RENOGY

TRUSTED **ENERGY** SOLUTIONS

RENOGY SOLAR

Installation & Maintenance Manual

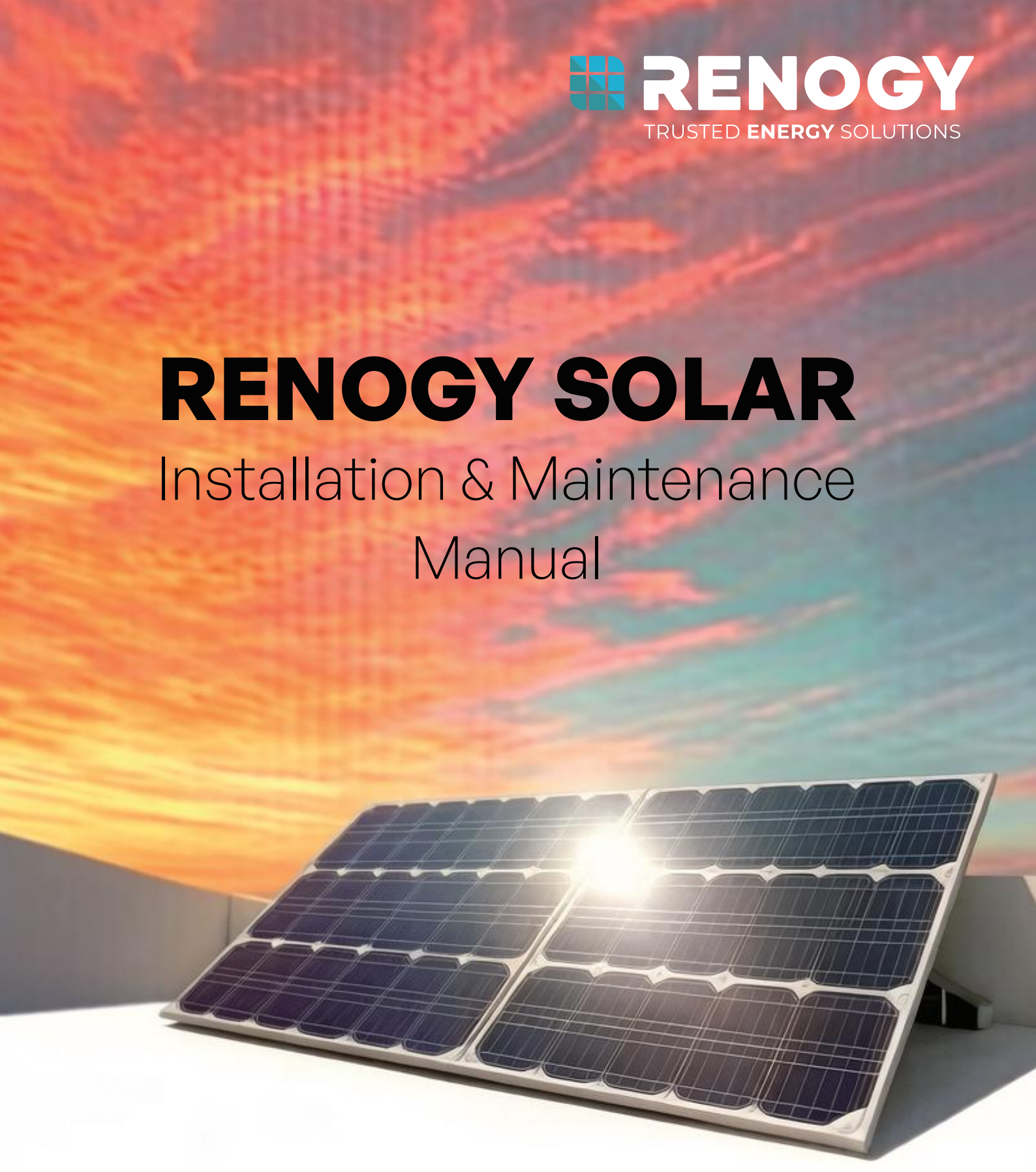








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Thank you for choosing Renogy solar panels! This manual is designed to provide you with comprehensive, clear guidance on the installation and maintenance of your solar panels, helping you safely and efficiently complete system setup and long-term use. The content covers the entire process from basic electrical knowledge to specific installation scenarios, with a strong emphasis on safety practices to ensure you and your equipment remain in optimal condition.

This manual is divided into five core sections. We recommend reading them in order:

1. **Product Specifications & Electrical Basics** – The foundation of system design. Includes interpreting electrical performance parameters, series/parallel logic, cable sizing, fuse calculation, and grounding requirements. Strongly recommended to read first.
2. **Installation Scenario Guides** – Specific mounting solutions and operating instructions for three typical scenarios: RVs, outdoor camping, and residential energy storage.
3. **Operation & Maintenance** – Daily cleaning, periodic inspections, and tilt angle adjustments to help you maintain peak generation efficiency and extend service life.
4. **Troubleshooting (FAQ)** – Diagnostic steps and solutions for common issues (reduced power output, no output, etc.).
5. **Safety & Compliance Statements** – Safety warnings, regulatory requirements, and product disclaimers.

Important Note: The content of this manual is specifically written for the installation, electrical connection, and maintenance of Renogy solar panels themselves. When connecting your solar panels to a charge controller, inverter/charger, battery, or other system equipment, you must also follow the instructions provided with those devices. This manual is based on U.S. NEC standards; users in other regions must comply with all applicable local electrical and building codes.

The meanings of the icons on the solar panel nameplate are as follows (specific icons may vary by model):

Symbol	Description	Symbol	Description
	Fragile		Read and understand the instruction manual before use.
	Materials used are recyclable.		Do not dispose of the product together with household waste.
RENOGY JAPAN株式会社	Corporation (Kabushiki Kaisha)		CE mark of conformity EU/EEA Importer
	Product complies with FCC requirements.		Restriction of Hazardous Substances compliant
	Australian compliance certifications		UKCA mark of conformity
	Product complies with ISED Canada requirements.		Caution, risk of electric shock.
	The quality control of products and services meets international standards.		Hot parts! Burned fingers when handling the parts. Wait one-half hour after switching off before handling parts

C US	Through testing and evaluation by CSA	C US Intertek	Passed safety standard tests.
	Double insulation		Product complies with KC Mark certification

1. Product Specifications & Electrical Basics

1.1 How to Obtain Solar Panel Electrical Performance Parameters

You can find the electrical performance parameters on the product specification table on the official website and on the label on the back of the solar panel.

Nominal electrical performance values (Short Circuit Current (Isc), Open Circuit Voltage (Voc), Maximum Power (Pmax)) are obtained under Standard Test Conditions: irradiance 1000 W/m^2, cell temperature 25°C/77°F, air mass AM1.5.

Low-Temperature Voltage Correction: $Voc_corrected = Voc_STC \times [1 + \beta \times (25 - T_min)]$

β is negative (e.g., -0.003), T_min is the lowest local temperature (°C). It is recommended to add a 10–20% safety margin after calculation.

Understanding solar panel parameters primarily helps you:

1. Meet power needs – Confirm that the power output is sufficient.
2. Ensure equipment safety – Avoid voltage, current, or power exceeding device ratings.
3. Extend system life – Choose stable, reliable, durable panels.

1.2 First, Check Your Energy Device Parameters

Before connecting panels in series or parallel, first check the parameters of your energy device (e.g., charge controller or inverter/charger). Understand three key values:

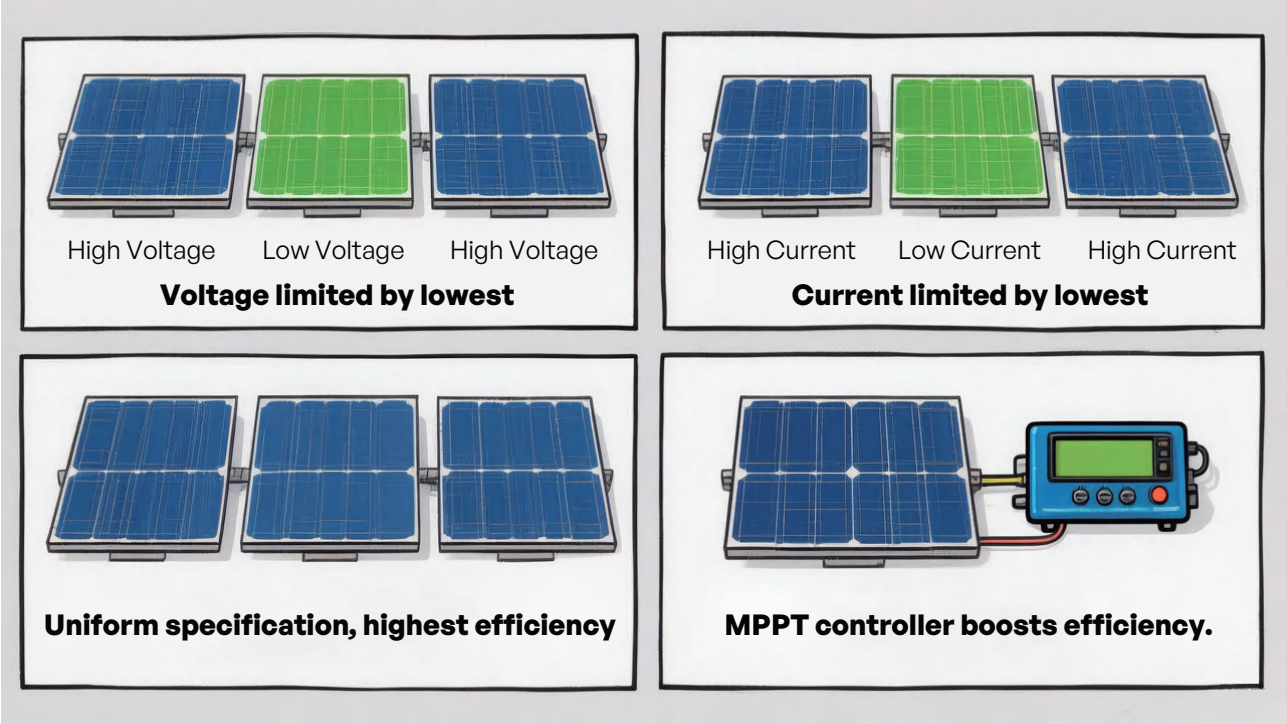
- PV maximum input power
- PV input voltage range
- PV maximum input current.

Then, based on those values, determine the series/parallel logic. Regardless of how you connect them, the resulting parameters must NOT exceed the energy device's PV maximum input power, PV input voltage range, or PV maximum input current. Exceeding these may damage the energy device.

