Morningstar Positive Ground Technical Note

Overview

Morningstar offers many solar charge controllers that are ideal for telecom applications. This can range from low power requirements with the ProStar and ProStar MPPT controllers for 24V systems to higher power 24V or 48V systems with TriStar and TriStar MPPT controllers. For very high power systems controllers can easily be configured to charge the battery bank in parallel. Digital data output is standard with these controllers for monitoring so they are ideally suited for telecom sites that need to measure performance and available power.

A common system characteristic of these telecom systems is that they often operate on a positive ground (PG) circuit. This is required because many DC telecom systems use PG equipment. Morningstar controllers are oriented towards use in a negative ground system since these are most typical. All of the negative terminals of Morningstar controllers are electrically common and both charge and load control switching is done in the positive leg of the circuit.

The common negative makes it possible to establish a common negative ground for the entire system including the solar array, battery and load. The ground bond is almost always made with a single connection to the negative conductor. One exception would be to provide a separate ground bond at the PV array and another ground bond at the controller which can help keep voltage surges induced from nearby lightning from affecting the power electronics equipment and loads. This is not an option for systems that include ground fault protection as it will be tripped if there is more than one ground bond.

A Single Point to Earth

In addition to negative grounded systems, all Morningstar controllers can be used in positive grounded systems if they are wired in the proper way. In addition, the positive ground of the system will not result with a sustained ground of all of the circuits in the system like it would with a negative grounded system.

Positive grounded systems are basically wired the same way as a negative grounded system. The main issue to keep in mind is that you cannot connect a positive ground bond to two separate circuits in the system. This means if you ground the + leg of the battery, do not do so on the + leg of the PV array. The same goes for the load. If you ground the + terminal of the load, do not ground the battery + or PV array + as well. Doing so will create a positive ground connection which will bypass the positive switching circuit. This will result with a direct connection from the battery to the solar array (disabling charging control) or a direct connection from the battery to the load (disabling load control).

The only exception to this rule would be to use a load control relay switch on the negative conductor of the load circuit so that there would be a permanent, common positive connection between the battery and load. All Morningstar controllers which include load control have a common negative with positive switching.

Positive Grounding Graphic Illustrations

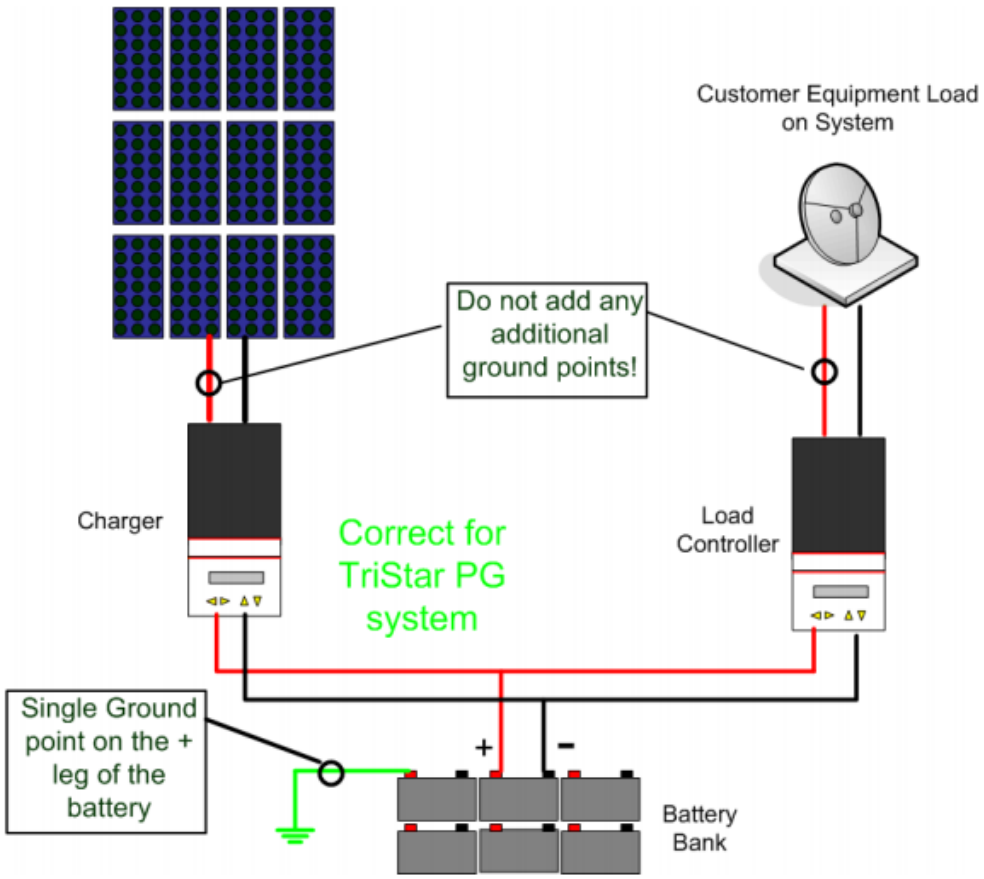

Fig. 1 – This system is grounded properly on the battery circuit only. Charging and Load Control will function properly.

