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Power Supply

NI PS-15 Power Supply User Manual

June 2011
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Electromagnetic Compatibility Information

This hardware has been tested and found to comply with the applicable regulatory requirements and limits for electromagnetic compatibility (EMC) as indicated in the hardware's Declaration of Conformity (DoC)[1]. These requirements and limits are designed to provide reasonable protection against harmful interference when the hardware is operated in the intended electromagnetic environment. In special cases, for example when either highly sensitive or noisy hardware is being used in close proximity, additional mitigation measures may have to be employed to minimize the potential for electromagnetic interference.

While this hardware is compliant with the applicable regulatory EMC requirements, there is no guarantee that interference will not occur in a particular installation. To minimize the potential for the hardware to cause interference to radio and television reception or to experience unacceptable performance degradation, install and use this hardware in strict accordance with the instructions in the hardware documentation and the DoC[1].

If this hardware does cause interference with licensed radio communications services or other nearby electronics, which can be determined by turning the hardware off and on, you are encouraged to try to correct the interference by one or more of the following measures:

- Reorient the antenna of the receiver (the device suffering interference).
- Relocate the transmitter (the device generating interference) with respect to the receiver.
- Plug the transmitter into a different outlet so that the transmitter and the receiver are on different branch circuits.

Some hardware may require the use of a metal, shielded enclosure (windowless version) to meet the EMC requirements for special EMC environments such as, for marine use or in heavy industrial areas. Refer to the hardware's user documentation and the DoC[1] for product installation requirements.

When the hardware is connected to a test object or to test leads, the system may become more sensitive to disturbances or may cause interference in the local electromagnetic environment.

Operation of this hardware in a residential area is likely to cause harmful interference. Users are required to correct the interference at their own expense or cease operation of the hardware.

Changes or modifications not expressly approved by National Instruments could void the user's right to operate the hardware under the local regulatory rules.

[1] The Declaration of Conformity (DoC) contains important EMC compliance information and instructions for the user or installer. To obtain the DoC for this product, visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

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About This Manual

The *NI PS-15 Power Supply User Manual* describes the features and specifications of the NI PS-15 power supply and contains information about installing the power supply.

Conventions

The following conventions are used in this manual:

»	The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **Options»Settings»General** directs you to pull down the **Options** menu, select the **Settings** item, and select **General** from the last dialog box.
	This icon denotes a note, which alerts you to important information.
	This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.
	When this symbol is marked on a product, it denotes a warning advising you to take precautions to avoid electrical shock.
bold	Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes parameter names.
italic	Italic text denotes variables, emphasis, a cross-reference, or an introduction to a key concept. Italic text also denotes text that is a placeholder for a word or value that you must supply.
`monospace`	Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames, and extensions.

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Related Documentation

The following documents contain information that you might find helpful as you read this manual:

- *NI PS-15/16/17 Side Mount Brackets Installation Guide*
- *NI PS-15/16/17 Panel Mount Brackets Installation Guide*
- *NI PS-15/16/17 Instruction Manual*

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1 Getting Started

This chapter describes the key features of the NI PS-15 power supply and lists the kit contents and mounting equipment you can order from National Instruments.

Unpacking

Carefully inspect the shipping container and the power supply for damage. Check for visible damage to the metal work. If damage appears to have been caused during shipment, file a claim with the carrier. Retain the packing material for possible inspection and/or reshipment.

What You Need to Get Started

The NI PS-15 power supply kit contains the following items:

- ❑ NI PS-15 power supply
- ❑ Printed *NI PS-15/16/17 Instruction Manual*

Key Features

The NI PS-15 includes a power reserve of 20%. This extra current may be used continuously at temperatures up to +45 °C. Additionally, the AC 100–120 V/200–240 V Auto-select input makes worldwide installation and usage very simple.

The key features of the NI PS-15 power supply include the following:

- Small size—power supply width of only 32 mm
- High efficiency—efficiency up to 90.2%
- Wide temperature range—full output power between –25 °C and +60 °C
- AC 100–120/200–240 V Auto-select input
- 20% output power reserves
- Minimal inrush current surge

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Hazardous Voltages Must be mounted in an enclosure by qualified personnel.

This power supply is designed for installation in an enclosure and is intended for general use, such as in industrial control, office, communication, and instrumentation equipment. Do not use this device in aircraft, trains and nuclear equipment, where malfunctioning of the power supply may cause severe personal injury or threaten human life. For more information, refer to Appendix A, *Specifications*.

Power Supply Description

Figures 1-1 and 1-2 show the functional description and front panel features of the NI PS-15 power supply.

Figure 1-1 provides the functional diagram for the NI PS-15.

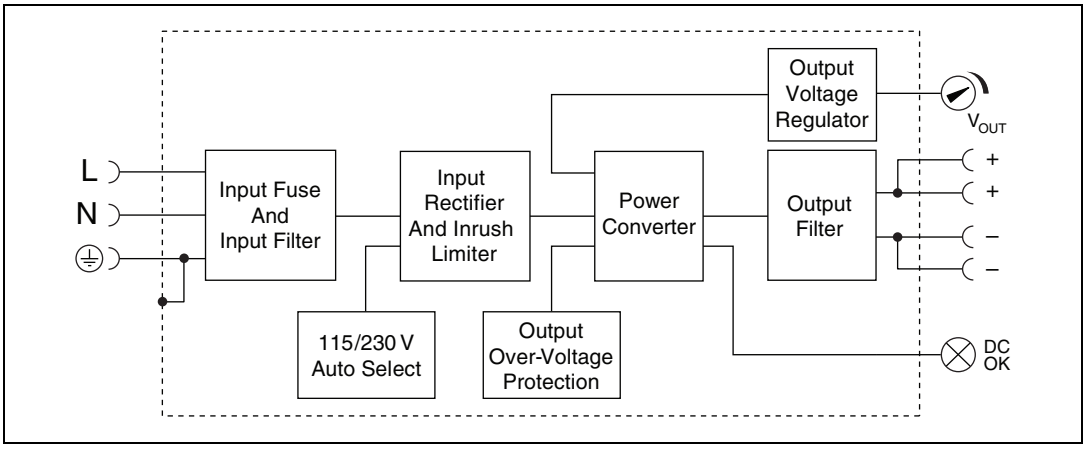
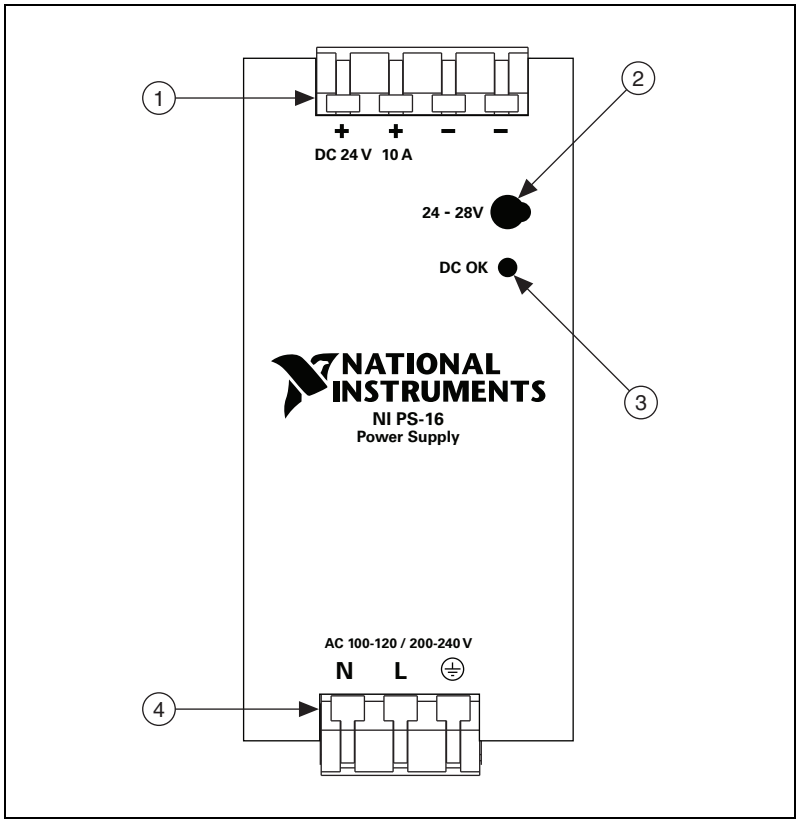


Figure 1-1. Functional Diagram for the NI PS-15 Power Supply

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Figure 1-2 provides the front panel features of the NI PS-15.