1.3 Solar Panel Series and Parallel Connections

1.3.1 Pre-connection Recommendations

It is strongly recommended to use panels of the same specification and same batch. Mixing different brands, power ratings, or ages will significantly reduce generation efficiency and increase safety risks.



1.3.2 Parameter Changes After Connecting Panels in Series or Parallel

1.3.2.1 Series Connection

Simple mnemonic: Series increases voltage, current stays the same, power always adds up.

In the formula, 1, 2, or 3 represents the solar panel number respectively.

Item	Solar Panels in Series
Maximum Output Power (W)	$W_1 + W_2 + W_3 + W...$
Open-Circuit Voltage (U)	$U_1 + U_2 + U_3 + U...$
Short-Circuit Current (I)	$I_1 = I_2 = I_3 = I...$

1.3.2.2 Parallel Connection

Simple mnemonic: Parallel increases current, voltage stays the same, power always adds up.

In the formula, 1, 2, or 3 represents the solar panel number respectively.

Item	Solar Panels in Parallel
Maximum Output Power (W)	$W_1 + W_2 + W_3 + W...$
Open-Circuit Voltage (U)	$U_1 = U_2 = U_3 = U...$
Short-Circuit Current (I)	$I_1 + I_2 + I_3 + I...$

Note: If you are paralleling strings that are already in series, use the total power, total voltage, and total current of each series string for the calculation. If paralleling individual panels, use each

panel's individual values.

1.3.3 Step-by-Step Series/Parallel Guide

In actual installation, you may need to perform series/parallel connections. This section guides you through the process and safely connecting to your energy device (e.g., charge controller or inverter/charger).

1.3.3.1 Total Power

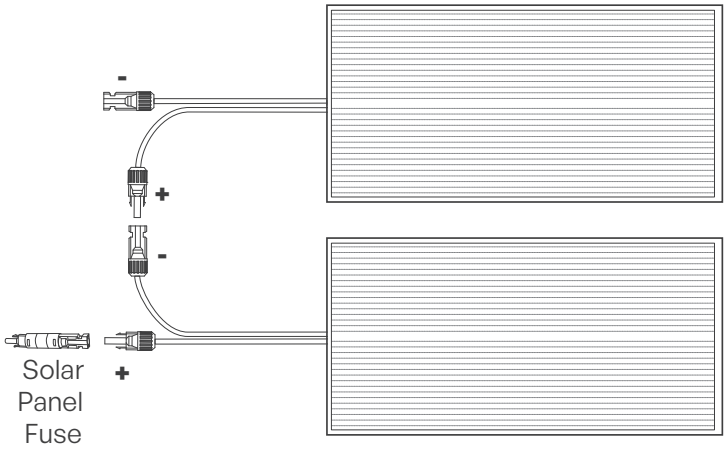
Add up the power of all panels. The total power must be less than the energy device's PV maximum input power, or it may burn out the device.

1.3.3.2 First, Connect in Series

When connecting panels in series, the sum of their open-circuit voltages (total Voc) must not exceed the energy device's PV maximum input voltage; exceeding this will damage the device. If it exceeds, reduce the number of panels in series until the total voltage meets the requirement.

For this series string, total Voc = sum of individual panel Voc, and output current equals the short-circuit current of a single panel.

Based on the determined series count, you can build multiple identical series strings (i.e., strings).

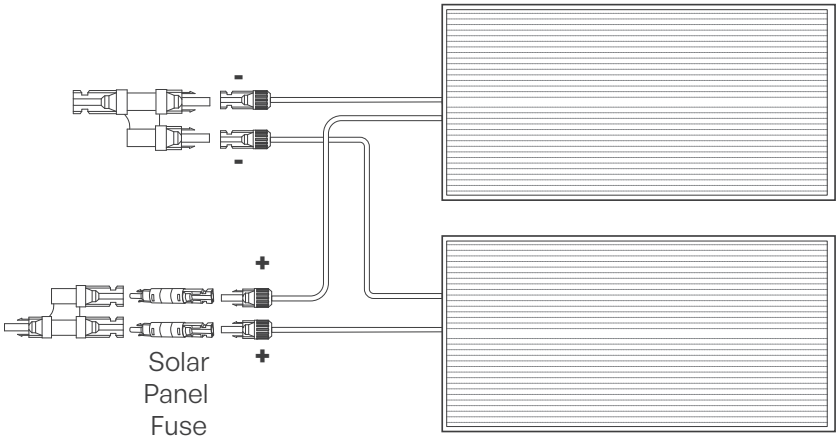


1.3.3.3 Then, Connect in Parallel

When paralleling multiple series strings, add their short-circuit currents together to get the total output current of the entire series-parallel array. This total current must be less than the energy device's (e.g., inverter or controller) PV maximum input current; exceeding this will damage the device. If it exceeds, reduce the number of paralleled strings.

Before paralleling, you must ensure that each series string has the same open-circuit voltage, short-circuit current, and power to avoid circulating currents or imbalance.

Additionally, each series string should be equipped with its own overcurrent protection device (e.g., solar fuse) and blocking diode.

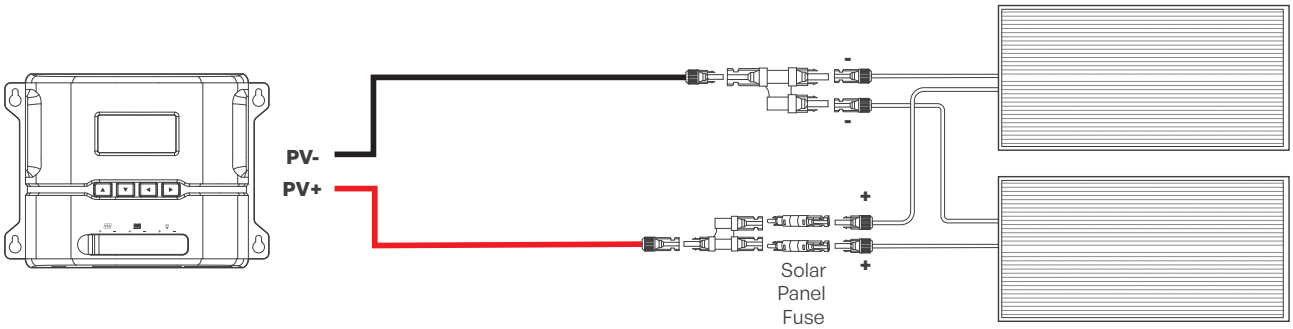


1.3.4 Cable Selection

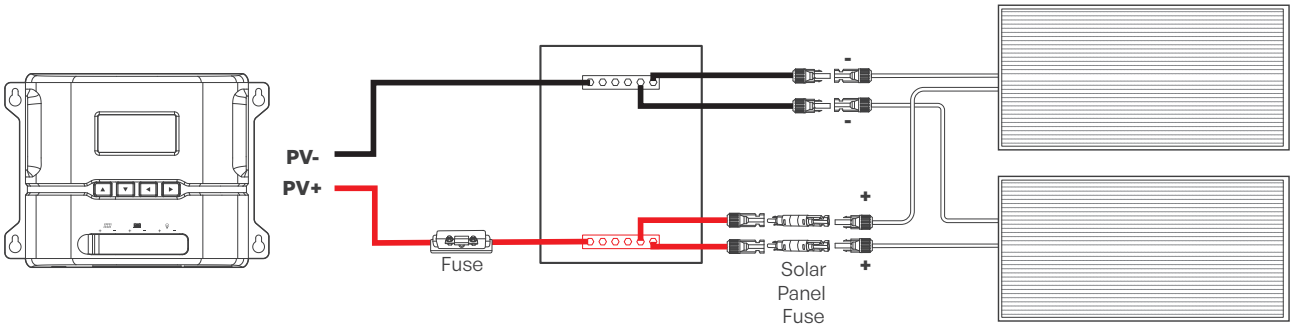
Important: You must use weather-resistant, UV-resistant PV1-F certified solar cables that comply with local regulations. Minimum bending radius ≥ 43 mm / 1.69 in.

PV cables sold on the market with MC4 waterproof connectors are typically 12 AWG / 4 mm^2 or 10 AWG / 6 mm^2. Their maximum current rating is 20A.

- Total current ≤ 20A – You can directly use Y-branch connectors.



- Total current > 20A – It is recommended to use a DC combiner box or bus bar, then use a thicker gauge main cable to connect to the energy device. After combining the total output, no additional fuse is required (though you may install one if desired).



The table below is based on copper PV cable (90°C/194°F temperature rating), DC voltage drop ≤ 3%, ambient temperature ≤ 40°C/104°F. For ambient temperatures > 40°C/104°F, the ampacity must be adjusted according to NEC 310.15(B) correction factors (e.g., for 90°C/194°F insulation at 40°C/104°F, correction factor is 0.91, a ~9% derating). When multiple cables are run in conduit, further derating of 15–25% is required.

Fuse Size	Cable Length	Cable Gauge Size
0 - 10A	0–16.4 ft / 0–5 m	12 AWG / 3.33 mm^2
10 - 20A	0–26.2 ft / 0–8 m	10 AWG / 5.26 mm^2
20 - 30A	0–32.8 ft / 0–10 m	8 AWG / 8.37 mm^2
30 - 40A	0–39.4 ft / 0–12 m	6 AWG / 13.30 mm^2
40 - 50A	0–49.2 ft / 0–15 m	4 AWG / 21.15 mm^2
50 - 60A	0–59.1 ft / 0–18 m	3 AWG / 26.67 mm^2
60 - 70A	0–65.6 ft / 0–20 m	2 AWG / 33.62 mm^2
70 - 80A	0–82.0 ft / 0–25 m	1 AWG / 42.41 mm^2
80 - 90A	0–98.4 ft / 0–30 m	1/0 AWG / 53.49 mm^2
90 - 100A	0–114.8 ft / 0–35 m	2/0 AWG / 67.43 mm^2
100 - 150A	0–131.2 ft / 0–40 m	4/0 AWG / 107.22 mm^2

The table provides typical recommendations. For precise sizing, calculate based on your specific system voltage, cable length, and allowable voltage drop. For more accurate calculations, refer to NEC Table 310.16 (US) or CSA C22.1 Tables 2/4/5 (Canada).

Renogy offers inter-panel extension cables (SKU: RNG-EXTCB, 10/12 AWG, max length 40 ft) and panel-to-controller extension cables (SKU: RNG-AK, 10/12 AWG, max length 40 ft).



