YouSolar.
Power Your Life.
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Installation Manual

PowerBloc®

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Table of Contents

Rack Height: 1 Rack Unit, "U",
1 U – 1.75 Inches

TRAFFIC™ Controller

The TRAFFIC™ Controller monitors and controls energy and power on the system, runs analytic and optimization software, and communicates with external devices, the DIYA™ User Interface, and the internet.

Inside TRAFFIC is the "brains" of the PowerBloc®, a rugged, industrial environment Linux single board computer (SBC).

The Linux SBC

- Runs PowerBloc's operating system, TRAFFIC OS™. TRAFFIC OS executes
  - The EDISON™ Energy Management System which analyzes the energy balance and operates the system to meet user-selectable criteria; and
  - PowerCon™ which analyzes and controls all modules of the PowerBloc, sets operating parameters of the TWIN™ Bi-directional Converters in real-time and coordinates all TWINs.
- Logs, compresses and stores data, and communicates with
  - Addressable modules (TWIN™, FORCE™, EXTEND™, STEP™, and BLOC-LINK™);
  - The DIYA™ User Interface;
  - The internet (if and when available); and
  - External devices such as an emergency stop, automatic transfer switch, controllable load panel, or generator.

The TRAFFIC controller communicates with all addressable modules (TWIN™, FORCE™, EXTEND™, STEP™, and BLOC-LINK™) using the BLOC-LINK protocol on the RS485 communications standard. There are four (4) RS485 channels in the PowerBloc which allow up to $4 \times 23 = 92$ addressable PowerBloc modules in one system. In addition to the individual addresses on each channel, each channel also sets aside one common address that is shared by all modules. This common address allows, most importantly, fast coordination of TWIN modules.

POWERBLOC ADVANTAGES

SCALABILITY: The PowerBloc® allows up to ninety-two (92) addressable modules on the Nano-Grid, including fifty (50) TWIN™ Bi-Directional Converters. A PowerBloc with 50 TWINs would have 50 × 2 × 5.1 kWh = 510 kWh of energy storage and 50 × 3.8 kW = 190 kW of battery power. It would use the same modules as a PowerBloc with one battery and one TWIN (5 kWh and 3.8 kW) and shows how easily the PowerBloc scales.

Each addressable module, TWIN™, FORCE™, EXTEND™, STEP™, and BLOC-LINK™, has a sticker next to the RS485 port on the back of the module which provides the address of the module. The address is made up of the module type and an integer from 1-15. For example, TWIN has the addresses T1 to T15 and STEP the addresses S1 to S4.

YouSolar assigns the address integer to each module before shipping a PowerBloc to the customer. Still, if for some reason a duplicate address is encountered on the Nano-Grid, for example, two TWINs with the integer 3, then one of the modules can be put on a channel which does not already have that address, or the integer of the address can be changed[1] in the field by YouSolar-authorized personnel.

The manuals for each of the addressable modules TWIN, FORCE, EXTEND, STEP, and BLOC-LINK show how to change the module's address. The manuals of all modules of the PowerBloc are available through the DIYA™ User Interface tablet in the Manual section of the Help page. The DIYA User Interface also has a list of all channels and addresses currently in use on the PowerBloc. When expanding an existing installation, please refer to the Registry section of the Settings page to check addresses and channels already in use.

TROUBLE SHOOTING

DUPLICATE ADDRESS: Make sure to check that there are no duplicate addresses on a channel during installation. When expanding an existing installation refer to the Registry section in the Settings page which shows a table of all channels and addresses in use. If for some reason a duplicate address is encountered, then the module can be put on a channel which does not already have that address, or the addresses can be changed in the field. The manuals of addressable modules, TWIN™, FORCE™, EXTEND™, STEP™, and BLOC-LINK™ show where and how to change the address[1].

The Linux SBC runs four main software programs one of which is the operating system. All software can be updated using the PowerBloc's internet connection (when and if available), or by YouSolar-authorized personnel using the **SERVICE PORT** on the Front Panel.

TRAFFIC OS™ is the operating system which runs on a customized version of Linux. TRAFFIC OS communicates with

- The DIYA™ User Interface using WIFI,
- The internet using WIFI (or Ethernet), and
- External devices using Modbus, RS485, or RS232.

TRAFFIC OS runs the EDISON™ Energy Management System and the power controller, PowerCon. EDISON receives a weather forecast from *Open Weather* and a solar forecast from YouSolar's SPOT™ solar production forecast running in YouSolar's CIRRUS™ cloud.
TRAFFIC OS also compresses and stores data on the SBC and creates an encrypted copy of the PowerBloc in the CIRRUS cloud.

(1) Changing the address requires opening the lid of the chassis and setting the DIP switch for the RS485 address. A DIP switch is a manual electric switch that is packaged with others in a group in a standard dual in-line package ("DIP") The manual for addressable modules shows where to find the DIP switch and how to change the address.

EDISON™ is the PowerBloc®'s Energy Management System, a learning and intelligent optimization engine which uses YouSolar's solar production forecast SPOT™, a forecast of load based on correlation of historical load on weather, dates, and holidays, and forecast or scheduled power outages to meet certain targets, such as highest reliability, maximum solar energy use, or lowest energy cost. Please check DIYA™ on the operating modes currently available on EDISON. Additional modes are automatically downloaded from time to time, and some are specific to the customer's location. EDISON makes intelligent decisions for the user which makes operating the PowerBloc solar+battery systems effortless.

PowerCon™ is the power controller which communicates with local controllers in each addressable module using the BLOC-LINK™ protocol on the RS485 standard. The primary task of PowerCon is to deliver power to the HVDC bus in response to load changes by the DC-AC inverter(s), including one or multiple FORCE™ or 3rd Party inverters—or a combination, thereof.

BLOC-LINK™ is the communication protocol used between TRAFFIC OS™ and all addressable modules. BLOC-LINK operates on the RS485 standard. BLOC-LINK also carries the 24 VDC communications power bus and Emergency Stop (E-Stop) signal.

Front Panel

1. NANO-GRID

The **NANO-GRID** switch turns on the PowerBloc®. A guard protects the switch to prevent the PowerBloc from being accidentally toggled. The PowerBloc turns on by first booting up the controls, then powering up the HVDC bus, and finally enabling the FORCE™ inverter.

Green NANO-GRID 🟢 LED
Double-blinks: *The Nano-Grid is starting up.*
Blinks slowly, 2 times per second: *The high potential bus is up.*
Solid: *The E-Stop is engaged.*
Off: *The HVDC bus is below 30 V.*

OPERATING INSTRUCTIONS

RESTARTING THE POWERBLOC AFTER AN E-STOP:
When the Emergency Stop (E-Stop) has been engaged while the NANO-GRID switch is in the "ON" position, releasing the E-Stop will not turn the Nano-Grid back on. To restart the PowerBloc® the NANO-GRID switch has to be first moved to the "OFF" position and then back to "ON."

When the NANO-GRID is switched to ON, PowerCon™ turns on and keeps the HVDC bus at 400 VDC. PowerCon uses the TWIN™-battery systems to bring up the bus to 400 VDC.

The EDISON™ Energy Management System checks the energy balance on the system. If energy is required, EDISON turns on the Solar Array during daytime and supplements energy from the grid or a generator. However, to add solar power to the HVDC bus the STEP™ Solar Input Module(s) need(s) to be enabled, which means the SOLAR switch has to be in the Enable position.

Similarly, the EXTEND™ Rectifier Module needs to be enabled so that PowerCon can turn on the AC line inputs to the EXTEND module.

2. E-STOP

Pressing the **E-STOP** will turn off the PowerBloc. The electric potential of the HVDC bus will fall below 30 Volts in under 30 seconds. The NANO-GRID LED will turn off when the HVDC bus is below 30 Volt.

Red E-STOP 🔴 LED:
Solid: *The E-Stop is engaged.*
Off: *The E-Stop is released.*

3. SERVICE PORT AND JUMP START

A door allows access to the Service Ports and 12 V/Common terminals. The **SERVICE PORT** is for YouSolar-authorized personnel only. In the unlikely event that the PowerBloc has been off for an extended period (of multiple months) and its internal boot battery has been exhausted, the **12 V TERMINALS** allow the PowerBloc to be powered up by a 12 Volt power source such as a car battery. Once the Nano-Grid is on (The green NANO-GRID LED is solid.), the battery used to jump start the PowerBloc can be removed.

⚠	**WARNING**
DO NOT CHARGE DEVICES FROM USB PORTS: The Service Port is for YouSolar-authorized personnel only. In particular, do not use the USB ports in the Service Port to charge any devices including the DIYA™ User Interface. The USB service ports are data ports only.	

Back Panel

1. EX-PORT™

The **Ex-Port™** is a 25-pin port which communicates with external devices including an emergency stop, automatic transfer switch, generator start/stop, or load management panel. The port has a number of customizable EX-PORT lines that can be factory-customized. Each TRAFFIC™ Controller comes with an EX-PORT connector and 6 feet of cable. A cable tag provides information on which wires are used for various communications and controls. The EX-PORT configuration is also stored in the TRAFFIC's memory and can be accessed by YouSolar-authorized personnel.