1	Output Terminals	3	DC OK LED
2	Output Voltage Potentiometer	4	Input Terminals

Figure 1-2. Front View of the NI PS-15 Power Supply

Output Terminals

The NI PS-15 has a total of four output terminals, providing two positive (+) output terminals and two negative (–) output terminals. Both positive terminals are wired together internally, and both negative terminals are wired together internally, as shown in Figure 1-1. The output terminals provide 24 V_{DC} with 5 A of current.

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Output Voltage Potentiometer

Note You must open the protective flap to turn the potentiometer.

Output voltage from the NI PS-15 is set by the output voltage potentiometer, shown in Figure 1-2. The factory setting output voltage is 24.1 V ±0.2% (at full load when the power supply is cold), and the potentiometer allows the output voltage to be adjusted from 24–28 V on any unit. The output voltage may be adjusted above 28 V by the potentiometer, but voltages beyond 28 V are *not* guaranteed.

Note Output voltages greater than 28 V are not supported on an NI PS-15 unit.

DC OK LED

This green LED indicates the status of available DC power through the output terminals. If the LED is lit, DC output of greater than 21 V is available for use through the output terminals. If the LED is not lit, DC is not currently available. The DC OK LED is wired internally to the power conversion circuitry prior to the output filtering stage, as shown in Figure 1-1.

If the DC OK LED does not light when power is provided through the input terminals, it may indicate a problem with the power supply. Contact National Instruments for more details.

Input Terminals

Caution National Instruments recommends that you wire all three input terminals for proper operation of the NI PS-15.

The NI PS-15 power supply derives power through the input terminals on the front panel, shown in Figure 1-2. There are three terminals corresponding to the Neutral input, the Line (or hot) input, and the Protective Earth (PE) input. The NI PS-15 rectifies both single-phase and two-phase AC input. The Neutral input terminal provides a MAINS return path for the input circuitry. The Line input is the primary power input for the supply. The PE input corresponds to an earth ground. As shown in Figure 1-1, the power supply case itself is grounded to the PE input.

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Mounting Equipment

Contact National Instruments to order the following mounting options for the NI PS-15 power supply. Refer to Table 1-1 for part numbers.

Table 1-1. Mounting Equipment

Part Number	Mounting Kit
199429-01	SIDE MOUNTING KIT FOR NI PS-15
199432-01	PANEL MOUNTING KIT FOR NI PS-15/16/17

Side Mounting Kit

The Side Mounting Kit (199429-01) allows you to mount the NI PS-15 on its side to a wall, panel surface, or a DIN-Rail for reduced installation depth. Refer to the *NI PS-15/16/17 Side Mount Brackets Installation Guide* at `ni.com` for more information.

Panel Mounting Kit

The Panel Mounting Kit (199432-01) allows you to mount the NI PS-15 to a wall or panel surface without using a DIN-Rail. Refer to the *NI PS-15/16/17 Panel Mount Brackets Installation Guide* at `ni.com` for more information.

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2

Installation and Configuration

This chapter describes how to prepare and operate the NI PS-15 power supply.

Mounting Orientation and Installation

This section describes the different mounting orientations, and the effect that mounting orientation has on power supply performance.

Mounting orientations other than input terminals on the bottom and output on the top require a reduction in continuous output power or a limitation in the maximum allowed ambient temperature. The amount of reduction influences the lifetime expectancy of the power supply. Therefore, two different derating curves for continuous operation are referenced in Figure 2-1:

- **Curve A1**—Recommended output current.
- **Curve A2**—Maximum allowed output current (which results in approximately half the lifetime expectancy for the power supply when following curve A1).

Note National Instruments recommends that the power supply be oriented such that the output terminals are located on top and the input terminals located on bottom. Figure 2-1 refers to this as the *Standard Orientation*.

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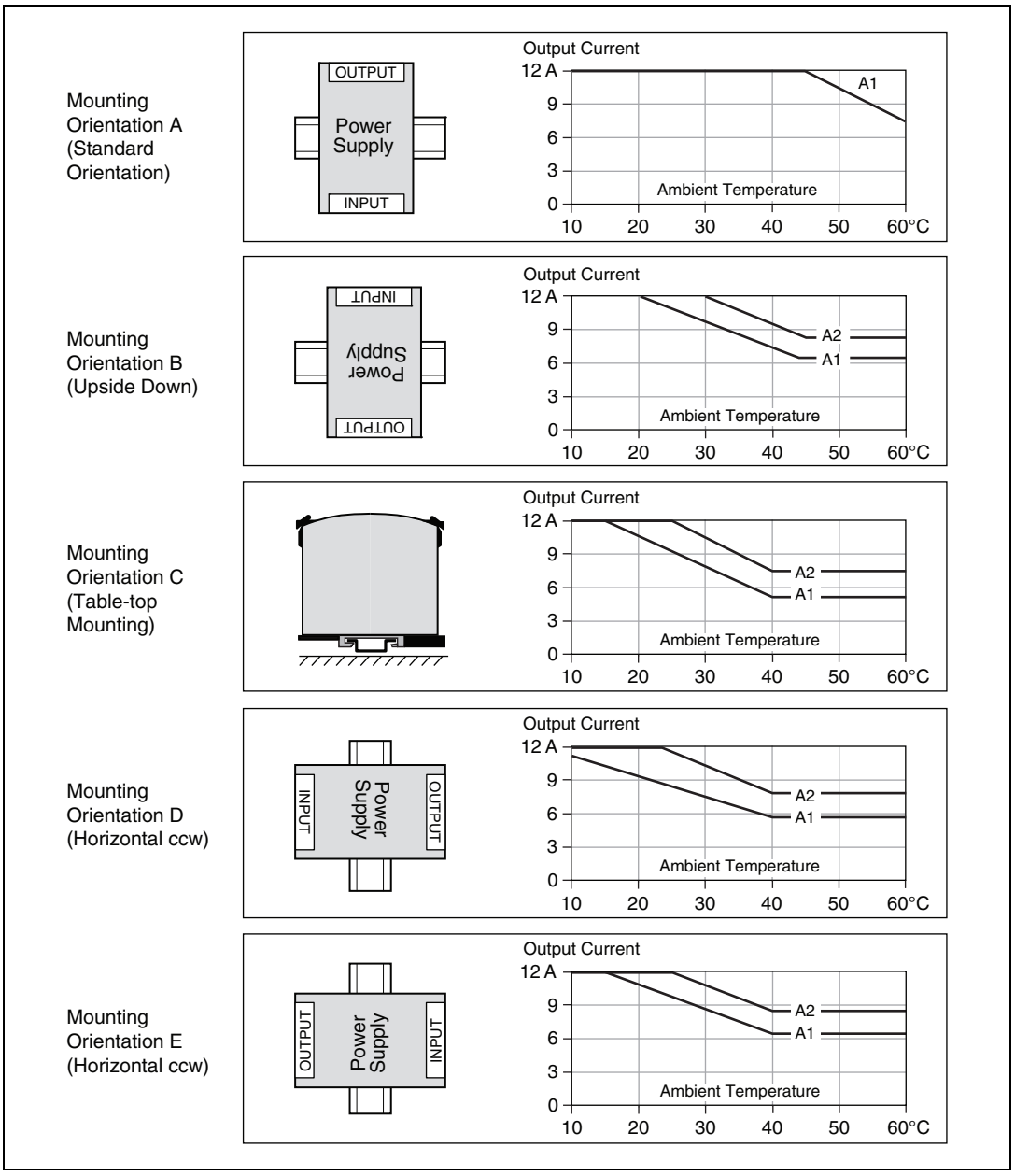


Figure 2-1. NI PS-15 Mounting Orientations

Mount the NI PS-15 power supply according to the installation instructions included with your mounting kit. For details on the mounting options available, refer to the *Mounting Equipment* section of Chapter 1, *Getting Started*.

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Wiring The Terminals

This section describes wiring for the NI PS-15 power supply. Table 2-1 provides a list of basic requirements for wiring.

Table 2-1. Wiring Requirements

Type	Spring-Clamp Terminals
Solid wire	0.5–6 mm
Stranded wire	0.5–4 mm
American wire gauge	20–10 AWG
Ferrules	Allowed, but not required
Wire stripping length	7 mm (0.275 in.)

