



Sol-Go Safety and Installation Manual

This document applies to all Sol-Go flexible modules.

Contents of this manual are subject to change without notice. Please see the most up to date manual at <https://sol-go.com/>

READ THIS MANUAL BEFORE INSTALLING OR USING. FAILURE TO READ THIS MANUAL IN ITS ENTIRETY AND FAILURE TO FOLLOW THE MANAL INSTRUCTIONS WILL INVALIDATE THE SOL-GO LIMITED PRODUCT AND POWER WARRANTY.

1. Introduction: This manual provides instructions for Sol-Go flexible solar modules. Specifically, it provides guidance for installation and safety when installing and using the modules. Owners of these modules should also take guidance from their local electrical code for electrical installations of solar modules.

2. Liability Disclaimer: Sol-Go assumes no liability for loss, damage or expense due to improper installation, handling or use.

3. Warranty Limitations: The Sol-Go warranties do not apply to: Sol-Go modules which are subjected to: a) misuse, abuse, neglect or accident, b) improper installation, including installation of modules or arrays of modules that do not comply with all Sol-Go installation, handling, inspection and wiring instructions, Sol-Go operations and maintenance instructions as described in this manual, and all national, state, and local laws, codes, ordinances, and regulations., c) damage due to repair, d) conditions exceeding the module specifications as listed in the module datasheets or any other operational specifications given by Sol-Go or any national, state and local laws, codes, ordinances, and regulations, e) power failure, power surges, actions of war, tornados, hurricanes, lightning, flood, fire, lava, ash, or other natural disasters, f) damage from persons, insects, animals or chemical exposure, g) module breakage from impact or other events outside Sol-Go's control. Please see Sol-Go's Limited Product and Power Warranty for further terms and conditions.

4. Safety Precautions:

READ SAFETY INSTRUCTIONS BEFORE INSTALLING THIS PRODUCT AND KEEP THESE INSTRUCTIONS FOR FUTURE REFERENCE

- All installations must comply with the National Electrical Code and any other local codes. In Canada, installations should be in agreement with CSA C22.1, Safety Standard for Electrical Installations.
- **DANGER!** Modules are electrically active when exposed to light or connected to a battery. Contact with electrical leads while the modules are electrically active may lead to electrical shock, injury or even death.
- The electricity will arc across a gap, possibly resulting in injury or even death. Arcing can occur while connecting or disconnecting the module electrical leads. **DO NOT** connect or disconnect modules when they are exposed to light or attached to an external power source (e.g. battery). This may result in personal injury or death and may damage the connectors, voiding the warranty.
- **DO NOT** install or handle the module when it is wet or during high winds. **DO NOT** allow water to gather on or near the module. These conditions present a dangerous situation via electrical shock and injury due to impact with the module.
- Use of exposed conductors brings significant risk to the user in terms of electrical shock, injury or even death.
- **DO NOT** short the leads together. If the module is accidentally shorted, cover the module so the solar cells receive no light before disconnecting.
- **DANGER!** High electrical currents may be present when modules are connected in parallel and high voltages may be present when modules are interconnected in series.
- **MODULE CARE:** Any actions listed below that are not followed will void the warranty.
 - Do not attempt to repair any part of the module.
 - Do not break or crack jboxes, cables, connectors, and metal ribbons in the module. These are all electrical hazards. The modules should not be used and should be disposed of properly. Many communities will accept solar modules as electrical waste products.
 - **DO NOT STAND OR WALK ON THE MODULE.** Do not drop the module. Do not drop objects on the module. Do not place objects on the module. These actions may result in damage to the solar cells, which will decrease module power output and possibly create an electric shock, injury or even death risk.
 - Do not carry the module by the cables. Do not bend the cables into a bend radius of less than 40mm. These actions may result in damage to the cable connection to the module, voiding the warranty, and may result in electrical shock, injury or even death.
 - Do not scratch the module. This may lead to exposure of module parts that are electrically active and could result in electrical shock, injury or even death.
 - Do not impact the module. This may lead to broken solar cells and loss of power. It may also lead to puncture of the plastic layers, exposing the underlying electrically active solar cells and electrical leads, which would create an electrical hazard,

electric shock, injury or even death. Additionally, the broken solar cells may lead to hot spots and further damage to the module.

