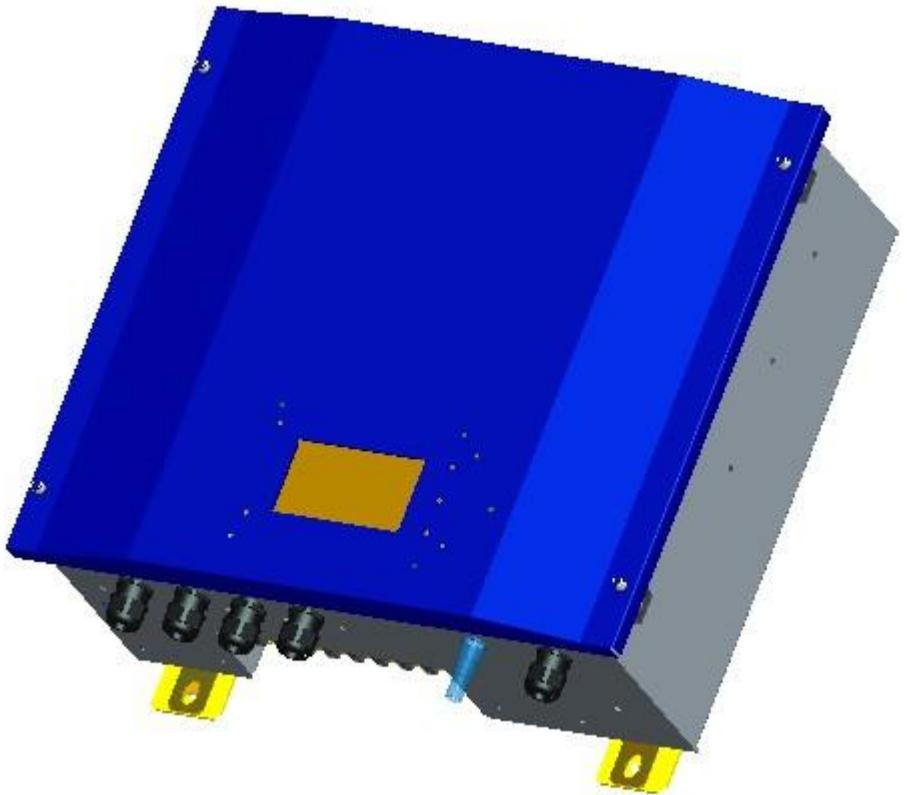




PV grid-connected inverter Digiwatts RN5000US Installation Guide



Copyright © Renovo Power Systems. All rights reserved.

Reproduction and storage in a retrieval system, or transmittal, even partially, of the contents of this manual is strictly forbidden without prior authorization of Renovo Power Systems. All such warranties are expressly disclaimed. Neither Renovo Power Systems nor its distributors or dealers shall be liable for any indirect, incidental, or consequential damages under any circumstance. (The exclusion of implied warranties may not apply in all cases under some statutes, and thus the above exclusion may not apply.)

Specifications are subject to change without prior notice. We make extensive effort to make this document is complete, accurate and receives timely updates. Readers are cautioned, however, the Renovo Power Systems reserves the right to make changes without notice and shall not be responsible for any damages, including indirect, incidental or consequential damages, caused by reliance on the material presented, including, but not limited to, omissions, typographical errors, arithmetical errors or listing errors in the content material.

Renovo Power Systems LLC
2723 South State Street
Suite 100
Ann Arbor, MI 48105
Tel: (855) RENOVO1 (736-6861)
Fax: 888-810-6454
<http://www.renovo-usa.com>

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual contains important instructions for Model RN5000US SOLAR INVERTERS. It must be accurately understood and followed during installation and maintenance of the inverter. The Digiwatts system is designed according to international safety standards, however with all electrical and electronic equipment, installation and operation must follow some preventive measures. To reduce the risk of electrical shock hazards and to ensure that equipment installation and commissioning is conducted safely; all instructions, cautions and warnings in this Installation Guide must be closely read and followed.

Warnings

A Warning describes a hazard to equipment or personnel. It calls attention to a procedure or practice, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the Renovo Power equipment and/or other equipment connected to the Renovo Power equipment or personal injury.



WARNING!

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION!

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.



NOTICE!

The paragraphs highlighted by this symbol contain processes and instructions that must be rigorously understood and followed to avoid potential damage to the equipment, negative results and to ensure the unit achieves optimal performance.

In addition to the safety and hazard symbols described on the previous pages, the following symbols are also used in this Installation Guide. Make sure to read the labels and fully understand them before installing the equipment.



INFORMATION

This symbol calls attention to supplementary information that you should know and to ensure optimal operation of the unit.

Markings on this product

The following symbols are used as markings on this product with the following meanings.



Warning regarding dangerous voltage

The product works with high voltages. All work on the product may only be done as described in the documentation.



Beware of hot surface

The product can generate heat during operation. Avoid coming into contact with the product during operation.



Observe the operating instructions

Read the product's documentation before working on it. Follow all safety precautions and instructions as described in the documentation.



Safety criterion

ETL is the standard applied by Electrical Testing Laboratories to the Digiwatts system to certify that it meets the requirements of the highest safety criterion of the USA and Canada.

General Warnings

All electrical installations must be done in accordance with the local and National Electrical Code ANSI/NFPA70. For installation in Canada the installations must be done in accordance with applicable Canadian standards.

The Digiwatts unit contains no user-serviceable parts. For all repair and maintenance always return the unit to an authorized Renovo Power Service Center.

Before installing or using the Digiwatts unit, read all of the instructions, cautions, and warnings on the Digiwatts unit, the PV array and in this Installation Guide.

PV arrays produce electrical energy when exposed to light and thus can create an electrical shock hazard. Wiring of the PV-arrays should only be performed by qualified personnel. According to these basic safety rules, qualified and trained people have skills for the assembling, start-up and operation of the product, as well as the necessary requirements and qualifications to perform such operations.

Table of Contents

1 Introduction.....	8
1.1 Validity	8
1.2 Target group.....	8
1.3 Product overview	9
1.4 Feature Overview	13
1.5 Safety.....	13
1.5.1 Protection and criterion	13
1.5.2 Safety instructions.....	16
1.5.3 Symbols on the Type Label.....	18
1.6 Installation Overview	19
2 Unpacking and Inspection.....	20
2.1 Scope of Delivery.....	22
3 AC Voltage Configuration	23
3.1 Opening the Digiwatts Unit.....	23
3.2 Locating Internal Components.....	24
3.3 Configuring the AC Voltage	25
4 Mounting.....	26
4.1 Choosing a Mounting Location	26
4.2 Dimensions and Required Clearances	28
4.3 Mounting Procedure	30
4.3.1 Mounting the Wall-Mounting Screw.....	30
4.3.2 Mounting the Digiwatts Unit to the Wall Bracket.....	31
5 Wiring the Digiwatts unit.....	32
5.1 Sequence of Connecting	35
5.2 Opening the Digiwatts	36
5.3 Wiring the AC Output.....	37
5.3.1 AC Connection Requirement.....	37
5.3.2 Connecting the AC Wires.....	38
5.4 Wiring the DC input.....	39

5.4.1 DC Connection Requirements	39
5.4.2 Connecting the DC Wires	43
5.5 Communication Wiring	43
5.6 Closing the Digiwatts unit	45
6 Commissioning	47
7 Displays and Messages	49
7.1 LED Operation Indicators	49
7.2 Status Messages on the LCD Display	50
7.3 Fault Messages on the LCD Display	52
7.4 Operating Modes	52
8 Troubleshooting	53
8.1 General	53
8.2 Error Messages	55
9 Technical Specifications	56
9.1 Digiwatts Wiring Diagrams	56
9.2 Specifications	56
9.3 Trip Limits / Trip Times	58
9.4 Torque Values and Wire Sizes	58

1 Introduction

1.1 Validity

This manual describes the assembly, installation, commissioning and troubleshooting of the following Renovo inverter: Digiwatts RN5000US.



Information

To help avoid problems during the installation, familiarize yourself with the installation process by reading the entire Installation Guide before starting the installation.



WARNING!

Lethal voltages are present at various points in a PV system. For safety reasons, it is recommended that only qualified personnel can install and operate this equipment.

Read and understand all the instructions contained in this manual and become familiar with the safety symbols in the relevant paragraphs before you install and commission the equipment.

1.2 Target group

This manual is for qualified electricians. The tasks described in this manual may be performed by electrically qualified persons only.

1.3 Product overview

● Basic information

The Digiwatts inverter is used to convert DC power generated by the PV arrays into stable AC power for output to the utility grid. The Digiwatts system is a transformerless inverter and performs this conversion in a very efficient way, without moving components, using only solid state power electronic devices. It is a crucial unit in the small-scale PV power system.

An example of basic PV power system components is shown in the Figure 1-1.

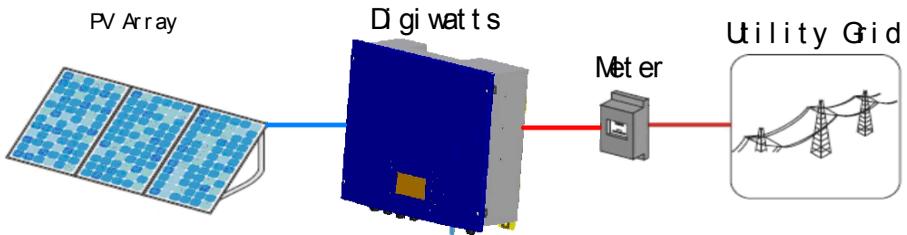


Figure 1-1: Digiwatts system is installed in a Utility Interactive PV System



Information

Policies vary from one utility company to another. Consult with a representative of the local utility company before designing and installing a PV system.



