



LL-12V128-GC2 User's Guide

Thank you for your purchase!

Lifeline Batteries is one of the world's most trusted deep-cycle batteries distributor. The battery you purchased was engineered to deliver superior power, performance, durability, and reliability for use in a broad range of demanding applications. Our goal is to provide reliable energy storage solutions that enhance the way people live and work around the world.

This User's Guide

Was created by our application engineers and contains vital information regarding proper care and maintenance of your new battery. Please read through this User's Guide carefully and completely before installing and using your battery. It will help you achieve optimum performance and long life from your new investment. If you have any questions concerning safety precautions or for any assistance in installing or using the battery in your system, contact the Lifeline Batteries technical support team at the number below, or send us an email through our website at www.lifelinebatteries.com.

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1. Introduction

Lifeline Batteries GC2 series deep-cycle lithium iron phosphate batteries are specifically designed for use in Recreational Vehicles, Marine vessels and similar personal transportation vehicles with 12V battery packs.

2. Scope

This document applies to the model # **LL-12V128-GC2**

3. Abbreviation

- State of Charge (SOC)
- State of Health (SOH)Over Voltage Protection (OVP)

- Over Voltage Protection (OVP)
- Under Voltage Protection (UVP)
- Over Temperature Protection (OTP)
- Under Temperature Protection (UTP)
- Over Current Protection (OCP)
- Short Circuit Protection (SCP)
- Light Emitting Diode (LED)
- Pulse Recovery Operation (PRO)
- Controller Area Network bus (CANbus)
- Battery Display Indicator (BDI)

4. Product Specification

4.1 General Specification

Model	LL-12V128-GC2
Nominal Voltage	12.8V
Cell Chemistry	LiFePO4
Cell Type	Cylindrical
Nominal Capacity	128AH
Watt-hours	1.638KWh
Energy density	110Wh/KG
Weight	15.6KG
Dimensions	260*180*275mm (BCI Size GC2) 10.24*7.09*10.83 in (BCI Size GC2)
Impedance (50% SOC, 1kHz)	15mΩ
Housing Material	ABS
Cycles @ 80% DOD	6000cycles

4.2 Electrical Specification

Charging Specification

Model	LL-12V128-GC2
Recommended Continuous Charge Current (single battery)	≤128A
Maximum Charge Current (BMS will disconnect if exceeded)	≤130A - 5sec
Recommended Charge Voltage	14.4V
Maximum Charge Voltage	14.6V
Charge Absorption Voltage	13.8V

Charge Float Voltage	13.6V
Charge Termination Current*	4.0A
High Voltage Disconnect	14.8V (3.7V/cell) 2sec
Over Voltage Reconnect	Automatic
Minimum Charger Output Voltage (for charge initiation)	14V
Temperature Compensation Required	None
<p>*Charge current termination is permitted to be less than specified. Note: when the charger termination current is lowered, the internal balancing function will have more time to operate.</p> <p>* Ensure that the charging system wiring accounts for voltage drops.</p>	

Discharging Specification

Model	LL-12V128-GC2
Continuous Discharge Current	150A
Peak Discharge Current	250A - 10sec
Short Circuit Protection	900A 256us
Low Voltage Disconnect	10.0V
Low Voltage Reconnect	11.2V

Parallel Specification

All the currents are additive in Parallel operation. See tables below.

LL-12V128-GC2

Parallel System	Capacity	Cont. Discharge Current	Peak Current	Continuous Charge Current	Energy/Usable Capacity	Reserve Capacity at 25A
2 batteries	256AH	300A	500A	256A	3276Wh	614 minutes
3 batteries	384AH	450A	750A	384A	4915Wh	921 minutes
4 batteries	512AH	600A	1000A	512A	6553Wh	1228 minutes

Note: When using more than one battery in parallel, we recommend limiting both continuous (charge/discharge) current and peak current to 75% of the specification. For example, if using 2, LL-12V128-GC2 batteries in parallel, do not exceed 90A continuous discharge current, 48A continuous charge current and 150A peak currents. This is to avoid the potential of a battery going into protection mode.

Environmental Specification

Environmental Specification	All Models
Charge Temperature	-0°C to 45°C (32°F to 113°F)
Discharge Temperature	-20°C to 55°C (-4°F to 140°F)
Storage Temperature (1 month)	-20°C to 45°C (-4°F to 113°F)
Storage Temperature (3 months)	-10°C to 30°C (14°F to 86°F)
Storage Temperature (6 years)	-5°C to 25°C (23°F to 77°F)

- Note:
1. This is the specified temperature of the cells and not ambient. Ambient temperature and cell temperature may not be the same.
 2. The Battery Management System will not allow charging of the cells below 0°C.
 3. The best storage performance is with 30~50% state of charge for the batteries at the specified temperature and recharge them at least one time in the storage period as above. Stored outside of specified temperatures will result in permanent capacity loss and invalidate the warranty.

