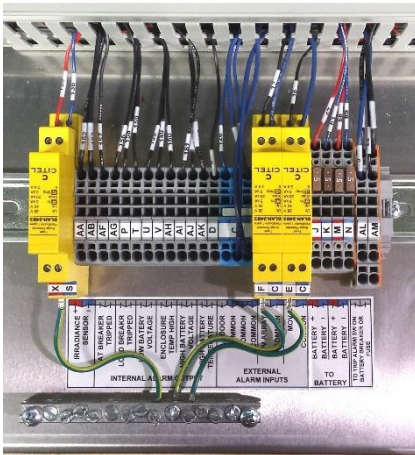




Enhanced Surge Protection option for Apollo Solar Cabinets



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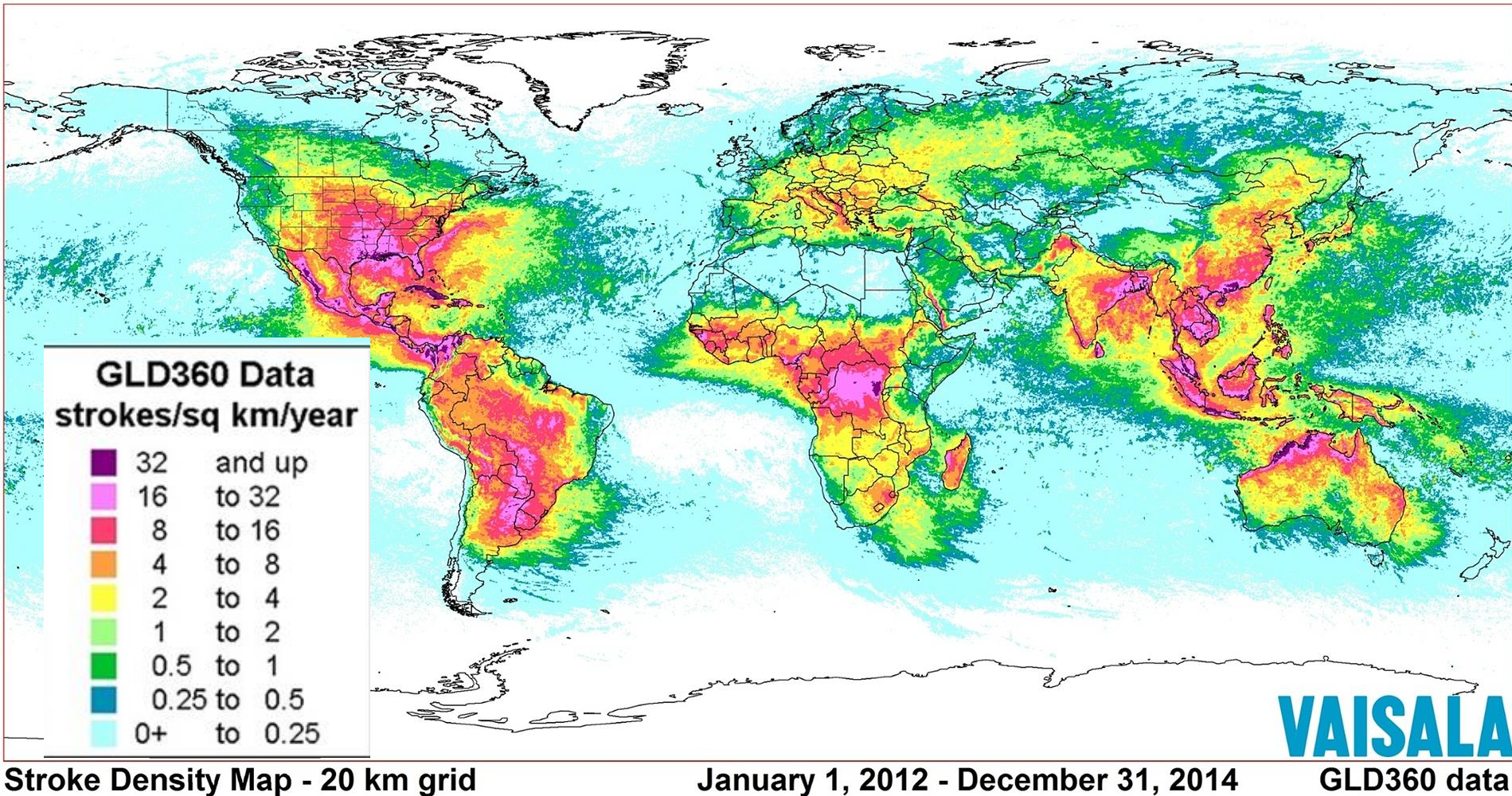
Enhanced Surge Protection Option

