OutBack POWER™

an EnerSys company

# FX Inverter/Charger

## FX and VFX Mobile Series

## Operator's Manual

## 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.

## Applicability

These instructions apply to OutBack inverter/charger models FX2012MT, FX2024M, FX2524MT, FX3048MT, VFX2812M, VFX3524M, and VFX3648M only.

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## Date and Revision


May 2020, Revision B


## Part Number


900-0198-01-00 Rev B

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# Introduction

## Audience

This manual provides instructions for setup and operation of the product. It does not cover installation. The manual is intended to be used by anyone required to operate the FX or VFX Mobile Series Inverter/Charger. Operators must be familiar with all the 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. Do not use this product unless it has been installed by a qualified installer in accordance with the *FX and VX Mobile Series Inverter/Charger Installation Manual*.

## Symbols Used

**WARNING: Hazard to Human Life**

This type of notation indicates that the hazard could be harmful to human life.

**CAUTION: Hazard to Equipment**

This type of notation indicates that the hazard may cause damage to the equipment.

**IMPORTANT:**

This type of notation indicates that the information provided is important to the installation, operation and/or maintenance of the equipment. Failure to follow the recommendations in such a notation could result in voiding the equipment warranty.

**NOTE:**

This type of notation indicates that the information provided is important to understanding the operation and limits of the equipment. Failure to follow the recommendations in such a notation could result in improper or failed operation.

**MORE INFORMATION**

When this symbol appears next to text, it means that more information is available in other manuals relating to the subject. The most common reference is to the *FX and VFX Mobile Series Inverter/Charger Installation Manual*. Another common reference is the system display manual.

# Welcome to OutBack Power

Thank you for purchasing the OutBack FX and VFX Mobile Series Inverter/Chargers. These products are designed to offer a complete power conversion system between batteries, shore power, and generator.

In shore-based mobile and marine connections, the shore power (utility grid) is used as the primary AC power source. When the shore power is removed, the inverter takes over to run the loads from the batteries.

**Figure 1 FX Mobile Series Inverter/Charger with Turbo Fan**

# Inverter Functions

- Battery (DC)-to-AC inverting which delivers single-phase power (120 Vac/60 Hz)
- Rapid transfer between AC source and inverter output with minimal delay time
- Wattages from 2.0 kVA to 3.6 kVA
- 12-, 24-, and 48-volt models
- Uses the MATE, MATE2 or MATE3s System Display and Controller or the AXS Port™ SunSpec Modbus Interface (sold separately) for user interface
  - MATE3s must have firmware revision 003.007.xxx or higher
- Supports the OPTICS RE™ online tool[1] for a cloud-based remote monitoring and control application
  - Requires the MATE3s or the AXS Port
  - Visit www.outbackpower.com to download
- Uses the HUB4™ or HUB10.3™ Communications Manager for stacking
  - Stackable in series (OutBack or Classic), parallel, series/parallel, and three phase configurations
- Automatic neutral-to-ground bond switching
- Listed to ANSI/UL 458 (5th Edition) and CSA C22.2 by ETL
- Single AC input with dual input programming; individualized priorities can be selected when switching from shore power to AC generator
  - external switching device required
  - system display required for individual programming

[1] **O**utback **P**ower **T**echnologies **I**ntuitive **C**ontrol **S**ystem for **R**enewable **E**nergy

# General Safety

| | |
|---|---|
|  | **WARNING: Limitations on Use**<br>This equipment is NOT intended for use with life support equipment or other medical equipment or devices. |
|  | **WARNING: Reduced Protection**<br>If this product is used in a manner not specified by FX product literature, the product's internal safety protection may be impaired. |
|  | **CAUTION: Equipment Damage**<br>Only use components or accessories recommended or sold by OutBack Power or its authorized agents. |

# Inverter Controls

The FX inverter has no external controls. It can operate normally without an external control or interface. Basic modes and settings are pre-programmed at the factory. (See the menu tables beginning on page 47.) However, external communication devices such as the OutBack MATE3s can be used to operate, program, or troubleshoot the inverter.

# System Display and Controller


**Figure 2 MATE, MATE2, MATE3s, and AXS Port**

The MATE, MATE2, and MATE3s System Display and Controller and the AXS Port SunSpec Modbus Interface (all sold separately) are designed to accommodate programming and monitoring of an OutBack inverter system.

# Introduction

The MATE system display provides the means to adjust the default settings to match the installation where needed, monitor system performance, and troubleshoot fault or shutdown conditions. It also has data logging and interface functions using the Internet.

The MATE2 is a system display designed for use with the mobile FX inverters. It is intended to be flush-mounted in a panel. It has programmed criteria for accepting shore or generator AC sources.

The MATE3s is an advanced system display. In addition to the functions above, it has improved accessibility to screens and readings. The programming items and settings have multiple password-protected access levels for increased security. It is intended to be surface-mounted.

**NOTE:**

Most references to screens, navigation, and menu items in this book are to the MATE3s. However, the tables of factory defaults and ranges at the back of the book are shown in MATE or MATE2 format. These begin with Table 14 on page 47.

The MATE3s Profile Wizard is capable of automatically configuring inverters to a series of preset values. This is often more efficient than attempting to manually program each setting in each inverter. Affected fields include system type, battery charging, and AC source configuration.

Once settings are modified using any system display, it can be removed from the installation. The settings are stored in the nonvolatile memory of the FX inverter. However, it is highly recommended to install it as part of the system. This provides the means to monitor system performance and respond quickly should it be necessary to correct a fault or shutdown condition.

All system displays possess the Advanced Generator Start (AGS) function which sets many parameters for generator control.

The AXS Port can perform similar functions using a computer interface.

**IMPORTANT:**

Some functions are not based in the inverter, but are part of the system display. They will not function if the system display is removed. These functions are listed beginning on page 34.

**IMPORTANT:**

The FX inverter can use the OPTICS RE online tool as a system display. OPTICS RE must be used in conjunction with the MATE3s or with the AXS Port SunSpec Modbus Interface. The MATE3s system display must have firmware revision 003.000.xxx or higher.

# On/Off Switch

If a system display is not in use, the inverter can be equipped with a switch to turn it on and off. This switch is not sold as an inverter accessory; a common toggle switch can be used. The switch is wired to the **INVERTER ON/OFF** auxiliary terminals. (See the *FX and VFX Mobile Series Inverter/Charger Installation Manual* for more information on wiring the switch.)

This switch turns only the inverter on and off. It does not turn the charger or any other function on or off. All inverter functions will operate according to their programmed settings. Functions included with a system display will not be available.

# Operation

## LED Indicators

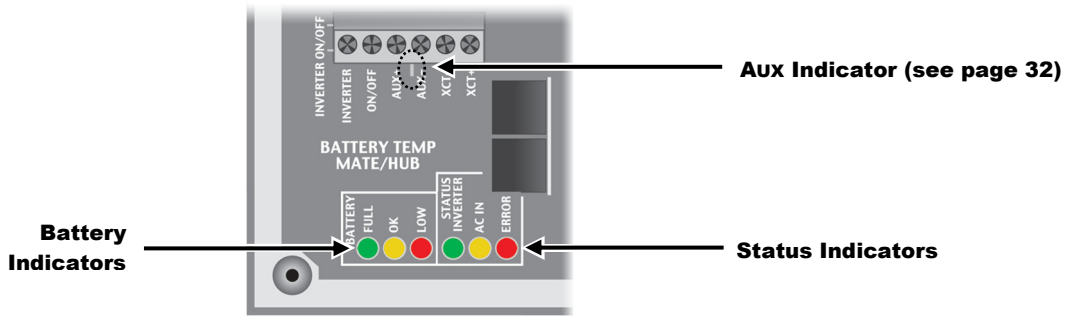



**Figure 3 LED Indicators**

## Battery Indicators

The **BATTERY** LED indicators show the approximate battery state. (See **IMPORTANT** note below.) The **BATTERY** indicators and the **INVERTER STATUS** indicators are independent. They may accompany each other depending on conditions. Common combinations are noted on page 12.

- A green indicator (ACCEPTABLE) means the batteries have an adequate charge at that time. It does not always mean they are full. It may be accompanied by a yellow **STATUS** indicator when an AC source is charging.
- A yellow indicator (MARGINAL) means the batteries are somewhat discharged.
- A red indicator (LOW) means the batteries are greatly discharged and may require attention. It may be accompanied by a red **STATUS** indicator to indicate a low battery error.

| Color | 12 Vdc Unit | 24 Vdc Unit, ± 0.2 Vdc | 48 Vdc Unit, ± 0.4 Vdc | Battery Status |
|---|---|---|---|---|
| **GREEN** | 12.5 Vdc or higher | 25.0 Vdc or higher | 50.0 Vdc or higher | ACCEPTABLE |
| **YELLOW** | 11.5 to 12.4 Vdc | 23.0 to 24.8 Vdc | 46.0 to 49.6 Vdc | MARGINAL |
| **RED** | 11.4 Vdc or lower | 22.8 Vdc or lower | 45.6 Vdc or lower | LOW |

**NOTES:**

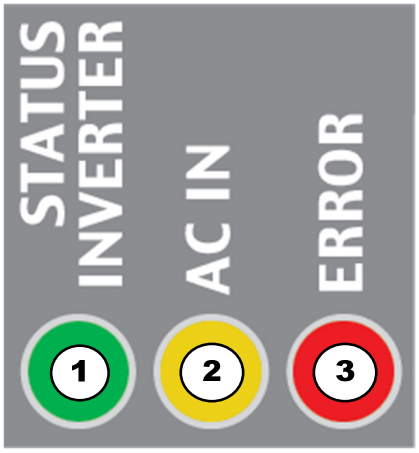
- Gaps in the table (higher-voltage units) are due to the resolution of the inverter's DC meter.
- These voltage settings are not the same as the Low Battery Cut-Out (LBCO) set point. (See page 14.) The Battery indicator settings cannot be changed.
- Voltages higher than shown in the **GREEN** row usually show that the batteries are charging.

**IMPORTANT:**

Due to different system states, battery voltage does not always indicate an accurate state of charge. It is accurate if batteries have been at rest for several hours at room temperature (25°C or 77°F, or as specified by the battery manufacturer). If they have **any** loads, a charging source, or are at another temperature, their voltage may not reflect their true state. The OutBack FLEXnet DC is a battery monitor that can be added to the system to provide accurate measurements.

# Status Indicators

**(1) STATUS INVERTER (Green):**




*Solid*: The FX inverter is on and providing power.

*Flashing*: The inverter has been turned on but is idle.

- The inverter is likely in Search mode. See page 14.

*Off*: The inverter is off. It is not waiting to provide power.

- See the system display manual to turn the inverter on.
- Any power present is from another source such as the utility grid or generator.
- The inverter may also be a slave that is in Silent mode due to the Power Save function. If so, the master inverter may still be providing power to the system.

  See page 28 for a description of **Power Save**.

**(2) AC IN (Yellow):**

*Solid:* The AC source is connected and providing power.

- The FX inverter may or may not be charging the batteries, depending on settings.
- May be accompanied by green **STATUS INVERTER** indicator (**1**).

*Flashing*: The AC source is present but has not been accepted.

- If flashing continues, the FX inverter is refusing the source. See **Troubleshooting** on page 37.

*Off*: No AC source is detected.

- If a source is supposed to be present, see **Troubleshooting** on page 37.

**(3) ERROR (Red):**

*Solid*: Error. The inverter has shut down due to a critical problem. It may be internal or external.

- This indicator is accompanied by an error message in the system display.
- See page 40 for a description of error messages.

*Flashing*: Warning. The inverter has detected a non-critical problem but has not yet shut down.

- A warning does not always lead to a shutdown — if it does, it becomes an error.
- This indicator is accompanied by a warning message in the system display.
- See page 41 for a description of warning messages.

*Off*: No problems are detected.

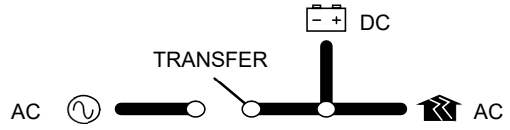
**Figure 4 Inverter Status LED Indicators**

# Inverter Functionality

FX inverters possess a set of common functions or operations. These operations are described in detail beginning on page 13.

Most of the inverter's individual operations and functions can be programmed using the system display. This allows customization or fine tuning of the inverter's performance.

Each distinct mode, function, or operation is accompanied by a symbol representing the inverter and that operation:




These items represent the input from the AC source, the output to the AC loads, DC functions (inverting, charging, etc.), and the transfer relay. Arrows on each symbol represent power flow.

The symbols may have other features depending on the operation.

# AC Input Connection

The FX inverter has one set of input connections. Only one AC source can be physically wired to it at any time. However, two different AC sources (usually shore power and generator) can be used with an external transfer switch. The inverter can be programmed with separate input criteria for each source. See the *Installation Manual* for more information on connections.

The inverter's two input selections can be programmed for separate input modes (see below). The selection (***Grid*** or ***Gen***) can be chosen in the ***AC Input and Current Limit*** menu. (See the MATE3s menu tables beginning on page 50.)

**NOTE:**

The input types are labeled for grid and generator due to common conventions, not because of inverter requirements. Each selection can accept any AC source as long as it meets the requirements of the FX inverter and the selected input mode. If necessary, the ***Gen*** selection can accept grid power. The opposite is also true.

# Description of Inverter Operations

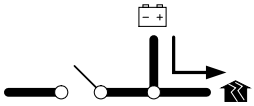
The items in this section are operations common to all FX inverters. These are used in most or all of the input modes described in the preceding section.

Some of the items in this section are functions which can be manually selected, enabled, or customized. Other items are general topics or applications for the inverter. These may not have their own menus, but their activity can still be influenced or optimized by changing certain settings.

Any of these items may need to be adjusted so that the inverter is best matched to a particular application. The operator should review these items to see which are applicable.

All items described as settable or adjustable have set points which can be accessed using the system display. The default settings and ranges of adjustment are listed in the MATE3s menu tables which begin on page 50 of this manual.

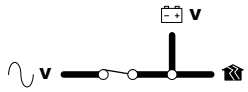
## Inverting



This is the FX inverter's primary task. The inverter converts DC voltage from batteries into AC voltage that is usable by AC appliances or devices. It will continue to do this as long as the batteries have sufficient energy. The batteries can be supplied or recharged from other sources, such as PV or alternator power.

The inverter's design uses a transformer and a high-frequency H-Bridge FET module to achieve the required high-wattage AC output. The inverter can deliver the rated wattage continuously at 25°C. The maximum output is derated at temperatures exceeding 25°C. See page 43 for these wattages.

Measure the total load so that it does not exceed the inverter's capacity. The inverter cannot maintain its AC voltage under excessive load. It will shut down with a ***Low Output Voltage*** error.

## DC and AC Voltages 

**The FX inverter requires batteries to operate**. Other sources may not maintain DC voltages that are consistent enough for the inverter to operate reliably.

> **CAUTION: Equipment Damage**
> Do not substitute other DC sources in place of the batteries. High or irregular voltages may damage the inverter. It is normal to use other DC sources with the batteries and the inverter, but not in place of the batteries.

The following items will affect the inverter's operation. These are only used when the inverter is generating AC power on its own.

- ***Low Battery Cut-Out***: This function prevents the inverter from draining the batteries completely. When the DC voltage drops below a specified level for 5 minutes, the inverter will stop functioning. The MATE3s system display will give a ***Low Battery V*** error. This is one of the error messages described on page 40. It appears as an event on the MATE3s.

  This function is intended to protect both the batteries and the inverter's output. (Continuing to invert on a low DC voltage may produce a distorted waveform.) This item is adjustable.

- ***Low Battery Cut-In***: The recovery point from ***Low Battery Cut-Out***. When the DC voltage rises above this point for 10 minutes, the error will clear and the inverter will resume functioning. ***Low Battery Cut-In*** is adjustable.
  - Connecting an AC source for the inverter to charge the batteries will also clear a low battery error.

- ***Output Voltage***: The AC output voltage can be adjusted within a limited range.

> **NOTE:**
> The inverter's output frequency is 60 Hz. This is not adjustable.

- The inverter is also controlled by a high battery cut-out limit. If the DC voltage rises above this limit, the inverter immediately stops functioning and gives a ***High Battery V*** error. The shutdown protects the inverter from damage due to excessive DC voltage.
  - The high battery cut-out voltages for each model are shown in Table 13 on page 46. This voltage is not a changeable set point.
  - If the voltage drops below this point, the inverter automatically recovers.
  - This is one of the errors on page 40. It appears as an event on the MATE3s system display.

The low battery and high battery functions are summarized in Table 13 on page 46.

## Search 

An automated search circuit is available to minimize the power draw when no loads are present. When enabled, the inverter does not always deliver full output. The output is reduced to brief pulses with a delay between them. These pulses are sent down the output lines to see if a resistance is present. Basically, the pulses "search" for a load. If a load is detected on the output, the inverter's output increases to full voltage so that it can power the load. When the load is turned off, the inverter "goes to sleep" and begins searching again.

Search mode sensitivity is adjusted with the ***Sensitivity*** menu item. See the menu tables, which begin on page 50, for the location of this item. The sensitivity is adjusted in small increments which are measured in fractions of one ampere.

**NOTE:**

Increment sizes are difficult to define due to varying load characteristics. However, the default setting, 6 increments, is approximately sufficient to detect the load of one compact fluorescent light (CFL). A load which draws this amount or greater will "wake up" the inverter.

- Search mode is not particularly useful with loads requiring continuous power. (These loads include clocks, answering machines, and similar devices.) "Sleep" operation with these loads is simply a power interruption or nuisance shutdown.
- Search mode may not be useful with loads that are critical or are intentionally operated a large portion of the time even if they are not continuous. (These loads include computers and similar devices.) The inverter may "sleep" so rarely that the mode has no benefit.
- Some devices may not be easily detected by Search mode.

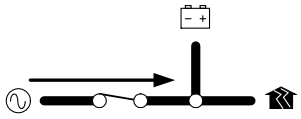
Search mode is ideal for use in small systems where it is critical to conserve battery capacity and avoid idle draw or "ghost" loads.