- Keep connectors dry and clean, and ensure the connector nut is tightened before connecting. Do not connect if wet, dirty, or in any other unfavorable condition.
- Connectors that are not mated positive-to-negative are not waterproof. After installing panels, connect them as soon as possible or take measures to prevent ingress of moisture and dust.
- Avoid exposing connectors to direct sunlight and immersion in water. Prevent connectors from falling onto the ground or roof, which may allow particles or dust to enter and affect future use.
- Incorrect connections may produce arcs and electric shock. Ensure all electrical connections are secure. Make sure all locked connectors are fully engaged (you should hear a “click”).
- Mixing different types of connectors is not recommended.

1.3.5 Fuse / Overcurrent Protection Calculation

Calculation Formula: Fuse rating = Isc (or total Isc) × 1.56, then round up to the nearest standard fuse size.

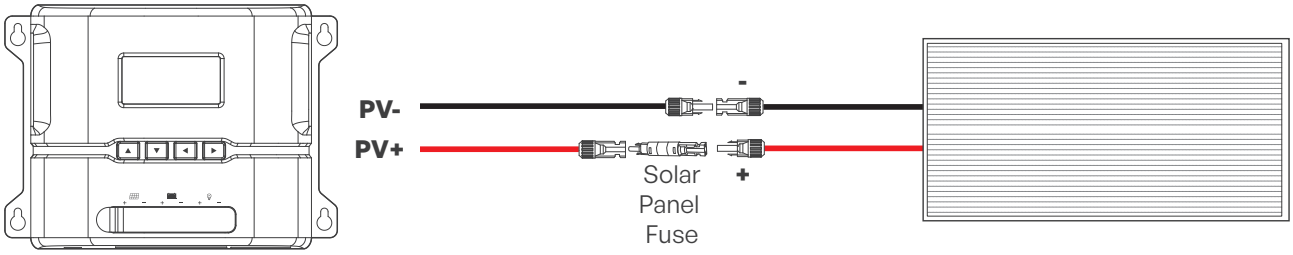
You may also refer to the table below:

Isc (or total Isc) range	Calculated value (Isc × 1.56)	Standard fuse (rounded up)
0 – 5A	≤ 7.8A	10A
5 – 8A	7.8 – 12.48A	15A
8 – 13A	12.48 – 20.28A	20A
13 – 16A	20.28 – 24.96A	25A
16 – 19A	24.96 – 29.64A	30A
19 – 23A	29.64 – 35.88A	40A

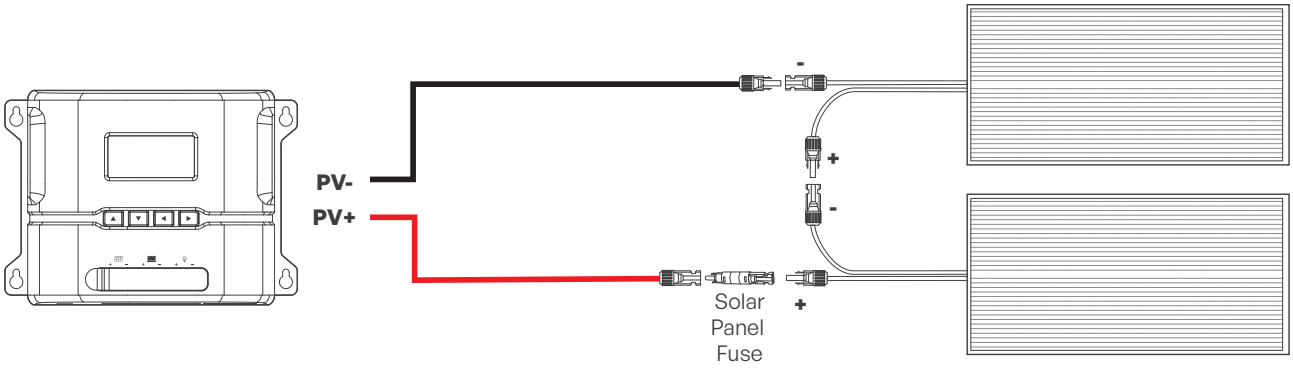
Note: When selecting a fuse, check the Maximum Fuse Rating listed in the solar panel specifications. The fuse rating must not exceed this value.

Required number of fuses:

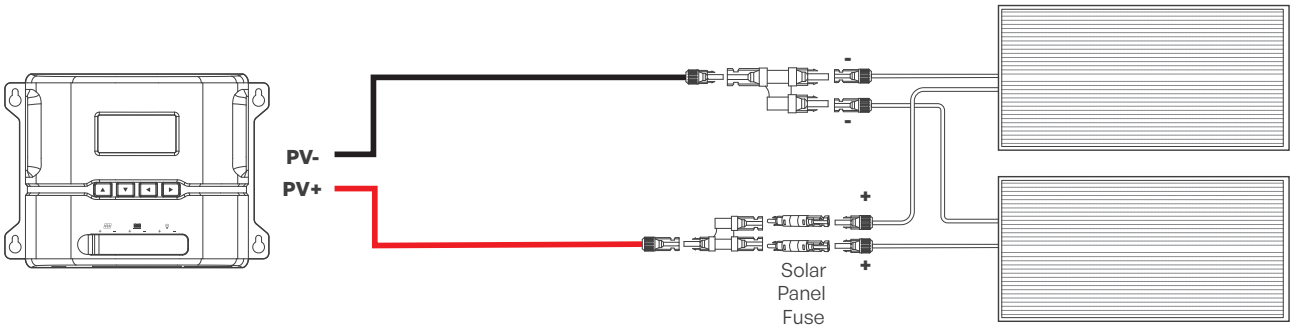
- Single panel (no parallel): One fuse on the positive output (not mandatory but recommended).



- Single series string (no parallel): One fuse on the positive output of the string (not mandatory but recommended).



- Multiple panels in parallel OR multiple strings in parallel: Each string must have its own independent fuse.



You can purchase solar fuses in the following ratings from the Renogy website (select as needed):

- 10A fuse (SKU: RNG-CNCT-FUSE10)
- 15A fuse (SKU: RNG-CNCT-FUSE15)
- 20A fuse (SKU: RNG-CNCT-FUSE20)
- 30A fuse (SKU: RNG-CNCT-FUSE30)



1.3.6 Use of Blocking Diodes

When connecting multiple panels or strings in parallel, you must install a blocking diode on each branch. This ensures current can only flow from the solar panels to the energy device, not backwards.

1.3.6.1 Why are blocking diodes needed?

When you connect two or more solar panels in parallel:

- If a panel becomes shaded, dirty, or fails, its voltage drops.
- The higher-voltage panel(s) will push current backward into the lower-voltage panel.

- Result: The low-voltage panel gets “reverse-charged,” heats up, burns out, or even catches fire.

A blocking diode specifically blocks this reverse path.

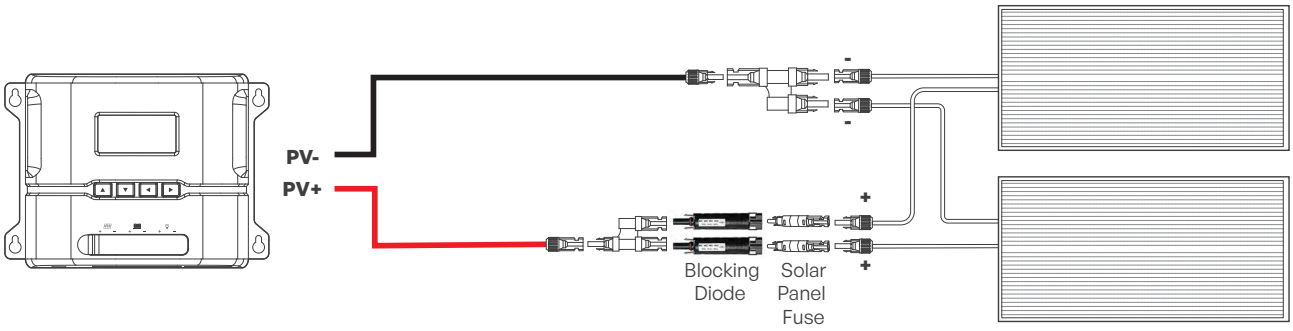
1.3.6.2 Blocking Diode Selection

- Voltage: The diode’s rated voltage must be at least 2× the system voltage.
- Current: Same as solar fuse – at least 1.5× the panel’s short-circuit current.

Note: Blocking diodes generate heat during operation and require additional heat sinking; without it they can overheat and fail. Therefore, we recommend purchasing ready-made MC4 blocking diode assemblies available on the market, which have integrated heat sinking for better safety.

1.3.6.3 How to install

Connect the blocking diode directly in series with the solar fuse, as shown in the diagram.



1.3.6.4 Common Questions

Q: For two panels in parallel, can’t I just use one diode on the combined output?

A: No. A single diode on the combined output prevents current from flowing back into the entire array, but it does not prevent current from flowing directly from one panel to another. Each branch must have its own independent blocking diode.

Q: Do blocking diodes conflict with fuses?

A: No. The diode prevents reverse current; the fuse interrupts overcurrent. They are used in series, each handling a different function.

Q: I only have one panel (no parallel). Do I need a blocking diode?

A: It depends on whether the energy device connected to the solar panel has built-in nighttime reverse-current protection.

- If yes: Not needed, because there is no other panel to feed backward.
- If no: Adding one provides extra protection, as the battery voltage may be higher than the panel voltage at night, causing a small reverse current.

