

USER MANUAL

**Pinnacle™ 20 kW
(400–1000 Vdc)**

**DeviceNet™ with MDXL User,
Terminal Block Output**

5702199-A

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User Manual

Pinnacle™ 20 kW

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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. 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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Introduction

READ THIS SECTION!

We know that some of you want to operate your Pinnacle supply now and that you don't feel you have time to read the entire manual. Below is a list of manual subsections you must read before getting started.

- “Theory of Operation” on page 2-2
- “Electrical Specifications” on page 3-4
- “Operating Overview” on page 6-1
- “Installation” on page 5-1
- “Conditions of Use” on page 1-5

In addition, we recommend that you scan “Interpreting the Manual” on page 1-1. This section explains the type conventions (what it means when a word appears in capitalized italic type, for instance) and icon (symbol) definitions.

INTERPRETING THE MANUAL

Type Conventions

To help you quickly find what is being discussed, the manual presents certain words and phrases in type that are different from the rest of the text. We use the following type conventions:

- Pin and signal names appear in capitalized italics (*DUTY CYCLE.A*).
- Labels that are on the unit (switches, indicators, etc.) generally appear in boldface capital letters (**MODIFY**). Exceptions are port names, which simply begin with a capital letter (User port).
- Functions are printed in boldface lowercase letters (**analog input filtering**).

Icons (Symbols)



This symbol represents important notes concerning potential harm to people, this unit, or associated equipment. It is found whenever needed in the manual.

We include this symbol in Danger, Warning, and Caution boxes to identify specific levels of hazard seriousness.



DANGER:

This box identifies hazards that could result in severe personal injury or death.



WARNING:

This box identifies hazards or unsafe practices that could result in personal injury.

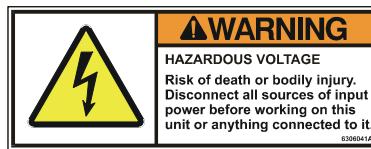


CAUTION:

This box identifies hazards or unsafe practices that could result in product or property damage.

The following symbols could appear on labels on your unit.

- Hazardous Voltage



1332

- Short circuit protected



1024

- High voltage



1028

- Protective earth ground



1029

- Earth ground



- Warning (refer to manual)



- CE label



- Non-ionizing radiation



- Hot surface



- NRTL /C label



SAFETY

Do not attempt to install or operate this equipment if you have not first acquired proper training.

- Ensure that this unit is properly grounded.
- Ensure that all cables are properly connected.

- Verify that input line voltage and current capacity are within specifications before turning on the power supply.
- Use proper ESD precautions.
- BE CAREFUL AROUND THIS EQUIPMENT.

**DANGER:**

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

PRODUCT SAFETY/COMPLIANCE

This product is designed to meet and is tested for compliance to the following standards and directives.

Directives

The following tables list the Electromagnetic Compatibility (EMC) and Safety directives.

Table 1-1. Electromagnetic Compatibility (EMC)

Directive	Description
89/336/EEC	EC Council directive on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive)
47 CFR Part 18	Code of Federal Regulations—Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific, and Medical Equipment

Table 1-2. Safety Directives

Directive	Description
73/23/EEC	EC Council directive on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits (LVD—Low Voltage Directive)
SEMI S2-0200	Safety Guidelines for Semiconductor Manufacturing Equipment

Standards

This device has been tested for and complies with the following Safety and EMC standard(s):

- EN 50178
- EN 50082-2
- EN 55011 (Class A, Group 2)(CISPR 11)

This device must be installed and used only in compliance with the standards listed in addition to VDE 0113, EN 60204 (IEC 204), and applicable requirements.

For more information, refer to the letter of conformance (US) or declaration of conformity (EU) accompanying the product.

Installation Requirements



WARNING:

Operating and maintenance personnel must receive proper training before installing, troubleshooting, or maintaining 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.

Conditions of Use

To be in compliance with the stated directives and standards, you must meet the following conditions of use.

- This device must be used in an overvoltage category II installation only.
- Before making any other connection, connect the auxiliary protective earth ground conductor on the rear panel.
- Use only a shielded cable on the input power connector.
- Use only a shielded power cable on the output power connector.
- Non-standard connectors for input and/or output power must be inaccessible to the user.
- Install and operate this device only in a pollution degree 2 or better environment, which means an indoor location such as a computer room, office, or factory floor where only non-conductive pollution occurs during operation. Occasionally, a temporary conductivity caused by condensation occurs when the device is not operating.
- If your unit does not have a circuit breaker, install and operate it with an AE-approved circuit breaker on the ac input to provide the required over-current protection.

Theory

GENERAL DESCRIPTION

The Advanced Energy Pinnacle™ series of dc power supplies provide the ultimate advantages in dc power.

They...

- Are light and compact
- Are highly efficient (low internal heat dissipation)
- Provide excellent regulation and stability
- Have a highly reliable solid state design
- Store very little energy in the output filter
- Quickly extinguish and recover from arcs
- Deliver full power over a 4:1 impedance range (with no taps)

Output Impedance Range

No taps, mechanical or electrical, exist in the Pinnacle supply. 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 supply 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 them to recover from input power interruptions and to ensure repeatability from run to run.

Interfaces

Pinnacle power supplies can be configured with a variety of interfaces. Your Pinnacle supply can be controlled from an active front panel, a Pinnacle Remote Active Panel, an analog/digital connector (User port), or a serial communications (Host) port. The serial communications port, active front panel, and Pinnacle Remote Panel provide access to all operating parameters and control functions. The User port provides limited access to operating parameters and control functions.

Microprocessor Advantages

The internal microprocessor checks for proper circuit operation while supervising all operating parameters. System diagnostics run when the unit is initially powered up. The most recent power settings and conditions (such as output production) are retained in non-volatile memory.

Displays

The displays on the passive panels as well as the control panels show power, current, or voltage levels. (The displays show levels for unit A and unit B if this is a dual unit.) They also display information about output, setpoint, interlock, bus fault, overtemperature, arcs, and error codes.

Arc-Suppression Feature

The Pinnacle supply's arc-handling feature ensures the shortest arc recovery time in the industry. With the feature enabled, the Pinnacle supply's hard-arc detection time is less than 1 μ s, and delivered arc energy is less than 10 mJ for a 10 kW inverter. (Depending on your unit's output configuration, the energy could be significantly less than 10 mJ.) You can implement preprogrammed arc-handling functions during your normal process cycle and your target conditioning cycle (TCC). Arc detect time and arc shutdown time are fixed by target type (metal or nonmetal). You also can customize your arc shutdown and arc detect delay times. Parameters, including long arc count limit and voltage trip level, are selectable through the Pinnacle Remote Active Panel or a serial communications (Host) port.

THEORY OF OPERATION

The Pinnacle power supply is a sophisticated and intelligent dc power supply designed exclusively for use in vacuum environments. Figure 2-1 on page 2-3 and the following paragraphs outline the theory of operation.

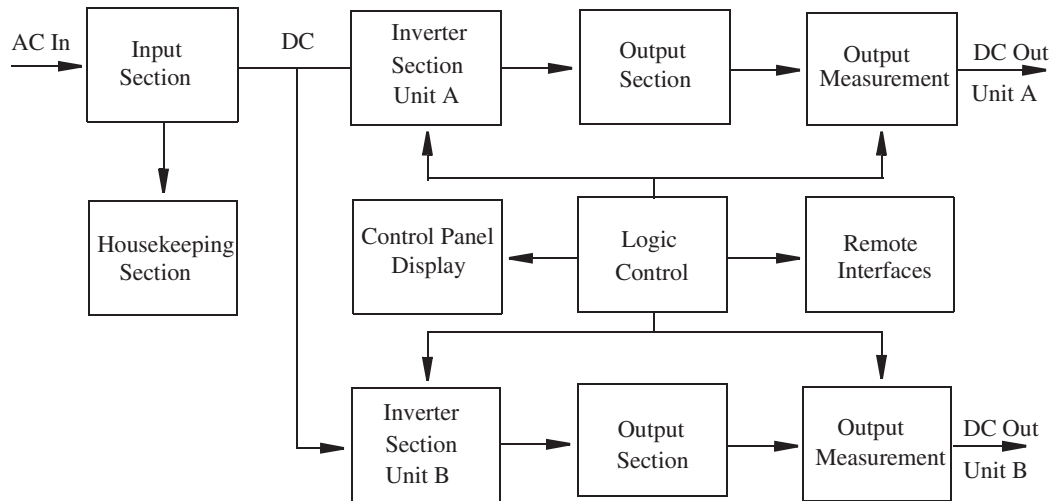


Figure 2-1. Pinnacle functional block diagram

INPUT

In the input section, ac line voltage is applied through the circuit breaker to a three-phase contactor. The contactor, when closed, delivers the line voltage to a rectifier bridge, where it is converted to dc. The dc voltage is applied to bus capacitors through soft-start circuitry. This bus provides dc voltage to the inverter section. The input section also provides power to the housekeeping section.

HOUSEKEEPING SUPPLY

The housekeeping supply section provides low voltage to power the electronic circuits within the Pinnacle unit.

INVERTER

The inverter section converts dc to high-frequency voltage by alternating the current through switching transistors.

OUTPUT

In the output section, an isolation transformer steps up the high-frequency voltage from the inverter section and sends it to a full-wave rectifier bridge.

The rectified dc power is then passed through a measurement section to the output connector.

OUTPUT MEASUREMENT

The output measurement section measures current, voltage, and power. These signals are typically scaled 0 to 10 Vdc and sent to logic control and interfaces.

LOGIC CONTROL

The microprocessor in the logic control section uses operator-supplied parameters and setpoints to control the output. This section is also responsible for controlling the input section and providing status information to the operator through all interfaces.

REMOTE INTERFACES

The Pinnacle supply supports four types of interfaces: a User port (analog/digital), a serial (Host) port (RS-232/422/485), an active front panel, and a Pinnacle Remote Panel. All four interfaces communicate operator-supplied inputs to the logic control section and provide the operator with status information.

Specifications

FUNCTIONAL SPECIFICATIONS

The following table lists the functional specifications.

Table 3-1. Functional Specifications

Modes of Control	Serial communications (Host) port, User port (analog/digital interface), active front panel, and/or Pinnacle Remote Active Panel
Passive Panel Options	Your unit also may feature either a passive front panel or a remote passive panel.
Method of Output Regulation	The regulation mode is the parameter that remains constant when the Pinnacle is producing output; it can be power, current, or voltage. Select one of these regulation modes from the optional Pinnacle Remote Active Panel, the active front panel, the User port, or the serial (Host) port.
Programmable Setpoints	You can program an output level (from low values up to the unit's maximum rates of output) for power, current, or voltage. Select this value from the optional Pinnacle Remote Active Panel, the active front panel, the User port, or the serial (Host) port.
Output Limits	You may set maximum output limits for power, voltage, and current. You also may select a maximum strike-voltage range. Select these values from the optional Pinnacle Remote Active Panel, the active front panel, the User port, or the serial (Host) port.
Target Supervision	You can select one of eight target-life counters from the active front panel, Pinnacle Remote Active Panel, User port, or serial (Host) port. Target life can be monitored from the Pinnacle Remote Active Panel, the active front panel, and the serial port. <i>Note:</i> The User port has priority when selecting targets.

Table 3-1. Functional Specifications (Continued)

Arc Control	Using an active front panel, Pinnacle Remote Active Panel, or a serial (Host) port, you can enable arc handling functions. Select a voltage arc trip level. Then choose between preprogrammed arc controls or custom arc controls. By selecting a target type (metal or nonmetal), you preprogram your Pinnacle unit to use target-specific arc shutdown times and arc detect delay times during your normal process cycle and your target conditioning cycle (TCC). By selecting the “custom” arc handling option, you can program the arc shutdown time and arc detect delay time for your process. Please refer to the “I/O Communication and Control” chapter for defaults and additional information.
Arc Density Monitoring	Using an active front panel, a Pinnacle Active Front Panel, or a serial (Host) 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.
Arc Energy	< 10 mJ per 10 kW inverter standard
Cooling	Air-cooled only
Ramping Recipes	Ramping recipes let you program the Pinnacle unit to ramp up in incremental steps. From the active front panel, Pinnacle Remote Active Panel, or serial (Host) port, select between 1 and 8 steps, then select ramp time, setpoint, and run time for each step.
Fault Conditions	Several fault conditions will either cause the Pinnacle supply to shut off output or prevent output from being turned on. These conditions include open interlock loops, input power failure, and over-temperature.

PHYSICAL SPECIFICATIONS

The following table lists the physical specifications.

Table 3-2. Physical Specifications

Size	
Power Supply	133 mm (H) x 483 mm (W) x 639 mm (D), including connectors 5.22" (H) x 19" (W) x 25.18" (D)
Pinnacle Remote Active Panel	89 mm (H) x 483 mm (W) x 107 mm (D) 3.5" (H) x 19" (W) x 4.2" (D)
Weight	
Power Supply	30 kg (66 lb)
Pinnacle Remote Active Panel	6.3 kg (13.9 lb)
Output Connector	Terminal block output connector For more information on the output connection, see “Connecting Output Power” on page 5-10
Input Power Connector	Five terminal, DIN compression terminal block
User Port Connector	Please reference the “I/O Communication and Control” chapter.
Serial (Host) Port Connector	Please reference the “I/O Communication and Control” chapter.
Remote Active Panel Connector	9-pin male, subminiature-D
Contactors Interlock Connector	9-pin male, subminiature-D
DeviceNet™ Connector	(If DeviceNet was ordered with your unit) Round 5-pin male connector; please reference the “I/O Communication and Control” chapter

ELECTRICAL SPECIFICATIONS

The following table lists the electrical specifications.

Table 3-3. Electrical Specifications

208 Vac Pinnacle Input Voltage	Not available for this configuration
208 Vac Pinnacle Input Current	Not available for this configuration
400 Vac Pinnacle Input Voltage	Not available for this configuration
400 Vac Pinnacle Input Current	Not available for this configuration
480 Vac Pinnacle Input Voltage	432 to 528 Vac, 3-phase, 4-wire, 50 to 60 Hz, no neutral required; leakage current less than 3.5 mA
480 Vac Pinnacle Input Current	28 A nominal per phase, at least 90% EFF; 40 A circuit breaker
Output Accuracy	Accuracy of actual output to readback value at 25°C is $\pm 1\%$ of the setpoint value (V, kW, or A) or $\pm 0.2\%$ of the full rated output (whichever is greater) for the full input voltage range and output impedance range.
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% to 100% of rated power.
Temperature Coefficient	$<0.005\%/^{\circ}\text{C}$ ($<50\text{ppm}/^{\circ}\text{C}$) variation in the regulated output parameter over a 20°C to 40°C ambient temperature range

Table 3-3. Electrical Specifications (Continued)

High- and Low-Frequency Output Ripple Voltage	<p>If you have a supply with a single inverter (a 6 kW or 10 kW unit), the component of output voltage ripple as related to input line frequency is less than 2% rms.</p> <p>If you have a supply with a single output but dual inverters (a 12 kW or a 20 kW unit) high-frequency output ripple options are selectable from the active front panel, Pinnacle Remote Active Panel, or serial (Host) port. The “high” option is 4 to 5% rms; the “low” option is less than 2% rms.</p>
Accuracy of All Analog Signals	$\pm 1\%$ of the actual value (V, kW, or A) or $\pm 0.2\%$ of the full scale value, whichever is greater
Power Factor	> 0.9 for loads greater than 1.2 kW
Standard Output Range (full power)	20 kW over the 400-to-1000-Vdc range, with a maximum current of 50 A
Usable Output Range	See Figure 3-1 on page 3-7.
Impedance Range	See Figure 3-2 on page 3-8.
Accuracy of User-Defined Limits	
Current	0 to 5% over the limit from 10 to 100% of full rated output
Voltage	0 to 5% over the limit from 10 to 100% of full rated output
Power	0 to 5% over the limit from 10 to 100% of full rated output
Readback Accuracy	Power is displayed as a simple multiplication of $P=V \cdot I$. 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.
Ignition Capability	<p>Selectable from the active front panel, Pinnacle Remote Active Panel, and serial (Host) port</p> <p>Voltage clamped to 1500 V at 60 mA maximum</p>

Table 3-3. Electrical Specifications (Continued)

Analog Interface Scaling	<p>Depending on the type and configuration of your User port, the analog input and output signals will be either 0 to 5 V or 0 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 as follows:</p> <table><tr><th>Power</th><th>Current</th><th>Voltage</th></tr><tr><td>0 to 20 kW</td><td>0 to 80 A</td><td>0 to 1500 V</td></tr></table>	Power	Current	Voltage	0 to 20 kW	0 to 80 A	0 to 1500 V
Power	Current	Voltage					
0 to 20 kW	0 to 80 A	0 to 1500 V					
Output Polarities	<p>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)</p>						

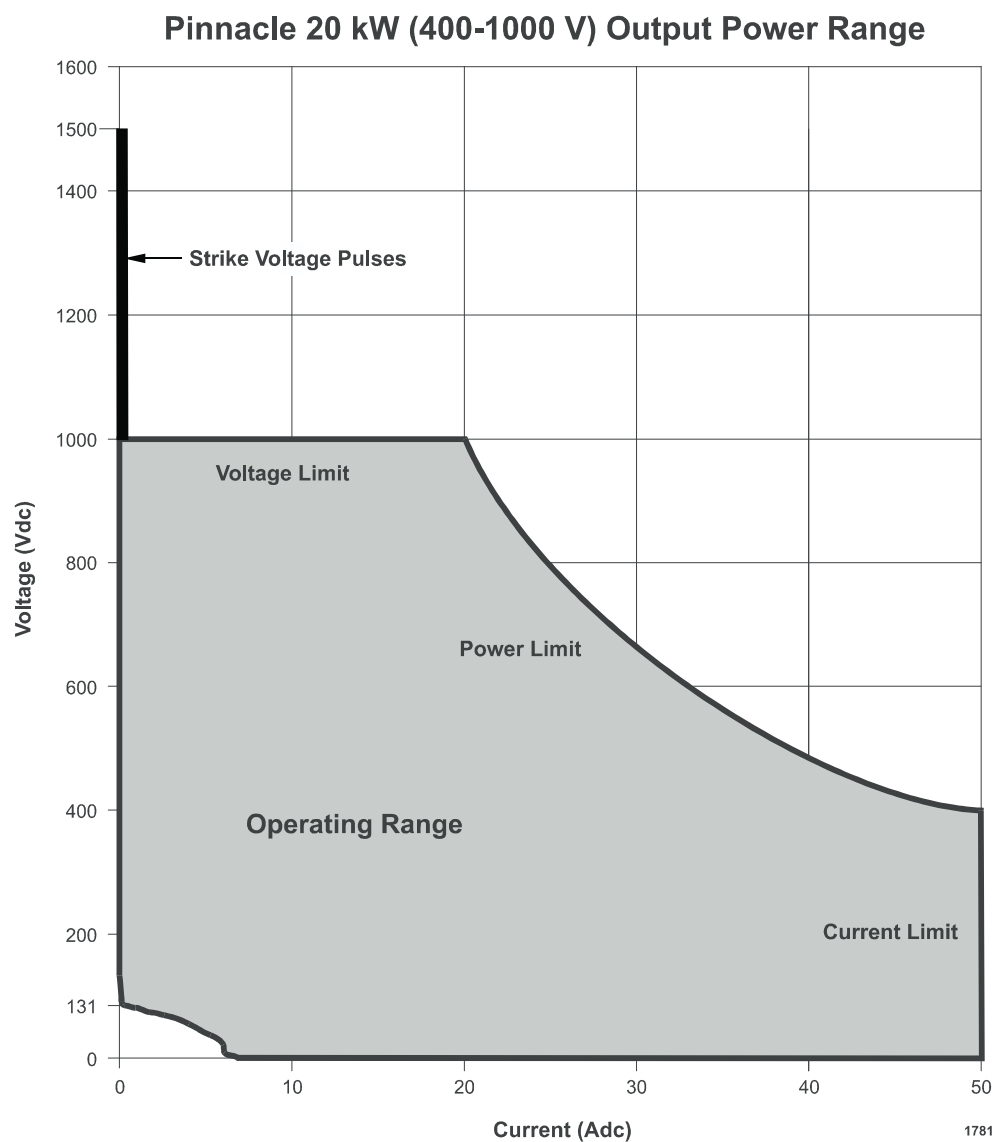


Figure 3-1. Operating range

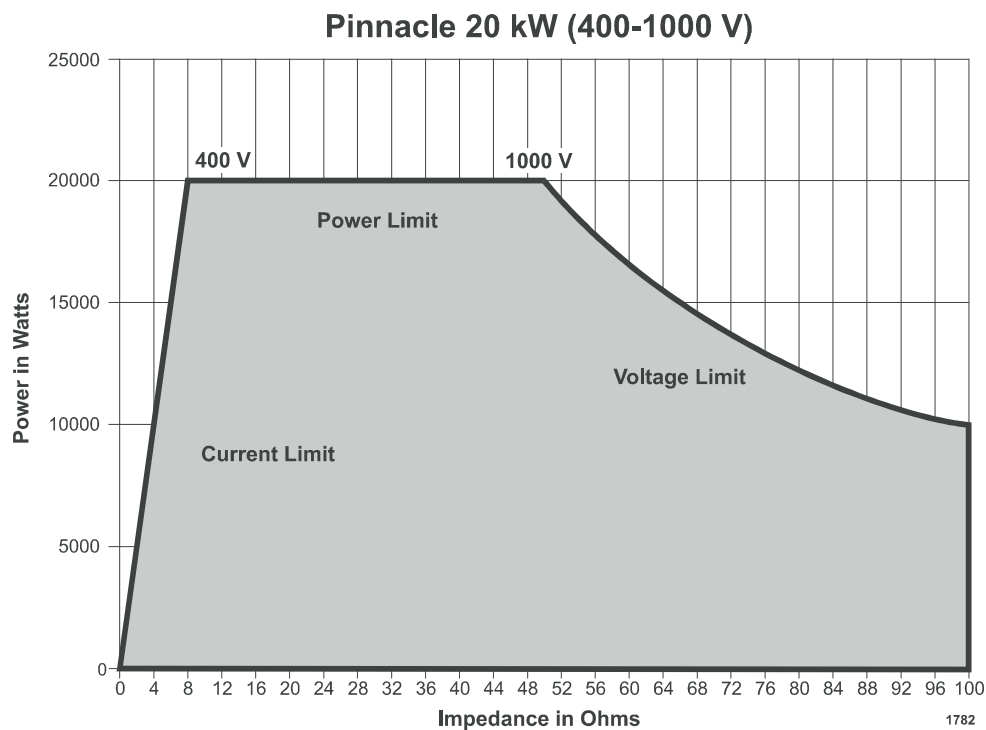


Figure 3-2. Impedance range

ENVIRONMENTAL SPECIFICATIONS

The following table lists the environmental specifications.

Table 3-4. Climatic Specifications

	Temperature	Relative Humidity	Air Pressure
Operating	Class 3K3 +5°C to +40°C +41°F to +104°F	Class 3K3 5% to 85% (Note 1) +1 g/m ³ to +25 g/m ³	Class 3K3 80 kPa to 106 kPa 800 mbar to 1060 mbar (approximately 2000 m above sea level)

Table 3-4. Climatic Specifications (Continued)

	Temperature	Relative Humidity	Air Pressure
Storage	Class 1K4 -25°C to +55°C -13°F to +131°F	Class 3K3 5% to 85% +1 g/m ³ to +25 g/m ³	Class 3K3 80 kPa to 106 kPa 800 mbar to 1060 mbar (approximately 2000 m above sea level)
Transportation	Class 2K3 -25°C to +70°C -13°F to +158°F	Class 2K3 95% (Note 2) +60 g/m ³ (Note 3)	Class 2K3 66 kPa to 106 kPa 660 mbar to 1060 mbar (approximately 3265 m above sea level)

Note 1 Non-condensing

Note 2 Maximum relative humidity when the unit temperature slowly increases or when the unit temperature directly increases from -25°C to +30°C

Note 3 Maximum absolute humidity when the unit temperature directly decreases from +70°C to +15°C

COOLANT SPECIFICATIONS

The following table lists the coolant specifications.

Table 3-5. Coolant Specifications

Coolant Temperature	Air (gas) minimum 0°C, maximum 35°C.
Pollution Degree	2 (or better). Cooling air must be normally free of corrosive vapors and particles, conductive particles and particles that could become conductive after exposure to moisture.
EMI/EMC	Tested for electromagnetic compatibility. See the “Safety/Compliance” section of the “Introduction” chapter and the declaring letter for specific standards.
Noise	Noise generated by this unit is 71.5 dB (A) at a 1 m distance

I/O Communication and Control

USER PORT

The User port allows you to control the Pinnacle unit through a remote controller. The connector is a 15-pin, subminiature-D, female connector (see the following illustration).

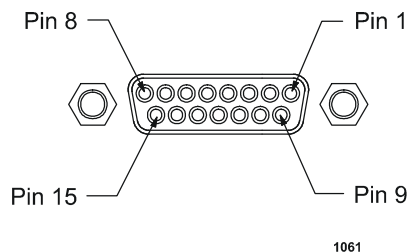


Figure 4-1. 15-pin User port

You may operate the Pinnacle unit solely through the 15-pin User port. User port operation does not require connection to a DeviceNet network.

Installation



DANGER:

Disconnect all sources of input power before working on this unit or anything connected to it.

Note: Signals at the User port can be sensitive to environmental noise. We recommend that you take standard preventative measures against electro-magnetic interference (EMI), including using shielded cabling on the User port.

Refer to the pin descriptions on the following pages when connecting your remote controller to the User port. Use shielded cabling to avoid EMI problems.

If you have a Pinnacle Active Remote Panel and you want to operate the Pinnacle supply from the User port, you must set the control mode for **USER** on the control panel.

Signals

The User port is primarily an “analog” interface. Signal descriptions appear in the following table. Note that a “A” suffix appended to a pin name indicates an analog signal; a “D” suffix appended to a pin name indicates a digital signal. An overline on a signal name (for example, OUTPUT ENABLE.D) indicates that the signal is true when low.

**DANGER:**

Power down the Pinnacle unit and take proper ESD precautions before removing the unit's top cover to position jumpers. Failing to power down the unit in this case could result in death or severe personal injury. Failing to take proper ESD precautions in this case could result in damage to the unit.

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 front panel, the Pinnacle Active Remote 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. User Port Pin Descriptions

Signal Pin	Return Pin	Pin Name	Signal Type	Description
1	10, 13, 14, 15	+24V	Input	This pin is the collector side of the opto-couplers for status LEDs
2	6	VOUT.A	Output	This pin provides a fully buffered 0 to 10 V signal representing output voltage: 10 V = 1000 Vdc. When the open circuit output voltage is 1500 Vdc, the voltage on <i>pin 2</i> is 12 Vdc. It will sink and source to 10 mA; its impedance is 100 Ω
3	6	POUT.A	Output	This pin provides a fully buffered 0 to 10 V signal representing output power: 10 V +/- 1% = 20,000 W in a single unit system (that is, without any slaves connected). It will sink and source to 10mA; its impedance is 100 Ω .