2. BLOC-LINK™

The **BLOC-LINK™** connector connects to any of the BLOC-LINK connectors on the BLOC-LINK™ Busbar. BLOC-LINK carries 24 VDC, the emergency stop, and four (4) RS485 lines which allow a of up to 92 modules to operate in one PowerBloc®.

3. WIFI

The **WIFI** port connects to an external antenna. TRAFFIC's WIFI port is a dual access point which connects TRAFFIC to the DIYA™ tablet and the internet at the same time.

4. EXPANSION

Expansion 1 and **2** are openings for future features.

Physical Specifications

Please see Appendix for TRAFFIC™ Controller Physical Specifications.

Height: 3 Rack Units, "U",
1 U = 1.75 Inches

BLOC-LINK™ Busbar

Each cabinet has one BLOC-LINK™ Busbar. The BLOC-LINK Busbar combines the High Potential Direct Current (HVDC) and the communication line (RS485, E-Stop, and 24 V bus) of modules in a cabinet. The daisy chained HVDC bus adds current from each module and terminates in the HIGH POTENTIAL BUS connector on the sides of the busbar chassis.

INSTALLATION

MODULE MOUNTS ON BACK OF CABINET: Unlike all other cabinet modules which mount in the front of the cabinet, the BLOC-LINK™ busbar mounts in the back of the cabinet.

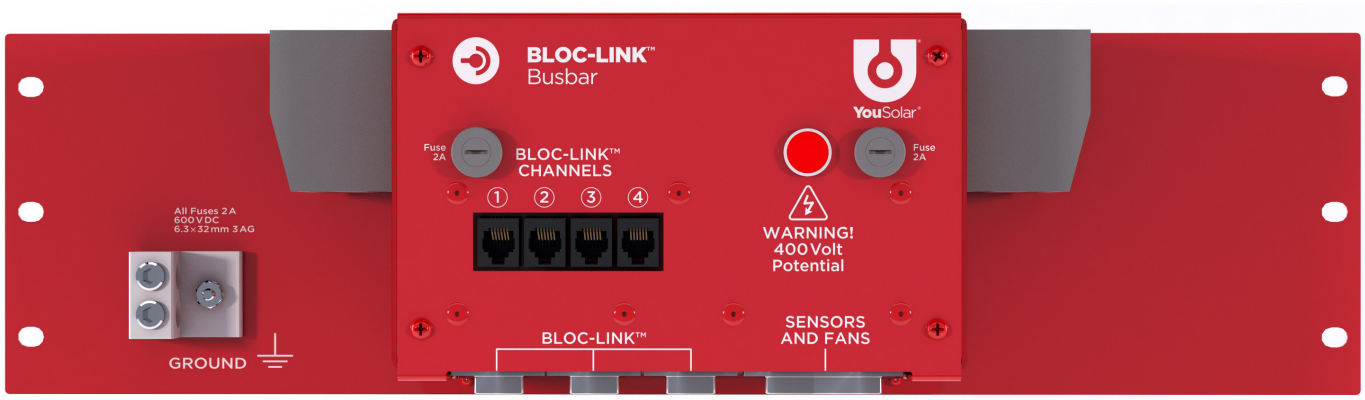
There are four (4) RS485 communications channels. Each CHANNEL can accept up to twenty-three (23) addressable modules (TWIN™, FORCE™, EXTEND™, and STEP™). It is good practice and makes for a simple RS485 daisy chain if only one of the four CHANNELS is used inside one cabinet.

DESIGN RECOMMENDATION

ONE CHANNEL PER CABINET: It is good practice and makes for a simple RS485 daisy chain if only one of the four CHANNELS is used inside one cabinet.

The BLOC-LINK™ Busbar module includes a 400 V-to-24 V converter which powers 24 Volt to all controllers and processors in the PowerBloc®, including the Linux single board computer of the TRAFFIC™ Controller.

The TRAFFIC Controller connects to one of the BLOC-LINK connectors located on the underside of the BLOC-LINK chassis. The 19-pin connector carries all four (4) RS485 communication channels, the E-Stop, and the 24 V bus.



Front

1. BLOC-LINK™ CHANNELS

Four (4) **BLOC-LINK CHANNEL** ports connect to a daisy chain of the communication line of the modules in the cabinet. Typically, only one CHANNEL is used per cabinet. Up to twenty-three (23) addressable modules (TWIN™, FORCE™, EXTEND™, and STEP™) can connect to one CHANNEL. See the TRAFFIC™ Controller Manual for more information on module addresses and how to resolve a conflict of duplicate addresses on a channel.

2. BLOC-LINK™

There are three (3) **BLOC-LINK™** ports that connect to the TRAFFIC™ Controller and to other BLOC-LINK™ Busbars in adjacent cabinets (if any). Only one cabinet contains a TRAFFIC Controller and not every cabinet connects to more than one cabinet or any cabinet at all. Therefore, some BLOC-LINK ports may not be used.

3. WARNING! 400 VOLT POTENTIAL

The "**WARNING! 400 Volt Potential**" light indicates whether the HVDC bus is energized or not.

Red "WARNING! 400 Volt Potential" 🔴 LED:
***Solid:** HVDC bus is at 30-400 V*
***Off:** HVDC bus is below 30 V*

4. SENSORS AND FANS

The **SENSORS AND FANS** connector connects to a door sensor, temperature sensors, fans and other sensors.

5. FUSE 2 A

Two (2) fuses with a 2 Ampere (A) current limit protect the 400 V-to-24 V power supply inside BLOC-LINK™ Busbar. The specifications of replacement fuses (2 A, 600 VDC, 6.3 × 32 mm, 3 AG) are printed above the GROUND terminal lug.

6. GROUND TERMINAL

The **GROUND** terminal connects the module to the GROUND terminal of another module or the ground post of the cabinet.

Side Panels

Each side panel has a terminal block for +200 V and -200 V of the HVDC bus, respectively. Each terminal block accommodates up to three (3) HVDC bus cables. One connector of the terminal block is used for the HVDC chain of the modules inside the cabinet. The additional two connectors allow to connect to other BLOC-LINK Busbars in adjacent cabinets (if any).

Physical Specifications

Please see Appendix for BLOC-LINK™ Busbar Physical Specifications.

Height: 3 Rack Units, "U",
1 U = 1.75 Inches

CAPS™ Bus Capacitor Module

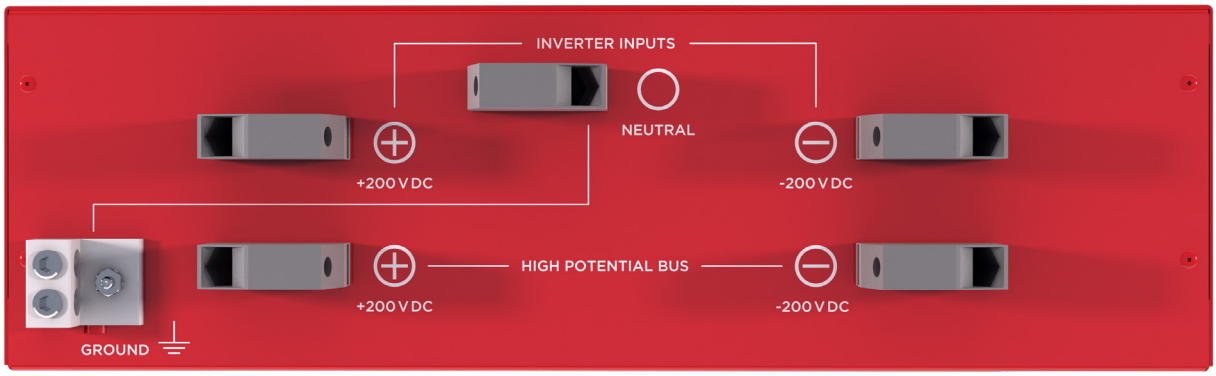
The CAPS™ Bus Capacitor Module holds six large capacitors which keep the High Potential Direct Current (HVDC) bus stable when the TWIN™ Bi-Directional Converters switch from charge to discharge mode. The capacitor module also absorbs ripples from the inverter. The CAPS™ module is the last module in the HVDC chain and receives the sum of currents of all modules via the busbar. CAPS™ creates the neutral point for the HVDC bus. The NEUTRAL output of the CAPS™ module is connected to GROUND.

Front Panel

1. NANO-GRID

Green NANO-GRID ● LED

Solid: *The HVDC bus is at 30-400 V.*
Off: *The HVDC bus is below 30 V.*



Back Panel

1. INVERTER INPUTS

The **+200 VDC**, **Neutral**, and **-200 VDC** connectors connect to the inputs of the inverter.

2. HIGH POTENTIAL BUS

The **+/- 200 V HIGH POTENTIAL BUS** connectors connect to the HIGH POTENTIAL BUS of the BLOC-LINK™ Busbar.

3. GROUND TERMINAL

The **GROUND** terminal connects the module to the GROUND terminal of another module or the ground post of the cabinet.

