

Packet Power™ Smart Power Cable

Users Manual

Version 1.5



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CAUTION

- ☐ Read all instructions carefully prior to installation.
- ☐ Smart Power Cables should only be connected to the type of power source indicated on the label.
- ☐ Adhere to voltage and amperage guidelines and utilize a proper branch circuit protector.
- ☐ No field-serviceable parts. Do not attempt to disassemble the product as potentially severe electrical shock may result. Installation and maintenance must be performed by qualified personnel.
- ☐ Follow basic safety precautions to reduce the risk of electrical shock and damage to equipment.
- ☐ Store in a clean, dry location. Clean with a dry cloth.
- ☐ Intended for indoor use only, do not install in a wet location.
- ☐ Adhere to all local electrical codes and guidelines.
- ☐ Failure to use the product in the specified manner may lead to injury or death and damage to equipment.

REGULATORY INFORMATION



This product has been certified to meet the following requirements:

- UL / ANSI standards 61010-1, Second Edition, Dated July 12, 2004 with revisions through and including October 28, 2008
- CAN/CSA-C22.2 No. 61010-1, second edition, including Amendment 1, or a later version of the same standard incorporating the same level of testing requirements.
- Council Directive 2006/95/EC (December 12, 2006) on Low Voltage Equipment Safety; IEC 61010-1:2001 (Second Edition) and EN 61010-1:2001 (Second Edition)
- Council Directive 1999/05/EC - European Union (EU) Radio & Telecommunications Terminal Equipment Directive (R&TTE) ETSI EN 300 220-2, Issued:2006/04/01 and ETSI EN 301 489-3, Issued:2002/08/01 V1.4.1
- Council Directive [2004/108/EC](#) (December 15, 2004) on Electromagnetic Compatibility CENELEC EN 61326-1 Issued:2006/05/01; IEC 61326-1:2005;:1997 –
- AS/NZS 4268: 2008

Class B Device Statement / FCC Regulations:

Section 15.105(a) of the FCC Rules: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Section 15.19 of the FCC Rules: This device complies with part 15 of the FCC Rules. Operation is subject to the 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.

Pursuant to Part 15.21 of the FCC Rules, any changes or modifications to this product not expressly approved by Packet Power LLC might cause harmful interference and void the FCC authorization to operate this product.

Pursuant to part 2.1091c of the FCC rules device is categorically excluded from routine RF Exposure regulations.

Industry Canada (IC) Compliance Statement

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) This device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Per section RSS-102, 2.5 of Industry Canada regulations, this device is categorically excluded from Routine Evaluation Limits.

Industrie Canada (IC) Déclaration de conformité

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement. Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isopente rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Safety summary and specifications

This manual is intended for use by personnel responsible for installing or removing the Smart Power Cables. Packet Power LLC assumes no liability for user's failure to comply with these safety guidelines. Please read this manual carefully before proceeding.



This symbol is used throughout this manual to indicate critical safety information. Failure to observe the information following this symbol may result in injury or death.

- ☐ ⚠ Smart Power Cables should only be connected to the type of power source indicated on the label.
- ☐ ⚠ Do not overload a Smart Power Cables as this can result in a risk of fire or electrical shock.
- ☐ Cables shall be connected according to their amperage ratings to a proper branch circuit protector.
- ☐ Cables must be connected to a terminal that is compatible with the connector on the cable and has the appropriate electrical rating.
- ☐ Cables must be connected to a grounded (earthed) outlet.
- ☐ Adhere to all local and national electrical codes and guidelines.
- ☐ Prior to installation, check to make sure the Smart Power Cable has not been damaged.
- ☐ Store in a clean, dry location.
- ☐ Intended for indoor use only. Do not install in a wet location.
- ☐ No field-serviceable parts. Do not attempt to disassemble the product as potentially severe electrical shock may result. Installation and maintenance must be performed by qualified personnel.
- ☐ ⚠ Failure to use the product in the specified manner may lead to injury or death and damage to equipment.

The "R" Model Smart Power Cables will support three-phase or single-phase power. Please note carefully the type of power your cable is designed to support as indicated on the cable's label. Use only with the indicated type of power.

