RENOGY

THE FUTURE OF CLEAN ENERGY

Solar Panel Installation Manual

For use with:

- 50W FKT1RNG-50D/P
- 70W FKT1RNG-70P
- 100W FKT1RNG-100D/P
- 200W FKT2RNG-100D/P
- 300W FKT3RNG-100D/P
- 400W FKT4RNG-100D/P

Complete Kits

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RENOGY
THE FUTURE OF CLEAN ENERGY

1

INTRODUCTION

Your new RENOGY Solar Charging or Expansion Kit will provide you with a clean, silent, and sustainable way to ensure that batteries are fully charged and capable of providing a continuous supply of electricity while either dry- camping or in any other situation where conventional electricity is unavailable. Each kit comes equipped with a high quality solar panel that features highly efficient silicon solar cells that are manufactured within the United States. These solar cells produce DC electricity when illuminated by sunlight. If you have purchased a RENOGY Solar Charging Kit, a state-of-the-art 30 Amp solar charge controller will also be included in your package. This controller will serve as a connector between the solar panel and the storage batteries. The solar charge controller will ensure that your battery is charged with the appropriate amount of solar power, as per the battery manufacturer's recommendations. The solar charge controller comes with eight selectable charging profiles to meet the charging requirements of most standard lead acid batteries as well as Nickel Cadmium (NiCad) batteries. The LCD screen on the charge controller provides important detailed information about the system status including battery voltage and charge current. The solar charge controller is flush mountable and simple to install, which means it is ideal for mounting directly within an RV interior. The RENOGY Solar Charging Kit also includes a mounting system comprised of sturdy aluminum Z-brackets as well as the nuts and bolts required to flat mount the solar panel onto the roof or any other flat surface. If you wish to optimize your panel's collection of sunlight by tilting the panel to a different inclination, an adjustable tilt-mount may be purchased separately. The cable management hardware incorporated into this kit will enable you to effectively manage any external wiring problems you may face. If you wish to expand your system further to harness more energy from the sunlight, you may purchase one of our Solar Expansion Kits which come with a solar panel and all of the hardware necessary to mount the extra solar panels and link them to your existing system.

This manual will provide you with instructions on how to assemble the various components of the RENOGY Solar Charging and Expansion Kit. Please refer to the separate solar charge controller manual for detailed information about the installation, operation, and programming of the solar charge controller.

Please read the manual carefully before installing or operating the solar kits to prevent personal injury or damage to the components. If you have any concerns about the suitability of the kits for your application or doubts about any of the instructions in this manual please contact RENOGY Support at (909) 517-3598.

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GENERAL SAFETY

Warning
Please read the instruction manual carefully before attempting to carry out any installation and wiring. Contact Technical support for any questions concerning the installation.

Installation and wiring compliance

Installation and wiring must comply with the local and National Electrical Codes and must be done by a certified electrician.

1. Disconnect all power sources before carrying out the installation.
2. Make sure the correct polarity is observed when making connections between the solar panel, charge controller, and the battery. Damage due to reverse polarity connection is not covered by warranty.
3. Make sure all wire connections are secure, as loose connections may cause sparks.
4. Wear appropriate clothing and safety gear including protective eyewear when performing any electrical installation.

Preventing fire and explosion hazards

Working with electronic/electrical equipment may produce arcs or sparks. Thus, such equipment should not be used in areas where there are flammable materials or gases requiring ignition protected equipment. These areas may include spaces containing gasoline-powered machinery, fuel tanks, and battery compartments.

Precautions when working with batteries

- Batteries contain very corrosive diluted sulfuric acid as electrolyte. Precautions should be taken to prevent contact with skin, eyes, or clothing.
- Batteries generate hydrogen and oxygen during charging, resulting in the evolution of an explosive gas mixture.
- Care should be taken to ventilate the battery area and follow the battery manufacturer's recommendations.
- Never smoke or allow a spark or flame near the batteries.
- Use caution to reduce the risk of dropping a metal tool on the battery. It could spark or short circuit the battery or other electrical parts and could cause an explosion.
- Remove metal items such as rings, bracelets, and watches when working with batteries. The batteries can produce a short circuit current high enough to weld a ring or the like to the metal and thus cause a severe burn.
- If you need to remove a battery, always remove the ground terminal from the battery first. Make sure that all the accessories are off so that you do not cause a spark.
- Only use properly insulated tools when making battery connections.

Precautions when working with solar panels

With the incidence of sunlight or other light sources on all solar panels, a voltage appears at the output terminals of the solar panel turning it into a source of electricity. To avoid a shock hazard make sure the solar panel is covered with an opaque (dark) material such as paper or cloth during the installation. Do not make contact with the terminals when the panel is exposed to sunlight or any other light source.

Precautions when working with Charge Controller Model No. PWM__CC (5A, 10A, 30A)

If two or more solar panels are connected in a series/parallel make sure that the sum of the short circuit current ratings of all panel strings does not exceed 80% of the charge controller's current rating (i.e. 24A for the 30A charge controller). The open circuit voltage of the solar array (i.e. the maximum voltage across the array) should not exceed 26V when the 12V setting on the charge controller is used, and may not exceed 52V when the 24V setting on the charge controller is used.

3.2. Routine Maintenance

- Inspect the solar panels and make sure the surfaces are free from dust, dirt, and other debris; clean with a wet cloth or glass cleaner if necessary.
- Check to make sure all structural components, mechanical fasteners, and electrical connections are secure, clean, and corrosion-free.
- Check and maintain the battery electrolyte levels at regular intervals as per the battery manufacturer's recommendations if flooded wet cell lead acid batteries are used.
- Check and replace damaged components if necessary.

3.3. Installation Overview

1. Read the manual in detail and make sure you understand the installation procedure.
2. Open the packaging and check to make sure that all parts have been received as per the parts list in the manual.
3. Arrange for the required tools to carry on the installation. A sample list of tools (not exhaustive) is provided in Section 4.
4. Determine the mounting location of the solar panel(s).
5. Mount the charge controller at the desired location (see Section 5).
6. Pass the cable from the solar panels to the interior (See Section 6).
7. Wire the battery to the charge controller and then the solar panel to the charge controller ensuring the correct polarity is observed (See Section 6).
8. Secure the solar panel to the roof or other flat surface (See Section 7).

3

REQUIRED TOOLS & MATERIALS

3.1. Required Tools

- 1/2" drill bit
- 3/8" wrench
- 7/16" wrench
- Hand Drill
- Jigsaw or suitable cutting tool
- Philips drive screwdriver
- Pliers
- Punch or Awl
- Wire crimping tool
- Wire stripper

3.2. Required Materials

1. Silicone or any suitable roof sealant
2. Anti-galling lubricant to prevent "thread galling" of all stainless steel fasteners exposed to the outdoor environment. This should be available at most hardware or auto-part stores. If anti-galling lubricant is not available, any standard lubricant will minimize the occurrence of "thread galling".
3. If wiring distances are longer than the lengths of wire provided with the kit, extra stranded copper wire will be required. Wires should be 12 AWG or thicker, single conductor, Type UF (Underground Feeder - marked as Sunlight resistant), Type SE (Service Entrance) or Type USE/ USE-2 (Underground Service Entrance).

