OutBack POWER™

member of The alpha Group™

# FXR Series Inverter/Charger

**FXR2012A** **FXR2524A** **FXR3048A**

**VFXR2812A** **VFXR3524A** **VFXR3648A**

## Operator's Manual

GRIDHybrid™

OPTICS RE Compatible

## About OutBack Power Technologies

OutBack Power Technologies 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.

## Grid/Hybrid™

As a leader in off-grid energy systems designed around energy storage, OutBack Power is an innovator in Grid/Hybrid system technology, providing the best of both worlds: grid-tied system savings during normal or daylight operation, and off-grid independence during peak energy times or in the event of a power outage or an emergency. Grid/Hybrid systems have the intelligence, agility and interoperability to operate in multiple energy modes quickly, efficiently, and seamlessly, in order to deliver clean, continuous and reliable power to residential and commercial users while maintaining grid stability.

## Applicability

These instructions apply to OutBack inverter/charger models FXR2012A, FXR2524A, FXR3048A, VFXR2812A, VFXR3524A, and VFXR3648A only.

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## Date and Revision


February 2015, Revision A (firmware revision 001.006.xxx)


## Part Number


900-0167-01-00 Rev A

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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 FXR 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 *FXR 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.

**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 *FXR Series Inverter/Charger Installation Manual*. Another common reference is the system display manual.

## General Safety

**WARNING: Limitations on Use**

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

**WARNING: Reduced Protection**

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

**CAUTION: Equipment Damage**

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

# Welcome to OutBack Power Technologies

Thank you for purchasing the OutBack FXR Series Inverter/Charger. It is designed to offer a complete power conversion system between batteries and AC power.

As part of an OutBack Grid/Hybrid™ system, it can provide off-grid power, grid backup power, or grid-interactive service which sells excess renewable energy back to the utility.

**Figure 1 FXR Series Inverter/Charger with Turbo Fan**

# Inverter Functions

- Battery-to-AC inverting which delivers power to run backup loads and other functions
  - ~ Provides single-phase output
  - ~ Adjustable range of output voltage
  - ~ Settable nominal output frequency
- AC-to-battery charging (OutBack systems are battery-based)
  - ~ Accepts a wide variety of single-phase AC sources
- Uses battery energy stored from renewable resources
  - ~ Can utilize stored energy from many sources (PV arrays, wind turbines, etc.)
  - ~ OutBack FLEXmax charge controllers will optimize PV power production as part of a Grid/Hybrid system
- Rapid transfer between AC source and inverter output with minimal delay time

- Uses the MATE3™ System Display and Controller or the AXS Port™ SunSpec Modbus Interface (sold separately) for user interface as part of a Grid/Hybrid system
  - MATE3 must have firmware revision 003.002.xxx or higher
- Supports the OPTICS RE™ online tool[1] for a cloud-based remote monitoring and control application
  - Requires the MATE3 or the AXS Port
  - Visit www.outbackpower.com to download
- Uses the HUB10.3™ Communications Manager for stacking as part of a Grid/Hybrid system
  - Stackable in series, parallel, series/parallel, and three-phase configurations
- Listed to UL 1741 (2nd Edition) and CSA 22.2 by ETL
- Field-upgradeable firmware (from www.outbackpower.com); requires MATE3 or AXS Port
- Seven selectable input modes for different applications
  - ***Generator***
  - ***Support***
  - ***Grid Tied*** (available in 24-volt and 48-models only)
  - ***UPS***
  - ***Backup***
  - ***Mini Grid***
  - ***GridZero***
- Single AC input with dual input programming; individualized modes and priorities can be selected when switching from utility grid to AC generator
  - external transfer device required
  - system display required for individual programming

**NOTE**: This product has a settable AC output range. In this book, many references to the output refer to the entire range. However, some references are made to 120 Vac or 60 Hz output. These are intended as examples only.

# Inverter Controls

The FXR 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 76.) However, external communication devices such as the OutBack MATE3 or AXS Port can be used to operate or program the inverter.

# MATE3 System Display and Controller

The MATE3 System Display and Controller (sold separately) is designed to accommodate programming and monitoring of a Grid/Hybrid power system. The MATE3 provides the means to adjust the factory default settings to correctly match the installation where needed. It provides the means to monitor system performance and troubleshoot fault or shutdown conditions. It also has data logging and interface functions using the Internet.

Once settings are modified using a MATE3, the MATE3 can be removed from the installation. The settings are stored in the nonvolatile memory of the FXR inverter. However, it is highly recommended

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

to include a MATE3 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.

The MATE3's Configuration 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.

**IMPORTANT:**
The MATE3 system display must have firmware revision 003.002.xxx or higher.

**IMPORTANT:**
Some functions are not based in the inverter, but are part of the MATE3 firmware. They will not function if the system display is removed. These functions are listed beginning on page 53.

**IMPORTANT:**
- The FXR inverter is only compatible with the MATE3 System Display and Controller. It is not intended for use with the OutBack MATE or MATE2 products.
- The FXR inverter can use the OPTICS RE online tool as a system display. OPTICS RE must be used in conjunction with the MATE3 or with the AXS Port SunSpec Modbus Interface.


**Figure 2 MATE3 and AXS Port**

# 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 *FXR 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.

# Commissioning

## Functional Test

| | |
|---|---|
| | **WARNING: Shock Hazard and Equipment Damage**<br>The inverter's AC and DC covers must be removed to perform these tests. The components are close together and carry hazardous voltages. Use appropriate care to avoid the risk of electric shock or equipment damage. |

It is highly recommended that all *applicable* steps be performed in the following order. However, if steps are inapplicable, they can be omitted.

If the results of any step do not match the description, see the Troubleshooting section on page 57.

## Pre-startup Procedures

1. Ensure all DC and AC overcurrent devices are opened, disconnected, or turned off.
2. Double-check all wiring connections.
3. Confirm that the total load does not exceed the inverter's rated power. (See page 27 and the specifications tables beginning on page 67.)
4. Inspect the work area to ensure tools or debris have not been left inside.
5. Using a digital voltmeter (DVM) or standard voltmeter, verify battery voltage. Confirm the voltage is correct for the inverter model. Confirm the polarity.
6. Connect the system display, if present.

| | |
|---|---|
| | **CAUTION: Equipment Damage**<br>Incorrect battery polarity will damage the inverter. Excessive battery voltage also may damage the inverter. This damage is not covered by the warranty. |
| | **IMPORTANT:**<br>Prior to programming (see Startup), verify the operating frequency of the AC source. This is necessary for correct AC operation. The default setting is 60 Hz, but this can be changed to 50 Hz. |

## Startup

**To start a single-inverter system:**

1. Close the main DC circuit breakers (or connect the fuses) from the battery bank to the inverter.

   Confirm that the system display is operational, if present.

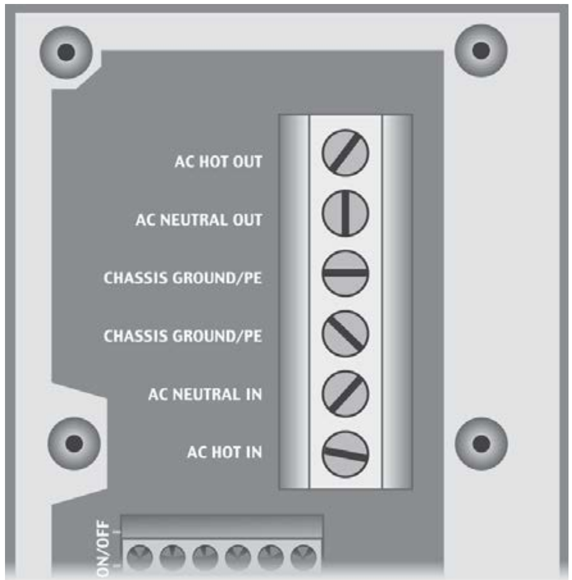



**Figure 3 AC Terminals**

2. If a system display is present, perform all programming for all functions.
   These functions may include AC input modes, AC output voltage, input current limits, battery charging, generator starting, and others.

   AC input modes are described beginning on page 17 and are summarized on page 25. The inverter's individual operations are described beginning on page 27.

3. Turn on the inverter using the system display (or external switch, if one has been installed). The inverter's default condition is Off. Do not turn on any AC circuit breakers at this time.

4. Using a DVM or voltmeter, verify 120 Vac (or appropriate voltage) between the AC HOT OUT and AC NEUTRAL OUT terminals. (See Figure 3 for AC terminals.) The inverter is working correctly if the AC output reads within 10% of 120 Vac or the programmed output voltage.

5. Proceed past the items below to Step 6 on the next page.

**To start a multiple-inverter (stacked) system:**

1. Close the main DC circuit breakers (or connect the fuses) from the battery bank to the inverter. Repeat for every inverter present. Confirm that the system display is operational.

   With the system display, perform any programming for stacking and all other functions.
   These functions may also include AC input modes, AC output voltage, input current limits, battery charging, generator starting, and others. When stacking in parallel, all slave inverters will observe the master programming settings. They do not need to be programmed individually. The MATE3 Configuration Wizard may be used to assist programming.

   AC input modes are described beginning on page 17 and are summarized on page 25. The inverter's individual operations are described beginning on page 27. Stacking is described beginning on page 43.

2. Turn on the master inverter using the system display (or external switch, if one has been installed). The inverter's default state is Off. Do not turn on any AC circuit breakers at this time.

3. Using the system display, temporarily bring each slave out of Silent mode by raising the Power Save Level of the master. (See page 47.)
   - As each slave is activated, it will click and create an audible hum.
   - Confirm that the system display shows no fault messages.
4. Using a DVM or voltmeter, verify appropriate voltage between the AC HOT OUT terminal on the master inverter and the AC HOT OUT terminal on each slave. Series inverters should read within 10% of 120 Vac or the programmed output voltage. Parallel inverters should read close to zero. Three-phase inverters should read within 10% of 208 Vac or the designated output voltage.
   - When this test is finished, return the master to its previous Power Save Level.

**After output testing is completed, perform the following steps:**

6. Close the AC output circuit breakers. If AC bypass switches are present, place them in the normal (non-bypass) position. *Do not connect an AC input source or close any AC input circuits.*
7. Use a DVM to verify correct voltage at the AC load panel.
8. Connect a small AC load and test for proper functionality.
9. Close the AC input circuit breakers and connect an AC source.
   - Using a DVM or voltmeter, check the AC HOT IN and AC NEUTRAL IN terminals for 120 Vac (or appropriate voltage) from the AC source.
   - If a system display is present, confirm that the inverter accepts the AC source as appropriate for its programming. (Some modes or functions may restrict connection with the source. If one of these selections has been used for the system, it may not connect.) Check the system display indicators for correct performance.
10. If the charger is activated, the inverter will perform a battery charging cycle after powering up. This can take several hours. If restarted after a temporary shutdown, the inverter may skip most or all of the charging cycle. Confirm that it is charging as appropriate by using the system display.
11. Test other functions which have been enabled, such as generator start, selling, or search mode.
12. Compare the DVM's readings with the system display meter readings. If necessary, the system display's readings can be calibrated to match the DVM more accurately. Calibrated settings include AC input voltage, AC output voltage, and battery voltage.

# Powering Down

These steps will completely isolate the inverter.

**To remove power from the system:**

1. Turn off all load circuits and AC input sources.
2. Turn off all renewable energy circuits.
3. Turn each inverter OFF using the MATE3 system display or external switch.
4. Turn off the main DC overcurrent devices for each inverter.

# Adding New Devices

When adding new devices to the system, first turn off the system according to the Power Down instructions. After adding new devices, perform another functional test, including programming.

# Firmware Updates

**IMPORTANT:**

All inverters will shut down during firmware updates. If loads need to be run while updating the firmware, bypass the inverter with a maintenance bypass switch. Communication cables must remain connected and DC power must remain on. Interrupted communication will cause the update to fail and the inverter(s) may not work afterward. Inverters automatically update one at a time beginning with the highest port. Each requires about 5 minutes.

Updates to the inverter's internal programming are periodically available at the OutBack website *www.outbackpower.com*. If multiple inverters are used in a system, all units must be upgraded at the same time. All units must be upgraded to the same firmware revision.

**IMPORTANT:**

All stacked FXR inverters must have the same firmware revision. If multiple stacked inverters are used with different firmware revisions, any inverter with a revision different from the master will not function. (See the stacking section on page 43.) The MATE3 will display the following message:

> **An inverter firmware mismatch has been detected. Inverters X, Y, Z [2] are disabled. Visit *www.outbackpower.com* for current inverter firmware.**

**NOTES:**

[2] The port designations for the mismatched inverters are listed here.

# Operation

## LED Indicators

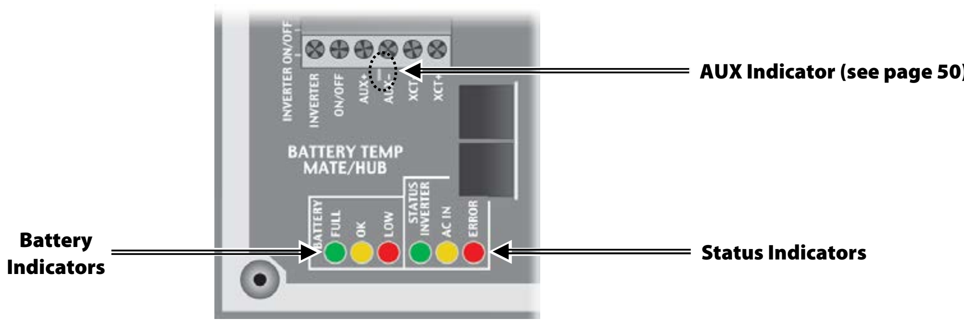



**Figure 4 LED Indicators**

## 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 16.

- A green indicator (FULL) 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 (OK) 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.

**Table 1 Battery Indicator Values**

| 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 |

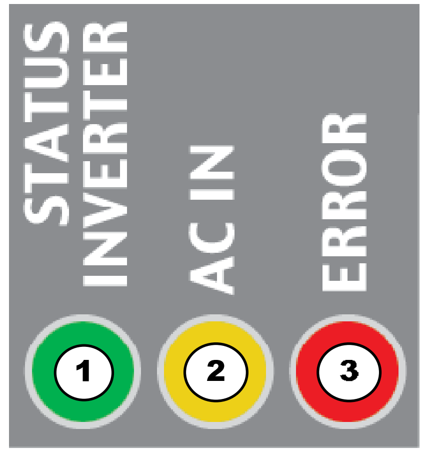
**NOTES**:

- 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 27.) 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 FXR inverter is on and providing power.

- If accompanied by a solid yellow **AC IN** indicator (**2**), the inverter is also connected to the utility grid with an AC input mode that uses both inverter power and grid power (***Support***, ***Grid Tied***, or ***GridZero***).
- See page 17 for descriptions of AC input modes.

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

- The inverter is likely in Search mode. See page 28.

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

- See Startup on page 11, or 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 47 for a description of Power Save.

## ② AC IN (Yellow):

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

- The FXR 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 FXR inverter is refusing the source. See the Troubleshooting section on page 57.

*Off*: No AC source is detected.

- If a source is supposed to be present, see the Troubleshooting section on page 57.

## ③ ERROR (Red):

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

- This indicator is accompanied by an error message in the system display.
- See page 62 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 63 for a description of warning messages.

*Off*: No problems are detected.

**Figure 5 Inverter Status LED Indicators**

# Inverter Functionality

The FXR inverter can be used for many applications. Some of the inverter's operations occur automatically. Others are conditional or must be enabled manually before they will operate.

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.

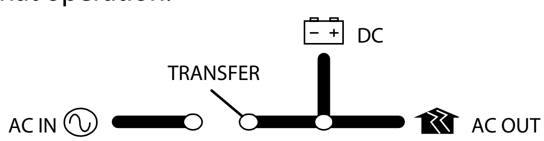
**Before operating the inverter:**

The operator needs to define the application and decide which functions will be needed. The FXR inverter is programmed with many AC input modes. Each mode has certain advantages which make it ideal for a particular application. Some modes contain functions unique to that mode.

The modes are described in detail following this section. To help decide which mode will be used, the basic points of each mode are compared in Table 2 on page 25.

Apart from the input modes, FXR inverters possess a set of common functions or operations. These operations are described in detail beginning on page 27. Most of these items operate the same regardless of which input mode is selected. The exceptions are noted where appropriate.

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 FXR 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 can be used with an external transfer switch. It is common for backup or grid-interactive systems to use the utility grid as the primary source, but switch to a gas- or diesel-powered generator in emergencies. The inverter can be programmed with separate input criteria for each source.

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 menu tables beginning on page 76.)

**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 FXR inverter and the selected input mode. If necessary, the ***Gen*** selection can accept grid power. The opposite is also true.

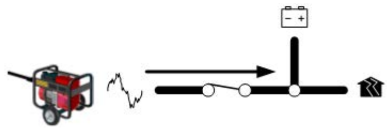
# Description of AC Input Modes

These modes control aspects of how the inverter interacts with AC input sources. Each mode is intended to optimize the inverter for a particular application. The names of the modes are ***Generator***, ***Support***, ***Grid Tied***, ***UPS***, ***Backup***, ***Mini Grid***, and ***GridZero***. The modes are summarized and compared in Table 2. See page 25.

When multiple inverters are stacked together in parallel, the master inverter's input mode is imposed on all slaves. (See the stacking section on page 43.) The slave settings are not changed; they retain any mode that was previously programmed. However, the slave will ignore its programmed mode and use that of the master. This also applies to any parameters in the mode menu (***Voltage Limit***, ***Connect Delay***, and so on).

The following pages compare the various functions of each input mode.

## Generator



The ***Generator*** mode allows the use of a wide range of AC sources, including generators with a rough or imperfect AC waveform. In other modes, a "noisy" or irregular waveform may not be accepted by the inverter. (Self-excited induction generators may require this mode when used with the inverter.) ***Generator*** allows these waveforms to be accepted. The charging algorithm of this mode is designed to work well with AC generators regardless of power quality or regulation mechanism. The generator must still comply with the inverter's nominal input specifications. (See page 29.)

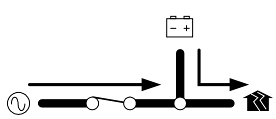
**BENEFITS**:

- The FXR inverter can charge the batteries from the generator even when the generator is undersized, of low quality, or has other problems. See page 32 for recommended parameters for sizing a generator.
- If the utility grid is unstable or unreliable, ***Generator*** mode may allow the inverter to accept the power.
- A programmable delay time is available which will allow a generator to stabilize before connection. In the MATE3, this menu item is ***Connect Delay***. It is available in both the ***Grid AC Input Mode and Limits*** and the ***Gen AC Input Mode and Limits*** menus, depending on which input is being programmed.

**NOTES**:

- Any AC fluctuations that are accepted by the inverter will be transferred to the output. The loads will be exposed to these fluctuations. It may not be advisable to install sensitive loads under these conditions.
- The name of ***Generator*** mode does not mean that the inverter requires a generator input when using this mode. The use of this mode does not require the use of the ***Gen*** input type; either selection can be used. Conversely, the inverter is not required to be placed in this mode because a generator is installed.

## Support



The ***Support*** mode is intended for systems that use the utility grid or a generator. In some cases the amount of current available from the source is limited due to size, wiring, or other reasons. If large loads are required, the FXR inverter augments (supports) the AC source. The inverter uses battery power and additional sources to ensure that the loads receive the power they demand.

In the MATE3 system display, the ***Grid Input AC Limit*** dictates the maximum AC draw for the Grid input. The ***Gen Input AC Limit*** sets the maximum draw for the Gen input. The Support function takes effect if the AC demand on either input exceeds the ***AC Limit*** setting.

**BENEFITS**:

- Large inverter loads can be powered while staying connected to the AC input, even if the input is limited. The added battery power prevents overload of the input source, but the batteries are not in constant use.
- The FXR inverter will offset the loads with excess renewable energy if it is available from the batteries. See page 42 for more information.

**NOTES**:

**IMPORTANT:**

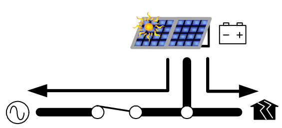
The inverter will draw energy from the batteries when the loads exceed the appropriate ***AC Limit***. With sustained loads and no other DC source, the batteries may discharge to the Low Battery Cut-Out point. The inverter will shut down with a Low Battery error. (See pages 27 and 62.) To prevent the loss of power, load use should be planned accordingly.

**IMPORTANT:**

A "noisy" or irregular AC source may prevent ***Support*** from working normally. The inverter will transfer the power, but will not support the source, charge the batteries, or interact with the current in any other way. This problem is more common with generators smaller than the wattage of the inverter.

- A programmable delay time is available which will allow an AC source to stabilize before connection. In the MATE3, this menu item is ***Connect Delay***. It is available in both the ***Grid AC Input Mode and Limits*** and the ***Gen AC Input Mode and Limits*** menus, depending on which input is being programmed.
- Because the inverter limits the current draw from the AC source, it will reduce the charge rate as necessary to support the loads. If the loads equal the appropriate ***AC Limit*** setting, the charge rate will be zero.
- If the AC loads **exceed** the ***AC Limit*** setting, the Support function is activated. Instead of charging, the inverter will take power from the batteries and use it to support the incoming AC current.
- The ***Support*** function is not available in any other input mode.