Consider the following when wiring the NI PS-15.

- Use appropriate copper cables that are designed for an operating temperature of:
  - 60 °C for ambient up to 45 °C.
  - 75 °C for ambient up to 60 °C minimum.
- Follow national installation codes and installation regulations.
- Up to two stranded wires with the same cross section are permitted in one connection point (except PE wire).
- Do not use the unit without the PE connection being wired.

Complete the following steps to connect wires to the input and output terminals.

1. Ensure that none of the wires are connected to live power.
2. Strip the ends of the wires according to the recommendations in Table 2-1.

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3. Ensure that the terminal lever is in an open position as shown in Figure 2-2.

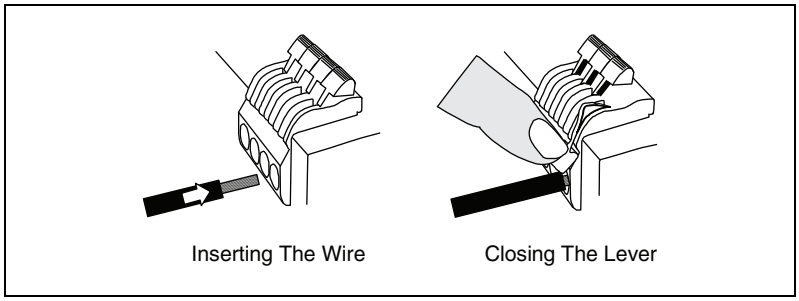


Figure 2-2. Connecting a Wire

4. Insert the end of the wire into the terminal until the exposed portion of the wire is completely inside of the terminal connection as shown in Figure 2-2. If you are using stranded wire, ensure that all strands of the wire enter the terminal connection.
5. Move the lever until the lever snaps into the closed position, as shown in Figure 2-2.
6. Repeat steps 4–5 for each of the other terminals.
7. Ensure that all wires are properly seated and not loose.
8. Ensure that the rest of your equipment is ready to be powered without creating a hazard.
9. Apply MAINS voltage to the NI PS-15 power supply.

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Operating the NI PS-15

This section provides general information on the operation of the NI PS-15 power supply.

Serial Operation

The NI PS-15 can operate in series to increase the output voltage. Figure 2-3 shows the NI PS-15 in a serial configuration.

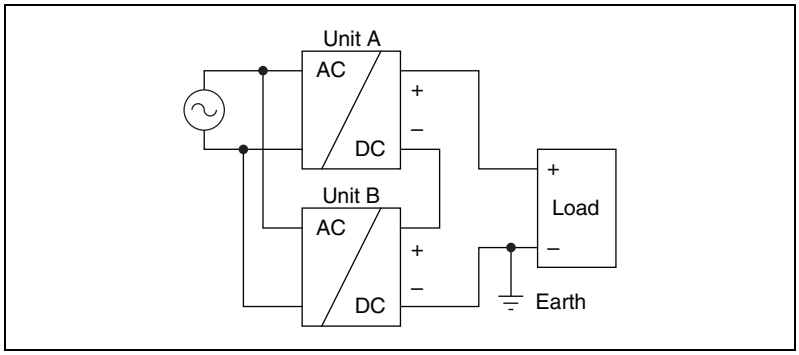


Figure 2-3. NI PS-15 in Serial Operation

Before operating the NI PS-15 in a serial configuration, consider the following:

- It is possible to connect as many units in series as needed, providing the sum of the output voltage does not exceed 150 V_{DC}.
- Voltages with a potential above 60 V_{DC} are not SELV-compliant any more and can be dangerous. Such voltages must be installed with a protection against touching.
- Use power supplies of the same type for serial operation.
- Earthing of the output is required when the sum of the output voltage is above 60 V_{DC}.
- Keep an installation clearance of 15 mm (left/right) between two power supplies and avoid installing the power supplies on top of each other.

Caution Avoid return voltage (for example, from a decelerating motor or battery) which is applied to the output terminals.

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Parallel Operation

Caution The power supply must *not* be used in parallel for the purpose of increasing the output power.

Power supplies can be paralleled for 1+1 redundancy to gain a higher system availability. Redundant systems require a certain amount of extra power to support the load in case one power supply unit fails. The simplest way is to put two NI PS-15 power supplies in parallel. If one power supply unit fails, the other one is automatically able to support the load current without any interruption. When using this method of building a redundant system consider the following:

- The faulty power supply can not be recognized. The green LED will still be on since it is reverse-powered from the other power supply.
- It does not cover failures such as an internal short circuit in the secondary side of the power supply. In such a case (nearly impossible), the defective unit becomes a load for the other power supplies and the output voltage can not be maintained.

Recommendations for building redundant power systems:

- Use separate input fuses for each power supply.
- When possible, connect each power supply to different phases or circuits.

Two-Phase Power Operation

The NI PS-15 power supply can operate with two-phase power, as shown in Figure 2-4.

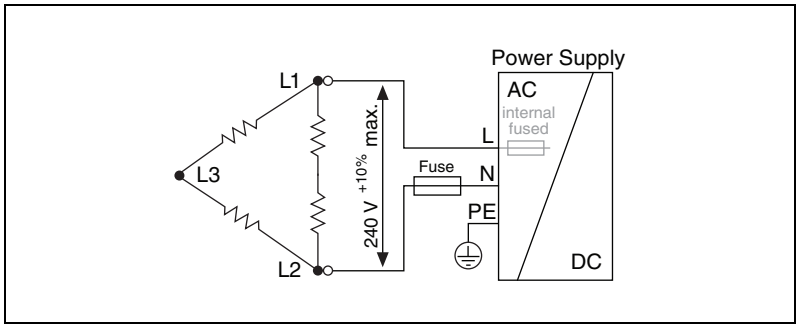


Figure 2-4. NI PS-15 in Two-Phase Operation

Before operating the NI PS-15 in this configuration, consider the following:

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- A phase-to-phase connection is allowed as long as the supplying voltage is below 240 V +10%.
- Use a fuse or a circuit breaker to protect the N (Neutral) input. The N input is not protected internally and in two-phase configuration would be connected to a hot wire.

Appropriate fuses and circuit breakers are specified in the *External Input Protection* section.

External Input Protection

The NI PS-15 power supply is tested and approved for branch circuits up to 20 A. External protection is only required if the supplying branch has an ampacity greater than 20 A. In some countries local regulations might apply, so check local codes and local requirements.

If an external fuse is utilized, a minimum value is required to avoid undesired tripping of the fuse, shown in Table 2-2.

Table 2-2. Maximum and Minimum Ampacities for External Fuses

Ampacity	B-Characteristic	C-Characteristic
Minimum	10 A	6 A
Maximum	20 A	20 A

Operation in a Sealed Enclosure

When the power supply is installed in a tightly sealed enclosure, the temperature inside the enclosure will be higher than outside. The inside temperature defines the ambient temperature for the power supply.

The following is the result of such an installation, where the NI PS-15 power supply was placed in the middle of a sealed enclosure, and no other heat producer was present:

Enclosure..... Rittal Type IP66 Box PK 9516 100, plastic, 110 mm × 180 mm × 165 mm

Load ..... 24 V, 4 A; (= 80%) load is placed outside the box

Input ..... 230 V_{AC}

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Temperature inside the box .....44.3 °C (in the middle of the right side of the power supply with a distance of 2 cm)

Temperature outside the box .....23.3 °C

Temperature rise .....21 °C

Cooling

The NI PS-15 is convection cooled, and direct cooling is not required. However, you must not cover the ventilation grid (for example, with cable conduits) by more than 30%.

Proper installation clearance for the NI PS-15 is 40 mm on top, 20 mm on the bottom, 5 mm on the left and right side when loaded permanently with full power. If the adjacent device is a heat source, 15 mm clearance is recommended between the NI PS-15 and the adjacent device.

Hazardous Risks

Cautions Do not use the unit without the proper earth connection (Protective Earth). Use the PE pin on the front panel terminal block for earth connection instead of one of the screws on the housing.

Turn the power off before working on the power supply. Protect against inadvertent re-powering.

Make sure the wiring is correct by following all local and national codes.

Do not open, modify, or repair the unit.

Use caution to prevent any foreign objects from entering into the housing.

Do not use in wet locations or in areas where moisture or condensation can be expected.