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Chapter 1: Introduction

Smart Power Cable Overview

Service types

Smart Power Cables are power cables with embedded wireless power monitors that transmit real time power and energy usage data wirelessly to a central Gateway module. The Smart Power Cable is a monitoring-only device and it cannot disconnect, switch or otherwise interfere with the electrical current flowing through the cable and is inherently failsafe with a no risk of interrupting the circuit in the event of failure to the monitoring device. The monitoring mechanism is powered from the cable itself and consumes less than 0.6W of power.

The cables are provided in an “S” (single phase) and “R” (three phase and high current single phase) form. Panel-mounted “P” models (independent power monitors with no cable assembly) are covered in a separate manual.

The appropriate Smart Power Cable is selected based on the appropriate voltage, current and connector type shown in the chart below. Smart Power Cables are available in just about any connector type and are universally operational at 50/60 Hz.



Figure 2: “S” Cable



Figure 1: “R” Cable

S Model Cables		R Model Cables	
Voltage	Amperage	Voltage	Amperage
1Ø 120VAC	10 amps or under	1Ø 120VAC	50 amps
1Ø 120VAC	15 amps or under	1Ø 208 to 240VAC	50 amps
1Ø 200 to 240VAC	15 amps or under	1Ø 200 to 240VAC	60 amps
1Ø 200 to 240VAC	16 amps or under	1Ø 240VAC	63 amps
1Ø 120VAC	20 amps	3Ø Wye 120V/208V	20 amps
1Ø 200 to 240VAC	20 amps	3Ø Wye 120V/208V	30 amps
1Ø 200 to 240VAC	20 amps	3Ø Wye 120V/208V	50 amps
1Ø 120VAC	30 amps	3Ø Wye 120V/208V	60 amps
1Ø 208VAC	30 amps	3Ø Delta 120/208VAC	30 amps
1Ø 200 to 240VAC	32 amps	3Ø Delta 120/208VAC	60 amps
		3Ø Wye either 240/415VAC or 200/346VAC	16 amps
		3Ø Wye either 240/415VAC or 200/346VAC	32 amps

		3Ø Wye either 240/415VAC or 200/346VAC	63 amps
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⚠ Cables should only be connected to the type of power source indicated on the label. If you are unsure of the type of power supply, consult an electrician or the power company. Refer to the highlighted section on the label to confirm the current and voltage rating.



Communication

The Smart Power Cables incorporate Packet Power's advanced zero-configuration wireless mesh networking technology to transmit power measurement data. Data is sent across the wireless network to the Packet Power Ethernet Gateway which connects using a standard Ethernet port to the customer's wired network infrastructure.



Packet Power Monitoring Solution Overview

The overall Packet Power system consists of the following components:

Wireless Monitoring Nodes

- Wireless Power and Environmental Monitors including:
 - o **Smart Power Cables** that can record true power usage and monitor temperature readings in real time integrated in a cable format
 - o **Environmental Monitors** that record up to 12 temperature channels, humidity and differential pressure
 - o **Current Monitors** that record up to six channels of current
 - o **Power Monitors** that can record true power usage and monitor temperature readings in real time
- One or more of the Packet Power **Ethernet Gateways** that can gather data from hundreds of monitoring devices via a wireless mesh radio network. The Ethernet Gateways form the bridge between the wireless monitoring network and the facility's LAN.



Figure 3: Ethernet Gateway

Software

- Customers can choose either to use Packet Power's monitoring applications or connect the wireless monitoring system to an existing monitoring system:

- o Packet Power's **EMX** monitoring portal provides access to real-time information on power, energy and environmental usage along with data analysis and reporting tools that can be easily customized. The **Power Manager** product compliments the portal and adds tools specific to advanced data center monitoring. Packet Power's applications can be accessed from a cloud-based service or installed at a customer site.



Figure 4: The EMX portal provides detailed energy use reporting and energy and power usage data along with alarm capabilities.

- o Certain models of the Ethernet Gateway provide protocol conversion and management capabilities allowing applications that can accept data in the SNMP or Modbus TCP/IP protocols to access data from the wireless monitoring devices.

A Smart Power Cable communicates with other cables and a Gateway using Packet Power's wireless mesh network. As soon as a Smart Power Cable is plugged in, it automatically tries to join the wireless network. If you already have an operating Packet Power network within your facility, information from a newly installed Smart Power Cable will become available shortly after it is plugged in. If you do not yet have a Packet Power network operating within your facility, please refer to the gateway section of the manual for additional information regarding wireless gateway and software setup.

