



# mPower™ DC Power Supplies

## 411 Series 2U, 3U, 4U

### Installation and Wiring Guide



Oct 2023 : P/N 501046-411-IN-A

© 2023 Marway Power Systems, Inc. All rights reserved.  
Some portions © Elektro-Automatik, used with permission.

mPower™, mPower DC™, mPower 411™ are trademarks of Marway Power Systems, Inc.  
All other trademarks are the property of their respective owners.

## Global Support Contacts

Web: [www.marway.com](http://www.marway.com)  
Email: [support@marway.com](mailto:support@marway.com)  
[sales@marway.com](mailto:sales@marway.com)  
Phone: 800-462-7929 (7am–5pm PST)

There may be updates to this documentation and the software it describes at:  
<http://www.marway.com/docs>

# 1 General

1.1 Documentation Symbols.....	4
1.2 Product Key.....	4
1.3 Intended Product Usage .....	4
1.4 Safety Notices.....	5

# 2 Installation Preparation

2.1 Operation and Programming Guides.....	6
2.2 Unpacking and Visual Check .....	6
2.3 Transport and Storage .....	6
2.3.1 Transport.....	6
2.3.2 Packaging .....	6
2.3.3 Storage.....	6
2.4 Safety Considerations Before Installation .....	7
2.4.1 Mounting the unit.....	7

# 3 Installation 4U 411-54 Models

3.1 4U 411-54 Physical Details.....	8
3.2 4U 411-54 AC Power Connections .....	10
3.2.1 AC phase requirements (4U 411-54).....	10
3.2.2 AC connection (4U 411-54).....	11
3.2.3 AC grounding (4U 411-54).....	11
3.2.4 AC strain relief bracket (4U 411-54).....	11
3.3 4U 411-54 DC Output Connections .....	12
3.3.1 DC cable requirements (4U 411-54).....	12
3.3.2 DC terminal types (4U 411-54) .....	12
3.3.3 DC output grounding (4U 411-54) .....	13

# 4 Installation 3U 411-53 Models

4.1 3U 411-53 Physical Details.....	14
4.2 3U 411-53 AC Power Connections .....	16
4.2.1 AC phase requirements (3U 411-53).....	16
4.2.2 AC connection (3U 411-53).....	17
4.2.3 AC grounding (3U 411-53).....	17
4.2.4 AC strain relief bracket (3U 411-53).....	17
4.2.5 AC connection balancing (3U 411-53).....	18
4.3 3U 411-53 DC Output Connections .....	19
4.3.1 DC cable requirements (3U 411-53).....	19
4.3.2 DC terminal types (3U 411-53) .....	19
4.3.3 DC output grounding (3U 411-53) .....	20

# 5 Installation 2U 411-02 Models

5.1 2U Physical Details.....	21
5.2 2U 411-02 AC Power Connections .....	23
5.2.1 AC phase requirements (2U 411-02).....	23
5.2.2 AC connection (2U 411-02) .....	24
5.2.3 AC grounding (2U 411-02).....	24
5.2.4 AC strain relief (2U 411-02).....	24
5.3 2U 411-02 DC Output Connections .....	25
5.3.1 DC cable requirements (2U 411-02).....	25
5.3.2 DC output terminals (2U 411-02) .....	25
5.3.3 DC output grounding (2U 411-02) .....	26

# 6 Control Connections

6.1 Rear Panel Overview .....	27
6.2 AnyBus Module Installation .....	28
6.3 USB Connector, Rear .....	29
6.3.1 USB driver installation (Windows®).....	29
6.3.2 Non-Windows drivers .....	29
6.4 LAN Ethernet Connector .....	30
6.5 Analog Interface Connector .....	30
6.6 Sense Connectors .....	31
6.7 Parallel Connections .....	32
6.7.1 Share connectors .....	32
6.7.2 Master/Slave connectors.....	33
6.7.3 Share vs. Master-Slave.....	33
6.7.4 Parallel wiring example .....	34




# 7 Contact and Support

7.1 Repairs.....	35
7.2 Contact Options .....	35
7.3 Two Year Warranty.....	35

# 1 General

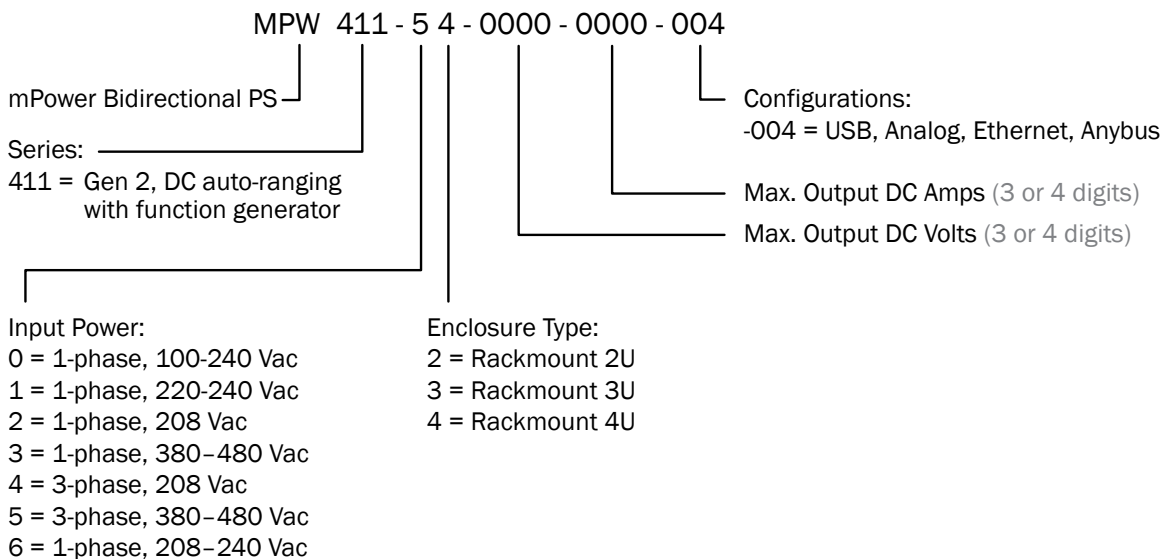
## 1.1 Documentation Symbols

Warning and safety notices as well as general notices in this document are shown in a box with a symbol as follows:

	Symbol for a life threatening danger
	• Symbol for general safety notices (instructions and damage protection bans) or important information for operation
	Symbol for general notices

## 1.2 Product Key

The mPower DC 411 model number uses the following pattern, using an example:



## 1.3 Intended Product Usage

The equipment is intended to be used only as a variable voltage and current source, or only as a variable current sink. Additionally, it's intended to be used, installed, and operated in suitable equipment (19" rack or similar), together with a rigid, non-retractable AC supply connection.

Typical application for a voltage source is DC power supply to any relevant user, including when used as battery charger to test charge various battery types, and for current sinks as the replacement of an ohmic resistor by an adjustable electronic DC load in order to load relevant voltage and current sources of any type.



## 1.4 Safety Notices

### Mortal danger - Hazardous voltage



- This is electrical equipment with some parts operating with dangerous voltage. All exposed components which can have live voltage must be covered.
- All work on connections must be carried out under zero voltage (output disconnect), and may only be performed by qualified and informed persons. Improper actions can cause fatal injury as well as serious material damage.
- Never touch cables or connectors directly after unplugging from mains supply as the danger of electric shock remains. Verify there is zero voltage with a handheld meter.
- Never touch the contacts on DC output terminal directly after switching off the DC output, because there still can dangerous voltage present, sinking more or less slowly depending on the load. There also can be dangerous potential between negative DC output to GND or positive DC output to GND due to charged capacitors. Verify there is zero voltage with a handheld meter.
- Always follow 5 safety rules when working with electric devices:
  - Disconnect completely.
  - Secure against reconnection.
  - Verify that the system has zero voltage.
  - Carry out earthing and short-circuiting.
  - Provide protection from adjacent live parts.



- The equipment must only be used as intended.
- The equipment is only approved for use within the connection limits stated on the product label.
- Do not insert any object, particularly metallic, through the ventilator slots
- Avoid any use of liquids near the equipment. Protect the unit from wet, damp and condensation.
- Do not connect loads, particularly low resistance, to power supplies under power; sparking may occur which can cause burns as well as damage to the equipment and to the user.
- ESD regulations must be applied when plugging interface cards or modules into the relative slot
- Interface cards or modules may only be attached or removed after the unit is switched off. It's not necessary to open the unit.
- Do not connect external power sources with reversed polarity to DC input or outputs. The equipment will be damaged.
- Avoid where possible connecting external power sources to the DC output, and never those that can generate a higher voltage than the nominal voltage of the unit.
- Never insert a CAT5 cable which is connected to Ethernet into the master-slave socket on the back of the unit.
- Always configure the various protecting features against overvoltage etc. for sensitive loads to what the target application requires.
- The 411 Series power supplies feature an energy recovery function which, similar to solar energy equipment, feeds energy back to the local or public energy grid. Utility companies are going to have regulations and technical requirements for the connection of this equipment to the grid. It is up to the end user to be aware of and meet all applicable requirements and registrations before installing and operating this unit. See [2.4.1. NS Protection Devices for Sink Operation](#).

## 2 Installation Preparation

### 2.1 Operation and Programming Guides

This document does not cover user operation and remote programming capabilities. To acquire the documentation for that, visit <http://www.marway.com/docs>. You want the *411 Series Operation Guide and Programming Reference*.

### 2.2 Unpacking and Visual Check

After every transport, with or without packaging, or before commissioning, the equipment should be visually inspected for damage. An obviously damaged unit (e.g. loose parts inside, damage outside) must under no circumstances be put into service.

### 2.3 Transport and Storage

#### 2.3.1 Transport



- **The handles on the front and rear side of the unit are not for carrying.**
- Because of its weight, transport by hand should be avoided where possible. If unavoidable then only the housing should be held and not on the exterior parts (handles, DC output, rotary knobs).
- Do not transport when switched on or connected.
- When relocating the equipment use of the original packing is recommended
- The unit should always be carried and mounted horizontally
- Use suitable safety clothing, especially safety shoes, when carrying the equipment, as due to its weight a fall can have serious consequences.

#### 2.3.2 Packaging

It's recommended to keep the complete transport packaging for the lifetime of the power supply for relocation or return to the manufacturer for repair.

#### 2.3.3 Storage

In case of long term storage of the equipment, it is recommended to use the original packaging or similar. Storage must be in dry rooms, if possible in sealed packaging, to avoid corrosion through humidity—especially to internal components.

## 2.4 Safety Considerations Before Installation

Review safety notes in section [1.4. Safety Notices](#).



- The product has considerable weight. Therefore, the proposed location of the equipment (table, cabinet, shelf, 19" rack) must be verified it is able to support the weight.
- When using a 19" rack, rails suitable for the width of the housing and the weight of the unit are to be used. Weight estimates are available in the Model Specifications tables of the *Operating Guide*.
- Before connecting to the mains ensure that the supply voltage is as shown on the product label. Overvoltage on the AC supply can cause equipment damage.
- The 411 Series power supplies feature an energy recovery function which, similar to solar energy equipment, feeds energy back to the local or public energy grid. Utility companies are going to have regulations and technical requirements for the connection of this equipment to the grid. It is up to the end user to be aware of and meet all applicable requirements and registrations before installing and operating this unit. See [2.4.1. NS Protection Devices for Sink Operation](#).

### 2.4.1 NS Protection Devices for Sink Operation

All models of the 411 Series feature the ability to sink power from an external source. When performing this function, energy is routed back to the AC source utility grid. **The electronic load function of the 411 Series cannot work unless the unit can sink energy to the grid.**

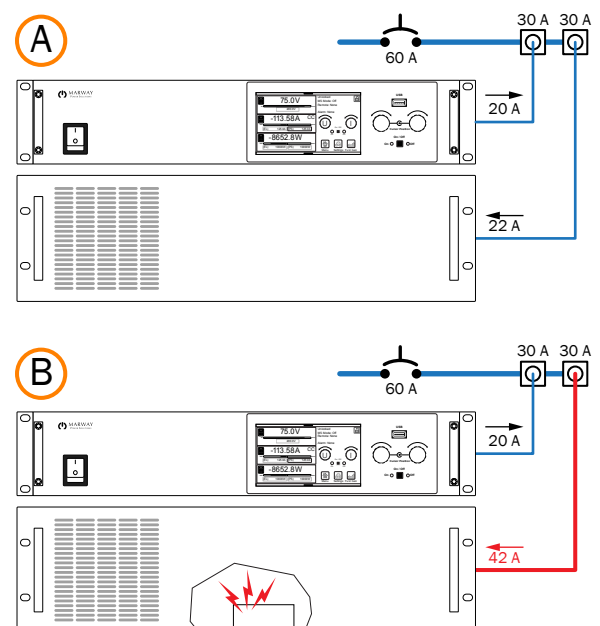
Utility companies are going to have regulations and technical requirements for the connection of this type of equipment to the grid. Often a *network and system protection device* will be required between the utility power source and the energy feedback system (the 411 power supply). The NS protection device ensures that the power from the 411 system is electrically compatible to connect to the utility grid. It will automatically disconnect the power supply if there are any incompatibilities with voltage or frequency. This device must meet local regulations, and is the responsibility of the end user to acquire and install.

### 2.4.2 Adjacent AC Branch Protection

It is critical to consider the protection of wiring on circuits shared with the regenerative power supply. For example, a breakered branch might have multiple outlets on it (A). One outlet for the regenerative power supply, one or more outlets for other devices. It would be common for there to not be any breakers or fuses for the individual outlets.

However, if one of the outlet powered devices were to have an internal problem (B) which caused extra current draw, that current could come from the regenerative power supply, and added to the current from the grid source. The hazard this may create is that the wiring from the outlet to the device may be overloaded without tripping the upstream breaker – creating a risk for fire.

It is important to consider additional breakers or fusing for each branch of wiring on circuits adjacent to the mPower 411.