Service Parts

The NI PS-15 power supply does not contain any serviceable parts. If an internal fuse trips, it is caused by an internal defect. If damage or malfunction occurs during operation, immediately turn the power off and send the NI PS-15 to National Instruments for inspection.

Note Attempting to repair or modify the NI PS-15 power supply will void your warranty.

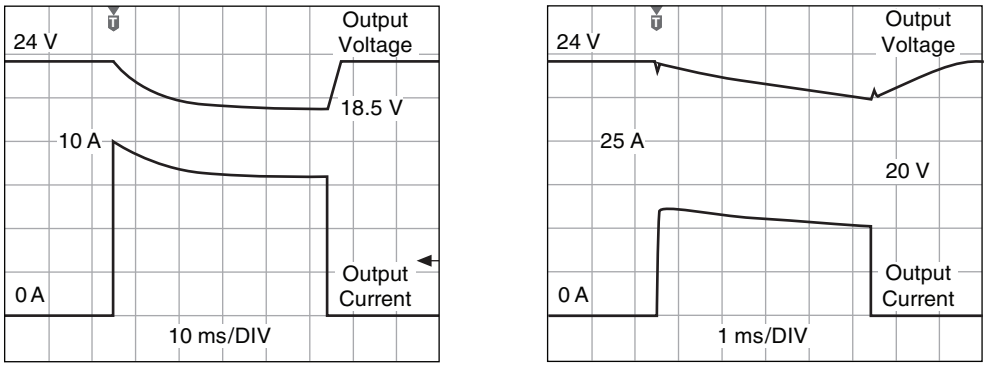
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Peak Current Capability

Solenoids, contactors and pneumatic modules often have a steady state coil and a pick-up coil. The inrush current demand of the pick-up coil is several times higher than the steady state current and usually exceeds the nominal output current (including the PowerBoost). The same situation applies when starting a capacitive load.

Branch circuits are often protected with circuit breakers or fuses. In case of a short or an overload in the branch circuit, the fuse needs a certain amount of over-current to trip or to blow. The peak current capability ensures the safe operation of subsequent circuit breakers.

Assuming the input voltage is turned on before such an event, the built-in large sized output capacitors inside the power supply can deliver extra current. Discharging this capacitor causes a voltage dip on the output. Figure 2-5 illustrates two typical voltage dips.



Peak load 10 A (resistive) for 50 ms
Output voltage dips from 24 V to 18.5 V.

Peak load 25 A (resistive) for 5 ms
Output voltage dips from 24 V to 12 V.

Figure 2-5. Peak Current Capacity Output Voltage Dips

Charging Batteries

The NI PS-15 power supply should *not* be used to charge batteries.

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Back Feeding Loads

Loads such as decelerating motors and inductors can feed voltage back to the power supply. This feature is also called return voltage immunity or resistance against back-EMF (Electro Magnetic Force). The NI PS-15 power supply is resistant to this and does not malfunction when a load feeds back voltage to the power supply, regardless of whether the power supply itself is on or off.

The maximum allowed feed back voltage is 35 V_{DC}. The absorbing energy can be calculated according to the built-in large sized output capacitor, which is specified in the *Output* section of Appendix A, *Specifications*.

Output Circuit Breakers

Standard miniature circuit breakers (MCBs) can be used for branch protection. Ensure that the MCB is also rated for DC voltage. The following tests show which circuit breakers the power supply typically trips.

Note Circuit breakers have huge tolerances in their tripping behavior. Therefore, these typical tests can only be used as a recommendation or for comparing two different power supplies. Furthermore, the loop impedance has a major influence on whether a breaker trips or not.

Test 1: Short circuit with S1 on the power supply end of the cable (loop impedance approximately 20 mΩ). The input voltage was 230 V_{AC} and the load current was 0 A.

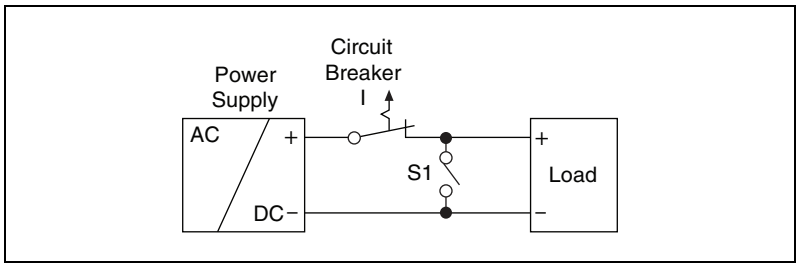


Figure 2-6. Breaker Trip Test 1

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The following circuit breaker tripped during the test:

A or Z-Characteristic ..... ≤ 8 A

B-Characteristic ..... No tripping ≥6 A
No breaker available <6 A

C-Characteristic ..... ≤ 4 A

Test 2: Short circuit with S1 on the load end (additional impedance is included in the form of longer load wire length). The input voltage was 230 V_{AC} and the load current was 0 A.

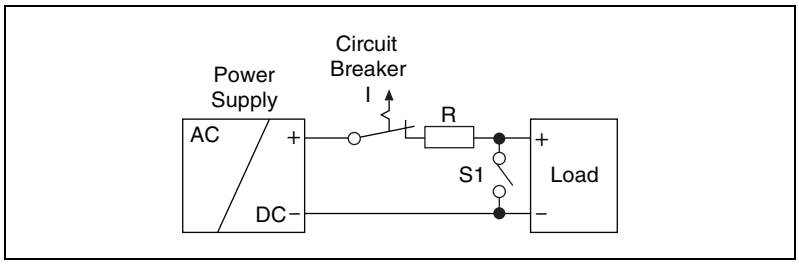


Figure 2-7. Breaker Trip Test 2

The following circuit breaker tripped during the test:

A or Z-Characteristic ..... ≤ 6 A and R = 180 mΩ

B-Characteristic ..... No tripping ≥6 A
No breaker available <6 A

C-Characteristic ..... ≤ 3 A and R = 270 mΩ

Table 2-3 provides a comparison of resistances in terms of wire gauge and length.

Table 2-3. Resistances for Wire Gauges and Lengths

Resistance	0.5 mm²	0.7 mm²	1.0 mm²	1.5 mm²	2.5 mm²	4.0 mm²
180 mΩ	5.0 m	7.0 m	10 m	15 m	25 m	40 m
270 mΩ	7.5 m	10.5 m	15 m	23 m	38 m	60 m

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For example: Which wire gauge must be used to trip a C-Characteristic circuit breaker with a rating of 3 A? The load wire length is 21 m.

Answer: A 3 A C-Characteristic circuit breaker requires a loop impedance of less than 270 mΩ (test results). Table 2-3 shows that up to 23 m of wire with a cross section of 1.5 mm^2 is below 270 mΩ. You should not use a wire smaller than 1.5 mm^2.

Inductive and Capacitive Loads

The NI PS-15 is designed to supply any kind of load, including unlimited capacitive and inductive loads.

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A

Specifications

This appendix contains specifications for the NI PS-15 power supply.

Note Specifications are subject to change without notice.

Hazardous Voltages Must be mounted in an enclosure by qualified personnel. Refer to Figure A-1 for more information.

This power supply is designed for installation in an enclosure and is intended for general use, such as in industrial control, office, communication, and instrumentation equipment. Do not use this device in aircraft, trains and nuclear equipment, where malfunctioning of the power supply may cause severe personal injury or threaten human life.