Communications

Information gathered by a power cable is transmitted via a Packet Power radio network operating at either 900 MHz or 2.4 GHz (the exact frequencies vary with region – please contact Packet Power for details). The network operates in a mesh topology. Each device in the network must be within range of at least one other device (either another monitoring node or the Gateway) in the network. The effective range of the radio in the Smart Power Cables varies depending on several factors, including the environment in which the product is used. Typically, each device has an effective range of 20 to 50 meters. The Smart

Power Cable will not transmit effectively if it is installed in an enclosure that entirely blocks radio signals such as fully enclosed metallic enclosures.

Every site where a Smart Power Cable is deployed must have installed at least one compatible Packet Power Gateway device and associated software to collect data and prepare it for transmission to approved monitoring and analysis applications. It is not necessary for all cables to communicate directly with the Gateway. As long as each cable can communicate with at least one other cable, and one cable can also communicate with the Gateway, information from all cables will reach the Gateway.

The rate at which power monitoring information is gathered from a cable depends primarily on the ratio of the number of cables to the number of gateways. As an example, at a ratio of 100 cables per Gateway, a Gateway should read from each cable every 5 to 15 seconds. The system will automatically reallocate network traffic across Gateways when new Gateways or devices are added.

Note: In the event of a loss of power to a power cable, energy consumption information (Wh) is retained in non-volatile memory and will be transmitted when power is restored.

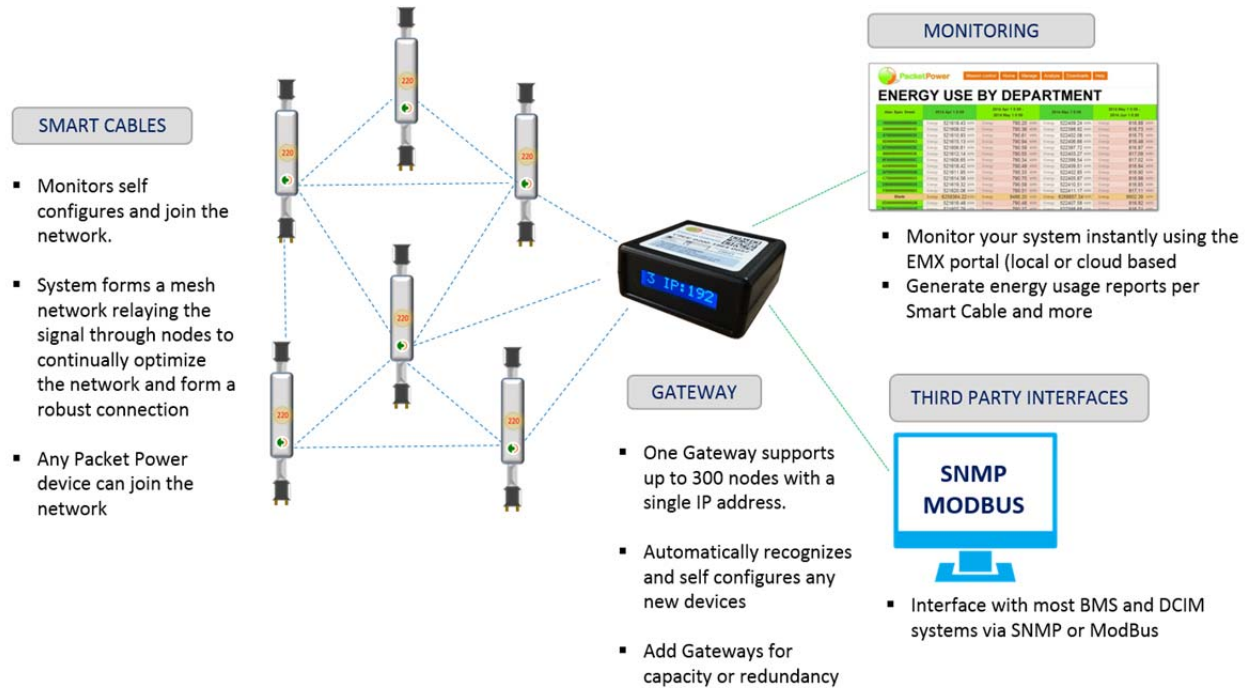
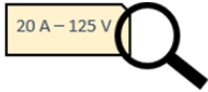
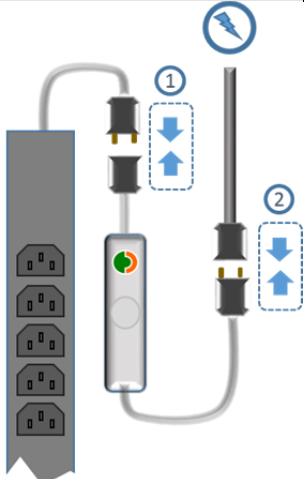
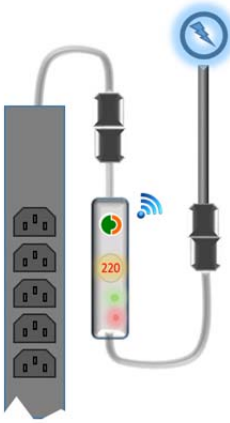