### To set up Search mode for use:

1. Turn off all loads.
2. Activate Search mode with the system display. The inverter should "sleep" with a flashing green **STATUS INVERTER** indicator. See page 12.
3. Determine the smallest load that is to be used and turn it on.
4. If the load operates, the inverter is active and is producing power. No further adjustments are needed.
5. If the inverter does not produce power and continues to "sleep", the sensitivity is set too high. Turn the load off and lower the ***Sensitivity*** menu item. Turn on the load and test whether the inverter activates.
6. Repeat step 5 as needed until turning on the load also reliably activates the inverter.

The pulse duration and the delay both have a time period that is measured in AC cycles. These two items, ***Pulse Length*** and ***Pulse Spacing***, are adjustable in the same menu as ***Sensitivity***. If ***Sensitivity*** does not achieve the desired results, it may be useful to perform similar adjustments on these items.

## Input



When the input terminals are connected to a stable AC source, the FX inverter will synchronize itself with that source and use it as the primary source of AC power. Its transfer relay will engage, linking the AC source directly with the inverter's output. It can also use the source to charge batteries. (See **Battery Charging** on page 18.)

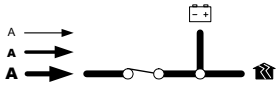
- The loads powered by the inverter **must not** exceed the size of the inverter's transfer relay.

**CAUTION: Equipment Damage**

Current draw in excess of the transfer relay rating can damage the transfer relay. This damage is not covered by warranty. Use protective devices of appropriate size.

- The inverter has a single AC input. However, it has two sets of AC source settings. With an external transfer switch, the inverter can be used on more than one AC source. It is common to use shore (utility grid) power and a generator. Other combinations are possible.

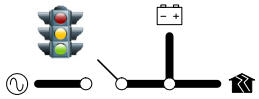
## AC Current Settings



The AC current settings, ***Grid Input AC Limit*** and ***Gen Input AC Limit***, control the amount of current that the inverter draws from the source. Adjust these settings to match the input circuit breakers.

- The adjustment is meant to protect a generator or shore supply that cannot supply enough current for both charging and loads. If the combined charging and loads exceed the setting, the inverter will reduce its charge rate and give priority to the loads. If the loads exceed this number on their own, the charge rate will be reduced to zero.
- The inverter's battery charger has individual settings. However, the ***AC Limit*** settings can also limit the charging or selling current.
- The AC input current is used to power both loads and battery charging. The combined amount should not exceed the size of the AC overcurrent device or AC source. These devices should be sized appropriately during planning and installation of the inverter system.
- If multiple parallel inverters are installed with an AC source of limited amperage, the total combined amperage settings for all units must be less than the AC input circuit. The MATE3s Profile Wizard can perform this calculation. However, the inverters do not perform this calculation. If the Wizard or similar tools are not used, divide the input size by the number of inverters and assign an equal part of the amperage to each port.

## AC Source Acceptance



The input source must meet the following specifications to be accepted.

- Voltage: 108 to 140 Vac
- Frequency: 54 to 66 Hz

See the menu tables which begin on page 50 for voltage programming information.

When these conditions are met, the inverter will close its transfer relay and accept the input source. This occurs after a delay which is specified below. If the conditions are not met, the inverter will not accept the source. If it was previously accepted and then rejected, the inverter will open the relay and return to inverting power from the batteries. This occurs after a specified transfer delay, which is an adjustable menu item.

- The voltage limits can be adjusted to allow (or exclude) a source with weak or irregular voltages. These items are adjustable in the appropriate menu of the MATE3s (***Grid AC Input Mode and Limits*** or ***Gen AC Input Mode and Limits***). The settings are titled ***Voltage Limit Lower*** and ***Upper***. There can be side effects to changing the range of allowed voltages.
- Each of the AC input selections has a settable ***Connect Delay***. This is intended as a warmup period which allows an input source to stabilize before connection.
  - The default setting for the ***Grid*** selection is 0.2 minutes (12 seconds).
  - The default setting for the ***Gen*** selection is 0.5 minutes (30 seconds).

  These items are adjustable in the appropriate menu of the MATE3s (***Grid AC Input Mode and Limits*** or ***Gen AC Input Mode and Limits***).

**NOTE:**

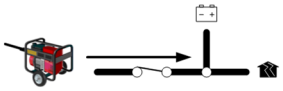
Several items external to the inverter may prevent the inverter from accepting AC power even if electrical conditions are met. An example is the MATE3s **AC INPUT** hot key menu, which can disconnect all inverters when set to ***Drop***.

## Multiple Inverters

In a stacked system, whenever the master inverter senses acceptable input, it orders all other inverters to transfer to the AC source. The other inverters do not use their own input readings to transfer. It is expected that the AC source delivers input (in the appropriate phase) to all inverters.

- If a slave inverter does not sense acceptable input, it will not transfer, but also will not invert. The slave will have no output. It also will display ***Phase Loss Error***.

## Generator Input

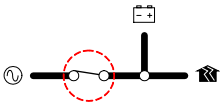


A generator should be sized to provide enough power for all inverters, both for loads and for battery charging. The generator's voltage and frequency must match the inverter's acceptance settings.

It is usually recommended that the generator be sized at twice the wattage of the inverter system. Many generators may not be able to maintain AC voltage or frequency for long periods of time if they are loaded more than 80% of rated capacity.

The generator is required to have a stable output before its power is accepted by the inverter. Some generators with less stable or uneven outputs may not be accepted. The use of the ***Generator*** input mode may assist with this problem.

## Transfer



The FX inverter uses a transfer relay to alternate between the states of inverting and of accepting an AC source. Until the relay energizes, the output terminals are electrically isolated from the input. When it closes, the input and output terminals become electrically common. When the relay changes states, the physical transfer delay is *approximately* 25 milliseconds.

**CAUTION: Equipment Damage**

Current draw in excess of the transfer relay rating can damage the transfer relay. This damage is not covered by warranty. Use protective devices of appropriate size.

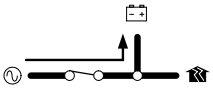
The relay contacts are limited to 30 amps per phase. The continuous loads on that output should never exceed this number. When connected to an AC source, the FX inverter cannot limit the load current. An overload condition is possible.

The inverter does not filter or actively condition the AC source. The voltage and power quality received by the output loads is the same as that of the source. If the voltage or quality do not meet the inverter's input requirements, it will disconnect and return to the inverting mode.

**NOTES:**

- To ensure a smoother transition, it may be advisable to raise the inverter's lower acceptance limit. The default setting is 108 Vac. A higher setting will cause the inverter to transfer sooner in the event of a quality problem.
- If the AC source meets the inverter's requirements but is irregular, any fluctuations will be transferred to the loads. If the loads are sensitive, it may be necessary to improve the quality of the AC source

If the charging function is turned off, the inverter will transfer power from the source but will not use it to charge. If the inverting function is turned off, the inverter will transfer ("pass through") the source power when connected, but will not invert when the source is removed.

# Battery Charging 

**IMPORTANT:**

Battery charger settings need to be correct for a given battery type. Always follow battery manufacturer recommendations. Making incorrect settings, or leaving them at factory default settings, may cause the batteries to be undercharged or overcharged.

## Charge Current

Batteries or battery banks usually have a recommended limit on the maximum charging current. Often this is calculated as a percentage or fraction of the battery capacity, represented by “C”. For example, C/5 would be a DC amperage figure that is 1/5 of the total amp-hours of the bank.

Any chargers must be set so that the peak charge current does not exceed the recommended battery maximum. If multiple chargers are present (including other types of chargers besides the inverter), this calculation must accommodate the total combined current. The FX charger may need to be set at less than maximum. The system display can be used to change charger settings.

**IMPORTANT:**

Although the recommended current is generally represented in DC amperes (Adc), the ***Charger AC Limit*** setting is measured in AC amperes (Aac), which use a different scale. To convert the DC current into a usable AC figure, divide the DC figure by the following number (based on inverter voltage) and round up. The result can be used as a charger setting for the FX inverter.

*12-volt inverters:* Divide by 10
*24-volt inverters:* Divide by 5
*48-volt inverters:* Divide by 2.5

**Examples**:

1) Bank consists of 8 x L16 FLA batteries in series for a 48-volt system. Recommended maximum charge current is 75 Adc. (75 ÷ 2.5 = 30 Aac)
2) Bank consists of 6 x OutBack EnergyCell 200RE VRLA batteries in series/parallel for a 24-volt system. Recommended maximum charge current is 45 Adc. (45 ÷ 5 = 9 Aac)

The maximum DC charge rate for FX models is specified in Table 8 on page 43. The actual ***Charger AC Limit*** setting is available in the ***AC Input and Current Limit*** menu of the MATE3s system display. (See the menu tables which begin on page 50.) These numbers are also summarized in Table 1.

**NOTE**: This table does not match the calculations above due to other factors in charging.

**Table 1 Charge Currents for FX and VFX Mobile Models**

| Model | Maximum DC Output (sent to battery) | Maximum AC Input (used from source) |
|---|---|---|
| FX2012MT | 80 Adc | 12 Aac |
| FX2024M | 40 Adc | 12 Aac |
| FX2524MT | 55 Adc | 14 Aac |
| FX3048MT | 35 Adc | 14 Aac |
| VFX2812M | 125 Adc | 16 Aac |
| VFX3524M | 82 Adc | 20 Aac |
| VFX3648M | 45 Adc | 20 Aac |

## Charge Current for Multiple Inverters

If FX inverters are stacked, the master inverter ***Charger AC Limit*** setting is used by all other inverters. Divide the total AC current by the number of chargers used and program the master with the result. The master will operate all chargers with this setting to achieve the maximum total charge current. The system display has a global ***Charger Control*** command of ***On*** which enables all available chargers.

### Limiting Charge Current (Multiple Inverters)

It is not advisable to set ***Charger AC Limit*** less than 12 Aac in a stacked system. The Power Save function requires the master to activate slave chargers in sequence only when the charge current exceeds 11 Aac. If the setting is less than 12, Power Save will not activate any other chargers.

For more information on this function, see the **Power Save** section beginning on page 28.

# Charge Cycle

FX and VFX mobile inverters use a “three-stage” battery charging process with Bulk, Absorption, and Float stages. These stages follow a series of steps which are shown on graphs and described beginning below. The inverter’s factory default settings are intended for three-stage charging of lead-acid batteries.

## Charging Graphs

When the charger is set to <**Auto**> using the system display, the charger automatically progresses through a three-stage cycle. Upon completion, the charger switches between Float stage and Silent as described on page 21. This is often selected to maintain batteries from shore power.

Figure 5 shows the progression of steps of the <**Auto**> charging cycle.

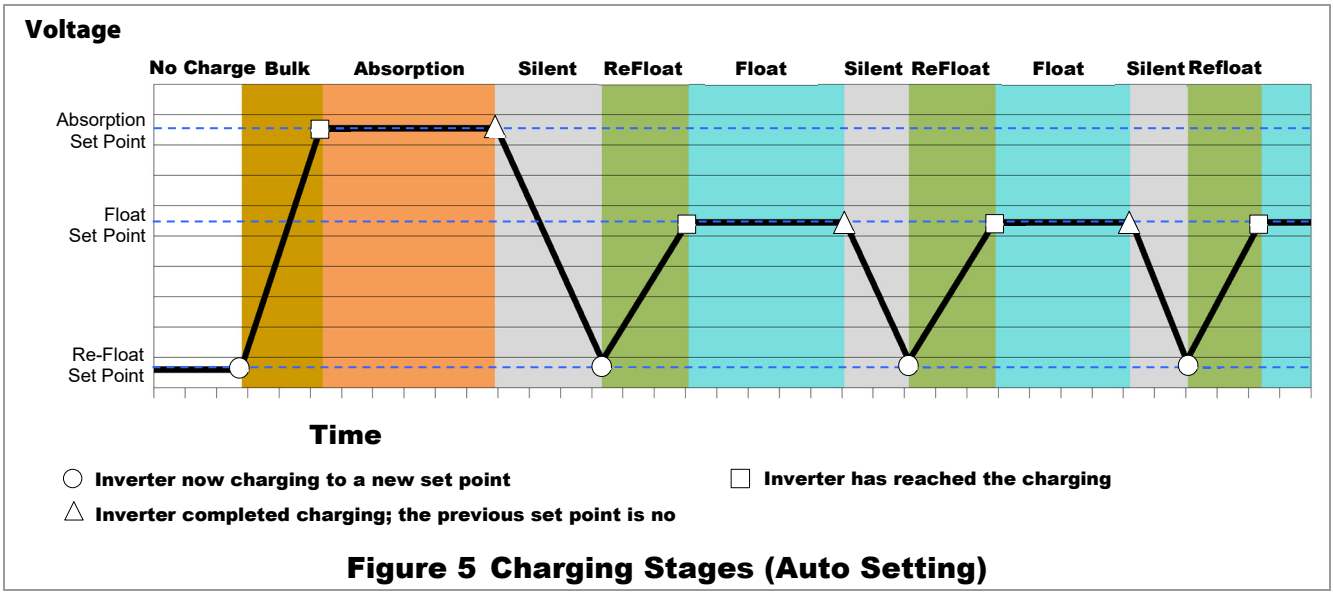



**Figure 5 Charging Stages (Auto Setting)**

When the charger is set to <**On**> using the system display, the charger automatically progresses through a three-stage cycle. However, this setting eliminates the Silent and Refloat steps. The charger remains in Float continuously. The Float stage lasts until the AC source is removed. This is often selected when charging from an automatic generator which shuts down at the Float stage.

Figure 6 on the next page shows the progression of steps of the <**On**> charging cycle.

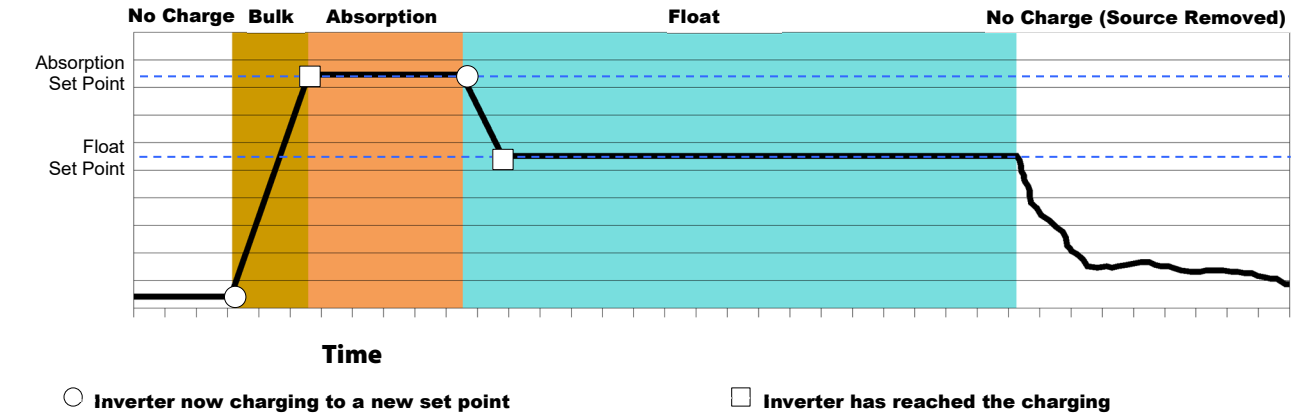



**Figure 6 Charging Stages (On Setting)**

# Charging Steps

The following items describe the operation and intended use for each individual charging step as shown in the graphs. Note that some charging cycles may not follow this exact sequence, including cycles which were previously interrupted.

See page 22 for a description of multiple cycles when the charger is restarted after completion. This page also describes multiple cycles when the charger is restarted after being interrupted.

**For multiple inverters:**

The charging of stacked inverters is synchronized and is governed by the master. The charger settings of all other inverters are ignored.

## No Charging

If the inverter is not charging, several conditions may apply:

- The unit is not connected to a qualified AC source. If a generator is present, it may not be running.
- The unit is connected to an AC source but the charger has been turned off.

## Bulk Stage

This is the first stage in the three-stage charge cycle. It is a constant-current stage which drives the battery voltage up. This stage typically leaves the batteries at 75% to 90% of their capacity, depending on the battery type, the exact charger setting, and other conditions.

**Voltage Used:** ***Absorb Voltage*** setting.

**Default Set Point** (nominal voltage): 14.4 Vdc (12-volt). This is multiplied accordingly for inverters of other voltages.

The initial DC current may be as high as the charger's maximum current, depending on conditions. The current will begin at a high level, but will tend to drop slightly as the voltage rises. This is not a reduction in charging. It can be viewed as a wattage "tradeoff". The actual kilowatts used by the charger are shown in the MATE3s ***Inverter*** menu. The reading is usually consistent at this stage. (See page 35.)

**To skip this step:** Setting ***Absorb Voltage*** equal to ***Float Voltage*** causes the charger to proceed through the normal three-stage cycle, but at a single voltage. Setting ***Absorb Time*** to 0 causes the charger to skip both the Bulk and Absorption stages and proceed directly to the constant-current Refloat stage. This may not be desired if the intent is to include the Bulk stage but skip Absorption.

## Absorption Stage

This is the second stage of charging. It is a constant-voltage stage. Current varies as needed to maintain the voltage, but will typically decrease to a very low number over time. This leaves the batteries at essentially 100% of capacity.

**Voltage Used:** ***Absorb Voltage*** setting. For the three-stage cycle to proceed normally, this setting should be kept higher than the ***Float Voltage*** and ***Re-Bulk Voltage*** settings.

**Time limit:** ***Absorb Time*** setting. The charger does not necessarily run through its full duration if it retained time from a previous charge cycle. The timer counts down from the inception of the Absorption stage until it reaches zero. The time remaining can be viewed in the system display.

The Absorption timer resets to its maximum amount when AC power is disconnected and reconnected. It only goes to zero if the timer runs out during the Absorption stage, or if an external STOP BULK command is sent. In all other cases it retains any remaining time.

**To skip this step:** Setting ***Absorb Time*** to a very short duration causes the charger to spend minimal time in Absorption once the Bulk stage is complete. Setting ***Absorb Time*** to zero will cause the charger to skip both the Bulk and Absorption stages and proceed directly to the constant-current Refloat stage. This may not be desired if the intent is to skip Absorption but retain the Bulk stage.