NOTICE!

Any other or additional use is not permitted except the intended use.

The inverter must only be connected to public utility grid. If output of inverter is connected to local loads (household appliance, lights, motor loads, etc.) the inverter will not start.

Electrical block diagram

Figure 1-2 shows the main circuit of Digiwatts transformerless grid-connected inverter system. A boost circuit raises input DC voltage within the inverter. Then a Maximum Power Point Tracker (MPPT) ensures that maximum power is extracted from the PV arrays. Afterwards, a full bridge inverter circuit converts DC power to AC power which is then output from the unit.

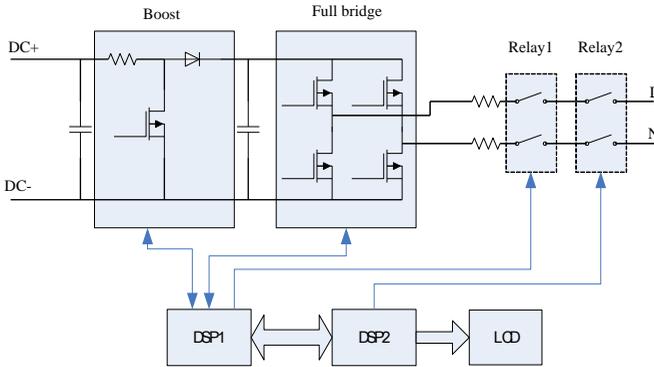


Figure 1-2 Electrical Block Diagram

Terminals of the Digiwatts system

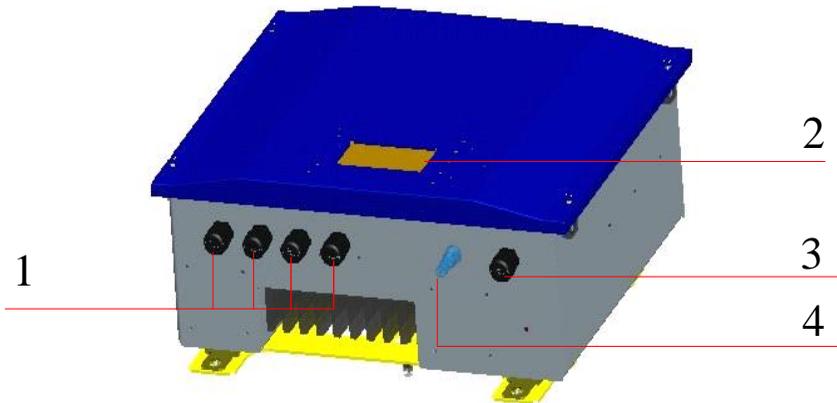


Figure 1-3 Product Description

Table 1-1 Terminals Description

Item	Name	Description
1	DC inputs	Two pairs of DC strain reliefs are the input ports
2	LCD display	Running data is displayed on the LCD screen
3	AC outputs	Output port strain relief of the Digiwatts unit
4	RS485 terminal	Standard communication interface

- **Dimensions and weight**

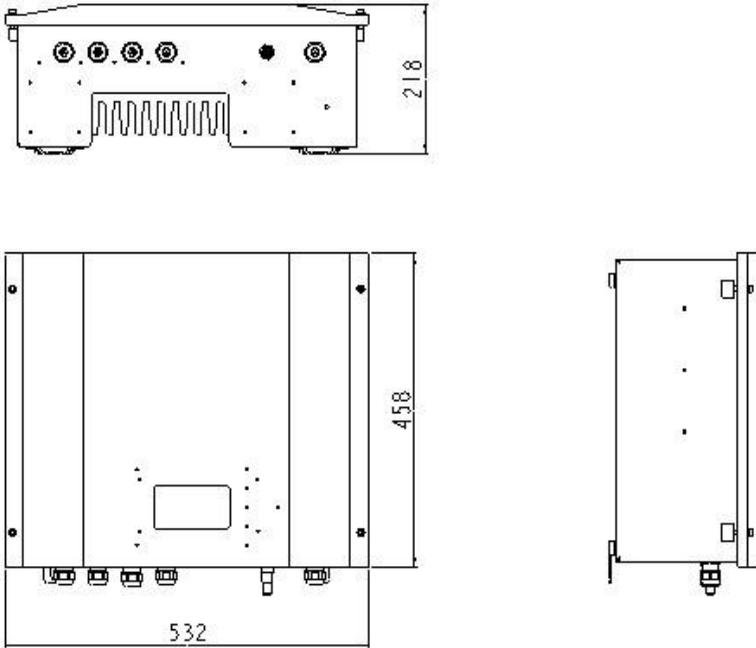


Figure 1-4 Dimensions of the Digiwatts unit

Table 1-2 Dimensions Value

Type	Depth (mm / inch)	Width (mm / inch)	Height (mm / inch)	Weight (kg / lb.)
RN5000US	218 / 8.6	532 / 20.9	458 / 18	27 / 59

1.4 Feature Overview

The Digiwatts system represents state-of-the-art technology. Several key features:

- High reliability and safety
- High efficiency
- Simple installation
- Quiet operation
- LCD Display
- Powder coated die-cast enclosure

Operating Temperature

The Digiwatts system has been equipped with a passive radiator used to maintain full power output at ambient temperatures as high as 45°C. The Digiwatts system will continue to operate well beyond 45°C and de-rates as needed to maintain a safe internal component temperature.



NOTICE!

Although the Digiwatts unit can be installed where temperatures reach up to +45°C, it is strongly recommend that it be installed where ambient temperature in the range of 0~+40°C.

1.5 Safety

1.5.1 Protection and criterion

Anti-Islanding Protection

Islanding is a condition that can occur if the utility grid is disconnected while the Digiwatts system is operating and the remaining load is resonant at 60 Hz and matches

the output of the Digiwatts perfectly. The Digiwatts system incorporates an advanced active islanding protection algorithm to ensure that the system will not export power into a balanced 60 Hz resonant load while the utility is disconnected. The Digiwatts system periodically injects both leading and lagging reactive current into the utility grid. This method has been proven by independent test labs to effectively destabilize and disconnect from a balanced island condition.

PV Insulation Fault Detection

Before the inverter connects to the grid, the Digiwatts system will detect the isolation of PV+ and PV- to the ground. When the insulate impedance is less than 1M Ω , the inverter will not function. After the inverter is connected to the grid, the system will detect the residual current. If a residual current greater than 30mA is detected, the Digiwatts system will shut down and display a fault condition on the LDC user interface display.

AC Overcurrent Protection

The system will detect the AC current real time. Should the AC current exceed 50 ampere, the Digiwatts system will shut down and display a fault condition on the LCD user interface display.

Surge Protection

Over-voltage protection though the use of surge protection devices (SPDs) or surge arresters should be provided when the PV power system is installed. The Digiwatts unit is not equipped with SPDs on either the PV input side or AC output side. Lightning can cause damage either from a direct strike or from surges due to a nearby strike. Induced surges are the more likely cause of lightning damage in the majority of installations, especially in rural areas where electricity supplies are usually by long overhead lines. Surges may be induced on both the PV array conductors and the AC cables leading to the building. The risk of a direct lightning strike into a building can be mitigated by using appropriate external lightning protection configured to discharge lightning current to ground. Specialists in lightning protection should be consulted regarding the

application.

To protect the DC system, surge suppression devices (SPD Type 2) should be fitted at both the inverter end and array end of the DC cabling. If the voltage protection level (VP) of the surge arresters is greater than 1100 V, an additional SPD Type 3 is required for surge protection for electrical devices.

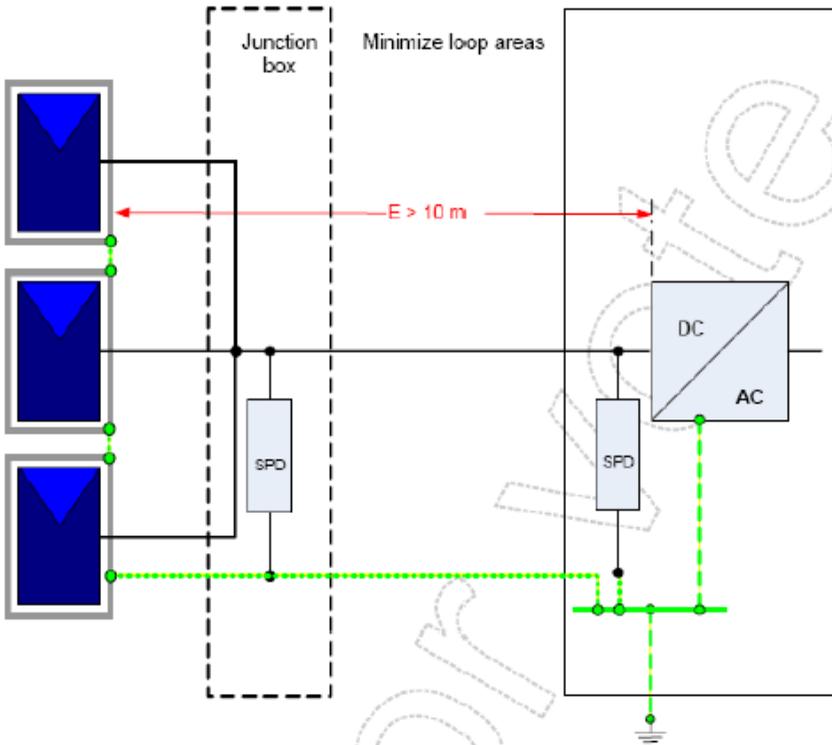


Figure 1-5 SPD Layout

To protect the AC system, surge suppression devices (SPD, type 2) should be fitted at the main AC input point (at the consumer's cutout), located between the inverter and

the meter/distribution system; SPD (test impulse D1) for signal line according to EN 6164321. All DC cables should be installed to provide runs as short as possible, and positive and negative cables of the same string or main DC supply should be bundled together, avoiding the creation of loops in the system. This requirement for short runs and bundling includes any associated earth/bonding conductors. Spark gap devices are not suitable for use in DC circuits as once conducting, they continue conducting until the voltage across their terminals is typically less than 30 volts.



