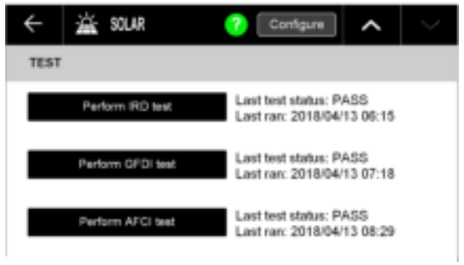
PV Self-Tests



Self-tests are available to detect PV system faults. These tests are available in the last screen under the **SOLAR** tile. (See page 9.) If any of these tests fail, contact the system installer.

- IRD test: Searches for impedance imbalances on the PV wires that may result from insulation problems.
- GFDI test: Tests the ground fault detection circuit for proper function. A ground fault can result from an insulation failure that allows current-carrying conductors to contact grounded, conductive surfaces. The ground fault detector-interrupter (GFDI) circuit shuts down the SkyBox if this occurs.
- AFCI test: Tests the arc fault detection circuit for proper function. An arc fault can result from arcing along the PV wires and may result in a fire. The arc fault circuit interrupter (AFCI) circuit shuts down the SkyBox if this occurs.

Rapid Shutdown

Any time a Rapid Shutdown event is triggered, a set of normally-closed terminals on a Rapid Shutdown Initiator will open. When the SkyBox Rapid Shutdown input terminals sense this, the SkyBox will shut down accordingly.

When this occurs, an **Alert** message will appear in the ***SYSTEM NOTIFICATION*** screen. (See pages 3 and 14.)

This shutdown may be limited to the solar portion of the system or it may extend to SkyBox AC input and output. The extent of the shutdown is selected in the ***RSD (rapid shutdown response)*** menu item. (See page 6.) The selections are ***PV*** or ***PV and AC***.

- When a rapid shutdown event occurs with ***PV*** selected, the solar charging is the only portion of the SkyBox shut down.
  - Solar charging is shut down. The **SOLAR** tile reads ***WAITING***.
  - Grid, load, and other operation continue normally.
  - The **Off/On** button turns yellow (if previously on). If pressed, the button turns red. All grid, load, and other operation are turned off. The display jumps to the ***Inverter Fault Status*** screen.

    NOTE: A fault code will not appear. A Rapid Shutdown initiation is a command given to the SkyBox.
  - If the SkyBox was turned off at the time of the shutdown, the **Off/On** button will be red. The button will turn yellow if turned on with the shutdown still occurring.

    NOTE: This behavior will also occur if the Rapid Shutdown terminals are left unconnected.
- When a rapid shutdown event occurs with ***PV and AC*** selected, all main SkyBox functions are shut down.
  - Solar charging is shut down. The **SOLAR** tile reads ***WAITING***.
  - The SkyBox disconnects from the grid. The **GRID** tile reads ***WAITING***.
  - The inverting function is shut down. The **LOAD** tile reads ***OFF***.
  - The **Off/On** button remains green (if previously on). If pressed, the button turns gray and all grid, load, and other operation are turned off.
  - If the SkyBox was turned off at the time of the shutdown, the **Off/On** button will be gray. The button will not respond. The SkyBox cannot be turned on until the shutdown is resolved.

    NOTE: This behavior will also occur if the Rapid Shutdown terminals are left unconnected.

Resolving a Rapid Shutdown normally requires simply resetting the Rapid Shutdown Initiator. Other conditions leading to the shutdown may need to be addressed.

Date and Revision

July 2018, Revision A

900-0210-12-00 Rev A
©2018 OutBack Power Technologies. All Rights Reserved.

IMPORTANT:
Not intended for use with life support equipment.



Contact Information

Mailing Address: Corporate Headquarters
17825 – 59th Avenue NE
Suite B
Arlington, WA 98223 USA

Web Site: www.outbackpower.com

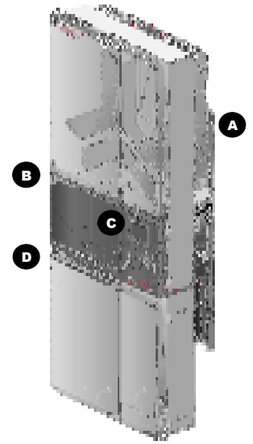
SKYBOX True Hybrid Energy System

Contents:

Interface Display 1
Home Screen..... 2-4
Date, Time, and Icons..... 4
System Notification Button 3
Off/On Button 3
Tiles: Description 5
SkyBox Select Button 6
SkyBox Button 6
Settings Button 7
LOGIN Tab 7
SYSTEM Tab 7
REGIONAL Tab 7
NETWORK Tab 8
FIRMWARE Tab 8
SOLAR Tile 9
GRID Tile 10
LOAD Tile 11
BATTERY Tile 12
GENERATOR Tile 13
Troubleshooting 14-15
PV Self-Tests 16
Rapid Shutdown 16

Features

A: Mounting Panel
B: Inverter connection panel
C: Graphical User Interface (GUI)
D: Balance of Systems (BOS)



WARNING: Limitations on Use

This equipment is NOT intended for use with life support equipment or other medical equipment or devices.

WARNING: Reduced Protection

If this product is used in a manner not specified by SkyBox product literature, the product's internal safety protection may be impaired.

CAUTION: EQUIPMENT DAMAGE

Only use components or accessories recommended or sold by OutBack Power Technologies or its authorized agents.

IMPORTANT

This document is for use by anyone required to operate the SkyBox True Hybrid Energy System. Operators must be familiar with all safety regulations pertaining to operating power equipment of this type as required by local code. Operators are advised to have basic electrical knowledge and a complete understanding of this equipment's features and functions.

Screens accessed with **Configure** or **Edit** buttons generally require a user access level not covered in this document.

In this document, accessing these screens either shows the settings as unchangeable (in gray text), or leads to a prompt screen for a higher access level.

This document depicts the SkyBox features and functions available to the ***Public*** and ***Owner*** access levels (see page 7). See the *SkyBox Programming Guide* for higher access levels.