## Silent

This is not a charging stage, but a quiescent period between stages. The inverter remains on the AC source, but the charger is inactive. When the charger is set to <**Auto**> in the system display, it enters this condition upon completing a timed stage such as Absorption, Float, or Equalize.

In Silent, the batteries are not in significant use by the inverter, but they are also not being charged. The voltage will naturally decrease when not maintained by another means such as a charger or alternator.

The term “Silent” is also used in an unrelated context regarding **Power Save** levels. See page 28.

**Voltage Used:** ***Re-Float Voltage*** setting. When the battery voltage decreases to this point, the charger becomes active again.

**Default Set Point** (nominal voltage): 12.5 Vdc (12-volt). This is multiplied accordingly for inverters of other voltages.

**To skip this step:** Setting the charger to <**On**> in the system display makes the charger remain in Float continuously so that it does not proceed through the Silent, Bulk, Absorption, or Float timer steps.

## Float Stage

This is the third stage of charging. It is sometimes known as maintenance charging. Float stage balances the batteries’ tendency to self-discharge (as well as balancing the draw of any other DC loads). It maintains the batteries at 100% of capacity.

**Voltage Used:** ***Float Voltage*** setting. For the charger to work normally, this setting needs to be higher than the ***Re-Float Voltage*** setting.

**Default Set Point** (nominal voltage): 13.6 Vdc (12-volt). This is multiplied accordingly for inverters of other voltages.

The charger may perform two functions during Float. Both are called ***Float*** in the system display. They are defined here as Refloat and Float.

### Refloat

Refloat is a constant-current function. The initial DC current may be as high as the charger's maximum current, depending on conditions. This stage is similar to Bulk, except that the charger uses the ***Float Voltage*** setting as noted above. The charger delivers current until the batteries reach this value.

### Float

Float is a constant-voltage function. The current varies as needed to maintain ***Float Voltage***, but typically drops to a low number. This stage is similar to Absorption, except that the voltage is different.

**Time limit:** ***Float Time*** setting. The charger will go Silent once the timer has expired (if another stage is not still in progress.) The Float timer is reset to its maximum amount whenever the batteries decrease to the ***Re-Float Voltage*** setting.

**NOTE:**

The Float timer begins running any time the battery voltage exceeds the Float Voltage set point. This usually means that it begins running during the Bulk stage, once the voltage rises above that level. Often the timer will expire before the bulk and absorption stages are complete. (This will occur if the Float Time setting is less than the total of the bulk and absorption stages.) The charger will not enter Refloat or Float but will go directly to Silent. The charger only spends time in Float stage if the timer is still running.

**To skip this step:** Decreasing the ***Float Time*** setting to zero causes the inverter to enter Silent as soon as the absorption stage is complete. The inverter will perform neither the constant-current Refloat nor the constant-voltage Float.

Setting ***Float Voltage*** equal to the ***Absorb Voltage*** level causes the charger to proceed through the normal three-stage cycle, but at a single voltage.

**ALSO:** Setting the charger to <**On**> in the system display causes the charger to remain in Float continuously so that the Float timer no longer applies. (The charger also skips Bulk, Absorption, and Silent.) The charger can still begin a single three-stage charge if the criteria are met, after which it will return to continuous Float.

### Silent

Following the expiration of the Float timer, the unit enters (or re-enters) the Silent stage. The unit remains connected to the AC source, but the charger is inactive. The unit will continue cycling between Float and Silent until the AC source is lost or a new charge begins.

## New Charging Cycle

If the AC source is lost or disconnected, the unit will return to inverting mode if enabled. The battery voltage will begin to decrease due to loads or natural loss. When the AC source is restored, the inverter will return to the charging cycle.

The ***Absorb Time*** setting is reset to its maximum amount whenever the AC source (shore power or generator) is reconnected. The three-stage cycle starts over from the beginning.

# Equalization

Equalization is a controlled overcharge that is part of regular battery maintenance. Equalization brings the batteries to a much higher voltage than usual and maintains this high voltage for a period of time. This has the result of removing inert lead sulfate compounds from the battery plates. It also reduces stratification by circulating the electrolyte.

Equalization follows the same pattern as standard three-stage charging, as shown in the figures on page 19. However, instead of the Absorption voltage and time set points, it is controlled by the ***Equalize Voltage*** and ***Equalize Time*** settings in the system display.

The equalization process must be started manually using the system display. The inverter cannot be programmed for automatic battery equalization. This is a safety measure.

Equalization is normally performed only on flooded lead-acid batteries. The equalization schedule varies with battery use and type, but it is usually performed every few months. If performed correctly, this process can extend battery life by a considerable amount.

Equalization is not normally performed on nickel-technology batteries or any sort of sealed battery.

**CAUTION: Battery Damage**

- Do not equalize OutBack EnergyCell batteries of any model.
- Do not equalize any sealed battery types (VRLA, AGM, Gel, or other) unless approved by the manufacturer. Some batteries may suffer severe damage from equalization.
- Contact the battery manufacturer for recommendations on equalization voltage, duration, schedule, and/or advisability. Always follow manufacturer recommendations for equalization.

# Battery Temperature Compensation

Battery performance will change when the temperature varies above or below room temperature (77°F or 25°C). Temperature compensation is a process that adjusts battery charging to correct for these changes.

When a battery is cooler than room temperature, its internal resistance goes up and the voltage changes more quickly. This makes it easier for the charger to reach its voltage set points. However, while accomplishing this process, it will not deliver all the current that the battery requires. As a result, the battery will tend to be undercharged.

Conversely, when a battery is warmer than room temperature, its internal resistance goes down and the voltage changes more slowly. This makes it harder for the charger to reach its voltage set points. It will continue to deliver energy as time passes until the charging set points are reached. However, this tends to be far more than the battery requires, meaning it will tend to be overcharged.

The inverter, when equipped with the Remote Temperature Sensor (RTS), will compensate for temperature changes. The RTS is attached to a single battery (near the bank center), to achieve representative temperature. The inverter has a designated port for installing the RTS.

If installed in a multiple-inverter system, only a single RTS is necessary. It must be plugged into the master inverter and will automatically control the charging of all slaves and all charge controllers.

When charging, an inverter system with an RTS will adjust the charging voltage inversely with changes in temperature. It will **increase** the charge voltage by 5 mV for every decrease of 1 degree Celsius per battery cell. Similarly, it will **decrease** the voltage 5 mV for every increase of 1 degree Celsius per cell.

Compensation affects the ***Absorption***, ***Float***, and ***Equalization*** set points. The ***Re-Float Voltage*** set point is not temperature compensated. Note that the ***Equalization*** set points are not compensated in OutBack charge controllers.

**Table 2 Temperature Compensation**

| Nominal Voltage | Number of 2-Volt Cells | Compensation (when above or below 25°C) | Maximum Compensation |
|---|---|---|---|
| 12 Vdc | 6 | 0.03 volts per degree C | ± 0.6 Vdc |
| 24 Vdc | 12 | 0.06 volts per degree C | ± 1.2 Vdc |
| 48 Vdc | 24 | 0.12 volts per degree C | ± 2.4 Vdc |

**EXAMPLES:**

- A 12 Vdc system with batteries at 10°C will compensate its charging to 0.45 Vdc **higher** than the set points.
- A 12 Vdc system with batteries at 35°C will compensate its charging to 0.3 Vdc **lower** than the set points.
- A 24 Vdc system with batteries at 40°C will compensate its charging to 0.9 Vdc **lower** than the set points.
- A 48 Vdc system with batteries at 15°C will compensate its charging to 1.2 Vdc **higher** than the set points.

## Slope

Some batteries require different amounts of compensation. The OutBack FLEXmax 100 charge controller has an adjustable rate of compensation (“slope”) and is not limited to 5 mV. The FLEXmax 100 can be networked with the inverter with the HUB Communications Manager. If this is done, the inverter can import the slope setting from the FLEXmax 100 controller.

**NOTE:**

Temperature compensation only applies to the battery charging function. Other set points in the inverter, such as the **AUX** functions, are not compensated for temperature.

# Multiple-Inverter Installations (Stacking)

Multiple inverters in a single system can support larger loads than a single inverter. Installing in this configuration is called “stacking”. This refers to how inverters are wired within the system and programmed to coordinate activity. Stacking allows inverters to work together as one system.

Each inverter is programmed to power an individual phase of the system and to operate at certain times. This order is assigned using a system display such as the OutBack MATE, MATE2, or MATE3s. FX stacking configurations include “classic series”, “OutBack series”, “parallel”, “series/parallel”, and “three-phase”.

Each inverter needs to be assigned a status — “master” or “slave”. The master provides the primary (L1) output. Slave inverters provide assistance when a master on any output cannot power the loads alone. See the *FX Mobile Series Inverter/Charger Installation Manual* for more information.

Stacking requires CAT5 non-crossover cable used with an OutBack HUB Communications Manager (either the HUB4 or the HUB10.3). The inverter on each port must be programmed with a status and stacking value. Different HUB products use different port assignments. There are usually other specialized instructions during installation.

An AC source for a split- or three-phase system should provide input to all inverters on all phases. A slave inverter will give a ***Phase Loss*** warning if it is not supplied. (See pages 17 and 41.)

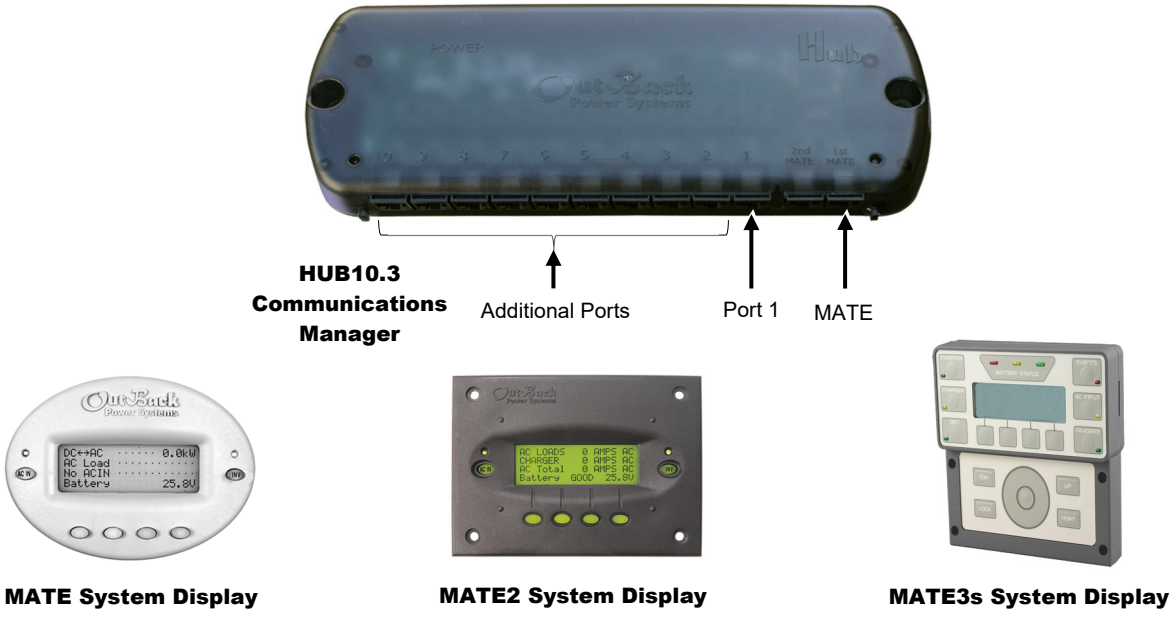



**Figure 7 OutBack HUB10.3, MATE, MATE2, and MATE3s**

**IMPORTANT:**

- The master inverter must always be connected to Port 1 on the HUB product. Connecting it elsewhere, or connecting a slave to Port 1, will result in backfeed or output voltage errors which will shut the system down immediately.
- All stacked inverters must be the same model and firmware revision.
- Installing multiple inverters without stacking them (or stacking them incorrectly) will result in similar errors and shutdown.
- Although stacking allows greater capacity, the loads, wiring, and overcurrent devices must still be sized appropriately. Additional terminations or bus bars may be required. Overloading may cause circuit breakers to open or inverters to shut down.

# Stacking Configurations

Each inverter must be assigned a particular mode in the ***Stack Mode*** menu. In the figures for each configuration below, the mode names are shown next to each inverter.

For example, Figure 8 shows ***1-2phase Master*** for the first (L1) inverter in a "classic" series-stacked system. The designation for the L2 inverter is ***Classic Slave***. On page 27, Figure 10 shows ***1-2phase Master*** for the first inverter in a parallel-stacked system. It shows ***OB Slave L1*** for the remaining inverters, which share the same output.

## Classic Series Stacking (Dual-Stack)

In series stacking, two inverters create two separate 120 Vac output phases. One inverter is the master. The other is a slave that is intentionally 180° out of phase with the master. Each output can be used to power separate 120 Vac loads. Collectively they form a "split-phase" configuration which produces 240 Vac. "Classic" series stacking is the simplest way to achieve this output.

- The 120 Vac loads on each output cannot exceed a given inverter's wattage. The second inverter cannot assist.
- Only two inverters, one per output, may be classic series stacked.

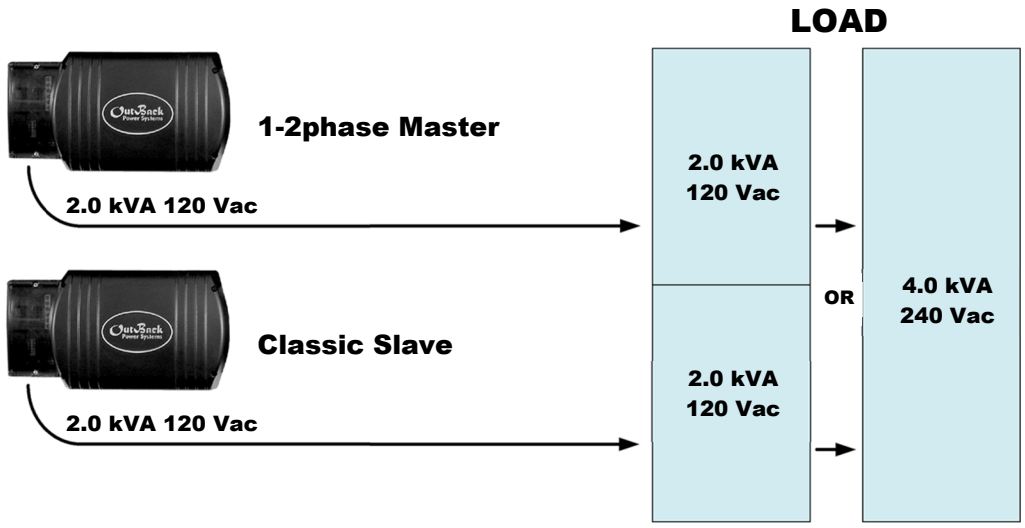



**Figure 8 Example of Classic Series Stacking Arrangement**

## OutBack Series Stacking (Dual-Stack)

In OutBack's unique series stacking, two inverters create two separate 120 Vac output phases in a "split-phase" configuration which produces 240 Vac. One inverter is the master. The other is a slave that is intentionally 180° out of phase with the master. Each of these outputs can be used to power a separate set of 120 Vac loads. However, the output loads are balanced with the FW-X240 autotransformer.

- The slave output is controlled directly by the master and cannot operate independently.
- In the event of a load imbalance in a 120/240 Vac system, the FW-X240 transformer can transfer power from one output to the other. The transfer balances the loads on each inverter. It also allows heavy 120 Vac loads on either output to use the full power of both inverters. (The loads in Figure 9 are marked "2+ kVA" per output. This means the power of a 2 kVA inverter is assisted by the other output.)
- The slave can go into Power Save mode when not in use. The FW-X240 autotransformer allows the master to power loads on either output. This reduces idle power consumption and improves system efficiency.
- Additional inverters can be added for combination series/parallel operation. See page 28.

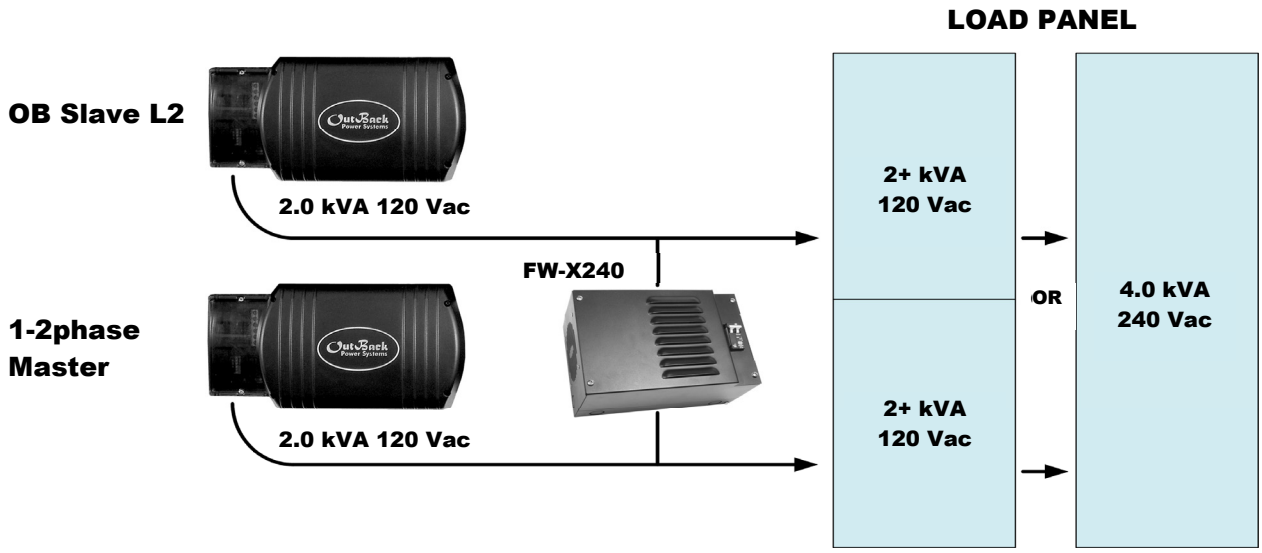



**Figure 9 Example of OutBack Series Stacking Arrangement**

# Parallel Stacking (Dual-Stack and Larger)

In parallel stacking, two or more inverters are stacked to create a single, common set of AC outputs.

