


















SOLATURN










FLASH4 Solar Power Package - 4 Panels -



System Supplies and Materials

#	Description	Qty	Image
1.	Solar Module - REC Solar, Alpha PURE Series 390W PV Module, 132 half-cut Bifacial heterojunction cells, Vmp: 40.6, Imp: 9.61, Voc: 48.4, Isc: 10.38, 71.7" x 40" x 1.2 (30mm), 45 lbs *MUST SHIP FREIGHT*	4	
2.	Inverter - Victron MultiPlus inverter & charger. 2000 Watts, 24 Volts DC, 120 Volts AC, 50 Amp charger, VE.Bus. Article code: PMP242200100	1	
3.	Charge Controller - Victron SmartSolar MPPT 250/60-Tr solar charge controller. 12, 24, 36, 48 Volts DC, 60 Amps max.... Article code: SCC125060221..	1	
4.	Battery - Discover energy AES professional 1.5kWh 25.6V 60AH with heating, on/off Key, LYNK COMM PORT. 10.2" x 7.1" x 10.1", 30.7 lbs.	2	
5.	Ameresco Solar BBA-6 solar battery box, holds 6 group 27 batteries, NEMA 3R,4 and 4X. 40.12" x 25.25" x 17.125", 61 lbs.	1	

6.	End clamp for PGRM mount. Made for 3" SCH40 pipe	2	
7.	Mid Clamp for PGRM mount. Made for 3" SCH40 pipe	2	
8.	IMO SI32-PEL64R-4 True DC Solar Isolator, Enclosed DC Switch IP66	1	
9.	This 1/2 in 1000V Heyco Strain Relief accepts two 6mm PV wires. Nut is included.	1	
10.	MidNite Solar surge protector for DC circuits. Rated for 300 volts DC nominal and 250 volts AC nominal.	1	
11.	MidNite Solar surge protector for AC circuits. Rated for 250 volts AC nominal and 300 volts DC nominal.	1	
12.	Discover Energy Systems 950-0040 LYNK LITE Communication Gateway intended to work with AES PROFESSIONAL (DLP) batteries. Doesn't work with AES RACKMOUNT.	1	
13.	50 ft. MC4 Solarline 2 (latching) extender cable, 10 AWG, Male to Female, 2kV single jacket 1kV rated connectors.	1	
14.	Bussmann MRCB breaker 100 amp DC 12-48 volts w/switch..(48 volt MAX)	1	
15.	Bussmann MRCB breaker 150 amp DC 12-48 volts w/switch	1	
16.	#2 AWG UL MTW CABLE, Stranded Copper Wire, BLACK	12	
17.	#2 AWG UL MTW CABLE, Stranded Copper Wire, RED	12	

18.	#2 x 5/16" stud ring connector tinned copper	4	
19.	#2 x 3/8" stud ring connector tinned copper	10	
20.	Heat Shrink for #4 AWG, 1.5 inch long, black. UL listed.	4	
21.	Heat Shrink for #4 AWG, 1.5 inch long, Red UL listed.	8	
22.	RJ45 UTP Cable 0.9 m ..Network cable for VE.Can, VE.Bus, VE.net..Article code: ASS030064920	3	
23.	Interface MK3-USB (VE.Bus to USB)..Article code: ASS030140000	1	
24.	Cerbo GX - operates as the communication-center of your installation. Cerbo-S does not include BMS-Can port, tank or temperature sense inputs. Dimensions: 6.07" x 3.08" x 1.9" Article code: BPP900450120	1	
25.	Discover networking accessories DLP CONNECTOR KIT 0.4M CABLE + T -DLP 0.4M cable + battery T connector kit	1	
26.	Discover networking accessories DLP COMM CABLE 25'/7.6M NEMA (HOMERUN) - DLP 7.6m battery interconnect network cables	1	

SOLATURN



The SolaTurn FLASH4 Solar Power Package features four high-efficiency solar panels, providing a complete solution for outdoor industrial applications.

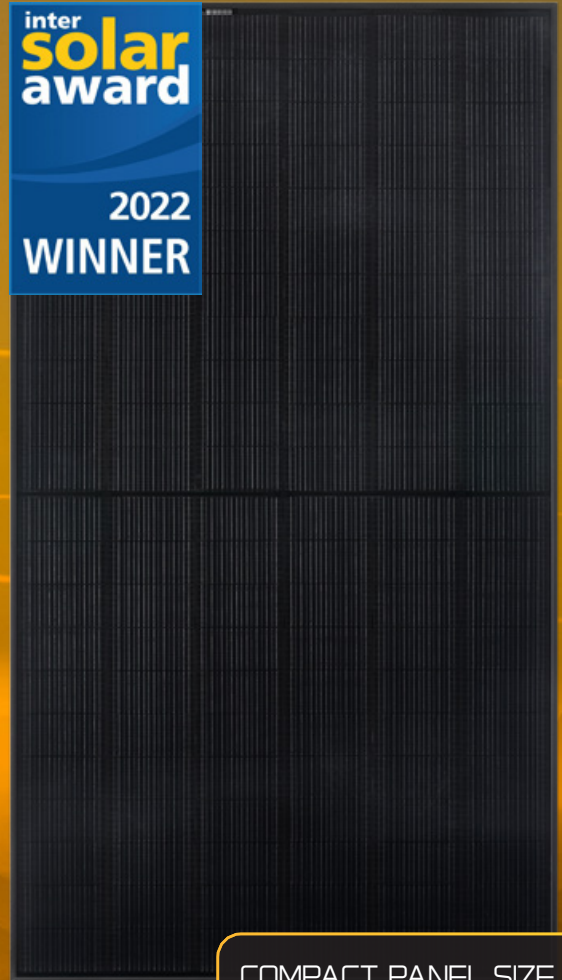
Ideal for powering card readers, turnstiles, ADA gates, and vehicle barrier gates in remote locations without access to traditional power, this durable kit ensures reliable performance in harsh conditions.

With all the components listed for easy installation, the FLASH4 package harnesses solar energy to deliver convenience and accessibility wherever you need it.

SolaTurn FLASH4 Solar Power Package

**PRODUCT
DOCUMENTATION**

Data Sheets, Installation Manuals, and Literature



REC ALPHA[®] PURE SERIES

PRODUCT SPECIFICATIONS

COMPACT PANEL SIZE

410 WP
222 W/M²



ELIGIBLE



LEAD-FREE
ROHS COMPLIANT

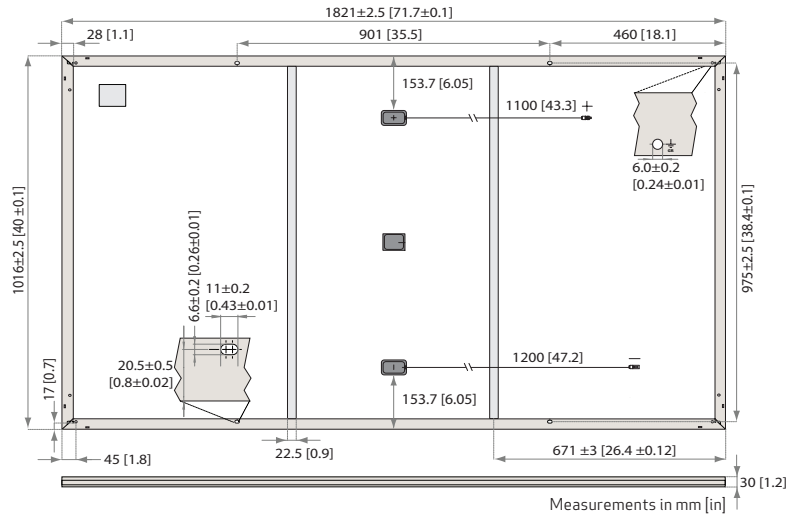
EXPERIENCE
α
PERFORMANCE

REC ALPHA PURE SERIES

PRODUCT SPECIFICATIONS

GENERAL DATA

Cell type:	132 half-cut REC heterojunction cells with lead-free, gapless technology, 6 strings of 22 cells in series
Glass:	3.2 mm solar glass with anti-reflective surface treatment in accordance with EN 12150
Backsheet:	Highly resistant polymer (black)
Frame:	Anodized aluminum (black)
Junction box:	3-part, 3 bypass diodes, lead-free IP68 rated, in accordance with IEC 62790
Connectors:	Stäubli MC4 PV-KBT4/KST4 (4 mm ²) in accordance with IEC 62852, IP68 only when connected
Cable:	4 mm ² solar cable, 1.1 m + 1.2 m in accordance with EN 50618
Dimensions:	1821 x 1016 x 30 mm (1.85 m ²)
Weight:	20.5 kg
Origin:	Made in Singapore



ELECTRICAL DATA

Product Code*: RECxxxAA Pure

	390	395	400	405	410
Power Output - P _{MAX} (Wp)	390	395	400	405	410
Watt Class Sorting - (W)	0/+5	0/+5	0/+5	0/+5	0/+5
Nominal Power Voltage - V _{MPP} (V)	40.6	41.0	41.4	41.8	42.2
Nominal Power Current - I _{MPP} (A)	9.61	9.64	9.67	9.69	9.72
Open Circuit Voltage - V _{OC} (V)	48.4	48.6	48.8	49.1	49.4
Short Circuit Current - I _{SC} (A)	10.38	10.39	10.40	10.41	10.42
Power Density (W/m ²)	211	214	216	219	222
Panel Efficiency (%)	21.1	21.4	21.6	21.9	22.2

	297	301	305	308	312
Power Output - P _{MAX} (Wp)	297	301	305	308	312
Nominal Power Voltage - V _{MPP} (V)	38.3	38.6	39.0	39.4	39.8
Nominal Power Current - I _{MPP} (A)	7.77	7.79	7.82	7.83	7.85
Open Circuit Voltage - V _{OC} (V)	45.6	45.8	46.0	46.3	46.6
Short Circuit Current - I _{SC} (A)	8.38	8.39	8.40	8.41	8.42

Values at standard test conditions (STC: air mass AM 1.5, irradiance 1000 W/m², temperature 25°C), based on a production spread with a tolerance of P_{MAX}, V_{OC} & I_{SC} ±3% within one watt class. Nominal module operating temperature (NMOT: air mass AM 1.5, irradiance 800 W/m², temperature 20°C, windspeed 1 m/s). * Where xxx indicates the nominal power class (P_{MAX}) at STC above.

MAXIMUM RATINGS

Operational temperature:	-40 ... +85°C
Maximum system voltage:	1000 V
Maximum test load (front):	+ 7000 Pa (713 kg/m ²)*
Maximum test load (rear):	- 4000 Pa (407 kg/m ²)*
Max series fuse rating:	25 A
Max reverse current:	25 A

* See installation manual for mounting instructions.
Design load = Test load / 1.5 (safety factor)

WARRANTY

	Standard	REC ProTrust
Installed by an REC Certified Solar Professional	No	Yes
System Size	All	≤25 kW 25-500 kW
Product Warranty (yrs)	20	25
Power Warranty (yrs)	25	25
Labor Warranty (yrs)	0	25
Power in Year 1	98%	98%
Annual Degradation	0.25%	0.25%
Power in Year 25	92%	92%

The REC ProTrust Warranty is only available on panels purchased through an REC Certified Solar Professional installer. Warranty conditions apply. See www.recgroup.com for more details.

CERTIFICATIONS

IEC 61215:2016, IEC 61730:2016, UL 61730	
IEC 62804	PID
IEC 61701	Salt Mist
IEC 62716	Ammonia Resistance
ISO 11925-2	Ignitability (Class E)
IEC 62782	Dynamic Mechanical Load
IEC 61215-2:2016	Hailstone (35mm)
IEC 62321	Lead-free acc. to RoHS EU 863/2015
ISO 14001, ISO 9001, IEC 45001, IEC 62941	



TEMPERATURE RATINGS*

Nominal Module Operating Temperature:	44°C (±2°C)
Temperature coefficient of P _{MAX} :	-0.24 %/°C
Temperature coefficient of V _{OC} :	-0.24 %/°C
Temperature coefficient of I _{SC} :	0.04 %/°C

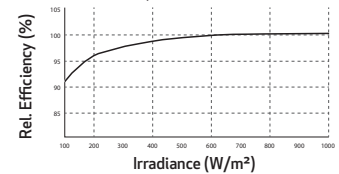
*The temperature coefficients stated are linear values

DELIVERY INFORMATION

Panels per pallet:	33
Panels per 40 ft GP/high cube container:	792 (24 pallets)
Panels per 13.6 m truck:	924 (28 pallets)
Panels per 53 ft truck:	891 (27 pallets)

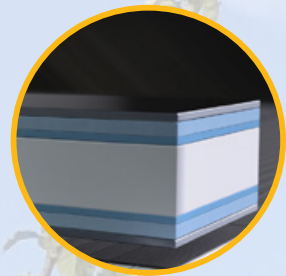
LOW LIGHT BEHAVIOUR

Typical low irradiance performance of module at STC:



The REC Alpha Pure Series unites leading cell technologies in a hybrid design to create a revolutionary, powerful and reliable solar panel:

- High power density maximizes energy generation from limited spaces - up to 20.3 W/ft²
- Advanced cell structure for high efficiency performance
- More power than conventional panels
- More savings from your roof



Heterojunction cells

- Combine the best of crystalline and thin-film technologies
- Highly efficient bifacial cell architecture for high performance

N-type technology = more power

- No LID protects panel from initial power loss
- You get the power you pay for

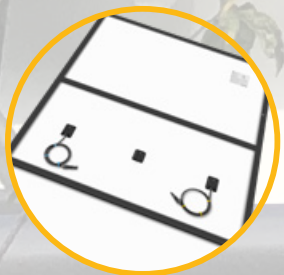


Unique Advanced Cell Connections

- Eliminates invasive soldering for better build quality
- Reduces thermal stress on the cells for long-term durability
- Great aesthetics

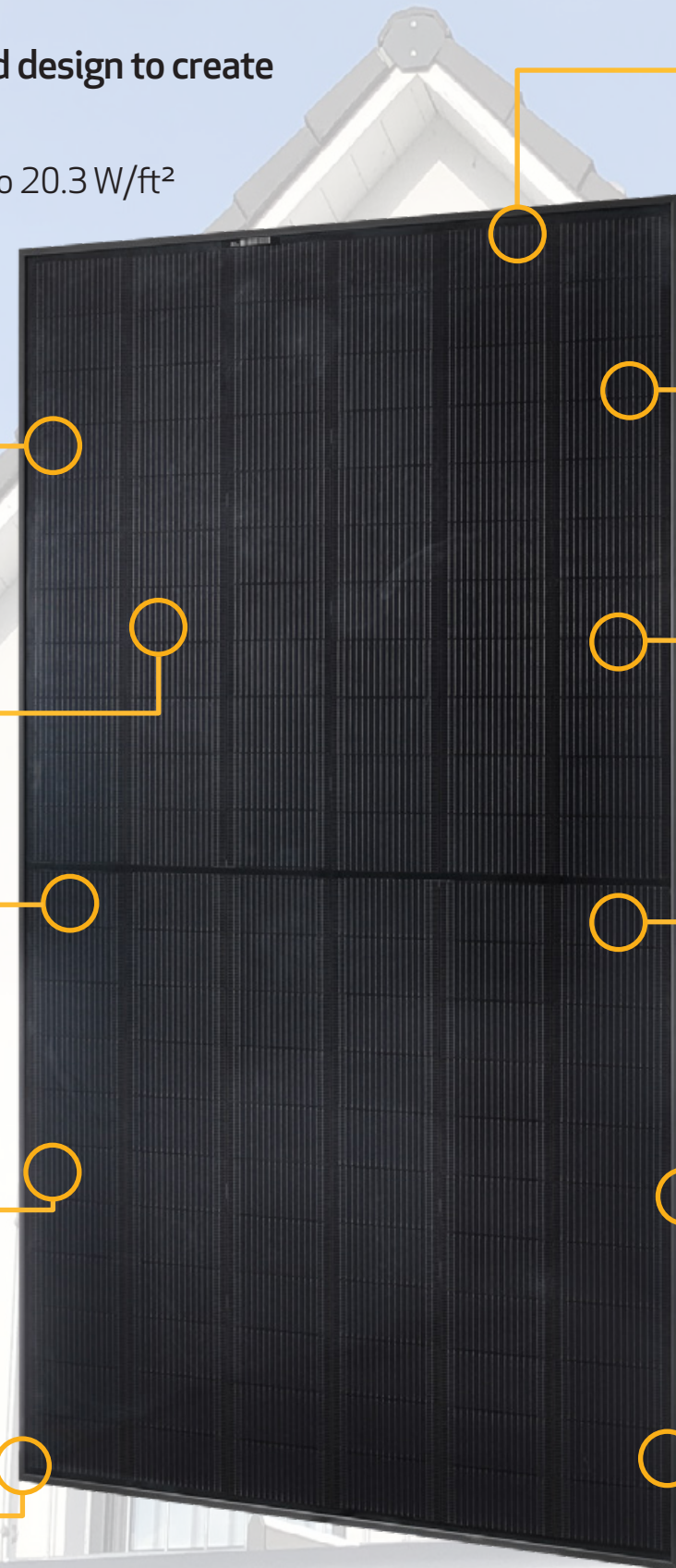
Higher light transmission

- Special anti-reflective glass increases light transmission for higher power
- Inherently bifacial cells can produce energy from both sides of the panel



Guaranteed better durability

- Super-strong frame withstands up to 146 lbs/sq ft
- Better protection against harsh weather
- Improves cell life for long-lasting high power



No busbars for an improved look

- Practically-invisible connections for the best choice for your home
- Black backsheet for an elegant look on your roof



High power density of 20.3W/ft²

- High power density panel
- Pack in more power in limited or restricted spaces
- Generate more clean energy

Higher efficiency at the hottest times

- Leading temperature coefficient for more production when the sun shines strongest
- Better performance in hot climates



REC's iconic Twin Design

- Reduces internal resistance for more power and reliability
- Improved output when shaded

Environmentally-friendly

- Lead-free (RoHS compliant)
- Energy-efficient manufacturing processes minimize carbon footprint



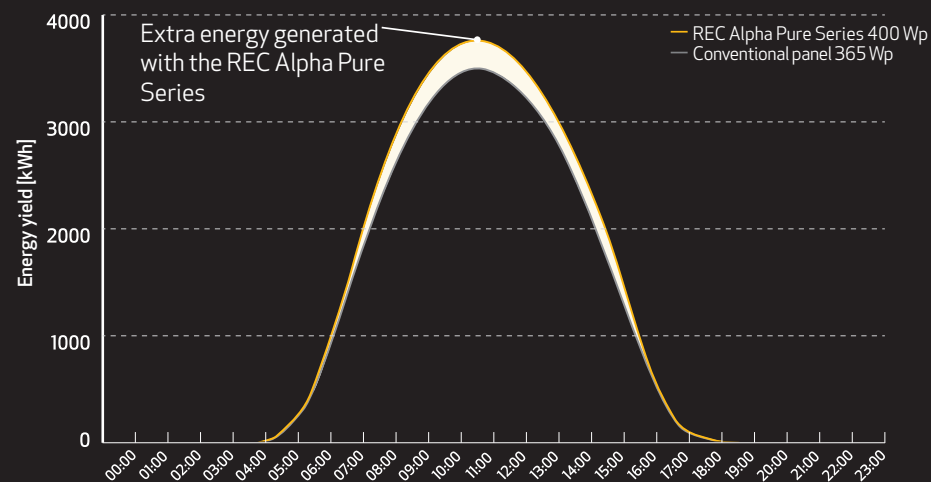
Exceptional quality

- Made in REC's state of the art, energy efficient facility in Singapore
- Highly automated production improves efficiency and reliability
- Consistently one of the lowest warranty claims rate in solar

GREATER YIELDS FROM DAWN TO DUSK

The REC Alpha Pure Series packs in more energy than ever before. With no LID, a leading temperature coefficient and its high power density, it is ideal for increasing energy yields and making the most of available rooftop space.

Average Daily Energy Production Comparison Over One Year

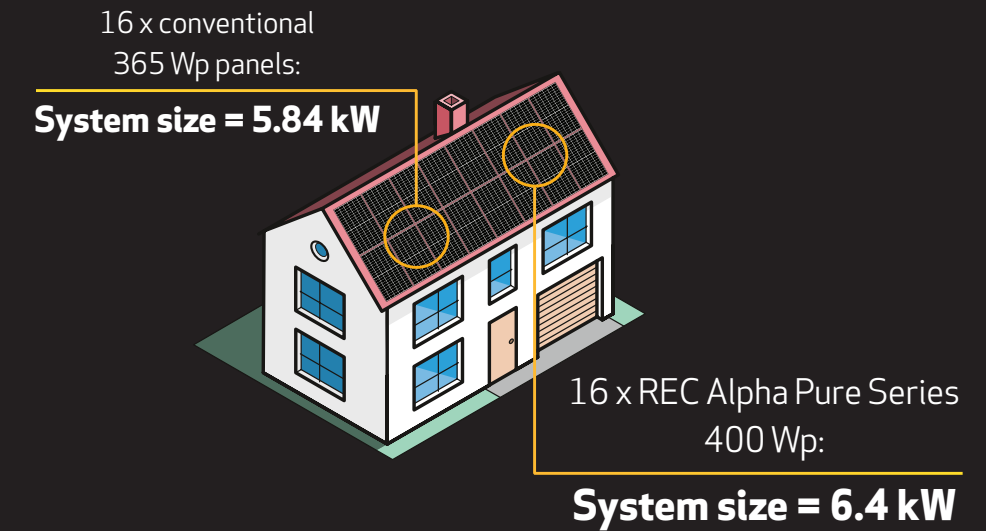


Calculations based on simulation results for full calendar year, based on an 1.2 kWp system in Palm Springs, CA, USA. Peak REC Alpha Pure Series energy yield difference at midday: +6%, with an overall greater annual yield of 7.6%. Performance may vary dependent on location.

**+10%
MORE
POWER
WITH THE
REC ALPHA PURE!**

MAXIMIZE SYSTEM POWER FOR MAXIMUM SAVINGS

Optimum use of rooftop space is key to a good solar installation. The REC Alpha Pure Series allows you to pack in as much power generation as possible, generating more energy and more savings on your bills.



The comparison is clear: even in a regular residential installation, the REC Alpha Pure Series gives you more power than conventional panels for more energy and more savings.

15% MORE WARRANTED POWER AFTER 25 YEARS

REC's consistently low claims rate justifies outstanding warranty terms. Our warranty offering reflects this leadership and supports our premium product quality.



Exclusively offered by REC Certified Solar Professionals, the REC ProTrust Warranty gives enhanced product and labor coverage*, ensuring peace of mind and a lifetime of high power generation:

- 25 years performance warranty
- 25 years product warranty
- Up to 25 year labor warranty*

MAKE MAJOR REDUCTIONS TO YOUR CO₂ FOOTPRINT

A 6 kW REC Alpha Pure Series installation generates over 7,200 kWh of clean energy per year, cutting the CO₂ emissions of a home by 4.7 tons per year*, equivalent to:

84 trees planted and grown over 10 years

CO₂ sequestered by
6 acres of forest per year

1.8 tons of waste recycled instead of entering landfill

12,500 miles in a family car

Charging a phone
650,000 times

2.5 tons of coal burnt for power



*Values may vary dependent on location



REC ALPHA PANELS INSTALLATION MANUAL

FOR ALL REC ALPHA SOLAR PANELS CERTIFIED
ACCORDING TO IEC 61215 & UL 61730 STANDARDS:

- REC Alpha Pure Series
- REC Alpha Pure-R Series
- REC Alpha Pure-RX
- REC Alpha Pure 2 Series

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INTRODUCTION




Thank you for choosing REC photovoltaic panels for your installation. REC Alpha solar panels are ideal for delivering long-lasting and reliable power output. They have been created through intelligent design and are manufactured to the highest quality and environmental standards. With correct installation and maintenance, REC panels will provide decades of clean and renewable energy.

Please read this entire manual carefully. It contains critical information on safety, as well as detailed instructions for the installation, operation and maintenance of the panels. Failure to follow these procedures will invalidate the warranty (www.recgroup.com/warranty). Review all instructions and safety notes in this manual before working on the system. Failure to do so may lead to injury or damage to property.

HOW TO USE THIS MANUAL

This manual describes the procedures for the terrestrial installation of all REC Alpha solar panels certified according to IEC 61215 & UL 61730 standards. This includes all product variants (indicated by the appropriate suffix in the panel name) e.g., a white or black backsheet. The installed panel is considered to be in compliance with IEC 61215 & UL 61730 only when mounted in the manner specified by this installation manual. Note that any panel without a frame (laminated) is not considered to comply with the requirements of IEC 61215 & UL 61730 unless mechanically installed with hardware that has been tested and evaluated with the panel under this standard or by a field inspection certifying that the installed panel complies with the requirements of IEC 61215 & UL 61730.

Except where specifically stated, the information and drawings in this manual refer to all frame, backsheet, and cell types; the illustrations are only a generic representation of the instructions regardless of color or exact design. Throughout the manual, you will see sections which highlight important information or notes:

 DANGER
Indicates potential for damage to personal safety.
 CAUTION
Indicates potential for damage to the array or property.
 NOTE
Indicates important notes to help with the installation.

YOUR RESPONSIBILITY AS AN INSTALLER

Installers are responsible for the safe and effective installation and operation of the system and for adhering to all applicable local standards and regulations. Prior to installation installers must check all current regulations and permits concerning solar installations and ensure all local directives are observed. Furthermore, installers are responsible for the following:

- Only qualified personnel must perform work on photovoltaic systems such as installation, commissioning, maintenance and repairs
- Be sure to follow the safety instructions for all system components
- Ensuring the REC panels are in a suitable condition for use and appropriate for the particular installation and environment
- Using only parts that comply with the specifications set out in this manual
- Ensuring a safe installation of all aspects of the electrical array
- All tools and equipment should be properly maintained and inspected prior to use

As this manual may contain instructions for different product variants, ensure you follow the instructions for the correct product where specified.

SUPPORT

Do not attempt to install REC solar panels if you are unsure of the procedure or suitability. For further support, questions or guidance with your installation, please call your distributor or contact your REC sales office, which can be found at: www.recgroup.com/contacts.

LIABILITY DISCLAIMER

REC SOLAR PTE. LTD. accepts no liability for the usability and functionality of its photovoltaic panels if the instructions in this guide are not observed. Since compliance with this guide and the conditions and methods of installation, operation, use and maintenance of the panels are not checked or monitored by REC SOLAR PTE. LTD., REC SOLAR PTE. LTD. accepts no liability for damage arising from improper application or incorrect installation, operation or maintenance. This does not apply to damages due to a panel fault, in cases of loss of life, bodily injury or damage to health or in the event of a grossly negligent breach of obligations on the part of REC SOLAR PTE. LTD. and/or in the event of an intentional or grossly negligent breach of obligations by a legal representative or vicarious agent. REC reserves the right to make changes or amendments to this manual at any time, without prior notice.

This document may be produced in different languages. If there is any conflict, the English language version shall be definitive.

LIMITED WARRANTY

The REC Limited Warranty is available to download from www.recgroup.com/warranty. Ignoring any of the instructions in this manual may be classed as improper installation or use and invalidate the Warranty Terms and Conditions. If you have any questions about installation and the Warranty validity, please contact REC.

SAFETY MEASURES

Installers are responsible for the safe and effective installation and operation of the system and for adhering to all applicable local and national standards and regulations. All relevant local codes and regulations should be referred to and observed.



DANGER - Electrical shock

Solar panels generate direct current (DC). Once current is flowing, breaking a connection (e.g., disconnecting two panels) can cause an electrical arc. Unlike low voltage AC wiring, DC arcs are not self-extinguishing; they are potentially lethal burn and fire hazards, capable of high temperatures that can destroy contacts and connectors:

- Isolate the system and remove/open the inverter AC fuse/circuit breaker from the grid before carrying out any maintenance or repair work.
- Follow inverter manufacturer's installation, handling and operating instructions.
- High-voltage components need sufficient time to discharge. Wait for the time specified by the manufacturer before commencing work.
- Do not use a panel which is broken or damaged. If the panel front glass is broken or laminate back sheet is damaged, it can expose personnel to hazardous voltages.

SAFETY IN THE WORKING AREA

Installation of REC solar panels may involve working on rooftops or raised platforms. Ensure all local regulations regarding working at heights and fall protection are followed. Before beginning work on an installation, ensure all working surfaces are structurally sound and capable of bearing the weight of employees and required equipment.

Preventing current generation

To prevent the panels automatically generating current (electricity) when exposed to light, shield the system with a non-transparent cover during installation, maintenance or repair work.

Specific hazards of DC electricity

The voltage produced by a single panel, and panels connected in series (voltages added together), or in parallel (currents added together) can be dangerous. Although the fully insulated plug contacts on the panel's output cables provide touch-safe protection, the following points must be observed during handling to avoid the risk of sparking, fire hazards, burns and lethal electric shocks:

- Exercise extreme caution when wiring panels and look out for damaged or dirty cables etc,
- Never insert metallic or other conductive objects into plugs or sockets,
- Ensure that all electrical connections are completely dry before assembly,
- Keep all materials, tools, and working conditions dry and tidy,
- Use appropriate safety equipment e.g., non-slip footwear, insulated gloves and insulated tools,
- Solar panels produce current when exposed to sunlight. Do not connect the system to the inverter during solar exposure.

PANEL HANDLING

In order to avoid damage, all REC solar panels should be handled with care and protected from damage at all times. All warnings and instructions on the packaging should be observed. Follow these guidelines when unpacking, transporting, carrying, installing or storing panels:

- Record the serial numbers prior to installation and note the information in the system documentation,
- Carry the panels using both hands and do not use the junction box or cables as a grip,
- Do not allow the panels to sag or bow under their own weight when being carried,
- Do not subject panels to loads or stresses, e.g., leaning on them or through the placing of weight on them,
- Do not stand or walk on the panels,
- Avoid dropping the panels as any damage caused may be unseen,
- Keep all electrical contacts clean and dry,
- Do not apply force to the backsheet,
- Avoid using sharp or pointed objects if panels require marking,
- Never apply paints, adhesives or detergents to the front or rear of the panel,
- Do not use any solar panel that is damaged or has been tampered with,
- Never attempt to disassemble, modify, or adapt the panels or labels in any way as this will void the warranty.

NOTE

Use clean and protective gloves when handling the panel as this will avoid the transfer of any fingerprints or soiling to the highly-sensitive and anti-reflective glass surface, ensuring improved light transmission and avoiding any contamination.

The pallet packaging is not water- or weatherproof. Prior to installation, and to avoid damage or degradation to the packaging or panel components, pallets and panels must be stored in a controlled environment, ideally internal, where it is protected from the elements, e.g., rain, dust, and direct sunlight. If overnight storage in an uncontrolled environment is unavoidable, the panels and the pallet packaging must be protected from direct exposure to the elements and from contact with the ground, including earth, mud etc.

CHOOSING AN INSTALLATION LOCATION

REC solar panels are designed to provide decades of durable and stable output in installations up to 6500 ft (2000 m) above sea level. Ambient operating temperatures must be between -40° - 185°F (-40° and +85°C).

The panels are not suitable for installation in potentially hazardous locations nor should they be installed in the following locations:

- Near sources of flammable gas or vapor e.g., gas containers or spray paint facilities,
- Near open flames,
- Where the panels are exposed to direct contact with salt water/spray,
- Under water or in water features,
- Where exposed to sulfur e.g., near sulfur springs or volcanoes,
- Where exposed to artificially concentrated sunlight,
- Where the panels may be exposed to harmful chemicals.

NOTE

For further information regarding installations on water platforms, e.g., floating pontoons, see Annex 1 at the rear of this manual.

ELECTRICAL INSTALLATION

DANGER - Electrical shock

Safety is paramount when working on the electrical installation. Always follow the electrical requirements to avoid the risk of sparking, fire hazards, burns and lethal electric shocks.

ELECTRICAL REQUIREMENTS

Application Class

REC solar panels are rated for use in Electrical Application Class A, Protection Safety Class II; at hazardous levels of voltage (>35V), current(>8A) and power (>240W) where general contact access is anticipated (panels qualified for safety through UL 61730-1 and -2).

System Requirements

REC solar panels are only for use where they meet the specific technical requirements of the complete system. Ensure other components will not cause mechanical or electrical damage to the panels. Only panels of the same type and power class should be connected.

String configuration

When connecting panels in a string, plan and execute according to the inverter manufacturer's instructions. The number of panels connected to an inverter must not exceed the voltage limits and operating range permitted by the manufacturer, nor under any circumstance exceed the maximum system voltage as stated in the technical specifications for the product at the rear of this manual. The maximum system fuse rating (overcurrent protection rating) and the maximum reverse current for each panel can be found in the technical specifications for the product at the rear of this manual.

The maximum number of panels in a string can be calculated by dividing the maximum system voltage of the panel by its V_{oc} accounting for the lowest ambient temperature at site, e.g.: for a 1000V system, if the lowest ambient temperature is 15°C, the panel has a V_{oc} of 44.3 V and a temperature coefficient of V_{oc} of -0.24%/°C, the maximum panels per string is 22 ($\Delta T^{\circ}C = 25^{\circ} - 15^{\circ} = 10^{\circ}$; $10^{\circ} \times 0.24 = 2.4\%$; $44.3 + 2.4\% = 45.4$; $1000 V / 45.4 = 22.0$, so a total of 22 panels or 976 V). Qualified system designers can make exact calculations that account for specific project requirements and site conditions.

String connection

If panels are connected in series, they must have the same ampere rating. If panels are connected in parallel, they must have the same voltage rating. The maximum number of panels that can be connected in series or parallel depends upon system design, type of inverter and environmental conditions. Panel and string configuration must correspond to the specifications of other system components e.g., inverter. Refer to the reverse current rating of the panel as indicated in the technical characteristics section to the rear of this manual or on the panel datasheet.

Wiring

Wiring installation shall be in accordance with the National Electric Code (NEC) (or CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1 where applicable). To minimize voltage surges (e.g., indirect lightning strikes), cables of the same string must be bundled together so loops are as small as possible. String configurations must be checked before commissioning. If open circuit voltage (V_{oc}) and short circuit current (I_{sc}) deviate from specification, this may indicate a configuration fault. Correct DC polarity must be observed at all times.

Electrical Ratings

Electrical ratings are within a specific tolerance of measured values at Standard Test Conditions (STC) as given in the technical characteristics for each panel at the rear of this manual. Under normal conditions, a photovoltaic panel is likely to experience conditions that produce more current and/or voltage than reported at STC. The requirements of the NEC in Article 690 must be followed to address these increased outputs. In installations not under the requirements of the NEC, the values of I_{sc} and V_{oc} marked on the panels must be multiplied by a factor of 1.25 (or according to local regulations) when determining component voltage ratings, conductor ampacities, overcurrent device ratings and size of controls connected to the PV output.

MECHANICAL INSTALLATION

FIRE GUIDELINES

The REC solar panels covered by this manual have a Class C (referencing UL 790) fire classification. REC Alpha Series panels are rated Type 2 fire classification according to IEC 61730-2:2016 (ref. ANSI/UL 1703). The fire performance rating of the panels is only valid when mounted in the manner specified in this installation manual. The complete system fire class rating is to be achieved by the combination of panel fire performance type and UL2703 certified mounting structure for a non-BIPV panel. Please refer to mounting structure UL2703 listing for System Fire Classification. Any specific limitations on the inclination or accessories required to maintain a specific System Fire Class Rating must be clearly specified in the mounting system manufacturer's installation instructions and UL2703 certification. Utilize the following fire safety guidelines when installing REC panels:

- Check with all relevant local authorities for fire safety requirements for any building or structure on to which the panels will be installed,
- The system design must ensure that it can be easily accessed in the event of a building fire,
- Check with relevant authorities for applicable regulations concerning setbacks or other placement restrictions that may apply for roof-mounted arrays,
- The use of DC ground fault interrupters is recommended. This may also be required by local and national codes,
- All electrical appliances are a fire risk. The panel must be mounted over a fire retardant roof covering rated for the application and a distance of at least 0.8 in (20 mm) between the panel and the mounting surface, to allow the free circulation of air beneath the panels at all times.

ORIENTATION

The optimal mounting position of a panel results in the sun's rays falling perpendicular (i.e., at 90°) to the surface. To maximize system output, panels should be installed at the optimum orientation and tilt angle. The specifics of this depend on location and can be calculated by a qualified system designer. All panels in a string should, wherever possible, have the same orientation and tilt to ensure the system does not underperform due to mismatched outputs. Dependent on local conditions, a lower angle of installation will potentially increase the requirement for regular cleaning.

NOTE

The IP rating of the junction box provides a level of protection that allows panels to be mounted in any orientation.

PANEL INSTALLATION

REC solar panels are designed for capturing solar radiation and can be installed where they conform to all local structural regulations. If installing REC solar panels in overhead or vertical constructions, the installer must ensure that all local building codes and regulations specific to such installations are correctly followed. There are different options for securing REC solar panels depending on the design of the array. Mounting hardware is not supplied by REC. Ensure the mounting structure can withstand anticipated wind and snow loads. Follow the mounting hardware manufacturer's instructions and recommendations at all times.

i NOTE
Panels must be installed so that the cells are not shaded as this will drastically reduce electrical output. If partial shading is inevitable at certain times of the day or year, it must be kept to an absolute minimum. Remove any labels or stickers that may be on the front of the panels and ensure no residue is left on the glass.

i NOTE
Common hardware items such as nuts, bolts, star washers, lock washers and the like have not been evaluated for electrical conductivity or for use as grounding devices and should be used only for maintaining mechanical connections and holding electrical grounding devices in the proper position for electrical conductivity. Such devices, where supplied with the panel and evaluated through the requirements in IEC 61215 & UL 61730, may be used for grounding connections in accordance with the instructions provided with the panel.

⚠ CAUTION
There must be a minimum clearance gap of 0.8 in (20 mm) between the uppermost part of the installation surface (e.g., rooftop) and the lowest part of the panel (i.e., underside of panel frame) to avoid any damage to the panel and to ensure sufficient airflow for cooling, helping to improve performance. The surface below the panels must be kept clear of any objects that may cause damage to the panel.

SECURING OF PANELS

A typical installation of solar panels will be carried out with suitable rails and clamps. Other types of panel support, e.g., plates, must meet the same specifications. Such installations have been found to be in compliance with IEC 61215 & IEC 61730 requirements for the stated maximum test loads of: +7000 Pa downwards pressure and -4000 Pa upwards pressure (+4666 Pa/-2666 Pa design loads).

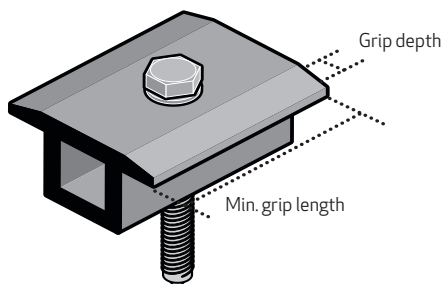
Site-specific factors such as high wind or snow levels must be taken into consideration to ensure this limit is not exceeded.

When installing on mounting rails, ensure they run underneath the panel and provide support to the frame. The positioning of the rail must ensure that the minimum clamp grip length (fig. 1) and the central point of the fixation, e.g., the bolt, is fully within the required clamping zone as indicated on the following pages.

REC modules must be secured with a torque as shown in the table below (fig. 1). Clamp installation must be carried out according to the manufacturer's instructions, including specific hardware and torque requirements. Ensure the clamps used are suitable for the planned installation and expected system design loads.

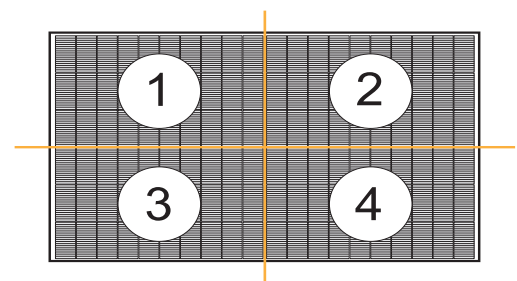
- The grip area must not extend onto the panel glass and/or cause cell shading,
- Avoid the application of excessive pressure to prevent frame deformation,
- The panel must be secured, e.g., clamped, at least once in each of the four marked zones shown below (fig. 2).