Figure 6: Packet Power Communications Architecture

Chapter 2: Installation

Installing the Cables

1	Confirm that the cable is correctly rated for the power and voltage.	
2	Make sure that any devices that may be interrupted by the process are safely powered down.	
3	While Smart Power Cables can be plugged into an energized source, It is recommended for that if possible, the power source energizing the Smart Power Cable be turn-off during installation.	
4	Remove any existing power cables	
5	Plug-in the supply-side (plug or “male”) connector of the Smart Power Cable into to the power source. (1) Connect the load side (receptacle or “female”) connector of the Smart Power Cable to the load device or power strip. (2)	
6	If the source power was disconnected, reconnect the source power.	

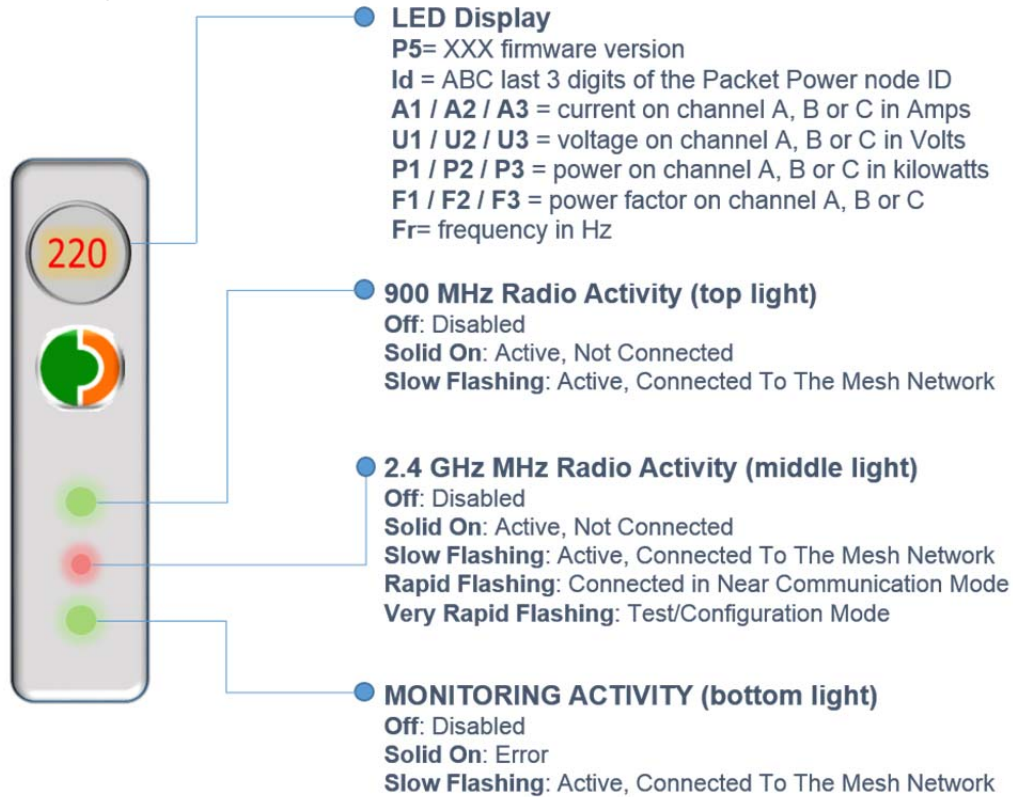
7	The cable should now be energized and the indicator lights and LED display will be active. The Smart Power Cable will immediately attempt to join the wireless network (if available) and transmit power data.	
8	Power up any devices.	

