calling AE Global Services, perform recommended checks and troubleshooting procedures. If you are still unable to resolve the issue and resume normal operation after following these checks and procedures, contact AE Global Services.

BEFORE CALLING AE GLOBAL SERVICES

DANGER:

RISK OF DEATH OR BODILY INJURY. Disconnect and lockout/tagout all sources of input power before working on this unit or anything connected to it.

DANGER:

Personnel must receive proper training before installing or troubleshooting high-energy electrical equipment. Potentially lethal voltages could cause death, serious personal injury, or damage to the equipment. Ensure that all appropriate safety precautions are taken.

This chapter contains a general checklist of potential problem areas, as well as lists of error codes and suggested responses. Please consult the appropriate section(s) if you believe you are experiencing trouble with your Ascent DMS power supply. If the problem continues or if you cannot find an adequate solution in these pages, please call AE and ask to speak with an AE Global Services representative.

First Troubleshooting Check

If you believe you are experiencing problems with a Ascent DMS power supply, check for obvious signs of damage to the unit itself, cables, and connectors. If damage has occurred, turn off the unit and call AE Global Services. If there are no obvious signs of damage, proceed with the checks on the following lists.

Checks With the AC Power Off

1. Ensure that the AC power to the unit is off.
2. Check for visible damage to the unit, cables, and connectors.

3. Ensure that all unit connectors are installed correctly and are fastened tightly.
4. Ensure that ground connections are adequate and secure.
5. Check the position of the switches on the DIP for the AE Bus interface against the addressing information in the manual.
6. Ensure that the interlock loop is closed.

Checks with the Power On

1. Ensure that there is input power to the unit.

   If the AE logo on the unit front is lit, then the unit is receiving input power.
2. Ensure that input power meets specifications.
3. Connect to the unit using one of the digital interfaces to access fault codes and unit status (recommended).
4. Check for error codes using the Virtual Front Panel (VFP) software or AE Host command **223**. Error codes are reported via any of the digital communication interfaces.
5. Determine whether the cooling fans are functioning, and ensure that the cabinet allows for adequate ventilation for all the units in the cabinet.

   If you cannot hear the fans running, check for air movement at the front and the rear of the unit.

   If the fans are not functioning properly, call AE Global Services.

Related Links

- "Troubleshooting Using Error Codes" on page 6-3
- "Error Types and Clearing Error Codes" on page 6-3
- "Error Code Troubleshooting Table" on page 6-4

Checks If the Process Power Output Does Not Turn On

1. Verify that the user-definable power, voltage, and current limits are set to values reasonable for the process application.
2. Verify that the output cover is correctly mounted and that all other interlocks are satisfied.
3. Check for faults. In particular, the following faults can prevent process power from coming on: interlock, bus fault, or overtemperature faults.
4. Verify that you have established a valid setpoint.
5. Verify that the arc sense levels (thresholds) are appropriate for your process.

TROUBLESHOOTING USING ERROR CODES

Error Types and Clearing Error Codes

The Ascent DMS power supply reports error codes (also called fault codes) and warnings:

- Error codes turn off output and, when activated, prevent turning on output. Error codes are generated by the following types of faults:
  - Fatal faults: this type of fault can occur at initialization or after running. You can try to clear it by AC power cycling the unit. If the fault persists, contact AE Global Services.
  - Explicit-clear faults: when faults occur when the output is on, they remain latched until the unit receives an off command. If the cause of the fault has not cleared, the fault indication does not clear.
  - Self-clearing faults: a fault is self-clearing only if the fault occurs while output is off. If the fault condition clears, the fault indication self clears. However, if the cause of the fault has not cleared, the fault indication does not clear. The unit does not require an off command before turning output on.
- Warnings do not affect output.

TO CLEAR A FAULT THAT OCCURS WHEN OUTPUT IS OFF

1. If necessary, correct the fault condition.
2. Does fault clear once the fault condition no longer exists?
   - Yes: Proceed to turn unit output on.
   - No: Cycle AC input power to unit.

     ☞ **Important**
     When cycling power, wait 30 seconds before turning power back on.
3. Does cycling AC input power to the unit clear the issue?
   - Yes: Proceed to turn unit output on.
   - No: A unit failure has occurred. Contact AE Global Services.