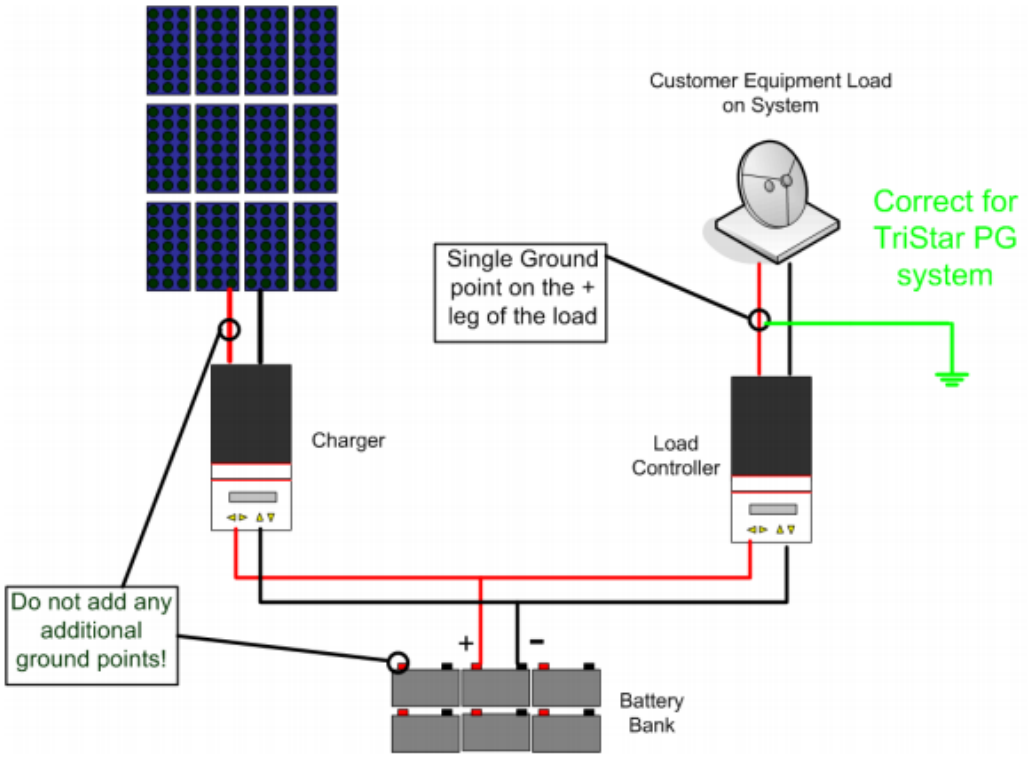

Fig. 2 – This is another example of a PG system that will function properly

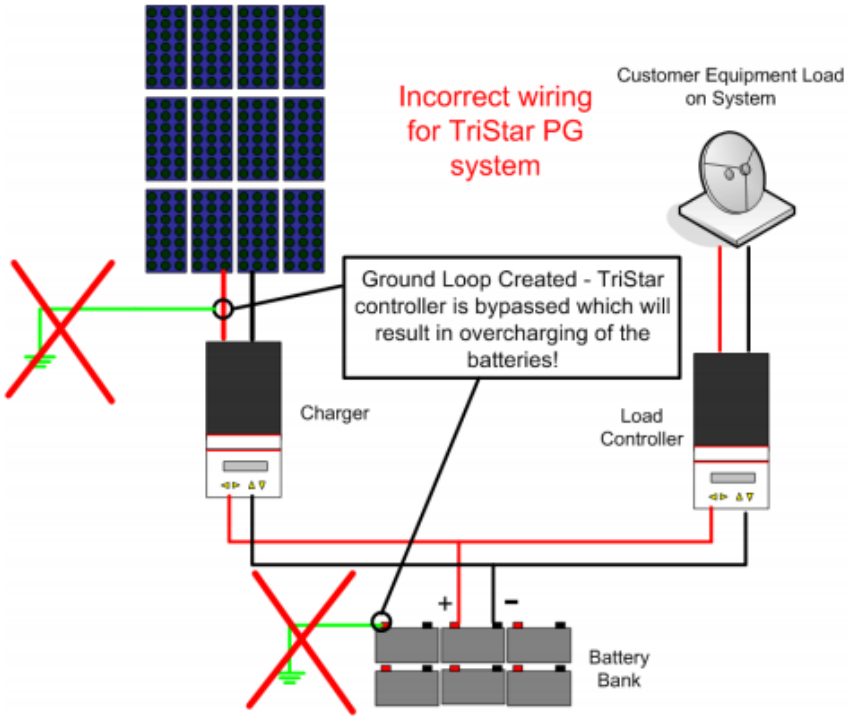

Fig. 3 – This system will not charge properly. It has been grounded in two locations and a ground loop will be created around the TriStar charge controller. The controller will now no longer be able to properly control charging current since its circuit has been bypassed.

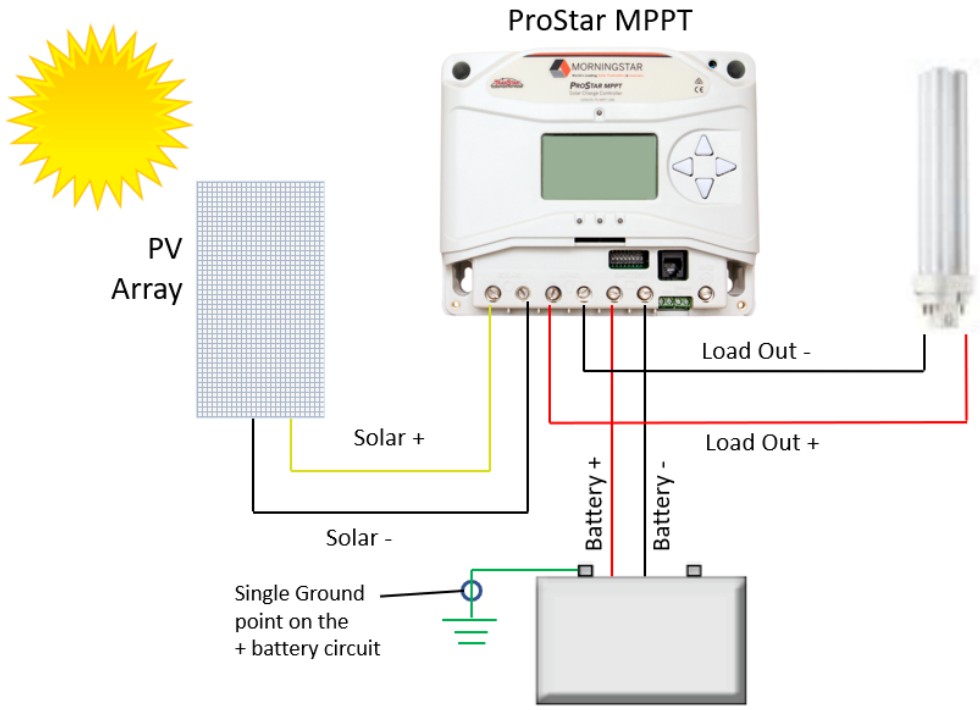

Fig. 4 – Example with positive grounding for a ProStar MPPT system.

Positive Ground for the Telecom Load

In order to keep the telecom load grounded during operation the positive ground has to be connected to the battery circuit or the load circuit as shown in Fig. 1 or Fig. 2. If it is grounded on the PV array circuit the battery and load will not have a positive ground. Morningstar controllers that include load control have a common negative so when it disconnects the load the load will no longer be grounded. However, the telecom equipment should not require a positive ground when disconnected. If for some reason this is considered a problem, it is possible to ground the load circuit or use a relay for load control with the negative conductor of the load circuit.

Chassis/Enclosure Ground

For Morningstar controllers the chassis is isolated from the DC circuits of the controller. Therefore, the chassis can be grounded the same for a positive ground system as it is for a negative grounded system. Grounding the chassis is required by code in many jurisdictions. Surge protection devices include a connection to the equipment ground in order to function properly to limit voltage surges from nearby lightning strikes. Many Morningstar controllers include a chassis ground terminal. If it doesn't it is possible to wire a equipment grounding conductor directly to the chassis. Please see the product manual for more information about equipment grounding and follow local electrical code equipment ground requirements.

Disconnect and Overcurrent Protection when using the Ethernet MeterBus Converter (EMC-1)

The NEC and many jurisdictions allow for using a disconnect and overcurrent protection on the ungrounded conductor. Therefore, single-pole battery breakers, switches or fuses may be installed on the negative power conductors. However, when using the Ethernet MeterBus Converter (EMC-1), this is not an option.