Fig. 1: Clamp specifications



Specifications	Length
Grip depth	0.2 - 0.4 in (5 - 10 mm)
Min. grip length	1.6 in (40 mm)
Torque	12 - 25 Nm (106-221 lbf/in)

Fig. 2: Panel quarter divisions



i NOTE

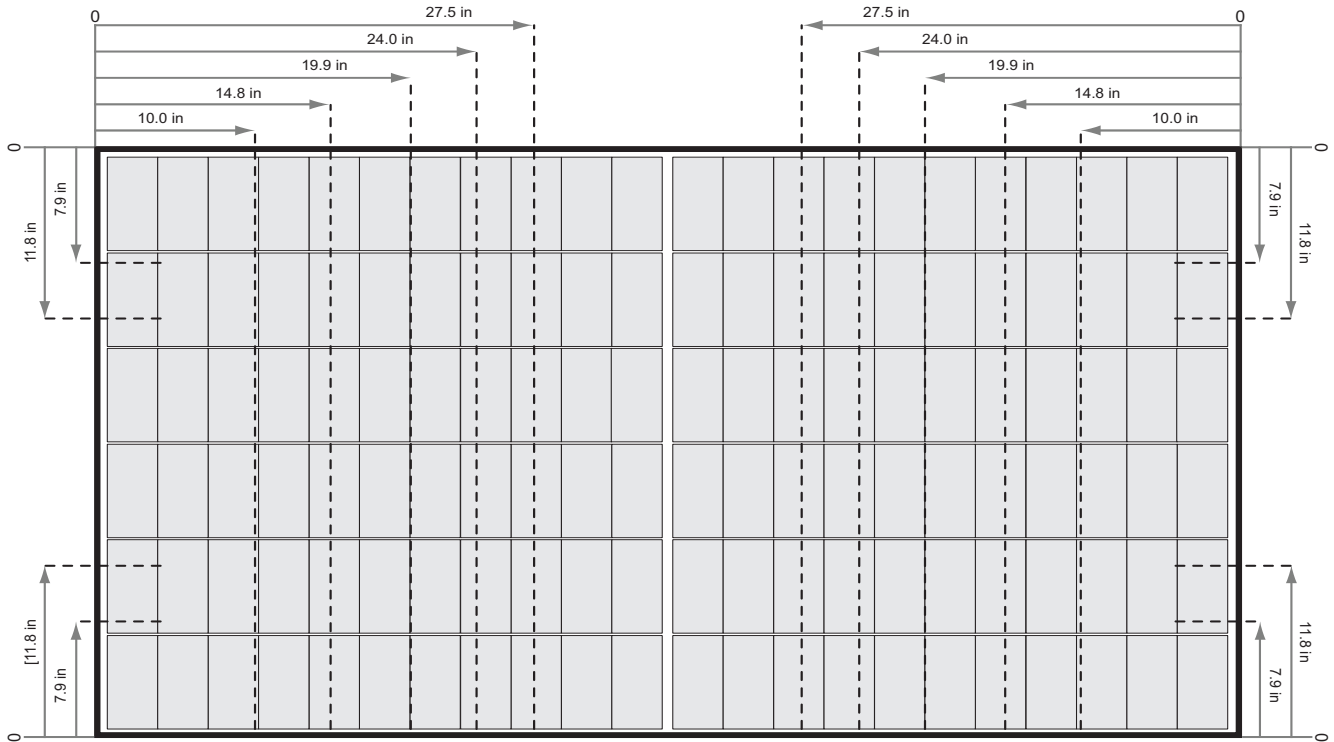
- In areas of snow build-up, panels can be subjected to forces in excess of the stated limit even when snow depth does not appear extreme, potentially causing damage to the panel. If the installation may be affected by this, further panel support is recommended, especially on the lower row of panels.
- In the case of any questions regarding mounting systems, or if the mounting system to be used does not match any of the instructions shown in this installation manual, please contact REC for further support.


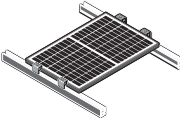

INSTALLATION OF REC ALPHA PURE SERIES PANELS

MOUNTING REC ALPHA PURE SERIES PANELS WITH CONTINUOUS RAILS PARALLEL TO SHORT SIDE OF THE PANEL

A continuous rail (or other support structure) spans the complete underside of the panel.

Fig. 3: Clamping of REC Alpha Pure Series panels with rails parallel to short side of the panel



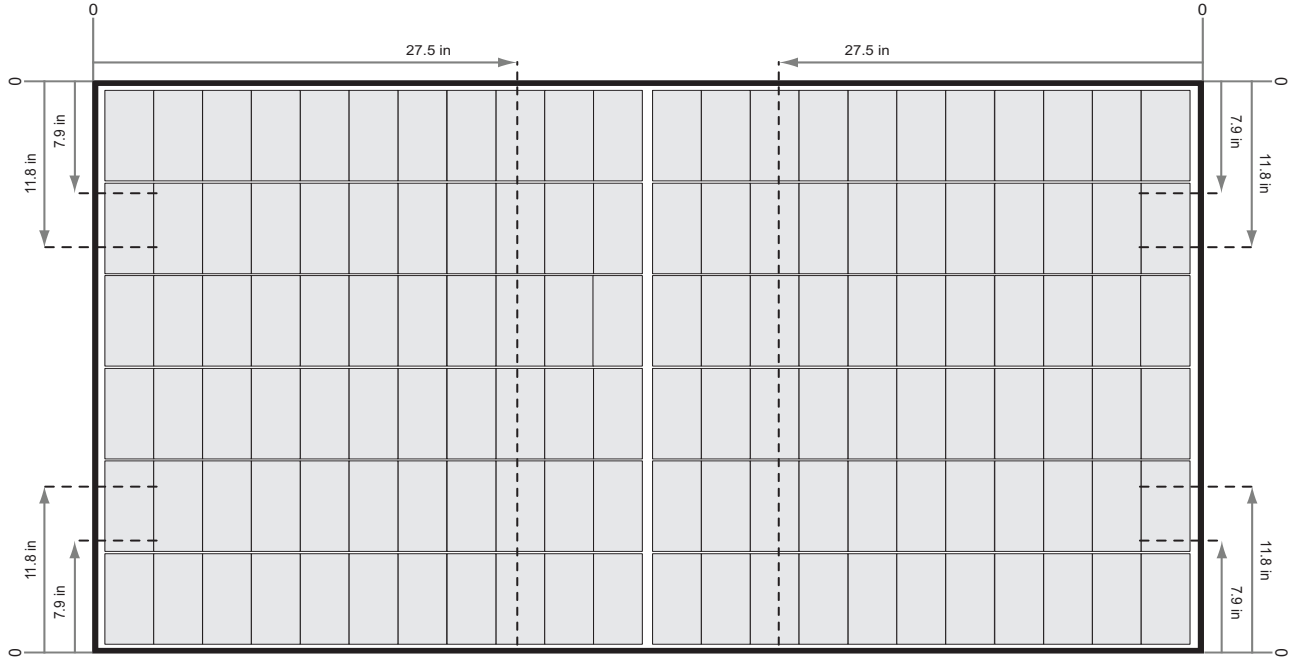
Legend	Clearance Gap		0.8 - 1.6 in (20-40 mm)	1.6 - 2.4 in (40-60 mm)	>2.4 in (>60 mm)
			Test Load (Design Load)	Test Load (Design Load)	Test Load (Design Load)
Rail position 	Long Side Mounting	0 - 10.0 in (0 - 255 mm)	X	+1200 Pa / -1200 Pa* (+800Pa/-800Pa)	+2400 Pa / -2400 Pa (+1600Pa/-1600Pa)
		10.0 - 14.8 in (255 - 375 mm)	+1800 Pa / -1800 Pa* (+1200Pa/-1200Pa)	+4200 Pa / -2400 Pa (+2800Pa/-1600Pa)	+5400 Pa / -2400 Pa (+3600Pa/-1600Pa)
		14.8 - 19.9 in (375 - 505 mm)	+1800 Pa / -1800 Pa* (+1200Pa/-1200Pa)	+6200 Pa / -4000 Pa (+4133Pa/-2666Pa)	+7000 Pa / -4000 Pa (+4666Pa/-2666Pa)
		19.9 - 24.0 in (505 - 610 mm)	+1200 Pa / -1200 Pa* (+800Pa/-800Pa)	+3000 Pa / -2400 Pa (+2400Pa/-1600Pa)	+5400 Pa / -2400 Pa (+3600Pa/-1600Pa)
		24.0 - 27.5 in (610 - 700 mm)	+2400 Pa / -2400 Pa (+1600Pa/-1600Pa)	+2400 Pa / -2400 Pa (+1600Pa/-1600Pa)	+2400 Pa / -2400 Pa (+1600Pa/-1600Pa)
Rail position 	Short Side Mounting	0 - 7.9 in (0 - 200 mm)	X	+1200 Pa / -1200 Pa* (+800Pa/-800Pa)	+1600 Pa / -1600 Pa* (+1066Pa/-1066Pa)
		7.9 - 11.8 in (200 - 300 mm)	X	+800 Pa / -800 Pa* (+533Pa/-533Pa)	+2400 Pa / -2400 Pa (+1600Pa/-1600Pa)
	Once a module is secured in each of the 4 zones "", additional clamps, i.e., ≥5, may be freely located on panel frame without affecting the warranty. Loads marked with a * were not certified as part of IEC 61215/61730 testing; these have been evaluated by REC's internal testing process.				


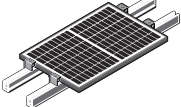

CAUTION
The center point of each clamp and the minimum grip length must be fully located in the same clamping zones to be rated to that load (fig. 3). If the panel is secured in zones with different load values, it is rated to the lowest load value only.

MOUNTING REC ALPHA PURE SERIES PANELS WITH CONTINUOUS RAILS PARALLEL TO LONG SIDE OF THE PANEL

A continuous rail (or other support structure) spans the complete underside of the panel.

Fig. 4. Clamping of REC Alpha Pure Series panels with rails parallel to long side of the panel



Legend	Clearance Gap		0.8 - 1.6 in (20-40 mm)	1.6 - 2.4 in (40-60 mm)	>2.4 in (>60 mm)
	Clamping zone		Test Load (Design Load)	Test Load (Design Load)	Test Load (Design Load)
 Rail position Long Side Mounting	0 - 27.5 in (0 - 700 mm)		+1200 Pa / -1200 Pa* (+800Pa/-800Pa)	+3000 Pa / -2400 Pa (+2400Pa/-1600Pa)	+5400 Pa / -2400 Pa (+3600Pa/-1600Pa)
 Rail position Short Side Mounting	0 - 7.9 in (0 - 200 mm)		X	+1200 Pa / -1200 Pa* (+800Pa/-800Pa)	+1600 Pa / -1600 Pa* (+1066Pa/-1066Pa)
	7.9 - 11.8 in (200 - 300 mm)		X	+800 Pa / -800 Pa* (+533Pa/-533Pa)	+2400 Pa / -2400 Pa (+1600Pa/-1600Pa)
	Installations with a clearance gap between the uppermost part of the roof and lowest part of the panel (i.e., frame) with a clearance gap of <0.8 in (20 mm) are not permitted. Once a module is secured in each of the 4 zones (fig. 2), additional clamps, i.e., ≥5, may be freely located on panel frame without affecting the warranty. Loads marked with a * were not certified as part of IEC 61215/61730 testing; these have been evaluated by REC's internal testing process.				

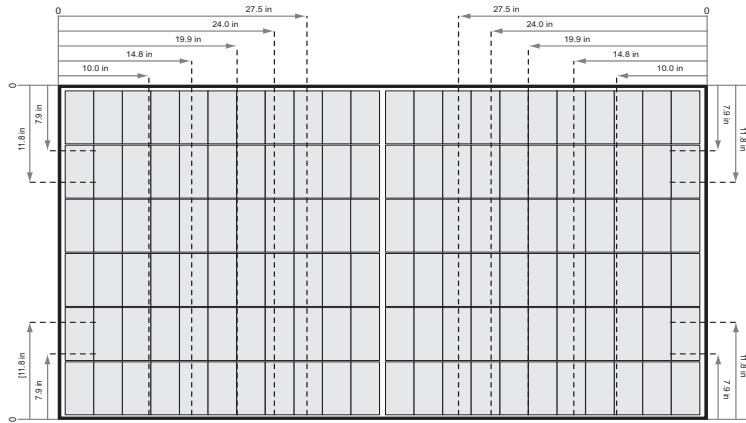
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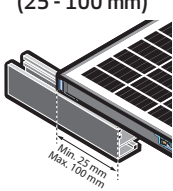
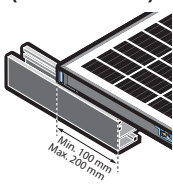
The center point of each clamp and the minimum grip length must be fully located in the same clamping zones to be rated to that load (fig. 4). If the panel is secured in zones with different load values, it is rated to the lowest load value only.

MOUNTING REC ALPHA PURE SERIES PANELS WITH SHORT RAILS

A short rail (or other short support structure) has a minimum length of 1 in (25 mm) and does not span the complete underside of a panel.

Fig. 5: Clamping of REC Alpha Pure Series panels using short rails



Legend	Clearance Gap		0.8 - 1.6 in (20-40 mm)	1.6 - 2.4 in (40-60 mm)	>2.4 in (>60 mm)	
			Test Load (Design Load)	Test Load (Design Load)	Test Load (Design Load)	
Rail length under module 1 - 3.9 in (25 - 100 mm) 	Long Side Mounting	0 - 10.0 in (0 - 255 mm)	X	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)	
		10.0 - 14.8 in (255 - 375 mm)	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+4100 Pa / -2400 Pa (+2733 Pa / -1600 Pa)	+4500 Pa / -2400 Pa (+3000 Pa / -1600 Pa)	
		14.8 - 19.9 in (375 - 505 mm)	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+3000 Pa / -3000 Pa (+2000 Pa / -2000 Pa)	+4200 Pa / -4000 Pa (+2800 Pa / -2666 Pa)	
		19.9 - 24.0 in (505 - 610 mm)	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	+3600 Pa / -2400 Pa (+2400 Pa / -1600 Pa)	
		24.0 - 27.5 in (610 - 700 mm)	+1800 Pa / -1800 Pa* (+1200 Pa / -1200 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	
	Short Side Mounting	0 - 7.9 in (0 - 200 mm)	X	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)	
		7.9 - 11.8 in (200 - 300 mm)	X	+800 Pa / -800 Pa* (+533 Pa / -533 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	
	Rail length under module 3.9 - 7.9 in (100 - 200 mm) 	Long Side Mounting	0 - 10.0 in (0 - 255 mm)	X	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)
			10.0 - 14.8 in (255 - 375 mm)	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+3600 Pa / -2400 Pa (+2400 Pa / -1600 Pa)	+3600 Pa / -2400 Pa (+2400 Pa / -1600 Pa)
			14.8 - 19.9 in (375 - 505 mm)	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+3000 Pa / -3000 Pa (+2000 Pa / -2000 Pa)	+3000 Pa / -3000 Pa (+2000 Pa / -2000 Pa)
19.9 - 24.0 in (505 - 610 mm)			+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	+3600 Pa / -2400 Pa (+2400 Pa / -1600 Pa)	
24.0 - 27.5 in (610 - 700 mm)			+1800 Pa / -1800 Pa* (+1200 Pa / -1200 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	
Short Side Mounting		0 - 7.9 in (0 - 200 mm)	X	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)	
		7.9 - 11.8 in (200 - 300 mm)	X	+800 Pa / -800 Pa* (+533 Pa / -533 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	



Installations with a clearance gap between the uppermost part of the roof and lowest part of the panel (i.e., frame) with a clearance gap of <0.8 in (20 mm) are not permitted. Once a module is secured in each of the 4 zones (fig. 2), additional clamps, i.e., ≥5, may be freely located on panel frame without affecting the warranty. Loads marked with a * were not certified as part of IEC 61215/61730 testing; these have been evaluated by REC's internal testing process.

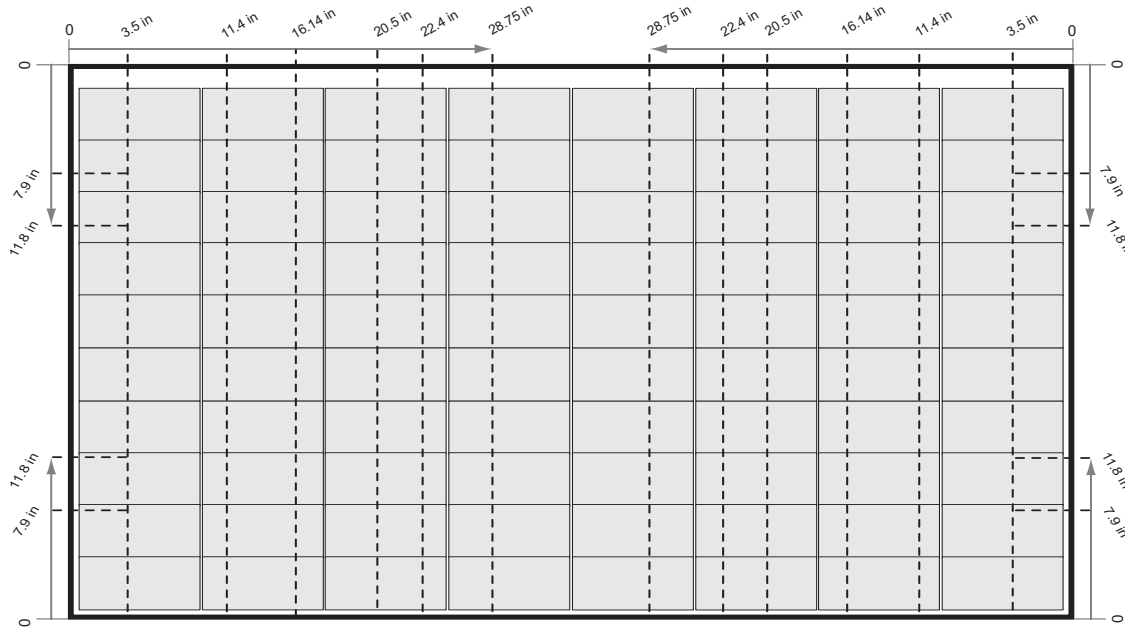
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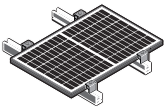
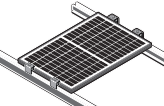

The center point of each clamp and the minimum grip length must be fully located in the same clamping zones to be rated to that load (fig. 5). If the panel is secured in zones with different load values, it is rated to the lowest load value only.

INSTALLATION OF REC ALPHA PURE-R AND REC ALPHA PURE-RX SERIES PANELS

MOUNTING REC ALPHA PURE-R AND REC ALPHA PURE-RX SERIES PANELS WITH CONTINUOUS RAILS PARALLEL TO SHORT SIDE OF THE PANEL
 A continuous rail (or other support structure) spans the complete underside of the panel.

Fig. 6: Clamping of REC Alpha Pure-R and Pure-RX Series panels with rails parallel to short side of the panel

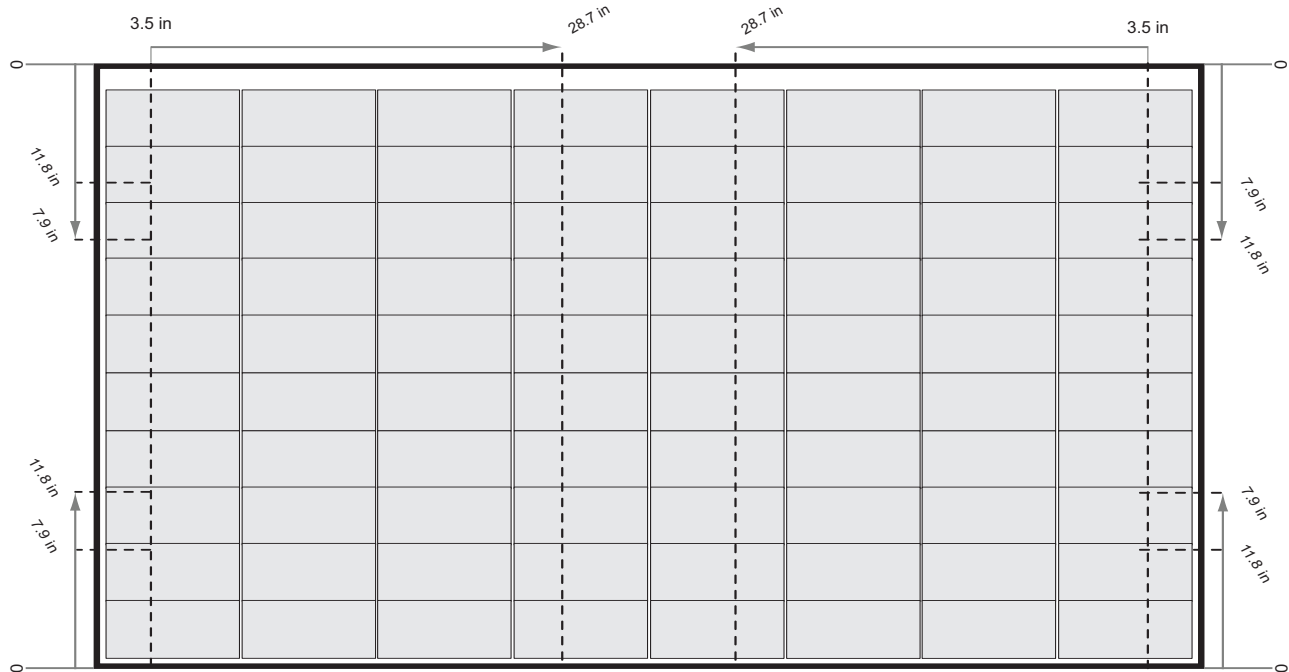


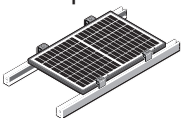
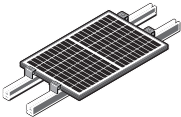
Legend	Clearance Gap		0.8 - 1.6 in (20-40 mm)	1.6 - 2.4 in (40-60 mm)	>2.4 in (>60 mm)
	Clamping zone		Test Load (Design Load)	Test Load (Design Load)	Test Load (Design Load)
Rail position 	Long Side Mounting	3.5 - 11.4 in	X	+2400 Pa / -2400 Pa* (+1600Pa/-1600Pa)	+2400 Pa / -2400 Pa (+1600Pa/-1600Pa)
		11.4 - 16.14 in	+1800 Pa / -1800 Pa* (+1200Pa/-1200Pa)	+4200 Pa / -2400 Pa (+2800Pa/-1600Pa)	+5400 Pa / -2400 Pa (+3600Pa/-1600Pa)
		16.14 - 20.5 in	+1800 Pa / -1800 Pa* (+1200Pa/-1200Pa)	+6200 Pa / -3000 Pa (+4133Pa/-2000Pa)	+7000 Pa / -4000 Pa (+4666Pa/-2000Pa)
		20.5 - 22.4 in	+1200 Pa / -1200 Pa* (+800Pa/-800Pa)	+3000 Pa / -2400 Pa (+2000Pa/-1600Pa)	+5400 Pa / -2400 Pa (+3600Pa/-1600Pa)
		22.4 - 28.75 in	+2400 Pa / -2400 Pa (+1600Pa/-1600Pa)	+2400 Pa / -2400 Pa (+1600Pa/-1600Pa)	+2400 Pa / -2400 Pa (+1600Pa/-1600Pa)
Rail position 	Short Side Mounting	0 - 7.9 in	X	+800 Pa / -800 Pa* (+533Pa/-533Pa)	+800 Pa / -800 Pa* (+533Pa/-533Pa)
		7.9 - 11.8 in	X	+800 Pa / -800 Pa* (+533Pa/-533Pa)	Pure-R +2400 Pa / -2400 Pa* (+1600Pa/-1600Pa) Pure-RX +1600 Pa / -1600 Pa* (+1066Pa/-1066Pa)
	Installations with a clearance gap between the uppermost part of the roof and lowest part of the panel (i.e., frame) with a clearance gap of <0.8 in (20 mm) are not permitted.				
	Once a module is secured in each of the 4 zones (fig. 2), additional clamps, i.e., ≥5, may be freely located on panel frame without affecting the warranty. Loads marked with a * were not certified as part of IEC 61215/61730 testing; these have been evaluated by REC's internal testing process.				

CAUTION
 The center point of each clamp and the minimum grip length must be fully located in the same clamping zones to be rated to that load (fig. 6). If the panel is secured in zones with different load values, it is rated to the lowest load value only.

MOUNTING REC ALPHA PURE-R AND REC ALPHA PURE-RX SERIES PANELS WITH CONTINUOUS RAILS PARALLEL TO LONG SIDE OF THE PANEL
 A continuous rail (or other support structure) spans the complete underside of the panel.

Fig. 7: Clamping of REC Alpha Pure-R and Pure-RX Series panels with rails parallel to long side of the panel



Legend	Clearance Gap		0.8 - 1.6 in (20-40 mm)	1.6 - 2.4 in (40-60 mm)	>2.4 in (>60 mm)
	Clamping zone		Test Load (Design Load)	Test Load (Design Load)	Test Load (Design Load)
 Rail position Long Side Mounting	3.5 - 28.7 in		+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)
 Rail position Short Side Mounting	0 - 7.9 in		X	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)
	7.9 - 11.8 in		X	+800 Pa / -800 Pa* (+533 Pa / -533 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)



Installations with a clearance gap between the uppermost part of the roof and lowest part of the panel (i.e., frame) with a clearance gap of <0.8 in (20 mm) are not permitted.
 Once a module is secured in each of the 4 zones (fig. 2), additional clamps, i.e., ≥5, may be freely located on panel frame without affecting the warranty. Loads marked with a * were not certified as part of IEC 61215/61730 testing; these have been evaluated by REC's internal testing process.

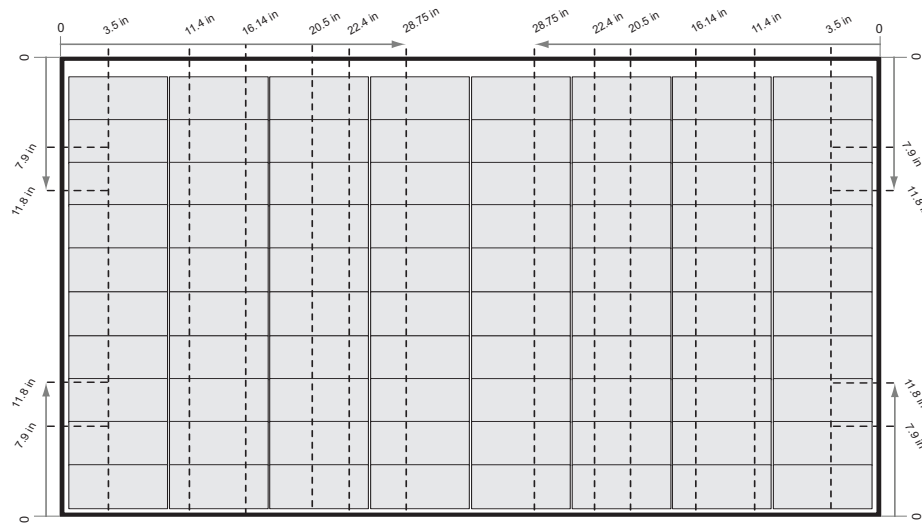
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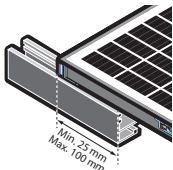
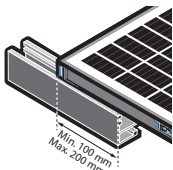

The center point of each clamp and the minimum grip length must be fully located in the same clamping zones to be rated to that load (fig. 7). If the panel is secured in zones with different load values, it is rated to the lowest load value only.

MOUNTING REC ALPHA PURE-R AND REC ALPHA PURE-RX SERIES PANELS WITH SHORT RAILS

A short rail (or other short support structure) has a minimum length of 1 in (25 mm) and does not span the complete underside of a panel.

Fig. 8: Clamping of REC Alpha Pure-R and Pure-RX Series panels using short rails



Legend	Clearance Gap		0.8 - 1.6 in (20-40 mm)	1.6 - 2.4 in (40-60 mm)	>2.4 in (>60 mm)
	Clamping zone		Test Load (Design Load)	Test Load (Design Load)	Test Load (Design Load)
Rail length under module 25 - 100 mm 	Long Side Mounting	3.5 - 11.4 in	X	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)
		11.4 - 20.14 in	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	+3000 Pa / -3000 Pa (+2000 Pa / -2000 Pa)
		16.14 - 20.5 in	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)
		20.5 - 22.4 in	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	+3600 Pa / -2400 Pa (+2400 Pa / -1600 Pa)
		22.4 - 28.75 in	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)
	Short Side Mounting	0 - 7.9 in	X	+800 Pa / -800 Pa* (+533 Pa / -533 Pa)	+800 Pa / -800 Pa* (+533 Pa / -533 Pa)
		7.9 - 11.8 in	X	+800 Pa / -800 Pa* (+533 Pa / -533 Pa)	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)
Rail length under module 100 - 200 mm 	Long Side Mounting	3.5 - 11.4 in	X	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)
		11.4 - 20.5 in	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)
		20.5 - 22.4 in	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	+3000 Pa / -3000 Pa (+2000 Pa / -2000 Pa)
		22.4 - 24.0 in	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)
		24.0 - 28.7 in	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)
	Short Side Mounting	0 - 7.9 in	X	+800 Pa / -800 Pa* (+533 Pa / -533 Pa)	+800 Pa / -800 Pa* (+533 Pa / -533 Pa)
		7.9 - 11.8 in	X	+800 Pa / -800 Pa* (+533 Pa / -533 Pa)	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)
	Installations with a clearance gap between the uppermost part of the roof and lowest part of the panel (i.e., frame) with a clearance gap of 0.8 in (<20 mm) are not permitted. Once a module is secured in each of the 4 zones (fig. 2), additional clamps, i.e., ≥5, may be freely located on panel frame without affecting the warranty. Loads marked with a * were not certified as part of IEC 61215/61730 testing; these have been evaluated by REC's internal testing process.				

CAUTION

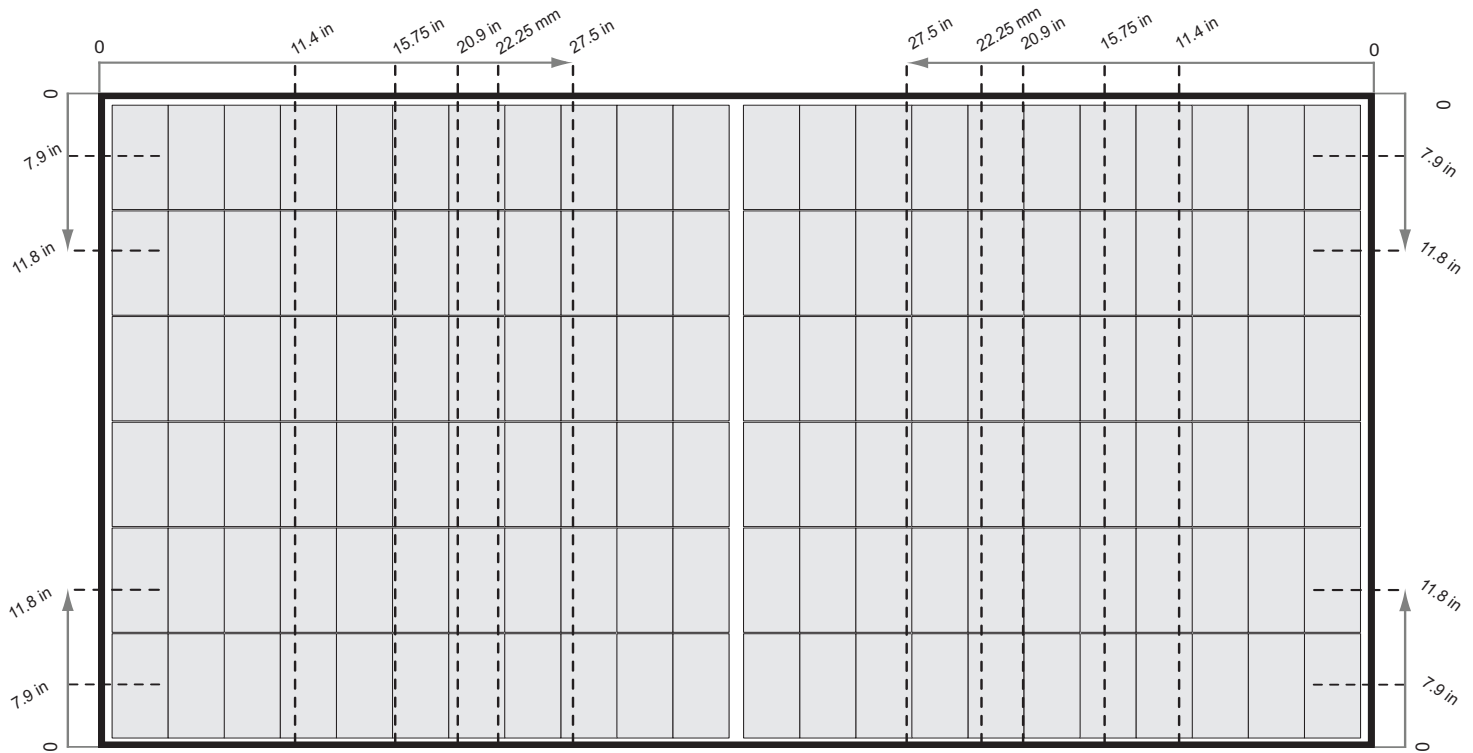
The center point of each clamp and the minimum grip length must be fully located in the same clamping zones to be rated to that load (fig. 8). If the panel is secured in zones with different load values, it is rated to the lowest load value only.


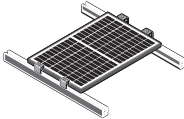

INSTALLATION OF REC ALPHA PURE 2 SERIES PANELS

MOUNTING REC ALPHA PURE 2 SERIES PANELS WITH CONTINUOUS RAILS PARALLEL TO SHORT SIDE OF THE PANEL

A continuous rail (or other support structure) spans the complete underside of the panel.

Fig. 9: Clamping of REC Alpha Pure 2 Series panels with rails parallel to short side of the panel



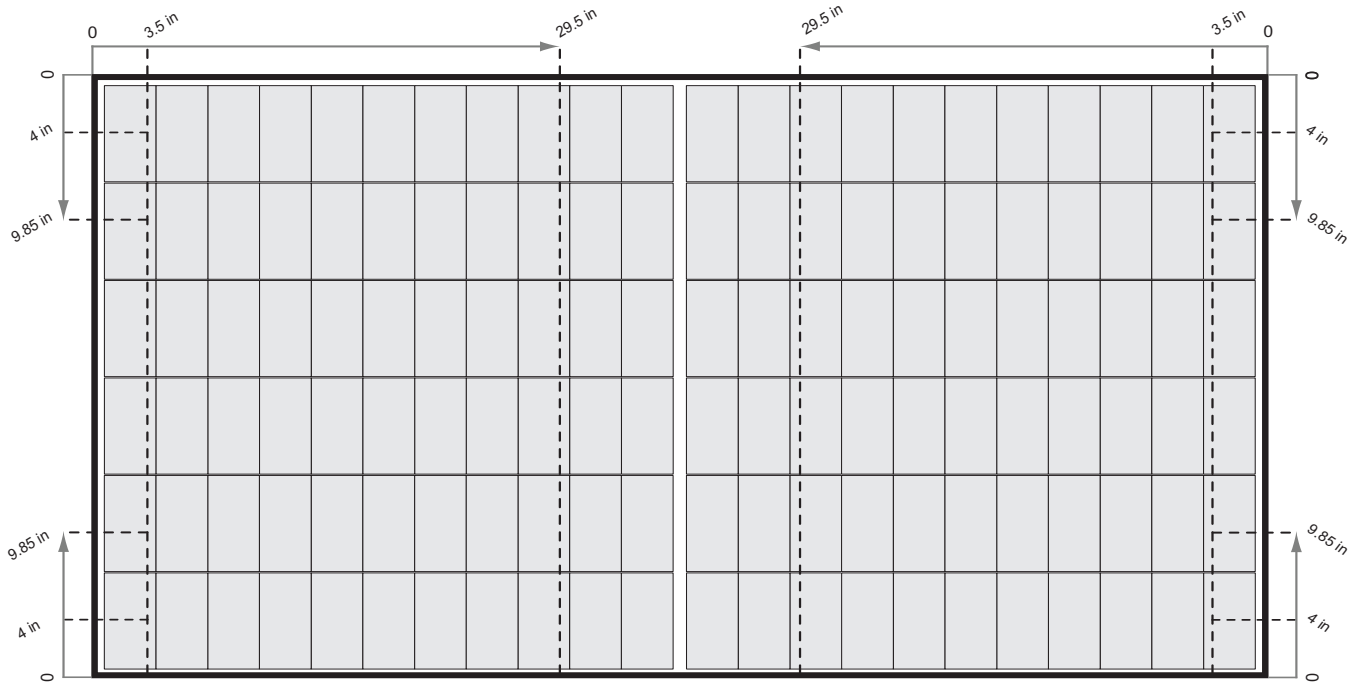
Legend	Clearance Gap		0.8 - 1.6 in (20-40 mm)	1.6 - 2.4 in (40-60 mm)	>2.4 in (>60 mm)
	Clamping zone		Test Load (Design Load)	Test Load (Design Load)	Test Load (Design Load)
Rail position 	Long Side Mounting	0 - 11.4 in	X	+1200 Pa / -1200 Pa* (+800Pa/-800Pa)	+2400 Pa / -2400 Pa (+1600Pa/-1600Pa)
		11.4 - 15.75 in	+1800 Pa / -1800 Pa* (+1200Pa/-1200Pa)	+4200 Pa / -2400 Pa (+2800Pa/-1600Pa)	+5400 Pa / -2400 Pa (+3600Pa/-1600Pa)
		15.75 - 20.9 in	+1800 Pa / -1800 Pa* (+1200Pa/-1200Pa)	+6200 Pa / -4000 Pa (+4133Pa/-2666Pa)	+7000 Pa / -4000 Pa (+4666Pa/-2000Pa)
		20.9 - 23.25 in	+1200 Pa / -1200 Pa* (+800Pa/-800Pa)	+3000 Pa / -2400 Pa (+2400Pa/-1600Pa)	+5400 Pa / -2400 Pa (+3600Pa/-1600Pa)
		23.25 - 27.5 in	+2400 Pa / -2400 Pa (+1600Pa/-1600Pa)	+2400 Pa / -2400 Pa (+1600Pa/-1600Pa)	+2400 Pa / -2400 Pa (+1600Pa/-1600Pa)
Rail position 	Short Side Mounting	0 - 3.9 in	X	+1200 Pa / -1200 Pa* (+800Pa/-800Pa)	+1600 Pa / -1600 Pa* (+1066Pa/-1066Pa)
		3.9 - 9.85 in	X	+800 Pa / -800 Pa* (+533Pa/-533Pa)	+2400 Pa / -2400 Pa (+1600Pa/-1600Pa)
	Installations with a clearance gap between the uppermost part of the roof and lowest part of the panel (i.e., frame) with a clearance gap of 0.8 in (<20 mm) are not permitted. Once a module is secured in each of the 4 zones (fig. 2), additional clamps, i.e., ≥5, may be freely located on panel frame without affecting the warranty. Loads marked with a * were not certified as part of IEC 61215/61730 testing; these have been evaluated by REC's internal testing process.				

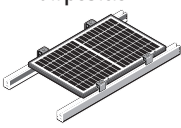
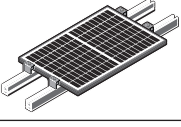

CAUTION
 The center point of each clamp and the minimum grip length must be fully located in the same clamping zones to be rated to that load (fig. 9). If the panel is secured in zones with different load values, it is rated to the lowest load value only.

MOUNTING REC ALPHA PURE 2 SERIES PANELS WITH CONTINUOUS RAILS PARALLEL TO LONG SIDE OF THE PANEL

A continuous rail (or other support structure) spans the complete underside of the panel.

Fig. 10: Clamping of REC Alpha Pure 2 Series panels with rails parallel to long side of the panel



Legend	Clearance Gap		0.8 - 1.6 in (20-40 mm)	1.6 - 2.4 in (40-60 mm)	>2.4 in (>60 mm)
			Test Load (Design Load)	Test Load (Design Load)	Test Load (Design Load)
 Rail position Long Side Mounting	Clamping zone	3.5 - 29.5 in	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)
 Rail position Short Side Mounting		0 - 3.9 in	X	+1200 Pa / -1200 Pa* (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa* (+1066 Pa / -1066 Pa)
		3.9 - 9.85 in	X	+800 Pa / -800 Pa* (+533 Pa / -533 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)
	Installations with a clearance gap between the uppermost part of the roof and lowest part of the panel (i.e., frame) with a clearance gap of 0.8 in (<20 mm) are not permitted. Once a module is secured in each of the 4 zones (fig. 2), additional clamps, i.e., ≥5, may be freely located on panel frame without affecting the warranty. Loads marked with a * were not certified as part of IEC 61215/61730 testing; these have been evaluated by REC's internal testing process.				

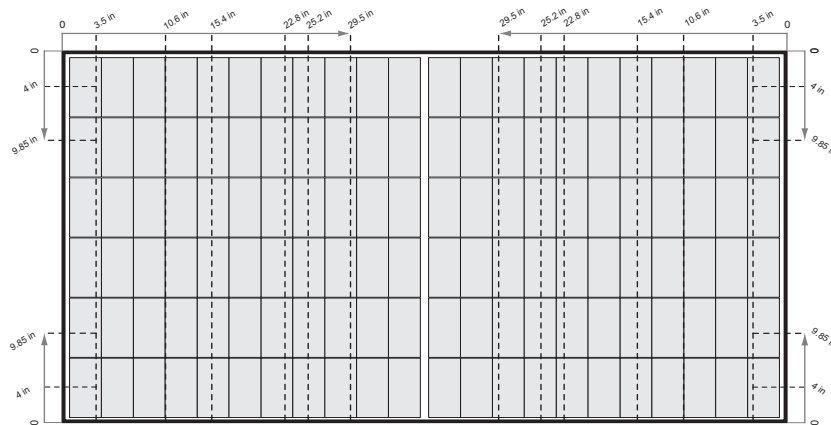
CAUTION

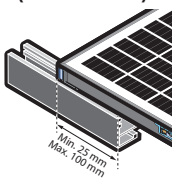
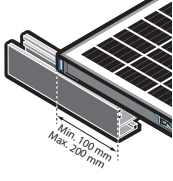
The center point of each clamp and the minimum grip length must be fully located in the same clamping zones to be rated to that load (fig. 10). If the panel is secured in zones with different load values, it is rated to the lowest load value only.

MOUNTING REC ALPHA PURE 2 SERIES PANELS WITH SHORT RAILS

A short rail (or other short support structure) has a minimum length of 1 in (25 mm) and does not span the complete underside of a panel.