- All inverters share a common input (AC source). The inverters run loads on a common output bus. The master inverter provides the primary output. The slaves are connected to the same output and assist the master.
- The slave outputs are controlled directly by the master and cannot operate independently.
- Slave inverters can go into Power Save mode when not in use. The master will activate individual slaves based on load demand. This reduces idle power consumption and improves system efficiency.
- Up to ten inverters may be installed in a parallel arrangement.

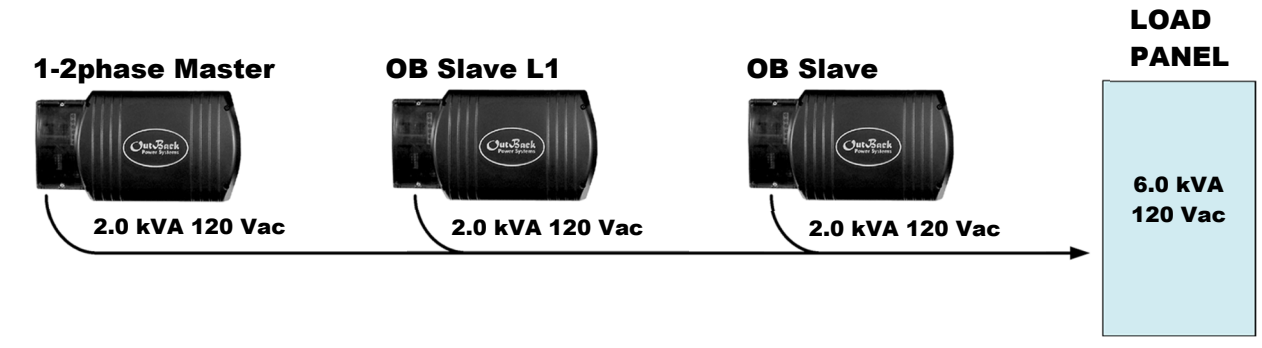



**Figure 10 Example of Parallel Stacking Arrangement (Three Inverters)**

# Series/Parallel Stacking (Quad-Stack or Larger)

In series/parallel stacking, inverters use OutBack series stacking create separate 120 Vac output phases and 240 Vac collectively. However, in this configuration, each output has parallel inverters. One output contains the master; the other uses a slave. Each has at least one additional slave.

- The 120 Vac loads on each output can be sized to the wattage of multiple inverters. They can be powered by all the inverters on that output. They can also be assisted by the other output.
- The slave outputs cannot operate independently. The slaves can go into Power Save mode when not in use.
- Up to ten inverters may be installed in a series/parallel arrangement.

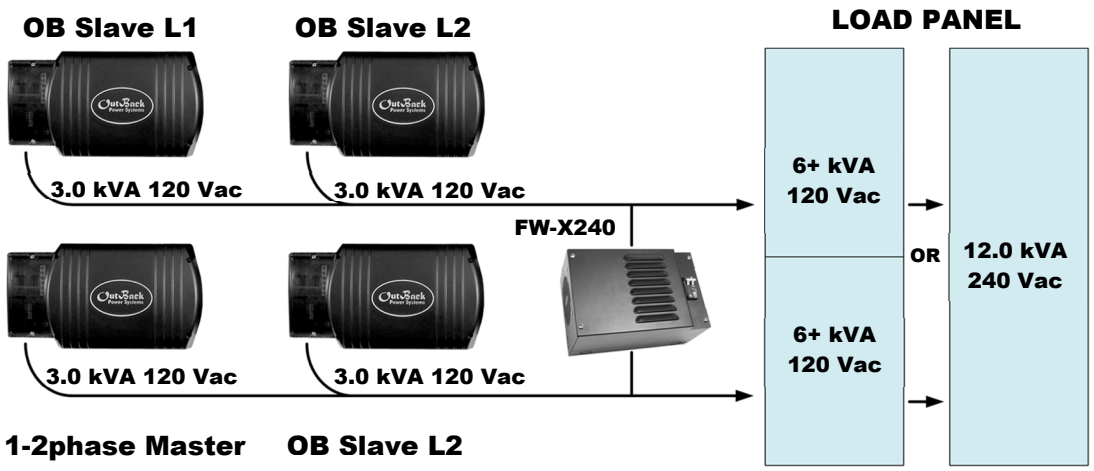



**Figure 11 Example of Series/Parallel Stacking Arrangement (Four Inverters)**

# Three-Phase Stacking

In three-phase stacking, inverters create three separate 120 Vac phases in a wye configuration.

- The output of each inverter is 120° out of phase from the others. Any two outputs produce 208 Vac between them. The outputs can be used to power three-phase loads when all inverters work together.
- The 120 Vac loads on each output cannot exceed a given inverter's wattage. The other outputs cannot assist.
- Only three inverters, one per phase, may be installed in a three-phase arrangement.

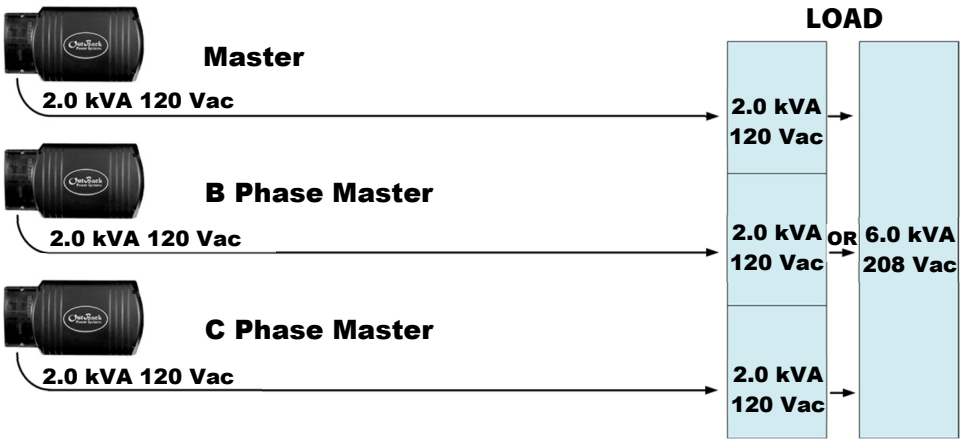



**Figure 12 Example of Three-Phase Stacking Arrangement (Three Inverters)**

# Power Save

Each FX inverter consumes 34 watts of idle power while it remains on, even if it is not actively inverting or charging. The Power Save function allows the option to put part of a parallel system into a quiescent state known as Silent mode. This mode minimizes the idle consumption. The inverters will come on again when the loads require power. (The term "Silent" is also used in an unrelated context during battery charging. See page 21.)

- When the load increases by 12 Aac, the master inverter activates an additional slave for assistance. When the load decreases to 4 Aac or less (as detected by the master), the slave is deactivated and returns to Silent mode. Each additional load increments of 12 Aac activates an additional slave.
- The order in which slaves activate (or return to Silent mode) is controlled by system display programming. The inverters are given a "rank", or level number. Lower rank numbers activate when lesser loads are applied. Higher ranks only activate when the load increases to a high level.
- The lowest-ranked inverters, particularly the master, do not enter Silent mode. They remain active unless specifically turned off. These inverters can still enter Search mode.

| | Master | Slave 1 | Slave 2 | Slave 3 |
|---|---|---|---|---|
| Minimal load | On | Off | Off | Off |
| Increasing load | On | On | Off | Off |
| High load | On | On | On | Off |
| Maximum load | On | On | On | On |

**Figure 13 Power Save Levels and Loads**

The watt and ampere thresholds for activating each model are depicted on the following pages.

### When using the MATE3s System Display:

It is advisable to use the MATE3s Profile Wizard to set up Power Save Levels.

### To set these items manually:

The system display uses ***Power Save Level*** selections to assign ranks to the inverter on each port. The screen reads ***Master*** or ***Slave Power Save Level***, depending on stacking designation.

- ***Master Power Save Level*** appears on an inverter which is set as master (the default setting). The range of rank numbers is 0 to 10. The default value is 0. The master is normally left at this value.
  - The ***Master Power Save Level*** function is used for the master inverter on Port 1. It is also used for any subphase masters in a series or three-phase system. The ranking of a subphase master is treated the same as the master. If the master is set at 0, subphase masters should also be 0.
- ***Slave Power Save Level*** appears on an inverter which is set as slave. The range of rank numbers is 1 to 10. (The default value for all ports is 1.)

The ranks are prioritized so that lower-numbered ranks turn on sooner and higher ranks turn on later. The lowest-ranked inverter does not go silent and remains on unless ordered otherwise. The lowest-ranked inverter is expected to be the master. The priorities are the same across both screens. If Port 1 (master) is set at 0 and Port 2 (slave) is set at 1, the slave will turn on later. Since the ***Master*** item is the only one that goes to 0, it is easy to ensure that all slaves go silent.

**NOTE:**

The stacking designations also control which ports are used on the HUB communications manager. The master inverter must be plugged into port 1. Other ports and jumper positions vary with model and stacking configuration.

**IMPORTANT:**

Set the master rank at 0 and arrange the slave ranks in order (1, 2, 3, 4, etc.). Another order may defeat the purpose of Power Save mode. Leaving the master at 0 makes power available from the master; the other inverters should not be active. If a slave is ranked lower (prioritized higher) than the master, that slave will not go silent.

**NOTE:** Disregard this rule if the installation requires some slaves continuously active.

**IMPORTANT:**

Do not give slave inverters the same rank numbers. If, for example, multiple slaves were all ranked at 1, they would all come on at the same time. Once they came on, the divided load would cause the master to detect a minimal load on its output, so it would shut off all the slaves, at which point the master would read a high load again. This could quickly escalate into a rapid on/off cycling of inverters and could cause long-term system problems.

**NOTE**: Power Save is used by the battery chargers of stacked systems with slave inverters. Not all chargers are activated immediately. Initially the master is the only active charger. The batteries will absorb current up to the maximum for all chargers. When the batteries (and the master) draw more than 12 Aac, the master will turn on the first slave charger. The batteries will absorb that additional current and more. The master will then turn on more slaves until all active chargers are operating.

If the master ***Charger AC Limit*** is turned to 11 or less, it will not turn on any slaves and will remain the only charger. For more information on charging with stacked inverters, see page 19.

Figure 14 shows a system of four FX2012MT inverters (the master and three slaves). These inverters are in a parallel system with a common load bus.

| | **Master**<br>Port 1<br>Master Power Save = 0 | **Slave 1**<br>Port 2<br>Slave Power Save = 1 | **Slave 2**<br>Port 3<br>Slave Power Save = 2 | **Slave 3**<br>Port 4<br>Slave Power Save = 3 |
|---|---|---|---|---|
| <12 Aac | **On** | **Off** | **Off** | **Off** |
| 12 Aac | **On** | **On** | **Off** | **Off** |
| 24 Aac | **On** | **On** | **On** | **Off** |
| 36 Aac | **On** | **On** | **On** | **On** |
| 16 Aac | **On** | **On** | **On** | **Off** |

**Figure 14 Power Save Priority (Parallel)**

- The captions at the top indicate the ranking of each unit.
- The captions also show the port assignments on the HUB4 Communications Manager (1 through 4).
- The notations at the bottom show how the units are activated in sequence as loads of 12 Aac are applied.

- The fourth line shows that loads of 36 Aac or more (approximately 4 to 4.5 kW) are present on the system. This load causes all four inverters to be activated.
- The last line shows that the loads are reduced to 16 Aac. Since this load is distributed among four inverters, the master reads 4 Aac, the lower threshold for Power Save. This causes one slave to enter Silent mode. The 16 Aac are distributed among the remaining three inverters. If the loads decreased to 12 Aac, a second slave would go silent.

Figure 15 shows a system of six FX2012MT inverters. In this example the inverters are stacked in an OutBack series/parallel system with FW-X240 transformers. The master inverter is on the L1 output with two slave inverters. The L2 output has three slave inverters.

- The captions at the top indicate the ranking of each inverter.
- The captions also show the port assignments on the HUB10.3 Communications Manager. The L1 inverters use ports 1, 2, and 3. However, the HUB10.3 requires the L2 inverters to use ports 7, 8, and 9.
- The notations at the bottom show how the inverters are activated in sequence as loads are applied.
  - The first line shows a load handled by the master alone.
  - The second line shows a total load of 15 Aac, even though the load on the master has not changed. (This load is visible to the master due to the balancing transformers.) The master turns on the first slave, L2 Slave 1 (Power Save Level 1).
  - The third line shows an increasing load of 28 Aac. The master turns on two more inverters (Power Save Levels 2 and 3).
  - The fourth line shows that loads of 36 Aac or more (approximately 4 to 4.5 kW) are present on both L1 and L2. This load causes all six inverters to be activated.
  - The last line shows that the total load is reduced to 25 Aac. The master turns off three inverters (Power Save Levels 3, 4, and 5) and leaves three active.

| | **L1 Master** Port 1 Master Power Save = 0 | **L1 Slave 1** Port 2 Slave Power Save = 2 | **L1 Slave 2** Port 3 Slave Power Save = 4 | | **L2 Slave 1** Port 7 Slave Power Save = 1 | **L2 Slave 2** Port 8 Slave Power Save = 3 | **L2 Slave 3** Port 9 Slave Power Save = 5 |
|---|---|---|---|---|---|---|---|
| **L1 Load** |  |  |  | **L2 Load** |  |  |  |
| 9 Aac | **On** | **Off** | **Off** | 0 Aac | **Off** | **Off** | **Off** |
| 9 Aac | **On** | **Off** | **Off** | 6 Aac | **On** | **Off** | **Off** |
| 15 Aac | **On** | **On** | **Off** | 13 Aac | **On** | **On** | **Off** |
| 36 Aac | **On** | **On** | **On** | 36 Aac | **On** | **On** | **On** |
| 16 Aac | **On** | **On** | **Off** | 9 Aac | **On** | **Off** | **Off** |

**Figure 15 Power Save Priority (Split-Phase)**

# Auxiliary Terminals

The FX inverter has a 12V **AUX** output which can respond to different criteria and control many operations. These terminals provide a 12 Vdc output that can deliver up to 0.7 Adc. This output shows its activity with an LED indicator. (See page 11.)

The **AUX** output has three states: continuous ***Off***, continuous ***On***, and ***Auto***, which allows that output to be activated using the automatic auxiliary functions. (All functions are defaulted to ***Auto***.) These items are based in the inverter and accessed using the system display. The system display and other devices also have programming, such as AGS, that can control the **AUX** outputs. To avoid conflicts, the output should be turned ***Off*** when the AGS function is active.

For the FX automatic functions, typical applications include signaling a generator to start, sending a fault alarm signal, or running a small fan to ventilate the batteries. When considering applications, plan for both connection requirements and programming with the system display.

The **AUX** terminals have a series of set points which are used by various functions. Not all set points are used by all functions. Each mode description (below) will show the set points used by that function.

- Low DC voltage settings
- High DC voltage settings
- On delay settings, in increments of 0.1 minutes
- Off delay settings, in increments of 0.1 minutes

These settings are not temperature compensated. Compensation is only used for inverter battery charging.

There are nine functions, each for a different application. They are summarized on page 34.

**NOTE:**

The AUX output is defaulted to ***Vent Fan***. A sealed FX inverter with the Turbo Fan is required to use the **AUX** output for fan control. In a single-inverter system, no other functions can be used.

- ***Cool Fan*** activates the **AUX** output when the inverter reaches a high internal temperature. It is intended to trigger a small external fan for additional cooling. See the **Warning Troubleshooting** table on page 41 for a description of the fan criteria.
  - This function does not have settable parameters.
- ***DC Divert*** activates the **AUX** output to divert (or "dump") excess renewable energy to a DC load, such as a resistor, a heater, or a fuel cell. This prevents overcharging of the batteries. This function can serve as rough charge regulation for an external charging source.
  - When battery voltage rises above a settable high voltage level, the **AUX** output is activated after a settable delay. The **AUX** output controls a larger, external relay. When energized, the external relay allows current to flow from the batteries to a dedicated DC load. The dedicated resistor or load must be sized to dissipate all of the energy from the renewable source if necessary. Diversion will turn off following a delay when a low DC voltage setting is reached.
  - Settable parameters include:
    - ✓ Low and high DC voltage
    - ✓ On and off delay
- ***AC Divert*** activates the **AUX** output to divert (or "dump") excess renewable energy to an AC load, usually an AC device powered by the inverter itself. This prevents overcharging of the batteries. This function can serve as rough charge regulation for an external charging source.
  - When battery voltage rises above a settable high voltage level, the **AUX** output is activated after a settable delay. The **AUX** output controls a larger relay, which allows current to flow from the batteries to a dedicated AC load when energized. Diversion is usually used to regulate battery charging. The AC device is usually wired to the output or load panel and must be left on. It must be sized to dissipate all of the energy from the renewable source if necessary. Diversion will turn off following a delay when a low DC voltage setting is reached.
  - The **AUX** output will automatically turn on to run the loads if the inverter accepts an AC source.

- Settable ***AC Divert*** parameters include:
  - ✓ Low and high DC voltage
  - ✓ On and off delay
- During variable conditions, the **AUX** output is triggered no more than once per minute (if voltage conditions are still met). This prevents rapid nuisance cycling of the AC load.
- ***AC Divert*** should not be used as the sole source of battery regulation. If the inverter shuts down or fails, the batteries could suffer severe damage. This function should be supported by an external regulator.
  - ✓ If the inverter shuts down due to overload, the **AUX** output will also shut down. If the inverter load exceeds 30 Aac, the **AUX** output will turn off to prevent an overload condition.
  - ✓ If either the FETs or the capacitors become too hot, the **AUX** will turn off due to diminished inverter wattage.

○ ***AC Drop*** activates the **AUX** output whenever the inverter disconnects from an AC source. It can activate a light or alarm to show that the shore power is no longer present or that a generator has stopped. Alternately, it could be used to show that the source has connected.

- This function does not have settable parameters.