1.4 Grounding

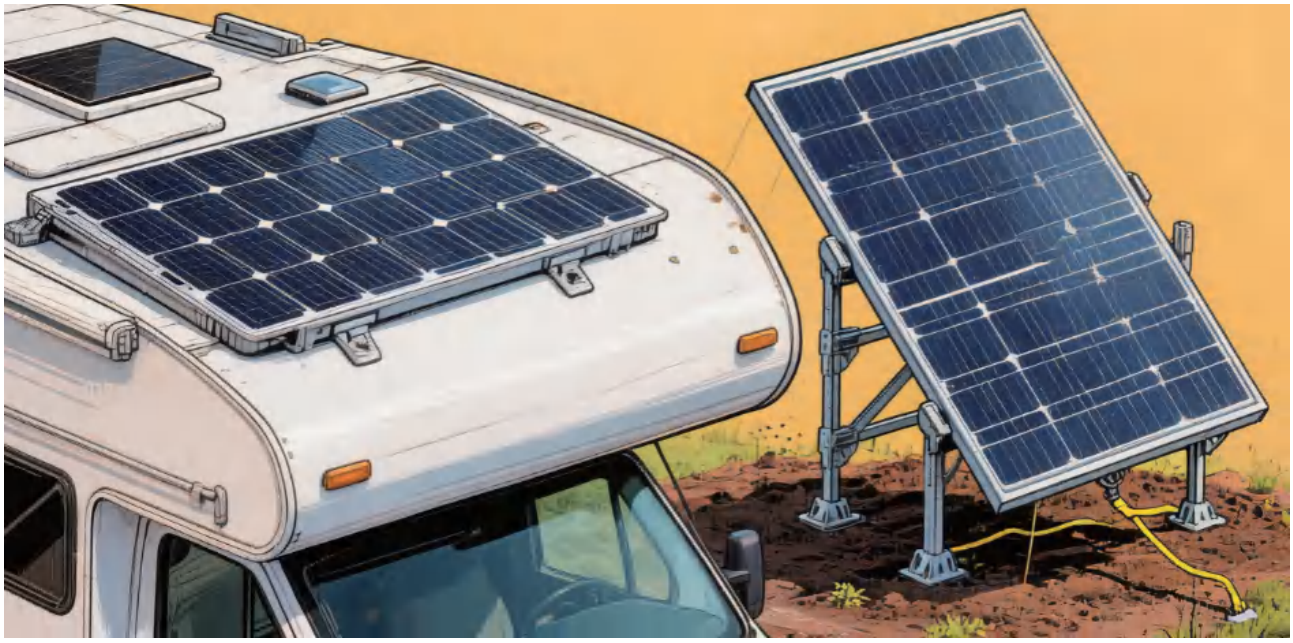
The solar panel frame (anodized aluminum) must be grounded for lightning and static protection. Use dedicated grounding hardware (e.g., ground clips, toothed washers) to penetrate the oxide film and ensure good conductivity. Do not drill extra holes (except for designated grounding holes). Grounding holes are for grounding only – do not use them for mounting brackets. If the grounding hole is blocked or not present, use a grounding clamp on the frame. The grounding conductor should be copper or compliant material and eventually connect to the earth. All metal brackets, rails, and frames must be bonded together and commonly grounded.

- RV: The solar panel metal frame contacts the RV’s metal roof through metal brackets. Additionally, prepare a separate ground rod wire – connect one end to the metal chassis, and drive the rod into the ground when parked.
- Outdoor camping: For panels with metal frames, the frame may contact the ground directly. For non-metal solar blankets/tents, the metal enclosure of the connected energy device should

contact the ground.

- Residential: The solar panel metal frame contacts metal mounting brackets; brackets have dedicated grounding points, and a cable connects these to the earth.

Note: Dry sand or asphalt surfaces provide poor grounding. The grounding area soil should be as moist as possible. If too dry, sprinkle water to increase soil moisture.



1.5 Safety Practices

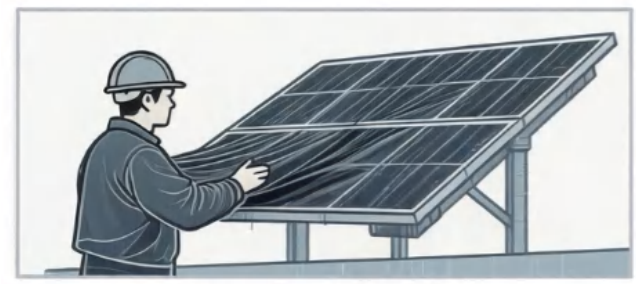
1.5.1 Personal Protective Equipment

- Must wear insulated gloves, insulated shoes, and use insulated tools. Ensure all tools meet electrical installation safety standards.
- Recommended to wear a hard hat to prevent falling objects or accidental impacts.
- Recommended to wear safety glasses to protect eyes from dust, debris, or arc flash.
- When working at heights (e.g., roof installation), must use fall protection such as a safety harness and lanyard to prevent falls.
- Do not wear metal jewelry, including rings, watches, earrings, nose rings, lip rings, etc., to prevent accidental contact with live parts causing electric shock.

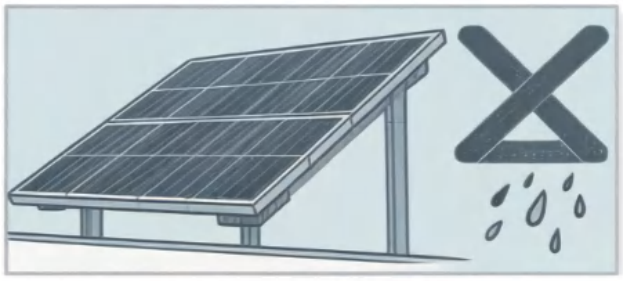


1.5.2 Pre-Installation Preparation

- Solar panels do not have an on/off switch. Before installation, completely cover the light-facing surface with an opaque material (e.g., cloth, cardboard) to prevent working on energized equipment.
- Do not work in bad weather, such as rain, snow, or high winds.
- Avoid outdoor installation during high-temperature periods (recommended 11 AM – 3 PM) and take precautions against heat stroke. It is recommended to stop outdoor work when ambient temperature exceeds 35°C/95°F.
- Before starting work, check that all tools are in good condition and that insulated tools show no damage or aging.



Shading treatment



Avoid bad weather



Avoid high temperature hours



Tool inspection

1.5.3 Electrical Safety

- 30V DC or higher can be lethal. Take appropriate precautions and avoid direct contact with live parts.
- Never disconnect electrical connections under load – this will create arcs and shock hazards.
- Connectors must remain dry, clean, and in good working condition. Do not insert any metal objects into connectors.
- Do not touch or operate solar panels with broken glass, detached frames, or damaged backsheets unless the panel has been electrically disconnected and you are wearing protective equipment.
- In wet conditions, do not touch solar panels or connectors unless wearing insulated protective gear.
- Do not open the junction box or replace internal components (e.g., diodes) without authorization.

2. Installation Scenario Guides

2.1 RV Installation

2.1.1 Tilt Angle Selection

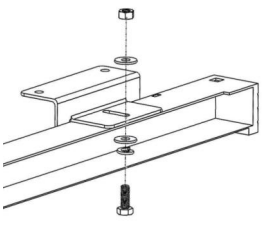
Because RVs are mobile, flat mounting is usually the most practical and safest method. If you use adjustable brackets, you can set them to the local latitude tilt angle during long-term stationary camping for maximum power generation.

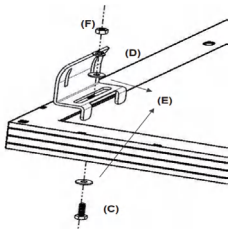
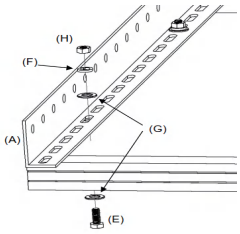
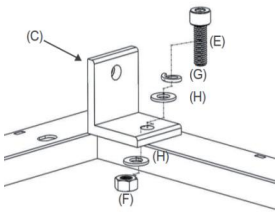


2.1.2 Rigid Monofacial / Bifacial Panel Mounting

- Use the pre-drilled mounting holes (M6 or M8) with bolts, flat washers, spring washers, and nuts.
- Recommended torque: M6 bolts 8–10 N·m, M8 bolts 12–15 N·m.
- Maintain at least 10 cm / 3.94 in ventilation gap between the brackets and the roof to prevent heat buildup.
- All fasteners must include locking measures (spring washers / threadlocker) to prevent loosening from vibration while driving.
- The roof must be able to withstand wind and snow loads. Thin sheet metal roofs require reinforcement.

Recommended mounting kits (SKU as shown on actual product):

SKU	Number per set	Bolt size	Pictures	Installation schematic
MTS-ZB	4	M6		

SKU	Number per set	Bolt size	Pictures	Installation schematic
MTS-ACB	4 (Each set has 2 parts)	M6		
MTS-TMB	1 Set for 1 panel	M6		
MTS-TM100	1 Set for 1 panel	M8		
MTS-CB	1 Set for 1 panel	/		This mounting method requires no additional drilling and is suitable for all Renogy solar panels. The module needs to be pre-fixed with silicone for installation.

2.1.3 Flexible Panel Mounting (Silicone Adhesive Method)



Application: Curved roofs, irregular surfaces.

Steps:

1. Clean the roof surface and the panel backside (isopropyl alcohol or dedicated cleaner) – no oil, no dust.
2. Apply neutral-cure structural silicone sealant (e.g., Dow Corning 995, Sika 252) along the long edges of the panel.

- Bead width: 6–10 mm / 0.24–0.39 in
- Thickness: 3–5 mm / 0.12–0.20 in
- Spacing between beads: approx. 10 mm / 0.39 in

3. Critical: Do not seal all four edges. Leave the short edges open for drainage and heat dissipation.

- Apply a small amount of double-sided tape on the short edges for temporary positioning.
- Within 5 minutes of applying adhesive, place the panel in position and lightly press with a roller along the adhesive beads.
- Gap between adjacent panels: 5–10 mm / 0.20–0.39 in.
- Allow 72 hours to cure, protected from direct sunlight, rain, and driving during that time.

Non-flat (corrugated) roofs:

- Ensure at least 6 adhesive contact lines. If not possible, flexible panels are not suitable.
- After the silicone cures, you may optionally add M5/M6 bolts (torque 5–7 N·m) as auxiliary fastening.

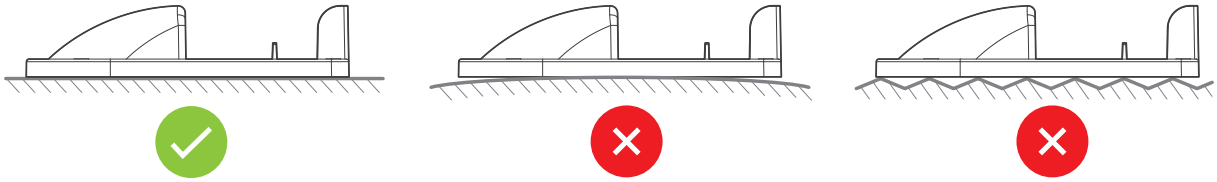
Bending limitation: The actual installed bend angle ≤30°. Exceeding this will cover >30% of the panel area and cause significant power loss.