TO CLEAR A FAULT THAT OCCURS WHEN OUTPUT IS ON

If a fault occurs when output is on, the power supply shuts output power off.

1. If possible, correct the fault condition.
2. Reset the power supply by sending an off command:

- From the Virtual Front Panel (VFP) software, click the **OFF** button to clear the fault.
- Through one of the digital communication ports, send an off command to clear the fault.
- For units with the standard 37-pin **USER** port:

  A high on pin 14 *RESET.D* will reset active explicit-clear faults, provided that the fault conditions are no longer present. This pin must be returned to the inactive state (low) to enable the unit output.
- For units with the PE II adapter kit, 25-pin user interface:

  A high-to-low on pin 19 *ON.D* will clear active explicit-clear faults, provided that the fault conditions are no longer present.

3. Does resetting the power supply clear the fault?
   - Yes: Proceed to turn unit output on.
   - No: Cycle AC input power to unit.

     ☞ **Important**
     When cycling power, wait 30 seconds before turning power back on.
4. Does cycling AC input power to the unit clear the issue?
   - Yes: Proceed to turn unit output on.
   - No: A unit failure has occurred. Contact AE Global Services.

Error Code Troubleshooting Table

The following tables describe the Ascent DMS power supply error and warning codes:

- Table 6-1, "Error codes" on page 6-4
- Table 6-2, "Warning codes" on page 6-10

Use one of the following methods to report error (fault) or warning codes:

- AE Host command **223**
- Virtual Front Panel (VFP) software

Table 6-1. Error codes

Error Code	Problem Indicated	Suggested Action
16 **Service Required Fault**	Unit needs servicing.	Cycle power. If the error persists, contact AE Global Services.

Table 6-1. Error codes (Continued)

Error Code	Problem Indicated	Suggested Action
79 **External Interlock Open Fault**	The system interlock on the unit analog **INTERLOCK** port has not been satisfied.	Power off the Ascent DMS unit. Ensure that the interlock pin on the **INTERLOCK** port connector has been properly connected. Ensure that all system interlocks have been satisfied. Power the unit back on.
80 **Cover Interlock Fault**	The cover interlock has not been satisfied.	Power off the Ascent DMS unit. Ensure that the cover interlock is properly connected. Ensure that all system interlocks have been satisfied. Power the unit back on.
81 **User Port Interlock Fault**	The system interlock on the unit analog **USER** port has not been satisfied. This condition might also be to due to improper seating of the **USER** port personality card.	Power off the Ascent DMS unit. Ensure that the interlock pin on the **USER** port connector has been properly connected. Ensure that all system interlocks have been satisfied. Power the unit back on. If the error persists, contact AE Global Services.
85 **Out of Setpoint Unit A Fault**	The out-of-setpoint timer has expired.	Increase the setpoint timer value, or disable the timer by setting it equal to 0. If the warning persists, check your process parameters for limiting factors. That is, ensure that your load impedance matches the impedance range of the Ascent DMS unit.
87 **Invalid Regulation Mode Unit A Fault**	The **USER** port regulation mode for the unit has been set to an invalid value.	Set the **USER** port regulation mode to a valid value.
89 **Snubber OverCurrent Density Fault**	Internal error.	Verify that output cable inductance and capacitance are within specifications. If the error persists, contact AE Global Services.
90 **Boost OverCurrent Density Fault**	Internal error	Verify that output cable inductance and capacitance are within specifications.