○ ***Vent Fan*** activates the **AUX** output in response to a high DC (battery) voltage set point. It can run a small fan to ventilate the battery compartment to eliminate gases from battery charging. When the voltage falls below this set point for a settable delay period, the **AUX** output turns off. This is the default selection.

- Settable parameters include:
  - ✓ High DC voltage
  - ✓ Off delay

○ ***Fault*** activates the **AUX** output when the inverter shuts down due to an error condition. (See page 40). It can activate a light or alarm to show that the inverter has failed. With the appropriate devices, it could send an alarm signal through a radio, pager, or telephone dialer.

- This function does not have settable parameters.

○ ***Gen Alert*** is used as a controller for an AC generator with a remote start feature, although it has limited functionality. (The generator recharges batteries using the inverter's battery charger.)

- The **AUX** output will activate to start the generator when the battery voltage falls to a low set point for a settable delay. The **AUX** output is deactivated, shutting off the generator, once the battery voltage rises to a high voltage setting for a settable delay period.
- Settable ***Gen Alert*** parameters include:
  - ✓ Low and high DC voltage
  - ✓ On and off delay

  ***Gen Alert*** control logic is located in the inverter. It has the advantage of functioning when the system display is removed. However, it may not completely charge the batteries and does not have all the advantages of the Advanced Generator Start (***AGS***) function that is found in the system display. For many users, the ***AGS*** function may prove more useful than ***Gen Alert***. ***Gen Alert***, however, could be used as a literal "Generator Alert", a signal to the user to manually start a generator.

○ ***Load Shed*** can perform load management. It is intended to turn off designated loads during low battery periods to conserve remaining battery power.

- When battery voltage rises above a settable high voltage level, the **AUX** output is activated after a settable delay. The **AUX** output is used to energize a larger external relay (normally open) which is connected to non-vital loads. The **AUX** will be deactivated once the battery voltage falls below a low voltage setting for a settable delay period.
- Load Shed will turn off when the inverter enters a high-temperature condition or when the AC output voltage drops below a specific AC voltage for more than 3 seconds. This limit is 15 volts below the setting of the inverter's output voltage. For the inverter's default output voltage of 120 Vac, the limit is 105 Vac. The limit is not otherwise settable.
- ***Load Shed*** will turn off if the input current exceeds the ***Input AC Limit*** setting while the inverter is using an AC source.
- Settable parameters include:
  - ✓ Low and high DC voltage
  - ✓ On and off delay

- ***Remote*** activates the **AUX** when the inverter receives an external command from the system display or a similar device. To prevent software conflicts, ***Remote*** should be selected when external functions such as AGS (see below) are used.
  - This function does not have settable parameters.

The **AUX** functions are summarized in Table 3.

**Table 3 AUX Mode Functions**

| Name | Purpose | Triggers | | Settable Points |
|---|---|---|---|---|
| | | Start | Stop | |
| ***Cool Fan*** | Runs fan to cool inverter | ❖ Internal sensor > 60°C | ❖ Internal sensor < 49°C | None |
| ***DC Divert*** | Turns on DC dump load to prevent overcharging | ❖ High Vdc | ❖ Low Vdc | ❖ Low & high Vdc<br>❖ On & Off delay |
| ***AC Divert*** | Turns on AC dump load to prevent overcharging | ❖ High Vdc<br>❖ AC source accepted | ❖ Low Vdc<br>❖ High output load<br>❖ High temperature | ❖ Low & high Vdc<br>❖ On & Off delay |
| ***AC Drop*** | Signals that the inverter has dropped an AC source | ❖ AC source disconnected | ❖ AC source connected | None |
| ***Vent Fan*** | Runs fan to vent batteries while charging | ❖ High Vdc | ❖ Below high Vdc | ❖ High Vdc<br>❖ Off delay |
| ***Fault*** | Signals that the inverter shut down due to error | ❖ Error present | ❖ Error cleared | None |
| ***Gen Alert*** | Starts generator to charge batteries | ❖ Low Vdc | ❖ High Vdc | ❖ Low & high Vdc<br>❖ On & Off delay |
| ***Load Shed*** | Operates designated loads normally; turns off loads in severe conditions | ❖ High Vdc | ❖ Low Vdc<br>❖ High temp<br>❖ Low output Vac<br>❖ High input Aac | ❖ Low & high Vdc<br>❖ On & Off delay |
| ***Remote*** | Allows external commands to activate the **AUX** without programming conflict | ❖ Gen start (example) | ❖ Gen stop (example) | None internal |

# System Display-Based Functions (AGS)

A system display such as the OutBack MATE3s can provide functions not available in the inverter. The most commonly used function is Advanced Generator Start, or AGS. It is summarized here to provide a better idea of overall system capabilities.

As noted under ***Gen Alert***, the system is capable of starting a generator. ***Gen Alert*** simply starts and stops the generator based on battery voltage. For more advanced control, AGS utilizes the entire three-stage charging cycle. It can start according to battery voltage, inverter load, time of day, and other criteria. AGS has a quiet time application which restricts the generator from starting at inconvenient times.

Additional functions aside from AGS are also available.

The system display must be present for AGS and similar functions to operate. If a function is set up (or already in operation) but the system display is removed, that function will not operate.

# Metering

## MATE3s Screens

The MATE, MATE2, and MATE3s system displays can each monitor the FX inverter and other networked OutBack devices. Menu navigation for the MATE3s is depicted in this chapter.

From the Home screen, the **<Inverter>** soft key accesses the screens for monitoring the inverter.

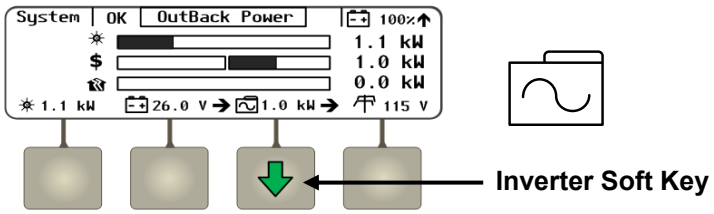
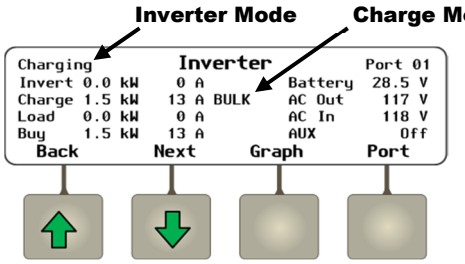



**Figure 16 Home Screen**

## Inverter Screen

The Inverter soft key opens a screen showing the inverter operating mode, battery voltage, and status of several AC operations. The **<Port>** soft key will select other networked OutBack inverters, if present. The **<Next>** soft key accesses the Battery screen.




**Inverter Modes:**

- ***Inverting*** (see page 13)
- ***Searching*** (see page 14)
- ***Charging*** (see Bulk on page 20)
- ***Charger Off*** (see pages 17 and 20)
- ***Float*** (see page 21)
- ***EQ*** (see page 23)
- ***Silent*** (see page 21)
- ***PassThru*** (see page 17)
- ***Error*** (see page 40)
- ***Off***

**Inverter Modes (slave):**

- ***Slave On***
- ***Slave Off***
- ***Error***

**Charge Modes:**

- ***BULK***
- ***FLOAT***
- ***EQ***

**Figure 17 Inverter Screens**

### Screen items:

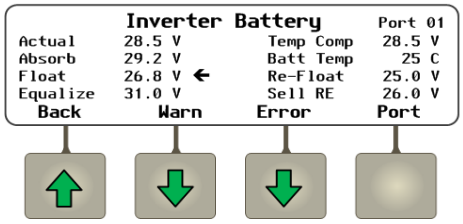
- The upper left corner is the Inverter Mode (see above). When ***Charging*** is indicated, the Charge Mode specifies the stage.
- ***Invert*** displays the kilowatts and AC amperage generated by the inverter. It may go to loads, or in a grid-interactive system it may be sold back to the utility grid.

- ***Charge*** displays the kilowatts and AC amperage consumed for the inverter to charge the battery bank. This line also shows the present charging stage.
- ***Load*** displays kilowatts and AC amperage consumed by devices on the inverter's output. It can be the same as ***Invert***.
- ***Buy*** displays the kilowatts and AC amperage brought into the inverter's input for both charging and loads. This is usually a total of ***Charge*** and ***Load***.
- ***Battery*** displays the uncompensated battery voltage.
- ***AC Out*** displays the AC voltage measured at the inverter's output. If an AC source is present, this reading is usually the same as ***AC In***.
- ***AC In*** displays the AC voltage measured at the inverter's input from an AC source. This number may be erratic or inaccurate upon first connection until the inverter synchronizes with the input source.
- ***AUX*** displays the current status of the inverter's Auxiliary (**AUX**) 12-volt output. (See page 31.)
- A diode symbol may appear to the left of the screen name to indicate "diode charging" mode. This is a mode that allows fine control of charging, selling, and load support. It does not visibly affect operation.

The **<Graph>** soft key brings up a series of screens which plot various types of data over time on the MATE3s screen.

# Battery Screen

The **<Next>** soft key brings up a screen showing charger status, charger settings, and battery voltage and temperature information.




**NOTE:** The charger settings cannot be adjusted on this screen.

An arrow will appear to the right of ***Absorb, Float***, or ***Equalize*** to indicate that the charger is in that stage. The arrow will not appear if the charger is in the Bulk stage, or if it is inactive.

**Figure 18 Battery Screen**

**Screen items:**

- ***Actual*** displays the uncompensated battery voltage.
- ***Absorb*** displays the charger's Absorption voltage setting. (See page 20.)
- ***Float*** displays the charger's Float voltage setting. (See page 21.)
- ***Equalize*** displays the charger's Equalization voltage setting. (See page 23.)
- ***Temp Comp*** displays the corrected battery voltage using temperature readings from the Remote Temperature Sensor (RTS). If no RTS is present, ***Temp Comp*** and ***Actual*** will read the same. (See page 23.)
- ***Batt Temp*** displays the battery temperature in degrees Celsius as measured by the RTS. This reading is only valid for port 1 on the HUB product. If other ports are selected, or if no RTS is present, the characters ### will be displayed.
- ***Re-Float*** displays the Re-Float setting which was programmed into the inverter's charger. This is the voltage used for the inverter to return from Silent mode to the float stage. (See page 21.)

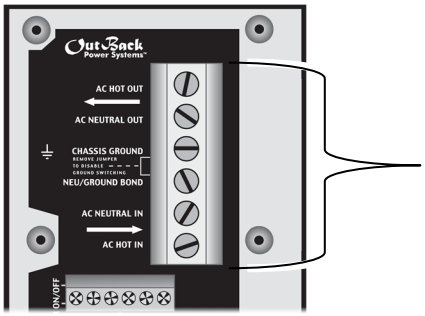
The **<Warn>** and **<Error>** keys bring up screens with various fault information. See the next section.

# Troubleshooting

## Basic Troubleshooting

Table 4 is organized in order of common symptoms, with a series of possible causes. Each cause also shows possible troubleshooting remedies, including system display checks where appropriate.

These instructions are for use by qualified personnel who meet all local and governmental code requirements for licensing and training for the installation of electrical power systems with AC and DC voltage up to 600 volts.




In troubleshooting, AC voltages can be measured at the attachment screw for each AC conductor.

**Figure 19 AC Test Points**

**WARNING: Shock Hazard**

During an error shutdown, the inverter's output terminals are not live. However, if the inverter recovers from a shutdown, the terminals will become live without notice. Several error shutdowns can be recovered automatically, including ***Low Battery V***, ***High Battery V***, and ***Over Temperature***. See page 40.

**Table 4 Troubleshooting**

| Symptom | Possible Cause | Possible Remedy |
|---|---|---|
| No AC output (will not invert). | No DC voltage. | Use a DC voltmeter to check the voltage directly on the DC terminals. If not present, the problem is external. If present, the inverter could be damaged. |
| | **INVERTER ON/OFF** jumper missing. | See the *Installation Manual* for the location of the jumper. Confirm the jumper is present. If missing, replace the jumper. Or follow the *Installation Manual* instructions to install an external switch. |
| | Inverter set to ***Off***. | *MATE3s:* Set to ***On*** with the **INVERTER** hot key.<br>*MATE / MATE2:* Set to ***ON*** with the **INV** hot key.<br>**NOTE**: The **ON/OFF** jumper must be installed. |
| | Inverter set to ***Search*** mode. | If constant power is required:<br>*MATE3s: S*et to ***On*** with the **INVERTER** hot key.<br>*MATE / MATE2:* Set to ***ON*** with the **INV** hot key.<br>If this setting was intentional, then no action is required. |

## Table 4 Troubleshooting

| Symptom | Possible Cause | Possible Remedy |
|---|---|---|
| One or more units have no output but others do (in multi-inverter system). | Unit is slave and is in Silent mode. | *MATE3s:* Check Power Save levels in the ***Inverter Stacking*** menu and test with loads.<br>*MATE / MATE2:* Check Power Save levels in the ***ADV/FX/STACK*** menu and test with loads.<br>Determine if the inverter comes on at the appropriate levels. If this setting was intentional, then no action is required. |
| Will not connect to the AC source. | No AC input. | Check the AC voltage on the inverter's input terminals. (See page 37.) If not present, the problem is external. If present, the inverter could be damaged. |
| | AC source does not meet requirements. | *MATE3s:* Check the ***Last AC Disconnect*** screen (using the **AC INPUT** hot key and the ***Discon*** selection) for the reason for disconnection.<br>*MATE/MATE2:* Check ***STATUS/FX/DISCON*** for the reason for disconnection.<br>If the unit never originally connected, check the ***Warning*** menu. Confirm source voltage and frequency. |
| | Inverter was manually set to disconnect from AC. | *MATE3s:* Change the AC Input Control setting from ***Drop*** to ***Use*** with the **AC INPUT** hot key.<br>*MATE/MATE2:* Change the AC Input Control setting from ***Drop*** to ***Use*** with the **AC IN** hot key.<br>If this setting was intentional, then no action is required. |
| | Grid use function has disconnected from AC. | *MATE, MATE2 or MATE3s:* If activated prematurely, check the system display's ***Grid Use Time*** settings and the clock settings.<br>***HBX*** or another grid use function may also be active. If more than one function is active, the programming may conflict. |
| Low charge rate. | Charge complete or nearly complete. | Check the DC voltage and charging stage using the system display, if present. Confirm with DC voltmeter. |
| | System display DC meter reads significantly higher than actual battery voltage. | Check the DC voltage on the inverter's DC terminals. If different from the system display reading, the inverter could be damaged. Otherwise check the DC voltage on the batteries with a voltmeter. If different from the reading on the inverter, this could be a DC connection problem. |
| | High output loads. | If total loads and charge exceed the AC input setting, charge rate decreases to give priority to the loads. Turn off some of the output loads and test the charge rate again. |
| | High temperature. | The inverter will reduce the current rate for charging and other activities if the internal temperature exceeds a certain level. Check temperature readings and allow the inverter to cool if necessary. (See page 42.) External cooling may also be applied. |
| Will not charge. | No AC input. | See "Will not connect to AC" category. |
| | Charger set to ***Off***. | *MATE3s:* Check the ***Charger Mode*** screen with the **CHARGER** hot key and set to ***On*** or ***Auto***. (If this setting was intentional, then no action is required.)<br>*MATE /MATE2:* Check the ***Charger Control*** screen with the **AC IN** hot key and set to ***ON*** or ***AUTO***.<br>If this setting was intentional, then no action is required. |

## Table 4 Troubleshooting

| Symptom | Possible Cause | Possible Remedy |
|---|---|---|
| Unusual and different voltages on AC hot input lines. | Inverter has not synchronized with input source. | *MATE3s:* The ***AC In*** reading accessed by the <**Inverter**> soft key may be erratic or inaccurate after initial connection until the inverter has synchronized with the AC source. This may require a short time. |
| Loads drop out or crash during transfer. | Erratic AC source voltage. | Check AC voltage on the **AC HOT IN** and **AC NEUTRAL IN** terminals. (See page 37.) If not consistent, the problem is external.<br>*MATE, MATE2, or MATE3s:* Source voltage may have dipped low enough to crash a sensitive load before the inverter could respond. The ***Grid*** or ***Gen AC Input Voltage Limits*** may have been lowered for a problematic AC source. To make the inverter respond sooner, raise the lower limit setting.<br>If this setting was intentional, then no action is required. |
| | Inverter set to ***Search*** (Search mode). | The unit will take a moment to come out of Search after transfer. If constant power is required:<br>*MATE3s:* Set to ***ON*** with the **INVERTER** hot key.<br>*MATE/MATE2:* Set to ***ON*** with the **INV** hot key.<br>(If this setting was intentional, then no action is required.) |
| | Loads too large. | The unit can transfer more power than it can invert. If loads are oversized, the unit will falter or crash when switching to batteries. Reduce the size of the loads. |
| | 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-battery condition. Size all cables correctly. |
| Unit reads AC input, even though no source is present. | Internal transfer relay may be damaged. | Disconnect AC input wires and turn inverter on. Test the **AC HOT** and **NEUTRAL OUT** terminals with an AC voltmeter. If voltage appears there, the inverter may be damaged. |
| Inverter clicks repeatedly. AC output voltage rises or drops to unusual levels with every click. | Inverter's output has been connected to its input. Voltage shifts are the result of trying to match its own voltage. | Disconnect the wires from the inverter's AC input or AC output terminals, or both. If the problem immediately disappears, it is an external wiring issue. The inverter's **AC HOT IN** and **AC HOT OUT** must remain isolated from each other. |
| | Low AC input voltage. Can be caused by weak AC source, or by faulty input connection. | Test **AC HOT IN** and **AC NEUTRAL IN** terminals with an AC voltmeter. (See page 37.) If low or fluctuating, this is an external problem. |
| Inverter hums loudly. System display may show messages for high battery voltage, low battery voltage, or backfeed error. | Inverter output is being supplied with an external AC source that is out of phase. | Disconnect **AC HOT OUT** and **AC NEUTRAL OUT** wires. Turn the inverter off and then on. If the problem clears, reconnect the AC output wires. If the problem recurs when reconnected, an external AC source is connected to the output. |
| | Inverter has been incorrectly stacked with another unit on the same output. All units come defaulted as master. | Check HUB10.3 ports and make certain the master inverter is plugged into port 1.<br>*MATE, MATE2, or MATE3s:* Check settings in the ***Inverter Stacking*** menu. Only one master is allowed per system. |
| Generator, external fan, etc. fails to start when signal is provided by **AUX** output. | **AUX** output is not connected. | Test the generator or device to confirm functionality. Test the **AUX** terminals with a DVM. If 12 Vdc is present when the menu indicates the function is ***On***, then there is an external connection problem. If 12 Vdc is not present with the function ***On***, the AUX circuit may be damaged |

# Error Messages

An error is caused by a critical fault. In most cases when this occurs the **ERROR** indicator will illuminate and the inverter will shut down. (See page 11 for the FX inverter's LED indicators.) The system display has a list of error messages. One or more messages will display ***yes*** in the MATE or MATE2. It will display ***Y*** in the MATE3s along with an event message. If a message says ***no*** or ***N***, it is not the cause of the error. See the system display literature for more instructions.

