



Installation and Operation Manual

PVG-1/2/3/4

PVG-C/-D1-D2

Rapid Shutdown Device



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COMPANY PROFILE

Northern Electric & Power Inc. (NEP) was founded in the United States and has manufacturing and R&D facilities in China. The mission of the company is to develop cutting-edge clean energy technologies and provide state-of-the-art solar inverter products to its customers. The first round of investment to the company was US\$20 Million, with a planned total investment of US\$50 Million. The company is headquartered in the city of Tsingtao, a major industrial center and trading port in the northeastern China. The company campus occupies more than 18 acres in the Tsingtao Export Processing Zone, and has more than 650,000 square feet building space. The campus is planned to be connected through a micro smart grid demo community and powered by electricity from solar, wind and micro turbines. Outside China, the company has operation offices in Chicago, U.S. and Vancouver, Canada.

The technology founders of the company are well-known experts in the fields of power electronics, automatic control, signal processing, and communications. Each of the founders has multiple U.S. and world patents in their specialty areas. They received Ph.D. degrees from top universities in North America, and each has more than 10 years engineering and management experiences in leading U.S. companies.

NEP has a complete product line of grid-tied solar inverters, including 180W~500W micro inverters, 1.5kW~5kW single phase solar inverters, and 10kW~500kW three-phase solar inverters. Field deployment results demonstrated high system efficiency and reliability of NEP solar inverters.

NEP is committed to develop Clean, Reliable, Affordable and Efficient (CARE) products for worldwide customers.

1. INTRODUCTION

1.1 Prefix

Dear customer, thank you for choosing the PVG rapid shutdown devices. We hope you will find our products meet your need for renewable energy. Meantime, we appreciate your feedback regarding our products.

1.2 Standards Compliance

PVG rapid shutdown devices comply with the NEC 2014 and NEC 2017 article 690.12, and CEC 2015 section 64-218.

1.3 How to Use This Manual

This manual provides detailed product information and installation instructions for the PVG rapid shutdown devices (RSD). Please read through this manual before installation and operation.



WARNING: This indicates a situation where failure to follow instructions may be a safety hazard or cause equipment malfunction. Use extreme caution and follow instructions carefully.

1.4 Label

The label is located on the side of the inverter. The information on the label includes technical data as well as type, firmware version and serial number of the device. Safety instructions on the label are listed and explained below:

| | |
|---|---|
|  | Danger! The term "danger" describes an issue which, if ignored, can cause personal injury. |
|  | Attention! With the term "attention" a circumstance is listed which may cause property damage if disregarded. |
|  | Instructions for use! Under "Instructions for Use", it is pointed out that installation and operating instructions are to be read and understood before installation or repair. |
|  | Caution, hot surface! Under "Caution, hot surface", it should be noted that surfaces of equipment may be hot and create a burn hazard. |
|  | Special disposal instructions! With "Note Separate Disposal", it is pointed out that this product may not be disposed of with normal garbage. An improperly conducted disposal can lead to damage to the environment. |
|  | CE mark The product complies with essential requirements of relevant directives of EU |

2. SAFETY INSTRUCTION



WARNING:

PLEASE READ THIS MANUAL BEFORE INSTALLATION. ANY DAMAGE TO THE PRODUCT DUE TO NOT FOLLOWING THIS MANUAL IS NOT COVERED BY THE WARRANTY.

ALL THE INSTALLATION SHOULD BE DONE BY CERTIFIED ELECTRICIAN.

BESIDES THE CABLE CONNECTORS, NOTHING INSIDE THE PRODUCT SHOULD BE MODIFIED.

ALL INSTALLATION SHOULD FOLLOW THE LOCAL ELECTRIC CODES.



WARNING:

WHEN THE PHOTOVOLTAIC ARRAY IS EXPOSED TO LIGHT, IT SUPPLIES A DC VOLTAGE TO THE PVG RSD.