Table 4-1. User Port Pin Descriptions (Continued)

Signal Pin	Return Pin	Pin Name	Signal Type	Description
4	9	$\overline{OUTPUT\ ENABLE.D}$	Input	This signal is used to turn on output power from the 15-pin User port. Closure between $\overline{OUTPUT\ ENABLE.D}$ and $OUT\ ENABLE\ COM.D$ (pin 9) will turn on output power.
5	6	$XPROG.A$	Input	This signal is the 0 to 10 V analog setpoint input which is sent through the custom CMR buffer. 1 to 10 V = 0 to full scale for each regulation mode.
6	n/a	$COM.A$	n/a	This signal is used as a remote ground. $VOUT.A$ (pin 2), $POUT.A$ (pin 3), and $XPROG.A$ (pin 5) should be referenced to this pin.
7	8	$\overline{PWRON.D}$	digital output	When output power is enabled, a contact closure between pin 7 and pin 8 occurs. Use 0.5 A maximum for this readback.
8	n/a	$PWRON\ COM.D$	n/a	This signal is the return for pin 7.
9	n/a	$OUT\ ENABLE\ COM.D$	n/a	This signal is the return reference for $\overline{SETPOINT.D}$, $\overline{OUTPUT\ ENABLE.D}$, and $\overline{OUTPUT.D}$ (pins 1, 4, and 13).
10	n/a	$MOD\ GREEN$	Output	This pin is the emitter side of an opto-coupler (for MOD LED).

Table 4-1. User Port Pin Descriptions (Continued)

Signal Pin	Return Pin	Pin Name	Signal Type	Description
11	12	<i>INTERLOCK.D</i>	Input	This digital signal provides a safety interlock. Closure between <i>pins 11</i> and <i>12</i> enables the ac input power contactor.
12	n/a	<i>INTLK COM.D</i>	n/a	This signal is the return reference for the interlock signal on <i>pin 11</i> .
13	n/a	<i>NET GREEN</i>	Output	This pin is the emitter side of an opto-coupler (for NET LED).
14	n/a	<i>MOD AMBER</i>	Output	This pin is the emitter side of an opto-coupler (for the MOD LED).
15	n/a	<i>NET AMBER</i>	Output	This pin is the emitter side of an opto-coupler (for the NET LED).

DEVICENET™ PORT

The rear panel of your Pinnacle unit features DeviceNet port for interfacing with a DeviceNet network. The DeviceNet port is a round, five-pin, male micro connector, which is electrically isolated from the power supply (see Figure 4-2).

Note: Dual Pinnacle units (units containing two, separate inverters) share the common DeviceNet network micro connector, *but each side is controlled and operated independently through this port*. The following discussion describes the operation of one side of the unit. The other side operates the same way.

The following paragraphs describe the interface and the associated rotary switches and LEDs.

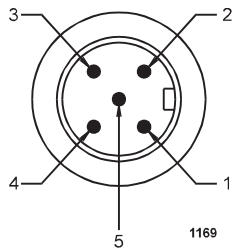


Figure 4-2. DeviceNet™ port with pin designations

Installation

Refer to the following pin descriptions when connecting to the DeviceNet port. Use the appropriate female, micro connector and cable. See the DeviceNet Specification (revision 2.0) from the Open DeviceNet Vendor Association, Inc. for specifics on the mating connector and cable. Use the rotary switches to select a baud rate and set the unit address (MAC ID).

PIN DESCRIPTIONS

This table lists the pin numbers and DeviceNet pin names. See the DeviceNet Specification (revision 2.0) for definitions of these pin names.

Table 4-2. DeviceNet™ Pin Descriptions

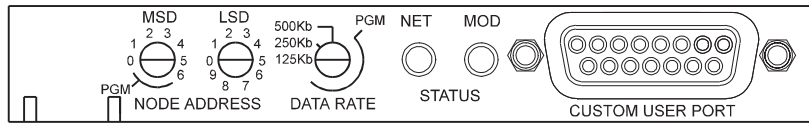
Pin Number	Pin Name
1	Drain
2	V+
3	V-
4	CAN_H
5	CAN_L

ROTARY SWITCHES: BAUD RATE AND ADDRESSING

The DeviceNet interface features three rotary switches, located on the rear of the Pinnacle unit, which are read each time the DeviceNet interface powers up (see Figure 4-3).

Use the **DATA RATE** switch to select a baud rate: 125, 250, or 500 kbaud (0 = 125, 1 = 250, 2 = 500 kbaud). The default is 500 kbaud. A switch setting in the “PGM” region lets you configure the baud rate via DeviceNet.

Note: If your dual Pinnacle unit has two DeviceNet cards (one for each side), it is important that you set the **DATA RATE** for both sides to the same setting as the DeviceNet network setting. Any card not set to the network setting will fault when the network is brought up.



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Figure 4-3. DeviceNet rotary switches and LEDs

Use the **NODE ADDRESS** rotary switches, **MSD** and **LSD**, to select the unit's address (MAC ID). MAC IDs 0 through 63 are valid. Use the **MSD** switch to select the MAC ID's most significant digit; use the **LSD** switch to select the MAC ID's least significant digit. Switch settings greater than 63 (or in the "PGM" region of the **MSD** switch) let you configure the MAC ID via DeviceNet.

Note: If your dual Pinnacle unit has two DeviceNet cards (one for each side), it is important that you set the combined **NODE ADDRESS** of the first card to a different setting than the combined **NODE ADDRESS** of the second card. If you do not, one side will fault when the network is brought up.

Operation

You may operate your Pinnacle unit either through the 15-pin User port (**user** control mode) or through the DeviceNet port (**host** control mode). To operate your Pinnacle unit through the DeviceNet port, you also must have a connection to the 15-pin User port. DeviceNet operation entails the use of User port *pins 11* and *12*.

For best results during DeviceNet operation, do *not* create a connection between *pins 4* and *9* on the 15-pin User port. Closing and opening a connection between these two pins overrides output **on** and **off** signals from DeviceNet.

When the Pinnacle unit powers up, it defaults to **user** control mode and **power** regulation mode. Engaging DeviceNet places the unit in **host** control mode and **power** regulation mode.

Before operating your Pinnacle unit through the DeviceNet port, ensure that your network connects with User port *pins 11* and *12* as well as with the DeviceNet port. (But ensure that no connection exists between *pins 4* and *9* on the User port.) Also ensure that you have selected an appropriate MAC ID and baud rate. Finally, ensure that you have read the following information about command and respond messages and the DeviceNet LEDs.

POLL COMMAND MESSAGE

The Pinnacle DeviceNet interface uses DeviceNet's Group 2 I/O Poll Command message (and the associated Group 1 I/O Poll Response message) to transfer low-level I/O data between the device (slave) and the master. For more information about this message, refer to section 7-6 of the DeviceNet specification (revision 2.0 or later). The following table represents the structure of the poll command message.

Table 4-3. Structure of the poll command message

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Power Output Setpoint AO (LSB)							
1	0*	0*	0*	0*	Power Output Setpoint AO (MSB)			
2	Ramp Rate Setpoint AO (LSB)							
3	0*	0*	0*	0*	Ramp Rate Setpoint AO (MSB)			
4								PO

Note: In Bit 0 of Byte 4, PO refers to Power On. In this bit, 1 = turns on the unit's output; 0 = turns off the units output.

Note: The 16-bit Power Output value (AI/AO) is shifted right four bits, and the remaining four bits are filled with 0s. This changes the 16-bit AO to a 12-bit AO with a value of 10 V = OFFF_{hex} .

Scaling

Parts of the message structure are based on binary representations of analog voltages. Thus they have analog scaling associated with them.

The scaling for Power Output is 0 to 10 V, where 10 V = the full rated output power capability of the Pinnacle 300 power system (master and slave units). Do not reset a value higher than the power system's maximum output power capability. (Such requests are always limited to the maximum output power capability of the power system.) For information about determining your power system's maximum output capability, see "Explicit Messaging" on page 4-9.

The scaling for the Ramp Rate Setpoint (ramping-to-setpoint rate) is also 0 to 10 V as follows:

- 10 V = 1 x power output setpoint per second
- 8 V = 0.8 x power output setpoint per second
- 5 V = 0.5 x power output setpoint per second
- 2.5 V = 0.25 x power output setpoint per second
- 0 V = No ramping rate specified; the Pinnacle unit ramps as fast as it can

If you request a ramping-to-setpoint value that exceeds 10 V, the setpoint will be limited to the equivalent of 10 V.

Ramping

The Pinnacle unit examines the ramping-to-setpoint rate only if the output power setpoint has been set to a new value. Ramping will begin again at 0 after an off-on sequence has occurred.

RESPONSE MESSAGE

The following table represents the structure of the response message.

Table 4-4. Structure of the poll command message

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Power Output AI (LSB)							
1	0*	0*	0*	0*	Power Output AI (MSB)			
2	Voltage Output AI (LSB)							
3	0*	0*	0*	0*	Voltage Output AI (MSB)			
4	Current Output AI (LSB)							
5	0*	0*	0*	0*	Current Output AI (MSB)			
6	Ramp Rate Setpoint AI (LSB)							
7	0*	0*	0*	0*	Ramp Rate Setpoint AI (MSB)			
8				INTS	ARCD	TS	SPS	POS

Note: The 16-bit Power Output value (AI) is shifted right four bits, and the remaining four bits are filled with 0s. This changes the 16-bit AI to a 12-bit AI with a value of 10 V = 0FFF_{hex}.

Note: For Byte 8, the abbreviations have the following meanings:

- POS stands for Power On Status: 1 = output on; 0 = output off
- SPS stands for Setpoint Status: 1 = setpoint reached; 0 = setpoint not reached
- TS stands for Temperature Status: 1 = good; 0 = over-temperature condition
- ARCD stands for Arc Detected: 1 = on; 0 = off
- INTS stands for Interlock Status: 1 = satisfied; 0 = open

Scaling

Parts of the Message structure are based on binary representation of analog voltages. Thus they have analog scaling associated with them.

The scaling for power output is 0 to 10 V, where 10 V = the full rated output power capability of the Pinnacle power system (master and slave units). The read back is limited to 10 V (0FFF_{hex}), even in those cases where output may temporarily exceed the maximum output capability of the power system.

The scaling for voltage output is 0 to 10 V, with 10 V = 1,000 V. The read back is limited to 10 V (0FFF_{hex}), even in those cases where output may temporarily exceed 1,000 V.

The scaling for current output is 0 to 10 V, with 10 V = the maximum output current capability of the unit. The read back is limited to 10 V (0FFF_{hex}), even in those cases where output may temporarily exceed the maximum output current capability.

EXPLICIT MESSAGING

The Pinnacle DeviceNet interface supports explicit messaging so that you can receive information about two power system parameters: maximum power and maximum current. Use the following Class Code 64 (40_{hex}), Instance 1 attributes to retrieve this information:

Attribute	Access	Name	Type	Value
6	Get	Max Power	UINT	(1)
7	Get	Max Current	UINT	(2)

Note: The Max Power attribute returns a value in Watts if the unit is operating stand alone. For example, a value of 20,000 equates to 20,000 W. The Max Power attribute scaling is Watts x 10 if the unit is operating as a master/slave set. In this case, a value of 2,000 equates to 20,000 W.

Note: The Max Current attribute returns a value in Amperes with 2 decimal places implied. For example, a value of 8,000 equates to 80 A.

For more information about this type of messaging, refer to section 4-2 of the DeviceNet Specification (version 2.0 or later). The following Common Services specifications apply:

Service Code	Class	Instance	Service Name
14 (0E _{hex})	Yes	Yes	Get_Attribute_Single

Rear Panel LEDs

The rear panel of the Pinnacle unit features two bi-color LEDs (see Figure 4-3). One is labeled **MOD** and indicates module status. The other is labeled **NET** and indicates network status.

MODULE STATUS LED

The **MOD** bi-color (amber/green) LED provides device status. It indicates whether the device has power and is operating properly. The following table shows the LED's various states and their meanings.

Table 4-5. MOD Status LED

If the LED is	the state indicated is	which means that
Off	No power	the unit is not receiving power.
Green (steady)	Operational	the unit is operating normally.
Flashing Green	Standby	the unit needs maintenance because the configuration is missing, incomplete, or incorrect.
Amber	Unrecoverable Fault	the unit has experienced a fault from which it cannot recover; you may need to replace the unit.
Flashing Amber/Green	Device Self-Testing	the unit is running self diagnostics

For information on LED flash rates, refer to section 8.2.8 of the DeviceNet Specification (revision 2.0).

For information about Module Status LED indications during power-up, refer to Section 8.2.4 of the DeviceNet Specification (revision 2.0).

NETWORK STATUS LED

The **NET** bi-color (amber/green) LED indicates the status of the communication link. The following table shows the LED's various states and their meanings.

Table 4-6. Network Status LED

If the LED is	the state indicated is	which means that
Off	No power	the unit is not on-line because: 1) it has not completed the Dup_MAC_ID test yet; or 2) it is not receiving power (check the MOD LED).
Green (steady)	Link Okay	the unit is on-line and allocated to the master.
Flashing Green	On-line, Not Connected	the unit is on-line but has no connections in its existing state because: 1) the unit has no established connections to other nodes; or 2) the unit is not allocated to the master.
Flashing Amber	Connection Time-out, Critical Link Failure	one or more I/O connections are in the timed-out state.
Amber	Critical Link Failure	communication has failed; that is, the unit has detected an error that has made it incapable of communicating on the network. <i>Note:</i> If you have a dual Pinnacle unit, the causes of this failure may be: 1) the two DeviceNet cards are not set to the same Data Rate as the network; or 2) the two DeviceNet cards have the same Node Address.

For information about Module Status LED indications during power-up, refer to Section 8.2.4 of the DeviceNet Specification (revision 2.0).

PASSIVE DISPLAY PANEL

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

Note: The master/slave functions listed in this section apply only to Pinnacle supplies with a master/slave Host card installed.

Display

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. For a detailed explanation of these codes and other troubleshooting materials, see the “Troubleshooting” chapter.

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. The following table describes the strings:

Table 4-7. Passive Display Panel Codes

PFP Display String	Personality Card
H----	No Cards
H-01	Dual User Card
H-03	Profibus Card
H-04	Host Protocol Translator Card
H-05	Single User Card
H-18	AE Bus Card
H-22	Master/Slave Card
H-23	DeviceNet
H-30	DeviceNet

LEDs

Table 4-8. Display Panel LEDs

POWER ON	Lights green when input power is on
OUTPUT	Lights green if output power is on
SETPOINT	<p>Lights green if the Pinnacle supply is operating within setpoint:</p> <ul style="list-style-type: none"> For a stand-alone unit, accuracy is within 0.4% of full scale or 2% of setpoint, whichever is greater. For master/slave systems, setpoint range is 3.125% of the full scale of the system. <p><i>Note:</i> The master of a master/slave system is also constrained by the stand-alone out-of-setpoint limit. This limit (0.4% of full scale or 2.0% of setpoint) only applies to the output of the master in the system.</p>
INTERLOCK	Lights green if all interlock conditions have been met
BUS FAULT	Lights green when a bus fault occurs
OVERTEMP	Lights green if the Pinnacle supply has exceeded the maximum operating temperature
ARC	After the output has been turned off, this LED lights green for a predetermined time (normally 100 ms) if the hard arc count limit was reached or exceeded during the previous run. If your unit has been configured for signaling on every hard arc, this 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.

ACTIVE FRONT PANEL/ PINNACLE REMOTE PANEL

The Pinnacle supply presents a broad array of features and settings that you can easily control through the Active Front Panel or the Pinnacle Remote Active Panel. If you are using the Pinnacle Remote Active Panel, first ensure that it has been properly connected to the Pinnacle supply; installation information appears in the following section.

Note: The master/slave functions listed in this section apply only to Pinnacle supplies with a master/slave Host card installed.

Connecting to the Remote Active Panel

The 9-pin, male, subminiature-D connector labeled REMOTE ACTIVE PANEL on the rear of the Pinnacle power supply lets you connect the supply to the Pinnacle Remote Active Panel.

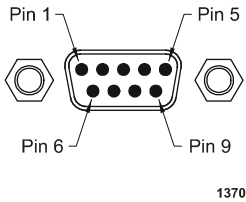


Figure 4-4. Remote active panel connector

The pin descriptions for this connector appear in the following list. Please see the next page for installation instructions.

Table 4-9. Remote Panel Pin Descriptions

Pin	Description
1	Do not connect
2	Do not connect
3	Do not connect
4	Do not connect
5	Ground
6	TR-
7	TR+
8	R-
9	R+



CAUTION:

When installing the Pinnacle Remote Active Panel, do not connect to or disconnect from a Pinnacle unit that is receiving ac input power. Damage to equipment could result. Before connecting or disconnecting the Pinnacle Remote Active Panel, first turn off the ac input power.

To connect your Pinnacle power supply to the Pinnacle Remote Active Panel:

1. Turn off ac input power to the Pinnacle unit.
2. Connect the cable between the REMOTE ACTIVE PANEL connector on the Pinnacle supply and the Pinnacle Remote Active Panel.
3. Turn on ac input power to the Pinnacle unit.

Understanding the Panel

CONTROL KEY

To control your Pinnacle supply from the panel, select local mode by pressing the CONTROL key on the panel until the LOCAL LED lights. Placing the unit in local mode gives you full access to the front panel menu (see Figure 4-5 on page 4-17).

To control the Pinnacle supply from the Serial interfaces or the DeviceNet port, press the CONTROL key until the HOST LED lights. To control the Pinnacle supply from the User port, press the CONTROL key until the USER LED lights. When the Pinnacle unit is in host or user control mode, you can view all the menu items, but you cannot modify parameters or lock the display.

OUTPUT DISPLAY SCREEN

The first screen that appears on the panel's vacuum fluorescent display when you power up is the "output display screen." See "Two-Line Output Display Screen" on page 4-18 for more information.

Viewing Output Information

The output display screen shows the actual output level in volts, amps, and watts or kilowatts. (See the front panel drawings at the end of the "Installation" chapter.) It also displays the setpoint.

Selecting Setpoint

To program the setpoint level from an active control panel, use the panel's CONTROL key to select local control mode (the LOCAL LED will light). Then turn the MODIFY knob until the setpoint you want is displayed. (See below for more information about the MODIFY knob.)

SOFT KEYS

The five unlabeled soft keys directly below the vacuum fluorescent display let you select menu choices. Menu choices appear on the second line of the display. Since different selections (different menu levels) are displayed at different times, this manual refers to the soft keys by whichever terms are displayed above them. For example, you are instructed to press the ARC soft key when ARC is the menu choice directly above that particular key. See Figure 4-5 on page 4-17 and Figure 4-6 on page 4-20.

MODIFY KNOB

Use the MODIFY knob to change values and move through the menus. When the display screen shows a flashing value, you can change it by turning the MODIFY knob. In addition, you can use the MODIFY knob to move quickly through the menus. Pressing the MODIFY knob once moves you up one level in the menu. Pressing it twice quickly moves you all the way out of the menu to the output display screen.

REGULATION SWITCH

At the SETPT menu, choose one of three methods of output regulation (power, current, or voltage) by pressing the REGULATION key until the relevant LED lights. If you switch from one method to another while output is on, the setpoint in the new regulation method will correspond in value to the output level selected at the time you switched. For example, if the Pinnacle supply is regulating power and the setpoint level is 5,000 W (voltage level is 500 V and current level is 10 A) and you select voltage regulation, the new setpoint will be 500 V.

ON/OFF SWITCHES & LEDS

The ON and OFF keys on the remote panel turn on and off the output power. The relevant LED lights to indicate output is on or off.

ARC LED

After the output has been turned off, this LED lights green for a predetermined time (normally 100 ms) if the hard arc count limit was reached during the previous run. You define this limit through a control panel or with Command 9. If your unit has been configured for signaling on every hard arc, this LED will blip for a predetermined time (normally 100 ms) 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.

CONTROL PANEL INTERFACE

Your Pinnacle unit may have either an active front panel, which is an integrated part of the unit, or an active remote panel, which is connected to the **DISPLAY** port on the rear panel of the unit. *This manual uses the term “control panel” to refer to either of these panels since they function identically.*

An active control panel has three main sections:

- ON and OFF switches at the far left of the panel
- CONTROL and REGULATION switches at the far right of the panel

- A two-line display, five soft keys, and a MODIFY knob

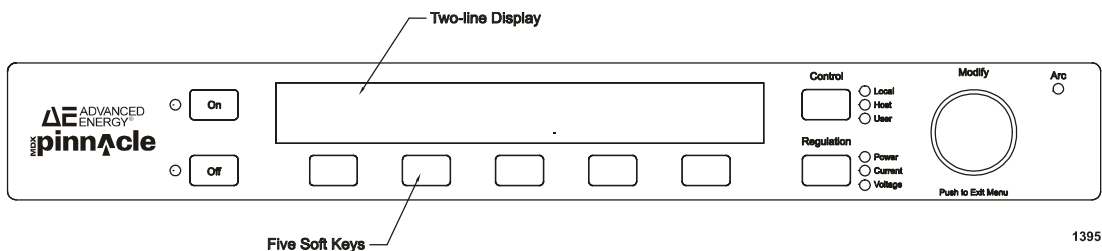


Figure 4-5. Control panel

Output Power Switches

Use the following switches to turn output power on and off.

ON	Turns on output power if the control panel has control of the on/off function and all interlock conditions are satisfied.
OFF	Turns off output power, no matter which interface is currently controlling the unit.

Control Switches

Use the following switches to select the controlling interface.

LOCAL	Takes back control from the serial port or User port and gives it to the control panel. If the control panel already has control or output is turned on, this switch is ignored.
HOST	Gives control to the host computer through the serial port no matter which interface is currently controlling the Pinnacle unit. If the serial port already has control or output is turned on, this switch is ignored.
USER	Gives control to the controller through the User port no matter which interface is currently controlling the Pinnacle unit. If the User port already has control or output is turned on, this switch is ignored.

Note: User control can only be selected when a User Interface Card is installed in the unit.

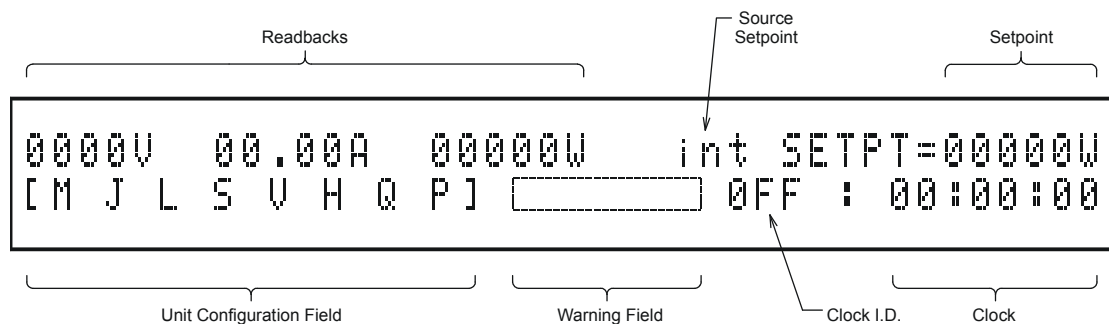
Regulation Switches

Use these switches to select the method of output regulation when the control panel has control.

POWER	Specifies that the method of output regulation is power .
CURRENT	Specifies that the method of output regulation is current .
VOLTAGE	Specifies that the method of output regulation is voltage .

Two-Line Output Display Screen

The display screen displays two lines of information. When you first power up, the display screen appears.



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

- Voltage readback
- Current readback (in amps)
- Power readback (in watts)
- Setpoint source (i = internal, e = external)
- Setpoint

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

- Unit Configuration Field
 - M/S: Master or slave
 - J: Joule mode enabled
 - L: Target life counter enabled
 - S: Setpoint timer enabled
 - V: Process voltage monitor enabled

- H: Hard arc counting enabled
- Q/T/R: Recipe queue, TCC mode, or ramp enabled
- C/P: Custom or predefined arc handling enabled

– Warning field

Warning field: flashes “EOTL” when end of target life or “ARCLIM” when the arc limit is reached.

Note: ARCLIM is only active when the Hard Arc Counting feature is enabled.

– Clock ID: what the supply is doing

- RMP = output is on and ramping
- RUN = output is on and the clock shows the elapsed time
- TCC = output is off and the TCC mode timer is active
- OFF = output is off and the clock shows the last run time

– Clock

Soft Keys

Use the soft keys to select whichever menu functions are shown immediately above them on the two-line display. “Understanding the Menu Options” on page 4-20 explains how to perform these operations from the Pinnacle control panel.

Note: If you’re at the top level, press the MENU soft key to make the menus appear.

Modify Knob

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

CONTROL PANEL CONTROLS

Use the MODIFY knob and the five unlabeled soft keys that are 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).

Note: When the Pinnacle unit is in User or Serial 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 returned to the output display screen immediately.

Press the MENU soft key when the top level display screen is displayed to cause the main menu to appear. The main menu contains three menu selections, which are shown in Figure 4-6. Generally, pressing a soft key causes another level of menu choices to display (for example, MONITOR, LIMITS, ARC, and CONTROL display if you press the PROCESS soft key).



Figure 4-6. Control panel main menu functions

As you press soft keys and move through the menu levels, the top line of the output display screen displays the path of the menu in the upper, left-hand corner of the display screen.

A parameter flashes if it can be modified; make such modifications with the MODIFY knob. Pressing the ENTER soft key enters the modification into nonvolatile memory. You can press the MODIFY knob at any time to cancel what you are doing (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 out until you clear the fault. See the Troubleshooting chapter for a list of fault messages.

UNDERSTANDING THE MENU OPTIONS

Pressing any soft key will bring up the main menu tree. When at the top level, you have three menu options:

- Service
- Supply
- Process

From the Service menu, you can access diagnostic information. From the Supply menu, you can modify supply-specific parameters, and from the Process menu, you can 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.