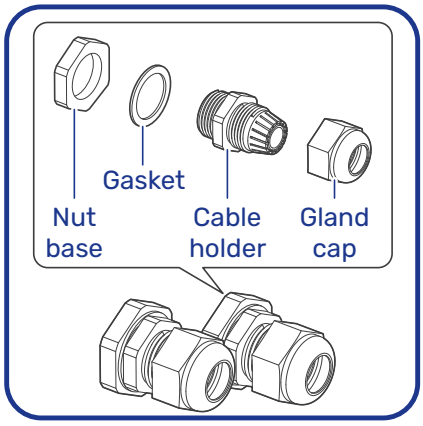
2.1.4 How to Route Cables Into the Vehicle

You can use the Renogy Solar Double Cable Entry Gland. The Renogy Solar Double Cable Entry Gland is a UV-resistant, waterproof ABS plastic membrane designed to provide a cable entry solution through roofs. With its dual cable entry, the entry gland box easily passes solar cables and can be conveniently mounted on virtually any roof surface.

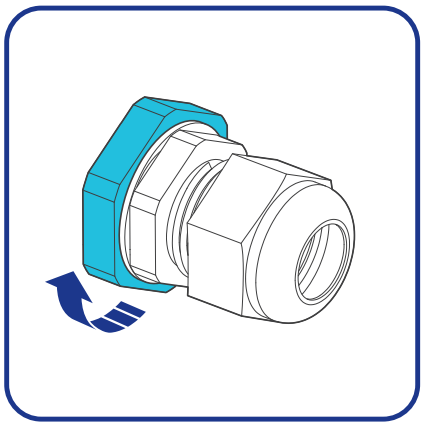
Products may be updated over time, and while the appearance may differ, the installation method is essentially the same. This manual uses RMT01CE as an example.

To ensure proper sealing and waterproof performance, install the entry gland box on a flat surface with no other cables underneath.

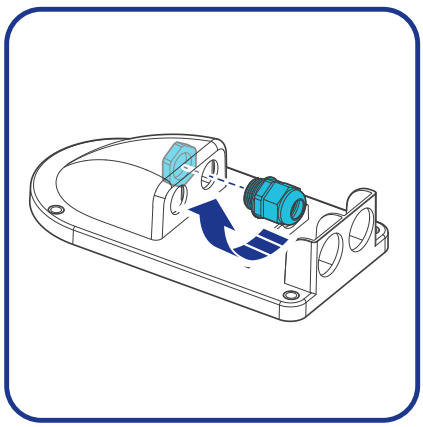




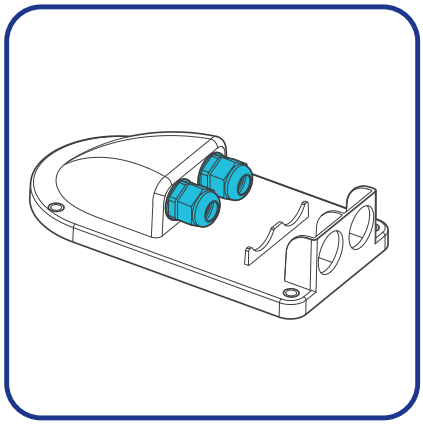
1. Install the included cable glands in a sequence as listed in the left illustration. A cable gland comprises a nut base, a gasket, a cable holder, and a gland cap.



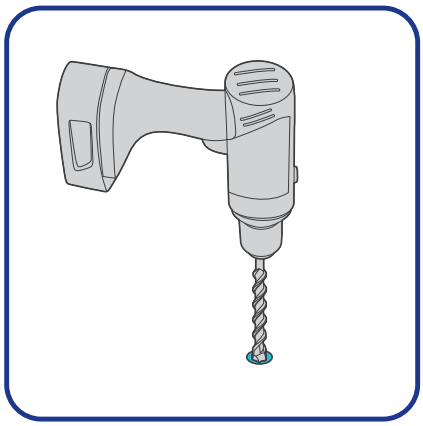
2. Remove a nut base from a cable gland by rotating it clockwise.



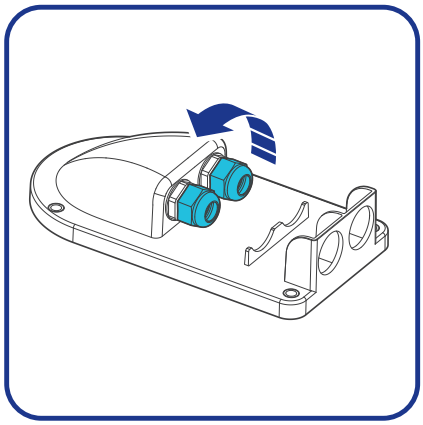
3. Place the nut base inside the gland box as shown in the illustration. Run the rest of the cable gland through the grommet into the nut base. Rotate the gland cap clockwise to secure the gland to the box.



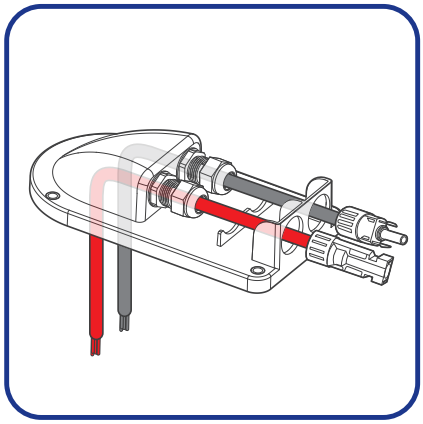
4. Repeat Steps 2 to 3 on the other gland, and ensure both glands are firmly secured.



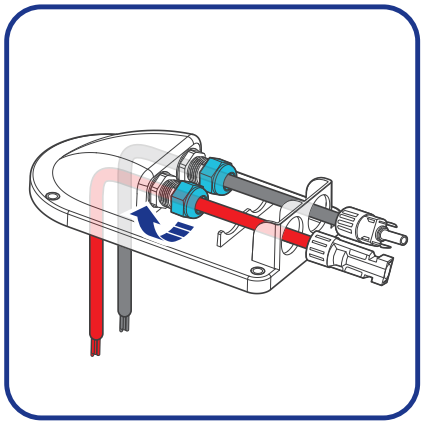
5. In this manual, we drill one grommet for both cables using an impact driver with a 31/32 in Masonry drill bit. You can drill two grommets in accordance with the specific cable size in actual applications.



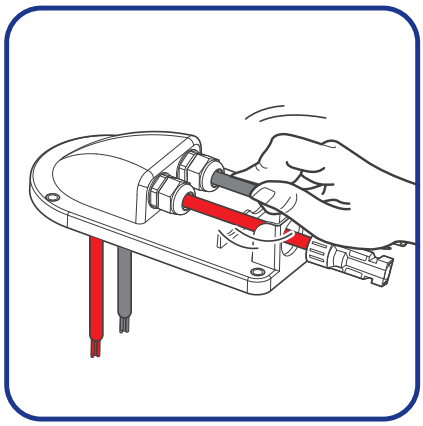
6. Loosen the gland caps by rotating them counterclockwise. The grommet should be large enough to accommodate MC-4 connectors.



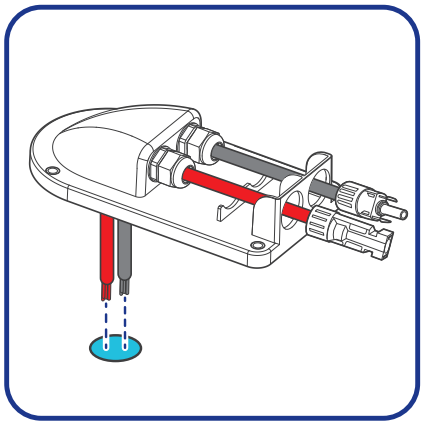
7. Run the bare ends of MC-4 adapter cables through the front grommets and cable glands.



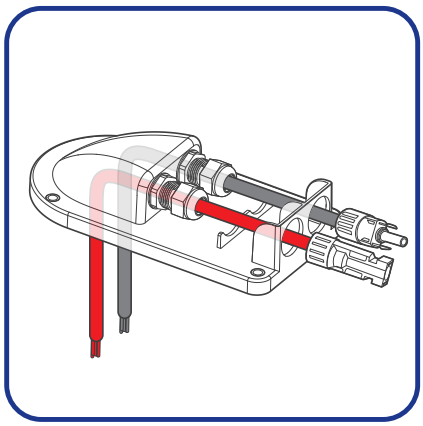
8. Rotate the gland caps clockwise to secure the MC-4 adapter cables.



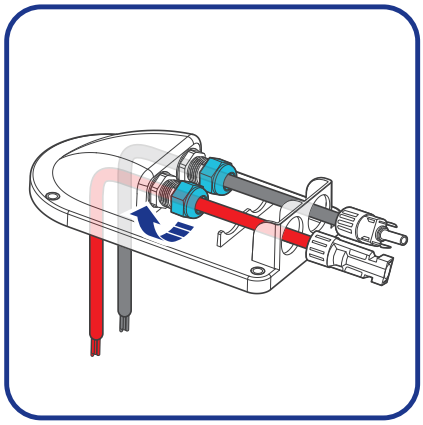
9. Ensure both MC-4 adapter cables are firmly secured.



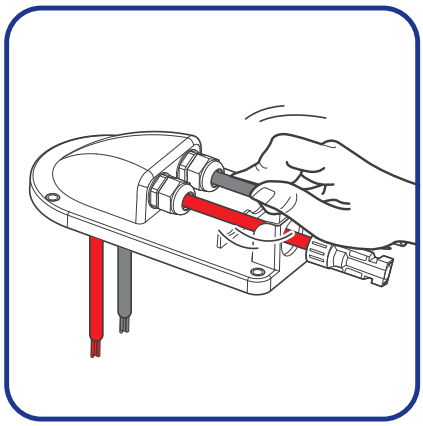
10. Run bare ends of both MC-4 adapter cables through the cable grommet on your installation site.



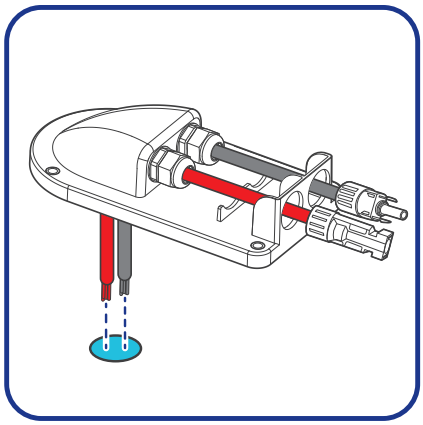
11. Run the bare ends of MC-4 adapter cables through the front grommets and cable glands.