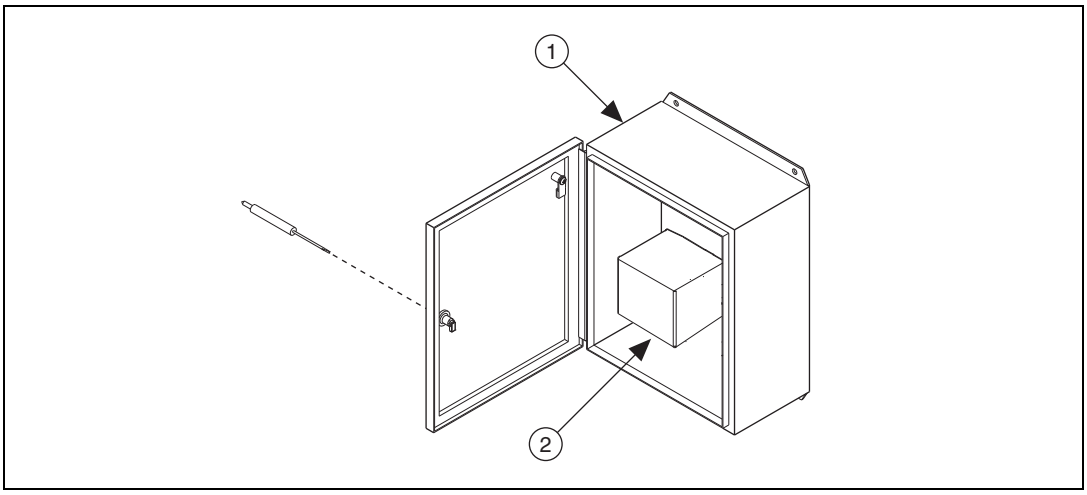
Dimensions and Weight

Dimensions

- Width ..... 32 mm
- Height..... 124 mm
- Depth..... 117 mm

Weight..... 500 g (1.1 lb)

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1	Suitably rated NEMA or IP enclosure that requires tool access	2	NI PS-15 Power Supply

Figure A-1. NI PS-15 Power Supply

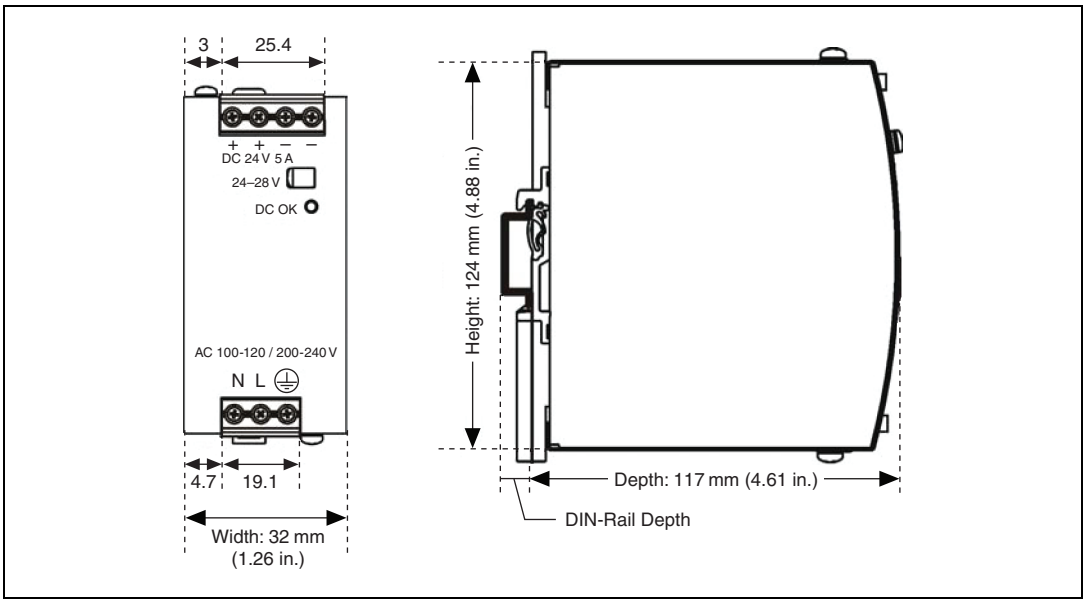


Figure A-2. NI PS-15 Dimensions

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AC Input

AC input	Nominal AC 100 –120 V/200 –240 V	Auto-select input, TN-, TT-, IT-Mains, refer to Figure A-3
AC input range	90–132 V_{AC} 180–264 V_{AC} 85–90 V_{AC} 264–300 V_{AC}	100–120 V range, continuous operation 200–240 V range, continuous operation Short term or with output derating <0.5 s
Input frequency	Nominal 50–60 Hz	±6%
DC input	Not allowed	—

	Typical/ Maximum	**AC 100 V**	**AC 120 V**	**AC 230 V**	
Input current	Typical	2.34 A	2.05 A	1.23 A	At 24 V, 5 A refer to Figure A-3
Power factor*	Typical	0.58	0.56	0.47	At 24 V, 5 A refer to Figure A-3
Crest factor**	Typical	2.9	3.1	3.7	At 24 V, 5 A
Start-up delay	Typical	740 ms	900 ms	720 ms	Refer to Figure A-4
Rise time	Typical Typical	8 ms 25 ms	8 ms 25 ms	8 ms 25 ms	0 mF, 24 V, 5 A, refer to Figure A-4 5 mF, 24 V, 5 A, refer to Figure A-4
Turn-on overshoot	Maximum	400 mV	400 mV	400 mV	Refer to Figure A-4
Turn-on voltage	Typical	75 V_{AC}	75 V_{AC}	—	Steady-state value, refer to Figure A-3
Shut-down voltage	Typical	55 V_{AC}	55 V_{AC}	—	Steady-state value, refer to Figure A-3

* The power factor is the ratio of the true (or real) power to the apparent power in an AC circuit.
** The crest factor is the mathematical ratio of the peak value to the RMS value of the input current waveform.

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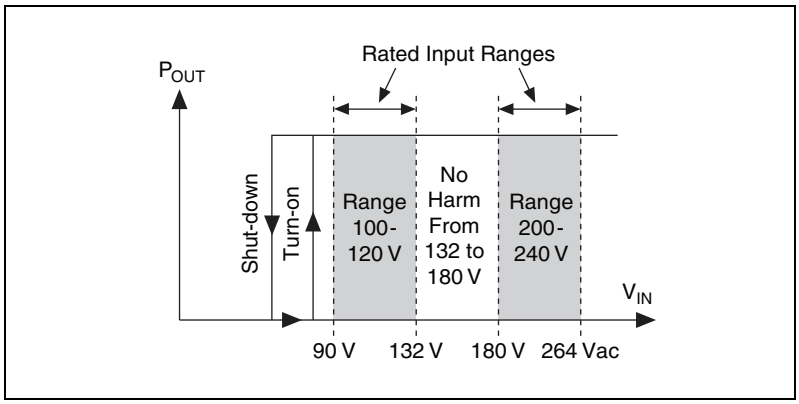


Figure A-3. Input Voltage Range

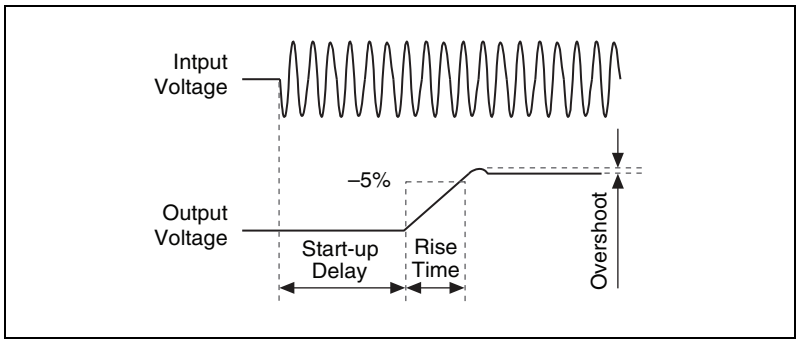


Figure A-4. Turn On Behavior, Definitions

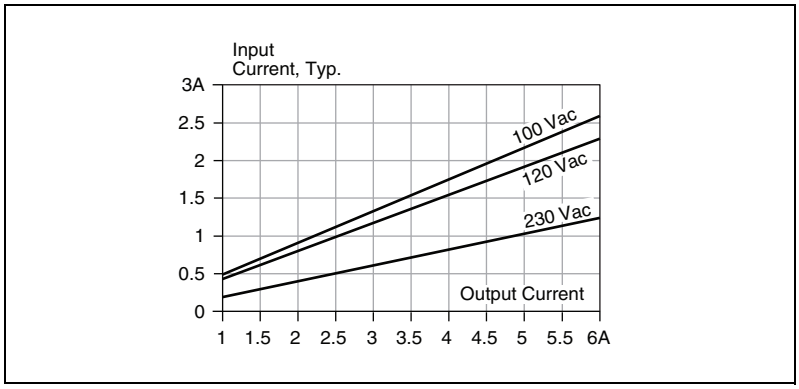


Figure A-5. Input Current Vs. Output Load

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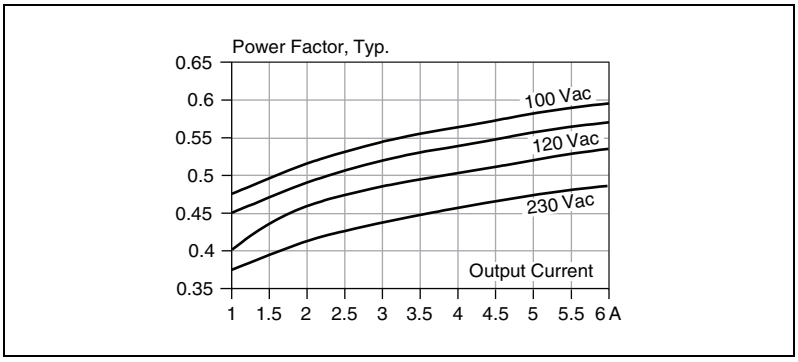
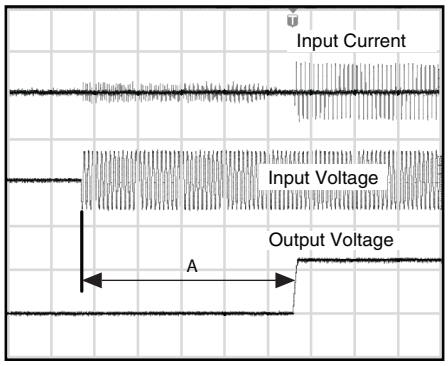