WARNING:

THIS PHOTOVOLTAIC RAPID SHUTDOWN EQUIPMENT (PVRSE) DOES NOT PERFORM ALL OF THE FUNCTIONS OF A COMPLETE PHOTOVOLTAIC RAPID SHUTDOWN SYSTEM (PVRSS). THIS PVRSE MUST BE INSTALLED WITH OTHER EQUIPMENT TO FORM A COMPLETE PVRSS THAT MEETS THE REQUIREMENTS OF NEC NFPA 70) SECTION 690.12 FOR CONTROLLED CONDUCTORS OUTSIDE THE ARRAY. OTHER EQUIPMENT INSTALLED IN OR ON THIS PV SYSTEM MAY ADVERSELY AFFECT THE OPERATION OF THE PVRSS. IT IS THE RESPONSIBILITY OF THE INSTALLER TO ENSURE THAT THE COMPLETED PV SYSTEM MEETS THE RAPID SHUTDOWN FUNCTIONAL REQUIREMENTS. THIS EQUIPMENT MUST BE INSTALLED ACCORDING TO THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.

3. FCC COMPLIANCE

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 in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the party responsible for compliance may void the user's authority to operate the equipment.

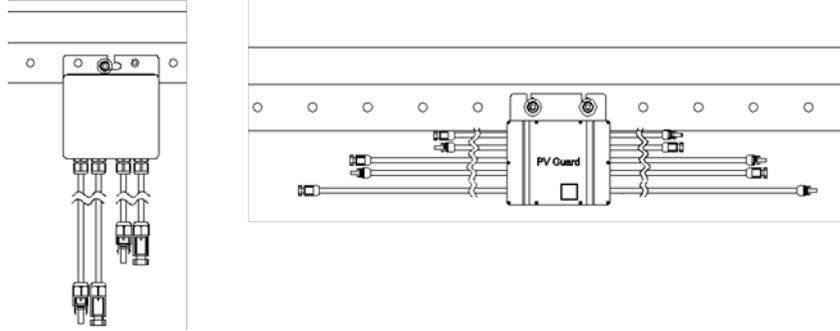
4. INSTALLATION



WARNING: PVG IS A DEVICE WITH MEMORY. IF THE LAST STATE OF A PVG IS UNKNOWN, PLEASE TEST AND CONFIRM IT IS AT OFF STATE BEFORE WIRING. ON-STATE PVGS MAY RESULT IN HIGH VOLTAGE ON THE PV STRINGS. BE AWARE THAT INSTALLATION OF THIS EQUIPMENT INCLUDES RISK OF ELECTRIC SHOCK.

4.1 Attach PVGs to the Racking

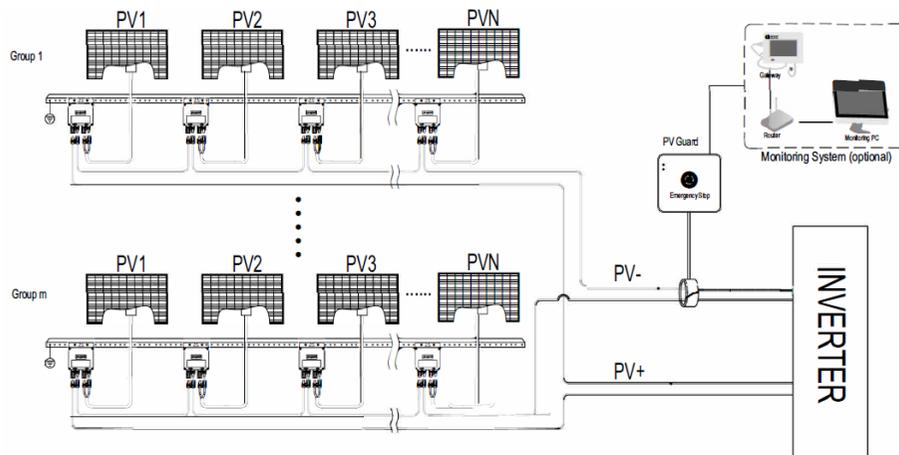
Mount PVGs on the racking use hardware recommended by module racking vendor. Recommend bolt size of 1/4" and torque no more than 76 in lbs