DISCLAIMER

Installation of Packet Power monitoring cables involves the disruption of power flow to your devices. Disconnecting power supply cables on running computing equipment and other electrical devices may lead to interruption of service, data loss, equipment damage and other potential losses. Packet Power is not responsible for any losses incurred due to power interruptions during the installation process. The customer is responsible for understanding and mitigating any consequences of interrupting and re-starting power flow to any equipment during the installation process. Installation should only be performed by personnel otherwise authorized to manage power connections to the equipment to be monitored. Dual-powered ("A & B") devices can in some cases be connected live, with one side (e.g. "A") being replaced first, followed by the other side (e.g. "B"). However, any time one of the power supplies is disconnected, the redundancy of a dual power supply and all of the protections it provides against failure are compromised. You are responsible for completely understanding this risk and taking responsibility for any consequences of a power loss while connecting power cables.

Smart Power Cable Indicator Lights and LED Display

All Smart Power Cables have three large alpha-numeric LEDs that provide for local display of monitoring data and three small lights adjacent to the LEDs that provide operating status information.



Installing the Wireless Ethernet Gateway

Each location in which Smart Power Cables are deployed must have one or more Packet Power Ethernet Gateway(s) to gather data from the Smart Power Cables.

The Ethernet Gateway version 3 is the central Gateway by which all Packet Power monitoring nodes (environmental and power) communicate. The following instructions are intended to provide a high level overview of how to commission a Gateway module. Refer to the support section of www.packetpower.com for additional support.

Gateway Placement

Gateway placement is critical. Gateway module(s) should be located 10-30 meters / 30-100 feet from one or more monitoring nodes (ideally line of site). The network is designed as a mesh network which means that the signal for distant nodes can be relayed through adjacent nodes until reaching

nodes in good radio proximity to the Gateway. Refer to the Gateway Placement manual on the support section of the website for additional details.

- Locate the gateway at a height above monitoring nodes when possible in a location with the best line of sight view of monitoring nodes.
- Do not locate inside metallic cabinets or directly on metal surfaces
- Use the Gateway mounting bracket for optimal placement and signal strength.
- Redundant Gateways are advised for any critical environment; additional Gateways should be placed in midway or in the opposite end of the device constellation when possible.

Gateway Types

There are various Gateway models. These include the standard Gateway designed to communicate exclusively with the Packet Power EMX portal, Modbus TCP/IP output versions (enterprise and solo), and SNMP output versions (solo and enterprise). All Gateway versions can communicate with the EMX portal simultaneously (i.e. a Modbus version can provide ModBus TCP/IP output as well as communicate with the EMX portal simultaneously).

Gateway Node Capacity

One Gateway can support up to 300 nodes (node count will affect polling time). The network is self-configuring and will auto recognize new nodes added. Multiple Gateways can be used within a network for capacity or redundancy and will automatically load balance the nodes.

Updates

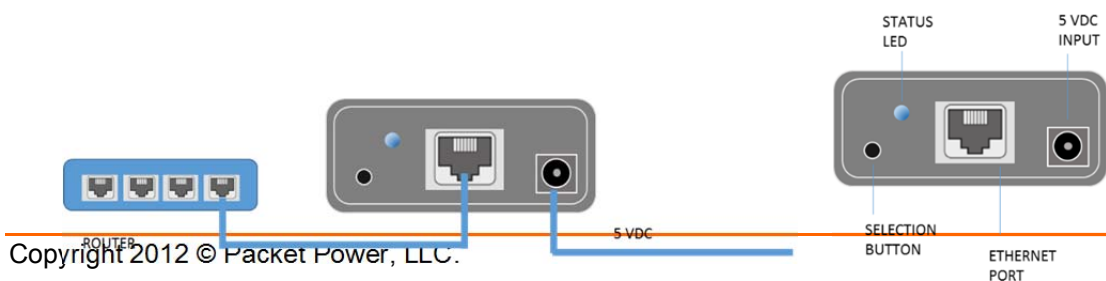
The Gateway and Smart Cable firmware is capable of being remotely updated over the network. Consult the support section of the website for additional details.

Security

The Packet Power network is designed to be the most secure monitoring system available with many inherent security features exclusive to the architecture that limit any possibility of penetration through the wireless nodes onto the host network. Additionally the Gateway can be equipped with 128 bit encryption. Refer to www.packetpower.com for additional explanations on security architecture.