# Grid Tied



**IMPORTANT:**

Selling power to the utility company requires the authorization of the local electric jurisdiction. How the utility company accommodates this will depend on their policies on the issue. Some may pay for power sold; others may issue credit. Some policies may prohibit the use of this mode altogether. *Please check with the utility company and obtain their permission before using this mode.*

The ***Grid Tied*** mode allows the FXR inverter to become grid-interactive. This means that in addition to using power from the utility grid for charging and loads, the inverter can also convert excess battery power and sell it to the utility grid. Excess battery power usually comes from renewable energy sources, such as PV arrays, hydroelectric turbines, and wind turbines.

**NOTE:** This mode is not available in 12-volt FXR models. It does not appear on the system display's list of available input modes.

The grid-interactive function uses Offset operation. See page 42 for more information.

**BENEFITS**:

- Excess power is returned to the utility grid.
  - ~ The inverter will offset the loads with excess renewable energy if it is available from the batteries.
  - ~ If the excess energy is greater than the AC demand (the load size), the excess will be sold to the grid.

**NOTES**:

- The inverter has a delay before selling will begin. This function, the ***Re-Connect Delay Timer***, has a default setting of five minutes. *During this time, the inverter will not connect to the utility grid.* The timer is adjustable in the ***Grid Interface Protection*** menu (see below).
- Upon initial connection to the utility grid, the inverter may be required to perform a battery charging cycle. This may delay the operation of the grid-interactive function.
- The grid-interactive function only operates when excess DC (renewable) power is available.
- The grid-interactive function is not available in any of the other input modes.
- When power is returned to the utility grid, it may be possible to reverse the utility meter. However, this depends on other loads in the system. Loads on the main panel (not on the inverter's output) may consume power as fast as it is sold. The meter would not run backwards, even if the system display showed the inverter selling power. The result of selling would be to reduce AC power consumption, not reverse it.
- The amount of power an inverter can sell is not necessarily equal to its specified output wattage. The ***Maximum Sell Current*** can be decreased if it is necessary to limit the power sold. This item is available in the ***Grid Interface Protection*** menu (see below).
  - ~ The amount of power that is sold is controlled by the utility grid voltage. The wattage sold equals this voltage multiplied by the current. For example, if the inverter sells 15 amps and the voltage is 116 Vac, the inverter will sell 1.74 kVA. If the voltage is 125 Vac, the inverter will sell 1.88 kVA. Additionally, output will vary with inverter temperature, battery type, and other conditions.
  - ~ This recommendation is specifically for the inverter's grid-interactive function. In some cases, the source may be sized larger to account for environmental conditions or the presence of DC loads. This depends on individual site requirements.

## Grid Interface Protection Menu

Due to varying requirements in different locations around the world, the grid-interactive settings are adjustable. These adjustments are made in the ***Grid Interface Protection*** menu.

- This menu is only available to operators with installer-level access. There are firm rules concerning the acceptable voltage range, frequency range, clearance time during power loss, and reconnect delay when exporting power to the utility. Generally it is expected that the end user cannot alter the settings.
- The installer password must be changed from the default in order to get access to these settings. Once this password has been changed, the settings can only be accessed with the MATE3 installer password.
- See the tables beginning on page 76 for the locations of all menu items in the MATE3 menus.
- The grid-interactive function can only operate while the utility grid power is stable and within specific limits.
  - ~ In ***Grid Tied*** mode, the inverter will operate in accordance with the ***Grid Interface Protection*** settings. The default settings and ranges are listed in the tables which begin on page 76.
  - ~ If the AC voltage or frequency vary outside the ***Grid Interface Protection*** limits, the inverter will disconnect from the utility grid to prevent selling under unacceptable conditions. These limits override the AC source acceptance limits described on page 30, which are used in other input modes. The inverter will not reconnect until the source is acceptable for the duration of the ***Re-Connect Delay Timer***.
  - ~ If the inverter stops selling or disconnects due to ***Grid Interface Protection***, the MATE3 will show the reason. Sell Status messages are listed on page 66. Disconnect messages are listed on page 65. Often these messages will be the same.
  - ~ Before operating in ***Grid Tied*** mode, contact the utility company that provides power to the installation. They can provide information regarding the rules that must be followed in order to export power back to the utility. The items in the following list are the selectable ***Grid Interface Protection*** options. The utility company may need to review these items to make certain their standards are met.

The utility may simply name a standard to be followed, as with UL1741 for the United States. It may be necessary to look up the requirements for a local standard and program them accordingly.

**STAGE 1 Voltage (basic settings)**

- Over Voltage Clearance Time (seconds)
- Over Voltage Trip (AC Voltage)
- Under Voltage Clearance Time (seconds)
- Under Voltage Trip (AC Voltage)

**STAGE 2 Voltage (if required by utility)**

- Over Voltage Clearance Time (seconds)
- Over Voltage Trip (AC Voltage)
- Under Voltage Clearance Time (seconds)
- Under Voltage Trip (AC Voltage)

**Frequency Trip**

- Over Frequency Clearance Time (seconds)
- Over Frequency Trip (Hertz)
- Under Frequency Clearance Time (seconds)
- Under Frequency Trip (Hertz)

**NOTE:** The ***Frequency Trip*** settings are dependent on the inverter's operating frequency, which must be set correctly. See page 11.

**Mains Loss**

- Clearance Time (seconds)
- Reconnect Delay (seconds)

See the tables beginning on page 76 for the default settings and ranges.

# Frequency and Phase Coordination

Several other inverter adjustments are located in the ***Grid Interface Protection*** menu. These sensitive items can only be changed with installer-level access.

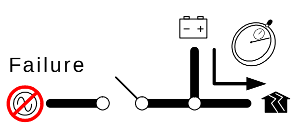
- The FXR inverter's operating frequency can be selected to either 50 or 60 Hz using the ***Grid Interface Protection*** menu. This setting changes the inverter's input acceptance parameters, as well as its output. See page 28 for more information on the inverter's frequency.
- The FXR inverter's stacking function includes the option called ***Multi-Phase Coordination***. The selectable menu item is ***Coordinated AC Connect/Disconnect***. The default setting is ***No***. If selected to ***Yes***, the AC source is required to deliver appropriate input to all inverters in a stacked system. If the master or subphase master inverters do not sense an acceptable AC source, the entire system disconnects from the source. None of the inverters will reconnect until the source is acceptable for the duration of the appropriate timer.
  - ~ If the inverter is in ***Grid Tied*** mode, the ***Re-Connect Delay*** timer is used.
  - ~ If the inverter is any other AC input mode, the ***Connect Delay*** timer is used.

  See pages 29 and 32 for more information on input acceptance and the transfer function.

  See page 43 for more information on the stacking function and subphase master inverters.

  See the tables beginning on page 76 for the default settings and ranges.

# UPS




In ***UPS*** mode, the FXR parameters have been optimized to reduce the response time. If the utility grid becomes unstable or is interrupted, the inverter can transfer to inverting with the fastest possible response time. This allows the system to support sensitive AC loads with minimal interruption.

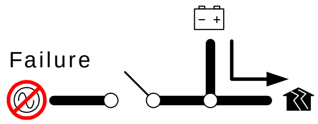
**BENEFITS**:

- Constant power is provided to the loads with virtually no drop in voltage or current.

**NOTES**:

- Due to the need for the FXR inverter to react quickly to AC source fluctuations, it must remain fully active at all times. The inverter requires a continuous consumption of 42 watts.
- For this reason, the Search function does not operate in this mode. (See page 28.)

## Backup

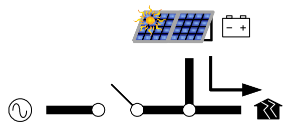



The ***Backup*** mode is intended for systems that have utility grid available as the primary AC source. This source will pass through the FXR inverter's transfer circuit and will power the loads unless utility power is lost. If utility grid power is lost, then the inverter will supply energy to the loads from the battery bank. When the utility power returns, it will be used to power the loads again.

**BENEFITS**:

- This mode will continuously maintain the batteries in a fully-charged state. It does not have the overhead consumption of the ***UPS*** mode.

## Mini Grid



In ***Mini Grid*** mode, the FXR inverter automatically rejects an AC source and runs solely from battery (and renewable) energy. The inverter only connects to the AC source (usually the utility grid) when the batteries run too low.

The FXR inverter runs on battery-supplied power for as long as the batteries can be sustained. It is expected that the batteries will also be charged from renewable sources such as PV. When the batteries become depleted, the system reconnects to the utility grid to operate the loads.

The inverter will reconnect to the utility grid if the battery voltage decreases to the ***Connect to Grid*** set point and remains there for the ***Delay*** time period. These items are shown in the tables which begin on page 76.

While connected to the utility grid, the FXR charger can be set either on or off. If the charger is turned on, the inverter will proceed through a full charging cycle. Upon reaching float stage, the inverter will disconnect from the grid.

If the inverter is connected to the utility grid and the charger is turned off, another DC source such as renewable energy should be present to charge the batteries. The inverter will observe the batteries as if it was performing the charge. When the batteries reach the required voltages and charging times to achieve float stage, the inverter will disconnect from the grid. This means that the regulator for the renewable source must be set to the same settings as the inverter (or higher). Check the settings of both devices as needed.

See page 33 for more information on the battery charging cycle.

**BENEFITS**:

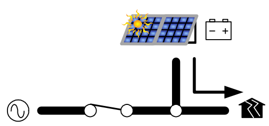
- ***Mini Grid*** mode allows a system to minimize or eliminate dependence on the utility grid. This is only possible if certain conditions are met. See below.

**NOTES**:

- The FXR inverter will offset the loads with excess renewable energy if it is available from the batteries. See page 42 for more information on Offset operation. However, the Offset function is inapplicable when the inverter disconnects from an AC source. The renewable energy supports the inverting function instead.
- ***Mini Grid*** mode has similar priorities to the high-battery transfer (***HBX***) function used by the MATE3 system display. However, it is not compatible with ***HBX*** and cannot be used at the same time. When using ***Mini Grid*** mode, the system display should disable ***HBX*** to prevent conflicts.

- ***Mini Grid*** mode is also incompatible with the ***Grid Use Time*** and ***Load Grid Transfer*** functions of the MATE3 system display. These functions do not have similar priorities to ***Mini Grid*** or ***HBX***, but they do control the inverter's connection and disconnection with the grid. ***Mini Grid*** should not be used with these functions.
- When deciding whether to use ***Mini Grid*** mode or ***HBX***, the user should consider the aspects of each.
  - ~ ***Mini Grid*** logic is based in the FXR inverter. After programming, it can function in the absence of the MATE3. ***HBX*** logic is based in the MATE3. It cannot function unless the MATE3 remains operating.
  - ~ ***Mini Grid*** can use utility grid power to fully recharge the batteries every time it reconnects to the grid. ***HBX*** can only do so under specific circumstances.
  - ~ ***HBX*** set points have a wide range of settings. ***Mini Grid*** uses settings intended to protect the batteries from excessive discharge; however, most of its settings are automatic and do not allow customization.
  - ~ ***HBX*** works more efficiently with a larger renewable source, but there is no specification for renewable size. ***Mini Grid*** cannot work properly unless the renewable source is larger than the size of the loads. If this condition is not met, ***Mini Grid*** will not disconnect the inverter from the utility grid.
  - ~ ***Mini Grid*** is one of seven inverter-level functions (modes) which share a single input. Selecting it prevents any other input mode from being used. ***HBX*** is a system-level function which can be combined with the settings of other input modes.
  - ~ See Table 6 on page 54 for a comparison summary. Pages 53 and 54 have more information on ***HBX***, ***Grid Use Time***, ***Load Grid Transfer***, and other functions of the system display.

# GridZero



In ***GridZero*** mode, the FXR inverter remains grid-connected, but prioritizes the use of battery or renewable sources to run loads. It uses only renewable energy to recharge the batteries. The inverter tries to "zero" the use of the utility grid, drawing on AC power only when needed to supplement stored DC sources. Note that the inverter draws up to 1 Aac regardless of the DC sources.

In the MATE3 system display, the selectable options are ***DoD Volts*** and ***DoD Amps***. The inverter sends battery power to the loads when the batteries exceed the ***DoD Volts*** setting. (12-, 24-, and 48-volt systems must exceed the setting by 0.2, 0.4, and 0.8 Vdc respectively.) As the battery voltage decreases to ***DoD Volts***, the inverter reduces the current toward zero. It will maintain the batteries at this setting.

The FXR inverter can manage large quantities of power. To prevent damage to the batteries from rapid discharge, the rate of discharge can be limited using the ***DoD Amps*** setting. This item should be set lower than the current provided by the renewable source.

- When ***DoD Volts*** is set low, this mode allows more renewable energy to be delivered from the batteries to the loads. However, it will also leave less of a battery reserve in the event of a grid failure.
- When ***DoD Volts*** is set high, the batteries will not be discharged as deeply and will retain more of a backup reserve. However, not as much renewable energy will be sent to the loads.

The renewable energy source needs to exceed the size of all loads and possible losses. The renewable source must also charge the batteries. The inverter does not charge the batteries in ***GridZero*** mode.

**BENEFITS**:

- This mode seamlessly blends the use of battery power and grid power. It puts renewable energy to the most effective use without selling power to the utility grid.
- ***GridZero*** mode minimizes dependence on the grid as long as certain conditions are met.
- The inverter remains connected to the utility grid in case the grid is needed. If large loads require the use of grid power, no transfer is necessary to support the loads.

**NOTES**:

**IMPORTANT:**

Setting ***DoD Volts*** too low will severely discharge the batteries. The battery bank may not have sufficient reserve to provide backup in the event of a grid failure. To prevent the loss of power, load use and the ***DoD Volts*** setting should be planned accordingly.

- If the renewable energy source is not greater than the size of the inverter loads, this mode will not work well over time. The renewable source must be capable of charging the batteries as well as running the loads. This occurs when renewable energy production exceeds the ***DoD Amps*** setting.
- The inverter will offset the loads with excess renewable energy if it is available from the batteries. See page 42 for more information on Offset operation. However, the behavior of Offset in ***GridZero*** mode is different because it uses the ***DoD Volts*** exclusively.
- The inverter's battery charger cannot be used in this mode. However, the charger menu settings and timer operations are not changed when this mode is selected.
- The battery should be discharged whenever possible in the attempt to "zero" the grid usage. If the ***DoD Amps*** setting is limited or loads are not present, the batteries will be unable to accept much renewable recharging the next time it is available. The renewable energy will be wasted, leaving the system dependent on the utility grid more than necessary.

## Table 2 Summary of Input Modes

| Mode | Summary | Benefits | Cautions | Intended | Charger |
|---|---|---|---|---|---|
| ***Generator*** | Accepts power from an irregular or low-quality AC source | ➢ Can use AC that may be unusable in other modes<br>➢ Can charge even with a poor generator or low-quality AC source | ➢ Will pass irregular or low-quality power to the output; could damage sensitive loads<br>➢ Offset unavailable | **Source:** Generator<br>**Loads:** Non-sensitive devices | Performs three-stage charge and goes silent as specified by settings |
| ***Support*** | Adds battery power to augment an AC source that has limited output | ➢ Can use battery power in conjunction with AC source<br>➢ Offset operation sends excess DC to loads | ➢ Drains batteries during support; intended for intermittent use only<br>➢ May not function with low-quality AC source | **Source:** Grid or Generator<br>**Loads:** Can be larger than AC source | Performs three-stage charge and goes silent as specified by user settings |
| ***Grid Tied*** | Inverter sells excess power (renewable) to utility; **available in 24-volt and 48-volt models only** | ➢ Bidirectional input<br>➢ Can reduce utility bills and still provide backup<br>➢ Offset operation sends excess DC to loads<br>➢ Any additional Offset excess is sold to the grid | ➢ Requires utility approval<br>➢ Other approvals may be required depending on electrical codes<br>➢ Has exact requirements for accepting AC input<br>➢ Requires renewable energy source | **Source:** Grid<br>**Loads:** Any type | Performs three-stage charge and goes silent as specified by user settings |
| ***UPS*** | In grid failure, unit switches to batteries with fastest possible response time | Quick backup for sensitive devices during grid outage | ➢ Uses higher idle power than other modes<br>➢ Search function unavailable<br>➢ Offset unavailable | **Source:** Grid<br>**Loads:** PC, audio, video, etc. | Performs three-stage charge and goes silent as specified by user settings |
| ***Backup*** | In grid failure, unit switches batteries to support loads | ➢ Simple use compared to other modes; often used with generators for this reason<br>➢ Less idle power than ***UPS***<br>➢ Does not drain battery as in ***Support*** | Has none of the special functions described in other modes | **Source:** Grid or Generator<br>**Loads:** Any type | Performs three-stage charge and goes silent as specified by user settings |
| ***Mini Grid*** | Stays off grid most of the time; only uses grid when batteries low | ➢ Can minimize/eliminate dependence on grid<br>➢ Offset operation sends excess DC to loads (but only when on grid) | ➢ Will not work properly unless renewable source is above a certain size<br>➢ Conflicts with related modes in MATE3 | **Source:** Grid<br>**Loads:** Any type | Performs three-stage charge on reconnect; if charger is disabled, inverter emulates charge cycle from external source and reacts accordingly |
| ***GridZero*** | On-grid but actual grid use is minimized ("zeroed") with battery and renewable power; does not sell or charge | ➢ Can minimize dependence on grid<br>➢ Offset operation sends excess DC to loads at adjustable rate<br>➢ Remains on-grid to avoid transfer problems | ➢ Discharges batteries while remaining on grid<br>➢ Will not work properly unless renewable source is above a certain size<br>➢ Battery charger inoperative | **Source:** Grid<br>**Loads:** Any type | Charger inoperative; batteries must be charged using an external (renewable) energy source |

**NOTES:**

# Description of Inverter Operations

The items in this section are operations common to all FXR 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 items 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 menu tables which begin on page 76 of this manual.

## Inverting

This is the FXR inverter's primary task. The inverter converts DC voltage from batteries into AC voltage that is usable by AC appliances. 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 solar, wind, or hydroelectric power.

The inverter's design uses a transformer and a high-frequency H-Bridge FET module to achieve the required high-wattage output. The inverter can deliver the rated wattage continuously at 25°C. The maximum output is derated at temperatures exceeding 25°C. See pages 67 and 71 for these wattages.

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

### DC and AC Voltages

**The FXR 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 MATE3 will give a ***Low Battery V*** error. This is one of the error messages described on page 62. It appears as an event on the MATE3 system display.

  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. This item is adjustable.
  - Connecting an AC source for the inverter to charge the batteries will also clear a low battery error.

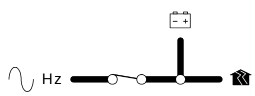
- ***Output Voltage***: The AC output voltage can be adjusted. Along with small changes, this allows the inverter to be used for different nominal voltages such as 100 Vac and 127 Vac.

> **IMPORTANT:**
> The output voltage can be adjusted to a different nominal value for a particular region. Making this change will not affect the default input voltage range accepted by the inverter from an AC source. The input range must be adjusted manually. These changes should be made at the same time. (See AC Source Acceptance on page 30.)

- 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 20 on page 73. 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 62. It appears as an event on the MATE3 system display.

The low battery and high battery functions are summarized in Table 20 on page 73.

## AC Frequency



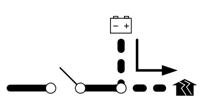

> **CAUTION: Equipment Damage**
> Setting the inverter's output frequency to deliver 50 Hz to 60-Hz loads, or setting it to deliver 60 Hz to 50-Hz loads, could damage sensitive devices. Make certain the inverter's output frequency matches the installation.

The inverter's output can operate at a frequency of either 60 or 50 Hertz. This output frequency (and the AC acceptance frequency) can be changed with the ***Operating Frequency*** menu item. This requires high-level access. Due to the possibility of damage, access to this setting was restricted by placing it in the ***Grid Interface Protection*** menu.

The installer password must be changed from the default in order to get access to this menu. Once this password has been changed, the ***Grid Interface Protection*** menu can only be accessed by using the installer password. This password can be changed in the system display.

See page 21 for more information on this selection in ***Grid Interface Protection***. See the menu tables, which begin on page 76, for the location of the ***Operating Frequency*** menu item.

## 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 76, 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, 30 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 is inoperative if the ***UPS*** input mode is in use. See page 21 for more information on this mode.

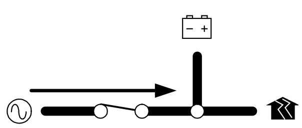
Search mode is ideal for use in small systems where it is critical to conserve battery capacity and avoid idle draw or “ghost” loads.

**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 16.
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 FXR 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 33.)

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

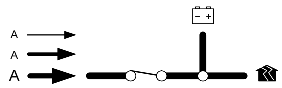
**CAUTION: Equipment Damage**

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 utility grid power and a gas or diesel generator. Other combinations of AC sources are possible.
- The inverter’s two input selections can be programmed for separate input modes. The selection (***Grid*** or ***Gen***) can be chosen in the ***Input Type*** menu.
- The interactions with AC input sources are controlled by the various input modes. The ***Grid Tied*** mode

allows certain models to sell power using the input connection. The ***Support*** mode can use battery power to assist a smaller AC source. When ***GridZero*** mode is selected, the battery charger cannot be used. See page 25 for descriptions of these and other input modes.