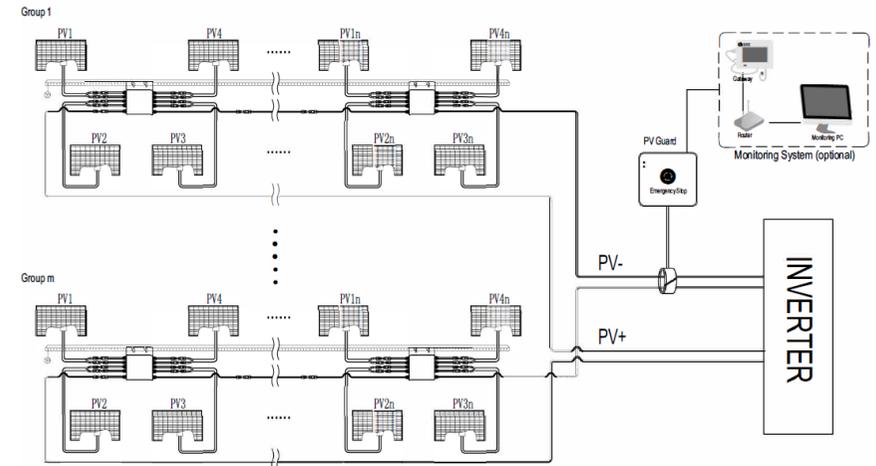
If the PVG is mounted at the back of a PV panel, installer shall follow PV module installation instructions. The minimum distance between any portion of PVG to the back of the PV panel shall be at least 0.5 in.

4.2 PVG System Diagram

4.2.1 PVG-1 System Diagram



4.2.2 PVG-4 System Diagram



Port PV-1 must be connected to a PV panel to power the PVG. Cables (PV+ and PV-) of an unused PV port shall be connected.

* Refer to "NEP RSD WIRING" for more details

5. OPERATING INSTRUCTIONS

WARNING: PVG RAPID SHUTDOWN SYSTEM SHALL BE CHECKED AFTER INSTALLATION. **TEST SHALL BE DONE AT DAYTIME AND WITH ALL INVERTERS HAVE STOPPED GENERATING POWER.** BY MANULLAY PUSHING DOWN THE EMERGENCY BUTTON OR DISCONNECTING AC POWER SUPPLY OF PVG CONTROLLER, THE DC VOLTAGE ACROSS ANY PV CONDUCTORS AND BETWEEN ANY PV CONDUCTORS AND GROUND SHALL DRO PTO LESS THAN 30 VDC WITHIN 30 SECONDS. INSIDE THE CONTROLLED ZONE, THE DC VOLTAGE ACROSS ANY PV CONDUCTORS AND BETWEEN ANY PV CONDUCTORS AND GROUND SHALL DROP TO LESS THAN 80 VDC WITHIN 30 SECONDS.

WARNING: PVG RAPID SHUTDOWN SYSTEM SHALL BE CHECKED REGULARLY TO MAKE SURE IT FUNCTIONS PROPERLY. **TEST SHALL BE DONE AT DAYTIME AND WITH ALL INVERTERS HAVE STOPPED GENERATING POWER.** BY MANULLAY PUSHING DOWN THE EMERGENCY BUTTON OR DISCONNECTING AC POWER SUPPLY OF PVG CONTROLLER, THE DC VOLTAGE ACROSS ANY PV CONDUCTORS AND BETWEEN ANY PV CONDUCTORS AND GROUND SHALL DROP TO LESS THAN 30 VDC WITHIN 30 SECONDS. INSIDE THE CONTROLLED ZONE, THE DC VOLTAGE ACROSS ANY PV CONDUCTORS AND BETWEEN ANY PV CONDUCTORS AND GROUND SHALL DROP TO LESS THAN 80 VDC WITHIN 30 SECONDS.

WARNING: RAPID SHUTDOWN SHALL ONLY BE INITIATED AFTER INVERTERS HAVE STOPPED GENERATING POWER, THROUGH DISCONNECTING MAIN AC SWITCH OR INVERTER AC SWITCH.