12. Rotate the gland caps clockwise to secure the MC-4 adapter cables.

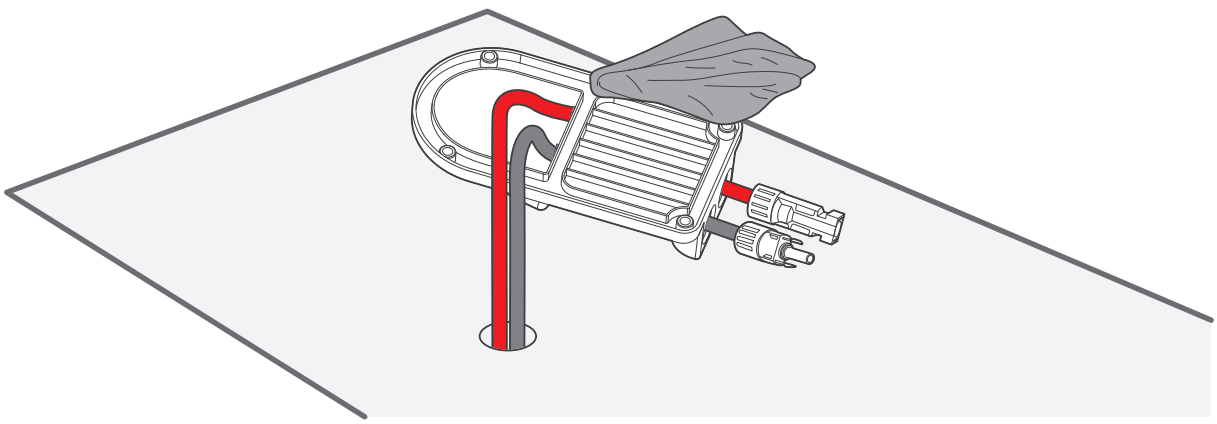


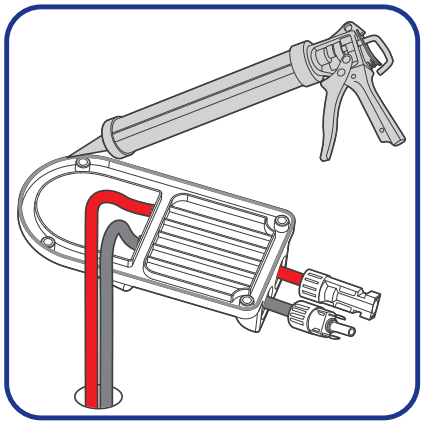
13. Ensure both MC-4 adapter cables are firmly secured.



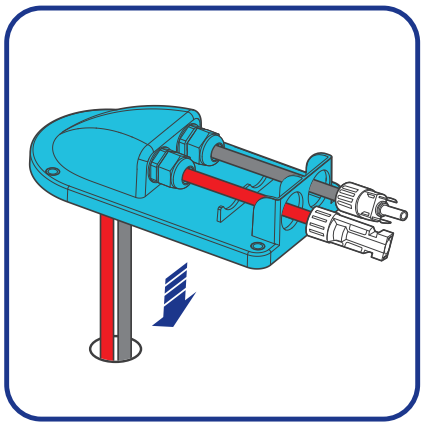
14. Run bare ends of both MC-4 adapter cables through the cable grommet on your installation site.
You can remove the gland caps from the gland to facilitate cable installation.

15. Wipe the bottom of the entry gland box and the surface of the installation site with a cleaning rag to ensure they are clean and dry; otherwise, it will affect the sealing performance. If necessary, roughen the surface of the installation site for better sealing.

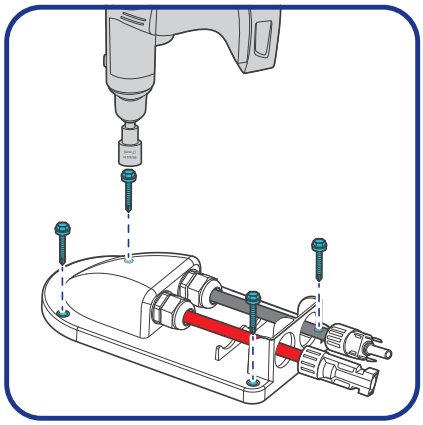




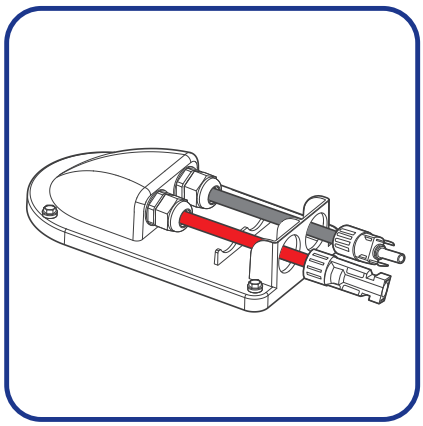
16. Apply adhesive to the bottom of the gland box where it will make contact with the flat mounting surface.



17. Attach the gland box to the mounting surface vertically to ensure they are in close contact.

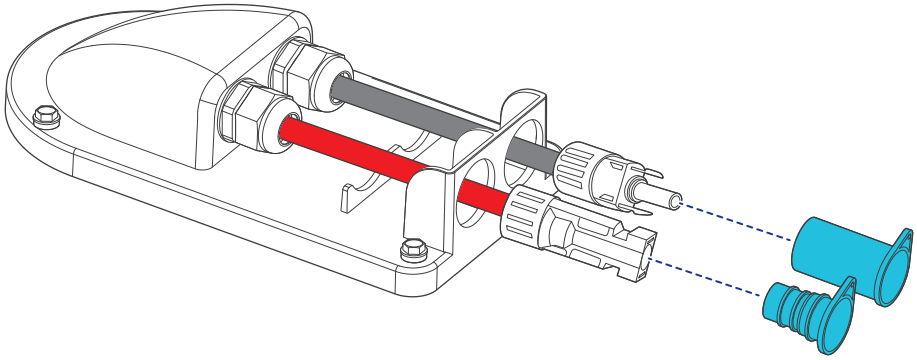


18. Hold the entry gland box in place to prevent it from moving during installation. Secure the gland box by driving the four included self-tapping screws through the mounting holes by using an impact driver and a 19/64 in. socket.



19. Let the gland box sit until the MS adhesive is fully dry.

20. For solar panels that will not be used for a period of time, we recommend that you should install the included waterproof heads on the MC-4 connectors to protect them from rain and oxidation.



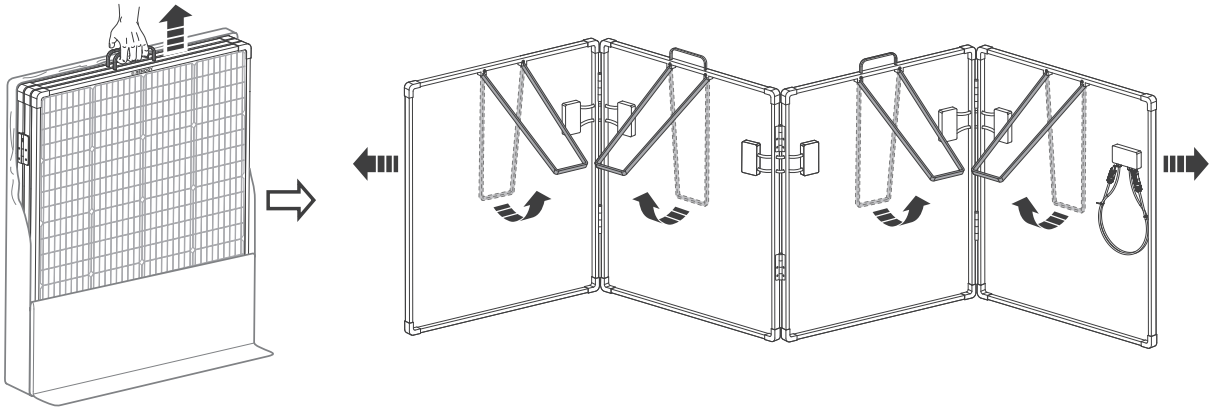
2.2 Outdoor Camping

For outdoor camping, we recommend using a solar blanket or portable solar panel paired with a portable power station. Their characteristics are as follows:

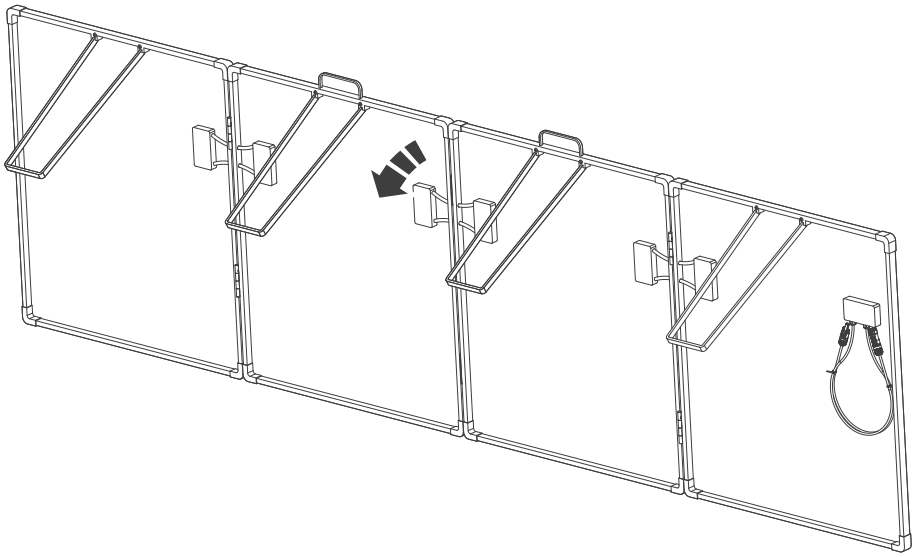
- Solar blanket: Lightweight design, easy to carry. Some models also feature USB ports for directly powering USB devices.
- Portable solar panel: Slightly heavier than a solar blanket, but offers higher generation efficiency. Paired with a high-capacity portable power station, it effectively relieves power anxiety.