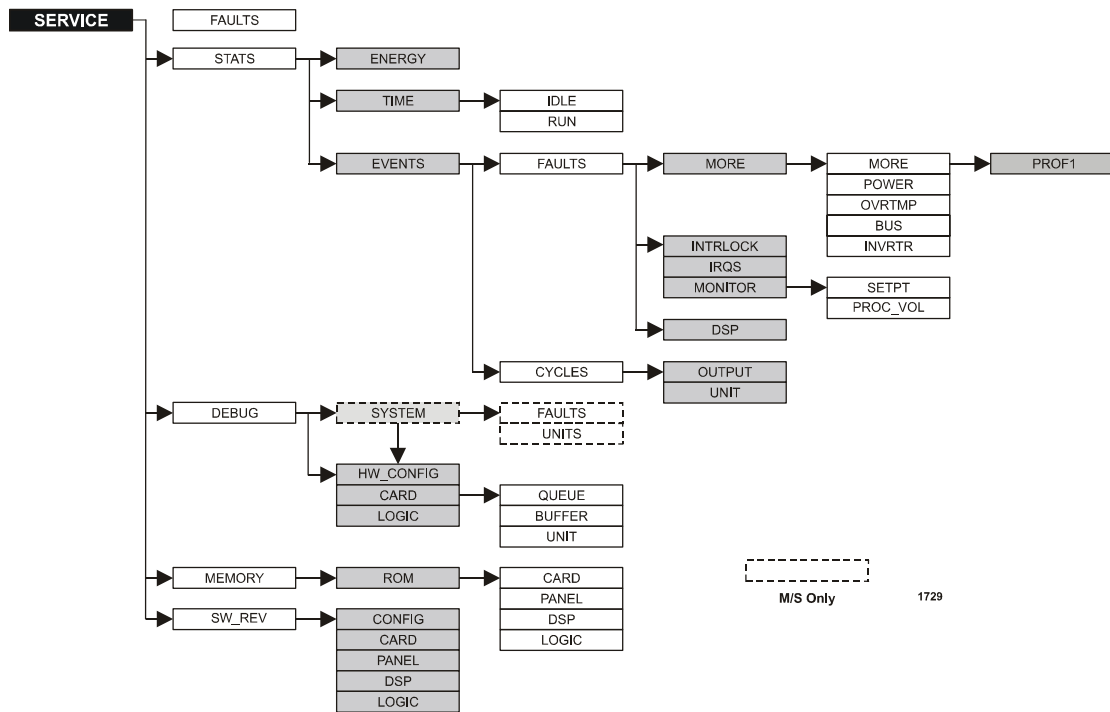


Figure 4-7. Service menu map

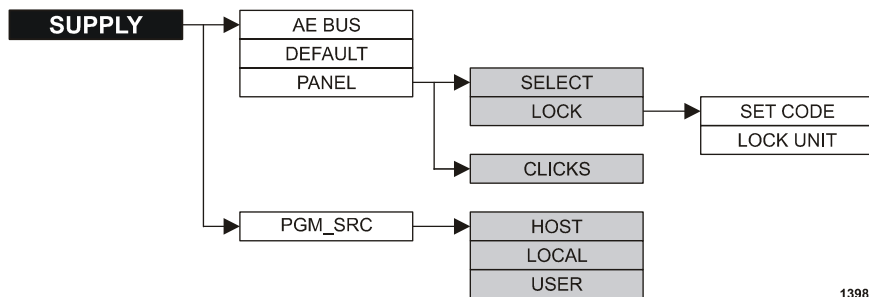


Figure 4-8. Supply menu map

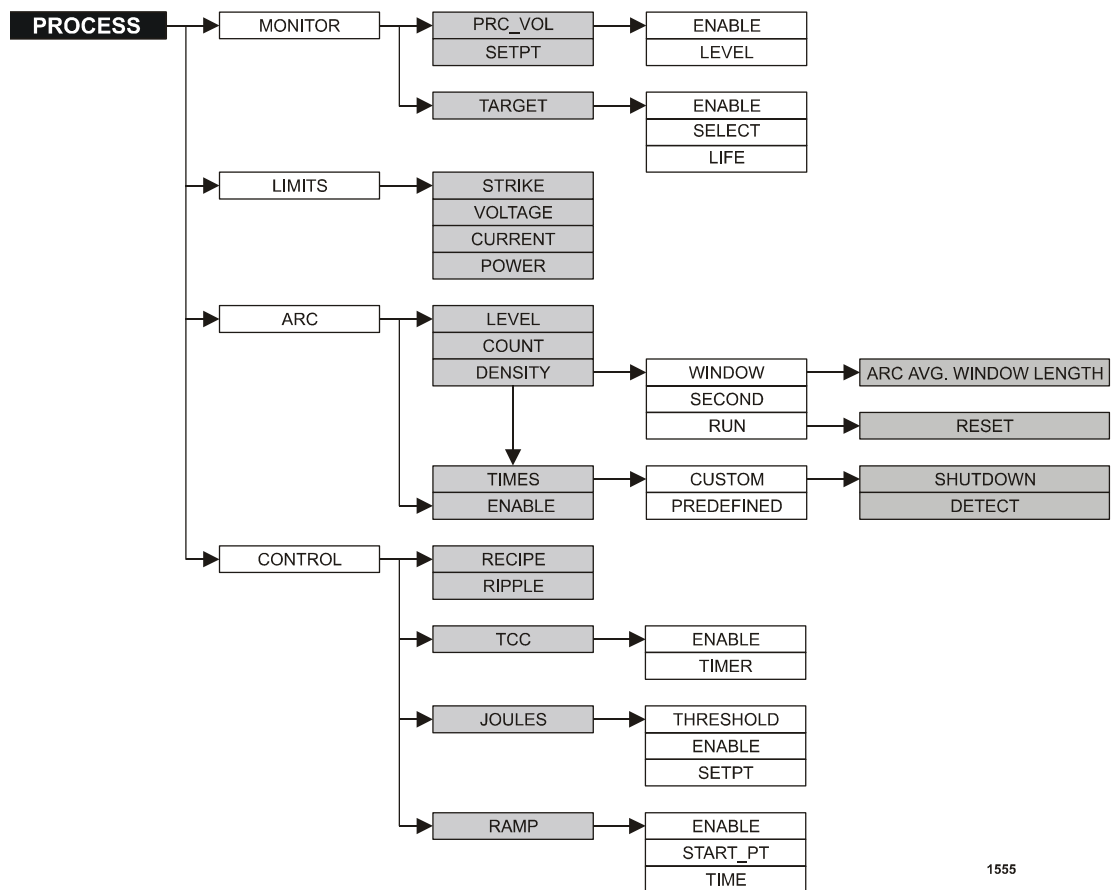


Figure 4-9. Process menu map

USING THE SERVICE FUNCTIONS

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

- FAULTS: customer service information
- STATS: supply statistics
- DEBUG: debug screens
- MEMORY: ROM CRC checksums
- SW_REV: software revision numbers

Checking Service-type Faults

SERVICE → FAULTS

Customer service will use this option.

Checking Service-type Statistics

SERVICE → STATS

Use this option to check the service-type statistics.

CHECKING THE TOTAL ENERGY OUTPUT

SERVICE → STATS → ENERGY

To check the total energy output:

Press SERVICE → STATS → ENERGY.

The total energy output for the unit appears.

CHECKING THE AMOUNT OF IDLE TIME

SERVICE → STATS → TIME

To check the amount of time idle and the amount of time running, follow these steps.

1. Press SERVICE → STATS → TIME.
2. To display the amount of time idle, press the IDLE soft key.
The amount of time idle appears.
3. To display the amount of time running, press the RUN soft key.
The amount of time running appears.

CHECKING THE NUMBER OF FAULTS

SERVICE → STATS → EVENTS

To check the number of faults, follow these steps:

1. Press SERVICE → STATS → EVENTS.
FAULTS and CYCLES options appear.
2. Press the FAULTS soft key.
3. MORE, INTRLOCK, IRQS, MONITOR, and DSP options appear.
4. If you press MORE, you can check the following faults:
 - MORE → PROF1 displays the number of Profibus faults

- POWER displays the number of line power faults.
 - OVRTMP displays the number of over temperature faults.
 - BUS displays the number of bus faults.
 - INVRTR displays the number of inverter faults.
5. If you press INTRLOCK, the number of contactor, user, and cable faults appears.
 6. If you press IRQ, the number of predefined and unassigned IRQs appears.
 7. If you press MONITOR, you can check the number of setpoint timer faults and process voltage faults.
 8. If you press DSP, the number of DSP control and DSP watch dog faults appears.

CHECKING THE NUMBER OF CYCLES

To check the cycles, follow these steps:

1. Press SERVICE → STATS → EVENTS.
FAULTS and CYCLES options appear.
2. Press the CYCLES soft key.
OUTPUT and UNIT options appear.
3. To get a report of the number of output on events, press the OUTPUT soft key.
4. To get a report of the number of power on events, press UNIT.

Debugging Your Unit

SERVICE → DEBUG

Use this option to check the hardware configuration, installed cards, and logic software options.

CHECKING YOUR MASTER/SLAVE SYSTEM

SERVICE → DEBUG → SYSTEM

Displays master/slave system size and number of slaves in system.

SERVICE → DEBUG → SYSTEM → FAULTS

Rotate the MODIFY knob to display master faults and slave faults individually. Use this option to check logic and master/slave card faults on master and slave(s).

SERVICE → DEBUG → SYSTEM → UNITS

Rotate the modify knob to display output power and output current of each unit in the master/slave system. Use this option to check output levels of individual units in the master/slave system.

CHECKING YOUR HARDWARE CONFIGURATION

SERVICE → DEBUG → HW CONFIG

To find out whether or not a card is installed in slot 1 or 2:

Press SERVICE → DEBUG → HW CONFIG.

A report of the personality cards installed in the supply in slot 1 and slot 2 appears.

CHECKING YOUR COMMUNICATIONS CARD

SERVICE → DEBUG → CARD

Use this option to find out specific communications debug information:

Press SERVICE → DEBUG → CARD.

Note: Not all cards support this feature.

CHECKING YOUR SOFTWARE LOGIC

SERVICE → DEBUG → LOGIC

Use this option to find out what software logic options are installed.

Press SERVICE → DEBUG → LOGIC.

A two-byte hex representation of the software options appears.

Checking Your ROM

SERVICE → MEMORY

To perform ROM cyclic redundancy check (CRC) checking, follow these steps:

Note: There is a momentary delay before the CRC will display.

Note: Not all cards support this option.

1. Press SERVICE → MEMORY → ROM → CARD.
2. To calculate and display the active panel (local or remote) CRC, press PANEL.
3. To calculate and display the DSP CRC, press DSP.
4. To calculate and display the logic board CRC, press LOGIC.

Checking Your Software Versions

SERVICE → SW_REV

To find out the software number and version of your system software components, follow these steps:

1. Press SERVICE → SW_REV.
2. To display the software version of the configuration, press CONFIG.
3. To display the software version of the cards installed in your unit, press CARD.
4. To display the software version of the active panel software, press PANEL.
5. To display the software version of the DSP software, press DSP.
6. To display the software version of the logic, press LOGIC.

USING THE SUPPLY FUNCTIONS

This option lets you modify specific components and parameters of your supply. The menu options are:

- AEBUS:
- DEFAULTS:
- PANEL:
- PGM_SRC:

Setting the AE Bus Timeout

SUPPLY → AE BUS

To set your AE Bus timeout time, follow these steps:

1. Press SUPPLY → AEBUS.
2. Rotate the MODIFY knob to adjust the AE Bus time out value (in 10 ms increments).
3. Press ENTER to accept and exit.

Note: We recommend you keep this value as small as possible to speed up error recovery due to noise.

Setting the Supply Parameters

SUPPLY → DEFAULTS

To set all your supply parameters to the defaults and then store them in non-volatile memory, follow these steps:

1. Press SUPPLY → DEFAULTS.
2. Rotate the MODIFY knob to display **Yes** or **No**.
3. Press ENTER to accept and exit.

4. Cycle power on the supply for the defaults to take effect.

Setting the Panel Mode

SUPPLY → PANEL

Use this option to select between a remote and local control panel, lock the control panel, set the lock code, or set the encoder rate for the knob clicks.

SELECTING REMOTE OR LOCAL MODE

SUPPLY → PANEL → SELECT

To switch between the remote active panel and the local active panel, follow these steps:

1. Press SUPPLY → PANEL → SELECT.
2. Rotate the MODIFY knob to display **Yes** or **No**, depending on whether or not you want to switch to a remote/local active panel.
3. Press ENTER to accept and exit.
4. Wait several seconds for verification of switch before using the other control panel.

SELECTING A LOCK CODE

SUPPLY → PANEL → LOCK

To enter a lock code for locking the active control panel, follow these steps:

1. Press SUPPLY → PANEL → LOCK.
SET CODE and LOCK UNIT options appear.
2. To set a lock code, press the SET CODE soft key. If a code is already entered, press LOCK UNIT.
Any further menu accesses will require entry of the code.

Note: Cycling power on the supply resets the lock status to UNLOCKED.

SELECTING THE NUMBER OF CLICKS

SUPPLY → PANEL → CLICKS

The clicks feature specifies the number of high speed counts per click for the MODIFY knob. The value you enter is a multiplier for each click of the knob when you turn the knob quickly. When you turn the knob slowly, the multiplier does not take effect. You can enter any number from one to 40. If you want a displayed value to change slowly as you turn the knob, set the number of counts per click to 1. If you want the value to change quickly, set the number of counts to 40.

To change the number of counts per click, follow these steps:

1. Press SUPPLY → PANEL → CLICKS.
2. Rotate the MODIFY knob to set the number of counts per click.
3. Press ENTER to accept and exit.

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 supply uses the information for output regulation mode and setpoint that has been established through either the Pinnacle Remote Active panel or the Standard Serial port. If the program source is set to external (EXT), the Pinnacle supply uses the setpoint and output regulation mode that has been established through the pins on the User port.

To select the desired source and type, follow these steps:

1. Press SUPPLY → PGM_SRC.
HOST, LOCAL, and USER options appear. Press one of these buttons to toggle between internal and external for that types.
2. Press EXIT.

Note: A user card must be installed in order to alter these settings.

USING PROCESS 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

Monitoring Your Process

PROCESS → MONITOR

This menu allows you to monitor elements of your process such as the life of your target, how long the process is running out of setpoint, or whether the process voltage drops below its threshold.

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 will appear on the display.

To enable and set the process voltage level, follow these steps:

1. Press PROCESS → MONITOR → PRC_VOL → ENABLE.
2. Rotate the MODIFY knob to select **Yes** or **No**.
3. Press ENTER to accept and exit.
4. Press the LEVEL soft key.
5. Rotate the MODIFY knob to select a process voltage level.
6. Press ENTER to accept and exit.

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.

Note: In units *without* master/slave cards, out-of-setpoint detection is disabled during arcs (including short circuits at the supply's output). However, when a master/slave card is installed, arcs (and short circuits) that are long enough to affect filtered readings (100 ms or longer) will cause an out-of-setpoint indication.

For a stand-alone unit, the out-of-setpoint limit is 0.4% of full scale or 2% of setpoint, whichever is greater.

In a master/slave system, the out-of-setpoint limit is 3.125% of full scale, and it is applied to the entire output of the master/slave system.

Note: The master of a master/slave system is also constrained by the stand-alone out-of-setpoint limit. This limit (0.4% of full scale or 2.0% of setpoint) only applies to the output of the master in the system.

When an out-of-setpoint condition occurs, the unit shuts off output and displays error code E001: OUT OF SETPOINT TIMER EXPIRED. (See the “Error Codes” section of the “Troubleshooting” chapter for more information about error codes).

To enable the out-of-setpoint timer, follow these steps to select a value (in 0.1 s increments).
To disable the timer, follow these steps and select a value of 0.

Note: Because the readbacks, which are compared to the setpoint, are filtered in the software, we recommend you do not use this feature for process runs that are less than 1 s.

1. Press PROCESS → MONITOR → SETPT.
2. Rotate the MODIFY knob to adjust the value.
3. Press ENTER to accept and exit.

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.

PROCESS → MONITOR → TARGET → ENABLE

To enable or disable the target life counter for the selected target, follow these steps:

1. Press PROCESS → MONITOR → TARGET → ENABLE.
2. Rotate the Modify knob to select **Yes** or **No**.
3. Press ENTER to accept and exit.

PROCESS → MONITOR → TARGET → SELECT

To change the active target life counter, follow these steps:

1. Press PROCESS → MONITOR → TARGET → SELECT.
2. Rotate the MODIFY knob to select the active target number.
3. Press ENTER to accept and exit.

Note: The User port has priority in selecting targets. Thus, if your unit has a user card installed, you must set the target to 1 at the User port if you want to select targets from the serial port, active front panel, or Pinnacle Remote Active Panel (that is, when the Pinnacle unit is in host or local control mode). Leaving the target bits open or leaving the User port pins unconnected causes the target selection at the User port to default to 1.

PROCESS → MONITOR → TARGET → LIFE

To set the target life in 0.01 kWh increments, follow these steps:

1. Press PROCESS → MONITOR → TARGET → LIFE.
2. Rotate the MODIFY knob to select a target life between 0 and 15000.00 kWh (The default is 0).

If you are rotating the MODIFY knob slowly, press the appropriate soft key to indicate how quickly you want the display to increment the value (x1000, x100, x10 or x1). Note: If you turn the MODIFY knob quickly, the counts per click setting takes effect.

3. Press ENTER to accept and exit.

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.

Note: 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: maximum output (voltage, current, and power).

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

Note: 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.

Note: High voltage output units (750–1500 Vdc and 1500–3000 Vdc) do *not* have strike voltage capability.

To set the strike voltage limit, follow these steps:

1. Press the PROCESS soft key at the main menu.
2. Press the LIMITS soft key.
3. Press the STRIKE soft key.
4. 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. See the following table for specific values.)

5. Press ENTER to accept and exit.

Table 4-10. Strike Voltage Limit

Strike Voltage Setting	Low-Z 200–400 Vdc	Standard-Z 400–800 Vdc	High-Z 400–1000 Vdc 500–1000 Vdc	High Voltage 750–1500 Vdc 1500–3000 Vdc
Low	400 V \pm 100 V	800 V \pm 100 V	1,000 V \pm 100 V	Strike voltage not available
Medium	650 V \pm 100 V	1,100 V \pm 100 V	1,200 V \pm 100 V	
High	900 V \pm 100 V	1,450 V \pm 150 V	1,450 V \pm 150 V	

SETTING 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. Accuracy is +0.3% of the full rated output voltage for the supply.

To set the user voltage limit, follow these steps:

1. Press PROCESS → LIMITS → VOLTAGE.
2. Rotate the MODIFY knob to select a value between 0 and the maximum rated output voltage for the supply.
3. Press ENTER to accept and exit.

SETTING THE 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. Accuracy is +0.3% of the full rated output current for the supply.

To set the user current limit, follow these steps:

1. Press PROCESS → LIMITS → CURRENT.
2. Rotate the MODIFY knob to select a value between 0 and the maximum rated output current for the supply.
3. Press ENTER to accept and exit.

Note: Master/slave units will refresh to the maximum limit for current on power up, after explicit slave faults, or after connecting or disconnecting slaves.

SETTING THE 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. Accuracy is +0.3% of full rated output power for the supply.

To set the user power limit, follow these steps:

1. Press PROCESS → LIMITS → POWER.
2. Rotate the MODIFY knob to select a value between 0 and the maximum rated output power.
3. Press ENTER to accept and exit.

Note: Master/slave units will refresh to the maximum limit for power on power up, after explicit slave faults, or after connecting or disconnecting slaves.

Setting Arc Handling

PROCESS → ARC

Use the ARC menu to implement arc-handling during your normal process cycle or during both your process cycle and your target conditioning cycle (TCC). 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.

Enabling the TCC algorithm places setpoint and arc handling under microprocessor control, letting you achieve fast, automated target conditioning. Before enabling the TCC algorithm, ensure that you have first entered a setpoint and set values for the PROCESS menu parameters.

SETTING THE VOLTAGE ARC TRIP LEVEL

PROCESS → ARC → LEVEL

This function lets you set the voltage arc trip level, i.e. the output voltage level at which the unit determines an arc is occurring for both process mode and the TCC algorithm. If the voltage level stays below the specified trip level for the amount of time you set (in the TIMES/DETECT function), the Pinnacle supply reacts by shutting down.

To set the arc trip level, follow these steps:

1. Press PROCESS → ARC → LEVEL.
2. Rotate the MODIFY knob to select an arc trip level.
3. Press ENTER to accept and exit.

SETTING THE ARC COUNT LIMIT

PROCESS → ARC → 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.

To set the hard arc count limit, follow these steps:

1. Press PROCESS → ARC → COUNT.
2. Rotate the MODIFY knob to select a hard arc count limit.
3. Press ENTER to accept and exit.

VIEWING THE ARC DENSITY

PROCESS → ARC → DENSITY

The hard arc counter counts one arc every time the 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.

To see the arc density of your process, follow these steps:

1. Press PROCESS → ARC → DENSITY.
SECOND and RUN options appear.
2. To see arcs per second, press SECOND.
3. To see arcs per run, press RUN.
4. This display is not zeroed until you turn the output on again.
5. Press EXIT to exit.

Note: You can also reset the counters through the menu commands by pressing PROCESS → ARC → DENSITY → RUN, then pressing the RESET softkey.

SETTING THE LENGTH OF THE ARC AVERAGE WINDOW

PROCESS → ARC → 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 and 10 seconds. With a window of 1 second, 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 second, 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 average window, follow these steps:

1. Press PROCESS → ARC → DENSITY → 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 TIMES

PROCESS → ARC → TIMES

You can customize your Pinnacle unit's arc handling. If you select "Custom," at the Process/Arc/Times menu, then two more menu selections become available to you: "Shutdown" for selecting an arc shutdown time, and "Detect" for selecting an arc detect delay time. Choose among several values for each. If you select "Predefined" then the shutdown and detect times are pre-set.

To select a custom arc shutdown time, follow these steps:

1. Press PROCESS → TIMES → CUSTOM
2. Rotate the MODIFY knob to select one of ten available settings in micro-seconds.
3. Press ENTER to accept and exit.

To select a custom arc detect delay time, follow these steps:

1. Press PROCESS → TIMES → CUSTOM
2. Press DETECT
3. Rotate the MODIFY knob to select one of ten available settings in micro-seconds.
4. Press ENTER to accept and exit.

PREDEFINED ARC HANDLING

This function lets you indicate the type of arc handling you would like for your process by identifying the type of target in your process: metal or non-metal. This is useful in situations where the arcing characteristics of a process are unknown, making it difficult to set "custom" arc times. Selecting a metal or non-metal target initiates pre-programmed arc detect times and arc shutdown times for the normal process cycle (PC) and for the target conditioning cycle (TCC) if TCC is enabled. The following table shows those values:

Table 4-11. Arc detect, arc shutdown, and TCC times for pre-defined targets

Target Type	PC Detect Time (μs)	PC Shutdown Time (μs)	TCC Detect Time (μs)	TCC Shutdown Time (μs)
Metal	0	30	20	50
Non-Metal	0	500	20	500

Note: 10 kW and 20 kW Pinnacle units with a 208 V input configuration have minimum PC Shutdown and TCC Shutdown times of 50 μsec.

To select a predefined arc handling mode follow these steps:

1. Press PROCESS → TIMES → PREDEFINED.
2. Rotate the MODIFY knob to select “metal” or “non-metal.”
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.



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 disable the arc handling, follow these steps:

1. Press PROCESS → ARC → ENABLE.
2. Rotate the MODIFY knob to select **Yes** or **No**.
3. Press ENTER to accept and exit.

Note: 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.

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
- RIPPLE
- TCC
- JOULES
- RAMP

Setting Recipes

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.

To set the number of recipe steps, do the following:

1. Press the CONTROL soft key at the main menu.
2. Press the RECIPE soft key.
3. Rotate the MODIFY knob to select a value from 1 through 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.

To set the ramp time, setpoint, and run timer value for each step, do the following:

1. After you have entered a value from 1 through 8 at the # OF STEPS screen (see steps 1 through 2 above), you should be looking at a screen that requests a RAMP TIMER value.
2. Rotate the MODIFY knob to select a value between 0.05 s to 600 s (in 0.01 s increments).
3. Press ENTER; the display progresses to a screen requesting a SETPOINT value.
4. Use the REGULATION key to toggle between power, current and voltage. Use the MODIFY knob to select a value between 0 and the full rated output of the supply.
5. Press ENTER; the display progresses to a screen requesting a RUN TIMER value.
6. Rotate the MODIFY knob to select a value between 0.00 s to 600 s (in 0.01 s increments).

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

7. If you are turning the MODIFY knob slowly, press the appropriate soft key to indicate how quickly you want the display to increment the value (x10 or x1).

Note: If you turn the MODIFY knob quickly, the counts per click setting takes effect.

8. 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.
9. Repeat Steps 2 through 7 as needed.

Note: If you assign 0 run time for the final recipe step, the unit will switch 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 programmed a joules setpoint.

Setting Ripple Level

PROCESS → CONTROL → RIPPLE

This function lets you set the output ripple to either a low amplitude ripple (less than 2% rms) or a high amplitude ripple (4 to 5% rms).

To set the RIPPLE mode, follow these steps:

1. Press PROCESS → CONTROL → RIPPLE
2. Rotate the MODIFY knob to select “low” or “high.”
3. Press ENTER to accept and exit.

Using the Target Conditioning Cycle (TCC)

PROCESS → CONTROL → TCC

The TCC menu lets you enable the TCC (Target Conditioning Cycle) algorithm and set the TCC “idle” timer. Enabling the TCC algorithm places setpoint and arc handling under microprocessor control, letting you achieve fast, automated target conditioning. Before enabling the TCC algorithm, ensure that you have first entered a setpoint and set values for the arc handling parameters.

When TCC algorithm is enabled and the unit receives an on command, the microprocessor sets the arc detect time to 20 μ s (in “custom” arc handling, the shutdown time remains unchanged) and initiates a series of trials (or “steps”) to reach your desired setpoint (“the final setpoint”). To begin, the microprocessor sets an initial setpoint equal to 50% of the final setpoint. After 10 ms, the microprocessor checks the output level and sets a new interim setpoint equal to 125% of the output level. The microprocessor continues to check the output level and to set a new interim setpoint (always 125% of the output level) every 10 ms until the output level is equal to 80% of the final setpoint. When 80% of the final setpoint is reached, the interim setpoint is set equal to the final setpoint, the TCC algorithm ends, and arc handling is returned to the parameters you set up previously.

ENABLING TARGET CONDITIONING CYCLE (TCC)

PROCESS → CONTROL → TCC

This function enables or disables the TCC algorithm.

To enable TCC mode, follow these steps:

1. Press PROCESS → CONTROL → TCC → ENABLE.
2. Rotate the MODIFY knob to select **Yes** or **No** to enable or disable TCC mode.
3. Press ENTER to accept and exit.

SETTING THE TARGET CONDITIONING CYCLE (TCC) TIMER

PROCESS → CONTROL → TCC

When TCC is enabled, the TCC algorithm executes automatically the first time the output is turned on. The TCC timer feature lets you set an acceptable idle time for subsequent runs. If the output is off for less than the idle time, the TCC algorithm does not re-initiate upon the next on command. If the output is off for longer than the idle time, the TCC algorithm executes with the next on command.

Note: If the timer is set to 0 and the TCC algorithm has been enabled, the unit will initiate the TCC algorithm every time output is turned on.

To enable the TCC timer, follow these steps:

1. Press PROCESS → CONTROL → TCC → TIMER.
2. Rotate the MODIFY knob to select the timer value.
3. Press ENTER to accept and exit.

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. Choose THRESHOLD to specify a power level that must be exceeded before beginning calculation, thereby enhancing the accuracy of the calculation by disabling the calculation during ignition. Choose ENABLE to enable or disable joule mode. Choose SETPT to program the number of joules you want to be delivered.

To enable joule mode, follow these steps:

1. Press PROCESS → CONTROL → JOULES → ENABLE.
2. Rotate the MODIFY knob to select **Yes** or **No**, to enable or disable joule mode.
3. Press ENTER to accept and exit.

SETTING THE JOULE SETPOINT

To program the number of joules you want to be delivered (joule setpoint), follow these steps:

1. Press PROCESS → CONTROL → JOULES → SETPT.
2. Rotate the MODIFY knob to select a value between 0 and 9,999,999 joules (in 1 joule increments).

If you are rotating the MODIFY knob slowly, press the appropriate soft key to indicate how quickly you want the display to increment the value (x1000, x100, x10 or x1). Note: If you turn the MODIFY knob quickly, the counts per click setting takes effect.

3. Press ENTER to accept and exit.

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, follow these steps:

1. Press PROCESS → CONTROL → JOULES → THRESHOLD.
2. Rotate the MODIFY knob to select a value between 10 W and maximum unit power divided by 8.
3. Press ENTER to accept and exit.

Setting the 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 .05 seconds. The maximum ramp time is 600.00 seconds.

Note: If your unit has the 100 ms ramp feature enabled, the range is 0.5 seconds to 6000.0 seconds.

Ramping, recipes, and TCC 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:

$(\text{setpoint} - \text{start_setpoint} / \text{ramp steps (in 10 ms increments)}) = \text{delta_setpoint}$

The start_setpoint is equal to $(\text{truncation})((\text{setpoint} * \text{ramp_start_setpoint_percentage}) / 100)$.

Note: 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 $(\text{delta_setpoint} * 65535) > 100$.