Protection Specification

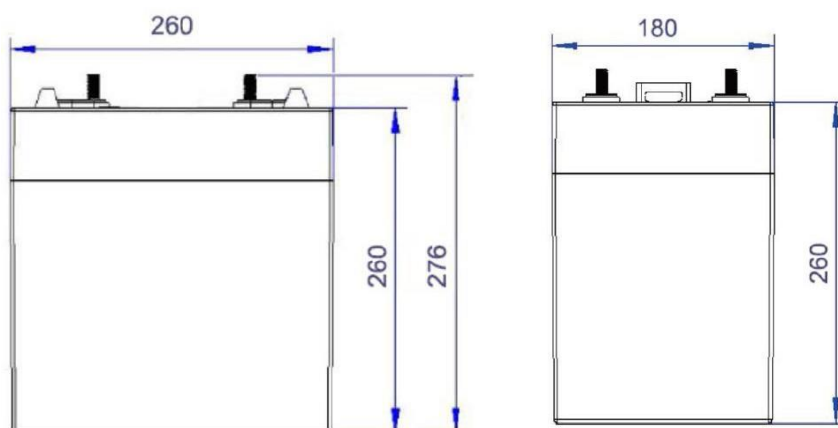
Charge Temperature	-0°C* to 45°C (32°F* to 113°F)
<ul style="list-style-type: none"> • If Temperature falls under -0°C (32°F) the charger will turn on internal Heat Pads before charge function. 	
Overvoltage	
Protection	>14.8 V for 2s
Recovery	Recovery after 2s and <13.6 V
Under voltage	
Protection	< 10 V for 2s
Recovery	>11.2 V for 2s
Over-charge Current	
Protection	>130 A -5sec
Recovery	Recovery after 15 seconds

Over-discharge Current	250 A - 10sec
Recovery	Recovery after 15 seconds
Over-temperature in Discharge	
Protection	Cell temperature above 65°C (149°F) for 2 s.
Recovery	Cell temperature below 60°C (140°F) for 2 s.
Under-temperature Discharge	
Protection	Cell temperature below -30°C (-22°F) for 2 seconds
Recovery	Cell temperature above -28°C (-18.4°F) for 2 seconds
Over-temperature in Charge	
Protection	Cell temperature above 55°C (131°F) for 2 seconds
Recovery	Cell temperature below 50°C (122°F) for 2 seconds
Under-temperature in Charge	
Protection	Cell temperature below 0°C (32°F) for 2 seconds and charge current detected
Recovery	Cell temperature above +2°C (35.6°F) for 2 seconds Note: Discharge will continue to be available to -20°C (-4°F)
Load Qualification Protection	
Protection	Mixed System Voltage, Short Circuit, Reverse Polarity, Input Capacitance Overload
Recovery	Re-Qualify after 120s. After 10 failed attempts to qualify, the battery will switch OFF

4.3 Mechanical Specification

Model	SPF12V128-GC2	SPF24V60-GC2	SPF48V30-GC2
BCI Size	GC2		
Dimensions (L x W x H)	10.2 x 7.1 x 10.9 in (260 x 180 x 276 mm)		
Weight	15.6KG	15.6KG	15.6KG
Case Material	ABS		
Stud Terminal	M8 X 1.25 - 20		
Insert Terminal	M8 X 1.25 - 20		
Torque	79.7-88.5 in-lbs. (9-10 N-m)		
Handles	Molded		
Enclosure Protection Marking	IP67		
Case Flame Rating	UL94 V-0		

4.4 Drawing





5. Safety


ALWAYS	NEVER
Always wear proper personal protective equipment (PPE) (eye protection and gloves).	Never wear jewelry or other metal objects when working on or around batteries.
Always use insulated tools when working on batteries	Never place objects on top of batteries
Always check connections for proper torque.	Never attempt to charge a battery when the temperature is below 32°F (0°C) or above 113°F (45°C). If Temperature falls under -0°C (32°F) the charger will turn on the internal Heat Pads before charge function.
Always keep sparks and flames away from batteries. This includes sources of static electricity.	Never store batteries below 30% State of Charge.
Always use short cables of appropriate size to minimize voltage drop.	Never exceed maximum charging currents for the battery's temperature.
Always make sure charger is set as recommended.	Never dispose of batteries as household waste. Use recycling channels in accordance with local, state and federal regulations.
Always charge batteries before installing.	Never connect or disconnect terminals from batteries without first disconnecting loads.
Always make sure chargers are off or disconnected while working on batteries.	Never attempt to open the battery case.
Always add additional GC2 batteries in parallel.	Never use pressure washers to clean the battery or immerse the battery in water.
Always use battery lifting strap.	Never short-circuit the battery terminals.

Always review product warning labels and GC2 batteries User's Guide.	Never physically damage the battery (this includes, without limitation): Puncturing, dropping, crushing, burning, penetrating, shaking, hammering, and misconnecting terminals.
Always install batteries while powered off.	Never lift by the battery terminals.
	Never over-charge or over-discharge the battery.
	Never attempt to connect GC2 batteries in series.