Fig. 11: Clamping of REC Alpha Pure 2 Series panels using short rails



Legend	Clearance Gap		0.8 - 1.6 in (20-40 mm)	1.6 - 2.4 in (40-60 mm)	>2.4 in (>60 mm)
			Test Load (Design Load)	Test Load (Design Load)	Test Load (Design Load)
Rail length under module 1 - 3.9 in (25 - 100 mm) 	Long Side Mounting	3.5 - 10.6 in	X	+1200 Pa / -1200 Pa (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa * (+1066 Pa / -1066 Pa)
		10.6 - 15.4 in	+1200 Pa / -1200 Pa (+800 Pa / -800 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	+3600 Pa / -2400 Pa (+2400 Pa / -1600 Pa)
		15.4 - 22.8 in	+1200 Pa / -1200 Pa (+800 Pa / -800 Pa)	+3000 Pa / -3000 Pa (+2000 Pa / -2000 Pa)	+4200 Pa / -4000 Pa (+2800 Pa / -2666 Pa)
		22.8 - 25.2 in	+1200 Pa / -1200 Pa (+800 Pa / -800 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	+3600 Pa / -2400 Pa (+2400 Pa / -1600 Pa)
		25.2 - 29.5 in	+1200 Pa / -1200 Pa (+800 Pa / -800 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)
	Short Side Mounting	0 - 3.9 in	X	+1200 Pa / -1200 Pa (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa * (+1066 Pa / -1066 Pa)
		3.9 - 9.85 in	X	+800 Pa / -800 Pa (+533 Pa / -533 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)
Rail length under module 3.9 - 7.9 in (100 - 200 mm) 	Long Side Mounting	3.5 - 10.6 in	X	+1200 Pa / -1200 Pa (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa * (+1066 Pa / -1066 Pa)
		10.6 - 15.4 in	+1200 Pa / -1200 Pa (+800 Pa / -800 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	+3600 Pa / -2400 Pa (+2400 Pa / -1600 Pa)
		15.4 - 22.8 in	+1200 Pa / -1200 Pa (+800 Pa / -800 Pa)	+3000 Pa / -3000 Pa (+2000 Pa / -2000 Pa)	+3000 Pa / -3000 Pa (+2000 Pa / -2000 Pa)
		22.8 - 25.2 in	+1200 Pa / -1200 Pa (+800 Pa / -800 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	+3600 Pa / -2400 Pa (+2400 Pa / -1600 Pa)
		25.2 - 29.5 in	+1200 Pa / -1200 Pa (+800 Pa / -800 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)
	Short Side Mounting	0 - 3.9 in	X	+1200 Pa / -1200 Pa (+800 Pa / -800 Pa)	+1600 Pa / -1600 Pa * (+1066 Pa / -1066 Pa)
		3.9 - 9.85 in	X	+800 Pa / -800 Pa (+533 Pa / -533 Pa)	+2400 Pa / -2400 Pa (+1600 Pa / -1600 Pa)



Installations with a clearance gap between the uppermost part of the roof and lowest part of the panel (i.e., frame) with a clearance gap of 0.8 in (<20 mm) are not permitted. Once a module is secured in each of the 4 zones (fig. 2), additional clamps, i.e., ≥ 5 , may be freely located on panel frame without affecting the warranty. Loads marked with a * were not certified as part of IEC 61215/61730 testing; these have been evaluated by REC's internal testing process.

CAUTION

The center point of each clamp and the minimum grip length must be fully located in the same clamping zones to be rated to that load (fig. 11). If the panel is secured in zones with different load values, it is rated to the lowest load value only.

MOUNTING METHODS: SLIDE IN SYSTEMS

When installing using slide in systems the mounting system must meet the same specifications including grip lengths, depths and spacing as specified for clamping and the mounting system must be able to withstand the correct load pressures.

When installing solar panels using a slide-in system, the drainage holes found in the underside of the panel frame (see fig. 17) must not be covered. For any questions regarding installation on such systems, please contact REC directly.

MOUNTING METHODS: MOUNTING HOLES

The REC solar panels covered by this manual can be installed utilizing the four mounting holes 0.43 x 0.26 in (11 x 6.6 mm) on the underside of the panel (fig. 12) in conjunction with a device, e.g., screws, lockbolts or structural blind fasteners, with specifications suitable for the installation (fig. 13).

Installing the REC Alpha & Alpha 72 Series solar panels using the mounting holes has been found to comply with IEC 61215 & UL 61730 requirements for downward pressure, e.g., snow, of up to 5400 Pa (3600 Pa design load*) and upward pressure, e.g., wind, of up to 2400 Pa (1600 Pa design load*) according to the following instructions (*design loads apply a safety factor of 1.5 to the stated test load, e.g., test load 5400 Pa / 1.5 = 3600 Pa design load).

When installing using mounting holes, the frame and panel edge of each panel must be supported by two rails of aluminium or galvanized steel suitable

⚠ CAUTION
The product warranty will be voided if additional holes are made in the frame. All fixing and fastening materials must be corrosion resistant.

Fig. 12: Mounting holes: REC Alpha panels

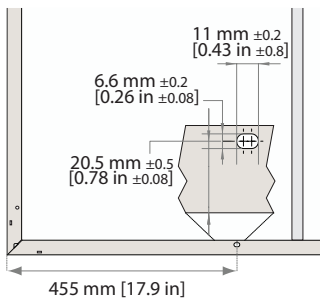


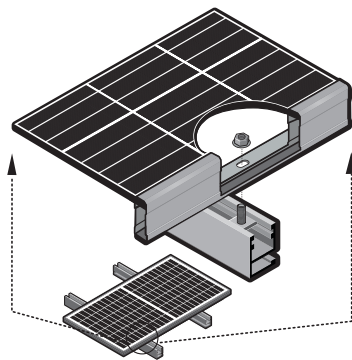
Fig. 13: Device specifications for mounting holes

Part Name	Specification	Material
Rail		6105 - T5 aluminum extrusion
Bolt	1/4" x 20 - 5/8"	ASTM F593 (stainless steel)
Nut	1/4" x 20	ASTM F593 (stainless steel)
Washer	Thickness: ≥ 0.06" Diameter: ≥ 0.7"	

for the application and appropriate for the local environment. Observe the following procedures when using mounting holes:

- The mounting construction must be of a corrosion resistant material, e.g., aluminum or galvanized steel, and appropriate for the local environment,
- All four mounting holes in the frame must be used (fig. 14),
- A washer must be used between frame and rail,
- Additional electrical bonding to Ground is required for the support structure,
- REC modules must be secured with a torque between 12 - 25 Nm (106-221 lbf/in). Refer to the fixing device manufacturer's installation instructions for preload or torque values.

Fig. 14: Mounting hole installation example



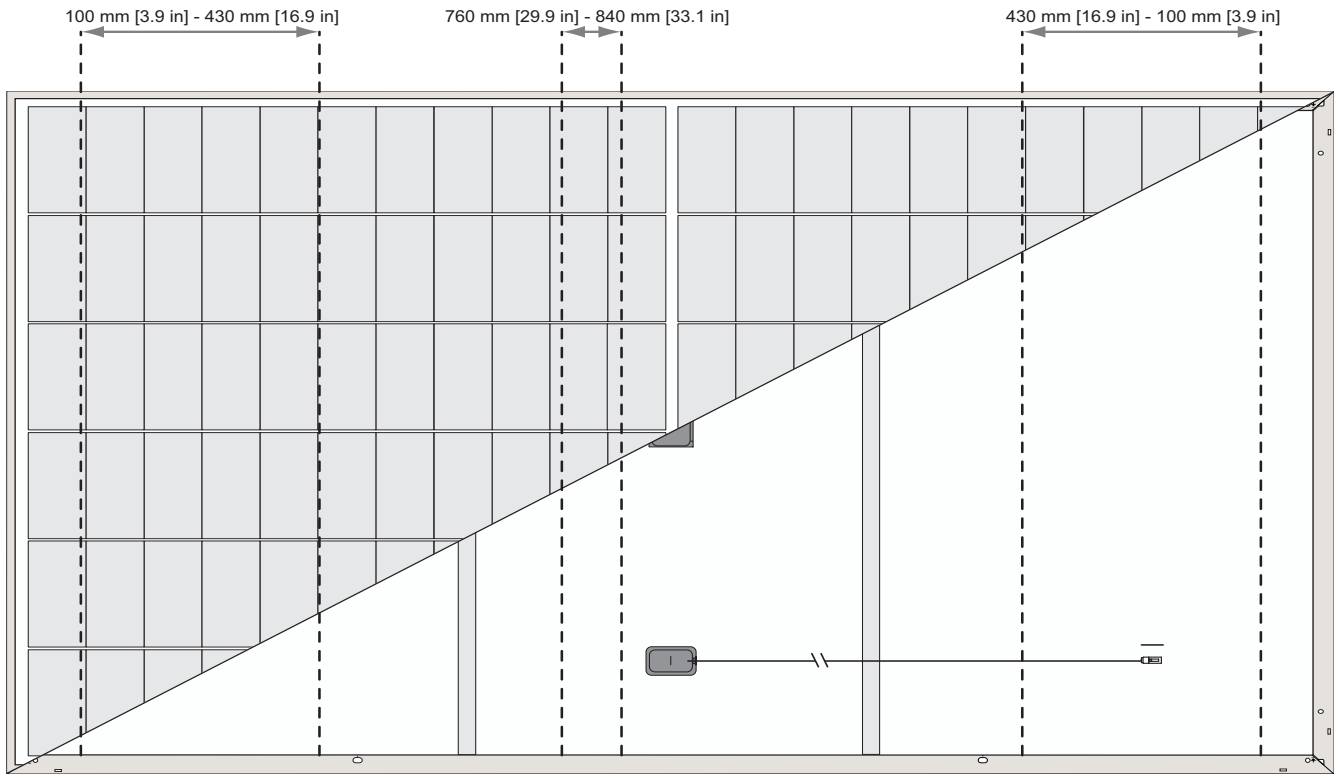
SIX-POINT MOUNTING: REC ALPHA PURE



These instructions are applicable to the following products only:

- REC Alpha Pure Series

A six-point mounting configuration secures the panel on three continuous rails (or other support structures) with three clamps on each side of the panel in the zones marked below:

Fig. 15: Six-point mounting configuration clamping zones: REC Alpha Pure Series



Legend	Clearance Gap Clamping zone	0.8 - 1.6 in (20-40 mm)	1.6 - 2.4 in (40-60 mm)	>2.4 in (>60 mm)
		Test Load (Design Load)	Test Load (Design Load)	Test Load (Design Load)
Rail position 	3.9 - 16.9 in	+2000 Pa / -2000 Pa* (+1333Pa / -1333Pa)	+6300 Pa / -6000 Pa* (+4200Pa / -4000Pa)	+8000 Pa / -6000 Pa* (+5333Pa / -4000Pa)
	29.5 - 33.1 in			
	Once a module is secured as described above (fig. 15), additional clamps, i.e., >7, may be freely located on panel frame without affecting the warranty. Loads marked with a * were not certified as part of IEC 61215/61730 testing; these have been evaluated by REC's internal testing process.			

CAUTION

- The middle rail must not be installed on the side of the junction box where the cables exit.
- A total of three continuous rails (or other support structures) must be used to secure the panel.
- The center point of each clamp and the minimum grip length must be fully located within the marked zone to be rated to the given value (fig. 15).

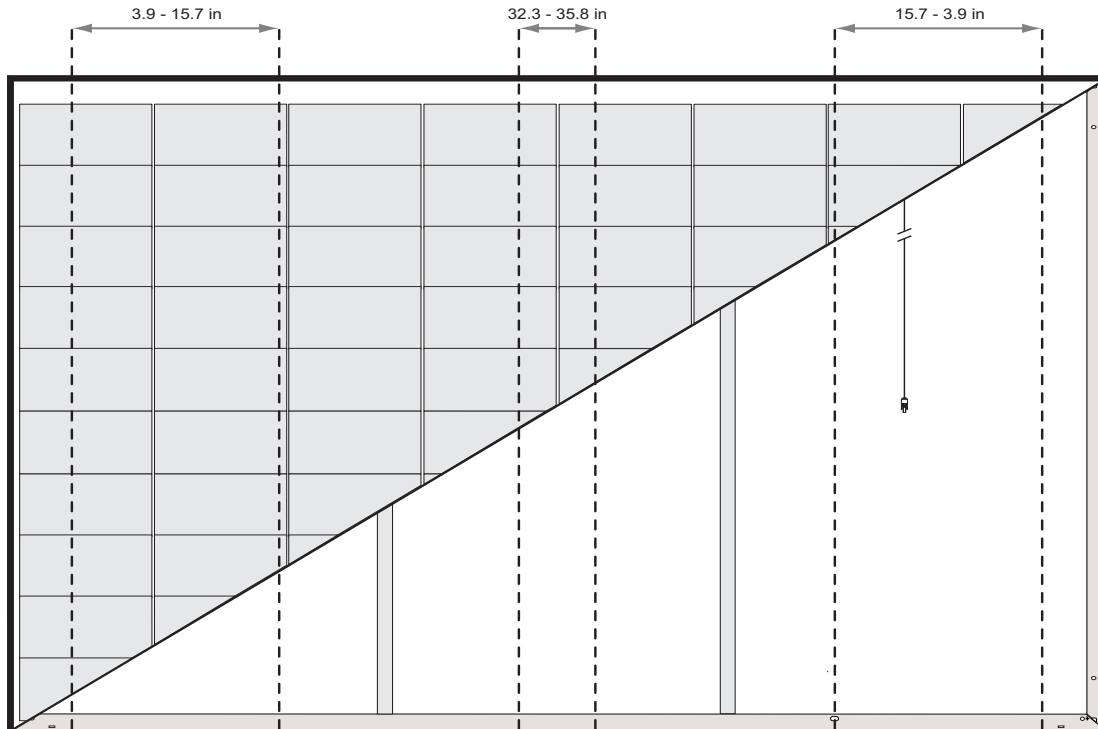
SIX-POINT MOUNTING: REC ALPHA PURE-R



These instructions are applicable to the following products only:

- REC Alpha Pure-R Series

A six-point mounting configuration secures the panel on three continuous rails (or other support structures) with three clamps on each side of the panel in the zones marked below:

Fig. 16: Six-point mounting configuration clamping zones: REC Alpha Pure-R Series



Legend	Clearance Gap	0.8 - 1.6 in (20-40 mm)	1.6 - 2.4 in (40-60 mm)	>2.4 in (>60 mm)
	Clamping zone	Test Load (Design Load)	Test Load (Design Load)	Test Load (Design Load)
Rail position 	3.9 - 15.7 in	+2000 Pa / -2000 Pa* (+1333Pa / -1333Pa)	+6300 Pa / -6000 Pa* (+4200Pa / -4000Pa)	+8000 Pa / -6000 Pa* (+5333Pa / -4000Pa)
	32.3 - 35.8 in			
	Once a module is secured as described above (fig. 16), additional clamps, i.e., >7, may be freely located on panel frame without affecting the warranty. Loads marked with a * were not certified as part of IEC 61215/61730 testing; these have been evaluated by REC's internal testing process.			

CAUTION

- The middle rail must not be installed on the side of the junction box where the cables exit.
- A total of three continuous rails (or other support structures) must be used to secure the panel.
- The center point of each clamp and the minimum grip length must be fully located within the marked zone to be rated to the given value (fig. 16).

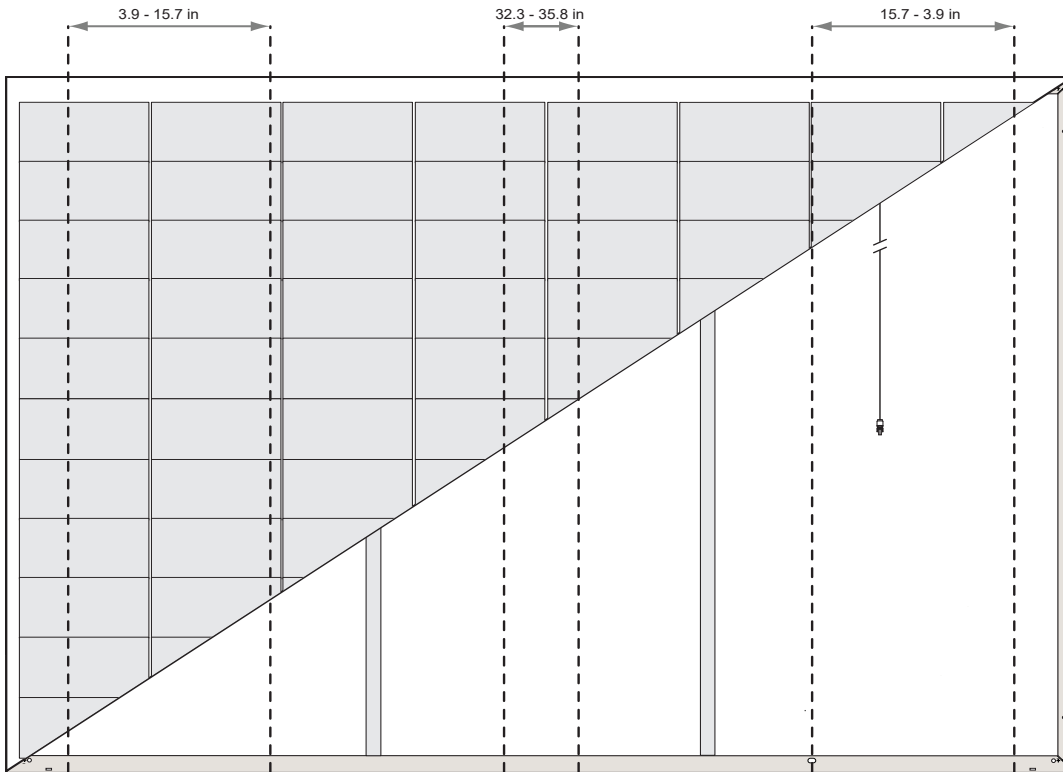
SIX-POINT MOUNTING: REC ALPHA PURE-RX



These instructions are applicable to the following products only:

- REC Alpha Pure-RX Series

A six-point mounting configuration secures the panel on three continuous rails (or other support structures) with three clamps on each side of the panel in the zones marked below:

Fig. 17: Six-point mounting configuration clamping zones: REC Alpha Pure-RX Series



Legend	Clearance Gap Clamping zone	0.8 - 1.6 in (20-40 mm)	1.6 - 2.4 in (40-60 mm)	>2.4 in (>60 mm)
		Test Load (Design Load)	Test Load (Design Load)	Test Load (Design Load)
Rail position 	3.9 - 15.7 in	+2000 Pa / -2000 Pa* (+1333 Pa / -1333 Pa)	+6300 Pa / -6000 Pa* (+4200 Pa / -4000 Pa)	+8000 Pa / -6000 Pa* (+5333 Pa / -4000 Pa)
	32.3 - 35.8 in			
	Once a module is secured as described above (fig. 17), additional clamps, i.e., ≥ 7 , may be freely located on panel frame without affecting the warranty. Loads marked with a * were not certified as part of IEC 61215/61730 testing; these have been evaluated by REC's internal testing process.			

CAUTION

- The middle rail must not be installed on the side of the junction box where the cables exit.
- A total of three continuous rails (or other support structures) must be used to secure the panel.
- The center point of each clamp and the minimum grip length must be fully located within the marked zone to be rated to the given value (fig. 17).

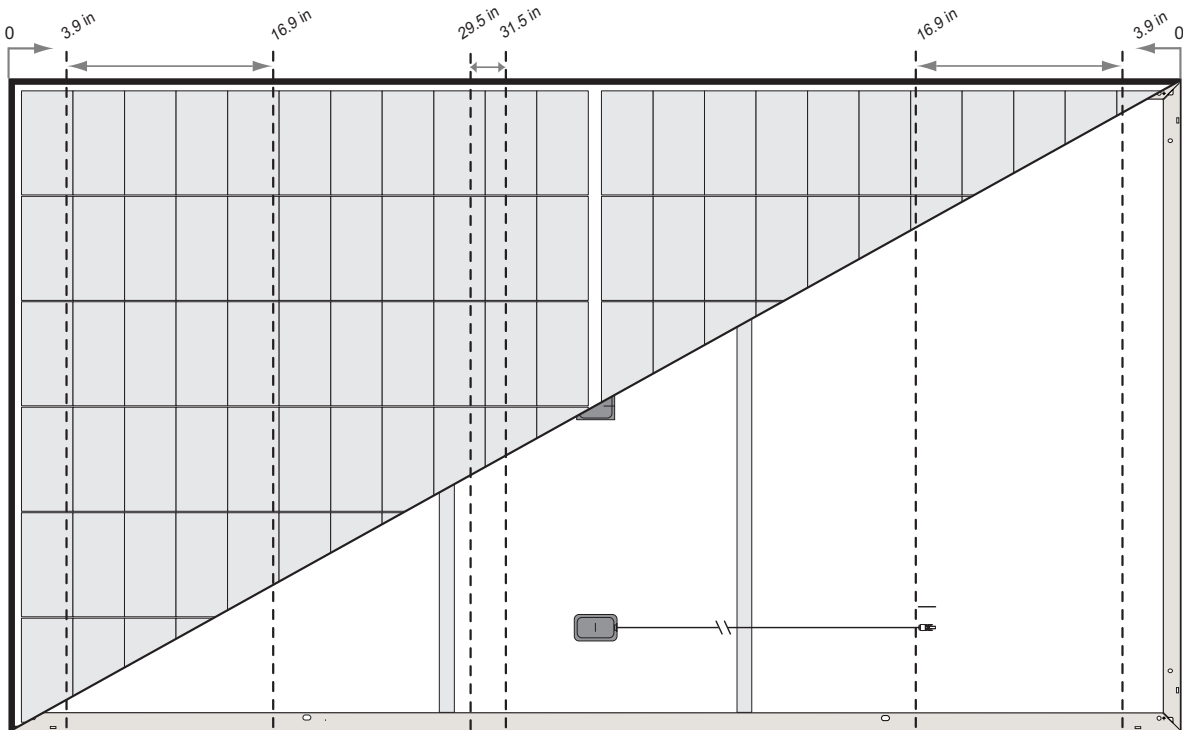
SIX-POINT MOUNTING: REC ALPHA PURE 2



These instructions are applicable to the following products only:

- REC Alpha Pure 2 Series

A six-point mounting configuration secures the panel on three continuous rails (or other support structures) with three clamps on each side of the panel in the zones marked below:

Fig. 18: Six-point mounting configuration clamping zones: REC Alpha Pure 2 Series



Legend	Clearance Gap Clamping zone	0.8 - 1.6 in (20-40 mm)	1.6 - 2.4 in (40-60 mm)	>2.4 in (>60 mm)
		Test Load (Design Load)	Test Load (Design Load)	Test Load (Design Load)
 Rail position	3.9 - 16.9 in	+2000 Pa / -2000 Pa* (+1333 Pa / -1333 Pa)	+6300 Pa / -6000 Pa* (+4200 Pa / -4000 Pa)	+8000 Pa / -6000 Pa* (+5333 Pa / -4000 Pa)
	29.5 - 31.5 in			
	Once a module is secured as described above (fig. 18), additional clamps, i.e., ≥ 7 , may be freely located on panel frame without affecting the warranty. Loads marked with a * were not certified as part of IEC 61215/61730 testing; these have been evaluated by REC's internal testing process.			

CAUTION

- The middle rail must not be installed on the side of the junction box where the cables exit.
- A total of three continuous rails (or other support structures) must be used to secure the panel.
- The center point of each clamp and the minimum grip length must be fully located within the marked zone to be rated to the given value (fig.18).

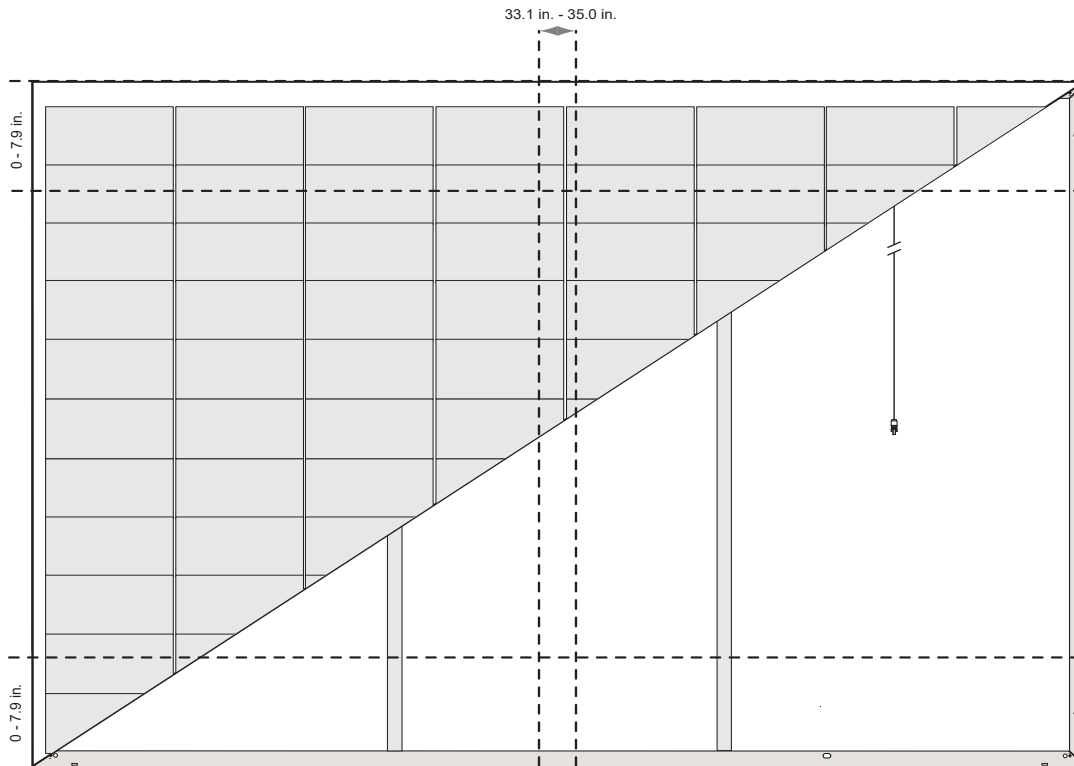
MIXED SIX-POINT MOUNTING FOR SHORT RAILS: REC ALPHA PURE-RX

These instructions are applicable to the following products only:

- REC Alpha Pure-RX Series

A mixed six-point mounting configuration secures the panel on three short rails (or other support structures) with clamps on each side of the panel in the zones marked below:

Fig. 19: Mixed six-point mounting configuration clamping zones: REC Alpha Pure-RX Series



Legend	Clearance Gap Clamping zone		0.8 - 1.6 in (20-40 mm)	1.6 - 2.4 in (40-60 mm)	>2.4 in (>60 mm)
			Test Load (Design Load)	Test Load (Design Load)	Test Load (Design Load)
Rail length under module 1 - 3.9 in (25 - 100 mm) 	Long Side Mounting	33.1 - 35.0 in.	X	X	+2400 Pa / -2400 Pa* (+1600Pa/-1600Pa)
	Short Side Mounting	0 - 7.9 in.	X	X	
Rail length under module 3.9 - 7.9 in (100 - 200 mm) 	Long Side Mounting	33.1 - 35.0 in.	X	X	+2400 Pa / -2400 Pa* (+1600Pa/-1600Pa)
	Short Side Mounting	0 - 7.9 in.	X	X	
	Installations with a clearance gap between the uppermost part of the roof and lowest part of the panel (i.e., frame) with a clearance gap of <0.8 in. (20 mm) are not permitted. Once a module is secured in each of the 4 zones (fig. 2), additional clamps, i.e., ≥5, may be freely located on panel frame without affecting the warranty. Loads marked with a * were not certified as part of IEC 61215/61730 testing; these have been evaluated by REC's internal testing process.				

CAUTION

- The middle rail must not be installed on the side of the junction box where the cables exit.
- A total of three short rails (or other support structures) must be used to secure the panel.
- The center point of each clamp and the minimum grip length must be fully located within the marked zone to be rated to the given value (fig.19).

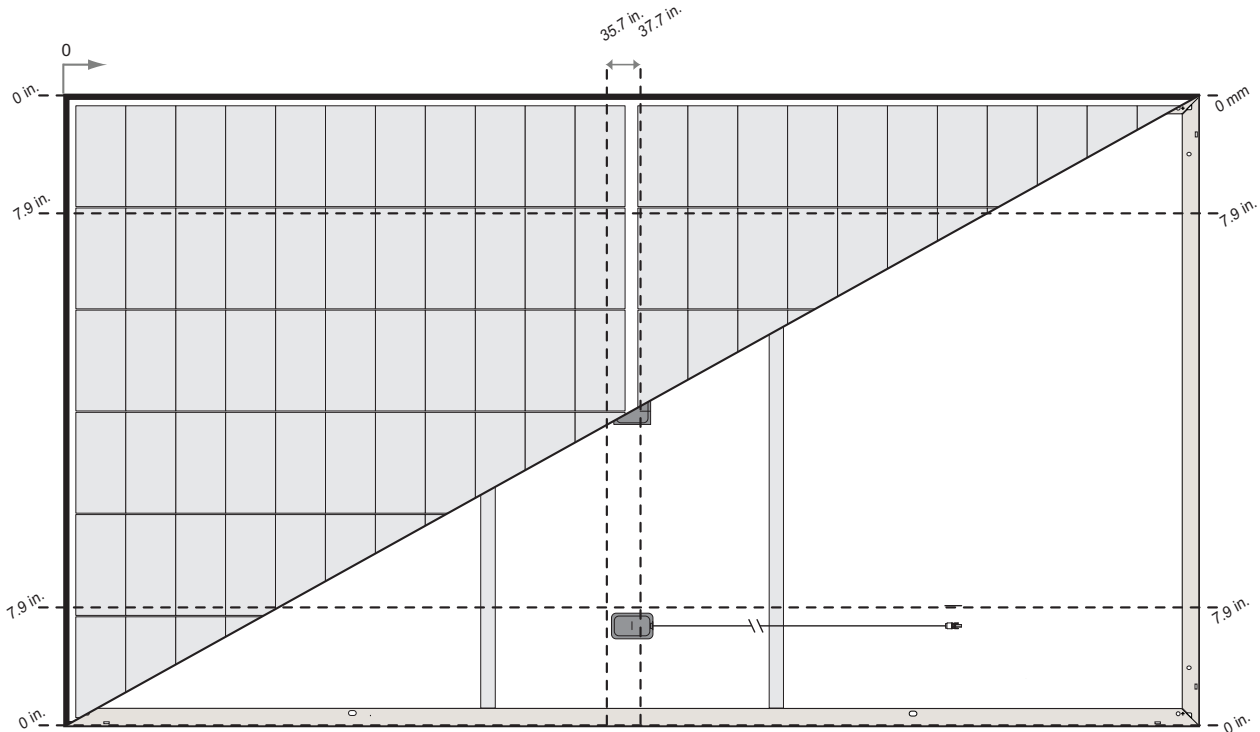
MIXED SIX-POINT MOUNTING FOR SHORT RAILS: REC ALPHA PURE-2

These instructions are applicable to the following products only:

- REC Alpha Pure 2 Series

A mixed six-point mounting configuration secures the panel on three short rails (or other support structures) with three clamps on each side of the panel in the zones marked below:

Fig. 20: Mixed six-point mounting configuration clamping zones: REC Alpha Pure 2 Series



Legend	Clearance Gap		0.8 - 1.6 in (20-40 mm)	1.6 - 2.4 in (40-60 mm)	>2.4 in (>60 mm)
			Test Load (Design Load)	Test Load (Design Load)	Test Load (Design Load)
Rail length under module 1 - 3.9 in (25 - 100 mm) 	Long Side Mounting	35.7 - 37.7 in.	X	X	+2400 Pa / -2400 Pa* (+1600 Pa / -1600 Pa)
	Short Side Mounting	0 - 7.9 in.	X	X	
Rail length under module 3.9 - 7.9 in (100 - 200 mm) 	Long Side Mounting	35.7-37.7 in.	X	X	+2400 Pa / -2400 Pa* (+1600 Pa / -1600 Pa)
	Short Side Mounting	0 - 7.9 in.	X	X	
	Installations with a clearance gap between the uppermost part of the roof and lowest part of the panel (i.e., frame) with a clearance gap of <0.8 in. (20 mm) are not permitted. Once a module is secured in each of the 4 zones (fig. 2), additional clamps, i.e., ≥5, may be freely located on panel frame without affecting the warranty. Loads marked with a * were not certified as part of IEC 61215/61730 testing; these have been evaluated by REC's internal testing process.				

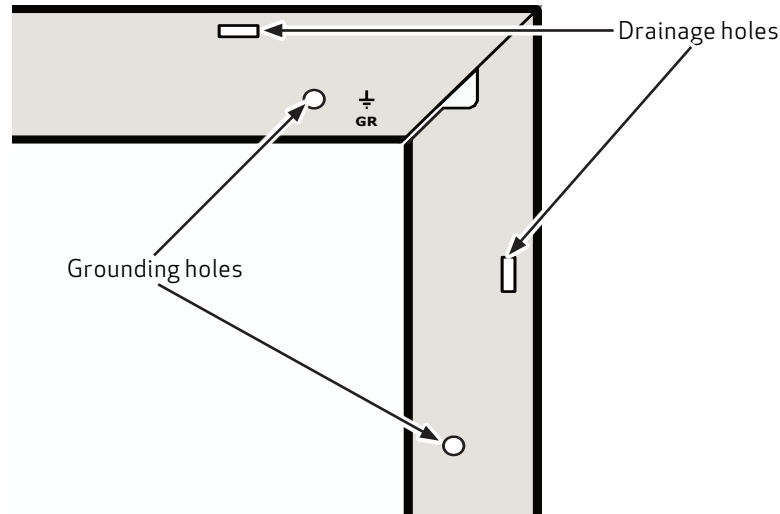
CAUTION

- The middle rail must not be installed on the side of the junction box where the cables exit.
- A total of three short rails (or other support structures) must be used to secure the panel.
- The center point of each clamp and the minimum grip length must be fully located within the marked zone to be rated to the given value (fig. 20).

DRAINAGE HOLES

On the long and short sides of the REC frame small drainage holes can be found that allow humidity and water to exit the frame easily and minimize damage (fig. 21). These are spaced 2.2 in from the frame corner. These holes must not be used for mounting the panel, and they must not be covered by any part of the mounting structure. To enable effective drainage and ensure there is no damage to the panel, the drainage holes must remain fully open and enable water egress during and after installation. The shape and dimensions of the drainage holes may vary depending on product and/or frame design.

Fig. 21: Drainage and grounding holes



GROUNDING

A panel with exposed conductive parts is considered to be in compliance with IEC 61215 & UL 61730 only when it is electrically grounded in accordance with the instructions presented below and the requirements of the National Electrical Code. When grounding a panel, it must be done using an electrical connection from the panel frame. Local regulations may require grounding of the panels. Grounding must be done using an electrical connection from the panel frame. REC solar panels have a clearly marked, small round $\varnothing 0.24$ in grounding hole positioned near each corner of the panel on both the long side and the short side, as shown in fig. 22 and can be further identified by the grounding symbol stamped in the frame next to it. Check all applicable requirements before beginning installation:

- Suitable grounding lugs must be used: Listed (KDER) ILSCO, GBL-4DBT (tin plated) (E34440),
- Grounding cable size should be between 4 - 14 AWG (2.1 mm² - 21.2 mm²),
- Attach grounds to the grounding holes in the panel frames,
- Fix lug to the frame using a star washer (#10) and lock nut (#10), ensuring a conductive connection,
- Follow the grounding device manufacturer's installation instructions to ensure a safe and conductive connection, including any supplementary hardware, e.g., star washer, and tighten according to recommended torque.

Fig. 22: Grounding lug dimensions and fastening torque

Cross section [AWG]	Type	Torque [in-lbs]
4 - 6	Stranded	35
8	Stranded	25
10 - 14	Stranded/Solid	28

i NOTE

- To avoid galvanic corrosion, galvanized or hot dipped zinc plated fasteners are preferred, however stainless steel fastening materials are equally suitable.
- The support bars across the rear of REC Alpha Series panels do not need to be individually grounded.
- Negative grounding of the panels is not required by REC.

CONNECTIONS AND CONNECTORS

The connector type(s) used on REC panels are indicated in the product specifications at the rear of this manual. The connector IP rating is only valid when correctly connected. All connectors and cables must be secure and tight as well as electrically and mechanically sound. UV-resistant cables and connectors approved for outdoor use must be used. Conductor gauge must be chosen to ensure DC power losses (voltage drop) are kept to a minimum (<1%).

Observe all local regulations when selecting cables.

- For string connections, use minimum 12 AWG (4 mm²) copper wires insulated for a maximum operating temperature of 194°F (90°C),
- Avoid exposing cables to direct sunlight and permanent tension.

In order to ensure a safe connection between panels and BOS equipment, the following instructions must be followed to protect the connections from the elements.

⚠ DANGER - Electrical shock

Safety is paramount when working with electrical connectors.

- Ensure that any installation work is not carried out on live or load-carrying parts.
- Connections must not be disconnected under load and the system must be isolated from the grid before carrying out any maintenance or repair work.

CONNECTORS

To ensure connector compatibility and reduce the potential for damage to the panels and the wider installation, the connectors used on REC Alpha panels are detailed in the Panel Characteristics at the rear of this manual. REC only permits the mating of connectors of the same manufacturer, type, and system rating.

i NOTE

Some countries and/or regions have specific regulations regarding the mating of connectors. Installers are responsible for ensuring the compliancy of the system with such local regulations.

CUTTING THE CABLES

The cutting of cables is only permitted in order to replace a factory-installed connector with another brand of connector to ensure 'like-for-like' mating when connected to a non-REC external device. All other changes are prohibited and will invalidate the REC warranty.

- The connector replacement procedure must be carried out correctly and according to the replacement connector manufacturer's instructions.
- The selected replacement connector must also fulfil all relevant technical specifications and be certified according to applicable standards (e.g., EN 50521, IEC 62852 or UL 6703) to ensure they are fit for purpose and safety.
- Use of any chemicals or lubricants on the connectors or contacts may only be carried out in line with the connector manufacturer's instructions.

The REC warranty does not extend to cover any fault traceable to the replaced connectors. Any other modification to the panel is prohibited, including the opening of the junction box, unless explicitly authorized by REC. Doing so will invalidate the warranty.

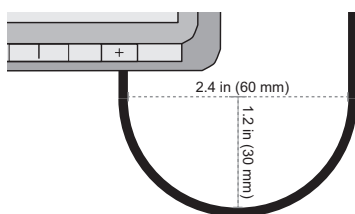
CABLE MANAGEMENT

To ensure a long life span of the cables and reduce the potential for damage to the cables, follow the instructions below:

- To prevent stress on the junction box casing, ensure the cable exits the junction box in a straight line before any bend in the cable and ensure cables are free from any external load,
- The cables must have a minimum bending radius of 1.2 in (30 mm) to avoid damage to the insulation (fig. 23),
- Ensure cables do not hang loose where they may be damaged through friction or stress, e.g., caused by mechanical abrasion or grazing animals,
- Protect connectors from falling or dropping water by locating them directly beneath a panel,
- Cables must be firmly secured to the structure, without over-tightening, as this can deform the cable insulation using UV-resistant cables,
- When securing the connector, place it so that it has with sufficient air circulation all around. This allows the connector to dry effectively and avoids the risk of damage or degradation of the connection,
- Secure the cable either side of the connectors to ensure no stress is exerted on the connector casing or cable entry,
- To enable correct cooling and drying of the connectors, do not add extra protection to the connector, e.g., heat shrink, grease or tape.

More detailed information is given in the *Guide to Best Practice - Connections and Connectors* which can be found via the REC online Download Center (www.recgroup.com/downloads)

Fig. 23: Minimum cable bend radius



PANEL MAINTENANCE

CLEANING INSTRUCTIONS

REC solar panels have been designed for easy maintenance. However cleaning solar panels can assist in optimizing electricity output. The need for cleaning will vary dependent on location, rainfall, pollution levels and the angle of installation – the lower the angle of installation, the more cleaning will be required. 'Normal' rainfall will naturally clean the panels if installed at a sufficient angle to ensure water runs off the surface. To optimize electrical output it is recommended to clean the panels when dirt can clearly be seen on the glass surface.

CAUTION

- Panel cleaning must always be carried out when the panels are cool, e.g., early morning, to avoid breakage through thermal shock.
- Use of high pressure hoses or cleaners is not permitted as these may damage the panels, laminate or cells.

NOTE

- Avoid putting pressure on the on the panel surface when cleaning or drying, e.g., leaning, standing or resting buckets on it.
- Use only deionized water free from grit and physical contaminants, at ambient temperature and use a sponge, microfiber cloth or a soft brush to wipe away the dirt (rainwater, tap water or diluted alcohol may also be used as a secondary solution).
- For further cleaning a mild, biological and biodegradable washing-up liquid may be used.
- If stains require more effort to be removed, Isopropyl alcohol of a concentration less than 10% may be used. Acidic or alkaline detergent may not be used.

Using a soft rubber squeegee, wipe the panel surface from the top downwards to remove any residual water from the panel glass. Take care not to scratch the surface or introduce foreign elements that may cause damage to the panel. Always rinse the panel with plenty of water. Panels can be left to dry in the air or wiped dry with a clean and soft cloth or chamois.