## 2.4.3 Mounting the unit

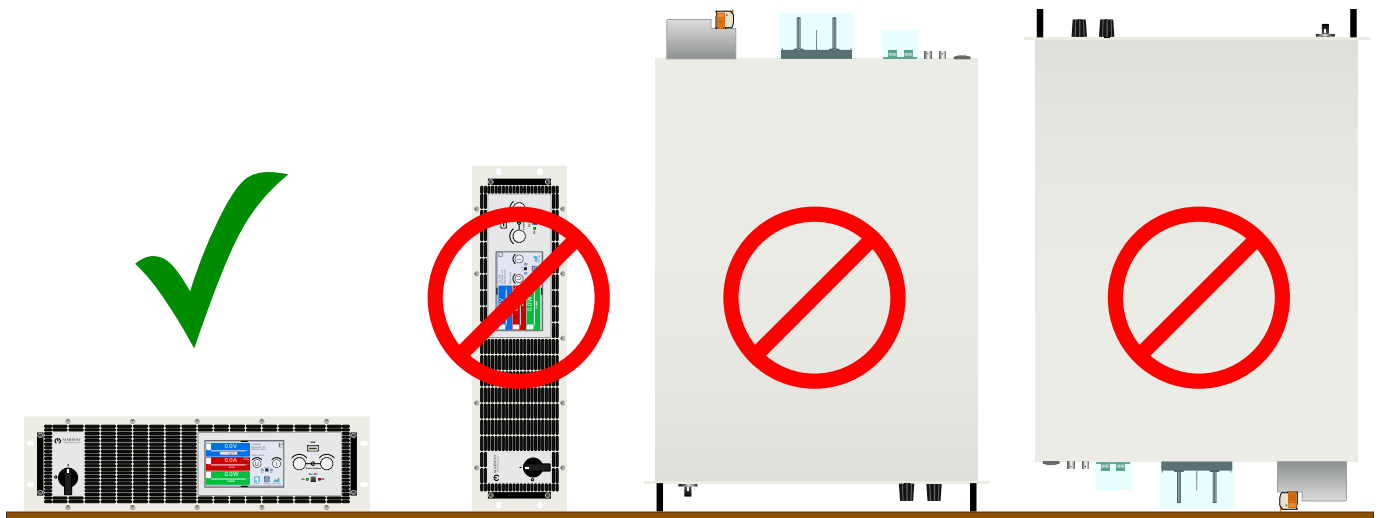


- Select the location for the equipment so that the connection to the load is as short as possible.
- Leave sufficient space behind the equipment, minimum 30 cm (1 ft), for ventilation.
- The unit is not stackable.
- Do not put anything with a total weight of more than 1 kg (2.5 lb) on top of the unit.

With all models, mounting brackets are included to mount the unit in a 19" rack. A rackmount installation will usually mount the power supply on suitable weight-rated rails (not included), and installed in 19" racks or cabinets. The depth of the power supply and rack, and its weight must be taken into account when selecting rails. The handles on the front are for sliding in and out of the cabinet. Slots on the mounting brackets of the front panel are for securing the unit to the rack's vertical rails to prevent inadvertent movement on the slides.

If the unit will be used in a table top setting, the brackets may be removed, and self-adhesive feet attached to the bottom of the unit.

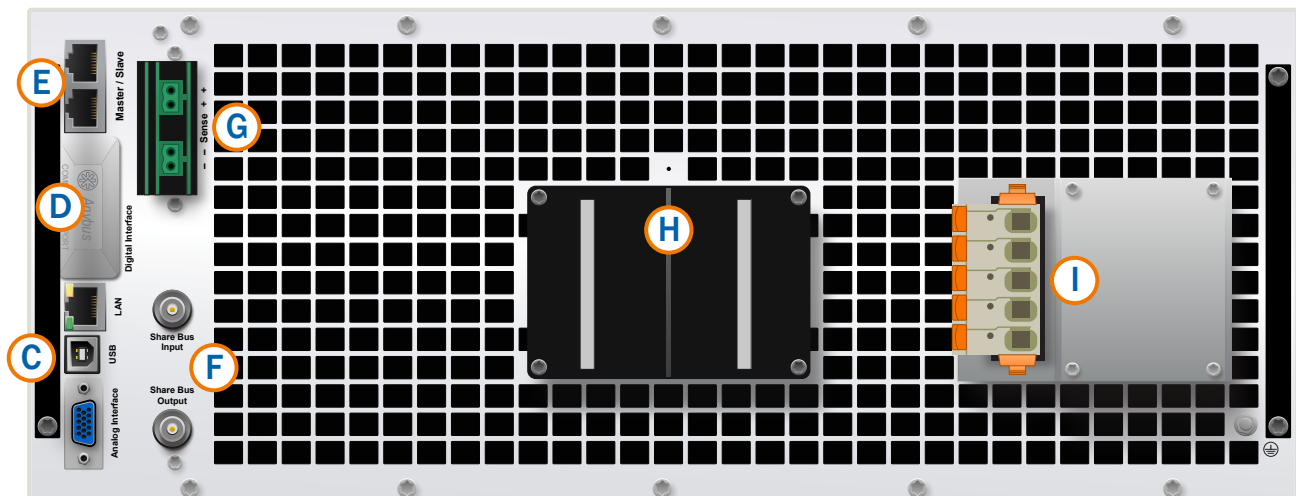
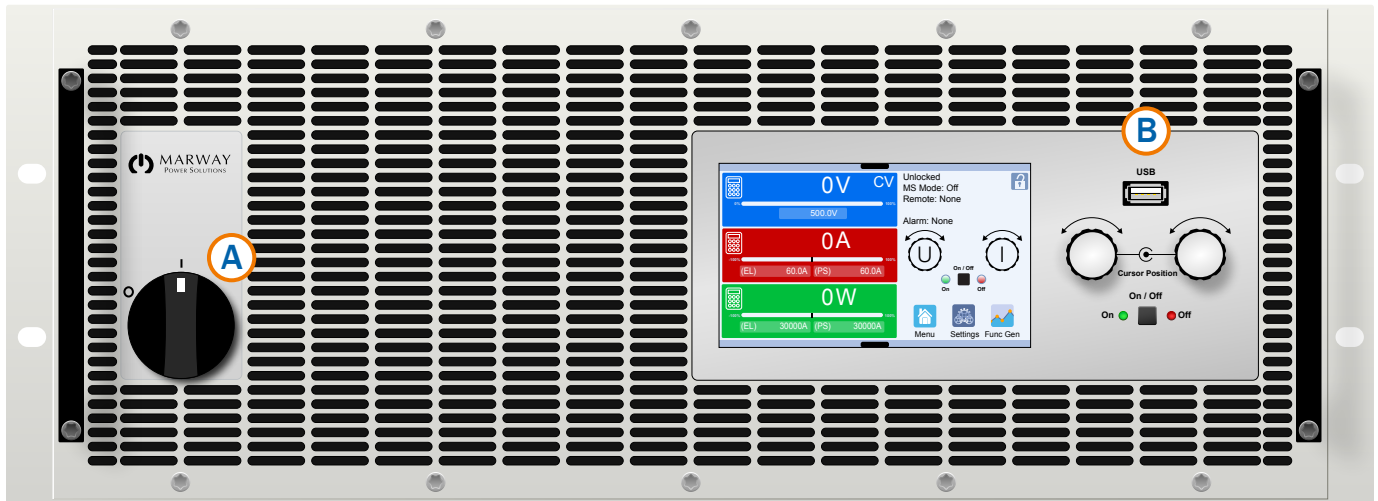
Acceptable and unacceptable installation positions relative to a table surface.



## 3 Installation 4U 411-54 Models

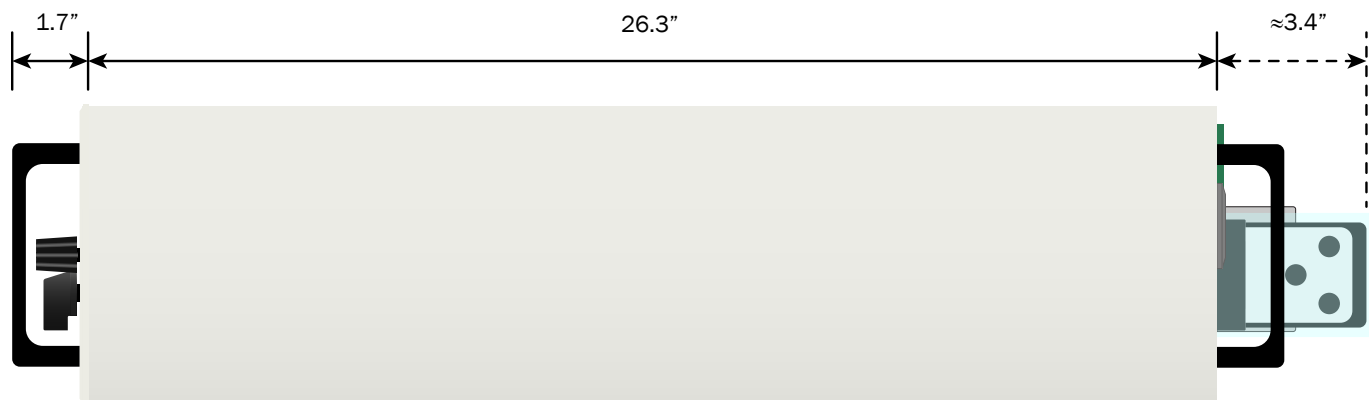
### 3.1 4U 411-54 Physical Details

This section covers mPower 411 Series 4U models with input power of 380–480 Vac three phase.

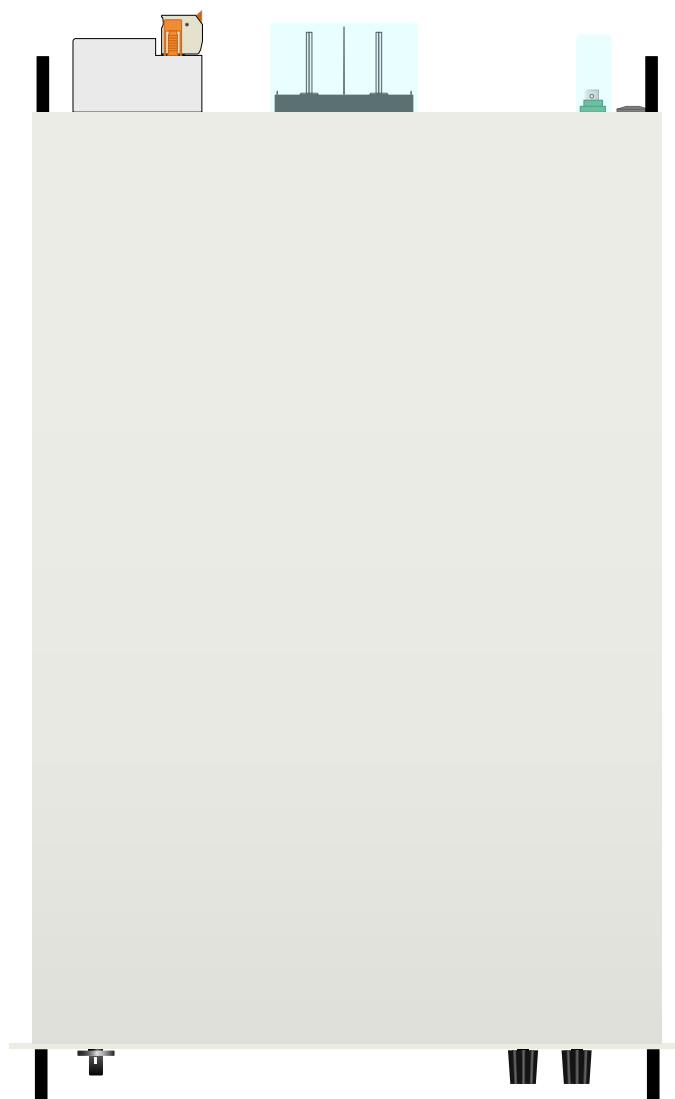


- |                                                         |                                     |
|---------------------------------------------------------|-------------------------------------|
| A - Power switch                                        | F - Share bus connectors            |
| B - Control panel                                       | G - Remote voltage sense connectors |
| C - Built-in remote interfaces<br>Ethernet, USB, Analog | H - DC output terminals             |
| D - Anybus expansion port                               | I - AC input connector              |
| E - Master/Slave ports                                  |                                     |

4U side shown with Type 2 DC terminals and cover. Note that DC outlet dimensions varies by type, with the maximum being noted, but does not include cable bend radius.



4U top view shown with Type 1 DC terminals and cover. (Shown at a smaller scale than the other views.) There are two types of DC terminals. The one used on your specific model depends on the DC output voltage rating of the unit. Details about these connections are covered in [3.3. 4U 411-54 DC Output Connections](#).



## 3.2 4U 411-54 AC Power Connections



- Connection to an AC mains supply may only be carried out by qualified personnel.
- Cable cross section must be suitable for the maximum input current of the unit (see tables below).
- Before connecting the input plug, ensure that the main power switch is OFF.
- The neutral conductor of a standard 5-conductor cable is not required, but can be connected to the free slot on the AC plug.
- GND must always be connected.
- The unit must always be connected DIRECTLY to the facility power source. DO NOT operate the unit on generators or on UPS equipment.
- The 411 Series power supplies feature an energy recovery function which, similar to solar energy equipment, feeds energy back to the local or public energy grid. Utility companies are going to have regulations and technical requirements for the connection of this equipment to the grid. It is up to the end user to be aware of and meet all applicable requirements and registrations before installing and operating this unit. See [2.4.1. NS Protection Devices for Sink Operation](#).

### 3.2.1 AC phase requirements (4U 411-54)

These models require 380/400/480 Vac 3-phase delta to deliver their full power. A 3-phase wye power source can be used, but neutral will not be used.

All models can run on 208 Vac 3-phase, but the unit will deliver 18 kW instead of 30 kW. Note the 10 Vdc model delivers a limit of 10kW.

Mains connection for the unit is done via the included 5-pole plug on the back panel. Wiring of the plug requires at least a 4-wire (3 lines and GND) cable of suitable cross section and length. 5-wire installation with neutral is also suitable.

Rated power	Supply Voltage	Inputs on AC Plug	DC Power
30 kW	380/400/480 Vac	L1, L2, L3, (N), GND	30,000 watts
30 kW	208 Vac	L1, L2, L3, (N), GND	18,000 watts

### Cable cross sections

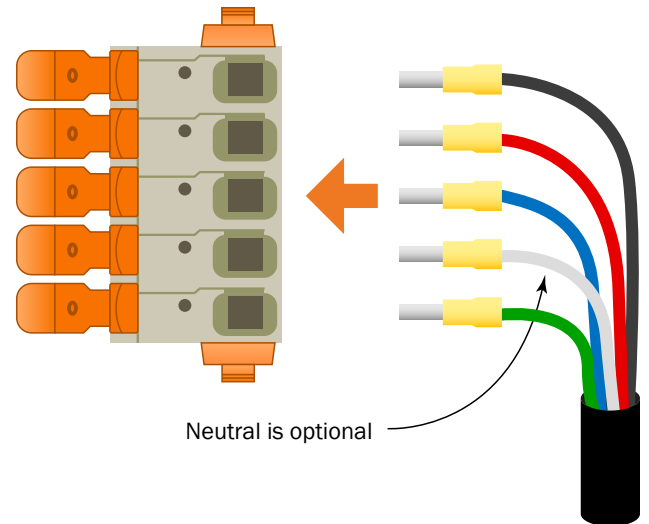
For the selection of a suitable cable **cross section** the rated AC current of the unit and the cable length are important factors. Based on the connection of a **single unit**, the table lists the maximum input current and recommended minimum cross section for each phase.

