Freedom e-GEN System User Guide

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A MISSION CRITICAL ELECTRONICS BRAND

FREEDOM eGEN

⚠⚠DANGER

HAZARD OF FIRE, ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

This Freedom e-GEN System User Guide is in addition to, and incorporates by reference, the relevant product manuals for each product in the power system. After reviewing this guide you must read the relevant product manuals. Unless specified, information on safety, specifications, installation, and operation is as shown in the primary documentation received with the product. Ensure you are familiar with that information before proceeding.

Failure to follow these instructions will result in death or serious injury.

Exclusion for Documentation

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1 Important Safety Information

READ AND SAVE THESE INSTRUCTIONS

Electrical equipment shall be installed, operated, serviced, and maintained only by qualified personnel. Certain configuration tasks shall only be performed by qualified personnel in consultation with your local utility and/or an authorized dealer. Servicing of batteries and the BMS shall only be performed or supervised by qualified personnel with knowledge of lithium-ion batteries and their required precautions. Qualified personnel have training, knowledge, and experience in:

- Installing electrical equipment
- Applying applicable installation codes
- Analyzing and reducing the hazards involved in performing electrical work
- Installing and configuring lithium-ion batteries
- Selecting and using Personal Protective Equipment (PPE)

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⚠⚠DANGER

HAZARD OF FIRE, ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- Equipment must only be installed and serviced by qualified electrical personnel.
- Equipment may be energized from multiple sources. Never operate equipment energized with covers removed.
- In case of fire, use only a Class ABC type (dry chemical) fire extinguisher. Water can be a dangerous extinguishing medium for energized equipment because of the risk of electrical shock.
- Always use a properly rated voltage sensing device to confirm all circuits are de-energized.
- Do not short-circuit the battery.
- Do not expose the battery to flames.
- Do not attempt to open or dismantle the lithium-ion battery. If the battery is damaged, do not touch the corrosive electrolyte or powder. In case battery content comes in contact with skin or eyes, immediately flush the affected area with large amount of clean water and seek medical help.
- Upon disposal, do not crush, puncture, drop, disassemble, dispose of in fire, or similar actions.

Failure to follow these instructions will result in death or serious injury.

⚠WARNING

HAZARD OF FIRE, ELECTRIC SHOCK, EXPLOSION, BURN, OR PERSONAL INJURY

- Always use the Xantrex Battery with the Xantrex BMS. Never bypass the BMS. The BMS must always be connected to the lithium-ion battery and in the circuit for proper operation and safety.
- Do not connect other battery types to the system DC load or the system DC bus.
- Do not expose any of the equipment to rain, snow, or liquids of any type. Products are designed for indoor use only.
- Battery is heavy. Employ precautions and appropriate lifting techniques when handling.
- Do not operate the battery or other equipment with damaged or substandard wiring.
- Do not replace the battery fuses or any other fuses in the system by yourself. Seek qualified assistance.
- Do not obstruct the air ventilation openings on the system devices. Do not install or operate any of the system devices in compartment containing flammable materials or in locations that require ignition-protected equipment.
- If the lithium-ion battery becomes damaged, it can release harmful gases. In such a case, ventilate the area whenever possible but evacuate the vicinity immediately.

Failure to follow these instructions can result in death or serious injury.

NOTICE

RISK OF EQUIPMENT DAMAGE

- Only charge the Xantrex Battery with an approved charger. Contact Xantrex for details.
- Do not physically modify the system devices, wiring harness, and accessories.
- Do not stand on the battery.
- Do not alter the factory settings on any of the system devices including the BMS.
- Do not disassemble the Xantrex Battery or the BMS. They contain non-serviceable parts.
- Do not operate or store the battery outside of the specified environmental limits.
- Do not charge the battery in ambient temperature below freezing.
- Do not charge the battery above the recommended voltage.
- Do not allow the battery to be completely depleted.
- Do not disconnect the battery while it is being charged.
- Always install the Xantrex Battery in an upright position only relative to a horizontal plane with battery power terminals facing upward. Installing batteries on their side or at an angle can lead to long-term performance degradation of the battery. Charging cycles may become severely affected.
- Components which can be recycled must be recycled and those that cannot be recycled must be disposed of according to local, regional, and national environmental regulations.