Interface Display

The SkyBox display is a touch-sensitive interface. It monitors all aspects of SkyBox performance. Onscreen items such as buttons, tiles or icons will respond or open when tapped with a finger or stylus.

Arrows ←, chevrons ⌄, or pointers ▾ are frequently used for navigation. To navigate:

- Arrows ← usually proceed to the previous or next screen in a series. Continuing to press the left arrow will generally return to the Home screen.
- Chevrons ⌄ proceed to the previous or next sub-screen in a series. Navigation within each **Tile** (see page 9) is usually performed with chevrons.
  - Chevrons pointing up or down access additional screens for monitoring, programming, or settings.
  - Chevrons pointing left or right access alternate views of the present screen from other dates. The left chevron brings up data from the previous day. The right chevron brings up the next day (if possible).

Home Screen

The Home screen is the entry point for all SkyBox monitoring.

- The items along the top, the **Buttons**, allow access to status messages, notifications, and settings for one or all SkyBoxes.
- The central items, the **Tiles**, show real-time data for different aspects of the system. The five **Tiles** display the five primary aspects of the SkyBox: solar power, grid power, loads, battery charging, and generator operation. See the next page for a summary of the **Tiles**.

Buttons

System Notification Button (A)





Tapping this button opens the ***System Notification*** screen. This screen contains two tabs: **Alerts** and **Logs**, with a historical record of up to 50 events.

A Log is simply a record of a change in SkyBox status. An Alert is a condition that may occur during normal operation and may need monitoring. Alerts also include error messages that accompany shutdown faults. (See the troubleshooting guide on page 14.)

When a Rapid Shutdown occurs, this will also generate an alert in this screen. See the Rapid Shutdown section on page 16.

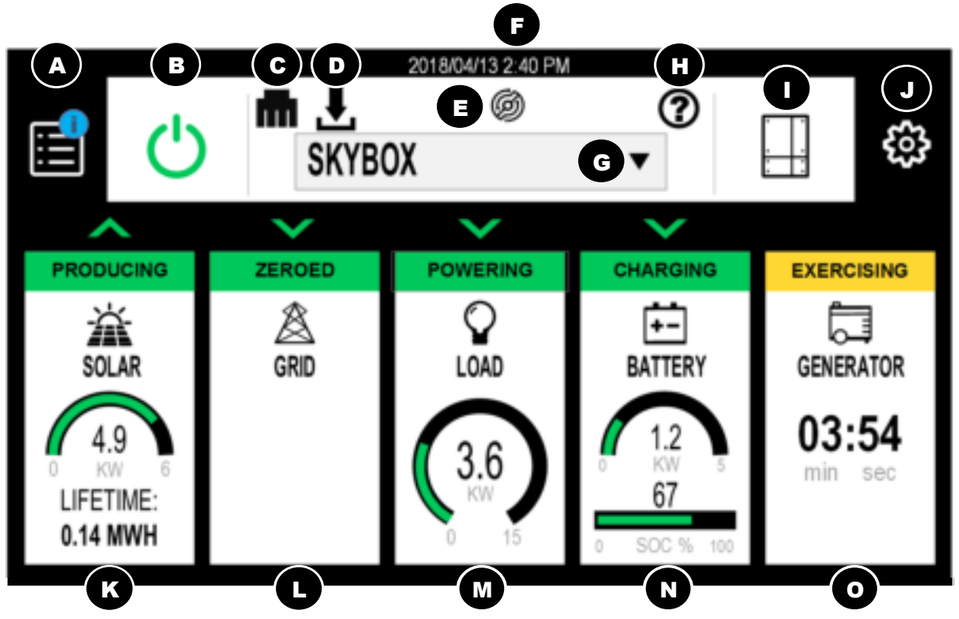
The tab name shows the number of new (unread) notifications in that tab. Entering the tab and tapping on a notification acknowledges it as no longer new. Tapping the number of unread notifications brings up the option to acknowledge all messages at once. This is only allowed when logged in under the ***Owner*** profile or higher. A login prompt will appear. (See page 7.)

Off/On Button (B)

This button controls all SkyBox functions. Tapping it will turn these functions on or off. This includes the inverting (load) function, connection to the utility grid or generator, PV harvest, and any selling or charging. The present state is indicated by the button color.

- Green — ON. Tapping the button will change to OFF.
- Black — OFF. Tapping the button will change to ON.
- Yellow — Partial operation with faults. Tapping the button opens the ***Inverter Fault Status*** page. If the SkyBox is turned off from this state, the button turns red (shutdown with faults). See pages 6 and 14.
- Red — SkyBox has shut down with faults. Tapping the button opens the ***Inverter Fault Status*** page.
- Gray — SkyBox has shut down and is unable to restart. This can occur due to a Rapid Shutdown command.

See pages 14 and 16, and the ***System Notification*** screen, for more information on faults and Rapid Shutdown.



Network Button (C)

A black icon means communications are normal. Red indicates the RJ45 cable is present but no connection is established. Yellow indicates a partial connection. Tapping this button opens the **NETWORK** tab (see page 8).

Firmware Update Button (D)

If this button is present, a firmware update is available. The button will not be present if no update is available. Tapping this button opens the **FIRMWARE** tab (see page 8).

OPTICS RE Button (E)

A black icon means the cable is connected, OPTICS RE has been enabled, and communications are normal. Red indicates that one of these conditions was not met. Tapping this button opens the ***OPTICS RE*** section of the **NETWORK** tab (see page 8).

Time and Date (F)

This is not a button, but a display. It uses the settings in the **REGIONAL** tab (see page 7).

Information Button (G)

Tapping this button, then tapping any other item on the screen, brings up a definition of that item. This mode is disabled by tapping the button again.

900-0210-01-00 Rev A
©2018 OutBack Power Technologies. All Rights Reserved.

SkyBox Select Button (H)

This selection represents the currently viewed SkyBox unit. See page 6.

NOTE: This button does not function if only one SkyBox is installed.