Safety criterion

ETL is the standard applied by Electrical Testing Laboratories to the Digiwatts system to certify that it meets the requirements of the highest safety criterion of the USA and Canada.

The Digiwatts system has been tested and listed by ETL to meet the requirements of UL1741 Static Inverters and IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems. The Digiwatts system is also listed under CSA Std C22.2 No.107.1-01.

1.5.2 Safety instructions



DANGER

Danger to life due to high voltages in the inverter!

- All work on the inverter may only be carried out by qualified personnel.
- The appliance is not to be used by children or persons with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction.
- Children should be supervised to ensure that they do not play with the appliance.



CAUTION

Risk of Burn Injuries!

Parts of the enclosure can become hot. The product can generate heat during operation. Avoid coming into contact with the product during operation.

**CAUTION**

Possible damage to health as a result of the effects of electro-magnetic radiation! Do not stay closer than 20 cm to the inverter for an extended of time.

**CAUTION****Risk of Electric Shock!**

Do not remove cover. No user serviceable parts inside. Refer servicing to qualified service personnel.

**CAUTION****Risk of Electric Shock!**

- Both AC and DC voltage sources are terminated inside this equipment. Each circuit must be individually disconnected before servicing.
- When the photovoltaic array is exposed to light, it supplies a DC voltage to this equipment.

**WARNING**

For continued protection against fire, replace fuses only with units of same type and ratings.

**CAUTION**

Risk of electric shock form energy stored in capacitor!

Do not remove cover until 15 minutes after disconnecting all sources of supply.

**CAUTION**

The Digiwatts system shall not be connected to a battery due to lack of over-current protection provided in the unit.

1.5.3 Symbols on the Type Label

Table1-3 Symbols on the Type Label

Icon	Explanation
	<p>The product works with high voltages. All work on the product may only be done as described in the documentation.</p>
	<p>The product can generate heat during operation. Avoid coming into contact with the product during operation.</p>
	<p>Read the product's documentation before working on it. Follow all safety precautions and instructions as described in the documentation.</p>
 Outdoor	<p>The inverter can be installed outdoors.</p>
	<p>Direct Current (DC)</p>
	<p>Alternating Current (AC)</p>
	<p>Certified safety The inverter complies with the requirements of Equipment and Product Safety Acts in USA and Canada.</p>
	<p>Symbol for equipment grounding conductor</p>
	<p>The inverter is transformerless.</p>

1.6 Installation Overview

This section provides an overview of the installation process and User Manual contents.

Section 1: Unpacking and Inspection

Provides instructions for unpacking and inspecting the Digiwatts system for shipping damage.

Section 2: General Use

Read this manual carefully before using this product. If you encounter any problem during installing or running this unit, please check this manual first before contacting your local dealer or representative. Many problems encountered can be solved according to the instructions inside.

Section 3: Mounting

- Provides guidelines for the best mounting location and detailed mounting instructions to insure optimum performance,
- Cautions and warnings to be followed to avoid injury and/or equipment damage.

Section 4: Wiring

- Guidelines for selecting the correct wire sizes
- Cautions and warnings that should be followed to avoid injury and/or equipment damage
- Step-by-step instructions for wiring the Digiwatts system to a PV array and the utility grid
- Procedures for connecting optional data-communication cables

Section 5: Commissioning

Commissioning involves applying DC input power to the Digiwatts unit and resolving any problems that occur.

Section 6: Displays and Messages

Provides screen display information, meanings and how to determine faults.

Section 7: Troubleshooting

Provides troubleshooting tips and procedures for resolving problems that may occur during installation and operation.

Section 8: Technical Specifications

Provides functional technical data plus connection diagrams and torque specifications for the connection of cables and fasteners of the Digiwatts unit.

2 Unpacking and Inspection



NOTICE!

The distributor delivered your Digiwatts unit to the carrier fully functional and securely packaged. Upon acceptance of the package, the carrier assumes responsibility for its safe delivery. In spite of careful handling, transport damage to package or its contents is always a possibility.

- Inspect the shipping box for apparent damage, such as holes, tears or any other sign of possible damage to its contents.
- Describe any damage or shortage on the receiving documents, making sure to obtain the carrier acknowledgment with his/her full signature.
- Open the shipping box and inspect the contents for internal damage. While unpacking, be careful not to discard any equipment, parts or manuals. If any damage is detected, call the delivering carrier to determine the appropriate action. Save all shipping material in the event the carrier sends an inspector to verify damage!
- If the inspection reveals damage to the inverter call your supplier, or authorized distributor. They will determine if the equipment should be returned for repair and provide instructions to process if required.
- It is the customer's responsibility to file a claim with the carrier. Failure to file a claim with the carrier may void all warranty service rights for any damage.
- If it becomes necessary to return the Digiwatts unit, use the original packaging in which it was delivered.



WARNING!

The Digiwatts unit weighs up to 27kg. To avoid injury, be sure to use proper lifting techniques and secure the help of someone to assist in the unpacking and installation of the inverter.

If you need assistance with a damaged Digiwatts unit, contact Renovo Power.

Contact information for Renovo Power is provided below.

North America:

Renovo Power Systems LLC
2723 South State Street
Suite 100
Ann Arbor, MI 48105
Tel: (855) RENOVO1 (736-6861)
Fax: 888-810-6454
<http://www.renovo-usa.com>

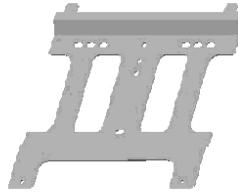
Asia:

Renovo Power Systems(Wuxi Lianyuan) Co., Ltd.
1608 Huishan Da Dao, Wuxi, Jiangsu,China
Tel: 86-510-83593809 Fax: 86-510-83595210
<http://www.renovo-power.com>

2.1 Scope of Delivery



A



B



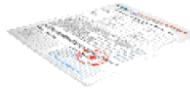
C



D



E



F



G



H



I

Table 2-1 Delivery Contents

Item	Description	Note
A	RN5000US	Digiwatts Inverter unit
B	Bracket	Used for mounting inverter onto the wall
C	Expansion screws	Fastening bracket onto the masonry wall
D	M6 machine screws	Fastening Digiwatts system onto the bracket
E	User manual	Installation and operation instructions
F	Warranty/Service statement	-
G	Packing list	-
H	Warranty card	-
I	Test and Inspection report	-

3 AC Voltage Configuration

3.1 Opening the Digiwatts Unit

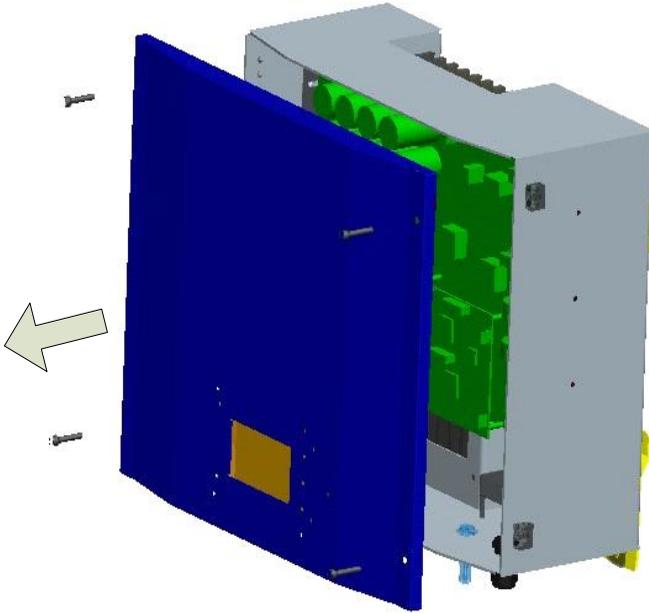


Figure 3-1 Opening the Digiwatts Unit

- 1) Remove the four machine screws and lock washers from the housing cover and pull the cover forward smoothly.
- 2) Remove any communication or power cables possibly connecting the front cover LCD board.
- 3) Place the cover, machine screws, and lock washers aside where they will be out of your way while you are connecting wires and cables to the Digiwatts unit.



CAUTION!

Be careful not to misplace the machine screws or the lock washers, as all four screws and lock washers are required to ensure that the cover is

grounded properly and is fully sealed to the case. Handle the cover carefully, as even seemingly minor damage to the cover could result in an inadequate seal between the cover and the case, thus allowing moisture to enter the case and damage the sensitive electronic components.



NOTICE!

Do not install the Digiwatts unit during periods of precipitation or high humidity (>95%). Moisture trapped within the enclosure may cause corrosion and damage to the electronic components.

3.2 Locating Internal Components

Figure 3-2 below illustrates the locations of the major internal components of the Digiwatts unit. Refer to this illustration as needed to locate particular components.