Rated power	L1		L2		L3		GND
	Ø	I <sub>max</sub>	Ø	I <sub>max</sub>	Ø	I <sub>max</sub>	Ø
30 kW	8 AWG 10 mm <sup>2</sup>	56 A	8 AWG 10 mm <sup>2</sup>	56 A	8 AWG 10 mm <sup>2</sup>	56 A	8 AWG 10 mm <sup>2</sup>
10 kW (10 Vdc model)	8 AWG 10 mm <sup>2</sup>	40 A	8 AWG 10 mm <sup>2</sup>	40 A	8 AWG 10 mm <sup>2</sup>	40 A	8 AWG 10 mm <sup>2</sup>

### 3.2.2 AC connection (4U 411-54)

The longer the connection cable, the higher the voltage loss due to the cable resistance. Therefore the mains cable should be kept as short as possible or have an even bigger cross section. Cables with 4 or 5 conductors can be used. When using a cable with neutral, it gets connected to what is an unused pin of the AC plug.

- When using cable sleeves, a cable of AWG 6 (16 mm<sup>2</sup>) max is possible.
- When using bare wires, a cable of AWG 4 (25 mm<sup>2</sup>) max is possible. Strip the cable insulation about 0.75 inch.



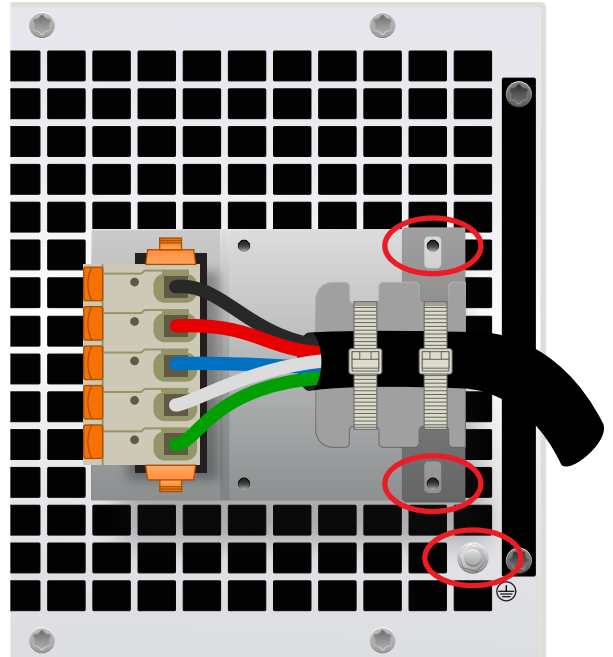
### 3.2.3 AC grounding (4U 411-54)

Below the AC input connector is a chassis grounding lug (on models built from 2022 onward). Connect this to an earth ground for added safety. The cable must be at least the same gage (or larger) than the gage used for the inlet power cables.

### 3.2.4 AC strain relief bracket (4U 411-54)

All models in this series come with a strain relief for the AC cable. Unless there are other plans for cable support, it's recommended to mount this strain relief bracket.

- Remove the two right screws from the AC filter box.
- Place the bracket and fix it with the included, longer screws (M3x8) and spring/curved washers.
- Connect the AC plug, then hold the cable in front of the bracket, and secure it with two cable ties.





## 3.3 4U 411-54 DC Output Connections



- In the case of a unit with a high nominal current and hence a thick and heavy DC connection cable it's necessary to take account of the weight of the cable and the strain imposed on the DC connection. Especially when mounted in a 19" cabinet or similar, where the cable hangs on the DC output, a strain reliever should be used.
- Connection to and operation with transformerless DC-AC inverters (e.g. solar inverters) is restricted, because the inverter can shift the potential of negative output (DC-) against ground. Mind the maximum allowed potential shift (see the Model Specifications tables of the *Operating Guide*).
- The DC load output is not protected by a fuse.

### 3.3.1 DC cable requirements (4U 411-54)

The cross section of the connection cable is determined by the current consumption, cable length, and ambient temperature.

For cables up to 5 ft (1.5m) and average ambient temperature up to 122 °F (50 °C), we recommend the following per pole connection (multi-conductor, insulated, openly suspended).

up to 40 A:	AWG 8 (6 mm <sup>2</sup> )	up to 180 A:	AWG 3/0 (70 mm <sup>2</sup> )
up to 60 A:	AWG 4 (16 mm <sup>2</sup> )	up to 240 A:	2x AWG 1 (2x 35 mm <sup>2</sup> )
up to 80 A:	AWG 2 (25 mm <sup>2</sup> )	up to 420 A:	2x AWG 4/0 (2x 95 mm <sup>2</sup> )
up to 120 A:	AWG 1 (35 mm <sup>2</sup> )	up to 1000 A:	3x 400 MCM (3x 185 mm <sup>2</sup> )

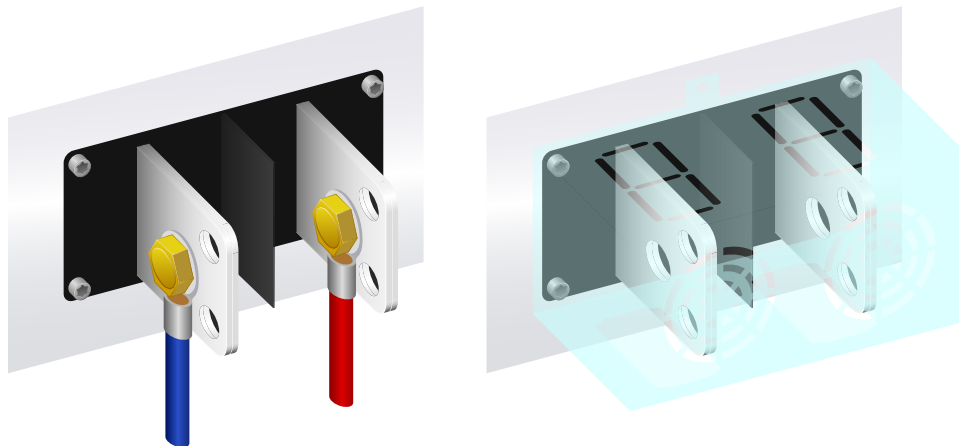
Single cables of, for example, AWG 3/0 may be replaced by 2x AWG 1 etc. If the cables are long, then the cross section must be increased to avoid voltage loss and overheating. This should be done in accordance with local electrical codes.

### 3.3.2 DC terminal types (4U 411-54)

The illustrations below show an overview of the two DC terminal types used on 411-54 Series units. The type on any particular unit depends on its output voltage rating. It's recommended that connection of load cables always utilize flexible cables with ring lugs. Some models will include a plastic cover for the DC terminals.

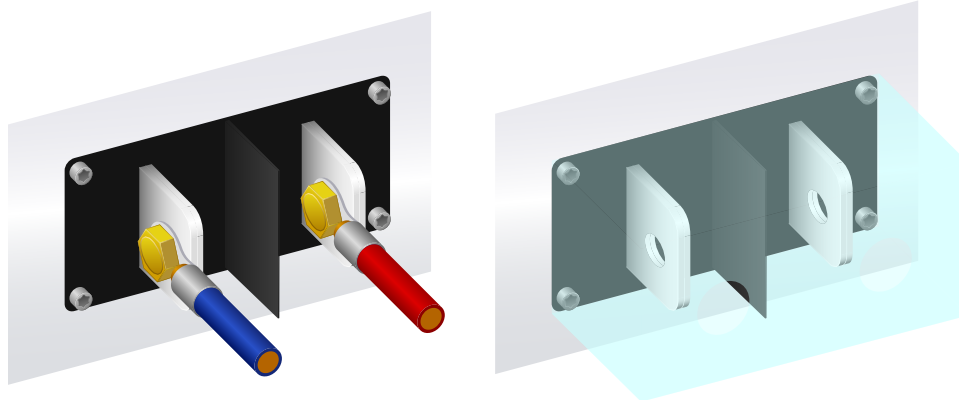
#### Type 1 output terminals

This type (shown with cover off and on) is used on models up to, and including, 200 Vdc. The terminal bolt is an M10 used with a ring lug having an 11 mm hole. Cables can be routed up, down, or straight back through openings in the cover.



## Type 2 output terminals

This type (shown with cover off and on) is used on models from 360 Vdc and greater. The terminal bolt is an M6 used with a ring lug having a 6.5mm hole. Cables are routed straight back through openings in the cover.



## DC connector cover

A clear plastic cover for contact protection is included for the DC terminal. It should always be installed. The cover for type 1 it is connected to the back of the unit, whereas for type 2, it is fixed to the DC connector itself. The cover for type 1 also has breakouts so that the supply cable can be laid in various directions. Type 2 connections can be horizontal only.



The connection angle and the required bending radius for the DC cable must be taken into account when planning the depth of the complete unit, especially when installing in a 19" cabinet or similar. For type 2 connectors only a horizontal lead must be used to allow for installation of the cover.

### 3.3.3 DC output grounding (4U 411-54)

No matter if the power supply is operated stand-alone or in series connection with others, it is always only allowed to ground one of all DC output poles. Additionally, because of isolation, there is a maximum allowed potential shift of the DC output poles. This value is model specific. Refer to the Model Specifications tables of the *Operating Guide*.

The DC minus pole of a stand-alone unit can be grounded right away, but it should only be done if absolutely necessary, because the DC output is connected to GND via X capacitors in order to gain better high frequency filtering.

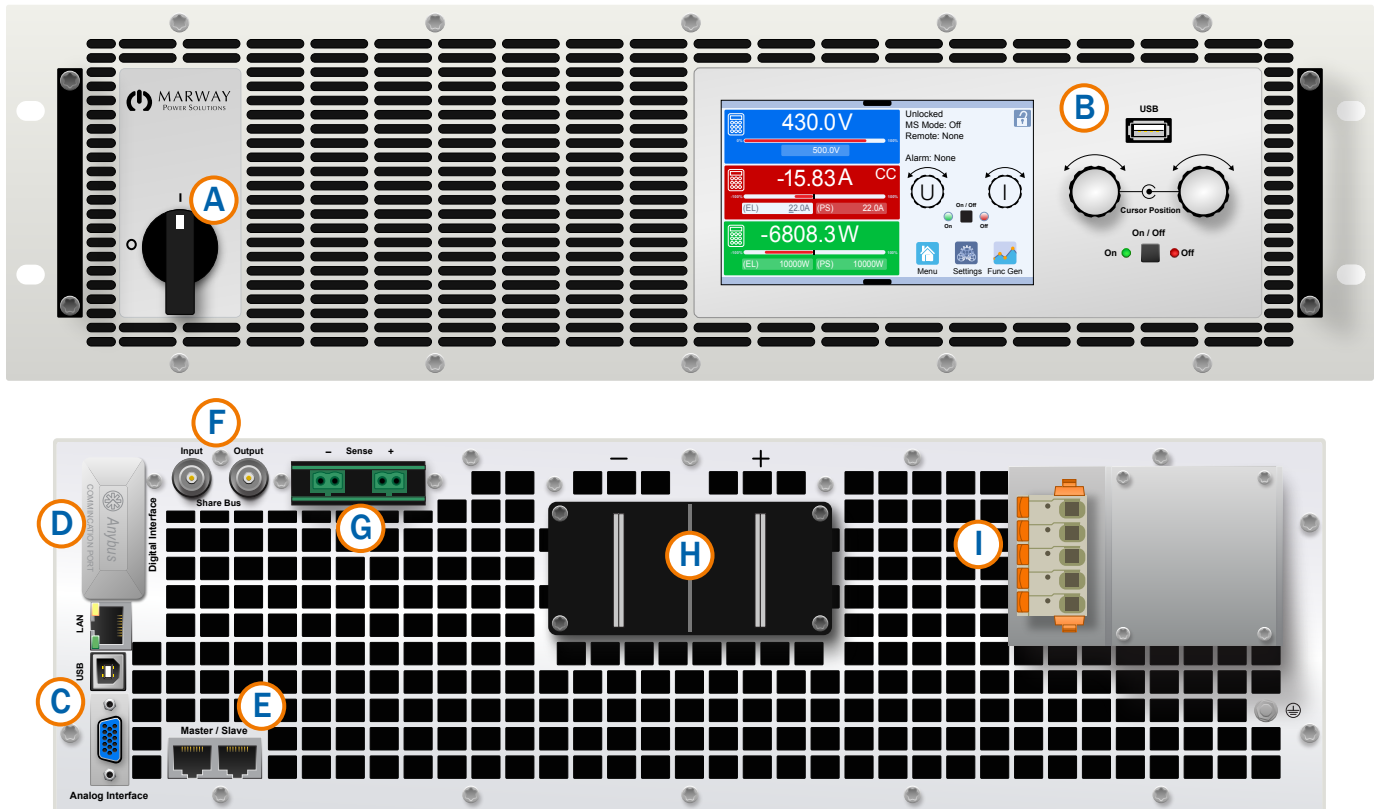


- Digital and analog interfaces are galvanically isolated from the DC output, and should never be grounded, but under no circumstances if any of the DC output poles are grounded too, because this will cancel the galvanic isolation.
- If one of the DC output poles is to be grounded, check if any pole of the load is already grounded. This could lead to a short circuit.

