LITHIUM BATTERY SYSTEMS

Powering Freedom™

Installation & User Guide

Standard Power (SP) Range

Models:

LBS-12110-SP

LBS-12110-SP-DCS

LBS-12150C-SP

LBS-12150C-SP-DCS

LBS-12150C-SP-FT

LBS-12150C-SP-DCS-FT

LBS-12150-SP

LBS-12150-SP-DCS

LBS-12225-SP

LBS-12225-SP-DCS

LBS-12300-SP

LBS-12300-SP-DCS

Contents

1.0 Acronyms & Abbreviations 2
2.0 Introduction 3
3.0 Do's and Don'ts 4
2.1 Ensure the battery is physically secure 4
2.2 Do not penetrate the battery enclosure 4
2.3 Maintain an acceptable temperature range 4
2.4 Avoid repeated shock and vibration 5
2.5 Avoid exposure to water or salt spray 5
2.6 Do not short circuit the battery 5
2.7 Mounting orientation 5
4.0 Longevity & Depth of Discharge 6
5.0 Battery Management System 7
6.0 Installation 8
5.1 Non-DCS Model 8
5.2 DCS Model 9
7.0 User Guide 11
8.0 Specifications 12
9.0 Care and Maintenance 13
10.0 FAQ 14
11.0 Contact Us 15

1.0 Acronyms & Abbreviations

4WD	Four Wheel Drive
A	Amperage
AC	Alternating Current
BMS	Battery Management System
DC	Direct Current
DoD	Depth of Discharge
HP	High Power
LBS	Lithium Battery Systems
LED	Light Emitting Diode
LFP	Lithium Iron Phosphate
LVD	Low Voltage Disconnect
RV	Recreational Vehicle
SoC	State of Charge
SP	Standard Power
V	Voltage
Voc	Voltage Open Circuit
VSR	Volt Sensing Relay

2.0 Introduction

Congratulations! You have purchased a state-of-the-art lithium battery and we hope you enjoy many years of trouble-free life. This User Guide describes how to connect and safely operate the Standard Power (SP) range of 12V batteries. The term Standard Power refers to the internal BMS charge and discharge current of 100A continuous. In contrast the LBS High Power (HP) range BMS can discharge 200A continuous current and can therefore be used in higher power applications.

This User Guide covers the following SP 12V battery range:

- LBS-12110-SP
- LBS-12110-SP-DCS
- LBS-12150C-SP
- LBS-12150C-SP-DCS
- LBS-12150C-SP-FT
- LBS-12150C-SP-FT-DCS
- LBS-12150-SP
- LBS-12150-SP-DCS
- LBS-12225-SP
- LBS-12225-SP-DCS
- LBS-12300-SP
- LBS-12300-SP-DCS

As with all batteries, you should consider the mechanical and environmental conditions that you intend to operate the battery in to maximise overall performance and achieve the longest battery life. LBS offer these general guidelines; however, you should seek LBS advice or that of a qualified electrical tradesperson if you are in doubt.

Figure 1 – SP Battery Range

3.0 Do's and Don'ts

This battery contains lithium iron phosphate (LFP) cells. While LFP cells are the safest Li-Ion chemistry, the stored chemical energy represents a risk of fire, burns or explosion if misused.

Avoid injury to yourself and others, adhere to the warnings in this Guide.

- Avoid mechanical shock
- Do not expose to fire
- Do not pierce battery
- Do not disassemble
- Do not drill into enclosure
- Do not short the terminals
- Do not allow water to enter
- Do not charge battery below 0°C
- Do not store battery below -20°C or above 60°C

To ensure a long and safe life from your battery, please ensure you consider the following:

2.1 Ensure the battery is physically secure

Even though lithium batteries are light weight in comparison to lead acid, they can still become a dangerous projectile in a moving vehicle, RV, cart or boat if not secured. Ensure the battery is safely secured before travel. If in doubt seek LBS advice and consider making use of LBS mounting brackets to safely secure the battery.

2.2 Do not penetrate the battery enclosure

You may be tempted to drill into the aluminium enclosure to secure mounting brackets. Doing so may inadvertently penetrate one of the cells which could cause thermal runaway and vapour emissions. Do not under any circumstances drill or penetrate into the enclosure. Use only existing mounting holes in the battery and short screw lengths no greater than 13mm.