5. Electrical Characteristics and Connections: The electrical characteristics of the SolGo modules are shown in each module datasheet, which may be updated from time to time. Electrical characteristics of Sol-Go modules are shown on the webpage <https://sol-go.com/>. For all modules the maximum fuse rating is 15A. The electrical characteristics of the modules as shown in the datasheets are for specific test conditions. Occasionally the modules may be exposed to even more sunshine than used in these test conditions, resulting in higher voltages and currents. Therefore, Sol-Go recommends the user multiply the voltage and current outputs of the modules by 1.25 when choosing components to connect to the module. Additionally, follow any additional multiplication factors as required by electrical codes.

The Sol-Go modules can be connected in series or parallel to other Sol-Go modules. In order to maximize the string power output, care should be taken by the user with respect to current and voltage matching of modules when stringing modules together in this manner. Stringing modules in series requires careful matching of module currents, while stringing in parallel requires careful matching of module voltages.

To connect modules in series, connect the negative connector of module #1 to the positive connector of module #2. This series configuration roughly doubles the voltage output.

To connect modules in parallel, connect the negative connectors of module #1 and #2 and connect the positive connectors of module #1 and #2. Cable adapters will be needed since the connectors are designed to connect positive to negative leads only. This parallel configuration roughly doubles the current output.

The higher voltage and current in these configurations may cause damage to the system charge controller, battery, and other components. Additionally, serious safety risks may occur when components are not properly matched to the module(s). The characteristics of any component attached to the solar module should be checked with the electrical output of the module or string of modules. Furthermore, with modules in a parallel configuration, shading can create damage to the modules and possibly even fire without additional components such as blocking diodes. In general, Sol-Go does not recommend a parallel configuration when shading will likely happen.

6. Module Installation, Mounting, Handling and Maintenance: The Sol-Go Limited Warranty is contingent upon the Sol-Go modules being used as described in this section.

6.1 Install Site: The Sol-Go modules must be installed such that the module temperature operates within a temperature range of -40C to +85C (-40F to +185F). Please note that this is the module temperature not the ambient air temperature. In environments with temperatures of 0C (32F) or less, Sol-Go does not recommend flexing the module or impacting the module as the plastic module materials may become brittle and can break easily. Sol-Go modules should not be installed and are excluded from the Sol-Go Limited Warranty in the following environments: flooding, hurricanes, tornados, immersion in liquids, contact with liquids with a pH greater than 8.5 or less than 6.5, hail, falling rocks or other projectiles, fire, meteorites, lava flow and volcanic eruptions.

6.2 Mounting: The Sol-Go module may be mounted to an underlying structure by using the grommets where the module is bolted or nailed or screwed down onto the underlying structure. The module may also be mounted using a Very High Bond (VHB) strength adhesive tape or high bond strength liquid glue on the module backside. Based on conversations with users, Heliobond tape from HB Fuller and a number of VHB tapes from 3M have been used for installations onto metal and some plastics. For liquid glue, there are many options but it is important to specify the right glue for the material that you are adhering the module to. Both grommets and a backside adhesive can be used together. The mounting preference is the user's decision based on their use case and what they are bonding the module to. Sol-Go flexible modules are often attached to canvas via stitching or with velcro. This is acceptable if done with professional care to avoid damage to the solar cells in the module.

In all cases, the modules should be mounted onto a fire resistant surface properly rated for the use case. The modules can be mounted at any angle but Sol-Go recommends mounting at at least a 5 degree angle in order to have easy water removal during rain and melting snow, which reduces soiling of the modules. The mounting is best with the junction box mounted at the highest position possible, in order to avoid water ingress.

Sol-Go modules can withstand high wind speeds if properly mounted to a secure supporting structure such that the modules do not significantly vibrate or flap. Our modules have been on vehicles for hundreds of thousands of miles at speeds of excess of 70mph. Sol-Go emphasizes that the modules should not be mounted in a way that the modules will vibrate or flap. Solar cells in flexible modules will crack with significant vibration or flapping, leading to power loss in the module. Sol-Go emphasizes this point because many customers strive to have air flow underneath the modules to lower the temperature of the module and to gain more power production with those lower operating temperatures. However, the air gap underneath the modules often

leads to module vibration or flapping. One option is to flush mount the modules onto a corrugated sheet, an example of a corrugated plastic sheet is shown below.



Figure 1: Corrugated plastic sheets

These corrugated sheets allow for some air flow under the module but also provides a solid layer for the module to adhere to and for the corrugated plastic to adhere to the underneath structure.