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CHARGE CONTROLLER INSTALLATION

1. The RENOGY Solar Kit (Eco kit and Complete Kit) comes with a PWM charge controller to optimally charge your batteries from the solar panel.
2. The Solar Charge Controller comes with a separate detailed manual. It is recommended that you read the Solar Charge Controller manual in detail. The instructions in this section are only a brief summary of the information contained in the manual.
3. Make sure the solar panels and batteries are disconnected from the charge controller before installing the charge controller.
4. The charge controller should ideally be located in an area relatively close to the battery.
5. The charge controller should be mounted indoors in a dry location.
6. Using the cutout template provided in the charge controller manual, mark the cutout on the installation surface and the location of the mounting holes.
7. Using a hand drill and suitable drill bit, drill the mounting holes.
8. Using a jigsaw or suitable cutting tool cut the material out from the installation surface.
9. After wiring the charge controller terminals (see Section 6 on wiring), fix the mounting plate to the installation surface using the screws provided with the charge controller (7 x 19, 5/8" Flat Head Tapping Screws - Philips Drive).

5

CONNECTOR SYSTEM FOR CONNECTING SOLAR PANELS

The Positive (+) and Negative (-) outputs of a solar panel are fed through a watertight junction box. The appropriate wire length is wired to the junction box for further connections. The solar panels supplied with these kits are provided with approximately 2 ft. each of Positive and Negative wires that are pre-connected to the junction box. The free ends of the wires are terminated with a special mating type of connectors （MC4 connectors) for ease in extending these wires for further connections.

In this manual, the MC-4 Series will be used for explanations. ***Please do not cut off the solar panel connectors, or the warranty will be voided.***

5.1. General Information on MC4 Connector System

MC4 Connector System consists of male and female connectors. This type of connector system is easy to install and uses a “snap-in” type of safety locking clips to lock the two mating connectors, thereby avoiding unintentional disconnection. Also, the mating contacts are sealed against ingress of dust and water. Specifications are as follows:

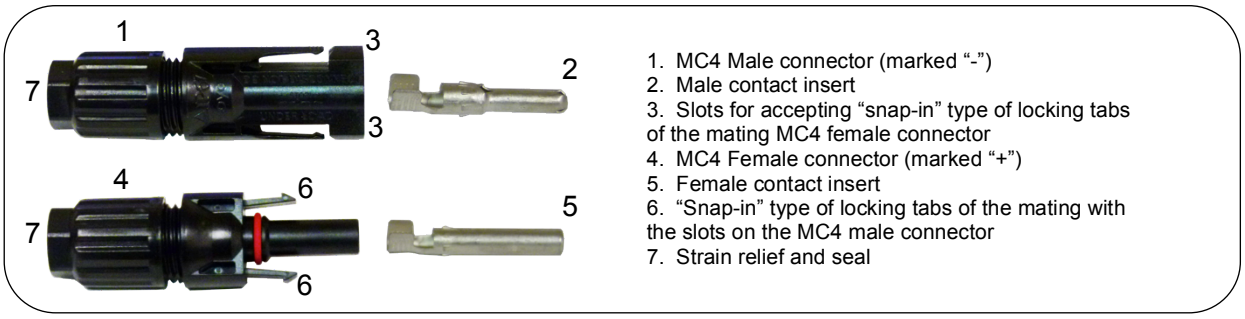
- Contact diameter: 4 mm
- Maximum rated current: 30A
- Maximum system voltage: 1000V
- Degree of ingress protection when connected and properly locked: IP67
- Temperature range: −40°C to 90+°C
- TÜV Rheinland approved

5.2. MC4 Connectors (Fig. 5.2)

The MC4 Connectors mentioned in this manual have been designated “Male” and “Female” ends based on the characteristics of the mating contact inserts inside the terminals.

In the MC4 Male Connector (No.1 of Fig. 5.2), the internal mating contact insert (No.2 of Fig. 5.2) is a male pin. It has two slots (No.3 of Fig. 5.2) for insertion of the two “snap-in” types of locking tabs (No.6 of Fig. 5.2) of the MC4 Female Connector (No.4 of Fig. 5.2) for firm mating connection. This connector is marked "–".

In MC4 Female Connector (No.4 of Fig. 5.2), the internal mating contact insert (No.5 of Fig. 5.2) is a female cylindrical socket. It has two “snap-in” types of locking tabs (No.6 of Fig. 6.2) that are inserted into the two slots (No.3 of Fig. 5.2) in the MC4 Male Connector (No.1 of Fig. 5.2) for firm mating connection. Wire is crimped to the contact inserts (2 and 5 of Fig. 5.2) using a special purpose-crimping tool designed for MC4 connectors. After the wire has been crimped, the contact insert is required to be seated securely inside the housing and the strain relief/seal (No.7 of Fig. 5.2)



1. MC4 Male connector (marked “-”)
2. Male contact insert
3. Slots for accepting “snap-in” type of locking tabs of the mating MC4 female connector
4. MC4 Female connector (marked “+”)
5. Female contact insert
6. “Snap-in” type of locking tabs of the mating with the slots on the MC4 male connector
7. Strain relief and seal

Fig.5.2. MC4 Male and Female Connectors
Note: Additional pairs of male/female MC4 connectors are also sold separately

5.3. Output Wires and Connections on the Solar Panel

Fig. 5.4 shows the output wires and connections of a solar panel. The output wires from the junction box of the solar panel are terminated with the help of MC4 connectors. The Positive (+) wire is terminated with a MC4 Female Connector (marked "+") and the Negative wire are terminated with a MC4 Male Connector (marked "-").

Warning!
When the surface of the solar panel/array is exposed to sunlight, a DC voltage appears at the output terminals turning it into a live voltage source. For example, a 24V nominal solar panel my put out an open circuit voltage of around 45VDC that may produce electrical shock. Multiple solar panels connected in a series (to increase the output voltage) will put out higher lethal voltages. To avoid any electrical shock hazard during installation, make sure that the solar panel/array is covered with an opaque (dark) material to block solar irradiation.

5.4. Extending to the Output Wires of the Solar Panel (Fig. 5.4)

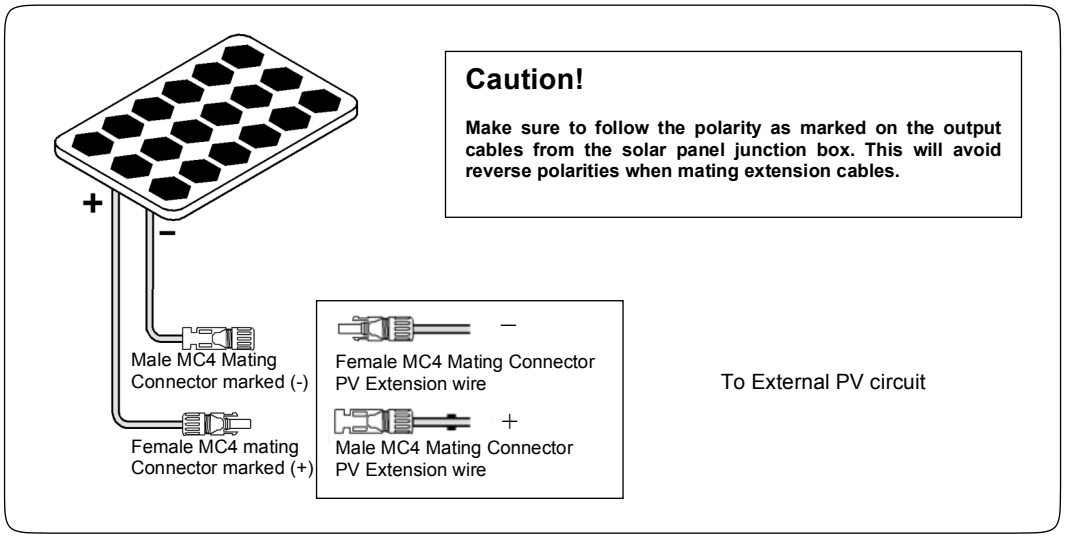


Fig 5.4. Connecting extension wires to the output wires of solar panel.