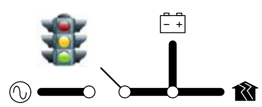
## AC Current Settings



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 source 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 and grid-interactive function have individual settings. However, the ***AC Limit*** settings can also limit the charging or selling current.
- The ***GridZero*** input mode requires the inverter to use DC sources, limiting the amount of AC current used. See page 23.
- The ***Support*** input mode allows the inverter to support the AC source with battery power. See page 18.
- 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 Configuration Wizard in the MATE3 can perform this calculation. However, the inverters do not perform this calculation. If the Configuration 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. This is true in all modes except ***Grid Tied***:

- Voltage (***GRID*** input selection): 108 to 132 Vac
- Voltage (***GEN*** input selection): 108 to 140 Vac
- Frequency (both input selections): If the output frequency is set to 60 Hz (default), the input acceptance range is 54 to 66 Hz. If output frequency is set to 50 Hz, the input range of acceptance is 45 to 55 Hz.
- See the menu tables which begin on page 76 for programming information for these items.

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.

**IMPORTANT:**

The inverter's output voltage can be adjusted to a different nominal value for a particular region. (See page 28.) If this occurs, the source acceptance range should be adjusted to match this nominal value or the inverter may not accept the new source normally.

- 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 MATE3 (***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 MATE3 (***Grid AC Input Mode and Limits*** or ***Gen AC Input Mode and Limits***).

  **NOTES:**
- The ***Grid Tied*** input mode does not use these acceptance limits and uses the ***Grid Interface Protection*** settings instead. (See page 20 for more information.) The inverter may not accept AC power if it meets the settings noted here but does not meet the ***Grid Interface Protection*** settings.
- Certain input modes such as ***Mini Grid*** may prevent the inverter from accepting AC power even if electrical conditions are met. (See page 22.)

  Several items external to the inverter may prevent the inverter from accepting AC power even if electrical conditions are met. Some examples are the ***High Battery Transfer***, ***Grid Usage Time***, or ***Load Grid Transfer*** functions, all of which are operated by the MATE3 system display. (See page 53.) Another example is the MATE3's **AC INPUT** hot key menu, which can order all inverters to disconnect 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.

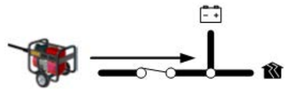
- A subphase master inverter may receive this command while not sensing acceptable input. It may have no input, or it may sense incorrect input. The inverter will not transfer and will continue inverting (in the correct phase). It will display a ***Phase Loss*** warning (see page 63).
- If a slave inverter does not sense acceptable input, it will not transfer, but also will not invert. The slave will have no output. It also will display a ***Phase Loss*** warning.
- In either case, this warning appears as an Event on the MATE3 system display.

The FXR inverter's stacking function includes the option called ***Multi-Phase Coordination***. The selectable menu item is ***Coordinated AC Connect/Disconnect***. If selected, the AC source is **required** to deliver input (in the appropriate phase) to all inverters.

- If the master or subphase master inverters do not sense an acceptable AC source, the entire system will disconnect from the source.
- None of the inverters will reconnect until the source is acceptable for the duration of the appropriate timer. This may be either the ***Connect Delay*** or the ***Re-Connect Delay*** timer. See page 21.
- This function does not apply to slave inverters. A slave inverter with an unacceptable AC source will not cause a general ***System Disconnect***.
- A general ***System Disconnect*** will not cause the inverters to show a ***Phase Loss*** warning.

See page 21 for more information on ***Multi-Phase Coordination***. See page 43 for more information on stacking. See the menu tables beginning on page 76 for the default settings and ranges.

## Generator Input

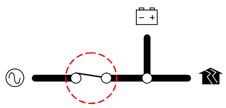


A generator should be sized to provide enough power for all inverters, both for loads and for battery charging. The generator's voltage and frequency must match the inverter's acceptance settings.

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 FXR 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 60 amps per phase or leg. The continuous loads on that output should never exceed this number. When connected to an AC source, the FXR 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.
- The ***Generator*** input mode is intended to accept irregular or unfiltered AC sources and is more likely to do so than other modes. This should be considered before using this mode with sensitive loads. (See page 18.)

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 current used for charging. 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 FXR 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 FXR 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 12 x OutBack EnergyCell 200RE VRLA batteries in series/parallel for a 24-volt system. Recommended maximum charge current is 90 Adc. (90 ÷ 5 = 18 Aac)

The maximum DC charge rate for FXR models is specified in Table 14 on page 67. The actual ***Charger AC Limit*** setting is available in the ***AC Input and Current Limit*** menu of the MATE3 system display. (See the menu tables which begin on page 76.) These numbers are also summarized in Table 3. **NOTE**: This table does not match the calculations above due to other factors in charging.

**Table 3 Charge Currents for FXR Models**

| Model | Maximum DC Output (sent to battery) | Maximum AC Input (used from source) |
|---|---|---|
| FXR2012A | 100 Adc | 14 Aac |
| VFXR2812A | 125 Adc | 18 Aac |
| FXR2524A | 55 Adc | 14 Aac |
| VFXR3524A | 82 Adc | 20 Aac |
| FXR3048A | 35 Adc | 14 Aac |
| VFXR3648A | 45 Adc | 20 Aac |

### Charge Current for Multiple Inverters

If FXR 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 activates the 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 47.

In some systems, lower currents may be required due to battery bank size or other reasons. To achieve lower currents, chargers can be individually set to ***Off*** so that the master inverter does not activate them.

For the location of the Charger Control command, see the menu tables beginning on page 76.

For more information on controlling the charger limits in a stacked system, see page 73.

## Charge Cycle

The FXR inverter uses 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

Figure 6 shows the progression of steps of the three-stage charging cycle.

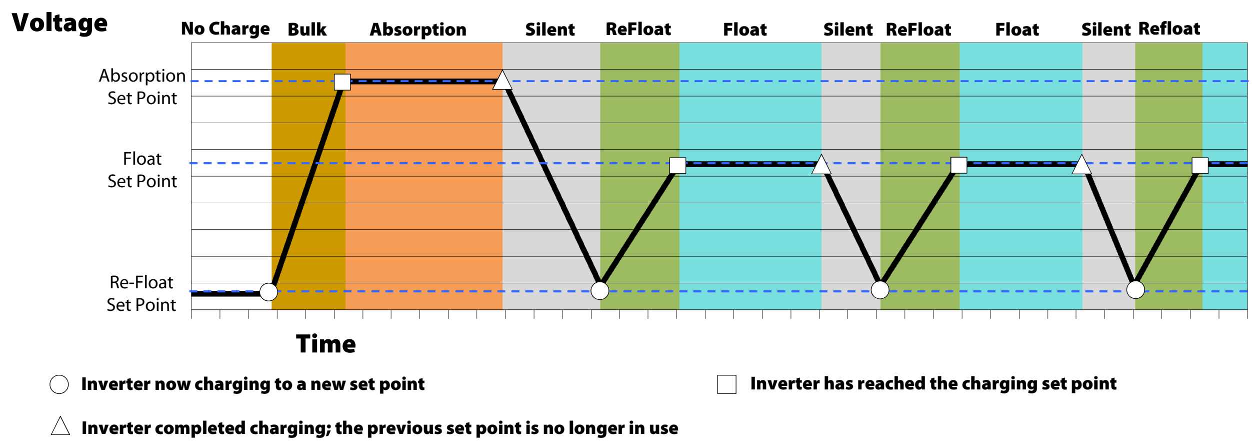



**Figure 6 Charging Stages Over Time**

Figure 7 shows the charge cycle used by the inverter when the ***Float Time*** menu item is set to ***24/7***. This setting eliminates the Silent and Refloat steps. The charger remains in Float continuously. The Float stage lasts until the AC source is removed.

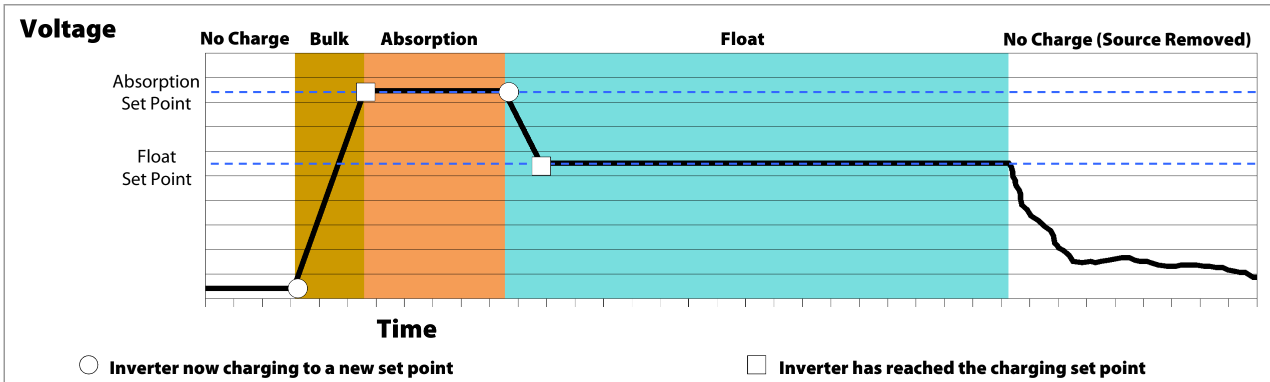



**Figure 7 Charging Stages Over Time (24/7)**

# Advanced Battery Charging (ABC)

Advanced battery technologies such as lithium-ion and sodium-sulfur may require very different settings from the inverter's defaults or the three-stage cycle in general. The Charging Steps section describes the individual selections and behavior. All charger settings are adjustable for different priorities. For example, the Float voltage could be set higher than the Absorption voltage, or a step could be completely skipped.

# 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. These include cycles which were previously interrupted, and also customized charging. Each step describes how to defeat or customize the step if specialized charging (ABC) is required.

See page 37 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. Slave and subphase master inverters use the master settings.

## 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), 28.8 Vdc (24-volt), 57.6 Vdc (48-volt)

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 ***Inverter*** menu. The reading is usually consistent at this stage. (See page 55.)

**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. This setting is also used by Offset when in this stage. (See page 42.) 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 does not reset to its maximum amount, or to zero, when AC power is disconnected or 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.

***Absorb Time*** is reset to its maximum amount whenever the battery voltage decreases to the ***Re-Bulk Voltage*** setting. The reset occurs immediately, regardless of the time spent below this voltage.

**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. 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 battery voltage will naturally decrease when not maintained by another means such as a renewable source.

The term “Silent” is also used in an unrelated context regarding Power Save levels. See page 47.

**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), 25.0 Vdc (24-volt), 50.0 Vdc (48-volt)

**To skip this step:** Setting ***Float Time*** to ***24/7*** 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. This setting is also used by Offset when in this stage. (See page 42.) 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), 27.2 Vdc (24-volt), 54.4 Vdc (48-volt)

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 battery 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.

**NOTE:** Setting ***Float Time*** to 24/7 causes the charger remain in Float continuously so that the Float timer no longer applies. (The charger also skips Bulk, Absorption, and Silent.) However, the charger can 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.

### Re-Bulk

If the battery voltage decreases due to discharge, the inverter will restart the cycle as soon as the AC source is available, beginning at Bulk stage.

**Voltage Used:** ***Re-Bulk Voltage*** setting. If the battery voltage does not decrease to the Re-Bulk point, the charger will not enter the Bulk stage and will return to its previous stage.

**Default Set Point** (nominal voltage): 12.0 Vdc (12-volt), 24.0 Vdc (24-volt), 48.0 Vdc (48-volt)

### Absorption Timer

**Time limit:** ***Absorb Time*** setting. This is reset to its maximum amount whenever the battery voltage decreases to the ***Re-Bulk Voltage*** setting. The reset occurs immediately, regardless of the duration spent below this voltage.

If the battery voltage does not decrease to the Re-Bulk point, the ***Absorb Time*** setting will not reset. It will retain any remaining time from the previous cycle. The Absorption stage will only last for the duration of the remaining time.

The remaining charging steps proceed as described on the previous pages.

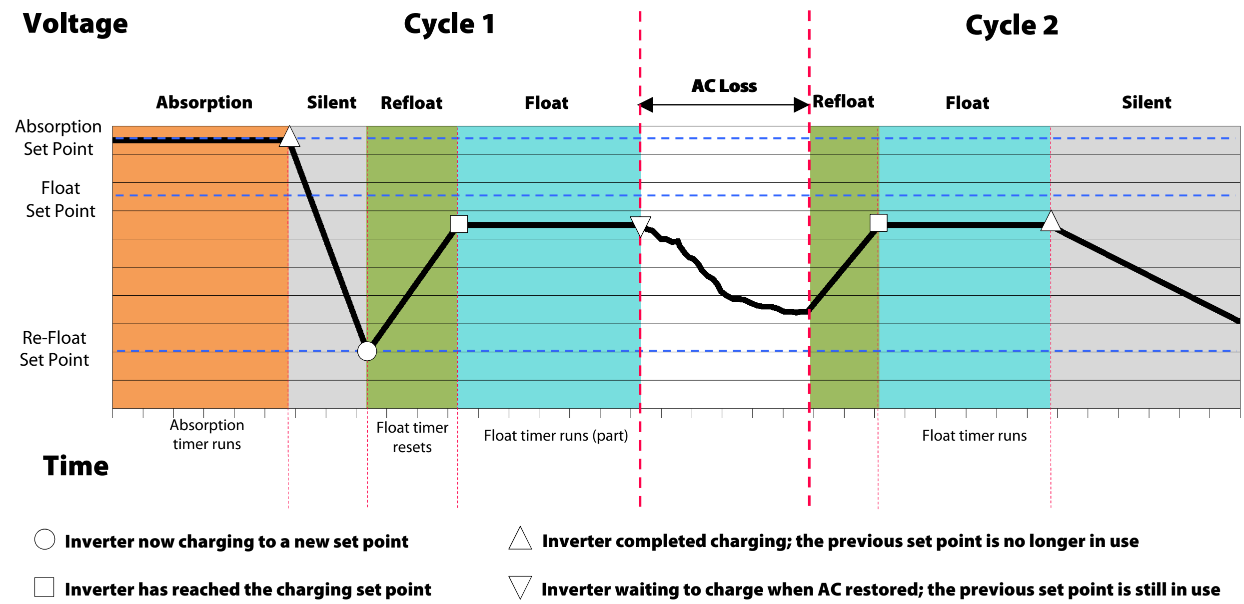



**Figure 8 Repeated Charging (1st and 2nd Cycles)**

## Example of Multiple Cycles

- In Figure 8 (Cycle 1), the charger initially completes Absorption. When the Absorption timer expires, the charger goes Silent until battery voltage decreases to the ***Re-Float*** setting. The Float timer is reset to its maximum. The charger proceeds through Refloat and Float until it is interrupted by a loss of AC power.
- Cycle 2 begins when the AC source is restored. During the AC loss, the battery voltage did not decrease to the ***Re-Float*** setting, so ***Float Time*** retains the remainder of the previous cycle. The charger returns to Refloat and proceeds through the Float stage. Cycle 2 completes the Float stage when its timer expires. It then goes Silent.

  Note that in Cycle 1, ***Absorb Time*** had expired. It was not reset afterward and retained a "remaining run time" of zero. The Bulk and Absorb stages do not occur on subsequent cycles until the timer reads something other than zero.
- This graph is continued in Figure 9. During the Silent period AC is lost again. The battery voltage decreases until it reaches the Re-Bulk set point. This causes the charger to prepare a new three-stage cycle from the beginning, but it cannot do so until the AC source is restored.

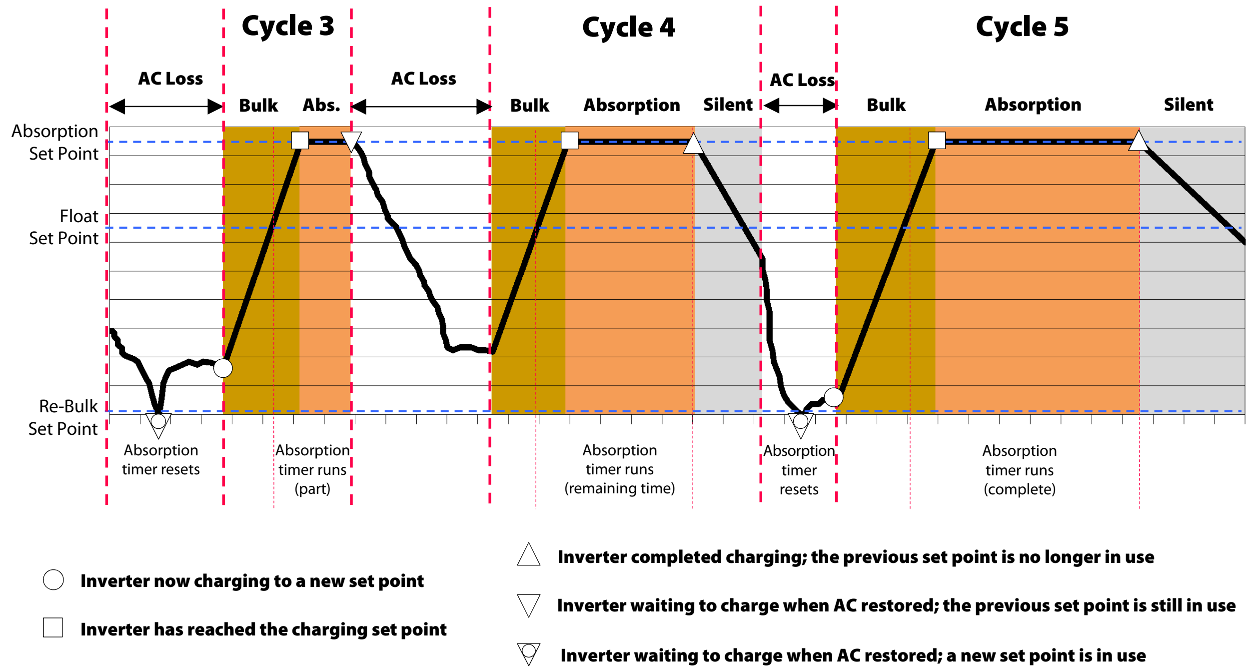



**Figure 9 Repeated Charging (3rd, 4th, and 5th Cycles)**

- Prior to the beginning of Cycle 3, the AC source was lost. The battery voltage decreased below the level of the ***Re-Bulk*** set point. Whenever this occurs, the Absorption timer resets to its maximum amount.
- In Figure 9, Cycle 3 begins when the AC source is restored again. The charger begins a new cycle by entering Bulk stage. When it enters Absorption, the timer runs until it is interrupted by a loss of AC power.
- Following Cycle 3, the voltage does not decrease below ***Re-Bulk***. The Absorption timer retains the remaining time from Cycle 3.
- Cycle 4 begins when the AC source is restored again. The charger enters Bulk stage and proceeds to Absorption. This stage does not last for the full duration of the ***Absorb Time*** setting. The timer uses up the remaining time from Cycle 3. Absorption ends when the timer expires.

  In this example, the duration was also longer than the ***Float Time*** setting. Because the Float timer began running near the beginning of Cycle 3 and also Cycle 4 (when the batteries exceeded the ***Float Voltage*** setting), the ***Float Time*** has also expired. The charger does not enter Refloat or Float and goes Silent.

  During the Silent period, AC is lost again. The battery voltage decreases until it reaches the ***Re-Bulk*** set point, prompting a new charge cycle. The Absorption timer resets to its maximum amount.
- When Cycle 5 begins, the charger proceeds through the Bulk stage and then the Absorption stage. At the end of Cycle 5, the ***Float Time*** has expired, so the charger goes Silent.

## 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 34. However, instead of the Absorption voltage and time set points, it is controlled by the ***Equalize Voltage*** and ***Equalize Time*** settings in the MATE3.

The FXR inverter can perform Offset when equalizing. (See page 42.) ***Equalize Voltage*** is also the reference voltage for Offset during equalization.

This 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 schedule for equalization 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 FXR inverter, when equipped with the Remote Temperature Sensor (RTS) will compensate for changes in temperature. The RTS is attached to a single battery near the center of the bank, to achieve a representative temperature. The FXR 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°C per cell.

This setting affects the ***Absorption***, ***Float***, and ***Equalization*** set points. The ***Sell Voltage*** and ***Re-Float Voltage*** set points are not temperature compensated. The ***Equalization*** set points are not compensated in OutBack charge controllers.

- In a 12 Vdc system (6 cells, 2 volts each), this means 0.03 volts per degree Celsius above or below 25°C. Maximum compensation is ± 0.6 Vdc.
- In a 24 Vdc system (12 cells, 2 volts each), this means 0.06 volts per degree Celsius above or below 25°C. Maximum compensation is ± 1.2 Vdc.
- In a 48 Vdc system (24 cells, 2 volts each), this means 0.12 volts per degree Celsius above or below 25°C. Maximum compensation is ± 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 24 Vdc system with batteries at 35°C will compensate its charging to 0.6 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.
- A 48 Vdc system with batteries at 40°C will compensate its charging to 1.8 Vdc **lower** than the set points.