As with the power circuits, MorningStar MeterBus (RJ-11) ports and the EMC-1 share a common negative with the negative power circuits of the system. Therefore, single-pole battery breakers, switches or fuses cannot be used on the negative battery circuit of the system. This is because the disconnect switch will be bypassed through the communications and damage can occur due to the unintentional current path through the smaller communications wiring and circuits.

The diagram below is an example of where the use of a single-pole breaker would not be an option.

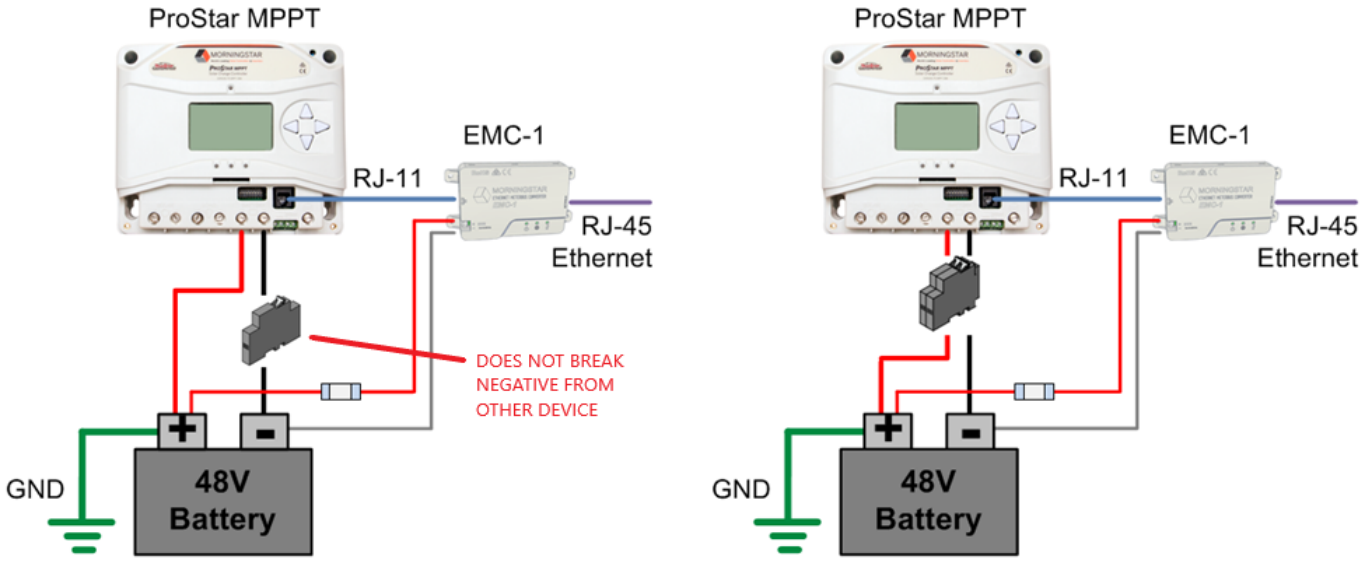

Fig. 5 – ProStar MPPT system with Ethernet MeterBus Converter (EMC-1): The EMC-1 power has a common negative with the RJ-11 port. Therefore, using a single-pole battery breaker as shown on the left will not break the negative connection to the controller and it could cause damage to the communications circuits. A double-pole breaker which disconnects both the positive and negative conductors as shown in the right can be used in order to disconnect the ProStar MPPT controller without harm to the serial communications. Also note that the fuse for the power circuit to the EMC-1 should be installed on positive wire.

PV Disconnect Switch Code Requirements

The NEC and other electrical codes may require a double pole PV disconnect switch with PV arrays that are not grounded. Since Morningstar controllers have a common negative instead of a common positive the PV array would not be grounded with a positively grounded system. Therefore, a double pole PV disconnect switch or breaker should be used with a positive grounded system.

Ground fault Protection and Positive Grounded Systems

One last consideration is Ground Fault Protection. Ground Fault Protection protects the system from ground faults that may be created in the PV circuit. Morningstar's Ground Fault Protection products, GFPD-150V and GFPD-600V can be used with either negative or positive grounded systems to detect and interrupt ground fault currents. If the system is grounded at the load and the load is disconnected the PV array and battery would not be grounded and the ground fault protection would not work. Therefore, in order to operate effectively under all circumstances positive grounded systems should be grounded on the battery circuit or PV array circuit and not on the load circuit when using a load controller which can break the positive leg.

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