1. The Positive (+) wire of the solar panel is terminated with an MC4 Female Connector (marked "+"). Connect this cable to the MC4 Male Extension wire as shown in **Figure 5.4**. Make sure that the locking tabs "snap in" for a firm connection. The bare end of the Positive extension wire will now be of Positive polarity. ***Use a piece of red sleeve or red tape near the bare end for identification as the Positive (+) wire.***
2. The Negative (-) wire of the solar panel is terminated with a MC4 Male Connector (marked "-"). Connect this cable to the MC4 Female Extension wire as shown in **Figure 5.4**. Make sure that the locking tabs "snap in" for a firm connection. The bare end of the Negative extension wire will now be of Negative polarity.
3. Connect the two wires to the external PV circuit.

Warning!
Ensure that the polarity (+ or -) of the wires is identified correctly before connecting to a circuit or a device. Damage due to wrong polarity may not be covered under warranty.

5.5. Connecting Two Adjacent Solar Panels in Parallel (Fig. 5.5)

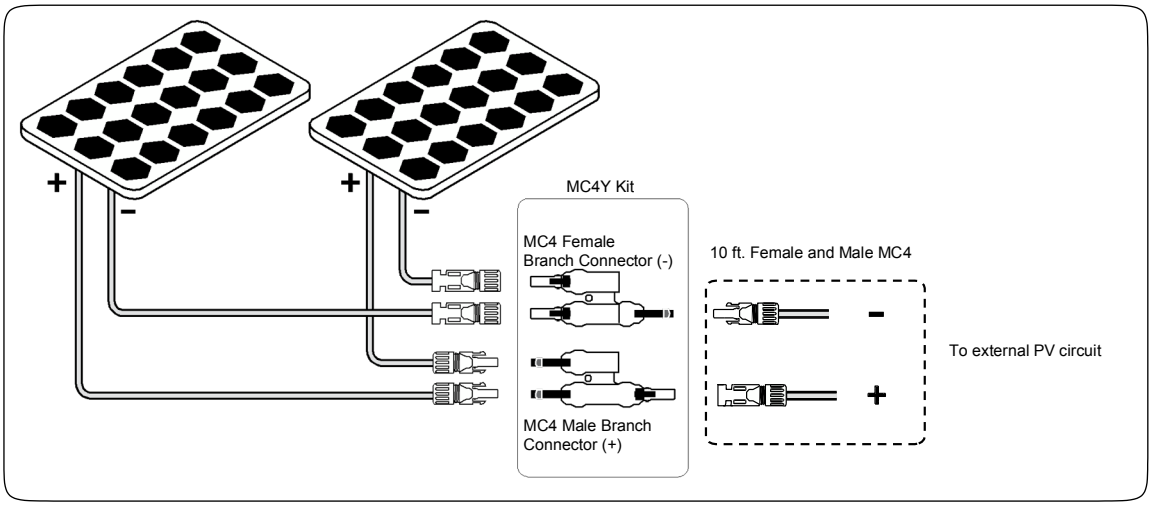


Fig. 5.5. Connecting two adjacent solar panels in parallel.

Two or more solar panels can be connected in parallel to increase the current output while the output voltage remains the same. Fig. 5.5 above shows the arrangement for connecting two solar panels in parallel using the 10 ft. Female and Male MC4 wires and one MC4 Branch Connector Kit (MC4Y). This arrangement is applicable if the two solar panels are to be mounted adjacent to one another.

The output wires of the two solar panels are first connected in parallel using the MC4 Male and Female Branch Connectors (MC4Y). The outputs of the Branch Connectors are then connected to the 10 ft. Female and Male MC4 wires. The resulting output can be connected to charge controller or external PV circuit.

5.6. Connecting Two Solar Panels in Parallel When Separated by Distance (Fig. 5.6)

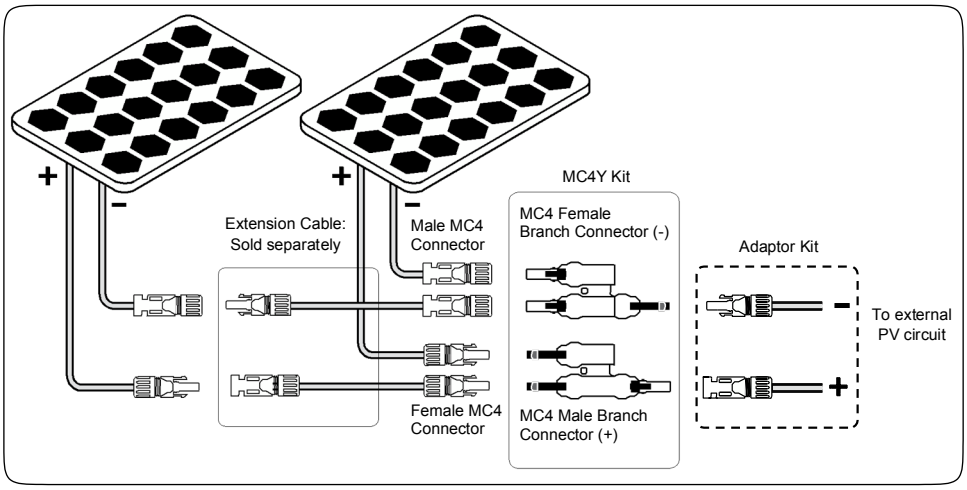


Fig. 5.6. Connecting two adjacent solar panels in parallel separated by an extended distance.

5

CONNECTOR SYSTEM FOR CONNECTING SOLAR PANELS (CONTINUED)

Fig. 5.6 above shows an arrangement for connecting two solar panels in parallel that are separated by an extended distance. In this case, the following will be required:

- Solar Extension Cables: 2 sets, sold separately as an optional item (Length to be determined).
- One MC4 Male Branch Connector and one MC4 Female Branch Connector
- Solar Adaptor Kit in pair (Length to be determined).

In this case, the two optional Solar Extension Cables and the MC4 Connector Kit “MC4Y” are first used to bridge the extended distance between the panels. Then the Adaptor Kit is used to connect to the external PV circuit.

Please note that this configuration will give you 10 ft. of wire length from solar panel to the charge controller or external PV circuit. If you want additional length, you can add extension cables in between MC4Y kit and 10 ft. Adaptor Kit sold separately.

6
WIRING

Caution!
The battery must be wired to the charge controller before the solar panel is connected to the charge controller.

A pair of 10 ft. pre-assembled cables with Multi-Contact (MC) male and female connectors is provided primarily to connect the solar panel to the charge controller. After making sure that sufficient length is available to wire the solar panel to the charge controller, any excess wire may be used to wire the battery to the charge controller (tray cable). Renogy sell the try cables separately from the solar kits.

6.1. Battery to Charge Controller

- Mark the cables to differentiate between Positive and Negative.
- Make sure the Positive terminal (marked '+') of the battery is connected to the Positive terminal (marked "BAT +") of the charge controller and the Negative terminal (marked '-') of the battery is connected to the Negative terminal (marked "BAT -") of the Charge Controller (Fig. 6.1.1). If you are not sure use a DC voltmeter to determine the polarity of the battery bank. ***Reverse polarity connection will damage the Charge Controller and the resulting damage will not be covered by warranty.***
- We recommend to crimp the insulated fork terminals (not provided, Fig. 6.1.3) to one end of the Positive and Negative battery leads.
- Insert the fork terminals (Fig. 6.1.3) or screw the bare cables into the appropriate terminal on the charge controller: Positive lead is connected to the Positive terminal (marked "BAT+") of the charge controller Negative lead is connected to the Negative terminal (marked "BAT -") of the Charge Controller (Fig. 6.1.1).
- Crimp the battery ring terminals (Fig. 7.1.2) to the Positive and Negative wire leads to be connected to the battery terminals.
- Clean the battery post terminals free of corrosion and other impurities.
- Bolt the ring terminals to the battery terminals making sure the correct polarity is observed.