For more information on cleaning REC solar panels, consult the *REC Cleaning Information Sheet* which is available to download from the online REC Download Center www.recgroup.com/downloads. If in doubt at any time when cleaning the panels, stop and obtain professional advice.

SYSTEM INSPECTION

The system should be inspected regularly to ensure that:

- Fasteners are secure, tight and free from corrosion,
- Electrical connections are secure, tight, clean and free of corrosion,
- The mechanical integrity of the cables is intact,
- Bonding points to ground are tight, secure and free from corrosion (which could break the continuity between the panels and ground).

RECYCLING

REC makes every effort to ensure panel packaging is kept to a minimum. The paper and cardboard packaging can be recycled and the protective wrapping and panel separating blocks are also recyclable in many areas. Recycle packaging and panels according to local guidelines and regulations.

DISPOSAL OF OLD ELECTRICAL AND ELECTRONIC EQUIPMENT

Panels should be recycled at the end of their useful life according to local guidelines and regulations. By ensuring REC solar panels are disposed of correctly, you will help prevent potential negative consequences for the environment and human health which could otherwise be caused by inappropriate waste treatment. The majority of the panel components can be recycled.

PANEL CHARACTERISTICS

TECHNICAL PROPERTIES: REC ALPHA PURE SERIES

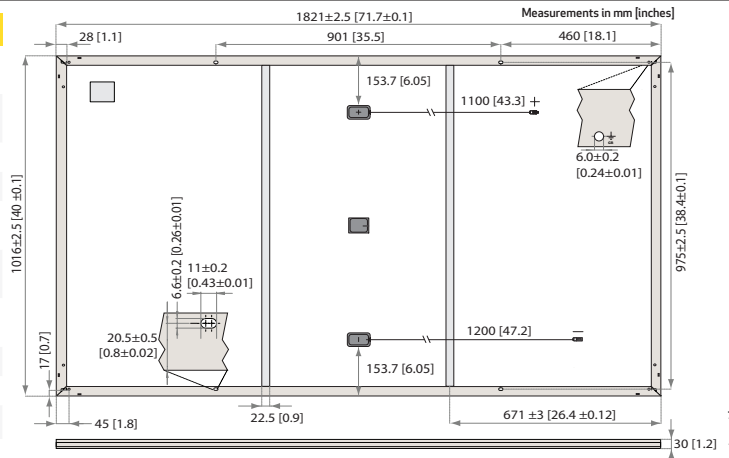
REC ALPHA[®] PURE SERIES

DATASHEET



GENERAL DATA

Cell Type	132 half-cut bifacial REC heterojunction cells, with lead-free technology
Glass	0.13 in solar glass with anti-reflective surface treatment in accordance with EN12150
Backsheet	Highly resistant polymer (Black)
Frame	Anodized aluminum (Black)
Junction Box	3-part, 3 bypass diodes, lead-free IP68 rated, in accordance with IEC 62790
Connectors	Stäubli MC4 PV-KBT4/KST4 (12AWG) in accordance with IEC 62852, IP68 only when connected
Cable	12 AWG solar cable, 43.3 in + 47.2 in in accordance with EN50618
Dimensions	71.7 x 40 x 1.2 in (19.9 ft ²)
Weight	45.2 lb
Origin	Made in Singapore



ELECTRICAL DATA

PRODUCT CODE[®]: RECxxxAA Pure

	390	395	400	405	410
Power Output - P _{max} (W _p)	390	395	400	405	410
Watt Class Sorting - (W)	0/+5	0/+5	0/+5	0/+5	0/+5
Nominal Power Voltage - V _{MPP} (V)	40.6	41.0	41.4	41.8	42.2
Nominal Power Current - I _{MPP} (A)	9.61	9.64	9.67	9.69	9.72
Open Circuit Voltage - V _{OC} (V)	48.4	48.6	48.8	49.1	49.4
Short Circuit Current - I _{SC} (A)	10.38	10.39	10.40	10.41	10.42
Power Density (W/ft ²)	19.6	19.8	20.1	20.4	20.6
Panel Efficiency (%)	21.1	21.4	21.6	21.9	22.2

CERTIFICATIONS

IEC 61215:2016; IEC61730:2016; UL61730
IEC 62804 PID
IEC 62782 Dynamic Mechanical Load
ISO 11925-2 Ignitability (EN 13501-1 Class E)
IEC 62716 Ammonia Resistance
IEC 61701 Salt Mist (SM6)
IEC 61215:2016 Hailstone (35mm)
UL 61730 Fire Type 2
IEC 62321 Lead-free acc. to RoHS EU 863/2015
ISO 14001; ISO9001; IEC45001; IEC62941



Living building challenge compliant

Take-e-way WEEE-compliant scheme

Declare.

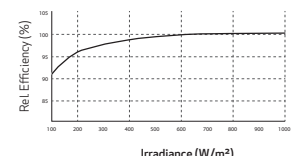
WARRANTY

	Standard	REC ProTrust	
Installed by an REC Certified Professional	No	Yes	Yes
System Size	All	<25 kW	25-500 kW
Product Warranty (yrs)	20	25	25
Power Warranty (yrs)	25	25	25
Labor Warranty (yrs)	0	25	10
Power in Year 1	98%	98%	98%
Annual Degradation	0.25%	0.25%	0.25%
Power in Year 25	92%	92%	92%

The REC ProTrust Warranty is only available on panels purchased through an REC Certified Solar Professional installer. Warranty conditions apply. See www.recgroup.com for more details

LOW LIGHT BEHAVIOR

Typical low irradiance performance of module at STC:



STC

NMOT

Values at standard test conditions (STC: air mass AM1.5, irradiance 1000 W/m², temperature 77°F (25°C)), based on a production spread with a tolerance of P_{max}, V_{oc} & I_{sc} ±3% within one watt class. Nominal module operating temperature (NMOT: air mass AM1.5, irradiance 800 W/m², temperature 68°F (20°C), windspeed 3.3 ft/s (1 m/s)). *Where xxx indicates the nominal power class (P_{max}) at STC above.

MAXIMUM RATINGS

Operational Temperature	-40 °F - 185 °F
System Voltage	1000 V
Maximum Test Load (front)	+7000 Pa (146 lb/ft ²)
Maximum Test Load (rear)	-4000 Pa (83.4 lb/ft ²)
Max Series Fuse Rating	25 A
Max Reverse Current	25 A

* See installation manual for mounting instructions. Design load = Test load / 1.5 (safety factor)

TEMPERATURE RATINGS*

Nominal Module Operating Temperature	44 °C ± 2°C
Temperature coefficient of P _{max}	-0.24%/K
Temperature coefficient of V _{oc}	-0.24%/K
Temperature coefficient of I _{sc}	0.04%/K

*The temperature coefficients stated are linear values

DELIVERY INFORMATION

Panels per Pallet	33
Panels per 40 ft GP/high cube container	792 (24 Pallets)

Specifications subject to change without notice.

Ref: PM-DS-12-06-Rev-10 3.2024

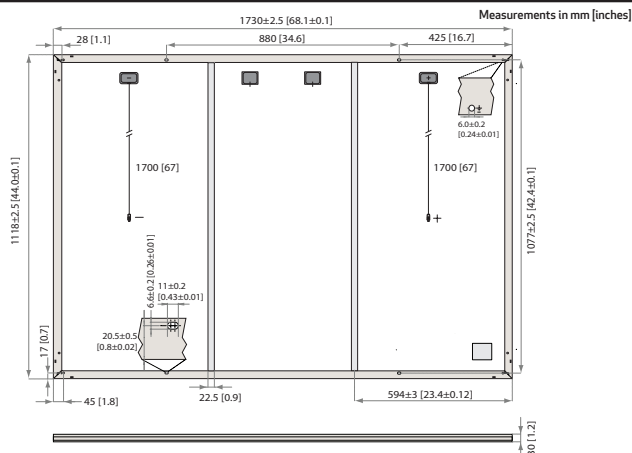
REC ALPHA[®] PURE-R SERIES

DATASHEET



GENERAL DATA

Cell Type	80 half-cut bifacial REC heterojunction cells, with lead-free, gapless technology
Glass	0.13 in solar glass with anti-reflective surface treatment in accordance with EN12150
Backsheet	Highly resistant polymer (Black)
Frame	Anodized aluminum (Black)
Junction Box	4-part, 4 bypass diodes, lead-free IP68 rated, in accordance with IEC 62790
Connectors	Stäubli MC4 PV-KBT4/KST4 (12AWG) in accordance with IEC 62852, IP68 only when connected
Cable	12 AWG solar cable, 66.9 in + 66.9 in in accordance with EN50618
Dimensions	68.1 x 44 x 1.2 in (20.8 ft ²)
Weight	47.4 lb
Origin	Made in Singapore



ELECTRICAL DATA

PRODUCT CODE*: RECxxxAA Pure-R

STC

	400	410	420	430
Power Output - P _{max} (W _p)	400	410	420	430
Watt Class Sorting - (W)	0/+10	0/+10	0/+10	0/+10
Nominal Power Voltage - V _{MPP1} (V)	48.8	49.4	50.0	50.5
Nominal Power Current - I _{MPP} (A)	8.20	8.30	8.40	8.52
Open Circuit Voltage - V _{OC} (V)	58.9	59.2	59.4	59.7
Short Circuit Current - I _{SC} (A)	8.80	8.84	8.88	8.91
Power Density (W/ft ²)	19.2	19.7	20.2	20.7
Panel Efficiency (%)	20.7	21.2	21.8	22.3

NMOT

Power Output - P _{max} (W _p)	305	312	320	327
Nominal Power Voltage - V _{MPP} (V)	46.0	46.6	47.1	47.6
Nominal Power Current - I _{MPP} (A)	6.64	6.70	6.80	6.88
Open Circuit Voltage - V _{OC} (V)	55.5	55.8	56.0	56.3
Short Circuit Current - I _{SC} (A)	7.11	7.16	7.2	7.24

Values at standard test conditions (STC: air mass AM1.5, irradiance 1000 W/m², temperature 77°F (25°C)), based on a production spread with a tolerance of P_{max}, V_{OC} & I_{SC} ±3% within one watt class. Nominal module operating temperature (NMOT: air mass AM1.5, irradiance 800 W/m², temperature 68°F (20°C), windspeed 3.3 ft/s (1 m/s)). *Where xxx indicates the nominal power class (P_{max}) at STC above.

MAXIMUM RATINGS

Operational Temperature	-40 °F - 185 °F
System Voltage	1000 V
Maximum Test Load (front)	+7000 Pa (146 lb/ft ²)
Maximum Test Load (rear)	-4000 Pa (83.4 lb/ft ²)
Max Series Fuse Rating	25 A
Max Reverse Current	25 A

* See installation manual for mounting instructions.
Design load = Test load / 1.5 (safety factor)

TEMPERATURE RATINGS*

Nominal Module Operating Temperature	44 °C ± 2°C
Temperature coefficient of P _{max}	-0.24% /K
Temperature coefficient of V _{OC}	-0.24% /K
Temperature coefficient of I _{SC}	0.04% /K

*The temperature coefficients stated are linear values

DELIVERY INFORMATION

Panels per Pallet	33
Panels per 40 ft GP/high cube container	858 (26 Pallets)

CERTIFICATIONS

IEC 61215:2021; IEC61730:2016; UL61730
 ISO 11925-2 Ignitability (EN 13501-1 Class E)
 IEC 62716 Ammonia Resistance
 IEC 61701 Salt Mist (SM6)
 IEC 61215:2016 Hailstone (35mm)
 UL 61730 Fire Type 2
 IEC 62321 Lead-free acc. to RoHS EU 863/2015
 ISO 14001; ISO9001; IEC45001; IEC62941



Declare.

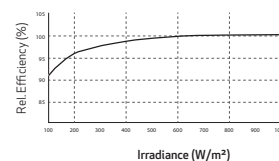
WARRANTY

	Standard	REC ProTrust	
Installed by an REC Certified Professional	No	Yes	Yes
System Size	All	<25 kW	25-500 kW
Product Warranty (yrs)	20	25	25
Power Warranty (yrs)	25	25	25
Labor Warranty (yrs)	0	25	10
Power in Year 1	98%	98%	98%
Annual Degradation	0.25%	0.25%	0.25%
Power in Year 25	92%	92%	92%

The REC ProTrust Warranty is only available on panels purchased through an REC Certified Solar Professional installer. Warranty conditions apply. See www.recgroup.com for more details

LOW LIGHT BEHAVIOR

Typical low irradiance performance of module at STC:



Specifications subject to change without notice.

Ref: PM-DS-12-06-Rev-43-2024

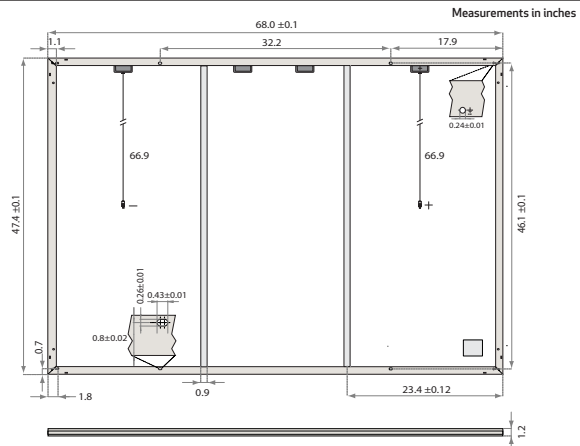
REC ALPHA[®] PURE-RX SERIES

DATASHEET



GENERAL DATA

Cell Type	88 half-cut bifacial REC heterojunction cells, with gapless technology
Glass	0.13 in. solar glass with anti-reflective surface treatment in accordance with EN12150
Backsheet	Highly resistant polymer (Black)
Frame	Anodized aluminum (Black)
Junction Box	4-part, 4 bypass diodes, IP68 rated, in accordance with IEC 62790
Connectors	Stäubli MC4 PV-KBT4/KST4 (12AWG) in accordance with IEC 62852, IP68 only when connected
Cable	12 AWG solar cable, 66.9 in. + 66.9 in. in accordance with EN50618
Dimensions	68 x 47.4 x 1.2 in. (22.4 ft ²)
Weight	50 lbs
Origin	Made in Singapore



ELECTRICAL DATA

PRODUCT CODE*: RECxxxAA Pure-RX

STC

Power Output - P _{MAX} (W _p)	450	460	470
Watt Class Sorting - (W)	0/+10	0/+10	0/+10
Nominal Power Voltage - V _{MPP} (V)	54.3	54.9	55.4
Nominal Power Current - I _{MPP} (A)	8.29	8.38	8.49
Open Circuit Voltage - V _{OC} (V)	65.1	65.3	65.6
Short Circuit Current - I _{SC} (A)	8.81	8.88	8.95
Power Density (W/ft ²)	20.1	20.5	21.0
Panel Efficiency (%)	21.6	22.1	22.6

NMOT

Power Output - P _{MAX} (W _p)	343	350	358
Nominal Power Voltage - V _{MPP} (V)	51.2	51.7	52.2
Nominal Power Current - I _{MPP} (A)	6.70	6.77	6.86
Open Circuit Voltage - V _{OC} (V)	61.3	61.6	61.8
Short Circuit Current - I _{SC} (A)	7.11	7.17	7.23

Values at standard test conditions (STC: air mass AM1.5, irradiance 1000 W/m², temperature 77°F (25°C)), based on a production spread with a tolerance of P_{MAX}, V_{OC} & I_{SC} ±3% within one watt class. Nominal module operating temperature (NMOT: air mass AM1.5, irradiance 800 W/m², temperature 68°F (20°C), windspeed 3.3 ft/s (1 m/s)). *Where xxx indicates the nominal power class (P_{MAX}) at STC above.

MAXIMUM RATINGS*

Operational Temperature	-40 °F - 185 °F
System Voltage	1000 V
Maximum Test Load (front)	+7000 Pa (146 lb/ft ²)
Maximum Test Load (rear)	-4000 Pa (83.4 lb/ft ²)
Max Series Fuse Rating	25 A
Max Reverse Current	25 A

* See installation manual for mounting instructions. Design load = Test load / 1.5 (safety factor)

TEMPERATURE RATINGS*

Nominal Module Operating Temperature	44 °C ± 2°C
Temperature coefficient of P _{MAX}	-0.24% /K
Temperature coefficient of V _{OC}	-0.24% /K
Temperature coefficient of I _{SC}	0.04% /K

*The temperature coefficients stated are linear values

DELIVERY INFORMATION

Panels per Pallet	33
Panels per 40 ft GP/high cube container	594 (18 Pallets)
Panels per 53 ft truck	792 (24 Pallets)

CERTIFICATIONS

IEC 61215:2021; IEC61730:2016; UL61730
 ISO 11925-2 Ignitability (EN 13501-1 Class E)
 IEC 62716 Ammonia Resistance
 IEC 61701 Salt Mist (SM6)
 IEC 61215:2016 Hailstone (35mm)
 UL 61730 Fire Type 2
 ISO 14001; ISO9001; IEC45001; IEC62941



Specifications subject to change without notice.

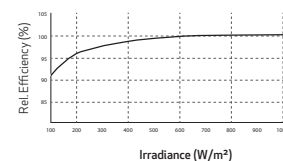
WARRANTY

	Standard	REC ProTrust	
Installed by an REC Certified Professional	No	Yes	Yes
System Size	All	<25 kW	25-500 kW
Product Warranty (yrs)	20	25	25
Power Warranty (yrs)	25	25	25
Labor Warranty (yrs)	0	25	10
Power in Year 1	98%	98%	98%
Annual Degradation	0.25%	0.25%	0.25%
Power in Year 25	92%	92%	92%

The REC ProTrust Warranty is only available on panels purchased through an REC Certified Solar Professional installer. Warranty conditions apply. See www.recgroup.com for more details.

LOW LIGHT BEHAVIOR

Typical low irradiance performance of module at STC:



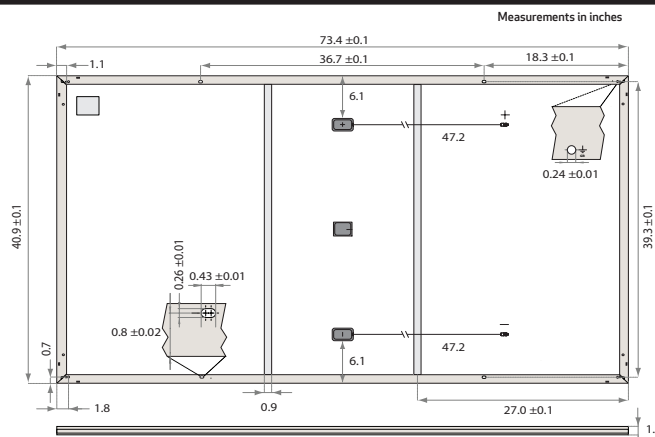
Ref: PM-DS-12-06-Rev-4.5.2024

REC ALPHA[®] PURE 2 SERIES DATASHEET



GENERAL DATA

Cell Type	132 half-cut bifacial REC heterojunction cells, with gapless technology
Glass	0.13 in solar glass with anti-reflective surface treatment in accordance with EN12150
Backsheet	Highly resistant polymer (Black)
Frame	Anodized aluminum (Black)
Junction Box	3-part, 3 bypass diodes, IP68 rated, in accordance with IEC 62790
Connectors	Stäubli MC4 PV-KBT4/KST4 (12AWG) in accordance with IEC 62852, IP68 only when connected
Cable	12 AWG solar cable, 47.2 in + 47.2 in in accordance with EN50618
Dimensions	73.4 x 40.9 x 1.2 in (20.8 ft ²)
Weight	47.8 lb
Origin	Made in Singapore



ELECTRICAL DATA

PRODUCT CODE*: RECxxxAA Pure 2

STC

Power Output - P _{max} (W _p)	400	410	420	430
Watt Class Sorting - (W)	0/+10	0/+10	0/+10	0/+10
Nominal Power Voltage - V _{MPP} (V)	41.1	41.6	42.2	42.8
Nominal Power Current - I _{MPP} (A)	9.74	9.86	9.96	10.05
Open Circuit Voltage - V _{OC} (V)	48.5	48.8	49.1	49.3
Short Circuit Current - I _{SC} (A)	10.60	10.67	10.74	10.81
Power Density (W/ft ²)	19.2	19.7	20.2	20.7
Panel Efficiency (%)	20.6	21.1	21.7	22.2

NMOT

Power Output - P _{max} (W _p)	304	312	320	327
Nominal Power Voltage - V _{MPP} (V)	38.7	39.2	39.8	40.3
Nominal Power Current - I _{MPP} (A)	7.86	7.96	8.05	8.12
Open Circuit Voltage - V _{OC} (V)	45.7	45.8	46.0	46.2
Short Circuit Current - I _{SC} (A)	8.5	8.62	8.68	8.73

Values at standard test conditions (STC: air mass AM1.5, irradiance 1000 W/m², temperature 77°F (25°C)), based on a production spread with a tolerance of P_{max}, V_{OC} & I_{SC} ±3% within one watt class. Nominal module operating temperature (NMOT: air mass AM1.5, irradiance 800 W/m², temperature 68°F (20°C), windspeed 3.3 ft/s (1 m/s)). *Where xxx indicates the nominal power class (P_{max}) at STC above.

MAXIMUM RATINGS*

Operational Temperature	-40 °F - 185 °F
System Voltage	1000 V
Maximum Test Load (front)	+7000 Pa (146 lb/ft ²)
Maximum Test Load (rear)	-4000 Pa (83.4 lb/ft ²)
Max Series Fuse Rating	25 A
Max Reverse Current	25 A

* See installation manual for mounting instructions.
Design load = Test load / 1.5 (safety factor)

TEMPERATURE RATINGS*

Nominal Module Operating Temperature	44 °C ± 2°C
Temperature coefficient of P _{max}	-0.24% /K
Temperature coefficient of V _{OC}	-0.24% /K
Temperature coefficient of I _{SC}	0.04% /K

*The temperature coefficients stated are linear values

DELIVERY INFORMATION

Panels per Pallet	33
Panels per 40 ft GP/high cube container	792 (24 Pallets)
Panels per 53 ft truck	858 (26 Pallets)

CERTIFICATIONS

IEC 61215:2021; IEC61730:2016; UL61730
IEC 62716 Ammonia Resistance
IEC 61701 Salt Mist (SM6)
IEC 61215:2016 Hailstone (35mm)
UL 61730 Fire Type 2
ISO 14001; ISO9001; IEC45001; IEC62941



Specifications subject to change without notice.

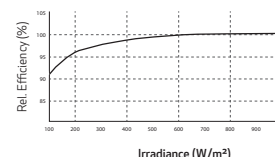
WARRANTY

	Standard	REC ProTrust	
Installed by an REC Certified Professional	No	Yes	Yes
System Size	All	<25 kW	25-500 kW
Product Warranty (yrs)	20	25	25
Power Warranty (yrs)	25	25	25
Labor Warranty (yrs)	0	25	10
Power in Year 1	98%	98%	98%
Annual Degradation	0.25%	0.25%	0.25%
Power in Year 25	92%	92%	92%

The REC ProTrust Warranty is only available on panels purchased through an REC Certified Solar Professional installer. Warranty conditions apply. See www.recgroup.com for more details

LOW LIGHT BEHAVIOR

Typical low irradiance performance of module at STC:



Ref: PM-DS-12-06-Rev-3.2.4.2024

ANNEX 1: INSTALLATIONS ON WATER PLATFORMS

The REC solar panels covered by this manual may be installed on water platform-type mounting systems (note that the certification testing of solar panels does not include testing on these types of systems). When installing REC solar panels on fixed position (e.g., anchored) water platforms, for example, floating pontoons, follow the instructions below specific to such applications. Failure to do so will invalidate the warranty.

i NOTE

For all installations on water platforms, first advise REC before the start of installation in case of any site specific instructions or constraints.

INSTALLATION ENVIRONMENT

i) Installation site

- REC solar panels may only be installed on closed bodies of fresh water where water salinity does not exceed 15 PSU (25 mS/cm) at 77°F (25°C). This specifically excludes mounting on sea and ocean applications.
- The maximum permitted wave height must not exceed 1 m from the crest to the trough of the wave.

ii) Floating platforms

- When using a floating platform, follow the manufacturer's instructions regarding installation, maintenance, inspection and cleaning at all times.

iii) Minimum installation height

- The minimum installation height of REC solar panels on floating platform systems is 6 in (15 cm) and is defined as the height between the water surface and the lowest edge/part of the panel during normal operation. This will help to shield the panel from direct water spray.

INSTALLATION INSTRUCTIONS

i) System installation

- All cables used for the installation must have sufficient length and slack to prevent damage due to water level changes and wave motions.

i NOTE

Negative system grounding is required for REC solar panels installed on a floating platform.

ii) Mounting panels

- Installation of REC solar panels must be in accordance with the aforementioned standard mounting instructions.
- The junction box should be oriented as far as possible from the water surface according to system design and the junction box, cables and connectors must be protected from direct water splash.
- The installation must allow for sufficient spacing between individual panels, in order to avoid all contact as caused by the natural movement and flexing of the floating structure.

iii) Panel protection

- In areas with high avian activity, additional bird repelling devices may be installed as long as they do not adversely affect system performance, e.g., shading or to the local environment etc.
- If using lightning protection equipment on the floating installation, all relevant local regulations must be respected.

MAINTENANCE

- Regularly inspect the installation to ensure all panels are securely mounted.

i NOTE

For installations with high avian activity, system cleaning may be required at more frequent intervals to reduce shading of panels caused by bird defecation.

SAFETY

- Immediately disconnect the system if the installation or the floating platform exhibits deviation from standard operating conditions.
- In the event of the floating platform being submerged, disconnect the DC connection at the inverter immediately. Do not attempt to salvage panels when sunlight is present.

ANNEX 2: INSTALLATIONS USING MODULE LEVEL POWER ELECTRONICS

This section is applicable to all REC products referred to in this installation manual.

Module Level Power Electronics (MLPE) is the name given to the range of panel-level components that can be installed in PV system circuits installed on or in buildings to reduce shock hazard for emergency responders. MLPE devices can be supplied pre-installed by panel manufacturers or as a 'retro-fit' system made by third-party manufacturers.

MLPE devices may be used on REC solar panels where desirable or mandatory (note that the certification testing of solar panels does not include testing with MLPE devices). When installing an MLPE device directly onto the frame structure of an REC solar panel, follow the instructions provided by the device manufacturer and the instructions specific for REC solar panels given below. Failure to follow the manufacturer and the REC instructions may invalidate the warranty.

INSTALLATION

i) Installation

- MLPE devices must be suitable for the location where the solar panels installed. Observe any limitations set by the MLPE manufacturer. (e.g., minimum mounting gap between MLPE and rooftop).
- When attaching an MLPE device directly to the solar panel frame, follow the MLPE manufacturer's instructions to ensure optimum mounting of the device and prevent any slippage during operation.
- When installing an MLPE device to the panel frame, ensure to leave a gap of minimum 15 mm between the MLPE device and any further part of the module architecture to ensure there is sufficient airflow around the device, e.g., between the MLPE device and junction box and/or support bar.
- Wherever possible, the installation of the MLPE device should not cover the product label on the rear of the panel.
- MLPE devices may also be attached to the mounting construction. In such cases, refer to the instructions provided by the manufacturer.

CAUTION

- To avoid damage to the panel and to allow for thermal expansion, there must be a minimum gap of 2.5 mm between the MLPE device and the panel backsheet.
- The mounting holes in the panel frame must not be used for the installation of MLPE devices.
- The drilling of extra holes in the frame is not permitted and will invalidate the panel warranty.

CONNECTION

- First ensure the installation of the MLPE device is secure and safe.
- Following the device manufacturer's instructions to connect the cables from the MLPE device to the solar panel correctly (usually positive [+ to +] and negative to negative [- to -]).
- Connection to the next panel in the array should be done from the 'free' cables.

SAFETY

- Immediately disconnect the device if there is a problem during installation.

SmartSolar Charge Controllers 250V and 99% efficiency MPPT 250/60, 250/70, 250/85 & 250/100



Ultra-fast Maximum Power Point Tracking (MPPT)

Especially in case of a clouded sky, when light intensity is changing continuously, an ultra-fast MPPT controller will improve energy harvest by up to 30% compared to PWM charge controllers and by up to 10% compared to slower MPPT controllers.

Advanced Maximum Power Point Detection in case of partial shading conditions

If partial shading occurs, two or more maximum power points may be present on the power-voltage curve. Conventional MPPTs tend to lock to a local MPP, which may not be the optimum MPP.

The innovative SmartSolar algorithm will always maximize energy harvest by locking to the optimum MPP.

Outstanding conversion efficiency

No cooling fan. Maximum efficiency exceeds 99%.

Flexible charge algorithm

Fully programmable charge algorithm (see the software page on our website), and eight pre-programmed algorithms, selectable with a rotary switch (see manual for details).

Extensive electronic protection

Over-temperature protection and power derating when temperature is high.

PV short circuit and PV reverse polarity protection.

PV reverse current protection.

Internal temperature sensor

Compensates absorption and float charge voltage for temperature.

Bluetooth Smart built-in: dongle not needed

The wireless solution to set-up, monitor and update the controller using Apple and Android smartphones, tablets or other devices.

VE.Direct

For a wired data connection to a Color Control panel, Venus GX, PC or other devices

Remote on-off

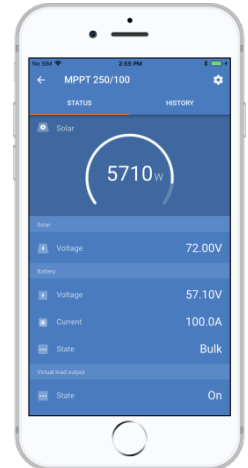
To connect for example to a VE.BUS BMS.

Programmable relay

Can be programmed (a.o. with a smartphone) to trip on an alarm, or other events.

Optional: pluggable LCD display

Remove the seal that protects the plug on the front of the controller, and plug-in the display.



**SmartSolar Charge Controller
MPPT 250/100-Tr
with pluggable display**



**SmartSolar Charge Controller
MPPT 250/100-MC4
without display**

SmartSolar Charge Controller	MPPT 250/60	MPPT 250/70	MPPT 250/85	MPPT 250/100
Battery voltage	12 / 24 / 48V Auto Select (software tool needed to select 36V)			
Rated charge current	60A	70A	85A	100A
Nominal PV power, 12V 1a,b)	860W	1000W	1200W	1450W
Nominal PV power, 24V 1a,b)	1720W	2000W	2400W	2900W
Nominal PV power, 48V 1a,b)	3440W	4000W	4900W	5800W
Max. PV short circuit current 2)	35A (max 30A per MC4 conn.)		70A (max 30A per MC4 conn.)	
Maximum PV open circuit voltage	250V absolute maximum coldest conditions 245V start-up and operating maximum			
Maximum efficiency	99%			
Self-consumption	Less than 35mA @ 12V / 20mA @ 48V			
Charge voltage 'absorption'	Default setting: 14,4 / 28,8 / 43,2 / 57,6V (adjustable with: rotary switch, display, VE.Direct or Bluetooth)			
Charge voltage 'float'	Default setting: 13,8 / 27,6 / 41,4 / 55,2V (adjustable: rotary switch, display, VE.Direct or Bluetooth)			
Charge algorithm	multi-stage adaptive			
Temperature compensation	-16 mV / -32 mV / -64 mV / °C			
Protection	Battery reverse polarity (fuse, not user accessible) PV reverse polarity / Output short circuit / Over temperature			
Operating temperature	-30 to +60°C (full rated output up to 40°C)			
Humidity	95%, non-condensing			
Data communication port	VE.Direct or Bluetooth			
Remote on/off	Yes (2 pole connector)			
Programmable relay	DPST AC rating: 240VAC / 4A DC rating: 4A up to 35VDC, 1A up to 60VDC			
Parallel operation	Yes (not synchronized)			
ENCLOSURE				
Colour	Blue (RAL 5012)			
PV terminals 3)	35 mm ² / AWG2 (Tr models) Two sets of MC4 connectors (MC4 models 250/60 and 250/70) Three sets of MC4 connectors (MC4 models 250/85 and 250/100)			
Battery terminals	35 mm ² / AWG2			
Protection category	IP43 (electronic components), IP22 (connection area)			
Weight	3 kg		4,5 kg	
Dimensions (h x w x d) in mm	Tr models: 185 x 250 x 95 MC4 models: 215 x 250 x 95		Tr models: 216 x 295 x 103 MC4 models: 246 x 295 x 103	
STANDARDS				
Safety	EN/IEC 62109-1			
1a) If more PV power is connected, the controller will limit input power to the stated maximum. 1b) The PV voltage must exceed Vbat + 5V for the controller to start. Thereafter the minimum PV voltage is Vbat + 1V.				
2) A PV array with a higher short circuit current may damage the controller in case of reverse polarity connection of the PV array.				
3) MC4 models: several splitter pairs may be needed to parallel the strings of solar panels. Maximum current per MC4 connector: 30A (the MC4 connectors are parallel connected to one MPPT tracker)				



victron energy

POWER FOR EVERYONE

SmartSolar charge controllers

Manual

MPPT 150/45-Tr
MPPT 150/60-Tr
MPPT 150/70-Tr

MPPT 150/45-MC4
MPPT 150/60-MC4
MPPT 150/70-MC4

MPPT 150/85-Tr
MPPT 150/100-Tr

MPPT 150/85-MC4
MPPT 150/100-MC4

MPPT 250/60-Tr
MPPT 250/70-Tr

MPPT 250/60-MC4
MPPT 250/70-MC4

MPPT 250/85-Tr
MPPT 250/100-Tr

MPPT 250/85-MC4
MPPT 250/100-MC4

1. General Description

Bluetooth Smart built-in: dongle not needed

The wireless solution to set-up, monitor and update the controller using Apple and Android smartphones, tablets or other devices.

VE.Direct port

For a wired data connection to a Color Control, Venus GX, PC or other devices.

Remote on-off input

On/off control by a VE.Bus BMS when charging Li-ion batteries.

Programmable relay

Can be programmed (a.o. with a smartphone) to trip on an alarm, or other events.

Optional: pluggable LCD display

Simply remove the rubber seal that protects the plug on the front of the controller and plug-in the display.

Ultra-fast Maximum Power Point Tracking (MPPT)

Especially in case of a clouded sky, when light intensity is changing continuously, an ultra fast MPPT controller will improve energy harvest by up to 30% compared to PWM charge controllers and by up to 10% compared to slower MPPT controllers.

Advanced Maximum Power Point Detection in case of partial shading conditions

If partial shading occurs, two or more maximum power points may be present on the power-voltage curve.

Conventional MPPTs tend to lock to a local MPP, which may not be the optimum MPP.

The innovative SmartSolar algorithm will always maximize energy harvest by locking to the optimum MPP.

Outstanding conversion efficiency

No cooling fan. Maximum efficiency exceeds 98%. Full output current up to 40°C (104°F).

Extensive electronic protection

Over-temperature protection and power derating when temperature is high. PV reverse polarity protection.

Internal temperature sensor

Compensates absorption and float charge voltages for temperature.



Automatic battery voltage recognition

The controllers will automatically adjust to a 12V, 24V or a 48V system **one time only**. If a different system voltage is required at a later stage, it must be changed manually, for example with the Bluetooth app or the optional LCD display. Similarly, manual setting is required in case of 36V system.

Flexible charge algorithm

Fully programmable charge algorithm, and eight preprogrammed algorithms, selectable with a rotary switch.

Adaptive three step charging

The SmartSolar MPPT Charge Controller is configured for a three step charging process: Bulk – Absorption – Float.

A regular equalization charge can also be programmed: see section 3.8 of this manual.

Bulk

During this stage the controller delivers as much charge current as possible to rapidly recharge the batteries.

Absorption

When the battery voltage reaches the absorption voltage setting, the controller switches to constant voltage mode.

When only shallow discharges occur the absorption time is kept short in order to prevent overcharging of the battery. After a deep discharge the absorption time is automatically increased to make sure that the battery is completely recharged. Additionally, the absorption period is also ended when the charge current decreases to less than 2A.

Float

During this stage, float voltage is applied to the battery to maintain it in a fully charged state.

When the battery voltage drops below float voltage during at least 1 minute a new charge cycle will be triggered.

Equalization

See section 3.10

Configuring and monitoring

- Bluetooth Smart built-in: the wireless solution to set-up, monitor and update the controller using Apple and Android smartphones, tablets or other devices.
- Use the VE.Direct to USB cable (ASS030530000) to connect to a PC, a smartphone with Android and USB On-The-Go support (requires additional USB OTG cable).
- Use a VE.Direct to VE.Direct cable to connect to a MPPT Control, a Color Control or the Venus GX.

Several parameters can be customized with the VictronConnect app.

The VictronConnect app can be downloaded from

<http://www.victronenergy.nl/support-and-downloads/software/>

Use the manual – VictronConnect - MPPT Solar Charge Controllers – to get the most out of the VictronConnect App when it's connected to a MPPT Solar Charge Controller:

<http://www.victronenergy.com/live/victronconnect:mppt-solarchargers>



MPPT Control

Color Control

Venus GX



2. Safety instructions

SAVE THESE INSTRUCTIONS - This manual contains important instructions that shall be followed during installation and maintenance.



WARNING

Danger of explosion from sparking

Danger of electric shock

- Please read this manual carefully before the product is installed and put into use.
- This product is designed and tested in accordance with international standards. The equipment should be used for the designated application only.
- Install the product in a heatproof environment. Ensure therefore that there are no chemicals, plastic parts, curtains or other textiles, etc. in the immediate vicinity of the equipment.
- The product is not allowed to be mounted in a user accessible area.
- Ensure that the equipment is used under the correct operating conditions. Never operate it in a wet environment.
- Never use the product at sites where gas or dust explosions could occur.
- Ensure that there is always sufficient free space around the product for ventilation.
- Refer to the specifications provided by the manufacturer of the battery to ensure that the battery is suitable for use with this product. The battery manufacturer's safety instructions should always be observed.
- Protect the solar modules from incident light during installation, e.g. cover them.
- Never touch uninsulated cable ends.
- Use only insulated tools.
- Connections must always be made in the sequence described in section 3.5.
- The installer of the product must provide a means for cable strain relief to prevent the transmission of stress to the connections.
- In addition to this manual, the system operation or service manual must include a battery maintenance manual applicable to the type of batteries used.

- Use flexible multistranded copper cable for the battery and PV connections.

The maximum diameter of the individual strands is 0,4mm/0,125mm² (0.016 inch/AWG26).

A 25mm² cable, for example, should have at least 196 strands (class 5 or higher stranding according to VDE 0295, IEC 60228 and BS6360). An AWG2 gauge cable should have at least 259/26 stranding (259 strands of AWG26).

Maximum operating temperature: $\geq 90^{\circ}\text{C}$.

Example of suitable cable: class 5 "Tri-rated" cable (it has three approvals: American (UL), Canadian (CSA) and British (BS))

In case of thicker strands the contact area will be too small and the resulting high contact resistance will cause severe overheating, eventually resulting in fire.



- Maximum current through a MC4 terminal: 30A

3. Installation

**WARNING: DC (PV) INPUT NOT ISOLATED FROM BATTERY CIRCUIT.
CAUTION: FOR PROPER TEMPERATURE COMPENSATION
THE AMBIENT CONDITION FOR CHARGER AND BATTERY MUST BE
WITHIN 5°C.**

3.1 General

- Mount vertically on a non-flammable surface, with the power terminals facing downwards.
 - Mount close to the battery, but never directly above the battery (in order to prevent damage due to gassing of the battery).
 - Improper internal temperature compensation (e.g. ambient condition battery and charger not within 5°C) can lead to reduced battery lifetime.
- We recommend installing the Smart Battery Sense option if larger temperature differences or extreme ambient temperature conditions are expected (not yet functional on the 250/85 and 250/100 models).**
- Battery installation must be done in accordance with the storage battery rules of the Canadian Electrical Code, Part I.
 - The battery connections (and for Tr version also PV connections) must be guarded against inadvertent contact (e.g. install in an enclosure or install the optional WireBox).

Tr models: use flexible multistranded copper cable for the battery and PV connections: see safety instructions.

MC4 models: several splitter pairs may be needed to parallel the strings of solar panels. (Maximum current through a MC4 terminal: 30A)

3.2 Grounding

- *Battery grounding:* the charger can be installed in a positive or negative grounded system.
Note: apply a single ground connection (preferably close to the battery) to prevent malfunctioning of the system.
- *Chassis grounding:* A separate earth path for the chassis ground is permitted because it is isolated from the positive and negative terminal.
- The USA National Electrical Code (NEC) requires the use of an external ground fault protection device (GFPD). These MPPT chargers do not have internal ground fault protection. The system electrical negative should be bonded through a GFPD to earth ground at one (and only one) location.
- The charger must not be connected with grounded PV arrays.

**WARNING: WHEN A GROUND FAULT IS INDICATED, BATTERY
TERMINALS AND CONNECTED CIRCUITS MAY BE UNGROUNDED
AND HAZARDOUS.**

3.3 PV configuration (also see the MPPT Excel sheet on our website)

- The controllers will operate only if the PV voltage exceeds battery voltage (V_{bat}).
- PV voltage must exceed $V_{bat} + 5V$ for the controller to start. Thereafter minimum PV voltage is $V_{bat} + 1V$.
- Maximum open circuit PV voltage: 150V or 250V, depending on model.

For example:

24V battery, mono- or polycrystalline panels, max PV voltage 150V:

- Minimum number of cells in series: 72 (2x 12V panel in series or one 24V panel).
- Recommended number of cells for highest controller efficiency: 144 cells (4x 12V panel or 2x 24V panel in series).
- Maximum: 216 cells (6x 12V or 3x 24V panel in series).

