Pinnacle® Power Supply

Dual Output (6 kW x 6 kW, 10 kW x 10 kW)

User Manual

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PRODUCT USAGE STATEMENT

WARNING:

Read this entire manual and all other publications pertaining to the work to be performed before you install, operate, or maintain this equipment. Practice all plant and product safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment might be impaired. All personnel who work with or who are exposed to this equipment must take precautions to protect themselves against serious or possibly fatal bodily injury.

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TRADEMARKS

CUSTOMER FEEDBACK

Advanced Energy's technical writing staff has carefully developed this manual using research-based document design principles. However, improvement is ongoing, and the writing staff welcomes and appreciates customer feedback. Please send any comments on the content, organization, or format of this user manual to:

- tech.writing@aei.com

To order a manual, please contact Technical Support:

- technical.support@aei.com

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Safety and Product Compliance Guidelines

IMPORTANT SAFETY INFORMATION

To ensure safe installation and operation of the Advanced Energy Pinnacle 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.
- Verify that input voltage and current capacity are within specifications before turning on the unit.
- Use proper electrostatic discharge (ESD) precautions.
- Use proper electrostatic discharge (ESD) and lockout/tagout precautions.
- Maintenance and service must be performed only by AE-trained service personnel.
- Ensure the power supply is locked at all times, allowing only authorized and trained personnel access to the Pinnacle power supply.

INTERPRETING PRODUCT LABELS

The following labels may appear on your unit:

CE label

Complies with applicable European directives.

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.

Hazardous voltage

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

Certified by CSA to North American Safety Standards for the United States

Certified by CSA to North American Safety Standards for both Canada and the United States

European Union RoHS compliant

Refer to manual for more information

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

Heavy object—can cause muscle strain or back injury

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 product, connect the primary Protective Earth (ground), and secondary Protective Earth (ground) if applicable, to a local earth ground using wire that is sized according to the applicable requirements.
- For corner-grounded delta configuration installation, excessive leakage occurs. Secondary Protective Earth (ground) must be connected.
- 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 declared in the specifications.
- You must install and operate this device with a disconnect switch that conforms to the applicable requirements. The switch must be easily accessible and near the device.
- Use only a shielded cable for the output process power connections.
- Use only a shielded cable for communications and/or control connections.
- Use an input cable with the diameter and inductance specifications described in the unit specifications.
- Non-standard connectors for input and/or output power must be inaccessible to the user.

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.

Product Overview

GENERAL DESCRIPTION

The Pinnacle series of DC power supplies delivers process consistency and control for significantly reduced variation and higher yields. These units are: light and compact, efficient (low internal heat dissipation), reliable, quickly extinguish and recover from arcs, and store very little energy in the output filter.

The Pinnacle power supply is sometimes called the Pinnacle III power supply.

Output Impedance Range

No taps, mechanical or electrical, exist in the Pinnacle unit. The unit delivers full power over a 6.25:1 impedance range without the need for tap changes. You never need to open the unit or generate signals to control taps.

Output Regulation

The Pinnacle unit can be used as a power, current, or voltage source, depending on the method of output regulation selected. Since setpoint levels are stored in nonvolatile memory, you can use these levels to recover from input power interruptions and to ensure repeatability from run to run.

Programmable Setpoints

You can program an output level (from low values up to the unit maximum rates of output) for power, current, or voltage. Select this value from the **USER** port or other communications port.

Output Limits

You can set maximum output limits for power, voltage, and current. You also can select a maximum strike-voltage range. Select these values from the **USER** port or other communications port.

Target Supervision

You can select one of eight target-life counters from the **USER** port or other communications port. Target life can be monitored from the serial port.

The **USER** port has priority when selecting targets.

Interfaces

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

- An analog/digital connector (**USER** port). The **USER** port provides limited access to operating parameters and control functions.
- A port on one or more communication cards. Communications ports provide access to all operating parameters and control functions. Your unit includes one or more of the following communications interfaces:
  - HOST
  - Ethernet
  - PROFIBUS

Displays

The Pinnacle series can include several display options. All displays show:

- Power, current, or voltage levels

  The display shows levels for unit A and unit B for dual output units.
- Information about output, setpoint, interlock, bus fault, overtemperature, arcs, and error codes

Arc Management Feature

The Pinnacle unit arc management feature ensures a short arc recovery time.

With the standard arc suppression feature enabled, the Pinnacle unit hard arc detection time is less than 1 µs, and delivered arc energy is less than 10 mJ for a 10 kW inverter. (Depending on the output configuration of your unit, the energy could be significantly less than 10 mJ.) You can customize your arc shutdown and arc persistence times. Other parameters, including hard arc count limit and voltage sense level, are selectable through a communications port. If your unit includes an active control panel, you can select arc management parameters through the active panel.

☞ **Important**
Output cable inductance should be less than 7 µH when measured at 1 kHz with one end of the cable shorted. This will ensure proper operation of the arc-out circuitry.

Using a communications port, you can monitor arc density (the number of hard arcs and micro arcs during the previous run). In addition, you can set a window of time for arc density monitoring so that the unit counts the number of arcs that occur during this window.

Fault Conditions

Several fault conditions will either cause the Pinnacle power supply to shut off output or prevent output from being turned on. These conditions include:

- Open interlock loops
- Input power failure
- Overtemperature

Specifications

PHYSICAL SPECIFICATIONS

Table 3-1. Physical specifications

Description	Specification
General Physical Specifications	
Size	128 mm (H) x 483 mm (W) x 574 mm (D) 5″ (H) x 19″ (W) x 22.6″ (D) Dimensions do not include front panel mounting extensions, the power connection cover, or other connectors.
Weight	Unit weight can vary by power level: • 6 kW x 6 kW: 27.6 kg (60.8 lb) • 10 kW x 10 kW: 27.6 kg (60.8 lb)
Connectors	
Output connector	The output connector varies from unit to unit. Output connector options include: • UHF, female (Amphenol Type 83-822/50-239 or equivalent) • Terminal block, 1/4-20 and 10-32, ring-lug • Three-terminal, multi-contact, pluggable connector • Military style 3470 All output connectors include a strain relief.
Input power connector	The input connector varies from unit to unit. Input connector options include: • 208 V units: Four-terminal connector, 10-4 AWG; strain relief box provided (for example, type WECO K007-328/04 or equivalent) • All other units: Five-terminal, nominal cross sectional area 0.16 mm^2 (0.025 in^2); strain relief box provided (for example, type WECO 327-FU-(-HDS)-5 or equivalent)

Table 3-1. Physical specifications (Continued)

Description	Specification
Communication Ports (Communication Ports Vary by Unit)	
User port connector (**USER**)	(Optional) The **USER** port connector varies from unit to unit. See the documentation of these interfaces for details on the available connectors and how to tell what connector is on a specific unit.
RS-232/RS-485 communications ports	9-pin subminiature-D, female
Ethernet port (**ETHERNET**)	RJ-45
Interlock connector (**INTERLOCK**)	9-pin subminiature-D, male
PROFIBUS connector (**PROFIBUS**)	(Optional) 9-pin subminiature-D, female, shielded, and associated DIP switch

ELECTRICAL SPECIFICATIONS

Table 3-2. Electrical specifications

Description	Specification
Input Electrical Specifications	
AC input voltage Current Power factor Efficiency	See "Input and Output Electrical Specifications for Dual Output Units"
Frequency	50/60 Hz (range: 47 Hz – 63 Hz)
Overcurrent protection	Install overcurrent protection in accordance with local regulations and codes.
Output Electrical Specifications	
Output power	One of the following (see your unit label for the maximum output power): • 6 kW x 6 kW (6 kW maximum, 15 W minimum) • 10 kW x 10 kW (10 kW maximum, 25 W minimum)
Output voltage Output current	See "Input and Output Electrical Specifications for Dual Output Units"

Table 3-2. Electrical specifications (Continued)

Description	Specification
Output 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 (± 0.25% when using the **DeviceNet** port) This applies to setpoints from 10% to 100% of rated power. Below setpoints of 10% rated power accuracy is indeterminate.
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.
Open circuit voltage (ignition capability)	1500 VDC minimum for up to 5 seconds, maximum ignition current 60 mA ☞ **Important** If the ignition is not achieved in 5 seconds, the output drops to 1000 VDC until the unit receives an **OFF** command.
Temperature coefficient	< 0.005% per °C (< 50 ppm per °C) variation in the regulated output parameter over a 20°C – 40°C (68°F – 104°F) ambient temperature range
Output ripple voltage	The component of output voltage ripple as related to input line frequency is less than 2% RMS into a resistive load.
Output range	Refer to "Output Power Range Specifications (Dual Units)" for the standard, usable, and limited duty (where applicable) output range as well as the impedance range for your unit.
Accuracy of all analog signals	± 1% of the actual value (V, kW, or A) or ± 0.2% of the full scale value, whichever is greater
Readback accuracy	Power is displayed as a simple multiplication of P=V*I. With supplies operated in low impedance loads (high current), a simple 1 V change could induce up to a 50 W change in power. Therefore, the readback accuracy may be greater than 1% in low impedance situations.
Output polarities	Positive, negative, or floating (customer configurable: neither the positive nor negative terminal is connected to chassis at the factory; output voltage from an output terminal should not exceed ±1600 V in relationship to the chassis)

Input and Output Electrical Specifications for Dual Output Units

INPUT AND OUTPUT ELECTRICAL SPECIFICATIONS (6X6 KW)

The output power and input voltage ratings are shown on unit labels. Use the output power and input voltage ratings to determine the correct row in the following table.

Table 3-3. *Input and output electrical specifications (6x6 kW)*

Input				Output	
Voltage	Current	Power Factor	Efficiency	Voltage	Current
400 V ± 10% *[1]*	25 A to 22 A *[2]*	> 0.90 for loads > 2 kW	> 90% at full power	400 VDC to 800 VDC	15 A/15 A maximum
208 V ± 10% *[1]*	45 A *[2]*	> 0.90 for loads > 2 kW	> 87% at full power		
208 V ± 10% *[1]*	45 A *[2]*	> 0.90 for loads > 2 kW	> 87% at full power	400 VDC to 1000 VDC	15 A/15 A maximum

1 3-phase, 4-wire (no neutral is required)

2 Nominal per phase

INPUT AND OUTPUT ELECTRICAL SPECIFICATIONS (10X10 KW)

The output power and input voltage ratings are shown on unit labels. Use the output power and input voltage ratings to determine the correct row in the following table.

Table 3-4. *Input and output electrical specifications (10x10 kW)*

Input				Output	
Voltage	Current	Power Factor	Efficiency	Voltage	Current
480 V ± 10% *[1]*	28 A *[2]*	> 0.90 for loads > x kW	> 90% at full power	400 VDC to 800 VDC	25 A/25 A maximum
400 V ± 10% *[1]*	38 A to 33 A *[2]*	> 0.90 for loads > x kW	> 90% at full power		
208 V ± 10% *[1]*	70 A *[2]*	> 0.90 for loads > x kW	> 88% at full power		

Table 3-4. Input and output electrical specifications (10x10 kW) (Continued)

Input				Output	
Voltage	Current	Power Factor	Efficiency	Voltage	Current
480 V ± 10% *[1]*	28 A *[2]*	> 0.90 for loads > 2 kW	> 90% at full power	400 VDC to 1000 VDC	25 A /25 A maximum
208 V ± 10% *[1]*	70 A *[2]*	> 0.90 for loads > 2 kW	> 88% at full power		
1 3-phase, 4-wire (no neutral is required) *2* Nominal per phase					

Output Power Range Specifications (Dual Units)

The output power and input voltage ratings are shown on unit labels. The following graphs display the operating range and impedance range for the unit power level:

- “6 kW x 6 kW (400 V to 800 V) Output Range Specifications” on page 3-6
- “6 kW x 6 kW (400 V to 1000 V) Output Range Specifications” on page 3-8
- “10 kW x 10 kW (400 V to 800 V) Output Range Specifications” on page 3-10
- “10 kW x 10 kW (400 V to 1000 V) Output Range Specifications” on page 3-12

6 KW X 6 KW (400 V TO 800 V) OUTPUT RANGE SPECIFICATIONS

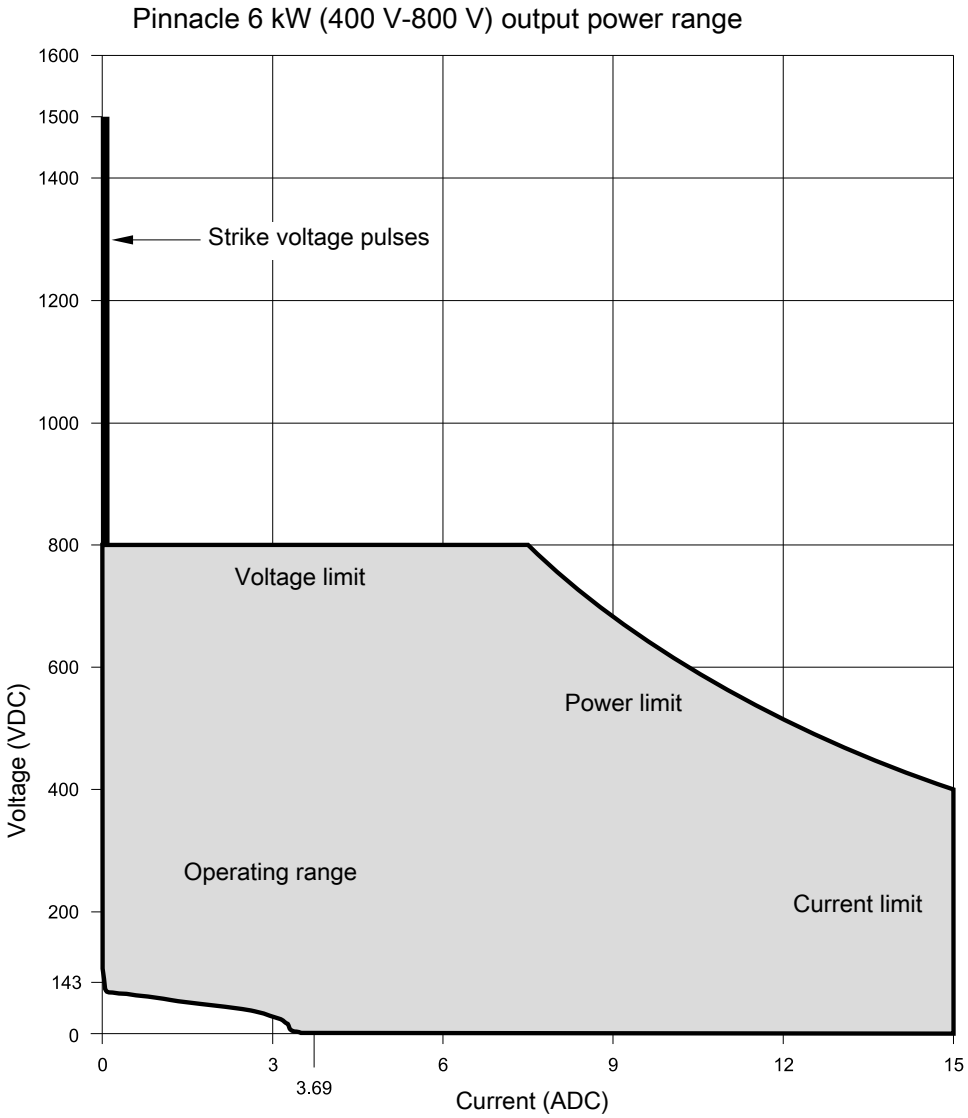


Figure 3-1. *Side A and B: 6 kW (400 V to 800 V) operating range*

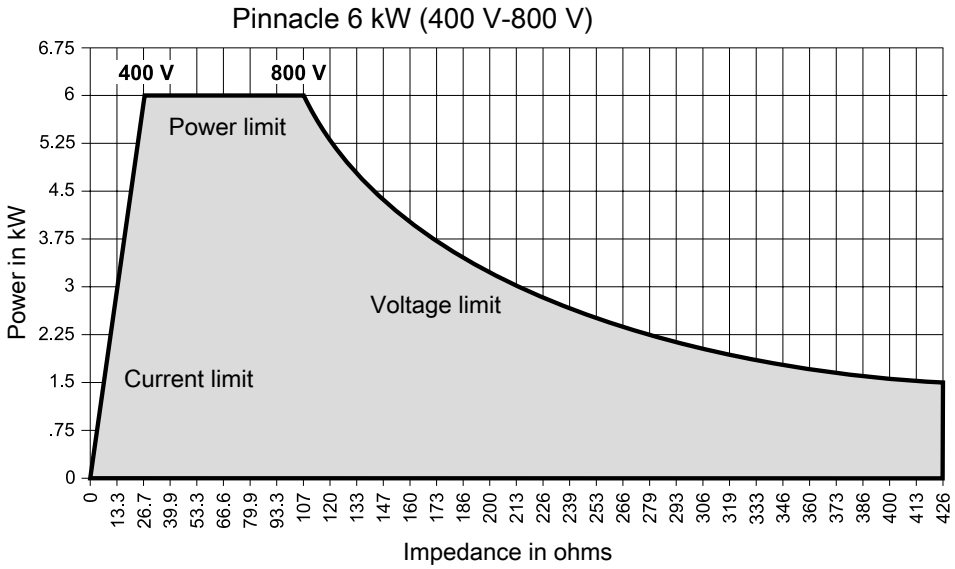


Figure 3-2. *Side A and B: 6 kW (400 V to 800 V) impedance range*

6 KW X 6 KW (400 V TO 1000 V) OUTPUT RANGE SPECIFICATIONS

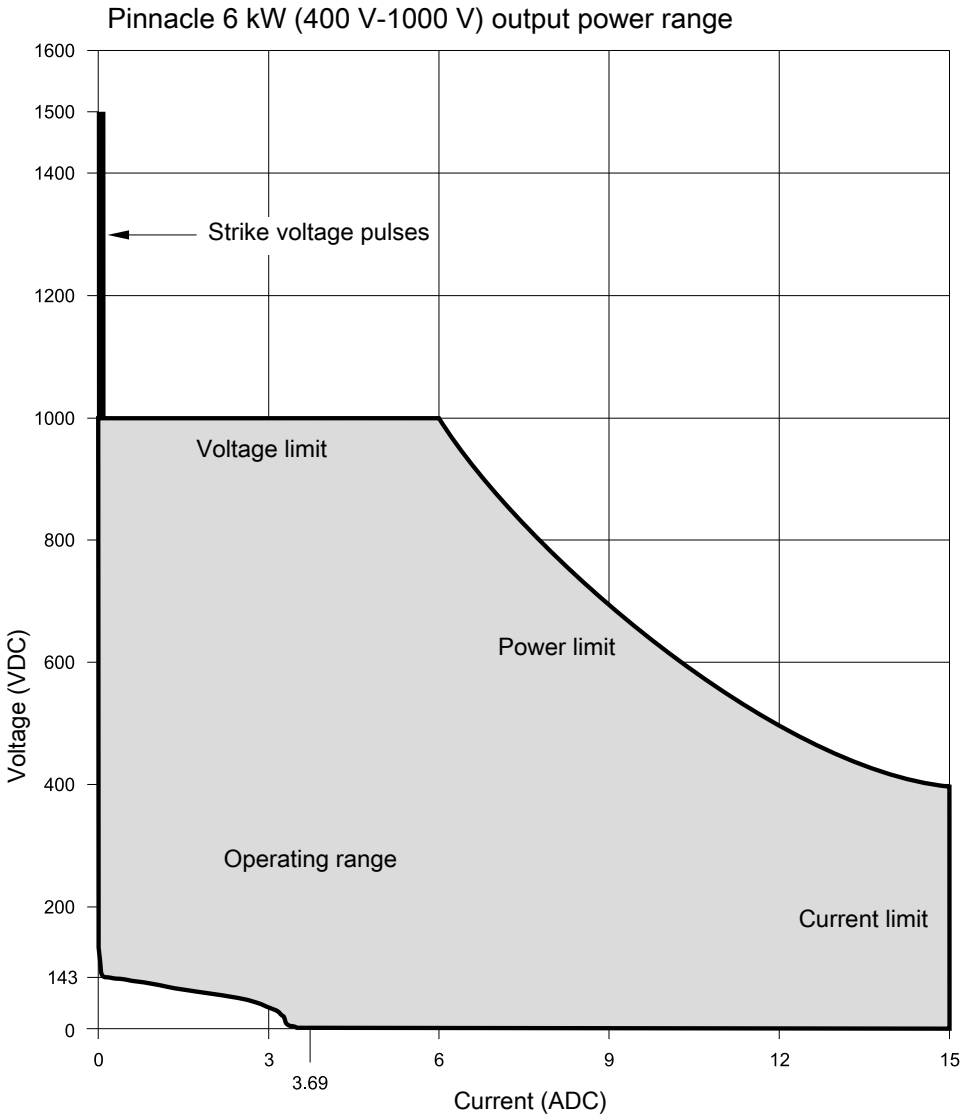


Figure 3-3. *Sides A and B: 6 kW (400 V to 1000 V) operating range*

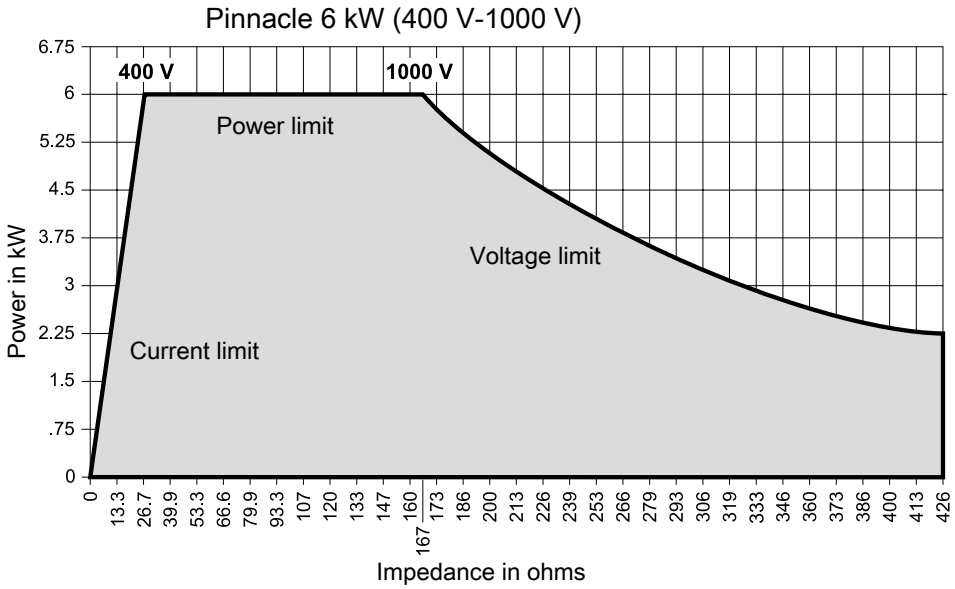


Figure 3-4. *Sides A and B: 6 kW (400 V to 1000 V) impedance range*

10 KW X 10 KW (400 V TO 800 V) OUTPUT RANGE SPECIFICATIONS

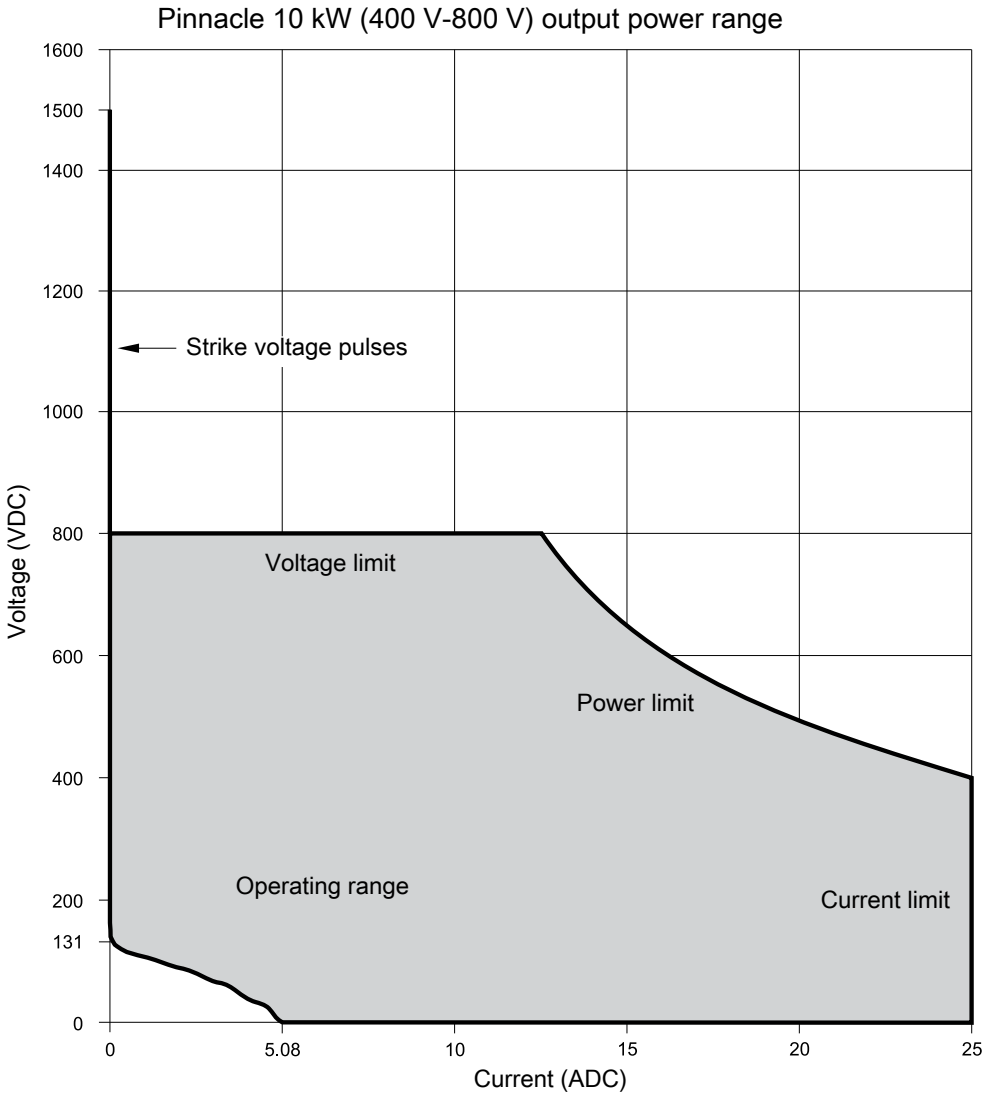


Figure 3-5. *Sides A and B: 10 kW x 10 kW (400 V to 800 V) operating range*

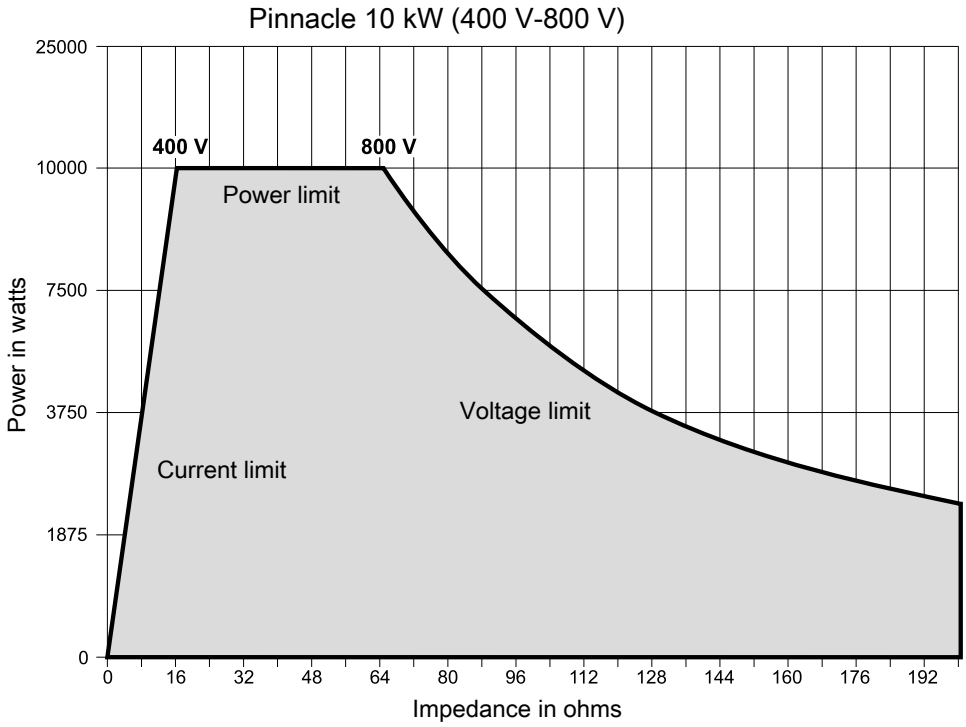


Figure 3-6. *Sides A and B: 10 kW x 10 kW (400 V to 800 V) impedance range*

10 KW X 10 KW (400 V TO 1000 V) OUTPUT RANGE SPECIFICATIONS

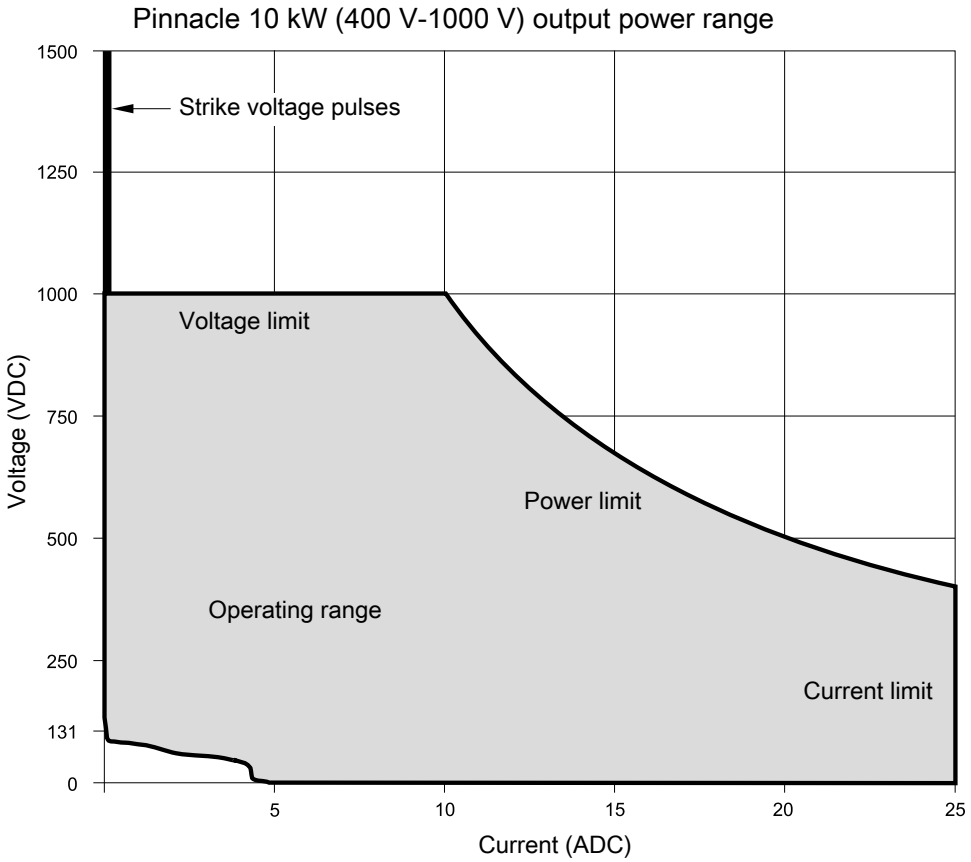


Figure 3-7. *Sides A and B: 10 kW x 10 kW (400 V to 1000 V) operating range*

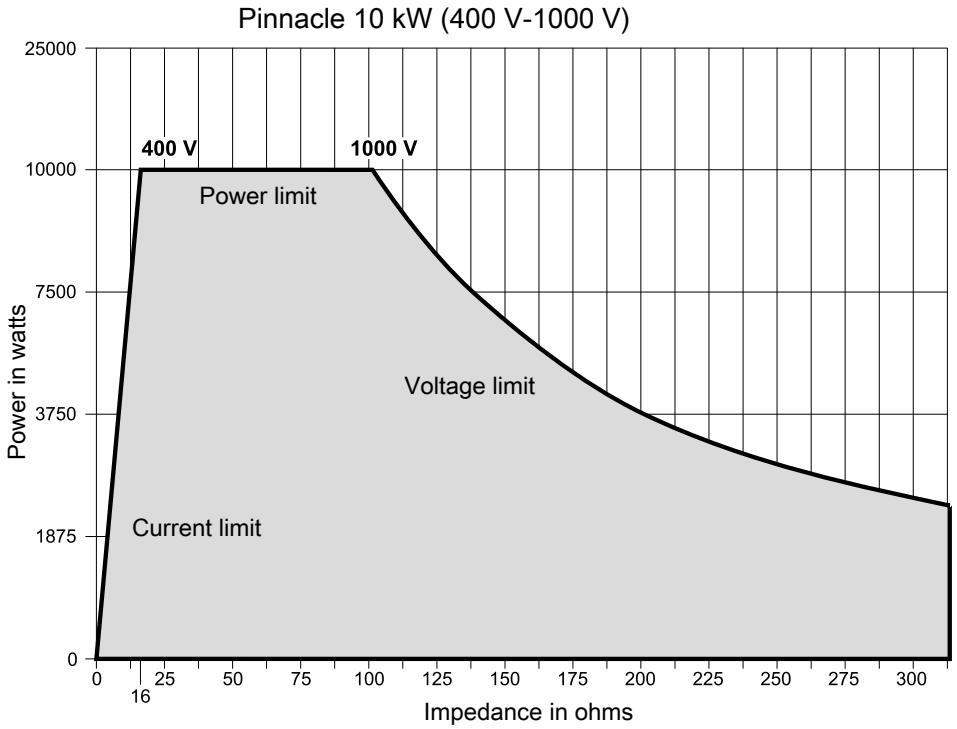


Figure 3-8. *Sides A and B: 10 kW x 10 kW (400 V to 1000 V) impedance range*

Analog Interface Scaling

This information is applicable for units that include a **USER** port.

Depending on the type and configuration of your **USER** port, the analog input and output signals will be either 0 V to 5 V or 0 V to 10 V full scale. If your supply does not contain a **USER** port that emulates another supply, full scale for setpoint input and readback output is shown in Table 3-5. In the table:

- The values are the unit full-scale values, not the user-limit values.
- If there are multiple current scaling ranges listed, use the range listed with your unit input voltage.

Table 3-5. *Analog interface scaling specifications*

Description	Specification			
Power	0 to the full-rated power for the side			
Current	**Power**	**Input Voltage**	**Output Voltage**	**Current Scaling**
	6 kW x 6 kW	400 V	400 V to 1000 V	0 A to 20 A

Table 3-5. Analog interface scaling specifications (Continued)

Description	Specification			
	Power	Input Voltage	Output Voltage	Current Scaling
	6 kW x 6 kW	208 V	400 V to 1000 V	0 A to 20 A
	6 kW x 6 kW	480 V	400 V to 1000 V	0 A to 40 A
	10 kW x 10 kW	480 V	400 V to 1000 V	0 A to 40 A
	10 kW x 10 kW	400 V	400 V to 1000 V	0 A to 40 A
	10 kW x 10 kW	208 V	400 V to 1000 V	0 A to 40 A
Voltage	1500 V ignition capability: 0 V to 10 V = 0 V to 1500 V			

ENVIRONMENTAL SPECIFICATIONS

The two following tables describe the environmental specifications for the Pinnacle unit.

Table 3-6. Environmental standard specifications

Description	Specification
Overvoltage category	II
Pollution degree	2

Table 3-7. 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′)

Table 3-7. Climatic specifications (Continued)

	Temperature	Relative Humidity	Air Pressure
Transportation	-25°C to +70°C -13°F to +158°F	95% [2] 60 g/m3 [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

Table 3-8. Cooling specifications

Description	Specification
Required spacing	• Minimum clearance between either side of the Pinnacle power supply and the enclosure: 51 mm (2″). • Minimum clearance between the top of the Pinnacle power supply and the top of the enclosure: 25 mm (1″). • Minimum clearance between the front and back of the Pinnacle power supply and the enclosure: 102 mm (4″), with adequate ventilation. • No clearance is required between power supplies.
Cooling air temperature	Air (gas) minimum 5°C (41°F), maximum 40°C (104°F)
Heat/power dissipation	See “Cooling Requirements” on page 5-5 for unit heat loss information.

Communication Controls

USER PORT INTRODUCTION

Some units include an analog port, labeled **USER**. If your unit includes a **USER** port, please see the appropriate section in this chapter.

SINGLE 15 V 37-PIN USER PORT

Some units include this **USER** port. If you are unsure which **USER** port is on the unit, contact AE Global Services with your unit 315*xxxxx-xxx* part number or unit serial number (SN).

Single 15 V 37-Pin User Port Connector

The **USER** port (analog/digital interface) is one of the following:

- 15 V isolated interface card with a 37-pin, subminiature-D, male connector
- 15 V non-isolated interface card with a 37-pin, subminiature-D, female connector

This interface emulates the MDX **USER** port and a subset of the MDXII **USER** port.