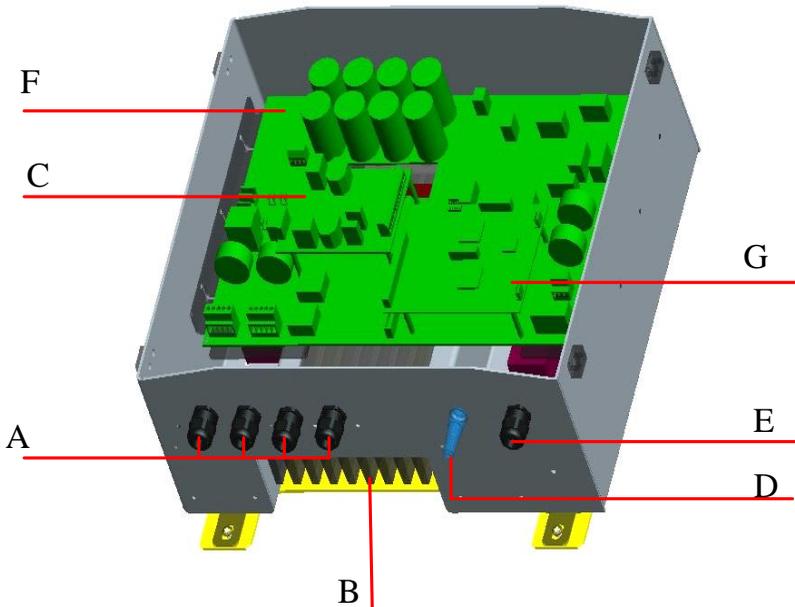


Figure 3-2 Locations of the Major Internal Components

Table 3-1 Internal Components

Item	Description
A	PV enclosure inputs
B	Heat sink
C	Power Supply Board
D	RS485
E	AC Out
F	Main board
G	DSP Board

3.3 Configuring the AC Voltage

The Digiwatts system is compatible with 240V AC output. The Digiwatts unit comes from the factory pre-configured for utility interconnection at 240V AC.

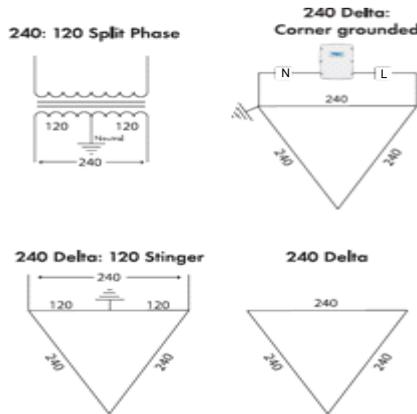


Figure 3-3: Common Utility Voltage Configurations



Information

When using 240 V Delta Corner grounded grids, connect the N terminal to the grounded corner.

4 Mounting

This section provides guidelines to help you select the best mounting location, suggestions to insure best performance, cautions and warnings that you should follow to avoid injury and/or equipment damage, and step-by-step instructions for mounting a Digiwatts inverter.



WARNING!

The Digiwatts unit weighs up to 27 kg. To avoid injury, be sure to use proper lifting techniques and secure the help of someone to assist in the unpacking and installation of the inverter.



Information

It is required that the inverter be mounted so that the rating label on the side of the inverter is visible.

4.1 Choosing a Mounting Location

Consider the following guidelines, cautions, and warnings when choosing a mounting location for the Digiwatts unit.



WARNING!

Danger to life due to fire or explosion. Do not install the inverter on flammable construction materials, in areas where highly flammable materials are stored or in potentially explosive areas!



CAUTION!

The Digiwatts unit weighs up to 27kg. Ensure that the mounting surface sufficiently sturdy to hold the weight of the Digiwatts. Do not mount the Digiwatts on plasterboard (sheet-rock) or thin wood paneling.



NOTICE!

This unit is designed for indoor or outdoor usage. But it is suggested that the unit not be exposed to rain or water directly and use of a shelter to protect the unit would be preferred.

Do not expose this unit to the sun directly. This may reduce the output power due to high temperature.

- Height from ground level should be such to ensure that display and status LEDs are easy to read
- The inverter should be installed in a location that is inaccessible to children.
- The Digiwatts unit emits a slight vibrating noise when operating. This vibration is normal and has no effect on performance, but it can be objectionable if the inverter is mounted on a wall in a living area, on the outside of a wall that is near a living area, or on certain types of materials, such as thin wood paneling or sheet metal.
- Install the Digiwatts unit in a location that maintains an ambient air temperature less than 45°C to maintain a safe internal component temperature.
- If the inverter is installed outside, it should be mounted vertically (see Figure 4-1).

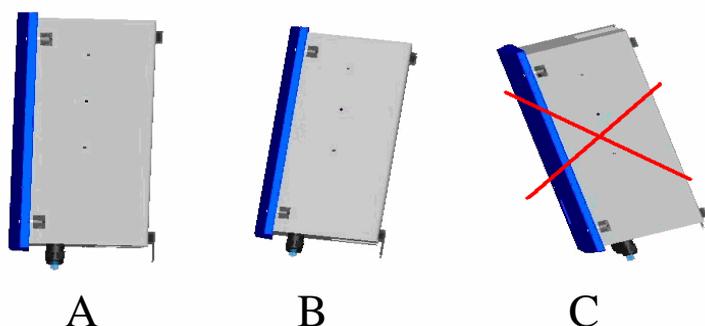


Figure 4-1 Digiwatts unit mounting positions

4.2 Dimensions and Required Clearances



CAUTION!

If you are installing the Digiwatts unit in a cabinet, closet, or other relative enclosed area, sufficient air circulation must be provided to dissipate the heat generated by the inverter.

Figure 4-2 shows the outer dimensions of the Digiwatts unit. The unit must be mounted so that there are at least 50cm of clearance at all points.

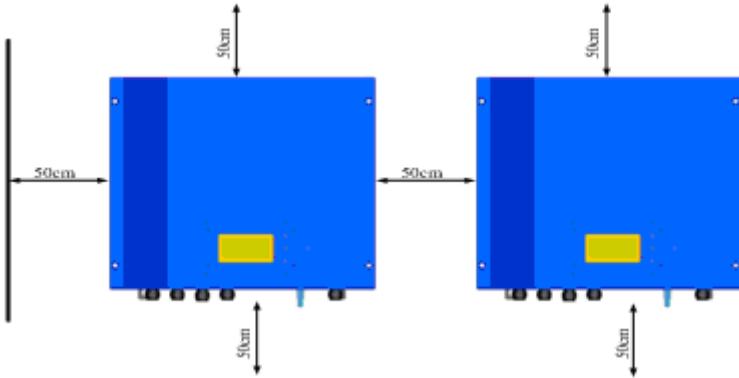


Figure 4-2 The Outer Dimensions of the Digiwatts unit

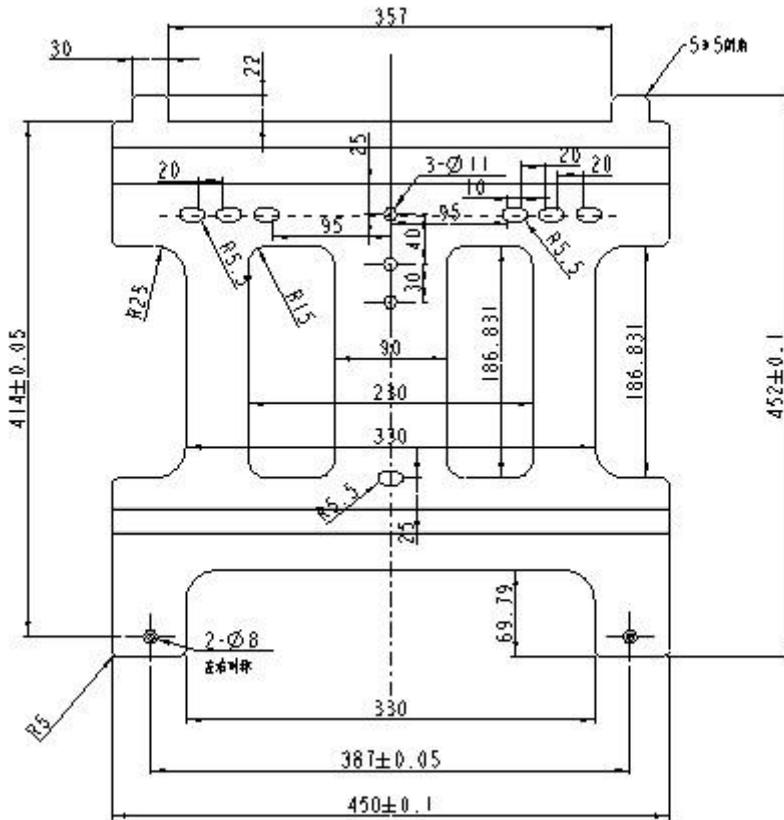


Figure 4-3 Dimensions of the Wall Mounting Bracket



Information You must ensure that there is sufficient clearance for the flow of the air around the Digiwatts unit! In a normal operating environment with good ventilation, 50 cm of clearance is sufficient. The National Electrical Code may require increased working clearances.

4.3 Mounting Procedure

4.3.1 Mounting the Wall-Mounting Screw

The Digiwatts unit is shipped with expansion screws suitable for use with most walls. Make sure that the wall you choose to mount the Digiwatts unit on is sturdy enough to support its weight (27 kg) over a long period of time and that the wall is plumb. The screws may also be mounted on masonry, brick or solid walls. Be sure to use the appropriate type of mounting hardware for the wall material.