Some errors will reset automatically when the cause is resolved. These are noted.

It is possible to clear an error by resetting the inverter. The inverter must be turned off, and then on, to reset it. Other possible steps are shown below. Each should be followed by resetting the inverter.

### Table 5 Error Troubleshooting

| Message | Causes | Possible Remedy |
|---|---|---|
| ***Low Output Voltage*** | Inverter's AC regulation cannot be maintained under high load conditions. | Check loads and measure current draw. Remove loads as necessary. |
| ***Stacking Error*** | Programming problem among stacked units. (Often occurs if there is no master.)<br>Can also occur when ***AC Output Backfeed*** occurs. | ❖ Check stacking programming and designation of master. (See page 24.)<br>❖ Check for output backfeed from an external source. Disconnect output if necessary. |
| ***Over Temperature***[2] | Inverter has exceeded its maximum allowed operating temperature. See page 42. | Allow the inverter to remain off to reduce the temperature, or add external cooling. |
| ***Low Battery V***[2] | DC voltage is below low battery cut-out set point, usually due to battery discharge. This occurs after 5 minutes at this voltage.<br>This error can be triggered by other causes. It can appear along with ***Low Output Voltage***, ***AC Output Shorted***, or ***AC Output Backfeed*** errors. | ❖ If this error accompanies other errors, treat those conditions as appropriate.<br>❖ If it occurs by itself: Recharge the batteries. The error will clear automatically if an AC source is connected and the charger turns on. |
| ***Phase Loss Error*** | A slave was ordered to transfer to AC by the master, but no AC is present. The unit continues inverting. This is the only "Error" that is not accompanied by a shutdown. | Check the AC voltage on the inverter input terminals. If AC voltage is not present, the problem is external. If AC voltage is present, the unit may be damaged. |
| ***High Battery V***[2] | DC voltage exceeded acceptable level. See page 13. | Check the charging source. This problem is usually the result of external charging. |
| ***AC Output Shorted*** | Inverter exceeded its maximum surge current due to severe overload. | Check the loads and wiring. This issue is usually the result of a wiring problem (a short), as opposed to a poorly-sized load. |
| ***AC Output Backfeed*** | Usually indicates another AC power source (out of phase with the inverter) was connected to the unit's AC output. | Disconnect the **AC OUT** wires from the inverter. Check the wires (not the inverter) with an AC voltmeter. If an AC source is present, shut it off. |

[2] This error will clear automatically when the cause of the error is resolved. The inverter will begin functioning again when this occurs.

# Warning Messages

A warning message is caused by a non-critical fault. When this occurs, the **ERROR** indicator will flash, although the inverter will not shut down. (See page 11 for the FX inverter's LED indicators.) The system display has a list of warning messages. One or more messages will display ***yes*** in the MATE or MATE2. It will display ***Y*** in the MATE3s along with an event message. If a message says ***no*** or ***N***, it is not the cause of the warning. See the system display literature for more instructions.

Some warnings can become errors if left unattended. Frequency and voltage warnings are meant to warn of a problematic AC source. Often the inverter will disconnect from the source. This will occur if the condition lasts longer than the inverter's transfer delay settings. If the inverter disconnects, the warning will display as long as the source is present, accompanied by a disconnect message. (See page 42.)

Warning screens can only display warnings; they cannot clear them. The way to correct the fault may be obvious from the message.

### Table 6 Warning Troubleshooting

| Message | Definition | Possible Remedy |
|---|---|---|
| ***AC Freq Too High*** | The AC source is above upper acceptable frequency limit and prevents connection. | Check the AC source. If it is a generator, reduce its speed. |
| ***AC Freq Too Low*** | The AC source is below lower acceptable frequency limit and prevents connection. | Check the AC source. If it is a generator, increase its speed. |
| ***Voltage Too High*** | The AC source is above upper acceptable voltage limit and prevents connection. | Check the AC source. The inverter's acceptance range is adjustable.<br>**NOTE:** Adjusting the range may accommodate a problematic AC source, but it will not fix it. |
| ***Voltage Too Low*** | The AC source is below lower acceptable voltage limit and prevents connection. | Check the AC source. Check the AC wiring. The inverter's acceptance range is adjustable.<br>**NOTE:** Adjusting the range may accommodate a problematic AC source, but it will not fix it. |
| ***Input Amps > Max*** | AC loads are drawing more current from the AC source than allowed by the input setting. | Check the loads. Oversized loads can open circuit breakers. If they exceed the inverter's transfer relay size, the relay can be damaged.<br>This issue is usually the result of a poorly-sized load, as opposed to a wiring problem. |
| ***Temp Sensor Bad*** | An internal inverter temperature sensor may be malfunctioning. One of the three internal sensor meters may give an unusual reading. | In the MATE3s, the three readings are labeled ***Transformer, Output FETs,*** and ***Capacitors***. These values are given in degrees Celsius. See next page. |
| ***Internal Comm Error*** | Probable failure on inverter's control board. Despite the name, this is not an inverter-defined error and is not accompanied by a shutdown. | Unit may require repair. |
| ***Fan Failure*** | The inverter's internal cooling fan is not operating properly. Lack of cooling may result in derated inverter output wattage. | Turn the battery disconnect off, and then on, to determine if the fan self-tests. After this test, contact an OutBack dealer. (The next step will depend on the results of the test.)<br>**NOTE:** The system can continue to operate if the inverter can be run at reasonable levels. External cooling may also be applied. |

### Table 6 Warning Troubleshooting

| Message | Definition | Possible Remedy |
|---|---|---|
| ***Transformer*** (in ***Temps*** screen) | Displays the ambient temperature around the inverter's transformer. | *MATE3s*: These values are given in degrees Celsius.<br>*MATE and MATE2 system*: Values are given in a representative "digital count". Lower counts equal higher temperatures. Higher counts equal lower temperatures. Room temperature is 210 to 220. The internal fan runs at 142 and stops at 164. A count of either 0 or 255 is a defective sensor.<br>If any reading does not seem to reflect the inverter's temperature or conditions, the unit may need service. |
| ***Output FETs*** (in ***Temps*** screen) | Displays the temperature of the FETs (Field Effect Transistors) and heat sink. | |
| ***Capacitors*** (in ***Temps*** screen) | Displays the temperature of the inverter's ripple capacitors.<br>See page 46 for a table of temperature operating points and effects. | |

# Disconnect Messages

Disconnect messages explain why the inverter has disconnected from an AC source after previously being connected. The unit returns to inverting mode if turned on. The system display has a list of disconnect messages. One or more messages will display ***yes*** in the MATE or MATE2. It will display ***Y*** in the MATE3s along with an event message. If a message says ***no*** or ***N***, it is not the cause of the disconnection. See the system display literature for more instructions.

The system display may generate a concurrent event and warning message following the disconnection. (See page 41.) If the AC source is removed, the warning will be blank, but the cause of the last disconnection will remain.

Disconnect messages only display the reason for disconnection; they cannot correct it. It is usually the result of external conditions, not an inverter fault. If the condition is corrected, the inverter will reconnect. A few settings can be changed to accommodate problems with the AC source.

### Table 7 Disconnect Troubleshooting

| Message | Definition | Possible Remedy |
|---|---|---|
| ***Frequency Too High*** | The AC source has exceeded acceptable frequency levels. | Check AC source. If it is a generator, reduce speed. |
| ***Frequency Too Low*** | The AC source has dropped below acceptable frequency levels. | Check AC source. If it is a generator, increase speed. |
| ***Voltage > Maximum*** | The AC source has exceeded acceptable voltage levels. | Check AC source. The inverter's acceptance range is adjustable.<br>**NOTE:** Adjusting the range may accommodate a problematic AC source, but it will not fix it. |
| ***Voltage < Minimum*** | The AC source has dropped below acceptable voltage levels. | Check AC source. The inverter's acceptance range is adjustable.<br>**NOTE:** Adjusting the range may accommodate a problematic AC source, but it will not fix it. |

# Specifications

## Electrical Specifications

**Table 8 Electrical Specifications for 12-Volt Mobile Models**

| Specification | FX2012MT | VFX2812M |
|---|---|---|
| Continuous Output Power at 25°C | 2000 VA | 2800 VA |
| Continuous AC Output Current at 25°C | 16.7 Aac | 23.3 Aac |
| AC Output Voltage | 120 Vac | 120 Vac |
| AC Output Frequency | 60 Hz | 60 Hz |
| AC Output Type | Single-phase | Single-phase |
| AC Waveform | True Sinewave | True Sinewave |
| Typical Efficiency | 90% | 90% |
| Total Harmonic Distortion (maximum) | 5% | 5% |
| Harmonic Distortion (maximum single voltage) | 2% | 2% |
| AC Output Voltage Regulation | ± 2% | ± 2% |
| Load Power Factor | –1 to 1 | –1 to 1 |
| AC Maximum Output Current (1 ms peak) | 56 Aac | 56 Aac |
| AC Maximum Output Current (100 ms RMS) | 40 Aac | 40 Aac |
| AC Overload Capability (100 ms surge) | 4800 VA | 4800 VA |
| AC Overload Capability (5 second) | 4000 VA | 4000 VA |
| AC Overload Capability (30 minute) | 2500 VA | 3200 VA |
| Power Consumption (idle) – Invert mode, no load | ~20 watts | ~20 watts |
| Power Consumption (idle) – Search mode | 6 watts | 6 watts |
| Power Consumption – Off | ~3 watts | ~3 watts |
| AC Input Voltage Range | 80 to 150 Vac | 80 to 150 Vac |
| AC Input Frequency Range | 54 to 66 Hz | 54 to 66 Hz |
| AC Input Current (maximum continuous) | 30 Aac | 30 Aac |
| DC Input Voltage (nominal) | 12 Vdc | 12 Vdc |
| DC Input Voltage Range | 10.5 to 17 Vdc | 10.5 to 17 Vdc |
| DC Input Power (continuous) | 2.4 kVA | 3.36 kVA |
| DC Input Maximum Current (continuous full power) | 200 Adc | 280 Adc |
| Battery Charger Maximum AC Input | 12 Aac | 16 Aac |
| Battery Charger Maximum DC Output | 80 Adc | 125 Adc |
| Auxiliary Output | 0.7 Adc at 12 Vdc | 0.7 Adc at 12 Vdc |

**Table 9 Electrical Specifications for 24-Volt Mobile Models**

| Specification | FX2024M | FX2524MT | VFX3524M |
|---|---|---|---|
| Continuous Output Power at 25°C | 2000 VA | 2500 VA | 3500 VA |
| Continuous AC Output Current at 25°C | 16.7 Aac | 20.8 Aac | 29.2 Aac |
| AC Output Voltage | 120 Vac | 120 Vac | 120 Vac |
| AC Output Frequency | 60 Hz | 60 Hz | 60 Hz |
| AC Output Type | Single-phase | Single-phase | Single-phase |
| AC Waveform | True Sinewave | True Sinewave | True Sinewave |
| Typical Efficiency | 92% | 92% | 92% |
| Total Harmonic Distortion (maximum) | 5% | 5% | 5% |
| Harmonic Distortion (maximum single voltage) | 2% | 2% | 2% |
| AC Output Voltage Regulation | ± 2% | ± 2% | ± 2% |
| Load Power Factor | –1 to 1 | –1 to 1 | –1 to 1 |
| AC Maximum Output Current (1 ms peak) | 70 Aac | 70 Aac | 70 Aac |
| AC Maximum Output Current (100 ms RMS) | 50 Aac | 50 Aac | 50 Aac |

### Table 9 Electrical Specifications for 24-Volt Mobile Models

| Specification | FX2024M | FX2524MT | VFX3524M |
|---|---|---|---|
| AC Overload Capability (100 ms surge) | 4800 VA | 6000 VA | 6000 VA |
| AC Overload Capability (5 second) | 4000 VA | 4800 VA | 5000 VA |
| AC Overload Capability (30 minute) | 2500 VA | 3200 VA | 4000 VA |
| Power Consumption (idle) – Invert mode, no load | ~20 watts | ~20 watts | ~20 watts |
| Power Consumption (idle) – Search mode | 6 watts | 6 watts | 6 watts |
| Power Consumption – Off | ~3 watts | ~3 watts | ~3 watts |
| AC Input Voltage Range | 80 to 150 Vac | 80 to 150 Vac | 80 to 150 Vac |
| AC Input Frequency Range | 54 to 66 Hz | 54 to 66 Hz | 54 to 66 Hz |
| AC Input Current (maximum continuous) | 30 Aac | 30 Aac | 30 Aac |
| DC Input Voltage (nominal) | 24 Vdc | 24 Vdc | 24 Vdc |
| DC Input Voltage Range | 21 to 34 Vdc | 21 to 34 Vdc | 21 to 34 Vdc |
| DC Input Power (continuous) | 2.4 kVA | 3.0 kVA | 4.2 kVA |
| DC Input Maximum Current (continuous full power) | 100 Adc | 125 Adc | 175 Adc |
| Battery Charger Maximum AC Input | 12 Aac | 14 Aac | 20 Aac |
| Battery Charger Maximum DC Output | 40 Adc | 55 Adc | 82 Adc |
| Auxiliary Output | 0.7 Adc at 12 Vdc | 0.7 Adc at 12 Vdc | 0.7 Adc at 12 Vdc |

### Table 10 Electrical Specifications for 48-Volt Mobile Models

| Specification | FX3048MT | VFX3648M |
|---|---|---|
| Continuous Output Power at 25°C | 3000 VA | 3600 VA |
| Continuous AC Output Current at 25°C | 25 Aac | 30 Aac |
| AC Output Voltage (default) | 120 Vac | 120 Vac |
| AC Output Frequency (default) | 60 Hz | 60 Hz |
| AC Output Type | Single-phase | Single-phase |
| AC Waveform | True Sinewave | True Sinewave |
| Typical Efficiency | 93% | 93% |
| CEC Weighted Efficiency | 91% | 91% |
| Total Harmonic Distortion (maximum) | 5% | 5% |
| Harmonic Distortion (maximum single voltage) | 2% | 2% |
| AC Output Voltage Regulation | ± 2% | ± 2% |
| Load Power Factor | –1 to 1 | –1 to 1 |
| AC Maximum Output Current (1 ms peak) | 70 Aac | 70 Aac |
| AC Maximum Output Current (100 ms RMS) | 50 Aac | 50 Aac |
| AC Overload Capability (100 ms surge) | 6000 VA | 6000 VA |
| AC Overload Capability (5 second) | 4800 VA | 5000 VA |
| AC Overload Capability (30 minute) | 3200 VA | 4000 VA |
| Power Consumption (idle) – Invert mode, no load | ~23 watts | ~23 watts |
| Power Consumption (idle) – Search mode | 6 watts | 6 watts |
| Power Consumption – Off | ~3 watts | ~3 watts |
| AC Input Voltage Range | 80 to 150 Vac | 80 to 150 Vac |
| AC Input Frequency Range | 54 to 66 Hz | 54 to 66 Hz |
| AC Input Current (maximum continuous) | 30 Aac | 30 Aac |
| DC Input Voltage (nominal) | 48 Vdc | 48 Vdc |
| DC Input Voltage Range | 42 to 68 Vdc | 42 to 68 Vdc |
| DC Input Power (continuous) | 3.6 kVA | 4.32 kVA |
| DC Input Maximum Current (continuous full power) | 90 Adc | 200 Adc |
| Battery Charger Maximum AC Input | 14 Aac | 20 Aac |
| Battery Charger Maximum DC Output | 35 Adc | 45 Adc |
| Auxiliary Output | 0.7 Adc at 12 Vdc | 0.7 Adc at 12 Vdc |

# Mechanical Specifications

**Table 11 Mechanical Specifications for Mobile Models**

| Specification | FX2012MT<br>FX2524MT<br>FX3048MT | VFX2812M<br>FX2024M<br>VFX3524M<br>VFX3648M |
|---|---|---|
| Inverter Dimensions (H × W × D) | 13 × 8.25 × 16.25" (33 × 21 × 41 cm) | 12 × 8.25 × 16.25" (30 × 21 × 41 cm) |
| Shipping Dimensions (H × W × L) | 21.75 × 13 × 22” (55 × 33 × 56 cm) | 21.75 × 13 × 22” (55 × 33 × 56 cm) |
| Inverter Weight | 62 lb (29 kg) | 61 lb (28 kg) |
| Shipping Weight | 67 lb (30 kg) | 67 lb (30 kg) |
| Accessory Ports | RJ11 (batt temp) and<br>RJ45 (system display) | RJ11 (batt temp) and<br>RJ45 (system display) |
| Non-volatile Memory | Yes | Yes |
| Neutral-Ground Bond Switching | Yes | Yes |
| Chassis Type | Sealed | Vented (FX2024M is sealed) |

# Environmental Specifications

**Table 12 Environmental Specifications for Mobile Models**

| Specification | Value |
|---|---|
| Rated Temperature Range (meets component specifications; however, please note that the inverter output wattage is derated above 25°C) | 32°F to 122°F (0°C to 50°C) |
| Operational Temperature Range (functions, but not rated for operation; does not necessarily meet all component specifications) | –13°F to 140°F (–25°C to 60°C) |
| IP (Ingress Protection) Rating of Enclosure | IP20 |
| Relative Humidity Rating | 93% |

# Regulatory Specifications

## Listings

This product carries a listing report by ETL. It is listed to the following standards:

- UL 458 — Standard for Safety Power Converters/Inverters and Power Converter/Inverter Systems for Land Vehicles and Marine Crafts, ANSI/UL 458, Ed:3, dated 2006/04/19 (with revisions through and including 2013/02/20)
- CSA C22.2, General Use Power Supplies, No. 107.1, Issue 2001/09/01, Ed:3 (R2011)

# Summary of Operating Limits

Severe conditions cause the inverter to limit its output or shut down for protection. The most common conditions are high voltage, low voltage, and temperature. The limits for these conditions are summarized in Table 13. See page 40 for more information on these conditions and the warning or error messages which accompany them.