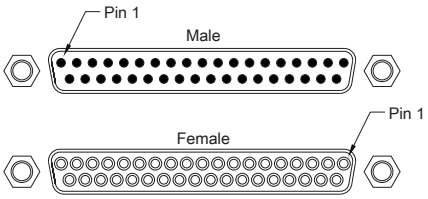


Figure 4-1. *37-pin male and female subminiature-D connectors*

Single 15 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.

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

Turn off AC input power to the Pinnacle unit before connecting a cable to the **USER** port connector. AE recommends taking standard preventive measures against electrostatic discharge (ESD) around all Pinnacle units.

Grounding the **USER** port at the power supply reduces noise interference. To avoid ground loop problems, you should typically ground only one end.

Single 15 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 source or sink up to 3.0 mA and have an output impedance of 100 Ω. The input impedance of the analog input is 200 kΩ.

DIGITAL SIGNALS

A "*.D*" suffix appended to the pin name indicates a digital signal. Digital commons are denoted by the "*COM.D*" suffix. Digital signals that are active when low are indicated with an overline on the pin name ($\overline{ARC.D}$).

Digital outputs are 0 V to 15 V, are internally pulled up to 15 V through a 10 kΩ resistor, and have an output impedance of 100 Ω. When low, each digital output line will sink up to 35 mA.

Digital inputs are also 0 V to 15 V, with a low input being less than 0.5 V. An open input defaults high via a 4.32 kΩ pull-up to 15 V. A low input will source up to 3.3 mA. All digital lines incorporate a low-pass filter that rejects signals less than 1 ms.

PIN DESCRIPTION TABLE

The **USER** port has priority for selecting targets, even when the unit is in local or host control. Thus to select targets from the active control panel or a host computer connected to the host port, you must set the target to 1 at the **USER** port. Leaving the target bits open or leaving the **USER** port pins unconnected causes the target selection at the **USER** port to default to 1.

*Table 4-1. Single 15 V 37-pin **User** port pin descriptions*

Signal Pin	Related Pin	Name	Signal Type	Description
1	37	$\overline{CS1.D}$	Output	This signal, with pin 20 ($\overline{CS2.D}$), tells an external device (such as a cathode switch box) which of the Pinnacle supply target-life counters is active. See "Reporting the Active Target Setting to an External Device" on page 4-8 for more information.
2	37	$\overline{OUTPUT.D}$	Output	This signal indicates that output power is on.
3	37	$\overline{SETPOINT.D}$	Output	This signal indicates that the output is within specified tolerance of the requested setpoint.
4	36	$\overline{TARGET0.D}$	Input	This signal is used with $\overline{TARGET1.D}$ (pin 35) and $\overline{TARGET2.D}$ (pin 34) to select the active target-life counter. See "Setting the Active Target-Life Counter" on page 4-8 for more information.
5	36	$\overline{IREG.D}$	Input	This signal is used with $\overline{PREG.D}$ (pin 6) to set the regulation mode. See "Setting the Regulation Mode" on page 4-9 for more information.
6	36	$\overline{PREG.D}$	Input	This signal is used with $\overline{IREG.D}$ (pin 5) to set the regulation mode. See the description of pin 5 for the logic table associated with this signal.
7	36	$\overline{ON.D}$	Input	This signal is used with $\overline{OFF.D}$ (pin 14) to enable/disable output power. Pin 14 must be low to turn the unit on. If $\overline{OFF.D}$ (pin 14) is low, a momentary low on pin 7 turns output power on. If pin 14 is high, pin 7 cannot enable output. Once the on is issued via $\overline{ON.D}$ (pin 7), pin 14 has priority to override all commands to turn the unit off. When pin 14 transitions high after the unit is turned on, it forces a power off. If pin 14 transitions low when pin 7 is low, pin 14 will enable output power. For more information on these two signals, see "User Port Output Enable/ Disable Behavior and Signal States" on page 4-7.

*Table 4-1. Single 15 V 37-pin **User** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
8	N/A	Unassigned	N/A	N/A
9	N/A	*OUTCOM.A*	N/A	Dedicated return for analog output. Reference pins 23, 24, 25, 31, and 32 to this pin.
10	N/A	*INCOM.A*	N/A	Dedicated return for analog output. Reference pin 27 to this pin.
11	19	*$\overline{AUX.D}$*	Input	This signal, with *$\overline{VAC.D}$* (pin 12) and *$\overline{WATER.D}$* (pin 13) monitors the system interlock string. If the interlock conditions are not all satisfied, the unit will be in a fault condition and output power will be disabled.
12	19	*$\overline{VAC.D}$*	Input	See description of pin 11 (*$\overline{AUX.D}$*).
13	19	*$\overline{WATER.D}$*	Input	See description of pin 11 (*$\overline{AUX.D}$*).
14	36	*OFF.D*	Input	This signal is used with *$\overline{ON.D}$* (pin 7) to enable/disable output power. See pin 7 description and "User Port Output Enable/Disable Behavior and Signal States" on page 4-7 for more information. Pin 14 also resets the Pinnacle unit after all fault conditions, except interlock, overtemperature, and A/D conversion faults. Pin 14 does not reset an "end of target life" signal.
15	19	*SPARE1.D*	Input	Spare input
16	19	*SPARE2.D*	Input	Spare input
17	19	*SPARE4.D*	Input	Spare input
18	N/A	*15 V*	Output	This protected 15 VDC supply (output) provides a maximum of 100 mA.
19	N/A	*INTLKCOM.D*	N/A	Dedicated return for interlocks. Reference pins 11, 12, and 13 to this pin.
20	37	*$\overline{CS2.D}$*	Output	This signal is used with pin 1 (*$\overline{CS1.D}$*) to tell an external device (such as a cathode switch box) which of the Pinnacle supply target-life counters is active. See "Reporting the Active Target Setting to an External Device" on page 4-8 for more information.

*Table 4-1. Single 15 V 37-pin **User** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
21	37	$\overline{ARC.D}$	Output	A pulse of a predetermined width (normally 100 ms—a few units are configured for 10 ms) will be seen on this pin under two different conditions: 1. If the hard arc count limit is nonzero and the number of hard arcs seen exceeded this limit during the last run, the pulse will occur when the output is turned off. 2. If you set the hard arc count limit to zero, this signal will pulse for a predetermined time 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. These conditions will also be indicated through the **Arc** LED on the display panel.
22	37	$\overline{EOTL.D}$ or $\overline{READY.D}$	Output	Normally, this pin is configured to signal the end of target life ($\overline{EOTL.D}$), but if your unit was ordered (and configured) for use with an Advanced Energy Varian® interface unit, see $\overline{READY.D}$ below: • $\overline{EOTL.D}$: This signal goes low when the active target-life counter reaches zero, thus indicating that target life has ended. • $\overline{READY.D}$: If your unit is configured for use with an Advanced Energy Varian Interface unit, a high on this pin indicates faults are active (ready bit is deasserted) and the unit is not ready to output power. A low on this pin indicates no faults are active and the unit is ready to output power—provided all other necessary conditions have been met.
23	9	*VOUT.A*	Output	This signal represents output voltage.

*Table 4-1. Single 15 V 37-pin **User** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
				Full scale represents the rating of the supply.
24	9	*POUT.A*	Output	This signal represents output power. Full scale represents the rating of the supply.
25	9	*IOUT.A*	Output	This signal represents output current. Full scale represents the rating of the supply.
26	N/A	Unassigned	N/A	N/A
27		*LEVELIN.A*		This signal is used to program the output level. Full scale represents the rating of the supply for the active regulation mode.
28	N/A	Unassigned	N/A	N/A
29	19	*SPARE3.D*	Input	spare input
30	N/A	Unassigned	N/A	N/A
31	9	*LEVELOUT.A*	Output	This signal represents the programmed setpoint level. Full scale represents the rating of the supply.
32	9	*REF.A*	Output	This signal provides an accurate 5 V or 10 V reference (10 V at 10 mV). The scaling (5 V or 10 V) is configured at the factory.
33	N/A	Unassigned	N/A	N/A
34	36	$\overline{TARGET2.D}$	Input	This signal is used with $\overline{TARGET0.D}$ (pin 4) and $\overline{TARGET1.D}$ (pin 35) to select the active target-life counter. See "Setting the Active Target-Life Counter" on page 4-8 for more information.
35	36	$\overline{TARGET1.D}$	Input	This signal is used with $\overline{TARGET0.D}$ (pin 4) and $\overline{TARGET2.D}$ (pin 34) to select the active target-life counter. See "Setting the Active Target-Life Counter" on page 4-8 for more information.
36	N/A	*INCOM.D*	N/A	Dedicated return for digital inputs.

*Table 4-1. Single 15 V 37-pin **User** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
				Pins 4, 5, 6, 7, 14, 34, and 35 should be referenced to this pin.
37	N/A	*OUTCOM.D*	N/A	Dedicated return for digital outputs. Pins 1, 2, 3, 20, 21, and 22 should be referenced to this pin.

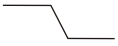
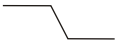
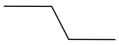
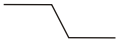
USER PORT OUTPUT ENABLE/DISABLE BEHAVIOR AND SIGNAL STATES

As described in the preceding table, pins 7 ($\overline{ON.D}$) and 14 ($\overline{OFF.D}$) are used to enable/disable output power. The following table illustrates the output enabled/disabled behavior of the unit, depending on the state of these two pins. In the table:

- H = High state
- L = Low state
- The lines represent transitions between high and low

Note that these state changes apply only when the **USER** port is the active control interface and is the only interface used to enable and disable the unit output.

*Table 4-2. **User** port output enable/disable behavior and signal states*

$\overline{ON.D}$	$\overline{OFF.D}$	Unit State
H		Output disabled
H		Output disabled
L		Output disabled
L		Output enabled
	L	Output enabled
	L	No change
	H	Output disabled
	H	Output disabled

REPORTING THE ACTIVE TARGET SETTING TO AN EXTERNAL DEVICE

The following table shows the pin state for pins 20 and 1 for a specific target-life counter setting. This information is used to communicate the active target setting to an external device, such as a cathode switch box.

Table 4-3. Cathode switch (pin 20 and pin 1)

Target-Life Counter	Pin 20	Pin 1
1 or 5	High	High
2 or 6	High	Low
3 or 7	Low	High
4 or 8	Low	Low

SETTING THE ACTIVE TARGET-LIFE COUNTER

The following table shows the pin state for pins 34, 35, and 4 to select a specific target-life counter as the active target.

If the unit includes a **USER** port:

- The **USER** port has priority for setting the active target. If the target selection pins are left floating, or are inactive, the default setting for the target is set to target 1. If the pins are set to any other setting than 1, this setting overrides any other control source to set the active target.
- If you want to enable the target using another interface, then you must actively set the target to target 1 via the **USER** port or leave the **USER** port pins 34, 35, and 4 floating.
- After a power cycle, the unit defaults to the **USER** port target settings. If you previously set the target settings through another interface, you must reset the target settings after a power cycle through the appropriate interface.

Other interfaces include the host port interface and the active control panel.

Table 4-4. Target life counter (pin 34, 35, and 4)

Target-Life Counter	Pin 34	Pin 35	Pin 4
1	High	High	High
2	High	High	Low
3	High	Low	High
4	High	Low	Low
5	Low	High	High
6	Low	High	Low

Table 4-4. Target life counter (pin 34, 35, and 4) (Continued)

Target-Life Counter	Pin 34	Pin 35	Pin 4
7	Low	Low	High
8	Low	Low	Low

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 (pin 5 and pin 6)

Regulation Mode	Pin 5	Pin 6
Voltage	High	High
Power	High	Low
Current	Low	High
Not valid	Low	Low

DUAL 15 V 37-PIN USER PORT

Some units include this **USER** port. If you are unsure which **USER** port is on the unit, contact AE Global Services with your unit 315*xxxxx-xxx* part number or unit serial number (SN).

Dual 15 V 37-Pin USER Port Connector

The **USER** port (analog/digital interface) is a 15 V, non-isolated interface card with a 37-pin, subminiature-D, female connector.

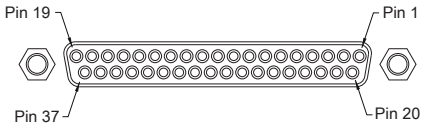


Figure 4-2. 37-pin, subminiature-D, female connector

Dual 15 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.

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

Turn off AC input power to the Pinnacle unit before connecting a cable to the **USER** port connector. Note that AE recommends taking standard preventive measures against electrostatic discharge (ESD) around all Pinnacle units.

Grounding the **USER** port at the power supply reduces noise interference. To avoid ground loop problems, you should typically ground only one end.

If you have an active control panel and you want to operate the Pinnacle supply from the **USER** port, use the active panel to set the control mode to user control.

Dual 15 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.

Signals that have the prefix "*A_*" control side A, and signals that have the prefix "*B_*" control side B. If your unit is a single output unit, ignore signals that control side B.

ANALOG SIGNALS

An "*.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 and have an output impedance of 100 Ω. The input impedance of the analog inputs is 10 kΩ.

CAUTION:

Power down the Pinnacle unit and take proper ESD precautions before removing the unit top cover to position jumpers. Otherwise, personal injury or damage to the unit could result. All personnel who work with or who are exposed to this equipment must take adequate precautions against serious or possibly fatal injury.

DIGITAL SIGNALS

A "*.D*" suffix appended to the pin name indicates a digital signal. Digital commons are denoted by the "*COM.D*" suffix. Digital signals that are active when low are indicated with an overline on the pin name ($\overline{ARC.D}$).

Digital outputs are 0 V to 15 V. They are composed of a 100 Ω series impedance and a Darlington transistor with a 10 kΩ pull-up to 15 V. When low, each digital output line sinks up to 35 mA.

Digital inputs are also 0 V to 15 V. A low input is less than 0.5 V and sources up to 3.3 mA. An open input defaults high via a 4.32 kΩ pull-up to 15 V. All digital signal input lines incorporate a low pass filter that rejects signals less than 1 ms.

PIN DESCRIPTION TABLE

*Table 4-6. Dual 15 V 37-pin **USER** port pin descriptions*

Signal Pin	Related Pin	Name	Signal Type	Description
1	20	$\overline{A\_INTLK.D}$	Input	This signal monitors the system interlock string. A low on this pin indicates the system interlock string is satisfied. If the interlock conditions are not all satisfied, then the unit will be in a fault condition and output power will be disabled. Reference this pin to *A_INTLKCOM.D* (pin 20).
2	N/A	*A_INCOM.A*	Input	This line is a dedicated return for side A analog inputs. Reference *A_LEVELIN.A* (pin 21) to this pin.
3	23	*A_POUT.A*	Output	This pin provides a signal representing output power. Full scale represents the rating of the supply. Reference this pin to *A_OUTCOM.A* (pin 23).
4	23	*A_IOUT.A*	Output	This pin provides a signal representing output current. Full scale represents the rating of the supply. Reference this pin to *A_OUTCOM.A* (pin 23).
5	N/A	*A_INCOM.D*	Input	This line is a dedicated return for side A digital inputs.

*Table 4-6. Dual 15 V 37-pin **USER** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
				Reference $\overline{A\_ON.D}$ (pin 6), $\overline{A\_PREG.D}$ (pin 7), $\overline{A\_RESET.D}$ (pin 24), and $\overline{A\_IREG.D}$ (pin 25), and $\overline{A\_SPARE.D}$ (pin 10) to this pin.
6	5	$\overline{A\_ON.D}$	Input	A low on this pin turns output power on. A high turns output power off. Reference this pin to *A_INCOM.D* (pin 5).
7	5	$\overline{A\_PREG.D}$	Input	This signal is used with $\overline{A\_IREG.D}$ (pin 25) to set the regulation mode. See Table 4-7 on page 4-16 for more information. Reference this pin to *A_INCOM.D* (pin 5).
8	28	$\overline{A\_ARC.D}$	Output	A pulse of a predetermined width (normally 100 ms) will be seen on this pin under two different conditions. Both conditions can be active during the same run. • If the hard arc count limit is nonzero and the number of hard arcs seen exceeded this limit during the last run, the pulse will occur when the output is turned off. • If your unit has been configured for signaling on every hard arc, this signal will pulse for a predetermined time 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.
9	28	$\overline{A\_SETPOINT.D}$	Output	When low, this signal indicates that the output is equal to the requested setpoint. Reference this pin to *A_OUTCOM.D* (pin 28).
10	5	$\overline{A\_SPARE.D}$	Input	Digital spare.
11	29	$\overline{B\_SETPOINT.D}$	digital output	When low, this signal indicates that the output is equal to the requested setpoint.

*Table 4-6. Dual 15 V 37-pin **USER** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
				Reference this pin to *B_OUTCOM.D* (pin 29).
12	29	$\overline{B\_ARC.D}$	Output	A pulse of a predetermined width (normally 100 ms) will be seen on this pin under two different conditions. Both conditions can be active during the same run. • If the hard arc count limit is nonzero and the number of hard arcs seen exceeded this limit during the last run, the pulse will occur when the output is turned off. • If your unit has been configured for signaling on every hard arc, this signal will pulse for a predetermined time 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.
13	15	$\overline{B\_PREG.D}$	Input	Used with $\overline{B\_IREG.D}$ (pin 32) to set the regulation mode. See Table 4-8 on page 4-16 for more information. Reference this pin to *B_INCOM.D* (pin 15).
14	15	$\overline{B\_ON.D}$	Input	A low on this pin turns the output on. A high on this pin shuts the output off. Reference this pin to *B_INCOM.D* (pin15).
15	N/A	*B_INCOM.D*	Input	This line is a dedicated return for side B digital inputs. Reference $\overline{B\_PREG.D}$ (pin 13), $\overline{B\_ON.D}$ (pin 14), $\overline{B\_IREG.D}$ (pin 32), and $\overline{B\_RESET.D}$ (pin 33), and $\overline{B\_SPARE.D}$ (pin 31) to this pin.
16	34	*B_IOUT.A*	Output	This pin provides a signal representing output current. Full scale represents the maximum current of the supply. Reference this pin to *B_OUTCOM.A* (pin 34).

*Table 4-6. Dual 15 V 37-pin **USER** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
17	34	*B_POUT.A*	Output	This pin provides a signal representing output power. Full scale represents the rating of the supply. Reference this pin to *B_OUTCOM.A* (pin 34).
18	N/A	*B_INCOM.A*	Input	This line is a dedicated return for side B analog inputs. Reference *B_LEVELIN.A* (pin 36) to this pin.
19	37	$\overline{B\_INTLK.D}$	Input	This signal monitors the system interlock string. A low on this pin indicates the system interlock string is satisfied. If the interlock conditions are not all satisfied, then the unit will be in a fault condition and output power will be disabled. Reference this pin to *B_INTLKCOM.D* (pin 37).
20	N/A	*A_INTLKCOM.D*	Input	This line is a dedicated return for $\overline{A\_INTLK.D}$ (pin 1).
21	2	*A_LEVELIN.A*	Input	This signal is used to program the output level. Full scale represents the maximum power, current, or voltage of the supply. Reference this pin to *A_INCOM.A* (pin 2).
22	23	*A_VOUT.A*	Output	This pin provides a signal representing output voltage. Full scale represents the rating of the supply. Reference this pin to *A_OUTCOM.A* (pin 23).
23	N/A	*A_OUTCOM.A*	Output	This line is a dedicated return for side A analog output. Reference *A_POUT.A* (pin 3), *A_IOUT.A* (pin 4), and *A_VOUT.A* (pin 22) to this pin.
24	5	$\overline{A\_RESET.D}$	Input	A low on this pin will reset active explicit-clear faults on side A, provided that the fault conditions are no longer present. This pin must be returned to the inactive state (high) to enable the unit output.

*Table 4-6. Dual 15 V 37-pin **USER** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
				Reference this pin to *A_INCOM.D* (pin 5).
25	5	*A_IREG.D*	Input	This pin is used with *A_PREG.D* (pin 7) to set the regulation mode. See Table 4-7 on page 4-16 for more information. Reference this pin to *A_INCOM.D* (pin 5).
26	N/A	*15 V SUPPLY*	Output	This protected 15 V power supply provides a maximum of 100 mA.
27	28	*A_OUTPUT.D*	Output	A low on this signal indicates that power for the A supply output is on. Reference this pin to *A_OUTCOM.D* (pin 28).
28	N/A	*A_OUTCOM.D*	Output	This signal is a dedicated return for side A digital outputs. Reference *A_ARC.D* (pin 8), *A_SETPOINT.D* (pin 9), and *A_OUTPUT.D* (pin 27) to this pin.
29	N/A	*B_OUTCOM.D*	Output	This signal is a dedicated return for side B digital outputs. Reference *B_SETPOINT.D* (pin 11), *B_ARC.D* (pin 12), and *B_OUTPUT.D* (pin 30) to this pin.
30	29	*B_OUTPUT.D*	Input	A low on this signal indicates that power for the B supply output is on. Reference this pin to *B_OUTCOM.D* (pin 29).
31	15	*B_SPARE.D*	Input	Digital spare.
32	15	*B_IREG.D*	Output	This pin is used with *B_PREG.D* (pin 13) to set the regulation mode. See Table 4-8 on page 4-16 for more information. Reference this pin to *B_INCOM.D* (pin 15).
33	15	*B_RESET.D*	Input	A low on this pin will reset active explicit-clear faults on side B, provided that the fault conditions are no longer present. This pin must be returned to the inactive state (high) to enable the unit output.

*Table 4-6. Dual 15 V 37-pin **USER** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
				Reference this pin to *B_INCOM.D* (pin 15).
34	N/A	*B_OUTCOM.A*	Output	This line is a dedicated return for side B analog outputs. Reference *B_IOUT.A* (pin 16), *B_POUT.A* (pin 17), and *B_VOUT.A* (pin 35) to this pin.
35	34	*B_VOUT.A*	Output	This pin provides a signal representing output voltage. Full scale represents the rating of the supply. Reference this pin to *B_OUTCOM.A* (pin 34).
36	18	*B_LEVELIN.A*	Input	This signal is used to program the output level. Full scale represents the maximum power, current, or voltage of the supply. Reference this pin to *B_INCOM.A* (pin 18).
37	N/A	*B_INTLKCOM.D*	Input	This signal is a dedicated return for $\overline{B\_INTLK.D}$ (pin 19).

SETTING THE REGULATION MODE

The following tables shows the pin states to select a specific regulation mode on sides A and B.

Table 4-7. Regulation mode for side A (pins 7 and 25)

Regulation Mode	Pin 7	Pin 25
Voltage	High	High
Power	Low	High
Current	High	Low
Not valid	Low	Low

Table 4-8. Regulation mode for side B (pins 13 and 32)

Regulation Mode	Pin 13	Pin 32
Voltage	High	High
Power	Low	High

Table 4-8. Regulation mode for side B (pins 13 and 32) (Continued)

Regulation Mode	Pin 13	Pin 32
Current	High	Low
Not valid	Low	Low

SINGLE 24 V 37-PIN USER PORT

Some units include this **USER** port. If you are unsure which **USER** port is on the unit, contact AE Global Services with your unit 315*xxxxx-xxx* part number or unit serial number (SN).

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

Single 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.

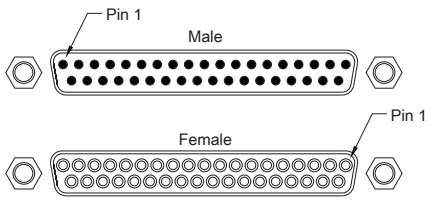


Figure 4-3. 37-pin subminiature-D male and female connectors

Single 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 port card, your card provides isolation of more than 500 V_{RMS} from the logic and control circuitry to all 37 pins on the connector.

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

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

Turn off AC input power to the Pinnacle unit before connecting a cable to the **USER** port connector. AE recommends taking standard preventive measures against electrostatic discharge (ESD) around all Pinnacle units.

If you have an active control panel and you want to operate the Pinnacle unit from the **USER** port, you must set the user control mode using the panel.

Connect your system 24 V supply to pin 18 on the Pinnacle 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

Single 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. For specific information about power, voltage, and current levels, see "Input and Output Electrical Specifications for Dual Output Units" on page 3-4.

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 5.0 mA. The input impedance of the analog inputs is 1 M Ω.

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 4-9. Single 24 V 37-pin **USER** port pin descriptions*

Signal Pin	Related Pin	Name	Signal Type	Description
1	37	*CS1.D*	Output	This signal, along with pin 20 (*CS2.D*), tells an external device (such as a cathode switch box) which of the Pinnacle supply target life counters is active. See "Reporting the Active Target Setting to an External Device" on page 4-23 for a list of signal conditions relative to target life counters.
2	37	*OUTPUT.D*	Output	When high, this signal indicates that the output power is on.
3	37	*SETPOINT.D*	Output	When high, this signal indicates that the output is equal to the requested setpoint.
4	36	*TARGET0.D*	Input	This signal is used with *TARGET1.D* (pin 35) and *TARGET2.D* (pin 34) to select the active target life counter.

*Table 4-9. Single 24 V 37-pin **USER** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
				See "Setting the Active Target Life Counter" on page 4-23 for a list of the signal conditions for each target selection.
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 4-24 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 "Setting the Regulation Mode" on page 4-24 for a list of signal conditions for each regulation mode.
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. 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. If the conditions are not all satisfied, the power supply interlock is opened, preventing the output from enabling.
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

*Table 4-9. Single 24 V 37-pin **USER** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
18	N/A	*24 V*	Input	Connect your system 24 V power supply to this pin. It must be connected to *AUX.D INTLK* (pin 11) to satisfy the interlock.
19	N/A	*INTLKCOM.D*	N/A	This pin is the dedicated return for the *AUX.D INTLK* pin (pin 11).
20	37	*CS2.D*	Output	This signal is used with pin 1 (*CS1.D*) to tell an external device (such as a cathode switch box) which of the Pinnacle supply target life counters is active. See "Reporting the Active Target Setting to an External Device" on page 4-23 for a list of signal conditions relative to target life counters.
21	37	*ARC.D*	Output	A pulse of a predetermined width (normally 100 ms) will be seen on this pin under two different conditions. Both conditions can be active during the same run: • If the hard arc count limit is nonzero and the number of hard arcs seen exceeded this limit during the last run, the pulse will occur when the output is turned off. • If you set the hard arc count limit to zero, this signal will pulse for a predetermined time 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. These conditions will also be indicated through the **Arc** LED on the unit front panel.
22	37	*EOTL.D*	Output	This signal goes high when the active target life counter reaches zero, thus indicating that target life has ended.
23	9	*VOUT.A*	Output	This signal represents output voltage. Full scale (10 V) represents the full rated output voltage of the supply.
24	9	*POUT.A*	Output	This signal represents output power.

*Table 4-9. Single 24 V 37-pin **USER** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
				Full scale (10 V) represents the full power of the supply.
25	9	*IOUT.A*	Output	This signal represents output current. Full scale (10 V) represents the maximum current of the supply.
26	N/A	Unassigned	N/A	N/A
27	10	*LEVELIN.A*	Input	This signal programs the output level. Full scale (10 V) represents the rating of the supply.
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) represents the rating of the supply.
32	N/A	Unassigned	N/A	N/A
33	N/A	Unassigned	N/A	N/A
34	36	*TARGET2.D*	Input	This signal is used with *TARGET0.D* (pin 4) and *TARGET1.D* (pin 35) to select the active target life counter. See "Setting the Active Target Life Counter" on page 4-23 for a list of the signal conditions for each target selection.
35	36	*TARGET1.D*	Input	This signal is used with *TARGET0.D* (pin 4) and *TARGET2.D* (pin 34) to select the active target life counter. See "Setting the Active Target Life Counter" on page 4-23 for a list of the signal conditions for each target selection.
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.

*Table 4-9. Single 24 V 37-pin **USER** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
				Pins 1, 2, 3, 20, 21, and 22 should be referenced to this pin.

REPORTING THE ACTIVE TARGET SETTING TO AN EXTERNAL DEVICE

The following table shows the pin state for pins 20 and 1 for a specific target life counter setting. This information is used to communicate the active target setting to an external device, such as a cathode switch box.

Table 4-10. Active target report (pins 20 and 1)

Target Life Counter	Pin 20	Pin 1
1 or 5	Low	Low
2 or 6	Low	High
3 or 7	High	Low
4 or 8	High	High

SETTING THE ACTIVE TARGET LIFE COUNTER

The following table shows the pin state for pins 34, 35, and 4 to select a specific target life counter as the active target.

Table 4-11. Active target selection (pins 34, 35, and 4)

Target Life Counter	Pin 34	Pin 35	Pin 4
1	Low	Low	Low
2	Low	Low	High
3	Low	High	Low
4	Low	High	High
5	High	Low	Low
6	High	Low	High
7	High	High	Low
8	High	High	High

SETTING THE REGULATION MODE

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

Table 4-12. Regulation mode (pins 5 and 6)

Regulation Mode	Pin 5	Pin 6
Voltage	Low	Low
Power	Low	High
Current	High	Low
Not valid	High	High

DUAL 24 V 37-PIN USER PORT

This section applies to the dual 24 V 37-pin **USER** port.

Some units include this **USER** port. If you are unsure which **USER** port is on the unit, contact AE Global Services with your unit 315*xxxxx-xxx* part number or unit serial number (SN).

Dual 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 Pinnacle unit.

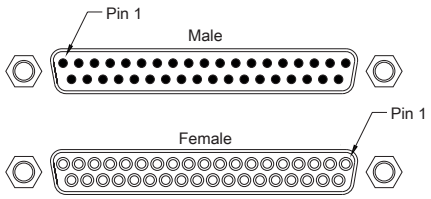


Figure 4-4. 37-pin subminiature-D male and female connectors

If you have an isolated 24 V **USER** port card, your card provides isolation of more than 500 V_{RMS} from the Pinnacle unit SELV logic and control circuitry to all 37 pins on the connector.

Dual 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.

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

Turn off AC input power to the Pinnacle unit before connecting a cable to the **USER** port connector. AE recommends taking standard preventive measures against electrostatic discharge (ESD) around all Pinnacle units.

Grounding the **USER** port 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 pins 10, 26, and 31 on the **USER** port. 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

Before operating your unit from the **USER** port, ensure that the control mode is set to user control. If you have been using another control mode, reset the control mode to user control before attempting to send signals to the **USER** port.

Dual 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.

Signals that have the prefix "*A_*" control side A, and signals that have the prefix "*B_*" control side B. For single-output units, ignore signals with the prefix "*B_*".

ANALOG SIGNALS

An "*.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 5.0 mA. The input impedance of the analog inputs is 1 MΩ.

DIGITAL SIGNALS

A "*.D*" suffix 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": 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 range: 0.5 mA to 0.5 A.

The signal levels for digital inputs are as follows:

- Logical "0": –35 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 4-13. *Dual 24 V 37-pin* ***USER*** *port pin descriptions*

Signal Pin	Related Pin	Name	Signal Type	Description
1	20	*A_INTLK.D*	Input	A low on this pin inhibits the power supply interlock from being satisfied. The pin needs to be pulled up to 24 V. The fault condition is shown on the front panel.
2	N/A	*A_INCOM.A*	N/A	This line is a dedicated return for analog inputs. Reference *A_LEVELIN.A* (pin 21) to this pin.
3	23	*A_POUT.A*	Output	This signal represents output power. Full scale (10 V) represents the rating of the supply.
4	23	*A_IOUT.A*	Output	This signal represents output current. Full scale (10 V) represents the rating of the supply.
5	N/A	*A_INCOM.D*	N/A	This line is a dedicated return for digital inputs. Reference *A_ON.D* (pin 6), *A_PREG.D* (pin7), *A_RESET.D* (pin 24), and *A_IREG.D* (pin 25) to this pin. You can also reference the 24 V supply (pins 10, 26, 31) to this return.
6	5	*A_ON.D*	Input	When operating in analog (user) control mode, a low to high transition on this pin

*Table 4-13. Dual 24 V 37-pin **USER** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
				turns on the output; a high to low transition shuts off the output.
7	5	*A_PREG.D*	Input	This pin is used with *A_IREG.D* (pin 25) to set the regulation mode for side A. See Table 4-14 on page 4-30 for further information.
8	28	*A_ARC.D*	Output	A pulse of a predetermined width (normally 100 ms) will be seen on this pin under two different conditions. Both conditions can be active during the same run. • If the hard arc count limit is nonzero and the number of hard arcs seen exceeded this limit during the last run, the pulse will occur when the output is turned off. • If your unit has been configured for signaling on every hard arc, this signal will pulse for a predetermined time 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. These conditions will also be indicated on the **Arc** LED on the display panel.
9	28	*A_SETPOINT.D*	Output	A high on this signal indicates that the output is equal to the requested setpoint (within the specified accuracy).
10	5	*24 V SUPPLY*	Input	Connect your system 24 V power supply to this pin.
11	29	*B_SETPOINT.D*	Output	A high on this signal indicates that the output is equal to the requested setpoint (within the specified accuracy).
12	29	*B_ARC.D*	Output	A pulse of a predetermined width (normally 100 ms) will be seen on this pin under two different conditions. Both conditions can be active during the same run.

*Table 4-13. Dual 24 V 37-pin **USER** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
				• If the hard arc count limit is nonzero and the number of hard arcs seen exceeded this limit during the last run, the pulse will occur when the output is turned off. • If your unit has been configured for signaling on every hard arc, this signal will pulse for a predetermined time 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. These conditions will also be indicated on the **Arc** LED on the display panel.
13	15	*B_PREG.D*	Input	This pin is used with *B_IREG.D* (pin 32) to set the regulation mode for side B. See Table 4-15 on page 4-31 for further information.
14	15	*B_ON.D*	Input	When operating in analog control mode, a low to high transition on this signal turns on the output, and a high to low transition shuts off the output.
15	N/A	*B_INCOM.D*	N/A	This line is a dedicated return for digital inputs. Reference *B_PREG.D* (pin 13), *B_ON.D* (pin 14), *B_IREG.D* (pin 32), and *B_RESET.D* (pin 33) to this pin.
16	34	*B_IOUT.A*	Output	This signal represents output current. Full scale (10 V) represents the maximum current of the supply.
17	34	*B_POUT.A*	Output	This signal representing output power. Full scale (10 V) represents the rating of the supply.
18	N/A	*B_INCOM.A*	N/A	This line is a dedicated return for analog inputs. Reference *B_LEVELIN.A* (pin 36) to this pin.
19	37	*B_INTLK.D*	Input	A low on this pin inhibits the power supply interlock from being satisfied. The pin needs to be pulled up to 24 V.

*Table 4-13. Dual 24 V 37-pin **USER** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
20	N/A	*A_INTLKCOM.D*	N/A	This line is a dedicated return for *A_INTLK.D* (pin 1).
21	2	*A_LEVELIN.A*	Input	This signal is used to program the output level. Full scale (10 V) represents the maximum power, current, or voltage of the supply.
22	23	*A_VOUT.A*	N/A	This signal represents output voltage. Full scale (10 V) represents the rating of the supply.
23	N/A	*A_OUTCOM.A*	N/A	This line is a dedicated return for analog output. Reference *A_POUT.A* (pin 3), *A_IOUT.A* (pin 4), and *A_VOUT.A* (pin 22) to this pin.
24	5	*A_RESET.D*	Input	A high on this pin will reset active explicit-clear faults for side A, provided that the fault conditions are no longer present. This pin must be returned to the inactive state (low) to enable the unit output.
25	5	*A_IREG.D*	Input	This pin is used with *A_PREG.D* (pin 7) to set the regulation mode. See Table 4-14 on page 4-30 for further information.
26	5	*24 V SUPPLY*	Input	Connect your system 24 V power supply to this pin.
27	28	*A_OUTPUT.D*	Output	When high, the interlock is satisfied and output power is on.
28	N/A	*A_OUTCOM.D*	N/A	This signal is a dedicated return for digital outputs. Reference *A_ARC.D* (pin 8), *A_SETPOINT.D* (pin 9), and *A_OUTPUT.D* (pin 27) to this pin.
29	N/A	*B_OUTCOM.D*	N/A	This signal is a dedicated return for digital outputs. Reference *B_SETPOINT.D* (pin 11), *B_ARC.D* (pin 12), and *B_OUTPUT.D* (pin 30) to this pin.
30	29	*B_OUTPUT.D*	Output	When high, the interlock is satisfied and output power is on.

*Table 4-13. Dual 24 V 37-pin **USER** port pin descriptions (Continued)*

Signal Pin	Related Pin	Name	Signal Type	Description
31	5	*24 V SUPPLY*	Input	Connect your system 24 V power supply to this pin.
32	15	*B_IREG.D*	Input	This pin is used with *B_PREG.D* (pin 13) to set the regulation mode. See Table 4-15 on page 4-31 for further information.
33	15	*B_RESET.D*	Input	A high on this pin will reset active explicit-clear faults for side B, provided that the fault conditions are no longer present. This pin must be returned to the inactive state (low) to enable the unit output.
34	N/A	*B_OUTCOM.A*	N/A	This line is a dedicated return for analog outputs. Reference *B_IOUT.A* (pin 16), *B_POUT.A* (pin 17), and *B_VOUT.A* (pin 35) to this pin.
35	34	*B_VOUT.A*	Output	This signal provides a fully buffered 0 V to 10 V signal representing output voltage. Full scale (10 V) represents the rating of the supply.
36	N/A	*B_LEVELIN.A*	Input	This signal is used to program the output level. Full scale (10 V) represents the rating of the supply.
37	N/A	*B_INTLKCOM.D*	N/A	This signal is a dedicated return for *B_INTLK.D* (pin 19).

SETTING THE REGULATION MODE

The following tables shows the pin states to select a specific regulation mode on sides A and B. For single-output units, ignore side B information.