Warning!
Be careful not to short the battery

Fig 6.1.1. Typical PWM Solar Charge Controller (top view) connection terminals

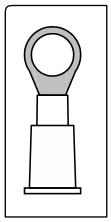


Fig 6.1.2 Battery Ring terminal

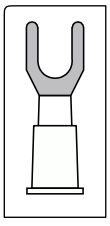


Fig 6.1.3 Fork terminal

6.2. Solar Panel to Charge Controller

1. Determine the position of the solar panel. While positioning panels, avoid shading of the solar panel by neighboring obstacles such as vents, air-conditioners, TV antennas of RV roof. Position the panels to minimize wiring distance between the solar panel and the charge controller. Place the panel at least 8-10 inches away from the roof edges and leave sufficient space to walk around the panel and access the mounting hardware.
2. Make sure the thickness of the roof at the installation location is at least ½" thick and the material is strong enough to provide mechanical support to the solar panel and mounting hardware against possible wind loading. Place the panel length-wise to reduce the effects of wind loading on the roof.

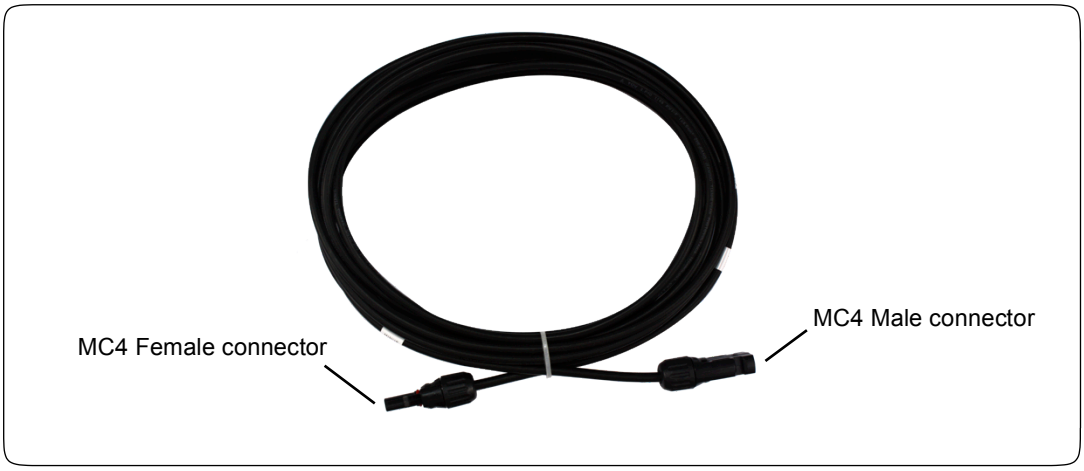


Fig. 6.2. PV extension wire

3. (A) Two pre-assembled, 10 ft., AWG #12, Positive (+) and Negative (-) PV extension wires have been provided for solar kits below 300 Watt (see Fig. 6.2). The wires have MC4 mating connectors on one end for connecting to the solar panel and bare ends on the other side for connecting to the Charge Controller. The extension cables should be marked (+) and (-) to identify the polarity from the output cables of the solar panel.
4. (B) Two 20 ft. AWG #12 solar extension cables with MC4 connectors on both ends and a pair of MC4 Adaptor kit will be provided for 400 Watt Solar Kit. The extension cables should be marked (+) and (-) to identify the polarity from the output cables of the solar panel.
5. Please read sections 6.3 and 6.4 on connecting the extension wires to the panels.

Warning!
Avoid sharp, heated, or abrasive material on the cable route.

6. It is better to crimp the bare end of the wires with the fork terminals (Fig 6.1.3).
7. Insert the terminals into the appropriate terminal on the charge controller (Fig 6.1.1): Positive PV lead is connected to the positive terminal (marked "PV +") of the charge controller and the negative PV lead is connected to the negative terminal (marked "PV -") of the charge controller. ***Reverse polarity connection will damage the Charge Controller and the resulting damage will not be covered by warranty.***

7

SOLAR PANEL INSTALLATION

1. Stainless steel can be subject to a process called “thread galling” in which bolts can twist off and/or the bolt threads seize to the nut’s thread. Apply Anti-galling lubricant available at most hardware or auto-part stores to all the stainless steel fasteners before installation. If anti-galling lubricant is not available, any standard lubricant will minimize the occurrence of “thread galling”.
2. Fix the mounting brackets (Fig. 7.2) to the frame of the previously positioned solar panel using the slotted opening and the ¼”-20 x ¾" Flange Bolt, Nylon Locknut and flat washer (Fig. 8.1)
3. Using a 7/16” wrench, tighten the nuts to secure the mounting brackets to the PV panel. Recommended tightening torque is 15 lbs.
4. Position the panel with the attached mounting brackets at the desired location and mark the position of the desired mounting hole using a suitable marker by tracing the hole on the mounting bracket. Please ensure that the mounting surface is strong enough to support the mounting hardware, solar panel, and wind loads.
5. The end holes on the mounting brackets (Fig.7.2) are sized to accept the ¼” hardware supplied with the unit.

6. A Well-Nut is a bushing of tough neoprene rubber with a flange at the top end and a captive brass nut mounted within the bore at the bottom end (Fig. 7.3). Tightening a conventional machine bolt or screw engages the captive nut thereby causing the bushing to expand outwards. This fastens securely to thinner roofs by bulging up and against the bottom surface of the roof (Fig. 7.6). If used in a blind hole in a solid surface material, the rubber will expand outwards to create a secure fastening (Fig.7.7). The neoprene and brass resist most environmental conditions. Additionally, the Well-Nut seals the drilled hole effectively against air and liquid leakage.

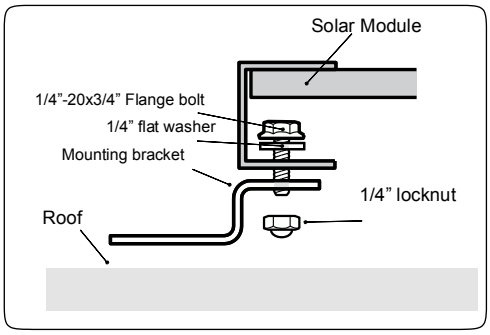


Fig. 7.1. Attaching solar panel to 5-hole mounting bracket.

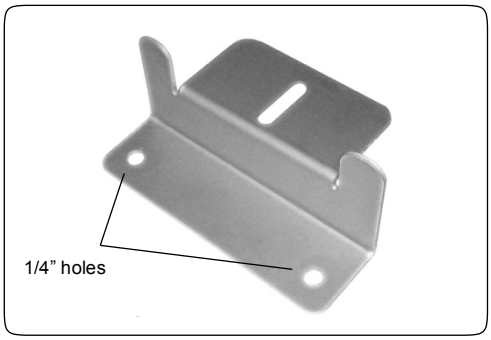


Fig. 7.2. Mounting bracket (Z Bracket).

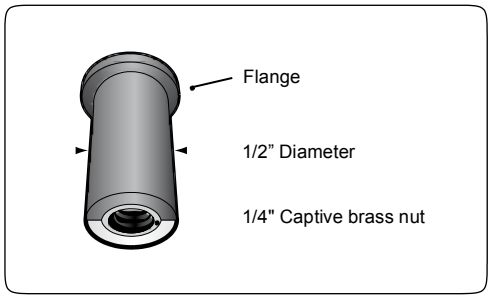


Fig. 7.3. Construction of a Well-nut

Typical Installation of a Well-Nut

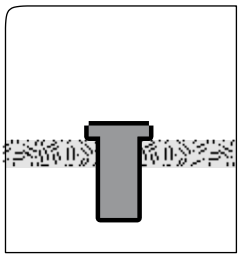


Fig. 7.4. Well-Nut is inserted into a pre-drilled hole with its flange against the outer surface. There is no need for access to the inner side.