**Table 13 Operating Limits for Mobile Models**

| **Voltage Limits** | | **12-Volt Model** | | **24-Volt Model** | | **48-Volt Model** | |
|---|---|---|---|---|---|---|---|
| **Limit** | **Adjustable** | **Off** | **On** | **Off** | **On** | **Off** | **On** |
| High Battery | No | >17 Vdc | <17 Vdc | >34 Vdc | <34 Vdc | >68 Vdc | <68 Vdc |
| Low Battery (default) | Yes | >10.5 Vdc | <12.5 Vdc | >21.0 Vdc | <25.0 Vdc | >42.0 Vdc | <50.0 Vdc |
| **Temperature Limits** | | | | | | | |
| **Limit** | | ***Transformer*** | | ***Output FETs*** | | ***Capacitors*** | |
| ***Over Temperature*** error | | <125°C | >125°C | <95°C | >95°C | <95°C | >95°C |
| Reduced charging | | >120°C | | >90°C | | >90°C | |
| Internal Fan | | <50°C | >60°C | <50°C | >60°C | <50°C | >60°C |

# Default Settings and Ranges (MATE/MATE2)

## Table 14 12-Volt Inverter Settings (MATE)

| Field | Item | | Default | Minimum | Maximum |
|---|---|---|---|---|---|
| **Search** | ***search sensitivity*** (see page 14 for increments) | | 6 | 0 | 50 |
| | ***search pulse length*** | | 8 | 2 | 20 |
| | ***search pulse spacing*** | | 60 AC cycles | 4 AC cycles | 120 AC cycles |
| **Input** | ***ac transfer control*** | | ***Grid*** | ***Grid*** or ***Gen*** | |
| | ***ac1/grid limit*** | | 28 Aac | 5 Aac | 30 Aac |
| | ***ac2/gen limit*** | | 28 Aac | 2 Aac | 30 Aac |
| **Inverter** | ***low battery cut-out (LBCO)*** | | 10.5 Vdc | 9 Vdc | 12 Vdc |
| | ***low battery cut-in (LBCI)*** | | 12.5 Vdc | 11 Vdc | 13 Vdc |
| | ***adjust output voltage*** | | 120 Vac | 110 Vac | 125 Vac |
| **Charger** | ***charger limit*** | FX2012MT | 10 Aac | 0 Aac | 12 Aac |
| | | VFX2812M | 14 Aac | 0 Aac | 16 Aac |
| | ***absorb voltage*** | | 14.4 Vdc | 13 Vdc | 16 Vdc |
| | ***absorb time limit*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| | ***float voltage*** | | 13.6 Vdc | 12 Vdc | 15 Vdc |
| | ***float time period*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| | ***refloat voltage*** | | 12.5 Vdc | 11 Vdc | 13 Vdc |
| | ***equalization voltage*** | | 14.4 Vdc | 14 Vdc | 17 Vdc |
| | ***equalization time period*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| **Grid** | ***ac1/grid lower limit*** | | 108 Vac | 40 Vac | 115 Vac |
| | ***ac1/grid upper limit*** | | 140 Vac | 130 Vac | 150 Vac |
| | ***ac1/grid input limit*** | | 28 Aac | 5 Aac | 30 Aac |
| | ***ac1/grid transfer delay*** | | 6 AC cycles | 0 AC cycles | 240 AC cycles |
| **Generator (Gen)** | ***gen input connect delay*** | | 0.5 minutes | 0.2 minutes | 15 minutes |
| | ***ac2/gen lower limit*** | | 108 Vac | 40 Vac | 115 Vac |
| | ***ac2/gen upper limit*** | | 140 Vac | 130 Vac | 150 Vac |
| | ***ac2/gen input limit*** | | 28 Aac | 2 Aac | 30 Aac |
| | ***ac2/gen transfer delay*** | | 60 AC cycles | 0 AC cycles | 240 AC cycles |
| **Auxiliary (Aux)** | ***aux output control*** | | ***AUTO*** | ***ON, OFF***, or ***AUTO*** | |
| | ***aux output function*** | | ***Cool Fan*** | ***Cool Fan, DivertDC, DivertAC, AC Drop, Vent Fan, Fault, GenAlert, LoadShed***, or ***Remote*** | |
| | ***genalert on voltage*** | | 11 Vdc | 10 Vdc | 14 Vdc |
| | ***genalert on delay*** | | 4 minutes | 0 minutes | 240 minutes |
| | ***genalert off set point*** | | 14 Vdc | 12 Vdc | 18 Vdc |
| | ***genalert off delay*** | | 9 minutes | 0 minutes | 240 minutes |
| | ***load shed off voltage*** | | 11 Vdc | 10 Vdc | 14 Vdc |
| | ***vent fan on set point*** | | 13 Vdc | 10 Vdc | 16 Vdc |
| | ***vent fan off period*** | | 5 minutes | 0 minutes | 30 minutes |
| | ***diversion on voltage*** | | 14.6 Vdc | 12 Vdc | 16 Vdc |
| | ***diversion off delay*** | | 30 seconds | 0 seconds | 240 seconds |
| **Stacking** | ***stack phase*** | | ***Master*** | ***1-2ph Master, Classic Slave, OB Slave L1, OB Slave L2, 3ph Master, 3ph Slave*** | |
| **Power Save** | ***master adjust only*** | | 0 | 0 | 7 |
| | ***slave adjust only*** | | 1 | 1 | 15 |
| **Sell** | ***sell re volts*** | | — | Inoperative | |
| | ***grid tie window*** | | — | Inoperative | |
| | ***grid tie authority*** | | — | Inoperative | |
| **Calibration (Cal)** | ***vac input adjustment***[3] | | 236 | 220 | 254 |
| | ***vac output adjustment***[3] | | 236 | 220 | 254 |
| | ***battery vdc adjustment***[4] | | 2 | 0 | 4 |

[3] These values are in digital counts, not volts. Lower counts stand for higher voltages, and higher counts mean lower voltages. One count equals approximately 1 Vac. The range of adjustment is 15 Vac above nominal and 17 Vac below nominal.

[4] These values are in digital counts, not volts. One count equals 0.1 Vdc. The range of adjustment is 0.2 Vdc above or below nominal.

## Table 15 24-Volt Inverter Settings (MATE)

| Field | Item | | Default | Minimum | Maximum |
|---|---|---|---|---|---|
| Search | ***search sensitivity*** (see page 14 for increments) | | 6 | 0 | 50 |
| | ***search pulse length*** | | 8 | 2 | 20 |
| | ***search pulse spacing*** | | 60 AC cycles | 4 AC cycles | 120 AC cycles |
| Input | ***ac transfer control*** | | ***Grid*** | ***Grid*** or ***Gen*** | |
| | ***ac1/grid limit*** | | 28 Aac | 5 Aac | 30 Aac |
| | ***ac2/gen limit*** | | 28 Aac | 2 Aac | 30 Aac |
| Inverter | ***low battery cut-out (LBCO)*** | | 21 Vdc | 18 Vdc | 24 Vdc |
| | ***low battery cut-in (LBCI)*** | | 25 Vdc | 22 Vdc | 26 Vdc |
| | ***adjust output voltage*** | | 120 Vac | 110 Vac | 125 Vac |
| Charger | ***charger limit*** | FX2524MT | 12 Aac | 0 Aac | 14 Aac |
| | | VFX3524M | 18 Aac | 0 Aac | 20 Aac |
| | ***absorb voltage*** | | 28.8 Vdc | 26 Vdc | 32 Vdc |
| | ***absorb time limit*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| | ***float voltage*** | | 27.2 Vdc | 24 Vdc | 30 Vdc |
| | ***float time period*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| | ***refloat voltage*** | | 25 Vdc | 22 Vdc | 26 Vdc |
| | ***equalization voltage*** | | 28.8 Vdc | 28 Vdc | 34 Vdc |
| | ***equalization time period*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| Grid | ***ac1/grid lower limit*** | | 108 Vac | 40 Vac | 115 Vac |
| | ***ac1/grid upper limit*** | | 140 Vac | 130 Vac | 150 Vac |
| | ***ac1/grid input limit*** | | 28 Aac | 5 Aac | 30 Aac |
| | ***ac1/grid transfer delay*** | | 6 AC cycles | 0 AC cycles | 240 AC cycles |
| Generator (Gen) | ***gen input connect delay*** | | 0.5 minutes | 0.2 minutes | 15 minutes |
| | ***ac2/gen lower limit*** | | 108 Vac | 40 Vac | 115 Vac |
| | ***ac2/gen upper limit*** | | 140 Vac | 130 Vac | 150 Vac |
| | ***ac2/gen input limit*** | | 28 Aac | 2 Aac | 30 Aac |
| | ***ac2/gen transfer delay*** | | 60 AC cycles | 0 AC cycles | 240 AC cycles |
| Auxiliary (Aux) | ***aux output control*** | | ***AUTO*** | ***ON, OFF***, or ***AUTO*** | |
| | ***aux output function*** | | ***Cool Fan*** | ***Cool Fan, DivertDC, DivertAC, AC Drop, Vent Fan, Fault, GenAlert, LoadShed***, or ***Remote*** | |
| | ***genalert on voltage*** | | 22 Vdc | 20 Vdc | 28 Vdc |
| | ***genalert on delay*** | | 4 minutes | 0 minutes | 240 minutes |
| | ***genalert off set point*** | | 28 Vdc | 24 Vdc | 36 Vdc |
| | ***genalert off delay*** | | 9 minutes | 0 minutes | 240 minutes |
| | ***load shed off voltage*** | | 22 Vdc | 20 Vdc | 28 Vdc |
| | ***vent fan on set point*** | | 26 Vdc | 20 Vdc | 32 Vdc |
| | ***vent fan off period*** | | 5 minutes | 0 minutes | 30 minutes |
| | ***diversion on voltage*** | | 29.2 Vdc | 24 Vdc | 32 Vdc |
| | ***diversion off delay*** | | 30 seconds | 0 seconds | 240 seconds |
| Stacking | ***stack phase*** | | ***Master*** | ***1-2ph Master, Classic Slave, OB Slave L1, OB Slave L2, 3ph Master, 3ph Slave*** | |
| Power Save | ***master adjust only*** | | 0 | 0 | 7 |
| | ***slave adjust only*** | | 1 | 1 | 15 |
| Sell | ***sell re volts*** | | — | Inoperative | |
| | ***grid tie window*** | | — | Inoperative | |
| | ***grid tie authority*** | | — | Inoperative | |
| Calibration (Cal) | ***vac input adjustment***[5] | | 236 | 220 | 254 |
| | ***vac output adjustment***[5] | | 236 | 220 | 254 |
| | ***battery vdc adjustment***[6] | | 2 | 0 | 4 |

[5] These values are in digital counts, not volts. Lower counts stand for higher voltages, and higher counts mean lower voltages. One count equals approximately 1 Vac. The range of adjustment is 15 Vac above nominal and 17 Vac below nominal.

[6] These values are in digital counts, not volts. One count equals 0.2 Vdc. The range of adjustment is 0.4 Vdc above or below nominal.

## Table 16 48-Volt Inverter Settings (MATE)

| Field | Item | | Default | Minimum | Maximum |
|---|---|---|---|---|---|
| Search | ***search sensitivity*** (see page 14 for increments) | | 6 | 0 | 50 |
| | ***search pulse length*** | | 8 | 2 | 20 |
| | ***search pulse spacing*** | | 60 AC cycles | 4 AC cycles | 120 AC cycles |
| Input | ***ac transfer control*** | | ***Grid*** | ***Grid*** or ***Gen*** | |
| | ***ac1/grid limit*** | | 28 Aac | 5 Aac | 30 Aac |
| | ***ac2/gen limit*** | | 28 Aac | 2 Aac | 30 Aac |
| Inverter | ***low battery cut-out (LBCO)*** | | 42 Vdc | 36 Vdc | 48 Vdc |
| | ***low battery cut-in (LBCI)*** | | 50 Vdc | 30 Vdc | 52 Vdc |
| | ***adjust output voltage*** | | 120 Vac | 110 Vac | 125 Vac |
| Charger | ***charger limit*** | FX3048MT | 12 Aac | 0 Aac | 14 Aac |
| | | VFX3648M | 18 Aac | 0 Aac | 20 Aac |
| | ***absorb voltage*** | | 57.6 Vdc | 52 Vdc | 64 Vdc |
| | ***absorb time limit*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| | ***float voltage*** | | 54.4 Vdc | 48 Vdc | 60 Vdc |
| | ***float time period*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| | ***refloat voltage*** | | 50 Vdc | 44 Vdc | 52 Vdc |
| | ***equalization voltage*** | | 57.6 Vdc | 56 Vdc | 68 Vdc |
| | ***equalization time period*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| Grid | ***ac1/grid lower limit*** | | 108 Vac | 40 Vac | 115 Vac |
| | ***ac1/grid upper limit*** | | 140 Vac | 130 Vac | 150 Vac |
| | ***ac1/grid input limit*** | | 28 Aac | 5 Aac | 30 Aac |
| | ***ac1/grid transfer delay*** | | 6 AC cycles | 0 AC cycles | 240 AC cycles |
| Generator (Gen) | ***gen input connect delay*** | | 0.5 minutes | 0.2 minutes | 15 minutes |
| | ***ac2/gen lower limit*** | | 108 Vac | 40 Vac | 115 Vac |
| | ***ac2/gen upper limit*** | | 140 Vac | 130 Vac | 150 Vac |
| | ***ac2/gen input limit*** | | 28 Aac | 2 Aac | 30 Aac |
| | ***ac2/gen transfer delay*** | | 60 AC cycles | 0 AC cycles | 240 AC cycles |
| Auxiliary (AUX) | ***aux output control*** | | ***AUTO*** | ***ON, OFF***, or ***AUTO*** | |
| | ***aux output function*** | | ***Cool Fan*** | ***Cool Fan, DivertDC, DivertAC, AC Drop, Vent Fan, Fault, GenAlert, LoadShed***, or ***Remote*** | |
| | ***genalert on voltage*** | | 44 Vdc | 40 Vdc | 56 Vdc |
| | ***genalert on delay*** | | 4 minutes | 0 minutes | 240 minutes |
| | ***genalert off set point*** | | 56 Vdc | 48 Vdc | 72 Vdc |
| | ***genalert off delay*** | | 9 minutes | 0 minutes | 240 minutes |
| | ***load shed off voltage*** | | 44 Vdc | 40 Vdc | 56 Vdc |
| | ***vent fan on set point*** | | 52 Vdc | 40 Vdc | 64 Vdc |
| | ***vent fan off period*** | | 5 minutes | 0 minutes | 30 minutes |
| | ***diversion on voltage*** | | 58.4 Vdc | 48 Vdc | 64 Vdc |
| | ***diversion off delay*** | | 30 seconds | 0 seconds | 240 seconds |
| Stacking | ***stack phase*** | | ***Master*** | ***1-2ph Master, Classic Slave, OB Slave L1, OB Slave L2, 3ph Master, 3ph Slave*** | |
| Power Save | ***master adjust only*** | | 0 | 0 | 7 |
| | ***slave adjust only*** | | 1 | 1 | 15 |
| Sell | ***sell re volts*** | | — | Inoperative | |
| | ***grid tie window*** | | — | Inoperative | |
| | ***grid tie authority*** | | — | Inoperative | |
| Calibration (Cal) | ***vac input adjustment***[7] | | 236 | 220 | 254 |
| | ***vac output adjustment***[7] | | 236 | 220 | 254 |
| | ***battery vdc adjustment***[8] | | 2 | 0 | 4 |

[7] These values are in digital counts, not volts. Lower counts stand for higher voltages, and higher counts mean lower voltages. One count equals approximately 1 Vac. The range of adjustment is 15 Vac above nominal and 17 Vac below nominal.

[8] These values are in digital counts, not volts. One count equals 0.4 Vdc. The range of adjustment is 0.8 Vdc above or below nominal.