Failure to follow these instructions can result in damage to equipment and may void the warranty.

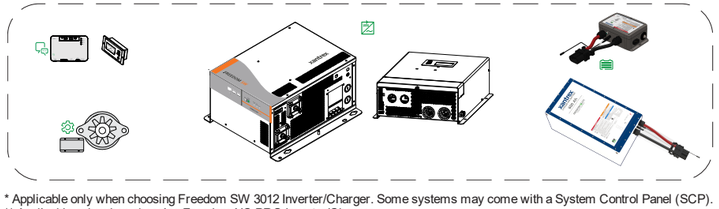
2 Introduction

The Freedom e-GEN System solution from Xantrex is a lithium-ion battery-based power system that offers safe, clean, and efficient onboard power. The system features a Xantrex lithium battery pack and a choice between two Xantrex inverter/chargers, capable of delivering grid-quality AC power to run onboard appliances for an extended period of time. The ability to charge from both the auxiliary alternator and shore power offers flexibility and fast recharge, further empowering your road experience.

The Freedom e-GEN System consists of the following core components:

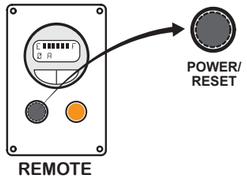
- Freedom SW 3012 Inverter/Charger or Freedom XC PRO Inverter/Charger
- Conext ComBox for Freedom SW and Tablet*
- Freedom X Remote Panel (Bluetooth)**
- Xantrex lithium battery pack and Xantrex BMS (Battery Management System)
- Auxiliary Alternator and dedicated regulator

This user guide provides you basic instructions on how to operate and maintain the Freedom e-GEN System. For more information, refer to each device's Owner's Guide.



* Applicable only when choosing Freedom SW 3012 Inverter/Charger. Some systems may come with a System Control Panel (SCP).
** Applicable only when choosing Freedom XC PRO Inverter/Charger.

3 Turn On Battery and Inverter



REMOTE PANEL

Turning ON the BMS

- A single, brief press of the **POWER/RESET** push button on the remote panel will turn on the BMS and engage battery power.

Turning OFF the BMS

- Press and hold the **POWER/RESET** push button for 3 seconds to turn off the BMS and disengage battery power.

Once battery power is engaged, you can enable and disable the inverter AC output through the SCP*, the Conext ComBox app*, or the FXC Control app** depending on which Xantrex inverter/charger you are using. Instant system status and aggregate usage data are available to help you monitor and assess your energy consumption.

* applicable to the Freedom SW only and the app requires an Android tablet.
** applicable to Freedom XC PRO only and an iOS/Android smart device with Bluetooth. XC PRO unit must be on.

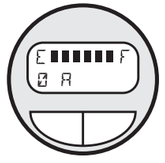
NOTICE

RISK OF EQUIPMENT OR BATTERY DAMAGE

- Do not change the factory settings of the Xantrex inverter/chargers.
- Do not leave appliances on if they are not in use as this will drain the battery..

Failure to follow these instructions can result in damage to equipment and may void the warranty.

4 Monitor Xantrex Battery Status



The SoC LCD Display (PN: 881-0401-12) on the system remote panel powers up whenever BMS is turned on. Its screen has two lines where battery information is displayed.

Press the Left (or Right) button to cycle through the following battery information displayed on the first (or second) line.

Example	Description
12.8V	Battery voltage (Volts)
77F t1	Battery temperature (t1 = battery one)
R0000100	Battery status code used for troubleshooting
D 225 0d	Remaining time until depletion (D) or full charge (C) in days (d) or hours (h)
T0000000	Total amount of amp-hours consumed from the battery since day of manufacture
600.0 Ah	Battery amp-hours (Ah) remaining
8040 Wh	Battery watt-hours (Wh) remaining
E▮▮▮▮▮▮▮F	Battery bar gauge (Empty-Full)
100% BAT	Remaining battery capacity before system shutdown
0A	Discharging current (Amps) no sign OR charging current (Amps) with "+" sign
0W	Load power consumption (Watts)

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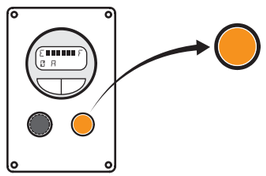
Low Battery Alarm (Orange Light)



REMOTE PANEL

The orange light on the system remote panel is illuminated when battery voltage is low (12% battery capacity left). When this occurs, **remove load** and charge the battery immediately either by turning on the vehicle engine or connecting to shore power.