6.3 Handling: Sol-Go recommends minimizing contact with the frontside (sun side) of the module in order to avoid staining and scratching of the surface. Avoid contact with sharp objects or abrasive surfaces since they may cut the frontside or backside of the module, leading to a potential safety issue as noted in the section earlier in this document. If the module does become stained via fingerprints or other markings, clean the module as noted in the next section of this document.

The module is designed to flex up to 30 degrees, measuring from the top to the bottom of the module. For a 1 meter (~3ft) tall module, this is approximately a 10cm (~4in) deflection at the center of the module. The module is not intended to be bent or folded.

The Sol-Go modules should not be handled in a manner that would twist the module or create a sharp bend in the module. For example, the module should not be handled only at one edge of the module because the weight of the module will sharply bend the module at the point where the module has been gripped. Best practice is to hold the module on opposite sides of the module without pinching the module. For bigger modules, more than one person should carry the module.

The jbox, cables and connectors should never be subjected to impact. This could result in cracks or gaps in the electrical insulation, resulting in a potential for electrical shock, injury, or even death. If cracks or gaps were to occur, the module should no longer be used.

6.4 Inspection: Sol-Go recommends a thorough inspection of the modules after installation. Visual inspection includes checking the condition of the junction box, cables and connectors as well as the solar module itself. As noted above, if damage is observed to any of these components, Sol-Go strongly recommends not to use the module in operation. Inspection of the mounting condition is also important to ensure stable attachment even in high velocity conditions. A critical inspection step is to use thermal imaging of the modules after installation. Thermal imaging can detect hot spots in the modules due to damage to the module. These hot spots can occur in flexible/plastic solar modules as well as glass modules with module damage. Hot spots can lead to melting plastic and possibly even fires with extreme damage for both flexible/plastic and glass modules. By use of thermal imaging, any hot spots after installation can be detected and the module can be replaced before put into use, avoiding problems in the field. To perform thermal imaging, you will need a thermal imaging camera. FLIR is a company that offers many types of thermal imaging cameras. Some cameras attach to your cell phone while others are stand-alone units. Sol-Go personnel have found that the cameras need to have imaging capabilities in order for you to scan the whole area of the module. This will help find any hot spots. Sol-Go finds the thermal measurement tools without imaging are not useful for module inspection because they provide temperature measurements at one specific point not over an area, making the task of finding hot spots over a module to be difficult. Detailed instructions follow below.

Equipment needed:

- Charge controller with power measurement capabilities
- RV Battery
- Solar module
- Wiring from solar module to charge controller (MC4 compatible connectors are preferred)

- Wiring from charge controller to battery
- Thermal imaging camera
- Fire extinguisher

Procedure:

1. Unbox modules and examine for damage.
2. Install module and examine for damage.
3. Connect module to the charge controller. The charge controller should already be connected to the battery and the module should connect directly to MC4 connectors.
4. Move the modules into the sun. Ensure power is being generated by the module(s) by use of the charge controller.
5. Follow setup procedures for your thermal imaging camera.
6. Scan across the module with the thermal imaging camera.
7. The thermal image should be relatively uniform. However, hot spots may be observed. Examples of thermal images are shown below.

