



POWERING YOU OFFROAD

Lithium Iron Phosphate Batteries User Manual



Models:

- 100ah – 175-320A BMS (12v)
- 100ah – 200-500A BMS (12v)
- 150ah – 175-320A BMS (12v)
- 250ah – 200-500A BMS (12v)
- 120ah – 175-320A BMS (24V)

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Disclaimer

Whilst all care has been taken in the production of this user manual to ensure the content is correct, due to ongoing product development and improvement, the contents may become inaccurate from time to time in between document revisions and Offroad Living take no responsibility for any errors or omissions it may or may not contain. If you have a specific requirement, please confirm the content is accurate first before purchase.

1. Welcome

Congratulations on your purchase. AllSpark is the leading performance brand of Lithium Iron Phosphate battery in Australia and has built a reputation for Premium quality manufacturing excellence, extreme performance for Australia's harsh conditions, reliability you can trust and longevity you expect for many years of trouble-free use.

Warnings

Please read this manual in full before use. Read the instructions and ensure you understand the requirements for safe use before installing your battery. Failure to heed the instructions and warnings in this user manual may result in damage or premature deterioration to your battery or may damage your vehicle, yourself or other people. Offroad Living take no responsibility for any damage or injury caused as a result of incorrect or improper use or failure to adhere to the conditions in this manual.

WARNING

Failure to adhere to the instructions and conditions of this manual be result in injury to persons or damage to your battery

- Do not submerge battery under water (short water crossings under 30 secs are acceptable)
- Do not throw in fire
- Keep away for high temperature sources and keep out of direct sunlight whenever possible
- Do not puncture, drop or cause impact to the battery at any time
- These are deep cycle batteries for storage applications. They should not be used as a dedicated cranking battery but can be used for jump starting if the starter motor draw is within the peak current rating of the battery
- Parallel or series installation is acceptable – see section of parallel & series batteries
- Never store at a flat battery without charging to 70% first. Keep voltages above 12.5V (>20% state of charge during long term storage)
- Always use a LiFePO4 charger. Using the wrong charger will void your warranty
- Don't short circuit or reverse the polarity
- If you encounter any abnormalities during use, like very high temperatures, leaks, smells or damage or distortion of the ABS case in any way, cease all use and contact us for assistance
- Never attempt to open the battery. This will void your warranty and expose the user to injury from high current or electrolytes. Should you get electrolyte in your eyes, flush with water and seek medical attention urgently
- AllSpark batteries can power a 2000w inverter from a single battery. Do not use larger inverters unless correctly matched with the right specification battery

2. Benefits of AllSpark Lithium Iron Phosphate Batteries

LiFePO₄ batteries are far superior to lead acid batteries in every way:

- 1/4 of the weight of AGM batteries with the same usable capacity
- Smaller physical dimensions (2/3 of the size)
- Up to 2000-5000 cycles
- Very low self-discharge – safely store for 12 months without charge
- Sealed and maintenance free
- Higher charge efficiency of 95% vs 70-80% for lead acid
- Rapid charge rates - allowing for rapid charge rates up to 1C – fully charge a battery in 1-3hrs

3. What size do I need?

If you have already purchased your battery, then you may well have already answered this question, however if you haven't here are a few important things to consider. Our recommendation is to have 2 days power usage as storage capacity in your batteries. This will provide you with a longer life for your battery and maintains higher overall battery voltage levels, whilst giving you a buffer in the event of using more power on occasion or if you aren't able to charge at expected levels (i.e. poor solar conditions)

To calculate capacity:

If your regular usage is only for only 1-3 days (overnighters and long weekends) then back in storage (and on charge) till the next use, then you can get away with a smaller battery bank. Calculate your daily power consumption (total amp hours required per day), minus any solar or DCDC charger input each day x 50%. If staying off-grid for extended durations, then a **minimum** of 2 days power consumption divided by 0.8 x 2 to give you the minimum battery capacity you should have.

To calculate maximum continuous current:

Capacity is measured in amp hours. A 100ah battery will last for 20 hours at a 5A current draw for example. Maximum continuous current is calculated by adding together the current draw of every device or appliance that may conceivably run at the same time. Add up all loads that could operate simultaneously on 12v or 230v from an inverter. Running small 12v devices will never be an issue all at the same time – i.e. fridges/freezers, lights, pumps, travel ovens, fans etc however if you plan to run larger inverters for powering microwaves, coffee machines, kettles, toaster, hairdryers or even air conditioning, then you will need a battery (or multiple batteries) than each can sustain the continuous output current required of the total load. Take a coffee pod machine at 1400w. When run through a pure sine wave inverter it uses 10% more power in the conversion process and will draw 115-130 Amps across a 12V to 13.5V range. All AllSpark LiFePO₄ battery have a continuous output current of 175 Amps (320A peak) with some models also having a 200A continuous output (and 500A peak). Each battery on its own can power a 2000w inverter. You can then parallel batteries up to 600ah to provide longer run time. Contact us for assistance if you need help with sizing or calculations.