SkyBox Button (I)

Tapping this button opens the ***SkyBox Status*** screen. See page 6.

Settings Button (J)

Tapping this button opens the ***Global Settings*** series of screens. Global settings affect the system as a whole as well as the GUI, network communications, and other large-scale settings. See page 6.

NOTE: Most of these settings cannot be changed without ***Installer*** login access.

Tiles

The central items, the **Tiles**, show real-time data for different aspects of the system. Tapping a tile allows access to status messages, historical data, and settings. The tiles have several common features.

- **Banner**. This appears at the top of each tile and includes a status message. The banner color also indicates general status. See below.
- **Chevron**. This appears above each tile. It is only present when the item in the tile is active. It may point either upward or downward. The chevron will point downward when power flows to that item (solar, battery, etc.). It will point upward when the item contributes power.

Tile color codes:

- Green — Item is in use and functioning normally
- Yellow — Item is functioning normally in an alternate mode or state from that indicated by green
- Black — Item is turned off and awaiting manual activation
- Gray — Item is not available or not present
- Red — Item is faulted and cannot be activated until the fault is corrected

These color codes apply to both the banners, the chevrons, and the meter bars shown on many tiles.

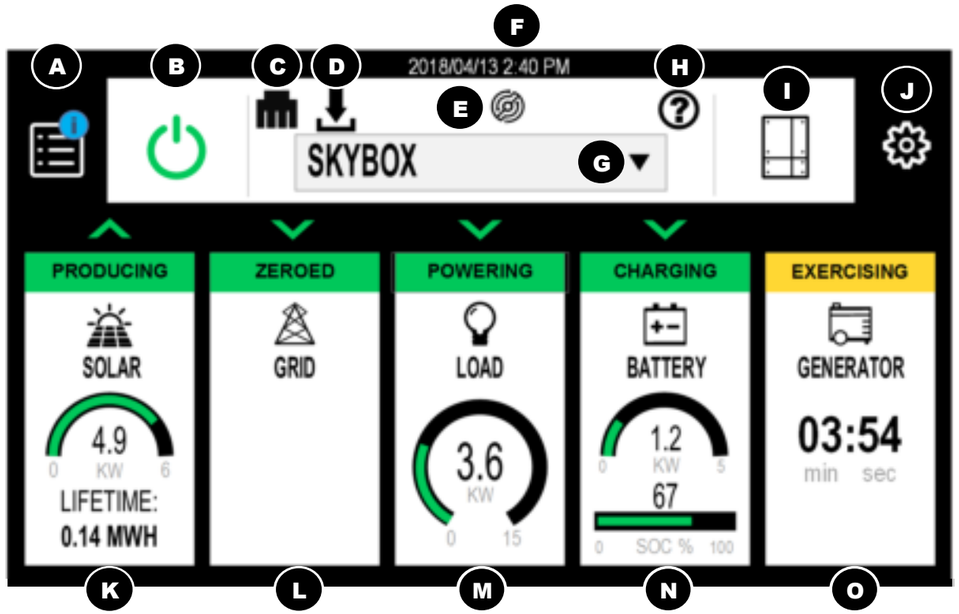
Solar Tile (K)

This tile and its screens summarize data (historical and real-time) regarding PV harvest. Information on lifetime production is available here. See page 9.

Grid Tile (L)

This tile and its screens summarize data (historical and real-time) regarding power bought from, or sold to, the utility grid. Information on grid performance is located here. See page 10.

900-0210-01-00 Rev A
©2018 OutBack Power Technologies. All Rights Reserved.



Load Tile (M)

This tile and its screens summarize data (historical and real-time) regarding power being used to sustain loads. Information is located here on load performance for both the L1 and L2 lines. See page 11.

Battery Tile (N)

This tile and its screens summarize data (historical and real-time) regarding battery status and state of charge. Information can be tracked for multiple independent battery banks. See page 12.

Generator Tile (O)

This tile and its screens summarize data (historical and real-time) regarding generator operation. The advanced generator start function (AGS) is managed here. See page 13.

SkyBox Select Button

The ***SkyBox Select*** dropdown menu **A** allows general viewing of a specific SkyBox or viewing of all units.

When multiple units are stacked (networked) together in one system, the pointer ▾ presents a dropdown list of all units by name. (An individual unit's ***System name*** is listed under **System Info**, below.) When a selection is made, it sets the five Home Screen **Tiles** to display the solar, grid, and related properties associated with that particular SkyBox.



Settings Button

Tapping the **Settings** button **E** opens the ***GLOBAL SETTINGS*** series of screens. Global settings affect the system as a whole as well as the GUI, network communications, and other large-scale settings. This menu shows several tabs accessing different categories.

NOTE: This button does not access settings for the charger, PV, etc. See the **Tiles** beginning on the next page.

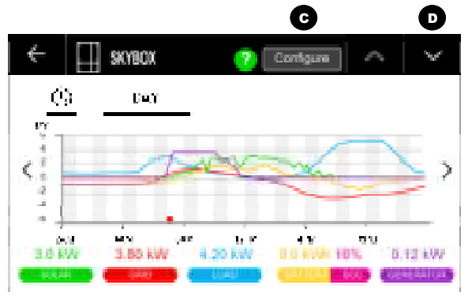
SkyBox Button

SkyBox Status Screen

Tapping the **SkyBox** button **B** brings up the ***SkyBox Status*** screens. The first page has a history graph for the full SkyBox system (showing either positive or negative kilowatts) with daily behavior of the following items.

- Green SOLAR
- Red GRID
- Blue LOAD
- Yellow BATTERY
- Pink STATE OF CHARGE
- Red GENERATOR

Each line on the graph is also displayed as a real-time measurement. Solar, grid, load and generator output are measured in kilowatts. The batteries are measured in kilowatt-hours (the net daily production) and percentage (the present state of charge or SOC).

