

## AC Coupling with SkyBox

This application note covers the proper set-up of a system with a single SkyBox connected to a grid-dependent inverter (GDI) through the protected loads panel. Radian AC-coupled systems are covered in the application note *How To AC Couple Grid Dependent Inverters with the OutBack Radian Inverter*.

This type of connection is referred to as AC coupling. AC coupling a GDI with a SkyBox allows the GDI to continue producing power from its solar (PV) array even during a grid outage. This configuration is not meant to support permanent off-grid operation. At this time AC coupling to more than one SkyBox in a single system is not supported.

### Basic Requirements

1. SkyBox firmware 001.004.015 or greater
2. Energy storage system connected to the SkyBox
3. If connecting an oversized array (5 to 7.6 kW), the GDI must support frequency-watt control

### Theory of Operation

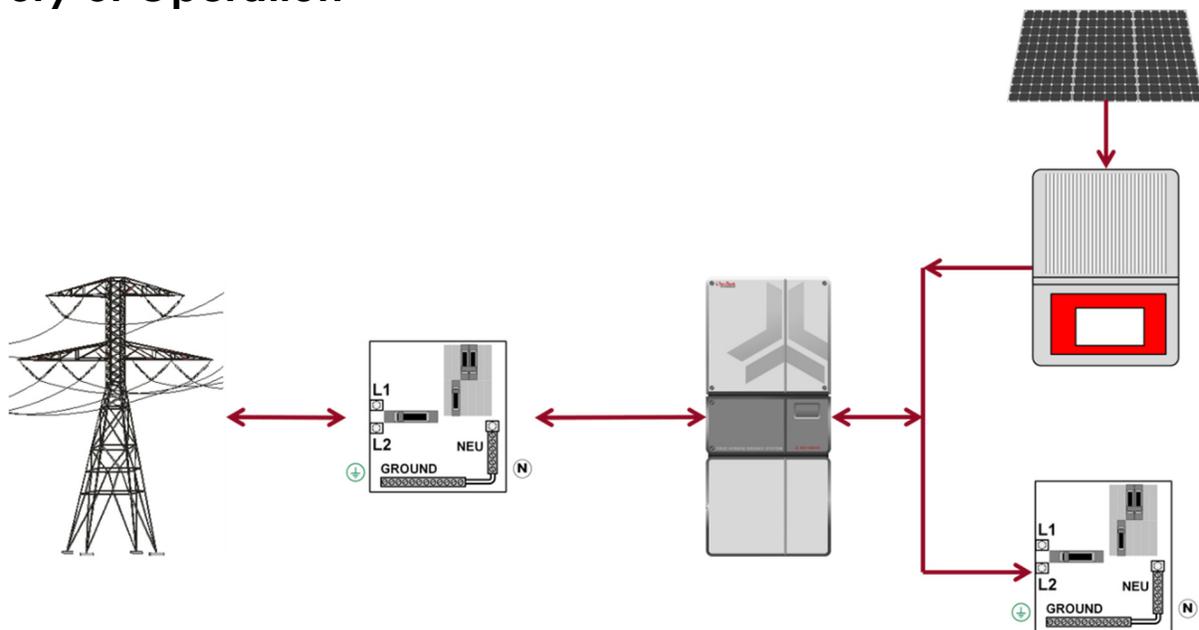


Figure 1: Block diagram of an AC-coupled SkyBox system

### On-Grid Operation

While connected to the grid, the GDI operates as it would without being coupled to a SkyBox. PV power is produced by the array and passed to the GDI where it is inverted from DC to AC. The AC power is passed from the GDI to the loads or the grid through the SkyBox. If the array is not making enough power to cover the demands of the loads, power is pulled from the grid.

At night, or when solar power is not available, the SkyBox will either supply power to the loads from its energy storage system or from the grid, depending on the grid use mode selected (see the **Programming** section).

## Off-Grid Operation

Typically during a grid outage, a GDI does not produce power from its PV array. When AC coupled, the SkyBox provides the reference waveform to the GDI. This allows the GDI to continue producing PV power. The power is used to support the protected loads and to charge the battery connected to the SkyBox.

If the GDI is producing more power than is necessary, SkyBox increases the frequency of the reference waveform. In UL1741SA compliant inverters, this rise in frequency causes a decrease in power produced. In pre-UL1741SA inverters, this rise in frequency forces the GDI to stop producing until the frequency is lowered. This method of control is called frequency-watt control. SkyBox uses this method to regulate power produced by the GDI.

## Physical Installation

No significant changes to the physical installation of the SkyBox are necessary to support AC coupling. All of the steps listed in the *Quick Start Guide* and *AC Coupling Planning Guide* should be followed for installation. A sample wiring diagram with an AC coupled inverter can be found on page 4.

## Programming

There is not a specific setting to enable or disable AC coupling in the SkyBox. However, there are several site-specific settings that will optimize the operation.

If the array is larger than 5 kW, the GDI must be capable of responding to frequency-watt control. This may require changing the grid support settings on the GDI. Typically, the most appropriate choices are HECO or CA Rule 21 rules.

## Grid Use Modes

SkyBox AC coupling will operate properly in any grid mode except **Maximum Independence**.



### IMPORTANT

AC coupling is not supported in the **Maximum Independence** grid use mode.