If you ignore the orange light and continue to drain the battery, the Xantrex inverter/charger will stop inverter operation and cut power to your AC appliances. The BMS also monitors battery capacity and will trigger shutdown events to protect the battery.

At 10% battery capacity, a reserve shutdown event occurs. A single press on the POWER/RESET button will re-engage the battery and allow access to the reserved capacity. Follow the steps in the "System Charging" section to begin charging the battery.

At 3% battery capacity, the battery is depleted and a low voltage shutdown event occurs. Follow the steps in the "Low Battery Recovery" section and charge the battery immediately.

NOTICE

RISK OF BATTERY DAMAGE
Do not allow the battery to be depleted. Charge the battery immediately when the low battery alarm orange light illuminates.
Failure to follow these instructions can result in damage to the battery and may void the warranty.

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System Charging

When the battery's SoC is greater than 10% and while battery power is still engaged, you may charge the battery by engaging power from the charging source.

When SoC is less than 10% but greater than 3%, and the reserve shutdown event has occurred, press the Power button on the BMS. While battery power is engaged, start charging the battery from the charging source.

NOTE: When charging, avoid using heavy loads to prevent prolonged charging time. Also, avoid using heavy DC loads during charging to prevent the system from transitioning to thermal protection mode.

To stop charging, disengage the power from any and all charging sources. Do not turn off the BMS to disconnect the battery while the system is charging.

NOTICE

RISK OF EQUIPMENT DAMAGE
Do not disconnect battery while the system is charging.
Failure to follow these instructions can result in damage to equipment and may void the warranty.

NOTICE

RISK OF BATTERY DAMAGE
- Fully charge the battery and turn off the BMS when the system is not in use for less than a month. Observe proper storage instructions from the battery manufacturer for long-term storage.
- Do not charge the battery in ambient temperature below freezing.
- Do not charge the battery above the recommended voltage.

Failure to follow these instructions can result in damage to the battery and may void the warranty.

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Low Battery Recovery

NOTICE

RISK OF BATTERY DAMAGE
Turn off (or disconnect) all loads completely before performing a Low Battery Recovery procedure.
Failure to follow these instructions can result in damage to battery.

When SoC is less than 3% and the low voltage shutdown event has occured, charge the battery immediately through an approved charging source. Follow the steps below.

1. Turn off (or disconnect) all DC and AC loads completely.
2. Start charging.

NOTE: If charging does not commence, then it is possible that the battery has been completely depleted. The battery including the entire power system has to be serviced by a qualified person such as an authorized technician. Contact your dealer for service.

NOTICE

RISK OF BATTERY DAMAGE
Do not perform the low battery recovery procedure repeatedly. Contact customer service so they can refer you to an authorized technician for service.
Failure to follow these instructions can result in damage to battery.

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Troubleshooting

PROBLEM	CAUSE	SOLUTION
Battery and LCD Display are turned off	Battery is low (reserve shutdown).	Follow the steps in *System Charging* and charge the battery immediately.
	Battery is critically low (low voltage shutdown).	Follow the steps in *Low Battery Recovery* and charge the battery immediately.
	The system is turned off.	Press the POWER/RESET button to turn the system on.
BMS will not turn on.	Battery temperature is outside normal range.	Apply proper ventilation and make sure ambient temperature is not too hot or too cold.
	Battery is critically low.	Follow the steps in *Low Battery Recovery* and charge the battery immediately.
	Battery fuse is blown due to overcurrent or short-circuit.	Call for service. Do not replace fuses in the system by yourself.
Battery information on LCD Display is inaccurate.	Battery is consistently left in a partially discharged state causing SoC reading to gradually drift.	Perform a full charge cycle to bring battery the SoC to 100% and the voltage to at least 14.2V to allow readings to recalibrate. Perform weekly to maintain accuracy. Check that the battery capacity is set correctly.
Charging from the auxiliary alternator is slow.	Alternator temperature is too high.	Allow the alternator to cool down by providing sufficient ventilation. When idle-charging, park the vehicle in a cool spot.
No charging from the auxiliary alternator	Fuse blown or the alternator or regulator is damaged	Call for service
NOTE: Refer to the Xantrex inverter/charger Owner's Guide for troubleshooting tips. Contact customer service if a problem persists.		