PVGS are powered by the output of PV panels. Thus rapid shutdown is operable during daytime when the PV panel is energized. Rapid shutdown can be activated by one of the following two operations only after inverters have stopped generating power:

- Option-1 Disconnect AC power supply
- Option-2 (OPTION) Press the E-STOP button attached to the PVG controller

To re-connect the PV panels, a re-connection command can be sent to each PVG by the following steps:

- Option-1: Reconnect AC power supply
- Option-2: (OPTION) Release the E-Stop button attached to the PVG controller

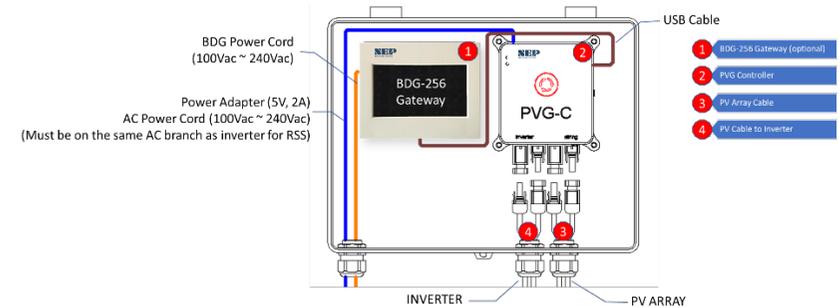
This operation can only be done at day time since the PVG is powered by PV panels.

6. PV PANEL MONITORING USING BDG 256

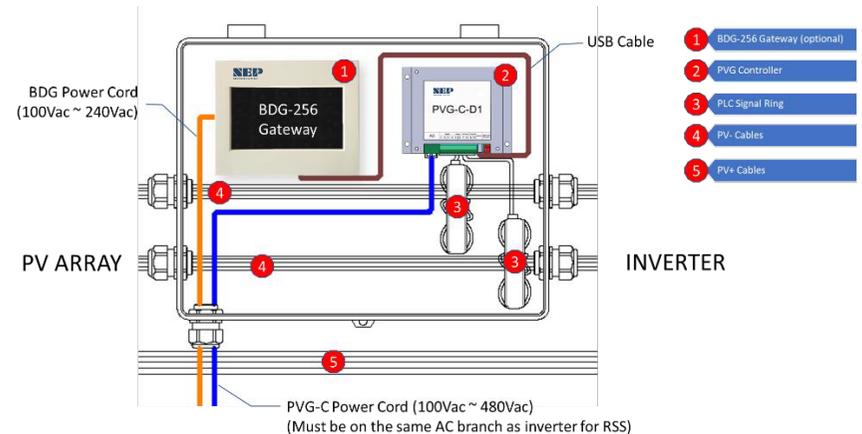
(OPTIONAL)

Using BDG-256 gateway, DC current, voltage, power, daily energy, and temperature of each PV panel can be monitored using MICROVIEWER locally, or NEPVIEWER remotely. BDG-256 usage should refer to the BDG256 gateway manual.

Connection of BDG-256 and PVG-C



Connection of BDG-256 and PVG-C-D1



7. SPECIFICATION

| PVG-n (n=1/2/3/4) | | PV Guard |
|-------------------|-----------------------------------|--|
| INPUT (DC) | Max DC Open Circuit Voltage (Vdc) | 90Vdc per input |
| | Max DC Input Current (Adc) | 15 |
| OUTPUT(DC) | Maximum Output Current (Adc) | 15 |
| | Maximum Output Voltage (Vdc) | 0 ~ Voc(*n) |
| SYSTEM | PV Cable | 12 AWG |
| | Maximum System Voltage (Vdc) | 1000/1500 |
| | Communications | DC Power Line |
| PROTECTION | Protection Degree | NEMA-6 |
| | Ambient Temperature | -40C——+85C |
| | Product Safety Compliance | UL 1741 |
| | | CSA C22.2 No. 107.1 NEC 2014/2017 690.12 Canada CEC 2015 64218 |

| PVG-C-D1 | | PV Guard Remote Controller |
|------------|------------------------------|---|
| INPUT (AC) | AC Input | 100~480Vac, 0.2Aac |
| SYSTEM | Maximum System Voltage (Vdc) | 1000/1500 |
| | Communications | DC Power Line |
| PROTECTION | Protection Degree | NEMA-1 |
| | Ambient Temperature | -20C——+85C |
| | Product Safety Compliance | UL 1741 |
| | | CSA C22.2 No. 107.1 NEC 2014/2017 690.12 Canada CEC 2015 64-218 |
| CONTROL | Optional Controls | On-Grid / Off-Grid Primary / Secondary 5Vdc output for relay |
| MONITORING | Optional Monitoring | Panel-by-Panel with BDG-256 |

| PVG-C | | PV Guard Remote Controller |
|------------|------------------------------|--|
| INPUT (DC) | DC Input | 5V, 2Adc |
| SYSTEM | Maximum System Voltage (Vdc) | 1000/1500 |
| | Communications | DC Power Line |
| PROTECTION | Protection Degree | NEMA-1 |
| | Ambient Temperature | -20C——+85C |
| | Product Safety Compliance | UL 1741 |
| | | CSA C22.2 No. 107.1 NEC 2014/2017 690.12 Canada CEC 2015 64218 |
| CONTROL | Optional Controls | On-Grid / Off-Grid Primary / Secondary 5Vdc output for relay |
| MONITORING | Optional Monitoring | Panel-by-Panel with BDG-256 |