Figure A-6. Power Factor Vs. Output Load

Input Current Inrush Surge

An active inrush limitation circuit limits the input inrush current after input voltage is applied. The charging current into EMI suppression capacitors is disregarded in the first milliseconds after power up.

	Typical/ Maximum	**AC 100 V**	**AC 120 V**	**AC 230 V**	
Inrush current	Maximum Typical	10 A_{peak} 3 A_{peak}	10 A_{peak} 3 A_{peak}	10 A_{peak} 3 A_{peak}	–25 °C to +70 °C –25 °C to +70 °C
Inrush energy	Typical	1 A^2s	1 A^2s	1 A^2s	–25 °C to +70 °C



A:	Start-up delay = Inrush delay
Input:	230 Vac
Output:	24 V, 10 A
Ambient:	25 °C
Upper curve:	Input current 10 A / DIV
Medium curve:	Input voltage 500 V / DIV
Lower curve:	Output voltage 20 V / DIV
Time scale:	100 ms / DIV

Figure A-7. Input Inrush Current, Typical Behavior

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Hold-up Time

	Typical/ Maximum	AC 100V	AC 120V	AC 230V	
Hold-up Time	Typical	109 ms	165 ms	161 ms	2.5 A, 24 V, refer to Figure A-8
	Typical	50 ms	80 ms	78 ms	5 A, 24 V, refer to Figure A-8
	Typical	37 ms	62 ms	63 ms	6 A, 24 V, refer to Figure A-8

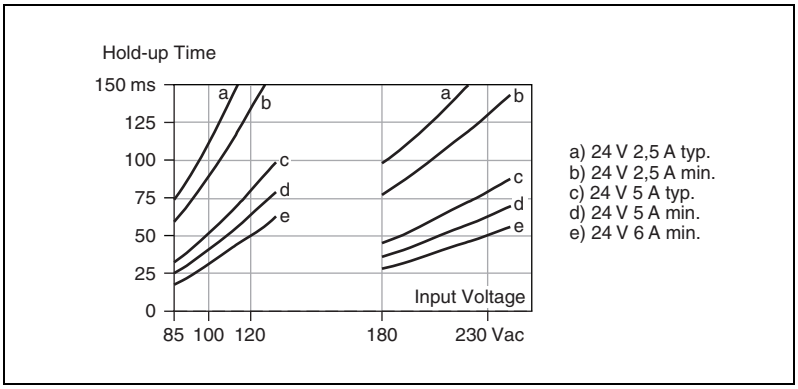


Figure A-8. Hold-Up Time Vs. Input Voltage

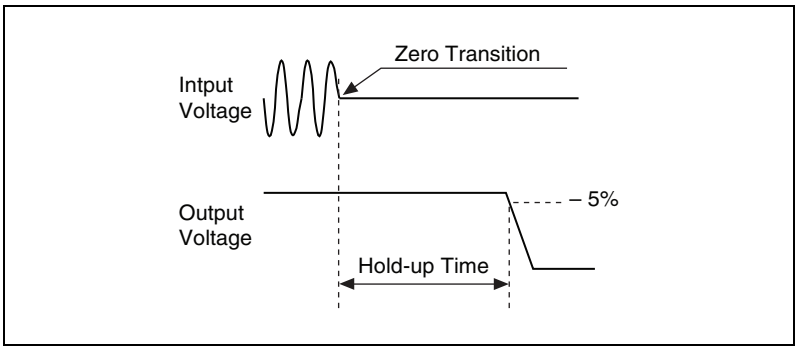


Figure A-9. Shutdown Behavior, Definitions

Note At no load, the hold-up time can be up to several seconds. The green DC OK LED is lit during this time.

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Output

Output voltage	Nominal	24 V	—
Adjustment range	Minimum Maximum	24–28 V 30 V	Guaranteed At clockwise end position of potentiometer
Factory setting	—	24.1 V	±0.2%, at full load, cold unit
Line regulation	Maximum	70 mV	90 V_{AC} to 132 V_{AC} or 180 V_{AC} to 264 V_{AC}
Load regulation	Maximum	100 mV	Static value, 0A → 5A → 0A
Ripple and noise voltage	Maximum	50 mVpp	20 Hz to 20 MHz, 50 Ω
Output capacitance	Typical	1,800 µF	—
Output current	Nominal Nominal Nominal Nominal	6 A* 5 A 5.1 A* 4.3 A	At 24 V, ambient < 45 °C, refer to Figure A-10 At 24 V, ambient < 60 °C, refer to Figure A-10 At 28 V, ambient < 45 °C, refer to Figure A-10 At 28 V, ambient < 60 °C, refer to Figure A-10
Output power	Nominal Nominal	144 W* 120 W	Ambient < 45 °C Ambient < 60 °C
Short-circuit current	Minimum Maximum	10 A 14 A	Load impedance 200 mΩ, refer to Figure A-10 Load impedance 200 mΩ, refer to Figure A-10

* The NI PS-15 may respond with a thermal shut-down when continuously loaded with more than 120 W and operated with a MAINS voltage of 100 V or below.

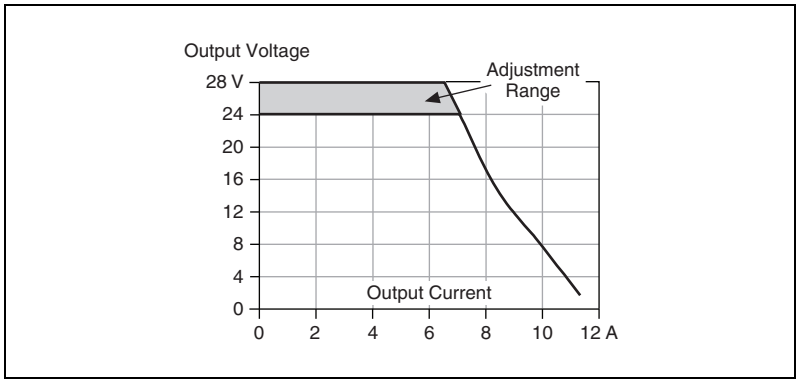


Figure A-10. Output Voltage Vs. Output Current, Typical

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Peak Current Capability

The power supply can deliver a peak current which is higher than the specified short term current. This helps to start current-demanding loads or to safely operate subsequent circuit breakers.

The extra current is supplied by the output capacitors inside the power supply. During this event, the capacitors will be discharged and cause a voltage dip on the output. Detailed curves can be found in the *Peak Current Capability* section of Chapter 2, *Installation and Configuration*.