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System and Battery Maintenance

1. Have a qualified service person first check the wiring and connections for wear and tear during routine vehicle (RV) maintenance.
2. Then, check the second alternator and belt for wear and tear and appropriate belt tension. Refer to this guide and all applicable guides for safety warning information.

If the Freedom e-GEN System is in regular use, then it is recommended that the Xantrex lithium battery pack be fully charged a minimum of once per two weeks in order for the Xantrex BMS to recalibrate its State of Charge (SoC) setting. This process also ensures that the SoC meter maintains its accuracy.

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BMS Configuration

Xantrex ships every BMS unit pre-configured for the specific lithium-ion battery. However, in some cases a customer may need to make changes to those parameters suited to their system requirements and in consultation with a qualified technician.

The BMS configuration can be done using the two buttons on the SoC LCD Display (sold separately).

Configuring BMS using the SoC LCD Display Unit

To enter the BMS Configuration Menu:

1. Long press for six seconds both buttons on the LCD Display. The BMS will enter Setup mode and will display the first configuration parameter and its current value.
2. Press the left button to scroll through the range of values.
3. Press the right button to lock the value and move to the next parameter screen.

NOTE: If no buttons are pressed within five minutes, the LCD will exit Setup Mode and switch to Display mode automatically.

The following list describes the setup screens and their variable descriptions.

Pack Size
Battery pack Amp Hour capacity
Settings are from 1 Ah to 3000 Ah. 0 – 50 Ah are in 1 Ah increments. 50 – 3000 Ah are in 10 Ah increments.

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Full Vlt
Full Voltage

Set this to the maximum per-cell voltage your battery reaches at the end-of-charge. This will be used to synchronize the SoC LCD Display's 100% reading when the battery reaches this voltage level.

Typically, this value is 3.55 V per cell. So, a 12 V (4 cell) battery is 4 x 3.55 = 14.2 V. When the battery reaches this voltage at the end of a charge cycle, the SoC value will reset to 100%.

NOTE: If you notice that your SoC LCD Display's value never reaches 100% at the end of a charge cycle, you may need to slightly lower the Full Vlt value to what the voltage reading is on the LCD Display at the moment, when the charger turns off. This value must be higher than the resting voltage of the battery since the charger's end voltage is higher than its resting voltage. The typical value range should be between 14.0 and 14.4 V.

Min SoC
Minimal State-of-Charge

This percentage value sets the Empty Battery level, also known as Reserve Capacity, so the user can utilize the BAT Gauge reading and not completely deplete the battery thus, preserving its lifecycles. For example, if this value is set to 10%, then the BAT Gauge will report 0% when there is still 10% reserve SoC. If you desire to use your battery to its full capacity and/or want the BAT Gauge to reflect true SoC, then set this value to zero.

In addition, when RVC Mode is enabled, the BMS will turn off battery power when SoC reaches this preset level (assuming it comes before battery voltage reaches RVC level), typically 3.00VPC. This allows the Xantrex Reserve feature to act on both voltage trigger and SoC level trigger, whichever comes first.

AGSR Lvl
Automatic Generator Start/Restart level

This percentage value determines the minimal Bat Gauge level at which the AGS/R circuit is triggered. AGS/R circuit triggers on voltage set to 3.05 V per cell, or the Low Bat level, whichever comes first, hence allowing flexible control of the generator starting point.