2.2.1 Fixed and Portable Solar Panels

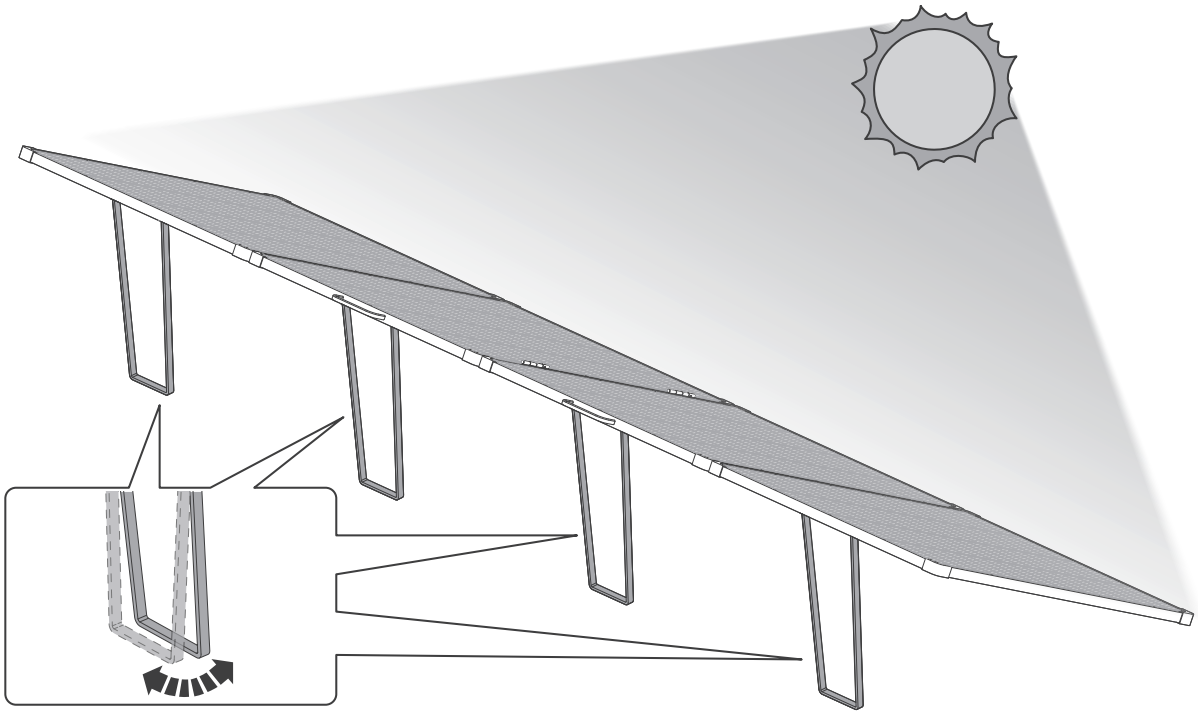
Open the packaging bag, grasp the handles and pull it upwards to extract the portable solar panel section and raise the brackets to their maximum positions.



Fully unfold the portable solar panel and place it on the ground.



Adjust the angle of the brackets to ensure the stability of the portable solar panel, with the light-receiving surface is facing towards the sun.



2.2.2 How to Charge Your Electronic Device?

Place the solar panel under direct sunlight and adjust the angle for maximum exposure.

Steer clear of trees or branches that can shade the solar panel and slow down the charging process. Connect devices to the solar panel's USB Ports using USB charging cables.

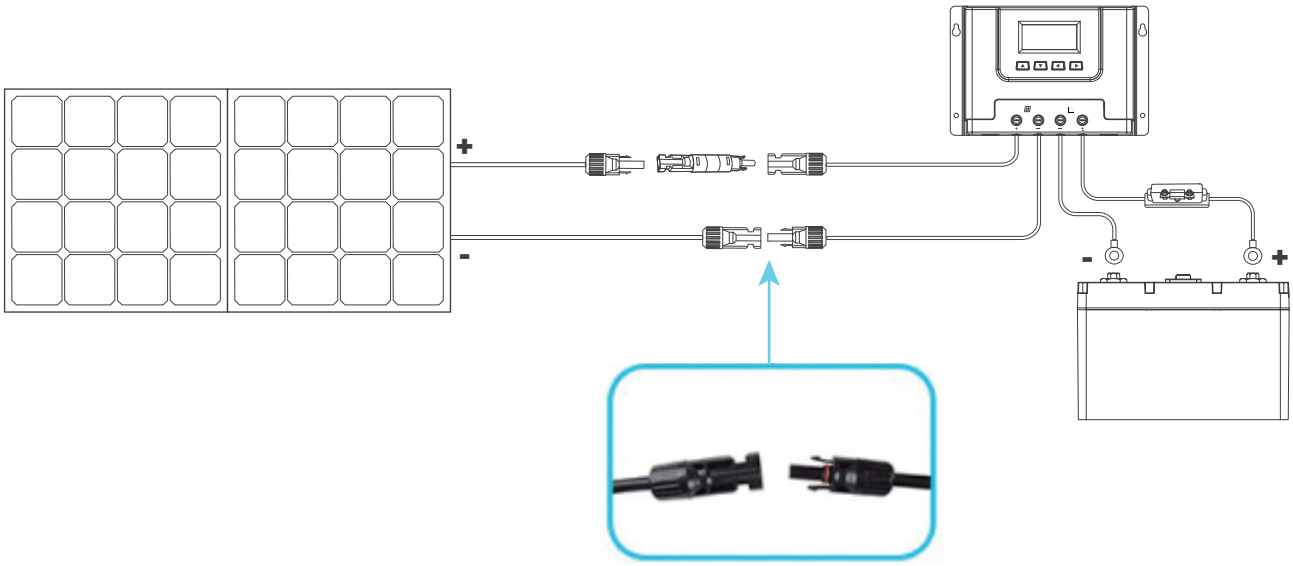
2.2.3 How to Charge a Battery?

The illustration in this section is based on a scenario involving one solar panel with a charge controller and a battery. Similar rules apply to other scenarios. The user manuals of your charge controller, battery charger, battery, and inverter charger shall prevail.

Step 1: Connect the battery terminals of the charge controller to a battery using tray cables (sold separately). A battery fuse is required on the positive end to protect your battery.

Step 2: Connect a solar panel to the solar input terminals of a charge controller (sold separately). A solar panel fuse is required on the positive end to protect your charge controller.

Step 3: Set charging parameters on the charge controller in accordance with the user manual of the controller, and the solar panel is ready to charge the battery.



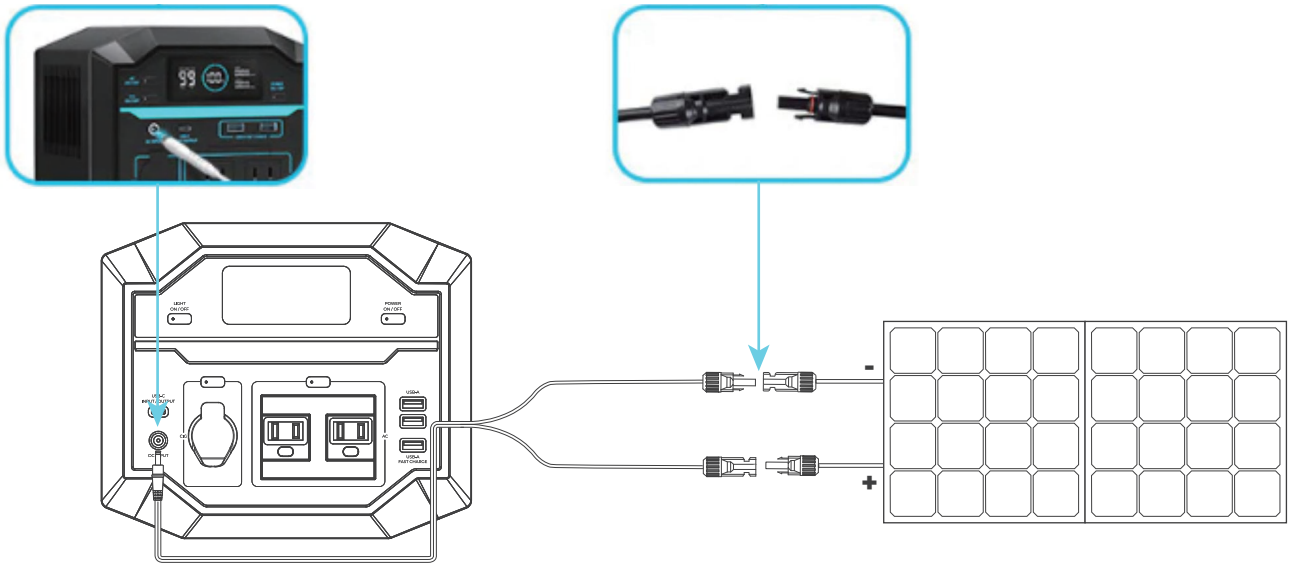
2.2.4 How to Charge a Portable Power Station?

Step 1: Place a solar panel under direct sunlight. Steer clear of objects that can shade the solar panel and slow down the charging process.

Step 2: Connect a solar charge cable (sold separately) from the MC4 solar connectors of the solar panel to the DC input port of a power station.

The solar charge time is highly dependent on the solar radiance and the ambient temperature.

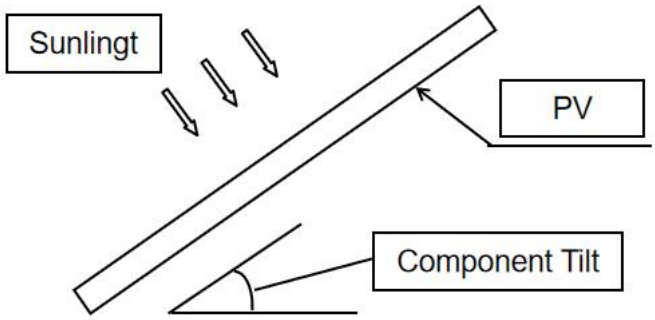
The operating voltage of the solar panel shall exceed the minimum DC input voltage of power station, and the open-circuit voltage shall not exceed the maximum DC input voltage of power station.



2.3 Residential (Home Energy Storage) Installation

2.3.1 Tilt Angle Selection

Definition: The angle between the solar panel surface and the horizontal plane. Maximum power output is achieved when the panel faces the sun directly.