Physical Specifications

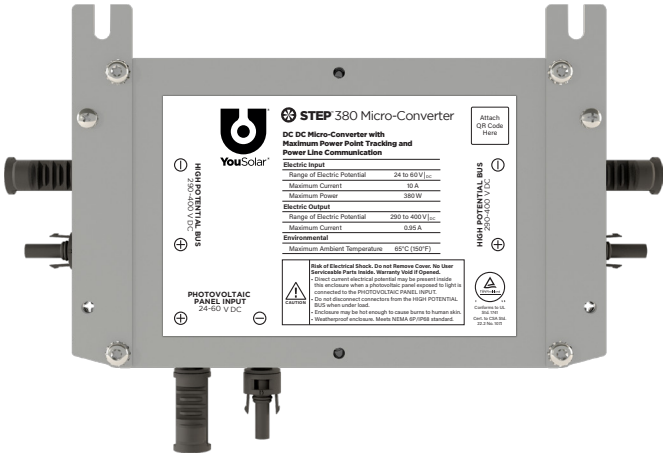
Please see Appendix for CAPS™ Physical Specifications.

STEP™ Micro-Converter

The STEP™ Micro-Converter is a panel-level DC-DC micro-converter that steps up each solar panel's electric potential between 24 Volt and 60 Volt to the High Potential Direct Current (HVDC) bus of the PowerBloc® Nano-Grid. STEP uses an innovative two-stage switching network to achieve 95% conversion efficiency.

By connecting solar panels equipped with STEPs in parallel, each solar panel-STEP pair becomes an independent power source whose energy production is maximized through panel-level Maximum Power Point Tracking (MPPT) whether the panel is under full sun or cloudy conditions. STEP is rail-mounted and allows the use of customer-specified panels.

STEP communicates with the PowerBloc®'s TRAFFIC™ Controller using YouSolar®'s CARP™ power line communication. STEP automatically shuts down if communication to the TRAFFIC Controller is lost due to a fault in the power line from the solar, when the SOLAR switch on the front panel of the STEP Solar Input Module is set to Disable, or when the Emergency Stop of the PowerBloc has been engaged.



Front/Back

The STEP Micro-Converter has three pairs of MC4-compatible connectors (TE Connectivity SOLARLOK PV4).

PHOTVOLTAIC PANEL INPUT

The connector pair PHOTVOLTAIC PANEL INPUT is located on the long side of the chassis. It is the input for the solar panel with a Maximum Power Potential (VMPP) of at least 24 V and an Open Circuit Potential (VOC) of no more than 60 V.

HIGH POTENTIAL BUS

The two connector pairs of the HIGHT POTENTIAL BUS on opposing short sides of the enclosure connect to the passthrough of the HVDC bus inside the enclosure. The solar panel connects to this passthrough via the micro-converter's power electronics.

IMPORTANT REFERENCE

STEP™ MICRO-CONVERTER MANUAL: The STEP Micro-Converter and how to install and operate it is described in the STEP™ Micro-Converter Installation and Operating Manual.

Physical Specifications

Please see Appendix for STEP™ Micro-Converter Physical Specifications.

Height: 2 Rack Units, "U",
1 U = 1.75 Inches

STEP™ Solar Input Module 1-Branch

The STEP™ Solar Input Module accepts inputs from a Branch of a Solar Array equipped with STEP™ Micro-Converters. Solar panel-level STEP Micro-Converters combined with the STEP Solar Input Module create a Solar Array that is safe, efficient, and flexible. A Branch is a "daisy chain" of up to thirty (30)× STEP Micro-Converters for up to 10 $kW|_{DC}$ of solar power.

Inside the STEP Solar Input Module each polarity of a Branch connects to the High Potential Direct Current Bus (HVDC) bus with diodes. These diodes prevent the HVDC Nano-Grid from energizing the Branch. The Branch will rapidly shut down, which means when a Branch is turned off its electric potential will fall below 30 Volts in less than 30 seconds. Both features increase the safety when working on the Solar Array.

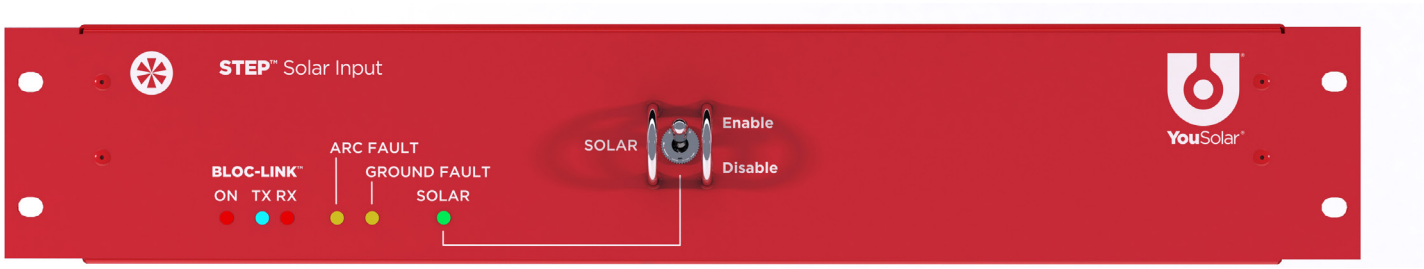
The module communicates with STEP Micro-Converters using YouSolar's CARP™ powerline communication.

There are two different STEP Solar Input Modules.

- 1-Branch Module and
- 2-Branch Module.

The 1-Branch Module connects a Branch of up to 30× micro-converters for 10 $kW|_{DC}$ of power while the 2-Branch module connects to one (1) or two (2) Branches for 10 or 20 $kW|_{DC}$ of power. 1-Branch and 2-Branch modules can be combined to reach higher Solar Array power. For example, one 1-Branch and one 2-Branch module can create an array with up to 30 $kW|_{DC}$ of power. Note that the BLOC-LINK™ Busbar's current rating limits solar power on the PowerBloc® to 50 $kW|_{DC}$.

This manual section discusses the 2-Branch STEP Solar Input Module.



Front Panel

1. BLOC-LINK™

BLOC-LINK™ is the communication link of the PowerBloc®. It carries communication using the RS485 standard, a 24 Volt bus, and the Emergency Stop (E-Stop) signal. The LEDs of the BLOC-LINK section on the front panel indicate whether the module is on, off, or E-Stopped, and whether the module is sending or receiving data.

Red "ON" 🔴 LED

Blinks slowly, twice per second: *STEP is on and the Solar Array is enabled. The TRAFFIC™ Controller may turn the STEP™ Micro-Converters on the Branches.*

Double-blinks: *The Emergency Stop has been engaged.*

Blinks fast, four times per second: *A command has been sent to the module's address to identify itself. This command may be used during trouble shooting by YouSolar-authorized personnel.*

Off: *(i) The Nano-Grid is not turned on, (ii) the BLOC-LINK cable(s) on the back panel of the module are not connected, or the BLOC-LINK daisy chain does not connect to the TRAFFIC Controller.*

Blue "TX" 🔵 LED

Single flash: *A command has been sent.*

Red "RX" 🔴 LED

Single flash: *A command has been received.*

2. ARC FAULT DETECTION

The STEP™ Solar Input Module detects if there is an arc fault on the Solar Array. Arcing may occur due to faulty wiring including at the MC4-compatible connectors. A fault could occur at the connectors if the Interconnection Wire Harnesses are not properly connected to the HIGH POTENTIAL BUS connectors of the STEP™ Micro-Converter. The **ARC FAULT** LED indicates if an arc fault has been detected in any of the two Branches of the Solar Array.

Yellow ARC FAULT 🟡 LED

Solid: *An arc fault has been detected. All Branches are disabled. (The red BLOC-LINK "ON" LED double-blinks and the green SOLAR LED is off.)*

Off: *No arc fault detected.*

3. GROUND FAULT DETECTION

The STEP Solar Input Module also checks for faults to ground which may occur if the 400 V Branch wires touch the body of the micro-converter or if there is any other short to ground from the Interconnection Wire Harnesses or the Branch home run cable.

⚠	CAUTION
BRANCH GROUND: The polarities of the Branch cables are electrically "floating" with a differential of 400 VDC between them until they are connected to the STEP™ Solar Input Module (of a fully wired and properly grounded system). Then the two polarities are +200 V and –200 V with a ground center point created at the CAPS™ Bus Capacitor Module.	

The **GROUND FAULT** LED indicates if a ground fault has been detected in the Solar Array.

Yellow GROUND FAULT 🟡 LED:

Solid: *A ground fault has been detected. The Solar Array is disabled.*

Off: *No ground fault detected.*

4. SOLAR ARRAY SWITCH

The **SOLAR** switch enables or disables the Solar Array. When SOLAR is enabled the TRAFFIC™ Controller can turn the Branch on or off. (When the Branch is turned on it may run at 100% of power or at any throttle value between 0% and 100%.) Disabling SOLAR will turn off the array and prevent the controller from turning it on. A guard protects the SOLAR switch from being accidentally toggled.

The green SOLAR 🟢 LED indicates the following status.