We strongly recommend the LBS mounting kit with screws and brackets that are designed to safely attach to the battery; alternatively use strapping and clamping to secure the battery in place.

2.3 Maintain an acceptable temperature range

Like all batteries, LBS batteries operate and perform the best, as well as last the longest, in a cool and stable temperature environment of between 10°C and 25°C. The maximum window of acceptable operation is 0-45°C.

If you regularly operate outside of this suggested range you should consider changing the battery location or actively cool or heat the environment in order to preserve battery life. If the ambient temperature that the battery operates in is greater than 60°C you should cease use immediately. Operating outside of these guidelines diminishes the life and performance of the battery and voids the warranty.

2.4 Avoid repeated shock and vibration

Whilst the battery is robustly constructed and protected in an aluminium enclosure, it is not designed to operate continuously in high shock or high vibration environments. Normal use in a 4WD environment is acceptable and the battery has been designed in accordance with these expected conditions. However, dropping the battery or exposing the battery to a high number of excessive vibrations may lead to a fault or failure of the battery.

2.5 Avoid exposure to water or salt spray

Whilst the battery is mechanically protected, the enclosure is only IP20 equivalent and is not designed for a wet environment. Do not submerge the battery in water or expose the battery to direct water spray. If it is likely that a water will be on the floor where the battery is located, ensure the battery is facing upwards with the terminals (and electronics) on the top, so that any water that gets into the bottom can drain out again without touching the electronics.

Avoid exposing the battery to salty water spray such as in a marine environment to avoid corrosion. Salt laden air may also cause corrosion in the long term; therefore, minimise exposure by installing the battery in a protected hatch or compartment.

2.6 Do not short circuit the battery

Whilst the BMS will protect the internal cells from short circuit, it is highly recommended to avoid short circuiting the battery. The MEGA Fuse on the external positive terminal of the battery also provides over-current protection; if voltage is not present on the +Fused terminal, check for voltage on the +Unfused terminal to check if the fuse has blown.

Pay attention when using metallic tools in the vicinity of the terminals, as accidentally contacting the positive and negative terminal with a metallic object like a spanner will cause a short circuit and spark. Always keep the plastic caps screwed on when not using the terminals.

Always perform work on passive wiring first and connect the live battery as the last connection. If you have to work on live circuits exercise due care and use insulated tools where possible. If you are unsure how to install the battery, seek advice from LBS or a suitably qualified electrical tradesperson.

2.7 Mounting orientation

The typical operating orientation is with the terminals facing upwards (except the 150C-SP-FT) and should be the first option if possible. Having the battery terminals facing forwards is also an acceptable orientation. The battery uses the aluminium lid as a heat sink, the function of which can be hampered by an upside-down orientation; therefore, mounting upside down is not recommended. If in doubt contact LBS or a suitable tradesperson for advice.

4.0 Longevity & Depth of Discharge

One of the advantages of lithium batteries over lead-acid batteries is longevity. If you want to realise the long life potential out of your lithium battery then consideration must be given to depth of discharge.

A battery lifespan is rated by the number of cycles before the original capacity has reduced by a certain amount; a cycle is defined as discharging from fully charged, to a percentage Depth of Discharge (DOD), and then charging back to full again. So, DOD describes what percentage of the battery capacity is being used each time.

Note: DOD is different to State of Charge (SOC, also known as Charge Level); in fact, they add together to 100%. So, 80% DOD equates to 20% SOC.

The less DOD you use each cycle, the longer the battery will last.

This fact should be considered when choosing the battery Amp hour capacity. You will have a higher return on battery investment if there is enough capacity at hand such that you are not heavily discharging the battery on every cycle. Extra capacity ensures lower DOD, extended life and a higher financial return on your investment.

LBS SP batteries have a cycle life of 5,000 at 50% and 2,000 at 80% DOD.

5.0 Battery Management System

Your battery comes with a Battery Management System (BMS) mounted internally.

The BMS is an electronic solid-state circuit board which manages the cells and protects the battery across a range of scenarios which primarily includes over charge and over discharge protection. Unlike lead acid batteries, over charging or over discharging a lithium battery may lead to a hazardous scenario. Therefore, the BMS is the heart and soul of a lithium battery.

The Standard Power (SP) family BMS is a highly reliable solid-state device which is primarily designed to keep the cells safe and the overall pack from being damaged by excessive voltage or excessive discharge event.