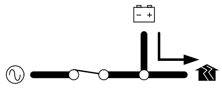
### Slope

Some batteries require different amounts of compensation. The OutBack FLEXmax Extreme charge controller has an adjustable rate of compensation ("slope") and is not limited to 5 mV. The FLEXmax Extreme 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 Extreme charge 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.

# Offset



Offset is an automatic operation which occurs in certain conditions. It is not a programmable function.

This operation uses excess battery energy to power the loads when an AC source is present. The system can take advantage of renewable energy sources, "offsetting" dependence on the AC source.

The battery voltage increases as a renewable energy source charges the batteries. When the voltage exceeds a designated reference voltage, the FXR inverter begins inverting. It draws power from the batteries (discharging them) and uses that power to offset the use of the AC source.

The FXR inverter uses excess DC energy for offset under the following rules:

- If the load demand is higher than the inverted power, the inverter's use of the AC source is reduced. The amount of inverted power has "offset" the same amount of demand on the AC source. (This is sometimes known as "selling to the loads".)
- If the excess DC energy (and inverted power) is equal or greater than the load demand, and the inverter is in the ***Grid Tied*** input mode, the inverter will sell the additional power to the utility grid. This is the key priority of the ***Grid Tied*** mode.

The FXR inverter uses several set points as reference voltages for the Offset operation, particularly the FXR battery charger settings.

- The charger settings ***Absorb Voltage***, ***Float Voltage***, and ***Equalize Voltage*** (as shown in the system display) are all used as reference voltages. Normally the charger regulates to these set points by adding power to the batteries. Offsetting does the opposite; it uses the same set points but regulates the voltage by *removing* power from the batteries.
- If none of the battery charger's timers are active, the reference voltage is ***Sell Voltage*** in the ***Grid-Tie Sell*** menu. This is true in any input mode where Offset is used, not just the ***Grid Tied*** input mode.
- The ***GridZero*** mode only uses a single reference voltage for Offset, the ***DoD Volts*** setting.

**NOTES**:

- The ***Offset Enable*** menu item must be set to ***Y*** (yes) for Offset to work.
- Offset operation is available in the ***Support, Grid Tied***, and ***GridZero*** modes.
- Offset operation is available in the ***Mini Grid*** mode. However, it may not be used often since the ***Mini Grid*** priority is to avoid grid use.
- Offset operation is not available in the ***Generator, UPS,*** and ***Backup*** input modes.

**Table 4 Offset Interaction with AC Source**

| Mode | Excess DC ≥ loads | Excess DC < loads |
|---|---|---|
| ***Generator*** | Does not function | |
| ***Support*** | Offsets load use, but also uses DC to support the AC source based on ***Support*** mode settings | |
| ***Grid Tied*** | Sells excess to AC source (grid); remains connected | Offsets loads with whatever power is available |
| ***UPS*** | Does not function | |
| ***Backup*** | Does not function | |
| ***Mini Grid*** | Offsets loads with whatever power is available; inapplicable if disconnected from utility grid | |
| ***GridZero*** | Offsets load use, but only according to the ***DoD Volts*** setting | |

# Multiple-Inverter Installations (Stacking)

Multiple inverters in a single system can support larger loads than a single inverter. Installing inverters in this configuration is called "stacking". Stacking 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 MATE3. FXR stacking includes "series" (split-phase), "parallel" (single-phase), "series/parallel" (split-phase) and "three-phase" configurations.

Each inverter needs to be assigned a status — "master" or "slave". The master provides the primary (L1) output. "Subphase" masters provide the output for other phases in series or three-phase systems. Slave inverters provide assistance when a master on any output cannot power the loads alone. See the *FXR Series Inverter/Charger Installation Manual* for more information.

Stacking requires an OutBack HUB10.3 Communications Manager and CAT5 non-crossover cable. The HUB10.3 has designated assignments for each of its ports. The inverter on each port is programmed with a status and stacking value. There are usually other specialized instructions during installation.

An AC source for a split-phase 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 31 and 63.)

If ***Coordinated AC Connect/Disconnect*** is enabled, the source **must** provide input to all phases. If any phase is not supplied, all inverters will disconnect. See pages 21 and 32 for more information.

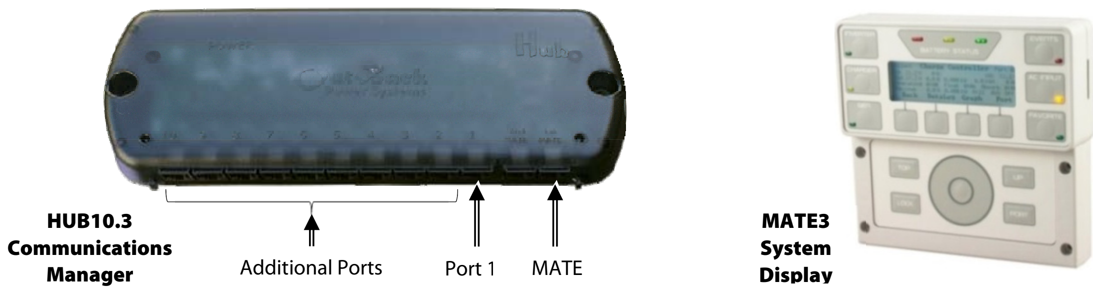



**Figure 10 OutBack HUB10.3 and MATE3**

**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 FXR inverters must have the same firmware revision. If inverters are stacked with different firmware revisions, any unit with a revision different from the master will not function. The MATE3 will display the following message:

  **An inverter firmware mismatch has been detected. Inverters X, Y, Z [3] are disabled. Visit *www.outbackpower.com* for current inverter firmware.**
- FXR-class inverters cannot be stacked with FX-class inverters. If more than one model class or series is stacked, any inverter different from the master will not invert or connect to an AC source. The MATE3 will register an Event in the log. It will display the following message:

  **A model mismatch has been detected. Inverters are incompatible. Inverters X, Y, Z [3] are disabled. Match all models before proceeding.**
- 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.

[3] The port designations for the mismatched inverters are listed here.

# 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 11 shows ***Master*** for the first (L1) inverter in a series-stacked system. The designation for the L2 inverter is ***L2 Phase Master***. Figure 12 shows ***Master*** for the first inverter in a parallel-stacked system and ***Slave*** for the remaining inverters.

## Series Stacking (Dual-Stack)

In series stacking, two inverters create two separate 120 Vac[4] output phases ("legs"). One leg is the master. The second inverter is a subphase master (not a slave). It creates a 120 Vac output that is intentionally 180° out of phase with the master. Each of these legs can be used to power a separate set of 120 Vac loads. Collectively they form a "split-phase" configuration. This configuration produces 240 Vac, which can be used to power 240 Vac loads when both inverters work together.

- The two legs operate independently of each other. The 120 Vac loads on each leg cannot exceed a given inverter's wattage. The second inverter cannot assist.
- Series stacking only uses two inverters, one per leg. See Series/Parallel Stacking on page 45 when using more than two inverters. All inverters must be the same model.

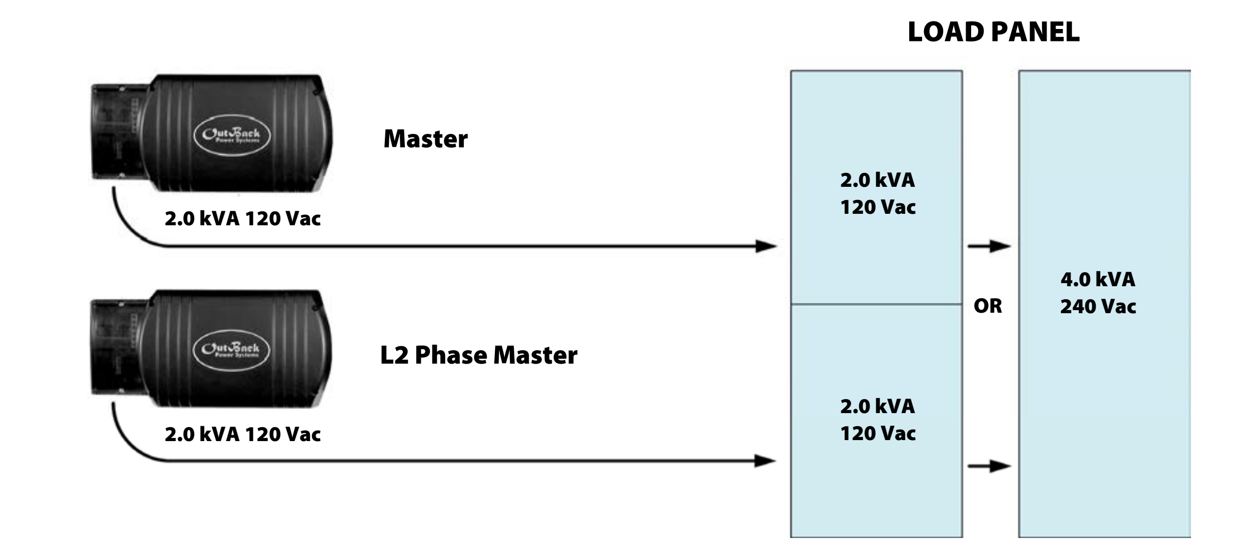



**Figure 11 Example of Series Stacking Arrangement**

## 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.

[4] Output voltages may vary with regional voltage standards.

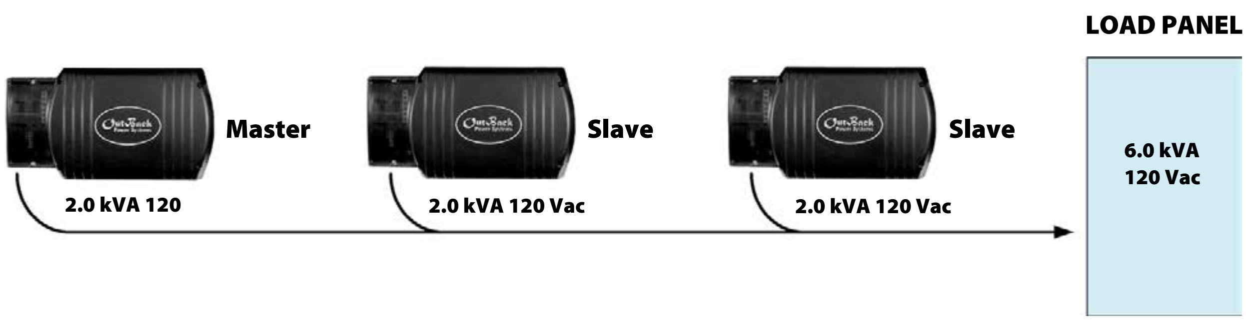



**Figure 12 Example of Parallel Stacking Arrangement (Three Inverters)**

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

In series/parallel stacking, inverters create separate 120 Vac[5] output legs and 240 Vac collectively, as in series stacking. However, in this configuration, each output has parallel inverters. One output contains the master; the other uses a subphase master. Each output has at least one slave.

- The 120 Vac loads on each leg can exceed the size of a single inverter. They can be powered by all the inverters on that leg.
- The slave outputs are controlled directly by their respective master inverters. They cannot operate independently. The slaves can go into Power Save mode when not in use.
- Up to eight inverters may be installed in a series/parallel arrangement. All inverters must be the same model.

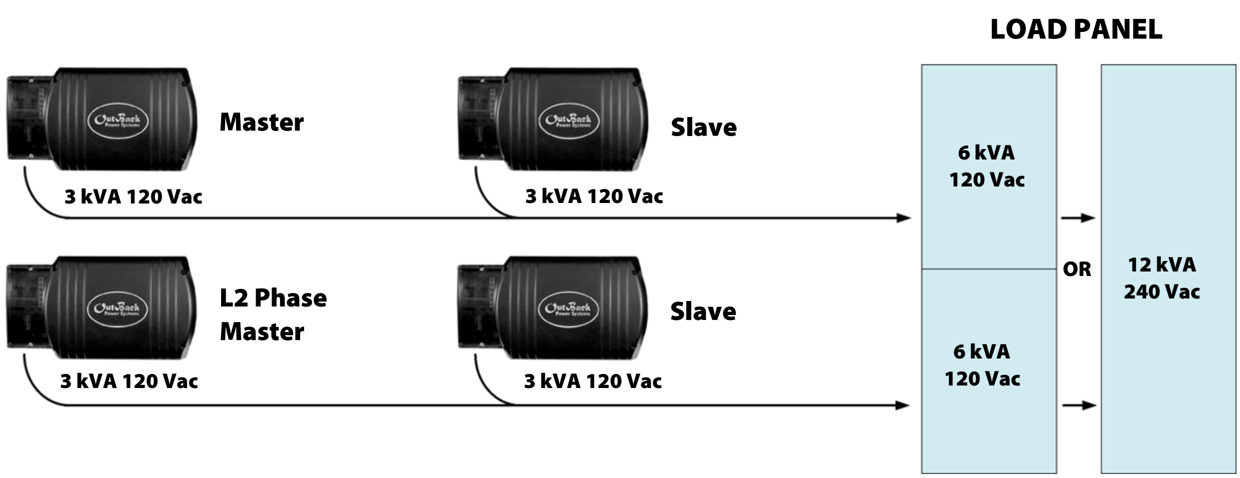



**Figure 13 Example of Series/Parallel Stacking Arrangement (Four Inverters)**

[5] Output voltages may vary with regional voltage standards.

## Three-Phase Stacking

In three-phase stacking, inverters create three separate 120 Vac[6] output legs in a wye configuration.

- The three legs operate independently of each other. 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.
- Up to nine inverters, three per phase, may be installed in a three-phase arrangement. Figure 14 shows one inverter per phase. Figure 15 shows three inverters per phase. All inverters must be the same model.

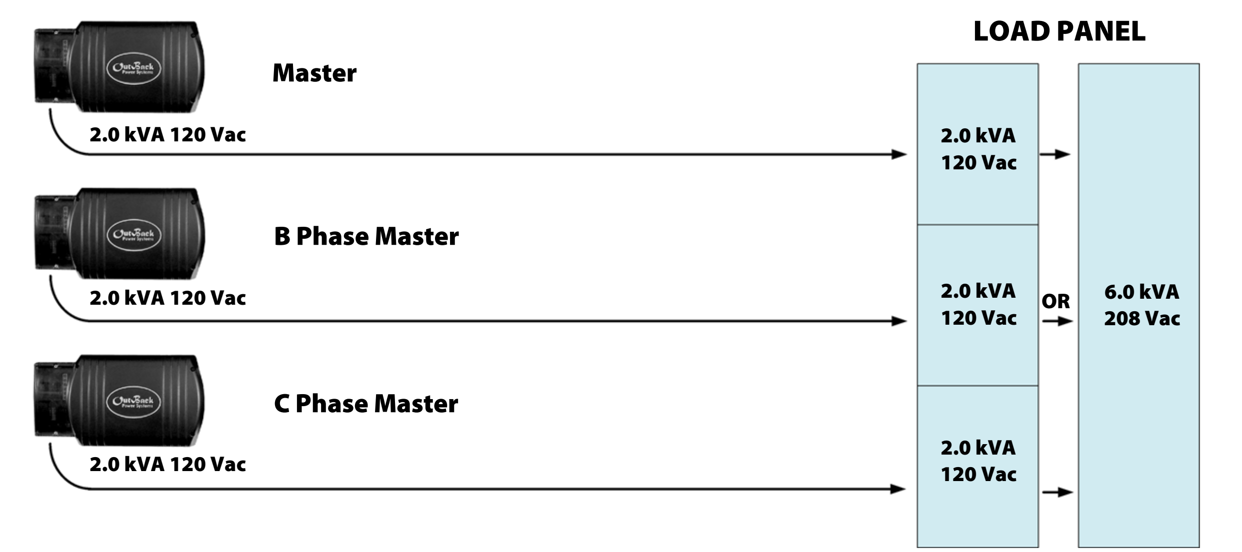



**Figure 14 Example of Three-Phase Stacking Arrangement (Three Inverters)**


**Figure 15 Example of Three-Phase Stacking Arrangement (Nine Inverters)**

[6] Output voltages may vary with regional voltage standards.

## Power Save

Each FXR 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 36.)

- When the load increases by 12 Aac, the master inverter activates an additional slave inverter 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 programming in the system display. 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 do not enter Silent mode. This includes the master and subphase masters. 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 16 Power Save Levels and Loads**

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

**IMPORTANT:**

It is highly recommended to use the MATE3 Configuration Wizard to set up this function. It is essential to set the slave Power Save Levels in sequential order. Failure to set them up correctly will cause erratic system performance. The Configuration Wizard automatically programs the correct priorities. (See the MATE3 owner's manual.)

### To set these items manually without the Configuration Wizard:

In the MATE3 system display, the ***Power Save Ranking*** screen uses ***Power Save Level*** selections to assign ranks to the inverter on each port. The screen reads ***Master Power Save Level*** or ***Slave Power Save Level***, depending on the inverter's stacking designation.

The stacking designations also control which ports are used on the HUB10.3 communications manager. The master inverter must be plugged into port 1. In parallel stacking, any slave inverter can use any other port, beginning with port 2. In series or three-phase stacking, the port assignments are very specific. They are also different from each other, as illustrated in the HUB10.3 literature.

- ***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.)
  - ~ When subphase master inverters are in use, the slaves for the additional phases are ranked identically to the slaves on the master phase. If the master inverter has two slaves ranked 1 and 2, any other phases should also rank their slaves 1 and 2. Slaves on multiple phases should not be ranked sequentially (1 through 6 and so on). This would cause delays in output.

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 slave inverters go silent.

Subphase master inverters are set at 0 because all phases must have at least one inverter that does not enter Silent mode. The slaves for each phase are set identically to each other so that all phases receive additional power at the same time as needed.

**IMPORTANT:**

Set the master (or subphase) 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 to be 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 33. If other adjustments are required to the maximum charge rate, see page 73.

Figure 17 shows a system of four FXR2012A inverters (the master and three slaves). These inverters in a parallel system with a common load bus.

- The captions at the top indicate the ranking of each unit.
- The captions also show the port assignments on the 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.

| | 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 17 Power Save Priority (Parallel)**

- 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 18 shows a system of six FXR2012A inverters. In this example the inverters have been stacked in a split-phase system. The master inverter is on the L1 output while a subphase master is on L2. Each master has two slave inverters.

- The captions at the top indicate the ranking of each inverter.
- The captions also show the port assignments on the communications manager. The L1 inverters use ports 1, 2, and 3. However, the communications manager 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 loads on L1 and L2 are not applied equally, so they are not activated at the same time.

| L1 Load | L1 Master<br>Port 1<br>Master Power<br>Save = 0 | L1 Slave 1<br>Port 2<br>Slave Power<br>Save = 1 | L1 Slave 2<br>Port 3<br>Slave Power<br>Save = 2 | L2 Load | L2 Subphase Master<br>Port 7<br>Master Power<br>Save = 0 | L2 Slave 1<br>Port 8<br>Slave Power<br>Save = 1 | L2 Slave 2<br>Port 9<br>Slave Power<br>Save = 2 |
|---|---|---|---|---|---|---|---|
| 9 Aac | On | Off | Off | 9 Aac | On | Off | Off |
| 12 Aac | On | On | Off | 9 Aac | On | Off | Off |
| 24 Aac | On | On | On | 18 Aac | On | On | Off |
| 36 Aac | On | On | On | 36 Aac | On | On | On |
| 16 Aac | On | On | Off | 12 Aac | On | Off | Off |

**Figure 18 Power Save Priority (Split-Phase)**

- 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 loads on L1 are reduced to 16 Aac. This causes one slave to go silent. The loads on L2 are reduced to 12 Aac, causing two slaves to go silent.

# Auxiliary Terminals

The FXR 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.

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. (See page 53.)

For the FXR 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 these 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 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 geared toward a different application. These functions are summarized in Table 5 on page 52.

**NOTE:** The AUX output is defaulted to ***Vent Fan.*** A sealed FXR 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.

- ➢ ***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 output will be deactivated once the battery voltage falls below a low voltage setting for a settable delay period.
  - ~ Load Shed will also 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 voltage 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. (See the menu tables beginning on page 75.) The limit is not otherwise settable.
  - ~ ***Load Shed*** will also 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
- ➢ ***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.

- ***Fault*** activates the AUX output when the inverter shuts down due to an error condition. (See page 62). 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.

- ***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 that result from battery charging. (This is illustrated in the *FXR Series Inverter/Charger Installation Manual*.) 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

- ***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 63 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 relay allows current to flow from the batteries to a dedicated DC load. (This is illustrated in the *FXR Series Inverter/Charger Installation Manual*.) The 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

- ***GT Limits*** activates the AUX output as an alert that the utility grid does not meet Grid Interface Protection parameters for the grid-interactive function. (See page 20). It can activate a light or alarm to show that the grid-interactive function has shut down and that there may be problems with the grid. The AUX output will cycle on and off if grid parameters are met and the reconnection timer is counting down.
  - ~ This function does not have settable parameters other than those of the ***Grid Interface Protection*** menu.

- ***Source Status*** activates the AUX output whenever the inverter accepts an AC source. It can activate a light or alarm to show that the utility grid is present or that a generator has started. Alternately, it could be used to show that the source has disconnected.
  - ~ This function does not have settable parameters.