When the **SOLAR** Switch is in the **Enable** position:

Solid: *The Solar Array is on.*

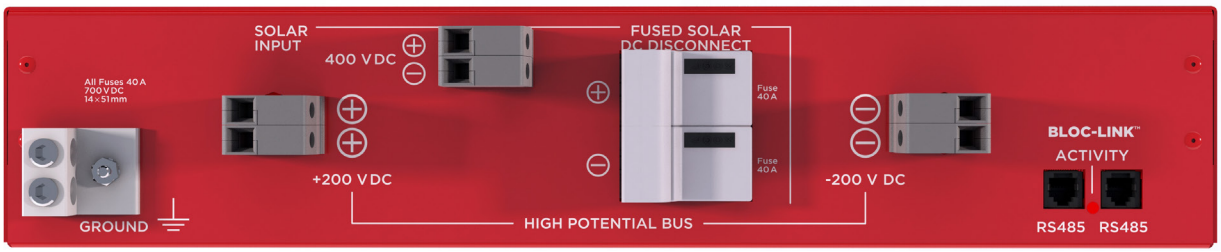
Off: *The Solar Array is off because the*
(i) TRAFFIC Controller has turned off the Solar Array because no energy is needed,
(ii) E-Stop is engaged, or
(iii) E-Stop has just been released.

When the **SOLAR** switch is in the **Disable** position:

- ***Off (Only):*** *The Branches of the Solar Array have been disabled and cannot be turned on by the TRAFFIC™ Controller.*

⚠	WARNING
MEASURING LESS THAN 30 VOLT ON THE ARRAY DOES NOT MEAN THE SOLAR ARRAY IS DISABLED AND OFF: The TRAFFIC™ Controller may turn off the Solar Array when the Nano-Grid cannot accept any or all of the solar energy. In this case, a measurement of the Branch may show a rapidly declining or no electric potential. However, at any time the controller may turn on the Branch of the Solar Array. Therefore, measuring a potential below 30 Volts (the threshold potential below which the Solar Array is considered to be off) does not mean you can safely work on the array. Before work on the array can begin the SOLAR switch must be in the Disable position. If the work is performed while the Nano-Grid is on, then we recommend, if accessible, to open the FUSED SOLAR DC DISCONNECT on the back panel of the module and to remove the fuses. This guarantees that the Nano-Grid's HVDC bus is disconnected from the Solar Array.	

When the E-Stop has just been released, the Solar Array will not turn on unless the SOLAR switch is first put into the **Disable** position and then returned to **Enable**. If after doing so ▪ the green SOLAR LED does not turn on ▪ the red ON LED of the BLOC-LINK is blinking slowly (2 times per second), and ▪ no faults have been detected, the TRAFFIC™ Controller is not turning on the Solar Array because the solar energy cannot be used by the system.



Back Panel

1. SOLAR INPUT

The **SOLAR INPUT** connects a Solar Array equipped with STEP™ Micro-Converters. The Branches connect to the HVDC bus with diodes in each polarity. These diodes prevent the Nano-Grid's HVDC bus from energizing the Branch.
See the graphic on the next page for further explanation on the diodes in the Branch inputs.

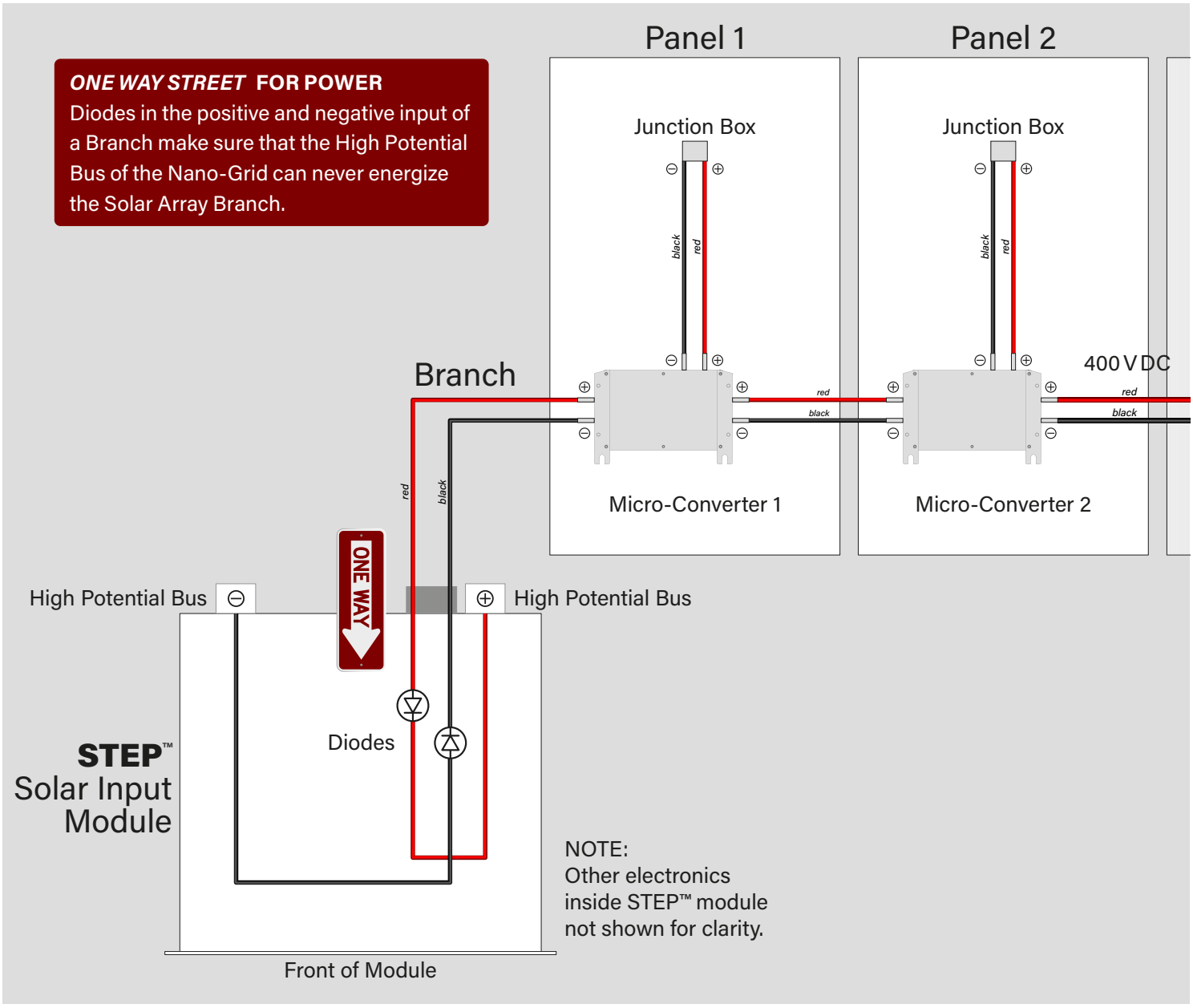
⚠	WARNING
CABLE POLARITY: Extreme care must be taken to connect the correct polarities of the Branch cable to the BRANCH INPUT on the back panel of the module. To avoid errors, the HIGH POTENTIAL BUS on the STEP™ Micro-Converters is clearly labeled, the Interconnection Wire Harnesses between micro-converters are color-coded (red for positive and black for negative), and the connectors only fit one way. Please make sure to label the positive and negative home run cables from the array to the module correctly.	

⚠	WARNING
DO NOT CONNECT A STRING ARRAY, *SOLAREDGE*, OR *ENPHASE* SOLAR ARRAY: Only connect a Solar Array equipped with STEP™ Micro-Converters to the SOLAR INPUT. Do not connect a string array. The STEP™ Solar Input Module does not provide Maximum Power Point Tracking (MPTT) and connecting a string array with a variable potential could damage the STEP Solar Input Module and other modules of the PowerBloc®. Also do not connect arrays with *SolarEdge* optimizers, *Enphase* micro-converters or other 3rd-party panel-level electronics to the SOLAR INPUT as these panel-level devices are incompatible with the PowerBloc.	

SAFETY FEATURE
DIODES IN THE SOLAR INPUTS: Both the positive and negative BRANCH input connect to the HVDC bus inside the STEP™ Solar Input Module with a diode. This prevents the HVDC Nano-Grid from energizing the Branches. When disabled the electric potential of the Solar Array will fall below 30 Volt in less than 30 seconds, while the HVDC bus may still be at 400 V and may continue to deliver power to the load. See also the STEP™ Micro-Converter Installation and Operating Manual for more information.

Schematic

Diodes in 1-Branch STEP™ Solar Input Module



2. FUSED SOLAR DC DISCONNECT

The **FUSED SOLAR DC DISCONNECT** protects each polarity of a Branch with a 40 A fuse and when opened disconnects that Branch from the HVDC bus. Both polarities need to be open to fully disconnect a Branch.