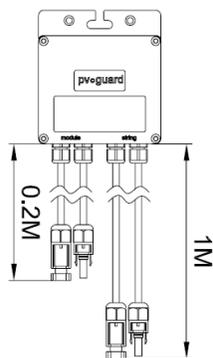
| PVG-C-D2 | | PV Guard Remote Controller |
|------------|------------------------------|---|
| INPUT (DC) | DC Input | 12Vdc, 1Adc |
| SYSTEM | Maximum System Voltage (Vdc) | 1000/1500 |
| | Communications | DC Power Line |
| PROTECTION | Protection Degree | NEMA-1 |
| | Ambient Temperature | -20C——+85C |
| | Product Safety Compliance | UL 1741 |
| | | CSA C22.2 No. 107.1 NEC 2014/2017 690.12 Canada CEC 2015 64-218 |
| MONITORING | Optional Monitoring | Panel-by-Panel with BDG-256 |

8.MODELS AND MARKING

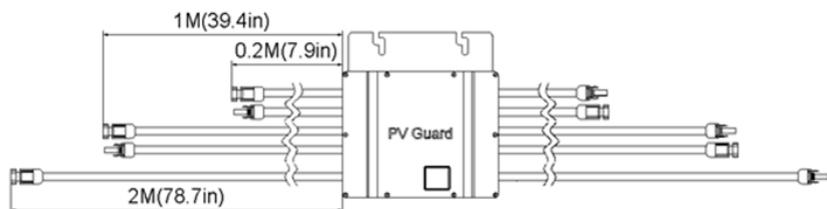
8.1 PV Connector Options

| xy | Manufacturer | Male Connector | Female Connector |
|----|------------------------------------|----------------|------------------|
| A1 | Stäubli Electrical Connectors (MC) | PV-KST 4/6X-UR | PV-KBT4/6X-UR |
| B1 | QC Connectors | QC4.10 | QC4.10 |
| C1 | Xietong Connectors | PV-XT101.1 | PV-XT101.1 |
| D1 | Amphenol | Helios H4 | Helios H4 |