## 4 Installation 3U 411-53 Models

### 4.1 3U 411-53 Physical Details

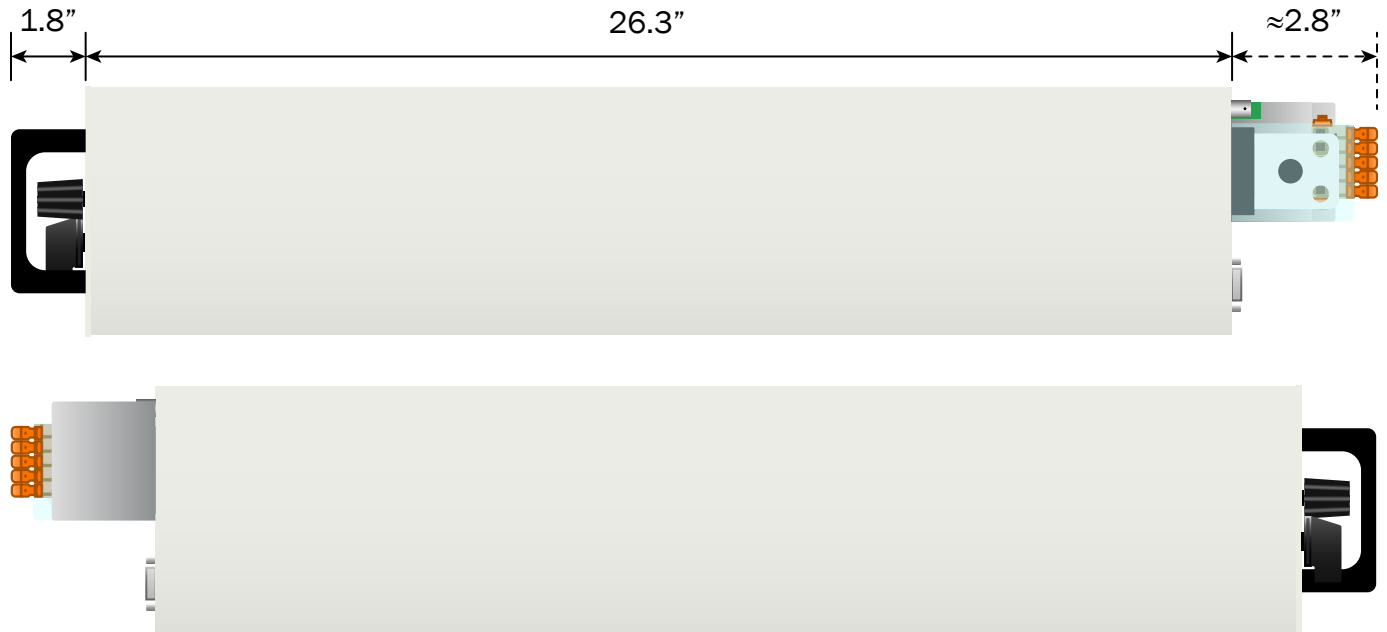
This section covers mPower 411 Series 3U models with input power of 380–480 Vac single phase and three phase.



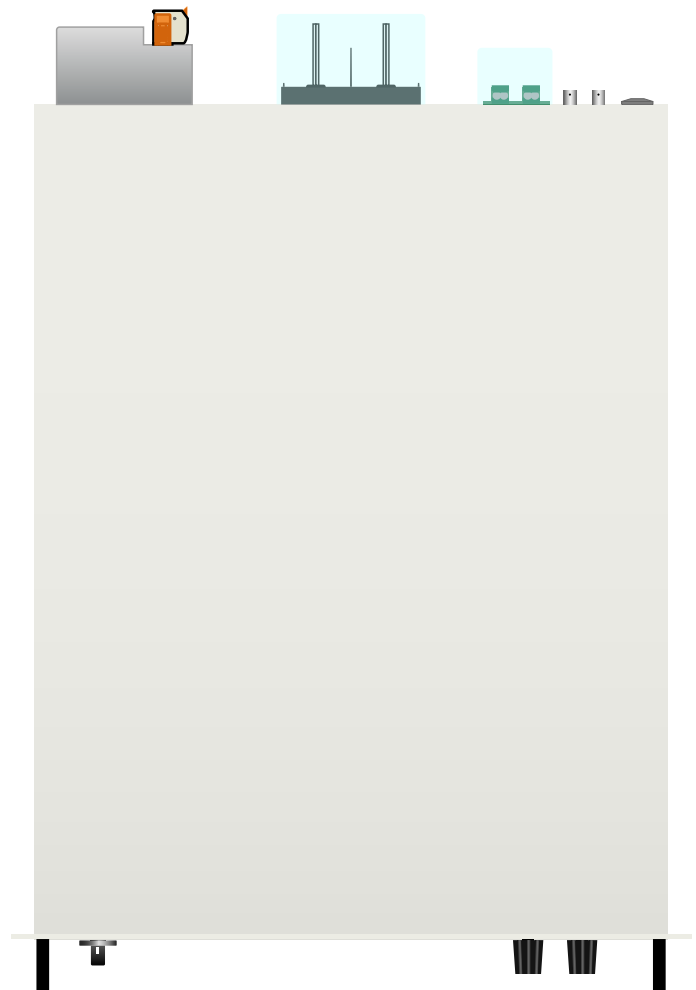
- A - Power switch
- B - Control panel
- C - Built-in remote interfaces  
Ethernet, USB, Analog
- D - Anybus expansion port
- E - Master/Slave ports

- F - Share bus connectors
- G - Remote voltage sense connectors
- H - DC output terminals
- I - AC input connector

3U sides shown with 3U Type 1 DC terminals and cover. Note that DC outlet dimensions varies by type, with the maximum being noted, but does not include cable bend radius.



3U top view shown with Type 1 DC terminals and cover. (Shown at a smaller scale than the other views.) There are two types of DC terminals. The one used on your specific model depends on the DC output voltage rating of the unit. Details about these connections are covered in [4.3. 3U 411-53 DC Output Connections](#).



## 4.2 3U 411-53 AC Power Connections



- Connection to an AC mains supply may only be carried out by qualified personnel.
- Cable cross section must be suitable for the maximum input current of the unit (see tables below).
- Before connecting the input plug, ensure that the main power switch is OFF.
- It is recommended to always connect all three phases, even if the unit doesn't require them, because then no phase can be missing.
- The unit must always be connected DIRECTLY to the facility power source. DO NOT operate the unit on generators or on UPS equipment.
- The 411 Series power supplies feature an energy recovery function which, similar to solar energy equipment, feeds energy back to the local or public energy grid. Utility companies are going to have regulations and technical requirements for the connection of this equipment to the grid. It is up to the end user to be aware of and meet all applicable requirements and registrations before installing and operating this unit. See [2.4.1. NS Protection Devices for Sink Operation](#).

### 4.2.1 AC phase requirements (3U 411-53)

These models are intended to run with 380/400/480 Vac 3-phase delta sources. Some models will use only 2 phases. A 3-phase wye power source can be used, but neutral will not be used.

All models can be run on 208 Vac 3-phase as well, but the power capacity of the unit will be derated to 60% of their rated power (5 kW becomes 3 kW, 10 kW become 6 kW, and 15 kW becomes 9 kW).

The equipment is delivered with a 5 pole mains plug. Depending on model, this will be connected with a 2-phase or 3-phase mains supply, which has to be connected according to the labeling on the plug.

Rated power	Supply Voltage	Inputs on AC Plug	DC Power
5 kW	380/400/480 Vac	L2, L3, GND	5,000 watts
5 kW	208 Vac	L2, L3, GND	3,000 watts
10 kW	380/400/480 Vac	L1, L2, L3, (N), GND	10,000 watts
10 kW	208 Vac	L1, L2, L3, (N), GND	6,000 watts
15 kW	380/400/480 Vac	L1, L2, L3, (N), GND	15,000 watts
15 kW	208 Vac	L1, L2, L3, (N), GND	9,000 watts

#### Cable cross sections:

For the selection of a suitable cable **cross section** the rated AC current of the unit and the cable length are important factors. Based on the connection of a **single unit**, the table lists the maximum input current and recommended minimum cross section for each phase. All 10 Vdc models can use the wiring for the 5 kW nominal power listing.

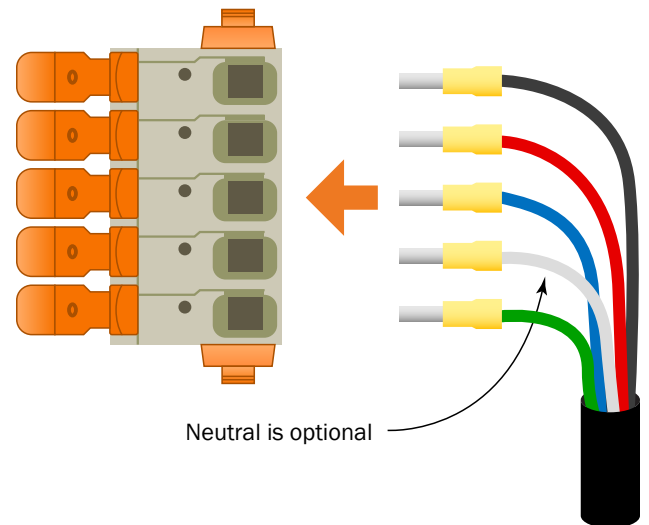
Nominal power	L1		L2		L3		GND
	Ø	I <sub>max</sub>	Ø	I <sub>max</sub>	Ø	I <sub>max</sub>	Ø
5 kW	n/a	n/a	14 AWG 2.5 mm <sup>2</sup>	16 A	14 AWG 2.5 mm <sup>2</sup>	16 A	14 AWG 2.5 mm <sup>2</sup>
10 kW	10 AWG 4 mm <sup>2</sup>	28 A	10 AWG 4 mm <sup>2</sup>	16 A	10 AWG 4 mm <sup>2</sup>	16 A	10 AWG 4 mm <sup>2</sup>
15 kW	10 AWG 4 mm <sup>2</sup>	28 A	10 AWG 4 mm <sup>2</sup>	28 A	10 AWG 4 mm <sup>2</sup>	28 A	10 AWG 4 mm <sup>2</sup>

## 4.2.2 AC connection (3U 411-53)

5kw models use only L2 and L3 connections. 10kw and 15kW units use all three connections. When servicing the 5kW units with a three phase source, it is recommended that all conductors actually be connected to prevent possible hazards from an untethered cable.

The longer the connection cable, the higher the voltage loss due to the cable resistance. Therefore the mains cable should be kept as short as possible or have an even bigger cross section. Cables with 4 or 5 conductors can be used. When using a cable with neutral, it gets connected to what is an unused pin of the AC plug.

- When using cable sleeves, a cable of AWG 10 (6 mm<sup>2</sup>) max is possible.
- When using bare wires, a cable of AWG 8 (10 mm<sup>2</sup>) max is possible. Strip the cable insulation about 0.75 inch.



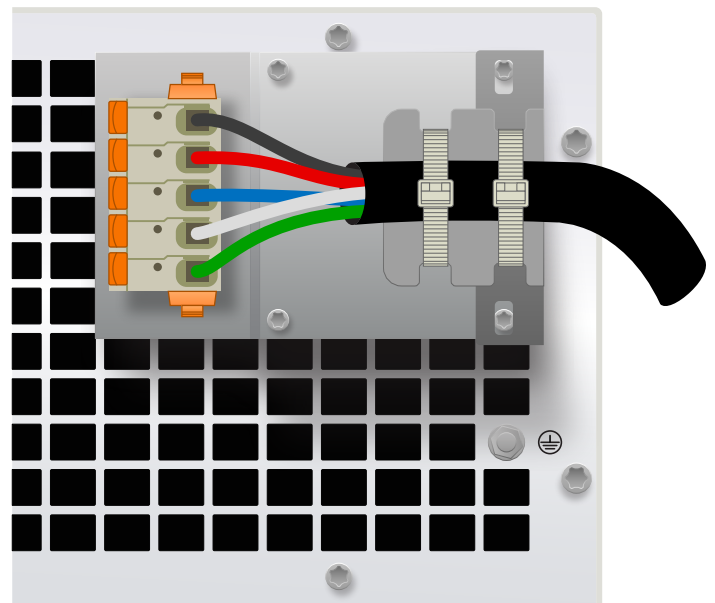
## 4.2.3 AC grounding (3U 411-53)

Below the AC input connector is a chassis grounding lug (on models built from 2022 onward). Connect this to an earth ground for added safety. The cable must be at least the same gage (or larger) than the gage used for the inlet power cables.

## 4.2.4 AC strain relief bracket (3U 411-53)

All models in this series come with a strain relief for the AC cable. Unless there are other plans for cable support, it's recommended to mount this strain relief bracket.

- Remove the two right screws from the AC filter box.
- Place the bracket and fix it with the included, longer screws (M3x8) and spring/curved washers.
- Connect the AC plug, then hold the cable in front of the bracket, and secure it with two cable ties.



## 4.2.5 AC connection balancing (3U 411-53)

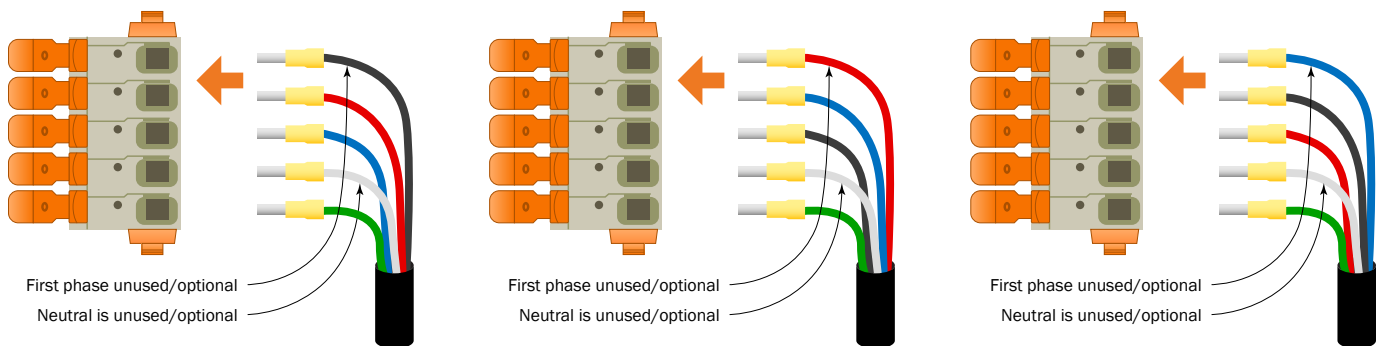
Depending on the maximum power rating of a specific model, it requires two or three phases of a three-phase AC supply. In case multiple units with 2-phase requirements are connected to the same main terminal, it is recommended to arrange units on different supply phases to better balance the current distribution on the three phases.

The 10 kW and higher power models already consume balanced current on all three phases. As long as only these models are installed, no unbalanced AC load is expected.

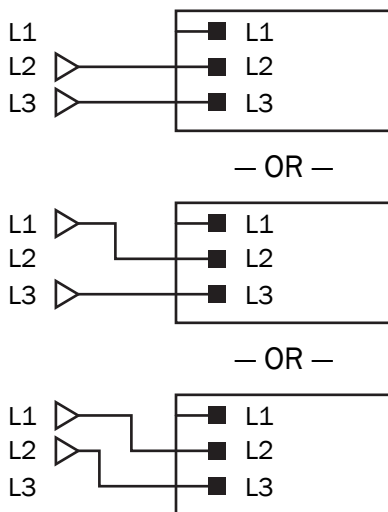
Mixed installations with 2-phase and 3-phase models are not automatically balanced.