⚠	CAUTION
SAFETY RECOMMENDATION: When working on the Solar Array while the PowerBloc is operating and the Nano-Grid's HVDC bus is at 400 Volt, the SOLAR switch must be in the Disable position. The SOLAR switch is protected by a guard. However, if the SOLAR switch is still accidentally enabled the controller could turn on the Branch. Therefore, prior to any service of the Solar Array we recommend to: ▪ Open both lines of the FUSED SOLAR DC DISCONNECT; and ▪ Remove both fuses (for absolute safety).	

3. HIGH POTENTIAL BUS CONNECTORS

The **HIGH POTENTIAL BUS** connects to the +200 V and -200 V terminal blocks. See the installation section for cable gauges and wiring instructions.

4. BLOC-LINK™ PORTS

The **BLOC-LINK™** ports connect to adjacent module(s) or BLOC-LINK Busbar Module.

Red BLOC-LINK ACTIVITY ● LED

Blinks: *A transmission has occured on the BLOC-LINK.*

5. GROUND TERMINAL

The **GROUND** terminal connects the module to the GROUND terminal of another module or the ground post of the cabinet.

Physical Specifications

Please see Appendix for STEP™ Solar Input Module, 1-Branch Physical Specifications.

Height: 3 Rack Units, "U",
1 U = 1.75 Inches

STEP™ Solar Input Module 2-Branch

The STEP™ Solar Input Module accepts inputs from a Branch of a Solar Array equipped with STEP™ Micro-Converters. Solar panel-level STEP Micro-converters combined with the STEP Solar Input Module create a Solar Array that is safe, efficient, and flexible. A Branch is a "daisy chain" of up to thirty (30)× STEP Micro-Converters for up to 10 $kW|_{DC}$ of solar power.

Inside the STEP Solar Input Module each polarity of a Branch connects to the High Potential Direct Current Bus (HVDC) bus with diodes. These diodes prevent the HVDC Nano-Grid from energizing the Branch. Each Branch will rapidly shut down, which means when a Branch is turned off its electric potential will fall below 30 Volts in less than 30 seconds. Both features increase the safety when working on the Solar Array.

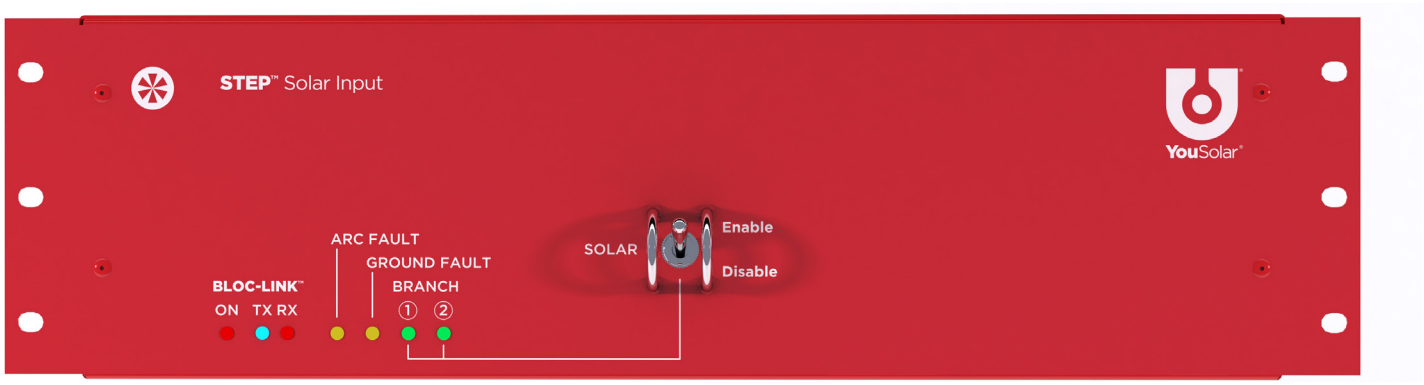
The module communicates with STEP Micro-converters using YouSolar's CARP™ powerline communication.

There are two different STEP Solar Input Modules.

- 1-Branch Module and
- 2-Branch Module.

The 1-Branch Module connects a Branch of up to 30× micro-converters for 10 $kW|_{DC}$ of power while the 2-Branch module connects to one (1) or two (2) Branches for 10 or 20 $kW|_{DC}$ of power. 1-Branch and 2-Branch modules can be combined to reach higher Solar Array power. For example, one 1-Branch and one 2-Branch module can create an array with up to 30 $kW|_{DC}$ of power. Note that the BLOC-LINK™ Busbar's current rating limits solar power on the PowerBloc® to 50 $kW|_{DC}$.

This manual section discusses the 2-Branch STEP Solar Input Module.



Front Panel

1. BLOC-LINK™

BLOC-LINK™ is the communication link of the PowerBloc®. It carries communication using the RS485 standard, a 24 Volt bus, and the Emergency Stop (E-Stop) signal. The LEDs of the BLOC-LINK section on the front panel indicate whether the module is on, off, or E-Stopped, and whether the module is sending or receiving data.

Red "ON" ● LED

Blinks slowly, twice per second: *STEP is on and the Solar Array is enabled. The TRAFFIC™ Controller may turn the STEP™ Micro-converters on the Branches.*

Double-blinks: *The Emergency Stop has been engaged.*

Blinks fast, four times per second: *A command has been sent to the module's address to identify itself. This command may be used during trouble shooting by YouSolar-authorized personnel.*

Off: *(i) The Nano-Grid is not turned on, (ii) the BLOC-LINK cable(s) on the back panel of the module are not connected, or the BLOC-LINK daisy chain does not connect to the TRAFFIC Controller.*

Blue "TX" ● LED

Single flash: *A command has been sent.*

Red "RX" ● LED

Single flash: *A command has been received.*

2. ARC FAULT DETECTION

The STEP™ Solar Input Module detects if there is an arc fault on the Solar Array. Arcing may occur due to faulty wiring including at the MC4-compatible connectors. A fault could occur at the connectors if the Interconnection Wire Harnesses are not properly connected to the HIGH POTENTIAL BUS connectors of the STEP™ Micro-converter. The **ARC FAULT** LED indicates if an arc fault has been detected in any of the two Branches of the Solar Array.

Yellow ARC FAULT ● LED

Solid: *An arc fault has been detected. All Branches are disabled. (The red BLOC-LINK "ON" LED double-blinks and the green SOLAR LED is off.)*

Off: *No arc fault detected.*

3. GROUND FAULT DETECTION

The STEP Solar Input Module also checks for faults to ground which may occur if the 400 V Branch wires touch the body of the micro-converter or if there is any other short to ground from the Interconnection Wire Harnesses or the Branch home run cable.

⚠	CAUTION
BRANCH GROUND: The polarities of the Branch cables are electrically "floating" with a differential of 400 VDC between them until they are connected to the STEP™ Solar Input Module (of a fully wired and properly grounded system). Then the two polarities are +200 V and –200 V with a ground center point created at the CAPS™ Bus Capacitor Module.	

The **GROUND FAULT** LED indicates if a ground fault has been detected in any of the two Branches of the Solar Array.

Yellow GROUND FAULT 🟡 LED:

Solid: *An ground fault has been detected. All Branches are disabled.*

Off: *No ground fault detected.*

4. SOLAR ARRAY SWITCH

The **SOLAR** switch enables or disables the Solar Array, comprising one or two Branches. When SOLAR is enabled the TRAFFIC™ Controller can turn a Branch on or off. (A Branch which is turned on may run at 100% of power or at any throttle value between 0% and 100%.) Disabling SOLAR will turn off the array and prevent the controller from turning it on. A guard protects the SOLAR switch from being accidentally toggled.

The green SOLAR LED 🟢 indicates the following status.

When the **SOLAR** Switch is in the **Enable** position:

Solid: *The Solar Array is on.*

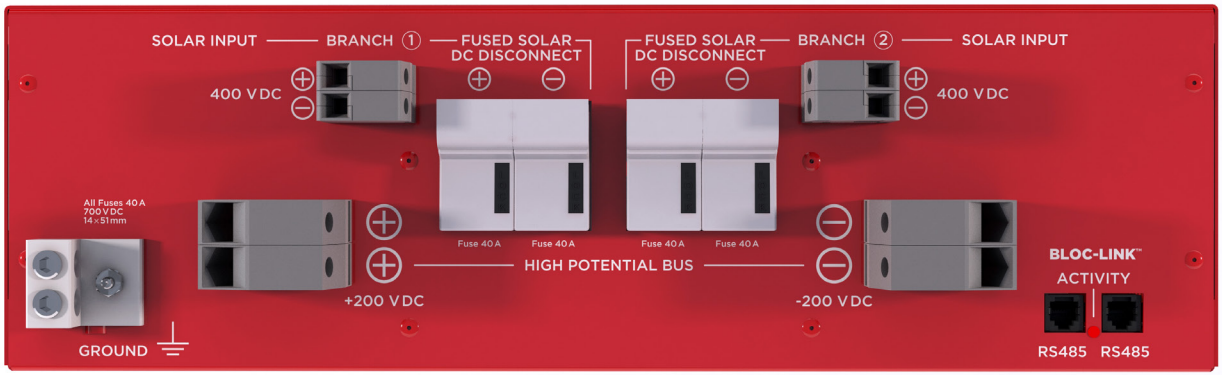
Off: *The Solar Array is off because the*
(i) TRAFFIC Controller has turned off the Solar Array because no energy is needed,
(ii) E-Stop is engaged, or
(iii) E-Stop has just been released.