Table 4-14. Regulation mode for side A (pins 7 and 25)

Regulation Mode	Pin 7	Pin 25
Voltage	Low	Low
Power	High	Low
Current	Low	High
Not valid	High	High

Table 4-15. Regulation mode for side B (pins 13 and 32)

Regulation Mode	Pin 13	Pin 32
Voltage	Low	Low
Power	High	Low
Current	Low	High
Not valid	High	High

INTERLOCK PORT

INTERLOCK Port Connector

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

To enable the Pinnacle 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 18 V, and it can source 60 mA. Pin 3 can sink 60 mA. The voltage on pins 3 and 4 should not exceed 20 V.

Pins 5, 6, 7, and 9 also provide Arc-Sync™ capability.

The following figure shows the **INTERLOCK** port.

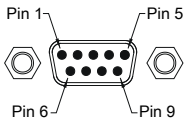


Figure 4-5. INTERLOCK port connector

INTERLOCK Port Cabling Requirements

To connect the **INTERLOCK** port, use a shielded, 9-wire, 22 AWG, jacketed cable (type UL 2343) or an equivalent cable. Twisted-pair wiring is allowed, but 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 preventive 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's connectors. Additionally, you must connect the unit chassis to a local earth ground through an adequately sized, copper grounding strap.

To satisfy the interlock, Advanced Energy includes a dummy plug to use for the interlock pins but does not include the cable.

To use the Arc-Sync feature on the on the **INTERLOCK** port, you must provide a custom cable connection (some options include the cable).

INTERLOCK Port Signal and Pin Descriptions

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

Table 4-16. 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 satisfy the Pinnacle unit interlock, short together pins 3 and 4 on the **INTERLOCK** port (through a cheater plug, external switch or relay). Pin 3 can sink 60 mA. Pin 4 supplies the interlock system (string) with 24 V. Pin 4 can sink 60 mA.
4	3	*UNIT ENABLE SIGNAL*		
5	8	*REMOTE ARC SHUTDOWN (SIDE B)*	Input	See pin 6
6	8	*REMOTE ARC SHUTDOWN (SIDE A)*	Input	To enable a remote arc shutdown, apply 5 V to the pin to signal a shutdown of output power for the power supply. The unit remains in the arc routine until the pin is brought low again.

Table 4-16. INTERLOCK port pin descriptions (Continued)

Signal Pin	Related Pin	Name	Signal Type	Description
				☞ **Important** This sequence does not turn the unit off because the unit thinks that an arc exists and enters the arc routine. The unit does not come back on because its logic board detects current on the output connection.
7	8	*ARC DETECT (SIDE A)*	Output (0 V to 5 V)	When high, this pin signals that the output voltage of the power supply is below the arc sense level set.
8	5, 6, 7, and 9	*RETURN*		Common return and reference signal for pins 5, 6, 7, and 9.
9	8	*ARC DETECT (SIDE B)*	Output (0 V to 5 V)	When high, this pin signals that the output voltage of the power supply is below the arc trip level set.

ETHERNET INTERFACE

The Pinnacle 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 Pinnacle unit through a network using an Ethernet Modbus®/TCP connection.

☞ **Important**

The Pinnacle 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.

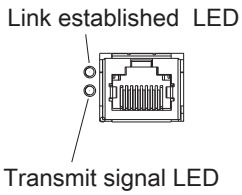


Figure 4-6. Ethernet connector and indicators

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 4-17. 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 Pinnacle 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 Pinnacle 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)

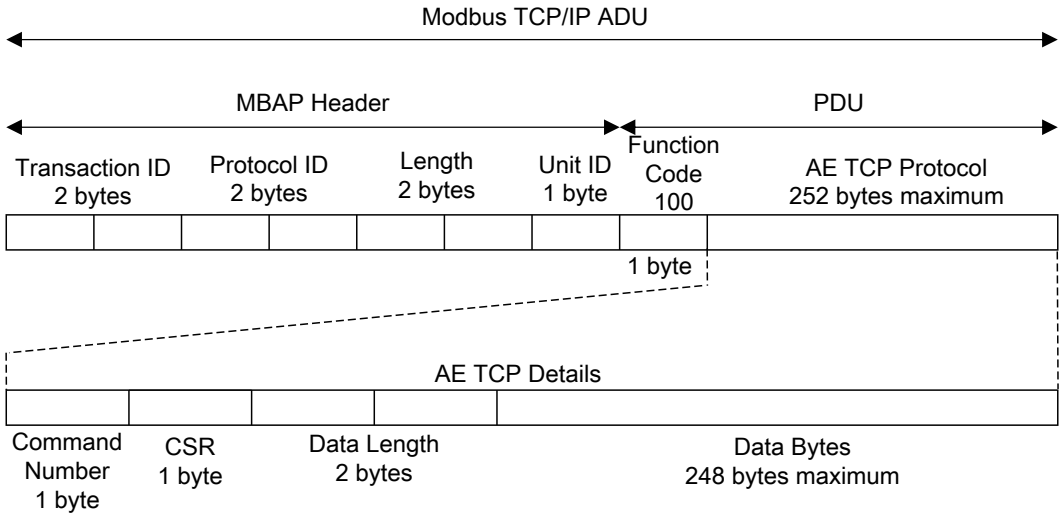


Figure 4-7. Data encoding for AE TCP using FC100

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 4-18. 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 4-18. 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 may 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 4-19. 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 4-19. 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 Pinnacle 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 Pinnacle unit replies to commands with a CSR packet.

Table 4-20. 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 4-21. Format for FC100 CSR packet

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

Table 4-21. 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 4-22. 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: 4 = **USER** port (analog)

This table illustrates the response packet for command 14.

*Table 4-23. 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	AE Host command status response = CSR value
10 and 11	0x00, 0x00	Number of data bytes in response

PROFIBUS INTERFACE

The Pinnacle unit provides a serial communications interface through the **PROFIBUS** (Process Field Bus) port. This interface allows the Pinnacle 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.

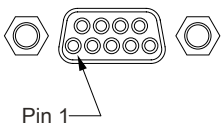


*Figure 4-8. **PROFIBUS** port connector*

PROFIBUS Port Pin and Signal Descriptions

Table 4-24. 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
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 4-25. 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.

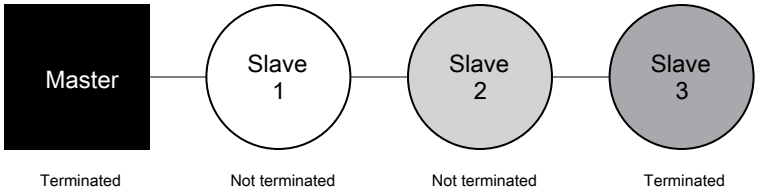


Figure 4-9. Example of a segment

AE PROFIBUS Protocol

The **PROFIBUS** port provides an interface that lets you communicate with the Pinnacle 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

Set the PROFIBUS address as follows:

- Unit A

  Set the Pinnacle unit PROFIBUS address to an even-numbered address from 2 through 124.

- Unit B

  Unit B will have the next sequential odd address. For example, when unit A address = 4, unit B address = 5. Allowable addresses for unit A are even

addresses between 2 and 124, thus making unit B addresses be between 3 and 125.

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

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

TO SET THE UNIT PROFIBUS ADDRESS THROUGH AN EXTERNAL DIP SWITCH

⚠ **WARNING:**
With an external DIP switch, you must shut off all power to the unit before setting the network address.

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.

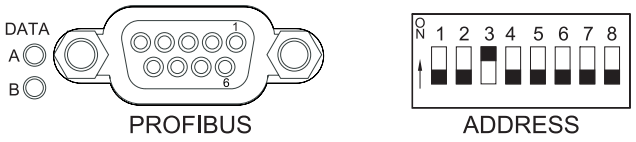


*Figure 4-10. **PROFIBUS** port, LEDs, and DIP switch*

PROFIBUS STATUS LED

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

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

PROFIBUS MASTER RESET COMMAND

Send the master reset command, PROFIBUS command **119**, when the Pinnacle 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 Pinnacle 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 Pinnacle unit waits between commands from the master. The timer counts down this time in 10 ms increments.

☞ **Important**
Commands **1** and **119** also turn off the power supply output.

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 Pinnacle 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 Pinnacle unit. Data inconsistency most often results in inappropriate value changes at the Pinnacle 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 Pinnacle 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 Pinnacle unit can respond. This situation can cause the Pinnacle 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 byte 13 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 Pinnacle unit at a rate faster than one command per 20 ms.

PROFIBUS Command Structure

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 900 µs.

PROFIBUS DOWNLOAD PACKET

The download packet for PROFIBUS contains four bytes.

Table 4-26. Configuration of PROFIBUS download packet bytes

Byte	Description
0	Command
1	Data byte (LSB)
2	Data byte
3	Data byte (MSB)

In the download packet, bytes 1, 2, and 3 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).

PROFIBUS UPLOAD PACKET

During every PROFIBUS data exchange, the Pinnacle unit supplies a 14-byte upload packet. This table defines the bytes contained in the upload packet.

Table 4-27. Configuration of PROFIBUS upload packet bytes

Byte	Description
0	Status flags—first byte
1	Status flags—second byte
2	Power low
3	Power high
4	Voltage low
5	Voltage high
6	Current low
7	Current high
8	Data byte (LSB) or CSR code when applicable
9	Data byte
10	Data byte
11	Data byte
12	Data byte (MSB)
13	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 Pinnacle unit.

Table 4-28. PROFIBUS upload packet status bit flags

Byte	Description
Byte 0—first status byte	Bits 0 and 1 = Control mode (00 = user, 01 = local, 10 = PROFIBUS) Bit 2 = Setpoint status OK Bit 3 = Unit enabled Bit 4 = End of target life Bit 5 = Active toggle bit (see Note 1) Bit 6 = Bus fault (high or low) Bit 7 = Inverter low
Byte 1—second status byte	Bit 0 = Fault active (1 = Fault exists) Bit 1 = Overtemperature condition Bit 2 = Interlock mechanism open Bit 3 = Momentary power failure Bit 4 = Joule mode enabled Bit 5 = Reserved Bit 6 = Joules reached Bit 7 = Output is on
Note 1: Byte 0, bit 5 indicates the status of the PROFIBUS interface. After the Pinnacle 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.	

PROFIBUS UPLOAD PACKET DATA BYTES 2 THROUGH 7

Upload bytes 2 through 7 give readback information for output levels in power, voltage, and current.

PROFIBUS UPLOAD PACKET DATA BYTES 8 THROUGH 13

In the upload packet, bytes 8, 9, 10, 11, and 12 make up the data field and contain information defined by byte 13, 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). Byte 13 references the requesting command.

AE BUS INTERFACE

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

Your unit might have two host ports on the rear panel, a standard host port labeled **HOST**, and an optional, isolated host port labeled **AE BUS**. In this manual these ports will both be referred to as **HOST** port. The interface protocol for both ports is nearly identical, and any differences are noted in the following sections and tables.

If you have an isolated communications card, your card provides isolation of more than 500 V_{RMS} from the Pinnacle unit SELV logic and control circuitry to all nine pins on the connector.

HOST Connector

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

*Figure 4-11. **HOST** port connector*

HOST Port Pin Descriptions (For Standard Port)

*Table 4-29. **HOST** port pin descriptions*

Signal Pin	Name	Description
1	*RESERVED*	Reserved for future use
2	*TX RS232*	RS-232 transmit data
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 low
8	*RESERVED*	Reserved for future use

Table 4-29. HOST port pin descriptions (Continued)

Signal Pin	Name	Description
9 [1]	*RESERVED (FACTORY)*	Reserved for future use

[1] Do not ground this factory reserved pin. Grounding this pin disrupts the operation of the unit.

Do not connect pins marked *RESERVED*.

HOST Port Pin Descriptions (For Optional Isolated Port)

Table 4-30. HOST port pin descriptions

Signal Pin	Name	Description
1	*RESERVED*	Reserved for future use
2	*TX RS232*	RS-232 transmit data
3	*RX RS232*	RS-232 receive data
4	*RESERVED*	Reserved for future use
5	COM	Data common
6	*RS485 -*	RS-485 low; RS-422 (−) receive data
7	*RS485 +*	RS-485 high; RS-422 (+) receive data
8	*T-*	RS-422 (−) transmit data
9	*T+*	RS-422 (+) transmit data

AE Bus Transmission Parameters

AE BUS TRANSMISSION PARAMETERS (STANDARD HOST PORT)

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

- RS-232 or RS-485 transmission standard
- Baud rate (for supported baud rates, see *Setting the Baud Rate* later in this section)
- Pinnacle 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 Pinnacle 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 Pinnacle unit before it initiates another transaction, either with the same unit or any other unit.

AE BUS TRANSMISSION PARAMETERS (OPTIONAL ISOLATED HOST PORT)

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

- RS-232, RS-422, or RS-485 transmission standard
- Baud rate (for supported baud rates, see *Setting the Baud Rate* later in this section)
- Pinnacle 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 Pinnacle unit is factory set at 0.20 seconds (that is, no more than 0.20 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 Pinnacle unit before it initiates another transaction, 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.

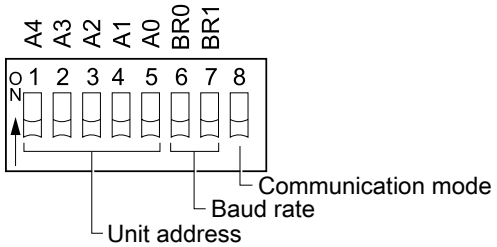


Figure 4-12. DIP switch

It might be difficult to see the numbers, and the orientation of the unit might change. However, the orientation of the DIP is always the same relative to the unit. When the unit is sitting right side up, the numbers are at the top of the DIP.

The following illustration shows the orientation of the **HOST** port and DIP switch on the back panel of the Pinnacle supply.

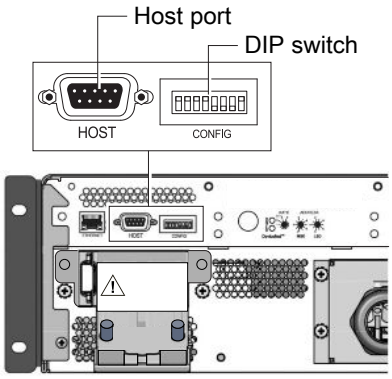


*Figure 4-13. **HOST** port and external DIP switch on the back panel*

SWITCHES

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

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

For units that support an isolated host port, the last switch (8, communication mode) is set at the factory.

SETTING THE BAUD RATE

Use DIP switches BR0 and BR1 to set the AE Bus baud rate.

STANDARD HOST PORT DIP SWITCH SETTINGS

Table 4-31. DIP switch settings for variable baud rate, switches 6 and 7

Baud	Switch 6	Switch 7
9600	On	On
19200	On	Off
57600	Off	On
115200	Off	Off

Table 4-32. DIP switch settings for communication mode, switch 8

Switch Position	Communication Mode
On	RS-232
Off	RS-485

OPTIONAL ISOLATED HOST PORT DIP SWITCH SETTINGS

Table 4-33. Setting the baud rate with the DIP switch

Standard Baud Rate RS-232	Standard Baud Rate RS-485/422	High Speed Baud Rate (Same for RS-232, RS-422, and RS-485	Switch 6	Switch 7
1200	9600	19000	On	On
4800	19200	38400	On	Off
9600	38400	57600	Off	On
19200	57600	115200	Off	Off

SETTING THE UNIT AE BUS ADDRESS

Use the DIP switch to set the unit AE Bus address. When the unit is a dual output power supply, the Unit B address is the Unit A address plus 15 decimal.

Table 4-34. AE Bus address settings

Address	A4	A3	A2	A1	A0
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 reassigns 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

Table 4-34. AE Bus address settings (Continued)

Address	A4	A3	A2	A1	A0
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
If your unit is a dual Pinnacle, 16 is the highest usable address for side A; Address for side B is side A address plus 15 decimal.					
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
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 Pinnacle 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 4-14 shows the organization of these fields in the AE Bus message packet. The subsequent paragraphs describe each field in detail.

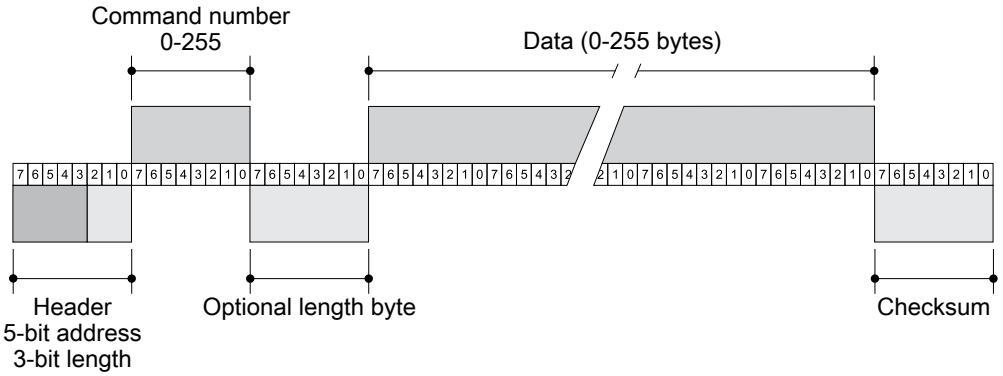


Figure 4-14. Graphic representation of a message packet

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 Pinnacle unit, for example). If the packet is going to the host, the address specifies the packet origin (from the Pinnacle unit). The address section of the header field is five bits long (bits 3 to 7), which allows a total of 32 distinct addresses. Address 0 (zero) is reserved for the network broadcast address, which the Pinnacle 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 1-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 Pinnacle 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 ≤ 6, 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 contains 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 1-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 contains 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 Pinnacle unit expects 0 to 6 data bytes. However, if the value in the header field is 7 (07h), the Pinnacle 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 4-35.

Table 4-35. 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 to 7 = 0xDF 0x40 0x02 0x00

AE BUS CHECKSUM BYTE

This 1-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 4-15 illustrates the steps in an ideal communications transaction between a host computer and the Pinnacle unit.

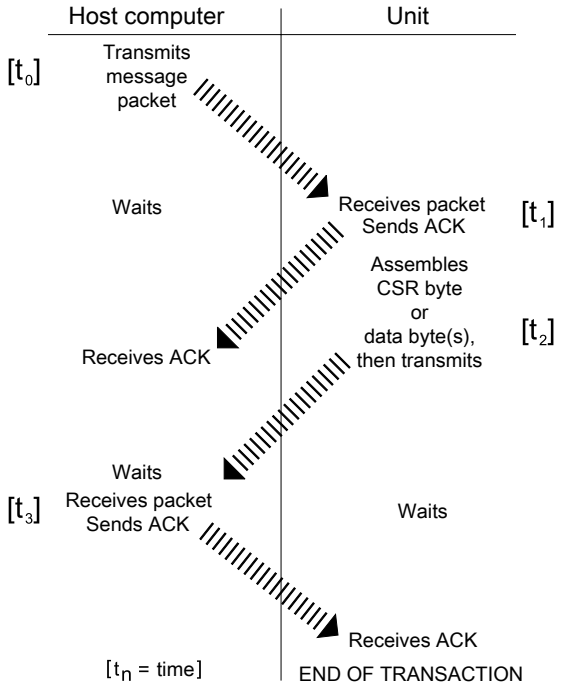


Figure 4-15. AE Bus communications transaction

T_0: HOST TRANSMITS MESSAGE PACKET

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

- If the address does not match, the Pinnacle unit does not respond to the host computer; the Pinnacle 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 Pinnacle unit sends a negative acknowledgment (NAK), hexadecimal 15h, to the host computer.

- If the address matches and the message is intact, the Pinnacle unit sends an acknowledgment (ACK), hexadecimal 06h, to the host computer.

If the Pinnacle 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 1-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 Pinnacle 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 Pinnacle 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 Pinnacle unit receives an ACK from the host computer, it returns to the normal waiting state. If the Pinnacle unit receives a NAK from the host computer, the unit retransmits the response packet. The Pinnacle unit continues to retransmit in response to NAK transmissions until the host computer stops the cycle. If the Pinnacle unit receives no response, it assumes an ACK and returns to the waiting state.

AE BUS COMMUNICATIONS TRANSACTION EXAMPLE

Figure 4-16 illustrates the steps in an example communications transaction between a host computer and the Pinnacle unit.

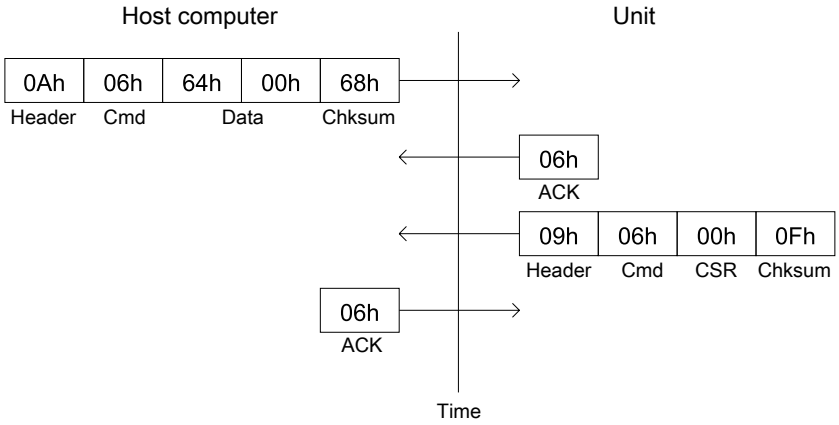


Figure 4-16. Communications transaction example

AE HOST COMMANDS

The following sections describe the command status response (CSR) codes returned by the Pinnacle unit in response to a command, as well as the AE Host commands for the Pinnacle unit.

AE Host Command Status Response (CSR) Codes

When the Pinnacle unit receives a command requesting a change in unit operation (commands **1** through **127**), or when the Pinnacle unit receives any command that it rejects (commands **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 4-36. 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 code is incorrect
2	Output is on (change not allowed)
3	Output is off (change not allowed)
4	Data is out of range
5	Invalid parameter
6	Program source is incorrect

Table 4-36. AE Host command status response (CSR) codes (Continued)

Code	Meaning
7	Active fault(s) exist
8	Ramping is active (change not allowed)
9	Data byte count is incorrect
10	**USER** port has priority (change not allowed)
12	This feature is not available on your unit
13	A front panel is active (change not allowed)
14	Regulation mode is invalid
15	Ramp invalid (reset ramp start setpoint parameter to valid setting)
16	Target life has expired
17	Output off timer active (minimum off time is 50 ms)
18	Limited duty cycle time active
19	Recipe is active (change not allowed)
20	Side disabled
21	Joule setpoint has not been reached
22	A process voltage fault has occurred
23	Inverter low fault active
24	A bus fault has occurred
27	Output off timer active (minimum off time is 50 ms.)
28	Setpoint exceeds user limit
29	Regulation mode is not selectable (because it is locked)
31	The **USER** port reset is active (you must deassert the reset line on the **USER** port)
37	Ramp/recipe inactive
38	Ramp and recipe hold is already active
39	Ramp and recipe hold is not active
41	VArc sense level is out of range
42	I threshold for VArc is 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

Table 4-36. AE Host command status response (CSR) codes (Continued)

Code	Meaning
55	Joule threshold out of range
56	Invalid joule type
57	Invalid recipe type
64	System size out of range
65	Arc profile index out of range
72	I threshold for VArc during arc out of range
79	Arc mask time out of range
92	IArc sense level out of range
94	Arc persistence time out of range
99	Command not accepted (there is no such command)

AE Host Command Set

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

- Commands **1** through **127** request a change to the Pinnacle 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.
- Commands **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.

☞ **Important**
Some Pinnacle units have limited features by design. Your unit might not include all commands listed.

Table 4-37. AE Host commands

Command	Description	Data Bytes Sent	Data Bytes Returned
0 null	NULL command. The Pinnacle unit will ignore this command.	0	CSR only

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
1 output off	Sets DC output off. This request is always honored, regardless of which interface has control.	0	CSR only
2 output on	Sets DC output on; host control must be selected (see command **14**). Command **161** reports the status of the last output-on event.	0	CSR only
3 regulation method	Sets the method of output regulation (power, voltage, or current). Send 1 data byte (8-bit value): • 6 = Power • 7 = Voltage • 8 = Current Command **154** reports this value.	1	CSR only
4 joule setpoint	Specifies the number of joules to be delivered. Send a 4-byte (32-bit value); the value must be from 0 to the unit maximum joule setpoint (normally 9,999,999). Command **173** reports the joule setpoint. Command **204** (subcommand 42) reports the joule setpoint range.	4	CSR only
5 joule mode enable	Enables or disables joule mode. Send 1 data byte (8-bit value): • 0 = Disable • Nonzero value = Enable Command **153** reports this value.	1	CSR only
6 setpoint	Specifies the output setpoint level for whichever method of regulation mode has been selected. Send 2 data bytes (16-bit value); an output power value should imply 3 decimal places, an output current value should imply 2 decimal places, and an output voltage value should imply 0 decimal places. For example, for a 6 kW standard Z unit send a value 0 and 6000 (6.000 kW, decimal is implied), or 0 and 1500 (15.00 A, decimal is implied), or 0 and 800 (maximum output voltage).	2	CSR only

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	☞ **Important** If the ramp feature is enabled (commands **15** and **16**), sending this command while the output is on and not currently ramping forces the unit to ramp from the existing setpoint to the new requested setpoint over the time specified in command **16**. Thus, by using this command and commands **15** and **16**, you can generate an output wave form during a process. Command **164** reports this value.		
7 set arc average window	Sets the size of the arc average window from 1 to 10 seconds. This value changes the arcs-per-second display and the return values from command **188**. Send 1 data byte (8-bit value). • When the window is set for 1 second, arcs per second will reflect the actual number of arcs per second. • When the window is set for a value greater than 1 second, arcs per second will reflect the average number of arcs per second over the length of the window (actual arcs over the number of seconds in the window). When the arc average window value is changed, the new value remains in effect for subsequent power ups. Command **192** reports this value.	1	CSR only
8 arc detect and shutdown times	Sets both the arc detect and shutdown delay index. The associated values for these indices are dependant on: • Whether standard or persistent arc handling mode is selected • Whether fast arc or slow arc response range is selected For the settings associated with these index values, see "Arc Detect and Delay Shutdown Index Settings (Command 8)" on page 4-103. Send 2 data bytes arranged as follows:	2	CSR only

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• Byte 0 = Arc detect time index (8-bit value from 0 to 9) • Byte 1 = Arc shutdown time index (8-bit value from 0 to 9) ☞ **Important** 10 kW and 20 kW Pinnacle units with a 208 VAC input configuration have a minimum arc shutdown time of 50 µs. For the settings associated with these index values, see "Arc Detect and Delay Shutdown Index Settings (Command 8)" on page 4-103. Command **170** reports these values.		
9 hard arc count limit	Sets the number of hard arcs required for the power supply to provide an arc indication. If the limit is reached during a process cycle, then, after output shuts off, the **Arc** LED lights. If you are using a 37-pin **USER** port, a pulse is also sent to the **USER** port *ARC.D* output signal. Send 4 data bytes (a 32-bit value) indicating the number of arcs; the value must be at least 0 but no greater than the maximum for your unit. ☞ **Important** A value of 0 disables the hard arc count limit feature so that the **Arc** LED does not light and no signal is sent to the **USER** port. Command **178** reports this value.	4	CSR only
10 voltage arc sense level	Specifies the voltage level at which the unit indicates an arc is occurring. Send 2 data bytes (16-bit value); the value must be at least 25 V but no greater than the maximum voltage for your unit. Command **171** reports this value.	2	CSR only
11 active target	Specifies which target will be active. Send 1 data byte (8-bit value); the value must be at least 1 but no greater than 8.	1	CSR only

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	☞ **Important** The **USER** port has priority for target selection. Thus to select targets from the active front panel or when in host control mode, you must set the target to 1 at the **USER** port. Leaving the target bits open or leaving the **USER** port pins unconnected causes the target selection at the **USER** port to default to 1. Command **156** reports this value.		
12 target life	Sets the life (in kilowatt-hours) of the target you specify. Send 1 data byte (8-bit value) plus 4 data bytes (32-bit value), arranged as follows: • Byte 0 = Target number • Bytes 1 to 4 = Target life (in kilowatt-hours) Two decimal places are implied (that is, to get 1 kW, send a value of 100). Command **157** reports this value.	5	CSR only
13 target enable	Enables or disables the target life counter. Send 1 data byte (8-bit value): • 0 = Disable the target life counter • Nonzero value = Enable the target life counter Command **163** reports this value.	1	CSR only
14 control mode	Chooses the mode of control for the Pinnacle unit. Send 1 data byte: • 2 = Host control mode (using the **HOST** port) • 4 = User control mode (using the **USER** port) • 6 = Local control mode using active or remote front panel Command **155** reports this value.	1	CSR only

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
15 ramp enable	Enables or disables the ramp feature. Send 1 data byte (8-bit value): • 0 = Disable • Nonzero = Enable Command **163** reports this value.	1	CSR only
16 ramp time	Sets the ramp time in 10 ms increments. The range is 50 ms to 600.00 s. Send a 2-byte value from 5 to 60,000. Two decimal places are implied. (A value of 100 = 1.00 s.) Command **158** reports this value.	2	CSR only
17 program source	Tells the Pinnacle supply whether the source of information for regulation mode and setpoints is internal or external (the source can be set independently for each of the three control modes). Send 3 data bytes as follows: • Byte 0 = Program source if the communications port is active • Byte 1 = Program source if a control panel is the active interface • Byte 2 = Program source if the **USER** port is active For each mode, send an 8-bit value as follows: • 0 = Program source is internal • Nonzero value = Program source is external (that is, an analog value from the **USER** port). A user card must be installed for this feature to be available. Command **163** reports these values.	3	CSR only
18 side enable	Enables or disables one power supply in a two-power-supply unit. If a unit is disabled, it cannot be turned on. Do not disable side A or side B while the global on feature is active. (See command **37**.)	1	CSR only

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	Send 1 data byte: • 0 = Disable • Nonzero value = Enable Command **163** reports this value.		
19 recipe steps	Specifies the number of recipe steps in your recipe. Send 1 data byte (8-bit value); the value must be at least 0 but no greater than 8. A value of 0 disables the recipe feature. ☞ **Important** For each recipe step, you must also set the regulation mode, setpoint, ramping time, and runtime (commands **20**, **21**, **22**, and **23**). Command **180** reports this value.	1	CSR only
20 recipe regulation mode	Specifies the regulation mode for a recipe step. Send 2 data bytes as follows: • Byte 0 = Recipe step (must be a value greater than 0 but no greater than 8) • Byte 1 = Regulation mode: ◦ 6 = Power ◦ 7 = Voltage ◦ 8 = Current Command **182** reports this value.	2	CSR only
21 recipe ramp time	Specifies the length of ramping time for a recipe step (that is, how long the unit will take to reach the setpoint you have defined for the selected recipe step). Send 3 data bytes arranged as follows: • Byte 0 = Recipe step (must be a value greater than 0 but no greater than 8) • Bytes 1 to 2 = Value from 5 to 60,000 (or from 0.05 s to 600 s); two decimal places implied. Command **181** reports these values.	3	CSR only

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
22 recipe setpoint	Specifies the setpoint for a recipe step. Send 3 data bytes arranged as follows: • Byte 0 = Recipe step (must be a value greater than 0 but no greater than 8) • Bytes 1 to 2 = Value from 0 to the full-rated output of the unit for the regulation mode set with command **20**. Send 2 data bytes (16-bit value); an output power value should imply 3 decimal places, an output current value should imply 2 decimal places, and an output voltage value should imply 0 decimal places. For example, for a 6 kW standard Z unit send a value from 0 to 6000 (6.000 kW, decimal is implied), or 0 and 1500 (15.00 A, decimal is implied), or 0 and 800 (maximum output voltage). Command **182** reports these values.	3	CSR only
23 recipe run time	Specifies the length of time the unit will run at setpoint for a recipe step. Send 3 data bytes arranged as follows: • Byte 0 = Recipe step (value must be greater than 0 but no greater than 8) • Bytes 1 to 2 = Value from 0 to 60,000 (or 0 to 600 s); two decimal places implied ☞ **Important** If you assign 0 runtime for the final recipe step, the unit switches to continuous output when it reaches setpoint for this step. In this situation, to turn off output, you must send an off command (using the **OFF** button or the appropriate **USER** port signal or serial port command), or you must have already enabled joule mode and programmed a joule setpoint. Command **183** reports these values.	3	CSR only
26 joule threshold	Specifies the output power level that needs to be met before the joule output energy calculation begins.	2	CSR only

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	To set the threshold (in watts), send 2 bytes (16-bit value) from 10 W to the maximum unit power divided by 8. ☞ **Important** The joule energy calculation begins after (n) ms, regardless of the output power level. The time value, (n) ms, is set in the configuration and cannot be changed. If the output power level meets the joule energy threshold prior to the time expiration, the joule energy calculation will begin. Command **136** reports this value.		
30 predefined target type	Specifies the type of target (metal or nonmetal) for the pre-defined arc handling mode: PC (normal process cycle). Send 1 data byte (8-bit value): • 0 = Predefined arc handling—metal • 1 = Predefined arc handling—nonmetal • 2 = Custom arc handling—settings established with command **8** Commands **162** and **174** reports these values.	1	CSR only
31 out-of-setpoint timer	Enables or disables an out-of-setpoint timer and specifies how long you want the power supply to tolerate an out-of-setpoint condition before shutting off output. Send 2 data bytes (16-bit value): • To enable the timer, send a value from 1 to the maximum value for the unit; one decimal place is implied (25 = 2.5 s) • To disable the timer, send a value of 0 Command **187** reports this value.	2	CSR only
32 ramp start point (percentage of setpoint)	For ramp mode, sets the ramp start point as a percentage of setpoint when output is turned on. Range is 0 to 95%. Send 1 byte with a value of 0 to 95. Command **152** reports this value.	1	CSR only

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
37 global on/off	Enables or disables global on/off. If global on/off is enabled, sending an on or off command to either side of the supply will turn both sides on or off. ☞ **Important** Side A and side B must both be enabled for this feature to function correctly. Send 1 data byte: • 0 = Disable • Nonzero = Enable Command **137** reports this value.	1	CSR only
38 reset arc density/run counters	Resets micro-arcs-per-run and hard-arcs-per-run counters to 0. These counters can be reset at any time, and resetting them can be useful for measuring arcs over a specific period of time.	0	CSR only
39 set comm watchdog timer	Sets the communications watchdog timer value in ms. Each interface has a unique watchdog timer that operates independently of all other interfaces. Any combination of enable, disable, and timeout values between interfaces is allowed. 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.	2	CSR only
40 set comm port timeout value	Specifies the amount of time the Pinnacle power supply waits between bytes from the host. Send 2 data bytes (16-bit value); the value represents increments of 10 ms, and the value must be at least 2 but no greater than 500 (20 ms to 5 s). Two decimal places are implied (enter 500 for 5.00). Command **140** reports this value.	2	CSR only

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
47 process voltage limit on/off	Enables or disables a voltage lower limit value for the process. Send 1 data byte (8-bit value): • 0 = Disable • Nonzero value = Enable Command **163** reports this value.	1	CSR only
48 process voltage lower limit	Sets a minimum process voltage. With this limit in place, the Pinnacle unit waits for the output voltage to first exceed the limit. Once that happens, output will remain on until you turn off the output or until the voltage falls below the established limit. If the voltage falls below the limit, output turns off and fault code **E110** or **E111** appears on the display. Send 2 data bytes (16-bit value). The value must be from 100 V to the limit set for the unit. Command **177** reports this value.	2	CSR only
You can set values for all three user output limits (commands **49**, **50**, and **51**); however, the Pinnacle unit responds to the first limit value that impacts output.			
49 user power limit	Sets a maximum limit for output power. Send 2 data bytes (16-bit value); the value must be from 0 to the maximum rated output power for the unit. Assume 3 decimal places (10000 = 10.000 kW). Command **141** reports this value.	2	CSR only
50 user voltage limit	Sets a maximum limit for output voltage. Send 2 data bytes (16-bit value); the value must be from 0 to the maximum rated output voltage for the unit in volts. Command **142** reports this value.	2	CSR only
51 user current limit	Sets a maximum limit for output current. Send 2 data bytes (16-bit value); the value must be from 0 to the maximum rated output current for the unit. Assume 2 decimal places (3000 = 30.00 A). Command **143** reports this value.	2	CSR only

Table 4-37. 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>52
user ignition strike limit</td><td>Sets an ignition strike limit range.
High voltage output units (750 VDC to 1500 VDC and 1500 VDC to 3000 VDC) do not have strike voltage capability.
Send 1 data byte representing a strike voltage range:
• 0 = Low
• 1 = Medium
• 2 = High
The values associated with each range depend on the output impedance range of your unit.
<table>
<tr><th>Strike Voltage Setting</th><th>Low-Z Unit 200 V to 400 V</th><th>Standard-Z Unit 400 V to 800 V</th><th>High-Z Unit 400 V to 1000 V and 500 V to 1000 V</th></tr>
<tr><td>Low</td><td>400 V
+ 100 V</td><td>800 V
+ 100 V</td><td>1,000 V
+ 100 V</td></tr>
<tr><td>Medium</td><td>650 V
± 100 V</td><td>1,100
± 100 V</td><td>1,200 V
± 100 V</td></tr>
<tr><td>High</td><td>900 V
± 100 V</td><td>1,450
± 150 V</td><td>1,450 V
± 150 V</td></tr>
</table>
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, select medium or low to reduce the effects of overshoot.
Command 144 reports your selection.</td><td>1</td><td>CSR only</td></tr>
<tr><td>62
arc management response time</td><td>Sets the arc response time to fast arc response or slow arc response.
Send 1 data byte:
• 0 = Slow arc</td><td>1</td><td>CSR only</td></tr>
</table>