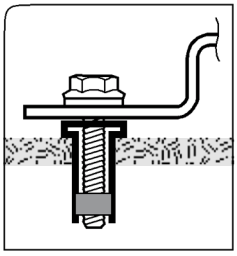


Fig. 7.5. The Z Bracket is placed against the flange of the Well-Nut and is secured by the bolt engaging the captive brass nut.

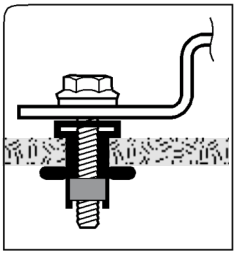


Fig. 7.6. As the bolt is tightened, the neoprene body of the Well-Nut is compressed and expanded, forcing it tightly into the bolt's threads and against the inner surface of the thin RV roof material.

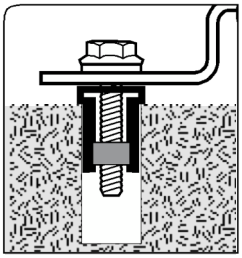


Fig. 7.7. Installed in a blind hole in a solid material, the body of the Well-Nut expands tightly against the walls of the hole, creating a secure, dependable fastening.

7. To install the Well-Nuts, drill holes 1¼" deep at the marked positions using a ½" size drill bit. Make sure that drilling does not interfere with pre-existing wiring installations.
8. Apply silicone or any appropriate sealant generously to the drilled holes for waterproofing.
9. Insert the ¼" Well-Nut into the drilled holes so that only the flange section remains above the roof surface (Fig. 7.4).
10. Fasten the mounting brackets to the roof surface by inserting the ¼ x 1¼" serrated flange bolt into the Well-Nut (Fig. 7.5). Tighten using a 3/8" wrench to a recommended torque of 15 lbs. When the serrated flange bolt is screwed into the Well-Nut, the material surrounding the well nut bulges slightly securing the structure to the roof (Fig. 7.6 & 7.8).

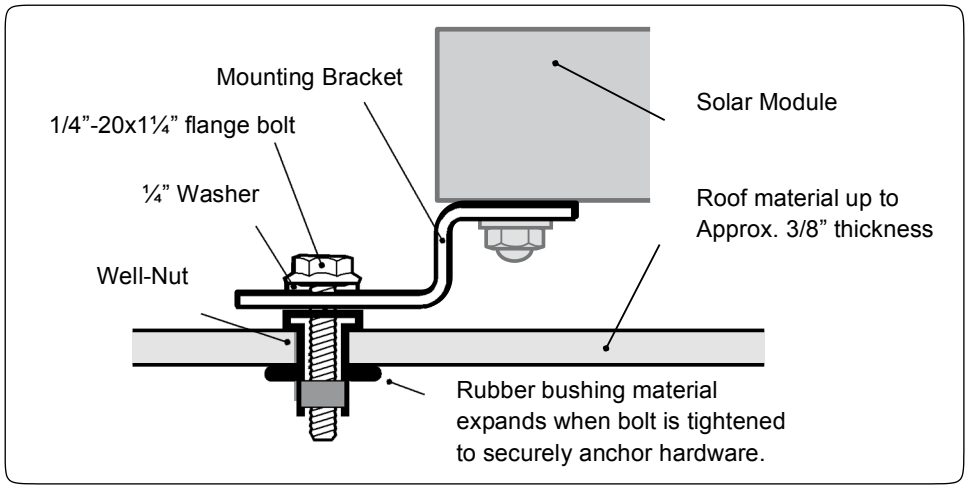


Fig. 7.8. Attaching the Z Bracket to the Roof

8

CONNECTING TWO SOLAR PANELS IN PARALLEL

1. If the existing panel is already connected to the mating connector on the pre-assembled cables provided in the original kit, remove this connection using tweezers or any other suitable tool.
2. Connect the Positive leads (marked as '+') from the two solar panels to the suitable mating branch connector (as in Fig 8.1).
3. Connect the Negative leads (marked as '-') from the two solar panels to the suitable mating branch connector (as in Fig 8.1).
4. Mate the MC branch connectors to the corresponding mating MC connector on the pre-assembled cables provided with your original kit.

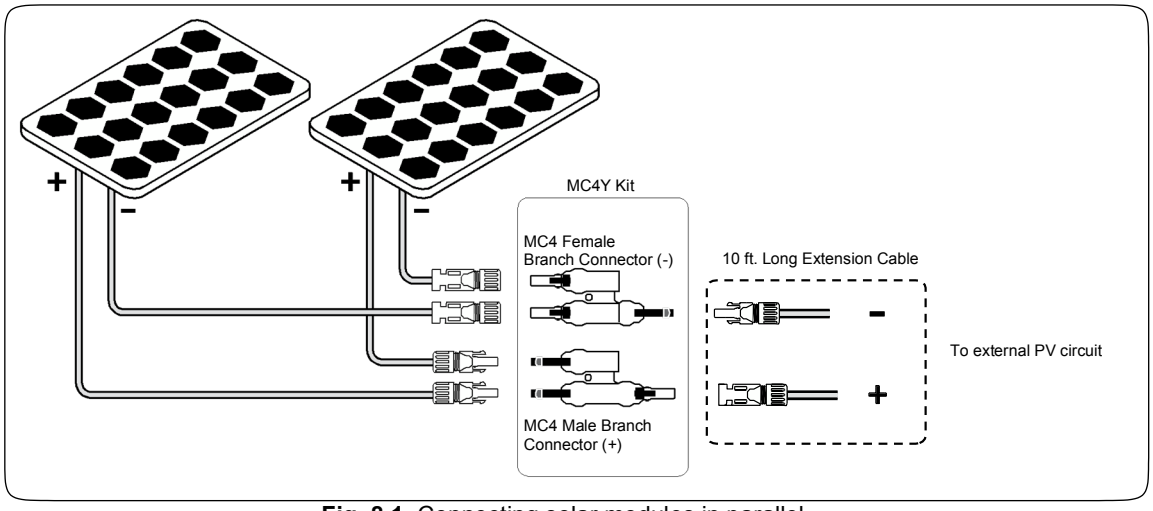


Fig. 8.1. Connecting solar modules in parallel.

If the additional solar panels are required to be mounted at a distance from the existing solar panel, a pair of cables with an MC4 connector, pre-assembled at one end, is provided.

1. For this setup, an optional set of 20MC4 wires that measure 20 ft. are required. It is optional to cut the pair of cables to the appropriate length.
2. In this case, once cable is cut, strip 0.25" of the insulation at the blunt ends using a suitable wire stripper.
3. Crimp the male and female MC4 connector to the blunt end of the appropriate cable with a suitable wire-crimping tool.
4. Complete the connections as shown in Fig. 8.2.