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

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

PROCESS → CONTROL → RAMP

To enable ramp mode, follow these steps:

1. Press PROCESS → CONTROL → RAMP → ENABLE.
2. Rotate the MODIFY knob to select **Yes** or **No** to enable or disable ramp mode.
3. Press ENTER to accept and exit.

To select the ramp starting point (a percentage of the setpoint to begin ramping), follow these steps:

1. Press PROCESS → CONTROL → RAMP → START_PT.
2. Rotate the MODIFY knob to select a percent.
3. Press ENTER to accept and exit.

To select the ramp time, follow these steps:

1. Press PROCESS → CONTROL → RAMP → TIME.
2. Rotate the MODIFY knob to select a time.
3. Press ENTER to accept and exit.

Note: Under “Host” control, one can generate multiple ramps between setpoints by setting new setpoints while the output is on.

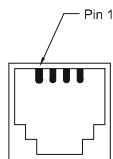
STANDARD SERIAL (FLASH) PORT

Your Pinnacle supply contains a modified AE Bus serial (Host) communications interface accessible through the Standard Serial port. This allows the Pinnacle unit to interface with a host computer. You can do everything from the host computer interfaced with the Pinnacle supply that you can do from the active front panel or the Pinnacle Remote Panel. For a complete list of available functions, refer to “Host/Pinnacle Software Commands” on page 4-55. To obtain a diskette containing sample software as well as an executable version of the AE Bus Host software, please call AE Customer Support.

Standard Serial Port Description

The Standard Serial port, or flash port, lets AE personnel program the internal flash function of the Pinnacle unit.

Located on the rear panel, the Standard Serial port is a shielded modular jack as Figure 4-4 illustrates (see also the rear panel illustration at the end of the Installation Chapter).



Connector is 2X actual size

1355

Figure 4-10. Standard Serial port

The pin descriptions for this port are as follows.

Table 4-12. Serial Port Pin Descriptions

Pin	Description
1	Do <i>not</i> connect
2	Power supply transmit
3	Power supply receive
4	Ground

We recommend that for optimal performance, you use only shielded modular cable between the Pinnacle unit's Standard Serial port and your host computer.

Transmission Parameters

The communications capability of the Standard Serial port is limited to the following parameters:

- RS-232 protocol
- Baud rate of 19.2 kbps
- Pinnacle unit address of 1
- Odd parity
- 1 start bit, 8 data bits, one stop bit
- Low-order bytes are transmitted before high-order bytes

Please note that the time-out period for Pinnacle units is factory set at .02 s (that is, no more than 20 ms can elapse between bytes or the unit will reset and begin looking for a new message packet). This can be changed using Command 40 or through the remote panel menu.

Note: This port is not available if your unit has an AE Bus card installed.

AE BUS SERIAL COMMUNICATIONS (HOST) PORT

Your Pinnacle supply features an AE Bus serial (Host) communications card with a 9-pin, female, subminiature-D connector for interfacing with a host computer. You can do everything from a host computer interfaced with the Pinnacle supply that you can do from the active front panel or Pinnacle Remote Active Panel.

To obtain a diskette containing sample software as well as an executable version of the AE Bus Host software, please call AE Customer Support. (See “AE Global Support” on page 7-18 for contact information) .

Note: If you have an isolated AE Bus serial communications card, your card provides isolation of more than 500 Vrms from the Pinnacle unit's SELV logic and control circuitry to all nine pins on the connector.

Make connections for the serial AE Bus (Host) port through its 9-pin, female subminiature-D connector on the rear panel of the unit.

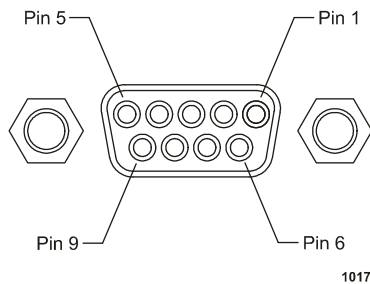


Figure 4-11. Host port connector

Pin Descriptions

Refer to the following table for pin descriptions.

Table 4-13. AE Bus (Host) Port Pin Descriptions

Pin	Pin Name	Description
1	UNASSIGNED	
2	TXD.D	RS-232 transmit data
3	RXD.D	RS-232 receive data
4	UNASSIGNED	
5	COM.D	Data common
6	TR- / R-	RS-485 (-) transmit/receive data; RS-422 (-) received data
7	TR+ / +	RS-485 (+) transmit/receive data; RS-422 (+) received data
8	T-	RS-422 (-) transmit data
9	T+	RS-422 (+) transmit data

Transmission Parameters

- RS-232, RS-422, or RS-485 transmission standard
- Four baud rates (selected by the DIP switch):
 - RS-232: 1200, 4800, 9600, 19,200
 - RS-422, RS-485: 9600, 19,200, 38,400, 57,600
- Odd parity
- 1 start bit, 8 data bits, one stop bit
- Low-order bytes are transmitted before high-order bytes

The time-out period for Pinnacle units is factory set at 0.02 s (that is, no more than 0.02 s can elapse between bytes or the unit will reset and begin looking for a new message packet). This can be changed using Command **40**.

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

Note: If you have selected RS-232, the Pinnacle unit sends data through pin 2 (*TXD.D*). This pin must be connected to to receive pin (*RXD.D*) on the host computer's PC serial connector. The receive pin is normally pin 2 for a standard 9-pin PC serial port and normally pin 3 for a standard 25-pin PC serial port.

Note: If you are using RS-422 or RS-485, the Pinnacle supply sends and receives data differentially. Thus pin 6 (TR- or R-) and pin 7 (TR+ or R+) are either RS-485 transmit and receiver lines or RS-422 receiver lines. Pins 8 and 9 are RS-422 transmit lines.

Using DIPs to Set the Pinnacle Unit's Network Address

A DIP switch provides the operator a way to set the network address of the Pinnacle unit.

SWITCH SETTINGS

The DIP switch (see Figure 4-12 on page 4-45 and Figure 4-13 on page 4-45) is used to set the address for each Pinnacle supply in a multi-drop configuration. In units without master/slave capability, the DIP switch is located on the rear panel of the Pinnacle supply next to the serial (Host) port.

***Note:* On units equipped with a master/slave interface card this DIP is located inside the unit on the master/slave interface card.**

There are two types of DIP switch on Pinnacle supplies: "rocker" DIPs and "slide" DIPs (see Figure 4-12 on page 4-45 and Figure 4-13 on page 4-45). Your supply will have one of these types. While the switches on these DIPs are slightly different, they serve the same function. Both DIPs contain eight miniature switches (here called "min-switches"). In all units, setting a switch to the "up" position means setting it toward the numbers on the DIP, and setting a

switch to the “down” position means setting it away from the numbers. On “rocker” DIPs, “up” means that the side of the switch toward the numbers is depressed. On “slide” DIPs, “up” means that the slide is pushed toward the numbers.

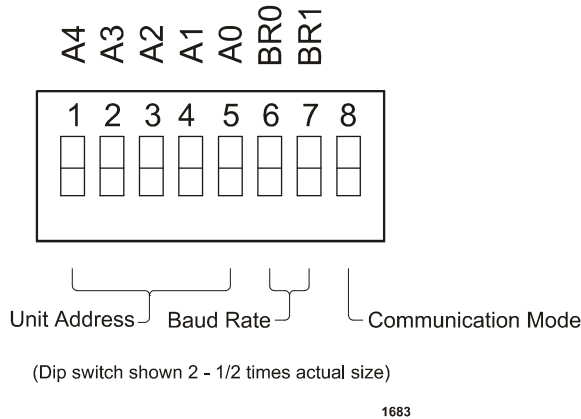


Figure 4-12. Rocker DIP switch (internally located on a master/slave interface card)

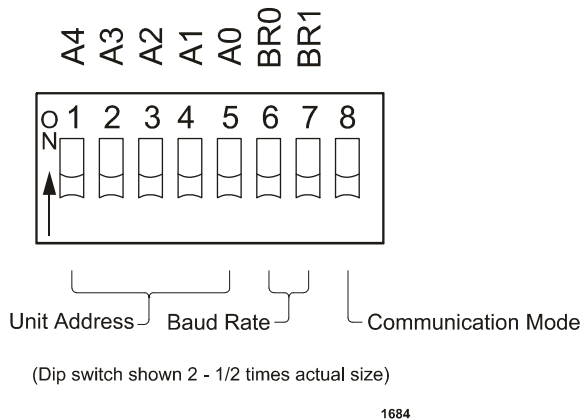


Figure 4-13. Slide DIP switch (externally located on units without a master/slave card)

EXTERNAL DIPS

On units where the DIP switch is located externally on the rear panel, it can be difficult to see the numbers, and the orientation of the unit may change. However, the orientation of the DIP is always the same relative to the unit and, 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.

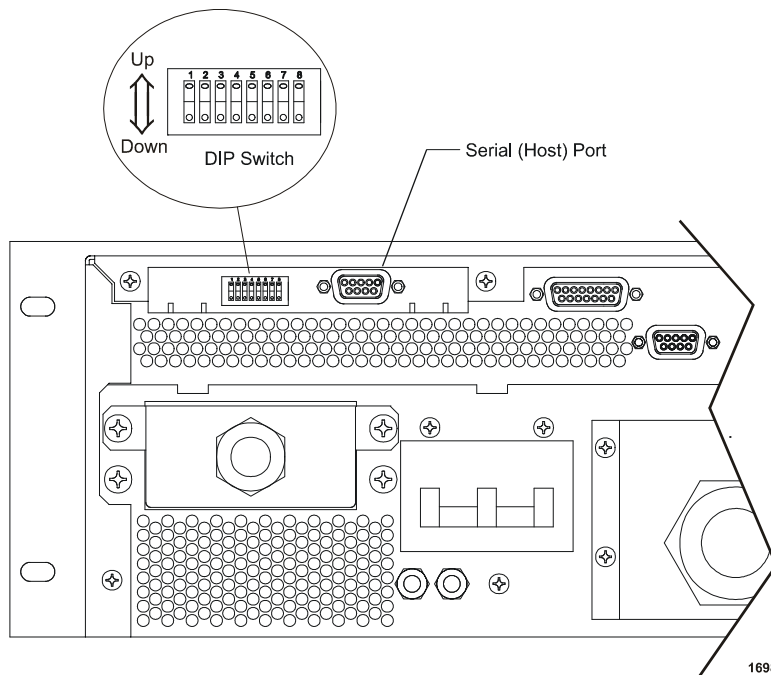


Figure 4-14. Orientation of the Host port and DIP switch on the back panel (units without a master/slave interface card installed)

INTERNAL DIPS

On units equipped with a master/slave interface card the DIP is located internally and can only be accessed after removing the the Pinnacle unit's cover.

Note: On units equipped with a master/slave interface card the DIP is internal and should only be accessed after first removing all input power.

The following figure shows the placement of the DIP switch in the interior of the unit.



MIN-SWITCHES

The next two min-switches (**BR1** and **BR0**) specify the serial AE Bus (Host) port's baud rate (see Table 4-14 on page 4-48). The last min-switch allows you to choose between RS-232 or differential communication (RS-485 or RS-422). RS-232 is selected when the switch is up. Differential communication is selected when the switch is down.



If you have selected RS-422 or RS-485, you also have to set two terminator jumpers. If have selected RS-422 or if your Pinnacle unit is the last device on an RS-485 multi-drop chain, place the jumpers across pins 1 and 2 (labeled **Term.**). If you have selected RS-485 and your Pinnacle unit is not the last device on a multi-drop chain, place the jumpers across pins 2 and 3 for no termination.

SETTING THE PINNACLE UNIT'S NETWORK ADDRESS

Use the DIP switch (see Figure 4-12 on page 4-45 and Figure 4-13 on page 4-45) to set the unit's network address.

Note: When the unit is a dual output power supply, side B's address is side A's address plus 15 decimal; thus, the highest usable address for side A is 16.

Table 4-14. Address Settings

Address	A4	A3	A2	A1	A0
0	Don't assign this address to a unit; it is the network broadcast address--all Pinnacle units receive a message sent to this address by the host, but will not reply.				
1	up	up	up	up	down
2	up	up	up	down	up
3	up	up	up	down	down
4	up	up	down	up	up
5	up	up	down	up	down
6	up	up	down	down	up
7	up	up	down	down	down
8	up	down	up	up	up
9	up	down	up	up	down
10	up	down	up	down	up
11	up	down	up	down	down
12	up	down	down	up	up
13	up	down	down	up	down
14	up	down	down	down	up
15	up	down	down	down	down
16	down	up	up	up	up
If your unit is a dual Pinnacle, 16 is the highest usable address for side A; side B's address is side A's address plus 15 decimal.					
17	down	up	up	up	down
18	down	up	up	down	up
19	down	up	up	down	down
20	down	up	down	up	up
21	down	up	down	up	down
22	down	up	down	down	up

Table 4-14. Address Settings (Continued)

Address	A4	A3	A2	A1	A0
23	down	up	down	down	down
24	down	down	up	up	up
25	down	down	up	up	down
26	down	down	up	down	up
27	down	down	up	down	down
28	down	down	down	up	up
29	down	down	down	up	down
30	down	down	down	down	up
31	down	down	down	down	down

SETTING BAUD RATES AND COMMUNICATION MODE

Also use the DIP switch (see Figure 4-12 on page 4-45 and Figure 4-13 on page 4-45) to set the serial (Host) port's baud rate. The following tables show the DIP switch settings for **BR0**, **BR1**, and Switch **8**. Switch **8** sets the supply to either RS-232 or RS-485/422. Switches **BR0** and **BR1** set the baud rates.

Table 4-15. Setting Switch 8

Switch Position	Communication Mode
up	RS-232
down	RS-485/422

Table 4-16. Baud Rate Settings

Baud Rate RS-232	Baud Rate RS-485/422	BR0	BR1
1200	9600	up	up
4800	19,200	up	down
9600	38,400	down	up
19,200	57,600	down	down

HOST/PINNACLE COMMUNICATIONS

The following sections describe host/Pinnacle communications.

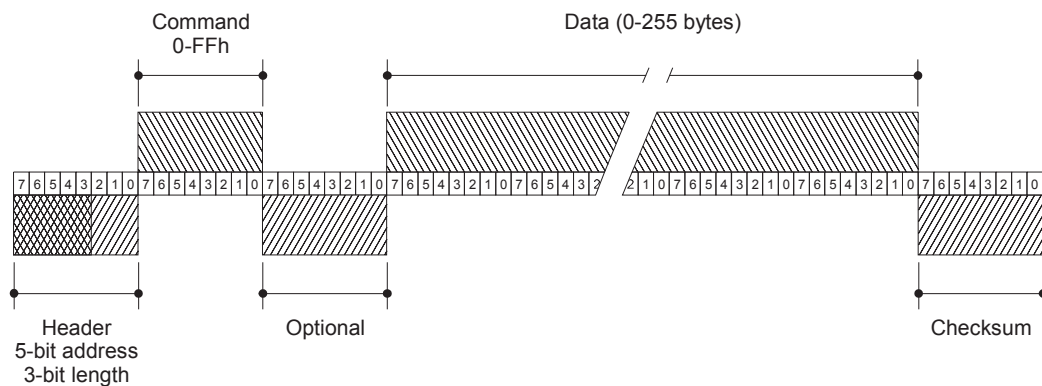
Communications Protocol

The AE Bus (Host) protocol uses pure binary data (nothing is coded ASCII) and is designed to facilitate direct communications between a host computer and the Pinnacle power supply.

Five types of information (fields) make up communications message packets (see Figure 4-5):

- header (address and length of data field)
- command (see command list later in this chapter)
- optional length byte
- data
- checksum (error checking)

Figure 4-16 on page 4-50 shows the organization of these data fields in the AE Bus message packet. The figure is followed by paragraphs that describe in detail the data fields.



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Figure 4-16. Graphic representation of a message packet

HEADER

The first byte in each message 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 (master), the address specifies the packet's destination (to a Pinnacle unit, for example). If the packet is going to the host, the address specifies the packet's origin (from the Pinnacle unit). The address section of the Header field is five bits long, which allows a total of 32 distinct addresses. Address 0 (zero) is reserved for the network broadcast address; when this address is used in a host-originated packet, all units execute the packet (but do not respond back to the host).

The remaining three bits tell the receiving unit how long the Data field is so that the unit can determine when the entire message has been received.

Note: The value in these bits should refer only to the number of actual data bytes. Do not include the checksum byte when calculating the value for these bits.

The Header field (address and length) must be at the beginning of the message packet so that the receiving unit can compute the length of the packet after receiving the first byte.

COMMAND

This field contains a one-byte value: 00h to FFh (0 to 255). 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. See Table 4-18 on page 4-55 for a complete list of host commands.

OPTIONAL LENGTH BYTE

This field supplements the Header field and exists only when the length bits in the Header field contain a value of 7. Under those circumstances, the Optional field contains a one-byte value (between 0 and 255) indicating the number of data bytes.

DATA (DATA BYTES)

The Data field can contain from 0 to 255 bytes of binary data, which are interpreted in various ways, depending on the value that appears in the Command field. The Data field typically contains data or a CSR (see “Creating an Ideal Communications Transaction” on page 4-52), depending on what was requested. Since some commands do not require data, sometimes the Data field is not present.

If the value specified in the length bits of the Header field is 0 to 6, the Pinnacle unit expects 0 to 6 bytes of data. However, if the value in the Header field is 7, the Pinnacle unit looks for an additional eight-bit byte after the Command field (the Optional field) and uses this value for the data byte count.

CHECKSUM

This one-byte field is the last one in the packet. The content depends on the value of each of the preceding fields. The transmitting unit determines this value by accumulating the XOR (exclusive-or) 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 packet has likely been received intact.

Only after the checksum of a message packet is validated (having no parity errors, and the address is valid) will the Pinnacle unit act on the message (which consists of the contents of the command, and if appropriate, the data fields).

Creating an Ideal Communications Transaction

Figure 4-17 is a simplified graphic showing the steps in an ideal communications transaction between a host computer and a Pinnacle unit.

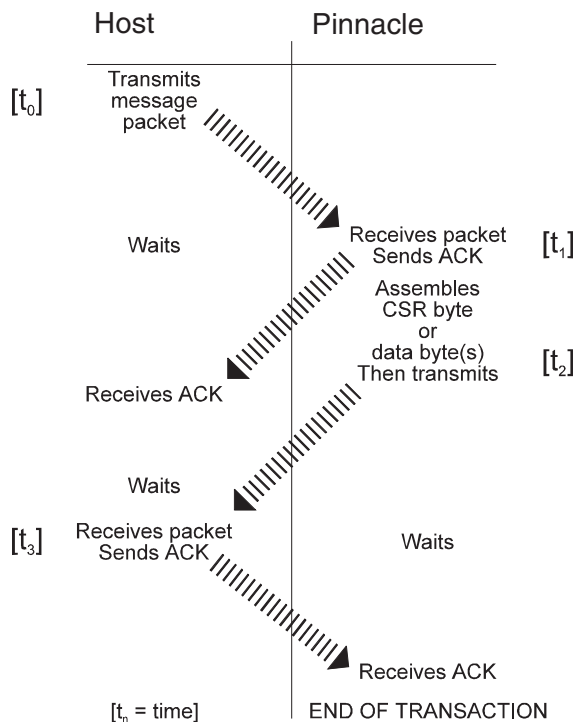


Figure 4-17. AE Bus communications transaction

First, 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

Once the Pinnacle unit receives the message packet, the Pinnacle unit verifies that the message is intended for it and not for another unit in 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; the Pinnacle unit resets and resumes waiting for a message addressed to it. If the address matches but the XOR (exclusive-or) sum of the bytes in the packet (including the checksum) is not zero, the Pinnacle unit sends a NAK (negative acknowledgment, hex code 15h) to the host. If the address matches correct and the message is intact, the Pinnacle unit sends an ACK (acknowledgment, hex code 06h) to the host.

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 (see “Understanding Command Status Response (CSR) Codes” on page 4-53). CSR code 0 is sent when the command has been accepted.

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

Meanwhile, the Pinnacle unit has prepared a message packet with the requested information or appropriate CSR code, which it then transmits to the host. The host determines by means of the checksum if the message is complete. If the host detects an error in the transmission (by using the Checksum), it can request the packet be sent again by transmitting a NAK.

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

Understanding Command Status Response (CSR) Codes

When the Pinnacle unit sends a Command Status Response (CSR) code in response to a command, interpret the CSR (a one-byte response) code in the following way:

Table 4-17. 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 (Change not allowed)
3	Output is off (Change not allowed)
4	Data is out of range
5	Invalid parameter
6	Program source is incorrect
7	Active fault(s) exist
8	Ramping is active (Change not allowed)
9	Data byte count is incorrect

Table 4-17. Command Status Response (CSR) Codes (Continued)

10	User port has priority (Change not allowed)
11	Bus is not ready (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 been consumed
17	Output OFF timer active (Minimum off time is 50 ms)
19	Recipe is active (Change not allowed)
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
25	Unit is a slave
27	Output OFF timer active (Minimum OFF time is 50ms.)
28	Setpoint exceeds user limit
29	Regulation lock
30	TCC is active (Change not allowed)
31	The User port reset is active (you must de-assert the reset line on the User port)
32	The contactor is open (you must clear all active faults)
37	Neither ramp nor recipe is active
38	Ramp and recipe HOLD is already active
39	Ramp and recipe HOLD is not active
80	Master/slave fault.
99	Command not accepted (There is no such command)

Figure 4-18 on page 4-55 is a simplified graphic showing the steps in an example communications transaction between a host computer and a Pinnacle unit.

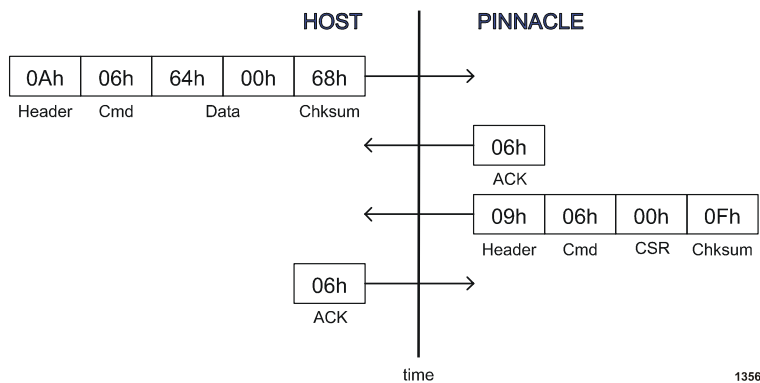


Figure 4-18. Communications transaction example

Host/Pinnacle Software Commands

To operate the power supply from a host computer, you must first set the control mode to host (Command 14).

Commands 1 through 127 change the value of a parameter or direct the power supply to perform a specific function

Note: The master/slave functions listed in this section apply only to Pinnacle supplies with a master/slave Host card installed.

Table 4-18. Host Port Commands

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
1 dc off	Sets dc output off; this request is always honored, regardless of which interface has control.	0	CSR only
2 dc on	Sets dc output on; host control must be selected (see Command 14). Read back the status of the last output on event with Command 161 .	0	CSR only
3 regulation method	Sets the method of output regulation (power, current or voltage). Send 1 data byte (8-bit value): <ul style="list-style-type: none"> 6 = power 7 = voltage 8 = current Read back this value with Command 154 .	1	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
4 joule setpoint	Specifies the number of joules to be delivered. Send a 4-byte (32-bit value); the value must be between 0 and 9,999,999. Read back this value with Command 173 .	4	CSR only
5 joule mode enable	Enables or disables joule mode. Send 1 data byte (8-bit value): 0=disable non-zero value = enable Read back this value with Command 153 .	1	CSR only
6 setpoint	<p>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 implies 3 decimal places for a stand-alone unit and 2 decimals for a master/slave unit. 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 stand-alone supply, send a value between 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). Please refer to the Specifications Chapter of this manual for your unit's capabilities.</p> <p><i>Note:</i> If the ramp feature is enabled (Commands 15 and 16), sending this command while the output is on will force 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.</p> <p>Read back this value with Command 164.</p>	2	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
7 set arc average window	<p>Sets the size of the arc average window between 1 and 10 seconds. This value changes the arcs-per-second display and the return values from Command 188. When the window is set for 1 second, arcs per second will reflect the actual number 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).</p> <p>When the arc average window value is changed, the new value remains in effect for subsequent power ups. Send 1 data byte (8-bit value).</p> <p>Read back this value with Command 192.</p>	1	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
8 arc shutdown detect times	<p>Specifies the amount of time that constitutes an arc, and how long after an arc until the power supply shuts down; requires 2 data bytes arranged as follows:</p> <ul style="list-style-type: none"> first byte = arc detect time index; accepts a value of 0 to 9: <ul style="list-style-type: none"> 0 = 0 μs 1 = 1 μs 2 = 2 μs 3 = 5 μs 4 = 10 μs 5 = 20 μs 6 = 50 μs 7 = 100 μs 8 = 200 μs 9 = 500 μs second byte = arc shutdown time index <ul style="list-style-type: none"> 0 = 10 μs 1 = 20 μs 2 = 30 μs 3 = 40 μs 4 = 50 μs 5 = 100 μs 6 = 200 μs 7 = 500 μs 8 = 1,000 μs 9 = 2,500 μs <p><i>Note:</i> 10 kW and 20 kW Pinnacle units with a 208 V input configuration have a minimum arc shutdown time of 50 μsec.</p> <p>Read back these values with Commands 162 and 170.</p>	2	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
9 hard arc count limit	<p>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 and, if applicable, a pulse is sent to the User port <i>ARC.D</i> 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.</p> <p><i>Note:</i> A 0 value disables the hard arc count limit feature so that the ARC LED does not light and no signal is sent to the User port.</p> <p>Read back this value with Command 178.</p>	4	CSR only
10 voltage arc trip level	<p>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 for your unit.</p> <p>Read back this value with Command 171.</p>	2	CSR only
11 active target	<p>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. Read back this value with Command 156.</p> <p><i>Note:</i> The User port has priority for target selection. Thus to select targets from the active front panel or from the Pinnacle Remote Panel (that is, when the Pinnacle unit is in local or 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.</p>	1	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
12 target life	<p>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:</p> <ul style="list-style-type: none"> first byte = the target number second/third/fourth/fifth bytes = target life in kilowatt-hours <p><i>Note:</i> Two decimal places are implied (that is, to get 1 kW, send a value of 100). Read back this value with Command 157.</p>	5	CSR only
13 target enable	<p>Enables or disables the target life counter. Send 1 data byte (8-bit value):</p> <ul style="list-style-type: none"> 0 = inactive non-zero value = target life is active <p>Read back this value with Command 163</p>	1	CSR only
14 control mode	<p>Chooses the mode of control for the Pinnacle supply. Send 1 data byte:</p> <ul style="list-style-type: none"> 2 = serial (Host) port 4 = User port 6 = an active control panel. <p>Read back this value with Command 155.</p>	1	CSR only
15 ramp enable	<p>Enables or disables the ramp feature. Send 1 data byte (8-bit value):</p> <ul style="list-style-type: none"> 0 = disable non-zero = enable <p>Read back this value with Command 163</p>	1	CSR only
16 ramp time	<p>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.</p> <p><i>Note:</i> Two decimal places are implied. (A value of 100 = 1.00 s.) If the unit has the 100 ms ramp feature, one decimal is implied. (A value of 100 = 10.0 s.)</p> <p>Read back this value with Command 158.</p>	2	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
17 program source	<p>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, arranged as follows:</p> <ul style="list-style-type: none"> • first byte = program source if the serial (Host) port is active • second byte = program source if a control panel is the active interface • third byte = program source if the User port is active <p>Read back these values with Command 163. For each mode, send an 8-bit value as follows:</p> <ul style="list-style-type: none"> • 0 = program source is internal • non-zero value = program source is external (that is, an analog value from the User port) <p><i>Note:</i> A User card must be installed for this feature to be available.</p>	3	CSR only
19 recipe steps	<p>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 0 value disables the recipe feature.</p> <p><i>Note:</i> For each recipe step, you must also set the regulation mode, setpoint, ramping time, and run time (Commands 20, 21, 22, and 23). Read back this value with Command 180.</p>	1	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
20 recipe regulation mode	<p>Specifies the regulation mode for a recipe step. Send two data bytes as follows:</p> <ul style="list-style-type: none"> • first byte = recipe step (must be a value greater than 0 but no greater than 8) • second byte = regulation mode: 6 = power 7 = voltage 8 = current <p>Read back these values with Command 182.</p>	2	CSR only
21 recipe ramp time	<p>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 three data bytes arranged as follows:</p> <ul style="list-style-type: none"> • first byte = recipe step (must be a value greater than 0 but no greater than 8) • second and third bytes = value between 5 and 60,000 (or between 0.05s and 600 s); two decimal places implied. <p><i>Note:</i> If the unit has the 100 ms feature, one decimal is implied.</p> <p>Read back these values with Command 181.</p>	3	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
22 recipe setpoint	<p>Specifies the setpoint for a recipe step. Send three data bytes arranged as follows:</p> <ul style="list-style-type: none"> • first byte = recipe step (must be a value greater than 0 but no greater than 8) • second and third bytes = value between 0 and the full rated output of the supply, for the regulation mode set with Command 20. (See the “Specifications” chapter for your unit's capabilities and Command 6 for the format of the value). <p>Read back these values with Command 182.</p>	3	CSR only
23 recipe run time	<p>Specifies the length of time the unit will run at setpoint for a recipe step. Send 3 data bytes arranged as follows:</p> <ul style="list-style-type: none"> • first byte = recipe step (value must be greater than 0 but no greater than 8) • second and third bytes = value between 0 and 60,000 (or between 0 and 600 s); two decimal places implied. <p><i>Note:</i> If unit has the 100 ms device, one decimal is implied.</p> <p>Read back these values with Command 183.</p> <p><i>Note:</i> If you assign 0 run time for the final recipe step, the unit will switch 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.</p>	3	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
24 calculate logic crc	Tells the Pinnacle supply to calculate its logic crc. <i>Note:</i> During the approximately 2 s it takes to calculate the crc, the Pinnacle unit will not respond to any other commands. Read this value back with Command 230 .	0	CSR only
25 calculate front panel crc	Tells the Pinnacle supply to calculate the front panel software crc. Note: During the approximately 2 s it takes to calculate the crc, the Pinnacle unit will not respond to any other commands. Read this value back with Command 230 .	0	CSR only
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 watts), send 2 bytes (16-bit value) between 10 W and maximum unit power divided by 8. Read back this value with command 136 .	2	0