48V battery, mono- or polycrystalline panels, max PV voltage 250V:

- Minimum number of cells in series: 144 (4x 12V panel or 2x 24V panel in series).
- Maximum: 360 cells (10x 12V or 5x 24 panel in series).

Remark: at low temperature the open circuit voltage of a 216 cell solar array may exceed 150V, and the open circuit voltage of a 360 cell array may exceed 250V, depending on local conditions and cell specifications. In that case the number of cells in series must be reduced.

3.4 Cable connection sequence (see figure 1)

First: connect the battery.

Second: if required, connect the remote on-off and programmable relay

Third: connect the solar array (when connected with reverse polarity, the controller will heat up but will not charge the battery).

3.5 Remote on-off

The left terminal is connected to the internal 3,3V supply, with a resistor in series for short circuit protection.

The right terminal (marked as +) will switch the controller on if $>3V$ is applied, and will switch the controller off if $<2V$ is applied or if the terminal is left free floating.

The recommended use of the remote on-off is:

- a. A switch wired between the left and right terminal
- b. A switch wired between battery plus and the right terminal.
- c) A switch between the right terminal and the charge disconnect terminal of a VE.Bus BMS

3.6 Configuration of the controller with the rotary switch

Fully programmable charge algorithm (see the software page on our website) and eight preprogrammed charge algorithms, selectable with a rotary switch:

Pos	Suggested battery type	Absorption V	Float V	Equalize V @%I _{nom}	dV/dT mV/°C
0	Gel Victron long life (OPzV) Gel exide A600 (OPzV) Gel MK	28,2	27,6	31,8 @8%	-32
1	Gel Victron deep discharge Gel Exide A200 AGM Victron deep discharge Stationary tubular plate (OPzS) Rolls Marine (flooded) Rolls Solar (flooded)	28,6	27,6	32,2 @8%	-32
2	Default setting Gel Victron deep discharge Gel Exide A200 AGM Victron deep discharge Stationary tubular plate (OPzS) Rolls Marine (flooded) Rolls Solar (flooded)	28,8	27,6	32,4 @8%	-32
3	AGM spiral cell Stationary tubular plate (OPzS) Rolls AGM	29,4	27,6	33,0 @8%	-32
4	PzS tubular plate traction batteries or OPzS batteries	29,8	27,6	33,4 @25%	-32
5	PzS tubular plate traction batteries or OPzS batteries	30,2	27,6	33,8 @25%	-32
6	PzS tubular plate traction batteries or OPzS batteries	30,6	27,6	34,2 @25%	-32
7	Lithium Iron Phosphate (LiFePo ₄) batteries	28,4	27,0	n.a.	0

Note 1: divide all values by two in case of a 12V system and multiply by two in case of a 48V system.

Note 2: equalize normally off, see sect. 3.9 to activate

Note 3: any setting change performed with the pluggable LCD display or via Bluetooth will override the rotary switch setting. Turning the rotary switch will override prior settings made with the pluggable LCD display or via Bluetooth.

A binary LED code helps determining the position of the rotary switch. After changing the position of the rotary switch, the LEDs will blink during 4 seconds as follows:

Switch position	LED Bulk	LED Abs	LED Float	Blink frequency
0	1	1	1	Fast
1	0	0	1	Slow
2	0	1	0	Slow
3	0	1	1	Slow
4	1	0	0	Slow
5	1	0	1	Slow
6	1	1	0	Slow
7	1	1	1	Slow

Thereafter, normal indication resumes, as described in the LEDs section.

3.7 LEDs

LED indication:

- permanent on
- ◎ blinking
- off

Regular operation

	LEDs	Bulk	Absorption	Float
Not charging (*1)		◎	○	○
Bulk		●	○	○
Absorption		○	●	○
Automatic equalisation		○	●	●
Float		○	○	●

Note (*1): The bulk LED will blink briefly every 3 seconds when the system is powered but there is insufficient power to start charging.

Fault situations

	LEDs	Bulk	Absorption	Float
Charger temperature too high		○	○	◎
Charger over-current		◎	○	◎
Charger or panel over-voltage		○	◎	◎
Internal error (*2)		◎	◎	○

Note (*2): E.g. calibration and/or settings data lost, current sensor issue.

3.8 Battery charging information

The charge controller starts a new charge cycle every morning, when the sun starts shining.

Default setting:

The maximum duration of the absorption period is determined by the battery voltage measured just before the solar charger starts up in the morning:

Battery voltage Vb (@start-up)	Maximum absorption time
$V_b < 23,8V$	6h
$23,8V < V_b < 24,4V$	4h
$24,4V < V_b < 25,2V$	2h
$V_b > 25,2V$	1h

(divide voltages by 2 for a 12V system and multiply by two in case of a 48V system)

If the absorption period is interrupted due to a cloud or due to a power hungry load, the absorption process will resume when absorption voltage is reached again later on the day, until the absorption period has been completed.

The absorption period also ends when the output current of the solar charger drops to less than 2Amps, not because of low solar array output but because the battery is fully charged (tail current cut off).

This algorithm prevents over charge of the battery due to daily absorption charging when the system operates without load or with a small load.

User defined algorithm:

Any setting change performed with the pluggable LCD display or via Bluetooth will override the rotary switch setting. Turning the rotary switch will override prior settings made with the pluggable LCD display or via Bluetooth.

3.9 Automatic equalization

Automatic equalization is default set to 'OFF'. With the VictronConnect app or the pluggable LCD display this setting can be configured with a number between 1 (every day) and 250 (once every 250 days). When automatic equalization is active, the absorption charge will be followed by a voltage limited constant current period (see table in section 3.5). The current is limited to 8% of the bulk current for all VRLA (Gel or AGM) batteries and some flooded batteries, and to 25% of the bulk current for all tubular plate batteries and the user defined battery type. The bulk current is the rated charger current unless a lower maximum current setting has been chosen. In case of all VRLA batteries and some flooded batteries (algorithm number 0, 1, 2 or 3) automatic equalization ends when the voltage limit maxV has been reached, or after $t = (\text{absorption time})/8$, whichever comes first.

For all tubular plate batteries and the user defined battery type automatic equalization ends after $t = (\text{absorption time})/2$.

When automatic equalisation is not completely finished within one day, it will not resume the next day, the next equalisation session will take place as determined by the day interval.

3.10 Pluggable LCD display - Live data

Remove the rubber seal that protects the plug on the front of the controller and plug-in the display module. The display is hot-swappable; this means that the charger may be operational while the display is plugged in.



The following information will be displayed if the "-" button is pressed (in order of appearance):

Displayed info	Icons	Segments	Units
Battery voltage and charge current		28.8 50	A
Battery charge current		50.0	A
Battery voltage		28.80	V
Battery charge power		720.0	W
Battery temperature ¹⁾		25.0, ---, Err	°C/°F
Charger temperature ¹⁾		25.0, ---, Err	°C/°F
Panel current		8.6	A
Panel voltage		85.0	V
Panel power		735.0	W
Warning message ²⁾		1 nF	65
Error message ²⁾		Err	2
ESS operation ²⁾		ESS	
BMS operation ²⁾		b7S	

Notes:

- 1) A valid temperature is shown, --- = no sensor information or Err = invalid sensor data.
- 2) These items are only visible when relevant.

Pressing the "-" button or the "+" button for 4 seconds activates the auto-scroll-mode. Now all LCD-screens will pop-up one by one with short intervals. The auto-scroll-mode can be stopped by pressing the "-" or the "+" button shortly.

3.11 Pluggable LCD display - History data

The charge controller tracks several parameters regarding the energy harvest. Enter history data by pressing the SELECT button when in monitor mode, a scrolling text will be visible. Press + or – to browse the various parameters as shown in the table below, press SELECT to stop scrolling and show the corresponding value. Press + or – to browse the various values. For the daily items it is possible to scroll back to 30 days ago (data becomes available over time), a brief popup shows the day number. Press SELECT to leave the historical menu and go back to the monitor mode, alternatively press SETUP to return to the scrolling text.

Scrolling text	Icons ⁽¹⁾	Segments	Units	Displayed info
Ⓜ ELD tOLtAL		258.0	kWh	Total yield
LASE ErrOr		E0	2	Total error 0 (most recent)
		E1	0	Total error 1 (shown when available)
		E2	0	Total error 2 (shown when available)
		E3	0	Total error 3 (shown when available)
PANEL vOLtAGE tAMt tUt		U	95.0 V	Total panel voltage maximum
bAtteRy vOLtAGE tAMt tUt		H	28.8 V	Total battery voltage maximum
Ⓜ ELD		Y	8.6	Day kWh
bAtteRy vOLtAGE tAMt tUt		H	28.8	Day V
bAtteRy vOLtAGE tAMt tUt		L	25.0	Day V
LASE ErrOr		E0	2	Day
		E1	0	Day
		E2	0	Day
		E3	0	Day
tI tE bULk		tB	60	Day
tI tE AbSORPtIOn		tA	30	Day
tI tE FLt		tF	630	Day
tAMt tUt PDeR		P	135	Day W
bAtteRy CURREnt tAMt tUt		C	50.0	Day A
PANEL vOLtAGE tAMt tUt		U	95.0	Day V

Note:

When the charger is not active (night time) the bulk, absorption and float icons will be shown as in the table above.

When the charger is active only one icon will be shown: the icon corresponding to the actual charge state.

3.12 Pluggable LCD display - Setup menu

- To enter the SETUP Menu, press and hold the SETUP-button during 3 seconds. The "Menu" icon will light up and a scrolling text is visible.
- Press the "-" or "+" button to scroll through the parameters.
- The table below lists, in order of appearance, all parameters which can be adjusted by pressing the "-" button.
- Press SELECT: the parameter to change will now blink.
- Use the "-" or "+" button to chose the desired value.
- Press SELECT to confirm the change, the value will stop blinking, and the change is made final.
- Press SETUP to return to the parameters menu. With the "-" or "+" button it is now possible to scroll to another parameter that needs change.
- To return to normal mode, press SETUP during 3 seconds.

Scrolling text	Icons	Segments	Units	Function or parameter
01 PO:Er On OFF	Menu Charging	On, OFF		On/off switch
02 rAR:uW CHAr:GE C UrrEnt	Menu	1.0-100.0	A	Maximum charge current
03 bAtteErY uDLtAgE	Menu	12-48	V	System voltage
04 CHAr:GE AL90rItEhT	Menu	0.1-0.5Er	Type	Charge algorithm (1)
05 AbSO:PtI On uDLtR GE	Menu	15.0-28.8-34.8	V	Absorption voltage (2)
06 FLDrE uDLtAgE	Menu	15.0-27.6-34.8	V	Float voltage (2)
08 EQUALIZrAbI On uDLtAgE	Menu Equalize	15.0-32.4-34.8	V	Equalization voltage (2)
09 AUtO:rAbI C EQUALIZrAbI On	Menu Equalize	OFF, AUtO		Automatic equalization (3)
10 rAR:uL EQUALIZrAbI On	Menu Equalize	StArT, StOP		Manual equalization (4)
11 rELAY rIdE	Menu	rEL., OFF, 1-3-10		Relay function (5)
12 rELAY LO: uDLtAgE	Menu	Lb 15.0-20.0-34.8	V	Low battery voltage alarm set
13 rELAY CLEAR LO: uDLtAgE	Menu	Lbc 15.0-21.0-34.8	V	Low battery voltage alarm clear
14 rELAY HI 9h uDLtAgE	Menu	Hb 15.0-33.0-34.8	V	High battery voltage alarm set
15 rELAY CLEAR HI 9h uDLtAgE	Menu	Hbc 15.0-32.0-34.8	V	High battery voltage alarm clear
16 rELAY HI 9h PArEL uDLtAgE	Menu	U 1.0-150.0	V	High panel voltage alarm set
17 rELAY CLEAR HI 9h PArEL uDLtAgE	Menu	Uc 1.0-149.0-150.0	V	High panel voltage alarm clear
18 rELAY rI n rIdE cL OSEd tI rIdE	Menu	rIdC 0-500		Relay minimum closed time (minutes)
20 tEr:PEr:RUr:E cO:rP EnSAbI On	Menu	-5.0--2.7-0.0	°C mV	Battery temperature compensation per cell (2)
22 BULM tI rE PrOtec tI On	Menu	OFF, ID	h	Bulk time protection
23 rAR:uW AbSO:PtI On tI rE	Menu	1.0-6.0-24.0	h	Absorption time
29 LO: tEr:PEr:RUr:E CHAr:GE C UrrEnt	Menu	1.0-100.0	A	Charge current below 5°C
31 bT5 PrESEnt	Menu	bT5 4n		BMS Present (6)
35 LOrd rIdE	Menu	LOrd 0-1-6		Load control (7)
36 LOrd LO: uDLtAgE	Menu	LL 15.0-20.0-34.8		Load user defined low voltage
37 LOrd HI 9h uDLtAgE	Menu	Lh 15.0-28.0-34.8		Load user defined high voltage
49 bACHLI 9hE I n tEnS I tY	Menu	0-1		Backlight intensity
50 bACHLI 9hE ALr:AYs On	Menu	OFF, On, AUtO		Backlight automatic turn off after 60s (8)
51 SCrOLL SPEEd	Menu	1-3-5		Text scroll speed
52 rH rIdE	Menu	rH 0-3		VE.Direct port RX pin mode (9)
58 rE rIdE	Menu	rE 0-4		VE.Direct port TX pin mode (10)
60 dEW CE I nStAnCE	Menu	dI 0-255		VE.Direct device instance
61 SOFt:ArE uErSI On	Menu	I, n		Software version
62 rESEt:Er dEFrULtS	Menu	rESEt		Reset to default settings (11)
63 CLEAR HI StOrY	Menu	CLEAR		History data reset (12)
64 LOCh SEtUP	Menu	LOCh 4n		Lock settings
67 tEr:PEr:RUr:E UnI t	Menu	CELC, FAhr		Temperature unit °C/°F

Notes:

- 1) The factory defined battery type can be selected with the rotary switch next to VE.Direct connector. The selected type will be shown here. The setting can alter between a factory defined type and "USER".
- 2) These values can ONLY be changed for the battery type "USER". The values in the table are for a 24V-battery.
- 3) Automatic equalisation can be set to "OFF" (default) or a number between 1 (every day) and 250 (once every 250 days). See section 3.8 for more details about automatic equalisation.
- 4) To allow the charger to equalise the battery properly, use the manual equalise option only during absorption and float periods, and when there is sufficient sunlight. Press SELECT: the text "S-E-R-V-E" will blink, press SELECT again to start equalisation. To terminate the equalisation mode prematurely, enter the setup menu and navigate to setup item 10, press SELECT: the text "S-E-O-P" will blink, press SELECT again to stop equalisation. The manual equalise duration is 1 hour.
- 5) Relay function (setting 11):

Value	Description
0	Relay always off
1	Panel voltage high (setup items 16 and 17)
2	Internal temperature high (>85°C)
3	Battery voltage too low (setup items 12 and 13, default setting)
4	Equalization active
5	Error condition present
6	Internal temperature low (<-20°C)
7	Battery voltage too high (setup items 14 and 15)
8	Charger in float or storage
9	Day detection (panels irradiated)
10	Load control (relay switches according to load control mode, see setting 35 and note 7)

- 6) The parameter BMS present will be set to 'Y'es internally when a compatible BMS is detected. Setting 31 can be used to revert the charger to normal operation (i.e. without BMS) by setting it manually to 'N'o. (for example if the charger is moved to another location where a BMS is not needed).

Warning: do not set this parameter to 'Y'es when using a VE.Bus BMS connected to the remote on-off port (see sect 3.5).

- 7) Load control mode (setting 35).

To use the relay (setting 11, value 10), or the VE.Direct port (setting 58, value 4) to control a load according to the options below:

Value	Description
0	Load output always off
1	Battery life algorithm (default)
2	Conventional algorithm 1 (off<22.2V, on>26.2V)
3	Conventional algorithm 2 (off<23.6V, on>28.0V)
4	Load output always on
5	User defined algorithm 1 (off<20.0V, on>28.0V)
6	User defined algorithm 2 (off<20.0V<on<28.0V<off)

- 8) Backlight automatic turn-off has the following options: OFF=backlight remains lit all the time, ON=the backlight will dim 60s after the last keypress, AUTO=when charging the backlight is lit, otherwise it will dim.



9) VE.Direct port RX pin mode (setting 57)

Value	Description
0	Remote on/off (default). Can be used for on-off control by a VE.Bus BMS (instead of connecting the BMS to the remote on-off port. VE.Direct non-inverting remote on/off cable needed. (ASS030550310)
1	No function.
2	The RX pin can de-energize the relay (relay off), if relay function 10 of setting 11 has been set (see note 5, value 10). The load control options (setting 35) remain valid. In other words, a AND function is created: both the load control and the RX pin must be high (value=2) or low (value=3) to energize the relay.
3	

10) VE.Direct port TX pin mode (setting 58)

Value	Description
0	Normal VE.Direct communication (default) For example to communicate with a Color Control panel (VE.Direct cable needed)
1	Pulse every 0.01kWh
2	Light dimming control (pwm normal) TX digital output cable needed (ASS0305505500)
3	Light dimming control (pwm inverted) TX digital output cable needed (ASS0305505500)
4	Load control mode: theTX pin switches according to load control mode, see note 7. TX digital output cable (ASS0305505500) needed to interface to a logic level load control port.

11) Press SELECT: the text "r-ESEt" will blink, press SELECT again to reset to original factory settings. The charger will re-boot. The history data will not be affected (kWh counter, etc).

12) Press SELECT: the text "CLEAR" will blink, press SELECT again to erase the history data (kWh-counter, etc). Note that this takes a few seconds to complete.

Note: any setting change performed with the pluggable LCD display or via Bluetooth will override the rotary switch setting. Turning the rotary switch will override prior settings made with the pluggable LCD display or via Bluetooth.

Warning: Some battery manufacturers do recommend a constant current equalization period, and others do not. Do not use constant current equalization unless recommend by the battery supplier.

4. Troubleshooting

Problem	Possible cause	Solution
Charger does not function	Reversed PV connection	Connect PV correctly
	Reverse battery connection	Non-replaceable fuse blown. Return to VE for repair
The battery is not fully charged	A bad battery connection	Check battery connection
	Cable losses too high	Use cables with larger cross section
	Large ambient temperature difference between charger and battery ($T_{\text{ambient_chrg}} > T_{\text{ambient_batt}}$)	Make sure that ambient conditions are equal for charger and battery
	<i>Only for a 24V or 48V system:</i> wrong system voltage chosen (e.g. 12V instead of 24V) by the charge controller	Set the controller manually to the required system voltage
The battery is being overcharged	A battery cell is defect	Replace battery
	Large ambient temperature difference between charger and battery ($T_{\text{ambient_chrg}} < T_{\text{ambient_batt}}$)	Make sure that ambient conditions are equal for charger and battery

Using the pluggable LCD display or VictronConnect and the procedures below, most errors can be quickly identified. If an error cannot be resolved, please refer to your Victron Energy supplier.

Error nr.	Problem	Cause / Solution
n. a.	The LCD does not light up (no backlight, no display)	The internal power supply used for powering the converter and the backlight is derived from either the solar-array or the battery. If PV and battery voltage are both below 6V the LCD will not light up. Make sure that the LCD display is properly inserted into the socket.
n. a.	The LCD does not light up (backlight works, no display, charger seems to work)	This may be due to low ambient temperature. If the ambient temperature is below -10°C (14°F) the LCD-segments can become vague. Below -20°C (-4°F) the LCD-segments can become invisible. During charging the LCD-display will warm up, and the screen will become visible.
n. a.	The charge controller does not charge the battery	The LCD-display indicates that the charge-current is 0 Amps. Check the polarity of the solar-panels. Check the battery breaker Check if there is an error indication on the LCD Check if the charger is set to "ON" in the menu. Check if the Remote input is connected. Check if the right system voltage has been selected
n. a.	High temperature: the thermometer icon blinks	This error will auto-reset after temperature has dropped. Reduced output current due to high temperature. Check the ambient temperature and check for obstructions near the heatsink.
Err 2	Battery voltage too high (>76,8V)	This error will auto-reset after the battery voltage has dropped. This error can be due to other charging equipment connected to the battery or a fault in the charge controller.
Err 17	Controller overheated despite reduced output current	This error will auto-reset after charger has cooled down. Check the ambient temperature and check for obstructions near the heatsink.
Err 18	Controller over-current	This error will auto-reset. Disconnect the charge controller from all power-sources, wait 3 minutes, and power up again. If the error persists the charge controller is probably faulty.
Err 20	Maximum Bulk-time exceeded	This error can only occur when the maximum bulk-time protection is active. This error will not auto-reset. This error is generated when the battery-absorption-voltage is not reached after 10 hours of charging. For normal solar installations it is advised not to use the maximum bulk-time protection.
Err 21	Current sensor issue	The charge controller is probably faulty. This error will not auto-reset.
Err 26	Terminal overheated	Power terminals overheated, check wiring and



Error nr.	Problem	Cause / Solution
		fasten bolts if possible. This error will auto-reset.
Err 33	PV over-voltage	This error will auto-reset after PV-voltage has dropped to safe limit. This error is an indication that the PV-array configuration with regard to open-circuit voltage is critical for this charger. Check configuration, and if required, re-organise panels.
Err 34	PV over-current	The current from the solar-panel array has exceeded 75A. This error could be generated due to an internal system fault. Disconnect the charger from all power-sources, wait 3 minutes, and power-up again. If the error persists the controller is probably faulty. This error will auto-reset.
Err 38	Input shutdown due to battery over-voltage	To protect the battery from over-charging the panel input is shut down. To recover from this condition first disconnect the solar panels and disconnect the battery. Wait for 3 minutes reconnect the battery first and next the panels. If the error persists the charge controller is probably faulty.
Inf 65	Communication warning	Communication with one of the paralleled controllers was lost. To clear the warning, switch the controller off and back on.
Inf 66	Incompatible device	The controller is being paralleled to another controller that has different settings and/or a different charge algorithm. Make sure all settings are the same and update firmware on all chargers to the latest version.
Err 67	BMS connection lost	Connection to the BMS lost, check the connection (Cabling / Bluetooth link). When the charger needs to operate in stand-alone mode again, change to setup menu setting 'BMS' from 'Y' to 'N' (setup item 31).
Err 114	CPU temperature too high	This error will reset after the CPU has cooled down. If the error persists, check the ambient temperature and check for obstructions near the air inlet and outlet holes of the charger cabinet. Check manual for mounting instructions with regard to cooling. If error persists the controller is probably faulty.
Err 116	Calibration data lost	This error will not auto-reset.
Err 119	Settings data lost	This error will not auto-reset. Restore defaults in the setup menu (setup item 62). Disconnect the charge controller from all power-sources, wait 3 minutes, and power up again.

5. Specifications, 150V models

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Appendix

SmartSolar charge controller	MPPT 150/45	MPPT 150/60	MPPT 150/70
Battery voltage	12/24/48V Auto Select (36V: manual)		
Maximum battery current	45A	60A	70A
Nominal PV power, 12V 1a,b)	650W	860W	1000W
Nominal PV power, 24V 1a,b)	1300W	1720W	2000W
Nominal PV power, 36V 1a,b)	1950W	2580W	3000W
Nominal PV power, 48V 1a,b)	2600W	3440W	4000W
Max. PV short circuit current 2)	50A (max 30A per MC4 conn.)		
Maximum PV open circuit voltage	150V absolute maximum coldest conditions 145V start-up and operating maximum		
Peak efficiency	98%		
Self consumption	Less than 35mA @ 12V / 20mA @ 48V		
Charge voltage 'absorption'	Default setting: 14,4V / 28,8V / 43,2V / 57,6V		
Charge voltage 'float'	Default setting: 13,8V / 27,6V / 41,4V / 55,2V		
Charge voltage 'equalization'	Default setting: 16,2V / 32,4V / 48,6V / 64,8V		
Charge algorithm	multi-stage adaptive (eight preprogrammed algorithms) or user defined algorithm		
Temperature compensation	-16mV/°C / -32mV/°C / -64mV/°C		
Protection	Battery reverse polarity (fuse, not user accessible) PV reverse polarity / Output short circuit / Over temperature		
Operating temperature	-30 to +60°C (full rated output up to 40°C)		
Humidity	95%, non-condensing		
Maximum altitude	5000m (full rated output up to 2000m)		
Environmental condition	Indoor, unconditioned		
Pollution degree	PD3		
Data communication port	VE.Direct or Bluetooth		
Remote on/off	Yes (2 pole connector)		
Relay (programmable)	DPST AC rating: 240VAC / 4A DC rating: 4A up to 35VDC, 1A up to 60VDC		
Parallel operation	Yes (not synchronized)		
ENCLOSURE			
Colour	Blue (RAL 5012)		
PV terminals 3)	35 mm ² / AWG2 (Tr models) or dual MC4 connectors (MC4 models)		
Battery terminals	35 mm ² / AWG2		
Protection category	IP43 (electronic components) IP22 (connection area)		
Weight	3 kg		
Dimensions (h x w x d)	Tr models: 185 x 250 x 95 mm MC4 models: 215 x 250 x 95 mm		
STANDARDS			
Safety	EN/IEC 62109-1		
1a) If more PV power is connected, the controller will limit input power.			
1b) The PV voltage must exceed Vbat + 5V for the controller to start. Thereafter the minimum PV voltage is Vbat + 1V.			
2) A higher short circuit current may damage the controller in case of reverse polarity connection of the PV array.			
3) Default setting: OFF			
4) MC4 models: several splitter pairs may be needed to parallel the strings of solar panels			



Specifications, 150V models continued

SmartSolar charge controller	MPPT 150/85	MPPT 150/100
Battery voltage	12/24/48V Auto Select (36V: manual)	
Maximum battery current	85A	100A
Nominal PV power, 12V 1a,b)	1200W	1450W
Nominal PV power, 24V 1a,b)	2400W	2900W
Nominal PV power, 36V 1a,b)	3600W	4350W
Nominal PV power, 48V 1a,b)	4900W	5800W
Max. PV short circuit current 2)	70A (max 30A per MC4 conn.)	
Maximum PV open circuit voltage	150V absolute maximum coldest conditions 145V start-up and operating maximum	
Peak efficiency	98%	
Self consumption	Less than 35mA @ 12V / 20mA @ 48V	
Charge voltage 'absorption'	Default setting: 14,4V / 28,8V / 43,2V / 57,6V	
Charge voltage 'float'	Default setting: 13,8V / 27,6V / 41,4V / 55,2V	
Charge voltage 'equalization'	Default setting: 16,2V / 32,4V / 48,6V / 64,8V	
Charge algorithm	multi-stage adaptive (eight preprogrammed algorithms) or user defined algorithm	
Temperature compensation	-16mV/°C / -32mV/°C / -64mV/°C	
Protection	Battery reverse polarity (fuse, not user accessible) PV reverse polarity / Output short circuit / Over temperature	
Operating temperature	-30 to +60°C (full rated output up to 40°C)	
Humidity	95%, non-condensing	
Maximum altitude	5000m (full rated output up to 2000m)	
Environmental condition	Indoor, unconditioned	
Pollution degree	PD3	
Data communication port	VE.Direct or Bluetooth	
Remote on/off	Yes (2 pole connector)	
Relay (programmable)	DPST AC rating: 240VAC/4A DC rating: 4A up to 35VDC, 1A up to 60VDC	
Parallel operation	Yes (not synchronized)	
ENCLOSURE		
Colour	Blue (RAL 5012)	
PV terminals 4)	35mm ² / AWG2 (Tr models), or three pairs of MC4 connectors (MC4 models)	
Battery terminals	35mm ² / AWG2 or three sets of MC4 connectors	
Protection category	IP43 (electronic components)	IP22 (connection area)
Weight	4,5kg	
Dimensions (h x w x d)	Tr models: 216 x 295 x 103mm MC4 models: 246 x 295 x 103mm	
STANDARDS		
Safety	EN/IEC 62109-1	
1a) If more PV power is connected, the controller will limit input power.		
1b) The PV voltage must exceed Vbat + 5V for the controller to start. Thereafter the minimum PV voltage is Vbat + 1V.		
2) A higher short circuit current may damage the controller in case of reverse polarity connection of the PV array.		
3) Default setting: OFF		
4) MC4 models: several splitter pairs may be needed to parallel the strings of solar panels		



6. Specifications, 250V models

SmartSolar charge controller	MPPT 250/60	MPPT 250/70	MPPT 250/85	MPPT 250/100
Battery voltage	12/24/48V Auto Select (36V: manual)			
Maximum battery current	60A	70A	85A	100A
Nominal PV power, 12V 1a,b)	860W	1000W	1200W	1450W
Nominal PV power, 24V 1a,b)	1720W	2000W	2400W	2900W
Nominal PV power, 36V 1a,b)	2580W	3000W	3600W	4350W
Nominal PV power, 48V 1a,b)	3440W	4000W	4900W	5800W
Max. PV short circuit current 2)	35A (max 30A per MC4)		70A (max 30A per MC4)	
Maximum PV open circuit voltage	250V absolute maximum coldest conditions 245V start-up and operating maximum			
Peak efficiency	99%			
Self consumption	Less than 35mA @ 12V / 20mA @ 48V			
Charge voltage 'absorption'	Default setting: 14,4V / 28,8V / 43,2V / 57,6V (adjustable)			
Charge voltage 'float'	Default setting: 13,8V / 27,6V / 41,4V / 55,2V (adjustable)			
Charge voltage 'equalization'	Default setting: 16,2V / 32,4V / 48,6V / 64,8V (adjustable)			
Charge algorithm	multi-stage adaptive (eight preprogrammed algorithms) or user defined algorithm			
Temperature compensation	-16mV/°C / -32mV/°C / -64mV/°C			
Protection	Battery reverse polarity (fuse, not user accessible) PV reverse polarity / Output short circuit / Over temperature			
Operating temperature	-30 to +60°C (full rated output up to 40°C)			
Humidity	95%, non-condensing			
Maximum altitude	5000m (full rated output up to 2000m)			
Environmental condition	Indoor, unconditioned			
Pollution degree	PD3			
Data communication port	VE.Direct or Bluetooth			
Remote on/off	Yes (2 pole connector)			
Relay (programmable)	DPST AC rating: 240VAC / 4A DC rating: 4A up to 35VDC, 1A up to 60VDC			
Parallel operation	Yes (not synchronized)			
ENCLOSURE				
Colour	Blue (RAL 5012)			
PV terminals 3)	35 mm ² / AWG2 (Tr models) Two pairs of MC4 connectors (MC4 models 250/60 and 250/70) Three pairs of MC4 connectors (MC4 models 250/85 and 250/100)			
Battery terminals	35 mm ² / AWG2			
Protection category	IP43 (electronic components)		IP22 (connection area)	
Weight	3 kg		4,5 kg	
Dimensions (h x w x d)	Tr models: 185 x 250 x 95 mm MC4 models: 215 x 250 x 95 mm		Tr models: 216 x 295 x 103 mm MC4 models: 246 x 295 x 103 mm	
STANDARDS				
Safety	EN/IEC 62109-1			
1a) If more PV power is connected, the controller will limit input power. 1b) The PV voltage must exceed Vbat + 5V for the controller to start. Thereafter the minimum PV voltage is Vbat + 1V. 2) A higher sort circuit current may damage the controller in case of reverse polarity connection of the PV array. 3) Default setting: OFF 4) MC4 models: several splitter pairs may be needed to parallel the strings of solar panels				

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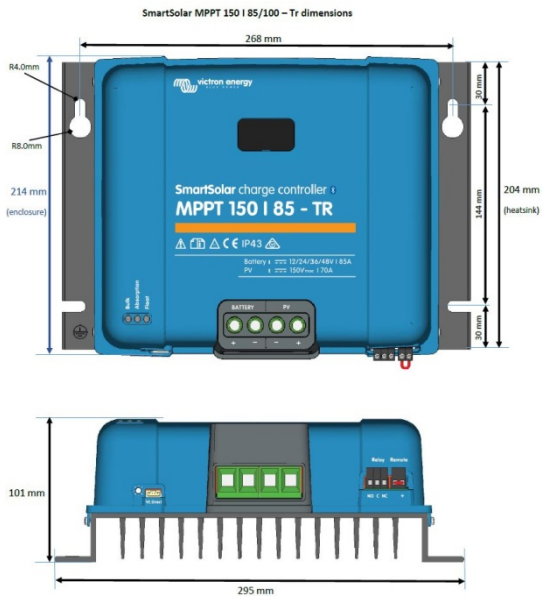
Appendix



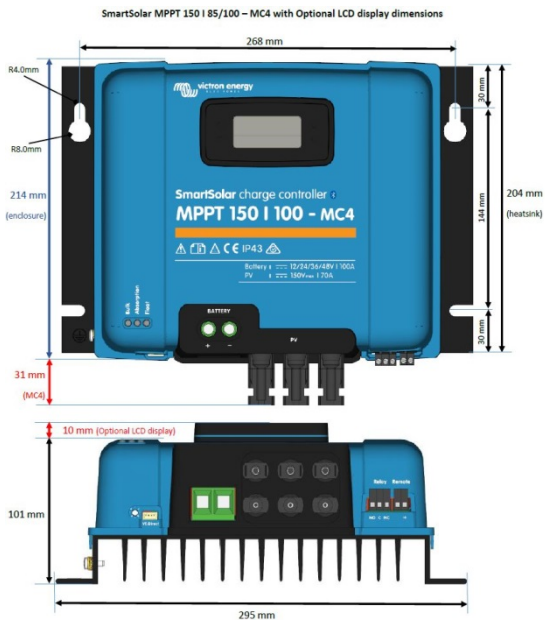
Figure 1: Power connections



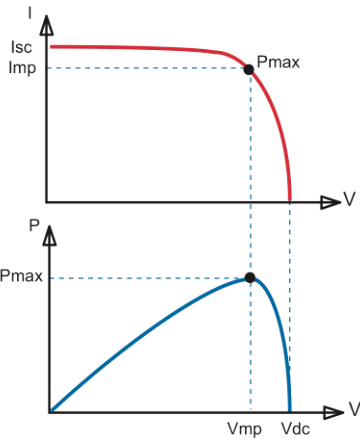
SmartSolar MPPT 150 | 85/100 – Tr dimensions



SmartSolar MPPT 150 I 85/100 – MC4 dimensions



BlueSolar and SmartSolar MPPT Charge Controllers Overview



Maximum Power Point Tracking (MPPT)

Upper curve:

Output current (I) of a solar panel as function of output voltage (V). The Maximum Power Point (MPP) is the point Pmax along the curve where the product $I \times V$ reaches its peak.

Lower curve:

Output power $P = I \times V$ as function of output voltage. When using a PWM (not MPPT) controller the output voltage of the solar panel will be nearly equal to the voltage of the battery, and will be lower than V_{mp} .



MPPT Control



SmartSolar Control



VictronConnect Application

Feature highlights common to all models

- Ultra-fast Maximum Power Point Tracking (MPPT).
- Advanced Maximum Power Point Detection in case of partial shading conditions.
- Outstanding conversion efficiency.
- Natural convection cooling.
- Automatic battery voltage recognition.
- Flexible charge algorithm.
- Over temperature protection and power derating when temperature is high.

Sizing options:

- Suitable for a variety of battery voltages. Most models connect to 12, 24, and 48V batteries, some only connect to 12 and 24V batteries, or only to 48V batteries.
- Charge currents rating from 10A all the way up to 100A.
- Maximum PV array Voc voltages ranging from 75V up to 250V.
- Multiple chargers can be used in parallel, for large systems we recommend to use the models with a VE.Can communication port.

PV terminal options:

- TR - one positive and one negative screw terminal.
- MC4 - 3 pairs of paralleled MC4 connectors.

Bluetooth options:

- SmartSolar models have Bluetooth.
- BlueSolar models do not have Bluetooth. They can be retrofitted to have Bluetooth by connecting the VE.Direct Bluetooth Smart dongle. Advantage: the product is not Bluetooth accessible when the dongle is not connected. Note that on the SmartSolar models, Bluetooth can be disabled.

Display options:

- VictronConnect Application. Connects via Bluetooth or via the VE.Direct - USB interface
- MPPT Control. Connects to all models via a VE.Direct cable
- SmartSolar Control Display. Plugs directly into the housing of the larger models
- GX device
- VRM website (GX monitoring device needed)

Communication ports:

- VE.Direct - all models
- VE.Direct and VE.Can - limited models. VE.Can is especially suitable for systems with multiple solar chargers. All units are simply "daisy chained" to each other with a single RJ45 cable between each unit and also between the last unit in the chain and the a GX monitoring device.

Temperature sensor options:

- Internally (all models).
- Externally via the Smart Battery Sense (only SmartSolar models).

Load output options:

- Physical output - On the 10, 15 and 20A models.
- Virtual output - via VE.Direct TX digital output cable and the BatteryProtect or a solid-state relay.

Remotely enabling and disabling the charger:

- All larger units feature the Victron standard remote on/off terminals. All models that don't feature an onboard Remote on/off terminal can be remotely controlled by using the [VE.Direct non inverting remote on/off cable - ASS030550310](#). Note that this prohibits using the VE.Direct port for anything else.

Firmware update options:

- Local updates via the VictronConnect Application (via Bluetooth or USB-VE.Direct interface)
- Remote updates via VRM website and a GX device

Optional accessories:

- VictronConnect Application (free download)
- Wire boxes, to cover and protect the terminals. See table on page 2 for wire box types
- Control and display panels: MPPT control or SmartSolar control)
- GX monitoring device (CCGX, Venus GX, Octo GX or Cerbo GX)
- Data cables: VE.Direct cable, RJ45 Cable (VE.Can models only), USB-VE.Direct interface
- External control cables: TX cable, non-inverting cable
- Bluetooth dongle (for non-smart models)

More information:

- To access the above-mentioned documents or information: press the search button on our website and enter the appropriate search word.
- For connection to a Color Control GX or other GX device

BlueSolar Charge Controller	Load output	Battery voltage	Optional display	Bluetooth	Com. port	Remote on-off	Programmable relay	Wire Box
75/10	15A	12/24V	MPPT control	Optional dongle	VE.Direct	No	No	S 75-10/15
75/15	15A	12/24V	MPPT control	Optional dongle	VE.Direct	No	No	S 75-10/15
100/15	15A	12/24V	MPPT control	Optional dongle	VE.Direct	No	No	S 100-15
100/20 (up to 48V)	20A/20A/1A	12/24/36/48V	MPPT control	Optional dongle	VE.Direct	No	No	S 100-20
100/30	No	12/24V	MPPT control	Optional dongle	VE.Direct	No	No	M
100/50	No	12/24V	MPPT control	Optional dongle	VE.Direct	No	No	M
150/35	No	12/24/36/48V	MPPT control	Optional dongle	VE.Direct	No	No	M
150/45	No	12/24/36/48V	MPPT control	Optional dongle	VE.Direct	No	No	M
150/45-Tr	No	12/24/36/48V	MPPT control	Optional dongle	VE.Direct	No	No	L
150/45-MC4	No	12/24/36/48V	MPPT control	Optional dongle	VE.Direct	No	No	L
150/60-Tr	No	12/24/36/48V	MPPT control	Optional dongle	VE.Direct	No	No	L
150/60-MC4	No	12/24/36/48V	MPPT control	Optional dongle	VE.Direct	No	No	L
150/70-Tr	No	12/24/36/48V	MPPT control	Optional dongle	VE.Direct	No	No	L
150/70-MC4	No	12/24/36/48V	MPPT control	Optional dongle	VE.Direct	No	No	L
150/100-Tr VE.Can	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Optional dongle	VE.Direct & VE.Can	Yes	Yes	XL
250/70-Tr VE.Can	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Optional dongle	VE.Direct & VE.Can	Yes	Yes	L
250/100-Tr VE.Can	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Optional dongle	VE.Direct & VE.Can	Yes	Yes	XL
SmartSolar Charge Controller	Load output	Battery voltage	Optional display	Bluetooth	Com. port	Remote on-off	Programmable relay	Wire Box
75/10	15A	12/24V	MPPT control	Built-in	VE.Direct	No	No	S 75-10/15
75/15	15A	12/24V	MPPT control	Built-in	VE.Direct	No	No	S 75-10/15
100/15	15A	12/24V	MPPT control	Built-in	VE.Direct	No	No	S 100-15
100/20 (up to 48V)	20A/20A/1A	12/24/36/48V	MPPT control	Built-in	VE.Direct	No	No	S 100-20
100/30	No	12/24V	MPPT control	Built-in	VE.Direct	No	No	M
100/50	No	12/24V	MPPT control	Built-in	VE.Direct	No	No	M
150/35	No	12/24/36/48V	MPPT control	Built-in	VE.Direct	No	No	M
150/45	No	12/24/36/48V	MPPT control	Built-in	VE.Direct	No	No	M
150/45-Tr	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct	Yes	Yes	L
150/45-MC4	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct	Yes	Yes	L
150/60-Tr	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct	Yes	Yes	L
150/60-MC4	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct	Yes	Yes	L
150/70-Tr	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct	Yes	Yes	L
150/70-MC4	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct	Yes	Yes	L
150/70-Tr VE.Can	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct & VE.Can	Yes	Yes	L
150/70-MC4 VE.Can	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct & VE.Can	Yes	Yes	L
150/85-Tr VE.Can	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct & VE.Can	Yes	Yes	XL
150/85-MC4 VE.Can	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct & VE.Can	Yes	Yes	XL
150/100-Tr VE.Can	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct & VE.Can	Yes	Yes	XL
150/100-MC4 VE.Can	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct & VE.Can	Yes	Yes	XL
250/60-Tr	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct	Yes	Yes	L
250/60-MC4	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct	Yes	Yes	L
250/70-Tr	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct	Yes	Yes	L
250/70-MC4	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct	Yes	Yes	L
250/70-Tr VE.Can	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct & VE.Can	Yes	Yes	L
250/70-MC4 VE.Can	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct & VE.Can	Yes	Yes	L
250/85-Tr VE.Can	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct & VE.Can	Yes	Yes	XL
250/85-MC4 VE.Can	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct & VE.Can	Yes	Yes	XL
250/100-Tr VE.Can	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct & VE.Can	Yes	Yes	XL
250/100-MC4 VE.Can	No	12/24/36/48V	MPPT ctrl & SmartSolar ctrl	Built-in	VE.Direct & VE.Can	Yes	Yes	XL



Color Control GX



Venus GX



Cerbo GX



Smart Battery Sense



VE.Direct Bluetooth Smart Dongle



VE.Direct to USB interface

MultiPlus Inverter/Charger 2000VA 120V

12 / 24 / 48V



**MultiPlus 2000 VA
(with bottom cover)**



**MultiPlus 2000 VA
(bottom cover removed)**

Multifunctional, with intelligent power management

The MultiPlus is a powerful true sine wave inverter, a sophisticated battery charger that features adaptive charge technology, and a high-speed AC transfer switch in a single compact enclosure. Next to these primary functions, the MultiPlus has several advanced features, as outlined below.