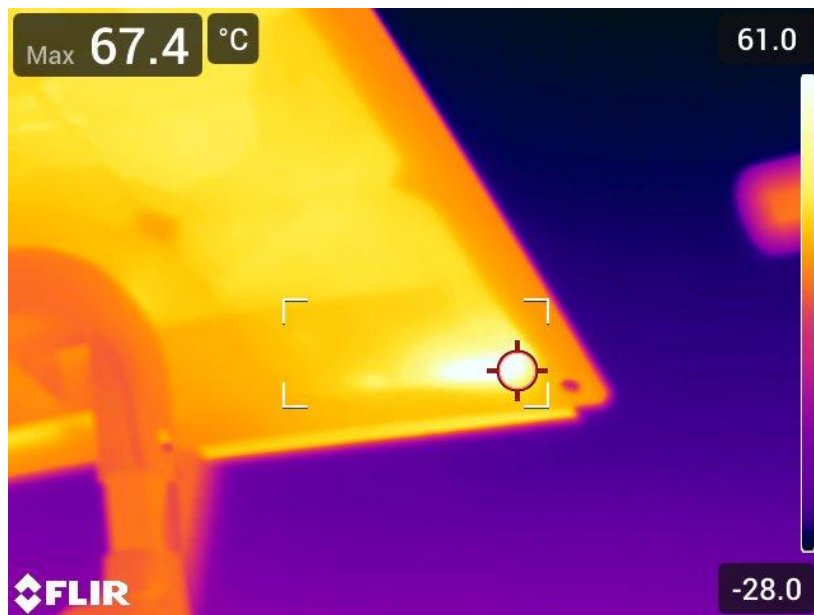


Figure 1: Thermal image of a solar module with a hot spot in the corner of the module. This is likely damage due to handling. The hot spot is at 67.4C as compared to the other parts of the module at 50-55C.

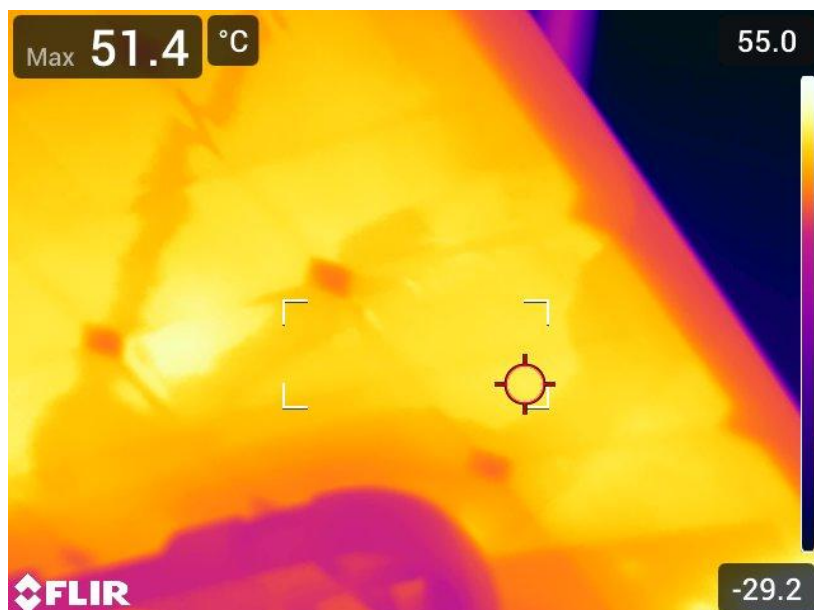


Figure 2: Thermal image of a solar module with no significant hot spots.

8. If a hot spot is detected, over at least a 5 minute period check to see if the hot spot is increasing in temperature. Ensure that there is no obvious browning of the backsheet where the hot spots are located or any other significant damage, such as melting. If at any point damage occurs (such as browning, melting, or a greater than 15% drop in power), stop the testing at that point and disconnect the module from the charge controller.
9. If the hot spot has a stable temperature and no visible damage, next check for hot spot stability. Using double sided tape that can be removed easily, place a piece of fire resistant opaque material (e.g. metal) over part of the identified cell, such that the cell is partially exposed to light but the hot spot can still be observed with the camera. Covering part of the cell should result in a power drop (current and/or voltage) as measured by the charge controller. By partially covering the solar cell, you are simulating a common occurrence in operation, shading, which may result in an increased temperature at the hot spot and potentially damage to the module.
10. Watch the module with the thermal camera for at least 5 minutes. Take images of the hot spot and record the temperature of the hot spot and surrounding cells.
11. A good result is if the hot spot does not increase in temperature. A negative result is if the hot spot greatly increases in temperature. Please note that some plastics can begin to brown, melt and burn at temperatures as low as 70C.
12. Running these tests provides you confidence in identifying a well installed solar module and it sets a baseline for future inspections of that module.

6.5 Maintenance: Sol-Go recommends cleaning the module with clean water with a soft sponge. If persistent stains remain, Sol-Go recommends using a 1-3% mild detergent/soap. Stronger chemicals and more abrasive sponges can result in damage to the module surface and would void the warranty. Cleaning is important when corrosive materials are deposited on the modules. For example, bird excrement and tree sap are corrosive materials. If these materials are not quickly cleaned off the module they will degrade the plastic, leading to discoloration and/or a haze across the module. This will lead to lower power generation. Without proper cleaning, the warranty for the modules is voided.

Best to you and thank you for your support as customers of Sol-Go. We've designed, made and sold flexible solar modules since 2015 and we enjoy every customer interaction.