- ***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 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 (see page 64) become too hot, the AUX will turn off due to diminished inverter wattage capacity.

Note that even if every function in the menu is set to ***Off***, external programming from other devices may still activate the AUX output. An example is the system display's AGS function. See page 53.

The AUX functions are summarized in Table 5.

**Table 5 Aux Mode Functions**

| Name | Purpose | Triggers | | Settable Points |
|---|---|---|---|---|
| | | **Start** | **Stop** | |
| ***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 |
| ***Gen Alert*** | Starts generator to charge batteries | ➢ Low Vdc | ➢ High Vdc | ➢ Low & high Vdc<br>➢ On & Off delay |
| ***Fault*** | Signals that the inverter shut down due to error | ➢ Error present | ➢ Error cleared | None |
| ***Vent Fan*** | Runs fan to vent batteries while charging | ➢ High Vdc | ➢ Below high Vdc | ➢ High Vdc<br>➢ Off delay |
| ***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 |
| ***GT Limits*** | Signals disconnect of grid-tied inverter due to AC conditions | ➢ GIP parameters not met | ➢ GIP parameters met | None |
| ***Source Status*** | Signals that the inverter accepted an AC source | ➢ AC source accepted | ➢ AC source disconnected | None |
| ***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 |

# System Display-Based Functions

A system display such as the OutBack MATE3 can provide functions not available in the inverter. These functions are summarized here to provide a better idea of overall system capabilities.

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

# Advanced Generator Start (AGS)

As noted under the ***Gen Alert*** function (see Table 5), the system is capable of starting a generator. ***Gen Alert*** simply starts and stops the generator based on battery voltage. For more advanced control, the inverter system can use the Advanced Generator Start (AGS) function, which 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 applications are also available.

**IMPORTANT:**
This function is higher-priority than ***Gen Alert*** or any other inverter function. It can activate the AUX output even if the inverter has disabled it. When AGS is in use, ***Gen Alert*** and other AUX functions should be disabled on that AUX output by setting it to **OFF**. This will avoid programming conflicts.

# Grid Functions

The following functions affect the transfer of the FXR inverter to and from an AC source (usually the utility grid). These functions are based in the system display because they are system-wide. They affect the transfer of all inverters on the system.

Table 6 on page 54 provides a comparison of these functions and the inverter's ***Mini Grid*** input mode.

## High Battery Transfer (HBX)

In HBX mode, the system is connected to the utility grid. However, it will use battery power as the first priority. The utility grid is locked out until needed.

The system runs on battery-supplied power for as long as the batteries can be sustained. It is expected that the system will be supplied by renewable sources such as PV power. When the batteries become depleted, the system reconnects to the utility grid to operate the loads.

The batteries may be recharged during this time using the renewable source. When the batteries are recharged to a high enough voltage, the system transfers back to the batteries as the primary source (hence the name High Battery Transfer).

**NOTE:** The inverter's charger should be off. High Battery Transfer mode is intended to use only the renewable source for charging batteries. Renewable charging is the motivator for returning to battery (and renewable) operation. Use of the inverter's charger interferes with this priority. It also may not charge effectively.

***HBX*** mode has similar priorities to the ***Mini Grid*** input mode contained within the FXR inverter. Either mode may achieve similar results, but they are not identical. See page 23 (and Table 6) for the advantages and disadvantages of each mode.

## Grid Use Time

The inverter system is capable of connecting to, or disconnecting from, the utility grid based on time of day. It can also be programmed to connect at different times on weekdays and on weekends.

## Load Grid Transfer

The inverter system is capable of connecting to, or disconnecting from, the utility grid based on load size. This avoids undesirable battery discharge from excessive loads. It can also be programmed to connect to the grid when the batteries reach a low voltage due to excessive discharge.

**Table 6 Comparison of Grid Functions**

| Mode | Complete Grid Recharge | System Display | Connects to Grid | Adjustability | Renewable Energy | Location of Function |
|---|---|---|---|---|---|---|
| ***Mini Grid*** | Yes | Required initial setup only | Low Battery | Limited (many settings are automatic) | Must be larger than inverter | Inverter |
| ***HBX*** | No | Remains installed | Low Battery | Full | Preferred to be larger than inverter | System |
| ***Grid Use Time*** | Depending on Duration | Remains installed | Time of Day | Full | Not required | System |
| ***Load Grid Transfer*** | Depending on Duration | Remains installed | High Load | Full | Not required | System |

# Metering

## MATE3 Screens

The MATE3 system display can monitor the FXR inverter and other networked OutBack devices. From the Home screen, the **<Inverter>** "soft" key accesses the screens for monitoring the inverter.

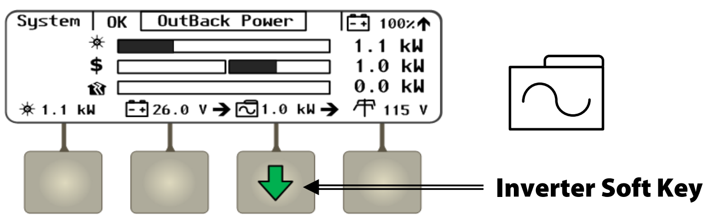
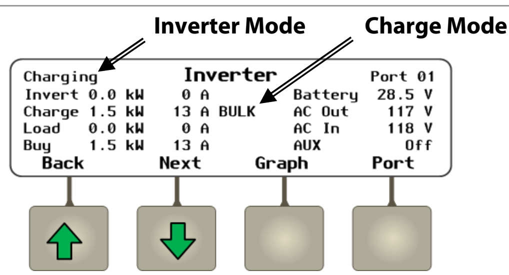



**Figure 19 Home Screen**

## 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 27)
- Searching (see page 28)
- Support (see page 18)
- Sell (see page 19)
- Charging (see Bulk on page 35)
- Charger Off (see pages 32 and 35)
- Float (see page 36)
- EQ (see page 39)
- Silent (see page 36)
- PassThru (see page 32)
- Error (see page 62)
- Off

**Inverter Modes (slave):**

- Slave On
- Slave Off
- Error

**Charge Modes:**

- BULK
- FLOAT
- EQ

**Figure 20 Inverter Screens**

**Screen items:**

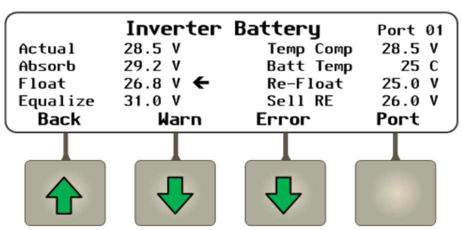
- The upper left corner is the Inverter Mode (see above). When ***Charging*** is indicated, the Charge Mode specifies the stage.
- ***Invert*** displays the kilowatts and AC amperage generated by the inverter. It may go to loads, or in a grid-interactive system it may be sold back to the utility grid.
- ***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 50.)
- 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 MATE3 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 21 Battery Screen**

**Screen items:**

- ***Actual*** displays the uncompensated battery voltage.
- ***Absorb*** displays the charger's Absorption voltage setting. (See page 35.)
- ***Float*** displays the charger's Float voltage setting. (See page 36.)
- ***Equalize*** displays the charger's Equalization voltage setting. (See page 40.)
- ***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 41.)
- ***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 36.)
- ***Sell RE*** voltage is the target voltage used by the inverter for both the Offset and grid-interactive functions when the charger is otherwise inactive. (See pages 19 and 42.)

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

# Troubleshooting

## Basic Troubleshooting

Table 7 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.

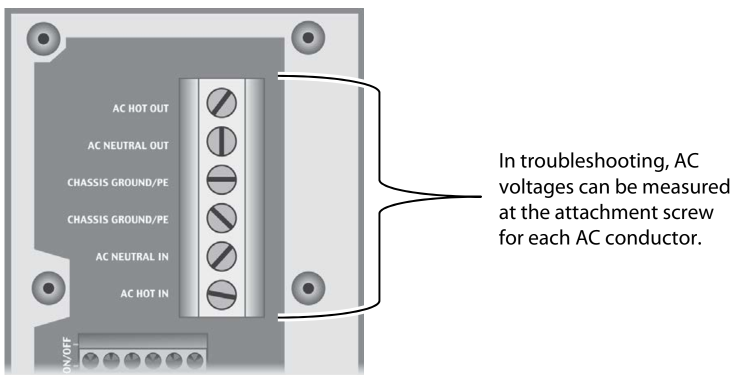



**Figure 22 AC Test Points**

**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 62.

**Table 7 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. Contact OutBack Technical Support.[7] |
| | 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. |
| | Unit defaulted off (No MATE3 present; initial install; Inverter ON/OFF jumper confirmed present). | The FXR inverter is given an initial Off command in the factory. With DC present, use narrow pliers to remove the jumper from its pins. Once removed, install it again. This is the equivalent of "jiggling the switch." |
| | Inverter set to ***Off***. | *MATE3 system display only:* Set to ***On*** with the INVERTER hot key. **NOTE**: The ON/OFF jumper must be installed. |
| | Inverter set to ***Search*** mode. | *MATE3 system display only:* If constant power is required, set to ***On*** with the INVERTER hot key. (If this setting was intentional, then no action is required.) |

[7] See inside front cover of this manual.

**Table 7 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. | *MATE3 system display only:* Check Power Save levels in the ***Inverter Stacking*** menu and test with loads. 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 57.) If not present, the problem is external. If present, the inverter could be damaged. Contact OutBack Technical Support.[8] |
| | AC source does not meet requirements. | *MATE3 system display only:* Check the ***Last AC Disconnect*** screen (using the AC INPUT hot key and the ***Discon*** selection) for the reason for disconnection. If the unit never originally connected, check the ***Warning*** menu (using the Inverter soft key from the Home screen). Confirm source voltage and frequency. |
| | AC source meets requirements but is "noisy" or irregular. | *MATE3 system display only:* The ***Generator*** input mode can accept irregular AC power. Select that mode for that input. |
| | Inverter was manually set to disconnect from AC. | *MATE3 system display only:* Change the AC Input Control setting from ***Drop*** to ***Use*** with the AC INPUT hot key. (If this setting was intentional, then no action is required.) |
| | Grid use function has disconnected from AC. | *MATE3 system display only:* If activated prematurely, check the MATE3's ***Grid Use Time*** settings and the MATE3 clock settings. (If this setting was intentional, then no action is required.) |
| | High Battery Transfer (***HBX***) mode has disconnected from AC. | *MATE3 system display only:* Check the AC INPUT hot key screen to see if ***HBX*** mode is in use. If activated prematurely, check the settings of ***HBX*** mode. (If this setting was intentional, then no action is required.) |
| | ***Load Grid Transfer*** mode has disconnected from AC. | *MATE3 system display only:* Check the AC INPUT hot key screen to see if ***Load Grid Transfer*** mode is in use. If activated prematurely, check the settings of ***Load Grid Transfer*** mode. (If this setting was intentional, then no action is required.) |
| | ***Mini Grid*** input mode has disconnected from AC. | *MATE3 system display only:* Check the ***Inverter*** part of the ***Settings*** menu to see if ***Mini Grid*** mode is in use. If activated prematurely, check the settings of ***Mini Grid*** mode. (If this setting was intentional, then no action is required.) |
| | Conflicting programming. | *MATE3 system display only:* Check to see if more than one of these is enabled: ***Mini Grid***, ***HBX***, ***Grid Use Time***, ***Load Grid Transfer***. These have conflicting priorities. Only one can be used at a time. |
| | ***Grid Tied*** mode has disconnected from AC. | AC source does not meet requirements; see related entry under "Will not sell power to the utility grid" (next page). |

[8] See inside front cover of this manual.

**Table 7 Troubleshooting**

| Symptom | Possible Cause | Possible Remedy |
|---|---|---|
| Low charge rate. | Charge complete or nearly complete. | Check the DC voltage and charging stage using the MATE3, if present. Confirm with DC voltmeter. |
| | MATE3's DC meter reads significantly higher than actual battery voltage. | Check the DC voltage on the inverter's DC terminals. If different from the MATE3 reading, the inverter could be damaged. Otherwise, check the DC voltage on 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 64.) External cooling may also be applied. |
| Will not charge. | No AC input. | See "Will not connect to AC" category. |
| | Charger set to ***Off***. | *MATE3 system display only:* 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.) |
| | ***GridZero*** mode in use. | *MATE3 system display only:* The charger is inoperative in ***GridZero*** mode. (If this setting was intentional, then no action is required.) |
| Will not sell power to the utility grid. | Grid-tied function has been manually disabled. | MATE3 system display only: Check the ***Grid-Tie Enable*** setting in the ***Grid-Tie Sell*** menu. Confirm it is set to ***Y***. |
| | ***Grid Tied*** mode not in use. | *MATE3 system display only:* Check the ***Inverter*** part of the ***Settings*** menu to see if ***Grid Tied*** mode is in use. |
| | AC source does not meet requirements; this item is usually accompanied by disconnecting from the utility grid when in ***Grid Tied*** mode. | Verify grid voltage and frequency. Determine if they are within the inverter's approved limits. If not, the inverter is operating correctly. Contact the utility company if necessary.<br>*MATE3 system display only:* The program limits are found in the inverter's ***Grid Interface Protection*** menu. See page 20 for more information on this menu. |
| | The inverter has other criteria besides the AC source which must be met, such as the qualifying time. | *MATE3 system display only:* Check ***Sell Status*** screen using the Home screen's soft keys. The inverter may be operating correctly. Depending on the conditions which need to be met, the delay may be temporary. |
| | The inverter will perform the Offset function before attempting to sell. | Output loads can consume all excess renewable power if they are large enough. (The Offset function "sells to the loads.") Turn off some output loads and observe the sell operation. |
| Reduced power sold to the utility grid. | AC source voltage is driven high when the inverter sells large amounts of power. | When the inverter senses a rise in grid voltage while selling, it reduces the sell current, to avoid forcing the voltage to unacceptable levels. Check AC input voltage while selling. The inverter may be operating correctly. |
| | High temperature. | The inverter will reduce the current rate for selling and other activities if the internal temperature exceeds a certain level. Check temperature readings and allow the inverter to cool if necessary. (See page 64.) External cooling may also be applied. |

## Table 7 Troubleshooting

| Symptom | Possible Cause | Possible Remedy |
|---|---|---|
| Inverter does not perform the Offset function when expected. | Incorrect input mode. | Offset does not function in ***Generator***, ***UPS***, and ***Backup*** modes. |
| | Specific mode only offsets under particular conditions. | ***Support*** mode will perform the Support function based on load. This may appear as Offset without reaching the reference voltage. ***GridZero*** mode will perform Offset based on the ***DoD Volts*** setting. Other reference voltages are not used. |
| Unusual voltage on hot or neutral output line. | System neutral and ground may not be bonded. | Test **AC HOT OUT** and **AC NEUTRAL OUT** terminals with AC voltmeter. (See page 57.) These measurements should give full voltage. Test neutral and ground connections. This measurement should read zero volts. Any other result means neutral and ground are not bonded correctly. If this is the case, the hot line often reads 60 to75 Vdc and the neutral reads 45 to 60 Vdc with respect to ground. (If bonding is not required or is prohibited by national or local codes, then no action may be required.) |
| Unusual and different voltages on AC hot input lines. | Inverter has not synchronized with input source. | *MATE3 system display only:* 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 57.) If not consistent, the problem is external. *MATE3 system display only:* AC source voltage may have dipped to a low enough point to crash a sensitive load before the inverter could take over. This can happen if the inverter's ***Grid AC Input Voltage Limits*** or ***Gen AC Input Voltage Limits*** were turned down to accommodate a problematic AC source. To make the inverter respond sooner, raise the lower limit setting in the appropriate menu. (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. *MATE3 system display only:* If constant power is required, set to ***ON*** with the INVERTER hot key. (If this setting was intentional, then no action is required.) |
| | Loads sensitive to inverter's transfer time. ***UPS*** mode not in use. | *MATE3 system display only:* Most of the inverter's input modes feature a small but noticeable response time during transfer. Certain loads (such as highly sensitive computers) may not respond well. The ***UPS*** input mode has a faster response time. (See page 21.) |
| | 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. May be accompanied by ***AC Relay Fault*** error and shutdown. | Disconnect AC input wires and turn inverter on. Test the **AC HOT OUT** and **AC NEUTRAL OUT** terminals with an AC voltmeter. (See page 57.) If voltage appears there, the transfer relay may be jammed. Contact OutBack Technical Support.[9] |
| | False reading due to noise. | Electrical noise can cause false readings on the metering circuits when no voltage is present. The readings are usually less than 30 Vac. If this is the case, no action is required. |

[9] See inside front cover of this manual.

### Table 7 Troubleshooting

| Symptom | Possible Cause | Possible Remedy |
|---|---|---|
| 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 57.) If low or fluctuating, this is an external problem. |
| | A generator is connected to the input terminals while the unit is in the ***Grid Tied*** input mode. | The inverter is not intended to sell power to a generator. The selling activity will drive the generator voltage up to the disconnection point. It will then reconnect to the generator and try again. Change input modes, or move the generator to an input with a different mode selected. |
| 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>*MATE3 system display only:* Check stacking 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*** (and the device still does not work), then there is an external connection problem. If 12 Vdc is not present with the function ***On***, the AUX circuit may be damaged. Contact OutBack Technical Support.[10] |
| Advanced Generator Start (***AGS***) fails to activate when conditions are met (or starts when conditions are not met). | MATE3 system display is not present. | ***AGS*** programming is located in the MATE3 and cannot function if the MATE3 is removed. |
| | Other AUX functions are in operation. | ***Gen Alert*** or another AUX function may try to start or stop the generator using the wrong criteria. Make sure all other AUX functions are disabled. |

[10] See inside front cover of this manual.

# 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 15 for the FXR inverter's LED indicators.) The MATE3 system display will show an event and a specific error message. This screen is viewed using the MATE3 Home screen's soft keys. (See the MATE3 manual for more instructions.) One or more messages will display ***Y*** (yes). If a message says ***N*** (no), it is not the cause of the error.

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 8 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. |
| ***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. |
| ***Stacking Error*** | Programming problem among stacked units. (Often occurs if there is no master.)<br>Can also occur if ***AC Output Backfeed*** occurs. | ➢ Check stacking programming and designation of master. (See page 43.)<br>➢ Check for output backfeed from an external source. Disconnect output if necessary. |
| ***Low Battery V***[11] | 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. |
| ***High Battery V***[10] | DC voltage exceeded acceptable level. See page 27. | Check the charging source. This problem is usually the result of external charging. |
| ***Over Temperature***[10] | Inverter has exceeded its maximum allowed operating temperature. See page 64. | Allow the inverter to remain off to reduce the temperature, or add external cooling. |
| ***Comm Fault*** | The inverter has suffered an internal communication failure. | Contact OutBack Technical Support.[12] |
| ***Loose DC Neg Terminals*** | Loose DC connection on internal power module. | Tighten all DC connections between inverter and battery. If this error is not resolved, contact OutBack Technical Support. [11] |
| ***Battery Voltage Sense*** | Internal sensing has detected battery voltages below 8 Vdc or above 18 Vdc for a 12-volt model (or equivalent for higher-voltage models). | If these readings are not correct, contact OutBack Technical Support.[12] |
| ***AC Relay Fault*** | AC transfer relay damaged. | Contact OutBack Technical Support. [11] |

[11] This error will clear automatically when the cause of the error is resolved. The inverter will begin functioning again when this occurs.
[12] See inside front cover of this manual.

# 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 15 for the FXR inverter's LED indicators.) The MATE3 system display will show an event and a specific warning message. This screen is viewed using the MATE3 Home screen's soft keys. (See the MATE3 manual for more instructions.) One or more messages will display ***Y*** (yes). If a message says ***N*** (no), it is not the cause of the warning.

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 65.)

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

**Table 9 Warning Troubleshooting**

| Message | Definition | Possible Remedy |
|---|---|---|
| ***AC Freq Too High*** | The AC source is above the 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 the 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 the 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 the 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 MATE3, the three readings are labeled ***Transformer, Output FETs,*** and ***Capacitors***. These values are given in degrees Celsius. See next page. |
| ***Phase Loss*** | A slave or subphase master inverter was ordered to transfer to an AC source by the master, but the AC source is the wrong phase or no AC source is present. | Check the AC voltage on the inverter input terminals. If AC voltage is not present, problem is external. If AC voltage is present, the unit may be damaged. Contact OutBack Technical Support.[13] |

[13] See inside front cover of this manual.

**Table 9 Warning Troubleshooting**

| Message | Definition | Possible Remedy |
|---|---|---|
| ***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 OutBack Technical Support for the next step.[13] (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. |
| ***Transformer***<br>(in ***Temps*** screen) | Displays the ambient temperature around the inverter's transformer. | In the MATE3, these values are given in degrees Celsius.<br><br>If any reading does not seem to reflect the inverter's temperature or conditions, contact OutBack Technical Support.[14] |
| ***Output FETs***<br>(in ***Temps*** screen) | Displays the temperature of the FETs (Field Effect Transistors) and heat sink. | |
| ***Capacitors***<br>(in ***Temps*** screen) | Displays the temperature of the inverter's ripple capacitors. | |

# Temperatures

As shown in Table 9, the ***Inverter Warnings*** screen has an ***Inverter Temps*** selection for three internal temperature readings. These readings can affect inverter operations in high temperatures. Table 10 shows the temperature limits used by each sensor and the effects on inverter operations.