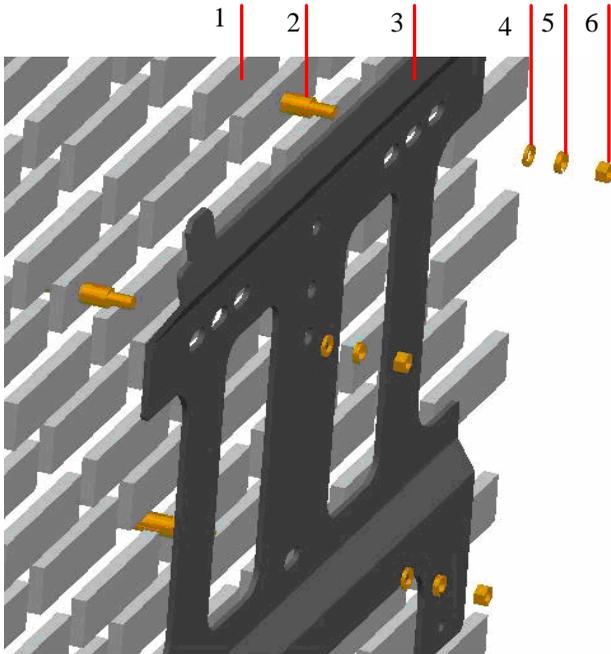


Figure 4-4 Fasten the Bracket against Masonry Wall with Expansion Screws

Table 5-1 Mounting Items

Item	Description
1	Concrete / block wall
2	Expansion cylinder
3	Bracket
4	Washer
5	Spring washer
6	Hexagonal nut

Mounting the expansion screws:

Three fasteners are required to secure the wall mounting bracket to a wall: Two fasteners along the top of bracket using the center holes on each side (centerline spacing of 252mm) and a third fastener at the centerline of the bottom of the bracket (Expansion screws are provided however it is installers responsibility fasteners are appropriate for wall material.) Ensure that all fasteners are well secured.

4.3.2 Mounting the Digiwatts Unit to the Wall Bracket

Use the following procedure to mount the Digiwatts unit once wall bracket is secured to the wall.

- 1) Carefully hook the slots on the rear of the Digiwatts case onto corresponding vertical tabs of the wall bracket.

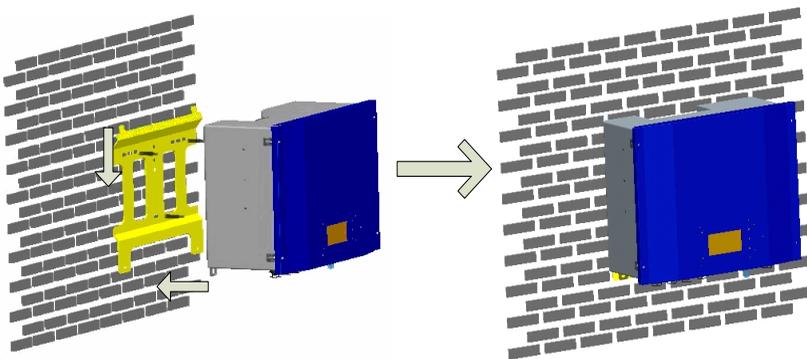


Figure 4-5 Attach the Inverter to Bracket



WARNING!

The Digiwatts unit weighs up to 27 kg. To avoid injury, be sure to use proper lifting techniques and secure the help of someone to assist in the unpacking and installation of the inverter.

- 2) Secure the bottom tabs protruding from the bottom of the Digiwatts units to the bracket using two M6 machine screws.

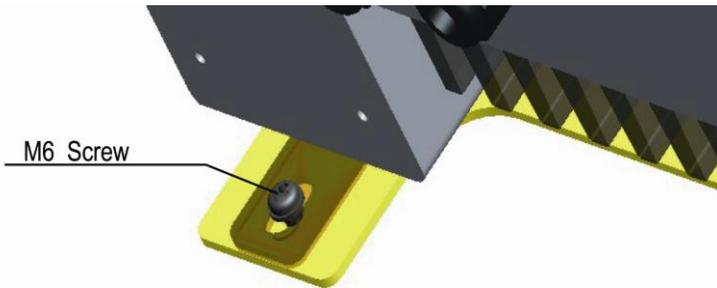


Figure 4-6 Affix Bottom Tabs of Digiwatts unit to Mounting Bracket.

- 3) Inspect the Digiwatts unit from both sides to ensure that it sits centered on the wall screws.
- 4) Carefully verify that the Digiwatts unit is mounted firmly in place.

5 Wiring the Digiwatts unit

This section provides step-by-step procedures and other information required for wiring the Digiwatts unit to the PV array and the utility grid. To complete the installation in a safe and efficient manner, complete the steps in the order that they appear.

**WARNING!**

Before connecting or operating the Digiwatts unit, read all of the instructions, cautions, and warnings on the Digiwatts unit, the PV array and in this Installation Guide.

**WARNING!**

You must connect the wires that carry the AC voltage from the Digiwatts unit to the utility grid and the wires that carry the DC voltage from the PV array to the Digiwatts unit in the order described in the procedures in this section. Deviating from these procedures could expose you to lethal voltage.

**WARNING!**

The inverter does not have integrated AC or DC disconnects. However, as a complete assembly or system, the unit requires that the customer shall supply external fuses and an isolation device. This is not only a good safety practice, but a mandatory requirement as a license condition of agency certified equipment. A manual AC switch disconnect and DC switch disconnect must be provided and located in an accessible position. Please check the unit nameplate and run ample capacity. A suitably rated Isolating switch should be fitted immediately adjacent to each unit and installed both for AC output and DC input.

**WARNING!**

POWER FED FROM MORE THAN ONE SOURCE.

**WARNING!**

Always turn OFF all switches in the PV system before connecting any wires to or disconnecting any wires from the Digiwatts unit.



Information

The DC input and AC output circuits are isolated from the enclosure and system grounding, as required by section 250 of the National Electric Code, ANSI/NFPA 70. Similarly, such isolation of DC input and AC output circuits from enclosure and system grounding is also required by the CANADIAN ELECTRICAL CODE, PART 1. It is the responsibility of the installer to maintain this isolation.

The Photovoltaic System Grounding shall be installed per the requirements of sections 690.41 through 690.47 of the National Electric Code, ANSI/NFPA 70. It is the responsibility of the installer to meet these requirements.

AC Grounding

The Digiwatts unit must be connected to the AC ground from the utility via the Ground Terminal. Use #10 AWG, 105°C, copper wire for AC grounding.

PV Grounding

The PV array ground should be connected to the PV Grounding and DC Grounding Electrode Conductor. Use #10 AWG, 105°C, copper wire for PV grounding.

5.1 Sequence of Connecting

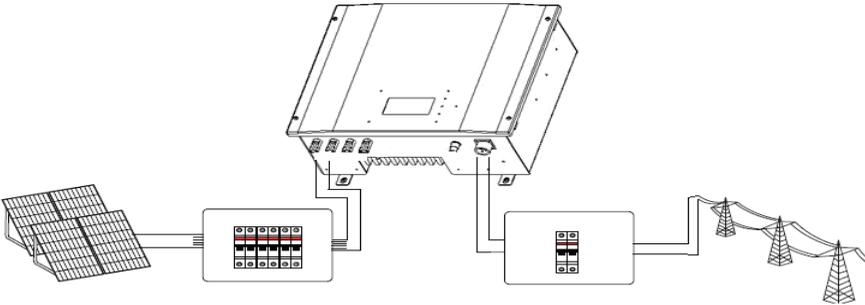


Figure 5-1 Electrical Connection Diagram

- 1) De-energize all energy sources by opening all AC and DC disconnects and/or breakers.
- 2) Wire from AC breaker to the AC disconnect switch.
- 3) Wire from the AC disconnect switch to the Digiwatts unit.
- 4) Wire from the PV wires to the DC disconnect.
- 5) Wire from the DC disconnect to the Digiwatts unit.
- 6) Turn the DC switches and/or breakers ON.
- 7) Turn the AC switch and/or breakers ON.
- 8) To disconnect the Digiwatts unit, first turn OFF all AC disconnects and then all DC disconnects. The AC system should always be disconnected before the DC system.



WARNING!

Always wait a minimum of 15 minutes for stored potentials in the Digiwatts unit to discharge completely before opening the enclosure.

5.2 Opening the Digiwatts

- 1) Remove the four machine screws from the housing cover and pull the cover forward smoothly.
- 2) Disconnect the three connections on the front cover LCD display board. Note that each connector is unique and only able to reconnect to a single position.
- 3) Put the cover, the machine screws and washers to one side so that they do not get lost. All four fasteners are required to provide sufficient enclosure sealing.