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• Nonzero = Fast arc Command **225** reports this value.		
63 arc management response mode	Sets the arc handling response mode to standard or persistent. Send 1 data byte: • 0 = Persistent • Nonzero = Standard Command **225** reports this value.	1	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 00 to 59) • Byte 1 = Minutes (values 00 to 59) • Byte 2 = Hours (values 00 to 23) • Byte 3 = Day of week (values 01 to 07, 01 = Sunday) • Byte 4 = Date (values 01 to 31) • Byte 5 = Month (values 01 to 12) • Byte 6 = Year (values 00 to 99) Command **205** reports this value.	7	CSR only
71 set system control	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. 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.	Varies	CSR only

Table 4-37. 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>This command allows you to send subcommands. The name and function of a subcommand depends on the value of the first byte. Each subcommands 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>200</td><td>Set domain name</td></tr>
<tr><td>202</td><td>Set DNS server IP address</td></tr>
<tr><td>203</td><td>Set DNS configuration</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>71
set IP address
subcommand 0</td><td>Sets the Ethernet IP address. The unit stores the address in non-volatile 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: Set at the factory.
Command 204 (subcommand 0) reports this value.</td><td>5</td><td>CSR only</td></tr>
</table>

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
71 set default gateway subcommand 1	Sets the unit network default gateway address. The unit stores the address in non-volatile 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. The default gateway address is sent LSB first; that is, byte 1 = least significant octet of the default gateway address. 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: Set at the factory. Command **204** (subcommand 1) reports this value.	5	CSR only
71 set subnet mask subcommand 2	Sets the unit subnet mask. The unit stores the value in non-volatile 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. The default subnet mask is sent LSB first; that is, byte 1 = least significant octet of the subnet mask. 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: Set at the factory. Command **204** (subcommand 2) reports this value.	5	CSR only
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.	2	CSR only

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	Send 2 data bytes: • Byte 0 = 5 (set DHCP client control) • Byte 1 = Client enable mode: ◦ 0 = Disable client ◦ 1 = Enable client Default value: Set at the factory. Command **204** (subcommand 5) reports this value.		
71 set user power limit subcommand 11	Sets the power limit in 32-bit format. This command is similar to command **49**, but it specifies the limit value as 4 bytes and the increments are in watts. Send 5 bytes: • Byte 0 (8 bit value) = 11 (user power limit in watts) • Bytes 1 to 4 (32-bit value) = User power limit in watts Command **204** (subcommand 12) reports this value.	5	CSR only
71 set user voltage limit subcommand 12	Sets the voltage limit in 32-bit format. This command is similar to command **50**, but it specifies the limit value as 4 bytes and the increments are in volts. Send 5 bytes: • Byte 0 = 12 (user voltage limit in volts) • Bytes 1 to 4 = User voltage limit in volts Command **204** (subcommand 12) reports this value.	5	CSR only
71 set user current limit subcommand 13	Sets the current limit in 32-bit format. This command is similar to command **51**, but it specifies the limit value as 4 bytes and the increments are in hundredths of amps. Send 5 bytes: • Byte 0 = 13 (user current limit in amps)	5	CSR only

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• Bytes 1 to 4 = User current limit in hundredths of amps Command **204** (subcommand 12) reports this value.		
71 set domain name subcommand 200	Sets the network domain name. The domain name is stored in non-volatile 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. 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.	Varies	CSR only
71 set DNS server IP address subcommand 202	Sets the IP address for the DNS server. The DNS server IP address is stored in non-volatile 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	CSR only
71 set DNS configuration subcommand 203	Sets the DNS configuration mode. This setting is stored in non-volatile memory and is restored each time the unit is powered on.	3	CSR only

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	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.		
78 32-bit setpoint	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. The setpoint must not be greater than the unit maximum limit or the user limit in the corresponding regulation mode. This command is accepted only when the unit is in host control mode. Send 4 bytes representing the setpoint value: • For power regulation, setpoint increments represent 1 W. Range = 0 to maximum power limit. For example, for a unit that has a maximum power limit of 20 kW, the allowed values are 0 to 20000. • For current regulation mode, setpoint increments represent 0.01 A. Range = 0 to maximum current limit (for example, for a unit that has a maximum current limit of 15 A, the allowed values are 0 to 1500). • For voltage regulation mode, setpoint increments represent 1 V. Range = 0 to maximum voltage limit (for example, for a unit that has a maximum voltage limit of 800 V, the allowed values are 0 to 800). Command **238** reports this value.	4	CSR only

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
100 recipe/ramp hold or resume	While a recipe or ramp is executing, this command provides a means to stop or restart the recipe or ramp. Send 1 data byte (an 8-bit value): • 0 = Resume • Nonzero = Hold Command **150** reports this value.	1	CSR only
101 run time recipe setpoint	Send this command to specify a new setpoint level that is applied during the execution of a recipe or ramp. The setpoint takes effect immediately upon receipt by the power supply and applies to the step currently executing for whichever method of regulation is currently active. See command **6** for the format of the 2 data byte setpoint value. If command **101** is issued during a ramp or the ramp portion of a recipe step, the power supply output ramps to the new setpoint linearly in the ramp time remaining. The new setpoint remains in place for the subsequent run following the ramp. If the recipe is not finished, the next ramp begins at the new setpoint and ramp to the preprogrammed setpoint value for the recipe step. If command **101** is issued during the run portion of the ramp or recipe step, the power supply output immediately steps to the new setpoint. Command **101** can be issued as many times as necessary during the execution of a recipe, with different setpoint values as needed. The originally programmed recipe values will not be affected by runtime changes of the setpoint value with command **101**, and will be available for the next recipe execution. ☞ **Important** To check the setpoint after adjusting the setpoint with command **101**, you should send command **164**, not command **182**.	2	CSR only

Table 4-37. 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 Pinnacle 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 non-volatile 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. If you send 0 bytes, the returning packet contains 4 ASCII characters representing the power supply type: `PNCL`. If you send 1 byte, the value sent determines the return value. • If byte 0 = 0: Returns 2 bytes. Bytes 0 to 1 = Number of units (1 = single; 2 = dual). • 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.	0 or 1	Varies
129 report supply size	Reports the output capacity of the power supply. The returning packet contains 6 characters indicating capacity in kilowatts. The data string implies three decimal places; for example, 10000 = 10.000 kW.	0	6

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
130 report setpoint limits	Reports the maximum setpoint limits. Returns 6 data bytes: • Bytes 0 to 1 = Maximum power setpoint (watts) • Bytes 2 to 3 = Maximum voltage setpoint (volts) • Bytes 4 to 5 = Maximum current (amps in hundredths)	0	6
136 report joule threshold	Reports the output power level that needs to be met before the joule output energy calculation begins. This level is set with command **26**.	0	2
137 report global on/off status	Reports the global on/off status set with command **37**. Side A and side B must both be enabled for this feature to function correctly. The returning packet contains 1 data byte: • 0 = Global on/off disabled • Nonzero = Global on/off enabled	0	1
139 report comm watchdog timer	Reports the communications watchdog timer value in ms. Since each interface has a unique watchdog timer, the value reported is the value of the watchdog timer associated with that specific interface. 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. The watchdog timer value is stored internally in 10 ms increments, and all reported values are multiples of 10 ms.	0	2
140 report host timeout value	Reports the communications port timeout value set in command **40**; the returning packet contains 2 data bytes (16-bit value) indicating the time in ms (a value of 2 indicates 20 ms).	0	2

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
141 report user power limit	Reports the output power limit set with command **49**. The returning packet contains 2 data bytes (16-bit value) indicating the limit in kilowatts. Assume three decimal places, that is 10000 = 100.00 kW.	0	2
142 report user voltage limit	Reports the output voltage limit set with command **50**. The returning packet contains 2 data bytes (16-bit value) indicating the limit in volts.	0	2
143 report user current limit	Reports the output current limit set with command **51**. The returning packet contains 2 data bytes (16-bit value) indicating the limit in amps. Assume two decimal places (3000 = 30.00 A).	0	2
144 report user strike voltage limit	Reports the strike voltage limit set by command **52**. High voltage output units (750 VDC to 1500 VDC and 1500 VDC to 3000 VDC) do not have strike voltage capability. The returning packet contains 1 data byte indicating the strike voltage: • 0 = Low • 1 = Medium • 2 = High	0	1
150 report ramp hold setting	Requests the ramp hold setting as set by command **100**. The returning packet contains 1 data byte indicating the hold setting: • 0 = Hold inactive • 1 = Hold active	0	1
152 report ramp start setpoint percentage	Reports the ramp start setpoint percentage set with command **32**; the returning packet contains 1 data byte (8-bit) from 0 to 95 (%). This setting only applies to regular ramp mode. It does not apply to ramp mode in a timed recipe.	0	1

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
153 report joule mode status	Reports joule mode status set by command **5**. The returning packet contains 1 byte: • 0 = Inactive • Nonzero value = Active	0	1
154 report regulation mode	Reports the output regulation mode set by command **3**. The returning packet contains 1 data byte (8-bit value): • 6 = Power • 7 = Voltage • 8 = Current	0	1
155 report active control mode	Reports control mode set by command **14**. If sending 0 data bytes, the returning packet contains 1 data byte (8-bit value): • 2 = Host control mode (using the **HOST** port) • 4 = User control mode (using the **USER** port) • 6 = Local control mode (using an active control panel) If sending 1 data byte: Byte 0 = 0. Returns 2 bytes indicating the control mode: • Bytes 0 to 1 = Control mode: ◦ 2 = Host control mode (using the **HOST** port) ◦ 4 = User control mode (using the **USER** port) ◦ 6 = Local control mode (using an active or remote control panel)	0 or 1	1 or 2
156 report active target number	Reports an indication of the active target set by command **11**. The returning packet contains 1 data byte indicating target 1, 2, 3, 4, 5, 6, 7, or 8.	0	1

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
157 report target life	Reports the amount of target life time (set by command **12**) remaining for the specified target. Send 1 data byte indicating the target. The returning packet contains 4 data bytes (32-bit value) indicating the time remaining in kilowatt hours. Two decimal places are implied. For example, a value of 100 indicates 1 kWh.	1	4
158 report ramp time	Reports the ramp time set with command **16**. Returns a 2-byte value (16 bits) indicating a ramp time of 5 (50 ms) to 60,000 (600.00 s).	0	2
159 report ramp time remaining	Reports how much ramp time is remaining. The returning packet contains 2 data bytes (16 bits), indicating how many 10 ms intervals remain.	0	2
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 • 16 = End of target life event • 44 = The Pinnacle 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. Sending byte 0 is optional. If you send byte 0, send a value of 1. Byte 0: • 0 = Reserved • 1 = Ramp is active (if available)	0 or 1	4

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• 2 = Recipe is active (if available) • 3 = Output power (0 = off, 1 = on) • 4 = Illegal regulation mode • 5 = Cable interlock open • 6 = End of target life • 7 = Setpoint status (0 = within tolerance, 1 = out of tolerance) Byte 1: • 0 = Reserved • 1 = **USER** port auxiliary, vacuum, and interlocks open • 2 = Reserved • 3 = Service required fault • 4 = Heat sink overtemperature event • 5 = User interlock open • 6 = **USER** port reset active • 7 = Interlock open Byte 2: • 0 = Reserved • 1 = Reserved • 2 = Reserved • 3 = Front panel communication fault • 4 = Reserved • 5 = Reserved • 6 = Reserved • 7 = PROFIBUS error Byte 3: • 0 = Bus fault • 1 = Process voltage low • 2 = Joules reached		

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• 3 = Reserved • 4 = Out-of-setpoint timer expired • 5 = Ground fault • 6 to 7 = Reserved		
163 report config status	Reports the system configuration status. Sending byte 0 is optional. If you send byte 0, send a value of 1. Returns 2 bytes. Byte 0: • 0 = Host program source (0 = internal, 1 = external) • 1 = Local program source (0 = internal, 1 = external) • 2 = User (analog) program source (0 = internal, 1 = external) • 3 = Arc handling (0 = custom, 1 = predefined) • 4 = Arc handling enabled (0 = disabled, 1 = enabled) • 5 = Unit disabled (0 = disabled, 1 = enabled) • 6 = Program source (0 = internal, 1 = external) • 7 = Target life status (0 = inactive, 1 = active) Byte 1: • 0 = Front panel status (0 = not present, 1 = present) • 1 = Front panel access (0 = unlocked, 1 = locked) • 2 = Joule mode (0 = disabled, 1 = enabled) • 3 = Contactor status (0 = open, 1 = closed) • 4 = Process voltage limit (0 = disabled, 1 = enabled)	0 or 1	2

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• 5 = ReservedRamp mode (0 = disabled, 1 = enabled) (if available) • 6 = Reserved • 7 = Reserved		
164 report setpoint/ regulation mode	Reports the setpoint level set by command **6** by whichever method of output regulation has been selected (set by command **3**). The returning packet contains 3 data bytes: • Bytes 0 to 1 (16-bit value) = Setpoint level An output power value should imply three decimal places, an output current value should imply two decimal places, and an output voltage value should imply no decimal places. For example, for a 6 kW standard Z unit, a value from 0 to 6000 (6.000 kW, decimal is implied), or 0 to 1500 (15.00 A, decimal is implied), or 0 to 800 (maximum output voltage). • Byte 2 (8-bit value) = Regulation mode: ◦ 6 = Power ◦ 7 = Voltage ◦ 8 = Current	0	3
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 power level in kilowatts. Assume three decimal places. For example, a value of 6000 indicates 6.000 kW.	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. For example, a value of 800 indicates 800 V (no implied decimal).	0	2
167 report actual output current	Reports a snapshot of the output current level at that instant.	0	2

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	The returning packet contains 2 data bytes (16-bit value). Two decimal places are implied. For example, a value of 1500 indicates 15.00 A.		
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 • Bytes 2 to 3 = Voltage level • Bytes 4 to 5 = Current level See commands **165**, **166**, and **167** for the format of the reported output values.	0	6
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 • Bytes 2 to 3 = Voltage setpoint • Bytes 4 to 5 = Current setpoint See commands **165**, **166**, and **167** for the format of the reported setpoint values.	0	6
170 report arc detect and shutdown times	Reports the arc delay and shutdown times set by command **8**. The returning packet contains 2 data bytes: • Byte 0 = Arc detect time index (8-bit value from 0 to 9) • Byte 1 = Arc shutdown time index (8-bit value from 0 to 9) For the settings associated with these index values, see "Arc Detect and Delay Shutdown Index Settings (Command 8)" on page 4-103.	0	2
171 report voltage arc sense level	Reports the voltage level at which the unit indicates an arc is occurring (set with command **10**); the returning packet contains 2 data bytes (16-bit value) indicating the trip level in volts.	0	2

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
172 report joules remaining	Reports how many joules remain during a run; the returning packet contains 4 data bytes (32-bit value) indicating the number of joules.	0	4
173 report joules setpoint	Reports the joules setpoint set with command **4**; the returning packet contains 4 data bytes (32-bit value) indicating the setpoint level in joules.	0	4
174 report target type	Reports the target type selected with command **30**. The returning packet contains 1 data byte (8-bit value): • 0 = Metal target • 1 = Nonmetal target • 2 = Custom arc handling	0	1
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
177 report process voltage lower limit	Reports the process voltage lower limit set with command **48**; the returning packet contains 2 data bytes (16-bit value) indicating the limit in volts.	0	2
178 report hard arc count limit	Reports the hard arc count limit set with command **9**; the returning packet contains 4 data bytes (a 32-bit value) indicating the limit.	0	4
179 report active recipe step, ramp/run status, and ramp/run time remaining	Reports the active recipe step number, the ramp/run status, and the ramp/runtime remaining. The returning packet contains 4 data bytes (32-bit value) indicating the following: • Byte 0 = Active recipe step number • Byte 1 = Ramp/run status (1 = Ramp, 2 = Run)	0	4

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• Bytes 2 to 3 = Ramp/runtime remaining in seconds. Two decimal places are implied. For example, a value of 5 indicates 0.05 s or 50 ms. ☞ **Important** If output is shut off either through a fault or an off command, the active recipe step number, ramp/run status, and ramp/runtime remaining will all maintain their last value. A subsequent off command will set recipe step number to 1 (or 0 if recipes are not active) and set ramp/runtime remaining to 65535 if the time is nonzero. If the run segment of the last recipe step is 0, ramp/runtime remaining is set to 65534 and never counts down.		
180 report recipe steps	Reports the number of recipe steps set with command **19**; the returning packet contains 1 data byte (8-bit value) indicating the number of steps. ☞ **Important** A value of 0 sent with command **19** disables the ramping recipe feature.	0	1
181 report recipe step ramp time	Reports the amount of ramping time set for a specific ramping recipe step (set with command **21**). Send 1 data byte (8-bit value) indicating the recipe step. The returning packet contains 2 data bytes (16-bit value) indicating the time in seconds. Two decimal places are implied. For example, a value of 5 indicates 0.05 s. If the unit has the 100 ms ramp feature, one decimal place is implied (5 = 0.5 s).	1	2
182 report recipe step setpoint and regulation mode	Reports the setpoint level you have set for a specific ramping recipe step set with command **22**. Send 1 data byte (8-bit value) indicating the recipe step.	1	3

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	The returning packet contains 3 data bytes: • Bytes 0 to 1 = Value of setpoint in the mode indicated • Byte 1 = Regulation mode ◦ 6 = Power ◦ 7 = Voltage ◦ 8 = Current		
183 report recipe step run time	Reports the runtime you have set for a specific recipe step set with command **23**. Send 1 data byte (8-bit value) indicating the recipe step. The returning packet contains 2 data bytes indicating the runtime in seconds. Two decimal places are implied. For example, a value of 5 indicates 0.05 s. If the unit has the 100 ms ramp feature, one decimal place is implied (5 = 0.5 s).	1	2
184 report out-of-setpoint interval	Reports the amount of time remaining on the out-of-setpoint timer before an error condition occurs. The returning packet contains 2 data bytes (16-bit value) indicating the interval value in seconds. One decimal place is implied. For example, a value of 999 indicates an interval of 99.9 s.	0	2
187 report out-of-setpoint timer	Reports the out-of-setpoint timer value set with command **31**; the returning packet contains 2 data bytes (16-bit value) indicating the timer value in seconds. One decimal place is implied. For example, a value of 999 indicates a timer value of 99.9 s.	0	2
188 report arc density per second	Reports arc density. • If the arc average window (command **7**) is set for 1 second, this command returns the number of arcs that occurred in the previous second. • If the arc average window is set for greater than 1 second, the command returns the	0	4

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	number of arcs per second averaged over the length of the window. The returning packet contains 4 data bytes: • Bytes 0 to 1 (16-bit value) = Number of micro arcs • Bytes 2 to 3 (16-bit value) = Number of hard arcs ☞ **Important** Even if you disable arc handling, the micro arc counter continues to count arcs as they occur.		
189 report micro arc density per run	Reports how many micro arcs occurred in the previous run; returning packet contains 4 data bytes (32-bit value) indicating the number of micro arcs in the previous run. The unit records a micro arc each time the output voltage goes below the voltage arc sense level set with command **10**. All arc counters are updated every 100 ms. ☞ **Important** Even if you disable arc handling, the micro arc counter continues to count arcs as they occur.	0	4
190 report hard arc density per run	Reports how many hard arcs occurred in the previous run; the returning packet contains 4 data bytes (32-bit value) indicating the number of hard arcs in the previous run. The unit records a hard arc every time the output voltage goes below the voltage arc sense level for longer than the arc detect time. The unit then shuts down for the arc shutdown time period. All arc counters are updated every 100 ms.	0	4
192 report arc average window length	Reports the length of the arc average window; the returning packet contains 1 data byte (8-bit value) indicating the number of seconds over which arc counts are being averaged. Set this value with command **7**.	0	1
198 report software revision level	Reports the revision level of the software The returning packet contains 12 ASCII characters that represent the revision name.	0	12

Table 4-37. 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>204
report system control</td><td>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 depends on the value of the first byte. The sent data byte (Byte 0) specifies the requested parameter; the returned data bytes specify the parameter values. For example, if 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</td></tr>
<tr><td>12</td><td>Report user limits (power, current, voltage)</td></tr>
<tr><td>27</td><td>Report current scaling information</td></tr>
<tr><td>42</td><td>Request valid joule setpoint 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>Varies</td><td>Varies</td></tr>
</table>

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
204 report IP address subcommand 0	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) Command **71** (subcommand 0) sets this value.	1	4
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:	1	4

Table 4-37. 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 = Status
◦ Bit 0 = Phy read fail (0 = OK; 1 = phy read fail)
◦ Bit 1 = Auto negotiate results (0 = OK; 1 = timeout fail)
◦ 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</td><td>
Reports the enabled/disabled status of the DHCP client.
Send 1 data byte:
• Byte 0 = 8 (report DHCP enable status)
</td><td>1</td><td>2</td></tr>
</table>

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
status (2-byte response) subcommand 8	Returns 2 data bytes: • Bytes 0 to 1 = Enable/disable status: ◦ 0 = DHCP client disabled ◦ 1 = DHCP client enabled Command **71** (subcommand 5) sets this value.		
204 report output limits subcommand 11	Reports output limits in 32-bit values for side A and side B, whichever is currently in use. Send 1 byte: • Byte 0 = 11 (report output limits) Returns 12 bytes: • Bytes 0 to 3 = Power output limit in watt increments • Bytes 4 to 7 = Voltage output limit in volt increments • Bytes 8 to 11 = Current output limit in 0.01 A increments. For example, 9500 = 95.00 A. Command 71 (subcommands 11 and 12) set output values.	1	12
204 report user limits (power, voltage, current) subcommand 12	Reports the user specified limits for output power, voltage, and current (similar to commands **141**, **142**, and **143**, but return values are 4 bytes each, providing readbacks for large-size systems). You can use this command for any size system, including master/slave. Acceptable range for each limit is 0 to maximum output range. Send 1 byte: • Byte 0 = 12 (report P, V, and I user limits in 32-bit values) Returns 12 bytes: • Bytes 0 to 3 = User power limit in watt increments • Bytes 4 to 7 = User voltage limit in volt increments	1	12

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• Bytes 8 to 11 = User current limit in 0.01 A increments. For example, 1000 = 10.00 A. Command **71** (subcommands 11 and 12) set user output values.		
204 report current scaling subcommand 27	Reports the current scaling for command **169**. Send 1 data byte: • Byte 0 = 27 (report current scaling) Returns 2 data bytes: • Bytes 0 to 2 = Current scaling: ◦ 1 = 0.01 A increments ◦ 10 = 0.1 A increments	1	2
204 request valid joule setpoint range subcommand 42	Reads maximum joule setpoint value. The 32-bit value represents the maximum value to be used with command **4**. The minimum joule setpoint is always 0. Send 1 byte: • Byte 0 = 42 (request valid joule setpoint range) Returns 4 bytes: • Byte 0 = Maximum joule setpoint (J) LSB • Byte 1 = Maximum joule setpoint (J) • Byte 2 = Maximum joule setpoint (J) • Byte 3 = Maximum joule setpoint (J) MSB	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. 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	3	Varies

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	Returns a variable number of data bytes depending on the type sent. The first part of the return data is the length. 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. 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. 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. • LEN = Length of the domain name, up to 64 characters	1	Varies

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• 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 IP address 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 = Disable/enable DNS server updates (0 = disable; 1 = enable)	1	2
205 report real time clock	Reads the real time clock on the CPU module. Send 0 bytes. Returns 7 data bytes: • Byte 0 = Seconds (values 00 to 59) • Byte 1 = Minutes (values 00 to 59) • Byte 2 = Hours (values 00 to 23) • Byte 3 = Day of week (values 01 to 07, 01 = Sunday) • Byte 4 = Date (values 01 to 31) • Byte 5 = Month (values 01 to 12) • Byte 6 = Year (values 00 to 99) Set this value with command **70**.	0	7

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
209 report 32-bit power, voltage, current read backs	Reports P, V, and I in 4-byte values. Returns 12 bytes: • Bytes 0 to 3 = Total power output in watts • Bytes 4 to 7 = Total voltage output in volts • Bytes 8 to 11 = Total current output in hundredths of amps. For example, 805 = 8.05 A.	0	12
220 report customer service statistics	Reports unit statistics. Send 1 data byte (8-bit value): • 0 = Total output in kWh • 1 = Total idle time • 2 = Total runtime • 3 = Total unit on events • 4 = Total output on events • 5 = Total overtemperature events • 8 = Total hard bus fault events • 9 = Total power fluctuation events • 10 = Total process voltage low events • 13 = Total user interlock open events • 15 = Total external interlock open events • 18 = Total PROFIBUS fault events • 24 = Total 10 ms bus fault events Returns 4 data bytes.	1	4
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	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	1	Varies, or CSR code 0 if no fault exists

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	contains 2 data bytes; if two faults are active, the packet contains 4 data bytes; and so on. If no faults are active, the packet contains 1 data byte (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 twenty 2-byte faults. ◦ 3 = Returns 40 bytes with up to twenty 2-byte faults. • If byte 0 = 2 or 4, report warnings: ◦ 2 = Returns a variable length list of up to twenty 2-byte warnings. ◦ 4 = Returns 40 bytes with up to twenty 2-byte warnings. The return packet for this command always starts with LEN (two times the number of faults or 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. Command **204** (subcommand 92) reports the fault and warning code descriptions. See the troubleshooting chapter for a list of the fault codes.		
225 report arc response setting and arc handling mode	Reports the unit arc response setting (fast arc response or slow arc response) as well as the arc handling mode (persistent or standard). Send the command only. The unit responds with 2 data bytes configured as follows: • Byte 0: ◦ Bit 0 = Arc response setting (0 = slow arc response, 1 = fast arc response)	0	2

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	◦ Bit 1 = Arc response mode (0 = standard, 1 = persistent) ◦ Bits 2 through 7 are reserved • Byte 1: Bits 0 through 7 are reserved Set these values with commands **62** and **63**.		
231 report unit information	Reports unit information, such as part number and serial number. Send either 0 or 1 data byte. 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
238 report 32-bit setpoint and regulation mode	Reports the output setpoint value (LSB first) for the following active regulation modes: • 6 = Power • 7 = Voltage • 8 = Current	0	3

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	Returns 3 data bytes: • When reporting a power setpoint, returns a value indicating watts. • When reporting a voltage setpoint, returns a value indicating volts. For example, a unit with a maximum voltage limit of 800 V would return values of 0 to 800. • When reporting a current setpoint, returns a value in hundredths of amps. For example, a unit with a maximum current limit of 15 A would return values of 0 to 1500. Command **78** sets this value. .		
248 report customer snapshot subcommand 140	Reports customer snapshot data. Sends 4 bytes: • Bytes 0 to 1 = 140 (report customer snapshot) (LSB first) • Bytes 2 to 3 = 0 Returns when LEN = 64: • Bytes 0 to 3 = Power • Bytes 4 to 7 = Voltage • Bytes 8 to 11 = Current • Bytes 12 to 15 = Intermediate setpointIntermediate setpoint (same as final setpoint if not ramping) • Bytes 16 to 19 = Final setpoint • Byte 20 = Regulation mode • Byte 21 = Program control mode (host, local, and user only) • Byte 22 = Expanded control mode • Byte 23 = Reserved • Bytes 24 to 27 = Process status (same as command **162** with byte 0 = 0, extended format	4	Varies

Table 4-37. AE Host commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• Bytes 28 to 31 = Configuration status (same as command **163** with byte 0 = 0, extended format • Bytes 32 to 35 = Micro arc count • Bytes 36 to 39 = Hard arc count • Bytes 40 to 41 = Micro arc density • Bytes 42 to 43 = Hard arc density • Bytes 44 to 63 = Reserved		

ARC DETECT AND DELAY SHUTDOWN INDEX SETTINGS (COMMAND 8)

The following tables show the arc settings associated with the index values that are set with command **8**, depending on the arc settings that you have selected. The first two tables show the arc detect settings depending on whether the unit is set for fast arc or slow arc range response time, and standard or persistent arc handling response mode. The third table shows the arc shutdown times.

Table 4-38. Command 8 index values for fast arc detect settings

Index	Standard Fast Arc Detect Length	Persistent Fast Arc Detect Length
0	0	0
1	0.5 µs	1 µs
2	1 µs	2 µs
3	3 µs	5 µs
4	3 µs	10 µs
5	3 µs	20 µs
6	3 µs	50 µs
7	3 µs	100 µs
8	3 µs	200 µs
9	3 µs	500 µs

Table 4-39. Command 8 index values for slow arc detect settings

Index	Standard Slow Arc Detect Length	Persistent Slow Arc Detect Length
0	0	0
1	8 µs	16 µs
2	16 µs	32 µs
3	48 µs	80 µs
4	48 µs	160 µs
5	48 µs	320 µs
6	48 µs	800 µs
7	48 µs	1600 µs
8	48 µs	3200 µs
9	48 µs	8000 µs

Table 4-40. Command 8 index values for arc shutdown settings

Index	Fast Arc Shutdown Times	Slow Arc Shutdown Times
0	10 µs	160 µs
1	20 µs	320 µs
2	30 µs	480 µs
3	40 µs	640 µs
4	50 µs	800 µs
5	100 µs	1600 µs
6	200 µs	3200 µs
7	500 µs	8000 µs
8	1000 µs	16000 µs
9	2500 µs	40000 µs

PROFIBUS COMMANDS

This section applies to units that include the PROFIBUS interface.

The following sections describe the command status response (CSR) codes returned by the Pinnacle unit in response to a PROFIBUS command as well as the PROFIBUS commands for the Pinnacle unit.

PROFIBUS Command Status Response Codes

When the Pinnacle unit receives a PROFIBUS command requesting a change in unit operation (command numbers 1 through 127), or when the Pinnacle unit receives any PROFIBUS 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 4-41. PROFIBUS 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 is incorrect
2	Output is on
3	Output is off
4	Data is out of range
5	Invalid parameter
6	Program source is incorrect
7	Active fault(s) exist
8	Ramping is active
9	Data byte count is incorrect
10	**USER** port has priority
11	Bus is not ready
12	This feature is not available on your unit
13	A front panel is active
14	Regulation mode is invalid
15	Ramp invalid (reset ramp start setpoint parameter to valid setting)
16	Target life has been consumed
17	Output OFF timer active
18	Ramping is active or limited duty cycle timer is active
19	Recipe is active
21	Joule setpoint has not been reached
22	A process voltage fault has occurred
23	Inverter low fault active
24	A bus fault has occurred

Table 4-41. PROFIBUS command status response (CSR) codes (Continued)

Code	Meaning
27	Output OFF timer active (minimum off time is 50 ms)
28	Setpoint exceeds user limit
29	Regulation mode is not selectable (because it is locked)
31	The **USER** port reset is active (you must deassert the reset line on the **USER** port)
82	Master/slave system check diagnostic failure
83	Master/slave system is not at a steady state
84	Master/slave system size (in kilowatts) does not match input parameter
85	Master/slave system size (in units) does not match input parameter
99	Command not accepted (there is no such command)
119	PROFIBUS master reset asserted

PROFIBUS Command Set

The PROFIBUS interface has two types of commands:

- Commands **1** through **127** request a change to the Pinnacle 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 that 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.

For more information on CSR codes, see "PROFIBUS Command Status Response Codes" on page 4-105.

The last column in the following table indicates how many data bytes (of the download packet) are needed to support the command. For example, "1" in the last column indicates that data must be entered in the first data byte; "3" indicates that data must be inserted in all three data bytes. If a data byte is not defined as containing data, its content is ignored.

Table 4-42. PROFIBUS commands

Command	Description	Data Bytes Sent	Data Bytes Returned
0 null	Null command.	0	1 (CSR only)

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	The Pinnacle unit ignores this command, but will acknowledge receipt of the command by returning CSR code zero.		
1 DC off	Sets DC output off. This request is always honored, regardless of which interface has control.	0	1 (CSR only)
2 DC off	Sets DC output on; host control must be selected (see command **14**). Command **161** reports this value.	0	1 (CSR only)
3 regulation method	Sets the method of output regulation (power, voltage, or current). Send 1 byte (8-bit value): • 6 = Power • 7 = Voltage • 8 = Current Command **154** reports this value.	1	1 (CSR only)
4 joule setpoint	Specifies the number of joules to be delivered. Send 3 bytes (24-bit value); the value must be from 0 to 16,777,215. Command **173** reports this value.	3	1 (CSR only)
5 joule mode enable	Enables or disables joule mode. Send 1 byte (8-bit value): • 0 = Disable • Nonzero value = Enable Command **153** reports this value.	1	1 (CSR only)
6 setpoint	Specifies the output setpoint level for the selected regulation mode. Send 2 bytes (16-bit value); an output power value should imply three decimal places for a standalone unit and two decimal places for a master/slave system. An output current value should imply two decimal places, and an output voltage value should imply no decimal places. For example, for a 6 kW, standalone unit, send a value from 0 to 6000 (6.000 kW, one decimal place is implied), or 0 and 1500 (15.00 A, two	2	1 (CSR only)

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	decimal places implied), or 0 and 800 (maximum output voltage). See "Electrical Specifications" on page 3-2. Command **164** reports this value.		
7 set arc average window	Sets the size of the arc average window from 1 second to 10 seconds. This value changes the arcs per second reported by command **188**. If the window is set for 1 second, arcs per second reflects the actual number of arcs that occurred in the previous second. If the window is set for a value greater than 1 second, arcs per second reports the number of arcs averaged over the number of seconds established by the window setting. When the arc average window value is changed, the new value remains in effect for subsequent power ups. Send 1 byte (8-bit value). Command **192** reports this value.	1	1 (CSR only)
8 arc detect and shutdown times	Sets both the arc detect and shutdown delay index, as well as the arc shutdown index. The associated values for these indices are dependant upon: • Whether standard or persistent arc handling mode is selected • Whether fast arc or slow arc response range is selected For details about standard and persistent arc handling modes and fast and slow arc response times, see "Understanding Arc Management" on page 5-34. Send 2 bytes: • Byte 0 = Arc detect time index (8-bit value from 0 to 9) • Byte 1 = Arc shutdown time index (8-bit value from 0 to 9) For the settings associated with these index values, see "Arc Detect and Delay Shutdown Index Settings (Command **8**)" on page 4-130.	2	1 (CSR only)

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	10 kW and 20 kW Pinnacle units with a 208 VAC input configuration have a minimum arc shutdown time of 50 µs. Commands **162** and **170** report these values.		
9 hard arc count limit	Sets the number of hard arcs required for the unit to provide an arc indication. If the limit is reached during a process cycle, after output shuts off, the **Arc** LED lights; if applicable, a signal is sent to the **USER** port. Send 3 bytes (a 24-bit value) indicating the number of arcs. The value must be at least 0, but no greater than the maximum set for the unit. ☞ **Important** A value of zero disables the hard arc count limit feature so that the **Arc** LED does not light and no signal is sent to the **USER** port. Command **178** reports this value.	3	1 (CSR only)
10 voltage arc trip level	Specifies the voltage level at which the unit indicates an arc is occurring. Send 2 bytes (16-bit value). Command **171** reports this value.	2	1 (CSR only)
11 active target	Specifies which target will be active. Send 1 byte (8-bit value). The value must be at least 1 but no greater than 8. The **USER** port has priority for target selection. Thus, to select targets from a serial port, set the target to 1 at the **USER** port. Leaving the target bits open or leaving the **USER** port pins unconnected causes the target selection at the **USER** port to default to 1. Command **156** reports this value.	1	1 (CSR only)
12 target life	Sets the life (in kWh) of a target. Send 3 bytes (24-bit value), indicating target life for the active target specified with command **11**. Two decimal places are implied (for 1 kWh, send a value of 100). Command **157** reports this value.	3	1 (CSR only)

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
13 target enable	Enables or disables the target life counter. Send 1 byte (8-bit value): • 0 = Target life is inactive • Nonzero value = Target life is active Command **163** reports this value.	1	1 (CSR only)
14 control mode	Chooses the mode of control for the Pinnacle unit. This request is always honored, regardless of which interface has control. Send 1 byte: • 2 = Serial (**HOST**) port • 4 = **USER** port Command **155** reports this value.	1	1 (CSR only)
15 ramp enable	Enables or disables the ramp feature. Send 1 byte (8-bit value): • 0 = Disable • Nonzero = Enable ☞ **Important** Target-conditioning cycle (TCC), recipe, and ramp features are mutually exclusive. Command **163** reports this value.	1	1 (CSR only)
16 ramp time	Sets the ramp time in 10 ms increments. Range is 50 ms to 600.00 s. Send a 2-byte value between 5 and 60,000. Two decimal places are implied (a value of 100 = 1.00 s). If the unit has the 100 ms ramp feature, one decimal place is implied (a value of 100 = 10.0 s). Command **158** reports this value.	2	1 (CSR only)
17 program source	Tells the Pinnacle unit whether the source of information for regulation mode and setpoints is internal or external (the source can be set independently for each of the three control modes).	3	1 (CSR only)