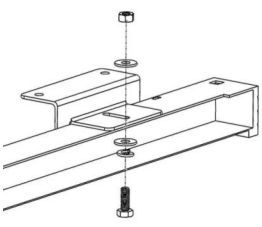


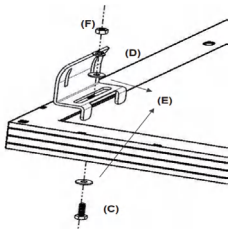
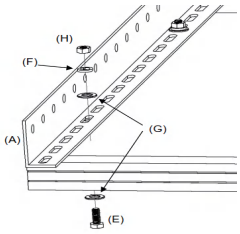
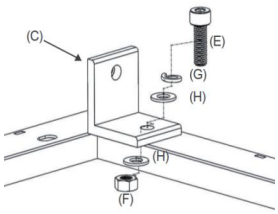
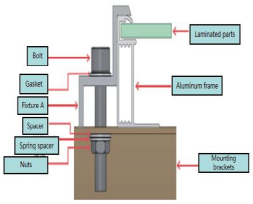
- **Orientation**: Face south in the Northern Hemisphere; face north in the Southern Hemisphere.
- **Angle**: Follow standard guidelines or recommendations from experienced installers. A tilt angle of at least 10 degrees is recommended to allow rainwater to wash away dust and ensure drainage, avoiding water stains that may affect appearance and performance.
- **Array consistency**: Multiple panels connected in series or parallel should all be installed at the same orientation and tilt angle. Different orientations or angles will cause different solar radiation exposure, resulting in power loss.
- For maximum annual power output, select the optimal tilt angle for your location, ensuring that even on the shortest sunny day of the year, sunlight still reaches the panels.
- If connected to a standalone system, the tilt angle can be adjusted seasonally. Typically, if output is sufficient at the lowest annual irradiation, that angle will meet year-round needs.

2.3.2 Roof / Ground Mount Systems

- Priority: Use certified aluminum rail + clamp systems (Renogy MTS series or third-party compatible products).
- Before installation, have a structural engineer evaluate roof load capacity (including panel self-weight, snow loads, wind loads).
- Comply with local electrical codes (US NEC/IBC, Canada CSA C22.1, Europe IEC 60364, UK BS 7671, Australia AS/NZS 5033, China GB/T 19939, Japan JIS C 8955, etc.) and utility interconnection requirements.

Recommended mounting kits (SKU as shown on actual product):

SKU	Number per set	Bolt size	Pictures	Installation schematic
MTS-ZB	4	M6		

SKU	Number per set	Bolt size	Pictures	Installation schematic
MTS-ACB	4 (Each set has 2 parts)	M6		
MTS-TMB	1 Set for 1 panel	M6		
MTS-TM100	1 Set for 1 panel	M8		
MTS-SP100	1 Set for 1 panel	M8		

2.3.3 Rigid Panel Mounting

- Secure panels to the rails using clamp blocks or bolts through mounting holes.
- Do not drill extra holes into the frame or scratch the anodized layer (except for grounding).
- For optimal heat dissipation, maintain at least 10 cm / 3.94 in ventilation gap between the panels and the roof surface. Installation location must comply with local code requirements.
- Grounding: Use dedicated grounding clamps or grounding holes to reliably ground the frame and connect to earth.



2.3.4 Flexible Panel Usage Restriction

Renogy does not recommend using flexible panels on standard residential roofs; their heat dissipation, performance, and longevity are inferior to rigid panels. If you must use them on a shed roof, curved roof, etc., refer to Section 2.1.3 (Flexible Panel Mounting – Silicone Adhesive Method) and ensure adequate ventilation gap.

3. Operation & Maintenance

3.1 Cleaning

- Clean in the early morning or evening (low voltage, low current) using a soft cloth or sponge with clean water and mild dish soap.
- Do not use a pressure washer, acid, or alkaline cleaners.
- If the glass is broken, immediately disconnect the circuit, wear insulated gloves, cover the damaged area, and contact Renogy for replacement.



3.2 Periodic Inspection (Every 6 Months)

- Visual: Glass cracks, backsheet blistering, frame corrosion, connector burn marks.
- Electrical: Measure Voc and Isc – they should be within ±5% of nominal values.
- Mechanical: Check all bolt torques, bracket rust/corrosion.



3.3 Seasonal Tilt Angle Adjustment

Because the sun's elevation angle changes with seasons, adjusting the panel's tilt angle to keep sunlight as perpendicular as possible improves generation efficiency.

Consequences of not adjusting: Panels face the sun directly only part of the time, and annual power output drops significantly. Adjusting for each season (spring, summer, fall, winter) maximizes power generation, especially at higher latitudes – winter output can increase by 20–50%.

- Summer: The sun is high, nearly overhead. If the panel is too steep, it faces away from the sun – reduce the tilt angle (more flat).
- Winter: The sun is low. Increase the tilt angle (steeper) to better face the sun.

Formula reference:

- Year-round optimum: Tilt angle ≈ local latitude (absolute value)
- Winter-biased: Tilt angle ≈ latitude + 10° to 15°
- Summer-biased: Tilt angle ≈ latitude – 10° to 15°

Summary: Regardless of which side of the equator – flatter in summer, steeper in winter.

4. Troubleshooting (FAQ)



Problem	Possible Causes	Solution Steps
Significant drop in power generation	Shading, dirt, loose connectors, diode failure	1. Remove obstructions (leaves, bird droppings, snow). 2. Clean panel surface. 3. Check all connectors are fully engaged (“click”). 4. Use a clamp meter to measure each panel’s Isc; if one is significantly low, diode may be shorted or cells damaged. 5. If normal, contact Renogy.
No output at all	Obscured panel, blown fuse, wiring error, internal open circuit	1. Confirm panel is exposed to light with no heavy covering. 2. Check fuse (continuity on multimeter). 3. Check polarity (reverse connection?). 4. Measure total Voc; if 0V, possible internal open (impact or severe hot spot). 5. Single-panel test: disconnect everything, measure Voc of that panel alone.

Problem	Possible Causes	Solution Steps
Normal voltage but low current	Partial shading, dirt, aging, shorted diode	1. Check for localized shadows (tree, antenna, bird droppings) 2. Clean panel surface. 3. Use thermal imaging or touch backside (careful – hot). If an area is noticeably hot, possible shorted diode. 4. Contact Renogy for confirmation.
Connector overheating	Not fully mated, contact oxidation, mixing incompatible types	1. Disconnect immediately. Check metal terminals for oxidation or melting. 2. Reconnect fully until “click”. 3. If damaged, replace with same-spec MC4 connectors (Renogy original parts recommended). 4. Do not mix brands.
Frame corrosion	Drain holes blocked, anodized layer scratched	1. Clear drain holes, ensure they are open. 2. Light corrosion: sand lightly with fine sandpaper, apply rust-preventive paint. 3. Heavy corrosion: replace panel. 4. In future, avoid scratching frame during installation.
Power fluctuates widely under similar light conditions	Temperature effects, loose connector, external device issue	1. Higher Voc at low temperature is normal as long as it stays within device limits. 2. Check all connectors for tightness. 3. If panels themselves are normal, check downstream controller or inverter.
Glass broken	Hail, impact	1. Immediately disconnect that panel from the system. 2. Wear insulated gloves, cover broken area with cloth to contain glass fragments. 3. Contact Renogy for replacement or repair. Do not continue using.

If the problem persists after following these steps, contact Renogy Technical Support with the solar panel's serial number and a description of the issue.

5. Safety & Compliance Statements

5.1 Solar Panel Safety

- Do not disassemble the solar panel or remove any attached components.
- Do not puncture, drop, crush, penetrate, shake, strike, or step on the solar panel.
- Do not open, dismantle, repair, tamper with, or modify the solar panel.
- Do not place the solar panel on a surface constructed from combustible material.
- Do not expose the solar panel to direct flame or heat sources.
- Please keep the solar panel out of reach of children unless supervised by an adult.
- Please keep the solar panel away from explosives and corrosive substances.
- Do not step, walk, stand, or jump on the solar panel. Localized heavy loads may cause damage to solar cells, which will ultimately compromise the performance of the solar panel.
- Do not bend the solar panel, or the panel will break.
- Do not move the solar panel by pulling on the junction box.
- Do not immerse the solar panel in water.
- Dispose of the solar panel according to local recycling and environmental regulations.

5.2 Important Safety Summary

- 30V DC or higher can be lethal. Use insulated tools and gloves.
- Never step, stand, or jump on a solar panel – this may cause micro-cracks in cells, leading to fire.
- Installation must be performed by a licensed professional. Non-professional installation voids the warranty.
- Never disconnect electrical connections under load (arcing and shock hazard). Solar panels have no switch – cover them before working.
- Do not drill holes or scratch the anodized layer on the frame except for grounding.
- For optimal heat dissipation, maintain at least 10 cm / 3.94 in ventilation gap between panels and the roof.

5.3 Regulations & Limitations

- The user must comply with all local electrical codes, building codes, and grid-connection requirements.
- Renogy is not responsible for: acts of God, misuse, improper installation, unauthorized modification, peripheral device failure, hazardous substance contamination, etc.

5.4 Detailed Installation Safety Instructions

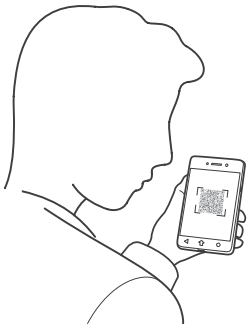
- Installation service qualification: Licensed electricians or trained professionals only.
- Warnings: Do not disassemble, puncture, drop, or place near open flame or combustibles.
- Electrical safety: Cover panels before wiring. Connectors must be kept dry and clean. Do not mix different connector brands.

- Handling safety: Carry by the frame – do not pull on junction box or cables.
- Fire safety: In case of emergency, first disconnect the DC side. Use a Class C dry chemical extinguisher. Do not use water while the system is live.
- Regulations: Where required by local codes, install appropriate rapid shutdown or DC disconnects. For grid-tie systems, consult your local utility first.

Renogy Support

To discuss inaccuracies or omissions in this quick guide or user manual, visit or contact us at:

contentservice@renogy.com



Questionnaire Investigation

To explore more possibilities of solar systems, visit Renogy Learning Center at:

renogy.com/learning-center

For technical questions about your product in the U.S., contact the Renogy technical support team through:

support@renogy.com

1(909)2877111

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Warranty Statement

For full warranty terms and conditions, visit the Warranty page of the RENOGY website at https://cdn.shopify.com/s/files/1/0631/0137/0483/files/RNG-4-243_Limited_warranty_A7_ALL_3910a2ea-f700-40f0-bfcd-daef5aaed0d7.pdf?v=1760930030.

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Renogy Empowered

Renogy aims to empower people around the world through education and distribution of DIY-friendly renewable energy solutions.

We intend to be a driving force for sustainable living and energy independence.

In support of this effort, our range of solar products makes it possible for you to minimize your carbon footprint by reducing the need for grid power.

Live Sustainably with Renogy

Did you know? In a given month, a 1kW solar energy system will...

- Save 170 pounds of coal from being burned
- Save 300 pounds of CO_2 from being released into the atmosphere
- Save 105 gallons of water from being consumed

Renogy Power PLUS

Renogy Power Plus allows you to stay in the loop with upcoming solar energy innovations, share your experiences with your solar energy journey, and connect with like-minded people who are changing the world in the Renogy Power Plus community.

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