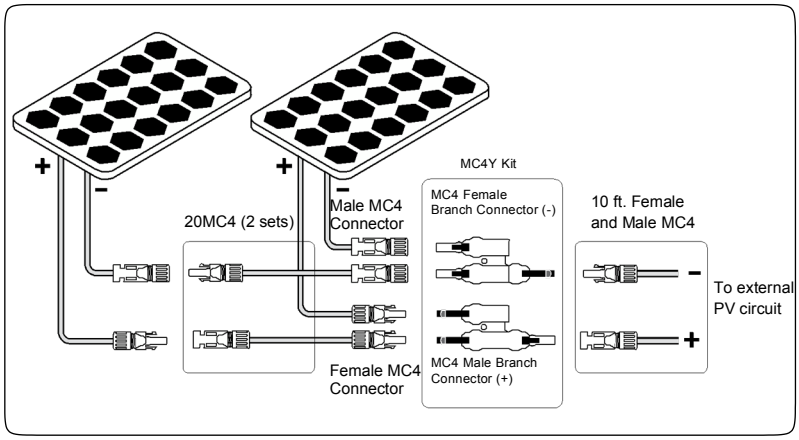


Fig. 8.2. Connecting solar modules in parallel with additional module.

9

CONNECTING MULTIPLE SOLAR PANELS IN PARALLEL

9.1 Connecting Three Adjacent Solar Panels in Parallel

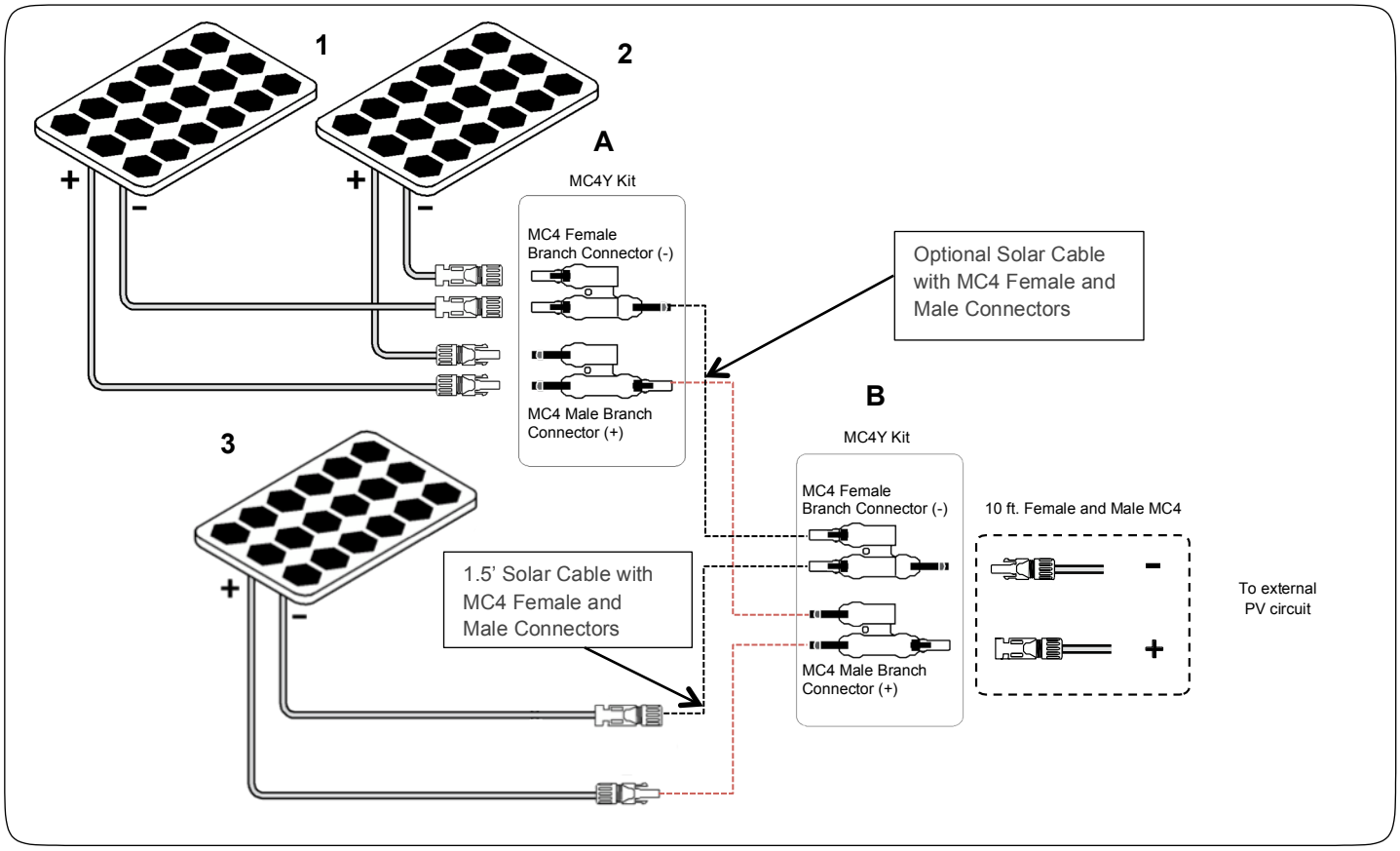


Fig. 9.1 Connection of three solar panels in parallel

Three solar panels can be connected in parallel to increase the current output while the output voltage remains the same. Fig. 9.1 above shows the arrangement for connecting **three solar panels in parallel** using the following:

- Four 1.5' Solar Cables with MC4 Female and Male Connectors
- Two pairs of MC4 Branch Connector Kit (MC4Y)
- Two 20MC4 Cables

This arrangement is applicable if the three solar panels are to be mounted adjacent to each other.

Connections

The output wires of solar panels no. 1 and 2 from Figure 10.1 are first connected in parallel with one pair of MC4 Male and Female Branch Connectors (MC4Y, labeled 'A'). The ends these Branch Connectors are then connected to two 1.5' Solar Cables with Male and Female ends. Similarly, the ends of the solar panel no. 3 connect to two 1.5' Solar Cables with Male and Female ends. Making these connections will result in a pair of Positive (+) and Negative (-) outputs shown in Figure 9.1 in red and black dashed lines respectively. These outputs are then connected to a second pair of MC4

Male and Female Branch Connectors (MC4Y, labeled 'B'). Finally, the outputs of the Branch Connectors (labeled 'B') are then connected to the 10 ft. Female and Male MC4 wires. The resulting output can be connected to charge controller or external PV circuit. **When the connections are completed, you can use a multimeter to check for the right voltage level and polarity at the ends of the MC4 Adaptor Kit.**