### Suggestions for assigning phases

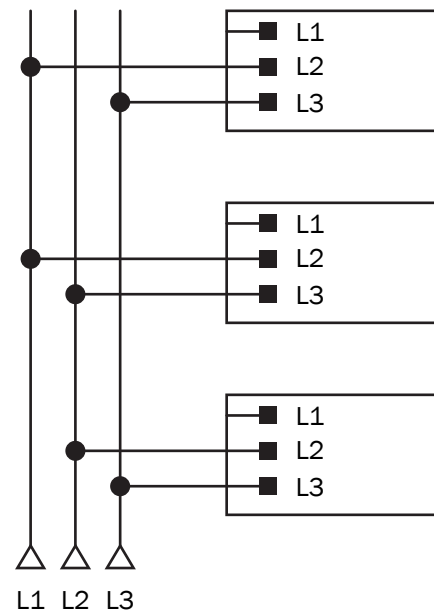
Rotate which phase is unused by installing it in L1. Both the unused phase and neutral, if present, should be installed in the connector to avoid untethered wires.



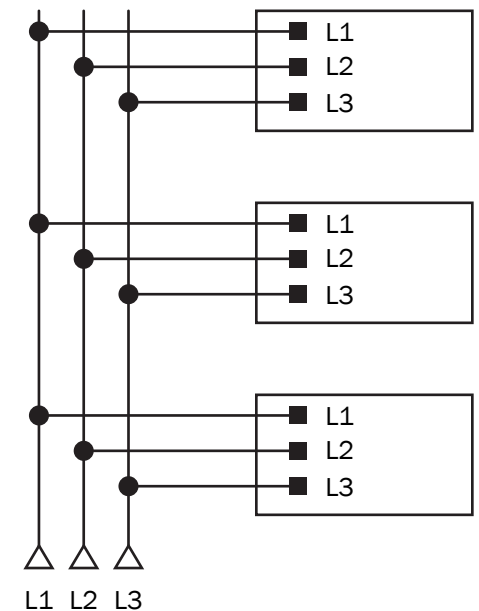
Single unit with 2-phase  
3 options



Multiple units with 2-phase  
Mix connections to balance the load



Multiple units with 3-phase  
All connections to corresponding phases



## 4.3 3U 411-53 DC Output Connections



- In the case of a unit with a high nominal current and hence a thick and heavy DC connection cable it's necessary to take account of the weight of the cable and the strain imposed on the DC connection. Especially when mounted in a 19" cabinet or similar, where the cable hangs on the DC output, a strain reliever should be used.
- Connection to and operation with transformerless DC-AC inverters (e.g. solar inverters) is restricted, because the inverter can shift the potential of negative output (DC-) against ground. Mind the maximum allowed potential shift (see the Model Specifications tables of the *Operating Guide*).
- The DC load output is not protected by a fuse.

### 4.3.1 DC cable requirements (3U 411-53)

The DC load output is on the back of the unit and is not protected by a fuse. The cross section of the connection cable is determined by the current consumption, cable length and ambient temperature.

For cables up to 5 ft (1.5m) and average ambient temperature up to 122 °F (50 °C), we recommend the following per pole connection (multi-conductor, insulated, openly suspended).

up to 30 A:	AWG 8 (6 mm <sup>2</sup> )	up to 170 A:	AWG 3/0 (70 mm <sup>2</sup> )
up to 70 A:	AWG 4 (16 mm <sup>2</sup> )	up to 210 A:	AWG 4/0 (95 mm <sup>2</sup> )
up to 90 A:	AWG 2 (25 mm <sup>2</sup> )	up to 340 A:	2x AWG 3/0 (2x 70 mm <sup>2</sup> )
up to 140 A:	AWG 1/0 (50 mm <sup>2</sup> )	up to 510 A:	2x 250 MCM (2x 120 mm <sup>2</sup> )

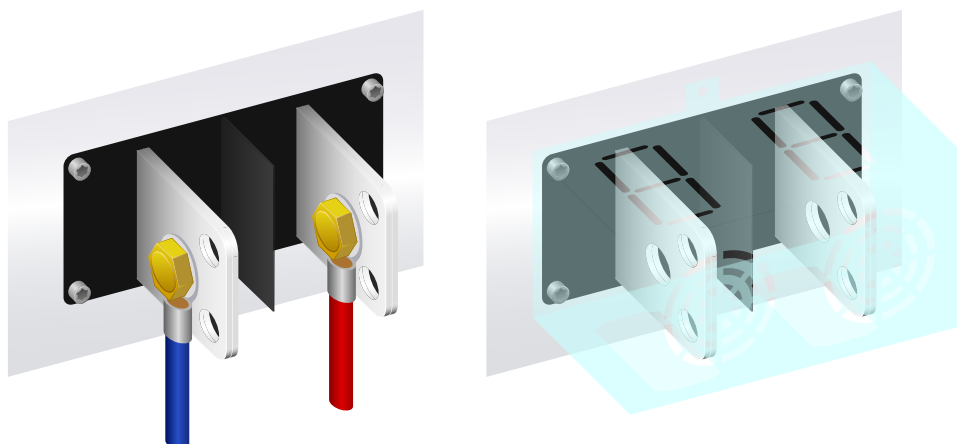
Single cables of, for example, AWG 3/0 may be replaced by 2x AWG 1 etc. If the cables are long, then the cross section must be increased to avoid voltage loss and overheating. This should be done in accordance with local electrical codes.

### 4.3.2 DC terminal types (3U 411-53)

The illustrations below show an overview of the two DC terminal types used on 310-33/310-53 units. The type on any particular unit depends on its output voltage rating. It's recommended that connection of load cables always utilize flexible cables with ring lugs.

#### Type 1 output terminals

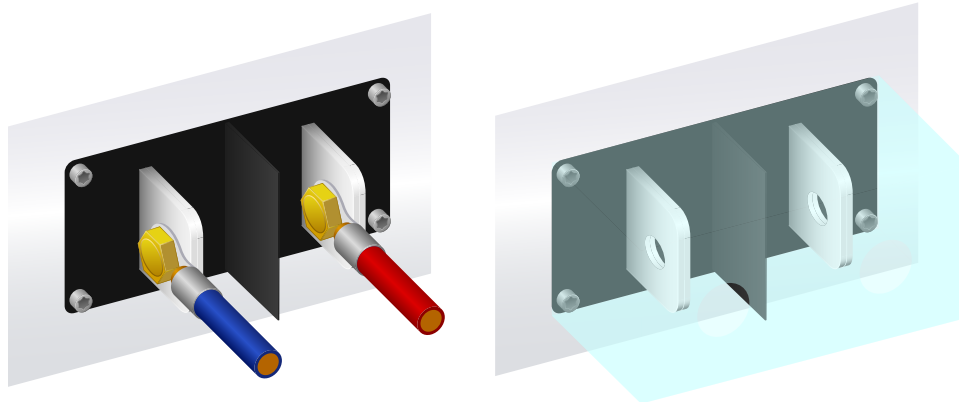
This type (shown with cover off and on) is used on models up to, and including, 360 Vdc. The terminal bolt is an M8 used with a ring lug. Cables can be routed up, down, or straight back through openings in the cover.





## Type 2 output terminals

This type (shown with cover off and on) is used on models from 500 Vdc and greater. The terminal bolt is an M6 used with a ring lug. Cables are routed straight back through openings in the cover.



## DC connector cover

A clear plastic cover for contact protection is included for the DC terminal. It should always be installed. The cover for type 1 it is connected to the back of the unit, whereas for type 2, it is fixed to the DC connector itself. The cover for type 1 also has breakouts so that the supply cable can be laid in various directions. Type 2 connections can be horizontal only.



The connection angle and the required bending radius for the DC cable must be taken into account when planning the depth of the complete unit, especially when installing in a 19" cabinet or similar. For type 2 connectors only a horizontal lead must be used to allow for installation of the cover.

### 4.3.3 DC output grounding (3U 411-53)

No matter if the power supply is operated stand-alone or in series connection with others, it is always only allowed to ground one of all DC output poles. Additionally, because of isolation, there is a maximum allowed potential shift of the DC output poles. This value is model specific. Refer to the Model Specifications tables of the *Operating Guide*.

The DC minus pole of a stand-alone unit can be grounded right away, but it should only be done if absolutely necessary, because the DC output is connected to GND via X capacitors in order to gain better high frequency filtering.

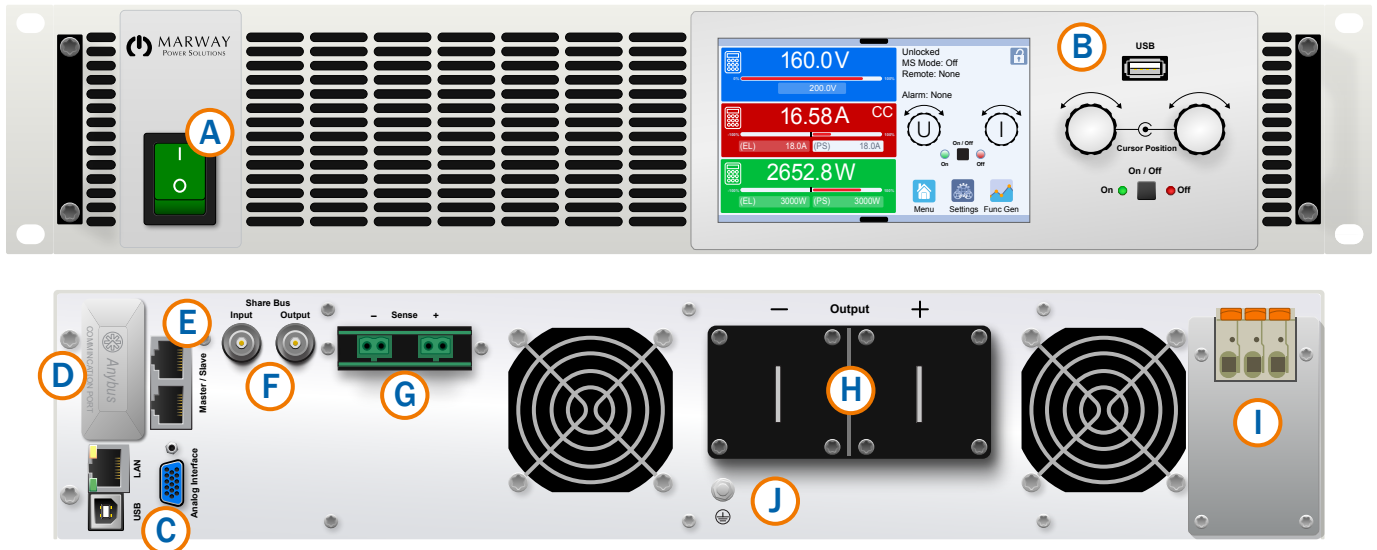


- Digital and analog interfaces are galvanically isolated from the DC output, and should never be grounded, but under no circumstances if any of the DC output poles are grounded too, because this will cancel the galvanic isolation.
- If one of the DC output poles is to be grounded, check if any pole of the load is already grounded. This could lead to a short circuit.

## 5 Installation 2U 411-02 Models

### 5.1 2U Physical Details

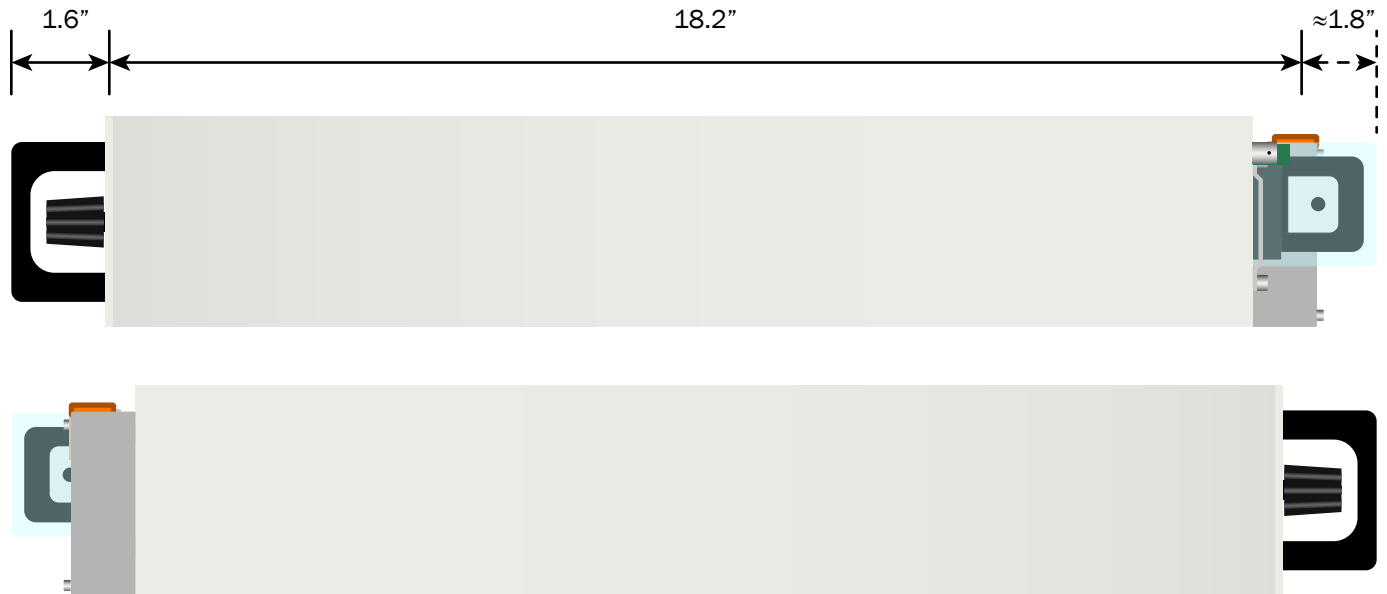
This section covers mPower 411 Series 2U models with input power of 120–240 Vac single phase.



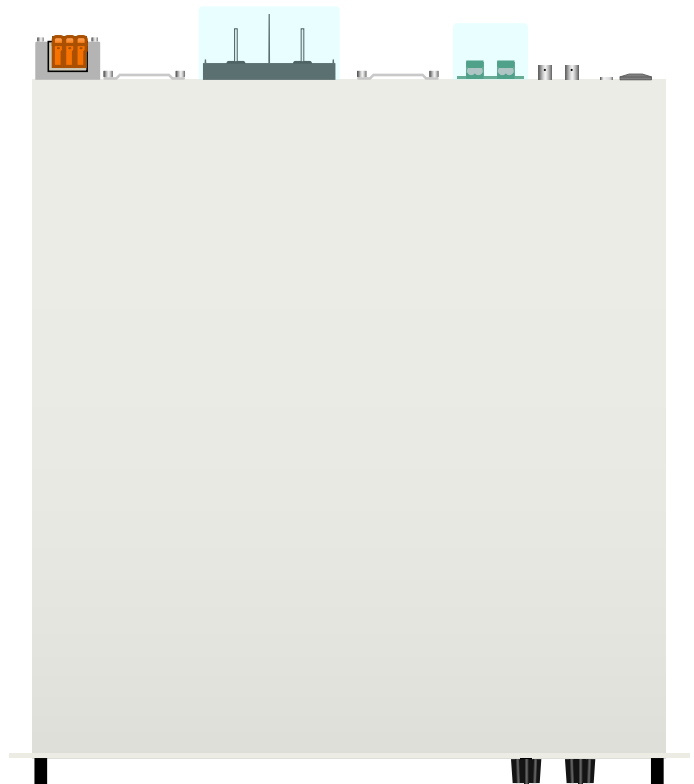
- A - Power switch
- B - Control panel
- C - Built-in remote interfaces  
Ethernet, USB, Analog
- D - Anybus expansion port
- E - Master/Slave ports

- F - Share bus connectors
- G - Remote voltage sense connectors
- H - DC output terminals
- I - AC input connector
- J - AC earth ground

2U sides shown with Type 1 DC terminals and cover. Note that DC outlet dimensions varies by type, with the maximum being noted, but does not include cable bend radius.