# Default Settings and Ranges (MATE3s)

## Table 17 12-Volt Inverter Settings (MATE3s)

| Field | Item | | Default | Minimum | Maximum |
|---|---|---|---|---|---|
| INVERTER Hot Key | **Inverter Mode** | | ***Off*** | ***On***, ***Off***, or ***Search*** | |
| CHARGER Hot Key | **Charger Control** | | ***On*** | ***On*** or ***Off*** | |
| AC Input Hot Key | **AC Input Mode** | | ***Use*** | ***Drop*** or ***Use*** | |
| **Search** | ***Sensitivity*** (see page 14 for increments) | | 6 | 0 | 50 |
| | ***Pulse Length*** | | 8 AC Cycles | 4 AC Cycles | 20 AC Cycles |
| | ***Pulse Spacing*** | | 60 AC Cycles | 4 AC Cycles | 120 AC Cycles |
| **AC Input and Current Limit** | ***Input Type*** | | ***Grid*** | ***Grid*** or ***Gen*** | |
| | ***Grid Input AC Limit*** | | 28 Aac | 5 Aac | 30 Aac |
| | ***Gen Input AC Limit*** | | 28 Aac | 2 Aac | 30 Aac |
| | ***Charger AC Limit*** | FX2012MT | 10 Aac | 0 Aac | 12 Aac |
| | | VFX2812M | 14 Aac | 0 Aac | 16 Aac |
| **Grid AC Input Voltage Limits** | ***Voltage Limit Lower*** | | 108 Vac | 40 Vac | 115 Vac |
| | (Voltage Limit) ***Upper*** | | 140 Vac | 130 Vac | 150 Vac |
| | ***Transfer Delay*** | | 0.1 second | 0.12 seconds | 4.0 seconds |
| **Gen AC Input Voltage Limits** | ***Voltage Limit Lower*** | | 108 Vac | 40 Vac | 115 Vac |
| | (Voltage Limit) ***Upper*** | | 140 Vac | 130 Vac | 150 Vac |
| | ***Transfer Delay*** | | 1.0 second | 0.12 seconds | 4.0 seconds |
| | ***Connect Delay*** | | 0.5 minutes | 0.2 minutes | 15.0 minutes |
| **AC Output** | ***Output Voltage*** | | 120 Vac | 110 Vac | 125 Vac |
| **Low Battery** | ***Cut-Out Voltage*** | | 10.5 Vdc | 9.0 Vdc | 12.0 Vdc |
| | ***Cut-In Voltage*** | | 12.5 Vdc | 11.0 Vdc | 13.0 Vdc |
| **Battery Charger** | ***Absorb Voltage*** | | 14.4 Vdc | 13.0 Vdc | 16.0 Vdc |
| | (Absorb) ***Time*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| | ***Float Voltage*** | | 13.6 Vdc | 12.0 Vdc | 15.0 Vdc |
| | (Float) ***Time*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| | ***Re-Float Voltage*** | | 12.5 Vdc | 11.0 Vdc | 13.0 Vdc |
| **Battery Equalize** | ***Equalize Voltage*** | | 14.4 Vdc | 14.0 Vdc | 17.0 Vdc |
| | (Equalize) ***Time*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| **Auxiliary Output** | ***Aux Control*** | | ***Auto*** | ***Off, Auto*** or ***On*** | |
| | ***Aux Mode*** | | ***Cool Fan*** | ***Cool Fan, DivertDC, DivertAC, AC Drop, Vent Fan, Fault, GenAlert, LoadShed***, or ***Remote*** | |
| | (Load Shed) ***Enable Voltage*** | | 11 Vdc | 10 Vdc | 14 Vdc |
| | (Gen Alert) ***ON Voltage*** | | 11 Vdc | 10 Vdc | 14 Vdc |
| | (Gen Alert ON) ***Delay*** | | 4 minutes | 0 minutes | 240 minutes |
| | (Gen Alert) ***OFF Voltage*** | | 14 Vdc | 12 Vdc | 18 Vdc |
| | (Gen Alert OFF) ***Delay*** | | 9 minutes | 0 minutes | 240 minutes |
| | (Vent Fan) ***Enable Voltage*** | | 13 Vdc | 10 Vdc | 16 Vdc |
| | (Vent Fan) ***Off Period*** | | 5 minutes | 0 minutes | 30 minutes |
| | (Divert DC or AC) ***Enable Voltage*** | | 14.6 Vdc | 12 Vdc | 16 Vdc |
| | (Divert DC or AC) ***Off Delay*** | | 30 seconds | 0 seconds | 240 seconds |
| **Inverter Stacking** | ***Stack Mode*** | | ***Master*** | ***1-2phase Master, Classic Slave, OB Slave L1, OB Slave L2, 3phase Master, 3phase Slave*** | |
| **Power Save Ranking** | ***Master Adjust Only*** | | 0 | 0 | 7 |
| | ***Slave Adjust Only*** | | 1 | 1 | 15 |
| **Grid-Tie Sell** | ***Grid Tie Enable*** | | — | Inoperative | |
| | ***Sell Voltage*** | | — | Inoperative | |
| | ***Grid Tie Window*** | | — | Inoperative | |
| **Calibrate** | ***Input Voltage***[9] | | -1 | -3 | 1 |
| | ***Output Voltage***[9] | | -1 | -3 | 1 |
| | ***Battery Voltage***[10] | | 0.0 | -0.2 | 0.2 |

[9] These values represent an adjustable setting with a total range of 4 Vac. The default value of -1 means the calibration will subtract 1 volt from the measured value. The range of settings allow up to 1 volt to be added to the measured value, or up to 3 volts to be subtracted from it. The result is also displayed.

[10] These values represent an adjustable setting with a range of ± 0.2 Vdc from the measured value. The range of settings allows up to 0.2 volts to be either added or subtracted from the measured value. The result is also displayed.

## Table 18 24-Volt Inverter Settings (MATE3s)

| Field | Item | | Default | Minimum | Maximum |
|---|---|---|---|---|---|
| INVERTER Hot Key | **Inverter Mode** | | ***Off*** | ***On***, ***Off***, or ***Search*** | |
| CHARGER Hot Key | **Charger Control** | | ***On*** | ***On*** or ***Off*** | |
| AC Input Hot Key | **AC Input Mode** | | ***Use*** | ***Drop*** or ***Use*** | |
| **Search** | ***Sensitivity*** (see page 14 for increments) | | 6 | 0 | 50 |
| | ***Pulse Length*** | | 8 AC Cycles | 4 AC Cycles | 20 AC Cycles |
| | ***Pulse Spacing*** | | 60 AC Cycles | 4 AC Cycles | 120 AC Cycles |
| **AC Input and Current Limit** | ***Input Type*** | | ***Grid*** | ***Grid*** or ***Gen*** | |
| | ***Grid Input AC Limit*** | | 28 Aac | 5 Aac | 30 Aac |
| | ***Gen Input AC Limit*** | | 28 Aac | 2 Aac | 30 Aac |
| | ***Charger AC Limit*** | FX2524MT | 12 Aac | 0 Aac | 14 Aac |
| | | VFX3524M | 18 Aac | 0 Aac | 20 Aac |
| **Grid AC Input Voltage Limits** | ***Voltage Limit Lower*** | | 108 Vac | 40 Vac | 115 Vac |
| | (Voltage Limit) ***Upper*** | | 140 Vac | 130 Vac | 150 Vac |
| | ***Transfer Delay*** | | 0.1 second | 0.12 seconds | 4.0 seconds |
| **Gen AC Input Voltage Limits** | ***Voltage Limit Lower*** | | 108 Vac | 40 Vac | 115 Vac |
| | (Voltage Limit) ***Upper*** | | 140 Vac | 130 Vac | 150 Vac |
| | ***Transfer Delay*** | | 1.0 second | 0.12 seconds | 4.0 seconds |
| | ***Connect Delay*** | | 0.5 minutes | 0.2 minutes | 15.0 minutes |
| **AC Output** | ***Output Voltage*** | | 120 Vac | 110 Vac | 125 Vac |
| **Low Battery** | ***Cut-Out Voltage*** | | 21 Vdc | 18 Vdc | 24 Vdc |
| | ***Cut-In Voltage*** | | 25 Vdc | 22 Vdc | 26 Vdc |
| **Battery Charger** | ***Absorb Voltage*** | | 28.8 Vdc | 26 Vdc | 32 Vdc |
| | (Absorb) ***Time*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| | ***Float Voltage*** | | 27.2 Vdc | 24 Vdc | 30 Vdc |
| | (Float) ***Time*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| | ***Re-Float Voltage*** | | 25 Vdc | 22 Vdc | 26 Vdc |
| **Battery Equalize** | ***Equalize Voltage*** | | 28.8 Vdc | 28 Vdc | 34 Vdc |
| | (Equalize) ***Time*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| **Auxiliary Output** | ***Aux Control*** | | ***Auto*** | ***Off, Auto*** or ***On*** | |
| | ***Aux Mode*** | | ***Cool Fan*** | ***Cool Fan, DivertDC, DivertAC, AC Drop, Vent Fan, Fault, GenAlert, LoadShed***, or ***Remote*** | |
| | (Load Shed) ***Enable Voltage*** | | 22 Vdc | 20 Vdc | 28 Vdc |
| | (Gen Alert) ***ON Voltage*** | | 22 Vdc | 20 Vdc | 28 Vdc |
| | (Gen Alert ON) ***Delay*** | | 4 minutes | 0 minutes | 240 minutes |
| | (Gen Alert) ***OFF Voltage*** | | 28 Vdc | 24 Vdc | 36 Vdc |
| | (Gen Alert OFF) ***Delay*** | | 9 minutes | 0 minutes | 240 minutes |
| | (Vent Fan) ***Enable Voltage*** | | 26 Vdc | 20 Vdc | 32 Vdc |
| | (Vent Fan) ***Off Period*** | | 5 minutes | 0 minutes | 30 minutes |
| | (Divert DC or AC) ***Enable Voltage*** | | 29.2 Vdc | 24 Vdc | 32 Vdc |
| | (Divert DC or AC) ***Off Delay*** | | 30 seconds | 0 seconds | 240 seconds |
| **Inverter Stacking** | ***Stack Mode*** | | ***Master*** | ***1-2phase Master, Classic Slave, OB Slave L1, OB Slave L2, 3phase Master, 3phase Slave*** | |
| **Power Save Ranking** | ***Master Adjust Only*** | | 0 | 0 | 7 |
| | ***Slave Adjust Only*** | | 1 | 1 | 15 |
| **Grid-Tie Sell** | ***Grid Tie Enable*** | | — | Inoperative | |
| | ***Sell Voltage*** | | — | Inoperative | |
| | ***Grid Tie Window*** | | — | Inoperative | |
| **Calibrate** | ***Input Voltage***[11] | | -1 | -3 | 1 |
| | ***Output Voltage***[11] | | -1 | -3 | 1 |
| | ***Battery Voltage***[12] | | 0.0 | -0.4 | 0.4 |

[11] These values represent an adjustable setting with a total range of 4 Vac. The default value of -1 means the calibration will subtract 1 volt from the measured value. The range of settings allow up to 1 volt to be added to the measured value, or up to 3 volts to be subtracted from it. The result is also displayed.

[12] These values represent an adjustable setting with a range of ± 0.4 Vdc from the measured value. The range of settings allows up to 0.4 volts to be either added or subtracted from the measured value (in increments of 0.2 Vdc). The result is also displayed.

## Table 19 48-Volt Inverter Settings (MATE3s)

| Field | Item | | Default | Minimum | Maximum |
|---|---|---|---|---|---|
| INVERTER Hot Key | **Inverter Mode** | | ***Off*** | ***On***, ***Off***, or ***Search*** | |
| CHARGER Hot Key | **Charger Control** | | ***On*** | ***On*** or ***Off*** | |
| AC Input Hot Key | **AC Input Mode** | | ***Use*** | ***Drop*** or ***Use*** | |
| **Search** | ***Sensitivity*** (see page 14 for increments) | | 6 | 0 | 50 |
| | ***Pulse Length*** | | 8 AC Cycles | 4 AC Cycles | 20 AC Cycles |
| | ***Pulse Spacing*** | | 60 AC Cycles | 4 AC Cycles | 120 AC Cycles |
| **AC Input and Current Limit** | ***Input Type*** | | ***Grid*** | ***Grid*** or ***Gen*** | |
| | ***Grid Input AC Limit*** | | 28 Aac | 5 Aac | 30 Aac |
| | ***Gen Input AC Limit*** | | 28 Aac | 2 Aac | 30 Aac |
| | ***Charger AC Limit*** | FX3048MT | 12Aac | 0 Aac | 14 Aac |
| | | VFX3648M | 18 Aac | 0 Aac | 20 Aac |
| **Grid AC Input Voltage Limits** | ***Voltage Limit Lower*** | | 108 Vac | 40 Vac | 115 Vac |
| | (Voltage Limit) ***Upper*** | | 140 Vac | 130 Vac | 150 Vac |
| | ***Transfer Delay*** | | 0.1 second | 0.12 seconds | 4.0 seconds |
| **Gen AC Input Voltage Limits** | ***Voltage Limit Lower*** | | 108 Vac | 40 Vac | 115 Vac |
| | (Voltage Limit) ***Upper*** | | 140 Vac | 130 Vac | 150 Vac |
| | ***Transfer Delay*** | | 1.0 second | 0.12 seconds | 4.0 seconds |
| | ***Connect Delay*** | | 0.5 minutes | 0.2 minutes | 15.0 minutes |
| **AC Output** | ***Output Voltage*** | | 120 Vac | 110 Vac | 125 Vac |
| **Low Battery** | ***Cut-Out Voltage*** | | 42 Vdc | 36 Vdc | 48 Vdc |
| | ***Cut-In Voltage*** | | 50 Vdc | 44 Vdc | 52 Vdc |
| **Battery Charger** | ***Absorb Voltage*** | | 57.6 Vdc | 52 Vdc | 64 Vdc |
| | (Absorb) ***Time*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| | ***Float Voltage*** | | 54.4 Vdc | 48 Vdc | 60 Vdc |
| | (Float) ***Time*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| | ***Re-Float Voltage*** | | 50 Vdc | 44 Vdc | 52 Vdc |
| **Battery Equalize** | ***Equalize Voltage*** | | 57.6 Vdc | 56 Vdc | 34 Vdc |
| | (Equalize) ***Time*** | | 1.0 hours | 0.0 hours | 24.0 hours |
| **Auxiliary Output** | ***Aux Control*** | | ***Auto*** | ***Off, Auto*** or ***On*** | |
| | ***Aux Mode*** | | ***Cool Fan*** | ***Cool Fan, DivertDC, DivertAC, AC Drop, Vent Fan, Fault, GenAlert, LoadShed***, or ***Remote*** | |
| | (Load Shed) ***Enable Voltage*** | | 44 Vdc | 40 Vdc | 56 Vdc |
| | (Gen Alert) ***ON Voltage*** | | 44 Vdc | 40 Vdc | 56 Vdc |
| | (Gen Alert ON) ***Delay*** | | 4 minutes | 0 minutes | 240 minutes |
| | (Gen Alert) ***OFF Voltage*** | | 56 Vdc | 48 Vdc | 72 Vdc |
| | (Gen Alert OFF) ***Delay*** | | 9 minutes | 0 minutes | 240 minutes |
| | (Vent Fan) ***Enable Voltage*** | | 52 Vdc | 40 Vdc | 64 Vdc |
| | (Vent Fan) ***Off Period*** | | 5 minutes | 0 minutes | 30 minutes |
| | (Divert DC or AC) ***Enable Voltage*** | | 58.4 Vdc | 48 Vdc | 64 Vdc |
| | (Divert DC or AC) ***Off Delay*** | | 30 seconds | 0 seconds | 240 seconds |
| **Inverter Stacking** | ***Stack Mode*** | | ***Master*** | ***1-2phase Master, Classic Slave, OB Slave L1, OB Slave L2, 3phase Master, 3phase Slave*** | |
| **Power Save Ranking** | ***Master Adjust Only*** | | 0 | 0 | 7 |
| | ***Slave Adjust Only*** | | 1 | 1 | 15 |
| **Grid-Tie Sell** | ***Grid Tie Enable*** | | — | Inoperative | |
| | ***Sell Voltage*** | | — | Inoperative | |
| | ***Grid Tie Window*** | | — | Inoperative | |
| **Calibrate** | ***Input Voltage***[13] | | -1 | -3 | 1 |
| | ***Output Voltage***[13] | | -1 | -3 | 1 |
| | ***Battery Voltage***[14] | | 0.0 | -0.8 | 0.8 |

[13] These values represent an adjustable setting with a total range of 4 Vac. The default value of -1 means the calibration will subtract 1 volt from the measured value. The range of settings allow up to 1 volt to be added to the measured value, or up to 3 volts to be subtracted from it. The result is also displayed.

[14] These values represent an adjustable setting with a range of ± 0.8 Vdc from the measured value. The range of settings allows up to 0.8 volts to be either added or subtracted from the measured value (in increments of 0.4 Vdc). The result is also displayed.

# Definitions

The following is a list of initials, terms, and definitions used in conjunction with this product.

**Table 20 Terms and Definitions**

| Term | Definition |
|---|---|
| AC | Alternating Current; refers to voltage produced by the inverter, utility grid, or generator |
| AGS | Advanced Generator Start |
| AUX | Inverter's 12-volt auxiliary output |
| Communications manager | Multi-port device such as the OutBack HUB 4 or HUB10.3; used for connecting multiple OutBack devices on a single remote display; essential for stacking inverters |
| CSA | Canadian Standards Association; establishes Canadian national standards and the Canadian Electrical Code, including C22.1 and C22.2 |
| DC | Direct Current; refers to voltage produced by the batteries or renewable source |
| DVM | Digital Voltmeter |
| ETL | Electrical Testing Laboratories; short for the company ETL Semko; refers to a certification issued by ETL to OutBack products indicating that they meet certain UL standards |
| GND | Ground; a permanent conductive connection to earth for safety reasons; also known as Chassis Ground, Protective Earth, PE, Grounding Electrode Conductor, and GEC |
| HBX | High Battery Transfer; a function of the remote system display |
| HUB | An OutBack communications manager product; used for system stacking and coordination |
| Invert, inverting | The act of converting DC voltage to AC voltage for load use or other applications |
| LBCO | Low Battery Cut-Out; set point at which the inverter shuts down due to low voltage |
| LED | Light-Emitting Diode; refers to indicators used by the inverter and the system display |
| Master | An inverter which provides the primary output phase of a stacked system; other stacked inverters base their output and on/off state on the master |
| MATE, MATE2, MATE3s | System display products, used for monitoring, programming and communicating with the inverter |
| NEU | AC Neutral; also known as Common |
| Neutral-to-ground bond | A mechanical connection between the AC neutral (Common) bus and the ground (PE) bus; this bond makes the AC neutral safe to handle |
| PV | Photovoltaic |
| RTS | Remote Temperature Sensor; accessory that measures battery temperature for charging |
| Split-phase | A type of utility electrical system with two "hot" lines that typically carry 120 Vac with respect to neutral and 240 Vac with respect to each other; common in North America |
| Slave | An inverter which adds additional power to the master in a stacked system; a slave does not provide an output of its own |
| System display | Remote interface device (such as the MATE3s), used for monitoring, programming and communicating with the inverter; also called "remote system display" |
| Three-phase, 3-phase | A type of utility electrical system with three "hot" lines, each 120° out of phase; each carries the nominal line voltage with respect to neutral; each carries voltage with respect to each other equaling the line voltage multiplied by 1.732 |
| UL | Underwriters Laboratories; refers to a set of safety standards governing electrical products |
| Utility grid | The electrical service and infrastructure supported by the electrical or utility company; also called "shore power", "mains", "utility service", or "grid" |

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