Table 6-1. Error codes (Continued)

Error Code	Problem Indicated	Suggested Action
		If the error persists, contact AE Global Services.
91 **Reverse I Arc Integral Fault**	Too many overcurrent events during reverse time.	Check if there is a short circuit in the reverse polarity. If the error persists, contact AE Global Services.
92 **Overvoltage Density Fault**	Too many internal overvoltage events.	Verify that output cable inductance and capacitance are within specifications. Try to reduce boost voltage setpoint. If the error persists, contact AE Global Services.
93 **PCB alim 5V 7.5VOG 5VOG Fault** (Fatal fault)	A voltage drop has been detected inside the unit.	Cycle power. If the error persists, contact AE Global Services.
94 **PCB alim 15V 5VIGA 5VIGB 3.3V Fault** (Fatal fault)	A voltage drop has been detected inside the unit.	Cycle power. If the error persists, contact AE Global Services.
95 **PCB alim 1.2V or FPGA DONE (RFA1) Fault** (Fatal fault)	A voltage drop has been detected inside the unit.	Cycle power. If the error persists, contact AE Global Services.
97 **Total Arc Integral Fault**	Arc density is too high.	Verify process conditions.
101 **Inverter A Temperature Fault**	Indicates that Inverter A temperature sensor has exceeded its limit.	Verify that cooling water temperature and water flow are within the specifications. If the error persists, contact AE Global Services.
102 **Inverter B Temperature Fault**	Indicates that Inverter B temperature sensor has exceeded its limit.	Verify that cooling water temperature and water flow are within the specifications. If the error persists, contact AE Global Services.

Table 6-1. Error codes (Continued)

Error Code	Problem Indicated	Suggested Action
103 **Pulse Bridge Temperature Fault**	Indicates that output bridge temperature sensor has exceeded its limit.	Verify that cooling water temperature and water flow are within the specifications. If the error persists, contact AE Global Services.
104 **IGBTs Temperature Fault**	Indicates that internal IGBT temperature sensor has exceeded its limit.	Verify that cooling water temperature and water flow are within the specifications. If the error persists, contact AE Global Services.
105 **Air In Temperature Fault**	Ambient air temperature is too high.	Verify that ambient temperature is within the specifications. If the error persists, contact AE Global Services.
106 **Water In Temperature Fault**	Cooling water temperature is too high.	Verify that cooling water temperature is within the specifications. If the error persists, contact AE Global Services.
108 **Vboost OverVoltage Fault**	Internal boost voltage exceeded its limit.	Try to reduce boost voltage. If the error persists, contact AE Global Services.
109 **Vreverse OverVoltage Fault**	Internal reverse voltage exceeded its limit.	Try to reduce reverse voltage. If the error persists, contact AE Global Services.
114 **Vbus DC high Fault**	High bus voltage.	Verify that the AC line voltage to unit is within specifications. If the error persists, contact AE Global Services.
115 **Vbus DC low Fault**	Low bus voltage.	Verify that the AC line voltage to unit is within specifications. If the error persists, contact AE Global Services.
120 **SyncPower Output Cable Not Installed**	The unit is configured as the intersystem frequency synchronization transmitter, but no cable is detected on the output **SYNC PWR** port.	Either connect a cable to the output **SYNC PWR** port or turn the intersystem frequency synchronization feature off.

Table 6-1. Error codes (Continued)

Error Code	Problem Indicated	Suggested Action
121 **SyncPower Input Cable Not Installed**	One of the following: 1. The unit is configured as the intersystem frequency synchronization receiver, but no cable is detected on the input **SYNC PWR** port. 2. Intersystem arc handling is enabled, but no cable is detected on the input our output **SYNC PWR** port.	1. Either connect a cable to the input **SYNC PWR** port or turn the intersystem frequency synchronization feature off. 2. Either connect a cable to the input or output **SYNC PWR** port or turn the intersystem arc handling feature off.
122 **SyncPower Input Cable Installed**	The unit is configured as the intersystem frequency synchronization transmitter, but has an input cable connected to the **SYNC PWR** input port.	Either disconnect the cable from the input **SYNC PWR** port, configure the unit as a receiver, or disable the intersystem frequency synchronization feature.
125 **Sync Pulse Communication Fault**	The unit is configured as the intersystem frequency synchronization receiver; however, communication is not working properly.	Ensure that all cables on the **SYNC PWR** port are properly connected. If the error persists, cycle power to the affected receiver and the previous units in the chain.
129 **Output Short Circuit Fault**	The output is shorted.	Check the output connections to verify there are no shorts. Check the short circuit parameters to make sure that they are correct.
201 **Comm Watchdog Timer Fault**	Serial port communications time between communications is greater than the limit set by the watchdog timer.	Shorten the time between serial port communications or increase the communications timeout (AE Host command **39**).
404 **PROFIBUS Master Released Slave Fault** (explicit-clear)	The PROFIBUS master has stopped communicating with the Ascent DMS unit using the proper protocol. This slave is now available to be owned by another master. If output is on, the Ascent DMS unit turns output off.	To recover from the off state, have a PROFIBUS master establish communication with the Ascent DMS unit and send a master reset to clear the Ascent DMS unit.