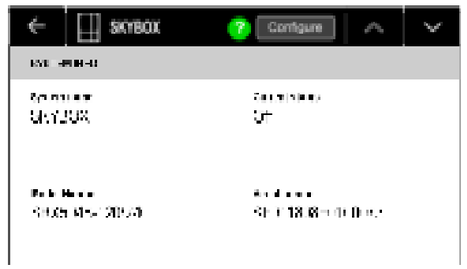


System Info

The chevrons **D** bring up ***SYSTEM INFO*** screens for the unit specified with the **SkyBox Select** button.

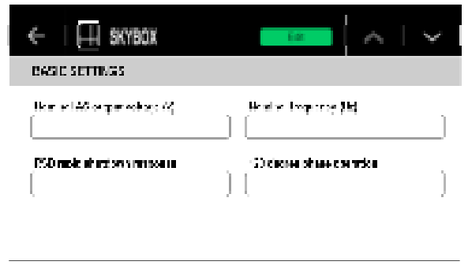
- ***System name***
- ***Model Number***
- ***Current status***
- ***Serial number***

The next chevron leads to the ***Inverter Fault Status*** screen which is used for troubleshooting. See page 14.



The **CONFIGURE** button **C** leads to a series of AC settings. These include AC operating parameters, Rapid Shutdown, and current transducer (CT) information:

- ***Nominal AC output voltage***
- ***Nominal frequency***
- ***RSD (rapid shutdown response)***
- ***120 degree phase operation***
- ***CT Type***
- ***Rated current***
- ***Phase shift (degrees)***
- ***Turns ratio***



LOGIN Tab

Tapping the Settings button **E** brings up a series of tabs beginning with **LOGIN** (**F**). This document covers the ***Public*** and ***Owner*** login profiles. In these profiles, the items in the other tabs are not editable or configurable even though the screens are present. Logging in under the ***Installer*** profile allows configuration access.



SYSTEM Tab

The **SYSTEM** tab **G** opens several screens showing items of system settings and information. These include:

- ***System name***
- ***Serial #***
- ***Display timeout***
- ***Brightness***
- ***System model***
- ***Login timeout***

The next chevron leads to screens which allow each login password to be changed. A password can only be changed by using the previous password.



REGIONAL Tab

Tapping the **REGIONAL** tab **H** opens several screens showing region-specific settings. These include:

- ***Language***
- ***Country***
- ***Date format***
- ***Time format***
- ***Temperature format***
- ***Time zone***
- ***Date***
- ***Time***

The final screen, ***INTERNET TIME***, allows automatic time settings.



900-0210-01-00 Rev A

©2018 OutBack Power Technologies. All Rights Reserved.

NETWORK Tab

Tapping the **NETWORK** tab **I** opens several ***INTERNET CONNECTION*** screens. These include:

- ***Connection mode***
- ***DHCP enable***
- ***Ethernet connection***
- ***IP address***
- ***Subnet mask***
- ***Gateway***
- ***Primary DNS***
- ***Secondary DNS***
- ***Automatic port forwarding enable or disable***
- ***UpnP port number***

I



The next chevron leads to the ***OPTICS RE*** screen.

- ***OPTICS RE communication***
- (OPTICS RE) ***Status***
- ***Average latency (ms)***

After ***OPTICS RE***, the chevrons lead to a series of ***SUNSPEC COMMUNICATION (RS-485)*** screens.

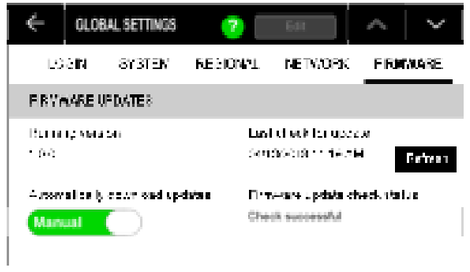
- ***RS-485***
- ***Device ID***
- ***Comm***
- ***Baud rate***
- ***TCP/IP***
- ***Port***
- ***Parity bit***
- ***Stop bits***
- ***Data bits***

FIRMWARE Tab

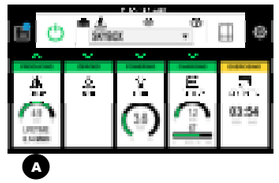
Tapping the **FIRMWARE** tab **J** opens several screens with the following information relating to SkyBox firmware:

- ***Running version***
- ***Last check for update*** (this item can be reset with the **Refresh** button)
- ***Automatically*** (or manually) ***download updates***
- ***Firmware update check status***
- ***Downloaded version***

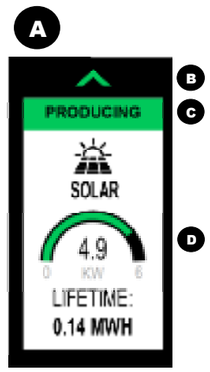
J



SOLAR Tile



A



The SkyBox harvests photovoltaic (PV) energy from a PV array using maximum power point tracking (MPPT) technology. This energy can be used to run loads, for battery charging, for grid-tied activity, or for other purposes.

The Home screen **SOLAR** tile **A** has several PV status indicators. The colors of each indicator use the same general key shown in the **TILE** section on page 5.

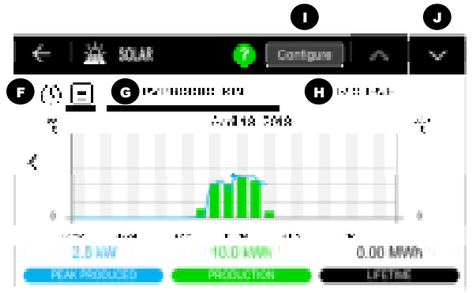
- The chevron **B** shows that PV energy is being harvested. It is only present when the status of **C** is ***PRODUCING***.
- Message **C** displays the specific status of the SkyBox PV input (also noted by the color of the box).
  - NONE (gray): The system was not configured with a PV array and one has not been detected.
  - SLEEPING (gray): The PV is not generating sufficient voltage to activate the input.
  - TESTING (yellow): The SkyBox is performing a ground fault, arc fault, or impedance test prior to ***SWEEPING***.
  - SWEEPING (yellow): The SkyBox is performing an MPPT prior to harvesting PV energy.
  - WAITING (green): PV energy is available but the SkyBox is unable to export it. The grid may be disconnected. The loads may be disconnected or running at full capacity. The battery may be fully charged.
  - PRODUCING (green): PV energy is available and being used (see **D**). The chevron in **B** points upward.
  - FAULT (red): The array is in a fault condition, which must be cleared before proceeding. See page 14.
- **D** is a green circular meter which advances clockwise to show the PV input (***PRODUCING***) in kilowatts (kW). The meter is fully lit when the SkyBox reaches full PV capacity (6 kW). The production is also displayed as a digit in the center.