 **WARNING! RISK OF FIRE, EXPLOSION OR BURNS. DO NOT DISASSEMBLE, HEAT ABOVE 140°F (60°C) OR INCINERATE.**

 **THE MOST EFFECTIVE FIRE EXTINGUISHER TYPES FOR LIFELINE LITHIUM BATTERIES ARE CO2 OR WATER. SEE SAFETY INSTRUCTIONS.**

 **DANGER!**
 UNLIKE LEAD-ACID BATTERIES, LITHIUM-ION BATTERIES, WILL DISCONNECT FROM THE HOST SYSTEM UNDER A VARIETY OF CONDITIONS IN ORDER TO AVOID INTERNAL DAMAGE (“AUTOMATIC DISCONNECTION”). FOR A FULL LIST OF CONDITIONS PLEASE SEE SECTION 4.2.5: “PROTECTION LIMITS: AUTOMATIC DISCONNECTION”. WHEN AUTOMATIC DISCONNECTION OCCURS IN EQUIPMENT POWERED BY GC2 BATTERIES, ALL POWER WILL BE LOST. IN EQUIPMENT WITH ESSENTIAL SYSTEMS THAT RELY ON BATTERY POWER (FOR EXAMPLE, LOW-SPEED VEHICLES WITH ELECTRONIC BRAKING SYSTEMS) (EACH AN “AFFECTED APPLICATION”), AN ABRUPT INTERRUPTION OF POWER CAN CAUSE UNDESIRABLE, UNEXPECTED AND POTENTIALLY DANGEROUS EQUIPMENT BEHAVIOR, INCLUDING BUT NOT LIMITED TO BRAKING LOSS OR SUDDEN BRAKING. USERS AND INSTALLERS OF THE GC2 BATTERIES MUST UNDERSTAND THE CONSEQUENCES OF AUTOMATIC DISCONNECTION. WHEN THE GC2 BATTERYIESARE USED IN AN AFFECTED APPLICATION, THE USER AND/OR INSTALLER OF THE GC2 BATTERY (“USER AND/OR INSTALLER”) ASSUMES ALL RISK AND LIABILITY FOR ANY DAMAGES, INJURIES TO PERSONS OR PROPERTY (INCLUDING BUT NOT LIMITED TO DEATH), OR ACCIDENTS ARISING OUT OF OR RELATED TO SUCH USE OR INSTALLATION. USERS AND/OR INSTALLERS MUST FAMILIARIZE THEMSELVES WITH THE CONDITIONS CAUSING AUTOMATIC DISCONNECTION AS DESCRIBED IN THIS USER GUIDE, SECTION4.2.5, “PROTECTION LIMITS: AUTOMATIC DISCONNECTION”. USERS AND/OR INSTALLERS SHOULD CONSULT THE MANUFACTURER OF ANY AFFECTED APPLICATION FOR RISK MITIGATION OPTIONS RELATED TO THE AUTOMATIC DISCONNETION BY EXCEEDING THE PROTECTION LIMITS OF THE BATTERY, WHICH MAY INCLUDE BUT NOT BE LIMITED TO HIGH VOLTAGE, LOW VOLTAGE, HIGH CURRENT, EXTERNAL SHORT CIRCUIT, HIGH TEMPERATURES, LOW TEMPERATURES, SELF DIAGNOSTICS, AND/OR AFTER MARKET MOTOR CONTROLLERS.

 **LITHIUM-ION BATTERIES, INCLUDING GC2 BATTERIES, WEIGH SUBSTANTIALLY LESS THAN LEAD-ACID BATTERIES OF COMPARABLE CAPACITY. MANY TYPES OF EQUIPMENT ARE DESIGNED TO UTILIZE THE WEIGHT OF LEAD-ACID BATTERIES TO ACHIEVE THE MANUFACTURER’S INTENDED WEIGHT DISTRIBUTION. IF GC2 BATTERIES ARE INSTALLED AS REPLACEMENT BATTERIES IN EQUIPMENT DESIGNED TO USE LEAD-ACID BATTERIES AS BALLAST, THE WEIGHT DISTRIBUTION OF THE EQUIPMENT COULD BE IMPACTED. THE USER AND/OR INSTALLER OF THE GC2 BATTERYIES IN SUCH EQUIPMENTMUST UNDERSTAND THE CONSEQUENCES OF MODIFIED WEIGHT DISTRIBUTION AND ENSURE THAT STABILITY REMAINS WITHIN A SAFE RANGE FOR THE INTENDED USE. THE PROPERINSTALLATION OF GC2 BATTERIES**

MAY REQUIRE ADDITIONAL BALLAST WEIGHTS OR OTHER ADJUSTMENTS OR EQUIPMENT MODIFICATIONS TO ENSURE STABILITY AND SAFE WEIGHT DISTRIBUTION. THE IMPROPER INSTALLATION AND/OR USE OF GC2 BATTERIES COULD COMPROMISE THE WEIGHT BALANCE AND PHYSICAL STABILITY OF THE EQUIPMENT LEADING TO UNSAFE CONDITIONS. THE USER AND/OR INSTALLER OF THE GC2 BATTERIES IN SUCH EQUIPMENT ASSUMES ALL RISK AND LIABILITY FOR ANY DAMAGES, INJURIES TO PERSONS OR PROPERTY (INCLUDING BUT NOT LIMITED TO DEATH), OR ACCIDENTS ARISING OUT OF OR RELATED TO DEGRADED STABILITY RESULTING FROM IMPROPER INSTALLATION AND/OR USE OF THE GC2 BATTERIES.