9.2 Connecting Four Adjacent Solar Panels in Parallel

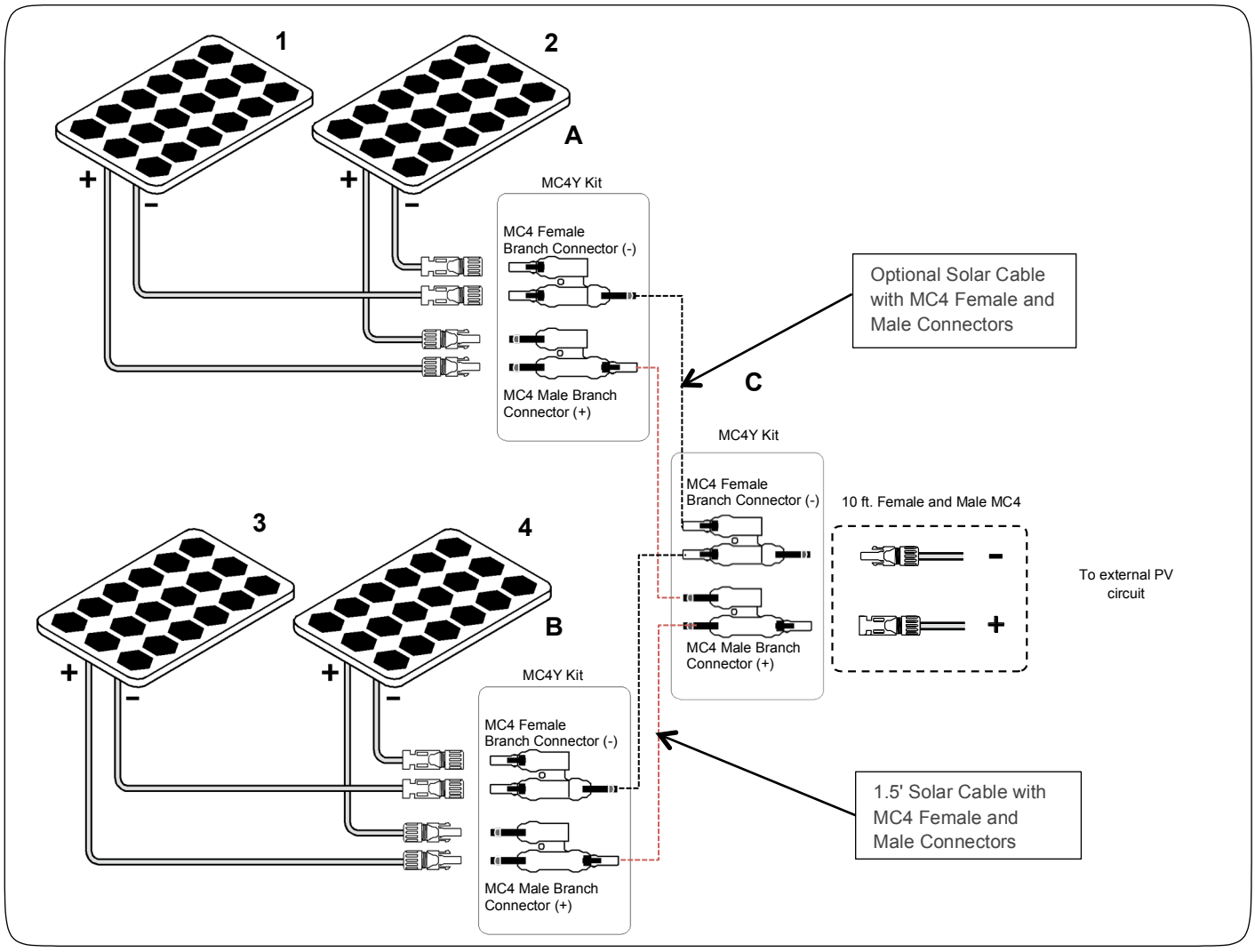


Fig. 10.2 Connection of four solar panels in parallel

Four solar panels can be connected in parallel to increase the current output while the output voltage remains the same. Fig. 9.2 above shows the arrangement for connecting **four solar panels in parallel** using the following:

- Four 1.5' Solar Cables with MC4 Female and Male Connectors
- Three pairs of MC4 Branch Connector Kit (MC4Y)
- Two 20MC4 Cables

This arrangement is applicable if the four solar panels are to be mounted adjacent to each other.

Connections

The output wires of the solar panels no. 1 and 2 from Figure 9.2 are first connected in parallel with one pair of MC4 Male and Female Branch Connectors (MC4Y, labeled 'A'). The ends of these Branch Connectors are then connected to two 1.5' Solar Cables with Male and Female ends. Similarly, repeat this process for solar panels no. 3 and 4 and the second

pair of MC4 Male and Female Branch Connectors (MC4Y, labeled 'B'). Making these connections will result in pair of Positive (+) and Negative (-) outputs as shown in Figure 9.2 in red and black dashed lines respectively. These outputs are then connected to a third pair of MC4 Male and Female Branch Connectors (MC4Y, labeled 'C'). Finally, the outputs of the Branch Connectors (labeled 'C') are then connected to the 10 ft. Female and Male MC4 wires. The resulting output can be connected to charge controller or external PV circuit. **When the connections are completed, you can use a multimeter to check for the right voltage level and polarity at the ends of the MC4 Adaptor Kit.**

9.3 Connecting Multiple Solar Panels in Parallel when Separated by a Distance

Please refer back to Section 6.6 on how to connect multiple solar panels in parallel when a distance separates those panels. Fig. 6.6 shows a basic arrangement for connecting two solar panels in parallel that are separated by an extended distance. You can use that same process when you have three or more panels that are required to be separated by a distance. After reading Section 6.6, you can refer back to Sections 10.1 and 10.2 for the required wiring parts and proper connection of three/four panels in parallel. Please note that connecting multiple solar panels in parallel when separated by a distance is optional, and it requires buying extra extension wires (20MC4 kit).

10

TYPICAL BATTERY CONNECTIONS

10.1. Series Connection of Batteries

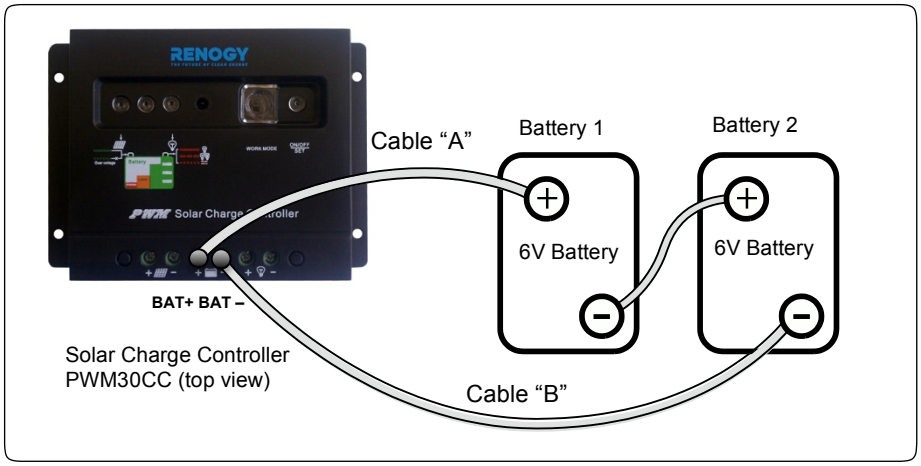


Fig. 10.1. Series Connection.

When two or more batteries are connected in a series, their voltages add up, but the Amp-Hour (AH) capacity remains the same. Fig. 10.1 above shows 2 batteries of 6V each, these 200 AH batteries connected in series to form a battery bank of 12V with a capacity of 200 AH. The Positive terminal of Battery 1 becomes the Positive terminal of the 12V bank. The negative terminal of Battery 1 is connected to the Positive terminal of Battery 2. The negative terminal of Battery 2 becomes the negative terminal of the 12V battery bank.

9.2. Parallel Connection of Batteries

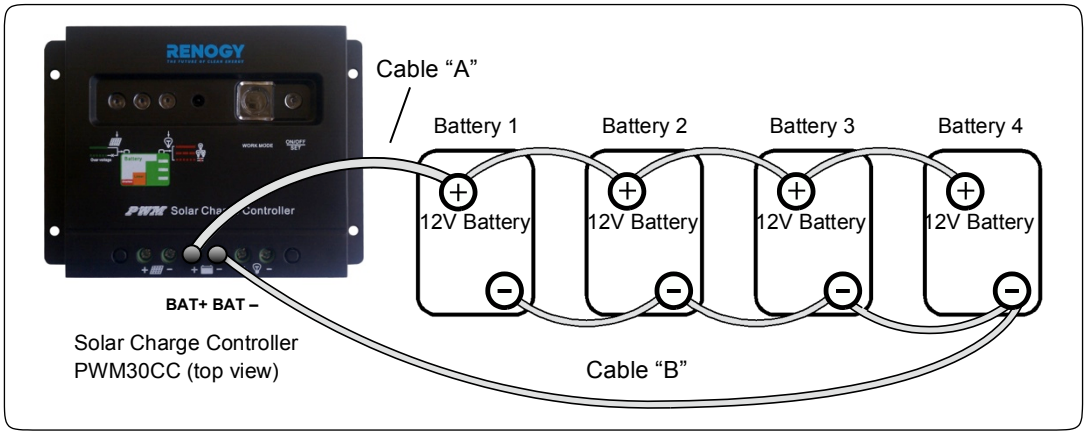


Fig. 10.2. Parallel Connection.