- It is not possible to protect against a direct lightning strike, but we can do a great deal to limit the surges caused by nearby strikes and the induced currents they create.
- BTS Towers are a good target for lightning to strike.
- The Mobile Phone industry does a good job of protecting their equipment from damage.
- PV arrays are in the open and also make good targets for lightning.
- In high lightning strike areas, we need to protect the inputs from the PV array from surges.
- A good ground is essential, and the tower can usually provide one.



Enhanced Surge Protection Option

The chance of a Lightning Strike damaging the Solar Power equipment is related to the frequency of lightning strikes. The map below shows the number of strikes per square km, per year.



Enhanced Surge Protection Option

Apollo created an R&D project in lightning protection for remote power systems.

It is not possible to be totally protected against lightning, but we can do many things to minimize the chances of damage from nearby strikes.

Apollo developed and tested surge protection circuits that were tested and proven to reduce the chances of damage from a nearby strike by a factor of at least 16 times.

The Enhanced Surge Protection option uses this advanced technology.



Using Apollo protection circuits, these solar powered products ran perfectly after being actually hit by over 100 lightning strikes ramping up to 25kAmps each in this high voltage lab.

Enhanced Surge Protection Option

A good grounding system is essential for limiting lightning surge damage.

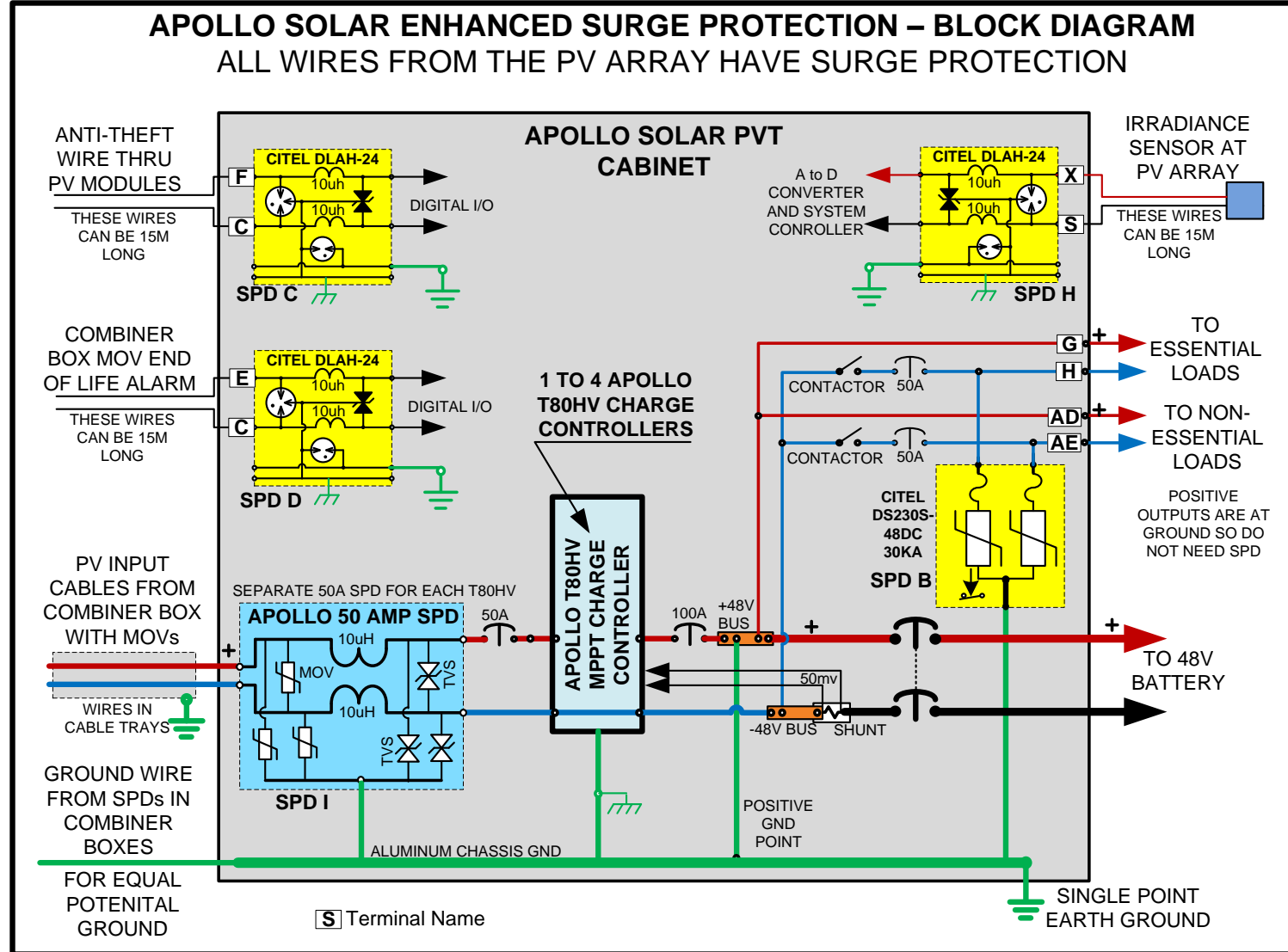
GOOD GROUNDS -- The quality of the connection to earth ground is the single most important issue. The resistance from the ground system to the earth must be very low. At 10 ohms a medium size strike of 30kA will lift the wires that you thought were ground up to 300,000 volts. You will need many ground rods and if the soil is dry and/or sandy, extreme measures, such as adding carbon dust, will be required to get a reasonably low resistance.