6. Equipment Needed

Before installation or maintenance of your batteries, have the following equipment available:

- Proper personal protective equipment
- Insulated tools (eye protection and gloves)
- Voltmeter (optional)
- Battery charger
- Cables
- Use of a battery lifting strap to aid installation is recommended. Lifting strap must be designed and rated for lifting batteries and able to securely engage integrated lifting brackets.

7. Battery Installation

To ensure proper operation of the battery (for single-battery or multiple-battery installations), follow the steps below:

- GC2 batteries can only be used in parallel (not series). Up to 10 batteries may be connected.
- Select proper wire gauge for your applications electrical current (A) demands (Suggested reference: NEC 2014: Table 310.15(B)(17) Allowable Ampacities of Insulated Conductors).
- On new installations it is recommended that new battery cables (free from corrosion) be used.
- Ensure that all battery cables are equal in length to avoid battery imbalances.

CAUTION:

Any existing 12V accessories (lights, radio, etc) must be connected to an auxiliary DC/DC converter (48V to 12V or 24V to 12V)

- All cables should terminate at bus bars with respect to their polarity.
- Torque the battery terminals appropriately as listed in Section 7.2.
- Connect the provided Controller Area Network bus (CANbus) cables as shown in Section 16.1.
- Turn batteries ON. See the table in Section 16.1 or Section 16.5 for written instructions.
- Charge the batteries to 100% State of Charge (SOC) prior to use.
- The installer should verify every battery is off before performing the installation procedure. See Section 10.

7.1 Inspection and 12V Accessories

Check for visible damage including cracks, dents, deformation and other visible abnormalities. The tops of the batteries and terminal connections should be clean, free of dirt and corrosion, and dry. If there are any problems detected with the batteries, contact Lifeline Batteries technical support or your battery distributor. If damage occurred in transit, contact your freight carrier.

To prevent damage to 12V accessories in the cart, first verify the voltage requirement of accessories like lights or others items in the vehicle. Then, if needed, the installer can use a voltage reducer to reduce the 48V battery voltage to 12V or as required. To ensure you install your batteries properly and safely, please use the following guidelines.

7.2 Terminals and Torque Values

Both the positive and negative terminals of the battery are M8-1.25 x 18mm threaded studs. Ensure that the nuts are

tightened to the proper dry torque of 80-90 in•lbs (9-10Nm). OVER-TIGHTENING TERMINAL CONNECTIONS CAN CAUSE TERMINAL BREAKAGE, AND LOOSE CONNECTIONS CAN RESULT IN TERMINAL MELTDOWN OR FIRE.

7.3 Correct Hardware Installation

If using flat or lock washers, it is very important to ensure the battery cable lug is contacting the top surface of the terminal, and the washer is placed on top of the lug. DO NOT PLACE A WASHER BETWEEN THE BATTERY TERMINAL AND THE LUG, AS THIS WILL CREATE HIGH RESISTANCE AND CAUSE EXCESSIVE HEATING OF THE CONNECTION, WHICH CAN RESULT IN FIRE. If assistance is needed in determining the appropriate hardware configuration, contact Lifeline Batteries technical support.

7.4 Cable Size

Battery cables should be sized to handle the expected load and be of sufficient length and flexibility to avoid applying undesirable mechanical loads on the battery terminals. Refer to Table 1 for the maximum amperage based on the cable/wire gauge size.