Tapping the **SOLAR** tile **A** opens **E** for a given day. The default view is the ***PV PRODUCTION*** tab **G**. It shows:

- Peak kilowatts (kW) produced that day (graphed with a blue line). A blue dot marks the instantaneous peak.
- Kilowatt-hours (kWh) accumulated that day (graphed with green bars).
- Lifetime megawatt-hours (MWh) accumulated (also shown on the tile).
- Displays for other days are available.

  NOTE: Most of these items are graphed by time of day. The peak value for each graph is also shown as a number. Tapping a colored bar at the bottom of the screen will hide that number and graph, or restore it.
- Tapping the clock symbol **F** changes the graph to a historical display showing daily, weekly, monthly, or yearly production.

E



The "down" chevron **J** opens several ***MORE INFO*** screens with:

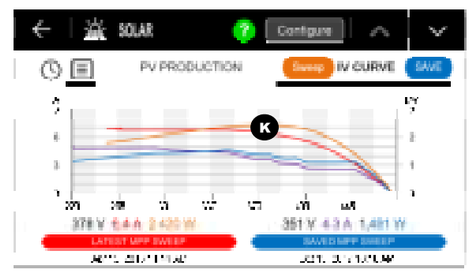
- The present level of PV voltage, current, and power harvested.
- The system's peak PV power and the time and date harvested.
- The system's highest V_{oc} and the time and date measured.

These are followed by an ***IRD***, ***GFDI***, and ***AFCI TEST*** screen. See page 16.

Tapping the ***IV CURVE*** tab **H** opens a view with I-V curves for MPPT. It also displays measurements for V_{mp}, I_{mp}, and P_{mp}.

- The present MPP sweep is displayed as well as the last sweep saved. Tapping either set of digits will remove that sweep from the graph.
- The **SWEEP** and **SAVE** buttons **K** can be used to perform a new MPPT sweep (replacing the present sweep) and to save the present sweep to memory. Only one sweep can be saved at a time.

H



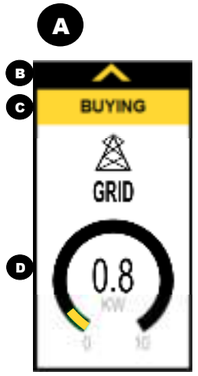
The **CONFIGURE** button **I** leads to a screen with a set of PV module specifications.

900-0210-01-00 Rev A

©2018 OutBack Power Technologies. All Rights Reserved.



GRID Tile



The SkyBox connects to the utility grid to charge batteries and run loads. It can also sell to the grid, or interact with the grid in other ways if sell-back is not permitted.

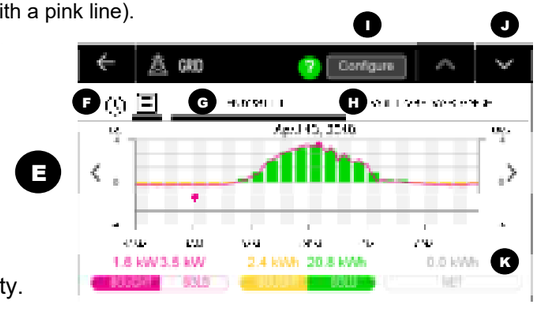
The Home screen **GRID** tile **A** has several grid status indicators. The colors of each indicator use the same general key shown in the **TILE** section on page 5.

- The chevron **B** is present when the status message **C** shows the unit is ***BUYING*** or ***SELLING***.
  - Chevron aimed upward: ***BUYING***
  - Chevron aimed downward: ***SELLING***
- Message **C** displays the specific status of the SkyBox grid connection.
  - OFF GRID (gray): The grid is disconnected.
  - OUT OF SPEC (gray): The grid is outside the grid protection parameter boundaries.
  - WAITING (green): The grid is within input range but the connection timer is still running.
  - ZEROING (green): The SkyBox is minimizing grid input with the GridZero™ function.
  - DROPPED (gray): The grid is available but the SkyBox programming has disconnected from it.
  - CONNECTED (green): The SkyBox is connected to the grid. Total activity is less than 100 watts (either bought or sold).
  - BUYING (yellow): More than 100 watts of power is being taken from the grid. The chevron in **B** points upward.
  - SELLING (green): More than 100 watts of power is being sold to the grid. The chevron in **B** points downward.
- **D** is a circular meter which advances clockwise to show the grid power being handled by the SkyBox (bought or sold) in kilowatts (kW). The meter is fully lit when the SkyBox reaches full capacity (10 kW when buying, 5 kW when selling). The power is also displayed as a digit in the center.

Tapping the **GRID** tile **A** opens **E** for a given day. The default view is the ***BUY/SELL*** tab **G**. It shows:

- Peak kilowatts (kW) either bought or sold that day (graphed with a pink line). Pink dots mark the instantaneous peaks of buying and selling.
- Kilowatt-hours (kWh) accumulated (bought and sold) that day (graphed with yellow and green bars).
- Net daily kWh accumulated (**K**). This is not graphed.

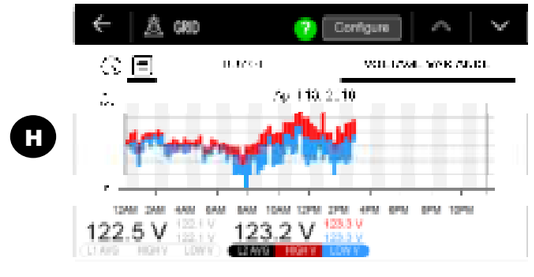
NOTE: These items are graphed by time of day. The peak value for each is also shown as a number. Tapping a colored bar at the bottom of the screen will hide that number and graph, or restore it. When the **NET** display is tapped, it replaces the daily kWh graph.