2U top view shown with Type 1 DC terminals and cover. (Shown at a smaller scale than the other views.) There are two types of DC terminals. The one used on your specific model depends on the DC output voltage rating of the unit. Details about these connections are covered in [5.3. 2U 411-02 DC Output Connections](#).



## 5.2 2U 411-02 AC Power Connections



- Connection to an AC mains supply may only be carried out by qualified personnel.
- The ground conductor is mandatory, and must always be wired to facility ground.
- Cable cross section must be suitable for the maximum input current of the unit (see tables below).
- Before connecting the input plug, ensure that the main power switch is OFF.
- It is recommend to always connect all three phases, even if the unit doesn't require them.
- The unit must always be connected DIRECTLY to the facility power source. DO NOT operate the unit on generators or on UPS equipment.
- The 411 Series power supplies feature an energy recovery function which, similar to solar energy equipment, feeds energy back to the local or public energy grid. Utility companies are going to have regulations and technical requirements for the connection of this equipment to the grid. It is up to the end user to be aware of and meet all applicable requirements and registrations before installing and operating this unit. See [2.4.1. NS Protection Devices for Sink Operation](#).

### 5.2.1 AC phase requirements (2U 411-02)

These models are intended to run with 208–240 Vac single phase sources. Technically, these models can be run on 110/120 Vac as well, but the power capacity of the unit would be derated below their nominal capacity (1.5 kW becomes 1.2 kW, and 3 kW becomes 1.5 kW).

Nominal power	Supply Voltage	Inputs on AC Plug	DC Power
1500 watts	208 / 220 / 230 / 240 Vac	Single-phase (L, N, G)	1500 watts
1500 watts	110 / 120 Vac	Single-phase (L, N, G)	1200 watts
3000 watts	208 / 220 / 230 / 240 Vac	Single-phase (L, N, G)	3000 watts
3000 watts	110 / 120 Vac	Single-phase (L, N, G)	1500 watts

#### Cable cross sections:

For the selection of a suitable cable **cross section**, the rated AC current of the unit and the cable length are important factors. Based on the connection of a **single unit**, the table lists the maximum input current and recommended minimum cross section for each phase. The 10 Vdc models can use the wiring of the 1500 watts nominal power listing.

Nominal power	Line		Neutral		GND
	Ø	I <sub>max</sub>	Ø	I <sub>max</sub>	Ø
1500 watts	≥ 18 AWG ≥ 1 mm <sup>2</sup>	11 A	≥ 18 AWG ≥ 1 mm <sup>2</sup>	11 A	≥ 18 AWG ≥ 1 mm <sup>2</sup>
3000 watts	≥ 16 AWG ≥ 1.5 mm <sup>2</sup>	16 A	≥ 16 AWG ≥ 1.5 mm <sup>2</sup>	16 A	≥ 16 AWG ≥ 1.5 mm <sup>2</sup>

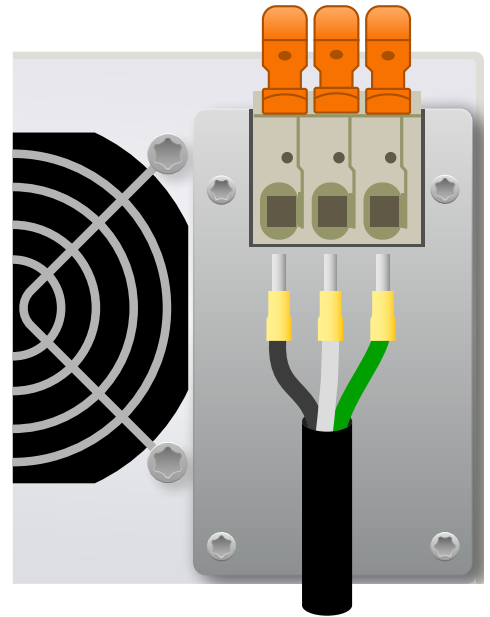
## 5.2.2 AC connection (2U 411-02)

The longer the connection cable, the higher the voltage loss due to the cable resistance. Therefore the mains cable should be kept as short as possible or have an even bigger cross section.

- When using cable sleeves, a cable up to AWG 10 (6 mm<sup>2</sup>) max is possible.
- When using bare wires, a cable of AWG 8 (10 mm<sup>2</sup>) max is possible. Strip the cable insulation about 0.5 inch

## 5.2.3 AC grounding (2U 411-02)

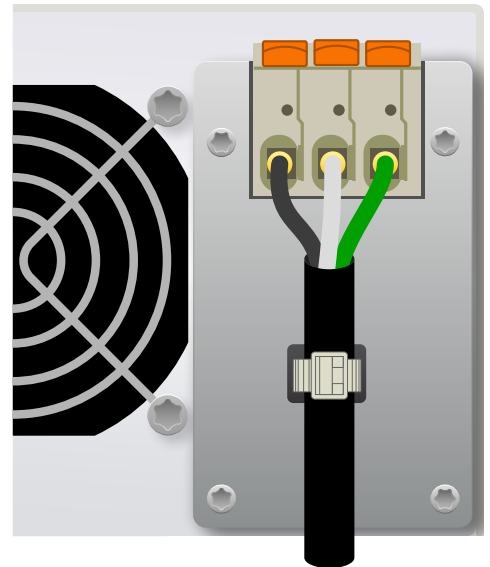
Below the DC output connector is a chassis grounding lug (on models built from 2022 onward). Connect this to an earth ground for added safety. The cable must be at least the same gage (or larger) than the gage used for the inlet power cables.



## 5.2.4 AC strain relief (2U 411-02)

All models in this series come with a strain relief for the AC cable. Unless there are other plans for cable support, it's recommended to use this strain relief point.

- Connect the AC plug, then hold the cable in front of the bracket, and secure it with a cable tie.



## 5.3 2U 411-02 DC Output Connections



- In the case of a unit with a high nominal current and hence a thick and heavy DC connection cable it's necessary to take account of the weight of the cable and the strain imposed on the DC connection. Especially when mounted in a 19" cabinet or similar, where the cable hangs on the DC output, a strain reliever should be used.
- Connection to and operation with transformerless DC-AC inverters (e.g. solar inverters) is restricted, because the inverter can shift the potential of negative output (DC-) against ground. Mind the maximum allowed potential shift (see the Model Specifications tables of the *Operating Guide*).
- The DC load output is not protected by a fuse.

### 5.3.1 DC cable requirements (2U 411-02)

The DC load output is on the back of the unit and is not protected by a fuse. The cross section of the connection cable is determined by the current consumption, cable length and ambient temperature.

For cables up to 5 ft (1.5m) and average ambient temperature up to 122 °F (50 °C), we recommend the following per pole connection (multi-conductor, insulated, openly suspended).

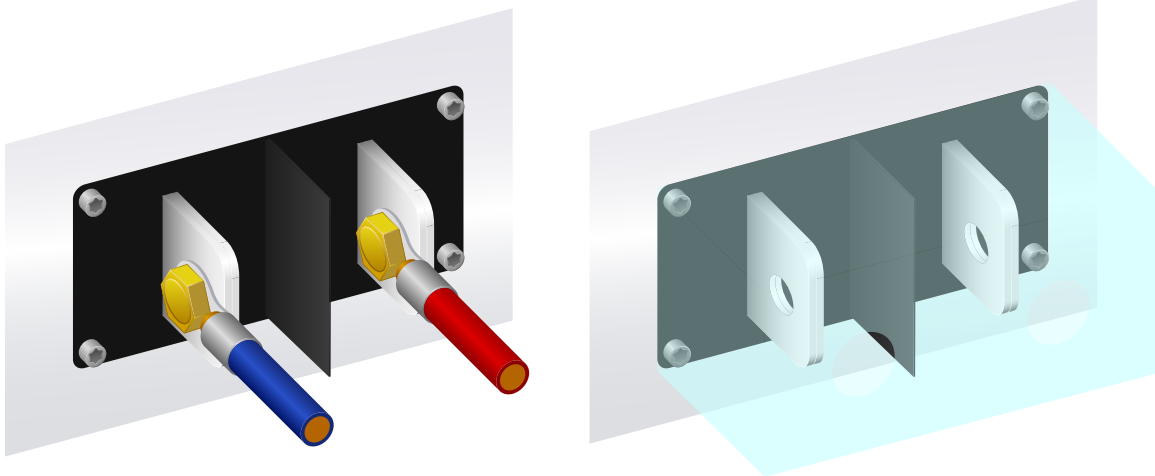
up to 10 A:	AWG 18 (0.75 mm <sup>2</sup> )	up to 40 A:	AWG 8 (6 mm <sup>2</sup> )
up to 15 A:	AWG 14 (1.5 mm <sup>2</sup> )	up to 60 A:	AWG 4 (16 mm <sup>2</sup> )
up to 30 A:	AWG 10 (4 mm <sup>2</sup> )	up to 120 A:	AWG 1 (35 mm <sup>2</sup> )

Single cables of, for example, AWG 8 may be replaced by 2x AWG 10 etc. If the cables are long, then the cross section must be increased to avoid voltage loss and overheating. This should be done in accordance with local electrical codes.

### 5.3.2 DC output terminals (2U 411-02)

All models use the same outlet terminals. It's recommended that connection of load cables always utilize flexible cables with ring lugs.

The terminal bolt is an M6 used with a ring lug. Cables can be routed up, down, or straight back through openings in the cover.



## DC connector cover

There are two clear plastic cover types for contact protection included for the DC terminal. One of the covers is larger, but allows for up, down, or straight out wiring. The other cover is smaller, but allow only straight back wiring. One of them should always be installed. The larger cover is connected to the back of the unit, whereas the smaller one is fixed to the DC connector itself.



The connection angle and the required bending radius for the DC cable must be taken into account when planning the depth of the complete unit, especially when installing in a 19" cabinet or similar.

### 5.3.3 DC output grounding (2U 411-02)

No matter if the power supply is operated stand-alone or in series connection with others, it is always only allowed to ground one of all DC output poles. Additionally, because of isolation, there is a maximum allowed potential shift of the DC output poles. This value is model specific. Refer to the Model Specifications tables of the *Operating Guide*.

The DC minus pole of a stand-alone unit can be grounded right away, but it should only be done if absolutely necessary, because the DC output is connected to GND via X capacitors in order to gain better high frequency filtering.

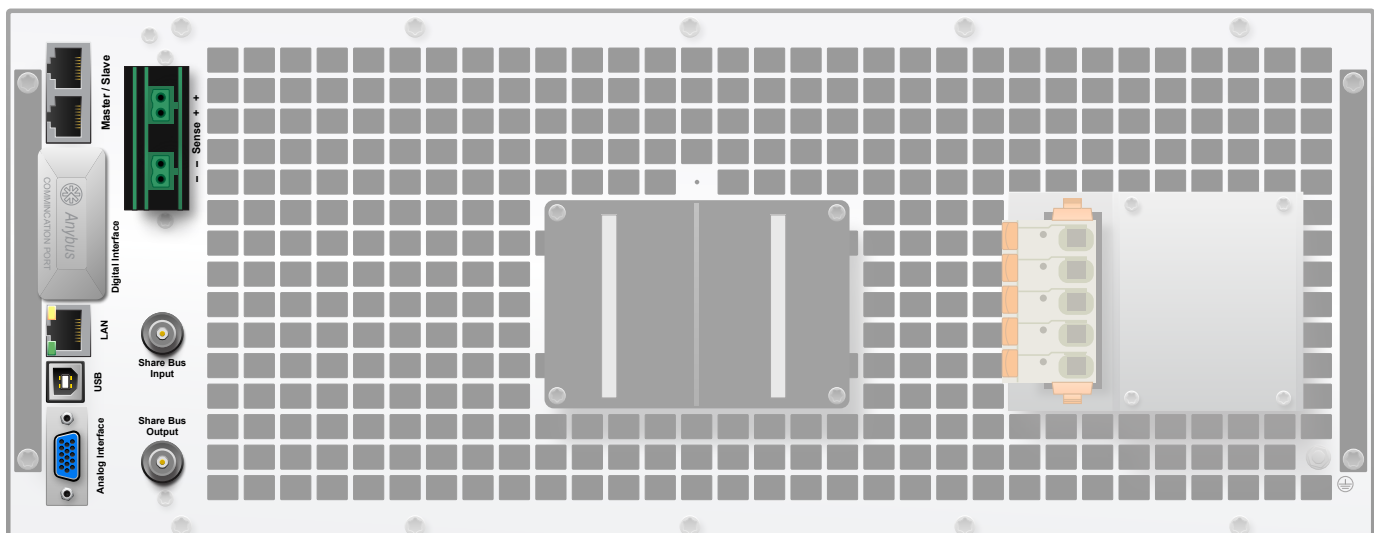
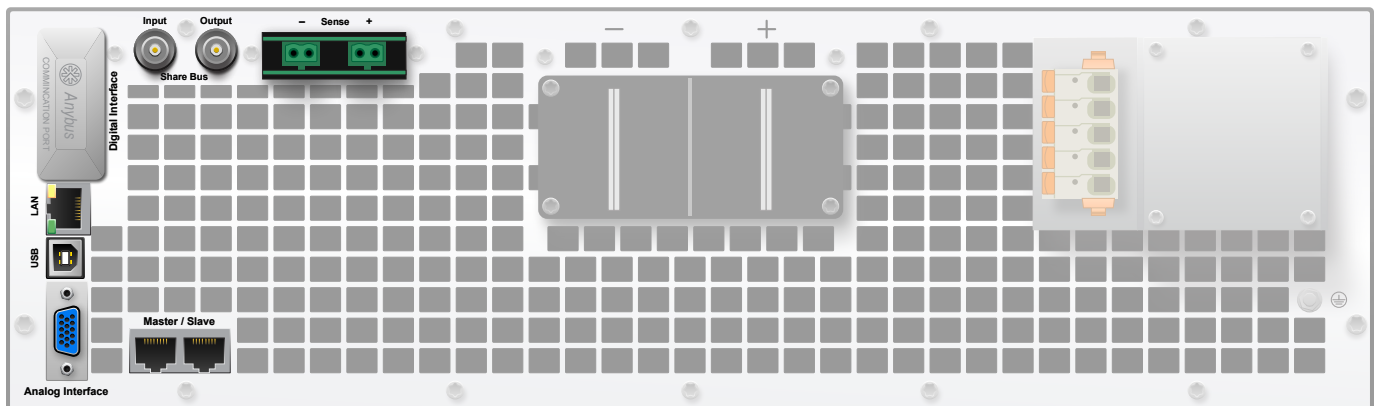


- Digital and analog interfaces are galvanically isolated from the DC output, and should never be grounded, but under no circumstances if any of the DC output poles are grounded too, because this will cancel the galvanic isolation.
- If one of the DC output poles is to be grounded, check if any pole of the load is already grounded. This could lead to a short circuit.