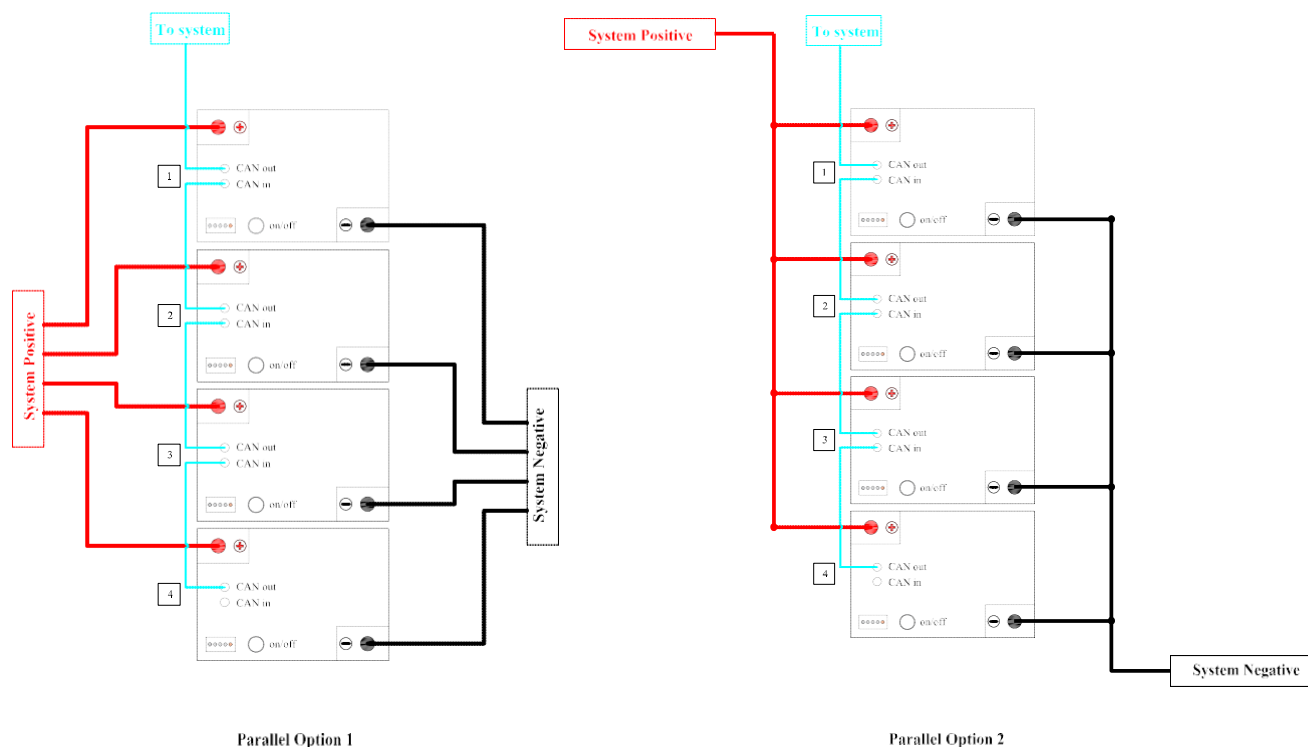


WARNING! SHOCK HAZARD – DO NOT TOUCH UN-INSULATED BATTERY, CABLES, OR TERMINALS. ALL TOOLS SHOULD BE ADEQUATELY INSULATED TO AVOID THE POSSIBILITY OF SHORTING CONNECTIONS. DO NOT LAY TOOLS ON THE TOP OF THE BATTERY.

CABLE/WIRE GAUGE SIZE, AWG (mm ²)	AMPACITY (Amps)
14 (2.08)	20
12 (3.31)	25
10 (5.26)	35
8 (8.36)	50
6 (13.3)	65
4 (21.1)	85
2 (33.6)	115
1 (42.4)	130
1/0 (53.5)	150
2/0 (67.4)	175

* Table values are from NEC Table 310.15(B) 16 for copper cables rated at 167°F (75°C), operating at an ambient temperature of no more than 86°F (30°C). Lengths in excess of 6 feet (1829mm) may require heavier gauge wire to avoid unacceptable voltage drop. In parallel battery banks, it is preferable for all cables to be the same length.

7.5 Parallel Connections – Options 1 and 2



7.6 Battery Orientation

The best way to install the battery is upright as the bottom of the case is flat. The battery can be placed in the following orientations:

- Upright
 - Short sides – either side
 - Long side – only with positive side up
- * DO NOT INSTALL the battery on the long side with the negative side up as this can put stress on the internal connections causing damage that may result in battery failure.
- Do not install batteries in a zero-clearance compartment, overheating may result. Always leave at least 100mm (4") of space around all sides and top of battery.
 - Keep any flammable/combustible material (e.g., paper, cloth, plastic, etc.) that may be ignited by heat, sparks, or flames at a minimum distance of two feet away from the batteries.
 - Battery compartment and any material within two feet should be noncombustible.

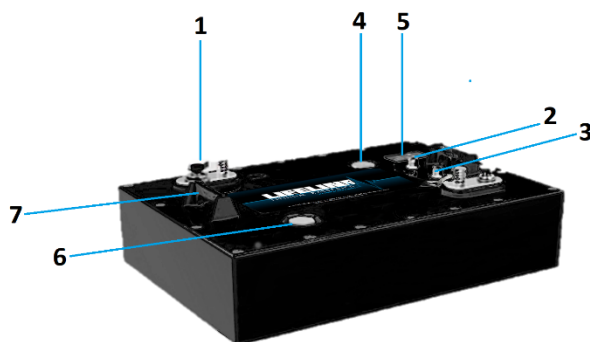
7.7 Ventilation

GC2 batteries do not release gas during normal use. There are no specific ventilation requirements for the batteries installations, although sufficient airflow should be provided to prevent excessive heat build-up.

7.8 Battery Environment

Batteries should be stored and installed in a clean, cool and dry place, keeping water, oil and dirt away from the batteries. If any of these materials are allowed to accumulate on the batteries, tracking and current leakage can occur, resulting in self-discharge and possible short-circuits. Battery chargers should also be installed in well-ventilated, clean areas that are easily accessible. Relative humidity should be <90%.