Tapping the clock symbol **F** changes the graph to a daily, weekly, monthly, or yearly historical display of buy/sell activity.

The "down" chevron **J** opens a ***MORE INFO*** screen with:

- The present grid wattage handled by the SkyBox.
- The present grid connection status
- A command telling the SkyBox to either drop or use the grid
- The present grid voltage and frequency



Tapping the ***VOLTAGE VARIANCE*** tab **H** opens a screen with average high and low grid voltages as shown.

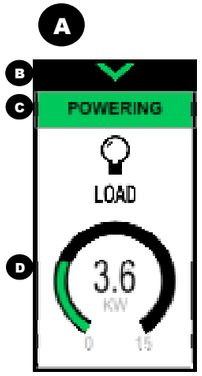
The **CONFIGURE** button **I** leads to a screen with various grid connection settings.

900-0210-01-00 Rev A

©2018 OutBack Power Technologies. All Rights Reserved.



LOAD Tile



The SkyBox uses an inverting function to convert battery (DC) power to AC output. It can run loads in the absence of an AC source. If an AC source is present (utility grid or generator), the SkyBox can switch to run loads directly from the AC source.

The inverting function can also work with the utility grid. It can add PV and battery power to support loads (self-supply) if the AC supply is not large enough. It performs similar activity for the grid-interactive (sell-back) and GridZero functions. It can also "AC couple" power from another grid-tied inverter to the grid.

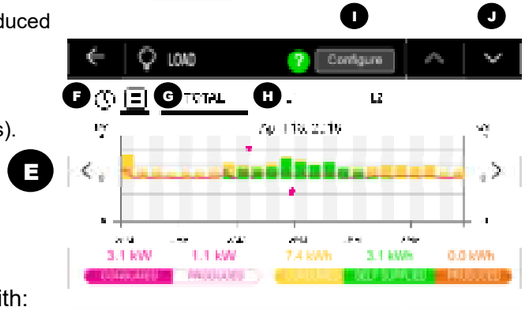
The Home screen **LOAD** tile has several load status indicators.

- The chevron **B** shows that the SkyBox is either buying or selling.
  - Chevron aimed downward: Sending power to loads (***POWERED***, ***SUPPORT***, ***PASS THROUGH***).
  - Chevron aimed upward: Receiving power from load input (***AC COUPLE***).
- Message **C** displays the specific status of the inverting function.
  - OFF (black): The loads are not being powered. The **Off/On** button (see page 3) is set to OFF.
  - POWERED (green): The loads are being powered by the SkyBox.
  - SUPPORTING (green): The loads are being supported by both the SkyBox and the grid.
  - PASS THROUGH (yellow): The loads are being powered by the grid.
  - AC COUPLE (yellow): The SkyBox is being powered through the load port.
- **D** is a green circular meter which advances clockwise to show the power kilowatts (kW) being handled by the output. The meter is fully lit when the SkyBox reaches full capacity (10 kW). The power is also displayed as a digit in the center.

Tapping the **LOAD** tile **A** opens **E** for a given day. The default view is the ***TOTAL*** tab **G**). It shows:

- Peak kilowatts (kW) either consumed that day (by loads) or produced through AC coupling (graphed with a pink line). Pink dots mark the instantaneous peaks of consumption and production.
- Kilowatt-hours (kWh) consumed (by loads), self-supplied, or produced that day (graphed with yellow, green, and orange bars).

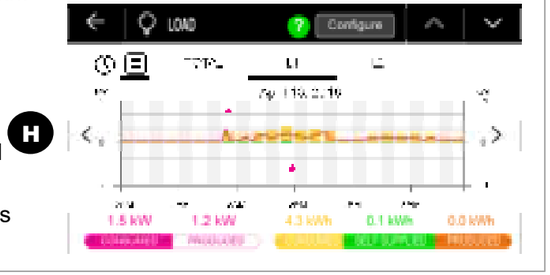
NOTE: These items are graphed by time of day. The peak value for each graph is also shown as a number. Tapping a colored bar at the bottom of the screen will hide that number and graph, or restore it.



Tapping the clock symbol **F** changes the graph to a daily, weekly, monthly, or yearly historical display of load output.

The "down" chevron **J** opens several ***MORE INFO*** screens with:

- ***Percent of SkyBox load capacity***
- ***L1*** and ***L2 Total load*** and ***Self supply*** (kilowatts of load supplied by battery and solar power)
- ***Today's Self supply*** and ***Lifetime Self supply*** (kWh)



Tapping the ***L1*** or ***L2*** tabs **H** brings up screens with individual daily kW and kWh figures similar to those in **G**.

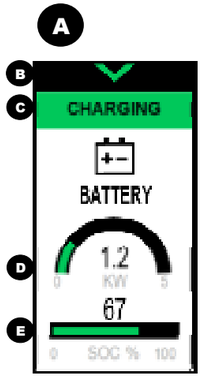
The **CONFIGURE** button **I** leads to a screen with various load management settings.



BATTERY Tile

The SkyBox can use a battery source to run loads, minimize consumption of grid power, and other applications. It uses a three-stage cycle to recharge batteries. It can also monitor usage and track the battery state of charge (SOC).

The Home screen **BATTERY** tile **A** has several battery status indicators.



- The chevron **B** shows the direction of battery current.
  - Chevron aimed downward: ***CHARGING***
  - Chevron aimed upward: ***DISCHARGING***

  NOTE: This chevron is not present when the state is ***Resting***.
- Message **C** displays the specific battery activity and status (also noted by the color of the box).
  - CHARGING (green): Power is being delivered to the battery from a charging source.
  - DISCHARGING (yellow): Power is being taken from the battery for one of several applications.
  - RESTING (green): Battery activity is less than 100 watts (charging or discharging).
- **D** is a circular meter that lights to show power in kilowatts (kW) being handled by the batteries. The meter is fully lit when the SkyBox reaches full capacity (5 kW when either ***CHARGING*** or ***DISCHARGING***). The power is also displayed as a digit in the center.
- **E** is a meter bar that lights to show the battery SOC in percentage. The SOC is also displayed as a digit above the bar.