Ethernet Gateway Setup

- Connect the Gateway to a router (using a standard network cable) with network access using the Ethernet port on the back of the Gateway.
- Connect the power supply provided or any 5 VDC source to the DC input of the Gateway. The Gateway can be powered using PoE (Power over Ethernet) using a splitter and 5VDC PoE source.



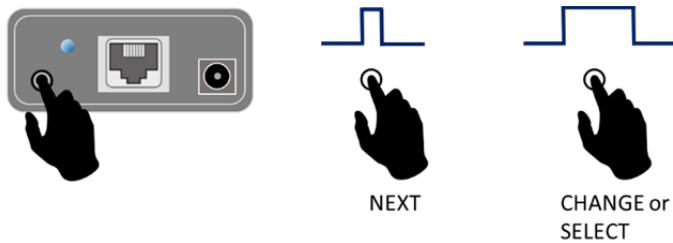
- Once energized the Gateway will indicate it's firmware version, then device ID number (also found on the top label of the Gateway) followed the IP address (may be blank if operating DHCP mode); note that the IP address may take up to two minutes to display.

POWER UP DISPLAY SEQUENCE



Menu Access and Navigation

To access the menu for the Gateway, press and hold the selector button on the back of the device for three seconds. To navigate the menu, use short clicks of the selection button; to change a setting or advance into a menu item press and hold the button. The menu tree is shown in the table below.



Gateway Menu Tree

- **SET IP ADDRESS**
 - ↳ DHCP [ON]
 - ↳ DHCP [OFF]
 - ↳ IP
 - ↳ NETMASK
 - ↳ GATEWAY
 - ↳ DNS
 - ↳ REBOOT
 - ↳ EXIT - HOLD BUTTON TO EXIT – WILL INDICATE DEVICE IS REBOOTING
- **UPDATE**
 - ↳ IP
 - ↳ NETMASK
 - ↳ GATEWAY
 - ↳ TFTP
 - ↳ DOWNLOAD
- **RESTORE FACTORY SETTINGS**
- **TEST PIN**
- **RESET**

Setting an IP Address

To configure the IP address of the Gateway, enter the setup menu by pressing and holding the “selection button” for three seconds.

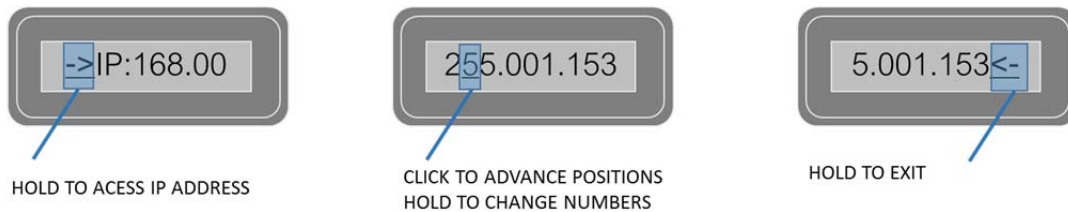
Use short clicks of the button to advance through the menu until the [-> Set IP] option appears. Click and hold [-> Set IP].

The LCD will show **DHCP:On** -or- **DHCP:Off**. Click and hold the button to toggle between DHCP on and off.

To set a static IP address click and hold **DHCP:Off**. The display will then show **CP: Off** <-.

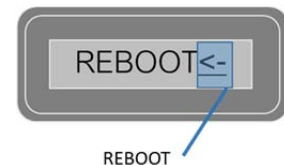
Click and hold the button and the IP address will appear. Use short clicks to scroll through specific digits of the IP address. Click and hold the button to change the underlined number of the IP address.

Once the correct IP address is entered you can exit the IP address console by advancing to the end of the screen and holding the selector button when the back arrow character <- is highlighted.



To properly configure the IP address, the Gateway, Netmask and DNS server address must also be entered. To change these parameters use the same menu navigation style as described above.

After the DNS Server address is set you will need to reboot to have implement your changes. Do this by pressing HOLD when “Reboot” is displayed. “Booting” will show on the display while the unit reboots and implements your changes.



To leave the configuration menu without having changes take effect, click and HOLD the “Exit”.

You can find additional information, including details on the SNMP MIB and Modbus register map, at www.packetpower.com/support.

Please see www.packetpower.com/support for detailed information on SNMP and Modbus connectivity. Contact support@packetpower.com for additional assistance.

The Ethernet Gateway Console

In about the technical status of an Ethernet Gateway is accessible from the Gateway Console. This can be accessed by entering the Gateway’s IP address in any web browser.