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	Send 3 bytes: • Byte 0 = Program source if the serial (**HOST**) port is active • Byte 1 = Program source if a control panel is the active interface • Byte 2 = Program source if the **USER** port is active For each mode, send an 8-bit value: • 0 = Program source is internal • Nonzero value = Program source is external (the program source is an analog signal from the **USER** port) Command **163** reports this value.		
19 recipe steps	Specifies the number of recipe steps in the ramping recipe. Send 1 byte (8-bit value); the value must be at least 0, but no greater than 8. A value of 0 disables the recipe feature. For each recipe step, set the regulation mode, setpoint, ramping time, and run time (commands **20**, **21**, **22**, and **23**). ☞ **Important** TCC, recipe, and ramp features are mutually exclusive. Command **180** reports this value.	1	1 (CSR only)
20 recipe regulation mode	Specifies the regulation mode for a recipe step. Send 2 bytes: • Byte 0 = Recipe step: ◦ Must be a value greater than 0, but no greater than 8 • Byte 1 = Regulation mode: ◦ 6 = Power ◦ 7 = Voltage ◦ 8 = Current Command **182** reports this value.	2	1 (CSR only)

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
21 recipe ramp time	Specifies the length of ramping time for a recipe step (how long the unit takes to reach the defined setpoint for the selected recipe step). Send 3 bytes: • Byte 0 = Recipe step: ◦ Must be a value greater than 0, but no greater than 8 • Bytes 1 and 2 = Value between 5 and 60,000 (or between 0.05 s and 600 s); two decimal places implied. ☞ **Important** If the unit has the 100 ms feature, one decimal place is implied. Command **181** reports this value.	3	1 (CSR only)
22 recipe setpoint	Specifies the setpoint for a ramping recipe step. Send 3 bytes: • Byte 0 = Recipe step: ◦ Must be a value greater than 0, but no greater than 8 • Bytes 1 and 2 = Value between 0 and the full rated output of the unit For the regulation mode set with command **20** (see "Electrical Specifications" on page 3-2 for unit capabilities, and see command **6** for the format of the value). Command **182** reports this value.	3	1 (CSR only)
23 recipe run time	Specifies the length of time the unit runs at setpoint for a recipe step. Send 3 bytes: • Byte 0 = Recipe step (value must be greater than 0, but no greater than 8) • Bytes 1 and 2 = Value between 0 and 60,000 (or between 0 s and 600 s); two decimal places implied. If the unit has 100 ms device, one decimal place is implied.	3	1 (CSR only)

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	☞ **Important** If run time for the final recipe step is set to 0, the unit switches to continuous output when it reaches setpoint for this step. To turn off output, send an off command (using the **OFF** button or the appropriate **USER** port signal or serial port command), or a joule mode must have already been enabled and a joule setpoint must have already been programmed. Command **183** reports this value.		
26 joule threshold	Specifies the output power level that needs to be met before the joule output energy calculation begins. To set the threshold (in W), send 2 bytes (16-bit value) from 10 W to the maximum unit power ÷ 8. ☞ **Important** The joule energy calculation begins after (n)mS, regardless of the output power level. The time value, (n)mS, is set when the unit is configured and cannot be changed. If the output power level meets the joule energy threshold before the time expires, the joule energy calculation begins. Command **136** reports this value.	2	1 (CSR only)
28 arc count duration window	Specifies a window of time in which to count the number of arcs that occur. If the arc count within this time window exceeds the arc limit, an arc limit fault occurs and shuts off output power. To set the threshold, send 2 bytes (16-bit value) from 10 ms to 500 ms in 10 ms increments. ☞ **Important** This command applies only to units configured to shut off output power when an arc limit is exceeded. Command **148** reports this value.	2	1 (CSR only)

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
30 pre-defined arc handling type	Specifies the type of target (metal or nonmetal) for the predefined arc handling mode: PC (normal process cycle). Send 1 byte (8-bit value): • 0 = Predefined arc handling (for example, handling metal) • 1 = Predefined arc handling (for example, handling nonmetal) • 2 = Custom arc handling (for example, handling settings established with command **8**) If you select either metal or nonmetal, the unit selects preset values depending on whether fast or slow arc handling is enabled. ☞ **Important** 10 kW and 20 kW Pinnacle units with a 208 V input configuration have a minimum PC shutdown time of 50 µs. Commands **162** and **174** report this value.	1	1 (CSR only)
31 out of setpoint timer	Enables or disables an out-of-setpoint timer and specifies how long the unit tolerates an out-of-setpoint condition before shutting off output. • To enable the timer, send a value (2 bytes) from 1 to the limit set for the unit; assume one decimal place (9999 = 999.9). • To disable the timer, send a value of 0. Command **187** reports this value.	2	1 (CSR only)
32 ramp start point (percentage of setpoint)	Sets the ramp start point as a percentage of setpoint when output is turned on. Range is 0% to 95%. Send 1 byte with a value of 0 to 95. Command **152** reports this value.	1	1 (CSR only)
38 reset arc density/run counters	Resets micro-arcs-per-run and hard-arcs-per-run counters to 0. These counters can be reset at any time. Resetting the counters can be useful for measuring arcs over a specific period of time.	0	1 (CSR only)

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
47 process voltage limit feature on/off	Enables or disables a voltage lower limit for the process (8-bit value): • 0 = Disable • Nonzero value = Enable Command **163** reports this value.	1	1 (CSR only)
48 process voltage lower limit	Sets a minimum process voltage. With this limit in place, the Pinnacle unit waits for the output voltage to exceed the limit. Once the limit is exceeded, output remains on until the output is turned off or until the voltage falls below the established limit. If the voltage falls below the limit, output turns off and the unit generates error code **110** or **111**. Send 2 bytes (16-bit value); the value must be from 100 V to the limit set for the unit. Command **177** reports this value.	2	1 (CSR only)
49 user power limit	Sets a maximum limit for output power, in kW. Send 2 bytes (16-bit value); value must be from 0 to the maximum rated output power for the unit. Assume three decimal places for a standalone unit (20000 = 20.000 kW or 20,000 W) and two decimal places for a master/slave unit (2000 = 20.00 kW or 20,000 W). Command **141** reports this value.	2	1 (CSR only)
50 user voltage limit	Sets a maximum limit for output voltage. Send 2 bytes (16-bit value); value must be from 0 to the maximum rated output voltage for the unit. Command **142** reports this value.	2	1 (CSR only)
51 user current limit	Sets a maximum limit for output current. Send 2 bytes (16-bit value); value must be from 0 to the maximum rated output current for the unit. Assume two decimal places (3000 = 30.00 A). Command **143** reports this value.	2	1 (CSR only)
52 user strike voltage limit	Sets a maximum strike voltage. Send 1 byte representing a strike voltage range: • 0 = Low • 1 = Medium	1	1 (CSR only)

Table 4-42. PROFIBUS 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>
• 2 = High

The values associated with each range depend on the output impedance range of the unit. The following table shows those values.
<table>
<tr><th>Strike Voltage Setting</th><th>Low-Z Unit 200 V to 400 V</th><th>Standard-Z Unit 400 V to 800 V</th><th>High-Z Unit 400 V to 1000 V and 500 V to 1000 V</th></tr>
<tr><td>Low</td><td>400 V
+ 100 V</td><td>800 V
+ 100 V</td><td>1,000 V
+ 100 V</td></tr>
<tr><td>Medium</td><td>650 V
± 100 V</td><td>1,100 V
± 100 V</td><td>1,200 V
± 100 V</td></tr>
<tr><td>High</td><td>900 V
± 100 V</td><td>1,450
± 150 V</td><td>1,450 V
± 150 V</td></tr>
</table>

☞ Important
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, select medium or low to reduce the effects of overshoot.

Command 144 reports this value.
</td><td></td><td></td></tr>
<tr><td>60
set ripple level</td><td>
Sets the high-frequency output ripple to either a low amplitude ripple (less than 2% rms) or a high amplitude ripple (4% to 5% rms).

Send 1 byte (8-bit value):

• 0 = Low ripple
• Nonzero value = High ripple

Command 163 reports this value.
</td><td>1</td><td>1
(CSR only)</td></tr>
<tr><td>61
arc handling enable</td><td>Enables or disables the arc handling functions:</td><td>1</td><td>1
(CSR only)</td></tr>
</table>

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• Enable = Arc detect and shutdown times are determined by the target type selected (see commands **8** and **30**). • Disable = The unit does not recognize any arc detect delay or shutdown times and does not respond to arcs. However, the micro arc counter will continue to count arcs as they occur. Send 1 byte: • 0 = Disable • Nonzero value = Enable Command **163** reports this value.		
62 arc range response time	Sets the arc response time to fast arc response or slow arc response. Send 1 byte: • 0 = Slow arc • Nonzero = Fast arc See "Understanding Arc Management" on page 5-34 for information on arc range response times. Command **225** reports this value.	1	1 (CSR only)
63 arc handling response mode	Sets the arc handling response mode to standard or persistent. Send 1 byte: • 0 = Persistent • Nonzero = Standard See "Understanding Arc Management" on page 5-34 for information on arc handling response modes. Command **225** reports this value.	1	1 (CSR only)
100 recipe/ramp hold or resume	Provides a means to stop or restart the recipe or ramp while a recipe or ramp is executing. • 0 = Resume • Nonzero = Hold Command **150** reports this value.	1	1 (CSR only)

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
101 runtime recipe setpoint	Specifies a new setpoint level applied during the execution of a recipe or ramp. The setpoint takes effect immediately upon receipt by the power supply and applies to the step currently executing for whichever method of regulation is currently active. See command **6** for the format of the 2-byte setpoint value. If this command is issued during a ramp or the ramp portion of a recipe step, the power supply output ramps to the new setpoint linearly in the ramp time remaining. The new setpoint remains in place for the subsequent run following the ramp. If the recipe is not finished, the next ramp begins at the new setpoint and ramps to the preprogrammed setpoint value for the recipe step. If this command is issued during the run portion of the ramp or recipe step, the power supply output immediately steps to the new setpoint. Command **101** can be issued as many times as necessary during the execution of a recipe, with different setpoint values as needed. The originally programmed recipe values are not affected by runtime changes of the setpoint value with command **101**, and are available for the next recipe execution. ☞ **Important** Send command **164** (not command **182**) to check the setpoint after adjusting the setpoint with command **101**.	2	1 (CSR only)
119 master reset	Clears the fault indication when the Pinnacle unit has experienced a non-recoverable (explicit clear) fault. This request is always honored, regardless of which interface has control.	0	1 (CSR only)
126 reset default settings	Sets all user-definable values to their defaults and stores them in non-volatile memory. User-definable limits are always set to their maximum values. Send 1 byte, with the value of 0. ☞ **Important** Cycle power to the unit after issuing this command.	1	1 (CSR only)

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
Commands **128** to **255** request a value to be read from the Pinnacle unit. None of these commands require the unit to be in host control mode. Some of these commands (for example, command **220**) require data in the download packet. In this case, the "Data Bytes Returned" column indicates how many data bytes (of the download packet) are needed to support the command.			
128 request power supply type	Requests the power supply type. Returns 4 ASCII characters: • PNCL = PROFIBUS interface is available	0	4
129 request power supply size	Requests the output capacity of the power supply. Returns five characters indicating capacity in kW. In standalone operation, the data string implies three decimal places (20000 = 20.000 kW). In master/slave operation, the data string implies two decimal places (4000 = 40.00 kW).	0	5
132 request slave count	Requests the number of slave units in the system. Returns 1 byte (8-bit value) indicating the slave unit total.	0	1
141 request user power limit	Requests the output power limit. Accuracy is +0.3% of the full rated output power for the unit. Returns 2 bytes (16-bit value) indicating the power limit. Set this value with command **49**.	0	2
142 request user voltage limit	Requests the output voltage limit. Accuracy is +0.3% of the full rated output voltage for the unit. Returns 2 bytes (16-bit value) indicating the limit in voltage. Set this value with command **50**.	0	2
143 request user current limit	Requests the output current limit. Accuracy is +0.3% of the full rated output current for the unit. Returns 2 bytes (16-bit value) indicating the limit in amperes. This value implies two decimal places. Set this value with command **51**.	0	2
144 request user strike voltage limit	Requests the strike voltage limit. Returns 1 byte indicating strike voltage: • 0 = Low	0	1

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• 1 = Medium • 2 = High Set this value with command **52**.		
148 request arc count duration window	Requests the window of time in which to count the number of arcs that occur. If the arc count within this time block exceeds the arc limit, an arc limit fault occurs and shuts off output power. ☞ **Important** This command applies only to those units configured to shut off output power when an arc limit is exceeded. Set this value with command **148**.		
150 request ramp hold setting	Requests the ramp hold setting. Returns 1 byte indicating the hold setting: • 0 = Hold inactive • 1 = Hold active Set this value with command **8**.	0	1
152 request ramp start setpoint percentage	Requests the ramp start setpoint percentage. Returns 1 byte (8-bit) between 0% and 95%. Set this value with command **32**.	0	1
153 request joules status	Requests joule mode status. Returns 1 byte: • 0 = Inactive • Nonzero value = Active See also command **163**.	0	1
154 request regulation mode	Requests the output regulation mode. Returns 1 byte (8-bit value): • 6 = Power • 7 = Voltage • 8 = Current Set this value with command **3**. See also command **164**.	0	1

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
155 request control mode	Requests control mode. Returns 1 byte (8-bit value): • 2 = Serial (**HOST**) port • 4 = **USER** port Set this value with command **14**.	0	1
156 request active target number	Requests an indication of the active target. Returns 1 byte indicating target 1, 2, 3, 4, 5, 6, 7, or 8. Set this value with command **11**.	0	1
157 request target life	Requests the amount of target life time remaining for the active target. Send 1 byte indicating the active target. Returns 4 bytes (32-bit value) indicating the time remaining in kWh. Two decimal places are implied. For example, a value of 100 indicates 1 kWh. Set this value with command **12**.	1	4
158 request ramp time	Requests ramp time. Returns a 2-byte value (16 bits) indicating a ramp time of 5 (50 ms) to 60,000 (600.00 s). Set this value with command **16**.	0	2
159 request ramp time remaining	Requests how much ramp time is remaining. Returns 2 bytes (16 bits), indicating how many 10 ms intervals remain.	0	2
160 status request	Requests the status of the logic board. The information in the returning packet is used by AE Global Services.	0	5
161 request status on output	Reports the status of the most recent output request since the last power up event of the unit. Returns 1 byte (8-bit value): • 0 = Output on sequence OK • 1 = Control mode invalid • 2 = Unit is already on • 7 = An active fault exists • 11 = The bus is not ready	0	1

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• 16 = End of target life reached • 17 = Minimum off time not reached • 31 = The **USER** port reset is active (de-assert the reset on the **USER** port) • 32 = The external interlock is open (clear all active faults) • 44 = The Pinnacle unit has not received a request to turn output on		
162 request process status	Requests process status. In the status definitions, unless otherwise noted, a value of 1 means the status is true, 0 means the status is false. Byte 0: • 0 = Reserved • 1 = Ramp is active • 2 = Recipe is active • 3 = Output power (0 = off, 1 = on) • 4 = Illegal regulation mode • 5 = Cable interlock open • 6 = End of target life • 7 = Setpoint status (0 = within tolerance, 1 = out of tolerance) Byte 1: • 0 = Reserved • 1 = **USER** port auxiliary, vacuum, and interlocks open • 2 = Reserved • 3 = Service required fault • 4 = Heat sink overtemperature event • 5 = User interlock open • 6 = **USER** port reset active	0	4

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• 7 = Interlock open Byte 2: • 0 = Reserved • 1 = Reserved • 2 = Reserved • 3 = Front panel communication fault • 4 = Reserved • 5 = Reserved • 6 = Reserved • 7 = PROFIBUS error Byte 3: • 0 = Bus fault • 1 = Process voltage low • 2 = Joules reached • 3 = Reserved • 4 = Out-of-setpoint timer expired • 5 = Ground fault • 6 and 7 = Reserved		
163 request config status	Requests the system configuration status. Returns 2 bytes: Byte 0: • 0 = Host program source (0 = internal, 1 = external) • 1 = Local program source (0 = internal, 1 = external) • 2 = Analog program source (0 = internal, 1 = external) • 3 = Arc handling (0 = custom, 1 = predefined) • 4 = Arc handling enabled (0 = disabled, 1 = enabled)	0	2

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	• 5 = Unit disabled (0 = disabled, 1 = enabled) • 6 = Program source (0 = internal, 1 = external) • 7 = Target life status (0 = inactive, 1 = active) • All other bits are reserved Byte 1: • 0 = Front panel status (0 = not present, 1 = present) • 1 = Front panel access (0 = unlocked, 1 = locked) • 2 = Joule mode (0 = disabled, 1 = enabled) • 3 = Contactor status (0 = open, 1 = closed) • 4 = Process voltage limit (0 = disabled, 1 = enabled) • 5 = Reserved Ramp mode (0 = disabled, 1 = enabled) • 6 = Reserved • 7 = Reserved		
164 request setpoint/ regulation mode	Requests the setpoint level by the method of output regulation that has been selected. Returns 3 bytes: • Bytes 0 and 1 = Setpoint level (16-bit value) • Byte 2 = Regulation mode (8-bit value): ◦ 6 = Power ◦ 7 = Voltage ◦ 8 = Current Set these values with command **6** (setpoint) and command **3** (output regulation).	0	3
170 request arc detect and shutdown times	Requests the arc detect and arc shutdown indices.	0	2

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	Returns 2 data bytes: • Byte 0 = Arc detect delay time index (8-bit value) • Byte 1 = Arc shutdown time index (8-bit value) Set this value with command **8**.		
171 request voltage arc trip level	Requests the voltage level at which the unit indicates an arc is occurring. Returns 2 bytes (16-bit value) indicating the trip level in voltage. Set this value with command **10**.	0	2
172 request joules remaining	Requests the number of joules remaining in the current run. Returns 4 bytes (32-bit value) indicating the number of joules.	0	4
173 request joules setpoint	Requests the joules setpoint. Returns 4 bytes (32-bit value) indicating the setpoint level in joules. Set this value with command **4**.	0	4
174 request target type	Requests the target type. Returns 1 byte (8- bit value): • 0 = Metal target • 1 = Nonmetal target • 2 = Custom arc handling Set this value with command **30**.	0	1
175 request time output on	Requests how much time has elapsed since output power was turned on. Returns 3 bytes: • Byte 0 = Number of hours • Byte 1 = Number of minutes • Byte 2 = Number of seconds	0	3
177 request process voltage limit	Requests the process voltage lower limit. Returns 2 bytes (16-bit value) indicating the limit in voltage.	0	2

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	Set this value with command **48**.		
178 request hard arc count limit	Requests the hard arc count limit. Returns 4 bytes (a 32-bit value) indicating the limit. Set this value with command **9**.	0	4
179 request active recipe step, ramp/run status, and ramp/run time remaining	Requests the active recipe step number, the ramp/run status, and the ramp/run time remaining. Returns 4 bytes (32-bit value) indicating the following: • Byte 0 = Active recipe step number • Byte 1 = Ramp/run status (1 = ramp, 2 = run) • Bytes 2 and 3 = Ramp/run time remaining in seconds. Two decimal places are implied. For example, a value of 5 indicates 0.05 s or 50 ms. ☞ **Important** If the unit has 100 ms ramp feature, the ramp/run time remaining value is in seconds with one implied decimal place. For example, a value of 5 indicates 0.5 s or 500 ms.	0	4
180 request recipe steps count	Requests the number of recipe steps requested. Returns 1 byte (8-bit value) indicating the number of steps. ☞ **Important** A value of 0 disables the recipe feature. Set this value with command **19**.	0	1
181 request recipe ramp time	Requests the amount of ramping time set for a specific recipe step. Send 1 byte (8-bit value) indicating the recipe step. Returns 2 bytes (16-bit value) indicating the time in seconds. Two decimal places are implied. For example, a value of 5 indicates 0.05 s.	1	2

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	☞ **Important** If the unit has the 100 ms ramp feature, the ramp/run time remaining value is in seconds with one implied decimal place. For example, a value of 5 indicates 0.5 s or 500 ms. Set this value with command **21**.		
182 request recipe setpoint	Requests the setpoint level set for a specific recipe step. Send 1 byte (8-bit value) indicating the recipe step. Returns 3 bytes: • Bytes 0 and 1 = Value of setpoint in the mode indicated • Byte 2 = Regulation mode: ◦ 6 = Power ◦ 7 = Voltage ◦ 8 = Current Set this value with command **22**.	1	3
183 request recipe run time	Requests the run time set for a specific recipe step. Send 1 byte (8-bit value) indicating the recipe step. Returns 2 bytes indicating the run time in seconds. Two decimal places are implied. For example, a value of 5 indicates 0.05 s. ☞ **Important** If the unit has the 100 ms ramp feature, the ramp/run time remaining value is in seconds with one implied decimal place. For example, a value of 5 indicates 0.5 s or 500 ms. Set this value with command **23**.	1	2
184 request out-of-setpoint interval	Requests the amount of time remaining on the out-of-setpoint timer before an error condition occurs. Returns 2 bytes (16-bit value) indicating the interval value in seconds. One decimal place is	0	2

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	implied. For example, a value of 999 indicates an interval of 99.9 s.		
187 request out-of-setpoint timer	Requests the out-of-setpoint timer value. Returns 2 bytes (16-bit value) indicating the timer value in seconds. One decimal place is implied. For example, a value of 999 indicates a timer value of 99.9 s. Set this value with command **31**.	0	2
188 request micro/ hard arc density per second	Requests arc density. If the arc average window (command **7**) is set for 1 second, this command returns the number of arcs that occurred in the previous second. If the arc average window is set for greater than 1 second, the command returns the number of arcs per second averaged over the length of the window. Returns 4 bytes: • Bytes 0 and 1 = Micro arcs (16-bit value) • Bytes 2 and 3 = Hard arcs (16-bit value) ☞ **Important** The micro arc counter continues to count arcs as they occur even if arc handling is disabled.	0	4
189 request micro arc density per run	Requests how many micro arcs occurred in the previous run. Returns 4 bytes (32-bit value) indicating the total number of micro arcs. The unit records a micro arc each time the output voltage goes below the voltage arc trip level (set with command **10**). Even if arc handling is disabled, the micro arc counter continues to count arcs as they occur per run.	0	4
190 request hard arc density per run	Requests how many hard arcs occurred in the previous run. Returns 4 bytes (32-bit value) indicating the total of hard arcs. The unit records a hard arc every time the output voltage goes below the voltage arc trip level for longer than the arc detect time. The unit then shuts down for the arc shutdown time period. Arc detect times and arc shutdown times depend on	0	4

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	the target type (set with command **8** or **30**), and whether the unit is operating in a normal process cycle (PC).		
192 request arc average window length	Requests the length of the arc average window. Returns 1 byte (8-bit value) indicating the number of seconds over which arc counts are being averaged. Set this value with command **7**.	0	1
198 request flash mainframe software	Requests the revision of the unit flash mainframe software. Returns the last five characters of the revision name.	0	5
220 request customer service statistics	Allows AE Global Services to access unit statistics. Send 1 byte (8-bit value): • 0 = Total output in kWh • 1 = Total idle time • 2 = Total run time • 3 = Total unit on events • 4 = Total output on events • 5 = Total overtemperature events • 8 = Total bus fault events • 9 = Total power fluctuation events • 10 = Total process voltage events • 13 = Total user interlock open events • 15 = Total external interlock events • 18 = Total PROFIBUS faults • 21 = Total master/slave fault events	1	4
225 request unit arc response setting and arc handling mode	Requests the unit arc response setting (fast arc response or slow arc response) as well as the arc handling mode (persistent or standard). Send the command only. The unit responds with 2 bytes:	0	2

Table 4-42. PROFIBUS commands (Continued)

Command	Description	Data Bytes Sent	Data Bytes Returned
	Byte 0: • Bit 0 = Arc response setting: ◦ 0 = Slow arc response ◦ 1 = Fast arc response • Bit 1 = Arc response mode: ◦ 0 = Standard ◦ 1 = Persistent • Bits 2 to 7 are reserved Second byte: • Bits 0 to 7 are reserved See "Understanding Arc Management" on page 5-34 for more information on arc response settings and arc handling modes. Set these values with commands **62** and **63**.		

ARC DETECT AND DELAY SHUTDOWN INDEX SETTINGS (COMMAND 8)

The following tables show the arc settings associated with the index values that are set with command **8**, depending on the arc settings selected. The first two tables show the arc detect settings depending on whether the unit is set for fast arc or slow arc range response time, and standard or persistent arc handling response mode. The third table shows the arc shutdown times.

Table 4-43. Command 8 index values for fast arc detect settings

Index	Standard Fast Arc Detect Length	Persistent Fast Arc Detect Length
0	0	0
1	0.5 µs	1 µs
2	1 µs	2 µs
3	3 µs	5 µs
4	3 µs	10 µs
5	3 µs	20 µs
6	3 µs	50 µs

Table 4-43. Command 8 index values for fast arc detect settings (Continued)

Index	Standard Fast Arc Detect Length	Persistent Fast Arc Detect Length
7	3 µs	100 µs
8	3 µs	200 µs
9	3 µs	500 µs

Table 4-44. Command 8 index values for slow arc detect settings

Index	Standard Slow Arc Detect Length	Persistent Slow Arc Detect Length
0	0	0
1	8 µs	16 µs
2	16 µs	32 µs
3	48 µs	80 µs
4	48 µs	160 µs
5	48 µs	320 µs
6	48 µs	800 µs
7	48 µs	1600 µs
8	48 µs	3200 µs
9	48 µs	8000 µs

Table 4-45. Command 8 index values for arc shutdown settings

Index	Fast Arc Shutdown Times	Slow Arc Shutdown Times
0	10 µs	160 µs
1	20 µs	320 µs
2	30 µs	480 µs
3	40 µs	640 µs
4	50 µs	800 µs
5	100 µs	1600 µs
6	200 µs	3200 µs
7	500 µs	8000 µs
8	1000 µs	16,000 µs
9	2500 µs	40,000 µs

PASSIVE DISPLAY PANEL

The passive display panel lets you monitor power, current, or voltage; receive error codes; and review several other conditions shown by the LEDs.

At any time while the Pinnacle supply is operating, you can press the **DISPLAY** buttons to the left of the four-digit display to find the number of kilowatts (or watts), volts, or amps being delivered.

This display also shows error codes when a fault or software error has occurred.

When only a Passive Front Panel (PFP) is available, the Pinnacle unit will display 4 character strings on start up to identify personality cards installed in the unit. A code will flash once for each card installed. For the list of the personality card codes, see "Passive Display Panel Personality Card Codes" on page 6-3.

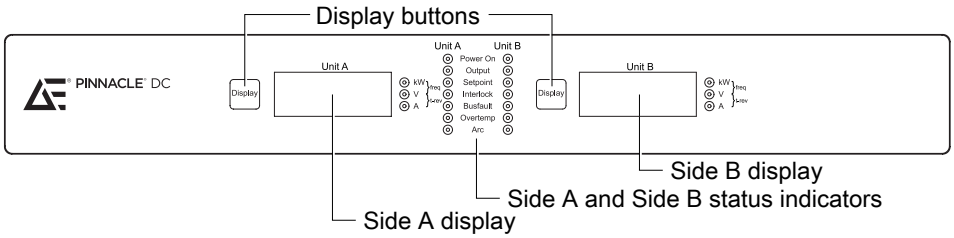


Figure 4-17. Dual unit passive display panel

ACTIVE PANEL

The Pinnacle supply presents a broad array of features and settings that you can easily control through the active control panel. The active control panel is an optional feature, and is sometimes called the active front panel (AFP), active panel, or active display panel.

Control Panel Interface

The control panel includes:

- **On** and **Off** buttons on the far left side of the panel
- **Control** and **Regulation** buttons on the right side of the panel
- A two-line display
- Five soft keys
- A **Modify** knob on the far right side of the panel

- The **Arc** LED

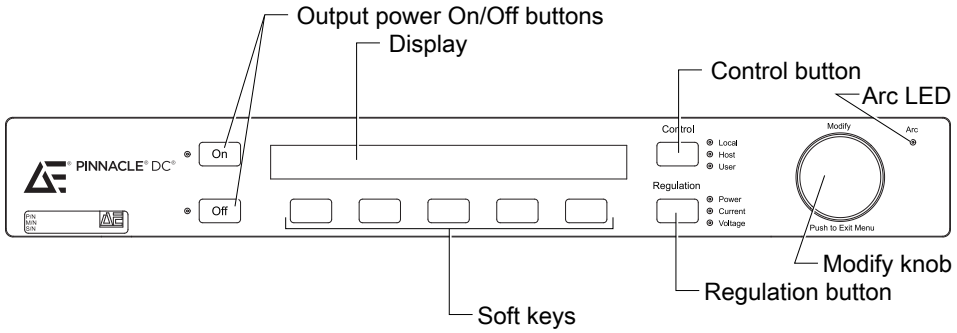


Figure 4-18. Control panel

OUTPUT POWER BUTTONS

To turn output power on and off, press the **On** and **Off** buttons:

- **On** button: Turns output power on if the control panel has control of the on/off function and all interlock conditions are satisfied.
- **Off** button: Turns output power off, no matter which interface is currently controlling the unit.

CONTROL BUTTON

Press the **Control** button to select how you will control the unit.

Important
To change the control interface, turn output power off before making your selection. Otherwise, the unit continues to operate in the control mode selected when you initially turned output on.

To use the front panel to select the method of control for the Pinnacle power supply, select the control mode by pressing the **Control** button on the control panel until the desired LED lights. You can operate in the following control modes:

- Local control mode: Press **Local** to control the unit through the control panel interface. This selection relinquishes control from the serial port or **User** port.
- Host control mode: Press **Host** to control the unit with a host computer that is connected through a serial (host) interface port.
- User control mode: Press **User** to control the unit with a controller through a user interface port (valid on units that include a user interface port).

When the unit is in host or user control mode, you can view all the menu items, but you cannot modify parameters or lock the display.

REGULATION BUTTON

Press the **Regulation** button to select the method of output regulation: **Power** (watts), **Current** (amps), or **Voltage** (volts). This button works when **Local** control mode is selected.

SOFT KEYS

Use the five soft keys directly below the display to select a menu function located directly above the key on the display. After an option is selected, the display refreshes and shows options for the specific function.

Specific tasks in this manual refer to the soft key by the menu option displayed directly above the key. For example, press the **MAIN** soft key when `MAIN` displays above that soft key.

If you are at the top level of information, press the **MENU** soft key to display the menus.

MODIFY KNOB

Use the **Modify** knob with the soft keys to change selections and modify values that appear on the two-line display.

TWO-LINE OUTPUT DISPLAY SCREEN

The display screen displays two lines of information. When you first power up, the display shows the top level of information:

- Line 1 displays side A information: The actual output level (in volts, amperes, and watts), setpoint source (`I` for internal, `e` for external), and setpoint.
- Line 2 (the bottom line) shows the same data for side B.

```
  0V   0.00A      0W  A: iSETPT=     0W
  0V   0.00A      0W  B: iSETPT=  1.82A
```

Figure 4-19. Two-line display screen (main)

To see the setpoint menu for a specific side, press the right-most soft key.

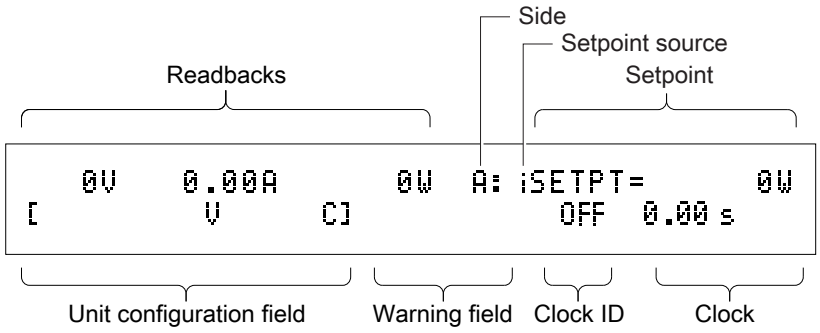


Figure 4-20. *Two-line display of side-specific setpoint information*

The following information appears in the top line of the display (left to right):

- Voltage readback (in volts)
- Current readback (in amps)
- Power readback (in watts)
- Side: `A` or `B`
- Setpoint source (`i` = internal, `e` = external)
- Setpoint and regulation mode (`V` = voltage, `A` = current, `W` = power)

The following information appears in the bottom line of the display (left to right):

- Unit configuration and status field
  - `J`: Joule mode enabled
  - `L`: Target life counter enabled
  - `S`: Setpoint timer enabled
  - `V`: Process voltage monitor enabled
  - `H`: Hard arc counting enabled
  - `Q`/`R`: Recipe queue or ramp enabled (not available on all units)
  - `C`/`P`: Custom or predefined arc handling enabled
- Warning field, which flashes the following codes:
  - `ARCLIM` = Arc limit is reached (active only when the hard arc counting feature is enabled)
  - `EOTL` = End of target life
- Clock ID: What the unit is doing
  - `RMP` = Output is on and ramping
  - `RUN` = Output is on and the clock shows the elapsed time
  - `OFF` = Output is off and the clock shows the last run time
- Clock

If the last run time is < 1 minute, the seconds displays in hundredths precision (12.5 s displays as 12.50 s).

Using the Control Panel Controls

Use the **Modify** knob and the five unlabeled soft keys (directly below the display) to select parameters and modify values. To change parameters using the menu, the Pinnacle unit must be in local control mode (the **Local** LED will be lit).

☞ **Important**
When the Pinnacle unit is in user or serial (host) mode, you can view all the menu items, but you cannot modify any of the items or lock the unit. If you switch the Pinnacle unit to user mode while you are viewing an item in the menu, you are immediately returned to the output display screen.

To access the main menu: Press any of the soft keys when the output display is showing.

The main menu contains three menu selections: **SERVICE**, **SUPPLY**, and **PROCESS**. Generally, pressing a soft key causes another level of menu choices to display (for example, if you press the **PROCESS** soft key, **MONITOR**, **LIMITS**, **ARC**, and **CONTROL** display).

As you navigate the menu levels using the soft keys, the top line of the output display screen presents the path of the menu in the upper left corner.

A parameter flashes if it can be modified. To modify a parameter:

1. Turn the **Modify** knob to the desired value.
2. Press the **ENTER** soft key to enter the modification into non-volatile memory.

To cancel, press the **Modify** knob at any time. This will leave the parameter(s) unchanged and return to the output display screen.

If a fault exists or the panel is locked, the soft keys are locked until you clear the fault.

Understanding the Menu Options

Pressing any soft key displays the main menu tree. Access the following menu options from the top level:

- **SERVICE**—Use to access diagnostic information
- **SUPPLY**—Use to modify supply-specific parameters
- **PROCESS**—Use to access options that affect your process or monitor your process

To select a menu option, press the soft key below the menu option. See the menu maps for a graphical representation of the menu options.

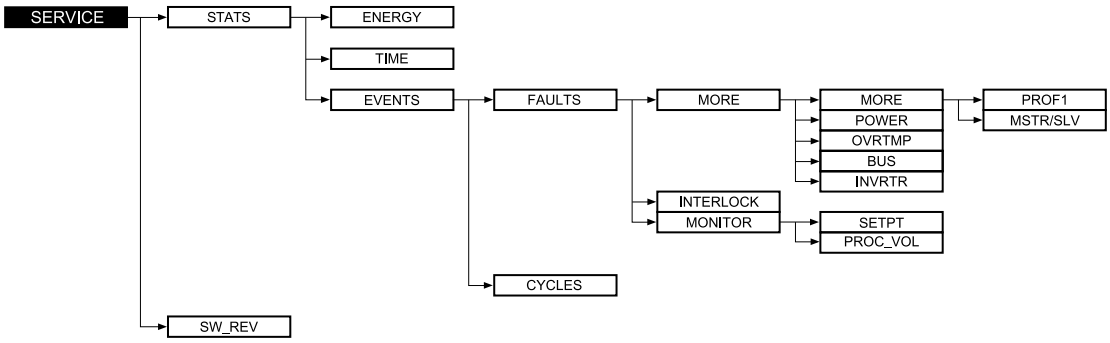


*Figure 4-21. **SERVICE** menu map*

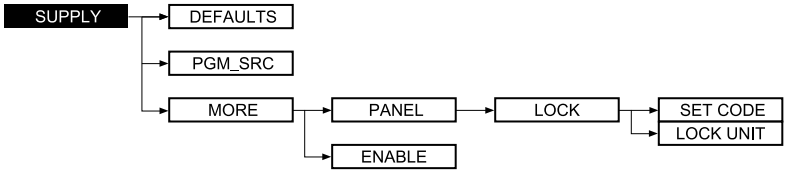


*Figure 4-22. **SUPPLY** menu map*

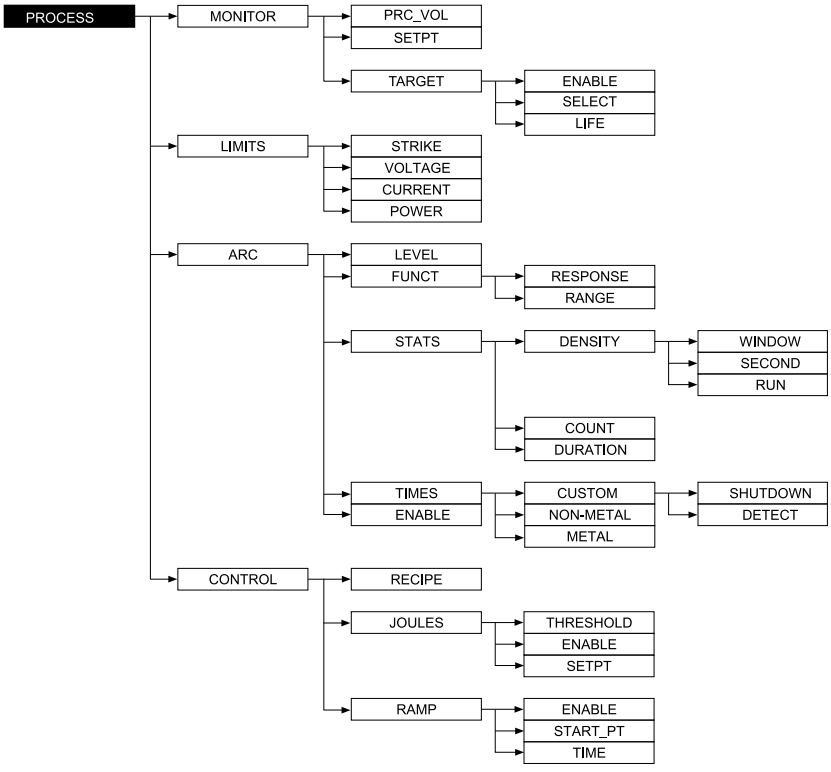


*Figure 4-23. **PROCESS** menu map*

USING THE SERVICE MENU FUNCTIONS

Use this option to view diagnostics and software versions of your supply. The menu options are:

- **STATS**: supply statistics
- **SW_REV**: software revision numbers

☞ **Important**
The menu options may vary depending on the configuration of the unit software.