Tapping the **BATTERY** tile **A** opens **F** for a given day. The default view is the ***TOTAL*** tab **H**. It shows:

- Peak kilowatts (kW) both charged and discharged that day (graphed with a pink line). Pink dots mark the instantaneous peaks of charging and discharging.
- Kilowatt-hours (kWh) used to charge and discharge the batteries that day (graphed with green and yellow bars).
- A changeable screen that shows a variety of other battery data for that day. This item (**K**) is initially blank and labeled **MISC**. Tapping on this screen will show the range of items, which include battery SOC as a percentage, battery voltage, and battery temperature.

  NOTE: These items are graphed by time of day. The peak value for each is also shown as a number. Tapping a colored bar at the bottom of the screen will hide that number and graph, or restore it. Only two displays can be shown at a time.



Tapping the clock symbol **G** changes the graph to a historical display showing daily, weekly, monthly, or yearly charging or discharging for a selected date range.



The "down" chevron **J** opens opens several ***BATTERY DETAILS*** screens. These include present data, commands that can be issued to the charging system, and historical performance data.

The **CONFIGURE** button **I** opens a series of configuration screens for SkyBox battery charging.

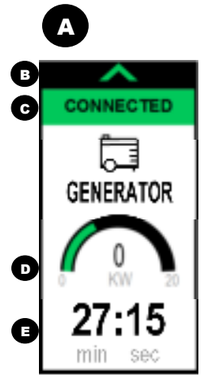
900-0210-01-00 Rev A
©2018 OutBack Power Technologies. All Rights Reserved.



GENERATOR Tile

The SkyBox can control a generator to run loads and charge batteries. The generator can be started with a manual command or programmed to run automatically with the Advanced Generator Start (AGS) function. The generator can start or stop according to battery state, time of day, or several other external conditions.

The Home screen **GENERATOR** tile **A** has several generator status indicators.



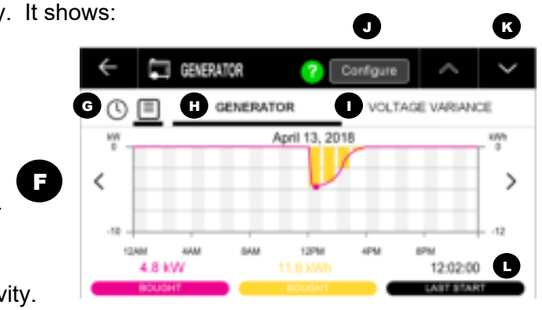
- The chevron **B** shows that the generator is delivering power.
  - Chevron aimed upward: ***CONNECTED***

  NOTE: This chevron is not present in states where no power is being used (***WARMING UP***, ***COOLING DOWN***, ***EXERCISING***, or others). The chevron does not point downward in any state.
- Message **C** displays the specific generator activity and status (also noted by the color of the box).
  - DISCONNECTED (gray): The generator is not operating or connected.
  - STARTING (yellow): The SkyBox has sent a start command. The generator should start.
  - WARMING UP (yellow): The generator has started and is going through the warmup period.
  - WAITING (green): The generator power is within limits, but it cannot be accepted because the grid is in use instead.
  - CONNECTED (green): The SkyBox transfer function is active. Generator power can be used for charging and loads.
  - COOLING DOWN (yellow): The generator is preparing to stop and is going through the cooldown period.
  - EXERCISING (yellow): The generator has been started with the Exercise function. Generator power will not be used.
  - OUT OF SPEC (yellow): Generator power is not within acceptable limits.
- **D** is a circular meter that advances clockwise to show power in kilowatts (kW) being used by charging, loads, or both. The meter is fully lit at full capacity (10 kW when ***CONNECTED***). The power is also displayed as a digit in the center.
- E is the amount of time elapsed since the generator was started. It counts up from zero when **C** shows ***CONNECTED***. When the message is ***WARMING UP***, ***COOLING DOWN***, or ***EXERCISING***, the timer counts down to zero.

Tapping the **GENERATOR** tile **A** opens **F** for a given day. It shows:

- Kilowatts (kW) used from the generator that day (graphed with a pink line). A pink dot marks the instantaneous peak.
- Kilowatt-hours (kWh) used from the generator that day (graphed with yellow bars).

  NOTE: These items are graphed by time of day. The peak value for each is also shown as a number. Tapping a colored bar at the bottom of the screen will hide that number and graph, or restore it.
- Time of the last generator start (**L**).



Tapping the clock symbol **G** changes the graph to a daily, weekly, monthly, or yearly historical display of generator activity.

The "down" chevron **K** opens a ***MORE INFO*** screen with:

- The present generator status.
- Manual generator commands (***On*** or ***Off***).
- The present generator output frequency.
- The total generator runtime since the last reset.
- The reason for the last AGS.
- A manual reset for generator runtime.

Tapping the ***VOLTAGE VARIANCE*** tab **I** opens a screen with average high and low generator voltages.

The **CONFIGURE** button **J** opens a series of screens with generator and AGS settings.

Troubleshooting

The SkyBox records several different kinds of data that may be useful when troubleshooting.

- Fault accompanied by unit shutdown: **Off/On** button **B** turns red.
- Fault, unit continues to operate: **Off/On** button **B** turns yellow.

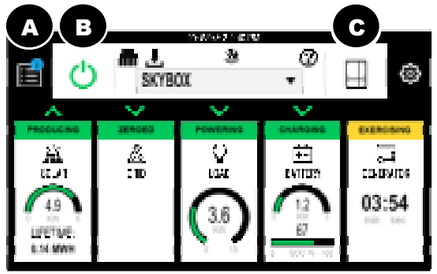
In all cases, faults are recorded under the **ALERTS** tab accessed under the **System Notification** button **A**.