Note: the MAC address of the Gateway will be the last 12 digits of the 16-digit ID number indicated on the Gateway's label.

The information available from the Console includes:

- Information on the status of the device, including its name and IP address and whether it is set to communicate to the Packet Power cloud service or transmit data in SNMP format locally.
- Data on which monitoring devices the Gateway is communicating with and the amount of time that has elapsed since it last communicated with each device.
- Configuration options for the Gateway and information used by Packet Power technical support to help in problem determination.

Detailed information on the Ethernet Gateway, including initial configuration instructions, can be found at www.packetpower.com/support. Please contact support@packetpower.com with any questions and include a snapshot of the information listed under the debug tab when requesting technical support.

Chapter 3: Technical Specifications

Communications

Operating frequency	From 860, 930MHz and 2.4 GHz. Specific frequency used varies by region.
Wireless protocol	Proprietary frequency hopping, self-configuring, load-balancing mesh network
Wired network protocol	TCP/IP (one IP address needed per Gateway), support for Modbus TCP/IP and SNMP protocols
Firmware updates	Wireless
Typical transmission range	10 to 50 meters indoors from any one device to any other
Antenna	Fully enclosed, fixed configuration
Cable to Gateway ratio	Up to 300 cables per gateway (unlimited Gateways per system)
Multi-site support	Yes
Encryption	Optional 128-bit

Environmental

Operating temperature	-7° to +45°C (+20° to +113°F)
Operating humidity	5% to 95% non-condensing
Water and dust resistance	Indoor applications
Max. operating altitude	3,300 meters (10,000 feet)
Power usage	Smart power cable: 0.6W Ethernet Gateway: 0.7W

Outputs

LED status indicators	Power (Red / Orange), Status (Red/Orange), Communications (Green)
Local display	3 Digit LED (cycles Amps, Volts, Watts by phase); user definable
Monitored points	Voltage (V), Current (A), Power (W), Energy (Wh), Apparent Power (VA), Power Factor (PF), Frequency (Hz), Internal Temperature; all measurements +/- 1%, Temperature (+/-2°C)

Outputs

LED status indicators	Power (Red / Orange), Status (Red/Orange), Communications (Green)
Local display	3 Digit LED (cycles Amps, Volts, Watts by phase); user definable
Monitored points	Voltage (V), Current (A), Power (W), Energy (Wh), Apparent Power (VA), Power Factor (PF), Frequency (Hz), Internal Temperature; all measurements +/- 1%, Temperature (+/-2°C)

Size and Weight

S Models under 16A	150 cm (60 in), 0.45kg (1 lbs)
S Models 16A and above	120 cm (48 in), 0.75 – 1.0kg (1.5 to 2 lbs)
R Models	Approximately 120 cm (48 in), 1.5 to 3 kg (3.5 to 7 lbs)
P Models	Varies – see product manual
Enclosure material	High-impact resistant Lexan, V0 flammability rating
Power cords	Each cord carries standard industry markings that describe its intended operating environment and power type

Models

Model	Voltage (V)	Amperage (A)	Type
S and R	120, 208-240	10, 15, 16, 20, 30, 32	Single phase
	120 / 208, 240 / 415	16, 20, 30, 32, 50, 63, 100	Three-phase L-L and L-N
Wireless PDU	120, 208, 120 / 208	20,30, 60	Single phase, Three-phase L-L and L-N

Connector Types

Model	NEMA	IEC	Other
S (all single phase)	5-15 / L5-15 5-20 / L5-20 L5-30 6-15 / L6-15 6-20 / L6-20/L6-30	60320 C13 / C14 60320 C19 / C20	Schuko CEE7-7, AS/NZA 3112 2000, BS 1363A (UK), BS 546A (India, S Africa), Whip, others on request
R – single phase		60309 2P+E 6h	CS6361/6360, CS8264/8265 360_6W, 3720/3913, 3750/3933, 3720U-1/ 3913U-1, 3720U-2/3913U-2, 9_23U2, 9_23U0, 9_33U0, 9_53U2, 9_63U2
R – 3-phase Wye	L21-20, L21-30	60309 3P+N+E 6h	516_6W, 532_6W, 530_6W, 560_6W, 563_6W
R – 3-phase Delta			420_9W, 430_9W, 460_9W, 9_54U2, IBM D/3760, 3934, CS8365/8364, 7428, and others on request