EQUAL POTENTIAL GROUNDS -- Equal Potential Grounding is an important rule. Even if your equipment ground is elevated in voltage during a surge event, we want ALL our equipment grounds to be elevated the same amount. The differential is the killer. This means a single “star point” ground in your equipment with the best earth connection you have connected to that same star point. Use the Panel in the Apollo Cabinet as the star point ground.

GROUND WIRING -- All ground wires must be short, thick and straight so they are free of resistance and inductance. Any coil in a ground wire makes an inductance which prohibits the fast surge from going to ground.

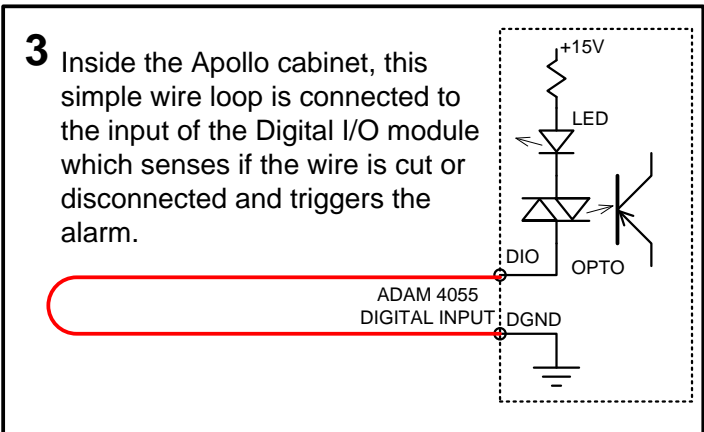
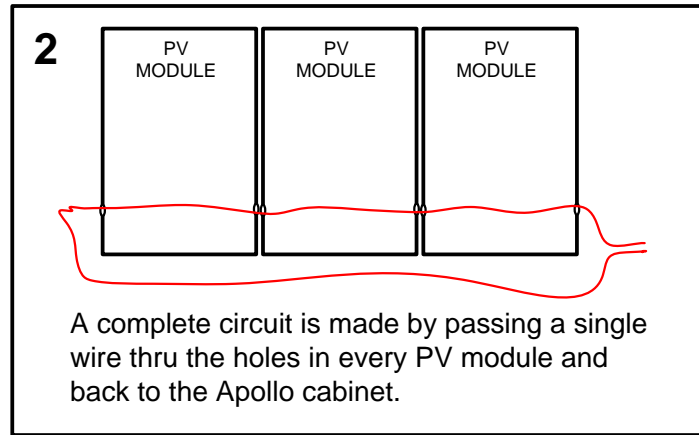
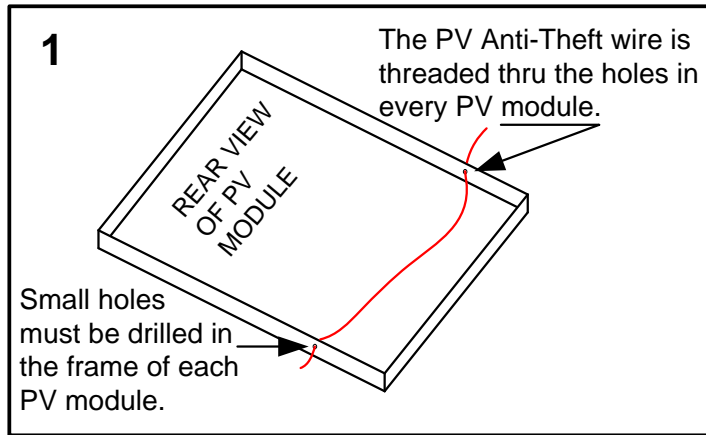
Enhanced Surge Protection Option