8. Battery Interface



1. Dual M8 Terminals (insert & stud)
2. CANbus Input (various models)
3. CANbus Output (various models)
4. Power Button
5. SOC/Status LEDs
6. Vent
7. Lifting Brackets

8.1 Power Button

The battery has a button located next to the LED display that is used to:

- Turn the battery ON/OFF/RESET
- Request the battery SOC

8.2 LED

The battery has five LED lights on the cover that are used to communicate:

- Battery Status
- Battery SOC
- Battery Protection/Error Status

9. Battery Mode Description

Mode	Description
OFF	Battery is OFF
ON (Active)	Battery is ON and being charged/discharged
ON (Standby)	Battery is ON and Idle
Sleep	Battery is cycling ON/OFF intermittently
Protection	BMS has disconnected voltage/current from terminals

10. Battery Mode Operation Details

Action	Operation	Remarks
Power ON	Press and hold button for 5s until: <ul style="list-style-type: none"> • LED1 to LED4 turn on at the relative SOC • Then release button 	Battery will turn on and indicate SOC (See section 11: SOC Status)
Power OFF	Tap and release, then press and hold button for 5s until: <ul style="list-style-type: none"> • LED5 Solid Red • Then release button 	Battery will turn OFF

Wake Up from Sleep	Charging current $\geq 500\text{mA}$ or discharging current $\geq 800\text{mA}$
Power off from Sleep (UVP)	Tap and release, then press and hold button for 5s until: <ul style="list-style-type: none"> • LED5 Solid Red • Then release button Or On sleep (UVP) status $\geq 24\text{days}$
Sleep from Power ON	Charging current $< 500\text{mA}$ or discharging current $< 800\text{mA}$ after 72hours
Sleep (UVP) from Sleep	Under voltage protection

11 LED Display

11.1 Displays in Discharging or Idle

SOC	LED 1	LED 2	LED 3	LED 4	LED 5
75~100%	On	On	On	On	Off
50~75%	On	On	On	Off	Off
25~50%	On	On	Off	Off	Off
0~25%	On	Off	Off	Off	Off

11.2 Displays in Charging

SOC	LED 1	LED 2	LED 3	LED 4	LED 5
75~100%	On	On	On	Flashing 2	Off
50~75%	On	On	Flashing 2	Off	Off
25~50%	On	Flashing 2	Off	Off	Off
0~25%	Flashing 2	Off	Off	Off	Off

11.3 Displays in Error or Protection

Error or Protection	LED 1	LED 2	LED 3	LED 4	LED 5
Address Error in Parallel	/	/	/	/	Red On and Orange On
Short Circuit Protection	/	/	/	/	Red On
Over Current (discharge) Protection	/	/	/	/	Red Flashing 1
Over Current (charge) Protection	/	/	/	/	Red Flashing 3
Temperature Protection	/	/	/	/	Orange On
Over Voltage Protection	On	On	On	On	Red Flashing 4
Under Voltage Protection	Flashing 4	Off	Off	Off	Off

Failure Protection	/	/	/	/	Red Flashing 4
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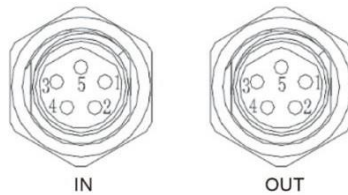
11.4 LED Flashing Mode

Item	On	Off
Flashing 1	0.25S	3.75S
Flashing 2	0.5S	0.5S
Flashing 3	0.5S	1.5S
Flashing 4	0.25S	0.25S

12. CAN Communication

This section provides the basics for CAN operation and/or integration **IF ENABLED**. For additional details on how to interface to the CANbus and interpret the messages consult the Lifeline Batteries CAN Specification Document. Parallel connected GC2 batteries communicate internally via CAN. External communication is available through the CAN OUT port of the battery.

12.1 CAN Battery Connectors: M6-5P



PIN	CAN INPUT	CAN OUTPUT
1	CAN-L	CAN-L
2	Reserve	Reserve
3	P- (Battery Negative)	P- (Battery Negative)
4	CAN Address in	CAN Address out
5	CAN-H	CAN-H

12.2 Communication Hardware

The batteries do not have 120Ω termination resistors. Up to ten batteries may be read in a single CANbus network.

12.3 CAN Details

- CAN2.0A
- Identifier: 11-bit
- Broadcast ID: 0x5FF
- Bit Rate: 250kbps
- Multi-Byte value form: Little-Endian

12.4 Broadcast Data

The BMS broadcasts alarms, system status, and SOC every 3 seconds via ID 0x5FF. If an alarm is triggered it will be broadcast immediately.

12.5 Broadcast Data Frame

ID	DLC	D0	D1	D2
0x5FF	8	0x20	0x81	0x21

D3	D4	D5	D6	D7
0x01	Alarm1	Alarm2	Status	SOC

13. Charging Guidelines

Follow these charging guidelines to achieve optimal performance and maximum life from your Lifeline Lithium Batteries Iron Phosphate (LiFePO4) GC2 battery.

Conventional lead acid chargers can be connected to the GC2 battery without concern/harm as the battery BMS will protect the battery against improper charge conditions (this will not void the warranty). Please read and exercise the charging practices below to achieve the best results.

13.1 Charger Inspection

Check that your charger's cables are insulated and free of breakage. Charger terminal connectors should be clean and properly mate with the battery terminals to ensure a good connection and optimum conductivity.

13.2 Charge Temperature

LiFePO4 batteries can be safely charged between 0°C to 55°C (32°F to 131°F).

LiFePO4 batteries do not require temperature compensation for voltage when charging at hot or cold temperatures.

The GC2 Series batteries come with a BMS that protects the battery from over-temperature. If the BMS disconnects due to high temperature, wait until the temperature reduces before using or charging the battery. Please refer to your specific battery's Data Sheet for the BMS high temperature cut-off and reconnect values.