Temp Unit
Temperature Units

Set this to Fahrenheit (°F) or Celsius (°C).

Charge Eff
Charging Efficiency

This percentage value slows down the rate of SoC climb during the charge to compensate for battery losses during the discharge cycle. The recommended setting is 98%. In applications with high discharge rates, energy losses are more pronounced, so this value must be set lower to accurately report SoC and BAT Gauge values during partial charges.This setting must be tuned experimentally for best accuracy. Ideal setting will cause SoC to reach 100% at approximately the same time as the charger is finishing up the full charge.

Dead Zone

Due to thermal drift in Hall Effect sensors when temperature fluctuations are wide and fast, the BMS might report non-zero current reading when no current is present. The Dead Zone value allows ignoring small current readings when they are likely false (such as, when small reading fluctuates between zero and non-zero values). Default value of 0.3A is recommended for best zero-point stability.

Idle Load
Shown as mA

This setting represents the constant idle load current powering the BMS system. This can be measured with a digital multi-meter in DC amperage mode in series with the BMS's negative reference wire. Allowed range is 0 – 200 mA. Since the idle current is usually too low to register by internal hall-effect sensor but still affects SoC reading over long time periods when the battery sits idle, setting this value allows for a better long-term accuracy of the SoC counter.

Alarm
Alarm function

Turns ON or OFF an Alarm function, which drives the internal buzzer as well as the AUXOUT2 external relay circuit when the BMS is in Alarm state.

RVC
Reserve voltage cutoff function

Default setting STD (Standard) would turn off the battery while leaving reserve charge, which can be accessed by pressing the Reset button. When set to EXT (Extended), the amount of reserve charge is increased on voltage-based triggers.

11 BMS LED Indicator

The e-GEN Xantrex BMS has an LED indicator integrated into the Power button on the unit itself. In some cases, there are also optional remote LED indicators – one to indicate power (On/Off/Alarm) status and one to indicate low battery status. Please refer to your specific installation to check which LEDs, if any, you have available in your system.

Power On/Off/Alarm – This LED indicator is integrated into the Power button on the BMS unit or is installed remotely as an option.

- The LED is off when the BMS is turned off and battery power is disabled.
- The LED is on when the BMS is on and battery power is enabled.
- The LED flashes rapidly when BMS is in alarm state and battery power is disabled.

12 Power and Environmental Specifications

NOTE: Specifications are subject to change without prior notice.

The specifications listed here are for the Freedom e-GEN System. Certain operating conditions apply. For complete specifications, refer to each device's datasheet and Owner's Guide.

Electrical Overview	**Energy Storage Capacity**	630 | 600 | 450 Ah
	Nominal System DC Voltage	12.8VDC
	Nominal System AC Voltage	120VAC @60Hz
	System AC Output Power Rating	3000W or 2000W up to 40 °C (104 °F) Depending on which inverter is used in the system

Lithium-ion Battery Voltage versus SoC

Battery State	Battery Voltage	State-of-Charge (SoC)
Fully Charged	14.6V – 13.6V	100%
Nominal Operation	14.6V – 12.2V	100% – 12%
Float Voltage	13.4V	100% – 80%
Low Battery Warning	12.2V	12%
Reserve Shutdown	12.0V	10%
Low Battery Shutdown	11.6V	<3%

Temperature	**Charging range***	0 – 45 °C (32 – 113 °F)
	Discharging range*	-20 – 55 °C (-4 – 131 °F)
	* Staying within the recommended ambient temperature range will yield optimal system performance. For maximum temperature specifications, refer to each device's datasheet and Owner's Guide.	

Storage	**Recommended temperature and humidity**	15 to 35°C (59 to 95°F)，45 to 75％RH
	Temperature range	< 1 Month, -20 to 35°C (-4 to 95°F) < 3 Months, -10 to 30°C (14 to 86°F) For long term storage, see the *Battery Storage Guide (doc number 975-1005-01-01)*.
Battery Disposal	At the end of the battery's useful life, proper disposal is required. Do not dispose the battery with ordinary household waste. Refer to your local codes for proper disposal of lithium-ion batteries.	

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