The LBS High Power (HP) family has a BMS with sophisticated diagnostics and if that is a requirement of your design then contact LBS about their HP battery products.

6.0 Installation

5.1 Non-DCS Model

The non-DCS model SP battery does not include an internal DC-DC charger. As illustrated in Figure 2, it can be charged via the red positive (**+ Fused**) and black negative (**-**) terminals from an:

- External AC charger source;
- External solar charger source; or
- External DC-DC charger source.

Figure 2 – Battery Charging Terminal Connections

The procedure of installing the SP battery (with no internal DC-DC charger) is as follows:

1) Before making any electrical connections to or from the battery, first secure the battery in place, preferably with the fit for purpose LBS mounting bracket kit, or using suitable straps.
2) Once the battery is securely in place, unscrew the plastic terminal caps from the fused red positive (**+ Fused**) and black negative (**-**) terminals.
    a. Do not lose or discard the plastic terminal caps as they are required at the end of installation.
    b. With exposed positive (**+ Fused**) and negative (**-**) terminals the battery is susceptible to short circuit if a metallic object such as a spanner or wrench accidentally dropped onto both terminals at the same time, causing sparks and potential damage to the battery.
3) Using a spanner or adjustable wrench, remove the metal nut and flat washer on each terminal. The nut will be re-used to ensure a tight connection following connection of the charging source and loads. Do not remove the MEGA fuse between the two **+** terminals.
4) Ensure the charging source positive (**+**) and negative (**-**) has M8 ring terminals suitable sized to match the battery M8 terminals.
5) Connect all the charging and load cables to the battery fused positive (**+ Fused**) terminal. Place the flat washer on top and then fasten the nut tight (or max 8Nm if you have a torque

wrench). Do not use excessive torque and overtighten. Finally screw on the red terminal cap or rubber cover to prevent short circuit and to ensure the securing nut remains tight.

6) Note, do not attach any loads or charging sources to the unfused positive (**+ Unfused**). Doing so would render the fuse ineffective and may overload the battery, tripping internal protection which would require return to LBS.

7) Second, connect the charging and load negative cables to the battery negative (**-**) terminal. Place the flat washer on-top and then fasten the nut tight (or max 8Nm if you have a torque wrench). Finally screw on the black terminal cap or rubber cover to prevent short circuit and to ensure the securing nut remains tight.

5.2 DCS Model

The DCS model SP battery is exactly the same, however it includes an internal DC-DC charger meaning it can be connected directly to a vehicle alternator / start battery via the DC-DC positive (**+**) and negative (**-**) terminals only as illustrated in Figure 3.

Figure 3 – DC-DC Charging Terminal Connections

The internal DC-DC charger contains a status LED light and Voltage Sensing Relay (VSR) adjustment trim pot, which indicates and adjusts at what input voltage (from the vehicle alternator / start battery) the DC-DC charger turns on and off. There is a dead-band of 0.5V, so that it typically turns on at 13.3V and turns off at 12.8V.

Note that the voltage sensed by the DC-DC charger when it is charging, will be slightly different to the voltage measured at the vehicle alternator / start battery. This is because of the voltage drop along the cable from the alternator / start battery to the LBS battery. If this voltage drop is too high, a thicker and/or shorter cable may be required.

Connect the alternator or start battery positive (**+**) first and negative (**-**) cables second to the M6 positive and negative on the DC-DC terminals.

1. Once the vehicle engine is started, the green LED status light should illuminate if the battery is charging. If the battery is not charging, check the:
    a. Cable size which may be too small with excessive voltage drop; and
    b. Voltage across the DC-DC terminals.
2. The DC-DC charger typically begins charging at 13.3V, and then the green light turns on.

3. If you need to adjust the VSR setting, you will need a small Phillips screwdriver to adjust the trim pot adjacent to the LED light.
4. Remove the clear plastic sticker before adjusting, and remember to put it back it afterwards!
5. Turning the trim pot in a clockwise direction reduces the voltage setting and turning it in an anti-clockwise increases the voltage setting. Use the LED status light to determine the correct setting.
6. If the trim pot voltage is too high the charger never turns on. However, if it is too low it could stay on too long and drain the start battery.
7. Once the trim pot is set it should never require adjusting again.

Other features of the DC-DC charger include three (3) switches:

Current Selection Switch

This switch allows you to select the amp charge rate from 10A to 20A.