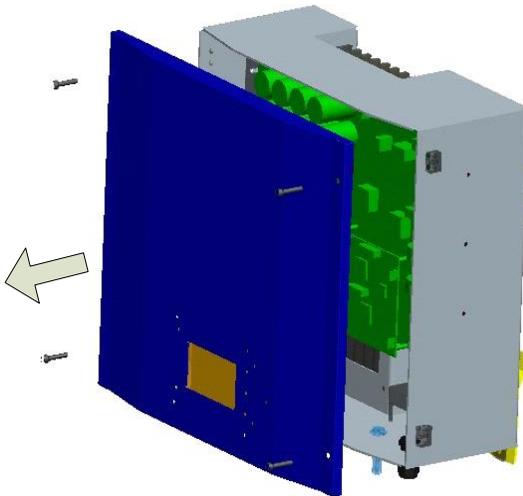


Figure 5-2 (a) Opening the Digiwatts unit

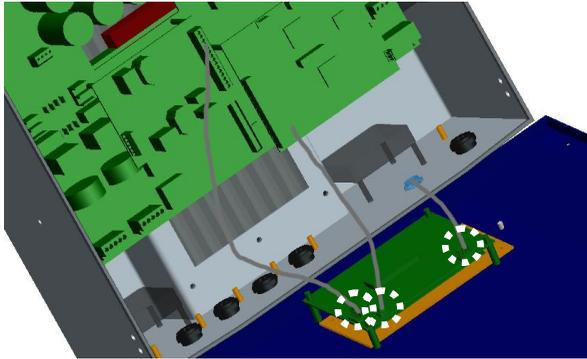


Figure 5-2 (b) Front Cover Electrical Connections

5.3 Wiring the AC Output

This subsection provides complete, step-by-step procedures for wiring the AC output from the Digiwatts unit to the utility grid.

5.3.1 AC Connection Requirement



WARNING!

All electrical installations must be done in accordance with all local electrical codes and with the National Electrical Code (NEC), ANSI/NFPA 70. Use #10 AWG, 105°C, copper wire for all AC wiring connections to the Digiwatts. Voltage drop and other considerations may dictate that larger size wires be used. Use only solid or stranded wire but not fine stranded wire.



WARNING!

The National Electrical Code (NEC) states that the inverter must be connected to a dedicated circuit, and that no other outlets or devices can be connected to the same circuit. See NEC Section 690-64(b) (1). The NEC also imposes limitations on the size of the inverter and the manner in which it is connected to the utility grid. See NEC Section 690-64(b)(2).

**WARNING!**

To reduce the risk of fire, connect only to a circuit provided with the required branch circuit over-current device sized in accordance with the National Electric Code, ANSI/NFPA 70. The maximum size over-current device shall not be more than 50 amperes.

**WARNING!**

You must connect the wires that carry the AC voltage from the Digiwatts unit to the utility grid in the order described in this procedure. Deviating from this procedure could expose you to lethal voltages that can cause serious injury and/or death.

5.3.2 Connecting the AC Wires

- 1) Turn OFF the main breaker in the main utility breaker box.
- 2) Remove the cover and disconnect LCD board connections on Digiwatts unit.
- 3) If you are replacing an existing inverter, disconnect the wires for the AC line you are working within the breaker box.
- 4) Pull the AC wires through the conduit from the interior AC terminal of the Digiwatts unit.
- 5) Connect the AC equipment-ground wire to the PE terminal labeled  within the Digiwatts unit.
- 6) Connect the L and N wires to the terminals labeled L and N.
- 7) Connect the wires to the terminal blocks in the Digiwatts unit and tighten them.
- 8) Verify that all connections are correctly wired and properly torqued (2.5Nm). Pull on the individual cables in order to make sure that they are sufficiently secured within the terminals.

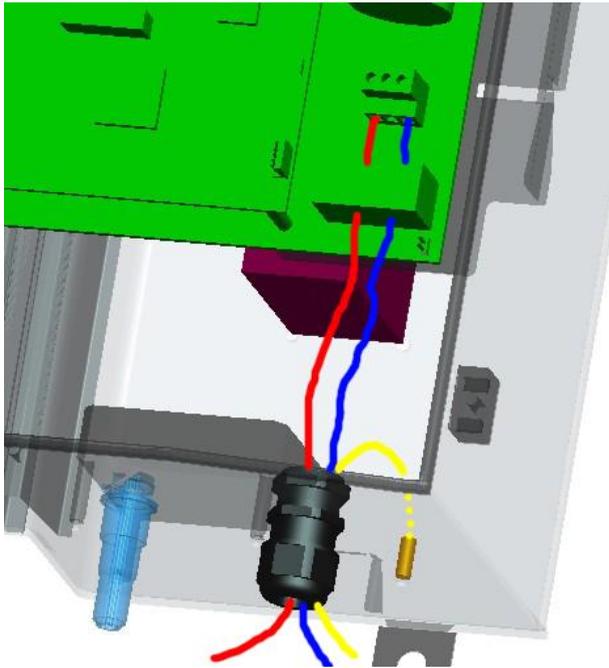


Figure 5-3 AC Connection Terminals

5.4 Wiring the DC input

This subsection provides procedures for wiring the DC input from the PV array to the Digiwatts unit. The figure 5-4 below shows a simplified wiring diagram of a PV system.

5.4.1 DC Connection Requirements



WARNING!

All electrical installations must be done in accordance with all local electrical codes and with the National Electrical Code (NEC), ANSI/NFPA 70. For installation in Canada the installations must be done in accordance with applicable Canadian standards.

**WARNING!**

Use #10 AWG, 105 °C, copper wire for all DC wiring connections to the Digiwatts. Voltage drop and other considerations may dictate that larger size wires be used. Use only solid or stranded wire but not fine stranded wire.

**WARNING!**

The DC disconnect for the inverter must have a minimum rating of 600VDC and 36A continuous.

**Information**

Series fusing may be required depending on the type of PV module used in the system. See NEC 690.9.

**WARNING!**

You must connect the wires that carry the DC voltage from the PV array to the Digiwatts unit in the order described in the following procedure. Deviating from this procedure could expose you to lethal voltages that can cause serious injury and/or death.

**WARNING!**

PV arrays are energized when exposed to light. Use safe working practices when working on PV arrays.

**WARNING!**

Always turn OFF all AC and DC breakers and switches in the PV system and wait a minimum of 15 minutes for the Digiwatts unit to completely discharge before connecting any wires to the Digiwatts unit or disconnecting any wires from the Digiwatts unit. Failure to do so could expose you to lethal voltages that can cause serious injury and/or death.



CAUTION!

Verify the polarity and the open-circuit voltage from the PV strings before you connect the DC wires to the Digiwatts unit. Applying an open-circuit DC-input voltage that exceeds the maximum DC-input-voltage range will cause irreversible damage to the Digiwatts unit and void the warranty! Always configure the DC-input-voltage range correctly before connecting the DC-input wires from the PV array to the Digiwatts unit.

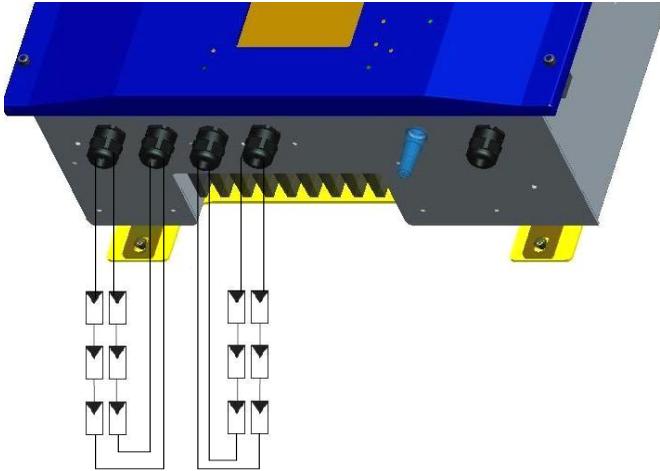


Figure 5-4 PV Modules Connection to Digiwatts unit

- The PV modules connected to either the left or right two DC connectors should be:
 - Same type
 - Same number
 - Identical alignment
 - Identical tilt
- The maximum length of DC connecting cables should not exceed 30m as required by the EMC Directive.
- When connecting just two identical strings, it is more efficient to connect these to the left or right two DC connectors. (Exception: shaded strings or if the total input current is more than 13A.).
- The connecting cables of the PV modules must be fitted with plug connectors.

You will find the necessary DC strain relief connectors for DC connection in the delivery package.

- The following limit values at the DC input of the inverter must not be exceeded:

Maximum input voltage	Maximum input current	
	Left 2 inputs	Right 2 inputs
500V	13 A	13 A



WARNING!

Verify that the DC current of your installation does not exceed the maximum values specified in the rating label. Check both the polarity and the open-circuit voltage from the PV strings

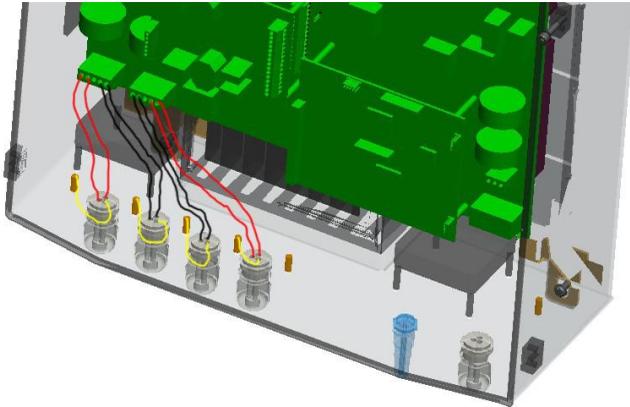


Figure 5-5 DC Connection Terminals



Information

The Digiwatts system has provisions for up to four PV strings.



CAUTION!

Avoid using wire nuts to for any connections in the PV system. Wire nuts are a frequent cause of unreliable, resistive connections, and ground faults.

5.4.2 Connecting the DC Wires

- 1) Verify that the AC breaker(s) are OFF.
- 2) Verify that the DC disconnect is open in the external DC disconnect enclosure.
- 3) Pull the DC wires from the DC disconnect through the conduit into the interior of the Digiwatts unit.
- 4) Connect the positive and negative DC wire to the terminal labeled DC+ and DC- in the Digiwatts unit.
- 5) Connect the PV array ground wire to the PE terminal labeled \oplus in the Digiwatts unit.
- 6) Verify that all connections are correctly wired and properly torqued (2.5Nm). Pull on the cables in order to make sure that they are sufficiently secured within the terminals.