When the **SOLAR** switch is in the **Disable** position:

- ***Off (Only):*** *The Branches of the Solar Array have been disabled and cannot be turned on by the TRAFFIC™ Controller.*

⚠	WARNING
MEASURING LESS THAN 30 VOLT ON THE ARRAY DOES NOT MEAN THE SOLAR ARRAY IS DISABLED AND OFF: The TRAFFIC™ Controller may turn off the Solar Array when the Nano-Grid cannot accept any or all of the solar energy. In this case, a measurement of the Branch may show a rapidly declining or no electric potential. However, at any time the controller may turn on the Branch of the Solar Array. Therefore, measuring a potential below 30 Volts (the threshold potential below which the Solar Array is considered to be off) does not mean you can safely work on the array. Before work on the array can begin the SOLAR switch must be in the Disable position. If the work is performed while the Nano-Grid is on, then we recommend, if accessible, to open the FUSED SOLAR DC DISCONNECT on the back panel of the module and to remove the fuses. This guarantees that the Nano-Grid's HVDC bus is disconnected from the Solar Array.	

When the E-Stop has just been released, the Solar Array will not turn on unless the SOLAR switch is first put into the **Disable** position and then returned to **Enable**. If after doing so ▪ the green SOLAR LED does not turn on ▪ the red ON LED of the BLOC-LINK is blinking slowly (2 times per second), and ▪ no faults have been detected, the TRAFFIC™ Controller is not turning on the Solar Array because the solar energy cannot be used by the system.



Back Panel

1. SOLAR INPUT

The **SOLAR INPUTS** connect BRANCH 1 and BRANCH 2 of the Solar Array equipped with STEP™ Micro-converters. The Branches connect to the HVDC bus with diodes in each polarity. These diodes prevent the Nano-Grid's HVDC bus from energizing the Branch.

See the graphic on the next page for further explanations on the diodes in the Branch inputs.

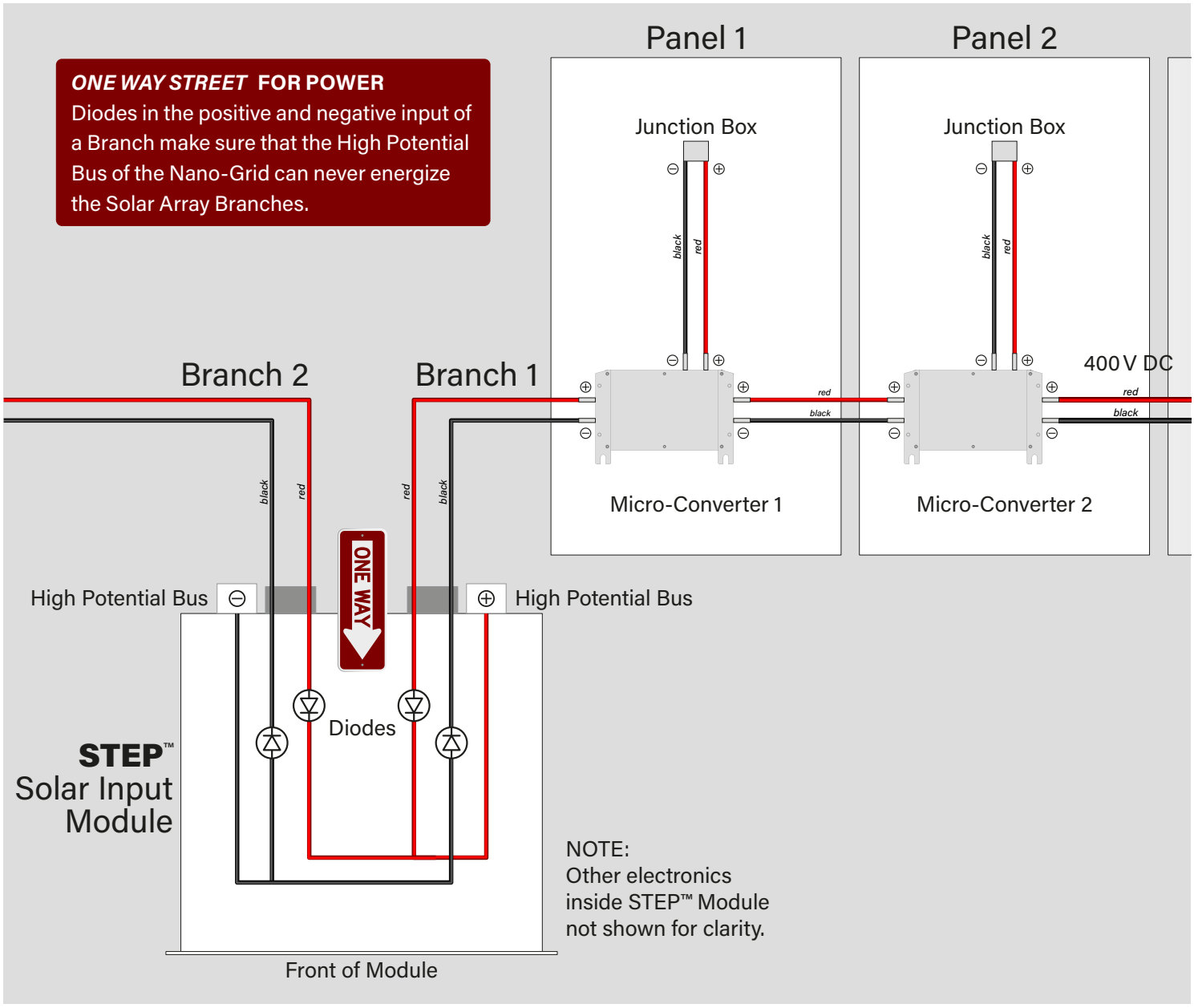
⚠	**WARNING**
CABLE POLARITY: Extreme care must be taken to connect the correct polarities of the Branch cable to the BRANCH INPUT on the Back Panel of the module. To avoid errors, the HIGH POTENTIAL BUS on the STEP™ Micro-Converters is clearly labeled, the Interconnection Wire Harnesses between micro-converters are color-coded (red for positive and black for negative), and the connectors only fit one way. Please make sure to label the positive and negative home run cables from the array to the module correctly.	

⚠	**WARNING**
DO NOT CONNECT A STRING ARRAY, *SOLAREDGE*, OR *ENPHASE* SOLAR ARRAY: Only connect a Solar Array equipped with STEP™ Micro-Converters to the Branch inputs. Do not connect a string array. The STEP Solar Input Module does not provide Maximum Power Point Tracking ("MPTT") and connecting a solar array with a variable potential of a string array could damage the STEP Solar Input Module and other modules of the PowerBloc®. Also do not connect an array with *SolarEdge* optimizers, *Enphase* micro-converters or other 3rd-party panel-level electronics to the SOLAR INPUT as these panel-level devices are incompatible with the PowerBloc.	

SAFETY FEATURE
DIODES IN THE SOLAR INPUTS: Both the positive and negative BRANCH input connect to the HVDC bus inside the STEP™ Solar Input Module with a diode. This prevents the HVDC Nano-Grid from energizing the Branches. When disabled the electric potential of the Solar Array will fall below 30 Volt in less than 30 seconds, while the HVDC bus may still be at 400 V and may continue to deliver power to the load. See also the STEP™ Micro-Converter Installation and Operating Manual for more information.

Schematic

Diodes in 2-Branch STEP™ Solar Input Module



2. FUSED SOLAR DC DISCONNECT

The **FUSED SOLAR DC DISCONNECT** protects each polarity of a Branch with a 40 A fuse and when opened disconnects that Branch from the HVDC bus. Both polarities need to be open to fully disconnect a Branch.

⚠	CAUTION
SAFETY RECOMMENDATION: When working on the Solar Array while the PowerBloc is operating and the Nano-Grid's HVDC bus is at 400 Volt, the SOLAR switch must be in the Disable position. The SOLAR switch is protected by a guard. However, if the SOLAR switch is still accidentally enabled the controller could turn on the Branch. Therefore, prior to any service of the Solar Array we recommend to: ▪ Open both lines of the FUSED SOLAR DC DISCONNECT; and ▪ Remove both fuses (for absolute safety). We further recommend to do so for both Branches even if only one Branch is being serviced, because it is easy to confuse Branches on a roof.	

3. HIGH POTENTIAL BUS CONNECTORS

The **HIGH POTENTIAL BUS** connects to the +200 V and -200 V terminal blocks. See the installation section cable gauges and wiring instructions.

4. BLOC-LINK™ PORTS

The **BLOC-LINK™** ports connect to adjacent module(s) or BLOC-LINK Busbar Module.

Red BLOC-LINK ACTIVITY ● LED

Blinks: *A transmission has occured on the BLOC-LINK.*

5. GROUND TERMINAL

The **GROUND** terminal connects the module to the GROUND terminal of another module or the ground post of the cabinet.