When in **Self-Consumption** and **Non-Export**, SkyBox normally only allows charging from PV. When AC coupled, SkyBox will allow charging from both the SkyBox connected PV and the AC coupled array. In this mode, it is expected to see small oscillations on the home screen tiles. If the solar arrays are producing more than is required by the loads and battery, the excess power will be sent to the grid. At night, the protected loads are supported from the SkyBox battery until it reaches minimum SOC. For more information on the operation of these modes, please refer to the *SkyBox Programming Guide* or the *SkyBox Handbook*.



### IMPORTANT

SkyBox **CANNOT** curtail GDI production while connected to the grid. Non-export mode will only curtail an array that is directly connected to the SkyBox.

## **(Optional) OPTICS RE Integration**

The OPTICS RE tool provides a means to remotely monitor and operate an AC-coupled SkyBox. The system is set up exactly like a standalone SkyBox system. The AC-coupled power will show up as a negative load on the graphs. The real-time power flow diagram will also show “AC coupling” when hovering over the **Load** icon.

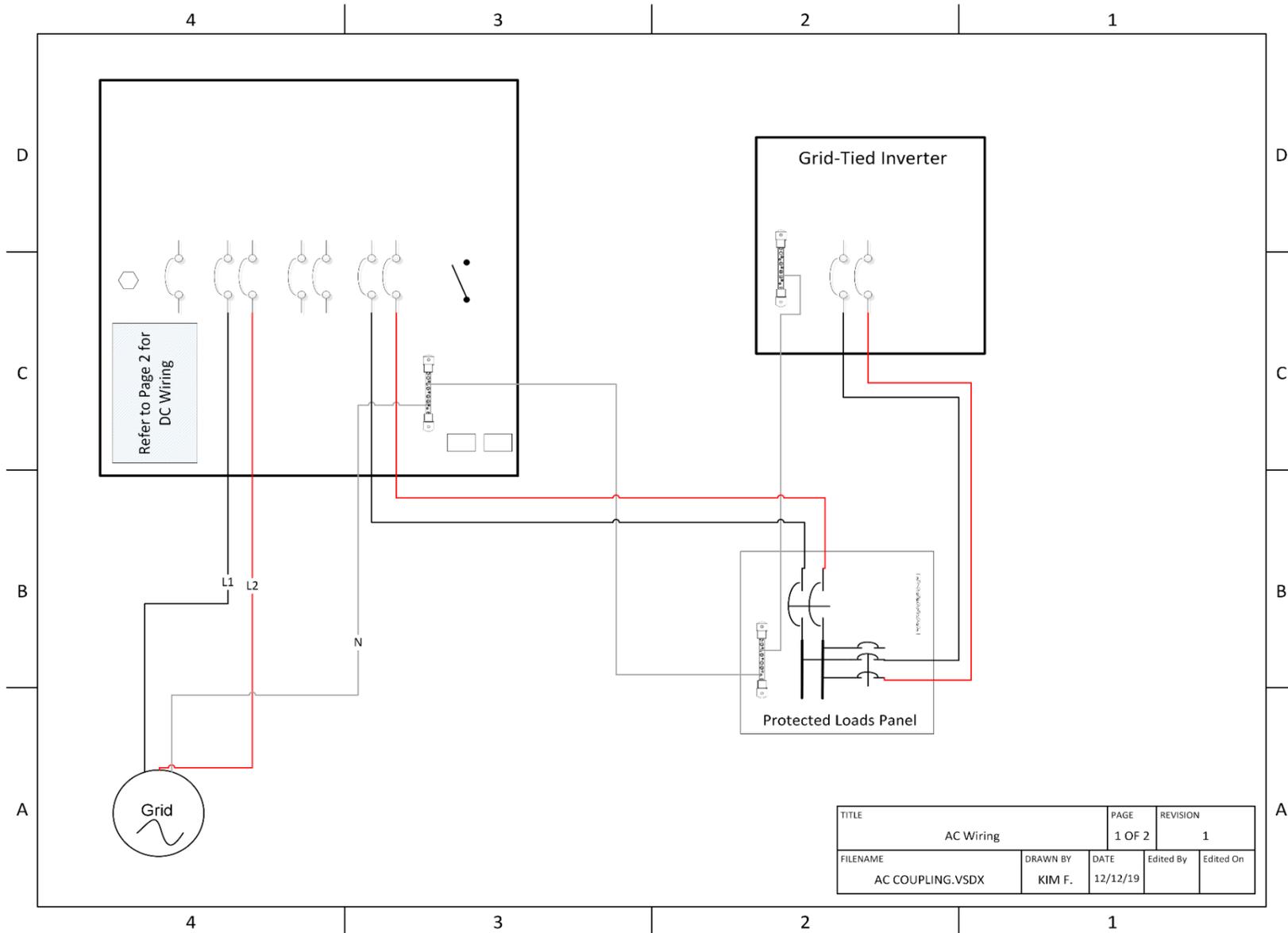
## **Basic Troubleshooting**

Q. I am continuously getting a fault when operating off grid. My GDI is cycling on and off every few minutes.

A. The GDI must be set up for frequency watt control. Older inverters that are not UL1741SA compliant cannot be used with the SkyBox if the array size is >5kW.

Q. Grid-tied inverters are turning off during grid outages.

A. Check for pre-existing faults on the SkyBox. If there was a fault prior to the grid outage, SkyBox can continue passing power through, but will not operate during a grid outage.



**Figure 2: Sample wiring diagram**

## About OutBack Power

OutBack Power is a leader in advanced energy conversion technology. OutBack products include true sine wave inverter/chargers, maximum power point tracking charge controllers, and system communication components, as well as circuit breakers, batteries, accessories, and assembled systems.

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## Other

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