Parallel operation and three phase capability

Up to six Multis can operate in parallel to achieve higher power output. In addition to parallel connection, three units can be configured for three-phase output.

PowerControl - Dealing with limited generator, shore side or grid power

With the Multi Control Panel a maximum generator or shore current can be set. The MultiPlus will then take account of other AC loads and use whatever is extra for charging, thus preventing the generator or shore supply from being overloaded.

PowerAssist - Boosting the capacity of shore or generator power

This feature takes the principle of PowerControl to a further dimension. It allows the MultiPlus to supplement the capacity of the alternative source. Where peak power is so often required only for a limited period, the MultiPlus will make sure that insufficient shore or generator power is immediately compensated for by power from the battery. When the load reduces, the spare power is used to recharge the battery.

Four stage adaptive charger and dual bank battery charging

The main output provides a powerful charge to the battery system by means of advanced 'adaptive charge' software. The software fine-tunes the three-stage automatic process to suit the condition of the battery, and adds a fourth stage for long periods of float charging. The adaptive charge process is described in more detail on the Phoenix Charger datasheet and on our website, under Technical Information. In addition to this, the MultiPlus will charge a second battery using an independent trickle charge output intended for a main engine or generator starter battery.

High start-up power

Needed to start high inrush loads such as power converters for LED lamps, halogen lamps or electric tools.

Search Mode

When Search Mode is 'on', the power consumption of the inverter in no-load operation is decreased by approx. 70%. In this mode the Multi, when operating in inverter mode, is switched off in case of no load or very low load, and switches on every two seconds for a short period. If the output current exceeds a set level, the inverter will continue to operate. If not, the inverter will shut down again.

Programmable relay

By default, the programmable relay is set as an alarm relay, i.e. the relay will de-energise in the event of an alarm or a pre-alarm (inverter almost too hot, ripple on the input almost too high, battery voltage almost too low).

Remote on / off / charger on

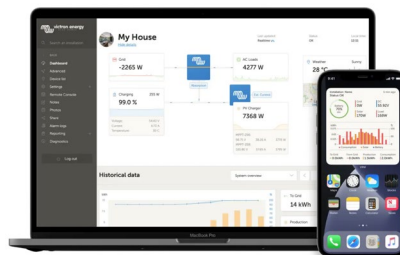
Three pole connector.

On-site system configuring, monitoring and control

After installation, the MultiPlus is ready to go. Settings which can be changed with DIP switches: battery charge voltage / search mode. For more settings use VE-Config or the VE.Bus Smart dongle.

Remote configuring and monitoring

Install a Cerbo GX or other GX product to connect to the internet. Operational data can be stored and displayed on our VRM (Victron Remote Management) website, free of charge. When connected to the internet, systems can be accessed remotely, and settings can be changed.



Ekran GX or Cerbo GX

Provides intuitive system control and monitoring and enables access to our free remote monitoring website: the VRM Online Portal.

VRM Portal

Our free remote monitoring website (VRM) will display all your system data in a comprehensive graphical format. System settings can be changed remotely via the portal. Alarms can be received by e-mail or push notification.

VRM app

Monitor and manage your Victron Energy system from your smart phone and tablet. Available for both iOS and Android.

	MultiPlus 12/2000/80-50	MultiPlus 24/2000/50-50	MultiPlus 48/2000/25-50
PowerControl / PowerAssist	Yes		
Three Phase and parallel operation	Yes		
Transfer switch	50 A		
INVERTER			
Input voltage range	9,5 – 17 V	19 – 33 V	38– 66 V
Output	Output voltage: 120VAC ± 2% Frequency: 60Hz ± 0,1% (1)		
Cont. output power at 25°C (3)	2000 VA		
Cont. output power at 25°C	1600 W		
Cont. output power at 40°C	1400 W		
Cont. output power at 65°C	1000 W		
Peak power	3500 W		
Maximum efficiency	93%	94%	95%
Zero-load power	10 W	11 W	11 W
Zero-load power in search mode	3 W	4 W	4 W
CHARGER			
AC Input voltage range	95-140 VAC		
AC input frequency range	45 – 65 Hz	55 – 65 Hz	45 – 65 Hz
Charge voltage 'absorption'	14,4 / 28,8 / 57,6 V		
Charge voltage 'float'	13,8 / 27,6 / 55,2 V		
Storage mode	13,2 / 26,4 / 52,8 V		
Charge current house battery (4)	80 A	50 A	25 A
Charge current starter battery	1A (12 V and 24 V models only)		
Battery temperature sensor	Yes		
GENERAL			
Programmable relay (5)	Yes		
Protection (2)	a – g		
VE.Bus communication port	For parallel and three phase operation, remote monitoring, and system integration		
Remote on-off	On/off		
DIP switches	Yes (7)		
Internal DC fuse	no		
Common Characteristics	Operating temp. range: -40 to +65°C (fan assisted cooling) Humidity (non-condensing): max 95%		
ENCLOSURE			
Common Characteristics	Steel (RAL 5012), IP22		
Battery-connection	M8 bolts		
230V AC-connection	Screw terminals 13 mm ² (6 AWG)		
Weight	15.5 kg		
Dimensions (h x w x d)	506 x 236 x 147 mm		
STANDARDS			
Safety	EN-IEC 60335-1, EN-IEC 60335-2-29, EN 62109-1		
Emission Immunity	EN 55014-1, EN 55014-2, EN-IEC 61000-3-2, EN-IEC 61000-3-3, IEC 61000-6-1, IEC 61000-6-2, IEC 61000-6-3		
Automotive Directive	ECE R10-5		
1) Can be adjusted to 50Hz 2) Protection: a. Output short circuit b. Overload c. Battery voltage too high d. Battery voltage too low e. Temperature too high f. 230VAC on inverter output g. Input voltage ripple too high	3) Non-linear load, crest factor 3:1 4) Up to 25°C ambient 5) Programmable relay which can be set for: general alarm, DC under voltage or generator start/stop signal function AC rating: 230V/4A DC rating: 4A up to 35VDC, 1A up to 60VDC 6) Remote / battery charge voltage / inverter frequency / search mode 7) Battery charge voltage / search mode		



Digital Multi Control Panel
A convenient and low-cost solution for monitoring and control. With an on/off charger-only switch, full LED readout and a rotary knob to set PowerControl and PowerAssist levels.



VE.Bus Smart Dongle
For monitoring and control via Bluetooth together with the VictronConnect app. It also measures battery voltage and temperature.



Interface MK3-USB
Needed to configure the MultiPlus. Can be used with the VictronConnect app or VE.Configure software. The interface connects to the MultiPlus via an RJ45 UTP cable and plugs into a USB port.



VictronConnect app
Use to monitor or configure the MultiPlus using your phone tablet or PC.



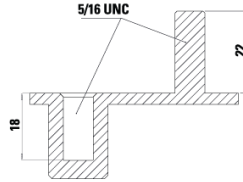
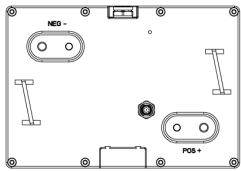
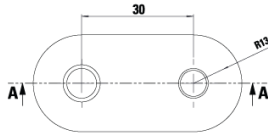
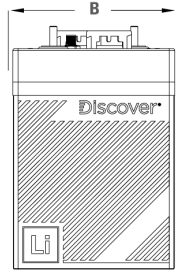
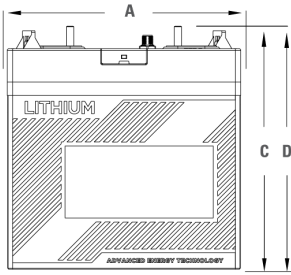
Battery Monitor
To monitor battery state of charge via Bluetooth or the VRM portal. The BMV 712 Smart has display, while the SmartShunt does not have a display. Both communicate via Bluetooth and have a VE.Direct communication port.

Discover® Innovative Battery Solutions



LITHIUM PROFESSIONAL Battery

Discover® AES PROFESSIONAL LiFePO₄ battery models are purpose built to replace and fit the standard groupings of BCI 6V, 8V and 12V (GC) batteries. AES PROFESSIONAL batteries incorporate a proprietary high-current BMS that delivers superior peak power along with lightning fast 1C continuous charge and discharge rates, plus they feature COLD CHARGE functionality allowing for cold temperature charging to begin from -20°C / -4°F. Independently tested to the highest safety, performance and transportation standards, a single battery will do the work of many lead-acid batteries and unlike lead-acid batteries can be continuously operated in a Partial State of Charge (PSOC) without degrading performance.



SECTION A-A

MECHANICAL SPECIFICATIONS

Industry Reference	BCI: GC2	
Length A (in/mm)	10.2	260
Width B (in/mm)	7.1	180
Height C (in/mm)	10.0	254
Total Height D (in/mm)	10.8	275
Weight (lbs/kgs)	30.7	14.0
Terminal *	BM 5/16	
Cell(s)	Prismatic 4S4P	
Case Material	UL94-VO PBT/PC	
IP Rating	67	
Electrolyte	LiFePO ₄	

NOTE 1: Dimensions have a ±2 mm (0.08 in) tolerance. Weights may vary.
NOTE 2: Refer to [terminal guide](#) on website for torque values.

SHIPPING CLASSIFICATION

UN 3480, Class 9 (Lithium batteries)

ELECTRICAL SPECIFICATIONS

Open Circuit Voltage (V)	12.8
Charge Voltage (Bulk Vdc)	13.8 - 14.2
Max Absorption Voltage (U1 Vdc)	13.8
Float Voltage (U2 Vdc)	13.6
BMS Max. Voltage protection (Vdc)	14.6 (Approximately)
Suggested Low Voltage Cutoff (Vdc) *	12.0
BMS Min. Voltage protection (Vdc)	10.0 (Approximately)
Max. Continuous Charge Current (I Max. Adc)	115
Min. Finishing Charge Current (I Min. Adc)	2%-3% C1 / Min. 200ma
Max Continuous Discharge Current (Adc)	120
Max Peak Current (Adc)	360 A RMS (3 seconds)
Self-Discharge (25°C / 77°F)	< 3% per month
Charge Temperature	Min: -20°C Max: 45°C (-4°F to 113°F)
Discharge Temperature	Min: -20°C Max: 55°C (-4°F to 131°F)
Storage Temperature	Min: -10°C (14°F) Max: 30°C (86°F)

Electrical Specifications at 25°C.

* Do not exceed maximum voltage at the battery terminals.

CAUTION: Extra considerations must be given to depths of discharge, operating voltages and currents when designing systems for use at maximum operating temperatures.

FEATURES

DLP-GC2-12V

LYNK PORT

- Connects battery string to LYNK Gateway
- Plug and Play Multi-battery BMS communication
- J1939 Protocol
- Remote ON / OFF Capable

HIGH-PERFORMANCE BMS

- Up to 3C peak power for inverters and motor controllers
- Discharge current up to 2C
- Continuous charge current up to 1C
- Sets voltage, broadcasts, SoC and temperature
- External field replaceable fuse protection

COLD CHARGING

- Integrated self-heating

STATUS VIEW

- ON / OFF multi-color status LED

ACCESSORIES

LYNK II GATEWAY

- Closed-loop communications with chargers and motor controllers
- CAN Open / Serial CAN
- Programmable relays for LVCO, Load Shedding
- SD Memory
- Download Battery Data

LYNK LITE GATEWAY

- Closed-loop communications with chargers and motor controllers
- CAN Open / Serial CAN
- Download Battery Data
- IP 65

BATTERY DISCHARGE INDICATOR

- At-a-glance SoC display

BENEFITS

RUNS LONGER

- 2x the high-current runtime of lead-acid battery
- Up to 100% usable capacity
- Easy to parallel more capacity

LASTS LONGER

- 10x the life of lead-acid battery (BCI-06)
- Unlimited Partial State of Charge cycles
- Energy throughput warranty

CHARGES FASTER

- Up to 5x faster than new lead-acid batteries
- 2x faster than C/2 rated lithium batteries
- Opportunity charge at 1C rate anytime, regardless of SoC

SURGE POWER

- High 3C Peak Power
- Discharge Current up to 2C

HIGH-EFFICIENCY

- Up to 50% more energy efficient than a lead-acid battery
- Up to 98% round-trip efficiency

PARALLEL POWER

- Easy to parallel more capacity
- Linear scaling of charge, discharge and peak capacity

QUICK INSTALL

- Fast installation
- No special tools

RELIABLE AND SAFE

- LiFePO₄ is safe
- Maintenance-free
- UL94-5VA flame retardant case and cover
- IP 67 rated

CERTIFIED QUALITY

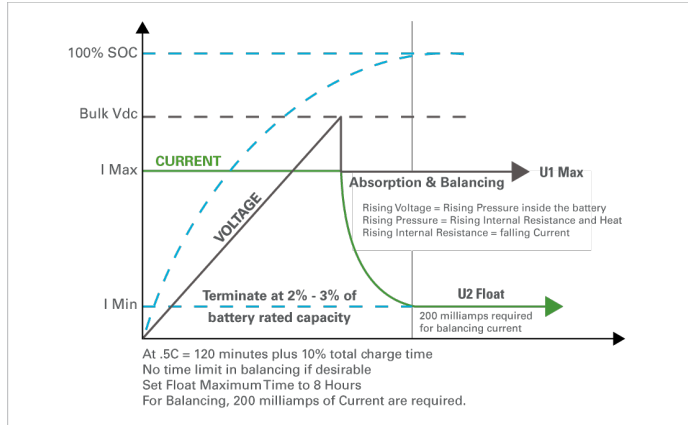
Discover® manufacturing facilities are fully certified to ISO 9001/14001 and OSHA 18001 standards.

- IEC 62619
- UL 2271
- CE
- UN 38.3

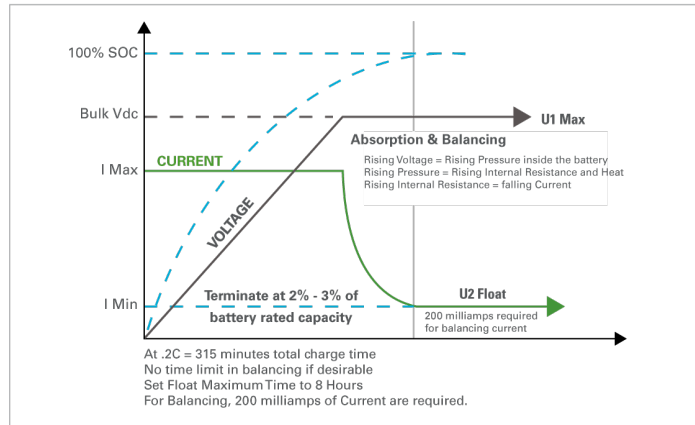
PERFORMANCE SPECIFICATIONS

Nominal Energy (kWh)	1.54	Minutes of Discharge				
Usable DoD	100%	@25A	@56A	@75A	@85A	@100A
Rated Wh Capacity (1C)	1536	288	128	96	84	72
Rated Ah Capacity (1C)	120					

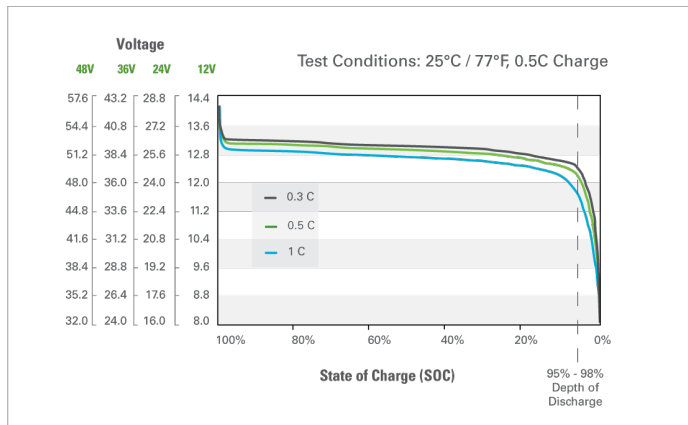
Fast Charging at .5C (2HR) to 1C (1HR)



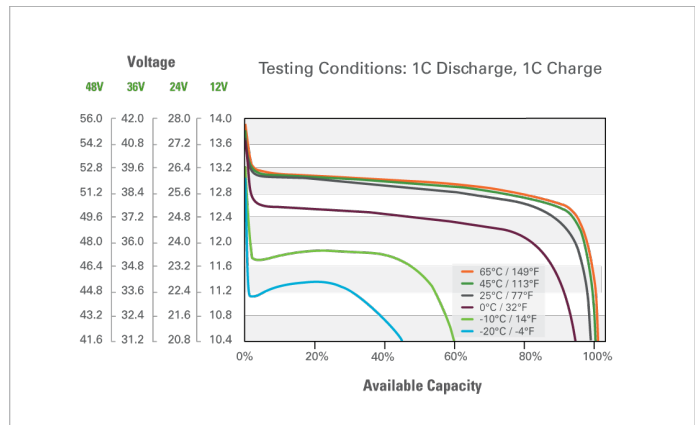
Standard to Low Rate Charging at .2C (5HR) to .5C (2HR)



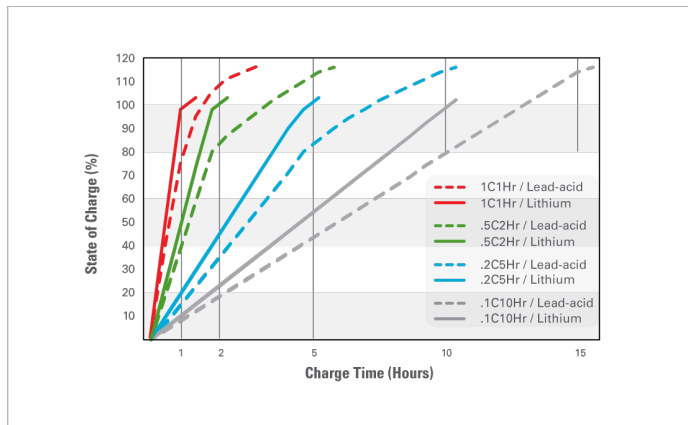
Voltage in Relation to Rate of Discharge



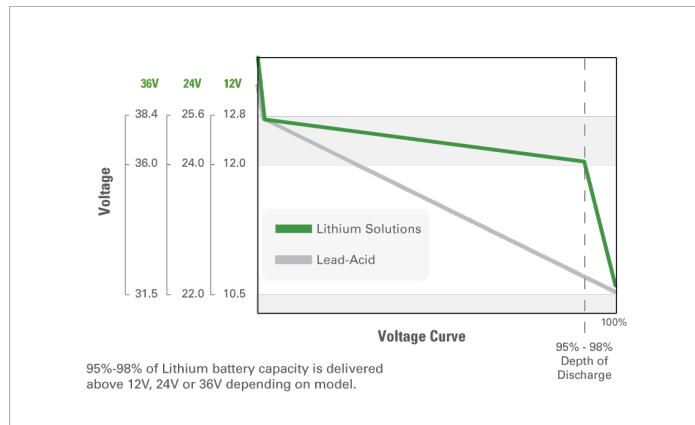
Discharge Voltage and Capacity vs. Temperature



Charge Performance (Lithium vs. Lead)



Discharge Performance (Lithium vs. Lead)



CAUTION: Direct connection to DC motors without proper safety protection, motor controllers, and external motor voltage clamping systems (such as high power anti-parallel diodes or braking resistor systems) may result in damage to the internal pack protection system which may result in unsafe situations. Please consult Discover technical support before directly connecting any motorloads. Discover® reserves the right to make adjustments to this publication at any time, without notice or obligation. Data in this publication are for reference use only and models may vary from shown. It is the responsibility of the reader of this information to verify any and all information presented herein. For more information contact us.

AMERESCO SOLAR

Green • Clean • Sustainable



Photographs are intended to portray typical enclosure appearance, actual appearance may vary.

Ameresco Solar supplies and distributes a complete line of enclosures to accommodate a wide range of off-grid applications. We have a large selection of enclosures and control cabinets ranging from single battery (for pole and ROHN towers) to custom skid-mounted, multi-battery enclosures. Our enclosure line has the flexibility to meet your solar system storage needs.

BBA-6 Series Features:

NEMA Ratings

- NEMA 3R (Standard), NEMA 4, NEMA 4X

Available Material and Finish

- Mill finished aluminum (Standard)
- Powder coated aluminum (White)
- Stainless steel (304 or 316)

Enclosure Dimensions

- Overall: (H) 40.125" x (W) 25.25" x (D) 17.125"
- Opening: (H) 31.625" x (W) 21.5"
- Inside: (H) 35.75" x (W) 23.75" x (D) 14.875"

Back Panel Dimensions

- (H) 17" x (W) 21.75"

Battery Capacity

- (6) BCI Group 27
- (6) BCI Group 30
- (6) BCI Group 31
- (2) BCI Group 8G4D
- (2) BCI Group 8G8D

Weight

- 61 lbs





- ① Mounting Tab
- ② Electrical Assembly (Not included)
- ③ Rain Drip Lip
- ④ Fiberglass "Insect Proof" Screen on all Louvered Openings
- ⑤ Back Panel
- ⑥ Stainless Lockable Draw Latch
- ⑦ BBA-6 Cabinet
- ⑧ Battery (Not included)
- ⑨ Filter Media (Removable for cleaning)
- ⑩ Double Flanged Door Opening
- ⑪ (2) 1/2" NPT Knock-outs (CGB's/Conduit Fittings)
- ⑫ Door Stop
- ⑬ Stainless Steel Hinge
- ⑭ Closed Cell Neoprene Gasket

Mounting Structures



Mounts on wall using 4 lag bolts
(Bolts not included)

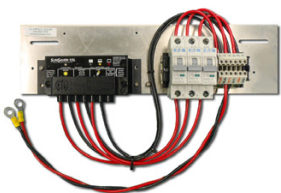


Mounts to ROHN25 tower using 4 u-bolts
(Bolts not included)



Mounts to 2-3" schedule 40 pole using 2 u-bolts
(Bolts not included)

Mounting Options



Custom designed assembly sized to meet solar system requirements



Door fans available in 12V, 24V, and 48V DC/120V AC



Banding available for unique mounting structures

Additional Options:

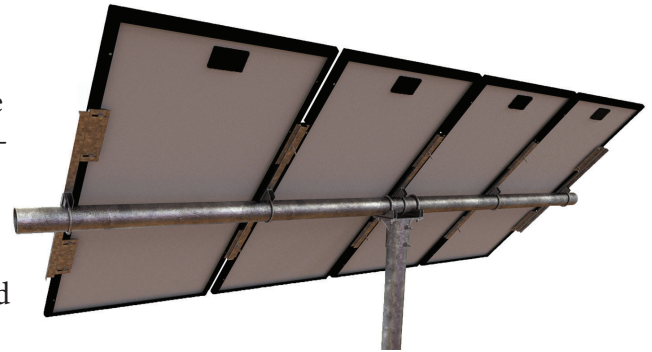
- Breather/drain for NEMA4 - 4X (Required for all battery applications)
- Heat strips (120V, 150W with thermostat)
- Interior insulation (Low E)
- Sun shields (Available for top, sides, and door)
- Key lock (#1 or #2 Pelco)

PGRM POLE MOUNT

for SOLAR PANEL MOUNTING



- The PGRM Series Pole Mount can be used to mount up to 6 solar modules with a frame thickness between 1.18" and 2"
- Install up to 92 square feet of modules on a single 4" Schedule 40 pole and up to 130 square feet of modules on two 4" schedule 40 poles
- Suitable for wind speeds up to 115 MPH
- For high wind locations add an additional vertical pole
- Tilt angle can be adjusted from 0° to 60° and is easily adjusted seasonally
- All sizes can ship by UPS Ground
- Simple one-person installation and adjustment



User supplies 4" schedule 40 steel pipe(s) for vertical pole and a 3" schedule 40 steel pipe for the horizontal beam.



Calculation of the required horizontal beam length (L) in inches:

$L = W \times N + (N + 1) \times 1.4$ where **N = number of modules** and **W = module width in inches**

Part Number	Description
UNI-PGRM/1P1	POLE MOUNT FOR 1 MODULE WITH 1 VERTICAL POLE
UNI-PGRM/2P1	POLE MOUNT FOR 2 MODULES WITH 1 VERTICAL POLE
UNI-PGRM/3P1	POLE MOUNT FOR 3 MODULES WITH 1 VERTICAL POLE
UNI-PGRM/4P1	POLE MOUNT FOR 4 MODULES WITH 1 VERTICAL POLE
UNI-PGRM/5P1	POLE MOUNT FOR 5 MODULES WITH 1 VERTICAL POLE
UNI-PGRM/5P2	POLE MOUNT FOR 5 MODULES WITH 2 VERTICAL POLES
UNI-PGRM/6P1	POLE MOUNT FOR 6 MODULES WITH 1 VERTICAL POLE
UNI-PGRM/6P2	POLE MOUNT FOR 6 MODULES WITH 2 VERTICAL POLES
70-0300-PGM	ADDITIONAL POLE CAP FOR HIGH WIND LOCATIONS

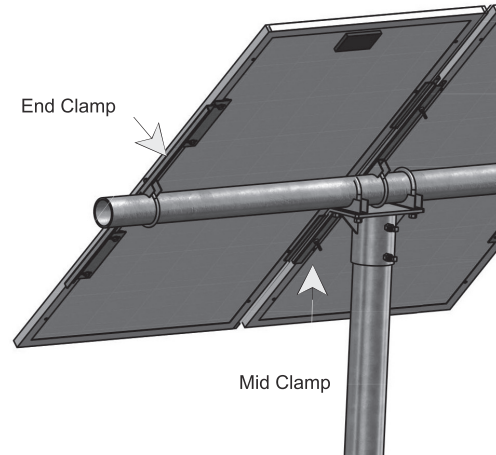
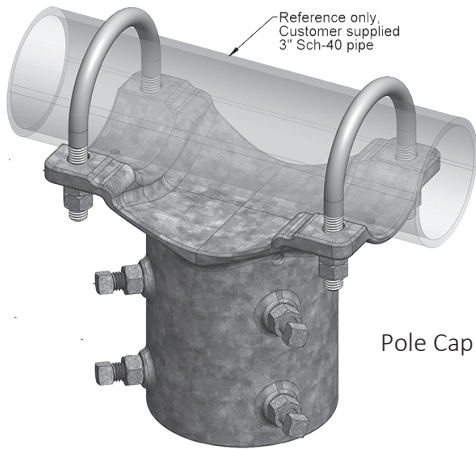
PGRM POLE MOUNT COMPONENTS

for SOLAR PANEL MOUNTING



VERTICAL AND HORIZONTAL SCHEDULE 40 PIPE IS NOT INCLUDED - PURCHASE LOCALLY

- The PGRM Series Pole Mount can be used to mount up to 6 solar modules with a frame thickness between 1.18” and 2”
- All parts are made from galvanized steel with stainless-steel hardware
- Two sizes of module clamps:
 - 35-inch long for modules with frame length of 38 to 72 inches
 - 47-inch long for modules with frame length of 72 to 96 inches.
- Tilt angle can be adjusted from 0° to 90° and is easily adjusted seasonally
- Parts can ship by UPS







User supplies 4” schedule 40 steel pipe(s) for vertical pole and a 3” schedule 40 steel pipe for the horizontal beam. Calculation of the required horizontal beam length (L) in inches:
 $L = 5 + (Q \times W) + ((Q-1) \times 1.28)$ where Q = module quantity, W = module width

Part Number	Description	Weight (lbs.)
70-0300-PGM-B	POLE CAP FOR 4” SCH-40 OR SCH-80 VERTICAL POST (4.5” O.D.)	12
PGRM-MID	MID CLAMP - 35-INCH USE ONE BETWEEN EACH MODULE	7
PGRM-END	END CLAMPS - 35-INCH USE TWO PER MOUNT	6
PGRM-MID-47	MID CLAMP - 47-INCH USE ONE BETWEEN EACH MODULE	9
PGRM-END-47	END CLAMPS - 47-INCH USE TWO PER MOUNT	8

SI32 Series - Switch Disconnecter Data Current & Voltage

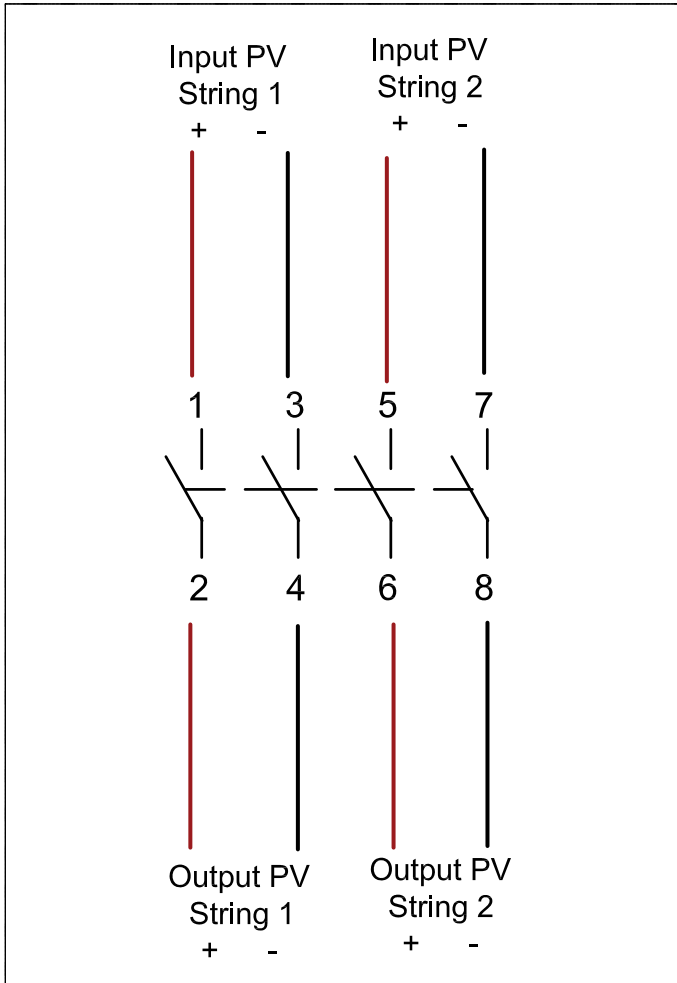


Switch Disconnecter Voltage, Current and Associated Data

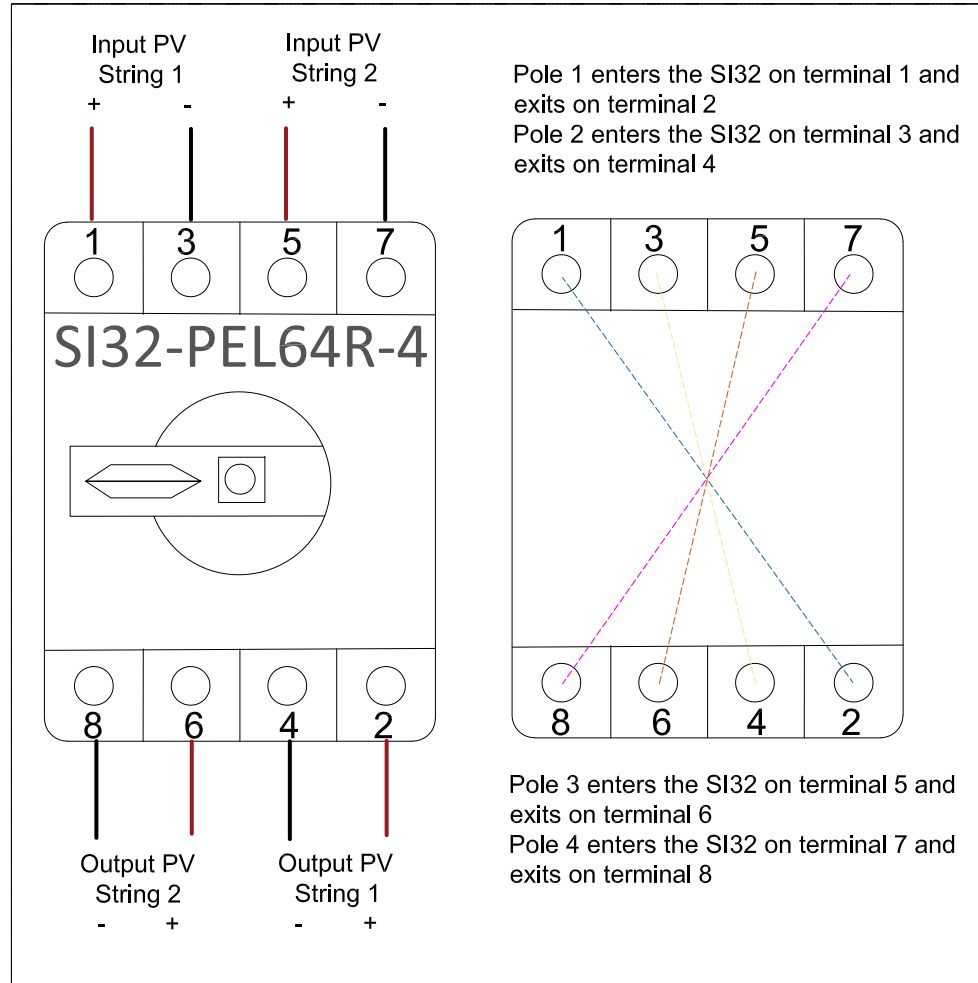
Identification	Rating Data			
Switch, unenclosed – catalogue number (with DC-PV2 rating)	SI32-DBL-4*			
Specific dedicated individual enclosure – catalogue number (with minimum IP56NW rating)	N/A			
Assembly of switch and dedicated individual enclosure – catalogue number	SI32-PEL64R-4*			
I_{th} rated thermal current, unenclosed, at 40°C shade ambient air temperature	32A			
I_{the} rated thermal current, indoor, at 40°C shade ambient air temperature, in a specific dedicated enclosure	32A			
I_{the} rated thermal current, outdoors, at 40°C shade ambient air temperature, without solar effects in a specific dedicated enclosure IP66NW	32A			
I_{the} solar current value, outdoors, at 40°C shade ambient air temperature with solar effects in a specific dedicated enclosure rated IP66NW	32A			
I_{the} solar current value, outdoors, at 60°C shade ambient air temperature with solar effects in a specific dedicated enclosure rated IP66NW	28.2A			
 <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>1 Pole</p>  </div> <div style="text-align: center;"> <p>2 Poles Series</p>  </div> <div style="text-align: center;"> <p>4 Poles Series</p>  </div> </div>	U_e rated Operational Voltage V d.c	I_e DC-PV2 rated operational current A	I_c (make) and I_b (break) DC-PV2 $4 \times I_e$ A	Min Cable Size mm ²
	≤500	14	56	2.5mm ²
	600	8	32	
	700	3	12	
	800	3	12	
	900	2	8	
	1000	2	8	
	≤500	32	128	6mm ²
	600	27	108	
	700	22	88	4mm ²
	800	17	68	
	900	12	48	2.5mm ²
	1000	6	24	
	≤500	32	128	6mm ²
	600	32	128	
	700	32	128	
	800	32	128	
	900	32	128	
	1000	32	128	

* Can be followed by T, M25A or T-M25A.
T= 2x2 poles series, M25A= M25 threaded gland entries

Schematic Diagram



Connection Diagram



SI32-PEL64R-4 Schematic & Connection Diagram

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“Stay Connected with Heyco” Solar Products



Heyco®-Tite UL Listed/Recognized and CSA Certified Liquid Tight Cordgrips for Solar Applications

Multi-Hole, NPT Hubs with Integral Sealing Ring - IP 68 Rated

The Ultimate in Liquid Tight Strain Relief Protection

- Integral Sealing Ring ensures a superior seal at the clearance or threaded mounting hole location, every time.
- IP 68 rated.
- Widest range of approved cable diameters.
- Cordgrips with an -SM suffix have Skinned-Over Break-thru glands that offer the flexibility to use from 1 to 31 of the available holes while still providing a liquid tight seal around the wire.
- All accompanying Cordgrips are made of nylon construction with TPE sealing glands that resist salt water, weak acids, gasoline, alcohol, oil, grease, and common solvents. (This feature is not assessed by UL.)
- For locknut specifications or to order locknuts separately, see pages 3-13 & 3-14.
- Multi-hole glands are only to be used with Heyco Liquid Tight Cordgrips and are not sold separately.
- For our complete range of Heyco Cordgrips, see Section 3 of the Heyco Catalog.

GLAND CONFIGURATION		PART NUMBER		DESCRIPTION	UL/CSA or	PART DIMENSIONS										
Size	Type	Conductors	Black			mm.	*	No.	A	B	C	D		E		
							Clearance Hole Dia.	Max. O.A. Length	Thread Length	Wrenching Nut Thickness		Flat Size				
							in.	mm.	in.	mm.	in.	mm.	in.	mm.		
Standard Multi-Hole Gland - Assembled Metal Locknuts INCLUDED																
4,5	USE-2	9	M8437GBF	LTCG 1	cULus	1.326	33,8	2.41	61,2	.76	19,3	.30	7,6	1,73	43,9	
		13	M4524GBG	LTCG 1-1/4		cULus	1.680	42,7	2.69	68,3	.78	19,8	.30	7,6	2,05	52,1
5,2	USE-2	2	M3231GAE	LTCG 1/2	UL/CSA	.875	22,2	1.70	43,2	.61	15,5	.21	5,3	.98	24,9	
		3	M3234GAF	LTCG 3/4		UL/CSA	1.040	26,4	2.00	50,8	.62	15,7	.25	6,4	1,30	33,0
5,6	USE-2	3	M3200GAH	LTCG LL 1/2	UL/CSA	.875	22,2	1.68	42,7	.44	11,2	.25	6,4	1,06	27,0	
Skinned-Over Break-thru Solar Masthead Gland - Assembled Metal Locknuts INCLUDED																
5,5	USE-2	5	M3234GBR-SM	SMCG 3/4	cULus	1.040	26,4	2.00	50,8	.62	15,7	.25	6,4	1,30	33,0	
		9	M8437GBK-SM	SMCG 1		cULus	1.326	33,8	2.41	61,2	.76	19,3	.30	7,6	1,73	43,9
		13	M4524GBM-SM	SMCG 1-1/4		cULus	1.680	42,7	2.69	68,3	.78	19,8	.30	7,6	2,05	52,1
		21	M3317GBQ-SM	SMCG 1-1/2		cULus	1.920	48,8	2.81	71,4	.76	19,3	.36	9,1	2,48	63,0
5,6	USE-2	31	M3321GBY-SM	SMCG 2	cULus	2.400	60,8	2.92	74,2	.79	20,1	.42	10,7	2,73	69,3	
		3	M3200GAH-SM	SMCG LL 1/2	UL/CSA	.875	22,2	1.68	42,7	.44	11,2	.25	6,4	1,06	27,0	
7,7	PV 1000 or USE-2**	3	M3234GBS-SM	SMCG 3/4	UL/CSA	1.040	26,4	2.00	50,8	.62	15,7	.25	6,4	1,30	33,0	
		5	M8437GBT-SM	SMCG 1		UL/CSA	1.326	33,8	2.41	61,2	.76	19,3	.30	7,6	1,73	43,9
		9	M4524GBW-SM	SMCG 1-1/4		UL/CSA	1.680	42,7	2.69	68,3	.78	19,8	.30	7,6	2,05	52,1
		11	M3317GBZ-SM	SMCG 1-1/2		cULus	1.920	48,8	2.81	71,4	.76	19,3	.36	9,1	2,48	63,0
8,9	PV 1000	19	M3321GBX-SM	SMCG 2	UL/CSA	2.400	60,8	2.92	74,2	.79	20,1	.42	10,7	2,73	69,3	
		7	M4524GCJ-SM	SMCG 1-1/4	UL/CSA	1.680	42,7	2.69	68,3	.78	19,8	.30	7,6	2,05	52,1	
9,9	PV 1000	9	M3317GCK-SM	SMCG 1-1/2	cULus	1.920	48,8	2.81	71,3	.76	19,3	.36	9,1	2,48	63,0	
		12	M3321GCM-SM	SMCG 2	UL/CSA	2.400	60,8	2.93	74,3	.79	20,1	.42	10,7	2,75	69,9	
Other Configurations with Approval Potential - Locknuts not included																
6,0	***	2	M3200GAJ	LTCG LL 1/2	-	.875	22,2	1.68	42,7	.44	11,2	.25	6,4	1,06	27,0	
		4	M3234GBC	LTCG 3/4	-	1.040	26,4	2.00	50,8	.62	15,7	.25	6,4	1,30	33,0	
6,5	***	6	M8437GAL	LTCG 1	-	1.326	33,8	2.41	61,2	.76	19,3	.30	7,6	1,73	43,9	
		6	M4524GAL	LTCG 1-1/4	-	1.680	42,7	2.69	68,3	.78	19,8	.30	7,6	2,05	52,1	
7,0	PV 1000	3	M3234GAM	LTCG 3/4	-	1.040	26,4	2.00	50,8	.62	15,7	.25	6,4	1,30	33,0	
7,4	PV 1000	2	M3234GAN	LTCG 3/4	-	1.040	26,4	2.00	50,8	.62	15,7	.25	6,4	1,30	33,0	

*AWG 10 and 12 for both USE-2 and PV 1000 except 4,5 mm Conductors Recognized for AWG 12 only.