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes																				
30 pre-defined arc handling type	Specifies the type of target (metal or non-metal) for the pre-defined arc-handling mode: PC (normal process cycle) and, if enabled, TCC (target conditioning cycle). Send 1 data byte (8-bit value): <ul style="list-style-type: none">0 = predefined arc handling, metal1 = predefined arc handling, non-metal2 = custom arc handling, settings established with Command 8 <p>If you select either metal or non-metal with this command, then the arc handling mode is set to “predefined;” the Pinnacle unit pre-selects values for arc detect time and arc shutdown time during both cycles (PC and, if enabled, TCC). The following table shows those values.</p> <p>See the discussion of the ARC menu earlier in this chapter for details on the relationship between target type and arc handling.</p>	1	CSR Only																				
	<table><tr><th>Target Type</th><th>PC Detect Time (μs)</th><th>PC Shutdown Time (μs)</th><th>TCC Detect Time (μs)</th><th>TCC Shutdown Time (μs)</th></tr><tr><td>Metal</td><td>0</td><td>50</td><td>20</td><td>30</td></tr><tr><td>Non-metal</td><td>0</td><td>500</td><td>20</td><td>500</td></tr><tr><td>Custom</td><td>Set by User</td><td>Set by User</td><td>20</td><td>Set by User</td></tr></table>			Target Type	PC Detect Time (μs)	PC Shutdown Time (μs)	TCC Detect Time (μs)	TCC Shutdown Time (μs)	Metal	0	50	20	30	Non-metal	0	500	20	500	Custom	Set by User	Set by User	20	Set by User
	Target Type			PC Detect Time (μs)	PC Shutdown Time (μs)	TCC Detect Time (μs)	TCC Shutdown Time (μs)																
	Metal			0	50	20	30																
	Non-metal			0	500	20	500																
Custom	Set by User	Set by User	20	Set by User																			
<p><i>Note:</i> 10 kW and 20 kW Pinnacle units with a 208 V input configuration have minimum PC Shutdown and TCC Shutdown times of 50 μsec.</p>																							
Read back with Commands 162 and 174.																							

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
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. To enable the timer, send a value (2 bytes) between 1 and the maximum value for your unit. One decimal is implied (25 = 2.5s). To disable the timer, send a value of 0. Read back this value with Command 187 .	2	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. Read back this value with Command 152 .	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
40 serial (Host) port time-out value	Specifies the amount of time the Pinnacle supply waits between bytes from the host. Send 2 data bytes (16-bit value); the value represents increments of 10 ms; it 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). Read back this value with Command 140 .	2	CSR only
44 panel text line 1	Lets you write up to 40 characters of text to line one (top line) of an active control panel	0 to 40	CSR only
45 panel text line 2	Lets you write up to 40 characters of text to line two (bottom line) of an active control panel	0 to 40	CSR only
46 erase panel text	Erases text displayed with commands 44 and 45 and refreshes the display.	0	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
47 process voltage limit on/off	Enables or disables a voltage lower limit value for the process (8-bit value): <ul style="list-style-type: none"> • 0 = disable • non-zero value = enable Read back this value with Command 163 .	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 will turn off and error message E010 will appear on the display. With this command, send 2 data bytes (16-bit value). Read back this value with Command 177 .	2	CSR only
Note: You may 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. Accuracy is +0.3% of the full rated output power for the supply. Send 2 data bytes (16-bit value); value must be between 0 and the maximum rated output power for the supply in kilowatts. Assume 3 decimals for a stand-alone unit (20000 = 20.000 kW or 20000 watts) and 2 decimals for a master/slave unit (2000 = 20.00 kW or 20000 watts). <i>Note:</i> Master/slave units will refresh to the maximum limit for power on power up, after explicit slave faults, or after connecting or disconnecting slaves. Read back this value with Command 141 .	2	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
50 user voltage limit	<p>Sets a maximum limit for output voltage. Accuracy is +0.3% of the full rated output voltage for the supply. Send 2 data bytes (16-bit value); value must be between 0 and the maximum rated output voltage for the supply in voltage.</p> <p>Read back this value with Command 142.</p>	2	CSR only
51 user current limit	<p>Sets a maximum limit for output current. Accuracy is +0.3% of the full rated output current for the supply. Send 2 data bytes (16-bit value); value must be between 0 and the maximum rated output current for the supply. Assume 2 decimals (3000 = 30.00 amps)</p> <p><i>Note:</i> Master/slave units will refresh to the maximum limit for current on power up, after explicit slave faults, or after connecting or disconnecting slaves.</p> <p>Read back this value with Command 143.</p>	2	CSR only
52 user strike voltage limit	<p>Sets a maximum strike voltage. Send 1 data byte representing a strike voltage range:</p> <ul style="list-style-type: none"> • 0 = low • 1 = medium • 2 = high <p>The values associated with each range depend on the output impedance range of your unit.</p> <p><i>Note:</i> High voltage output units (750–1500 Vdc and 1500–3000 Vdc) do <i>not</i> have strike voltage capability.</p> <p>Read back your selection with Command 144.</p>	1	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
60 ripple level	<p>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 data byte (8-bit value):</p> <ul style="list-style-type: none"> • 0 = low ripple • non-zero value = high ripple <p>Read back this value with Command 163.</p>	1	CSR only
61 arc handling enable/ disable	<p>Enables or disables arc handling features. Send 1 data byte (8-bit value):</p> <ul style="list-style-type: none"> • 0 = disable • non-zero = enable <p>Read back this value with Command 163.</p> <p><i>Note:</i> Cycling power to the unit resets arc handling mode to enabled.</p> <p>See warning on page -26.</p>	1	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
79 TCC enable	<p>Enables or disables TCC. Enabling the TCC places setpoint and arc handling under microprocessor control, letting you achieve fast, automated target conditioning. Before enabling TCC, ensure that you have first entered a setpoint. When TCC is enabled and the unit receives an on command, the microprocessor sets the arc detect time to 20 ms and initiates a series of trials (“the TCC algorithm”) to reach your desired setpoint (“the final setpoint”). To begin, the microprocessor sets an initial setpoint equal to 50% of the final setpoint. After 100 ms, the microprocessor checks the output level and sets a new interim setpoint equal to 125% of the output level. The microprocessor continues to check the output level and to set a new interim setpoint (always 125% of the output level) every 100 ms until the output is equal to 80% of the final setpoint. When 80% of the final setpoint is reached, the interim setpoint is set equal to the final setpoint, and the TCC algorithm ends. Send 1 data byte (an 8-bit value):</p> <ul style="list-style-type: none"> • 0 = disable • non-zero value = enable <p>Read back this value with Command 163.</p>	1	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
80 TCC timer	Sets an acceptable idle time during TCC. When TCC is enabled, the TCC algorithm executes automatically the first time output is turned on. If the output, then, is turned off for less than the requested idle time, the TCC algorithm does not execute on the next output on cycle. If the output is off for longer than the requested idle time, the TCC algorithm executes on the next output on cycle. With this command, send 1 data byte (an 8-bit value): the value must be between 0 and 60 and represents seconds. Read back this value with Command 185 .	0	CSR only
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. <ul style="list-style-type: none"> • 0 = Resume • 1 = Hold 	1	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
101 runtime recipe setpoint	<p>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 which ever method of regulation is currently active. See command 6 for the format of the 2 data byte setpoint value.</p> <p>If command 101 is issued during a ramp or the ramp portion of a recipe step, the power supply output will ramp to the new setpoint linearly in the ramp time remaining. The new setpoint will remain in place for the subsequent run following the ramp. If the recipe is not finished, the next ramp will begin at the new setpoint and ramp to the preprogrammed setpoint value for the recipe step.</p> <p>If command 101 is issued during the run portion of the ramp or recipe step, the power supply output will immediately step to the new setpoint.</p> <p>Command 101 can be issued as many times as necessary during the execution of a recipe with different setpoint values as needed.</p> <p>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.</p> <p>Note: The user should send command 164 to check the setpoint not command 182 after adjusting the setpoint with command 101.</p>	2	CSR only

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
119 master reset	Send this command to clear the fault indication when the Pinnacle supply has experienced a non-recoverable (“explicit clear”) fault. 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. With this command, send one data byte = 0 (8-bit value of 0). <i>Note:</i> Cycle power on unit after issuing this command.	1	CSR only
127 write to scratch pad	Lets you write 40 ASCII characters to a scratch pad memory (non-volatile). Retrieve this information with Command 131 .	40	CSR only
Commands 128 through 255 request a value to be read from the Pinnacle unit.			
128 request supply type	Requests the power supply type; the returning packet contains 4 ASCII characters: “PNCL”.	0	4
129 request supply size	Requests the output capacity of the power supply; the returning packet contains 6 characters indicating capacity in kilowatts. The data string implies 3 decimal places for a stand-alone unit (10000 = 10.000 kW) and implies 2 decimal places for a master/slave system (4000 = 40.00 kW).	0	6
131 request scratch pad memory	Displays most recent entry (40 characters) to scratch pad memory. Set with Command 127 .	0	40
132 request slave count	Requests the number of slave units in the system; the returning packet contains 1 data byte (an 8-bit value) indicating the number of slave units in the system.	0	1

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
133 request slave status/size	Requests the size and status of a slave unit. Send 1 data byte indicating which slave. The returning packet contains 4 data bytes: <ul style="list-style-type: none"> • first byte = slave size • second byte = personality card status • third/fourth bytes = slave status (16-bit value) 	1	4
134 request slave output power/current	Requests the output power and current of a slave unit. Send 1 data byte indicating which slave. The returning packet contains 4 data bytes: <ul style="list-style-type: none"> • first/second bytes = slave output power in kilowatts (16-bit value); assume 2 decimals • third/fourth bytes = slave output current (16-bit value); assume 1 decimal 	1	4
135 request master fault/status	Requests the master unit's status; the returning packet contains 3 data bytes: <ul style="list-style-type: none"> • first/second bytes = master status (16-bit value) • third byte = personality card status (8-bit value). For more information about the returning packet, see the “Troubleshooting” chapter.	0	3
136 request joule threshold	Requests 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
140 request host time-out value	Requests the serial (Host) port time-out 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 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
141 request user power limit	Requests the output power limit you set with Command 49 . Accuracy is +0.3% of the full rated output power for the supply. The returning packet contains 2 data bytes (16-bit value) indicating the power limit. See Command 49 for format of value. <i>Note:</i> Master/slave units will refresh to the maximum limit for power on power up, after explicit slave faults, or after connecting or disconnecting slaves.	0	2
142 request user voltage limit	Requests the output voltage limit you set with Command 50 . Accuracy is +0.3% of the full rated output voltage for the supply. The returning packet contains 2 data bytes (16-bit value) indicating the limit in voltage.	0	2
143 request user current limit	Requests the output current limit you set with Command 51 . Accuracy is +0.3% of the full rated output current for the supply. The returning packet contains 2 data bytes (16-bit value) indicating the limit in amperes. Assume 2 decimals (3000 = 30.00 amps). <i>Note:</i> Master/slave units will refresh to the maximum limit for current on power up, after explicit slave faults, or after connecting or disconnecting slaves.	0	2
144 request user strike voltage limit	Requests the strike voltage limit as set by Command 52 . The returning packet contains 1 data byte indicating the strike voltage: <ul style="list-style-type: none"> • 0 = low • 1 = medium • 2 = high <i>Note:</i> High voltage output units (750–1500 Vdc and 1500–3000 Vdc) do <i>not</i> have strike voltage capability.	0	1

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
152 request ramp start setpoint percentage	Requests the ramp start setpoint percentage set with Command 32 ; returning packet contains 1 data byte (8-bit) between 0 and 95 (%).	0	1
153 request joules status	Requests joule mode status set with Command 5 ; the returning packet contains 1 byte: <ul style="list-style-type: none"> • 0 = inactive • non-zero value = active 	0	1
154 request regulation mode	Requests the output regulation mode set by Command 3 ; the returning packet contains 1 data byte (8-bit value): <ul style="list-style-type: none"> • 6 = power • 7 = voltage • 8 = current 	0	1
155 request control mode	Requests control mode (set by Command 14); the returning packet contains 1 data byte (8-bit value): <ul style="list-style-type: none"> • 2 = serial (Host) port • 3 = an active control panel (Local) • 4 = User port 	0	1
156 request active target number	Requests 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
157 request target life	Requests the amount of target life time set by Command 12 remaining for the target you specify. Send 1 data byte indicating which 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 request ramp time	Requests ramp time set with Command 16 . Returns a 2-byte value (16 bits) indicating a ramp time of 5 (50ms) to 60,000 (600.00 s).	0	2

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
159 Ramp time remaining	Requests how much ramp time is remaining. Returning packet contains 2 data bytes (16 bits), indicating how many 10 ms intervals remain.	0	2
160 request status	Requests the status of the logic board. The information in the returning packet is used by AE Customer Service.	0	6
161 request output on status	Requests the status of most recent output on sequence; the returning packet contains 1 data byte (8-bit value): <ul style="list-style-type: none"> • 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

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
162 request process status	<p>Requests a report on process status; the returning packet contains 4 data bytes (see the following illustration).</p> <p>1st status byte:</p> <ul style="list-style-type: none"> 0 = Arc handling (0 = custom, 1 = predefined metal or non-metal) 1 = Ramp is active 2 = Run is active 3 = Output power (0 = off, 1 = on) 4 = Illegal regulation mode 5 = Cable interlock 6 = End-of-target-life event 7 = Setpoint status (0 = within tolerance, 1 = out-of-tolerance) <p>2nd status byte:</p> <ul style="list-style-type: none"> 0 = User port auxiliary interlock 1 = User port vacuum interlock 2 = User port water interlock 3 = Control circuit fault 4 = Heat sink over-temp event 5 = User interlock open 6 = User port reset active 7 = Main contactor interlock open <p>3rd status byte:</p> <ul style="list-style-type: none"> 0 = Momentary power failure 1 = Master/slave fault 2 = Unassigned 3 = Unassigned 4 = Side A inverter low 5 = Side B inverter low 6 = Unassigned interrupt event 7 = Profibus error <p>4th status byte:</p> <ul style="list-style-type: none"> 0 = Bus fault 1 = Process voltage low 2 = Joules reached 3 = Unassigned 4 = Out-of-setpoint timer expired 5 = Ground fault 6 = Unassigned 7 = Unassigned 	0	4

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
163 request config status	<p>Requests the system configuration status; the returning packet contains 2 data bytes (see the following illustration).</p> <p>1st status byte:</p> <ul style="list-style-type: none"> 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 = master unit 4 = slave unit 5 = arc handling (0 = disabled, 1 = enabled) 6 = program source (0 = internal, 1 = external) 7 = target life status (0 = inactive, 1 = active) <p>2nd status byte:</p> <ul style="list-style-type: none"> 0 = firt panel status (0 = not present, 1 = present) 1 = firt 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 = ramp mode (0 = disabled, 1 = enabled) 6 = TCC status (0 = disabled, 1 = enabled) 7 = ripple level (0 = low, 1 = high) 	0	2
164 request setpoint/ regulation mode	<p>Requests 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:</p> <ul style="list-style-type: none"> • first/second byte (16-bit value) = setpoint level • third data byte (8-bit value) = regulation mode (6 = power; 7 = voltage, 8 = current) 	0	3

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
165 request actual power	Requests 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 3 decimal places for a stand-alone unit (1000 = 1.000 kW) and 2 decimal places for a master/slave unit (1000 = 10.00 kW). Please refer to the “Specifications” chapter of this manual for your unit's capabilities.	0	2
166 request actual voltage	Requests 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 would indicate 800 V (no implied decimal).	0	2
167 request actual current	Requests a snapshot of the output current level at that instant; 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.	0	2
168 request actual power, voltage, current	Requests a snapshot of the output power, voltage, and current at that instant; the returning packet contains 6 data bytes: <ul style="list-style-type: none"> • first/second byte = power level • third/fourth byte = voltage level • fifth/sixth byte = current level Refer to Commands 165 , 166 , and 167 for the format of the reported output values	0	6
169 request setpoints: power, voltage, and current	Requests the setpoint levels for power, voltage, and current; the returning packet contains 6 data bytes (three 16-bit values). Refer to Commands 165 , 166 , and 167 for the format of the reported setpoint values.	0	6

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
170 request custom arc settings	Requests the arc delay and shutdown times set by Command 8 ; returning packet contains 2 data bytes: <ul style="list-style-type: none"> first byte (8-bit value) = arc detect time index second byte (8-bit value) = arc shutdown time index 	0	2
171 request voltage arc trip level	Requests 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 voltage.	0	2
172 request joules remaining	Requests 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 request joules setpoint	Requests 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 request target type	Requests the target type you selected with Command 30 . The returning packet contains 1 data byte (8-bit value): <ul style="list-style-type: none"> 0 = metal target 1 = non-metal target 2 = custom arc handling 	0	1
175 request time output on	Requests how much time has elapsed since output power was turned on; the returning packet contains 3 data bytes: <ul style="list-style-type: none"> first byte = number of hours second byte = number of minutes third byte = number of seconds 	0	3
177 request process voltage limit	Requests the process voltage lower limit set with Command 48 ; the returning packet contains 2 data bytes (16-bit value) indicating the limit.	0	2
178 request hard arc count limit	Requests 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

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
179 request active recipe step, ramp/run status, and ramp/run time remaining	<p>Requests the active recipe step number, the ramp/run status, and the ramp/run time remaining; the returning packet contains 4 data bytes (32-bit value) indicating the following.</p> <ul style="list-style-type: none"> • first byte = active recipe step number • second byte = ramp/run status (1 = ramp, 2 = run) • third and fourth bytes = ramp/run time remaining in seconds. Two decimal places are implied. For example, a value of 5 would indicate 0.05s or 50 ms. <p><i>Note:</i> 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 would indicate 0.5s or 500 ms.</p>	0	4
180 request recipe steps	<p>Requests the number of recipe steps that you have set with Command 19; the returning packet contains 1 data byte (8-bit value) indicating the number of steps.</p> <p><i>Note:</i> Recall that a value of 0 sent with Command 19 disables the ramping recipe feature.</p>	0	1
181 request recipe step ramp time	<p>Requests the amount of ramping time you have 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 would indicate 0.05 s.</p> <p><i>Note:</i> If the unit has the 100 ms ramp feature, one decimal is implied (5 = .5 s).</p>	1	2

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
182 request recipe step setpoint and regulation mode	Requests 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. The returning packet contains 3 data bytes: <ul style="list-style-type: none"> • first and second bytes = value of setpoint in the mode indicated • third byte = regulation mode (6 = power; 7 = voltage; 8 = current) 	1	3
183 request recipe step run time	Requests the run time 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 run time in seconds. Two decimal places are implied. For example, a value of 5 would indicate 0.05 s.	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; 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 would indicate an interval of 99.9 s.	0	2
185 request TCC timer	Requests the acceptable idle time set with Command 80; the returning packet contains 1 data byte (8-bit value) indicating the idle time in seconds.	0	1
187 request out- of-setpoint timer	Requests 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 would indicate a timer value of 99.9 s.	0	2

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
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. The returning packet contains 4 data bytes. <ul style="list-style-type: none"> • first/second byte (16-bit value) = micro arcs • third/fourth bytes (16-bit value) = hard arcs. 	0	4
189 request micro arc density per run	Requests 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. <i>Note:</i> The unit records a micro arc each time the output voltage goes below the voltage arc trip level set with Command 10. All arc counters are updated every 100 ms or 10 times per second.	0	4
190 request hard arc density per run	Requests how many hard arcs occurred in the previous run; returning packet contains 4 data bytes (32-bit value) indicating the number of hard arcs in the previous run. <i>Note:</i> 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. All arc counters are updated every 100 ms or 10 times per second.	0	4

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
192 request arc average window length	Requests the length of the arc average window; 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
195 request personality card	Requests the identity of the unit's personality cards. The returning packet contains 2 data bytes: <ul style="list-style-type: none"> first byte = identity of card in slot 1 <ul style="list-style-type: none"> 0 = card not present 01 or 17 = dual User port 03 or 26 = Profibus 05 or 21 = single User port 30 = DeviceNet second byte = identity of card in slot 2 <ul style="list-style-type: none"> 0 = card not present 03 or 26 = Profibus 04 = Host Protocol Translator 05 or 21 = single User port 18 or 28 = AE Bus 22 or 29 = master/slave card with AE Bus 	0	2
197 request flash configuration	Requests the version level of the unit's flash memory; returning packet contains 32 data bytes.	0	32
198 request s/w rev level—mainframe	Requests the revision level of the mainframe software; the returning packet contains 12 ASCII characters.	0	12

Table 4-18. Host Port Commands (Continued)

Command	Description	Number of Transmit Data Bytes	Number of Response Data Bytes
220 request customer service statistics	Requests unit statistics. Send 1 data byte (8-bit value): 0 = Total output in kilowatt-hours 1 = Total idle time 2 = Total run time 3 = Total unit on events 4 = Total output on events 5 = Total over-temperature events 6 = Total control circuit faults 7 = Total out-of-setpoint events 8 = Total hard bus fault events 9 = Total power fluctuation events 10 = Total process voltage low events 11 = Total Side A inverter low events 12 = Total Side B inverter low events 13 = Total user interlock open events 14 = Total cable interlock open events 15 = Total contactor interlock open events 18 = Total Profibus fault events 19 = Total pre-defined interrupt events 20 = Total unassigned interrupt events 22 = Total dsp watchdog faults 24 = 10 ms Bus fault events	1	4
230 request logic, panel, or dsp crc	Requests the crc of the logic, front panel or dsp. Returning packet contains 2 data bytes (16-bit value). To receive the logic crc, first send Command 24 , which calculates the value. To receive the front panel crc, first send Command 25 . With Command 230 , send one data byte: <ul style="list-style-type: none"> • 0 = logic • 1 = front panel • 2 = dsp 	1	2

Host Port Command Sequence Examples

The following two examples illustrate how you may communicate with the Pinnacle unit using the AE Bus command protocol.

EXAMPLE 1: SETTING THE TIMEOUT VALUE

This example shows how to use command 40 to set the Host port timeout value to 4.32 seconds. The example assumes that the Pinnacle unit address is 16.

For command 40, the upload packet sent from the PC host to the Pinnacle unit requires the following information:

- Address of Pinnacle unit
- Number of data bytes in the upload packet
- Data bytes
- Checksum

The first byte of the upload packet contains the unit address and the number of data bytes. The first five bits contain the address (16 = binary 10000). The last three bits contain the number of data bytes required for command 40, which is two (2 = binary 010). The whole byte has a hex value of 82h (binary 10000010).

The second byte of the packet contains the command number.

The third and fourth bytes of the packet are the data bytes, which contain the value for the command. In this case, the value is in seconds, with two decimal places implied. Since you want a value of 4.32 seconds, the data bytes should contain a value of 432. Data bytes are sent least significant byte first, most significant byte last. The value of 432 has a hex value of 01B0h.

The upload packet from the PC host to the Pinnacle unit:

- Byte 1 = 82h – address and # of data bytes
- Byte 2 = 28h – command 40
- Byte 3 = B0h – least significant
- Byte 4 = 01h – most significant
- Byte 5 = 1Bh – checksum

The Pinnacle unit responds to the request by sending a download packet that contains an acknowledgement, the address and number of data bytes, the command, a command status response (CSR) code, and a checksum.

The reply packet from the Pinnacle unit to the PC host:

- Byte 1 = 06h – (ACK)
- Byte 2 = 81h – address 16, and 1 data byte (binary 10000001)
- Byte 3 = B0h – command
- Byte 4 = 00h – CSR code

- Byte 5 = A9h – checksum

The PC host should then respond to the unit with an acknowledgement.

- Byte 1 = 06h – (ACK)

EXAMPLE 2: SETTING TARGET LIFE

This example shows how to use command 12 to set the target life in Target 1 to 7500.00 kWh. The example assumes that the Pinnacle unit address is 16.

For command 12, the upload packet sent from the PC host to the Pinnacle unit requires the following information:

- Address of Pinnacle unit
- Number of data bytes in the upload packet
- Data bytes
- Checksum

The first byte of the upload packet contains the unit address and the number of data bytes. The first five bits contain the address (16 = binary 10000). The last three bits of byte #1 contain the number of data bytes required for command 12, which is five (5 = binary 101). The whole byte has a hex value of 85h (binary 10000101).

The second byte of the packet contains the command number.

The third byte of the packet contains the first data byte = target number.

The fourth through seventh bytes of the packet are the last four data bytes and contain the value for the target life. In this case, the value is in kW hours, with two decimal places implied. Since you want a value of 7,500 kWh, the data bytes should contain a value of 750000. Data bytes are sent least significant byte first, most significant byte last. The value of 750000 has a hex value of B71B0h.