Physical Specifications

Please see Appendix for STEP™ Solar Input Module, 2-Branch Physical Specifications.

Height: 3 Rack Units, "U",
1 U = 1.75 Inches

EXTEND™ Rectifier

The EXTEND™ Rectifier extends the direct current Nano-Grid to integrate alternating current (AC) power sources such as utility or generator power. The EXTEND has four bays which can each hold a 3 kW Rectifier Pack. All four AC input lines are electrically isolated. Therefore, up to four different AC sources can connect to the EXTEND (or one AC input line can be distributed over multiple LINES).

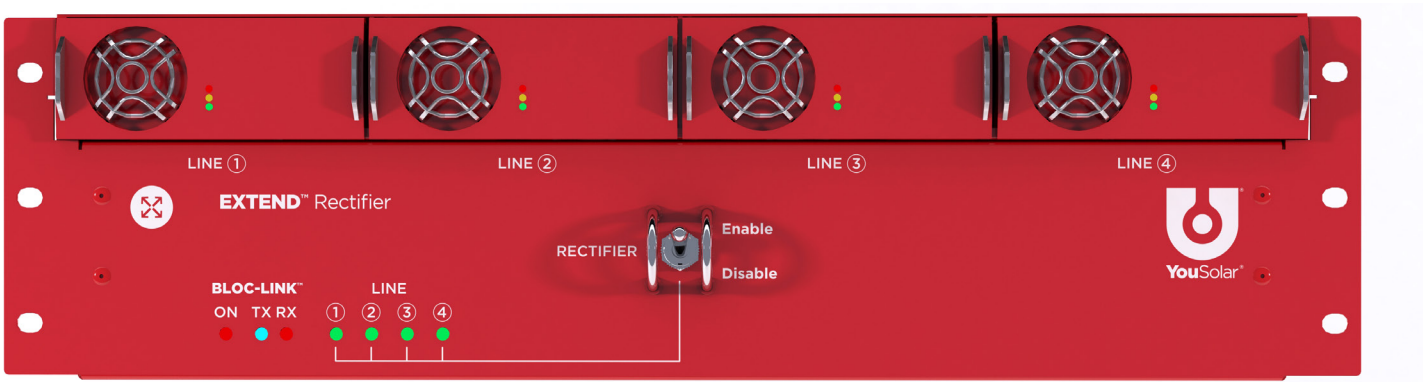
The EXTEND can accept power at frequencies of 50 or 60 Hertz and electric potentials of 200-250 Volts. A 3 kW Rectifier Pack will accept 120 V but the power of the DC output will be less than 3 kW.

DESIGN ADVANTAGE

MULTIPLE AC INPUTS: The input to LINE 1 and LINE 2 could be 240 V of utility power, while LINE 3 has a generator and LINE 4 could be open. Or LINES 1-3 could each by one phase of 3-phase power and LINE 4 a generator, etc.

DESIGN NOTE

120 VOLT GENERATORS: The PowerBloc®'s HVDC bus is able to deliver high power and a generator would act primarily as an energy source (while, of course adding power to the HVDC bus when it is running). For most residential home a small 3-6 kW generator is sufficient to supplement energy. These small generators may not come with a 240 V output. In this case, the 120 V output should be connected to 120 V-to-240 V transformer before connecting to the input of an AC INPUT.



Front Panel

1. LINES 1 TROUGH 4

The four bays of the module can hold up to four (4) × 3 kW rectifier packs for a total of up to 12 kW of DC power. The 3 kW-rectifier is inserted and locks into the bay. Each AC INPUT is electrically isolated from all other LINES.

2. RECTIFIER SWITCH

The **RECTIFIER** switch enables the 3 kW-rectifiers to be turned on or off by the TRAFFIC™ Controller. The switch is protected by a guard so that it is not accidentally toggled. The TRAFFIC™ Controller controls relays in the AC INPUT of each LINE individually. When the EXTEND is disabled it cannot deliver power to the Nano-Grid.

Green RECTIFIER 🟢 LED

When the Switch is in the **Enable** position:

Solid: *EXTEND is on. The TRAFFIC™ Controller may close the relays of any of the four (4) AC INPUTS.*
Off: *E-Stop is on. The AC Relays are open and EXTEND is off. (The HVDC bus has been turned off.)*

When the Switch is in the **Disable** position:

Off (only): *EXTEND is disabled. The AC Relays are open and EXTEND is off.*

3. BLOC-LINK™

BLOC-LINK™ is the communication link of the PowerBloc®. It carries communication using the RS485 standard, a 24 Volt bus, and the Emergency Stop (E-Stop) signal. The LEDs of the BLOC-LINK section on the front panel indicate whether the module is on, off, or E-Stopped, and whether the module is sending or receiving data.

Red "ON" 🔴 LED

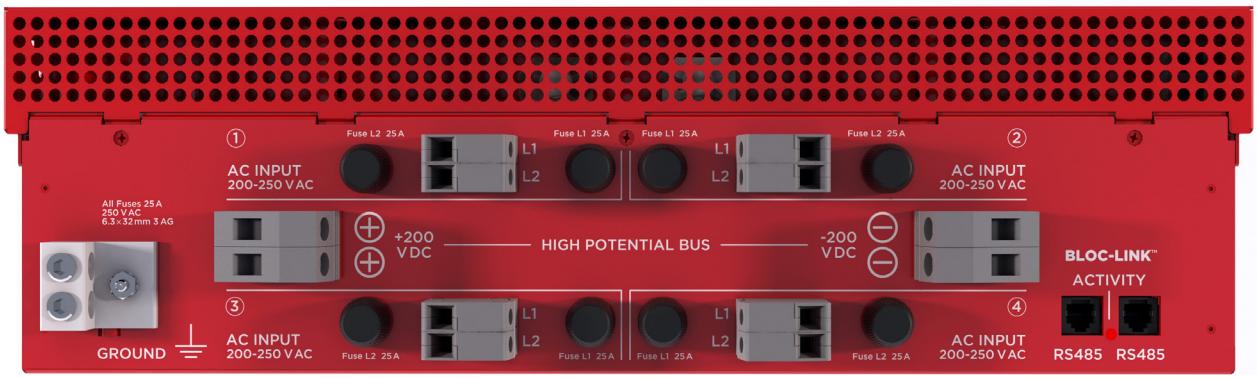
Blinks slowly, twice per second: *EXTEND is on.*
Solid: *The Emergency Stop has been engaged.*
Double-blinks: *EXTEND is disabled.*
Blinks fast, four times by per second: *A command has been sent to the module's address to identify itself. This command may be used during trouble shooting by YouSolar-authorized personnel.*
Off: *(i) The Nano-Grid is not turned on, (ii) the BLOC-LINK cable(s) on the back panel of the module are not connected, or the BLOC-LINK daisy chain does not connect to the TRAFFIC Controller.*

Blue "TX" 🔵 LED

Single flash: *A command has been sent.*

Red "RX" 🔴 LED

Single flash: *A command has been received.*



Back Panel

1. AC INPUTS

There are four (4) **AC INPUT**s which allow an input potential range of 200-250 V and frequencies of 50-60 Hz. These input ranges accommodate most single-phase and 3-phase utility or generator power in residential or commercial applications worldwide. An AC INPUT can accept 120 V but the power of the DC output of the corresponding Rectifier Pack will be less than 3 kW. The AC INPUTS are floating and the L and N outputs of 240 V utility or generator power can be connected to either the L1 or L2 connector.

⚠	**WARNING**
GENERATOR GROUND: Any generator connected to L1 and L2 of an AC INPUT must be grounded. Connection of the generator to the input of an AC LINE does not provide a ground for the generator.	

2. AC LINE

Each **AC LINE** is protected with a 25 A fuse in the lines L1 and L2. The specifications of replacement fuses (25 A, 250 VAC, 6.3 × 32 mm, 3 AG) are printed above the GROUND terminal lug.

1. BLOC-LINK™ PORTS

The **BLOC-LINK™** ports connect to adjacent module(s) or the BLOC-LINK Busbar Module.

Red BLOC-LINK ACTIVITY ● LED

Blinks: *A transmission has occured on the BLOC-LINK.*

2. GROUND TERMINAL

The **GROUND** terminal connects the module to the GROUND terminal of another module or the ground post of the cabinet.

Physical Specifications

Please see Appendix for EXTEND™ Rectifier Physical Specifications.

Height: 2 Rack Units, "U",
1 U = 1.75 Inches

TWIN™ Bi-Directional Converter

The TWIN™ Bi-Directional Converter steps up the Battery's 50 V electric potential to the 400 Volt of the PowerBloc®'s High Potential Direct Current (HVDC) bus and, vice versa, the potential of the HVDC bus down to the Battery potential. TWIN can charge at any rate in the range of 0-4 kW and discharge in the range of 0-3.8 kW. TWIN can be connected to one or two Batteries. When two Batteries are used, the Batteries operate in parallel.