Every wire from the PV Array area gets a properly rated 3 Stage Tandem Surge Protector.



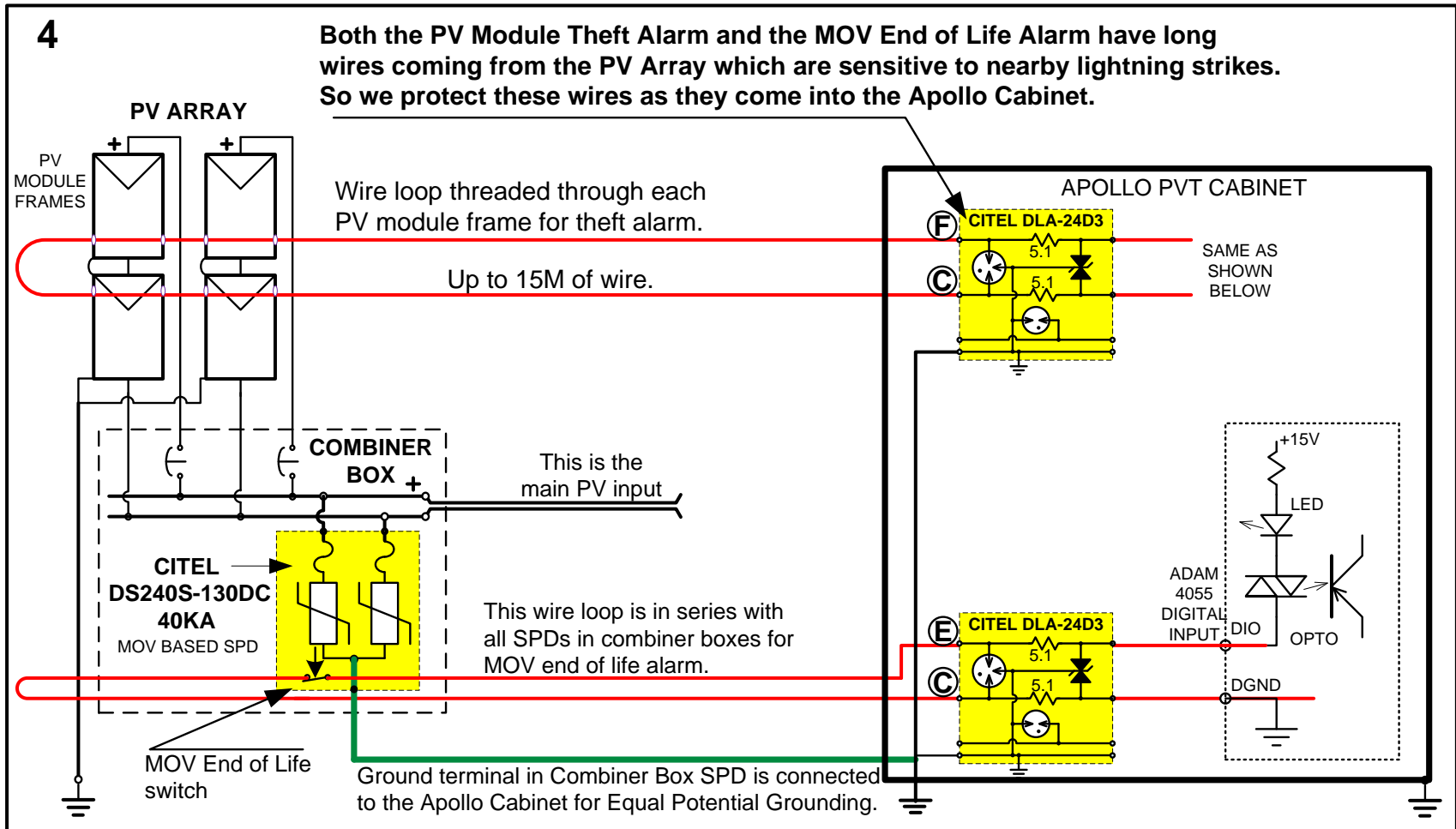
Enhanced Surge Protection Option

Installing the wire to detect an attempt to steal PV modules.



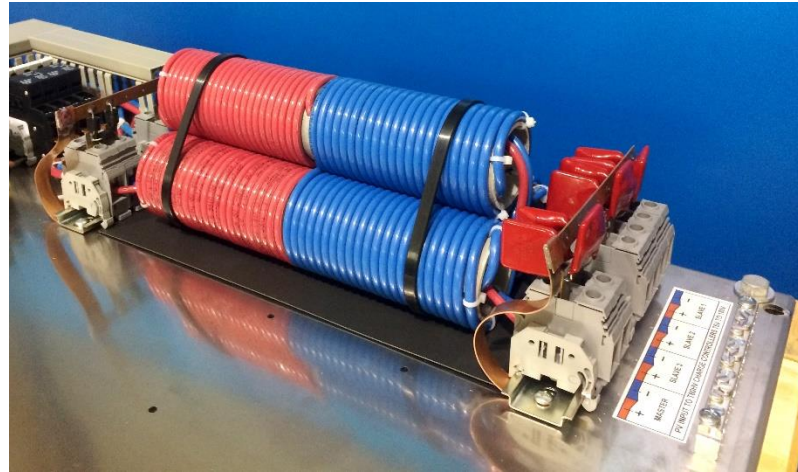
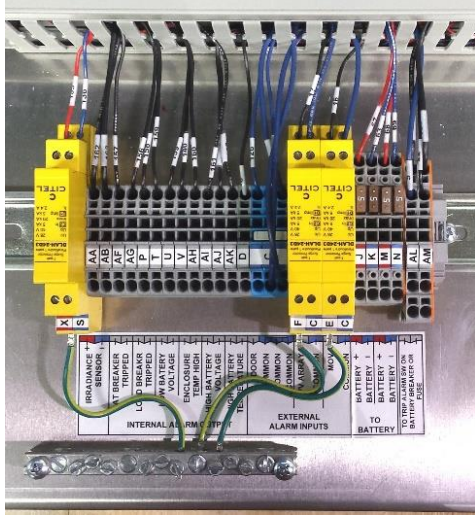
Enhanced Surge Protection Option

The PV Theft Detection Wire is also protect with the Enhanced Surge Protection Option. The wiring is slightly different since there are Surge Protection Devices in the Cabinet.



Enhanced Surge Protection Option

Our R&D program resulted in the design of a custom 3 Stage, Tandem surge protector that can withstand the constant 50 Amp current from the PV Array.