5.5 Communication Wiring

The inverter provides RS485 interface to communicate with remote PC or logger. User can monitor the state of the inverter and observe real-time and historical functional information via this interface.



WARNING!

The cable should be no longer than 1200 meters with a common shield, and a wire size no smaller than 24 AWG.

5.5.1 RS485 Communication

RS485 is a communication standard for bidirectional transmission of data between one or more Digiwatts units and a PC.

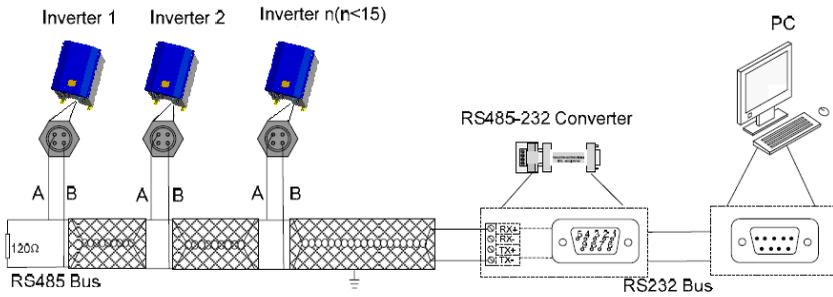


Figure 5-6 Communication Wiring

Wiring procedure:

- 1) A resistance with 120Ω is connected at the initiating terminal of RS485 bus.
- 2) Plug the connector of the RS485 cable into corresponding RS485 terminal of Inverter 1
- 3) The two lines of the other end of RS485 cable, labeled A and B, are connected to corresponding lines of RS485 bus, as the above diagram.
- 4) Connect other inverters to RS485 bus in the same way.
- 5) At the end of RS485 bus, connect RS485 A cable to “RX+” port of RS232-RS485 converter and connect RS485 B cable to “TX-” port of RS232-RS485 converter
- 6) Connect RS232 port of RS485-232 converter to RS232 port of PC.



Information

All Digiwatts inverters are capable of RS485 communication. You can mix different Digiwatts models on a single RS485 communication bus.



NOTICE!

RS485 bus requirements to ensure quality of communication:

- Shielding twist-pair type
- Shielding layer of RS485 bus should be single-point grounding to avoid ground loops.

5.6 Closing the Digiwatts unit

When you have finished connecting the AC-output wires, the DC-input wires, re-check all your connections to ensure that everything is in the right place and that all connections and knockout fittings are secure and properly torqued. Check all of the knockout fittings on the bottom of the Digiwatts unit to ensure that they provide a weather-tight seal.



WARNING!

Never install the Digiwatts unit during rain or very damp conditions. Because the Digiwatts unit is completely sealed, you must be sure no moisture is trapped inside the enclosure when securing the lid.



CAUTION!

Be careful not to misplace the machine screws or the enclosure seal that attach the cover to the case, as all four screws and enclosure seal are required to ensure that the cover is grounded properly and is fully sealed to the case. Handle the cover carefully, as even seemingly minor damage to the cover could result in an inadequate seal between the cover and the case, thus allowing moisture to enter the case and damage the sensitive electronic components.

Use the following procedure to replace the cover on the Digiwatts unit:

- 1) Secure the three connections with the appropriate mating connectors on the LCD board.
- 2) Check wire routing to ensure that no wires can interfere with proper sealing of the cover and that no pressure will be exerted on the connections when the cover is replaced.
- 3) Locate the four machine screws and enclosure gasket you removed to take the cover off the Digiwatts unit. Make sure you have all four screws and enclosure

seal, as all of this hardware is necessary to ensure proper grounding and a weather-tight seal.

- 4) Check the enclosure seal on the inside of the cover to ensure it is undamaged and in the correct position.
- 5) Carefully position the cover on the front of the Digiwatts unit so that the four holes in the cover are aligned correctly with the four threaded holes in the case.
- 6) While holding the cover in place, carefully insert the four machine screws with lock washer, through the holes in the cover into threaded holes in the case and turn them until they are finger-tight. Be careful not to cross-thread any of the screws. Do not use power tools to start the screws.
- 7) Verify that the cover is in the correct position and that the seal is in place between the case and the cover.
- 8) Tighten the cover screws.

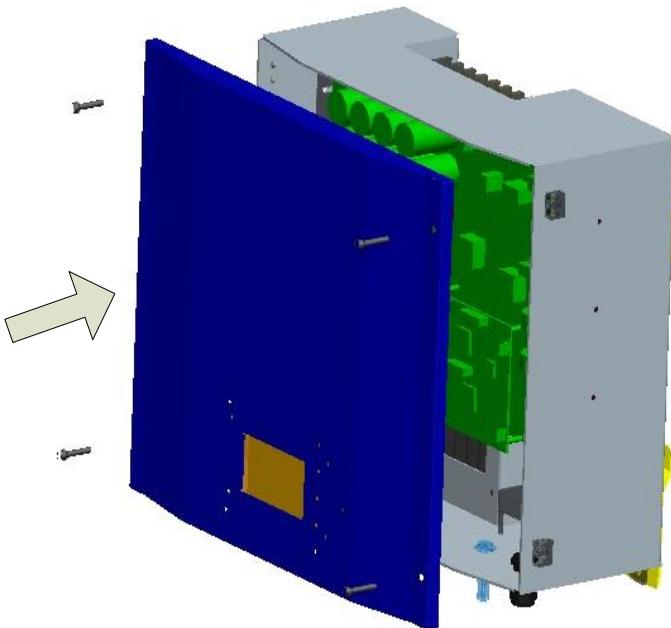


Figure 5-8 Closing the Digiwatts unit

6 Commissioning



WARNING!

Follow the steps in the commissioning procedure in the order they are presented. Deviating from these procedures could expose you to lethal voltages that can cause serious injury and/or death.



CAUTION!

Follow the steps in the commissioning procedure in the order they are presented. Deviating from these procedures could cause irreversible damage to the Digiwatts unit and void the warranty.



Observe the operating instructions

To commission the Digiwatts unit, follow these instructions:

- 1) Make sure any covering placed over the PV array is removed.
- 2) Connect the grid voltage to Digiwatts unit by switching on main AC circuit breaker.
- 3) Connect the external DC. If there is sufficient sunlight available, the Digiwatts unit will enter the “Wait” mode at this time and the green LED will begin to blink.
- 4) If no AC faults are detected, the “Wait” mode will end after 60 seconds and the green LED will stop blinking, the Digiwatts unit will begin to operate normally. If an AC fault was registered, the Digiwatts unit will wait 90 seconds prior to starting.



Information

If the Digiwatts unit is not operating as expected after the commissioning procedure has been completed, refer to section 7 and 8.



Information

If there is adequate solar irradiation and the resulting PV input voltage is

greater than 250V DC, the Digiwatts unit will automatically begin feeding power to the utility grid.



Information

The Digiwatts unit operates from the power produced by the PV array and is designed for minimal internal DC-power consumption. The maximum power that the Digiwatts unit will consume in normal operation is 8W.



Information

Anytime the AC power is disconnected from the inverter, either manually or as a result of an AC disturbance, the inverter will wait 5 minutes after the AC power has been restored to reconnect. When servicing the inverter, always disconnect the AC first, then the DC.

7 Displays and Messages

Each Digiwatts inverter comes equipped with three LED status indicators. This shows users the main status when the inverter is working.

The basic definitions of the indicator lights are as follows:

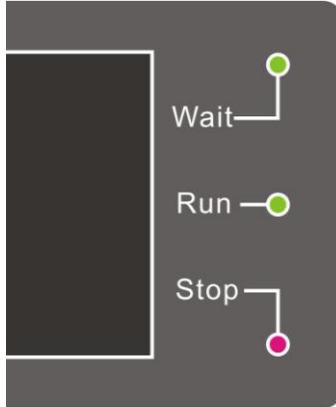


Figure 7-1 Front Cover LED Status Indicators

- The upper green LED indicates the Digiwatts unit is waiting, and the middle green LED indicates the Digiwatts unit is running.
- The red LED indicates the status of stop. It means that there is some fault, either inside the inverter or somewhere in the PV system. The inverter will not operate until the fault has been corrected.

7.1 LED Operation Indicators

Night All LEDs are off.

The inverter is in standby mode because the input voltage is too low for operation.

Initialization All LEDs are on.

The inverter is initializing. The power from the array is sufficient to initialize control

power, but not yet powerful enough to begin normal operation. Data transmission is not possible during initialization. Occasionally, during inclement weather or low irradiation, the LEDs may all turn on at once and then go off again. This indicates that the inverter is trying to initialize but the power available from the array is not sufficient for normal operation. This is not a malfunction.

Waiting The wait LED is blinking, the other two are off.

The PV energy is sufficient to enable self-checking, but is insufficient for feeding power to the utility grid.

Normal Operation The run LED is on, the other two are off.

The inverter has determined that there is enough voltage from the array to operate. The Digiwatts unit adjusts the voltage and current from the PV array to maximize PV output power.

Derating The run LED is blinking, the others are off.

The Digiwatts is designed to operate at full rated power up to 45°C ambient. The inverter will continue to operate beyond 45°C and derate as required to limit internal component temperature.