13.3 Prior to Charge

- It is best to use/select a Lithium, GEL or AGM charge profile in that order of availability. Consult your manual or charger manufacturer for directions on this capability. Some charger models only have the stock charge profile available.
- Spot check the battery SOC LED indicators with a quick press and release of the battery Power Button. See the table in Section 10 to determine the SOC.

13.4 During Charge

- Check if charge current is being supplied in one of the following ways:
- Battery LED indicators: The proper LED sequence display (see section 11).
- Lifeline Batteries Battery Display Indicator (BDI): Spot check to see the accessory gauge if charge current is flowing and battery SOC percentage is increasing.
- Digital Voltmeter w/amp clamp (DVM): Spot check to see the accessory gauge if charge current is properly flowing.

13.5 Charge Completion

- The Charger behavior at the end of a Lithium battery recharge may vary from the standard operation consistent with charging lead-acid batteries.
- Charger typically displays a solid Green Light when the charge is completed, and a flashing green light when the battery is near the end of charge (will vary by charger). Both conditions may or may not occur depending on your charger design. Neither condition is necessarily required to properly achieve a full recharge.
- Lithium batteries may temporarily disconnect their voltage as they reach a full charge, before the charger is complete. This may cause the charger to repeat its charge initiation sequence when this occurs (various lights and noises may occur during this sequence). This is acceptable and will not harm the battery. Simply unplug or disconnect the charger, if this occurs, and the battery voltage will return.
- Check to see if a full charge was completed in one of the following ways:
- Battery LED indicators: Spot check the battery LED's with a quick press and release of the battery power Button. See the table in Section 10 to determine the SOC.
- Lifeline Batteries Battery Display Indicator (BDI): Spot check to see the accessory gauge if battery SOC percentage reached 100%.

13.6 Charge Parameters

LiFePO4 batteries can be charged with either a 1-stage profile (constant current (CC) aka Bulk Stage) or a 2-stage profile (constant current, constant voltage (CC-CV) profile aka Bulk and Absorption Stages). The 1-stage profile will charge the battery ~97% and the 2-stage profile will charge the battery 100%. The 1-stage profile is sufficient, since LiFePO4 batteries do not need to be fully charged; this will not reduce life as it does with lead-acid batteries.

CC Charge Profile – 1-Stage

1-STEP CHARGE DESCRIPTION	STEP	Description	Charge Parameters
Step 1 - Charge at a constant current until the battery reaches termination voltage. Once the termination voltage is reached, stop the charge.	1	Maximum Charge Current per battery	See 4.2.1 and 4.2.3
	System Voltage		12V
	Stop	Termination Voltage	13.8V

CC-CV Charge Profile – 2-Stage

1-STEP CHARGE DESCRIPTION	STEP	Description	Charge Parameters
Step 1 - Charge at a constant current until the battery reaches absorption voltage.	1	Maximum Charge Current per battery	See 4.2.1 and 4.2.3
	System Voltage		12V
Step 2 - Hold absorption voltage until charge current reduces to the termination current	2	Absorption Voltage	13.8V
	Stop	Termination Current	4.0A

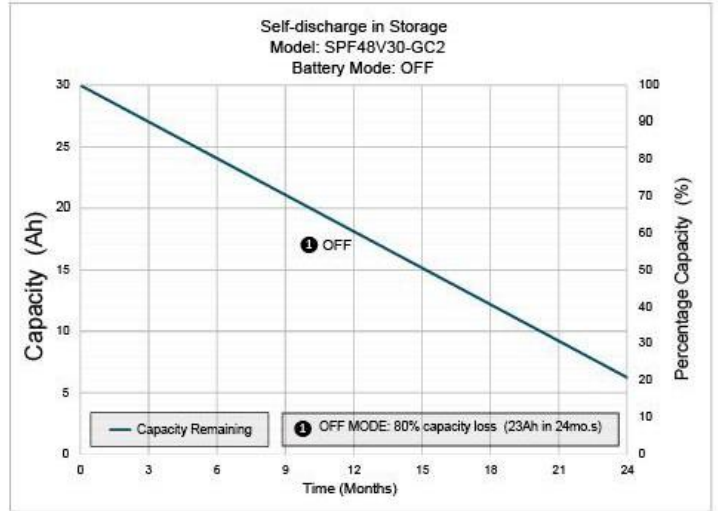
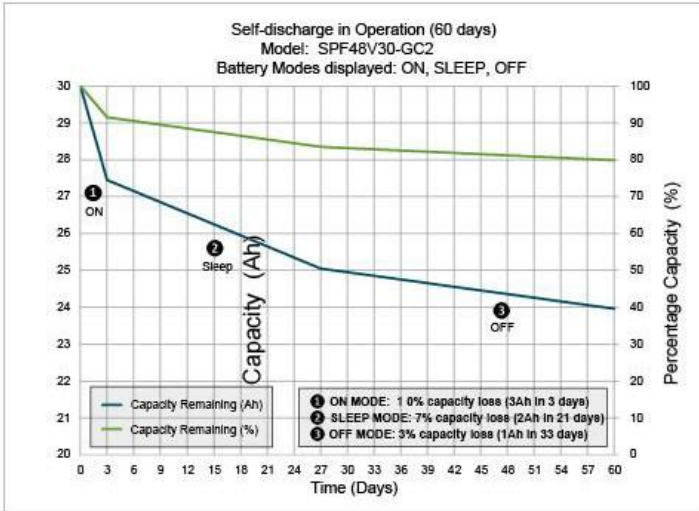
14. Battery Indicator

If you are using a voltage-based fuel gauge that is designed for lead-acid batteries it will not accurately provide state of charge (SOC). Please replace your fuel gauge with one that measures current rather than voltage. The BMS in the battery provides the SOC of the battery via CAN or via the Lifeline Batteries Bluetooth App available for free download.