When two or more batteries are connected in parallel, their voltage remains the same but the AH capacities add up. Fig. 10.2 shows four 12V batteries with a rating of 100 AH connected in parallel to form a battery bank of 12V with a capacity of 400 AH. The four Positive terminals of Batteries 1 to 4 are paralleled (connected together) and this common Positive connection becomes the Positive terminal of the 12V bank. Similarly, the four Negative terminals of Batteries 1 to 4 are paralleled (connected together) and this common Negative connection becomes the Negative terminal of the 12V battery bank.

10.3. Series – Parallel Connection of Batteries

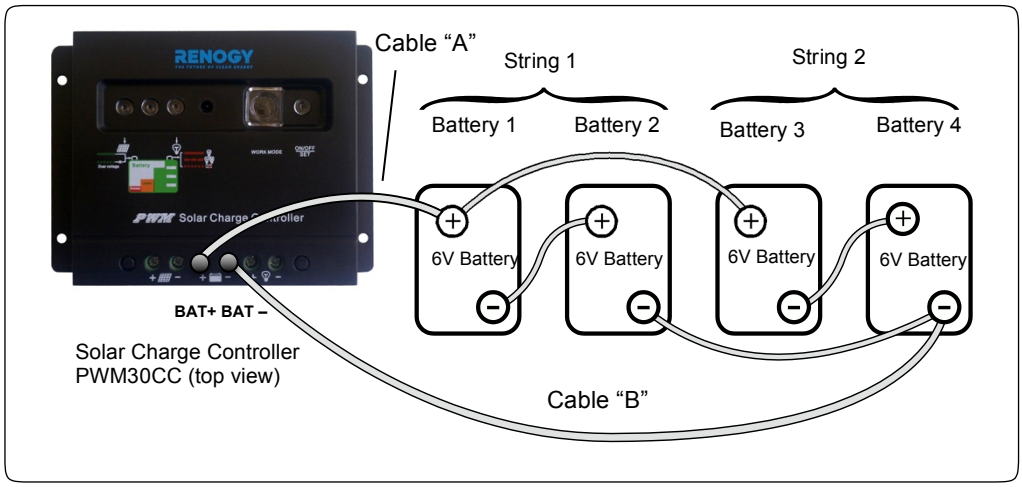


Fig. 10.3. Series-Parallel Connection.

Figure 10.3 above shows a series-parallel connection consisting of four 6V, 200 AH batteries, to form a 12V, 400 AH battery bank. Two 6V, 200 AH batteries, Batteries 1 and 2 are connected in series to form a 12 V, 200 AH battery (String 1). Similarly, two 6V, 200 AH batteries, Batteries 3 and 4 are connected in series to form a 12V, 200 AH battery (String 2). These two 12 V, 200 AH Strings 1 and 2 are connected in parallel to form a 12V, 400 AH bank.

CAUTION!

When 2 or more batteries/battery strings are connected in parallel and then are connected to the Solar Charge Controller (See Figs. 10.2 and 10.3 given above), attention should be paid to the manner in which the solar charge controller is connected to the battery bank. Please ensure that if the positive output cable of the solar charge controller (Cable "A") is connected to the positive battery post of the first battery (Battery 1 in Fig. 10.2) or to the positive battery post of the first battery string (Battery 1 of String 1 in Fig. 10.3. Then ensure that the Negative output cable of the Solar Charge Controller PWM30CC (Cable "B") should be connected to the Negative battery post of the last battery (Battery 2 as in Fig. 10.2) or to the Negative Post of the last battery string (Battery 4 of Battery String 2 as in Fig. 10.3). This connection ensures the following:

- The resistances of the interconnecting cables will be balanced.
- All the individual batteries/battery strings will see the same series resistance.
- All the individual batteries will charge at the same charging current and thus, will be charged to the same state at the same time.
- None of the batteries will see an overcharge condition.

If the positive output cable of the battery charger (Cable "A") is connected to the positive battery post of the first battery (Battery 1 in Fig. 10.2) or to the positive battery post of the first battery string (Battery 1 of String 1 in Fig.10.3), and the Negative output cable of the battery charger (Cable "B") is connected to the Negative battery post of the first battery (Battery 1 as in Fig. 10.2) or to the Negative Post of the first battery string (Battery 1 of Battery String 1 as in Fig. 10.3), the following abnormal conditions will result:

- The resistances of the connecting cables will not be balanced.
- The individual batteries will see different series resistances.
- All the individual batteries will be charged at different charging current and thus, will reach fully charged state at different times.
- The battery with lower series resistance will take shorter time to charge as compared to the battery, which sees higher series resistance and hence, will experience over charging and its life will be reduced.

11
WARRANTY

Warranty

The RENOGY Solar Charging and Expansion Kits manufactured by RENOGY LLC (the “Warrantor“) are warranted to be free from defects in workmanship and materials under normal use and service. This warranty is in effect from the date of purchase by the user (the “Purchaser“).

Product	Warranty Period
RENOGY 50W/70W/100W Solar Panel	• 5-year product workmanship warranty. • 10-year 90% power output warranty. • 25-year 80% power output warranty.
RENOGY 10A Solar Charge Controller (Model No. PWM10CC)	• 1-year product workmanship warranty.
RENOGY 30A Solar Charge Controller (Model No. PWM30CC)	• 1-year product workmanship warranty.
Mounting Hardware and Wiring	• 5-year product workmanship warranty.

Table 11.1. Warranty information.

For a warranty claim, the Purchaser should contact the place of purchase to obtain a Return Authorization Number. The defective part or unit should be returned at the Purchaser's expense to the authorized location. A written statement describing the nature of the defect, the date of purchase, the place of purchase, and the Purchaser's name, address, and telephone number should also be included.

If upon the Warrantor's examination, the defect proves to be the result of defective material or workmanship, the equipment will be repaired or replaced at the Warrantor's option without charge, and returned to the Purchaser at the Warrantor's expense.

No refund of the purchase price will be granted to the Purchaser, unless the Warrantor is unable to remedy the defect after having a reasonable number of opportunities to do so.

Only the Warrantor shall perform warranty service. Any attempt to remedy the defect by anyone other than the Warrantor shall render this warranty void.

There shall be no warranty for defects or damages caused by faulty installation or hook-up, abuse or misuse of the equipment including exposure to excessive heat; salt or fresh water spray, or water immersion.

No other express warranty is hereby given and there are no warranties, which extend beyond those described herein. This warranty is expressly in lieu of any other expressed or implied warranties, including any implied warranty of merchantability, fitness for the ordinary purposes for which such goods are used, or fitness for a particular purpose, or any other obligations on the part of the Warrantor or its employees and representatives.

DISCLAIMER OF LIABILITY

There shall be no responsibility or liability whatsoever on the part of the Warrantor or its employees and representatives for injury to any persons, or damage to person or persons, or damage to property, or loss of income or profit, or any other consequential or resulting damage which may be claimed to have been incurred through the use or sale of the equipment, including any possible failure of malfunction of the equipment, or part thereof.

The Warrantor assumes no liability for incidental or consequential damages of any kind.

RENOGY LLC. (the "Warrantor")
14288 Central Ave, Unit A
Chino, CA 91710