Most vehicle cigarette sockets on the dashboard are rated for 10A only. So, if you are using the 10A vehicle cigarette socket to charge the lithium battery then select the 10A on the rocker switch.

If your vehicle is fitted with a 20A connection, or you are connecting directly to the start battery, then you can select the 20A charge setting on the battery.

Beware: If you select 20A when connected via a standard cigarette socket, you may blow the fuse connected to that circuit in your vehicle.

Direction Switch

This switch provides the ability to reverse the DC charge direction (Out) so that the lithium battery can be used to charge a flat vehicle start battery. The normal charge direction (In) uses the vehicle alternator to charge the lithium battery via the start battery.

Note – this feature is not intended to 'jump start' the starter battery. It is a controlled charge (at the selected current based on the switch, 10A or 20A). So, you might need to wait for 30-60 minutes before the start battery is sufficiently charged to crank the vehicle engine, depending on how flat the start battery is.

External Shunt Switch

An external shunt can be applied across the two (2) black negative terminals to measure current in and out of the battery for accurate state of charge measurement, including charge current from the built-in DC-DC charger.

If an external shunt is applied, select Yes.

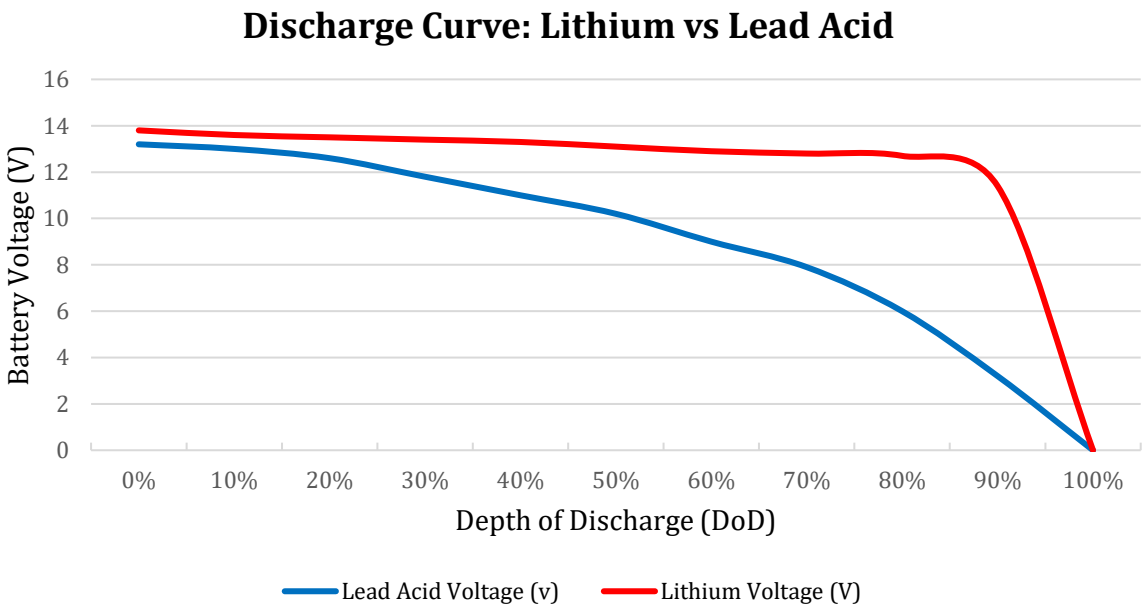
If there is no external shunt applied (which is the default case) select No. This connects the 2 black negative terminals together internally.

7.0 User Guide

Once the battery is securely installed and electrically connected it will automatically be available for use. The internal BMS will actively ensure the battery is protected and operating safely at all times. The battery requires no user interface or intervention under normal conditions.

The SP models come with a digital colour LED voltmeter which measures the battery voltage in real time and can be used as an indication of battery state of charge. The voltmeter can be turned on and off via the red rocker switch.

Please note, unlike lead acid batteries, lithium batteries hold their voltage over the cycle, dropping off only when the battery is ~90% discharged, as indicated below for illustrative purposes.



Pay attention to this when assessing how full the battery is. Once the voltage starts to approach 12V it is nearing empty and should be charged. Some helpful hints:

1. A normal full battery open circuit voltage (Voc) with no load rests at 13.3V to 13.4V;
2. Depending on the load it may dip 0.5V below the Voc;
3. Below 12V the battery is close to empty and should be charged; and
4. Low Voltage Disconnect (LVD) is set at ~10.5V.