**Table 10 Inverter Temps**

| Effect | Temperature Reading | | |
|---|---|---|---|
| | ***Transformer*** | ***Output FETs*** | ***Capacitors*** |
| ***Over Temperature*** error | >125°C | >95°C | >95°C |
| Reduced charging or selling | =120°C | =90°C | =90°C |
| Fan turns on | >60°C | >60°C | >60°C |
| Fan turns off | <50°C | <50°C | <50°C |

# GT Warnings

This screen is also available under ***Inverter Warnings***. The GT (grid-tie) warnings in Table 11 indicate why a grid-interactive inverter has stopped selling. These warnings are caused when the grid exceeds one of the settings in the ***Grid Interface Protection*** menu. A GT warning may accompany a Disconnect message (see Table 12) or a regular warning (see Table 9), depending on conditions.

**Table 11 GT Warnings**

| Message | Definition |
|---|---|
| ***AC Freq Too High*** | The AC source has exceeded ***Grid Interface Protection*** frequency levels. |
| ***AC Freq Too Low*** | The AC source has dropped below ***Grid Interface Protection*** frequency levels. |
| ***Voltage Too High*** | The AC source has exceeded ***Grid Interface Protection*** voltage levels. |
| ***Voltage Too Low*** | The AC source has dropped below ***Grid Interface Protection*** voltage levels. |

[14] See inside front cover of this manual.

# 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 ***Last AC Disconnect*** screen is viewed using the AC INPUT hot key on the MATE3. One or more messages will display ***Y*** (yes). If a message says ***N*** (no), it is not the cause of the disconnection. The MATE3 system display may generate a concurrent event and warning message following the disconnection. (See page 63.) 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 the 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.

The reasons shown in the Sell Status screen for ceasing to sell power (see next page) may be the same as disconnect messages. If the Grid Interface Protection settings are exceeded (see page 20), the inverter will disconnect from the utility grid.

Table 12 shows the primary seven reasons for disconnection. An eighth field may be visible, but it can feature several different messages which vary with conditions. A list of these messages and their definitions is featured on the OutBack website at www.outbackpower.com.

**Table 12 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. |
| ***Backfeed*** | Usually indicates that another AC power source (out of phase with the inverter) was connected to the AC output.<br>Can also occur if an out-of-phase AC source is connected to the AC input. | Disconnect the AC OUT wires. Check the wires (not the inverter) with an AC voltmeter. If an AC source is present, shut it off. (This is more often accompanied by an ***AC Output Backfeed*** error.)<br>Check input source and wiring. This can be caused by a source with phase problems. |
| ***Phase Lock*** | The unit cannot remain in phase with an erratic AC source. | Check AC source. This can be caused by a generator with a poorly regulated output. Some generators perform this way when low on fuel. If necessary, use the ***Generator*** input mode. (See page 18.) |
| ***Island Detect*** | The grid seems to be present but normal grid conditions are not detected. This can occur if the inverter's input is powered by another inverter instead of the grid. It may be the result of an open main disconnect. | Check all input disconnects or circuit breakers for an open circuit. Check for any other inverters installed in the system and disable them.<br>This may (rarely) occur with a generator. If necessary, use the ***Generator*** input mode. (See page 18.) |

# Sell Status

Sell Status messages describe conditions relating to the inverter's grid-interactive mode. This screen is viewed using the MATE3 Home screen's soft keys. (See the MATE3 manual for more instructions.) One or more messages will display ***Y*** (yes). If a message says ***N*** (no), it is not the cause of the disconnection.

If the inverter has stopped selling or charging unexpectedly, this screen may identify the reason. More often these messages are used by a normally functioning inverter to identify external conditions that are preventing selling or charging. (If nothing has stopped, the messages will indicate that as well.)

The acceptable limits for AC source voltage and frequency are controlled by the Grid Interface Protection settings, which are shown in the default menus beginning on page 76. If the AC source exceeds these limits, the inverter will stop selling and display the appropriate code. (At the same time it will disconnect from the utility grid, with an appropriate message as shown in Table 12 on page 65.) After the source returns to the acceptable range, the screen will begin its reconnection timer (with a default setting of five minutes). When the timer expires, the inverter will reconnect to the utility grid and begin selling power again.

If the AC source is unstable, it may become unacceptable before the timer expires. This may cause the timer to continually reset. It is possible for brief fluctuations to occur that are too fast to be seen on a DVM. If this happens, the appropriate message will still appear on the system display for a short time to help troubleshoot the problem.

Additionally, undersized wires or bad connections can result in local voltage problems. If a ***Voltage Too Low*** or ***Voltage Too High*** message is accompanied by voltage changes that do not appear at the main utility connection, check the wiring.

**Table 13 Sell Status Messages**

| Sell Status | Definition |
|---|---|
| ***Selling Disabled*** | The ***Grid-Tie Enable*** command has been set to ***N*** (no). |
| ***Qualifying Grid*** | All utility grid conditions are acceptable. The inverter is running a timed test during which it confirms the grid quality. The timer is shown on the screen. At the end of that time, the inverter may be ready to sell. |
| ***Frequency Too Low*** | The utility grid's AC frequency is below the acceptable range for selling. |
| ***Frequency Too High*** | The utility grid's AC frequency is above the acceptable range for selling. |
| ***Voltage Too Low*** | The utility grid's AC voltage is below the acceptable range for selling. |
| ***Voltage Too High*** | The utility grid's AC voltage is above the acceptable range for selling. |
| ***Battery < Target*** | The battery voltage is below the target voltage for that stage (Float, Selling, etc.). No excess energy is available to sell. |

# Specifications

## Electrical Specifications

**NOTE**: Items qualified with "default" can be manually changed using the system display.

**Table 14 Electrical Specifications for 12-Volt FXR Models**

| Specification | FXR2012A | VFXR2812A |
|---|---|---|
| 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 (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 | 90% | 90% |
| Total Harmonic Distortion (maximum) | < 5% | < 5% |
| Harmonic Distortion (maximum single voltage) | < 2% | < 2% |
| AC Output Voltage Regulation | ± 2.5% | ± 2.5% |
| Appliance Protective Class (IEC) | Class I | Class I |
| Load Power Factor | –1 to 1 | –1 to 1 |
| Inrush Current | None | None |
| 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) | 4500 VA | 4500 VA |
| AC Overload Capability (30 minute) | 2500 VA | 3200 VA |
| AC Maximum Output Fault Current and Duration | 56.6 Aac for 0.636 seconds | 56.6 Aac for 0.636 seconds |
| Power Consumption (idle) – Invert mode, no load | 34 watts | 34 watts |
| Power Consumption (idle) – Search mode | 9 watts | 9 watts |
| Power Consumption – Off | 3 watts | 3 watts |
| AC Input Voltage Range | 85 to 140 Vac | 85 to 140 Vac |
| AC Input Frequency Range | 54 to 66 Hz at 60-Hz setting<br>45 to 55 Hz at 50-Hz setting | 54 to 66 Hz at 60-Hz setting<br>45 to 55 Hz at 50-Hz setting |
| AC Input Current (maximum continuous) | 60 Aac | 60 Aac |
| DC Input Voltage (nominal) | 12 Vdc | 12 Vdc |
| DC Input Voltage Range | 10.5 to 17 Vdc | 10.5 to 17 Vdc |
| DC Maximum Input Voltage | 17 Vdc | 17 Vdc |
| DC Input Power (continuous) | 2.4 kVA | 3.36 kVA |
| DC Input Maximum Current (continuous full power) | 200 Adc | 280 Adc |
| DC Input Maximum Current (surge) | 480 Adc | 480 Adc |
| DC Input Maximum Current (short-circuit) | 1891 Adc for 0.105 seconds | 1891 Adc for 0.105 seconds |
| Battery Charger Maximum AC Input | 14 Aac | 18 Aac |
| Battery Charger Maximum DC Output | 100 Adc | 125 Adc |
| DC Output Voltage Range (charging) | 10.5 to 17 Vdc | 10.5 to 17 Vdc |
| Auxiliary Output | 0.7 Adc at 12 Vdc | 0.7 Adc at 12 Vdc |

**Table 15 Electrical Specifications for 24-Volt FXR Models**

| Specification | FXR2524A | VFXR3524A |
|---|---|---|
| Continuous Output Power at 25°C | 2500 VA | 3500 VA |
| Continuous AC Output Current at 25°C | 20.8 Aac | 29.2 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 | 92% | 92% |
| CEC Weighted Efficiency | N/A | 90.5% |
| Total Harmonic Distortion (maximum) | < 5% | < 5% |
| Harmonic Distortion (maximum single voltage) | < 2% | < 2% |
| AC Output Voltage Regulation | ± 2.5% | ± 2.5% |
| Appliance Protective Class (IEC) | Class I | Class I |
| Load Power Factor | –1 to 1 | –1 to 1 |
| Inrush Current | None | None |
| 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) | 5400 VA | 5400 VA |
| AC Overload Capability (30 minute) | 3200 VA | 4000 VA |
| AC Maximum Output Fault Current and Duration | 71.9 Aac for 0.636 seconds | 71.9 Aac for 0.636 seconds |
| Power Consumption (idle) – Invert mode, no load | 34 watts | 34 watts |
| Power Consumption (idle) – Search mode | 9 watts | 9 watts |
| Power Consumption – Off | 3 watts | 3 watts |
| AC Input Voltage Range | 85 to 140 Vac | 85 to 140 Vac |
| AC Input Frequency Range | 54 to 66 Hz at 60-Hz setting<br>45 to 55 Hz at 50-Hz setting | 54 to 66 Hz at 60-Hz setting<br>45 to 55 Hz at 50-Hz setting |
| AC Input Current (maximum continuous) | 60 Aac | 60 Aac |
| Grid-Interactive Voltage Range (default) | 106 to 132 Vac | 106 to 132 Vac |
| Grid-Interactive Frequency Range (default) | 59.3 to 60.5 Hz | 59.3 to 60.5 Hz |
| DC Input Voltage (nominal) | 24 Vdc | 24 Vdc |
| DC Input Voltage Range | 21 to 34 Vdc | 21 to 34 Vdc |
| DC Maximum Input Voltage | 34 Vdc | 34 Vdc |
| DC Input Power (continuous) | 3.0 kVA | 4.2 kVA |
| DC Input Maximum Current (continuous full power) | 125 Adc | 175 Adc |
| DC Input Maximum Current (surge) | 300 Adc | 300 Adc |
| DC Input Maximum Current (short-circuit) | 1891 Adc for 0.105 seconds | 1891 Adc for 0.105 seconds |
| Battery Charger Maximum AC Input | 16 Aac | 20 Aac |
| Battery Charger Maximum DC Output | 55 Adc | 82 Adc |
| DC Output Voltage Range (charging) | 21 to 34 Vdc | 21 to 34 Vdc |
| Auxiliary Output | 0.7 Adc at 12 Vdc | 0.7 Adc at 12 Vdc |

**Table 16 Electrical Specifications for 48-Volt FXR Models**

| Specification | FXR3048A | VFXR3648A |
|---|---|---|
| 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 | ± 2.5% | ± 2.5% |
| Appliance Protective Class (IEC) | Class I | Class I |
| Load Power Factor | –1 to 1 | –1 to 1 |
| Inrush Current | None | None |
| 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) | 5400 VA | 5400 VA |
| AC Overload Capability (30 minute) | 3200 VA | 4000 VA |
| AC Maximum Output Fault Current and Duration | 71.9 Aac for 0.636 seconds | 71.9 Aac for 0.636 seconds |
| Power Consumption (idle) – Invert mode, no load | 34 watts | 34 watts |
| Power Consumption (idle) – Search mode | 9 watts | 9 watts |
| Power Consumption – Off | 3 watts | 3 watts |
| AC Input Voltage Range | 85 to 140 Vac | 85 to 140 Vac |
| AC Input Frequency Range | 54 to 66 Hz at 60-Hz setting<br>45 to 55 Hz at 50-Hz setting | 54 to 66 Hz at 60-Hz setting<br>45 to 55 Hz at 50-Hz setting |
| AC Input Current (maximum continuous) | 60 Aac | 60 Aac |
| Grid-Interactive Voltage Range (default) | 106 to 132 Vac | 106 to 132 Vac |
| Grid-Interactive Frequency Range (default) | 59.3 to 60.5 Hz | 59.3 to 60.5 Hz |
| DC Input Voltage (nominal) | 48 Vdc | 48 Vdc |
| DC Input Voltage Range | 42 to 68 Vdc | 42 to 68 Vdc |
| DC Maximum Input Voltage | 68 Vdc | 68 Vdc |
| DC Input Power (continuous) | 3.6 kVA | 43.2 kVA |
| DC Input Maximum Current (continuous full power) | 90 Adc | 200 Adc |
| DC Input Maximum Current (surge) | 150 Adc | 150 Adc |
| DC Input Maximum Current (short-circuit) | 1891 Adc for 0.105 seconds | 1891 Adc for 0.105 seconds |
| Battery Charger Maximum AC Input | 16 Aac | 20 Aac |
| Battery Charger Maximum DC Output | 35 Adc | 45 Adc |
| DC Output Voltage Range (charging) | 42 to 68 Vdc | 42 to 68 Vdc |
| Auxiliary Output | 0.7 Adc at 12 Vdc | 0.7 Adc at 12 Vdc |

# Mechanical Specifications

**Table 17 Mechanical Specifications for FXR Models**

| Specification | FXR2012A, FXR2524A, and FXR3048A | VFXR2812A, VFXR3524A, and VFXR3648A |
|---|---|---|
| Inverter Dimensions (H x W x D) | 13 x 8.25 x 16.25" (33 x 21 x 41 cm) | 12 x 8.25 x 16.25" (30 x 21 x 41 cm) |
| Shipping Dimensions (H x W x L) | 21.75 x 13 x 22" (55 x 33 x 56 cm) | 21.75 x 13 x 22" (55 x 33 x 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 RJ45 (remote) | RJ11 (batt temp) and RJ45 (remote) |
| Non-volatile Memory | Yes | Yes |
| Neutral-Ground Bond Switching | No | No |
| Chassis Type | Sealed | Vented |

# Environmental Specifications

**Table 18 Environmental Specifications for all FXR Models**

| Specification | Value |
|---|---|
| Rated Temperature Range (meets component specifications; however, please note that the inverter output wattage is derated above 25°C) | –4°F to 122°F (–20°C to 50°C) |
| Operational Temperature Range (functions, but not rated for operation; does not necessarily meet all component specifications) | –40°F to 140°F (–40°C to 60°C) |
| Storage Temperature Range | –40°F to 140°F (–40°C to 60°C) |
| IP (Ingress Protection) Rating of Enclosure | IP20 |
| Environmental Category | Indoor unconditioned |
| Wet Locations Classification | Wet locations: No |
| Relative Humidity Rating | 93% |
| Pollution Degree Classification | PD 2 |
| Maximum Altitude Rating | 6561' (2000 m) |
| Overvoltage Category (AC Input) | 3 |
| Overvoltage Category (DC Input) | 1 |

# Temperature Derating

All FXR inverters can deliver their full rated wattage at temperatures up to 25°C (77°F). The FXR maximum wattage is rated less in higher temperatures. Above 25°C, each inverter model is derated by a factor of 1% of that model's rated wattage for every increase of 1°C. This derating applies to all power conversion functions (inverting, charging, selling, offsetting, etc.)

Figure 23 is a graph of wattage over temperature, showing the decrease in rated wattage with increased temperature. The graph ends at 50°C (122°F) because the FXR inverter is not rated for operation above that temperature.

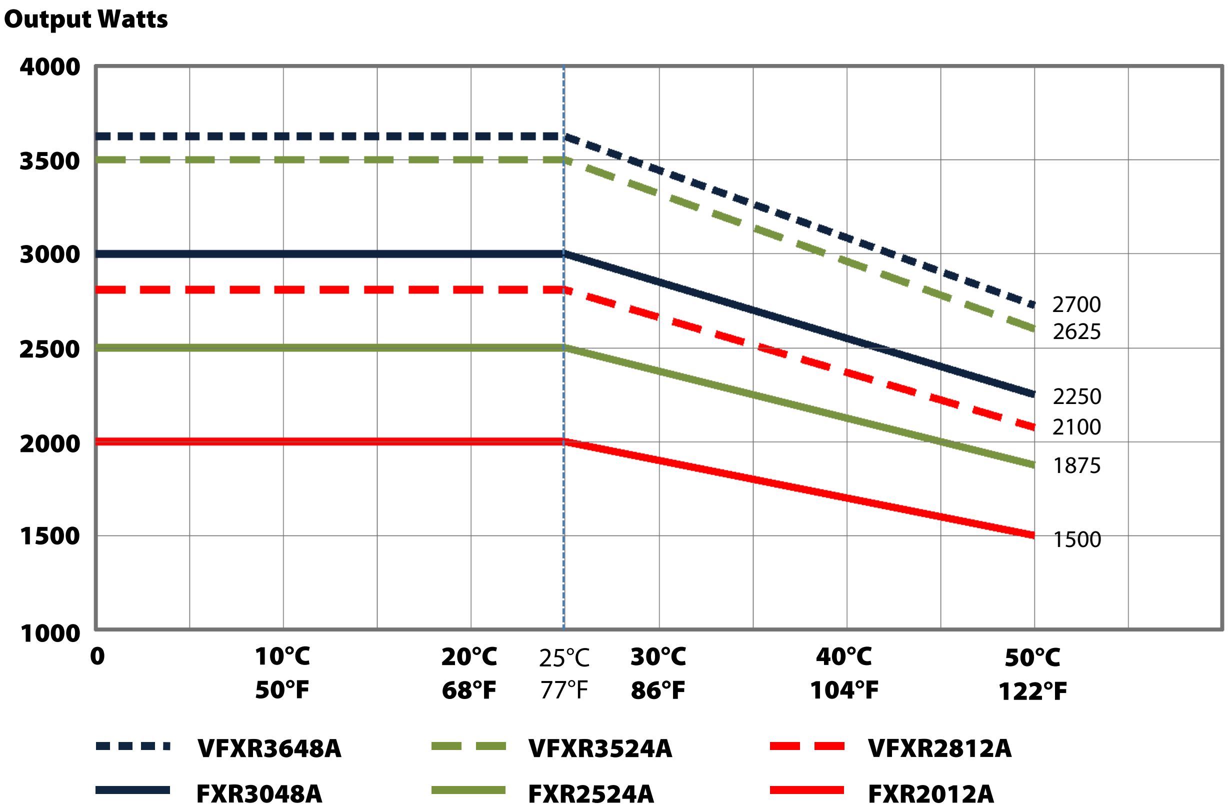



**Figure 23 Temperature Derating**

# Regulatory Specifications

## Listings

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

- UL 1741— Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources (2nd Edition, 1/28/2010)
- CSA C22.2 — General Use Power Supplies, No. 107.1-01 Issue: 2001/09/01 Ed:3 (R2006)

## Certifications

This product has been certified by ETL to meet the following standards:

- UL 1778 — Uninterruptible Power Systems, Annex FF (normative): Backfeed Protection Test

## Compliance

- RoHS: per directive 2011/65/EU
- FCC Part 15.109(G): 2012 Class B

### FCC Information to the User

This equipment has been tested and found to comply with the limits for a Class B digital device when powered by a DC source, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment to a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

## Specification Compliance

Inverters intended for grid-interactive use in the United States and Canada must comply with the established standards of UL 1741 and IEEE 1547 and 1547.1. These standards provide regulation for acceptable output voltage ranges, acceptable output frequency, total harmonic distortion (THD) and anti-islanding performance when the inverter is exporting power to a utility source.

The OutBack grid-interactive models are tested using the procedures listed in IEEE 1547.1 to the standards listed in both UL 1741 and IEEE 1547. The following specifications have been validated through compliance testing and refer to exporting power to a simulated utility source of less than 1% voltage total harmonic distortion (THD).

- The inverter output exceeds the minimum power factor of 0.85 with a typical power factor of 0.96 or better.
- The individual harmonics do not exceed the limits specified in Table 3 of IEEE 1547 Section 4.3.3.
- The THD of the root mean square (RMS) current is less than 5%.
- The inverter ceases to export power to the simulated utility source under islanding conditions specified in IEEE 1547 Section 4.4.1.
- The inverter also ceases to export power to the simulated utility source after the output voltage or frequency of the simulated utility source are adjusted to each of the conditions specified in IEEE 1547 Section 4.2.3 Table 1 and Section 4.2.4 Table 2 within the times specified in those tables. All grid-interactive FXR inverters are tested to comply with Table 19.

**Table 19 Interconnection Response Times to Abnormal Voltages or Frequencies**

| Voltage Range (AC Volts) | Frequency (Hz) | Seconds Allowed | Cycles Allowed |
|---|---|---|---|
| V < 60.0 | 60.0 | 0.16 | 9.6 |
| 60.0 < V < 105.6 | 60.0 | 2.0 | 120.0 |
| 105.6 < V < 132.0 | 60.0 | no cessation | no cessation |
| 132.0 < V < 144.0 | 60.0 | 1.0 | 60.0 |
| V > 144.0 | 60.0 | 0.16 | 9.6 |
| 120.0 | < 59.3 | 0.16 | 9.6 |
| 120.0 | > 60.5 | 0.16 | 9.6 |

The reconnection delay has a default setting of 5 minutes. The grid-interactive default settings are shown in the ***Grid Interface Protection Menu*** portion of Table 23.