Packet sent to unit from PC host:

- Byte 1 = 85h – address and # of data bytes
- Byte 2 = 0Ch – command 12
- Byte 3 = 01h – target # 1
- Byte 4 = B0h – least significant
- Byte 5 = 71h
- Byte 6 = 0Bh
- Byte 7 = 00h – most significant
- Byte 8 = 42h – checksum

Reply returned from unit:

- Byte 1 = 06h – (ACK)
- Byte 2 = 81h – address 16, and 1 data byte (binary 1000001)
- Byte 3 = 0Ch – command

- Byte 4 = 00h – CSR code
- Byte 5 = 8D – checksum

The PC host should then respond to the unit with an acknowledgement.

- Byte 1 = 06h – (ACK)

UNIT ILLUSTRATIONS

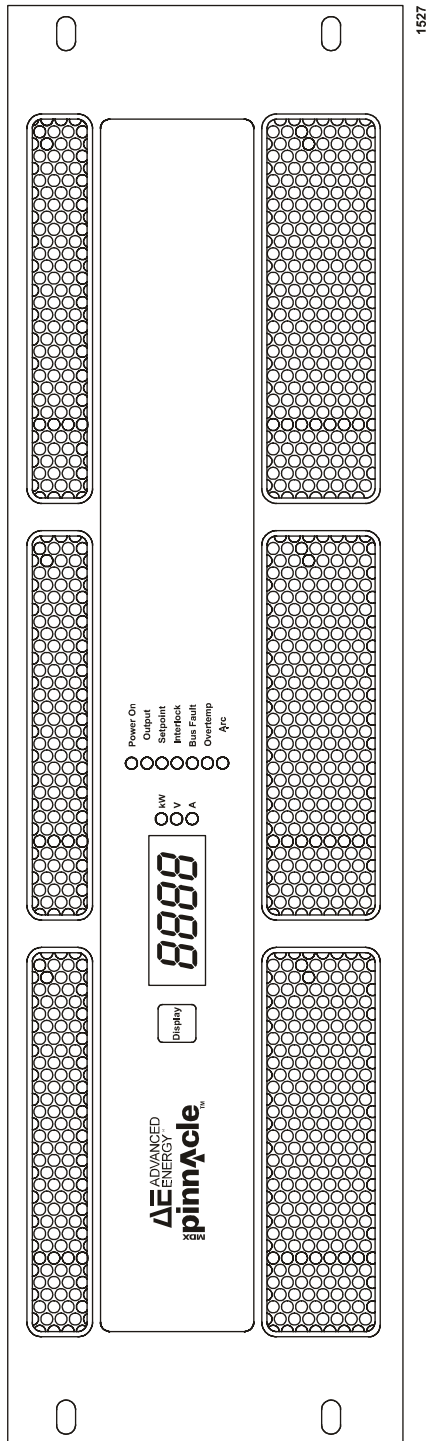


Figure 4-19. Passive front panel (front view)

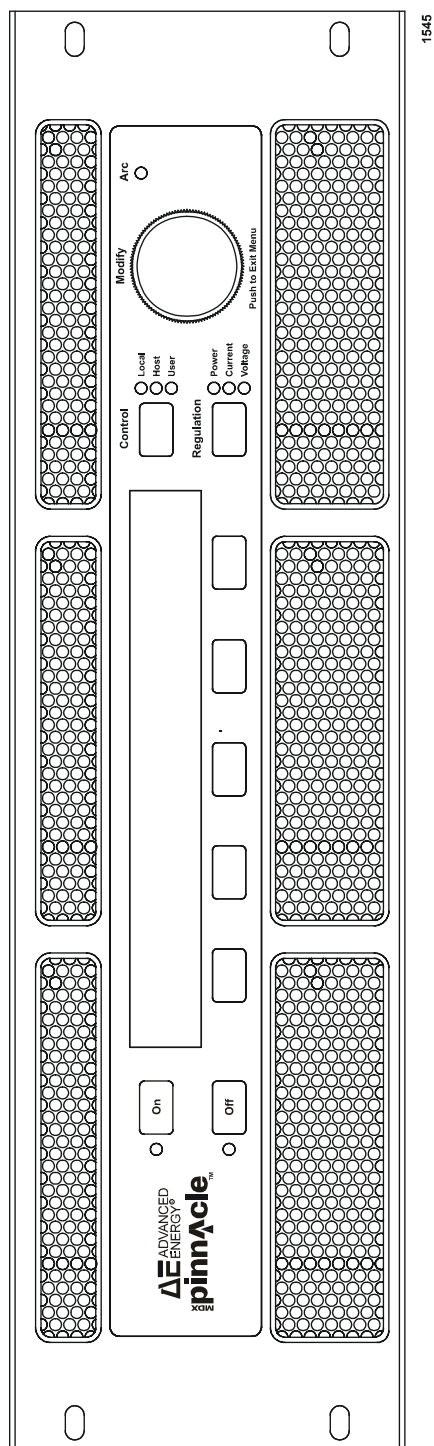


Figure 4-20. Active front panel (front view)

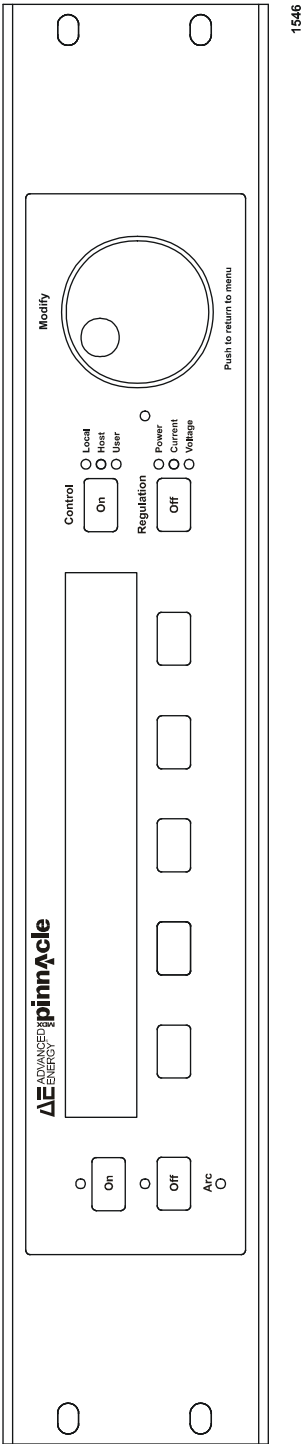


Figure 4-21. Remote panel (front view)

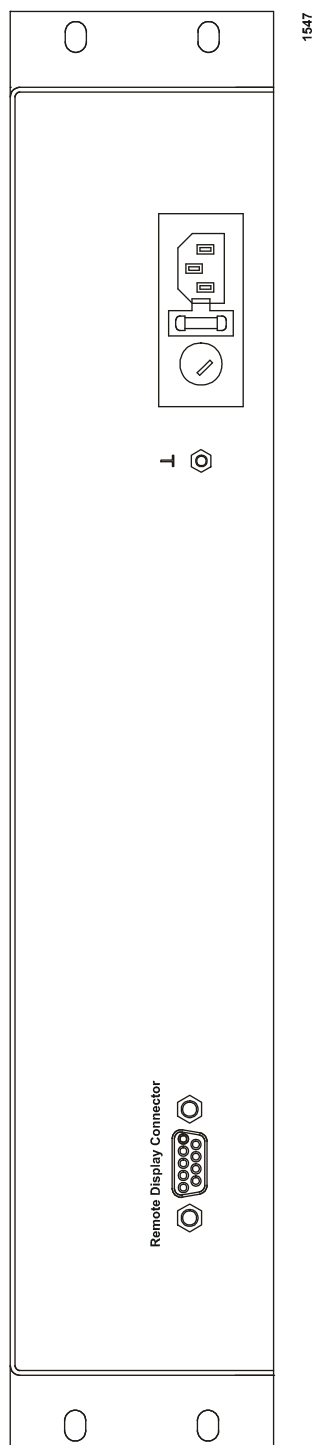


Figure 4-22. Remote panel (rear view)

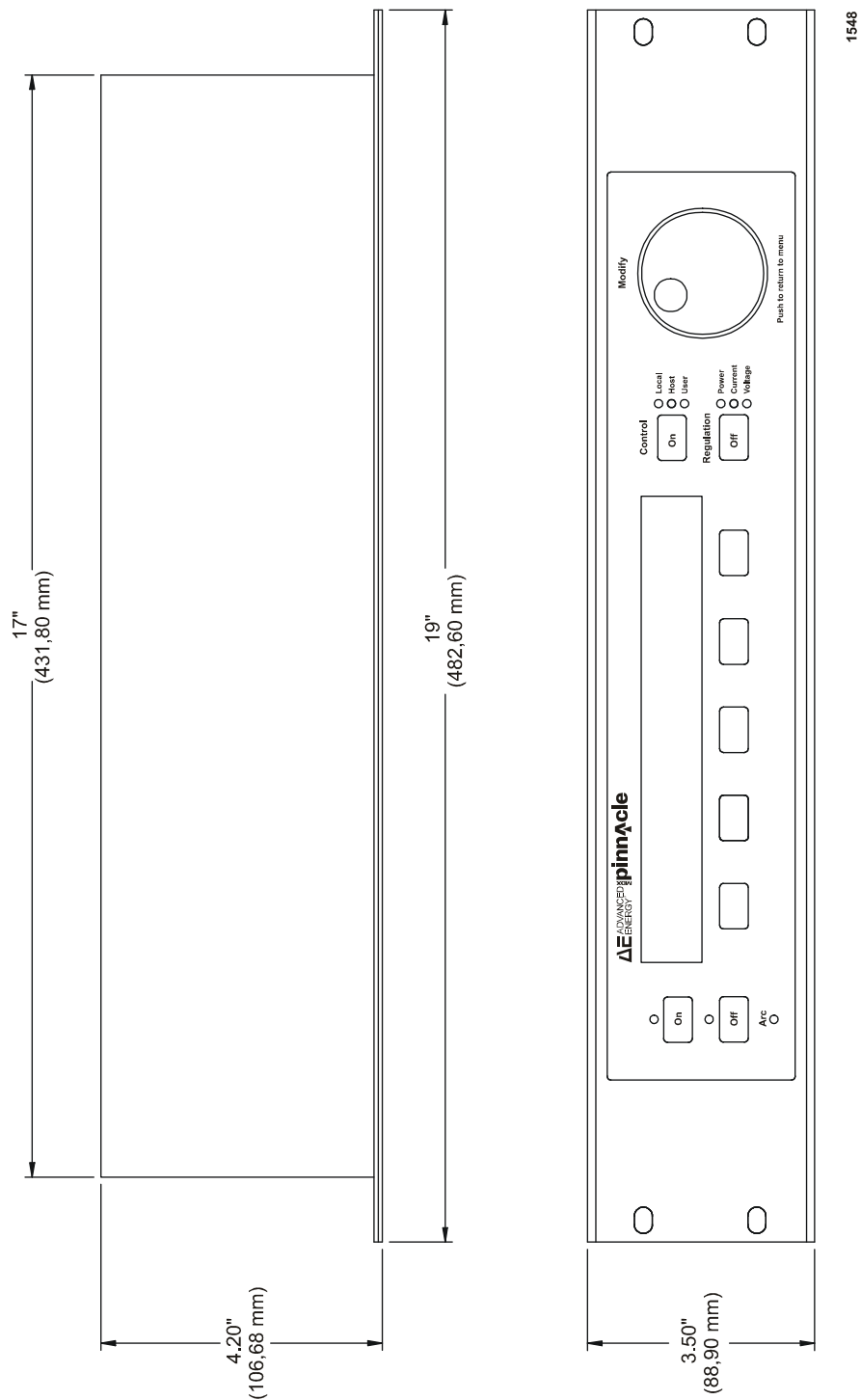


Figure 4-23. Remote panel (dimensions)

Installation

UNPACKING

Unpack and inspect your power supply carefully. Check for obvious physical damage. If no damage is apparent, proceed with the unit connections. If you do see signs of shipping damage, contact Advanced Energy Industries, Inc., and the carrier immediately. Save the shipping container for submitting necessary claims to the carrier.

MEETING SPACING REQUIREMENTS

See Figure 5-1 on page 5-2 for a graphical representation of the spacing requirements.

- The clearance between either side of the Pinnacle supply and the enclosure must be 76 mm (3 in).
- The clearance between the top of the Pinnacle supply and the top of the enclosure must be 25 mm (1 in).
- No clearance is required between power supplies.
- The clearance between the rear of the Pinnacle supply and the enclosure must be 102 mm (4 in), with adequate ventilation.

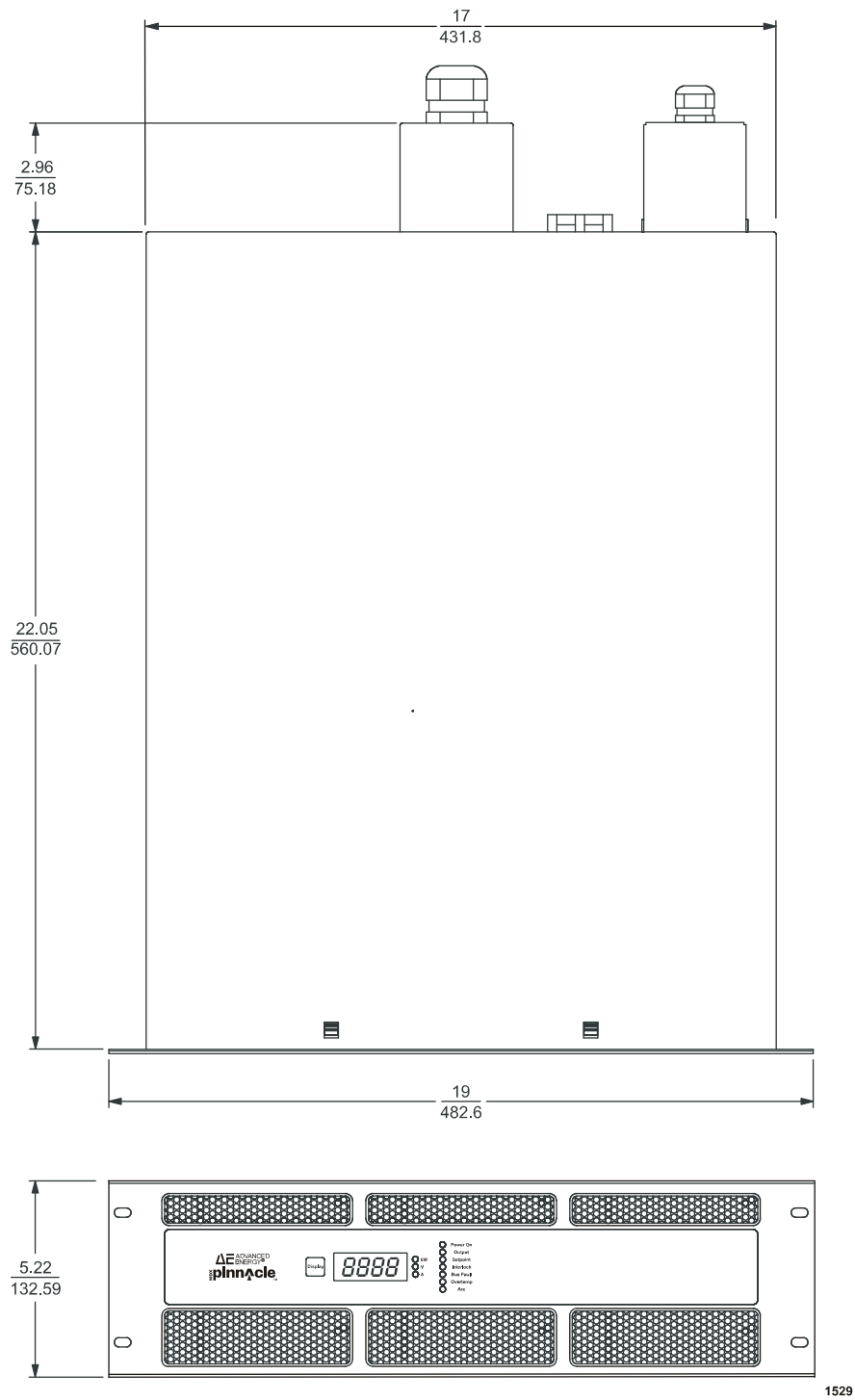


Figure 5-1. Dimensional drawing

COOLING REQUIREMENTS

For the Pinnacle supply to be sufficiently cooled, the cabinet must be set up to:

- Bring in coolant air of the correct temperature (40°C maximum)
- Distribute coolant air to the power supplies
- Prevent air exhausted from the cabinet from circulating back and becoming input air
- Exhaust the hot air from the cabinet with minimal airflow restriction.

See Figure 5-2 on page 5-5.

Cabinet Design

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

Coolant 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, we recommend that fans or blowers be mounted 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. The minimum air flows in CFM (cubic feet per minute) required by individual Pinnacle supplies are shown in Table 5-1 on page 5-3. 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 supplies are mounted in a cabinet, the minimum CFM requirement would be three times the CFM of cabinet air volume compared to an individual supply. Approximations of this figure, the total power dissipation, and the temperature difference between coolant air and exhaust air are shown as an example in Table 5-2 on page 5-4..

Table 5-1. Minimum CFM Required for a Pinnacle Supply

Pinnacle Supply	CFM Required
6 kW	100 CFM
6x6 kW	120 CFM
12 kW	120 CFM
10 kW	120 CFM
10x10 kW	200 CFM
10x6 kW	160 CFM
20 kW	200 CFM

Table 5-2. Approximate Cooling Requirements for Three Supplies Mounted in a Cabinet

Type of Pinnacle Supply	CFM for 3 Supplies	Total Power Dissipation	Dif. in Temp. Between Coolant & Exhaust Air
6 kW	300 CFM (100+100+100=300)	1800 W (600+600+600=1800)	20°C
6x6 kW	360 CFM (120+120+120=360)	3600 W (1200+1200+1200=3600)	20°C
12 kW	480 CFM (120+120+120=360)	3600 W (1200+1200+1200=3600)	20°C
10 kW	360 CFM (120+120+120=360)	3000 W (1000+1000+1000=3000)	20°C
10x10 kW	600 CFM (200+200+200=600)	6000 W (2000+2000+2000=6000)	20°C
10x6 kW	480 CFM (160+160+160=480)	4800 W (1600+1600+1600=4800)	20°C
20 kW	600 CFM (200+200+200=600)	6000 W (2000+2000+2000=6000)	20°C

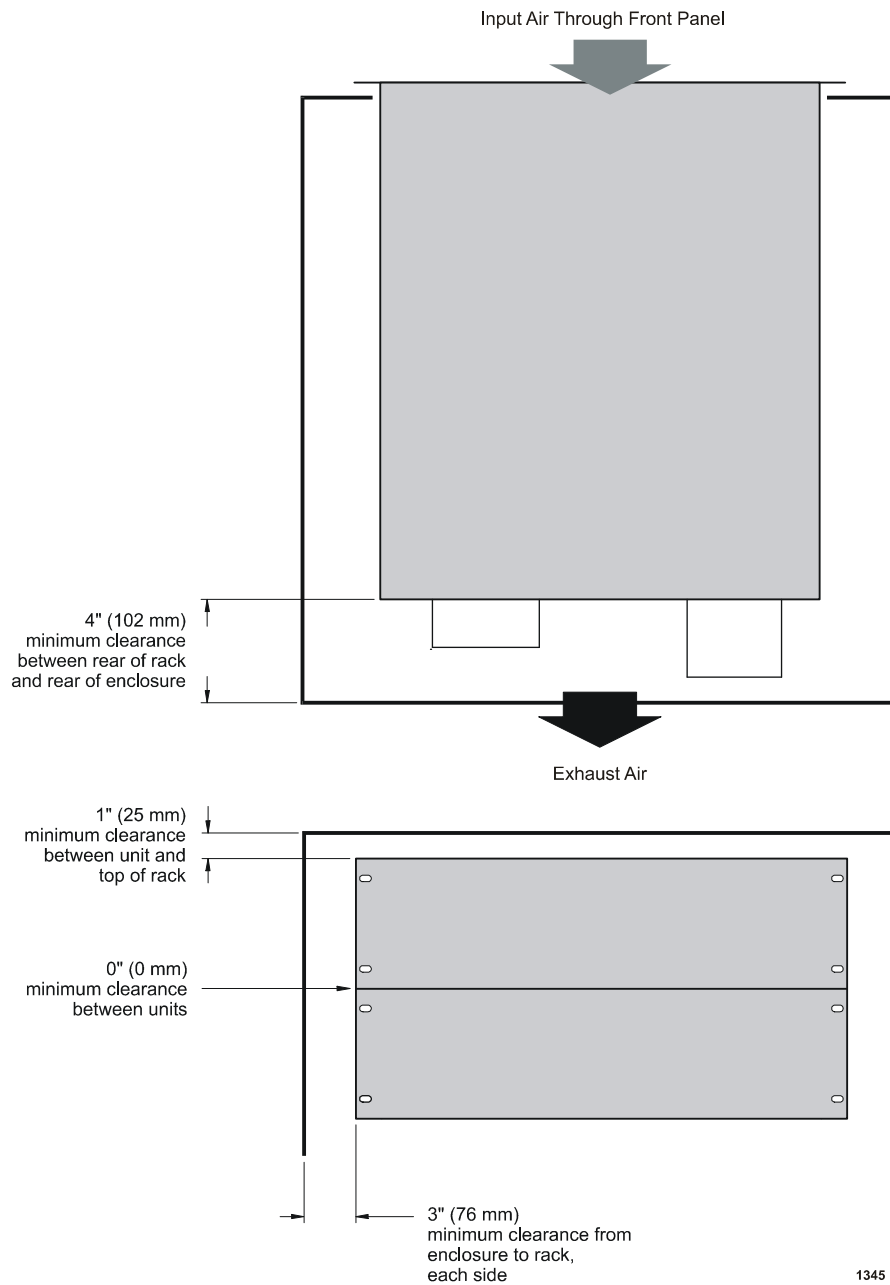


Figure 5-2. Top, side, and inter-unit clearance for Pinnacle units stacked in a cabinet

MAKING REAR PANEL CONNECTIONS

**DANGER:**

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

**WARNING:**

Operating and maintenance personnel must have the correct training before setting up and maintaining high-energy electrical equipment. This equipment must be installed according to applicable requirements.

**CAUTION:**

Do not apply RF power directly to the output of the Pinnacle unit. Damage to the Pinnacle unit could result. If you are using both an RF power supply and a Pinnacle supply in the same system, include an RF filter in the system.

Grounding

For your convenience, the rear panel of the Pinnacle supply features three equi-potential ground studs: two M5 studs and a 10-32 stud. These are indicated on the rear panel by a ground symbol. (For more information about grounding, refer to AE Application Note #5600031 (Grounding), available from Customer Support.)

**WARNING:**

Before making any other connection, connect one of the equi-potential ground studs to earth ground.

Note: For optimal performance, ground an equi-potential ground stud to the system ground.

Connecting a Pinnacle Remote Active Panel

Connections for an Advanced Energy Pinnacle Remote Active Panel are made through a 9-pin, male, subminiature-D connector labeled REMOTE ACTIVE PANEL on the rear panel. See the “I/O Communication and Control” chapter.

Note: To reduce EMI interference, we recommend using shielded cable to connect to the Remote Active Panel port.

Connecting a Remote Passive Panel

Connections for a remote passive front panel are made through the female, 15-pin, subminiature-D connector labeled REMOTE PASSIVE PANEL on the rear panel. The rear of the remote passive panel features a male, 15-pin, subminiature-D connector. Use the cable provided with the remote passive panel to connect the panel to your Pinnacle unit.

Connecting for User Port Control

Please reference the “I/O Communication and Control” chapter for instructions on connecting your analog/digital interface.

Note: To reduce EMI interference, we recommend using shielded cable to connect to the User port.

Connecting to the Standard Serial Port

This interface lets you use most parameters of the AE Bus communications protocol during serial communications with a host computer. Please reference the “I/O Communication and Control” chapter for details on making this connection.

Connecting for Serial (Host) Port Control

Please reference the “I/O Communication and Control” chapter for instructions on connecting your serial communications (Host) port.

Note: To reduce EMI interference, we recommend using shielded cable to connect to the serial port.

Contactor Interlock

The CONTACTOR INTERLOCK port, located on the rear panel, is a 9-pin, male, subminiature-D connector (see Figure 5-3 on page 5-8). Before turning on output, ensure that the interlock loop is closed. To enable the Pinnacle supply's main contactor, short together *pins 3 and 4* on the CONTACTOR INTERLOCK port (through a cheater plug, external switch, or relay). *Pin 4* supplies the interlock system (string) with 18 V. It can source 60 mA.

Pin 3 can sink 60 mA, and the voltage on *pin 4* should not exceed 20 V. On the 400 V Pinnacle supply, *pins 1* and *2* on this port are feedback connections from a set of (normally open) auxiliary connectors on the main contactor.

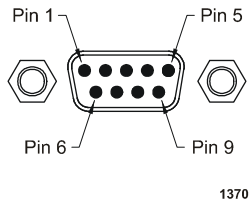


Figure 5-3. Contactor interlock connector

Note: The mating connector, connector shell, and post screws are included in the hardware kit that accompanied your Pinnacle unit.

Connecting for DeviceNet™ Control

If you have a DeviceNet interface, please reference the DeviceNet section in chapter 4 of this manual for instructions on connecting it.

Note: To reduce EMI interference, we recommend using shielded cable to connect to the serial port.

Connecting Input Power

Your Pinnacle supply's input voltage is 208 Vac, 400 Vac, or 480 Vac, three phase, 50/60 Hz. All power supplies leave the factory with their input voltages identified on the rear panel and on an enclosed test checklist.

The ac line input connection is provided by means of a five terminal, DIN terminal block on the rear panel. Labels on the input terminal shield and below each terminal position on the rear panel show line (L3, L2, L1), neutral (N), and protective earth/ground connections (GND). Note that no neutral connection is required. However, if neutral is present, connect it to the N terminal.



DANGER:

This equipment must be wired using a fixed connection.



DANGER:

The input power cable must be installed so that it is inaccessible to the operator.

**WARNING:**

This device must be used in an overvoltage category II installation only.

**CAUTION:**

If your unit does not have a circuit breaker, install and operate it with an AE-approved circuit breaker on the ac input to provide the required over-current protection.

To connect your system to the power supply, you need stranded wire of a gauge consistent with your application and applicable requirements. To connect to the power supply's input power connector, follow these steps:

1. Strip approximately 60 to 70 mm of the insulation from the end of the power cord.
2. Separate the five wires and strip approximately 10 mm of the insulation from each wire.
3. Ensure that the ground wire (the yellow and green wire) is approximately 7 mm longer than the other wires.
4. Remove the cover from the strain relief.
5. Slip the cable through the cord grip.
6. Connect each wire to the proper input terminal block according to the labels. Tighten the cable clamp on the line cord, and replace the cover.

Note: Use only a shielded input cable on the input power connector.

Connecting Output Power



DANGER:

RISK OF DEATH OR BODILY INJURY. Disconnect and Lockout/Tagout all sources of input power before disconnecting output cables. Disconnect all sources of input power before working on this unit or anything connected to it.



DANGER:

This unit must be installed so that the input and output connections are inaccessible to the user. Lethal voltages are potentially present once the input connections are complete. Be sure connectors are terminated and follow normal safety precautions when the system is operating.



CAUTION:

Improper connection to the output connector could hamper operation of the Pinnacle unit. If you are unsure how to connect your output cable between the Pinnacle unit and your chamber, please contact AE Customer Support.