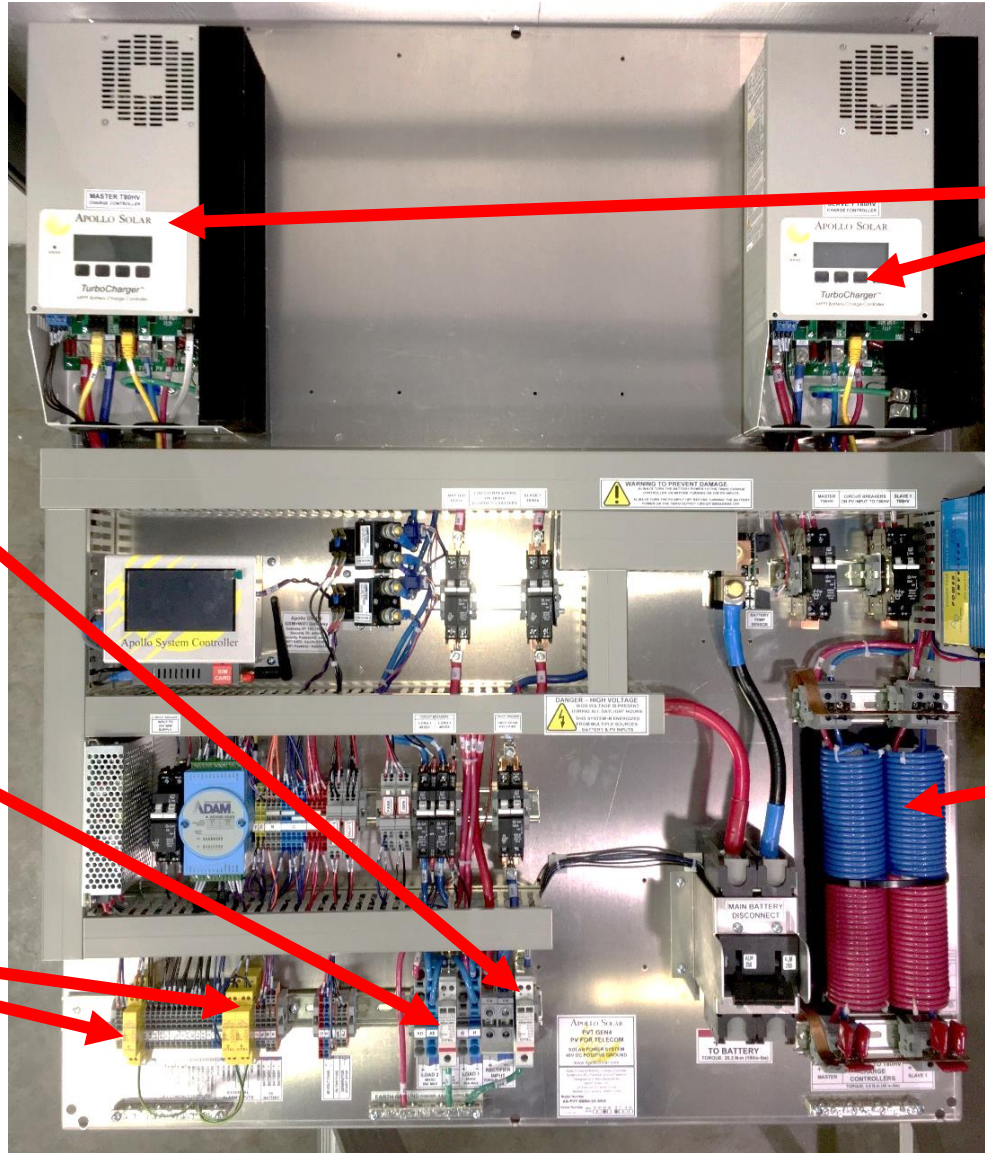
We limit the voltage spikes at the input with high current MOVs using heavy copper ground straps. Our secret sauce is our custom high current, differential mode inductors we use to slow down the leading edge of a surge. After the inductors we use Transient Voltage Suppressors to accurately clip off spikes to a safe voltage.

The Ground Wires from the Combiner Boxes should be terminated at the Bus Bar just below the Positive and Negative PV Inputs. This is the equal potential grounding with the SPD in the Combiner.

At installation, the wires from the Combiner Boxes are connected here.

TORQUE = 4.6 N-m

Enhanced Surge Protection Option



This system has
2 T80HV Charge
Controllers

SPD protection on
the input wires from
the DG rectifier

Final protection on
the 48V outputs to
the BTS load

Multi-stage SPDs in
series with all wires
from the PV array

Apollo 50A
surge protection
circuits on each
PV input