## 6 Control Connections

### 6.1 Rear Panel Overview

In the following sections, several connections on the rear panel will be discussed in terms of initial setup and preparation. All of the 2U, 3U, and 4U models use the same connectors for control and communication, though they may be located and oriented differently.





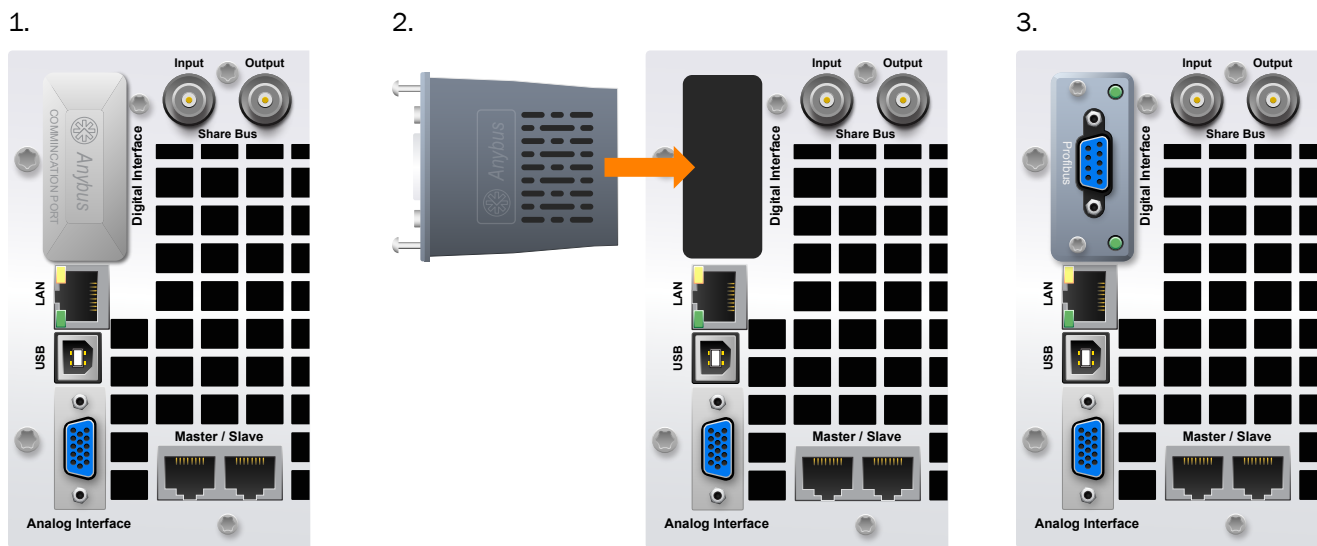
## 6.2 AnyBus Module Installation

The optional interface modules can be installed by the end user. Settings for each installed module varies, and needs to be checked after initial installation and after module exchange. Additional information about using the port modules can be found in the section Programming Introduction.



- The power supply main power must be switched off before insertion or removal of a module.
- Use common ESD protection procedures when inserting or exchanging a module.
- Never insert any other hardware other than an interface module into the slot.
- If no module is in use, it's recommended that the slot cover be mounted in order to avoid internal accumulation of dust and debris.

Installation steps using the 3U layout as an example:



Remove the slot cover. If needed, use a screw driver. Keep this cover for later replacement if the module is removed.

Insert the interface module into the slot. The shape ensures correct alignment.

When inserting, take care that it's held as close as possible to a 90° angle to the rear wall of the unit. Use the green PCB which is visible from the open slot as a guide. At the end is a socket for the module.

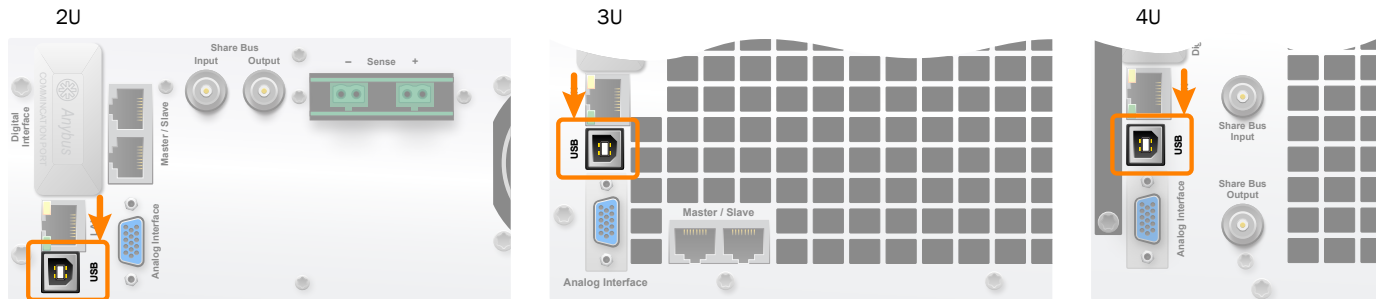
On the bottom side of the module are two plastic nibs which must click into the green board (PCB) so that the module is properly aligned on the rear wall of the unit.

The two outer screws (Torx 8) are used to secure the module, and should be fully screwed in. After installation, the module is ready for use and can be connected.

Removal follows the reverse procedure. Once loosened, the screws can be used to assist in pulling out the module.

## 6.3 USB Connector, Rear

The USB port on the back of the power supply is provided for connection to a PC for remote control and for firmware updates. When remote control is in operation, the USB port has no priority over the LAN port, Anybus module, or the analog interface. Therefore, only one interface should be used for control at any one time. However, monitoring is always available on any port at any time.



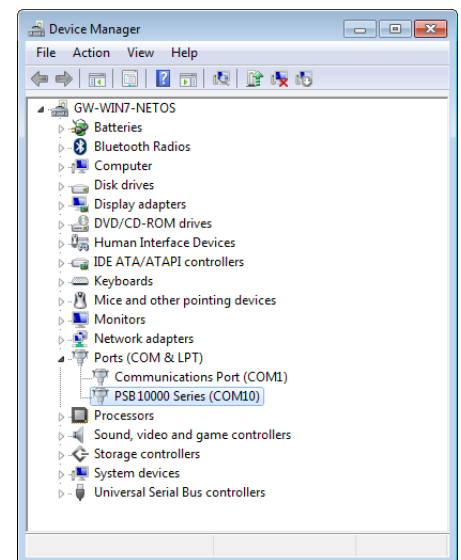
### 6.3.1 USB driver installation (Windows®)

Before a computer can be used to remote control the power supply through the USB port, whether through the EA Power Control software, LabView, or hand written scripts, the computer must have the USB driver.

Upon the initial connection with a PC, the operating system will identify the unit as new hardware, and will try to install a driver. The required driver is for a Communications Device Class (CDC) device, and is usually integrated in operating systems such as Windows 7 or 10. However, it is strongly recommended to install and use the mPower USB Driver available from our web site to ensure the best compatibility between the computer and power supply.

Once the driver is installed, the power supply will appear as a COM port. To determine which COM port is used for a given power supply, attach one power supply at a time, so it is easier to find which COM port is the newest.

In Windows, navigate to **Control Panels > Device Manager**, and look for **Ports** in the list, and expand it. Make note of the existing COM ports. Attach a power supply, and turn on the AC power (it does not need any connections except for AC power and USB. Eventually an entry for **PSB 10000 Series** will appear – this is the name of the driver for the mPower DC 411. Next to that name you will see **(COMnn)** where nn will be a single or double-digit number. That is the COM port number. As you add one unit at a time, it should be apparant which COM has been added (and therefore which unit it connects to). How the port number(s) match up to power supplies will be needed for remote control.



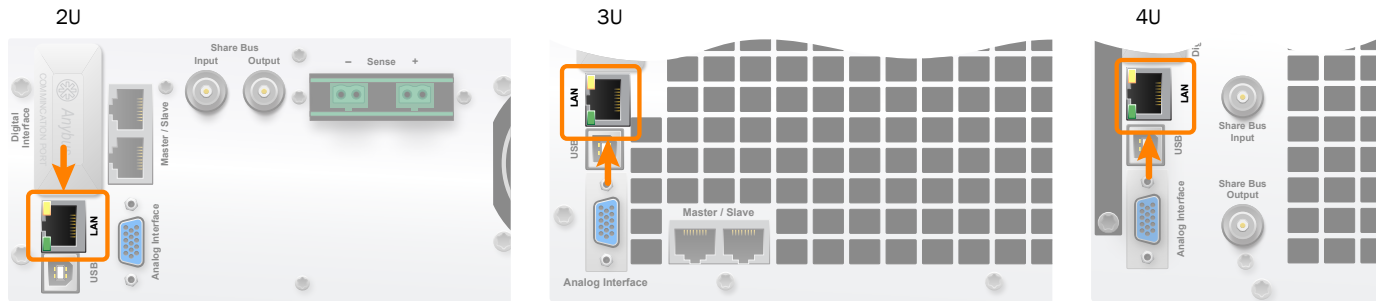
### 6.3.2 Non-Windows drivers

We do not have drivers or installation instructions for other operating systems. Whether native drivers on other operating systems are sufficient to engage in remote control has not been tested. It is possible 3rd party commercial suppliers can help. Search the Internet for suppliers using the keywords “cdc driver windows” or “cdc driver linux” or “cdc driver macos.”

## 6.4 LAN Ethernet Connector

The LAN port on the back of the power supply is provided for connection to a PC for remote control. When remote control is in operation, the USB port has no priority over the LAN port, Anybus module, or the analog interface. Therefore, only one interface should be used for control at any one time. However, monitoring is always available on any port at any time.

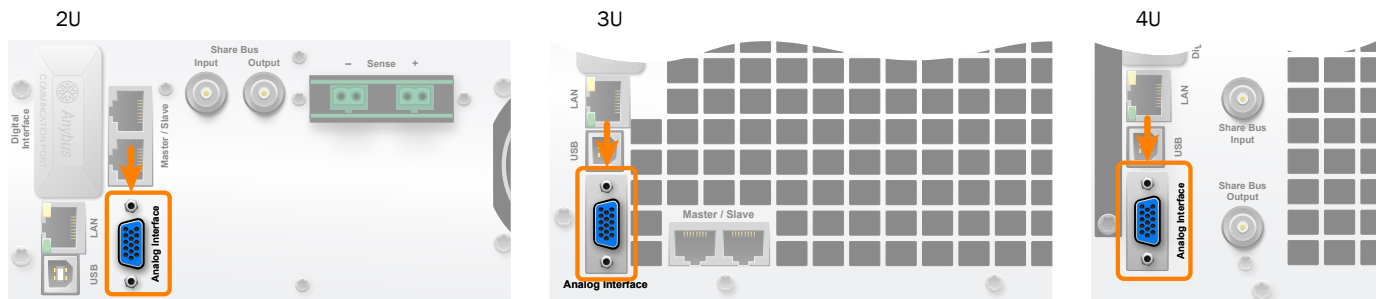
The LAN interface has no special requirements. Any CAT5 or better cabling is sufficient.



## 6.5 Analog Interface Connector

The 15-pin, Sub-D socket on the back of the unit is provided for remote control via analog and discrete signals. To connect this to an external controller (PC, PLC, or other), a standard mating plug is necessary (not included in shipment).

The input voltage range of the set values, the output voltage range of the monitor values, and the reference voltage level can be switched in the Settings menu of the system as 0–5 V or 0–10 V, in each case for 0–100% of the unit's nominal ranges.



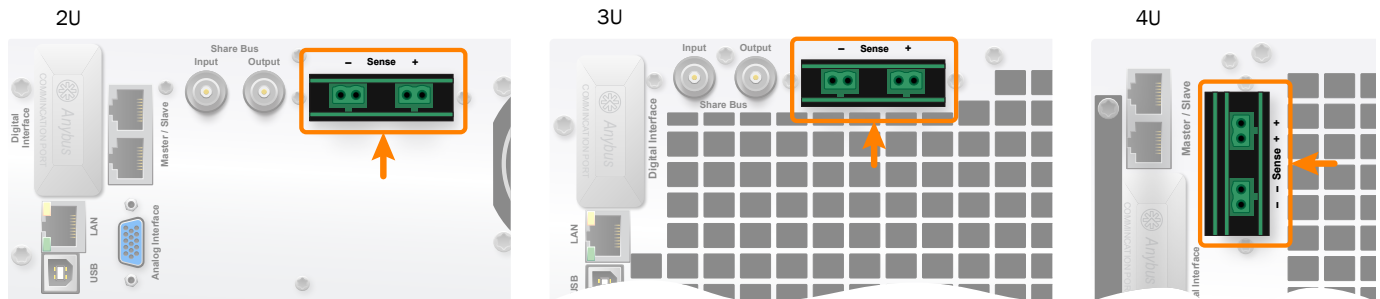
- The analog interface is galvanically isolated from the unit internally. If not absolutely necessary, you should never not connect any ground of the analog interface (AGND) to the DC minus output as this will cancel the galvanic isolation.
- It is generally advisable to switch the unit completely off before connecting or disconnecting this connector, but at least switch off the DC output.

## 6.6 Sense Connectors

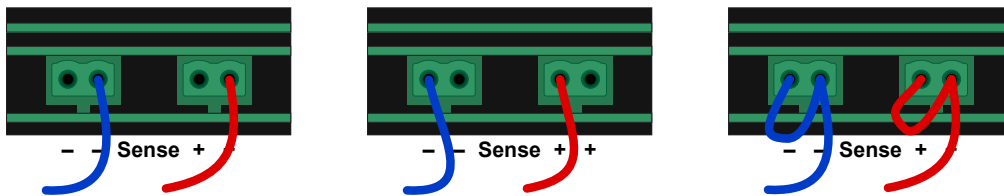
Use the Sense connection when it is important that adjusted output voltage is held constant at the load terminals rather than at the power supply's DC output terminals.