4. Parallel & Series connection

All AllSpark batteries can be connected in parallel. Extensively tested and with thousands of customers across Oz with parallel battery setups (including our own vehicles), this practice is very safe and will not affect longevity of your batteries and is covered by your 4-year warranty under the following conditions:

Parallel

1. Parallel connection is permitted up to 600ah on 12v battery banks
2. Parallel connection is only permitted with the same model of AllSpark battery. Amp hour capacity and BMS specifications must be the same
3. Do not connect other LiFePO4 batteries in parallel as this will void your warranty. The cells and BMS quality across other brands can vary greatly and poor-quality components on other products or lack of protection mechanisms may damage your battery
4. Age of the battery must also be the same – a few months between additions won't matter but adding additional batteries in parallel 12 months later is not an acceptable practice. Contact us for further details should you need to do something like this
5. Charge each battery to 100% first and allow cells to balance for 24 hours before connecting in parallel to other batteries. 1-2 batteries can be connected in parallel by daisy chains from battery to battery. 3 or more should be connected using a common busbar setup for both positive and negative connections with each cable connection to the busbar of the same cable gauge and length to ensure equal charge and discharge resistance. You can then connect your chargers and loads to the busbar instead of directly to the battery terminals. This is also helpful when installing shunt-based battery monitors.
6. We recommend using a minimum of a 2B&S gauge cable for parallel connections.

Series – rules for parallel connection also apply to series connection

1. Series connection is permitted up to 2 batteries to double the voltage. 12v to 24v if using 12v batteries or 24V to 48V using 24V batteries. If you need larger storage capacity, then consider using larger battery packs in the first place before series connection to avoid series and also parallel connection in the same banks. Be very careful when connecting in series to avoid short circuit events. Whilst the BMS has short circuit protection to avoid damage to the BMS and cells, a short circuit event may still cause extensive damage to the external terminals of the battery. This is not covered under warranty.

5. Battery usage – Charge and Discharge

Discharging

Maximum life in terms of cycles and time will be obtained by keeping battery state of charge above 50%, however all AllSpark batteries can be discharged to 100% (10.5V) without damage to the cells or BMS. Regular deep discharge of the battery will “wear” the battery at a faster rate, however you are also receiving more “used amp hours” at the same time and therefore getting more use from the battery. A battery that is extensively cycled and reaches the end of its usable life even within the warranty period is not covered by the warranty. Warranty covers manufacturing defects in materials and labour and not wear to the battery due to ongoing and extensive use.

The BMS has a limit on the amount of current it can provide on a continuous basis. Whilst AllSpark battery BMS has a higher duty cycle compared to other LiFePO4 brands, they aren't magic and still have certain limitations. The minimum rating across the range is 175A continuous output (with a 320A peak for 10 secs) in comparison to most other brands with a 100A continuous output (200A peak). All models can sustain a 2000w inverter from a single battery. If you draw more than the rated continuous output, the battery may enter high current protection mode and disconnect the operating loads. To reset, remove the offending excess current and the battery will automatically reset.

Charging

A LiFePO4 battery needs similar charge voltages to AGM batteries for full cell charging, however that is about the only thing that is similar and is where so many battery sellers that claim you can use a lead acid charger go wrong and where so many unsuspecting customers get caught out by these sub-standard el-cheapo batteries on the Australian market.

Correct charging is critical to ensure maximum capacity is availability each usage cycle and to maximise longevity of the battery. Lithium batteries require specialised charge profiles and must not be charged using lead acid chargers, especially those with de-sulphation and equalisation modes. This will cause significant charging issues (and ongoing activation of high voltage protection modes in the BMS). These chargers can cause damage to the BMS and cells if used and are not covered by warranty. The way that dedicated LiFePO4 chargers apply voltage and current is different to a lead acid charger.

A charger with a Constant Current/Constant Voltage LiFePO4 charge profile is required for proper charging and increased longevity. To correctly charge your AllSpark LiFePO4 battery to 100% state of charge please use the settings below.