**8 AWG USE-2 Wire

***Depends on actual wire: 10 AWG USE-2 or 12 AWG PV 1000.



Use Heyco Multi-Hole Cordgrips with Heyco Female Threaded Couplings and Heyco-Flex III Tubing to insulate exposed PV wiring when making complete liquid tight connections to solar combiner or inverter enclosures. See page 3-1 for details.

Material	Nylon 6/6 with TPE sealing gland
Certifications	<ul style="list-style-type: none"> UL Listed under Underwriters' Laboratories File E51579 cULus Recognized under the Component Program of Underwriters' Laboratories File E51579 to both Canadian and U.S. requirements CSA Certified by the Canadian Standards Association File 93876
Flammability Rating	94-V2
Temperature Range	Static -40°F(-40°C) to 239°F (112°C) Dynamic -4°F (-20°C) to 212°F (100°C)
IP Rating	IP 68

MidNite Surge Protection Devices

PART NUMBER	MNSPD-115	MNSPD-300-AC	MNSPD-300-DC	MNSPD-600
Nominal Voltage	0 to 90 VAC 0 to 115 VDC	0 to 250 VAC	0 to 300 VDC	0 to 480 VAC 0 to 600 VDC
MCOV	180V	470V	470V	780V
VPR Line to Ground	600V	1200V	1200V	1800V
Suggested Placement	Up to 90VAC circuits, 12V, 24V, 48VDC battery circuits	120/240 VAC circuits	Off-grid PV combiners Charge controller inputs up to 300VDC	316V/480 VAC circuits Grid-tie PV combiners Grid-tie inverter input Non-Isolated Inverters
Type	UL1449 4th Ed. Type 1	UL1449 4th Ed. Type 1	UL1449 4th Ed. Type 1	UL1449 4th Ed. Type 1
Diagnostic Blue LED	MNSPD-300-AC LED indicates when voltage is present between L1 + ground and L2 + ground MNSPD-115, MNSPD-300-DC and MNSPD-600: LED indicates when voltage is present between L1 + L2 (PV+ PV-)			
Thermal Disconnect	Internal Fuse			
Response Time	<1 micro sec.			



Surge Protection You Can Count On!

MidNite Solar Surge Protection Devices are type 1 devices, designed for indoor and outdoor applications. Engineered for both AC and PV DC electrical systems, they provide protection to service panels, load centers or electronic devices that are directly connected to a MidNite Surge Protection Device (SPD).

Compare our SPDs against other surge protection devices. You will see there is no comparison in both our price and features. All our SPDs are made in the USA and have a 5 year warranty.

Model No.	Max Operating Voltage	Surge Current per Phase	Configuration	MCOV	SCCR	VPR 600V/3kA L G
MNSPD-115	100 VAC/150VDC	80kA	1 Ø, 3-wire (2 Legs)	180V L-N	10kA	600V
MNSPD-300-AC	300VAC	80kA	1 Ø, 3-wire (2 Legs)	470V L-N	10kA	1200V
MNSPD-300-DC	385VDC	80kA	1 Ø, 3-wire (2 Legs)	470V L-N	10kA	1200V
MNSPD-600	480VAC/600VDC	80kA	1 Ø, 3-wire (2 Legs)	780V L-N	10kA	1800V

MIDNITE SOLAR INC.

Surge Protection

Surge Protection You Can Count On!

MidNite Solar Surge Protection Devices are type 1 devices, designed for indoor and outdoor applications. Engineered for both AC and PV DC electrical systems, they provide protection to service panels, load centers or electronic devices that are directly connected to a MidNite Surge Protection Device (SPD).

MidNite's SPD's are offered in four models to protect a variety of different voltage ranges. They achieve this protection by clamping surge voltage to a level that your system can sustain without damaging the components of the system.

Compare our SPD's against other surge protection devices. You will see there is no comparison in both our price and features. All our SPD's have a 5 year warranty.

With lightning you only get one chance, so get the best!



MNSPD300ACFM (Cut-in box)
(MNSPD-300-AC included)



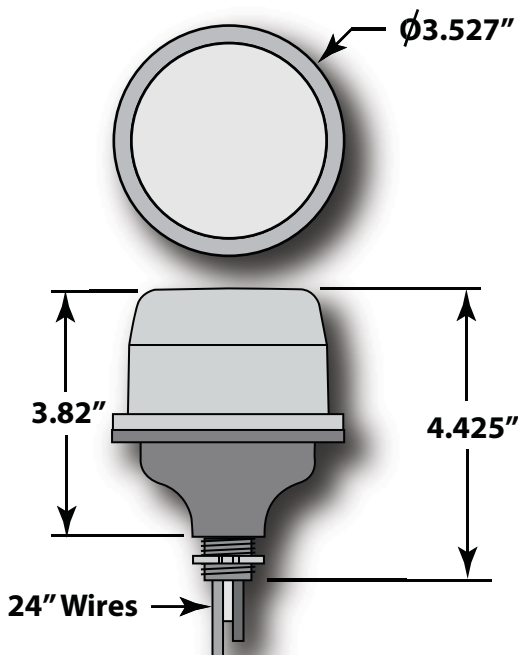
Four Models:

- MNSPD-115**
- MNSPD-300-AC**
- MNSPD-300-DC**
- MNSPD-600**



MidNite Surge Protection Devices

PART NUMBER	MNSPD-115	MNSPD-300-AC	MNSPD-300-DC	MNSPD-600
Nominal Voltage	0 to 90 VAC 0 to 115 VDC	0 to 250 VAC	0 to 300 VDC	0 to 480 VAC 0 to 600 VDC
MCOV	180V	470V	470V	780V
VPR Line to Ground	600V	1200V	1200V	1800V
Suggested Placement	Up to 90VAC circuits, 12V, 24V, 48VDC battery circuits	120/240 VAC circuits	Off-grid PV combiners Charge controller inputs up to 300VDC	316V/480 VAC circuits Grid-tie PV combiners Grid-tie inverter input Non-Isolated Inverters
Type	UL1449 4th Ed. Type 1	UL1449 4th Ed. Type 1	UL1449 4th Ed. Type 1	UL1449 4th Ed. Type 1
Diagnostic Blue LED	MNSPD-300-AC LED indicates when voltage is present between L1 + ground and L2 + ground MNSPD-115, MNSPD-300-DC and MNSPD-600: LED indicates when voltage is present between L1 + L2 (PV+ PV-)			
Thermal Disconnect	Internal Fuse			
Response Time	<1 micro sec.			



Performance

Surge Current Rating per Phase	80kA
Short Circuit Current Rating	10kA

Fusing	Individually fused MOVs
Thermal Fusing	Yes
Over current Fusing	Yes
Operating Frequency	0 to 500 Hz

Mechanical Description

Enclosure	Polycarbonate UL94V-0
Environmental Rating	Type 4X
Connection Method	#12 AWG
Weight	1 lb.
Mounting Method	1/2" Conduit Knockout
Operating Altitude	Sea Level – 12,000' (3,658 Meters)
Storage Temp	-40° F to +185° F (-40° C to +85° C)
Operating Temp	-40° F to +185° F (-40° C to +85° C)

Diagnostics

Blue status LED, one per leg

Listings and Performance

UL Standard for Safety, UL 1449 Surge Protective Devices-Fourth Edition
CSA C22.2 No. 8-M1986 Electromagnetic Interference (EMI) Filters, Fourth Edition

Model No.	Max Operating Voltage	Surge Current per Phase	Configuration	MCOV	SCCR	VPR 600V/3kA L G
MNSPD-115	100 VAC/150VDC	80kA	1 Ø, 3-wire (2 Legs)	180V L-N	10kA	600V
MNSPD-300-AC	300VAC	80kA	1 Ø, 3-wire (2 Legs)	470V L-N	10kA	1200V
MNSPD-300-DC	385VDC	80kA	1 Ø, 3-wire (2 Legs)	470V L-N	10kA	1200V
MNSPD-600	480VAC/600VDC	80kA	1 Ø, 3-wire (2 Legs)	780V L-N	10kA	1800V



SURGE PROTECTIVE DEVICE INSTALLATION MANUAL



UL Standard for Safety, UL 1449

CSA C22.2 No. 8-M1986

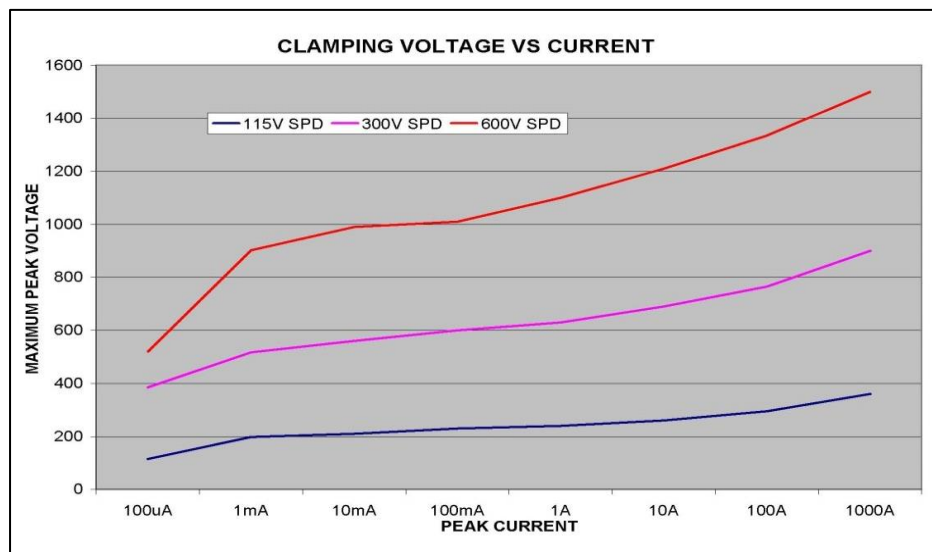
The MidNite Solar Surge Protective Device (MNSPD) is a Type 1 device, designed for indoor and outdoor applications. Engineered for both AC and DC electric systems, it protects both transformer and transformer-less inverters without interfering with the GFP protection circuit, it provides protection to service panels, load centers or where the SPD is directly connected to the electronic device requiring protection. Maximum protection will only be achieved if the SPD is properly installed. Please read the following installation manual carefully and follow the instructions.

The MidNite Solar SPD is offered in three different voltages to maximize the required protection level. Protection is achieved by reducing the clamping voltage to a safe voltage that your system can sustain without damaging any electronics in the system. By using the chart on page 2 select the SPDs that provide the protection your system requires.

The maximum operating voltage of the SPD must be higher than the system voltage. If the SPD operating voltage is equal to or lower than the system voltage the SPD will see this as an overvoltage event and begin shunting current to ground.

This can result in degraded performance, or failure of the SPD, and it is not so good for the system either. Selecting the correct voltage SPD will provide excellent protection and peace of mind for years to come.

Midnite Solar Surge Protection Device.		8-009-1	
Part No.	MNSPD115	MNSPD300AC and DC	MNSPD600
Nominal Voltage	0 to 90 VAC 0 to 115 VDC	0 to 250 VAC (AC model) 0 to 300 VDC (DC model)	0 to 485 VAC 0 to 600 VDC
MCOV VRMS @1mA	180V (162-198)	470V (423-517)	780V (702-858)
ClampV @ 100A Current 8/20µs	295V	775V	1290V
I peak (8/20µs) (Current)	100kA (Full Device) 50kA (Each Section)	100kA (Full Device) 50kA (Each Section)	100kA (Full Device) 50kA (Each Section)
Energy Absorption	1120 J (Full Device) 560 J (Each Section)	3130 J (Full Device) 1560 J (Each Section)	4320 J (Full Device) 2160 J (Each Section)
Suggested Placement	Up to 90 VAC circuits, 12V,24V,48V DC battery circuits	120/240VAC circuits, offgrid PV combiners and charge controller inputs up to 300VDC,	316V/480VAC circuits Grid tie PV combiners Grid tie inverter input
Diagnostics	SPD300AC -LED indicators when voltage is present between L1+Ground and L2+ground SPD115, 300DC and 600- LED Indicators when voltage is present between DC+ and DC-		
Operating Temperature Range	-40°c to +85°c		
Nominal Discharge Current INA	20kA		
Thermal Disconnecter Internal	Internal		
Response time	<15n sec.		





DANGER: Electrical shock or burn hazard. Installation of this SPD should only be done by qualified personnel. Failure to lockout electrical power during installation or maintenance can result in fatal electrocution or severe burns.



CAUTION: Check to make sure system voltages do not exceed the SPD voltage requirement and the correct SPD voltage/model has been selected.



CAUTION: This unit must be installed in accordance with the National Electrical Code (ANSI/NFPA-70) and applicable local codes.



CAUTION: Ungrounded power systems are inherently unstable and can allow excessively high line-to-ground voltages during certain fault conditions. During these fault conditions any electrical equipment, including an SPD, may be subjected to voltages which exceed their designed ratings. This information is being provided to the user so that an informed decision can be made before installing any electrical equipment on an ungrounded power system.

ATTENTION: les systèmes d'alimentation sans terre sont intrinsèquement instables et peuvent produire des tensions de ligne trop élevé-sol au cours de certaines conditions de défaut. Au cours de ces conditions de défaut, tout équipement électrique, y compris un SPD, peut être soumis à des tensions qui dépassent leurs notations conçu. Cette information est fournie à l'utilisateur afin qu'une décision éclairée puisse être prise avant l'installation de tout équipement électrique sur un système d'alimentation sans fondement.

NOTICE: *Do not cut wires until the SPD is mounted and minimum wire lengths have been verified. All connection leads should be cut to minimum possible length; never coil or push aside excess length.*

INSTALLATION INSTRUCTIONS

1. *Verify system voltage. Measure L-N, L-G, L-L and N-G of the AC system. DC systems measure from positive and negative input. Confirm that the SPD is correctly rated for the system to which it is to be connected to. Do this by comparing the measured voltages to the SPD voltage ratings shown on the product's rating label. The measured voltage should NOT BE ABOVE the maximum continuous operating voltage (MCOV) of the surge protector device rating, during normal operation. Some circuits like PV arrays may need to be calculated for worst case maximum operating voltages.

2. Identify proper location for the SPD. Locate the unit as close as physically possible to the panel being protected and as close to the electrical connection as possible. Avoid excess lead lengths and the need for sharp bends in the wires. **Refer to fig 1.1 and fig 1.2as an example.**

3. Install green wire to the GROUND bus bar. In AC circuits it is not uncommon to connect the green wire to AC neutral, install the white sleeving over the green wire when connecting to AC neutral. Make sure the green wire takes the shortest path to earth ground!!

4. Connect phase conductors. The phase wires are black and red in color. The orientation is not critical to the operation. (AC) With the POWER OFF, connect one wire to AC HOT IN (line) and other wire to AC HOT OUT (load) as shown in **fig. 1.2** (DC) connect the red wire to PV + and the black wire to PV - or battery minus. PV combiners get installed as shown in **figure 1.1**

5. Apply voltage to SPD. Both LED's in the SPD should glow blue as a sign that voltage is present in system, SPD is connected correctly and working and the system is protected. *Note. LED's will only be on when voltage is present. In PV circuits the lights will go out at night because arrays are not producing voltage. This does not indicate that the SPD is broken. If voltage is present and the blue LED's are off, the SPD needs repair. When connecting one half of the SPD to PV- and ground, the PV- led will not light. The circuit is protected, but there is normally no voltage between PV- and ground.*

Important! A good grounding system is essential for both safety and lightning protection. The NEC recommends a ground resistance of 25 ohms or less. The lightning protection industry recommends 10 ohms or less. A thorough assessment of the grounding system is strongly recommended.

- 1) This product *contains No Serviceable Parts.*
- 2) USE SUPPLY WIRE SUITABLE FOR 90° C.

The conductors used to connect the SPD to the line or bus shall not be any longer than necessary and shall avoid unnecessary bends

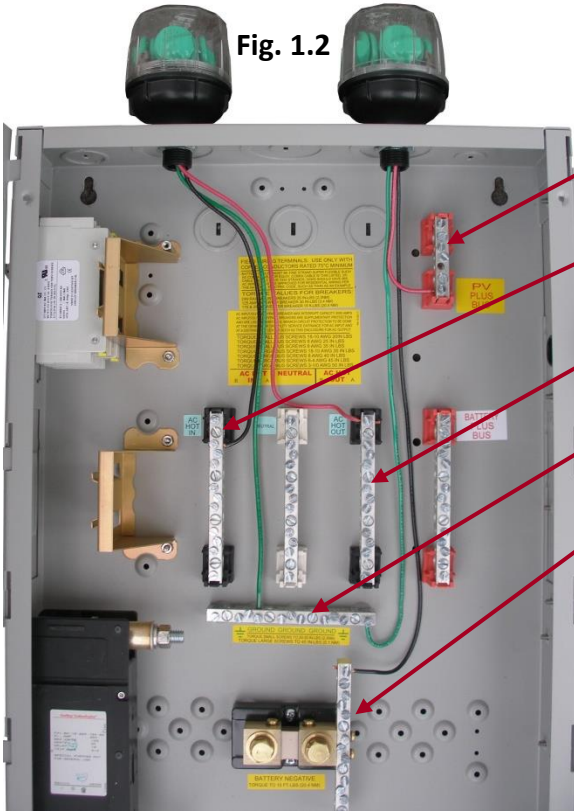


Fig. 1.2

Use screw, washer, nut & ring terminal on MNPV Combiner.

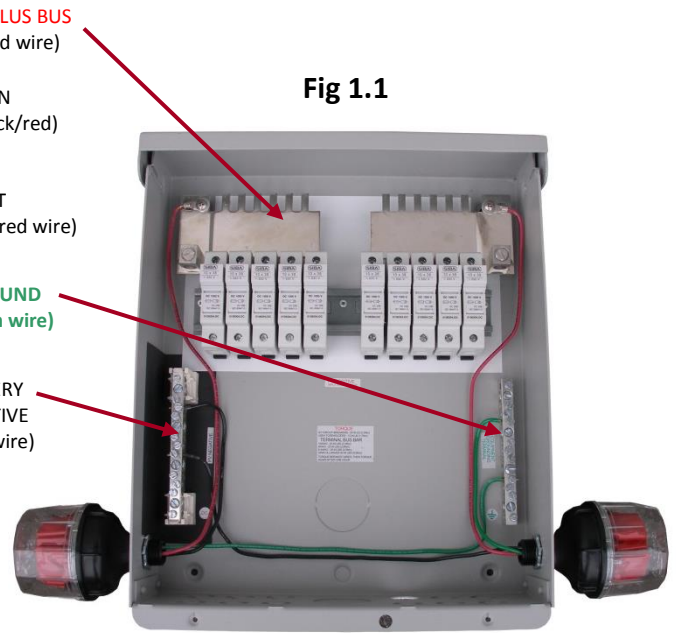


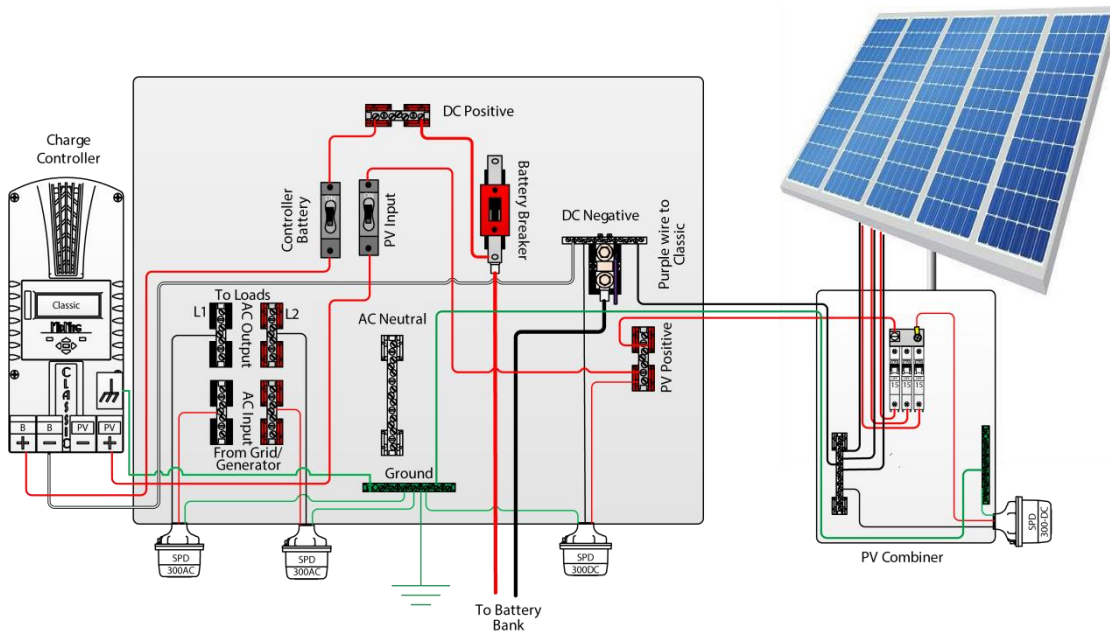
Fig 1.1

Installation shown in an MNPV12. Configured for 2 grid tie inverters.

Installation shown in a MidNite Solar 120v E-Panel.

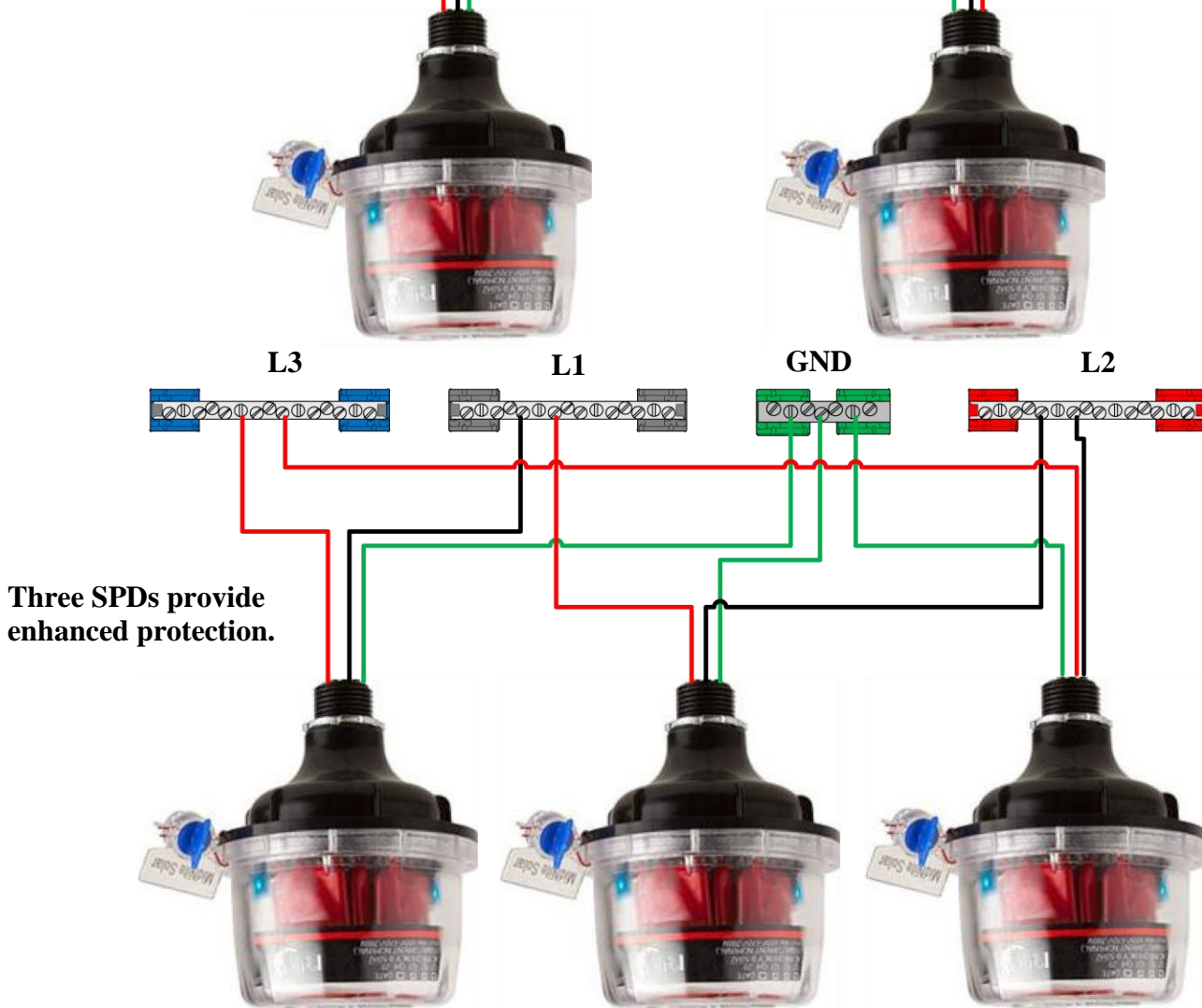
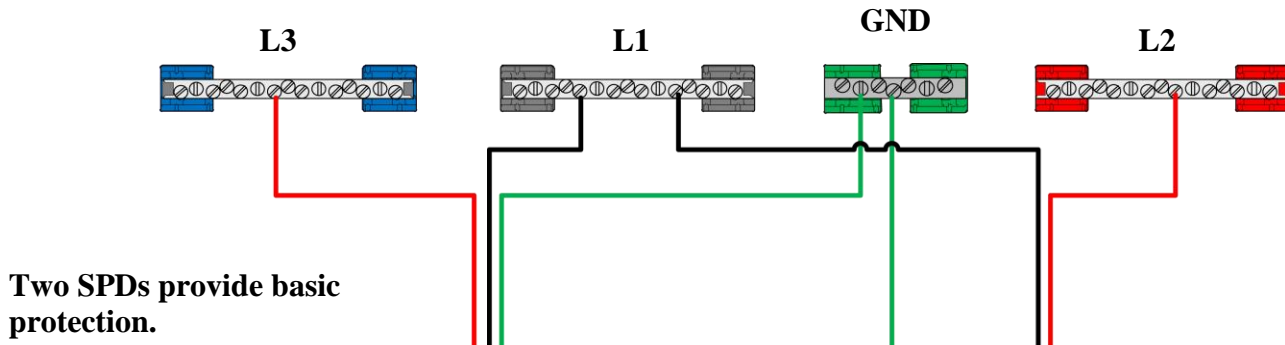
INSTALLATION SHOWN WITH MIDNITE SOLAR E-PANEL AND COMBINER BOX. SPD CAN BE USED WITH ANY ELECTRIC PANEL THAT IS WITHIN THE SPD RATINGS.

The following represents a wiring diagram of SPDs in a typical system.



Three Phase wiring.

Midnite SPDs can be used for 3 phase applications.
As shown in the diagram, two or three SPDs can be used.



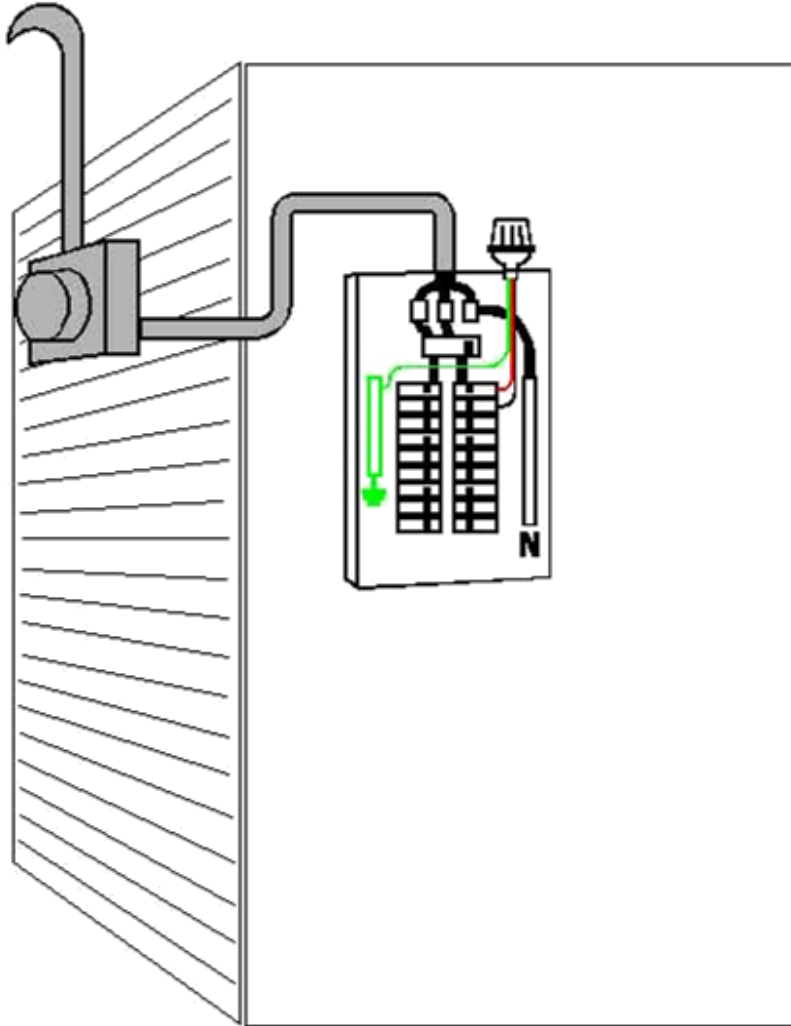


Fig 1.5

In a utility connected home, one of the most vulnerable points of entry is the service entrance panel. All house wiring connects to the service entrance panel and therefore everything plugged in is at risk. The MidNite SPD300AC provides protection against near lightning strikes up to 100,000 amps of surge current. Hooking up to the service entrance can be done in a few different ways.

Figure 1.6 shows the two hot wires connected to a 240V circuit breaker. The circuit breaker in this case has no other house loads and is dedicated strictly to the SPD. This was done just to have a convenient place to connect the hot leads of the SPD to the panel.

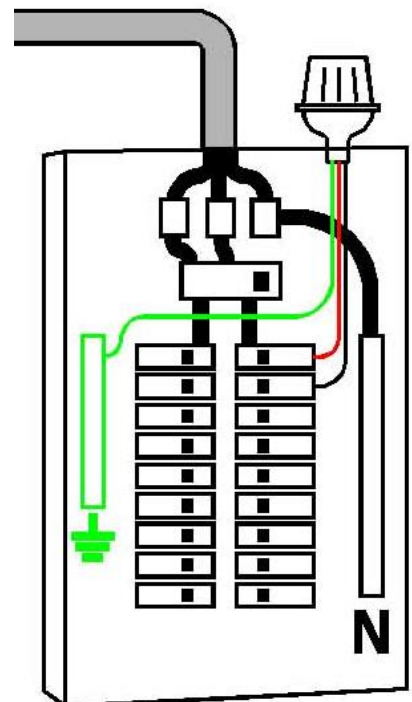


Fig 1.6

Figure 1.7 shows a more economical method to connect the SPD to the service entrance distribution panel. This installation utilizes a 240V breaker that is already in use. This could be a deep well pump, air conditioner etc. Unless the circuit breaker is listed to have two wires connected, you must pigtail the wiring as shown. Breakers that are listed for two wires are very rare, so this method of installing the SPD is probably your best bet.

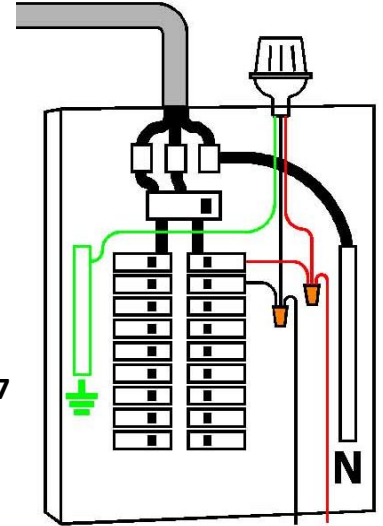


Fig 1.7

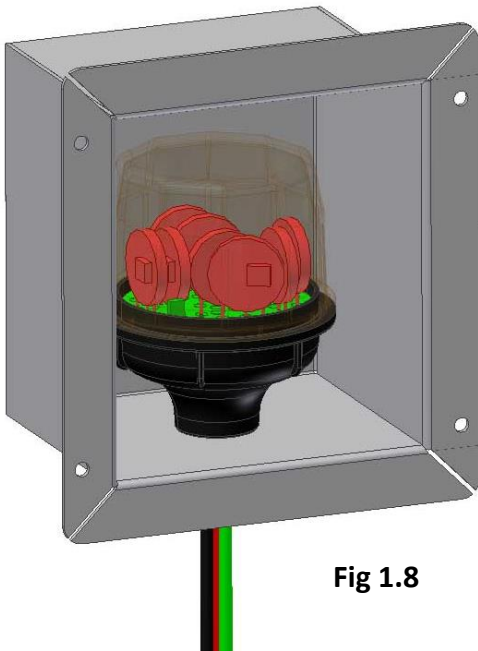


Fig 1.8

Some homes have surface mounted distribution panels. Those are easy to add an SPD to. Simply pop out a 7/8" diameter knockout and mount the SPD on the hole.

Other homes have service entrances that are flush mounted and are not exposed. This type of installation will benefit from the MidNite SPD Flush mount box. Cut a hole in the sheet rock close to the distribution panel and mount the box in the hole. Secure the box after wiring is completed using drywall anchors. Make sure to grommet the hole in the distribution box.

***MIDNITE SOLAR INC. LIMITED WARRANTY. MidNite Solar Surge Protection Device (SPD)**








Midnite Solar Inc. warrants to the original customer that the SPD products shall be free from defects in materials and workmanship for a period of five (5) years. At its option, MidNite Solar will repair or replace at no charge any SPD that proves to be defective within such warranty period. This warranty shall not apply if the MidNite Solar product has been damaged by unreasonable use, accident, negligence, service or modification by anyone other than MidNite Solar, or by any other causes unrelated to materials and workmanship. The original consumer purchaser must retain original purchase receipt for proof of purchase as a condition precedent to warranty coverage. To receive in-warranty service, the defective product must be received no later than two (2) weeks after the end of the warranty period. The product must be accompanied by proof of purchase and Return Authorization (RA) number issued by MidNite Solar. For an RMA number contact MidNite Solar Inc, 17722 67th Ave NE, Arlington, WA 98223(360) 403-7207. Purchasers must prepay all shipping charges to MidNite Solar product under this warranty policy. Except for the warranty that the products are made in accordance with the specifications therefore supplied or agreed to by customer, MIDNITE SOLAR MAKES NO WARRANTY IF SPD MCOV RATING IS CHOSEN BELOW SYSTEM'S NOMINAL VOLTAGE. Products will be considered accepted by customer unless written notice to the contrary is given to MIDNITE SOLAR within ten (10) days of such delivery to customer. MIDNITE SOLAR shall not in any case be liable for any event occurring or defect discovered with regard to said product unless written notice thereof is given to MIDNITE SOLAR within ninety (90) days of such product delivery to customer. MIDNITE SOLAR is not responsible for loss or damage to other products owned by customer and beyond MIDNITE SOLAR's control. This warranty is in lieu of all other warranties expressed or implied.



FOR AES PROFESSIONAL AND AES LiFePO₄ MOBILE & INDUSTRIAL BATTERIES

LYNK LITE Communication Gateway aggregates and displays in real-time the State of Charge for AES PROFESSIONAL and AES LiFePO₄ batteries. Unlock the full potential of these lithium batteries by integrating them with inverter-chargers, on and off-board chargers, displays, load centers, motor controls, PLCs, and telematics to optimize system performance.

Improve system integration using multiple communication interfaces and CAN-based protocols. LYNK ACCESS Software for LYNK LITE includes device programming, firmware uploads, battery digital signal simulation, and data analysis to reduce development time and effort.

 REAL-TIME DATA	State of Charge (SoC), voltage, temperature and battery status is communicated in real time to on-board devices.
 FASTER CHARGING	Up to 25% faster 0% to 100% SoC charging with dynamic charge management.
 COMMUNICATION	Configurable - CANopen, Serial CAN, J1939, RV-C
 FULL COMPATIBILITY	Battery related settings are automatically programmed for multiple brands of industrial chargers.
 STATUS VIEW	At-a-glance SoC LEDs, communication status LED.
 MAXIMIZE THE BATTERY	Internal cell balancing is optimized, enabling the highest usable capacity and true 100% depth of discharge over the entire life of the battery.
 SIMPLE SERVICE	Download data logs, upload battery firmware, and more.

SPECIFICATIONS

DEVICE	LYNK II COMMUNICATION GATEWAY
Part Number	950-0040
L x W x H	95 x 56 x 30 mm / 4.7 x 2.2 x 1.2 in
Weight	0.1 kg / 0.2 lb
IP Rating	IP65
Temperature	Operating: -20°C to 50°C (-4°F to 122°F) / Storage: -40°C to 85°C (-40°F to 185°F)
Humidity	Operating: < 95%, Non-condensing / Storage: < 95%
Mounting	Built-in Surface / Flush Mount Bracket
Display LEDs	1 x LYNK Port Connection LED, 1 x CAN Status LED
COMMUNICATION PORTS	
LYNK Ports	IEC (M12 -5 PIN)
Memory	Internal SD Memory Card
CAN Out	IEC (M12 -5 PIN)
DATA INTERFACE	
USB Device	Type-B Mini
POWER INPUT	
LYNK Port	12 V Nominal
USB Device	5 V
STANDARDS	
Marking	CE
COMPATIBLE BATTERIES	
AES LiFePO ₄	130 Ah 48 V (12-48-6650), 57 Ah 48 V (14-48-3000), 76 Ah 36 V (14-36-3000), 175 Ah 24 V (12-36-6700), 110 Ah 24 V (14-24-2800)
AES PROFESSIONAL	30 Ah 48 V (DLP-GC2-48V), 30 Ah 36 V (DLP-GC2-36V), 60 Ah 24 V (DLP-GC2-24V), 120 Ah 12 V (DLP-GC2-12V)

ADVANCED INTEGRATION

Turn a good system into a great one with ultra-fast charging, real-time status, predictive equipment control and diagnostics.

- SoC Display
- Auto Programming of Charge Parameters
- Configurable COMMs
- SD Card Memory
- USB Device
- Download Battery Data
- Upload Battery Firmware

AVAILABLE DEVICE CONFIGURATIONS

- Serial CAN
- CANopen
- RV-C
- Victron Energy - Color Control GX, Venus GX, VE.CAN Devices
- SPE Chargers
- CAN Devices
- Others



LYNK ACCESS - Windows 64 bit

Download from discoverlithium.com

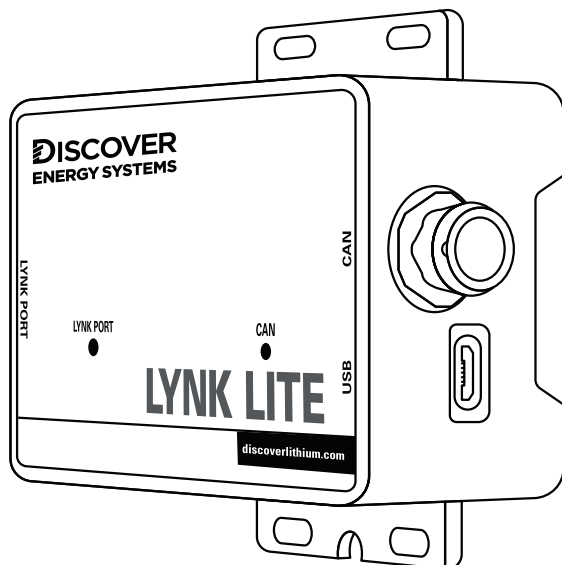
- Configure LYNK LITE for Devices
- Battery Diagnostics
- Upload Battery Firmware
- Download Battery Data
- Analyze and Visualize Battery Data

ACCESSORIES - LITHIUM PROFESSIONAL

- 950-0035 COMM Cable (0.4 m / 15.75 in)
- 950-0036 COMM Cable (1.8 m / 70.87 in)
- 950-0037 COMM Cable (7.6 m / 299.25 in)
- 950-0038 COMM T Connector with COMM Cable (0.4 m / 15.75 in)
- 950-0041 COMM T Connector



DISCOVER
ENERGY SYSTEMS



LYNK LITE

(950-0040)

INSTALLATION AND OPERATION MANUAL

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1.0. AUDIENCE, SAFETY, MESSAGES AND WARNINGS

1.1 Audience

Qualified personnel should perform configuration, installations, service, and operating tasks in consultation with local utilities and authorized dealers. Qualified personnel should have training, knowledge, and experience in:

- Installing electrical equipment
- Applying applicable installation codes
- Analyzing and reducing hazards involved in performing electrical work
- Installing and configuring batteries

1.2 Safety, Messages and Warnings

WARNING

Important information regarding hazardous conditions that may result in personal injury or death.