Responses to power from the HVDC bus when TWIN is in discharge mode is nearly instantaneous and a short 60 milliseconds when switching from charge to discharge mode. The CAPS™ Bus Capacitor module stabilizes the bus when a TWIN reverses direction to deliver power. Small changes in the potential of the HVDC set the direction of the power flow (charge or discharge) of a TWIN. The TRAFFIC™ Controller manages the operation of multiple TWINs on the Nano-Grid. A PowerBloc®, typically, has three (3) or more TWINs.

Because TWIN connects the Batteries to the HVDC bus, Batteries on other TWINs in a PowerBloc can be at different states of charge. Controls of the TWIN-Battery units also allow having some TWIN-Battery units in discharge mode while others are in charge mode without the TWIN-Battery(s) in discharge mode charging TWIN-Battery(s) in charge mode. TWIN delivers unprecedented flexibility and performance to the PowerBloc Nano-Grid.

Front Panel

1. 50 VDC AND COMMON TERMINAL BLOCKS

The positive **50 VDC** and the **COMMON** terminal blocks connect to one (1) or two (2) Batteries with a nominal electric potential of 51.2 Volt.

2. BATTERY COMMUNICATION

The **RS232** ports on the front panel connect the RS232 port of one or two Batteries. The RS232 connection allows TWIN to read the battery management system of the Batteries.

3. BLOC-LINK™

BLOC-LINK™ is the communication link of the PowerBloc®. It carries communication using the RS485 standard, a 24 Volt bus, and the Emergency Stop (E-Stop) signal. The LEDs of the BLOC-LINK section on the front panel indicate whether the module is on, off, or E-Stopped and whether the module is sending or receiving data.

Red "ON" ● LED

Blinks slowly, twice per second: *TWIN is on and either in Charge, Discharge, or Standby mode.*

Solid: *The Emergency Stop has been engaged.*

Blinks fast, four times by per second: *A command was sent to the module's address to identify itself. This command may be used during trouble shooting by YouSolar-authorized personnel.*

Off: *(i) The Nano-Grid is not turned on, (ii) the BLOC-LINK cable(s) on the back panel of the module are not connected, or the BLOC-LINK daisy chain does not connect to the TRAFFIC Controller.*

Blue "TX" ● LED

Single flash: *A command has been sent.*

Red "RX" ● LED

Single flash: *A command has been received.*

4. DISCHARGE AND CHARGE

The **DISCHARGE** and **CHARGE** LED indicate when the TWIN is in discharge and charge mode, respectively.

Yellow "Discharge" ● LED

Solid: *TWIN is in Discharge mode and discharges at 0-3.8 kW.*

Green "Charge" ● LED

Solid: *TWIN is in Charge mode and charges at 0-4 kW.*

"Discharge" ● LED and "Charge" ● LED

Both off: *TWIN is in Standby mode. TWIN does not discharge or charge.*

Back Panel

1. HIGH POTENTIAL BUS TERMINAL BLOCKS

The High Potential Direct Current (HVDC) bus connects to the **+200 VDC** and **-200 VDC HIGH POTENTIAL BUS** terminal blocs.

2. BLOC-LINK™ PORTS

The **BLOC-LINK™** ports connect to adjacent module(s) or the BLOC-LINK Busbar Module.

Red BLOC-LINK ACTIVITY 🔴 LED

Blinks: *A transmission has occured on the BLOC-LINK.*

3. GROUND TERMINAL

The **GROUND** terminal connects the module to the GROUND terminal of another module or the ground post of the cabinet.

4. EXHAUST OPENING

The **EXHAUST** is an opening in the chassis that exhausts air.

Physical Specifications

Please see Appendix for TWIN™ Bi-Directional Converter Physical Specifications.

Height: 5 Rack Units, "U",
1 U = 1.75 Inches

Battery, 51.2 Volt, Lithium Iron Phosphate

The PowerBloc uses a safe and high-discharge Lithium Iron Phosphate ($LiFePO_4$) battery which requires no active cooling. Each battery pack is equipped with a battery management system (BMS). YouSolar uses a 50 V battery pack.

The battery has energy storage of 5.1 kWh and delivers up to 100 A of current over the entire range of the discharge curve at a nominal power of 5 kW.

Front Panel

1. TERMINAL BLOCKS

The positive **NOMINAL +51.2 V** and negative **COMMON** terminal blocks connect to the 50 VDC and COMMON input terminals on the front of the TWIN™ Bi-Directional Converter.

2. BREAKER

A 125 A breaker protects the battery and allows to connect (ON) or disconnect (OFF) the battery inside the chassis from the Terminal Blocks. Setting the breaker to OFF does not turn off the battery management system (BMS).

3. CHARGE INDICATOR

Four green Light Emitting Diodes (LEDs) indicate the state of charge (SOC) of the battery as determined by the Battery's battery management system. Each LED indicates approximately ¼ of the battery's storage capacity. The PowerBloc® uses the battery's SOC value and other BMS data to arrive at more accurate SOC value of the battery.

4. ALARM

The red **ALARM** 🔴 LED indicates if any of the battery alarms, e.g. the over-voltage alarm, have been triggered.

5. RUN

The green **RUN** 🟢 LED indicates that the battery is operating normally.

6. ADDRESS

The **ADDRESS** is set with a dual in-line package (DIP) switch and allows giving the battery an address in the range of 1-16. This address is used in RS485 communication. However, the Battery's RS485 communication port is not used by the PowerBloc. Therefore, the ADDRESS can have any value. By default the ADDRESS is set to 1.

7. RS232

The Battery's **RS232** port connects to any of the two RS232 ports on the front panel of the TWIN™ Bi-Directional Converter and allows TWIN to read the Battery BMS.

8. RS485

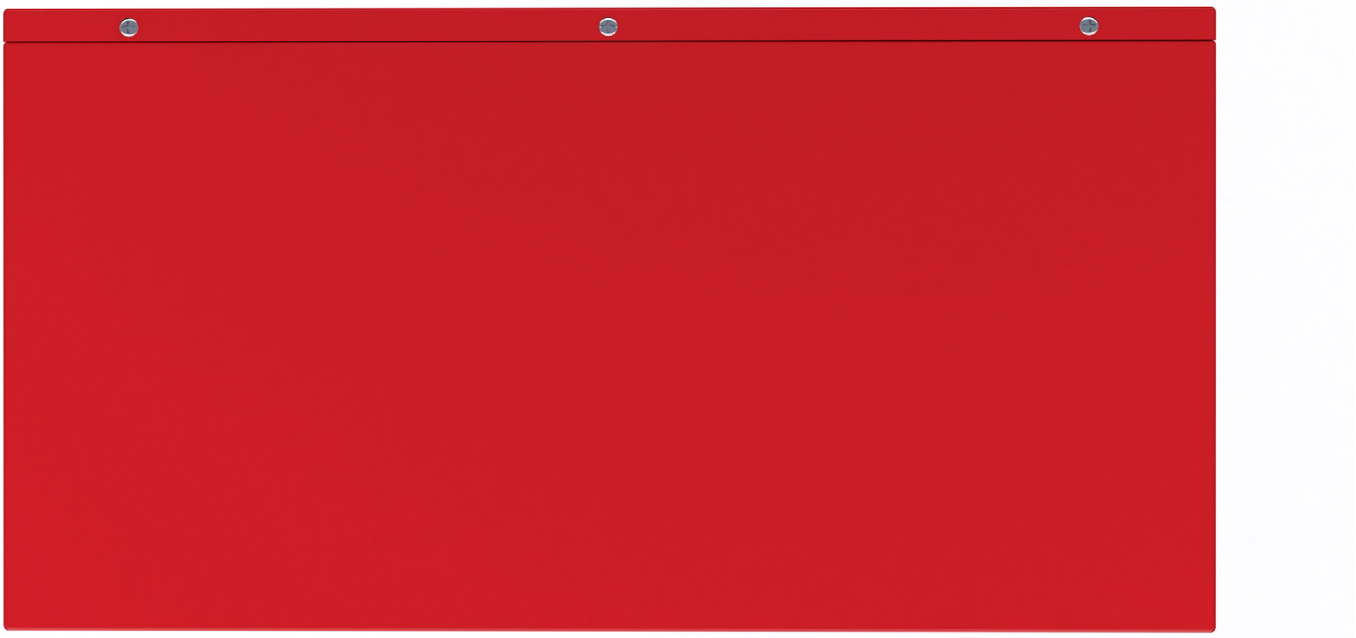
The two **RS485** ports are used in RS485 communication with the Battery's BMS. The Battery's RS485 port is not used by the PowerBloc.

9. RESET

The **RESET** button turns the Battery BMS on and off. It is also used to reset faults. Batteries are shipped with the Battery BMS turned off. After the installation of all modules in the cabinet is completed, the Battery BMS is turned on by pressing the RESET button. Note that the Breaker should always be in the OFF position before turning on the Battery's BMS.

10. DRY CONTACT

The **DRY CONTACT** allows for an external display of the battery status. The DRY CONTACT is not used by the PowerBloc.



Back Panel

The back panel of the battery has no connectors, ports, or indicator lights.

Physical Specifications

Please see Appendix for Battery Physical Specifications.