CAUTION:

To comply with EMI/EMC standards, you must use a shielded output cable and connect the shield to the ground terminal on the Pinnacle unit's output connector.

TERMINAL BLOCK OUTPUT CONNECTOR



WARNING:

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

The output connector for your Pinnacle supply provides two 10-32 studs as ring lug terminals. A strain relief box is provided with the connector, but the output cable is not provided. With this connector, we recommend using a UL-type CATVP cable or equivalent.

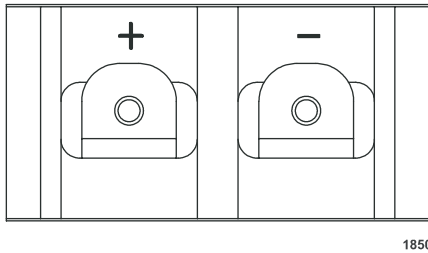


Figure 5-4. Rear view of terminal block housing without strain relief attached.

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

When connecting the Pinnacle 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

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

To make the output connections, strip approximately 1 cm of insulation from each end of the output cable to expose the wires. Install proper ring lugs to stripped ends of wire. Tighten terminal block nuts onto ring lugs.

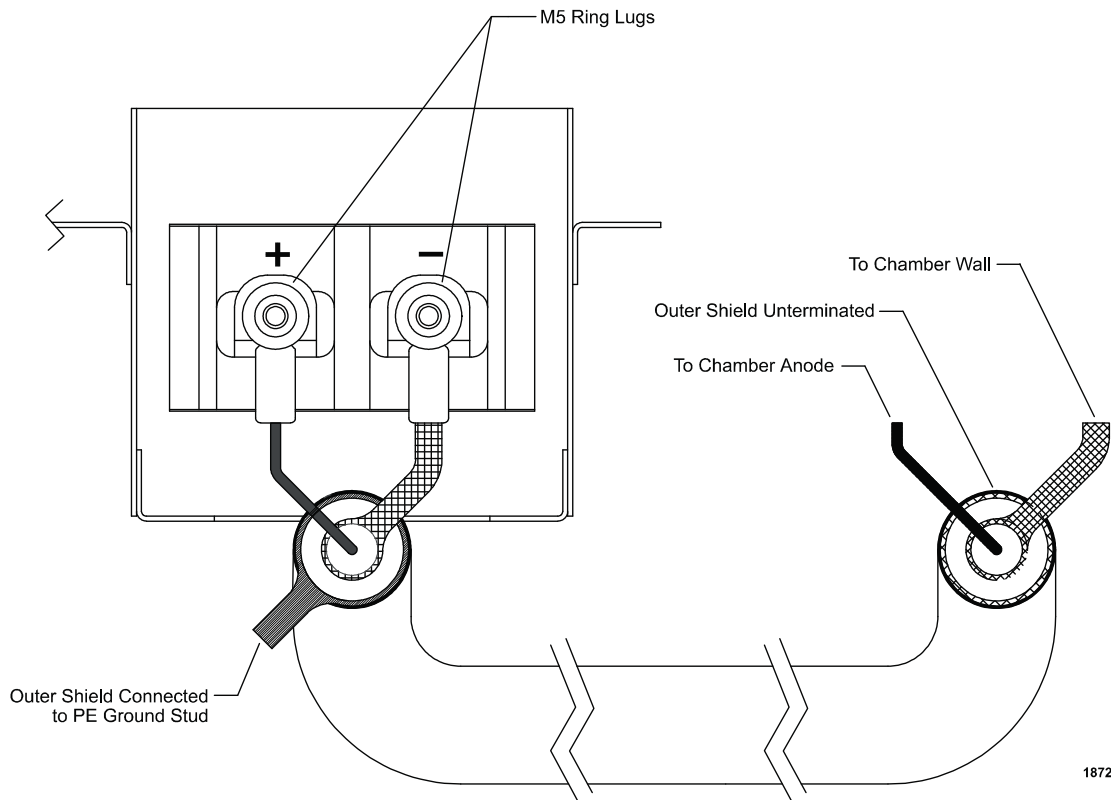


DANGER:

For safety compliance, do not allow the maximum voltage at the Pinnacle unit's output connector terminals to exceed ± 1500 V with respect to ground when configuring for floating output. Take into account allowances for ignition voltage (1500 V standard ignition) when determining safety compliance.

Optimal Output Connection

We recommend using shielded output cable between the Pinnacle supply and your chamber and connecting that cable in the manner described here. The shielded cable minimizes system noise from chamber arcs and takes full advantage of the Pinnacle unit's improved process rate.



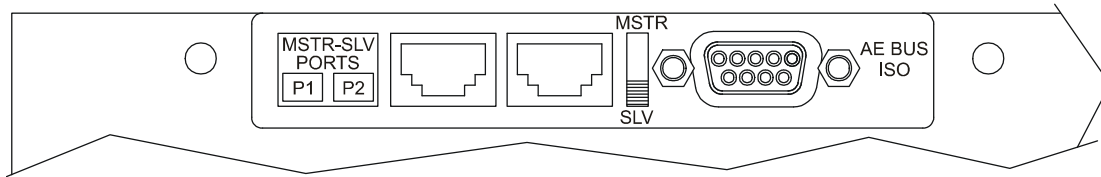
Optimal output connection using triax cable

Connecting for Master/Slave

The Pinnacle design lets you configure up to six Pinnacle supplies as a master/slave system. Any Pinnacle unit that features the master/slave Host card (see Figure 5-5 on page 5-13) can function as either a master unit or a slave unit. Pinnacle units without the master/slave Host card cannot function as a master or slave.

The master/slave card is located near the top right side of the unit's rear panel. It includes three ports: a 9-pin, male, subminiature-D serial communications port for external control, and two modular ports (P1 and P2) for interfacing master and slave units in a daisy chain (see Figure 5-

5 on page 5-13). You will use P1 and P2 to connect a master unit to a slave unit and a slave unit to another slave unit. The card also includes a Master / Slave switch. You will use this switch to indicate whether the supply is functioning as master / stand-alone or slave.



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Figure 5-5. Pinnacle master/slave interface

CONFIGURING YOUR MASTER UNIT

To configure the master unit, follow these four steps (see Figure 5-6 on page 5-14):

1. Remove all input power from the master and slave units.
2. Set the Master / Slave switch in the "up" (MSTR) position.
3. Connect the included interface cable between port P1 (the MSTR port) on the master unit and port P2 (the SLV port) on the first slave unit.

Note: Your master unit will not have an interface cable connected to port P2.)

4. Use the grounding strap provided to connect an equi-potential ground stud on the master unit to an equi-potential ground stud on the first slave unit.

If you want to configure your master unit as a stand-alone unit, do the following:

1. Set the Master / Slave switch in the "up" (MSTR) position.
2. Remove all Master / Slave interface cables from the master unit.

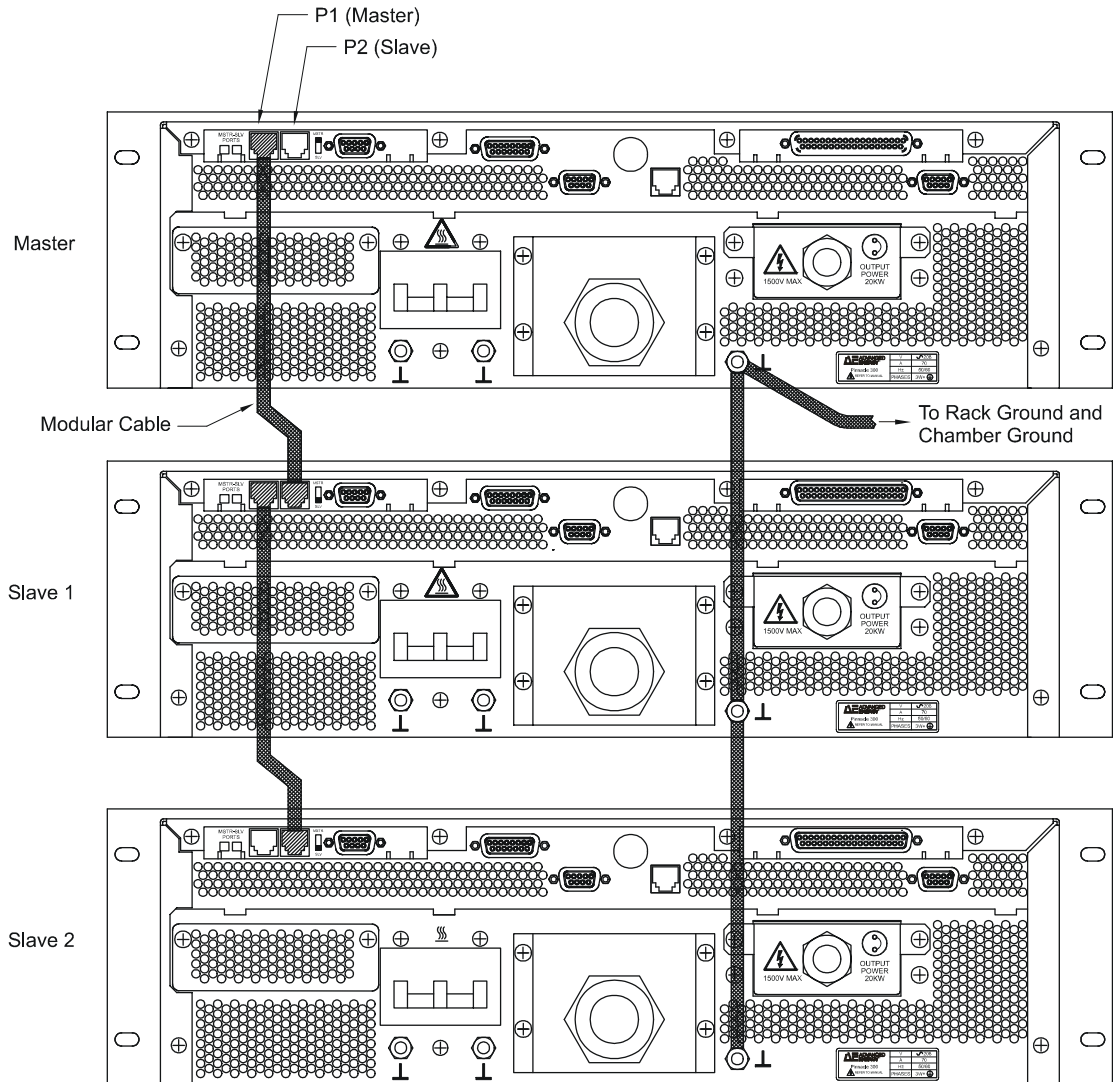
CONFIGURING YOUR SLAVE UNITS

To configure a slave unit, do the following (see Figure 5-6 on page 5-14):

1. Remove input power from the master and slave units.
2. If the Pinnacle supply includes a User card, ensure that the interlock inputs are satisfied. Refer to the "I/O Communication and Control" chapter for specific User port pin descriptions and required voltage levels.
3. Set the Master / Slave switch in the "down" (SLV) position.
4. Connect the included interface cable between port P1 on the first slave unit and port P2 on the next slave unit. Continue cabling slave units together in this daisy-chain manner.

Note: The last slave unit on your system will not have an interface cable connected to port P1.

5. Use the grounding strap provided to connect an equi-potential ground stud on the first slave unit to an equi-potential ground stud of the next slave unit. Continue connecting together subsequent slave unit chassis in this manner. We recommend you connect the ground stud on the master unit to system ground.



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Figure 5-6. Configuration for Pinnacle master/slave system

MONITORING YOUR MASTER / SLAVE SYSTEM

- If you have a passive front panel or remote passive panel attached to your master unit, you can view the combined output of your master/slave system (power or current). The passive front panel of each slave unit displays the individual unit's output. For more information, see the “I/O Communication and Control” chapter.
- If you have an active front panel or Pinnacle Remote Active Panel attached to your master unit, you can monitor the output (power, current, or voltage) of your system and the output of each individual unit. For more information, see the “I/O Communication and Control” chapter.
- If you have a host computer connected to a serial port on your master unit, you can monitor the output (power, current, or voltage) of your system and the output of each individual unit.

CLEARING FAULTS IN A MASTER/SLAVE SYSTEM

If a slave unit experiences a self-clearing fault, both the master and slave units display an error code and the master unit shuts off output from all attached power supplies. When the fault condition clears, the master and slave units reset. You may then turn on output.

If a slave unit experiences an explicit clear fault, both the master and slave units display an error code and the master unit shuts off output from all attached power supplies. When the fault condition clears, you must acknowledge the condition at the master unit before turning on output. (For example, you must press the OFF button to acknowledge the condition and then the ON button to turn on output.) For more information about error codes, please refer to the “Troubleshooting” chapter.

UNDERSTANDING MASTER/SLAVE INPUT ON/OFF COMBINATIONS

Unique logic in the Pinnacle power supply lets you power on and off master and slave units independently of one another. Table 5-3 on page 5-16 lists valid input on and off sequences. During valid on and off sequences, the master unit "re-scales" the total output; that is, its I/O signals adjust to accommodate the most recent change in output capability of the combined units.

Note: You cannot power up a Pinnacle master/slave system if output is on.

Table 5-3. Input Sequences for Master and Slave Units

Acceptable Sequence for ...	Condition of Master Unit's AC Input	Condition of Slave Unit's AC Input	Condition of Output	Response (Type of Fault)
Powering up the master unit as a stand-alone power supply	Switching ac input power ON	ac input power is OFF	Off by default (Master ac input power is OFF)	No fault; master unit can output up to full power as a stand-alone unit, or the master is ready to recognize any slave unit
Powering up the master/slave power supply system	Switching ac input power ON	ac input power is ON	Off by default (Master ac input power is OFF)	No fault; the master unit re-scales system output; the system can output up to the combined output capability of the master and slave units
	ac input power is OFF	Switching ac input power ON	Off by default (Master ac input power is OFF)	No fault; the slave unit waits for the master unit
	ac input power is ON	Switching ac input power ON	Off	No fault; the master unit re-scales system output to the combined output capability of the master and slave units
Powering down the master unit as a stand-alone power supply	Switching ac input power OFF	ac input power is OFF	Off	No fault
	Switching ac input power OFF	ac input power is OFF	Off	No fault

Table 5-3. Input Sequences for Master and Slave Units (Continued)

Acceptable Sequence for ...	Condition of Master Unit's AC Input	Condition of Slave Unit's AC Input	Condition of Output	Response (Type of Fault)
Powering down the master/slave power supply system	ac input power is OFF	Switching ac input power OFF	Off by default (Master ac input power is OFF)	No fault
	Switching ac input power OFF	ac input power is ON	Off	Slave unit experiences a self-clearing fault and then waits for the master unit ^a
	Switching ac input power OFF	ac input power is ON	On	Slave unit experiences a self-clearing fault and then waits for the master unit ^a
	ac input power is ON	Switching ac input power OFF	Off	If the slave remains off, this results in an explicit-clear fault; the master unit re-scales system output after the fault has cleared and you have acknowledged the condition. ^b If the slave powers on again, this results in a self-clearing fault.
	ac input power is ON	Switching ac input power OFF	On	If the slave remains off, this results in an explicit-clear fault; the master unit re-scales system output after the fault has cleared and you have acknowledged the condition. ^b If the slave powers on again, this results in a self-clearing fault

Table 5-3. Input Sequences for Master and Slave Units (Continued)

Acceptable Sequence for ...	Condition of Master Unit's AC Input	Condition of Slave Unit's AC Input	Condition of Output	Response (Type of Fault)
Illegal power on sequence for master/slave power supply system	ac input power is ON	Switching ac input power ON	On	Explicit-clear fault; the master unit re-scales system output after the fault has cleared and you have acknowledged the condition

- a. These sequences also occur when the master unit is losing ac input power
- b. These sequences also occur when a slave unit is losing ac input power.

BACK PANEL ILLUSTRATION

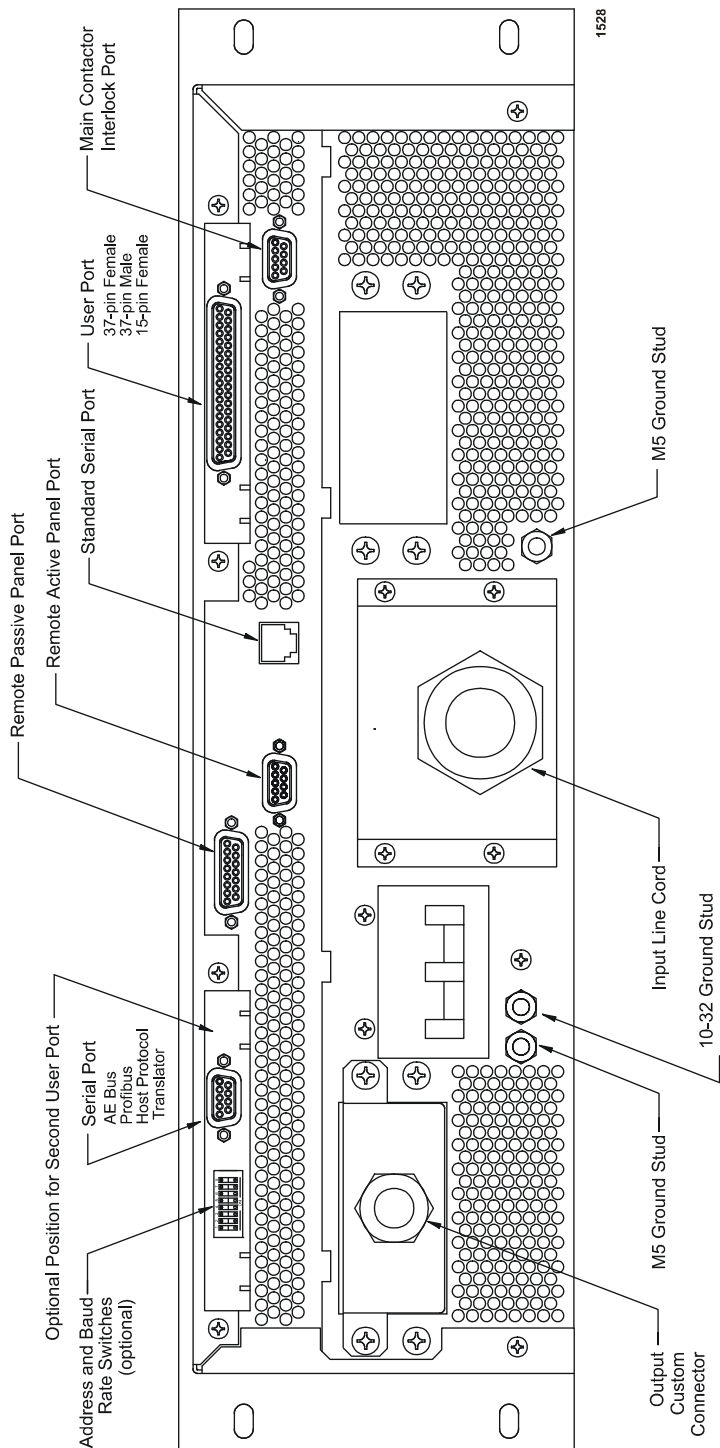


Figure 5-7. Passive and active front panel (rear view)

Operation

OPERATING OVERVIEW

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

Note: If an error code (that is, an “E xx” code) appears on the front panel or on the Pinnacle Remote Active Panel, refer to the “Troubleshooting” chapter for an explanation and troubleshooting suggestions.

1. Turn on the Pinnacle unit.

Verify your unit's LEDs. If you are using a passive panel, verify that the POWER ON and INTERLOCK LEDs light. If the INTERLOCK LED does not light, an error code should appear (see the “Troubleshooting” chapter for more information).

If you are using an active front panel or a Pinnacle Remote Panel, verify that the display screen displays two messages in sequence: “Advanced Energy, Fort Collins, Colorado” and then “Power Up Sequence, Please Wait.” In addition, verify that an LED lights to show the control setting and another lights to show the regulation setting. Finally, verify that the OFF LED lights.

Note: The unit defaults to the previously selected control and regulation settings. If the unit had been in LOCAL mode with a Pinnacle Remote Panel but the Remote Panel is removed, the unit will boot up in Host control mode. If there is no Host card, the unit will boot up in User control mode. An active DeviceNet card will act as a Host card, but if the DeviceNet card is not active the unit will boot up in User control mode.

Note: If the display screen shows no message and/or if no control or regulation LEDs light, ensure that the unit is properly installed and is receiving ac input power.

2. Check non-lighted LEDs and the display panel. If you are using the passive panel, verify that the BUS FAULT and OVERTEMP LEDs are not lit. If either or both is lit, power down the Pinnacle unit, clear the fault, and return to Step 1. (Refer to the “Troubleshooting” chapter for error code explanations and troubleshooting suggestions.)

If you are using an active front panel or the Pinnacle Remote Panel, verify that the “output display screen” information shows on the display screen (see the “Active Front Panel/Pinnacle Remote Panel” section of Chapter 4 for details). If the display screen shows an error code and message, note the error code number and refer to the “Troubleshooting” chapter.

3. Select a method of control: Host (serial) port, User port, or local (panel control).
4. Select a regulation mode: power, current, or voltage.

5. Enter a setpoint value.
6. If necessary, enable joule mode and select a setpoint in joules (available only through the serial port, the active front panel, or the Pinnacle Remote Panel).
7. If necessary, enable target life counters and select a target life for each applicable target (available only through the serial port, the active front panel, or the Pinnacle Remote Panel).
8. If necessary, enter appropriate arc-handling parameters for your normal process cycle and, if needed, for your target conditioning cycle (available only through the serial port, active front panel, or the Pinnacle Remote Panel).

Note: If you enable the TCC algorithm, you cannot use ramping recipes.

9. If necessary, create a ramping recipe (available only through the serial port, active front panel, or Pinnacle Remote Panel).

Note: You cannot use ramping recipes if you have enabled the TCC algorithm.

10. If necessary, set the out-of-setpoint timer to a value other than 0 (available only through the serial port, active front panel, or Pinnacle Remote Panel).
11. If necessary, set limits for output power, output voltage, output current, strike voltage, and/or process voltage (available only through the serial port, active front panel, or Pinnacle Remote Panel).
12. Verify all output power load conditions and connections, and when the system is ready, enable the output. The output information on the output display screen should equal your requested setpoint.

Verify your unit's LEDs. If you are using a passive front panel, verify that the OUTPUT and SETPOINT LEDs light. If these LEDs do not light, see the “Troubleshooting” chapter for more information.

If you are using an active front panel or the Pinnacle Remote Panel, verify that the ON LED lights. Also, verify that the display screen shows values for output information. If the display screen shows an error code and message, see the “Troubleshooting” chapter for error code explanations and troubleshooting suggestions.

UNDERSTANDING PINNACLE™ ARC HANDLING

Your Pinnacle unit has been shipped with arc handling enabled. You should disable arc handling only if your system includes special post-process equipment that provides arc interruption.



CAUTION:

Disabling the Pinnacle unit's arc handling ability without providing external arc interruption could cause severe target damage.

In addition to shipping with arc handling enabled, the Pinnacle ships with these arc handling defaults: metal target, 50 V trip level. These settings provide the highest through-put with minimal arc damage to metal targets. You can change these and other arc handling settings through the Pinnacle Remote Active Panel or the serial port. But before changing any arc handling settings, first take some time to understand them:

- Voltage arc trip level
- TCC algorithm enable
- Target type
 - Metal
 - Non-metal
 - Custom
 - Arc detect delay time
 - Arc shutdown time

The following paragraphs describe what the arc handling settings are and how they might interact with each other, with your system, and with your process.

Voltage Arc Trip Level

By setting the voltage arc (V-arc) trip level you are indicating the voltage threshold at which the Pinnacle recognizes an arc. The best value for a voltage arc trip level is somewhere between your process's normal operating voltage and the typical low voltage that occurs when your system experiences a hard arc. The latter depends on your target type, but typical low voltages for hard arcs are between 10 and 25 V. Thus a reasonable voltage arc trip level might be 50 V. Note, however, that some target types experience hard arcs at 100 V, so do not assume that 50 V is right for all processes. To set the V-arc trip level, use the ARC menu on the Pinnacle Remote Panel or AE Bus/Profibus Command 10 (see Chapter 4).

TCC Algorithm Enable

When the Target Condition Cycle (TCC) algorithm is enabled and the unit receives an on command, the Pinnacle microprocessor sets the arc detect time to 20 μ s and initiates a series of trials (or “steps”) to reach your desired setpoint (“the final setpoint”). To begin, the microprocessor sets an initial setpoint equal to 50% of the final setpoint. After 10 ms, the microprocessor checks the output level and sets a new interim setpoint equal to 125% of the output level. The microprocessor continues to check the output level and to set a new interim setpoint (always 125% of the averaged output level) every 10 ms until the output level is equal to 80% of the final setpoint. When 80% of the final setpoint is reached, the interim setpoint is set equal to the final setpoint, and the TCC algorithm ends. You can enable TCC mode through the ARC menu on the Pinnacle Remote Panel or through AE Bus/Profibus Command 79 (see Chapter 4).

Note: You cannot enable the TCC algorithm if you have already set up ramping recipes.

Target Type: Metal

Use the metal setting only for metal targets. Indicating a metal target pre-selects an arc detect delay time of 0 μ s during a normal process cycle and 20 μ s during the TCC. It sets an arc shutdown time of 30 μ s during both a normal cycle and the TCC. You can select target type through the ARC menu on the Pinnacle Remote Active Panel or through AE Bus/Profibus Command **30** (see Chapter 4).

Note: 10 kW and 20 kW Pinnacle units with a 208 V input configuration have a minimum arc shutdown time of 50 μ sec

Target Type: Non-Metal

Use the non-metal setting if your target is, for example, silicon or carbon. Indicating a non-metal target, pre-selects an arc detect delay time of 0 ms during a normal process cycle and 20 μ s during the TCC; it sets an arc shutdown time of 500 μ s during both a normal cycle and the TCC. You can select target type through the ARC menu on the Pinnacle Remote Panel or through AE Bus/Profibus Command **30** (see Chapter 4).

Target Type: Custom

If you want more flexibility in controlling your system's response to arcs, then indicate a “custom” target to the Pinnacle unit. This setting lets you select from a range of values for arc detect delay time and arc shutdown time. You can select target type through the ARC menu on the Pinnacle Remote Panel or through AE Bus/Profibus Command 30 (see Chapter 4s).

Arc Detect Delay Time

Arc detect delay time is the length of time from when the supply senses an arc to when it interrupts output power. Selecting a target type of “metal” or “non-metal” will pre-select arc detect delay times for you. However, if you want a custom arc detect delay time, select one based on target conditions. For target conditions that require a power interruption at every arc event, select a detect delay time of 0. For target conditions that experience self-extinguishing arcs (“micro arcs”), select a detect time of 2 μ s to 5 μ s. For times when you want to deliver more energy to the arc nucleation site, select one of the longer detect times (10 to 500 μ s). You can set a custom arc detect delay time through the ARC menu on the Pinnacle Remote Panel or through AE Bus/Profibus Command 8 (see Chapter 4).

Note: The Pinnacle design greatly reduces the power supply's stored energy. But we recognize that 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 selecting a long arc detect delay time. Avoid long arc detect delay times, except when you want this effect.

Arc Shutdown Time

Arc shutdown time is the length of time that the Pinnacle supply interrupts power flow in response to an arc. Selecting a target type of “metal” or “non-metal” will pre-select arc shutdown times for you. However, if you want a custom arc shutdown time, select one based on system conditions. 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 automatically extends its arc control circuitry. You can set a custom arc shutdown time through the ARC menu on the Pinnacle Active Remote Panel or through AE Bus/Profibus Command 8 (see Chapter 4).