Checking Service-Type Statistics

SERVICE→ STATS

Use this option to check the service-type statistics.

TO CHECK THE TOTAL ENERGY OUTPUT

SERVICE→ STATS→ ENERGY

- Press **SERVICE→ STATS→ ENERGY**.

  The total energy output for sides A and B appears.

TO CHECK THE AMOUNT OF TIME IDLE AND THE AMOUNT OF TIME RUNNING

SERVICE→ STATS→ TIME

This function reports time in seconds.

This function checks idle and run time for both side A and side B.

- Press **SERVICE→ STATS→ TIME**.
  - To display the amount of time idle, press the **IDLE** soft key.

    The amount of time idle appears.
  - To display the amount of time running, press the **RUN** soft key.

    The amount of time running appears.

TO CHECK THE NUMBER OF FAULTS

SERVICE→ STATS→ EVENTS→ FAULTS

1. Press **SERVICE→ STATS→ EVENTS→ FAULTS**.

   The following options display: **MORE**, **INTRLOCK**, and **MONITOR**,

   ◦ Press the following soft keys to check these faults:

   ▪ **MORE→ PROF1** displays the number of PROFIBUS faults (not available on all units).

   ▪ **MORE→ POWER** displays the number of line power faults.

   ▪ **MORE→ OVRTMP** displays the number of overtemperature faults.

   ▪ **MORE→ BUS** displays the number of bus faults.

   ▪ **MORE→ INVRTR** displays the number of inverter faults.

   ◦ Press the **INTRLOCK** soft key to display the number of user and cable faults.

   ◦ Press the **MONITOR** soft key to check the following faults:

   ▪ **SETPT** displays the number of setpoint timer faults.

   ▪ **PROC_VOL** displays the number of process voltage faults.

TO CHECK THE NUMBER OF CYCLES

SERVICE→ STATS→ EVENTS

1. Press **SERVICE→ STATS→ EVENTS**.

   The following options appear: **FAULTS**, **CYCLES**

2. Press the **CYCLES** soft key.

   The following options appear: **OUTPUT**, **UNIT**

   ◦ To get a report of the number of output on events, press the **OUTPUT** soft key.

   ◦ To get a report of the number of power on events, press the **UNIT** soft key.

To Check Your Software Versions

SERVICE→ SW_REV

Use this option to find out the number and version of your system software components.

- Press **SERVICE→ SW_REV**.

  ◦ To display the software version of the configuration, press **CONFIG**.

  ◦ To display the software version of the cards installed in the unit, press **CARD**.

  ◦ To display the software version of the active panel software, press **PANEL**.

◦ To display the software version of the logic, press **LOGIC**.

USING THE SUPPLY MENU FUNCTIONS

This option lets you modify specific components and parameters of the unit with the following menu options:

- **DEFAULTS**
- **PGM_SRC**
- **MORE→ PANEL**
- **MORE→ ENABLE**

To Set Supply Parameters to Default

SUPPLY→ DEFAULTS

This option sets the power supply parameters to the system defaults, then stores them in memory.

1. Press **SUPPLY→ DEFAULTS**.
2. Rotate the **Modify** knob to display **YES** or **NO**.
3. Press **ENTER** to accept and exit.

   The unit restarts itself to reset the system defaults.

Setting the Program Source

SUPPLY→ PGM_SRC

The program source (**PGM_SRC**) feature specifies for each control mode the program source for regulation mode and setpoint information. For each control mode, if the program source is set to internal (**INT**), the Pinnacle unit uses the information for output regulation mode and setpoint that has been established through either the active panel or the standard serial port. If the program source is set to external (**EXT**), the Pinnacle unit uses the setpoint and output regulation mode that has been established through the pins on the **User** port. A user card must be installed to alter these settings.

TO SELECT THE SOURCE AND MODE

1. Press **SUPPLY→ PGM_SRC**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.

HOST, **LOCAL**, and **USER** options display.

3. For the selected control mode, assign either internal or external source.
4. Press **Enter** to accept and exit.
5. Repeat for the other side.

Making Active Control Panel Settings

SUPPLY→ MORE→ PANEL

Use this option for the following:

- Lock the control panel

TO SET A LOCK CODE AND LOCK THE ACTIVE CONTROL PANEL

SUPPLY→ MORE→ PANEL→ LOCK

1. Press **SUPPLY→ MORE→ PANEL→ LOCK**.

   The following options appear: **SET CODE**, **LOCK UNIT**.

2. Set the lock code:

   a. Press the **SET CODE** soft key.

      The following instructions and options appear:

      ```
      ENTER NEW 5-DIGIT CODE
      [0/1]   [2/3]   [4/5]   [6/7]   [8/9]
      ```

   b. Using the soft keys, enter a 5-digit code.

3. To lock the unit once the code is set, press **LOCK UNIT**.

Any further menu access requires entry of the code.

Cycling power on the unit resets the lock status to unlocked.

Selecting the Side to Enable

SUPPLY→ MORE→ ENABLE

This feature assists in turning on only one side from an active panel because there is only one **On** button.

Output for one side can be turned on at the setpoint menu for that side (see **PROCESS→ CNTROL→ SETPT**).

TO SELECT THE SIDE TO ENABLE

1. Press **SUPPLY→ MORE→ ENABLE**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select **Enabled** or **Disabled** for the selected side.
4. Press **ENTER**.
5. Repeat these steps for the other side.

USING THE PROCESS MENU FUNCTIONS

Use this option to access parameters that control, limit, or monitor your process. The menu options are:

- **MONITOR**: monitor your process
- **LIMITS**: set limits
- **ARC**: set arc parameters
- **CONTROL**: set process control parameters

The menu options can vary depending on the configuration of the unit software.

Monitoring Your Process

PROCESS→ MONITOR

Establishing a Minimum Process Voltage

PROCESS→ MONITOR→ PRC_VOL

This menu lets you establish a minimum process voltage. To use this feature, you must first enable it and then establish a desired threshold limit. With the process voltage limit feature enabled, the Pinnacle unit waits for the output voltage to first exceed the limit. Once the limit is exceeded, output will remain on until you turn the output off or until the voltage falls below the established limit.

If the voltage falls below the limit, output will turn off and error message **E010: Process Voltage Low Limit Fault Unit A** for Side A or **E011: Process Voltage Low Limit Fault Unit B** for Side B will appear on the display.

TO ENABLE AND SET THE PROCESS VOLTAGE LEVEL

1. Press **PROCESS→ MONITOR→ PRC_VOL→ ENABLE**.

2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select **YES** or **NO**.
4. Press **ENTER** to accept and exit.
5. Press the **LEVEL** soft key.
6. Rotate the **Modify** knob to select a process voltage level.
7. Press **ENTER** to accept and exit.
8. Repeat for the other side.

Setting an Out-of-Setpoint Timer

PROCESS→ MONITOR→ SETPT

Use this option to enable and set an out-of-setpoint timer. This function lets you indicate how long you want the power supply to tolerate an out-of-setpoint condition before it shuts off output. An out-of-setpoint condition occurs whenever output moves out of a range determined by your selected setpoint. The out-of-setpoint function operates in all three regulation modes.

Because the readbacks, which are compared to the setpoint, are filtered in the software, AE recommends that you do not use this feature for process runs that are less than 1.0 s.

The out-of-setpoint limit is 0.4% of full scale or 2.0% of setpoint, whichever is greater.

When an out-of-setpoint condition occurs, the unit shuts off output and displays error code **E0085: Out of Setpoint Fault Unit A** for side A and **E0086: Out of Setpoint Fault Unit B** for side B.

TO DISABLE OR ENABLE AND SET THE OUT-OF-SETPOINT TIMER

1. Press **PROCESS→ MONITOR→ SETPT**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to adjust the value:
   - To enable and set the out-of-setpoint timer, select a value that is greater than 0 (in 0.1 s increments).
   - To disable the out-of-setpoint timer, select a value of 0.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

Changing the Target Functions

PROCESS→ MONITOR→ TARGET

The target functions let you enable or disable the target life counter (**ENABLE**), change the active target (**SELECT**), and set the target life (**LIFE**) in 0.01 kWh increments.

TO ENABLE OR DISABLE THE TARGET LIFE COUNTER FOR THE SELECTED TARGET

PROCESS→ MONITOR→ TARGET→ ENABLE

1. Press **PROCESS→ MONITOR→ TARGET→ ENABLE**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select **YES** or **NO**.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

CHANGING THE ACTIVE TARGET NUMBER

PROCESS→ MONITOR→ TARGET→ SELECT

The **USER** port has priority in selecting targets. If the Pinnacle unit has a user interface, and is in host or local control mode, set the target to 1 at the **USER** port to select targets from the serial port or active panel. Leaving the target bits open or leaving the **USER** port pins unconnected causes the target selection at the **USER** port to default to 1.

To Change the Active Target Number

1. Press **PROCESS→ MONITOR→ TARGET→ SELECT**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select the active target number.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

TO SET THE TARGET LIFE

PROCESS→ MONITOR→ TARGET→ LIFE

1. Press **PROCESS→ MONITOR→ TARGET→ LIFE**.

2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Select the increment value.

   The default increment value shows on the display. To change the increment, press the associated soft key until the desired increment displays (x0.1, x1, x10, x100).
4. Rotate the **Modify** knob to select a target life between 0 and 15000.00 kWh (the default is 0).
5. Press **ENTER** to accept and exit.
6. Repeat for the other side.

This function will also display how much target life is left as the counter decreases.

When the end-of-target-life is reached, the output display screen flashes `EOTL` and the Pinnacle unit continues running until a normal off command is received.

☞ **Important**
The Pinnacle unit cannot turn back on until the target life is reset, or until the target status is disabled or a new active target is selected.

Setting Process Limits

PROCESS→ LIMITS

This menu lets you control user-selectable operating limits for the Pinnacle unit: strike voltage and maximum output (voltage, current, and power).

Before entering a maximum output limit, consider the system output impedance, and consider how your selected power limits will interact. The unit limits output when output reaches the first applicable limit.

You cannot set a setpoint greater than the corresponding limit in that regulation mode.

SETTING A STRIKE VOLTAGE LIMIT

PROCESS→ LIMITS→ STRIKE

This function lets you select a maximum 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.

To Set a Strike Voltage Limit

1. Press **PROCESS→ LIMITS→ STRIKE**.

2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select **LOW**, **MEDIUM**, or **HIGH**.

   The values associated with each selection depend on the output impedance range of your unit, as shown in Table 4-46.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

If the unit has a special ignition profile, it reverts to the standard ignition profile after 5 seconds. The special ignition profile occurs only at the beginning of a cycle, and it will not restart unless the setpoint is changed during a high impedance (open circuit) load condition. Therefore, if the plasma goes out during a run, the standard ignition profile starts up (not the special ignition profile). However, the special ignition profile 5-second interval restarts if the setpoint is changed while running ignition into an open load. Maximum strike voltages are unchanged in a special ignition profile.

Table 4-46. Strike voltage limits

Strike Voltage Setting	Low-Z 200 VDC to 400 VDC	Standard-Z 400 VDC to 800 VDC	High-Z 400 VDC to 1000 VDC 500 VDC to 1000 VDC	High Voltage 750 VDC to 1500 VDC 1500 VDC to 3000 VDC
Low	400 V ± 100 V	800 V ± 100 V	1000 V ± 100 V	Strike voltage not available
Medium	650 V ± 100 V	1100 V ± 100 V	1200 V ± 100 V	
High	900 V ± 100 V	1450 V ± 150 V	1450 V ± 150 V	

TO SET A MAXIMUM LIMIT FOR OUTPUT VOLTAGE

PROCESS→ LIMITS→ VOLTAGE

This function lets you set a maximum limit for output voltage. The maximum allowable value is the maximum rated output for the supply.

1. Press **PROCESS→ LIMITS→ VOLTAGE**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select a value from 0 to the maximum rated output voltage for the supply.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

TO SET A MAXIMUM LIMIT FOR OUTPUT CURRENT

PROCESS→ LIMITS→ CURRENT

This function lets you set a maximum limit for output current. The maximum allowable value is the maximum rated output for the supply.

1. Press **PROCESS→ LIMITS→ CURRENT**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select a value from 0 to the maximum rated output current for the supply.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

TO SET A MAXIMUM LIMIT FOR OUTPUT POWER

PROCESS→ LIMITS→ POWER

This function lets you set a maximum limit for output power. The maximum allowable value is the maximum rated output for the supply.

1. Press **PROCESS→ LIMITS→ POWER**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select a value from 0 to the maximum rated output power.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

Setting Arc Handling

PROCESS→ ARC

Use the **ARC** menu to implement arc handling during your normal process cycle. Selections in the **ARC** menu let you establish arc handling parameters for normal process runs. In addition, the **PROCESS** menu lets you view arc density statistics.

☞ **Important**
Units with a 10 kW inverter and a 208 V input configuration have a minimum arc shutdown time of 50 µs.

SETTING THE VOLTAGE ARC TRIP LEVEL

PROCESS→ ARC→ LEVEL

This function lets you set the voltage arc trip level, which is the output voltage level at which the unit determines an arc is occurring. If the voltage level stays below the specified trip level for the amount of time you set (in the **PROCESS→ ARC→ TIMES→ CUSTOM→ DETECT** function), the Pinnacle unit shuts down.

To Set the Voltage Arc Trip Level

1. Press **PROCESS→ ARC→ LEVEL**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select an arc trip level.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

TO SELECT AN ARC RESPONSE MODE

PROCESS→ ARC→ FUNCT→ RESPONSE

1. Press **PROCESS→ ARC→ FUNCT→ RESPONSE**.
2. Select either **PERSISTENT** or **STANDARD**.

   The currently enabled selection is identified with an asterisk.
3. Press **EXIT** to accept and exit.

TO SELECT AN ARC RESPONSE RANGE

PROCESS→ ARC→ FUNCT→ RANGE

1. Press **PROCESS→ ARC→ FUNCT→ RANGE**.
2. Select either **FAST** or **SLOW**.

   The currently enabled selection is identified with an asterisk.
3. Press **ENTER** to accept and exit.

SETTING ARC COUNT LIMIT

PROCESS→ ARC→ STATS→ COUNT

This function provides a count of hard arcs and of micro arcs that have occurred while the DC output has been on (density).

The hard arc counter counts one arc every time output is shut off due to an arc condition. The micro arc counter counts one arc every time an arc is extinguished. Both counters return to 0 when the output is cycled off and then back on.

This function sets the number of arc conditions (as defined by the arc trip level and the arc detect time) that are allowed to occur before the unit indicates that the user-

specified hard arc limit has been exceeded. The hard arc count is stored in non-volatile memory and will not reset when the unit powers up or down.

If your unit is configured with the arc limit fault feature, when the arc count limit is exceeded during a set window of time in a process run, the unit shuts output power off. You must send an off command to clear the fault.

When output turns off (output is de-energized), if the hard arc count limit has been met, the **Arc** LED will light on the front panel of the power supply for a predetermined amount of time (usually 100 ms). Units with a **USER** port: a signal will also be sent to the *ARC.D* line on the **USER** port.

To Set the Arc Count Limit

1. Press **PROCESS→ ARC→ STATS→ COUNT**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select a hard arc count limit. A zero value disables the arc count limit function.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

If your unit is configured with the arc limit fault feature, you must also set an arc limit duration window.

VIEWING THE ARC DENSITY

PROCESS→ ARC→ STATS→ DENSITY

The hard arc counter counts one arc every time an arc occurs that meets the conditions set for a hard arc shutdown. The micro arc counter counts one arc every time an arc occurs. Both counters return to 0 when the output is cycled off and then back on. If you disable arc handling, you disable arc shutdowns. However, the micro arc counter continues to count arcs as they occur. Both counters return to 0 when the output is cycled off and then back on.

To View The Arc Density of Your Process

1. Press **PROCESS→ ARC→ STATS→ DENSITY**.
   - **WINDOW**: To see the arc average window length, press **WINDOW**.
   - **SECOND**: To see arcs per second, press **SECOND**.
   - **RUN**: To see arcs per run, press **RUN**.

   This display is not zeroed until you turn the output on again.
2. Press **Enter** to accept and exit.

You can also reset the counters through the menu commands by pressing **PROCESS→ ARC→ STATS→ DENSITY→ RUN**, then pressing the **RESET** soft key.

CHANGING THE LENGTH OF THE ARC DENSITY WINDOW

PROCESS→ ARC→ STATS→ DENSITY→ WINDOW

This feature changes the window of time over which the Pinnacle unit averages the density of hard and micro arcs. You can select a value between 1.0 s and 10 s. With a window of 1.0 s, the display will show the actual number of arcs that occurred in the previous second. If the window is set at a value greater than 1.0 s, however, arcs per second will show the number of arcs averaged over the number of seconds established by the window. When the arc average window value is changed, the new value remains in effect for subsequent power ups.

To Change the Length of the Arc Density Window

1. Press **PROCESS→ ARC→ STATS→ DENSITY→ WINDOW**.

   WINDOW, **SECOND**, and **RUN** options appear.
2. Rotate the **Modify** knob to select an arc average window in seconds.
3. Press **ENTER** to accept and exit.

SETTING THE ARC COUNT DURATION WINDOW

PROCESS→ ARC→ STATS→ DURATION

Depending on the unit configuration, you can set a window of time in which to count the number of arcs that occur. If the arc count within this time block exceeds the arc limit, an arc limit fault occurs and shuts output power off.

1. Press **PROCESS→ ARC→ STATS→ DURATION**.
2. Rotate the **Modify** knob to select a value between 10 ms and 500 ms (in 10 ms increments).
3. Press **ENTER** to accept and exit.

ENABLING ARC HANDLING

PROCESS→ ARC→ ENABLE

This function enables or disables the arc handling functions of the Pinnacle supply.

If your unit is configured to default to arc handling enabled and you disable arc handling, cycling power to the unit resets arc handling mode to enabled.

Although arc handling is disabled, the micro arc counter continues to count arcs as they occur.

WARNING:

In most configurations, default at power up is arc handling enabled. If you choose to disable arc handling, your Pinnacle unit will not respond to arcs, which could potentially damage your process tool.

To Enable or Disable Arc Handling

1. Press **PROCESS→ ARC→ ENABLE**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select **YES** or **NO**.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

Setting Arc Handling Times

PROCESS→ ARC→ TIMES

This function lets you indicate the type of arc handling needed for your process. You can set custom shutdown or detect times, or set a predefined target type of metal or nonmetal.

Setting custom arc handling allows you to set shutdown and detect times specific to your process. The arc shutdown time defines the amount of time that the Pinnacle unit turns output off after an arc is detected. The arc detect delay time is the amount of time that an arc must last to be considered an arc.

Setting a predefined target type of metal or nonmetal is useful in situations where the arcing characteristics of a process are unknown, making it difficult to set custom arc times. Selecting a target initiates preprogrammed arc detect times and arc shutdown times for the normal process cycle (PC).

These times are shown in the following table.

Table 4-47. Arc detect and arc shutdown times

Target Type	Arc Response Setting	PC Detect Time	PC Shutdown Time
Metal	Fast arc	0	50 µs
Nonmetal	Fast arc	0	500 µs
Metal	Slow arc	0	480 µs
Nonmetal	Slow arc	0	8000 µs

Table 4-47. Arc detect and arc shutdown times (Continued)

Target Type	Arc Response Setting	PC Detect Time	PC Shutdown Time
Custom	Fast arc	Set by user	Set by user
Custom	Slow arc	Set by user	Set by user

The following arc times processes are described in the following sections:

- "Custom Time Settings"
- "Predefined Arc Handling Mode"

CUSTOM TIME SETTINGS

PROCESS→ ARC→ TIMES→ CUSTOM

From the **CUSTOM** menu, you can set the following:

- Arc shutdown time (using the **SHUTDOWN** option)
- Arc detect delay time (using the **DETECT** option)

To Set Custom Arc Shutdown Times

This procedure provides a setting for output to be turned off after an arc is detected.

1. Press **PROCESS→ ARC→ TIMES→ CUSTOM**.

   The **SHUTDOWN** and **DETECT** options appear.
2. Select **SHUTDOWN**.
3. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
4. Rotate the **Modify** knob to select one of ten available settings in microseconds.
5. Press **ENTER** to accept and exit.
6. Repeat for the other side.

To Set Custom Arc Detect Delay Times

This procedure provides a setting to define the amount of time that an arc must last to be considered an arc.

1. Press **PROCESS→ ARC→ TIMES→ CUSTOM**.

   The **SHUTDOWN** and **DETECT** options appear.
2. Select **DETECT**.
3. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
4. Rotate the **Modify** knob to select one of ten available settings in microseconds.

5. Press **ENTER** to accept and exit.
6. Repeat for the other side.

PREDEFINED ARC HANDLING MODE

PROCESS→ ARC→ TIMES

This procedure provides a way to identify the type of target in your process, either metal or nonmetal.

To Select a Predefined Arc Handling Mode

1. Press **PROCESS→ ARC→ TIMES**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Select **METAL** or **NON-METAL**.

   The setting takes effect immediately.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

Setting Control Parameters

PROCESS→ CONTROL

Use this menu option to set up Pinnacle parameters that directly control the output of your process. The menu options are:

- **RECIPE**
- **JOULES**
- **RAMP**

Setting Recipes

PROCESS→ CONTROL→ RECIPE

☞ **Important**
You cannot set ramping recipes when in **User** control mode.

Use the **RECIPE** menu to implement a ramping recipe. This function lets you program the Pinnacle unit to ramp up in incremental steps (1 to 8 steps are possible). For each step, you must set a ramp time, a setpoint, and a run timer. Ramp time is the amount of time (in seconds) that the Pinnacle unit takes to ramp up to the setpoint for the specified step. Run timer is the amount of time (in seconds) for which the Pinnacle unit runs at setpoint for the specified step.

To enable this function, set the number of steps to 1, 2, 3, 4, 5, 6, 7, or 8. To disable this function, set the number of steps to 0.

MAKING RECIPE SETTINGS

PROCESS→ CONTROL→ RECIPE

The setpoint source must be set to internal to run a recipe.

To Make Recipe Settings

1. Press **PROCESS→ CONTROL→ RECIPE**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select a value from 1 to 8.
4. Press **ENTER**.

   The display progresses to a series of screens through which you enter ramp time, setpoint, and run timer for each step. After you have entered a value from 1 to 8 at the previous screen, a screen that requests a **RAMP TIMER** value appears. This is the starting screen for setting the first recipe step.
5. Rotate the **Modify** knob to select a value from 0.05 s to 600 s (in 0.01 s increments).
6. Press **ENTER**.

   The display progresses to a screen requesting a **SETPOINT** value.
7. Press the **REGULATION** key to toggle between power, current, and voltage. Rotate the **Modify** knob to select a value from 0 to the full rated output of the supply.
8. Press **ENTER**.

   The display progresses to a screen requesting a **RUN TIMER** value.
9. Rotate the **Modify** knob to select a value from 0.00 s to 600 s (in 0.01 s increments).

   If your unit has the 100 ms ramp feature, the range is 0 s to 6000.0 s.

   Turn the **Modify** knob and press the appropriate soft key to indicate how quickly you want the display to increment the value (x10 or x1).
10. Press **ENTER**.

    If you have indicated that your recipe contains more than one step, the display returns to the **RAMP TIMER** screen, so that you can enter recipe values for the next step.
11. Repeat the steps for setting step values as needed.
12. Repeat for the other side.

If you assign 0 run time for the final recipe step, the unit switches to continuous output when it reaches setpoint for this step. To turn off output, send an off command (using the **OFF** button, the appropriate **USER** port signal, or the serial port command), or you must have already programmed a joules setpoint.

Setting Joule Mode

PROCESS→ CONTROL→ JOULES

This option lets you use joule mode, a method of automatically delivering a specified number of joules to the target. From this menu, you can choose the following:

- **THRESHOLD**: Specify a power level that must be exceeded before beginning calculation, thereby enhancing the accuracy of the calculation by disabling the calculation during ignition.
- **ENABLE**: Enable or disable joule mode.
- **SETPT**: Program the number of joules (the joule setpoint) to be delivered.

TO ENABLE JOULE MODE

PROCESS→ CONTROL→ JOULES→ ENABLE

1. Press **PROCESS→ CONTROL→ JOULES→ ENABLE**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select **YES** or **NO** to enable or disable joule mode.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

TO SET THE NUMBER OF JOULES TO BE DELIVERED (JOULE SETPOINT)

PROCESS→ CONTROL→ JOULES→ SETPT

1. Press **PROCESS→ CONTROL→ JOULES→ SETPT**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Select the increment value.

   The default increment value shows on the display. To change the increment, press the associated soft key until the desired increment displays (x1000, x100, x10, or x1).
4. Rotate the **Modify** knob to select a value from 0 joules to 9,999,999 joules.
5. Press **ENTER** to accept and exit.

6. Repeat for the other side.

SETTING THE JOULE THRESHOLD

PROCESS→ CONTROL→ JOULES→ THRESHOLD

This option allows you to set a level of output power that must be met or exceeded before joule calculation begins. You can use this feature to improve the accuracy for processes that have long ignition times.

To Set the Joule Threshold

1. Press **PROCESS→ CONTROL→ JOULES→ THRESHOLD**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select a value from 10 W to the maximum unit power divided by 8.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

Setting the Ramp

PROCESS→ CONTROL→ RAMP

Use this option to ramp the output to a process setpoint. This option allows you to enable the feature, set a ramp start setpoint percentage, and set a ramp time. The ramp time is set in 10 ms increments. The minimum ramp time is 0.05 seconds. The maximum ramp time is 600.00 seconds.

☞ **Important**
If your unit has the 100 ms ramp feature enabled, the range is 0.5 seconds to 6000.0 seconds and the ramp time is set in 100 ms increments.

Ramping and recipe modes are mutually exclusive.

The out-of-setpoint timer is disabled while output is ramping.

The following equation is used to determine if the ramp is achievable by the processor:

- (setpoint − start_setpoint / ramp steps (in 10 ms increments)) = delta_setpoint

The start_setpoint is equal to:

- (truncation)((setpoint * ramp_start_setpoint_percentage)/100).

Because this calculation does not allow a fractional portion, the ramp will be more accurate with a greater separation between start and end setpoints.

If you want to allow the ramp, make sure (delta_setpoint * 65535) > 100.

If the ramp is not achievable by the processor, an error message will flash on the display. However, output will turn on and the output will step directly to the requested setpoint.

In current regulation there are two implied decimal places, thus 1000 = 10.00 amps.

The setpoint source must be set to internal to run a ramp.

When the unit is in host control mode, you can generate multiple ramps between setpoints by sending new setpoints while the output is on.

TO ENABLE RAMP MODE

PROCESS→ CONTROL→ RAMP→ ENABLE

1. Press **PROCESS→ CONTROL→ RAMP→ ENABLE**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select **YES** or **NO** to enable or disable ramp mode.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

SETTING THE RAMP START POINT

PROCESS→ CONTROL→ RAMP→ START_PT

This value is the output level from which the ramp starts, and is set as a percentage of the setpoint. This setting only applies to regular ramp mode. It does not apply to ramp mode in a timed recipe.

To Set the Ramp Start Point

1. Press **PROCESS→ CONTROL→ RAMP→ START_PT**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.
3. Rotate the **Modify** knob to select a percent.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

TO SELECT THE RAMP TIME

PROCESS→ CONTROL→ RAMP→ TIME

1. Press **PROCESS→ CONTROL→ RAMP→ TIME**.
2. Press the soft key under **A/B** to select side A or B. An arrow displays next to the letter of the side that is currently selected.

3. Rotate the **Modify** knob to select a time in seconds.
4. Press **ENTER** to accept and exit.
5. Repeat for the other side.

Installation, Setup, and Operation

PREPARING TO INSTALL THE UNIT

Spacing Requirements

- Minimum clearance between either side of the Pinnacle power supply and the enclosure: 51 mm (2″).
- Minimum clearance between the top of the Pinnacle power supply and the top of the enclosure: 25 mm (1″).
- Minimum clearance between the front and back of the Pinnacle power supply and the enclosure: 102 mm (4″), with adequate ventilation.
- No clearance is required between power supplies.

Dimensional Drawings

UNIT DIMENSIONS

The following drawings are representative. Your unit might differ from these drawings.

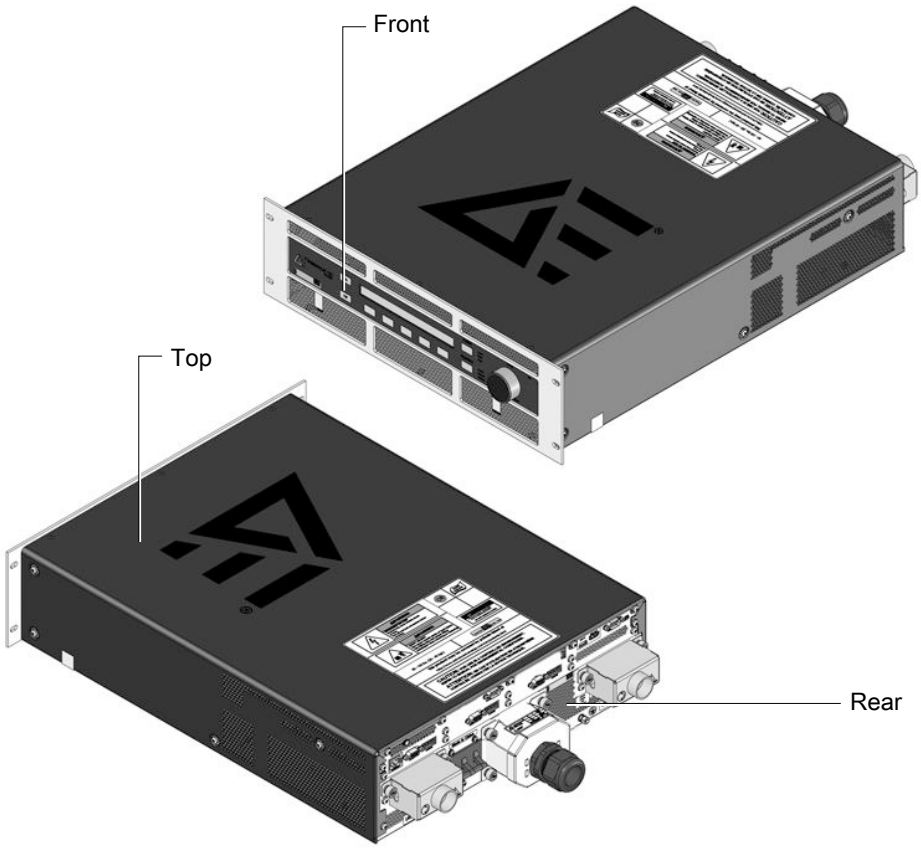


Figure 5-1. Isometric view

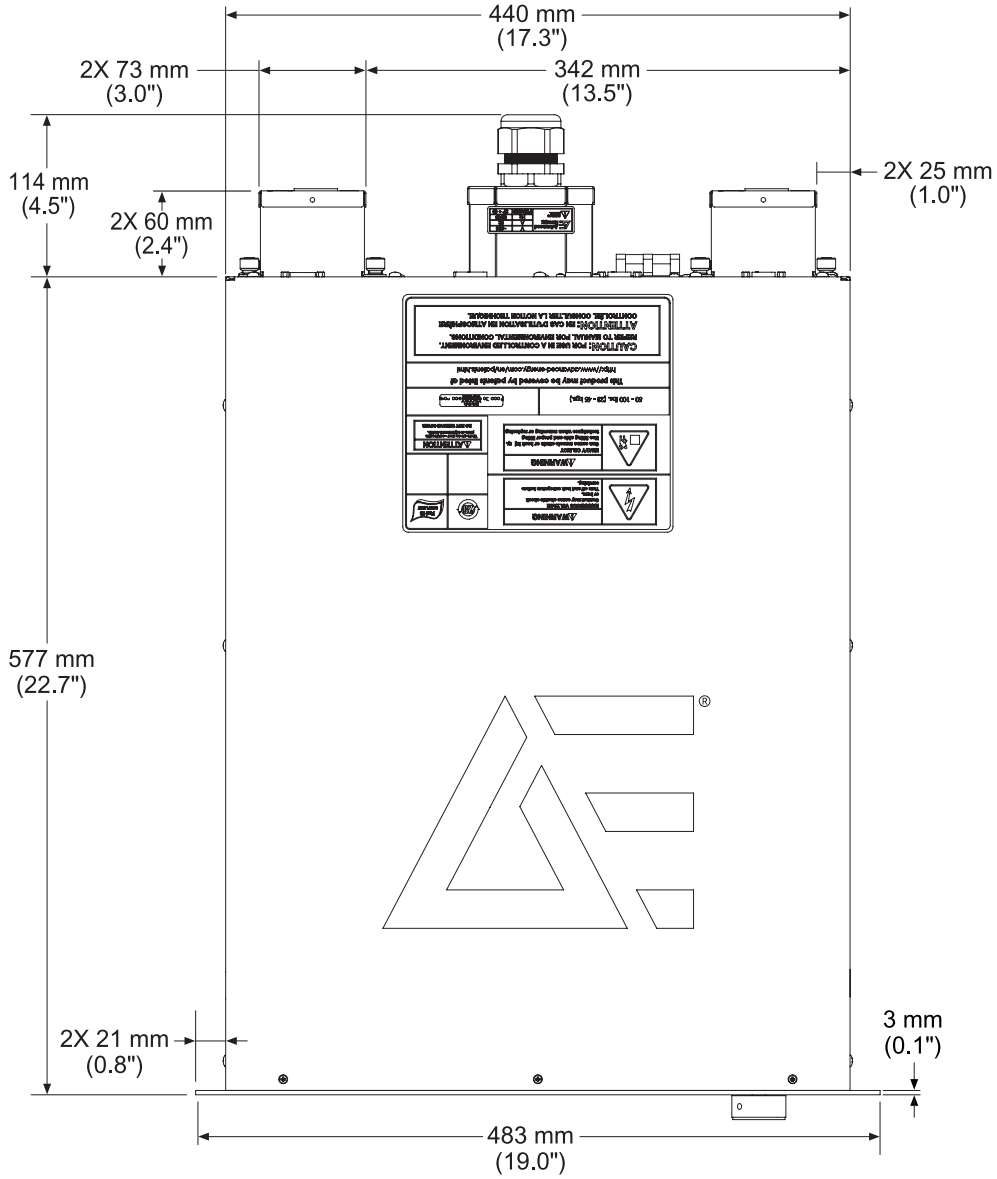


Figure 5-2. *Top view*

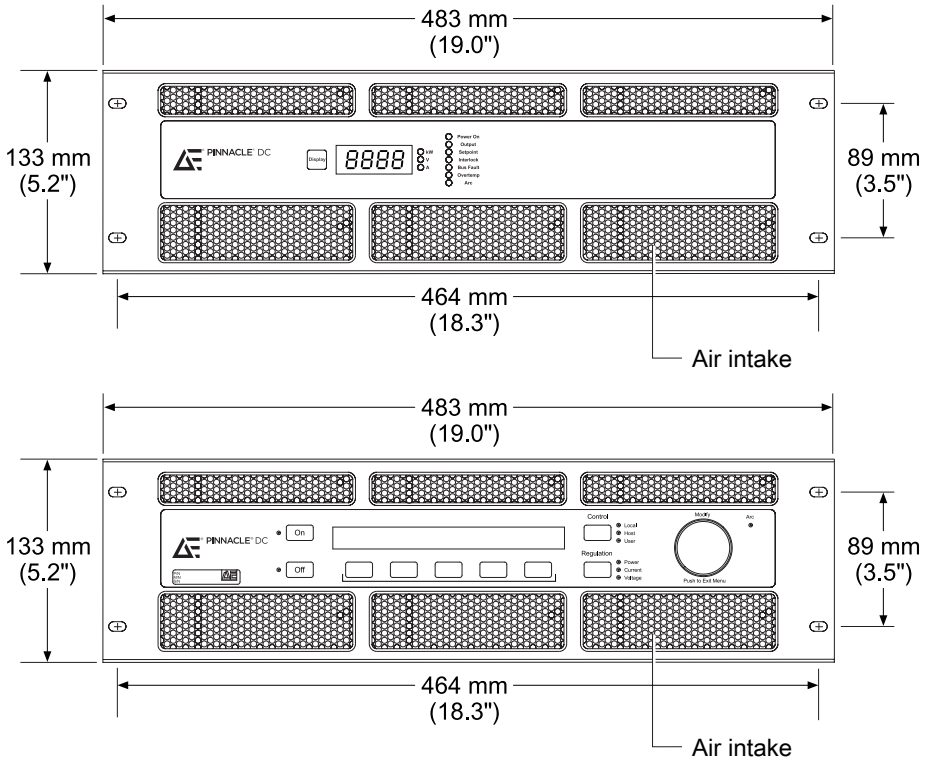


Figure 5-3. *Front view*

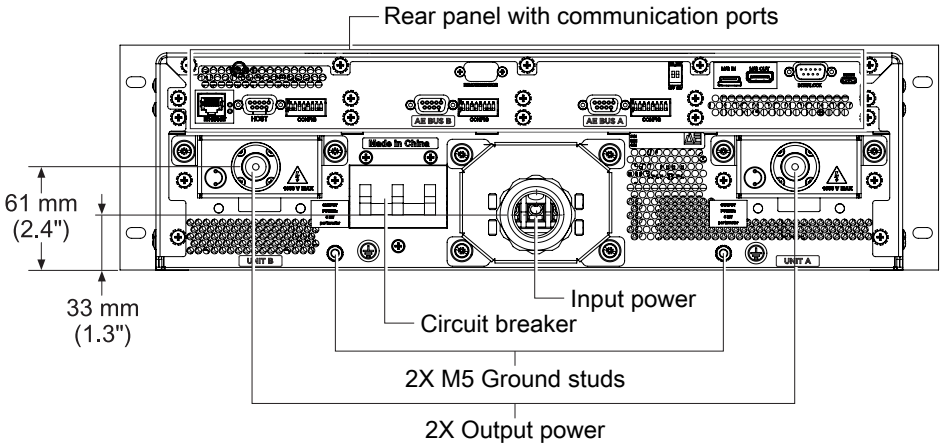


Figure 5-4. *Rear view (connectors on your unit might vary)*

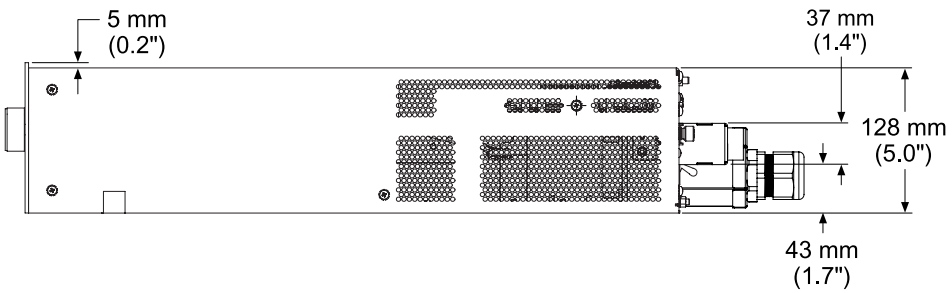


Figure 5-5. *Right side view*

REAR PANEL

Figure 5-6 shows communication ports and connectors that are common to all units. This drawing is representative. Your unit might differ from these drawings.