Peak current voltage dips	Typical	From 24 V to 18.5 V	At 10 A for 50 ms, resistive load
	Typical	From 24 V to 22 V	At 25 A for 2 ms, resistive load
	Typical	From 24 V to 20 V	At 25 A for 5 ms, resistive load

Efficiency and Power Losses

		AC 100V	**AC 120V**	**AC 230V**	
Efficiency	Typical	88.8%	89.4%	90.2%	5 A, 24 V
Power losses	Typical	1.9 W	2.0 W	1.7 W	0 A
	Typical	9.1 W	8.8 W	8.2 W	2.5 A, 24 V
	Typical	15.3 W	14.5 W	13.2 W	5 A, 24 V
	Typical	19.4 W	18.2 W	16.1 W	6 A, 24 V

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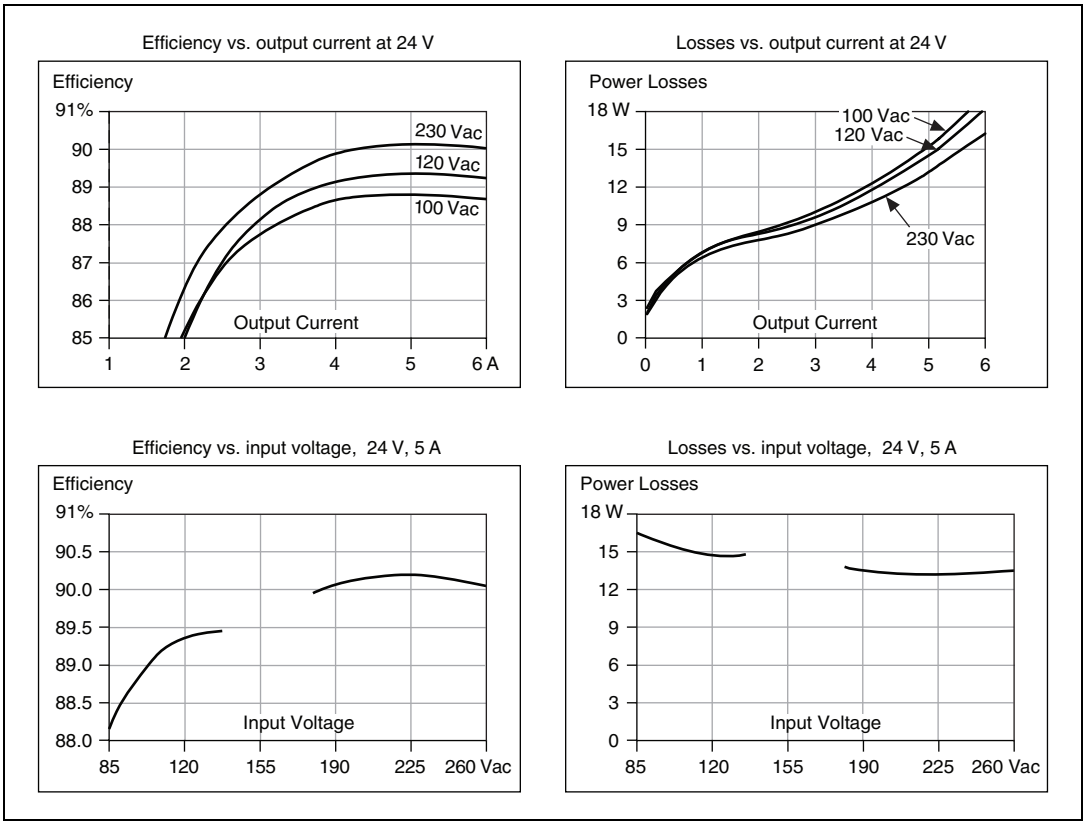


Figure A-11. NI PS-15 Efficiency and Losses

Reliability

The lifetime expectancy shown in Table A-1 indicates the service life of the NI PS-15, and is determined by the lifetime expectancy of the built-in electrolytic capacitors. Lifetime expectancy is specified in operational hours. Lifetime expectancy is calculated according to the capacitor's manufacturer specification. The prediction model allows a calculation of up to 15 years from the date of shipment.

MTBF (Mean Time Between Failure) is calculated according to statistical device failures and indicates reliability of a device. It is the statistical representation of the likelihood of a unit to fail and does not necessarily represent the life of a product.

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Table A-1. Reliability Specifications

	Minimum/ Maximum	AC 100V	AC 120V	AC 230V	
Lifetime expectancy	Minimum	52,000 hours	58,000 hours	72,000 hours	40 °C, 24 V, 5 A
	Minimum	27,000 hours	34,000 hours	42,000 hours	40 °C, 24 V, 6 A
	Minimum	135,000 hours	128,000 hours	144,000 hours	40 °C, 24 V, 2.5A
	Minimum	142,000 hours	15 years	15 years	25 °C, 24 V, 5 A
MTBF SN 29500, IEC 61709	—	638,000 hours	661,000 hours	869,000 hours	40 °C, 24 V, 5 A
		542,000 hours	562,000 hours	739,000 hours	40 °C, 24 V, 6 A
		1,077,000 hours	1,111,000 hours	1,495,000 hours	25 °C, 24 V, 5 A
MTBF MIL HDBK 217F	—	552,000 hours	546,000 hours	574,000 hours	40 °C, 24 V, 5 A, Ground Benign GB40
		497,000 hours	491,000 hours	517,000 hours	40 °C, 24 V, 6 A, Ground Benign GB40
		788,000 hours	775,000 hours	800,000 hours	25 °C, 24 V, 5 A, Ground Benign GB25

Dielectric Strength

Notes The output voltage is floating and has no ohmic connection to ground.

To fulfill the PELV requirements according to EN60204-1 § 6.4.1, we recommend that either the + pole, the – pole or any other part of the output circuit should be connected to the protective earth system. This helps to avoid situations in which a load starts unexpectedly or can not be switched off when unnoticed earth faults occur.

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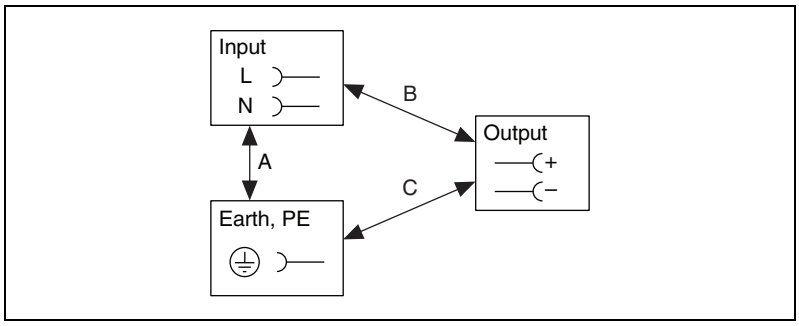


Figure A-12. Dielectric Strength

Table A-2 lists the tests that have been run to determine the NI PS-15 dielectric strength, and the results of each test.

Table A-2. Dielectric Strength Test Results

Test	Duration	A	B	C
Type test	60 s	2500 V_{AC}	3000 V_{AC}	500 V_{AC}
Factory test	5 s	2500 V_{AC}	2500 V_{AC}	500 V_{AC}
Field test	5 s	2000 V_{AC}	2000 V_{AC}	500 V_{AC}

Type tests and factory tests
Conducted by the manufacturer. Do *not* repeat test in field.

Rules for field test
Use appropriate test equipment which applies the voltage with a slow ramp. Connect L and N together as well as all output poles.

Used Substances

- The unit does not release any silicone and is suitable for the use in paint shops.
- Electrolytic capacitors included in this unit do not use electrolytes such as Quaternary Ammonium Salt Systems.
- Plastic housings and other molded plastic materials are free of halogens, wires and cables are not PVC insulated.

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- The production material within our production does not include following toxic chemicals: Polychlorized Biphenyl (PCB), Polychlorized Terphenyl (PCT), Pentachlorophenol (PCP), Polychlorinated naphthalene (PCN), Polybrom Biphenyl (PBB), Polybrom Bipheny-oxyd (PBO), Polybrominated Diphenylether (PBDE), Polychlorinated Diphenylether (PCDE), Polydibromphenyl Oxyd (PBDO), Cadmium, Asbest, Mercury, Silicia.