8.0 Specifications

LBS Battery	Charge Voltage	Charge Current	Discharge Current Cont / Surge		Battery Weight	Op. Temp (Charge)	Op. Temp (Disch)	Lifespan 80% DOD / 50% DOD		Dimensions (mm)			
	V	A	A	A	kg	°C	°C	Cycles	Cycles	Length	Depth	H1*	H2*
LBS-12110-SP	12	100	100	200	12	0-45	-20 to 60	2,000	5,000	257	177	190	215
LBS-12110-SP-DCS	12	100	100	200	12	0-45	-20 to 60	2,000	5,000	257	177	190	215
LBS-12150C-SP	12	100	100	200	15	0-45	-20 to 60	2,000	5,000	265	163	240	270
LBS-12150C-SP-DCS	12	100	100	200	15	0-45	-20 to 60	2,000	5,000	265	163	240	270
LBS-12150C-SP-FT	12	100	100	200	15	0-45	-20 to 60	2,000	5,000	265	163 (190)	240	240
LBS-12150C-SP-DCS-FT	12	100	100	200	15	0-45	-20 to 60	2,000	5,000	265	163 (190)	240	240
LBS-12150-SP	12	100	100	200	16	0-45	-20 to 60	2,000	5,000	326	245	260	285
LBS-12150-SP-DCS	12	100	100	200	16	0-45	-20 to 60	2,000	5,000	326	245	260	285
LBS-12225-SP	12	100	100	200	23	0-45	-20 to 60	2,000	5,000	326	245	260	285
LBS-12225-SP-DCS	12	100	100	200	23	0-45	-20 to 60	2,000	5,000	326	245	260	285
LBS-12300-SP	12	100	100	200	29	0-45	-20 to 60	2,000	5,000	326	245	260	285
LBS-12300-SP-DCS	12	100	100	200	29	0-45	-20 to 60	2,000	5,000	326	245	260	285

Notes
H1* to top of battery enclosure
H2* or () to top of terminals / handles / highest point

9.0 Care and Maintenance

Like any battery, the environmental conditions impact the health and longevity. Therefore, consider the following with respect to proper care and maintenance of your lithium battery:

1. If not intending to use the battery for a prolonged period of time (one week or longer), turn off the voltmeter by selecting 'Meter Off' on the red rocker switch. This will ensure the voltmeter is isolated and not drawing a small current. If the voltmeter was left on, then over weeks and months it would drain the battery and ultimately flatten it.
2. If the battery is unintentionally discharged flat then it can be recovered. First remove all loads sources and switch off the LED voltmeter. Apply a 'dumb' charger which charges the battery without needing to 'see' the battery first.
3. For long battery life, keep it charged at above 13V at all times. Check the battery once a month. If the open circuit voltage has dropped to 13V or below, then give it a boost. Ensure the voltmeter is turned off at the red rocker switch.
4. All batteries, whether they are lead acid or lithium degrade faster in extreme cold and extreme hot environments.
    a. Do not charge battery when the ambient temperature is less than zero or above 45°C.
    b. Do not operate the battery in environments are -20°C or above 60°C. Doing so would reduce its life expectancy.

10.0 FAQ

Will the battery be damaged if allowed to fully discharge?

Firstly, the BMS has a low voltage disconnect at around 10.5V, so the battery will never discharge to zero volts. If the battery is flattened and cuts out at LVD at 10.5V then it can be recovered without damage if on occasion. If it is done repeatedly then it will have a negative impact on longevity.

Maintaining the battery charge at 13V or higher will maintain good battery life.

Look after your lithium battery and it will give you many years of service.

Can the battery be recovered from flat?

Yes. See Section 8.

Does the battery capacity degrade over time?

Yes, all batteries degrade slowly over time, even with no load sources connected. Storage temperature is important to degradation. Roughly every 10°C above ambient 20°C doubles the degradation rate. Cool ambient conditions are better as it slows down degradation rate.

11.0 Contact Us

Head Office & Manufacturing:

Address:	Unit 16 / 20-22 Ellerslie Road, Meadowbrook, QLD 4131 (by appointment only)
Phone:	1800 844 869
Office Hours:	9am to 5pm Monday to Friday
Email:	info@lithiumbatterysystems.com.au
Website:	www.lithiumbatterysystems.com.au
ABN:	16 608 590 503
ACN:	608 590 503