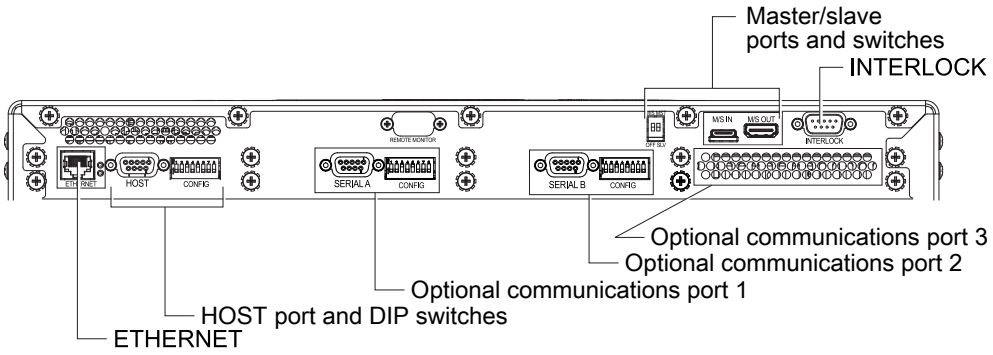


Figure 5-6. Rear panel

Cooling Requirements

To sufficiently cool the Pinnacle power supply, see product specifications in the user manual and install the cabinet as follows:

- Distribute cooling air to the power supplies.
- Prevent air exhausted from the cabinet from circulating and becoming input air.
- Exhaust the hot air from the cabinet with minimal airflow restriction.

CABINET DESIGN

The following is a synopsis of the principles to follow when designing a cabinet containing a stack of Pinnacle power supplies.

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

Each Pinnacle power supply dissipates up to 10% of its maximum power at full-rated output. Table 5-1 on page 5-6 shows the minimum air flow in cubic feet per minute (CFM) required by individual Pinnacle power supplies. The static pressure (inches of water) of the empty cabinet 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 cabinet.

For example, if three Pinnacle power supplies are mounted in a cabinet, the minimum CFM requirement would be three times the CFM of the cabinet air volume needed for an individual supply. Table 5-2 on page 5-6 shows the approximate cooling requirements for three Pinnacle power supplies mounted in a cabinet.

Table 5-1. Minimum CFM required

Power Supply	CFM Required
6x6 kW	120 CFM (56.6 liters/second)
10x10 kW	200 CFM (94.4 liters/second)

Table 5-2. Approximate cooling requirements for three Pinnacle power supplies mounted in a cabinet

Power Supply	CFM for Three Supplies	Total Power Dissipation	Temperature Difference Between Cooling [1] and Exhaust Air
6x6 kW	360 CFM (120+120+120=360) (169.9 liters/second)	3600 W (1200+1200+1200=3600)	20°C (68°F)
10x10 kW	600 CFM (200+200+200=600) (283.2 liters/second)	6000 W (2000+2000+2000=6000)	20°C (68°F)
[1] See cooling specifications for the maximum cooling air temperature.			

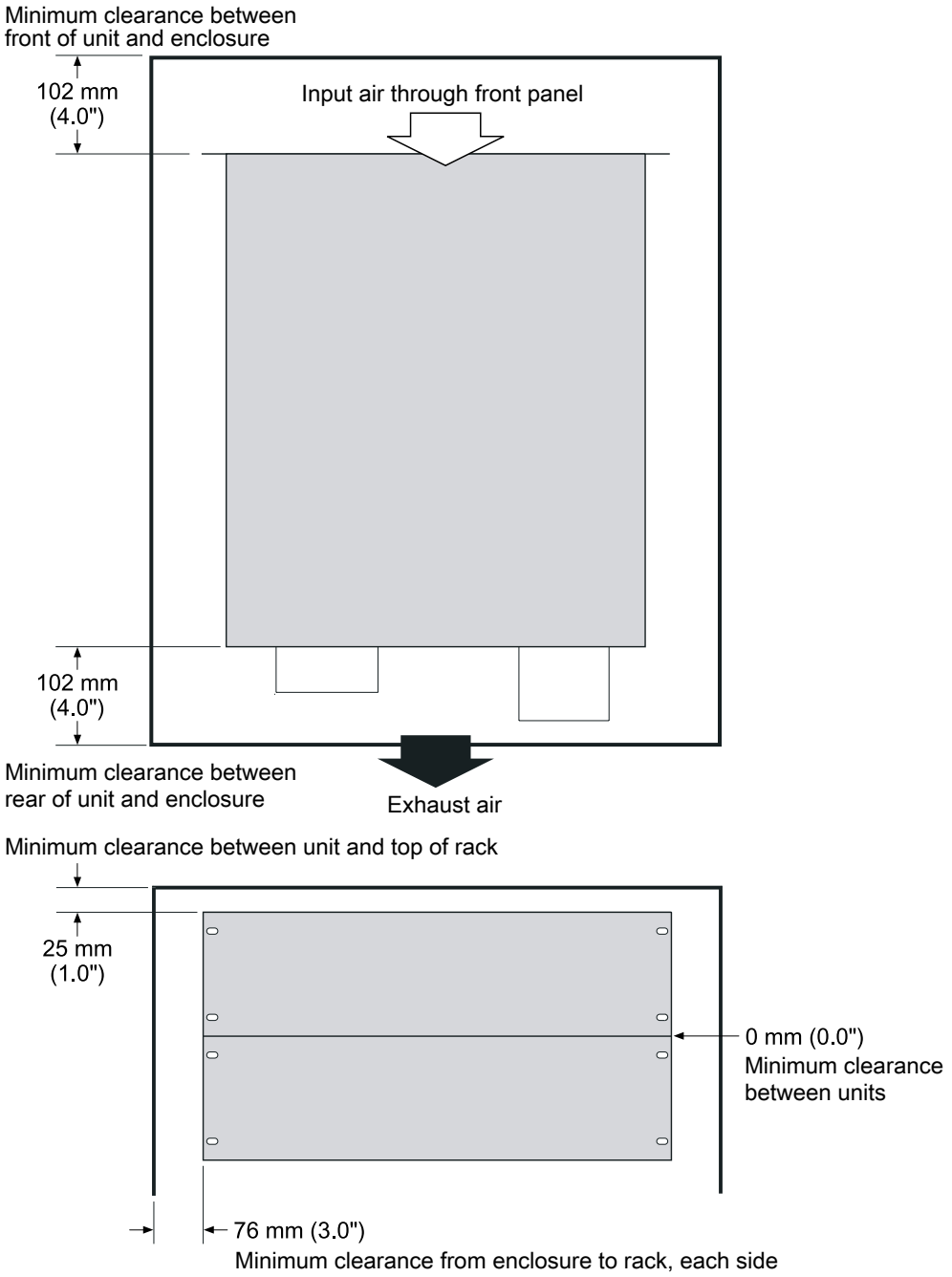


Figure 5-7. Clearances for Pinnacle power supplies stacked in a cabinet

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 3-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.

DANGER:

The Pinnacle on/off power switch does not completely disconnect the Mains. You must have an external switch installed to completely disconnect the Mains.

CAUTION:

Grounding either interlock connection does not satisfy the system interlock.

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.

CSA has evaluated this equipment only under the conditions of usage specifically described in the conditions of use section in the user manual. These conditions of use require adaptation to the following system(s) of supply:

- 208 VAC models must be on a 120/208Y 3PH+PE (4 conductor) system.

- 400 VAC models must be on a 240/416Y 3PH+PE (4 conductor) system.
- 480 VAC models must be on a 277/480Y 3PH+PE (4 conductor) system.

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.

INSTALLING THE UNIT

Related Links

- "Grounding" on page 5-10
- "Connecting the INTERLOCK Port" on page 5-10
- "Connecting Input Power" on page 5-12
- "Connecting Output Power" on page 5-15

Grounding

WARNING:

For a corner-grounded delta configuration, connect the secondary Protective Earth (ground) stud to the system ground terminal before making any other connection. This connection is mandatory.

The rear panel of the Pinnacle power supply features two M5 Protective Earth (ground) studs. These are 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 (for example, 65 A for a 208 V 20 kW unit).

For optimal performance, ground the equipotential ground stud to the system ground.

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 preventive 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.

To enable the Pinnacle 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 18 V, and it can source 60 mA. Pin 3 can sink 60 mA. The voltage on pins 3 and 4 should not exceed 20 V.

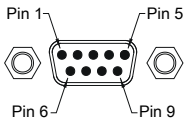


Figure 5-8. INTERLOCK port connector

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

Making Communications Connections

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 preventive measures against electromagnetic interference (EMI), including using shielded cabling on this port.

Figure 5-9 shows typical connectors for a Pinnacle power supply. The connectors vary by model. Communication port connectors 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.

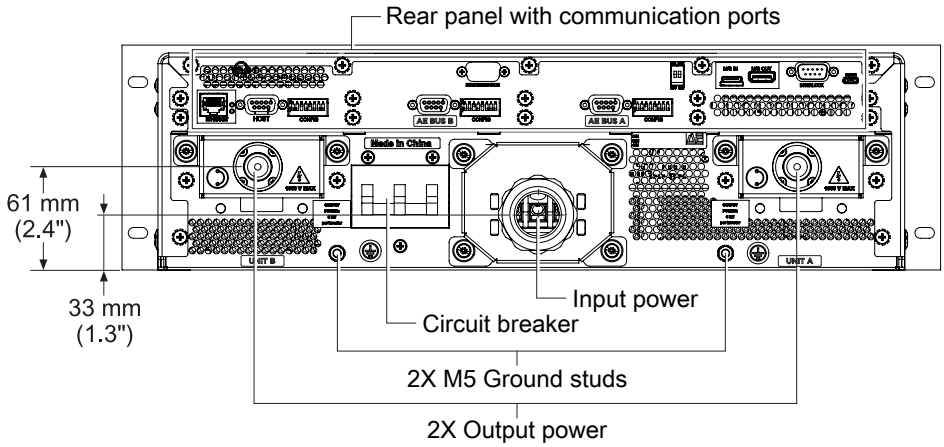


Figure 5-9. Rear view drawing

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

INPUT CONNECTOR

The Pinnacle power supply requires a 3-phase, 50 Hz to 60 Hz AC input voltage (see the electrical specifications for the AC voltage range).

The unit includes one of the following AC line input connections, located on the rear panel:

- WECO 327-FU-(HDS)-5 or equivalent five-terminal, nominal cross section area AC line input connection (units with an input voltage other than 208 V)

- WECO K007-328/04 or equivalent four-terminal AC line input connection (units with an input voltage of 208 V)

Related Links

• "Electrical Specifications" on page 3-2

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.

While AE cannot recommend a maximum cable length, input cables exceeding certain lengths can cause instability in rectified bus voltage inside the unit. This can cause output power fluctuations and bus faults which interrupt process power for 10 ms. In extreme cases, this can cause limitations in the maximum output power deliverable to a load in master/slave or standalone systems. This effect is due to excess line inductance. AE recommends the line-to-nuetral inductance not exceed 90 µH/*n*, where *n* is the number of units.

FOUR-TERMINAL INPUT CONNECTOR (208 V UNITS)

Use this section for units with 208 V input voltage.

To connect to the four-terminal input power connector:

1. Remove the strain relief housing.
2. Prepare the cable as needed and pass the cable through the strain relief.

   ☞ **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.

   Strip the wire insulation to enable connection (WECO specifies a strip length of 13 mm [0.5″]). AE recommends using wire ferrules (from WECO or another vendor) to keep the wires from fraying too much during tightening.
3. Connect the AC line input to the four-terminal, screw terminal connector located on the rear panel of the unit and tighten to 2.6 Nm (23 in-lbs). Labels on the input terminal shield identify the line (**L3**, **L2**, and **L1**).
4. Replace the strain relief housing.

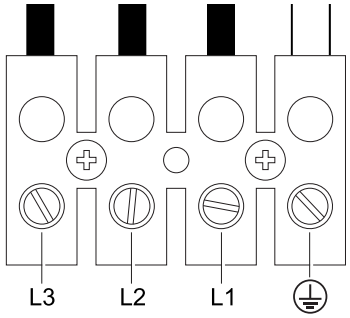


Figure 5-10. Four-terminal input power connector (208 V units)

FIVE-TERMINAL INPUT CONNECTOR

To connect to the five-terminal input power connector:

1. Remove the strain relief housing.
2. Prepare the cable as needed and pass the cable through the strain relief.

   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.

   Strip the wire insulation to enable connection (WECO specifies a strip length of 9 mm [0.35″]). AE recommends using wire ferrules (from WECO or another vendor) to keep the wires from fraying too much during tightening.
3. Connect the AC line input to the five-terminal, screw terminal connector located on the rear panel of the unit and tighten to 1.8 Nm (16 in-lbs). Labels on the input terminal shield identify the line (**L3**, **L2**, **L1**), neutral (**N**), and Protective Earth (ground) connections.

   You are not required to make a neutral input connection. However, if a neutral wire exists for the cable connection, connect it to the **N** terminal.
4. Replace the strain relief housing.

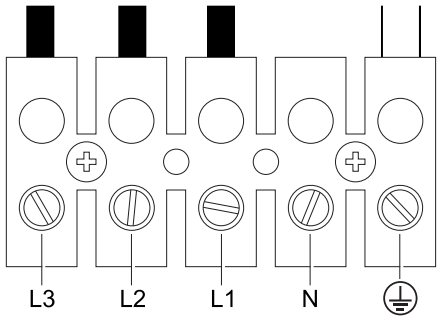


Figure 5-11. Five-terminal input power connector

Connecting Output Power

See the appropriate section for information on how to connect your output connector for the Pinnacle power supply. Each section contains a drawing of the output connector to help you determine your type of output connection.

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 Pinnacle unit. To comply with EMI/EMC standards, use a shielded output cable and connect the shield to the ground terminal on the Pinnacle power supply output connector. 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 Pinnacle 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
- “UHF Output Connector” on page 5-16
- “Three-Terminal, Multicontact, Pluggable Connector (Standard)” on page 5-21

MILITARY STYLE MS-3470 OUTPUT CONNECTOR

Important

Before making your output power connection, see “Connecting Output Power” on page 5-15 for safety information and requirements.

WARNING:

To meet SELV (Safe Extra Low Voltage) requirements, you must tie the positive output to chamber ground. Do not allow either positive connection to exceed ± 40 V with respect to ground.

The output connector for your Pinnacle power supply is a female, military style MS-3470 connector, as shown in the following illustration. Before working with this connector, you should note its military specification number and pin descriptions. Your dual unit features two of these connectors.

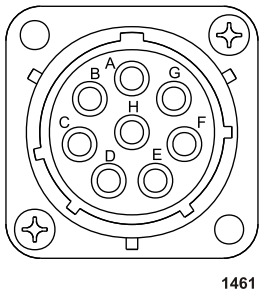


Figure 5-12. MS-3470 output connector

Military Spec Number

The full military specification number for this connector is MS-3470-L18-8S. Cabling and other attached components (for example, a mating connector) for this connector also have mil-spec numbers. To configure and/or assemble connecting components, refer to the appropriate mil-spec for specifications.

Pin Descriptions

Table 5-3. Military-style MS-3470 output connector pin descriptions

Pin	Description
A	Unused
B	Positive output
C	Ground
D	Interlock
E	Interlock
F	Ground
G	Unused
H	Negative output

UHF OUTPUT CONNECTOR

Important

Before making your output power connection, see "Connecting Output Power" on page 5-15 for safety information and requirements.

WARNING:

To meet SELV (Safe Extra Low Voltage) requirements, you must tie the positive output to chamber ground. Do not allow either positive connection to exceed ± 40 V with respect to ground.

The output connector for your Pinnacle power supply is a female UHF connector as shown in the following figure. Your dual unit features two of these connectors.

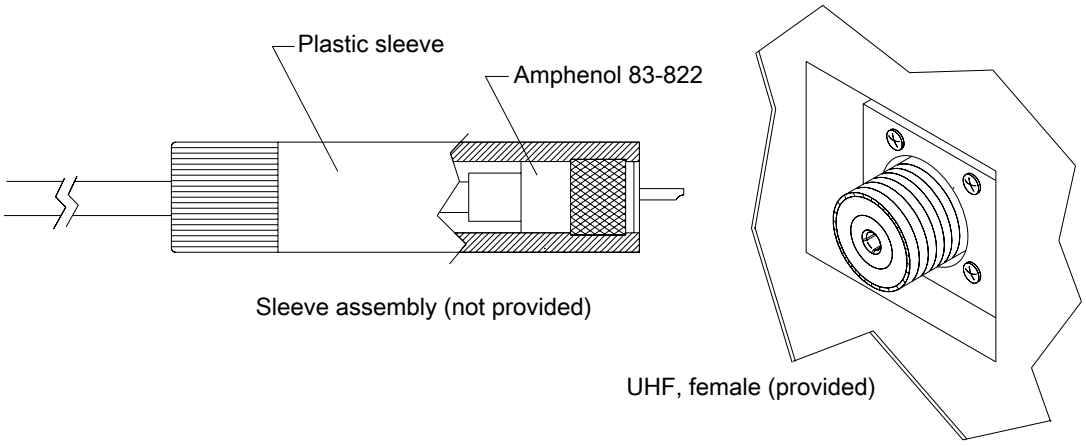


Figure 5-13. UHF connector and sleeve assembly

Important

Advanced Energy does not provide the sleeve assembly and male connector with your unit at the time of shipment, but you can order these parts separately through Advanced Energy using AE part number 3052078. Advanced Energy does not provide the cable and you cannot purchase it through Advanced Energy.

Military Spec Number

The military specification number for this connector is SO-239. Select cables and tools appropriate for this mil-spec, and assemble connecting materials according to specifications. Some UHF connectors provide interlock capability.

UHF Connection Interlock Capability

The following illustration shows the UHF connector without interlock capability.

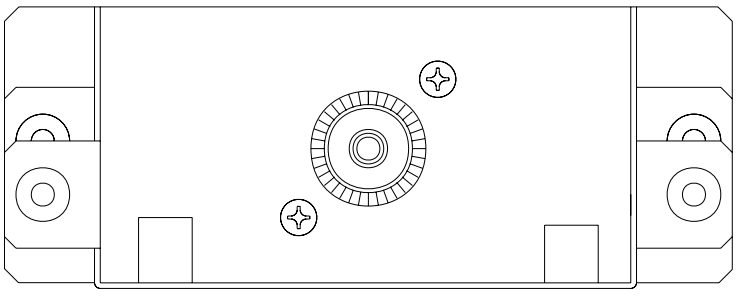


Figure 5-14. Rear view of UHF housing without interlock (back plate removed)

The following illustration shows a UHF connector with interlock capability. The interlock is closed when the connector housing back plate (with its three interlock pins) is properly attached. When you remove the back plate, the interlock is open and output from your Pinnacle power supply is turned off.

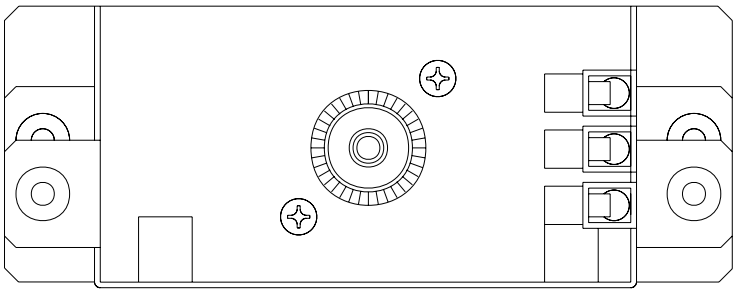


Figure 5-15. Rear view of UHF housing with interlock (back plate removed)

TERMINAL BLOCK OUTPUT CONNECTOR WITH 1/4-20 AND 10-32 RING LUG CONNECTIONS

☞ **Important**

Before making your output power connection, see "Connecting Output Power" on page 5-15 for safety information and requirements.

WARNING:

To meet SELV (Safe Extra Low Voltage) requirements, you must tie the positive output to chamber ground. Do not allow either positive connection to exceed ± 40 V with respect to ground.

The terminal block output connector for your Pinnacle power supply provides two studs as ring lug terminals that vary in size. Use the 1/4-20 terminal for the positive (+) connection and the 10-32 terminal for the negative (–) connection. A strain relief box is provided with the connector, but the output cable is not provided.

The strain relief provides output interlock, but it does not provide grounding.

Cabling Requirements and Preparation

With this connector, we recommend using a UL-type CATVP cable or equivalent. While we cannot recommend a maximum cable length, a long cable or small wire gauge can affect the accuracy of the power supply's voltage and power metering circuits, thus affecting the process voltage and power accuracy. This is due to the voltage drop along the cable and power delivered to the cable. We recommend you consider this when designing a system or process.

Use the following steps to prepare the output cable:

1. Strip approximately 70 mm (2.76″) from the end of the power cord.

2. Separate the wires and strip approximately 10 mm (0.40″) of the insulation from each wire.

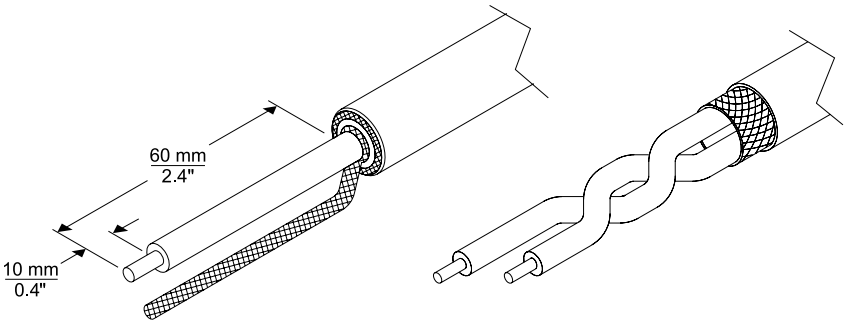


Figure 5-16. Output cable preparation

When connecting the Pinnacle power supply output to the system, ensure that the cable shield (also the positive) connects with the chamber ground and that the negative wire (cable core) connects to the target.

Negative Output Configuration

The most important configuration for sputtering applications is negative output (negative voltage with respect to ground). To achieve negative output, connect the Pinnacle power supply negative terminal on the output connector to the chamber cathode. Connect the positive terminal on the power supply output connector to the chamber common or ground.

Positive Output Configuration

For special applications that require a positive output voltage (positive with respect to ground), connect the Pinnacle power supply positive terminal on the output connector to the load. Connect the negative terminal on the power supply output connector to the load common or ground.

Use the ground terminal on the Pinnacle power supply output connector to terminate the output cable shield only. Neither the terminal nor the outer shield of the output cable should carry load current. Do not use the power supply ground terminal as a system ground. Do not connect a current-carrying conductor to the terminal, even if the conductor is a shield element of the cable.

Floating Output Configuration

You can configure the Pinnacle power supply output such that neither the positive output terminal nor the negative output terminal have a direct connection to ground (floating output). To achieve the floating output configuration, connect either the positive or the negative terminal of the Pinnacle power supply output connector to the load, and connect the opposite polarity terminal to ground indirectly through a passive component or a second power source.

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 ±1800 V with respect to ground.

Optimal Output Connection

You must use a shielded output cable between the Pinnacle power supply and your chamber to comply with EMI/EMC standards. Using a shielded cable minimizes system noise from chamber arcs and takes full advantage of the improved process rate in the Pinnacle power supply.

See the following figure for an illustration of the optimal output connection using shielded cable.

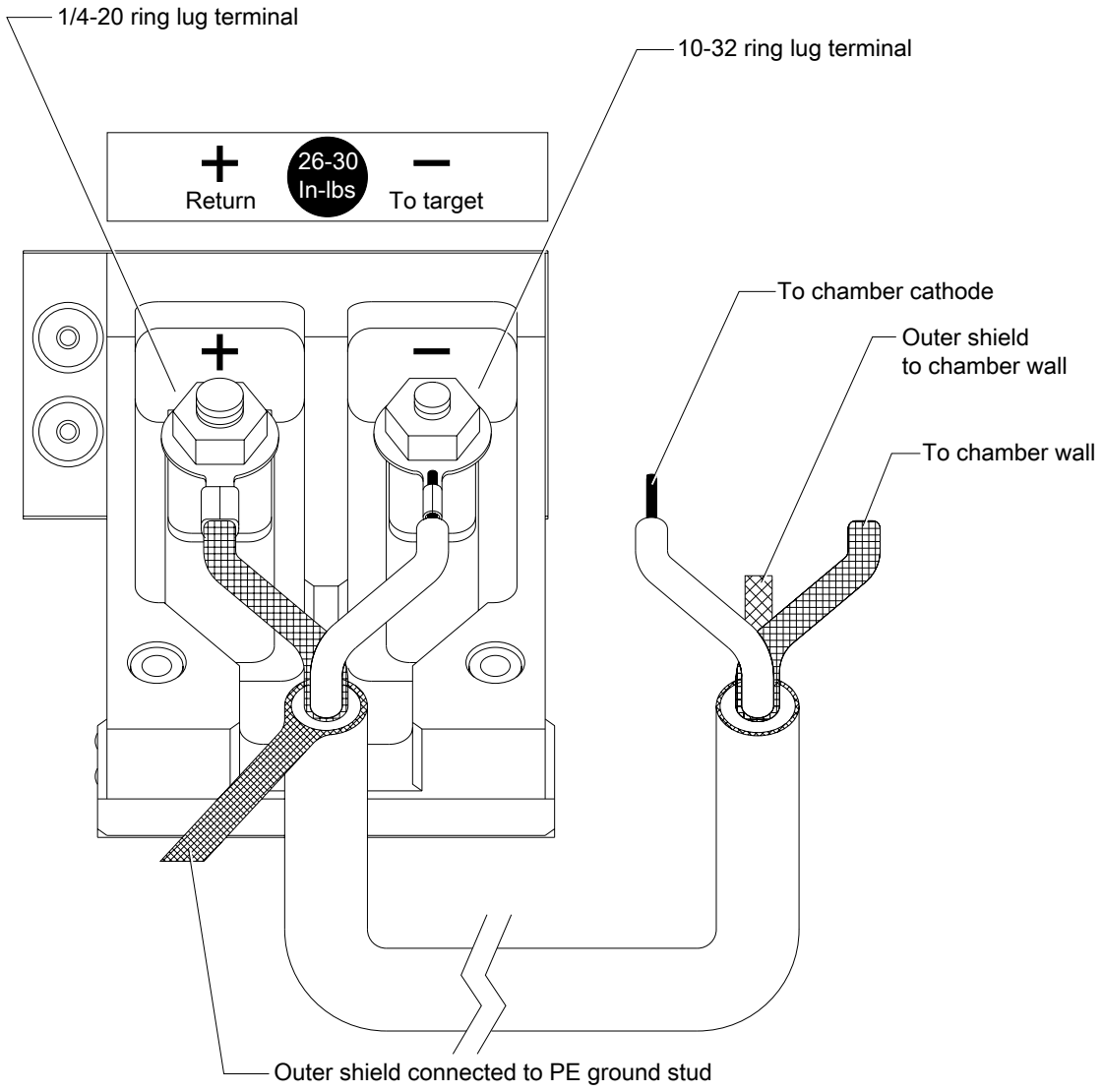


Figure 5-17. Optimal output connection using triax cable

THREE-TERMINAL, MULTICONTACT, PLUGGABLE CONNECTOR (STANDARD)

Important

Before making your output power connection, see "Connecting Output Power" on page 5-15 for safety information and requirements.

WARNING:

To meet SELV (Safe Extra Low Voltage) requirements, you must tie the positive output to chamber ground. Do not allow either positive connection to exceed ± 40 V with respect to ground.

The standard output connector is a three-terminal, multicontact, pluggable connector (see Figure 5-18).

The cables for the output connection are not included with the Pinnacle power supply. Use connecting wire consistent with your application and applicable requirements.

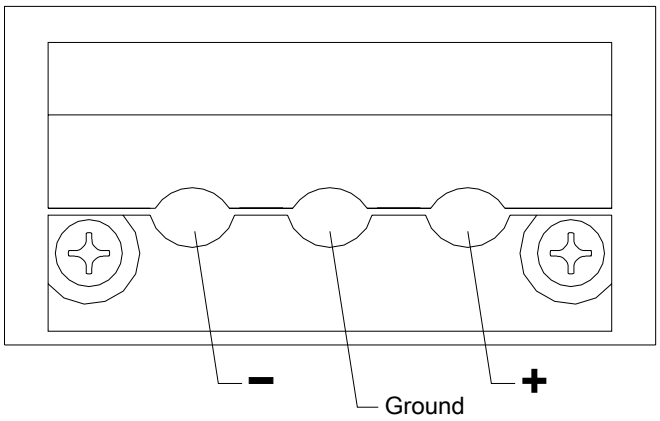


Figure 5-18. Three-terminal, multicontact, pluggable connector

Strain Relief Fitting

The three-terminal, multicontact output connector includes a liquid-tight, grounded strain relief fitting. Depending on the option ordered for your power supply, the fitting will be one of the following options:

- PG-11 style with 19 mm (0.75″) diameter
- PG-16 style with 23 mm (0.90″) diameter
- PG-36 style with 47 mm (1.85″) diameter
- M-25 style with 25 mm (0.98″) diameter
- M-32 style with 34 mm (1.34″) diameter

You might also have a triax cable termination package. The dimensions of the fittings are slightly different, but they function essentially the same.

On dual output units, each output connector has the same size and type of strain relief fitting.

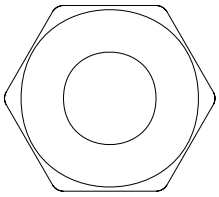


Figure 5-19. PG style strain relief fitting

Triax Cable Diameters for Strain Relief Fittings

Table 5-4. Triax cable diameters

Strain Relief Fitting	Outside Diameter of Cable
PG-11 style	8.5 mm (0.33″) minimum 11 mm (0.43″) maximum
PG-16 style	12.0 mm (0.47″) minimum 14 mm (0.55″) maximum
PG-36 style	31 mm (1.22″) minimum 33.5 mm (1.32″) maximum
M-25 style	9 mm (0.35″) minimum 16 mm (0.63″) maximum
M-32 style	15 mm (0.59″) minimum 21 mm (0.83″) maximum

Negative Output Configuration

The most common output configuration for sputtering applications is negative output (negative voltage with respect to ground). To achieve negative output, connect the power supply negative terminal on the output connector to the chamber cathode. Connect the positive terminal on the power supply output connector to the chamber common or ground.

Positive Output Configuration

If your application requires a positive output voltage (positive with respect to ground), please contact AE Global Services for information.

Floating Output Configuration

If your application requires floating output (neither the positive output terminal nor the negative output terminal have a direct connection to ground), please contact AE Global Services for information.

Optimal Output Connection

Use shielded output cable between the Pinnacle power supply and your chamber to comply with EMI/EMC standards. Using shielded cable minimizes system noise from chamber arcs and takes full advantage of the power supply improved process rate.

See the following figure for an illustration of the optimal output connection using shielded cable.

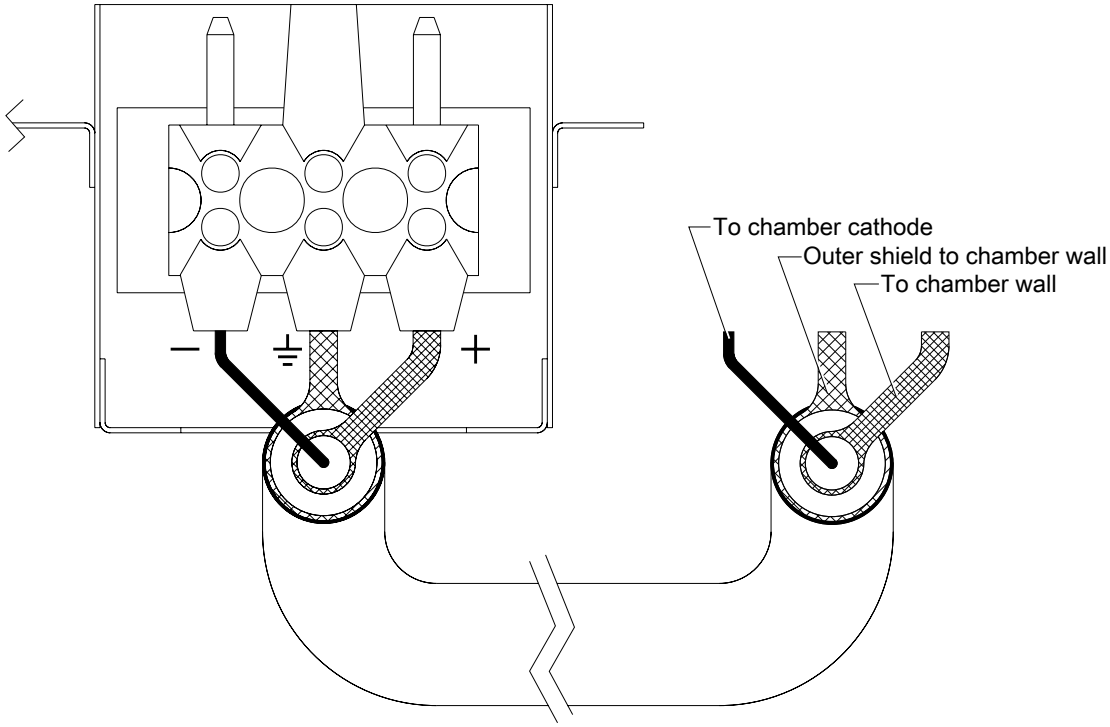


Figure 5-20. *Optimal output connection using triax cable*

The most effective output connection has the following qualities:

- The outer shield should be terminated at both ends. Terminate the outer shield at the ground connection provided at the Pinnacle output connector.
- The current-carrying elements of the output cable should be in close proximity to each other to minimize magnetic noise fields. (The conducting elements are those parts of the cable connected to the positive and negative terminals on the Pinnacle output connector.) Magnetic noise fields occur in a size proportional to the loop area between the conducting elements. If you minimize the loop area, you can minimize the magnetic noise.

Two styles of output cabling satisfy both of the described conditions: triax cabling and twinax cabling. Triax cable is much like coax cable, except that triax contains an additional shield that surrounds an inner shield and center conductor. Twinax cable consists of a twisted pair of wires that are surrounded by an outer shield. Regardless of which style output cable you use, do not allow the outer shield to carry load current.