Environment

Operational temperature	–25 °C to +70 °C (–13 °F to 158 °F)	Reduce output power according to Figure A-13
Output de-rating	1.6 W/°C	45–60 °C (113 °F to 140 °F)
	3 W/°C	60–70 °C (140 °F to 158 °F)
Storage temperature	–40 to +85 °C (–40 °F to 185 °F)	Storage and transportation
Humidity	5 to 95% r.H.	IEC 60068-2-30 Do not energize while condensation is present
Vibration sinusoidal	2–17.8 Hz: ±1.6 mm; 17.8–500 Hz: 2 g 2 hours / axis	IEC 60068-2-6
Shock	30 g 6 ms, 20 g 11 ms 3 bumps/direction, 18 bumps total	IEC 60068-2-27
Altitude	0 to 6000 m (0 to 20,000 ft)	Reduce output power or ambient temperature above 2000 m sea level
Output de-rating (for altitude)	7.5 W/1000 m or 5 °C/1000 m	Above 2000 m (6500 ft), refer to Figure A-14
Over-voltage category	III	EN 50178, altitudes up to 2000 m
	II	Altitudes from 2000 m to 6000 m
Degree of pollution	2	EN 50178, not conductive

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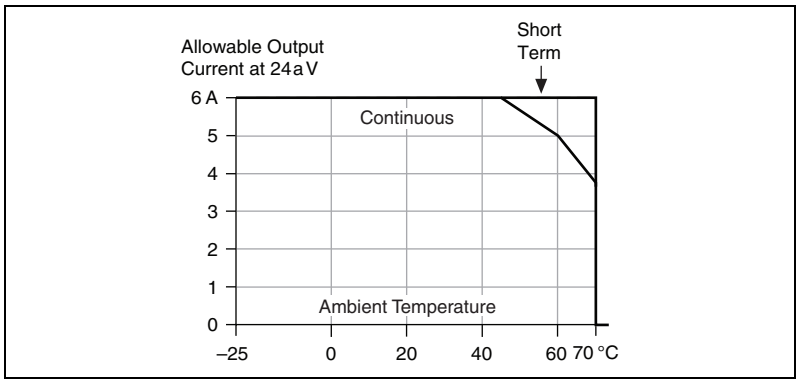


Figure A-13. Output Current Vs. Ambient Temperature

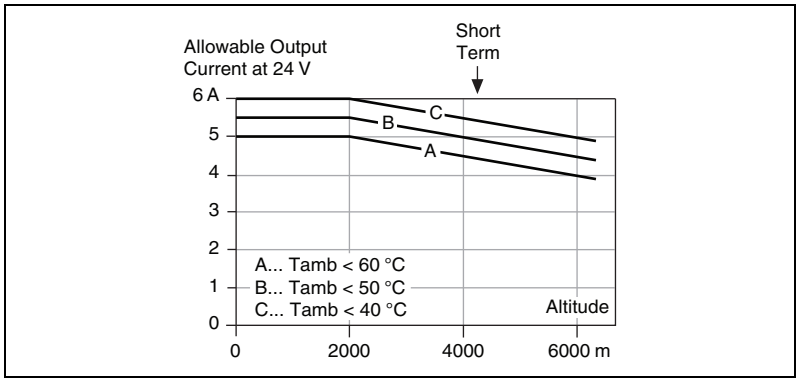


Figure A-14. Output Current Vs. Altitude

Note The ambient temperature is defined as the temperature 2 cm below the NI PS-15.

Protection Features

Output protection	Electronically protected against overload, no-load and short-circuits	
Output over-voltage protection	Typical 35 V_{DC} Maximum 39 V_{DC}	In case of an internal power supply defect, a redundant circuitry limits the maximum output voltage. The output shuts down and automatically attempts to restart.
Output over-current protection	Electronically limited	Refer to Figure A-10.
Degree of protection	IP 20	EN/IEC 60529
Penetration protection	>3.5 mm	From screws, small parts, and so on

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Over-temperature protection	Yes	Output shut-down with automatic restart
Input transient protection	MOV	Metal Oxide Varistor
Internal input fuse	T4A H.B.C.	Not user replaceable

Note In case of a protection event, audible noise may occur.

Safety

This product is designed to meet the requirements of the following standards of safety for industrial control and information technology equipment:

- IEC/EN 60950-1, UL 508

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product is designed to meet the requirements of the following standards of EMC for industrial control and information technology equipment:

EMC Immunity	EN 61000-6-2 EN 61000-6-1	Generic standards		
Electrostatic discharge	EN 61000-4-2	Contact discharge Air discharge	8 kV 15 kV	Criterion A Criterion A
Electromagnetic RF field	EN 61000-4-3	80 MHz–1 GHz	10 V/m	Criterion A
Fast transients (Burst)	EN 61000-4-4	Input lines Output lines	4 kV 2 kV	Criterion A Criterion A
Surge voltage on input	EN 61000-4-5	L → N N/L → PE	2 kV 4 kV	Criterion A Criterion A
Surge voltage on output	EN 61000-4-5	+ → – +/– → PE	500 V 500 V	Criterion A Criterion A
Conducted disturbance	EN 61000-4-6	0.15–80 MHz	10 V	Criterion A

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Mains voltage dips	EN 61000-4-11	0% of 100 V_{AC}	0 V_{AC}, 20 ms	Criterion A
		40% of 100 V_{AC}	40 V_{AC}, 200 ms	Criterion C
		70% of 100 V_{AC}	70 V_{AC}, 500 ms	Criterion A
		0% of 200 V_{AC}	0 V_{AC}, 20 ms	Criterion A
		40% of 200 V_{AC}	80 V_{AC}, 200 ms	Criterion C
		70% of 200 V_{AC}	140 V_{AC}, 500 ms	Criterion A
Voltage interruptions	EN 61000-4-11		0 V_{AC}, 5000 ms	Criterion C
Powerful transients	VDE 0160	Over entire load range	750 V, 1.3 ms	Criterion A
Criterions: **A**: Power supply shows normal operation behavior within the defined limits. **C**: Temporary loss of function is possible. Power supply might shut-down and restarts by itself. No damages or hazards for the power supply occur.				

Switching Frequency

175 kHz to 225 kHz ..... input voltage dependent 24 V, 2.5 A

100 kHz to 130 kHz ..... input voltage dependent 24 V, 5 A

EMC Emission	EN 61000-6-4	Generic standards
Conducted emission	EN 55011, EN 55022, FCC Part 15, CISPR 11, CISPR 22	Class B, input lines
	EN 55022	Class A, output lines
Radiated emission	EN 55011, EN 55022	Class B
Harmonic input current	EN 61000-3-2	>2.7 A output current not fulfilled
Voltage fluctuations, flicker	EN 61000-3-3	fulfilled

Notes This device complies with FCC Part 15 rules.

Operation is subjected to following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Above an average output current of 2.7 A, the harmonic current standard EN 61000-3-2 is not fulfilled.

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A power supply has to comply with EN 61000-3-2 (Standard for harmonic input current) when:

- the end-device is used within the European Union and
- the end-device is connected to a public mains supply with a nominal voltage greater than or equal to 220 V_{AC} and
- the power supply is:
  - fitted in an end-device with an average input power in excess of 75 W

    or
  - fitted in an end-device with a continuous input power in excess of 75 W

    or
  - part of a lighting system.

Exceptions
End-devices for professional applications with an input power > 1000 W do not need to fulfill EN 61000-3-2.

Comments
- The average input power must be determined in accordance with EN 61000-3-2.
- Industrial MAINS supplies with their own transformer are considered to be *non-public*.
- Where individual self-contained items of equipment are installed in a rack or case (for example, devices connected in parallel), they are regarded as being individually connected to the MAINS supply. The rack or case need not be tested as a whole. Alternatively, it is also permitted to assess the whole rack or case. This is recommended for devices used in professional applications with an input power greater than 1000 W.

Notes For the standards applied to assess the EMC of this product, refer to the *Online Product Certification* section.

For EMC compliance, operate this device with shielded cabling.

CE Compliance CE

This product meets the essential requirements of applicable European Directives as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

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Certifications

18WM LISTED IND. CONT. EQ.	LISTED as Industrial Control Equipment (UL 508)
c US	RECOGNIZED as Information Technology Equipment (UL 60950-1)
GL	GL (Germanischer Lloyd) classified for marine and offshore applications. Environmental category: C, EMC2

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at `ni.com/environment`. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of the product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste and Electronic Equipment, visit `ni.com/environment/weee`.

电子信息产品污染控制管理办法 （中国 RoHS）

中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。
关于 National Instruments 中国 RoHS 合规性信息，请登录 `ni.com/environment/rohs_china`。
(For information about China RoHS compliance, go to `ni.com/environment/rohs_china`.)

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B

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Visit the following sections of the award-winning National Instruments Web site at `ni.com` for technical support and professional services:

- **Support**—Technical support at `ni.com/support` includes the following resources:
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- **Declaration of Conformity (DoC)**—A DoC is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electromagnetic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting `ni.com/certification`.
- **Calibration Certificate**—If your product supports calibration, you can obtain the calibration certificate for your product at `ni.com/calibration`.

You also can visit the Worldwide Offices section of `ni.com/niglobal` to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

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