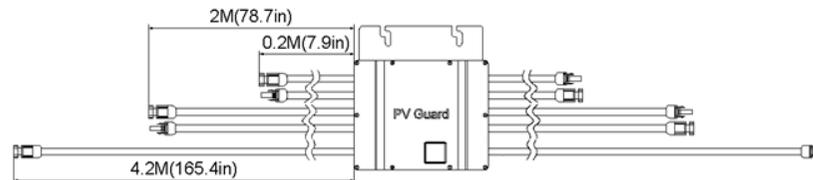
8.2 PVG-1-xy



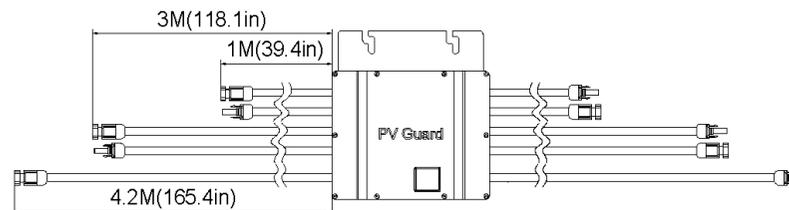
8.3 PVG-4-P-xy



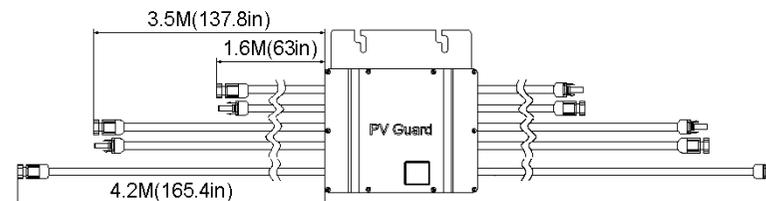
8.4 PVG-4-L-xy



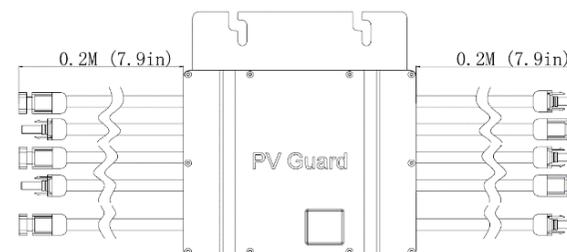
8.5 PVG-4-LR-xy



8.6 PVG-4-H-xy



8.7 PVG-4-B-xy

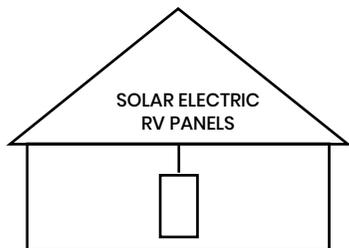


9. SYSTEM MARK

The following label shall be permanently placed close to the PVG-C remote controller.

**SOLAR PV SYSTEM EQUIPPED
WITH RAPID SHUTDOWN**

**PUSH RAPID SHUTDOWN
BUTTON TO SHUT
DOWN PV SYSTEM
AND REDUCE
SHOCK HAZARD
IN THE ARRAY**



10. WARRANTY AND PRODUCTION INFORMATION

What does this warranty cover and how long does it last?

This Limited Warranty is provided by Northern Electric & Power Co. Ltd (NEP) and covers defects in workmanship and materials in your PVG and PVG-C. This Warranty

Period lasts for 10 years from the date of purchase at the authorized point of sale to you, the original end user customer, unless otherwise agreed in writing. You will be required to demonstrate proof of purchase to make warranty claims.

This Limited Warranty is transferable to subsequent owners but only for the unexpired portion of the Warranty Period. Subsequent owners also require original proof of purchase as described in "What proof of purchase is required?"

What will NEP do?

During the Warranty Period, NEP will, at its option, repair the product (if economically feasible) or replace the defective product free of charge, provided that you notify NEP of the product defect within the Warranty Period, and provided that NEP through inspection establishes the existence of such a defect and that it is covered by this Limited Warranty.

NEP will, at its option, use new and/or reconditioned parts in performing warranty repair and building replacement products. NEP reserves the right to use parts or products of original or improved design in the repair or replacement. NEP repairs or replaces a product, its warranty continues for the remaining portion of the original Warranty Period or 90 days from the date of the return shipment to the customer, whichever is greater. All replaced products and all parts removed from repaired products become the property of NEP.

How do you get service?

If your product requires troubleshooting or warranty service, contact your merchant. If you are unable to contact your merchant, or the merchant is unable to provide service, contact NEP directly at:

Northern Electric & Power Inc
Email: support@northernep.com

What does this warranty not cover?

Claims are limited to repair and replacement or if in NEP's discretion that is not possible, reimbursement up to the purchase price paid for the product. NEP will be liable to you only for direct damages suffered by you and only up to a maximum amount equal to the purchase price of the product.

This Limited Warranty does not warrant uninterrupted or error-free operation of the product or cover normal wear and tear of the product or costs related to the removal, installation, or troubleshooting of the customer's electrical systems. This warranty does not apply to and NEP will not be responsible for any defect in or damage to: a) the product if it has been misused, neglected, improperly installed, physically damaged or altered, either internally or externally, or damaged from improper use or use in an unsuitable environment; b) the product if it has been subjected to fire, water, generalized corrosion, biological infestations, or input voltage that creates operating conditions beyond the maximum or minimum limits listed in the NEP product specifications including high input voltage from generators and

lightning strikes; c) the product if repairs have been done to it other than by NEP or its authorized service centers (hereafter "ASCs"); d) the product if it is used as a component part of a product expressly warranted by another manufacturer; e) the product if its original identification (trade-mark, serial number) markings have been defaced, altered, or removed; f) the product if it is located outside of the country where it was purchased; and g) any consequential losses that are attributable to the product losing power whether by product malfunction, installation error or misuse.