The ***Grid Interface Protection*** settings are adjustable. However, this is only available to operators with installer-level access. The reason for this limitation is that there are firm rules concerning the acceptable voltage range, frequency range, clearance time during power loss, and reconnect delay when exporting power back to the utility. The rules differ in different locations around the world, although generally it is expected that the settings cannot be altered by the end user. For this reason, the installer password must be changed from the default to get access to these settings.

Once this password has been changed, the ***Grid Interface Protection*** settings can be accessed by using the installer password.

See the ***Grid Tied*** mode on page 19 for more information. Also see **Default Settings and Ranges**.

# 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 20. See pages 62 and 64 for more information on these conditions and the warning or error messages which accompany them.

**Table 20 Operating Limits for all FXR 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 or selling | | >120°C | | >90°C | | >90°C | |
| Internal Fan | | <50°C | >60°C | <50°C | >60°C | <50°C | >60°C |

# 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 activates the 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 47.

When the ***Charger AC Limit*** setting is 12 Aac or more, other active chargers add the same amount to the total. The total current equals the ***Charger AC Limit*** setting times the number of active chargers. In some systems, lower currents may be required due to battery bank size or other reasons. To achieve lower currents, chargers can be individually set to ***Off*** so that the master inverter does not activate them. (The global ***Charger Control On*** only enables inverters not individually set to ***Off***.) Combining the charger limit settings with a reduced number of chargers allows better control over the current.

In Table 21, **Max Charge Adc** shows examples of DC charging values which may be recommended for a battery bank. **Aac** converts these values into AC amperes.

**On** provides recommendations for the smallest number of chargers in operation. **Set** recommends the inverter ***Charger AC Limit*** setting. Note that this table specifies the number of chargers to leave **on**. All other chargers should be turned off using the ***Charger Control*** menu item. (See the menu tables beginning on page 76 to locate this command in the menu structure.)

The lowest Adc figures in this table allow for a single inverter to perform all charging. All other inverters would be turned off. The highest Adc figures are for the maximum of ten stacked chargers.

The recommended settings ensure the charging will not exceed a designated current. The amount is likely to be less.

### To determine the chargers and settings using Table 21:

1. Obtain the battery bank's maximum charge current (in Adc) from the battery manufacturer.
2. Locate the closest number to this amount (rounded down) on Table 21.
3. Read across to the entry for the appropriate inverter model.
4. Adjust the master inverter's ***Charger AC Limit*** setting to the designated amount (in Aac).
5. Turn off the chargers for all inverters that exceed the number shown as ***On***.

   In a stacked system (using the HUB communications manager), chargers on higher-numbered HUB ports should be turned off first. Slave chargers should be turned off before turning off any subphase masters. (See page 43 for information on stacking.)

**Table 21 Chargers On and Current Settings**

| Max Charge Adc | FXR2012A | | | VFXR2812A | | | FXR2524A | | | VFXR3524A | | | FXR3048A | | | VFXR3648A | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aac | On | Set | Aac | On | Set | Aac | On | Set | Aac | On | Set | Aac | On | Set | Aac | On | Set |
| 40 | 5 | 1 | 5 | 5 | 1 | 5 | 11 | 1 | 11 | 9 | 1 | 9 | 18 | 1 | 16 | 17 | 1 | 17 |
| 60 | 8 | 1 | 8 | 8 | 1 | 8 | 17 | 1 | 16 | 14 | 1 | 14 | 27 | 2 | 13 | 26 | 2 | 13 |
| 80 | 11 | 1 | 11 | 11 | 1 | 11 | 23 | 1 | 16 | 19 | 1 | 19 | 36 | 2 | 16 | 35 | 2 | 17 |
| 100 | 14 | 1 | 14 | 14 | 1 | 14 | 29 | 2 | 14 | 24 | 2 | 12 | 45 | 3 | 15 | 44 | 3 | 14 |
| 120 | 16 | 1 | 14 | 17 | 1 | 17 | 34 | 2 | 17 | 29 | 2 | 14 | 54 | 4 | 13 | 53 | 3 | 17 |
| 140 | 19 | 1 | 14 | 20 | 1 | 18 | 40 | 3 | 13 | 34 | 2 | 17 | 64 | 4 | 16 | 62 | 3 | 20 |
| 160 | 22 | 1 | 14 | 23 | 1 | 18 | 46 | 3 | 15 | 39 | 2 | 18 | 73 | 5 | 14 | 71 | 4 | 17 |
| 180 | 25 | 2 | 12 | 25 | 2 | 12 | 52 | 4 | 13 | 43 | 3 | 14 | 82 | 5 | 16 | 80 | 4 | 20 |
| 200 | 28 | 2 | 12 | 28 | 2 | 12 | 58 | 4 | 14 | 48 | 3 | 16 | 91 | 6 | 15 | 88 | 5 | 17 |
| 220 | 30 | 2 | 12 | 31 | 2 | 12 | 64 | 4 | 16 | 53 | 3 | 17 | 100 | 6 | 16 | 97 | 5 | 19 |
| 240 | 33 | 2 | 12 | 34 | 2 | 12 | 69 | 5 | 13 | 58 | 3 | 19 | 109 | 7 | 5 | 106 | 6 | 17 |
| 260 | 36 | 3 | 12 | 37 | 3 | 12 | 75 | 5 | 15 | 63 | 3 | 20 | 118 | 8 | 14 | 115 | 6 | 19 |
| 280 | 39 | 3 | 13 | 40 | 3 | 13 | 81 | 5 | 16 | 68 | 4 | 17 | 128 | 8 | 16 | 124 | 6 | 20 |
| 300 | 42 | 3 | 14 | 43 | 3 | 14 | 87 | 6 | 14 | 73 | 4 | 18 | 137 | 9 | 15 | 133 | 7 | 19 |
| 335 | 46 | 3 | 14 | 48 | 3 | 16 | 97 | 6 | 16 | 81 | 4 | 20 | 153 | 9 | 16 | 148 | 8 | 18 |
| 370 | 51 | 4 | 12 | 53 | 3 | 17 | 107 | 7 | 15 | 90 | 5 | 18 | 169 | 10 | 16 | 164 | 8 | 20 |
| 400 | 56 | 4 | 13 | 57 | 3 | 18 | 116 | 7 | 16 | 97 | 5 | 19 | --- | --- | --- | 177 | 9 | 19 |
| 435 | 60 | 5 | 12 | 62 | 4 | 15 | 126 | 8 | 15 | 106 | 6 | 17 | --- | --- | --- | 193 | 9 | 20 |
| 470 | 65 | 5 | 13 | 67 | 4 | 16 | 136 | 9 | 15 | 114 | 6 | 19 | --- | --- | --- | 208 | 10 | 20 |
| 500 | 70 | 5 | 14 | 72 | 4 | 18 | 145 | 9 | 16 | 121 | 6 | 20 | --- | --- | --- | --- | --- | --- |
| 535 | 74 | 5 | 14 | 77 | 5 | 15 | 155 | 9 | 16 | 130 | 7 | 18 | --- | --- | --- | --- | --- | --- |
| 570 | 79 | 6 | 13 | 82 | 5 | 16 | 165 | 10 | 16 | 139 | 7 | 19 | --- | --- | --- | --- | --- | --- |
| 600 | 84 | 6 | 14 | 86 | 5 | 17 | --- | --- | --- | 146 | 8 | 18 | --- | --- | --- | --- | --- | --- |
| 640 | 89 | 6 | 14 | 92 | 5 | 18 | --- | --- | --- | 156 | 8 | 19 | --- | --- | --- | --- | --- | --- |
| 680 | 95 | 7 | 13 | 97 | 6 | 16 | --- | --- | --- | 165 | 9 | 18 | --- | --- | --- | --- | --- | --- |
| 720 | 100 | 7 | 14 | 103 | 6 | 17 | --- | --- | --- | 175 | 9 | 19 | --- | --- | --- | --- | --- | --- |
| 760 | 106 | 8 | 13 | 109 | 6 | 18 | --- | --- | --- | 185 | 9 | 19 | --- | --- | --- | --- | --- | --- |
| 800 | 112 | 8 | 14 | 114 | 7 | 16 | --- | --- | --- | 195 | 9 | 20 | --- | --- | --- | --- | --- | --- |
| 840 | 117 | 9 | 13 | 120 | 7 | 17 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 880 | 123 | 9 | 13 | 126 | 7 | 18 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 920 | 128 | 9 | 14 | 132 | 8 | 16 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 960 | 134 | 10 | 13 | 138 | 8 | 17 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1000 | 140 | 10 | 14 | 144 | 8 | 18 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1050 | --- | --- | --- | 151 | 8 | 18 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1100 | --- | --- | --- | 158 | 9 | 17 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1150 | --- | --- | --- | 165 | 9 | 18 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1200 | --- | --- | --- | 172 | 9 | 18 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1250 | --- | --- | --- | 180 | 10 | 18 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

### Calculating Limits

If other numbers are needed than those featured in Table 21, the results can be calculated. Do not use the calculations on page 33, due to charger efficiencies and other factors.

**To calculate the chargers and settings:**

1. Look up the values for **A**, **B**, and **C**.

   **A** = the battery bank's maximum charge current (in Adc) from the battery manufacturer.

   **B** = the maximum DC output of the appropriate inverter model. This is taken from Table 22.

   **C** = the maximum AC input of the appropriate inverter model. This is taken from Table 22.

2. Select a value for D and perform the following calculation.

   **D** = the ***Charger AC Limit*** setting. This value must be 12 or higher. (See pages 49 and 73.) A higher value uses fewer chargers and turns off all others. A lower value, or 12, leaves more chargers on.

3. Perform the following calculation.

   $$\frac{\mathbf{A}}{\mathbf{B}}(\mathbf{C}) \div \mathbf{D} = \mathbf{E}$$

   **E** = the number of chargers to use. This number should be rounded down in all cases.

4. Adjust the master inverter's ***Charger AC Limit*** setting to equal **D**.
5. Turn off the chargers for all inverters that exceed **E**. In a system stacked on the HUB communications manager, chargers on higher-numbered ports should be turned off first. Chargers should be turned off by setting the ***Charger Control*** menu item to ***Off***. (See the menu tables beginning on page 76 to locate this command in the menu structure.)

**Table 22 Charge Currents for Calculations**

| Model | Maximum DC Output (sent to battery) | Maximum AC Input (used from source) |
|---|---|---|
| FXR2012A | 100 Adc | 14 Aac |
| VFXR2812A | 125 Adc | 18 Aac |
| FXR2524A | 55 Adc | 14 Aac |
| VFXR3524A | 82 Adc | 20 Aac |
| FXR3048A | 35 Adc | 14 Aac |
| VFXR3648A | 45 Adc | 20 Aac |

# Firmware Revision

This manual applies to inverter models with Revision 001.006.xxx or higher.

Updates to the inverter's firmware are periodically available. These can be downloaded from the OutBack website *www.outbackpower.com*. See page 14.

# Default Settings and Ranges

**NOTES:** Certain items are retained at the present setting even when the inverter is reset to factory defaults. These items are noted with the letter "X" in the Item column.

Certain items, particularly those in the Auxiliary menus, share common set points. If one of these items is changed in a mode menu, all menus with this set point will show the same change.

Certain menus are only visible when the installer password is used, particularly the Grid Interface Protection menu. These menus are bordered in the table with a double line of this style:

### Table 23 FXR Settings for 12-Volt Models

| 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 28 for increments) | | | 30 | 0 | 200 |
| | ***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*** | |
| | ***Charger Control*** | | | ***On*** | ***On*** or ***Off*** | |
| | ***Grid Input AC Limit*** | | | 60 Aac | 5 Aac | 60 Aac |
| | ***Gen Input AC Limit*** | | | 60 Aac | 5 Aac | 60 Aac |
| | ***Charger AC Limit*** | FXR2012A | | 12 Aac | 0 Aac | 14 Aac |
| | | VFXR2812A | | 16 Aac | 0 Aac | 18 Aac |
| **Grid AC Input Mode and Limits** | ***Input Mode*** | | | ***Support*** | ***Generator, Support, UPS, Backup, Mini Grid, Grid Zero*** | |
| | ***Voltage Limit Lower*** | | | 108 Vac | 85 Vac | 110 Vac |
| | (Voltage Limit) ***Upper*** | | | 132 Vac | 125 Vac | 140 Vac |
| | ***Transfer Delay*** | | | 1.0 second | 0.12 seconds | 4.0 seconds |
| | ***Connect Delay*** | | | 0.2 minutes | 0.2 minutes | 25.0 minutes |
| | If ***Mini Grid*** mode is selected: | ***Connect to Grid*** | | 12.0 Vdc | 11.0 Vdc | 16.0 Vdc |
| | | (Connect) ***Delay*** | | 10 minutes | 2 minutes | 200 minutes |
| | If ***GridZero*** mode is selected: | ***DoD Volts*** | | 12.5 Vdc | 11.0 Vdc | 16.0 Vdc |
| | | ***DoD Amps*** | FXR2012A | 12 Aac | 1 Aac | 16 Aac |
| | | | VFXR2812A | 12 Aac | 1 Aac | 22 Aac |
| **Gen AC Input Mode and Limits** | ***Input Mode*** | | | ***Generator*** | ***Generator, Support, UPS, Backup, Mini Grid, Grid Zero*** | |
| | ***Voltage Limit Lower*** | | | 108 Vac | 85 Vac | 110 Vac |
| | (Voltage Limit) ***Upper*** | | | 140 Vac | 125 Vac | 140 Vac |
| | ***Transfer Delay*** | | | 1.0 second | 0.12 seconds | 4.0 seconds |
| | ***Connect Delay*** | | | 0.5 minutes | 0.2 minutes | 25.0 minutes |
| | If ***Mini Grid*** mode is selected: | ***Connect to Grid*** | | 12.0 Vdc | 11.0 Vdc | 16.0 Vdc |
| | | (Connect) ***Delay*** | | 10 minutes | 2 minutes | 200 minutes |
| | If ***GridZero*** mode is selected: | ***DoD Volts*** | | 12.5 Vdc | 11.0 Vdc | 16.0 Vdc |
| | | ***DoD Amps*** | FXR2012A | 12 Aac | 1 Aac | 16 Aac |
| | | | VFXR2812A | 12 Aac | 1 Aac | 22 Aac |
| **AC Output** | ***Output Voltage*** | | **X** | 120 Vac | 100 Vac | 130 Vac |
| **Low Battery** | ***Cut-Out Voltage*** | | | 10.5 Vdc | 9.0 Vdc | 12.0 Vdc |
| | ***Cut-In Voltage*** | | | 12.5 Vdc | 10.0 Vdc | 14.0 Vdc |
| **Battery Charger** | ***Absorb Voltage*** | | | 14.4 Vdc | 11.0 Vdc | 16.0 Vdc |
| | (Absorb) ***Time*** | | | 1.0 hours | 0.0 hours | 24.0 hours |
| | ***Float Voltage*** | | | 13.6 Vdc | 11.0 Vdc | 16.0 Vdc |
| | (Float) ***Time*** | | | 1.0 hours | 0.0 hours | 24/7 |
| | ***Re-Float Voltage*** | | | 12.5 Vdc | 11.0 Vdc | 16.0 Vdc |
| | ***Re-Bulk Voltage*** | | | 12.0 Vdc | 11.0 Vdc | 16.0 Vdc |
| **Battery Equalize** | ***Equalize Voltage*** | | | 14.6 Vdc | 11.0 Vdc | 17.0 Vdc |
| | (Equalize) ***Time*** | | | 1.0 hours | 0.0 hours | 24.0 hours |

## Table 23 FXR Settings for 12-Volt Models

| Field | Item | | Default | Minimum | Maximum |
|---|---|---|---|---|---|
| **Auxiliary Output** | ***Aux Control*** | | ***Auto*** | ***Off, Auto*** or ***On*** | |
| | ***Aux Mode*** | | ***Vent Fan*** | ***Load Shed, Gen Alert, Fault, Vent Fan, Cool Fan, DC Divert, GT Limits, Source Status, AC Divert*** | |
| | (Load Shed) ***ON: Batt >*** | | 14.0 Vdc | 10.0 Vdc | 18.0 Vdc |
| | (Load Shed ON) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (Load Shed) ***OFF: Batt <*** | | 11.0 Vdc | 10.0 Vdc | 18.0 Vdc |
| | (Load Shed OFF) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (Gen Alert) ***ON: Batt <*** | | 11.0 Vdc | 10.0 Vdc | 18.0 Vdc |
| | (Gen Alert ON) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (Gen Alert) ***OFF: Batt >*** | | 14.0 Vdc | 10.0 Vdc | 18.0 Vdc |
| | (Gen Alert OFF) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (Vent Fan) ***ON: Batt >*** | | 14.0 Vdc | 10.0 Vdc | 18.0 Vdc |
| | (Vent Fan) ***Off Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (DC Divert) ***ON: Batt >*** | | 14.0 Vdc | 10.0 Vdc | 18.0 Vdc |
| | (DC Divert ON) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (DC Divert) ***OFF: Batt <*** | | 11.0 Vdc | 10.0 Vdc | 18.0 Vdc |
| | (DC Divert OFF) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (AC Divert) ***ON: Batt >*** | | 14.0 Vdc | 10.0 Vdc | 18.0 Vdc |
| | (AC Divert ON) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (AC Divert) ***OFF: Batt <*** | | 11.0 Vdc | 10.0 Vdc | 18.0 Vdc |
| | (AC Divert OFF) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| **Inverter Stacking** | ***Stack Mode*** | | ***Master*** | ***Master, Slave, L2 Phase Master, B Phase Master, C Phase Master*** | |
| **Power Save Ranking** | Mode = ***Master***: ***Master Power Save Level*** | | 0 | 0 | 10 |
| | Mode = ***Slave***: ***Slave Power Save Level*** | | 1 | 1 | 10 |
| **Grid-Tie Sell** | ***Offset Enable*** | | ***Y*** | ***Y*** or ***N*** | |
| | ***Sell Voltage*** | | 13.0 Vdc | 11.0 Vdc | 16.0 Vdc |
| **Calibrate** | ***AC Input Voltage*** | X | 0 Vac | –7 Vac | 7 Vac |
| | ***AC Output Voltage*** | X | 0 Vac | –7 Vac | 7 Vac |
| | ***Battery Voltage*** | X | 0.0 Vdc | –0.2 Vdc | 0.2 Vdc |
| **Grid Interface Protection Menu** | | | | | |
| **Operating Frequency** | ***Operating Frequency*** | X | 60 Hz | 50 Hz, 60 Hz | |
| **Stage 1 Voltage Trip**[15] | ***Over Voltage Clearance Time*** | X | 1.0 seconds | 0.12 seconds | 5.0 seconds |
| | ***Over Voltage Trip*** | X | 132 Vac | 120 Vac | 150 Vac |
| | ***Under Voltage Clearance Time*** | X | 2.0 seconds | 0.12 seconds | 5.0 seconds |
| | ***Under Voltage Trip*** | X | 106 Vac | 80 Vac | 120 Vac |
| **Stage 2 Voltage Trip**[15] | ***Over Voltage Clearance Time*** | X | 0.16 seconds | 0.12 seconds | 5.0 seconds |
| | ***Over Voltage Trip*** | X | 144 vac | 120 Vac | 150 Vac |
| | ***Under Voltage Clearance Time*** | X | 0.16 seconds | 0.12 seconds | 5.0 seconds |
| | ***Under Voltage Trip*** | X | 60 Vac | 60 Vac | 120 vac |
| **Frequency Trip**[15] | ***Over Frequency Clearance Time*** | X | 0.16 seconds | 0.12 seconds | 5.0 seconds |
| | ***Over Frequency Trip*** 60-Hz system | X | 60.5 Hz | 60.2 Hz | 65.0 Hz |
| | ***Over Frequency Trip*** 50-Hz system | | 50.5 Hz | 50.2 Hz | 55.0 Hz |
| | ***Under Frequency Clearance Time*** | X | 0.16 seconds | 0.12 seconds | 5.0 seconds |
| | ***Under Frequency Trip*** 60-Hz system | X | 59.3 Hz | 55.0 Hz | 59.8 Hz |
| | ***Under Frequency Trip*** 50-Hz system | | 49.3 Hz | 45.0 Hz | 49.8 Hz |
| **Mains Loss**[15] | ***Clearance Time*** | X | 2.0 seconds | 1.0 seconds | 25.0 seconds |
| | ***Reconnect Delay*** | X | 300 seconds | 2 seconds | 302 seconds |
| **Multi-Phase Coordination** | ***Coordin. AC Connect/Disconn.*** | | ***N*** | ***Y*** or ***N*** | |
| **Sell Current Limit** | ***Maximum Sell Current*** | X | *This selection inoperative in 12-volt models* | | |
| **Model Select** | | X | Vented | Vented or Sealed | |

[15] The grid-interactive function is not available in 12-volt models. Adjusting these items will not affect operation.