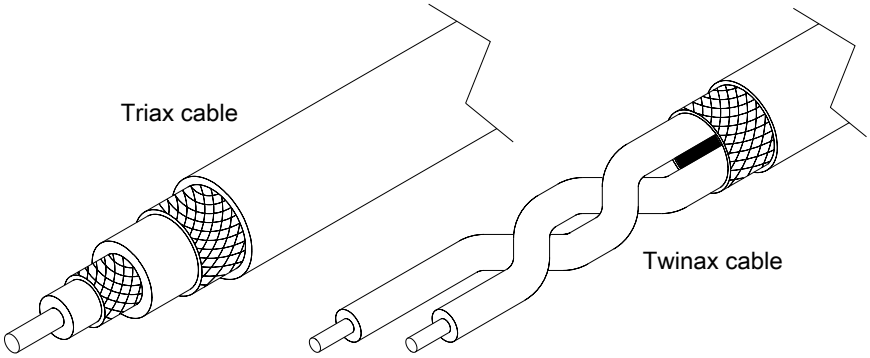


Figure 5-21. *Two styles of cables for optimal output connection*

To Connect the Three-Terminal, Multicontact Pluggable Output Connector

1. Disconnect all sources of input power to the Pinnacle power supply.
2. Prepare the appropriate output cable. AE recommends triaxial cable.
3. Remove the output box.
4. Remove the cover from the output box, but note the relative positions of positive, negative, and ground.
5. Turn the braided shield up over the fitting sealing insert and clamp in place with the seal ring.
6. Attach the output cable wires to the three terminals for your selected mode of output (negative or positive) by stripping approximately 1 cm (0.4″) of insulation from the end of the cable to expose the three wires, feeding one wire into each opening according to the labels on the output connector, and tightening the two small screws on each compression terminal.
7. Lock the strain relief fitting in place with the lock nut.
8. Replace the output box and cover.

Output Box and Connector Diagrams

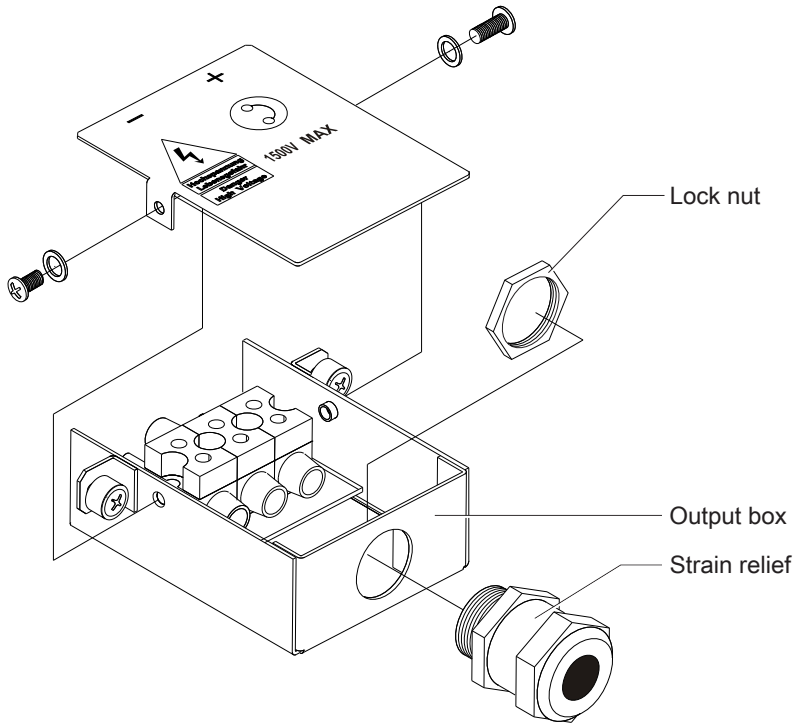


Figure 5-22. *Output box and connector for PG-11, PG-16, and M-25 style fittings*

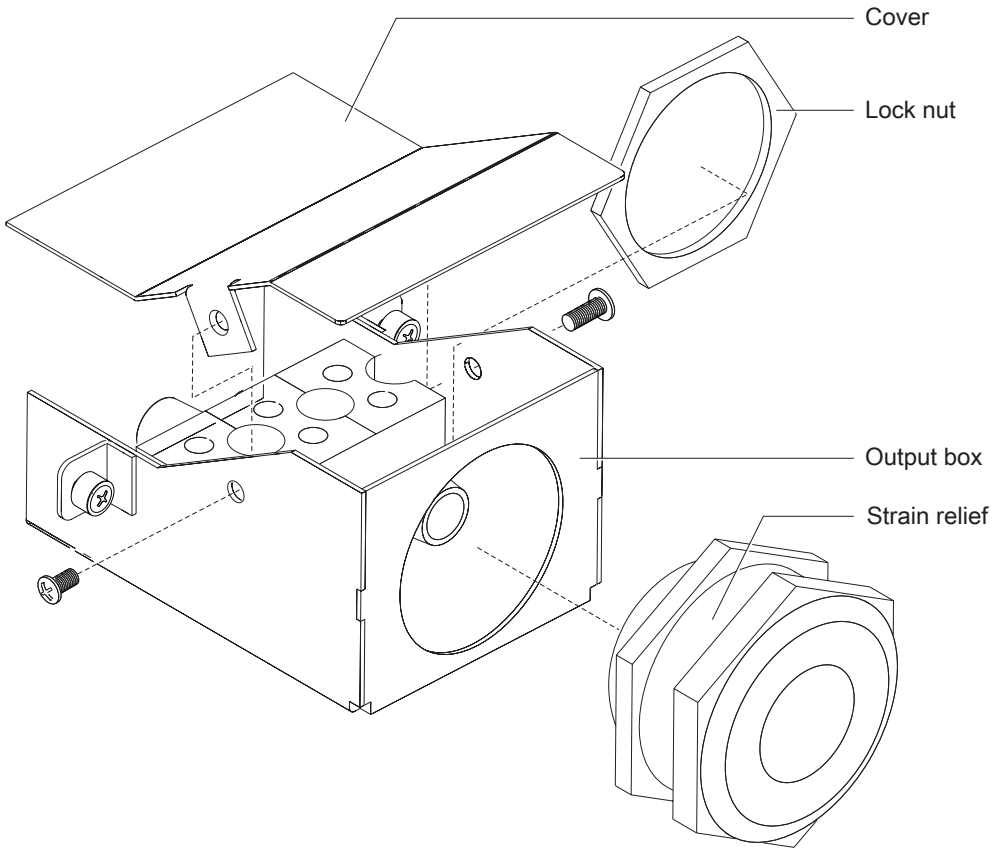


Figure 5-23. *Output box and connector for PG-36 style fitting*

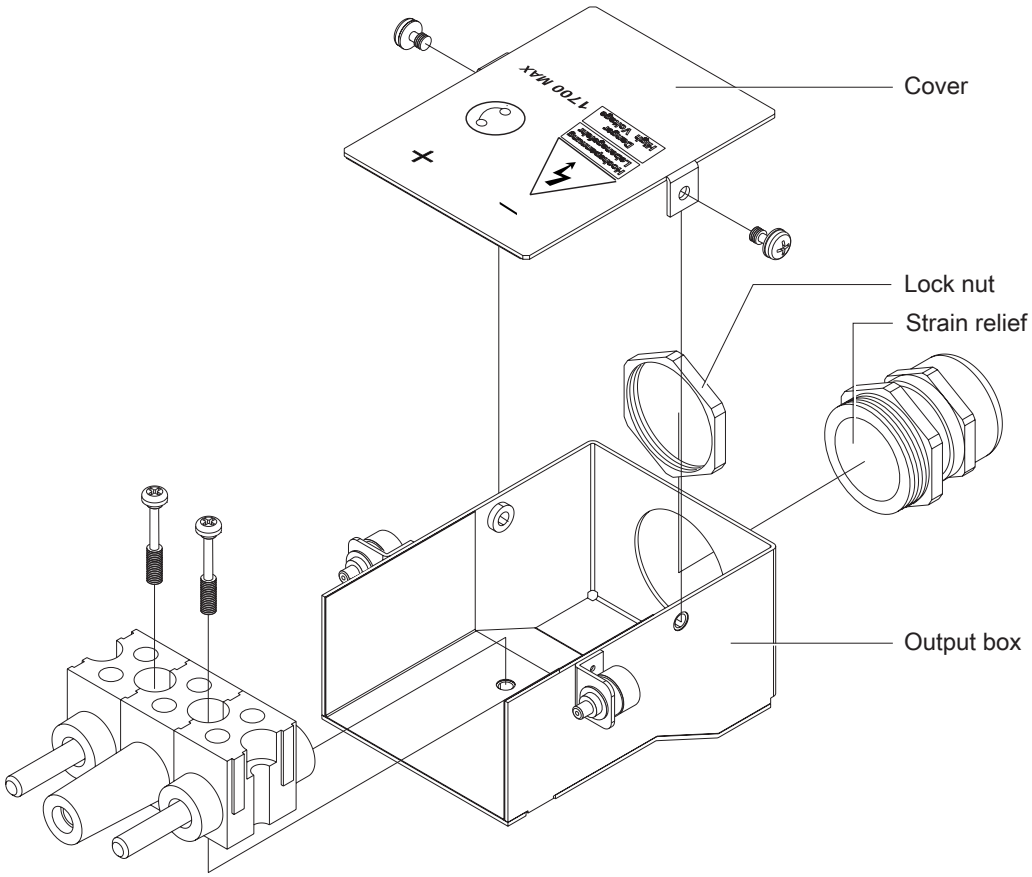


Figure 5-24. Output box and connector for M-32 style fitting

NORMAL OPERATION

The following list provides a general description of how to operate the Pinnacle power supply. You will want to adapt this list to your power supply configuration and your application, environment, and requirements.

1. Supply power to the unit.
2. Verify which power supply LEDs are lit:
   - **Power On** and **Interlock**: Should be lit
   - All other LEDs: Should be unlit
3. If no LEDs are lit, ensure that the unit is properly installed and is receiving AC input power.
4. Select a method of control:
   - Host control mode (using the **HOST** port)
   - User control mode (using the **USER** port)

User control mode is the default. You can change the control mode via:

- Through a host port by using the Virtual Front Panel (VFP) application or other software
- AE Host command **14**

You cannot set ramping recipes when in user control mode.

5. 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.

6. Enter a setpoint value.
7. If necessary and if the unit supports the feature, enter the following parameters through the communications port:
   - Enable joule mode and select a setpoint in joules.
   - Enable target life counters and select a target life for each applicable target.
   - Enter appropriate arc management parameters for your normal process cycle.
   - Create a ramping recipe.
   - Set the out-of-setpoint timer to a value other than 0.
8. If necessary, set limits for output power, output voltage, output current, strike voltage, and/or process 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.

9. Verify all output power load conditions and connections, and, when the system is ready, enable the output.
10. Verify the status of the power supply LEDs:
    - **Power On**, **Output**, **Setpoint**, **Interlock**: Should be lit.
    - All other LEDs: Should be unlit.

Related Links

- “Status Indicators (LED Troubleshooting)” on page 6-4

JOULE MODE

Understanding Joule Mode

☞ **Important**
Some Pinnacle units have limited features by design. Your unit might not include this feature.

Joule mode allows you to regulate Pinnacle power supply output by defining the number of joules that the unit will deliver in an output-on session. In joule mode, when output turns on the unit begins calculating the number of joules the system puts out. When the cumulative output reaches the joule setpoint, the unit shuts output off.

☞ **Important**
In a master/slave system, joules delivered is calculated using the output of the entire system, not just the individual unit.

Joule Mode Parameters

Joule mode operates on two parameters:

- Unit setpoint—Sets the power, voltage, or current level at which the Pinnacle unit will produce output
- Joule setpoint—The number of joules that the unit delivers before turning output off

You can set these parameters using any of the following methods:

- Active panel
- Through a host port by using the Virtual Front Panel (VFP) application or other software
- AE Host port commands **4**, **5**, and **26**

RECIPES

Understanding Recipes

A recipe allows you to program the Pinnacle power supply to ramp to the unit setpoint in incremental steps. You can program a recipe with one to eight steps. You can use one of two types of recipe:

- Timed: The incremental steps are in seconds.

- Joule: The incremental steps are a number of joules (watts x seconds). You can select one of two types of joule recipe:
  - Joule continuous: When the unit completes one step, it automatically progresses to the next step.
  - Joule discrete: The unit does not automatically progress from step to step. When the unit completes one step, it turns output off. To proceed to the next step, you must turn output on.

☞ **Important**
In a master/slave system, joules delivered is calculated using the output of the entire system, not just the individual unit.

Do not confuse joule recipes with joule mode. If you are using joule recipes, you cannot use the standard joule mode. You can set up both joule recipes and joule mode; however, running joule recipes takes precedence.

Recipe Parameters

The recipe feature of the Pinnacle unit operates on several parameters. You can set these parameters using any of the following methods:

- An active panel
- Through a serial port by using the Virtual Front Panel (VFP) application or other software
- AE Host commands

Parameter	Description	Related Commands
Recipe steps	The number of steps in the recipe. Command **179** reports which step is currently active.	Set: **19** Report: **180**
Ramp time	The amount of time (in seconds) that the power supply takes to ramp up to the setpoint for the specified step.	Set: **21** Report: **181**
Setpoint	The value (in the active regulation mode) that the power supply must ramp up to for the specified step.	Set: **22** Report: **182**
Runtime	The amount of time (in seconds) the power supply runs at setpoint for the specified step.	Set: **23** Report: **183**
Regulation mode	Set power, voltage, or current regulation mode for the recipe step.	Set: **20** Report: **182**

IGNITION VOLTAGE

Understanding Ignition Voltage

To ignite a plasma, the Pinnacle power supply produces higher-than-full-power output voltage. The unit automatically enters ignition mode upon enabling the output current. At that point, the unit switches to voltage regulation mode and drives output toward the preset ignition profile. When the output current rises above the factory-configured level, the unit leaves ignition mode, switching back to the normal regulation mode and setpoint.

You can set these parameters using any of the following methods:

- Active panel
- Through a host port by using the Virtual Front Panel (VFP) application or other software
- AE Host port command **52**

TARGET LIFE

Understanding Target Life

Target life is the number of kilowatt-hours you can use a target.

You can set the target life for up to eight targets and select an active target (the target to use in your process). The Pinnacle power supply includes a target life counter, which counts down the life of the active target.

If the target life expires when output is on, the Pinnacle power supply does not shut output off. However, once output is turned off, you cannot turn it back on until you have reset the target life, changed the active target, or disabled the target life feature.

☞ **Important**
In a master/slave system, the target life is calculated using the output of the entire system, not just an individual unit.

Target Life Parameters

Target life involves three parameters:

- Enable target life counter—Turns on the feature.
- Target—Selects which target to use as the active target.

- Target life—Sets the number of kilowatt-hours you want to use the target.

  ☞ **Important**
  In a master/slave system, the target life is calculated using the output of the entire system, not just an individual unit.

When selecting targets, the **USER** port setting has priority over other control mechanisms (such as the remote active panel or Virtual Front Panel (VFP) software). Leaving the target bits open or leaving the **USER** port pins unconnected causes the target selection at the **USER** port to default to 1. If your unit has a user card installed, you must set the target to "1" at the **USER** port, and then you can select targets using the serial port or remote active panel.

You can set these parameters using any of the following methods:

- Through a serial port by using the Virtual Front Panel (VFP) application or other software
- AE Host commands

  Applicable AE Host commands are **11**, **12**, and **13**.

The end-of-target-life is reported with AE Host command **162**.

RAMP MODE

Understanding Ramp Mode

Ramp mode allows Pinnacle power supply output to change from one level to another at a defined rate of change. When ramp mode is enabled, each time output turns on, the Pinnacle unit changes output from a specified percentage of setpoint to full setpoint over a specified time.

Ramp Mode Parameters

Ramp mode operates on four parameters. You can set these parameters using any of the following methods:

- Through a serial port by using the Virtual Front Panel (VFP) application or other software
- AE Host commands

Table 5-5. Ramp mode parameters

Parameter	Description	Related AE Host Commands
Unit setpoint	Sets the power, voltage, or current level at which the Pinnacle unit will produce output.	Set: **6** Report: **164**
Ramp mode enable	Turns the ramp mode on.	Set: **15**
Start percentage	Sets the percentage of the unit setpoint at which the unit begins to ramp when output turns on. ☞ **Important** This feature applies to only the regular ramp mode and not to the ramp mode in a timed recipe.	Set: **32** Report: **152**
Ramp time	Sets the time over which the unit ramps from the start percentage to the full setpoint. The out-of-setpoint timer is disabled while output is ramping.	Set: **16** Report: **158**

OUT-OF-SETPOINT TIMER

Understanding the Out-of-Setpoint Timer

For several reasons, a unit might start to operate at values that do not match the setpoint. The Pinnacle power supply has a setpoint tolerance range that equals the setpoint ± 1% of full scale or 5% of setpoint—whichever is greater. (The setpoint tolerance values are factory configurable.) If the output remains within this tolerance range, the unit continues to operate as if it were operating at setpoint with the **Setpoint** and **Output** status indicators lit. If output exceeds the tolerance of the setpoint, the unit will continue to generate output but the **Setpoint** status indicator will not be lit. In addition, if you are using the 37-pin **USER** port the $\overline{SETPOINT.D}$ signal will be deasserted.

When enabled, the out-of-setpoint timer sets the amount of time the unit will continue to operate out of setpoint before turning the output off. If the out-of-setpoint timer turns the output off, a setpoint timer fault is reported.

Out-of-Setpoint Timer Parameter

Setting the out-of-setpoint timer to a value greater than zero enables the out-of-setpoint feature. A value of zero disables the out-of-setpoint timer.

You can set this parameter using any of the following methods:

- Active panel
- Through a host port by using the Virtual Front Panel (VFP) application or other software
- AE Host command **31**

UNDERSTANDING ARC MANAGEMENT

Arc management is always enabled on the Pinnacle power supply.

Figure 5-25 illustrates the stages that the Pinnacle unit goes through during the arc management process, including the user-settable parameters. As shown in the illustration, arc management is triggered when the voltage level crosses the voltage arc (VArc) sense level.

Persistence time is the time the arc condition must be continuously met before the system will register an arc and shut down. If the voltage rises above the threshold before the timer is expired, the timer will reset. Excessive ringing on the output due to inductive and capacitive cables may extend the time before the arc is detected. Persistence time is sometimes referred to as detect time.

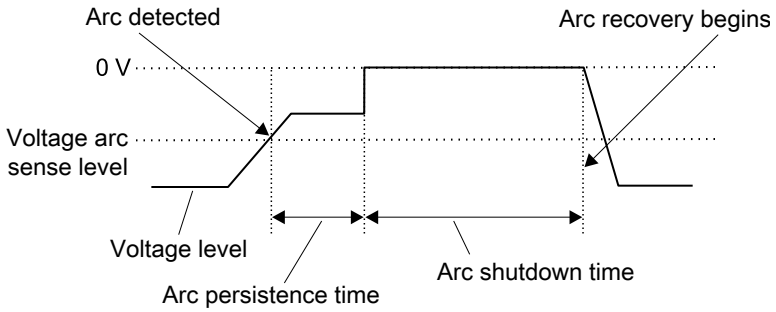


Figure 5-25. *Arc management waveform*

The following sections describe the arc management parameters that can be set, and also provide additional information about the arc management process.

Voltage Arc (VArc) Sense Level

The voltage arc (VArc) sense level is the voltage threshold, as measured at the output of the unit, at which the Pinnacle power supply recognizes an arc. The best value for a voltage arc sense level is somewhere between normal operating voltage for your process and the typical low voltage that occurs when your system experiences a hard arc.

☞ **Important**

Some target types experience hard arcs at 100 V, so do not assume that 50 V is right for all processes.

If the output voltage falls below the VArc sense level and the current exceeds 5% of the full rated system current, an arc event starts the persistence timer. Persistence time (time an arc condition must be continuously satisfied before the unit responds to an arc) is 50 µs (default).

You can set the VArc sense level using any of the following methods:

- Through a host port by using the Virtual Front Panel (VFP) application or other software
- AE Host command **10**

Arc Persistence and Arc Shutdown (Target Type)

Arc persistence and arc shutdown timers affect the arc management response. The unit provides preset values for these parameters, depending on target type. You can also create custom settings You can select from the following target types:

- Predefined target types: metal or nonmetal—These settings provide preset values for arc persistence and arc shutdown.
- Custom—With custom settings, you can select from a range of values for arc persistence and arc shutdown. These timers are set with two index values. One index sets the arc shutdown. The other index sets the arc persistence.

You can set the target type using any of the following methods:

- Through a host port by using the Virtual Front Panel (VFP) application or other software
- AE Host command **30**

Custom Arc Management Settings

With custom settings, you can select from a range of values for arc persistence and arc shutdown.

With custom arc management, you can make the following settings:

- Arc persistence time
- Arc shutdown time

Settings should be made based on target conditions.

Arc persistence time—Time an arc condition must be continuously satisfied before the unit responds to an arc. The following list provides some suggestions for making this setting:

- For target conditions that experience self-extinguishing arcs (micro arcs), select a persistence time of 2 µs to 5 µs.

- For times when you want to deliver more energy to the arc nucleation site, select one of the longer persistence times (10 µs to 500 µs).

☞ **Important**
The Pinnacle power supply design greatly reduces the power supply stored energy. However, there are occasions when your Pinnacle power supply can enhance your process by delivering more energy during arc events. You can achieve this effect by increasing the persistence time. Where possible, avoid long arc persistence times.

Arc shutdown time—The length of time that the Pinnacle power supply interrupts power flow in response to an arc.

To extinguish an arc properly, the power supply must interrupt power until the output (arc) current decays to a value near 0. The decay of output current largely depends on system cable inductance and the impedance of the arc. If you select an arc shutdown time that is shorter than the actual decay time of the arc current, then the Pinnacle power supply automatically extends the shutdown time.

You can set these parameters using any of the following methods:

- Active panel (**ARC** menu)
- Through a host port by using the Virtual Front Panel (VFP) application or other software
- AE Host commands:
  - Persistence time: command **8**
  - Shutdown time: command **8**

Single 10 kW and 20 kW Pinnacle units with a 208 V input configuration have a minimum arc shutdown time of 50 µs.

Dual units with a 10 kW inverter and a 208 V input configuration have a minimum arc shutdown time of 50 µs.

Arc Management Response Mode

The single Pinnacle power supply features two arc management modes: standard and persistent.

Some units include only the standard arc management mode.

You can make this setting using any of the following methods:

- Active panel (**ARC** menu)
- Through a host port by using the Virtual Front Panel (VFP) application or other software

- AE Host command **63**

Arc Management Response Time

The single Pinnacle power supply features two ranges of arc response times: fast and slow. These ranges act in tandem with the selected arc management mode to provide an array of possible arc persistence and arc response times.

You can make this setting using any of the following methods:

- Active panel (**ARC** menu)
- Through a host port by using the Virtual Front Panel (VFP) application or other software
- AE Host command **62**

Arc Recovery Test

After the arc shutdown time has expired, the Pinnacle power supply reapplies output power to the load and examines the output voltage level.

The output voltage must rise above your selected VArc sense level within an internally fixed time of 10 µs. If the output voltage rises above the VArc sense level before the 10 µs period has ended, the unit will resume normal output. If the output voltage does not rise above the VArc sense level by the end of the 10 µs time limit, then the unit initiates another arc shutdown.

Arc Limit Warning

For a dual Pinnacle unit, the arc limit feature acts as a warning signal that indicates that greater than a specified number of arcs occurred during a process run.

You can enable this feature by setting the hard arc count limit using any of the following methods:

- Active front panel
- Through a host port by using the Virtual Front Panel (VFP) application or other software
- AE Host command **9**

A value of zero disables the arc limit function.

The arc limit is a fixed count limit, meaning the limit count is reset at the beginning of each run and the count continues (towards the limit) throughout the entire run. If the arc limit is reached during a run, when output is turned off the **Arc** LED on the front panel is active for approximately 100 ms. If your unit includes the 37-pin **USER** port, the *ARC.D* **USER** port signal is active for approximately 100 ms.

If the unit has been configured for signaling on every arc response, the **Arc** LED will blip for a predetermined time for every hard arc detected by the unit. If another hard

arc is detected before the last blip is complete, the blip pulse width will be refreshed to the full width.

Arc Limit Fault

For single Pinnacle units, an alternate configuration (set at the manufacturer) is the arc limit fault feature. This feature creates a unit fault and shuts output power off when the arc limit is exceeded during a process run.

Once you enter an arc count limit, you must also enter an arc limit duration value. The arc limit duration is a block of time for which you want to count the number of arcs that occur. You can set a value between 10 ms and 500 ms in 10 ms increments. If the arc limit is exceeded within this set window of time, an arc limit fault occurs.

For example: You set the window to be 10 ms and the arc count limit to 50 arcs. Unless 50 arcs occur within a 10 ms block of time, no fault occurs. The arc count is reset for each 10 ms block of time. If you set the window to be 250 ms and 50 arcs occur within this block of time, the unit will trigger the fault.

With the feature enabled, when the arc limit is exceeded the current run is interrupted and output power is shut off. Fault code **E72** or **E73** displays on the front panel. This error is considered an explicit clear error and requires you to send an off command to clear the error. The **Arc** LED on the front panel is active and held until the error is cleared.

If your unit includes the 37-pin **USER** port, a **USER** port reset signal also clears the error. The *ARC.D* **USER** port signal is active and held until the error is cleared.

To enable the arc limit feature, use one of the following methods:

- Active front panel
- Through a host port by using the Virtual Front Panel (VFP) application or other software
- AE Host commands
  - Arc limit fault: command **9**
  - Arc limit duration: command **28**

The default value for the arc count is zero, which disables the arc limit fault function.

Arc-Sync Operation

Depending on the unit configuration, the **INTERLOCK** port provides an enhanced arc management capability called Arc-Sync operation. To set up the Arc-Sync feature, see *Communication Controls*.

MAINTENANCE

Consumable Parts

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

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 Pinnacle 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 Pinnacle 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 AC Power On

1. Ensure that there is input power to the unit.
2. Ensure that input power meets specifications.
3. Note any fault code.

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

   - AE Host command **223**
   - Virtual Front Panel (VFP) software
   - Passive display panel (displays as the fault code preceded by an **E**)
   - Active control panel (displays the fault code preceded by **E**). If a description is available, the description displays after the error code.
4. Ensure that the following LEDs are lit: **Power On**, **Interlock**, **Output**, and **Setpoint**.

   Note which, if any, of these are not lit.

   - If the **Interlock** LED is not lit, fault code **30** will flash momentarily, then one of the following fault codes will display: **79**, **80**, or **81**.
   - If the **Interlock** LED is not lit and no fault code is displayed, ensure that the LED is functioning.
5. If you suspect an LED is malfunctioning, cycle the Pinnacle unit power off, then on. If the problem recurs, call AE Global Services.
6. Check the unit LEDs:

   - If the **Bus Fault** LED is lit, fault code **60** should be displayed.
   - If the **Overtemp** LED is lit, fault code **31** should be displayed.
   - If no fault code is displayed, cycle the Pinnacle unit power off, then on, to determine whether the LED is functioning properly.
7. Determine whether the cooling fans are functioning, and ensure that the cabinet allows for adequate ventilation for all the units in the cabinet.

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

Related Links

- “Status Indicators (LED Troubleshooting)” on page 6-4

• “Troubleshooting Using Error Codes” on page 6-5

Checks If the Process Power Output Does Not Turn On

1. Verify that the joules mode is disabled or has a valid setpoint value.
2. Verify that the target life counter is disabled or has a valid value.
3. Verify that the user-definable power, voltage, and current limits are set to values reasonable for the process application.
4. Check for interlock, bus fault, or overtemperature faults.
5. Verify that you have established a valid setpoint.
6. For dual Pinnacle supplies, verify that both inverters are enabled.

   For more information, consult the descriptions of error codes **E040**, **E041**, and **E042**.
7. Verify that the arc sense levels (thresholds) are appropriate for your process.
8. Try again to turn on output power.

UNDERSTANDING AC OUT-OF-RANGE

The following information explains the types of bus faults that might occur in your unit, and how the unit responds to the occurrence of a bus fault.

When the Pinnacle unit detects that AC is outside of the specified operating window, the output will shut off for at least 10 ms and will automatically restart if the AC line recovers within 1 second. If the AC line does not recover within 1 second, a bus fault will occur.

If the unit registers, or counts, a hard bus fault, it also registers a bus out-of-range reaction. However, if the unit registers a bus out-of-range reaction, it does not always register a hard bus fault.

To recover from this situation, shut input power off and verify the level and quality of input power to the unit. If input power meets the power supply specifications and power quality appears sufficient, contact AE Global Services.

PASSIVE DISPLAY PANEL PERSONALITY CARD CODES

When only a passive display is available, the Pinnacle unit will display three-character strings followed by a trailing space, on startup, to identify personality cards

installed in the unit. A code will flash once for each card installed. Not all units display help codes.

Table 6-1. Passive display panel help codes

PFP Display String	Personality Card
H-0	No cards
H-1	37-pin user card
H-3	PROFIBUS card
H-4	15-pin user card
H-6	DeviceNet (host control)

STATUS INDICATORS (LED TROUBLESHOOTING)

The status indicators or LEDs are located on the front panel of the unit. All LEDs are green.

Refer to this table before you call AE Global Services.

Table 6-2. Troubleshooting LEDs

LED	On	Off	Status
Power On	X		Normal
		X	The Pinnacle unit is not receiving AC input power. Power the unit off. Using all applicable safety precautions, inspect your AC input power source to ensure that it is properly connected and that the specified voltage is being applied to the Pinnacle unit.
Output	X		Normal
		X	The Pinnacle unit is not producing output.
Setpoint	X		Normal
		X	The Pinnacle unit is not operating within setpoint. Check the display for error codes and troubleshoot any codes that appear.
Interlock	X		Normal

Table 6-2. Troubleshooting LEDs (Continued)

LED	On	Off	Status
		X	An interlock fault condition exists. Check the display for error codes and troubleshoot any codes that appear.
Bus Fault	X		A bus fault condition exists. Check the display for error codes and troubleshoot any codes that appear.
		X	Normal
Overtemp	X		An overtemperature fault condition exists. Check the display for error codes and troubleshoot any codes that appear.
		X	Normal
Arc	X		After the output shuts off, this LED lights momentarily to indicate that the hard arc count limit was reached during the previous run.
		X	During an on cycle, this LED normally remains unlit. After the output shuts off, if this LED remains unlit, the hard arc limit was not reached during the previous run.

TROUBLESHOOTING USING ERROR CODES

Error Types and Clearing Error Codes

Error codes (also called fault codes) are typically generated by two types of faults: self-clearing or explicit-clear.

- When the unit experiences a self-clearing fault condition (also called a non-latching fault), the unit turns off output and displays an error code. When the fault condition is no longer present in the system, the unit ceases to display the error code. You can then turn on the output.
- When the unit experiences an explicit-clear fault condition (also called a latching fault), the unit turns off output and displays an error code. Once the fault condition is no longer in the system, you must acknowledge the condition from your controlling interface to clear the error before turning on output.

To acknowledge a fault condition and clear the error code, do one of the following:

- From the active control panel, press the **Off** button to acknowledge the condition. Then press the **On** button to turn on output.

- Through one of the digital communication port interfaces, send the off command (**1**), then send the on command (**2**) to turn on output.
- Through the **USER** port interface, turn the output off and then on. The pins to turn output on/off vary, depending on the user interface on your unit.

Fault and Warning Code Troubleshooting Table

The following tables describe the Pinnacle power supply fault and warning codes:

- Table 6-3, "Fault codes" on page 6-6
- Table 6-4, "Warning codes" on page 6-10

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

- AE Host command **223**
- Virtual Front Panel (VFP) software
- Passive display panel (displays as the fault code preceded by an **E**)
- Active control panel (displays the fault code preceded by **E**). If a description is available, the description displays after the error code.

Table 6-3. Fault codes

Fault Code	Problem Indicated	Suggested Action
16 **Service Required Fault**	(Self-clearing) Unit needs servicing.	Cycle power. If the error persists, contact AE Global Services.
30 **Interlock Open Fault**	(Self-clearing) The interlock has not been satisfied.	Power off the Pinnacle unit. Ensure that the interlock is properly connected. Ensure that all system interlocks have been satisfied. Power the unit back on.
31 **Overtemp Fault**	(Self-clearing) The unit is overheating.	Inspect the unit cooling system and review cooling specifications. Ensure that the input air temperature is correct, that the Pinnacle unit fans are functioning properly, and that your cabinet allows for adequate ventilation for all the units in the cabinet.
60 **Bus Fault**	(Explicit-clear)	Using all applicable safety precautions, inspect your AC input power source to ensure

Table 6-3. Fault codes (Continued)

Fault Code	Problem Indicated	Suggested Action
	The DC bus has failed, probably due to an AC input power problem.	that it is properly connected and that the specified voltage is being applied to the Pinnacle unit.
61 **Output Ground Unit A Fault**	(Explicit-clear) Side A output: Output positive terminal is not connected to Protective Earth (ground).	Connect output positive terminal to PE ground.
62 **Output Ground Unit B Fault**	(Explicit-clear) Side B output: Output positive terminal is not connected to Protective Earth (ground).	Connect output positive terminal to PE ground.
72 **Arc Limit Unit A Fault**	(Explicit-clear) Side A output: Output power shut off because an arc limit was exceeded during the process run. This error occurs if the arc limit fault feature was enabled.	Send off command to clear the error.
73 **Arc Limit Unit B Fault**	(Explicit-clear) Side B output: Output power shut off because an arc limit was exceeded during the process run. This error occurs if the arc limit fault feature was enabled.	Send off command to clear the error.
79 **External Interlock Open Fault**	(Self-clearing) The system interlock on the unit analog **INTERLOCK** port has not been satisfied.	Power off the Pinnacle 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 Open Fault**	(Self-clearing) The cover interlock has not been satisfied.	Power off the Pinnacle 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**	(Self-clearing)	Power off the Pinnacle unit. Ensure that the interlock pin on the **USER** port connector has

Table 6-3. Fault codes (Continued)

Fault Code	Problem Indicated	Suggested Action
	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 interface card.	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**	(Explicit-clear) Side A output: The out-of-setpoint timer has expired.	Increase the setpoint timer value, or disable the timer by setting it equal to 0. If the problem persists, check your process parameters for limiting factors. That is, ensure that your load impedance matches the impedance range of the Pinnacle unit.
86 **Out of Setpoint Unit B Fault**	(Explicit-clear) Side B output: The out-of-setpoint timer has expired.	Increase the setpoint timer value, or disable the timer by setting it equal to 0. If the problem persists, check your process parameters for limiting factors. That is, ensure that your load impedance matches the impedance range of the Pinnacle unit.
87 **Invalid Regulation Mode Unit A Fault**	(Self-clearing) Side A output: 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.
88 **Invalid Regulation Mode Unit B Fault**	(Self-clearing) Side B output: The **USER** port regulation mode has been set to an invalid value.	Set the **USER** port regulation mode to a valid value.
110 **Process Voltage Unit A Fault**	(Explicit-clear) Side A output: The voltage at the output has dropped below the process voltage value you have set.	Reprogram or disengage the Pinnacle unit process voltage limit check feature.
111 **Process Voltage Unit B Fault**	(Explicit-clear) Side B output: The voltage at the output has dropped below	Reprogram or disengage the Pinnacle unit process voltage limit check feature.

Table 6-3. Fault codes (Continued)

Fault Code	Problem Indicated	Suggested Action
	the process voltage value you have set.	
117 **Master/Slave Missing Cable Shutdown Fault**	(Explicit-clear) With output on, a disruption occurs in the connector or cable between the master and slave units. When this fault occurs, it can also include faults **762** (no egress) or **763** (no ingress).	Ensure that connectors and cables are properly connected. Then, clear all faults. If any of these errors persist, call AE Global Services.
118 **Master/Slave Hardware Comm Shutdown Fault**	(Explicit-clear) A disruption occurred in the connector or cable between the master and slave units.	Ensure that connectors and cables are properly connected. Then, clear the fault. If the error returns, replace the ingress cable and cycle power on the unit. If the error persists, call AE Global Services.
201 **Comm Watchdog Timer Fault**	(Explicit-clear) 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 Pinnacle unit using the proper protocol. This slave is now available to be owned by another master. If output is on, the Pinnacle unit turns output off.	To recover from the off state, have a PROFIBUS master establish communication with the Pinnacle unit and send a master reset to clear the Pinnacle unit.
405 *[]* **PROFIBUS Watchdog Fault**	(Explicit-clear) The PROFIBUS master stopped communicating with the Pinnacle supply after establishing communications.	Have the master re-establish communications and send a master reset to clear the Pinnacle unit.
406 *[]* **PROFIBUS MAC Reset Fault**	(Explicit-clear) The SPC (PROFIBUS controller) has taken itself offline, probably in response to another error.	Cycle the Pinnacle unit power off and on and re-establish communications between the master and slave. If the error code reappears, contact AE Global Services.

Table 6-3. Fault codes (Continued)

Fault Code	Problem Indicated	Suggested Action
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.

Table 6-4. 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 Pinnacle unit.
56 **Network DHCP Warning**	Cannot find DHCP server.	Verify the DHCP server on the Ethernet network. Disable the DHCP in network settings.
57 **Network DNS Warning**	Unable to communicate with DNS server.	Check network settings.

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 6-5. 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
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 910370 10 (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
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.

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