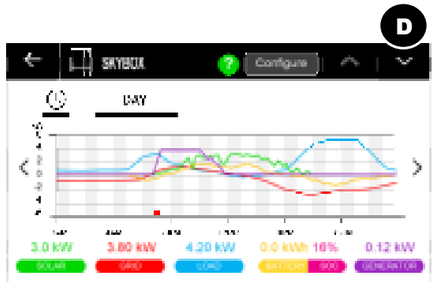
NOTES:

- The **ALERTS** tab will identify a Rapid Shutdown event if one occurs. See page 16 if that message appears.
- The **LOG** tab accessed under **A** shows up to 50 status changes of any type (faults or otherwise). This may also be useful for troubleshooting.
- **ALERTS** and **LOG** notifications are historical data and may not reflect current unit status.

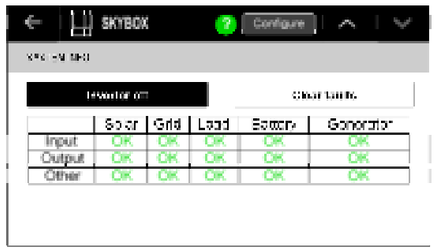
When a defined fault occurs it will generate a fault code as well as an alert. All defined fault codes are shown under ***Inverter Fault Status***. Normally this is available by pressing the **SkyBox** button **C** and the "down" chevron **D**.

NOTE: Fault codes are for internal OutBack use only. However, to identify the latest fault, go to the **ALERTS** tab and acknowledge all items. (See page 3.) Any notifications that continue to appear (at the top of the list) should match the latest fault codes.





When **Off/On** is red or yellow, pressing it causes the display to jump directly to ***Inverter Fault Status***. (As the button cannot also turn the SkyBox off in this state, an **Inverter off** button is located on this screen.) Faults can be cleared directly with the **Clear faults** button.



NOTE: If **Off/On** is yellow but the SkyBox is turned off anyway, the button will turn red (shutdown with faults) until the fault is cleared.

Most faults are automatically recoverable. The only faults that remain active under ***Inverter Fault Status*** are those that could not be handled automatically and need to be manually cleared.

To manually clear a fault:

1) Push the **Clear faults** button under ***Inverter Fault Status***.

If this does not succeed:

2) Remove all sources of power from the SkyBox (battery, solar, utility grid, and generator) and wait five minutes. Reconnect the sources.

If a fault cannot be manually cleared, there may be a physical problem with the SkyBox. Contact the system installer for instructions.

Symptoms and Remedies

Symptom	System Type	Possible Cause	Possible Remedy
Screen freezes	Any	Display processing error	To recover, press anywhere on the screen and hold for 30 seconds.
Low charge rate	Any charging source	Charge complete or nearly complete	Check DC voltage and charging stage.
		High loads	If total loads and charging exceed the AC input and PV sources, the charge rate decreases to give priority to the loads. Turn off some loads and test the charge rate again.
		High temperature	Performance is derated in high temperatures. Allow SkyBox to cool, or apply external cooling.
Loads interrupted upon transfer	AC source (grid or generator)	Erratic AC source voltage	Check input AC voltage. If not consistent, the problem is external. AC source voltage may have dipped to a low enough point to disrupt loads before the inverter could take over.
		Loads are sensitive to transfer time.	The SkyBox features a small but noticeable response time during transfer. Some devices may require an uninterruptible power supply (UPS). Consult the manufacturer of that device for backup power requirements.
		Loads are too large.	The SkyBox can pass through more power than it can invert. Reduce load size.
		Undersized battery cables.	Battery cables smaller than recommended will cause a significant voltage drop when switching to batteries, acting like either an overload or a low-voltage condition. Size all cables correctly.
Off/On button green, no AC output, will not accept AC input	AC source (grid or generator)	Rapid shutdown device and jumper have not been installed	Install the jumper (see *SkyBox Quick Start Guide*).
No AC output, will not accept AC input	AC source (grid or generator)	Standard fault has shut down SkyBox	See opposite page.
		Unit turned off.	Make certain the Off/On button is set to on.
		Rapid shutdown has occurred.	Check **ALERT** messages and Rapid Shutdown Initiator.
	No batteries	AC source does not meet requirements	Check the AC source (voltage, frequency, and other factors).
Will not connect	AC source (grid or generator)	AC source does not meet requirements	Check the AC source (voltage, frequency, and other factors).
	Generator source	Grid source is present	SkyBox will not connect to generator if grid is present.
	Grid source	Connection timer is still running	Wait for timer to expire (**GRID** tile reads ***Waiting***).
		Use Grid set to ***DROP***	Set to ***USE*** (requires login).
		Programmed disconnection (due to time of day, operating mode, or other priority)	Adjust programming as needed (requires login).
Will not sell	Grid source	Batteries still charging	SkyBox will not sell while the charger is still active. Wait until the charge cycle is complete, then try again.
Reduced selling	Grid source	***Sell limit*** set too low	Adjust setting as needed (requires login).
		Power used for other purposes	Power must supply loads (self-supply) and batteries before being sold. Check loads and all Tile readings.
		Limited PV size or conditions	Check solar conditions or PV voltage.
		High temperature	Performance is derated in high temperatures. Allow SkyBox to cool, or apply external cooling.
Will not charge	Generator source	Requires minimum 600 W load before charging can occur	Apply load to SkyBox.
		Will not use generator power to charge if PV power is already charging	No action required.
Blank screen, unit unresponsive, battery voltage present	Off-grid	Insufficient "bootstrap" voltage	SkyBox requires 44 Vdc or more before it can function. Check voltage.
		Battery-related internal fault	Cycle all power and restart.
		Surge-load-related internal fault	Remove likely loads, cycle all power, and restart.

900-0210-01-00 Rev A
©2018 OutBack Power Technologies. All Rights Reserved.