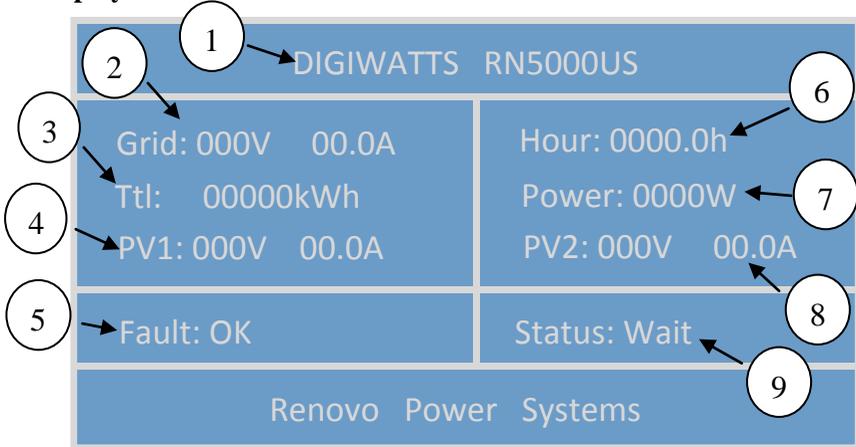
7.2 Status Messages on the LCD Display

Activation of the LCD Backlight

The LCD backlight is activated by knocking twice on the lid. The backlight shuts off automatically after 2 min.



LCD Display Parameters



Parameter Description

Table 7-1 Parameter Descriptions

Item	Parameter	Description
1	Model	Inverter Model
2	Grid	Grid voltage and current
3	Ttl	Accumulated energy yield of the device since installation
4	PV1	PV1 input voltage and current
5	Fault	Inverter fault (<i>OK</i> if none)
6	Hour	Total operating hours since installation
7	Power	Power fed to grid
8	PV2	PV2 input voltage and current
9	Status	Operational status of the inverter

7.3 Fault Messages on the LCD Display

If the Status message is “Stop”, the inverter has a fault and the specific issue will be displayed at *Fault* parameter location.

DIGIWATTS RN5000US	
Grid: 243V 00.0A Ttl: 00000kWh PV1: 096V 00.0A	Hour: 0000.0h Power: 0000W PV2: 002V 00.0A
Fault: Vdc_L	Status: Stop
Renovo Power Systems	

7.4 Operating Modes

- Offset Offset calibration of the electronics (at start-up)
- Wait PV voltage is not high enough to start
- Run Normal operation
- Derating Reduction of the grid fed power due to abnormal temperatures
- Stop Inverter fault, user interaction required

8 Troubleshooting

8.1 General

Our quality control program assures that each inverter is manufactured to exact specifications and is thoroughly verified prior to leaving the factory. In the unlikely event difficulty is encountered with the operation of the inverter, follow the steps below to correct the problem.

1. Check & record the exact “Mode” and/or “Fault” messages on the LCD display.
2. Check the DC and AC voltages at terminals inside the inverter. Be sure to observe all of the safety precautions listed throughout this manual when doing so, or hire a qualified professional.
3. If the system problem persists, contact RENOVO POWER technical support at: 810-923-2643

In order to better assist you when contacting RENOVO POWER, please provide the following information:

Required Information for Digiwatts unit Service:

- Serial number
- Model Number
- Short description of the problem
- Display message
- What error code is indicated?
- AC line voltage
- DC line voltage
- Can you reproduce the failure? If yes, how?
- Has this problem occurred in the past?
- What were the ambient conditions when the problem occurred?

Information Regarding the PV modules:

- Manufacturer name and model number of the PV module
- Output power of the module
- Open circuit voltage (Voc) of the module
- Number of modules in each string

If it becomes necessary to send the Digiwatts unit back to the manufacturer for service, please ship it in the original packaging to avoid damage during shipping.

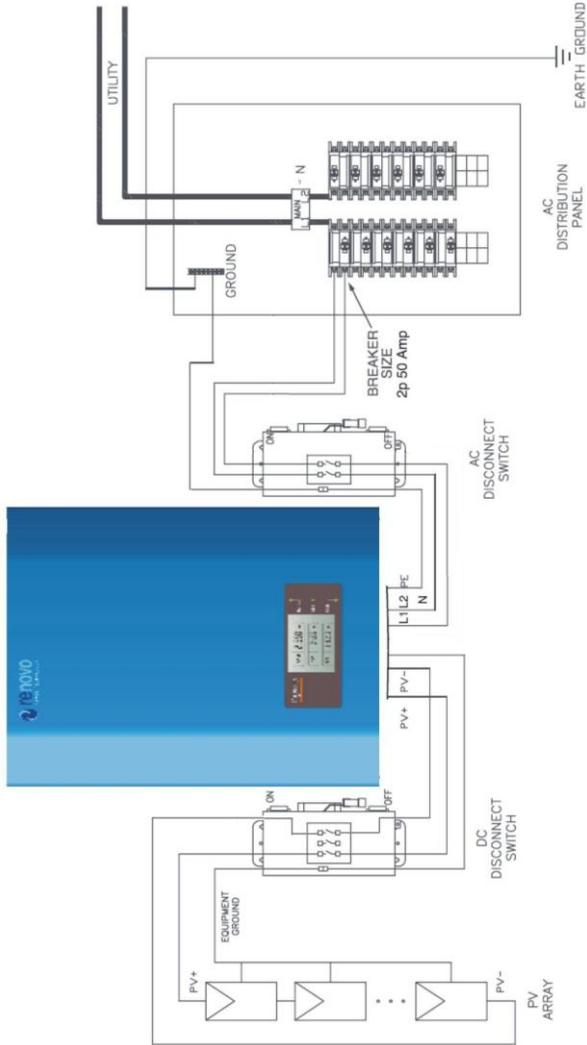
8.2 Error Messages

If a fault occurs, the Digiwatts system generates an error message according to the operating mode and the detected fault.

Fault Code	Description
No_Ug	There is no grid.
Ug_L	The AC grid voltage is too low
Ug_H	The AC grid voltage is too high
Ig_H	Over current on the AC side
IgRMS_H	Over current on the AC side
Ilost_H	The residual current is too high
Fre_H	The frequency of the grid is too high
Fre_L	The frequency of the grid is too low
Pw_H	The output power is too high
No_balan	Output power – input power > 700W
Relay1_un	Relay1 is not work properly
Relay2_un	Relay2 is not work properly
Vdc_H	DC bus voltage is too high
VdcL_Wait	DC bus voltage is too low when the inverter at Wait mode
VdcL_Run	DC bus voltage is too low when the inverter at Run mode
Idc_H	The dc current of the grid is too high
Tmpr_H	The temperature is too high
Tmpr_L	The temperature is too low
Fan_Err	Fan err
IPM_Err	IPM err
Iso_Err	The insulation of PV+/PV- to the ground is too low
CPU_Err	Cpu err
EPROM_Err	Eprom err
SCI_Err	SCI communication err
SDRAM_Err	SDRAM err
HW_Vdc	The voltage of the DC bus is too high
HW_Cap	The capacitance of the DC bus is short circuit
HW_Low	The voltage source of 12V/5V/3.3V is too low
L_N_Opp	The L and N of ac wire are opposite
SPI_Err	SPI communication err
Slo_RAM	The ram of the slave dsp is err
Comm_un	Communication err

9 Technical Specifications

9.1 Digiwatts Wiring Diagrams



9.2 Specifications

Item	Description	Specification
A	Maximum input voltage	500V
B	Range of input operating voltage	200-450V
C	Maximum input current (dc)	2*10A
D	Maximum array short circuit current (dc)	2*12.5A
E	Maximum utility backfeed current (ac)	50A
F	Output power factor rating (ac)	1
G	Operating voltage range (ac)	215-265V
H	Operating freq. range or single freq.	59.3-60.5Hz
J	Nominal output voltage (ac)	240V
K	Normal output frequency	60Hz
L	Maximum continuous output current (ac)	20.8A
M	Maximum continuous output power (ac)	5000W
N	Maximum output fault current (ac)	58A
O	Maximum output overcurrent protection	50A
P	Peak Power Tracking Voltage	250–440 V
Q	Number of Inputs	4
R	PV Start Voltage	250V
S	Peak Inverter Efficiency	97%
T	Dimensions	L x W x H - (mm) 532 x 458 x 218 (in) 8.6' x 20.9' x 18'
U	Weight	27 kg / 59 lb
V	Ambient Temperature Range	-25 C to 60 C -14° F to 140° F
W	Power consumption	0 W nighttime, ≤ 8W operating

9.3 Trip Limits / Trip Times

Nominal Freq. (Hz)	Trip Limit (Hz)	Trip Freq. (Hz)	Trip Times (s)
60	> 60.5	60.45 - 60.55	max. 0.1602
	< 59.3	59.25 - 59.35	max. 0.1602

Nominal Voltage (V)	Trip Limit	Trip Voltages Line-to-Neutral (V)*	Trip Times (s)
240	50%	119 - 121	max. 0.1602
	88%	210 - 212	max. 2.002
	110%	261 - 263	max. 1.001
	120%	287 - 289	max. 0.1602

NOTE: This unit or system is provided with fixed trip limits and shall not be aggregated above 30 kW on a single Point of Common Connection.

9.4 Torque Values and Wire Sizes

Terminal	Install Torque (Nm / ft-lbs)	Wire Size
Green AC & DC Terminal Blocks (Phoenix)	2.5 / 1.8	10 AWG
Cover Machine Screws	6 / 4.4	--