Table 6-1. Error codes (Continued)

Error Code	Problem Indicated	Suggested Action
405 **PROFIBUS Watchdog Fault** (explicit-clear)	The PROFIBUS master stopped talking to the Ascent DMS supply after establishing communications.	Have the master re-establish communications and send a master reset to clear the Ascent DMS unit.
406 **PROFIBUS MAC Reset Fault** (explicit-clear)	The SPC (PROFIBUS controller) has taken itself offline, probably in response to another error.	Cycle the Ascent DMS unit power off and on and re-establish communications between the master and slave. If the error code reappears, contact AE Global Services.
407 **PROFIBUS Buffer Overflow Fault** (explicit-clear)	The PROFIBUS communication has overflowed the buffer.	Slow down the PROFIBUS communication rate or the rate at which commands are sent. Make sure data consistency (module consistency) is enabled in the PROFIBUS master.
756 **Master-Slave Configuration Fault**	This is a configuration fault.	Power off the unit and ensure that cables are properly connected and that the master/slave selection switch is set properly, then power the unit back on. If the error persists and you have verified that the units are configured correctly, then you likely have a hardware problem.
759 **Master-Slave Multi Master Fault**	The **MST SLV** switch is set to **MST** on more than one unit.	Check the **MST SLV** switch on each unit in the master/slave system. Ensure that only one unit **MST SLV** switch is set to **MST**. You must cycle power to the unit after changing the switch.
760 **Master-Slave No Master Fault**	Slave unit has not been provisioned by a master.	Ensure that one of the units in the master/slave system is configured to be a master.
761 **Master-Slave No Slaves Fault**	Master unit did not find any slave units when attempting to provision master/slave system.	Ensure that master/slave system has one unit configured as a master and at least one unit configured as a slave.

Table 6-1. Error codes (Continued)

Error Code	Problem Indicated	Suggested Action
762 **Master-Slave No Egress Cable Fault**	No connection to **M/S OUT** cable was detected.	Ensure that a cable is attached to the **M/S OUT** port and the **M/S IN** port of another unit.
763 **Master-Slave No Ingress Cable Fault**	No connection to **M/S IN** cable was detected.	Ensure that a cable is attached to the **M/S IN** port and the **M/S OUT** port of another unit.
764 **Master-Slave Cable Interlock Fault**	One or more of the master/slave system cables is defective.	Troubleshoot master/slave cables.
765 **Master-Slave Loss of Communications Fault**	This is a slave-only fault. The slave unit has stopped receiving communications from the master unit.	Check the master unit for correct behavior. Troubleshoot master/slave system cables.
766 to **780** **Slave *x* Communication Fault**	With output off, a communication break occurred within the master/slave system. Slaves are numbered sequentially within the master/slave daisy chain. The fault occurred on slave number *x*, but the error displays only on the master.	Cycle AC power, then check the slave error code to determine the slave fault. If the fault persists, contact AE Global Services.
781 to **796** **Slave *x* Reports Fault**	Slave *x* is reporting a fault.	Check the slave unit to see what fault displays on the unit.

Table 6-2. Warning codes

Warning Code	Problem Indicated	Suggested Action
39 **Out of Setpoint Warning**	Tolerance between setpoint and power output has been exceeded.	Increase the setpoint timer value, or disable the timer by setting it equal to 0. If the problem persists, check the process parameters for limiting factors. That is, ensure that the load impedance matches the impedance range of the Ascent DMS unit.
56 **Network DHCP Warning**	Cannot find DHCP server.	Verify the DHCP server on the Ethernet network. Disable the DHCP in network settings.

