MidNite Power Installation Tips

Reusing PV arrays with the MN15-12KW-AIO Inverter

One of the features of the MidNite MN15-12KW-AIO inverter is the ability to upgrade older PV systems with new functionality. These are some tips for using existing PV arrays with the MidNite inverter.

AC coupling an existing grid-tied PV array to a battery backup system:

The MidNite AIO can be used to AC couple an existing grid tied PV array while adding battery functionality. This can be useful in situations where the existing array uses micro-inverters, and cannot easily be rewired as a DC array.

1. The AC output of the PV array grid-direct inverter is connected to SmartLoad 2 (SmartLoad B – the 50A breaker).
2. Maximum output amperage of the AC coupled PV array should be less than 42 amps.
3. If using an AC coupled PV array with multiple stacked AIO inverters, the smartLoad2 inputs also need to be paralleled, so the AC PV array feeds equally into all of the AIO inverters. Do not connect a portion of the AC coupled PV array to each stacked inverter separately.
4. If doing self consumption with AC coupling, “support normal loads” needs to be enabled.
5. **Zero export to grid or limited export to grid is not supported** when using an AC coupled PV array.
6. Set the SmartLoad2 input to AC coupling and set STOP and START charge points for the AC coupled array battery charging. These will be in SOC for a closed loop battery, and volts for an open loop battery.
7. If the system is off-grid and the batteries are full, the inverter will adjust the frequency between 60Hz and the maximum frequency set. With a sunspec compliant grid-direct inverter this will throttle the array to maintain some charging as it approaches full. If the grid-direct invert is an older non sunspec compliant one, the array will just turn on and off rather than tapering the charging. If the grid-direct inverter fails to turn off from frequency shifting, the system will open the relay to SmartLoad2 to shut off the PV array.
8. If the system is grid-tied and the system needs to shut off incoming power from the PV array, it will open the relay to SmartLoad2 to shut off the PV array.
9. **If the AC coupled PV array is connected to the AC output instead of to SmartLoad2, the AIO inverter will not be able to measure incoming PV power, resulting in erratic behavior and inaccurate monitoring data.**
10. The PV array will take up to 5 minutes to turn on once it sees AC voltage from the AIO inverter.
11. Control options for an AC coupled array is much more limited than control of a DC PV array connected to the MPPT inputs of the AIO inverter.
12. **An AC coupled PV array cannot dark start a battery that the BMS has shut off or charge the battery if the inverter has shut off from low SOC or voltage**. For off-grid systems, it is recommended to have at least a portion of the PV array be connected to the DC PV MPPT inputs.

Reusing an existing high voltage PV array from a string inverter:

If the existing array was previously wired into a high voltage string inverter, it may be possible to remove the string inverter and wire the array into the PV MPPT’s of the AIO inverter, simplifying the system and removing an old component that may be past its warrantee period.

1. **The array must be floating**. Many older grid direct string inverters used a 1A ground fault fuse for array ground fault protection. This design is blind to a ground fault on the negative home run. Existing arrays will be need to checked for any ground faults before reusing them. Measure voltage between each array negative and ground, and between each array positive and ground. All of these should be floating (not a fixed voltage, but not 0.0 volts either, usually shows up on a multimeter initially as a high voltage that quickly drops and continues fluctuating, not fixed).
2. Older string inverters often had several strings of lower amperage modules, paralled in the inverter. There are two input terminals for each MPPT of the AIO. Two strings can be paralleled using input A and B of an MPPT. If you have more than two strings, you generally need a series fuse on each string, and will need an exernal fused combiner box to parallel the strings. Make sure you do not exceed the limit of 30 amps per MPPT1, and 22 amps for MPPT2 and MPPT3 (40 A Isc and 29A Isc) if paralleling strings of modules.
3. When paralleling PV strings, measure voltage and polarity before and after paralleling them. If voltage drops to near zero after being paralleled, it is possible that the polarity of one string has been reversed, and that the strings are shorted. **This can be very dangerous to disconnect**, and ideally you should wait till nighttime to disconnect paralleled strings in this condition. Any time you measure zero volts from a PV string, it is potentially shorted, which is a dangerous condition to disconnect. Measure the current with a DC clamp on ammeter and verify that current is also zero before disconnecting any PV string that measures zero voltage.
4. Remember that all strings in parallel need to have the same number of modules in series.
5. Ideally, strings facing different directions would be connected to different MPPT inputs of the AIO, even if they have the same number of modules in series, as they will be operating with different array temperatures and irradiances.

Reusing an existing lower voltage PV array from a MPPT charge controller battery system:

If the PV system is being upgraded from an older battery based inverter/charge controller system, there are a few things that will usually need to be changed in the array to work well with the AIO inverter.

1. Most charge controllers were designed for 150 Voc, at relatively higher amperage. For example: a 12 module 3kW array on a 60 amp charge controller might be around 90 volts operating voltage, at 33 amps. Four strings of three modules each. Ideally for the AIO inverter the operating voltage should be above 140 volts, and the current needs to be less than 30 amps for MPPT1, and less than 22 amps for MPPT2 and MPPT3. Reconfiguring the array in the combiner box to series sets of two strings, then running those in parallel for an operating voltage of around 180 volts and 16 amps would be a much better design. You could also series all four strings so all twelve modules were in series, for an operating voltage of 360 volts around 8 amps. Details will depend on the exact configuration of the existing array, but in most cases, some reconfiguring of the array for higher voltage will result in much better production than using it as is.
2. **The array must be floating**. The negative cannot be grounded. Most charge controllers used a common negative with the battery bank, so the PV array negative may have been landed outside the charge controller. Or, it may have been inadvertently grounded in the combiner box and would have still functioned normally. Measure voltage between each array negative and ground, and between each array positive and ground. All of these should be floating (not a fixed voltage, but not 0.0 volts either, usually shows up on a multimeter initially as a high voltage that quickly drops and continues fluctuating, not fixed).
3. The input terminals for the MPPT inputs can accept a maximum of 8AWG wire. Many older low voltage arrays were wired with 6AWG or larger wire, and thus the existing array home runs cannot be directly wired into the PV MPPT inputs. They will need to be transitioned to 8AWG or 10AWG with a “polaris” type connector, or a terminal block.