## Table 24 FXR Settings for 24-Volt Models

| 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 28 for increments) | | | 30 | 0 | 200 |
| | ***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*** | |
| | ***Charger Control*** | | | ***On*** | ***On*** or ***Off*** | |
| | ***Grid Input AC Limit*** | | | 60 Aac | 5 Aac | 60 Aac |
| | ***Gen Input AC Limit*** | | | 60 Aac | 5 Aac | 60 Aac |
| | ***Charger AC Limit*** | FXR2524A | | 12 Aac | 0 Aac | 14Aac |
| | | VFXR3524A | | 18 Aac | 0 Aac | 20 Aac |
| **Grid AC Input Mode and Limits** | ***Input Mode*** | | | ***Support*** | ***Generator, Support, Grid Tied, UPS, Backup, Mini Grid, Grid Zero*** | |
| | ***Voltage Limit Lower*** | | | 108 Vac | 85 Vac | 110 Vac |
| | (Voltage Limit) ***Upper*** | | | 132 Vac | 125 Vac | 140 Vac |
| | ***Transfer Delay*** | | | 1.0 second | 0.12 seconds | 4.0 seconds |
| | ***Connect Delay*** | | | 0.2 minutes | 0.2 minutes | 25.0 minutes |
| | If ***Mini Grid*** mode is selected: | ***Connect to Grid*** | | 24.0 Vdc | 22.0 Vdc | 32.0 Vdc |
| | | (Connect) ***Delay*** | | 10 minutes | 2 minutes | 200 minutes |
| | If ***Grid Zero*** mode is selected: | ***DoD Volts*** | | 25.0 Vdc | 22.0 Vdc | 32.0 Vdc |
| | | ***DoD Amps*** | FXR2524A | 12 Aac | 1 Aac | 20 Aac |
| | | | VFXR3524A | 12 Aac | 1 Aac | 28 Aac |
| **Gen AC Input Mode and Limits** | ***Input Mode*** | | | ***Generator*** | ***Generator, Support, Grid Tied, UPS, Backup, Mini Grid, Grid Zero*** | |
| | ***Voltage Limit Lower*** | | | 108 Vac | 85 Vac | 110 Vac |
| | (Voltage Limit) ***Upper*** | | | 140 Vac | 125 Vac | 140 Vac |
| | ***Transfer Delay*** | | | 1.0 second | 0.12 seconds | 4.0 seconds |
| | ***Connect Delay*** | | | 0.5 minutes | 0.2 minutes | 25.0 minutes |
| | If ***Mini Grid*** mode is selected: | ***Connect to Grid*** | | 24.0 Vdc | 22.0 Vdc | 32.0 Vdc |
| | | (Connect) ***Delay*** | | 10 minutes | 2 minutes | 200 minutes |
| | If ***GridZero*** mode is selected: | ***DoD Volts*** | | 25.0 Vdc | 22.0 Vdc | 32.0 Vdc |
| | | ***DoD Amps*** | FXR2524A | 12 Aac | 1 Aac | 20 Aac |
| | | | VFXR3524A | 12 Aac | 1 Aac | 28 Aac |
| **AC Output** | ***Output Voltage*** | | **X** | 120 Vac | 100 Vac | 130 Vac |
| **Low Battery** | ***Cut-Out Voltage*** | | | 21.0 Vdc | 18.0 Vdc | 24.0 Vdc |
| | ***Cut-In Voltage*** | | | 25.0 Vdc | 20.0 Vdc | 28.0 Vdc |
| **Battery Charger** | ***Absorb Voltage*** | | | 28.8 Vdc | 22.0 Vdc | 32.0 Vdc |
| | (Absorb) ***Time*** | | | 1.0 hours | 0.0 hours | 24.0 hours |
| | ***Float Voltage*** | | | 27.2 Vdc | 22.0 Vdc | 32.0 Vdc |
| | (Float) ***Time*** | | | 1.0 hours | 0.0 hours | 24/7 |
| | ***Re-Float Voltage*** | | | 25.0 Vdc | 22.0 Vdc | 32.0 Vdc |
| | ***Re-Bulk Voltage*** | | | 24.0 Vdc | 22.0 Vdc | 32.0 Vdc |
| **Battery Equalize** | ***Equalize Voltage*** | | | 29.2 Vdc | 22.0 Vdc | 34.0 Vdc |
| | (Equalize) ***Time*** | | | 1.0 hours | 0.0 hours | 24.0 hours |

## Table 24 FXR Settings for 24-Volt Models

| Field | Item | | Default | Minimum | Maximum |
|---|---|---|---|---|---|
| Auxiliary Output | ***Aux Control*** | | ***Auto*** | ***Off, Auto*** or ***On*** | |
| | ***Aux Mode*** | | ***Vent Fan*** | ***Load Shed, Gen Alert, Fault, Vent Fan, Cool Fan, DC Divert, GT Limits, Source Status, AC Divert*** | |
| | (Load Shed) ***ON: Batt >*** | | 28.0 Vdc | 20.0 Vdc | 36.0 Vdc |
| | (Load Shed ON) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (Load Shed) ***OFF: Batt <*** | | 22.0 Vdc | 20.0 Vdc | 36.0 Vdc |
| | (Load Shed OFF) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (Gen Alert) ***ON: Batt <*** | | 22.0 Vdc | 20.0 Vdc | 36.0 Vdc |
| | (Gen Alert ON) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (Gen Alert) ***OFF: Batt >*** | | 28.0 Vdc | 20.0 Vdc | 36.0 Vdc |
| | (Gen Alert OFF) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (Vent Fan) ***ON: Batt >*** | | 28.0 Vdc | 20.0 Vdc | 36.0 Vdc |
| | (Vent Fan) ***Off Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (DC Divert) ***ON: Batt >*** | | 28.0 Vdc | 20.0 Vdc | 36.0 Vdc |
| | (DC Divert ON) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (DC Divert) ***OFF: Batt <*** | | 22.0 Vdc | 20.0 Vdc | 36.0 Vdc |
| | (DC Divert OFF) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (AC Divert) ***ON: Batt >*** | | 28.0 Vdc | 20.0 Vdc | 36.0 Vdc |
| | (AC Divert ON) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (AC Divert) ***OFF: Batt <*** | | 22.0 Vdc | 20.0 Vdc | 36.0 Vdc |
| | (AC Divert OFF) ***Delay*** | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| Inverter Stacking | ***Stack Mode*** | | ***Master*** | ***Master, Slave, L2 Phase Master, B Phase Master, C Phase Master*** | |
| Power Save Ranking | Mode = ***Master***: ***Master Power Save Level*** | | 0 | 0 | 10 |
| | Mode = ***Slave***: ***Slave Power Save Level*** | | 1 | 1 | 10 |
| Grid-Tie Sell | ***Offset Enable*** | | ***Y*** | ***Y*** or ***N*** | |
| | ***Sell Voltage*** | | 26.0 Vdc | 22.0 Vdc | 32.0 Vdc |
| Calibrate | ***AC Input Voltage*** | X | 0 Vac | –7 Vac | 7 Vac |
| | ***AC Output Voltage*** | X | 0 Vac | –7 Vac | 7 Vac |
| | ***Battery Voltage*** | X | 0.0 Vdc | –0.4 Vdc | 0.4 Vdc |
| **Grid Interface Protection Menu** | | | | | |
| Operating Frequency | ***Operating Frequency*** | X | 60 Hz | 50 Hz, 60 Hz | |
| Stage 1 Voltage Trip | ***Over Voltage Clearance Time*** | X | 1.0 seconds | 0.12 seconds | 5.0 seconds |
| | ***Over Voltage Trip*** | X | 132 Vac | 120 Vac | 150 Vac |
| | ***Under Voltage Clearance Time*** | X | 2.0 seconds | 0.12 seconds | 5.0 seconds |
| | ***Under Voltage Trip*** | X | 106 Vac | 80 Vac | 120 Vac |
| Stage 2 Voltage Trip | ***Over Voltage Clearance Time*** | X | 0.16 seconds | 0.12 seconds | 5.0 seconds |
| | ***Over Voltage Trip*** | X | 144 vac | 120 Vac | 150 Vac |
| | ***Under Voltage Clearance Time*** | X | 0.16 seconds | 0.12 seconds | 5.0 seconds |
| | ***Under Voltage Trip*** | X | 60 Vac | 60 Vac | 120 vac |
| Frequency Trip | ***Over Frequency Clearance Time*** | X | 0.16 seconds | 0.12 seconds | 5.0 seconds |
| | ***Over Frequency Trip*** 60-Hz system | X | 60.5 Hz | 60.2 Hz | 65.0 Hz |
| | ***Over Frequency Trip*** 50-Hz system | | 50.5 Hz | 50.2 Hz | 55.0 Hz |
| | ***Under Frequency Clearance Time*** | X | 0.16 seconds | 0.12 seconds | 5.0 seconds |
| | ***Under Frequency Trip*** 60-Hz system | X | 59.3 Hz | 55.0 Hz | 59.8 Hz |
| | ***Under Frequency Trip*** 50-Hz system | | 49.3 Hz | 45.0 Hz | 49.8 Hz |
| Mains Loss | ***Clearance Time*** | X | 2.0 seconds | 1.0 seconds | 25.0 seconds |
| | ***Reconnect Delay*** | X | 300 seconds | 2 seconds | 302 seconds |
| Multi-Phase Coordination | ***Coordin. AC Connect/Disconn.*** | | ***N*** | ***Y*** or ***N*** | ***Y*** |
| Sell Current Limit | ***Maximum Sell Current*** FXR2524A | X | 20 Aac | 5 Aac | 20 Aac |
| | ***Maximum Sell Current*** VFXR3524A | | 20 Aac | 5 Aac | 28 Aac |
| Model Select | | X | Vented | Vented or Sealed | |

## Table 25 FXR Settings for 48-Volt Models

| 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 28 for increments) | | | 30 | 0 | 200 |
| | ***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*** | |
| | ***Charger Control*** | | | ***On*** | ***On*** or ***Off*** | |
| | ***Grid Input AC Limit*** | | | 60 Aac | 5 Aac | 60 Aac |
| | ***Gen Input AC Limit*** | | | 60 Aac | 5 Aac | 60 Aac |
| | ***Charger AC Limit*** | FXR3048A | | 12 Aac | 0 Aac | 14 Aac |
| | | VFXR3648A | | 18 Aac | 0 Aac | 20 Aac |
| **Grid AC Input Mode and Limits** | ***Input Mode*** | | | ***Support*** | ***Generator, Support, Grid Tied, UPS, Backup, Mini Grid, Grid Zero*** | |
| | ***Voltage Limit Lower*** | | | 108 Vac | 85 Vac | 110 Vac |
| | (Voltage Limit) ***Upper*** | | | 132 Vac | 125 Vac | 140 Vac |
| | ***Transfer Delay*** | | | 1.0 second | 0.12 seconds | 4.0 seconds |
| | ***Connect Delay*** | | | 0.2 minutes | 0.2 minutes | 25.0 minutes |
| | If ***Mini Grid*** mode is selected: | ***Connect to Grid*** | | 48.0 Vdc | 44.0 Vdc | 64.0 Vdc |
| | | (Connect) ***Delay*** | | 10 minutes | 2 minutes | 200 minutes |
| | If ***Grid Zero*** mode is selected: | ***DoD Volts*** | | 50.0 Vdc | 44.0 Vdc | 64.0 Vdc |
| | | ***DoD Amps*** | FXR3048A | 12 Aac | 1 Aac | 24 Aac |
| | | | VFXR3648A | 12 Aac | 1 Aac | 30 Aac |
| **Gen AC Input Mode and Limits** | ***Input Mode*** | | | ***Generator*** | ***Generator, Support, Grid Tied, UPS, Backup, Mini Grid, Grid Zero*** | |
| | ***Voltage Limit Lower*** | | | 108 Vac | 85 Vac | 110 Vac |
| | (Voltage Limit) ***Upper*** | | | 140 Vac | 125 Vac | 140 Vac |
| | ***Transfer Delay*** | | | 1.0 second | 0.12 seconds | 4.0 seconds |
| | ***Connect Delay*** | | | 0.5 minutes | 0.2 minutes | 25.0 minutes |
| | If ***Mini Grid*** mode is selected: | ***Connect to Grid*** | | 48.0 Vdc | 44.0 Vdc | 64.0 Vdc |
| | | (Connect) ***Delay*** | | 10 minutes | 2 minutes | 200 minutes |
| | If ***GridZero*** mode is selected: | ***DoD Volts*** | | 50.0 Vdc | 44.0 Vdc | 64.0 Vdc |
| | | ***DoD Amps*** | FXR3048A | 12 Aac | 1 Aac | 24 Aac |
| | | | VFXR3648A | 12 Aac | 1 Aac | 30 Aac |
| **AC Output** | ***Output Voltage*** | | **X** | 120 Vac | 100 Vac | 130 Vac |
| **Low Battery** | ***Cut-Out Voltage*** | | | 42.0 Vdc | 36.0 Vdc | 48.0 Vdc |
| | ***Cut-In Voltage*** | | | 50.0 Vdc | 40.0 Vdc | 56.0 Vdc |
| **Battery Charger** | ***Absorb Voltage*** | | | 57.6 Vdc | 44.0 Vdc | 64.0 Vdc |
| | (Absorb) ***Time*** | | | 1.0 hours | 0.0 hours | 24.0 hours |
| | ***Float Voltage*** | | | 54.4 Vdc | 44.0 Vdc | 64.0 Vdc |
| | (Float) ***Time*** | | | 1.0 hours | 0.0 hours | 24/7 |
| | ***Re-Float Voltage*** | | | 50.0 Vdc | 44.0 Vdc | 64.0 Vdc |
| | ***Re-Bulk Voltage*** | | | 48.0 Vdc | 44.0 Vdc | 64.0 Vdc |
| **Battery Equalize** | ***Equalize Voltage*** | | | 58.4 Vdc | 44.0 Vdc | 68.0 Vdc |
| | (Equalize) ***Time*** | | | 1.0 hours | 0.0 hours | 24.0 hours |
| **Auxiliary Output** | ***Aux Control*** | | | ***Auto*** | ***Off, Auto*** or ***On*** | |

## Table 25 FXR Settings for 48-Volt Models

| Field | Item | | | Default | Minimum | Maximum |
|---|---|---|---|---|---|---|
| | ***Aux Mode*** | | | ***Vent Fan*** | ***Load Shed, Gen Alert, Fault, Vent Fan, Cool Fan, DC Divert, GT Limits, Source Status, AC Divert*** | |
| | (Load Shed) ***ON: Batt >*** | | | 56.0 Vdc | 40.0 Vdc | 72.0 Vdc |
| | (Load Shed ON) ***Delay*** | | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (Load Shed) ***OFF: Batt <*** | | | 44.0 Vdc | 40.0 Vdc | 72.0 Vdc |
| | (Load Shed OFF) ***Delay*** | | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (Gen Alert) ***ON: Batt <*** | | | 44.0 Vdc | 40.0 Vdc | 72.0 Vdc |
| | (Gen Alert ON) ***Delay*** | | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (Gen Alert) ***OFF: Batt >*** | | | 56.0 Vdc | 40.0 Vdc | 72.0 Vdc |
| | (Gen Alert OFF) ***Delay*** | | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (Vent Fan) ***ON: Batt >*** | | | 56.0 Vdc | 40.0 Vdc | 72.0 Vdc |
| | (Vent Fan) ***Off Delay*** | | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (DC Divert) ***ON: Batt >*** | | | 56.0 Vdc | 40.0 Vdc | 72.0 Vdc |
| | (DC Divert ON) ***Delay*** | | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (DC Divert) ***OFF: Batt <*** | | | 44.0 Vdc | 40.0 Vdc | 72.0 Vdc |
| | (DC Divert OFF) ***Delay*** | | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (AC Divert) ***ON: Batt >*** | | | 56.0 Vdc | 40.0 Vdc | 72.0 Vdc |
| | (AC Divert ON) ***Delay*** | | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| | (AC Divert) ***OFF: Batt <*** | | | 44.0 Vdc | 40.0 Vdc | 72.0 Vdc |
| | (AC Divert OFF) ***Delay*** | | | 0.5 minutes | 0.1 minutes | 25.0 minutes |
| **Inverter Stacking** | ***Stack Mode*** | | | ***Master*** | ***Master, Slave, L2 Phase Master, B Phase Master, C Phase Master*** | |
| **Power Save Ranking** | Mode = ***Master***: | ***Master Power Save Level*** | | 0 | 0 | 10 |
| | Mode = ***Slave***: | ***Slave Power Save Level*** | | 1 | 1 | 10 |
| **Grid-Tie Sell** | ***Offset Enable*** | | | ***Y*** | ***Y*** or ***N*** | |
| | ***Sell Voltage*** | | | 52.0 Vdc | 44.0 Vdc | 64.0 Vdc |
| **Calibrate** | ***AC Input Voltage*** | | X | 0 Vac | –7 Vac | 7 Vac |
| | ***AC Output Voltage*** | | X | 0 Vac | –7 Vac | 7 Vac |
| | ***Battery Voltage*** | | X | 0.0 Vdc | –0.8 Vdc | 0.8 Vdc |
| **Grid Interface Protection Menu** | | | | | | |
| **Operating Frequency** | ***Operating Frequency*** | | X | 60 Hz | 50 Hz, 60 Hz | |
| **Stage 1 Voltage Trip** | ***Over Voltage Clearance Time*** | | X | 1.0 seconds | 0.12 seconds | 5.0 seconds |
| | ***Over Voltage Trip*** | | X | 132 Vac | 120 Vac | 150 Vac |
| | ***Under Voltage Clearance Time*** | | X | 2.0 seconds | 0.12 seconds | 5.0 seconds |
| | ***Under Voltage Trip*** | | X | 106 Vac | 80 Vac | 120 Vac |
| **Stage 2 Voltage Trip** | ***Over Voltage Clearance Time*** | | X | 0.16 seconds | 0.12 seconds | 5.0 seconds |
| | ***Over Voltage Trip*** | | X | 144 vac | 120 Vac | 150 Vac |
| | ***Under Voltage Clearance Time*** | | X | 0.16 seconds | 0.12 seconds | 5.0 seconds |
| | ***Under Voltage Trip*** | | X | 60 Vac | 60 Vac | 120 vac |
| **Frequency Trip** | ***Over Frequency Clearance Time*** | | X | 0.16 seconds | 0.12 seconds | 5.0 seconds |
| | ***Over Frequency Trip*** | 60-Hz system | X | 60.5 Hz | 60.2 Hz | 65.0 Hz |
| | | 50-Hz system | | 50.5 Hz | 50.2 Hz | 55.0 Hz |
| | ***Under Frequency Clearance Time*** | | X | 0.16 seconds | 0.12 seconds | 5.0 seconds |
| | ***Under Frequency Trip*** | 60-Hz system | X | 59.3 Hz | 55.0 Hz | 59.8 Hz |
| | | 50-Hz system | | 49.3 Hz | 45.0 Hz | 49.8 Hz |
| **Mains Loss** | ***Clearance Time*** | | X | 2.0 seconds | 1.0 seconds | 25.0 seconds |
| | ***Reconnect Delay*** | | X | 300 seconds | 2 seconds | 302 seconds |
| **Multi-Phase Coordination** | ***Coordin. AC Connect/Disconn.*** | | | ***N*** | ***Y*** or ***N*** | ***Y*** |
| **Sell Current Limit** | ***Maximum Sell Current*** | FXR3048A | X | 24 Aac | 5 Aac | 24 Aac |
| | | VFXR3648A | | 24 Aac | 5 Aac | 30 Aac |
| **Model Select** | | | X | Vented | Vented or Sealed | |

# Definitions

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

**Table 26 Terms and Definitions**

| Term | Definition |
|---|---|
| 12V AUX | Auxiliary connection that supplies 12 Vdc to control external devices |
| AC | Alternating Current; refers to voltage produced by the inverter, utility grid, or generator |
| AGS | Advanced Generator Start |
| 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 |
| FCC | Federal Communications Commission |
| GND | Ground; a permanent conductive connection to earth for safety reasons; also known as Chassis Ground, Protective Earth, PE, Grounding Electrode Conductor, and GEC |
| Grid/Hybrid™ | System technology which optimizes both grid-interactive and off-grid options |
| Grid-interactive, grid-intertie, grid-tie | Utility grid power is available for use and the inverter is a model capable of returning (selling) electricity back to the utility grid |
| HBX | High Battery Transfer; a function of the remote system display |
| IEEE | Institute of Electrical and Electronics Engineers; refers to a series of standards and practices for the testing of electrical products |
| IEC | International Electrotechnical Commission; an international standards organization |
| 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 |
| NEC | National Electric Code |
| NEU | AC Neutral; also known as Common |
| Off-grid | Utility grid power ***is not*** available for use |
| PV | Photovoltaic |
| RELAY AUX | Auxiliary connection that uses switch (relay) contacts to control external devices |
| 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 |
| System display | Remote interface device (such as the MATE3), 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;<br>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 |
| Utility grid | The electrical service and infrastructure supported by the electrical or utility company; also called "mains", "utility service", or "grid" |

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