Bulk voltage 14.4V - 14.6V

Float voltage 13.5V - 13.8V

Recommended charge current (per battery) 30 Amps*

Termination current (if applicable) shall be set at 3-5% of battery capacity

* Recommendation based on extensive age testing of cells. Best longevity and residual capacity obtained by controlling charge temperatures through controlled charge current at 30 Amps.

Special Note for engine bay applications

AllSpark 100ah battery with 200A continuous output (500A peak – 5 secs) BMS is designed for use in engine bay applications but must be treated correctly to maximise its performance and longevity. Charge current must be of a range of 15-30A when installed in engine bays. Rapid charge currents produce excess heat and when applied in addition to already high ambient temperatures in engine bays, temperatures can exceed the high temperature protection set points in the BMS. Internal cell temperatures (not ambient temperatures) must be kept below 65 deg C to avoid activating high temperature protection mechanisms. The use of this battery in engine bays is covered by warranty, however users should be aware that high temperatures will wear battery cells at an accelerated rate and as such is a trade-off of convenient installation location (i.e. not taking up precious cargo space) vs higher cell/battery longevity in non-engine bay installations. It is entirely possible that a battery in an engine bay may reach the end of its useful life during the warranty period if sustained high temperatures are experienced through towing or regular off road driving (especially in low range with limited airflow) or just high heat location. Installation in battery trays adjacent to turbos or exhaust manifolds should have a heat shield installed and the battery wrapped in an insulating air cell blanket for improved temperature performance and increased longevity.

6. Charge sources – DCDC, Solar, Alternator & Mains/Generators

If you need help selecting or matching a charger for your battery, please contact us for recommendations on makes/models to correctly and safely charge your AllSpark LiFePO4 battery.

You may charge your battery using any or all of the following types of chargers. Each charger must have a dedicated LiFePO4 profile and be of the correct nominal voltage.

- AC mains to DC charger - using either mains power or generator power. Only use generators with clean Pure sine wave output to avoid damage to sensitive electronics in your AC to DC charger. Do not use the 12V output that many generators have. They have limited current output and generally have very low voltage compared to that needed for proper charging
- DC to DC chargers – from alternator or solar inputs. Do not charge directly from the alternator without using a DCDC charger as there is no control or regulation of voltage or current directly from the alternator.
- Solar charge controllers – never charge directly from the solar panel without a solar controller

When using multiple charge sources, it is critical to ensure that the total charge current is always controlled. You must ensure that your batteries are not being excessively charged. A common scenario is having roof top solar on a caravan connected to a dedicated solar charge controller, that is sized to provide the maximum recommended charge rate for the battery/s, then the user hooks up a tow vehicle, thereby connecting the DCDC charger with input from the alternator as well. It is possible to more than double the recommended charge rate and must be considered when sizing your batteries, chargers and solar setup. Contact us for assistance if required. We are more than happy to help.

AllSpark batteries have a recommended charge rate for each model. This recommended charge rate is based on extensive age testing in laboratory conditions over tens of thousands of cycles to provide you with the maximum longevity and output capacity.

All models have a rapid charge rate (or maximum charge rate) of 1C, but this must be used only in emergency conditions and temperature must be monitored and controlled. Any increase of internal cell temperature of 15 deg during charging will reduce the life of the battery. Ongoing rapid charging above the recommended rate may lead to premature failure of the battery and is not covered by warranty.

7. State of Charge

State of charge is somewhat difficult to determine on LiFePO4 batteries by voltage alone due to the very stable and much higher operating voltage throughout much of the range of use from 100% down to 20%. AllSpark batteries required 14.6V (3.65V per cell) for 100% charge, though you will see a slight increase in overall cycle life if you limit charging to as low as 13.9V (3.475V per cell). This is a user preference. Charging to 13.9V will obviously give you a smaller capacity range to work with over about 90% less.

A fully charged battery will reach 14.6V at the end of the bulk and absorption charge stages and be held at that voltage until the termination current is reached (usually between 3-5% or battery capacity), then the charger will enter the float stage ranging from 13.5 - 13.8V for most brands. Most chargers will not re-enter bulk charging again until the battery voltage drops below 13.3V. A fully charged battery at rest (open circuit) will sit between 13.3 – 13.4V. During normal operation the battery state of charge from 100% to 50% will only move a small amount of around 0.2 – 0.3V. As you can see, due to the very stable voltage curve, it is hard to determine an accurate state of charge from voltage alone. As a general rule (subject change due to very high current use from large power inverters) AllSpark batteries will reach 20% state of charge at approx. 12.5V. This is the recommended minimum voltage to maximise life of the battery. 0% will be reached at 10.5V. Low voltage protection mode is activated at 10.0V and the BMS will disconnect all load output.