CAUTION

Important information regarding hazardous conditions that may result in personal injury.

NOTICE

Important information regarding conditions that may result in damage to the equipment but not personal injury.

NOTE

Ad hoc information concerning important procedures and features not related to personal injury or equipment damage.

2.0 About LYNK LITE

2.1 Overview

LYNK LITE Communication Gateway unlocks the full potential of a Discover lithium battery by enabling the internal Battery Management System (BMS) to communicate closed-loop and in real-time State-of-Charge, voltage, temperature and status to compatible devices, such as solar or mobile inverter-chargers, on and off-board industrial chargers, displays, load centers, motor controls, PLCs and telematics. CANopen Interface and Discover Generic Serial CAN Guides are also available for developers.

2.2 Compatible Batteries and Devices

A battery or device must have a compatible port such as a LYNK Port to communicate with a LYNK LITE device.

LYNK Port

- AES PROFESSIONAL batteries: DLP-GC2-12V, DLP-GC2-24V, DLP-GC2-36V, DLP-GC2-48V

2.3 Compatible Communication Protocols

LYNK ACCESS software for 64-bit Windows 10 is required to configure LYNK LITE devices for communication with compatible external devices such as inverters, chargers and motor controllers. Download the current version of LYNK ACCESS software from the Discover Energy Systems website to obtain the most up-to-date suite of available device configurations. Interface guides for CAN open and Discover Generic Serial CAN are available from the Discover Energy Systems website.

2.4 Firmware Revision

This User Manual is valid for LYNK firmware version 1.4.0 and above. Use LYNK ACCESS software to view the firmware version of your LYNK LITE device.

3.0 Items Shipped in the Box

1	Discover LYNK LITE device
---	---------------------------

4.0 Design and Features

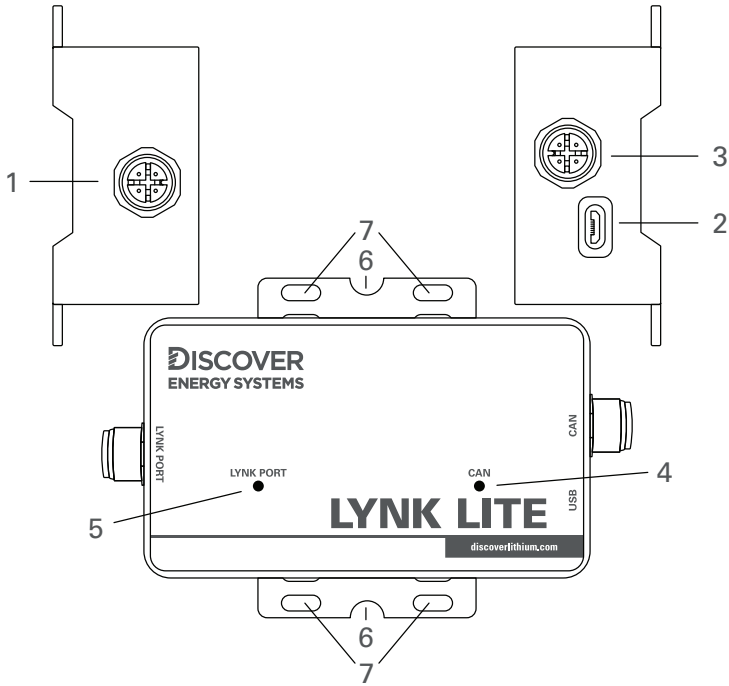


Figure 1: Ports, Buttons, LEDs, and Mounting Hold Downs

1	LYNK Port	IEC M12 PIN connector used for network communications. Termination Configurable. (Terminated by Default)
2	USB Type-B Micro	USB device port used to connect with LYNK ACCESS software on Windows 10 devices.
3	CAN Out	RJ45 connection used for CAN communications. Termination Configurable
4	CAN Out LED	Indicates communication activity.
5	LYNK Port LED	LYNK Port LED indicates LYNK Port activity.
6	Hold Down Points	Hold down points for mounting the device with straps.
7	Mounting Slot	Slots for mounting the device with screws or bolts.

4.1 Reset Operation

To reset LYNK LITE, remove and reconnect power to the device.

NOTICE

HAZARD OF EQUIPMENT DAMAGE

Cycling power to LYNK II will cause communications with other devices to be interrupted. Cycling power will not alter previous settings.

Failure to follow these instructions may cause damage to the equipment.

4.2 LED Indicators

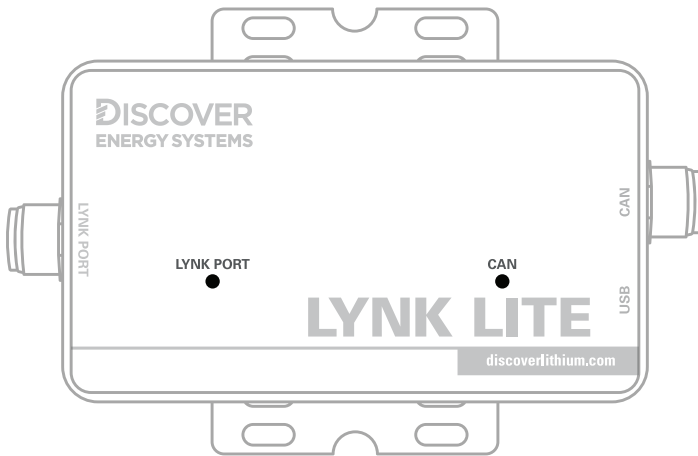


Figure 2: LYNK LITE LED Indicators

Data LEDs	Indication
LYNK Port LED	Flashes when a new battery is detected on the LYNK Port. Solid when there is active communication on the LYNK Port.
CAN Out LED	This indicates that a CAN heartbeat message has been received in the proper protocol within the past 5 seconds.

4.3 LYNK Port Pin Assignment

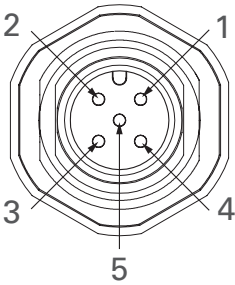


Figure 3. PIN Map for M12 A-Code Circular Metric Connector.

PIN	Description
1	Do not populate. Do not terminate to ground. Do not terminate to power. Do not terminate to CAN L or CAN H.
2	AEbus CAN L
3	AEbus CAN H
4	AEbus +12V
5	AEbus GND

4.4 CAN Out Port Pin Assignment

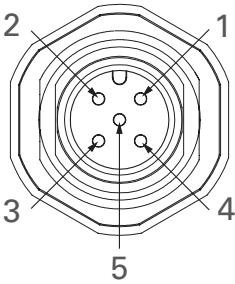


Figure 4. PIN Map for M12 A-Code Circular Metric Connector.

PIN	Description
1	Do not populate. Do not terminate to ground. Do not terminate to power. Do not terminate to CAN L or CAN H.
2	CAN L
3	CAN H
4	Inactive
5	GND

4.5 Power Sources for LYNK LITE

LYNK LITE can utilize two power sources. Both power sources can be used alone or simultaneously. LYNK LITE will automatically use the highest priority source.

Priority	Source
1	LYNK Port of enabled batteries
2	USB device

NOTE

LITHIUM PROFESSIONAL batteries must be set to ON to supply power and communicate data with LYNK LITE devices.

LITHIUM PROFESSIONAL Batteries

LITHIUM PROFESSIONAL batteries will supply power to LYNK LITE using the network cable connected to the LYNK Port.

5.0 Installation

Choose a clean, dry, easily accessible indoor location. All the communication ports on the LYNK LITE are accessible when mounted. Clearance of at least 100 mm (4 inches) from the connection points on the device is needed to allow for the bend radius of connected cables.

5.1 Mounting LYNK LITE

Screws or bolts can be threaded through the integrated Mounting Slots to affix LYNK LITE to a flat surface. Mounting screws, bolts and nuts are not included. Threading straps through the integrated Hold Down Points can be used to secure LYNK LITE to an object. Secure all cables to prevent them from working loose or becoming damaged.

5.2 Installing the External Power Source

LYNK LITE can utilize two power sources. Both power sources can be used alone or simultaneously. LYNK will automatically use the highest priority source.

Connect LYNK LITE to one or more of the following:

- The LYNK Port of a Discover LITHIUM PROFESSIONAL battery.
- A USB device

5.3 LYNK Network Communication Cables

⚠ CAUTION

HAZARD OF EQUIPMENT DAMAGE

- Turn OFF all devices before connecting cables.
- Mixing the LYNK Network with other networks may result in equipment malfunction and damage.

Failure to follow these instructions can damage equipment.

Networking Guidelines:

- Separate data and power cables and allow for separation between data and power cables. Avoid interference and data corruption caused by running network cables bundled with power cables.
- Allow for LYNK Network cable slack. Ensure that LYNK Network cables are slack and not in tension.
- Isolate the LYNK Network. Do not mix other networks with the LYNK Network.

NOTE

The LYNK LITE Communication Gateway is internally terminated. A termination resistor is not required.

LYNK Network Installation and Layout for LITHIUM PROFESSIONAL batteries:

1. Mount the devices according to their installation instructions before beginning network installations.
2. Attach the **950-0038 DLPT Connector** to the LYNK Port on each battery (Figure 5). Ensure that the mating connectors are securely fastened.
3. Insert the male end of the cable into the female end of the **950-0038 DLPT Connector** and vice versa.
4. Repeat until all batteries have been attached in a series network (Figure 6).
5. Attach one end of the series network to the LYNK Port on LYNK LITE. Termination of the other end is not required.

LYNK Network Cables Available for LITHIUM PROFESSIONAL Batteries	Part Number
DLP B2B-400 (COMM Cable 0.4 m)	950-0035
DLPTOL-7600 (COMM Cable 7.6 m)	950-0037
DLPTOL-1800 (COMM Cable 1.8 m)	950-0036
DLPT Connector (COMMT Connector) with DLP B2B-400 (COMM Cable 0.4 m)	950-0038
DLPT Connector (COMMT Connector)	950-0041

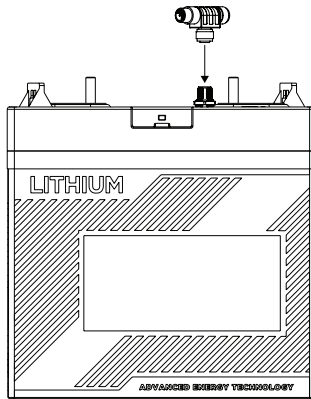


Figure 5. PIN Map for M12 A-Code Circular Metric Connector

Figure 6. Network Installation

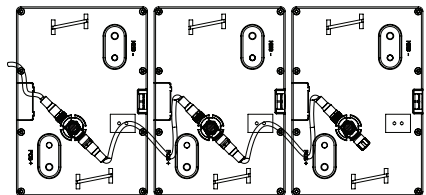
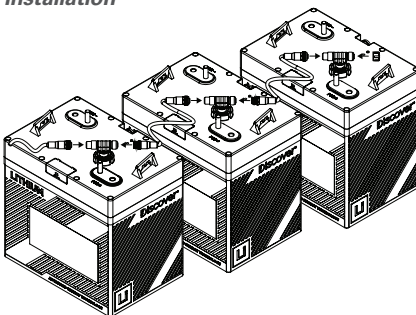


Figure 7. Complete Network Installation

5.4 Verification of the LYNK Network

Verify the LYNK Network is complete using LYNK LITE.

- An illuminated LYNK Port LED confirms that communications are active for the LYNK Network.
- LYNK ACCESS software can be used via a computer to confirm the number of batteries in the LYNK Network

6.0 Connecting to LYNK ACCESS

LYNK ACCESS software for 64-bit Windows 10 is required to configure LYNK devices for CAN communication with compatible external devices such as inverters, chargers and motor controllers.

Download the current version of LYNK ACCESS software from the Discover Energy Systems website to obtain the most up-to-date suite of available device configurations.

Using a USB cable with a Type-B micro plug, connect the Windows 10 device running LYNK ACCESS software to the USB port on LYNK LITE.

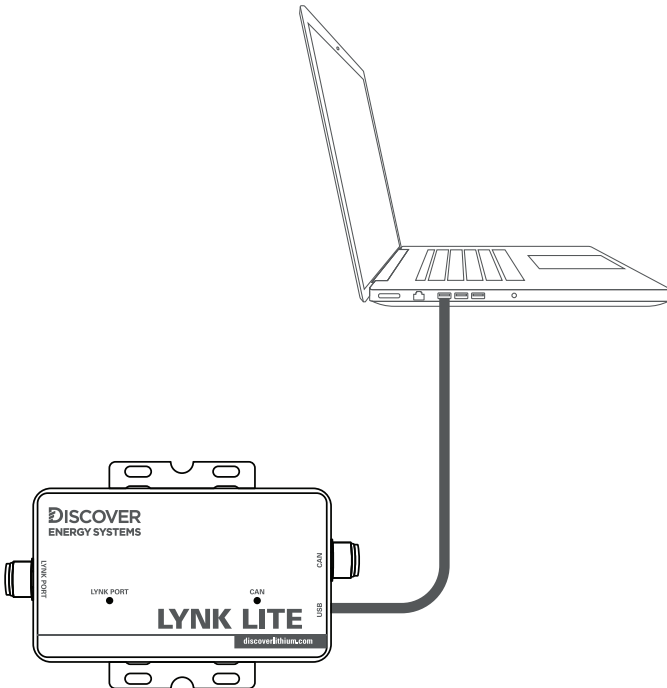
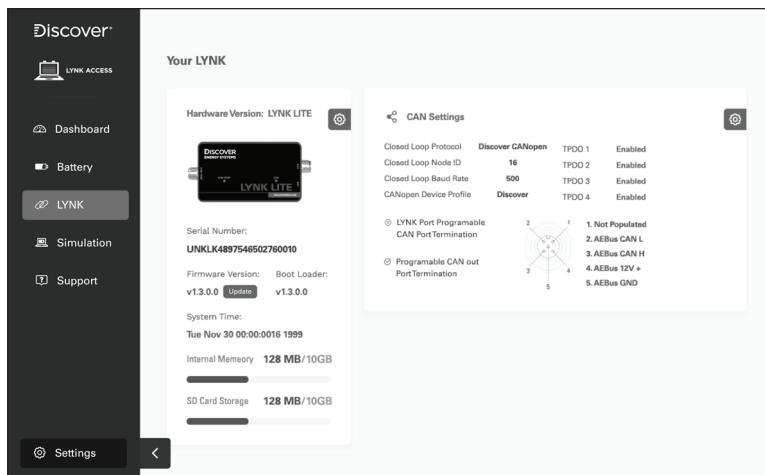


Figure 8. LYNK LITE and LYNK ACCESS USB connection.

NOTE

A powered USB hub may be required.

Open LYNK ACCESS. LYNK LITE configurations and settings can be found by selecting the LYNK tab.



7.0 Configuring the CAN Communication with LYNK ACCESS

Connect the LYNK and open LYNK ACCESS. Ensure that you only have one LYNK device connected to the Computer.

Open LYNK ACCESS and select the LYNK tab. Select the blue gear icon in the upper right area of the CAN Settings tile.

Select one of the pre-configured Closed-Loop Protocols. To complete the configuration enable or disable termination for the CAN Out port as required. Click SAVE to confirm the configuration.

Refer to the appropriate application note for instructions on setting the external device to communicate correctly with LYNK LITE. Up-to-date application notes for various external devices are available from the Discover Energy Systems website.

NOTICE

HAZARD OF EQUIPMENT DAMAGE

Saving configuration changes using LYNK ACCESS will automatically restart LYNK II and cause communications with other devices to be interrupted.

Failure to follow these instructions may cause damage to the equipment.

8.0 Updating LYNK LITE Firmware with LYNK ACCESS

Open LYNK ACCESS and select the LYNK Tab. Select the Firmware Version update button and follow the on-screen prompts to complete the update process. Click SAVE to confirm the configuration.

9.0 Specifications

Device	LYNK LITE COMMUNICATION GATEWAY
Part Number	950-0040
L x W x H	95 x 56 x 30 mm / 4.7 x 2.2 x 1.2 in
Weight	0.1 kg / 0.2 lb
IP Rating	IP65
Temperature Operating	-20°C to 50°C (-4°F to 122°F)
Temperature Storage	-40°C to 85°C (-40°F to 185°F)
Humidity Operating	< 95%, Non-condensing
Humidity Storage	< 95%, Non-condensing
Mounting	Built-in Surface Mount Bracket
Marking	CE

Series 187 Marine Rated Circuit Breaker (MRCB)

Manual Reset Circuit Breakers With Switch Function

Specifications

Single Pole Thermal Type Breakers

Applications: Typically used in DC power systems in marine applications (as a main or branch circuit breaker), truck and bus systems, RV systems, add-on protection for accessories, lift gates, etc. This unit is external ignition protected and weatherproof.

Rating: 25-200A, 48Vdc

Interrupt Rating: Main Breaker Protection Interrupt Rating (5,000A@ 14Vdc, 3,000A@ 28Vdc and 1,500A@ 48Vdc).

Operating Temperature Rating: -40°F (-40°C) to 185°F (85°C)

Storage Temperature Rating: -40°F (-40°C) to 260°F (125°C)

Materials: Black UL-rated 94V0 thermoset plastic body. Cover and lever are UL-rated 94V0 thermoplastic

Marking: Standard marking includes amp/volt ratings. Custom markings also available

Termination: 5/16-18 threaded studs

Torque Rating: 75 in-lbs (8.5N•m) max

Mounting Torque Rating: Panel or surface-mount options; 50 in-lbs (5.6 N•m) max

Ingress Protection Rating: IP66

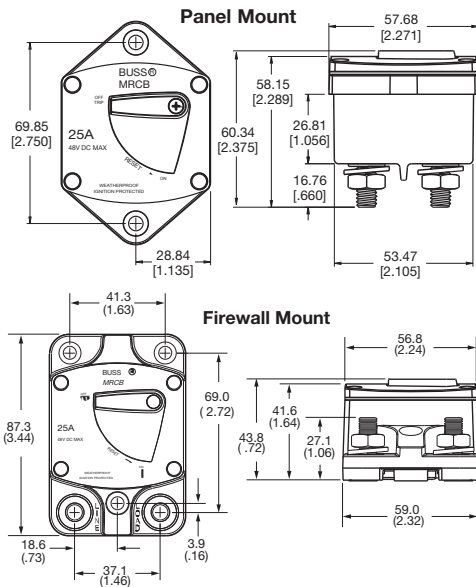
Features / Options: A manual reset circuit breaker with On-Off switch capability

Compliances: ABYC E-11; CE; SAE J1171 (ignition protected)

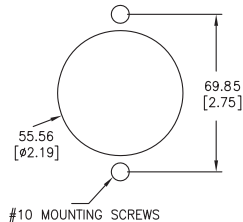
Consult factory for time characteristic curves.



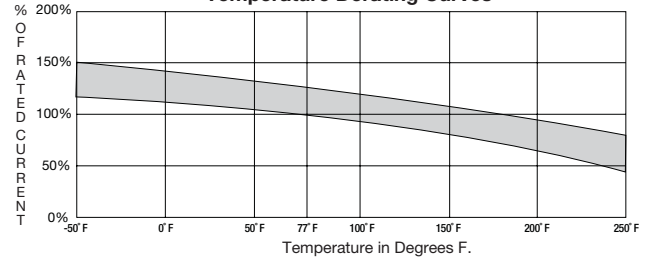
Dimensions - mm(in) (Dims. shown are for reference only. Consult factory for latest prints)



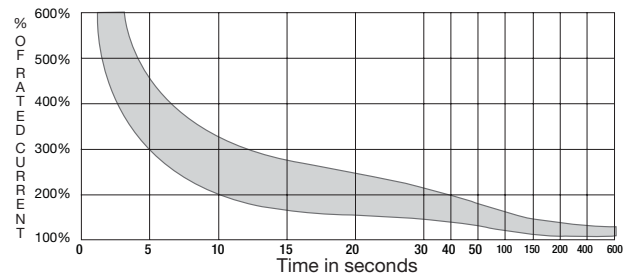
Mounting Template



Temperature Derating Curves



Time vs Percent of Rated Current



Part Numbering System

Series

187

187 - Manual Reset - Switching Style Circuit Breaker

Rating

025

025 - 25 amps
030 - 30 amps
035 - 35 amps
040 - 40 amps
050 - 50 amps
060 - 60 amps
070 - 70 amps
080 - 80 amps
100 - 100 amps
110 - 110 amps
120 - 120 amps
135 - 135 amps
150 - 150 amps
200 - 200 amps

Mounting

F

F - Surface mount
P - Panel mount

Hardware

00

00 - No hardware
03 - Stainless nuts & lockwashers - installed on studs
04 - Stainless nuts & lockwashers - supplied bulk packed

Marking

1

1 - Standard marking; Part Number, Amp Rating
(Consult factory for special marking options.)

COOPER Bussmann

DIRECTTM

MANUFACTURING

All-Flex[®]

All-Flex[®] multipurpose power cable is used in transformers, UPS, switchboard panels, controls, electronic circuits and meters. Applications include battery cable, battery charger cable, motor lead and power hookup cable. Approved for both indoor and outdoor use.



- UL AWM Syles: 1232 - 1283 - 1284 - 1337 - 1338 - 1339 - 10070 - 10269
- MTW & THW
- BC-5W2 Boat Cable
- TEW FT1
- UL1426
- VW 1
- RoHS
- CSA Approved

CONSTRUCTION:

CONDUCTORS

Class K 30 Gauge bare or tinned copper

INSULATION

PVC Jacket

TEMP RANGE

105C° dry 75C° Wet Rated 600V

STOCK SIZES

500' Reels, Custom Sizes and Packaging upon request



Resists
Moisture



Resists
Abrasion



Resists
Acid



Resists
Diesel/Fuel



Resists
Oil



Resists
Weather



Made in
U.S.A.

CABLE OPTIONS



CONSTRUCTION

GAUGE	STRANDING	INSULATION		NOMINAL O.D.		WEIGHT LBS/1000'
		IN	MM	IN	MM	
#6	166/.010	.060	1.52	.305	7.47	106
#4	429/.010	.060	1.52	.350	8.89	160
#2	676/.010	.060	1.52	.419	10.64	241
#1	845/.010	.080	2.03	.490	12.44	315
1/0	1066/.010	.080	2.03	.530	13.46	391
2/0	1339/.010	.080	2.03	.579	14.70	478
3/0	1677/.010	.080	2.03	.632	16.05	594
4/0	2109/.010	.080	2.03	.695	17.85	735
250 MCM	2527/.010	.100	2.54	.793	20.14	884
350 MCM	3478/.010	.100	2.54	.915	23.24	1192
500 MCM	5054/.010	.100	2.54	1.380	35.05	1277



SunGen® XLPE, Photovoltaic Wire 2000 V, UL Type PV or RHW-2 Single Conductor, Copper

SPEC 5851
March, 2016



Product Construction:

Conductor:

- 12 AWG thru 2 AWG bare copper, compressed, Class B or Class C stranding per ASTM B33 and B8
- 1 AWG thru 1000 kcmil bare copper, compressed, Class B stranding per ASTM B33 and B8

Insulation:

- Flame-retardant Cross-linked Polyethylene (XLPE), black

Print:

- GENERAL CABLE® (PLANT OF MFG) SUNGEN® 2000 V PV WIRE DIR BUR OR RHW-2 (SIZE) XLPE 90°C WET OR DRY SUN RES (UL) -40°C VW-1 OR C(UL) 2000 V RPVU90 FT1 MONTH/ YEAR OF MFG SEQUENTIAL FOOTAGE MARK

Options:

- Tinned coated copper
- Other sizes and stranding options available upon request
- Now available in colors
- Available in UL 1685 CT Flame rated ≥ 1 AWG RHW-2



Applications:

- Single conductor, sunlight-resistant, direct burial photovoltaic wire rated 90°C wet or dry, 2000 V for interconnection wiring of grounded and ungrounded photovoltaic power systems as described in Section 690.31(A) and other applicable parts of the National Electrical Code (NEC), NFPA 70

Features:

- Rated 90°C wet and dry
- Rated for direct burial
- Deformation-resistant at high temperatures
- Excellent moisture resistance, exceeds UL 44
- Stable electrical properties over a broad temperature range
- Increased flexibility
- Excellent resistance to crush and compression cuts
- UV/sunlight-resistant
- Meets cold bend and cold impact tests at -40°C

Compliances:

Industry Compliances:

- UL 4703 Type PV, UL File # E343277
- c(UL) CSA C22.2 No. 271 RPVU90 File # E343277
- National Electrical Code (NEC)
- UL 44 Type RHW-2, UL File # E39406

Flame Test Compliances:

- UL 1581 VW-1

Other Compliances:

- EPA 40 CFR, Part 261 for leachable lead content per TCLP
- OSHA Acceptable

Packaging:

- Material cut to length and shipped on non-returnable wood reels

CATALOG NUMBER	COND. SIZE (AWG/kcmil)	NUMBER OF WIRES	NOMINAL COND. O.D.		MINIMUM AVG. INSULATION THICKNESS		NOMINAL CABLE DIAMETER		COPPER WEIGHT		NET WEIGHT	
			INCHES	mm	INCHES	mm	INCHES	mm	LBS/1000 FT	kg/km	LBS/1000 FT	kg/km

12 AWG - 1000 kcmil CONDUCTORS

5851.711200B	12	19/.0185	0.089	2.25	0.075	1.91	0.239	6.06	20	29	38	55
426400	10	19/.0234	0.112	2.84	0.075	1.91	0.262	6.65	32	47	53	76
426300	8	19/.0295	0.141	3.58	0.085	2.16	0.311	7.90	51	74	79	115
5851.710600B*	6	19/.0372	0.180	4.57	0.085	2.16	0.353	8.95	81	118	115	168
5851.710400B*	4	19/.0469	0.235	5.96	0.085	2.16	0.405	10.27	129	188	169	246
5851.710200B*	2	19/.0591	0.296	7.52	0.085	2.16	0.466	11.84	205	298	253	369
5851.710100B*	1	19/.0664	0.322	8.18	0.105	2.67	0.532	13.51	258	375	323	469
5851.715100B*	1/0	19/.0745	0.362	9.19	0.105	2.67	0.572	14.53	326	474	397	577
5851.715200B*	2/0	19/.0837	0.405	10.29	0.105	2.67	0.615	15.62	411	598	489	712
5851.715300B*	3/0	19/.0940	0.456	11.58	0.105	2.67	0.666	16.92	518	754	605	880
5851.715400B*	4/0	19/.1055	0.512	13.00	0.105	2.67	0.722	18.34	653	950	750	1091
5851.716250B*	250	37/.0822	0.558	14.17	0.120	3.05	0.798	20.27	772	1123	892	1299
5851.716300B*	300	37/.0900	0.611	15.52	0.120	3.05	0.851	21.62	926	1347	1057	1539
5851.716350B*	350	37/.0972	0.661	16.79	0.120	3.05	0.901	22.89	1063	1547	1202	1749
5851.716400B*	400	37/.1040	0.706	17.93	0.120	3.05	0.946	24.03	1235	1797	1383	2012
5851.716500B*	500	37/.1159	0.789	20.04	0.120	3.05	1.029	26.14	1509	2196	1674	2435
5851.716600B*	600	61/.0992	0.866	22.00	0.135	3.43	1.136	28.85	1883	2740	2084	3032
5851.716750B*	750	61/.1109	0.968	24.59	0.135	3.43	1.238	31.45	2316	3370	2540	3696
5851.717000B*	1000	61/.1280	1.117	28.37	0.135	3.43	1.387	35.23	3088	4494	3346	4869

12 AWG - 2 AWG CONDUCTORS

5851.711200B7	12	7/.0305	0.089	2.26	0.075	1.91	0.242	6.15	20	29	38	56
406400	10	7/.0385	0.113	2.87	0.075	1.91	0.266	6.76	32	47	53	77
426600	8	7/.0481	0.142	3.61	0.085	2.16	0.312	7.92	51	74	80	116
5851.710600B7*	6	7/.0612	0.178	4.52	0.085	2.16	0.348	8.84	81	118	115	167
5851.710400B7*	4	7/.0772	0.225	5.72	0.085	2.16	0.395	10.03	129	188	168	244
5851.710200B7*	2	7/.0974	0.283	7.19	0.085	2.16	0.462	11.73	205	298	252	366

12 AWG - 2 AWG CONDUCTORS

5851.7112007	12	7/.0305	0.089	2.26	0.075	1.91	0.242	6.15	20	29	38	56
5851.7111007	10	7/.0385	0.113	2.87	0.075	1.91	0.266	6.76	32	47	53	77
5851.7108007	8	7/.0481	0.142	3.61	0.085	2.16	0.312	7.92	51	74	80	116
5851.7106007*	6	7/.0612	0.178	4.52	0.085	2.16	0.348	8.84	81	118	115	167
5851.7104007*	4	7/.0772	0.225	5.72	0.085	2.16	0.395	10.03	129	188	168	244
5851.7102007*	2	7/.0974	0.283	7.19	0.085	2.16	0.462	11.73	205	298	252	366

Dimensions and weights are nominal; subject to industry tolerances.

* Non-stock item; minimum runs apply. Please contact Customer Service for price and delivery.

Heat Shrink Tube

Use of Heat Shrink Tube Extends Life of Cables & Connectors



- Protects Against Corrosion**
 Heat shrink tube protects battery cables and connectors from corrosive acid fumes near batteries. It also protects against oil, fuel, water, salt, grease, animal acids and other chemicals.
- Identifies Positive & Negative Polarity**
 Use red heat shrink tube on positive cables, black on negative cables. Color coded battery cables are easier to route and to service.
- Acts as Strain Relief & Prevents Abrasion**
 Heat shrink tube acts as a strain relief between the cable and connector. It can also be used where abrasion is a potential cause of failure. Long heavy battery cables can fail because of fatigue caused by vibration.

	MagnaTube™
Material	Polyolefin
Shrink Ratio	3:1
Wall Thickness After Shrinking	1/8"
Water Proof	Yes
Colors	Red & black
Meltable Sealant	Yes
UL Approval	Yes # 486D
Typical Use	Battery connectors - heavy duty
Operating Temperature	-55 C to +110 C -67 F to +230 F

Expanded & shrunk diameters may vary ± 15%

Heat Shrink MagnaTube

- Premium quality for heavy duty applications or for use in abusive environments requiring protection from abrasion
- Inner surface lined with adhesive sealant which melts when heated; permanently seals connection as tube cools and shrinks
- Conforms to DOD Mil-DTL-23053/15A Class 1 and 2 specifications



MagnaTube				
Expanded Diameter	Shrunk Diameter	Use With	Black	Red
3/8"	1/8"	6 - 8 Ga.	5611B	5612R
1/2"	3/16"	6 - 2 Ga.	5651B	5651R
3/4"	1/4"	4 - 2/0 Ga.	5613B	5614R
1-1/8"	3/8"	1/0 - 250 MCM	5615B	5616R
1-1/2"	1/2"	4/0 - 250 MCM	5617B	5618R
2"	5/8"	250 MCM	5619B	5619R



Cerbo GX, Cerbo-S GX and GX Touch

Cerbo GX: communication-centre

This communication-centre allows you to always have perfect control over your system from wherever you are and to maximise its performance. Simply access your system via our Victron Remote Management (VRM) portal, or access it directly, using the optional GX Touch screen, a Multi-Functional Display (MFD) or our VictronConnect app thanks to its Bluetooth capability.

GX Touch: display accessory

The GX Touch 50 and GX Touch 70 series are display accessories for the Cerbo GX. The five inch and seven inch touch screen displays are available in two versions: top/wall (GX Touch 50 and 70) or flush mount (GX Touch 50 and 70 Flush). They give an instant overview of your system and allows you to adjust settings. Simply connect the display to the Cerbo GX with just one cable. The GX Touch displays have a waterproof design and are simple to install. The supplied (from serial number HQ2242 – not for GX Touch Flush) protection cover prevents damage from UV light during prolonged exposure to the sun.

Remote Console on VRM

Monitor, control and configure the Cerbo GX remotely, over the internet. Just like if you were standing in front of the device, using Remote Console. The same functionality is also available on the local network LAN, or using the WiFi Access Point of the Cerbo GX.

Perfect monitoring & control

Instantly monitor the battery state of charge, power consumption, power harvest from PV, generator, and mains, or check tank levels and temperature measurements. Easily control the shore power input current limit, (auto)start/stop generator(s) or change any setting to optimise the system. Follow up on alerts, perform diagnostic checks and resolve complications remotely.

Simple mounting and configuration

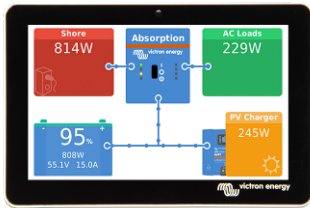
The Cerbo GX is easily mountable and can also be mounted on a DIN-Rail using the DIN35 adapter small, (not included). Its separate touchscreen can be bolted on a dashboard, eliminating the need to create perfect cut-outs (like with the Color Control GX). Connection is easy via just one cable, taking away the hassle of having to bring many wires to the dashboard. The Bluetooth feature enables a quick connection and configuration via our VictronConnect app.



Cerbo GX



Accessories included with the Cerbo GX



GX Touch (optional display for Cerbo GX and Cerbo-S GX)



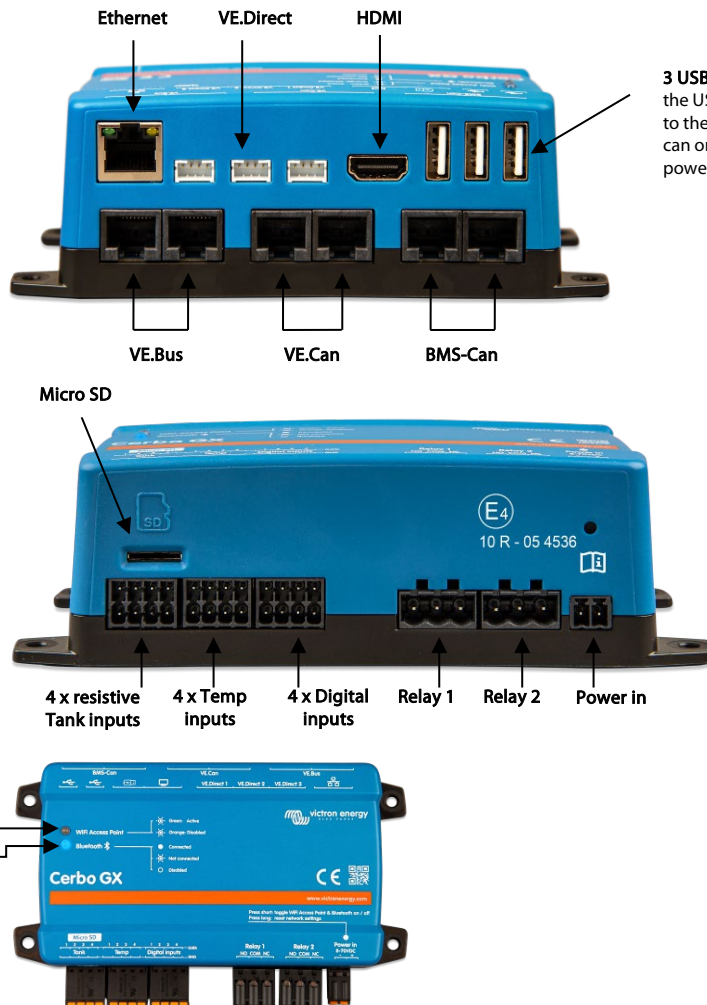
GX Touch 50 & 70 protective plastic cover (not for the Flush model)

WiFi indicator LED

The Cerbo GX can connect to a WiFi Network

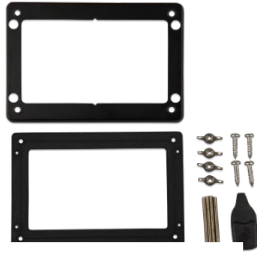
Bluetooth indicator LED

The Cerbo GX can be accessed directly via Bluetooth using the VictronConnect app.



3 USB ports the USB socket closest to the HDMI connector can only be used to power a GX Touch

Cerbo GX, Cerbo-S GX and GX Touch



Accessories included with the GX Touch 50 / 70

Optional accessories for GX Touch 50 / 70 only



GX Touch adapter for CCGX cut-out

This adapter is designed to easily replace the CCGX display with the newer GX Touch 50 or the GX Touch 70. Contents of the packaging are the metal bracket, the plastic bezel, and four mounting screws.



Accessories included with the GX Touch 50 / 70 Flush



Temperature sensor for Quattro, MultiPlus and GX Device (such as the Cerbo GX)



DIN35 adapter small
DIN-Rail adapter to easily mount a device on a DIN-Rail. Suitable for the Cerbo GX.

	Cerbo GX (PN BPP900450100)	Cerbo GX BPP900450110 + BPP900451100	Cerbo-S GX
Supply voltage	8 – 70 VDC		
Power draw without GX Touch	2.8 W @ 12 V		
Power draw with GX Touch	Backlight off: 3.8 W @ 12 V Backlight at max: 4.8 W @ 12 V		
Mounting	Wall or DIN rail (35 mm) ⁽²⁾		
Communication ports			
VE.Direct ports (always isolated)	3 (max. possible VE.Direct devices: 15) ⁽³⁾		
VE.Bus (always isolated)	2 paralleled RJ45 sockets		
VE.Can	Yes - non isolated	Yes VE.Can 1 isolated VE.Can 2 non-isolated	Yes – non-isolated
BMS-Can port	Yes – BMS-Can only	Yes – see VE.Can	No
Bluetooth	Yes ⁽⁴⁾		
Ethernet	10/100 RJ45 socket - isolated except shield ⁽⁷⁾		
WiFi	Built-in		
USB	2 USB Host ports & 1 power only port	3 USB Host ports	2 USB Host ports & 1 power only port
IO			
Resistive tank level inputs	4		0
Temperature sense inputs	4		0
Digital Inputs	4 ⁽⁶⁾		4 ⁽⁶⁾
Relays ⁽⁵⁾	2 x NO/NC DC up to 30 VDC: 6 A DC up to 70 VDC: 1 A AC: 6 A, 125 VAC		
Other			
Outer dimensions (h x w x d)	78 x 154 x 48 mm		
Operating temperature range	-20 to +50 °C		
IP Rating	IP20		
Standards			
Safety	IEC 62368-1		
EMC	EN 301489-1, EN 301489-17		
Automotive	ECE R10-6		
	GX Touch 50 / GX Touch 70		GX Touch 50 Flush / GX Touch 70 Flush
Mounting	Top/wall mount with included mounting accessories		Flush mount or embossed (totally flush)
Protection cover	Included with every GX Touch from serial number HQ2242 Can also be purchased individually: Part # BPP900462050: GX Touch 50 protection cover Part # BPP900462070: GX Touch 70 protection cover		No
Display Resolution	GX Touch 50: 800 x 480GX Touch 70: 1024 x 600		
IP Rating	IP54 (without connectors)		IP65 (when installed with the included rubber gasket)
Outer dimensions (h x w x d)	GX Touch 50: 87 x 128 x 12.4 mm GX Touch 70: 113 x 176 x 13.5 mm GX Touch 50 Flush: 94 x 136 x 12 mm GX Touch 70 Flush: 120 x 184 x 13 mm		
Cable length	2 meter		
Notes			
1. For more detailed information about the Cerbo GX and the GX Touch, please visit the Victron GX product range page at Victron live: www.victronenergy.com/live/venus-os:start			
2. DIN rail mounting requires an additional accessory - DIN35 adapter small .			
3. The listed maximum in above table is the total connected VE.Direct devices such as MPPT Solar Charge controllers. Total means all directly connected devices plus the devices connected over USB. The limit is mostly bound by CPU processing power. Note that there is also a limit to the other type of devices of which often multiple are connected: PV inverters. Up to three or four three phase inverters can typically be monitored on a CCGX. Higher power CPU devices can monitor more.			
4. Bluetooth functionality is intended to be used to assist with initial connection and networking configuration. You cannot use Bluetooth to connect to other Victron products (e.g. SmartSolar charge controllers).			
5. In Cerbo GX hardware there are two relays. Currently, Relay 1 can be used for programming as an alarm relay, generator start/stop, tank pump, temperature-controlled relay or manual operation. Relay 2 is available for programming as a temperature-controlled relay or manual operation in the Relay menu of the GX (requires firmware 2.80 or higher).			
6. The digital inputs on the Cerbo GX PN BPP900450100 and Cerbo-S GX are not able to do pulse counting.			
7. On Cerbo GX PN BPP900450110 and BPP900451100, the RJ45 sockets are rotated 180 degrees to make it easier to remove the cable.			

THANK YOU!

TURNSTILES.us

COMPANY BRIEF

www.TURNSTILES.us, Inc.
Small Business

CAGE: 36SD8
GSA: GS 07F 9239S
DUNS: 181428611
NAICS: 238990
SIC: 1799

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TURNSTILES.us is a professional organization specializing in the physical and electronic securing of building entrances with Turnstiles, Mantraps, EntraPASS Access Control Hardware, and Software since 1989. We are a U.S. Federal Government Contract Holder and are registered with the U.S. Federal Government System for Award Management.

TURNSTILES.us headquarters is located in the Rocky Mountain Region of Colorado. Our team of engineers and sales professionals are strategically located across the United States to enable us to address our clientele. Our expert project team offers turnkey solutions for commercial public sector and private markets including access control system analysis, design, installation, and implementation, and raises the bar for the highest standards in the turnstile security industry.