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

Arc Recovery Test

After the arc shutdown time has expired, the Pinnacle supply reapplies output power to the load and examines the output voltage level. The output voltage must rise above your selected V-arc trip level within an internally fixed time of 20 μs . If the output voltage rises above the V-arc trip level before the 20 μs period has ended, the Pinnacle power supply will resume normal output. If the output voltage does not rise above the V-arc trip level by the end of the 20 μs time limit, then the Pinnacle unit initiates another arc shutdown. Metal flakes and unusually dirty target conditions may be responsible for multiple arc shutdowns. Connecting large capacitors ($>.047\mu\text{F}$) on the Pinnacle output can hinder the Pinnacle from achieving proper output voltage within 20 μs .

Arc Recovery Time

Recovery to the pre-arc output level usually occurs in less than 25 μs from the end of your selected arc shutdown time. This recovery time is typical when you have selected a metal target or an arc shutdown time between 10 μs and 2500 μs . However, it may be too rapid for some processes. Some target materials respond better to a slow (or “soft”) recovery period. A “soft” recovery allows for greater plasma stability at the time of recovery or prevents any possibility of overshooting the operating point. If you select an arc shutdown time of 500 μs or greater, the unit automatically selects a 1 ms “soft” recovery time period.

Troubleshooting and Customer Support

BEFORE CALLING AE GLOBAL SUPPORT

**DANGER:**

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

**WARNING:**

Operating and maintenance personnel must have the correct training before setting up, maintaining, or troubleshooting high-energy electrical equipment. Potentially lethal voltages may cause serious personal injury or damage to equipment. Ensure that proper 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 a Global Support representative.

First Check

If you believe you are experiencing problems with a Pinnacle 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 Support. If there are no obvious signs of damage, proceed with the checks on the following lists.

Checks with the Power Off

1. Ensure the power to the unit is off.
2. Check for visible damage to the unit, cables, and connectors.
3. Ensure all unit connectors are installed correctly and are fastened tightly.
4. Check to determine whether any system-related circuit breakers have been tripped.
5. Ensure there is input power to both the unit and the remote.

6. Ensure that input power meets specifications. (See the “Specifications” chapter for specifics.)
7. Ensure ground connections are adequate and secure.
8. Check the position of the switches on the DIP for the serial (Host) port (if your unit has a Host port) against the addressing information in the “I/O Communication and Control” chapter.
9. Ensure that the interlock loop is closed both at the Contactor Interlock and at the User port. (See the description of the Contactor Interlock in the “Installation” chapter for more information.)

Checks with the Power On

1. Check the unit’s input and remote power connections to ensure the proper power is being supplied to the unit.
2. Check the LEDs on all units to determine that the proper ones are lit.
3. Note any error code (that is, any “Exxx” number) displayed on the front panel or Pinnacle Remote Active Panel. See “Error Code Troubleshooting Table” on page 7-8 for additional information.
4. Working with the passive front panel, ensure that the front panel LEDs POWER ON, INTERLOCK, OUTPUT, and SETPOINT LEDs are lit (see “Troubleshooting LEDs” on page 7-6). Note which, if any, of these are not lit. If the INTERLOCK LED is not lit, error code E020, E022, or E023 should be displayed on the front panel. See “Error Code Troubleshooting Table” on page 7-8 for a suggested response to any of these errors. If the INTERLOCK LED is not lit and no error code is displayed, ensure that the LED is functioning.
5. Working with the Pinnacle Remote Active Panel, verify that LEDs light to show the control and regulation settings. Then verify that the OFF LED is lit.
6. If you suspect an LED is malfunctioning, cycle the Pinnacle unit's power on and off. If the problem re-occurs, call AE Global Support.
7. Working with the passive front panel, note whether the BUS FAULT or OVERTEMP LEDs on the front panel are lit. If the BUS FAULT LED is lit, error code E002 or E003 should be displayed on the panel. If the OVERTEMP LED is displayed, error code E004 should be displayed. For more information on error codes and suggested responses, see “Error Code Troubleshooting Table” on page 7-8. If no error code is displayed, cycle the Pinnacle unit's power on and off to determine whether the LED is functioning properly.
8. Working with the Pinnacle Remote Active Panel, verify that the output display screen information is displayed (see the “Output Display Screen” section of the “I/O Communications and Control” chapter for details). If the display screen shows an error message, see “Error Code Troubleshooting Table” on page 7-8. If the display remains blank, cycle the Pinnacle unit's power on and off. If the problem re-occurs, call AE Global Support.

9. Determine whether the cooling fans are functioning, and ensure your cabinet allows for adequate ventilation for all the units in the cabinet. (To determine the correct volumes, see the “Installation” chapter.) If the fans are not functioning properly, call AE Global Support.

Checks if the Output Does Not Turn On

1. Verify that the joules mode is disabled or has a valid setpoint value. (For more information, read about the “Energy” function in the “I/O Communication and Control” chapter.)
2. Verify that the target life counter is disabled or has a valid value. (For more information, read about the “Target” function in the “I/O Communication and Control” chapter.)
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 over-temperature faults.
5. Verify that you have established a valid setpoint.

Help Code Troubleshooting Table

In certain cases, your unit may display one of the following help codes.

Table 7-1. Help Codes

Help Code	Problem Indicated	Suggested Action
H000 Faults Are Active	A fault exists.	Clear the fault.
H001 Invalid Control Mode	The action requested was not from the control source, i.e. an AE Bus command was issued, but the unit is in Local control mode.	Check the control mode.
H002 Contactor is Open	The contactor is open.	Clear any faults and “listen” to hear if the contactor closes. Close the contactor.
H003 Parameter Limit Exceeded	The AE Bus command issued had a parameter that was out of range.	Review the AE Bus command list.
H004 Invalid Setpoint Source	The Host port issues a setpoint change, but the program source is external.	Change program source to internal.
H005 Ramping is Active	The requested action could not be performed while output is ramping.	Wait until the ramp is done then reissue command.

Table 7-1. Help Codes (Continued)

Help Code	Problem Indicated	Suggested Action
H006 AEBus: Data Byte Count Incorrect	The number of data bytes sent by the Host via AE Bus is incorrect.	Review the AE Bus command list.
H007 User Port has Priority	The User port is overriding your command request.	Disable User port feature for the command you desire.
H008 Target Conditioning Is Active	The requested action could not be performed while TCC is active.	Wait until unit exits TCC mode.
H009 User Port Reset Is Active	User port “reset” line is active.	De-assert User port “reset” line.
H010 Host Port: Reset Asserted	An AE Bus command 119 was received.	No action.
H011 Arc Handling Disabled	The requested action could not be performed, because the Arc Handling feature is disabled.	Enable Arc Handling.
H013 Ramp Feature Disabled	The requested action could not be performed, because the ramp feature is disabled.	Enable the ramp feature.
H015 TCC Mode Enabled	The requested action could not be performed, because the TCC feature is enabled.	TCC, Ramp, and Recipe features are mutually exclusive. Disable the TCC feature and repeat the action.
H017 Ramp Mode Enabled	The requested action could not be performed because the ramp feature is enabled.	TCC, Ramp, and Recipe features are mutually exclusive. Disable the Ramp feature and repeat the action.
H019 Recipes Enabled	The requested action could not be performed because the recipe feature is enabled.	TCC, Ramp, and Recipe features are mutually exclusive. Disable the Recipe feature and repeat the action.
H020 User port standby.d is active	The standby.d line on the User port has been asserted.	Review user port functionality and assert/de-assert standby.d as needed.

Table 7-1. Help Codes (Continued)

Help Code	Problem Indicated	Suggested Action
H021 Ramp Parameters Out Of Range	The output could not ramp to the requested setpoint. however, the output is ON.	Adjust the ramp parameters.
H080 Configured as Slave Unit	The action requested could not be performed because the unit is configured as a slave.	No action.
H099 AEBus: Command Not Implemented	The command sent via AE Bus is not recognized by the unit.	Review the AE Bus commands.

Passive Display Panel Codes

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. The following table describes the strings:

Table 7-2. Passive Display Panel Codes

PFP Display String	Personality Card
H----	No Cards
H-01	Dual User Card
H-03	Profibus Card
H-04	Host Protocol Translator Card
H-05	Single User Card
H-18	AE Bus Card
H-22	Master/Slave Card
H-30	DeviceNet

LED Troubleshooting Table

Refer to this table before you call AE Global Support .

Table 7-3. Troubleshooting LEDs

LED	On	Off	Status
POWER	X		Normal
POWER		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. (See the “Specifications” chapter for ac input power specifications.)
OUTPUT	X		Normal
OUTPUT		X	The Pinnacle unit is not producing output. See “Checks if the Output Does Not Turn On” on page 7-3.
SETPOINT	X		Normal
SETPOINT		X	The Pinnacle unit is not operating within setpoint. Note the error code on the display and see “Error Code Troubleshooting Table” on page 7-8.
INTERLOCK	X		Normal
INTERLOCK		X	An interlock fault condition exists. Note the error code on the display and see “Error Code Troubleshooting Table” on page 7-8.
BUS FAULT	X		A bus fault condition exists. Note the error code on the display and see “Error Code Troubleshooting Table” on page 7-8.
BUS FAULT		X	Normal
OVERTEMP	X		An over-temperature fault condition exists. Note the error code on the display and see “Error Code Troubleshooting Table” on page 7-8.
OVERTEMP		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.
ARC		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.

If you cannot identify the problem by following this checklist, please call AE Global Support. If the unit's front panel or Pinnacle Remote Active Panel displays an error code, see “Error Code Troubleshooting Table” on page 7-8. To reset the unit's user-selectable parameters to the factory defaults, read about the default function in the “I/O Communication and Control” chapter.)

Clearing the Error Code

Error codes are typically generated by two types of faults: self-clearing or explicit clear. When the unit experiences a self-clearing fault condition, the unit turns off output and displays an error code on the panel. When the fault condition is no longer present in the system, the panel ceases to display the error code. (You then can turn on the output.)

When the unit experiences an explicit-clear fault condition, 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 before turning on output.

To reset the Pinnacle unit, do one of the following:

- From the front panel, press the OFF button to acknowledge the condition. Then press the ON button to turn on output.
- Through the DeviceNet interface, send the Poll Command message twice: once to turn off output and once to turn on output (see the description of Byte 4).
- Through the AE Bus interface, serial port or Profibus interface send the OFF command, then send the ON command to turn on output.
- Through the User port interface, release and reestablish closure between *pins 4* and *9* to turn off and on the output.

Error Code Troubleshooting Table

Use the following table to trouble shoot error codes.

Table 7-4. Error Codes

Error Code and Message	Problem Indicated	Suggested Action
E000 Control Circuit Fault	The DSP failed to respond to the processor.	Power the unit off and then back on. If the problem persists, call AE Global Support.
E001 A: Out of Setpoint Timer Expired (explicit clear)	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. (See the “Specifications” chapter for an impedance range graph.)
E002 Bus Fault (explicit clear)	The buses have failed, probably due to an ac input power problem.	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. (See the “Specifications” chapter for ac input power specifications.)
E003 Bus Not Ready (explicit clear)	The bus failed to power up when the contactor closed, probably due to an ac input power problem.	Using all applicable safety precautions, inspect your ac input power source to ensure that it is properly connected and that specified voltage is being applied to the Pinnacle unit. (See the “Specifications” chapter for ac input power specifications.)

Table 7-4. Error Codes (Continued)

Error Code and Message	Problem Indicated	Suggested Action
E004 Heat Sink Over-temperature (self clear)	The unit is overheating.	Inspect the unit's cooling system and review cooling specifications: ensure that the input air temperature is correct, that the Pinnacle unit's fans are functioning properly, and that your cabinet allows for adequate ventilation for all the units in the cabinet. For more information, see the "Installation" chapter.
E005 Momentary Power Fluctuation (explicit clear)	The ac input power line dipped below required operating conditions. This condition may be due to an ac power black-out or brown-out.	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. (See the "Specifications" chapter for ac input power specifications.)
E006 DSP Watchdog Failure	The DSP has failed.	Call AE Global Support.
E007 NOVRAM is not Initialized	The unit has not been properly initialized.	Call AE Global Support.
E009 Output Ground Fault Detected	Output positive terminal is not PE grounded.	Connect output positive terminal to PE ground.
E010 Side A: Process Voltage Low (explicit clear)	The voltage at output on the unit has dropped to the "process voltage" value you have set.	Re-program or disengage the Pinnacle unit's process voltage limit check feature. For more information, see the "I/O Communication and Control" chapter.

Table 7-4. Error Codes (Continued)

Error Code and Message	Problem Indicated	Suggested Action
E011 Side A: Inverter Fault Occurred (explicit clear)	The unit's power inverter on Side A cannot produce power.	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. Check the input power line voltage on all phases to ensure that it meets specifications (see the "Specifications" chapter). Run the power supply to a dummy load to determine if it will indeed produce voltage or current.
E012 Side B: Inverter Fault Occurred (explicit clear)	The unit's power inverter on Side B cannot produce power.	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. Check the input power line voltage on all phases to ensure that it meets specifications (see the "Specifications" chapter). Run the power supply to a dummy load to determine if it will indeed produce voltage or current.
E016 Invalid Request: Output is on	The requested action can not be performed while output is on.	Turn output off and repeat action.
E020 Interlock Open: User (self clear)	The unit's power inverter cannot produce power.	Power off the Pinnacle unit. Ensure that the interlock pin on the User port connector has been properly connected (see the "I/O Communication and Control" chapter). Ensure that all system interlocks have been satisfied. Power the unit back on.

Table 7-4. Error Codes (Continued)

Error Code and Message	Problem Indicated	Suggested Action
E021 Interlock Open: Cable (self clear)	The cable between the logic card and the inverter output board has come loose.	Power the unit off, check the cable connection, and then power the unit on. If the problem persists, call AE Global Service.
E022 Interlock Open: Contactor (self clear)	The unit's Contactor Interlock has not been satisfied.	Power off the Pinnacle unit. Ensure that the Contactor Interlock is properly connected. Ensure that all system interlocks have been satisfied. Power the unit back on. For more information about Contactor Interlock connector, refer to the "Installation" chapter.
E023 User Port Interlock Open (self clear)	The system interlock on the unit's analog User port has not been satisfied. This condition may be due to improper seating of the User port personality card.	Power off the Pinnacle unit. Ensure that the interlock pin on the User port connector has been properly connected (see the "I/O Communication and Control" chapter). Ensure that all system interlocks have been satisfied. Power the unit back on.
E024 Invalid Regulation Mode (self clear)	The User port regulation mode for the unit has been set to an invalid request.	The User port regulation mode for the unit has been set to an invalid request.
E025 Reset Target Life (clears through suggested action)	The end of target life timer has expired or was never set for the active target. This error occurs only if the target life timer for the unit was previously enabled.	Select the active target and set a new target life timer value. Or select a new target. Or disable the target life timer feature. For more information about these features, refer to the Pinnacle Remote Active Panel's "Target" functions ("Connectors, Indicators, and Controls" chapter) and your serial (Host) port's command list or download bytes information.

Table 7-4. Error Codes (Continued)

Error Code and Message	Problem Indicated	Suggested Action
E030 Processor Flash not Initialized	Flash memory was not initialized properly.	Call AE Global Support.
Error Codes E51 through E69 refer to Profibus interface errors.		
E051 Watch Dog Expired (explicit clear)	The Profibus master stopped talking to the Pinnacle supply after establishing communications.	Have the master re-establish communications and send a “master reset” to clear the Pinnacle unit's display.
E054 MAC Reset Off-line (explicit clear)	The unit's SPC (Profibus Controller) has taken itself “off-line,” probably in response to another error	Cycle the Pinnacle unit's power off and on and re-establish communications between the master and slave.
E055 Mem Buffer Overflow	The Profibus communication has overflowed the buffer.	Increase the time between packets being sent to the unit via the Profibus master.
E059 Master Released Slave (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's display.
Error Codes 70 through 79 are internal errors in the unit's logic card microprocessor.		
E070 Divide by 0	Internal software error.	Call AE Global Support.
E071 Single Step	Internal software error.	Call AE Global Support.
E072 Breakpoint	Internal software error.	Call AE Global Support.
E073 Overflow	Internal software error.	Call AE Global Support.
E074 Array Bound	Internal software error.	Call AE Global Support.
E075 Opcode Error	Internal software error.	Call AE Global Support.

Table 7-4. Error Codes (Continued)

Error Code and Message	Problem Indicated	Suggested Action
E076 Escape Opcode	Internal software error.	Call AE Global Support.
E077 Co-processor	Internal software error.	Call AE Global Support.
E078 Pre-defined Interrupt	Internal software error.	Call AE Global Support.
E079 Unassigned Interrupt	The Pinnacle unit's software has experienced an interruption and vectored to an unknown interrupt service routine.	Call AE Global Support.
Error codes E80 through E85 are for Master/Slave Pinnacle supplies.		
E080 Configured as a Slave Unit	The Pinnacle unit being communicated with is configured as a slave power supply, not the master power supply.	Ensure that you are indeed trying to communicate with a master unit. Ensure that all Pinnacle units in your Master/Slave configuration have the Master/Slave selection switch set properly. Ensure that cabling between the master and slave units and among the slave units is installed correctly. (See the Installation Chapter of this manual for more information about Master/Slave cabling and switches.)

Table 7-4. Error Codes (Continued)

Error Code and Message	Problem Indicated	Suggested Action
E081 Master/Slave Fault (See the “Error E081 Fault Vector” section below) (explicit clear)	An error occurred while the Master/Slave system was running.	If you have a Pinnacle Remote Active Panel or an active front panel, the error message should be displaying a fault vector. The fault vector is described in the following section. If consulting this information fails to indicate a solution or if you do not have an active front panel or a Pinnacle Remote Active Panel, power off the unit and ensure that cables are properly connected and that the Master/Slave selection switch is set properly; then power the unit back on. (See the “Installation” chapter for more information about Master/Slave cabling and switches.)
E082 Master of Slave Fault Occurred	The Pinnacle Master/Slave system failed to initialize properly.	Call AE Global Support.
E083 Master/Slave Parameterization Fault	An error occurred in the master/slave system.	Check the master/slave setup, and power the unit off and then back on. If the error persists, call AE Global Support.
E084 Master/Slave Fault Occurred	The processor detected an error and turned off the output from the Master/Slave system.	Power the unit off and then back on. If the error persists, call AE Global Support.
E085 Output On: Cannot Add/Rename Slave	The action can not be performed while output is on.	Turn output off and repeat this action. If the problem persists, call AE Global Support.

Table 7-4. Error Codes (Continued)

Error Code and Message	Problem Indicated	Suggested Action
E090 Internal DeviceNet Com Error	Loss of external DeviceNet bus power to the Pinnacle DeviceNet card. Internal communications between the DeviceNet module and the Pinnacle central processor have failed. <i>Note:</i> This error occurs only in units with DeviceNet cards and only in Host mode.	Ensure that DeviceNet is properly attached to the Pinnacle supply and that the DeviceNet bus is receiving power. Verify that DeviceNet status LEDs are lit. Disable output to clear the fault. If failure persists, contact AE Global Support. <i>Note:</i> This problem may occur occasionally if the Pinnacle supply is operating in noisy conditions.
E120 Interlock Open: AUX (self clear)	The unit's power inverter cannot produce power.	Power off the Pinnacle unit. Ensure that the <i>AUX</i> interlock pin on the User port connector has been properly connected (see the "I/O Communication and Control" chapter). Ensure that all system interlocks have been satisfied. Power the unit back on.
E220 Interlock Open: VAC (self clear)	The unit's power inverter cannot produce power.	Power off the Pinnacle unit. Ensure that the <i>VAC</i> interlock pin on the User port connector has been properly connected (see the "I/O Communication and Control" chapter). Ensure that all system interlocks have been satisfied. Power the unit back on.
E320 Interlock Open: WATER (self clear)	The unit's power inverter cannot produce power.	Power off the Pinnacle unit. Ensure that the <i>WATER</i> interlock pin on the User port connector has been properly connected (see the "I/O Communication and Control" chapter). Ensure that all system interlocks have been satisfied. Power the unit back on.

Error E081 Fault Vector

The Master/Slave fault vector associated with error code E081 E81 contains three hex bytes, separated into one two-byte word and a one-byte word (see Command 135 of the AE Bus command list). The two-byte word is a bit-wise “or” of all the slave unit errors; thus if a bit is set, the error exists in one or more slaves.

Note: If your Pinnacle master unit features an active panel, you can view error code information for each slave by turning the MODIFY knob.)

The one-byte word describes the faults in the communication bus between the master and slaves.

The three hex bytes are displayed in this order from left to right: slave status high byte, slave status low byte, personality card status byte. The bit definitions of these bytes are as follows:

SLAVE STATUS LOW BYTE

BIT	7	6	5	4	3	2	1	0	
	|	|	|	|	|	|	|	|	Setpoint status 0=ok, 1=out of setpoint
	|	|	|	|	|	|	|	|	.....Bus fault
	|	|	|	|	|	|	|	|	.....Inverter low fault
	|	|	|	|	|	|	|	|	..... Momentary power failure
	|	|	|	|	|	|	|	|	.....Pre-defined interrupt
	|	|	|	|	|	|	|	|	.....Xilinx detected fault
	|	|	|	|	|	|	|	|	.....Reserved
	|	|	|	|	|	|	|	|	.....Reserved

SLAVE STATUS HIGH BYTE

BIT 7	6	5	4	3	2	1	0	
|	|	|	|	|	|	|	|	Control circuit fault
|	|	|	|	|	|	|	|	.....Configuration fault
|	|	|	|	|	|	|	|	.....Over-temperature fault
|	|	|	|	|	|	|	|	.....Interlock open
|	|	|	|	|	|	|	|	.....Contactor not closed
|	|	|	|	|	|	|	|	.....Reserved
|	|	|	|	|	|	|	|	.....Reserved
|	|	|	|	|	|	|	|	.....Reserved

PERSONALITY CARD STATUS

BIT 7	6	5	4	3	2	1	0	
|	|	|	|	|	|	|	|	Initialization error
|	|	|	|	|	|	|	|	.....Multiple Masters
|	|	|	|	|	|	|	|	.....Bad address range
|	|	|	|	|	|	|	|	.....Bad function
|	|	|	|	|	|	|	|	.....Reserved
|	|	|	|	|	|	|	|	.....External off received
|	|	|	|	|	|	|	|	.....Slave not responding
|	|	|	|	|	|	|	|	.....Dual port ram error

See Table 7-3 on page 7-6 and “Error Code Troubleshooting Table” on page 7-8 to determine the proper action to take in response to any fault indicated in the status bytes. If you are unsure how to respond, please contact AE Global Support.

AE GLOBAL SUPPORT

Please contact one of the following offices if you have questions:

Table 7-5. AE Global Support Locations

Office	Telephone
AE, World Headquarters 1625 Sharp Point Drive Fort Collins, CO 80525 USA	Phone: 800.446.9167 Fax: 970.407.5981 Email: technical.support@aei.com
AE, Voorhees, NJ 1007 Laurel Oak Road Voorhees, NJ 08043 USA	Phone: 856.627.6100 Fax: 856.627.6159
AE, California 491 Montague Expressway Milpitas, CA 95035 USA	Phone: 408.263.8784 Fax: 408.263.8992
AE, Austin 8900 Cameron Road Suite 100 Austin, TX 78754	Phone: 512.231.4200 Fax: 512.719-9042
AE, GmbH Raiffeisenstrasse 32 70794 Filderstadt (Bonlanden) Germany	Phone: 49.711.77927.0 Fax: 49.711.7778700
AE, Japan KK TOWA Edogawabashi Bldg. 347 Yamabuki-cho Shinjuku-ku, Tokyo Japan	Phone: 81.3.32351511 Fax: 81.3.32353580
AE, Korea Ltd. Gongduk Building, 4th floor 272-6 Seohyun-Dong, Bundang-Gu, Sungam Si Kyunggi, 463-050 Korea	Phone: 82.31.705.2100 Fax: 82.31.705.2766

Table 7-5. AE Global Support Locations (Continued)

Office	Telephone
AE, Taiwan, LTD 10F-6, No. 110, Chung Shan Rd., Sec. 3, Chungho City, Taipei Hsien, Taiwan 235	Phone: 886-2-82215599 Fax: 886-2-82215050
AE, United Kingdom Unit 5, Minton Place, Market Court, Victoria Road Bichester, Oxon OX6 7QB UK	Phone: 44.1869.320022 Fax: 44.1869.325004

RETURNING UNITS FOR REPAIR

Before returning any product for repair and/or adjustment, ***first follow all troubleshooting procedures***. If, after following these procedures, you still have a problem or if the procedure instructs you to, call AE Global Support and discuss the problem with a representative. Be prepared to give the model number and serial number of the unit as well as the reason for the proposed return. This consultation call allows Global Support to determine whether the problem can be corrected in the field or if the unit needs to be returned. Such technical consultation is always available at no charge.

If you return a unit without first getting authorization from Global Support and that unit is found to be functional, you will be charged a retest and calibration fee plus shipping charges.

To ensure years of dependable service, Advanced Energy® products are thoroughly tested and designed to be among the most reliable and highest quality systems available worldwide.

WARRANTY

Advanced Energy® (AE) products are warranted to be free from failures due to defects in material and workmanship for 12 months after they are shipped from the factory (please see warranty statement below, for details).

In order to claim shipping or handling damage, you must inspect the delivered goods and report such damage to AE within 30 days of your receipt of the goods. Please note that failing to report any damage within this period is the same as acknowledging that the goods were received undamaged.

For a warranty claim to be valid, it must:

- Be made within the applicable warranty period
- Include the product serial number and a full description of the circumstances giving rise to the claim
- Have been assigned a return material authorization number (see below) by AE Global Support

All warranty work will be performed at an authorized AE service center (see list of contacts at the beginning of this chapter). You are responsible for obtaining authorization (see details below) to return any defective units, prepaying the freight costs, and ensuring that the units are returned to an authorized AE service center. AE will return the repaired unit (freight prepaid) to you by second-day air shipment (or ground carrier for local returns); repair parts and labor will be provided free of charge. Whoever ships the unit (either you or AE) is responsible for properly packaging and adequately insuring the unit.

Authorized Returns

Before returning any product for repair and/or adjustment, call AE Global Support and discuss the problem with them. 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 Support to determine if the unit must actually be returned for the problem to be corrected. Such technical consultation is always available at no charge.

Units that are returned without authorization from AE Global Support and that are found to be functional will not be covered under the warranty (see warranty statement, below). That is, you will have to pay a retest and calibration fee, and all shipping charges.

Warranty Statement

The seller makes no express or implied warranty that the goods are merchantable or fit for any particular purpose except as specifically stated in printed AE specifications. The sole responsibility of the Seller shall be that it will manufacture the goods in accordance with its published specifications and that the goods will be free from defects in material and workmanship. The seller's liability for breach of an expressed warranty shall exist only if the goods are installed, started in operation, and tested in conformity with the seller's published instructions. The seller expressly excludes any warranty whatsoever concerning goods that have been subject to misuse, negligence, or accident, or that have been altered or repaired by anyone other than the seller or the seller's duly authorized agent. This warranty is expressly made in lieu of any and all other warranties, express or implied, unless otherwise agreed to in writing. The warranty period is 12 months after the date the goods are shipped from AE. In all cases, the seller has sole responsibility for determining the cause and nature of the failure, and the seller's determination with regard thereto shall be final.

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