Table 6-2. Warning codes (Continued)

Warning Code	Problem Indicated	Suggested Action
57 **Network DNS Warning**	Unable to communicate with DNS server.	Check network settings.
62 **Inverter A Temperature Warning**	The inverter A temperature sensor is close to its limit.	Verify that the cooling water temperature and water flow are within the specifications.
63 **Inverter B Temperature Warning**	The inverter B temperature sensor is close to its limit.	Verify that rhw cooling water temperature and water flow are within the specifications.
64 **Pulse Bridge Temperature Warning**	The output bridge temperature sensor is close to its limit.	Verify that the cooling water temperature and water flow are within the specifications.
65 **IGBTs Temperature Warning**	The IGBT temperature sensor is close to its limit.	Verify that the cooling water temperature and water flow are within the specifications.
66 **Air In Temperature Warning**	Ambient air temperature is close to the maximum.	Verify that ambient temperature is within the specifications.
67 **Water In Temperature Warning**	Cooling water temperature is close to the maximum.	Verify that cooling water temperature is within the specifications.
70 **Unsynchronized from CEX Chain Warning**	The unit is configured as the intersystem frequency synchronization receiver; however, the unit is not synchronized with the other units in the chain because of incoherent pulse parameters.	Change the pulse parameters on the receiver to synchronize with transmitter (for example, off time might be too long for the frequency received from the transmitter).
71 **Ignition Warning Unit A**	Unit is applying ignition voltage but plasma does not ignite.	Verify the process conditions.
765 to **780** **Slave *x* Communications Warning**	Communication intermittent to one or more slave unit(s).	Cycle power to the affected slave unit(s).

AE GLOBAL SERVICES

Please contact AE Global Services if you have questions or problems that cannot be resolved by working through the provided troubleshooting. When you call Global Services, make sure to have the unit serial number and part number. These numbers are available on unit labels.

☞ **Important**
For returns and repairs, please call AE Global Services to get the correct shipping address.

Table 6-3. AE Global Services 24 X 7 contact information

Office	Contact
AE World Headquarters	Address: 1625 Sharp Point Drive Fort Collins, CO 80525 USA Phone (24 hrs/day, 7 days/week): 800.446.9167 or +1.970.221.0108 Email: (We will respond to email by the next business day.) mailto:technical.support@aei.com
Sekidenko thermal product support	Contact by phone or email: +1.360.694.7871 mailto:thermalapplications@aei.com
Power Control Module product support	Contact by phone or email: +49 (0)2902 763 520 (technical support during German business hours) mailto:powercontroller@aei.com
High Voltage product support: HiTek Power, Ltd.	Contact by phone or email: +44 (0) 1903 712400 mailto:support.centre@aei.com

Table 6-3. AE Global Services 24 X 7 contact information (Continued)

Office	Contact
High Voltage product support: UltraVolt, Inc.	Contact by phone or email: +1.631.471.4444 mailto:sales.support-uv@aei.com
Local or regional sales or service office	Visit the Advanced Energy website for current contact information: http://www.advanced-energy.com

RETURNING UNITS FOR REPAIR

Before returning any product for repair and/or adjustment, first follow all troubleshooting procedures. After following troubleshooting procedures, if your unit is unable to resume normal operation, contact AE Global Services and discuss the problem with a representative. Be prepared to give them the model number and serial number of the unit as well as the reason for the proposed return. This consultation call will allow Global Services to determine if the unit must actually be returned for the problem to be corrected. Such technical consultation is always available at no charge.

Purging Water for Transport or Storage

Before transporting or storing water-cooled units, you must first purge water from the unit. Failure to do so can result in damage to the unit and will void the unit warranty.

DANGER:

RISK OF DEATH OR BODILY INJURY. Disconnect and lockout/tagout all sources of input power before working on this unit or anything connected to it.

CAUTION:

Purge all water from the unit before shipping. Failure to do so can result in damage to the unit during shipping and will void the unit warranty.

To purge water from the unit:

1. Uninstall the unit and, if applicable, remove the unit from the rack.
2. Apply compressed air to the water intake connector. Water will exit through the water outflow connector.

3. Apply compressed air until water no longer exits the water outflow connector.

If you need additional information on how to purge water from the unit, contact AE Global Services.

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