Disclaimer Product

THIS LIMITED WARRANTY IS THE SOLE AND

EXCLUSIVE WARRANTY PROVIDED BY NEP IN CONNECTION WITH YOUR NEP PRODUCT AND IS, WHERE PERMITTED BY LAW, IN LIEU OF ALL OTHER WARRANTIES, CONDITIONS, GUARANTEES, REPRESENTATIONS, OBLIGATIONS AND LIABILITIES, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE IN CONNECTION WITH THE PRODUCT, HOWEVER ARISING (WHETHER BY CONTRACT, TORT, NEGLIGENCE, PRINCIPLES OF MANUFACTURER'S LIABILITY, OPERATION OF LAW, CONDUCT, STATEMENT OR OTHERWISE), INCLUDING WITHOUT RESTRICTION ANY IMPLIED WARRANTY OR CONDITION OF QUALITY, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE TO THE EXTENT REQUIRED UNDER APPLICABLE LAW TO APPLY TO THE PRODUCT SHALL BE LIMITED IN DURATION TO THE PERIOD STIPULATED UNDER THIS LIMITED WARRANTY.

IN NO EVENT WILL NEP BE LIABLE FOR: (a) ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS, LOST REVENUES, FAILURE TO REALIZE EXPECTED SAVINGS, OR OTHER COMMERCIAL OR ECONOMIC LOSSES OF ANY KIND, EVEN IF NEP HAS BEEN ADVISED, HAD REASON TO KNOW, OF THE POSSIBILITY OF SUCH DAMAGE, (b) ANY LIABILITY ARISING IN TORT,

WHETHER OR NOT ARISING OUT OF NEP'S NEGLIGENCE, AND ALL LOSSES OR DAMAGES TO ANY PROPERTY OR FOR ANY PERSONAL INJURY OR ECONOMIC LOSS OR DAMAGE CAUSED BY THE CONNECTION OF A PRODUCT TO ANY OTHER DEVICE OR SYSTEM, AND (c) ANY DAMAGE OR INJURY ARISING FROM OR AS A RESULT OF MISUSE OR ABUSE, OR THE INCORRECT INSTALLATION, INTEGRATION OR OPERATION OF THE PRODUCT.

IF YOU ARE A CONSUMER (RATHER THAN A PURCHASER OF THE PRODUCT IN THE COURSE OF A BUSINESS) AND PURCHASED THE PRODUCT IN A MEMBER STATE OF THE EUROPEAN UNION, THIS LIMITED WARRANTY SHALL BE SUBJECT TO YOUR STATUTORY RIGHTS AS A CONSUMER UNDER THE EUROPEAN UNION PRODUCT WARRANTY DIRECTIVE 1999/44/EC AND AS SUCH DIRECTIVE HAS BEEN IMPLEMENTED IN THE EUROPEAN UNION MEMBER STATE WHERE YOU PURCHASED THE PRODUCT. FURTHER, WHILE THIS LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, YOU MAY HAVE OTHER RIGHTS WHICH MAY VARY FROM EU MEMBERSTATE TO EU MEMBERSTATE OR, IF YOU DID NOT PURCHASE THE PRODUCT IN AN EU MEMBER STATE, IN THE COUNTRY YOU PURCHASED THE PRODUCT WHICH MAY VARY FROM COUNTRY TO COUNTRY AND JURISDICTION TO JURISDICTION.

Warranty Card

Customer Information

Name: _____

Address: _____

City: _____ State: _____ Zip Code: _____

Tel: _____ Fax: _____ E-mail: _____

System Information

Fault Product(s) Serial Numbers: _____

System Commissioning Date: _____ Product Models: _____

No. of Products Used: _____ Bill of Lading Date: _____

Fault Product(s) Quantities: _____ Fault Time/Date: _____

Fault Message(s) or Code(s): _____

Brief Fault Description and Photos: _____

Installation Information

Modules Used: _____

Modules Quantity: NEP Product quantity per string: _____

Installation Company Name: _____

Installer Name: _____

For the information on our warranty terms and conditions, please see our website: www.northernep.com/en
All fields must be completed in order to process claim.

Customer Signature: _____ Date: _____

*All rights reserved by NEP. This information is subject to changes without notice.



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