Remote sensing is only effective during constant voltage operation (CV) and for other regulation modes the sense input should be disconnected, if possible, because connecting it generally increases the oscillation tendency

In the Model Specifications tables of the *Operating Guide* the maximum possible compensation is defined. If that is insufficient, the DC output cable cross section must be increased.



Make sure the load sense wires are connected in one of these patterns:

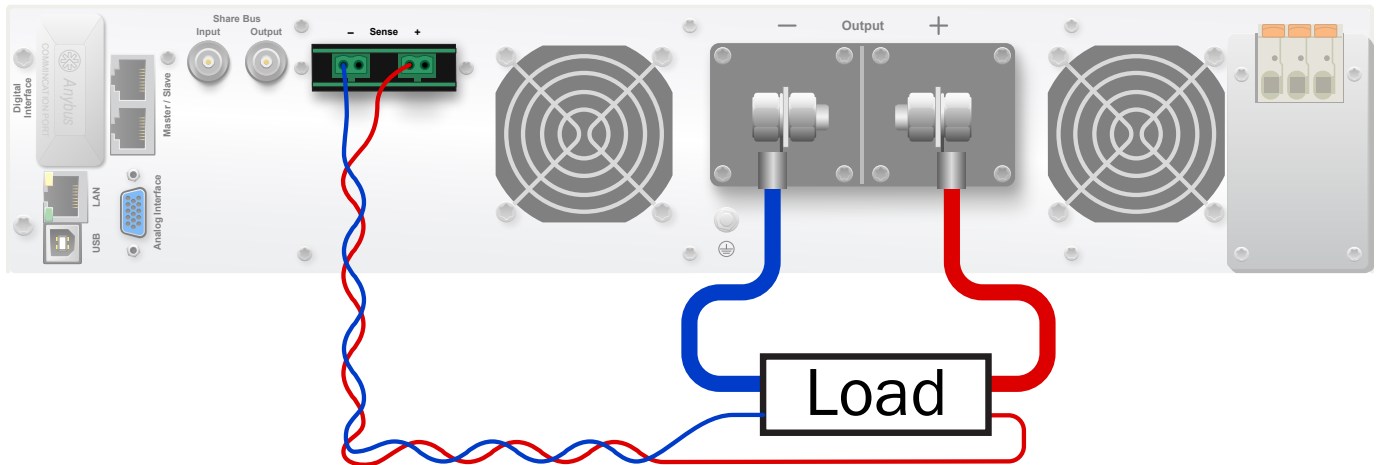


- Be mindful of the voltage rating of the sense cables, especially with models of  $\geq 500$  V. The dielectric strength of the sense wires must always at least match the DC voltage rating.
- Commonly available wire is typically rated for 600 V maximum.



- Ideally, DC cables should be sized (length and diameter) to eliminate or reduce voltage drop as much as possible.
- Sense cable gage is generally noncritical. For cables up to 15 feet, use at least 18 AWG.
- Sense cables should be twisted (or shielded), and laid close to the DC cables to dampen or avoid possible oscillation. If necessary, to eliminate oscillation, add a capacitor at the load to counteract the frequency of any oscillation experienced.
- The Sense + cable must be connected to DC + on the load and Sense - to DC - at the load, otherwise the sense input of the power supply can be damaged.
- In parallel unit operation, the remote sensing should be connected to the master unit only.

Using a 2U unit as an example, this is how the Sense wiring would be installed. However, keep the sense wires close to the DC cables if the cable runs are lengthy.



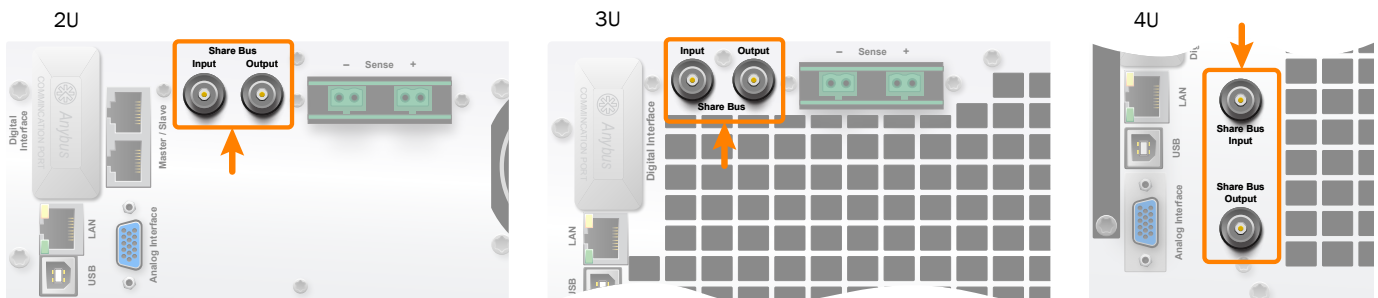
## 6.7 Parallel Connections

This section shows the essential cabling requirements for connecting multiple units for parallel operation — however, there are several other configuration requirements. Refer to the [Parallel Operation](#) section in the main operating guide.

Older systems with firmware versions prior to 3.02 support parallel operation with identical units only — that is, units of the exact same model number. As of firmware 3.02 (early 2022), parallel operation amongst 411 series units of different power capacities is possible. Therefore, a 4U 30 kW unit can be connected with a 3U 15 kW unit, etc. Of course, all units having the same voltage and current ratings would still be ideal to avoid unintended test parameter problems. However, ALL units must have firmware 3.02 or later. Older and newer units cannot be mixed unless all have been updated to the same firmware version of at least 3.02.

### 6.7.1 Share connectors

The two BNC sockets (50  $\Omega$  type) labeled Share Bus are part of the communications system used in multi-unit, parallel operation. Connect the master unit Share Bus Output to the next unit's Share Bus Input. Continue that daisy chain to the last unit. Do not connect the last unit back to the master.

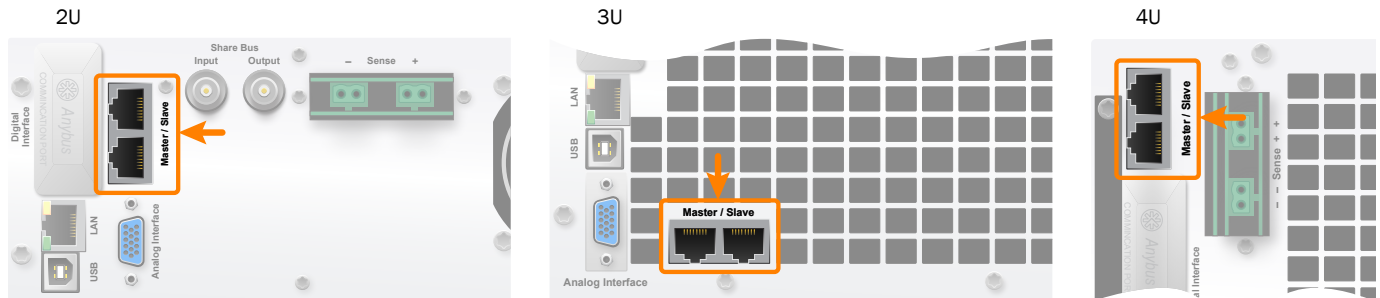


## 6.7.2 Master/Slave connectors

The RJ45 Master/Slave connectors are also a part of the communications system used in multi-unit parallel operation. Connect the master unit M/S RJ45 to the next unit's M/S RJ45. Continue that daisy chain to the last unit. Do not connect the last unit back to the master. Common CAT5 cabling is sufficient, but keep the cable lengths as short as possible. (Using pre-wired 2 or 3 foot cables is better than using 25 foot cables.)



- Do not use crossover cables



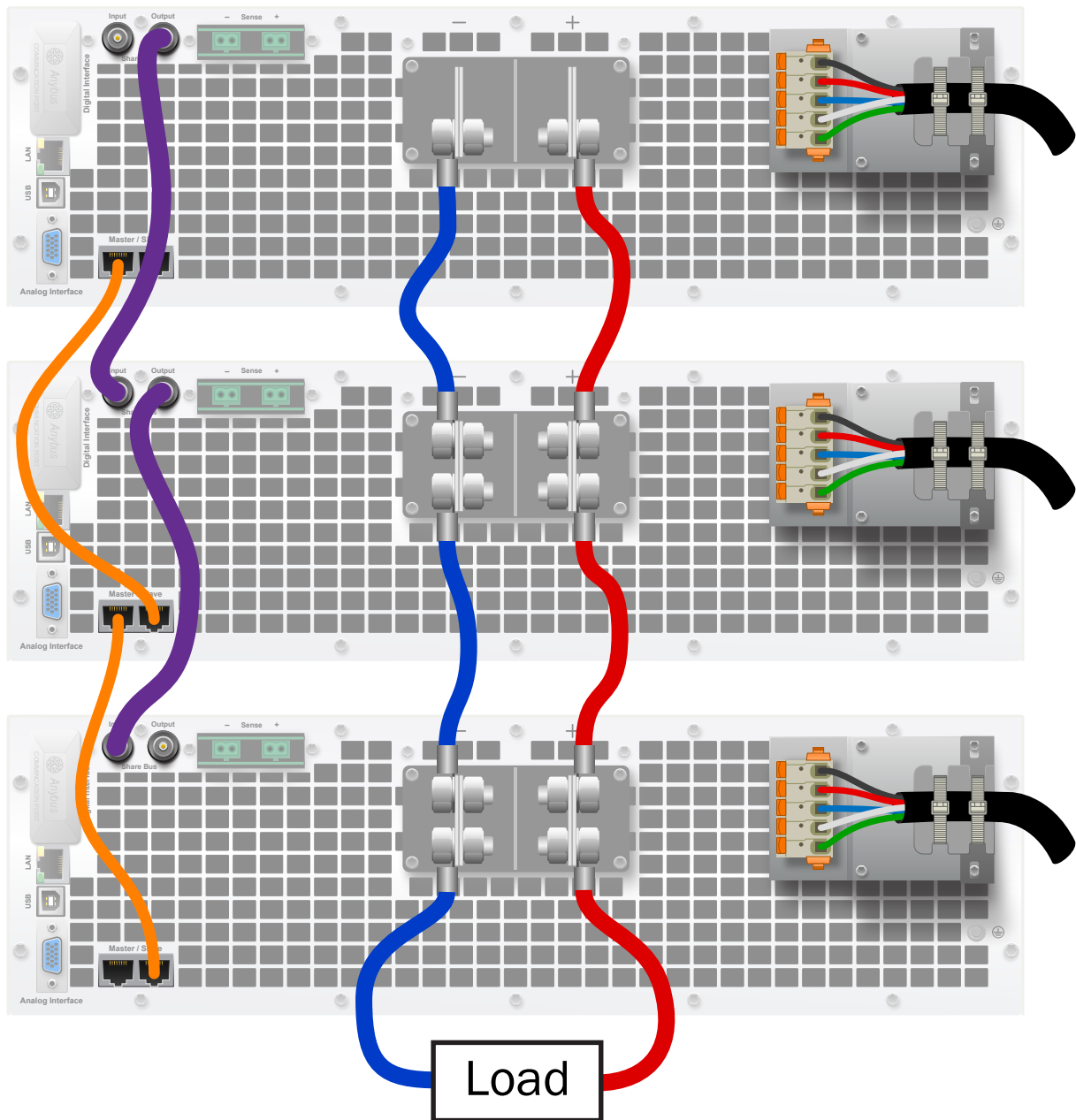
## 6.7.3 Share vs. Master-Slave

The Share bus and Master/Slave bus are both used for parallel operation. These two buses have evolved over the product line's history with Share bus being first, and the Master/Slave bus added to expand control capabilities, while leaving the original Share bus for compatibility with previous generation systems.

At this point, it is technically possible to use only the Share bus, but there's no advantage to doing so. With both buses connected, the master unit can share setpoints, alarms, and other data with all systems making the parallel setup much easier and more efficient to use.

## 6.7.4 Parallel wiring example

Using a set of 3U units as the example, this is how the interconnects of the Share and Master-Slave are wired. Note that the Share and Master/Slave cabling does *not* loop back to the first unit. If the Sense wires are to be used, they would connect from the load to the Master unit only.



## 7 Contact and Support

### 7.1 Repairs

If not otherwise arranged between Marway and the customer, repairs must be carried out by Marway. The unit must be returned to Marway clearly labeled with a Return Materials Authorization (RMA) number. Contact Marway Support to obtain an RMA. Package the equipment adequately and send it, together with a detailed description of the problem, and if still under warranty, a copy of the invoice, to the address below.

### 7.2 Contact Options

Problems with or questions about operation of the unit, use of optional components, with the documentation or software, can be addressed to technical support either by telephone or email.

Address	Email	Telephone
Marway Power Solutions 1721 S. Grand Ave. Santa Ana, CA 92705	Technical support: support@marway.com  All other issues: info@marway.com	714-917-6200

### 7.3 Two Year Warranty

Marway Power Solutions warrants each of its manufactured units to be as described in its specifications, made with quality materials and good workmanship, but also limited by this warranty and no other.

**Two Year Warranty** — For a period of two years following the date of shipment, Marway will repair or exchange, at Marway's sole discretion, any unit purchased shown to be defective in materials or workmanship when used for its intended purpose. This will be done at no charge to the purchaser. Purchaser will return unit(s) at its own expense and only with prior authorization from the factory. Instructions will be given by an authorized factory representative at the time an inquiry is made. All repairs will be made at Marway Power Solutions' corporate headquarters.

**Transferability** — This warranty is fully transferable to the end user if the purchaser is an original equipment manufacturer and the Marway unit is a component of their product or system sold to an end user.

**Further Limitations** — Marway's liability under the terms of this warranty and the purchase and sale of its units is limited to the repair or replacement of its units. Marway shall in no situation be liable for any special, consequential damages or other damages of any kind or nature. Marway's warranty does not cover units damaged by accident, abuse, misuse, unauthorized repair and such-the-like occurrences out of Marway's control.

**Exclusion of all Implied Warranties** — **There are no warranties which extend beyond description on the face hereof. There are no warranties that any unit is fit for any particular purpose nor that they are merchantable.**



# mPower™ DC Power Supplies 411 Series 2U, 3U, 4U

## Installation Guide P/N: 501046-411-IN-A

© 2023 Marway Power Systems, Inc. All rights reserved.



Marway Power Solutions  
1721 S. Grand Ave., Santa Ana, CA 92705  
800-462-7929 • [marway@marway.com](mailto:marway@marway.com)