15. Energy Consumption during Storage

Important notes about battery self-discharge:

- Golf carts consume power when idle (even in tow mode)
- The battery BMS uses battery power when idle
- Charge the batteries whenever used to maintain full vehicle range.
- The batteries will turn off after 3 days when idle to prevent substantial discharge
- Pressing the Power button for 5 seconds will wake them up



16. Recycling

Terminals must be covered with a protective cap or non-conductive tape prior to battery disposal to lithium recycler. Dispose of LiFePO₄ batteries at an authorized lithium recycling facility.

17. Warranty Registration

Please contact Lifeline Batteries directly at 1-800-527-3224 for warranty claims.

18. Precautions

Lithium Iron Phosphate (LiFePO₄) batteries are an inherently safe chemistry. Please reference the Lifeline Lithium Batteries LiFePO₄ Safety Data Sheet (SDS) available at www.lifelinebatteries.com for more details. However, as with any electronics, safety measures should always be taken. Please adhere to the instructions within this manual for safe handling and operation.

- Always wear protective gear when handling batteries.
- Use a wrench with a rubber coated handle.
- Do not place any objects on top of batteries.
- Do not place batteries on a metallic surface.
- Check that all cables are in good condition.
- Make sure all cable connections are properly tightened.
- Install and remove batteries using lifting strap brackets.
- Do not smoke near batteries
- Do not install batteries in a zero-clearance compartment, overheating may result. Always leave at least 4" of space around all sides and top of battery.
- Keep any flammable/combustible material (e.g., paper, cloth, plastic, etc.) that may be ignited by heat, sparks, or flames at a minimum distance of two feet away from the batteries.
- Battery compartment and any material within two feet should be noncombustible.
- Keep sparks, flames and metal objects away from batteries.
- Have Lifeline Lithium Batteries LiFePO₄ Safety Data Sheet (SDS) on premises.

- Have a Class ABC fire extinguisher on the premises.

19. Preventative Maintenance

19.1 Inspection

- Power off battery before inspection.
- Examine the outside appearance of the battery. The tops of the batteries and terminal connections should be clean, dry and free of corrosion.
- Check battery cables and connections. Replace any damaged cables and tighten any loose connections. Refer to Section 7.2: “Terminals and Torque Values.”

19.2 Cleaning

Check the battery for cleanliness at regular intervals and keep terminals and connectors free of corrosion. Terminal corrosion may adversely affect the performance of the battery and present a safety hazard.

- Power off battery before cleaning.
- Disconnect the battery from the charging source and the load.
- Clean the top of the battery, terminals and connections with a damp cloth or non-metallic brush. If the battery is extremely soiled, a household cleaner may be used.
- Dry with a clean cloth.
- Keep the area around batteries clean and dry.

20. Storage and Shipping

A 50% state of charge can be safely stored in climate-controlled conditions for up to one year (6 months) while in sleep mode. It is recommended that the battery state of charge is checked every 3 months. Temperature exceeding 77°F (25°C) will cause the battery to self-discharge faster and will require more frequent checks. Never put the battery into prolonged storage if the state of charge is below 30%. The following tips will help ensure that your batteries emerge from storage in good condition:

- Prior to long-term storage of the battery at 50% state of charge. Storing a discharged battery can result in permanent damage or decreased run time.
- Store in a cool and dry location, protected from the elements.
- Place the battery in storage mode to eliminate potential parasitic loads that may discharge the battery.

NOTE: IF YOU SHIP THIS BATTERY, YOU MUST COMPLY WITH STATE, FEDERAL AND INTERNATIONAL LAWS, RULES, REGULATIONS AND REQUIREMENTS REGARDING LITHIUM BATTERIES. YOU MUST UTILIZE A QUALIFIED SHIPPING AGENT PROPERLY CERTIFIED FOR HAZARDOUS MATERIALS (“HAZMAT”) SHIPMENTS.

21. Maximizing the Performance of Battery

- Follow all the procedures in this User’s Guide for proper installation, maintenance and storage.
- If you have any questions or concerns about battery care, please contact the Lifeline technical support team as or before a problem develops.

22. What’s Your Expectation from Lifeline Batteries Lithium-ion Battery?

- Your LL-12V128-GC2 batteries will deliver rated capacity when it is new. No “break-in” period is required.
- When operating batteries at low temperatures, they will deliver less than the rated capacity.
- When operating batteries at high temperatures, battery life will be reduced.
- The life of a battery is difficult to predict and will vary by application, frequency of usage and load characteristics.