To accurately measure state of charge and allowing for regular monitoring of your battery health we recommend using a quality battery monitor with a current shunt to measure current (or amps) in and out of the battery. Please contact us for recommendations on reliable and accurate brands.

We have started to introduce Bluetooth monitoring into our range for monitoring state of charge from smart phones and tablets. This is available in our 100ah battery with 200A continuous output (500A peak) and will be added to other models during 2020. Available for Android and Apple devices early 2020.

8. BMS protection re-activation

If by chance you happen to use the full 100% capacity of the battery and allow the voltage to drop to 10.0V (or any cell drops to 2.5V), then the low voltage protection mode will be activated. This disconnects all loads and the battery will go open circuit with no voltage output at the terminals. This is designed to protect the cells from damage in the event of excess discharge either from lack of charging or if loads are accidentally left on when not in use.

A LED light left on for example may continue to run even at less than 6V and if the BMS did not switch off, would cause irreparable damage to the cells. Other devices like external battery monitors, DCDC chargers and solar controllers or vehicle management systems can draw very small currents every hour (many in the 10-50mah range). In normal operation your system won't even measure this and is lost in the rounding, but when left connected when in storage with no charge input, can drain a fully charged 100ah battery down to 0% state of charge and activate the LV protection mode in around 4-8 weeks.

Once LV protection mode is activated, most chargers on the market (Solar, DC to DC and some cheaper AC mains to DC chargers) will not be able to start recharging the battery until the BMS is re-activated (woken up or brought out of protection mode). When in protection mode, the battery will not provide any voltage and as such, most chargers won't recognise that a battery is connected, hence they cannot start the charge process until the BMS is re-activated.

The process for reactivation of the BMS is quite straight forward:

- Ensure your normal charging source is connected and ready to start charging once the BMS is re-activated – this can be AC mains to DC, DC to DC or solar
- Apply 10.0V or more and 1A or more to the terminals of the battery with an external source – this can be done with a parallel battery, external power supply, jump starter pack or an AC mains charger with the correct functionality to re-activate the LiFePO4 BMS (using one with a switch mode power supply)
- As soon as the BMS is activated (only takes a couple of seconds), the normal charger will read the battery and start the charging process.
- If you have an AC mains charger with power supply mode, then simply turn on and charging will commence

We have a number of charger options that do include this functionality to avoid the challenges of waking up LiFePO4 batteries in protection. Contact us for assistance.

9. AllSpark LiFePO4 battery care

To get the best life out of your battery, you want to do a few key things to look after your battery.

- Read this manual in full before using or charging the battery
- Keep your battery cool and dry and away from direct sunlight (which increases cell temperatures unnecessarily)
- Check battery terminals are tight on a regular basis, especially if driving over lots of corrugations and are free of any type of corrosion
- Avoid water crossings where possible and keep the battery dry. Whilst the case is sealed, they cannot sustain extended periods of submersion and as such water ingress into the battery under pressure can occur. Water ingress is not covered under warranty.
- Don't attempt to open the battery for any reason. This will void your warranty and can cause damage to the BMS and cells. There are no user serviceable parts inside
- Do not try to charge the battery using the BMS to PC communications port on the top of some models. This is a diagnostic port for downloading BMS data only and can only be accessed by AllSpark services technicians
- High charge currents create large amounts of heat. Excessively charging your battery may cause damage that is not covered under warranty. The BMS logs all extreme events of temperature, current and voltage
- Avoid short circuiting your battery or reverse polarity. Failure to do so may cause damage not covered by warranty
- Charge it correctly using a dedicated LiFePO4 charge profile
- Don't excessive discharge the battery every cycle. Try and keep it above 20% state of charge
- Don't leave it in a discharged state in LV protection mode for more than 2 weeks without charge

10. Storage

- In storage keep cool and dry - ideally between 10-45 deg C
- Avoid storing on concrete floors
- If leaving in storage for long durations, disconnect the negative cable or install a master isolation switch in the positive cable
- You will get an increase in life expectancy by storing your AllSpark battery between 40 and 80% state of charge. If placing in storage, discharge the battery to 80% before disconnecting all loads or use a mains charger that has a dedicated LiFePO4 storage mode. Contact us for recommendations
- Check the open circuit voltage every 3-6 months and recharge back to 80% if continuing in storage

11. Warranty

Australian Consumer Law

All AllSpark products come with guarantees that cannot be excluded under the Australian Consumer Law. You are entitled to a replacement or refund for a major failure and for compensation for any other reasonably foreseeable loss or damage. You are also entitled to have the goods repaired or replaced if the goods fail to be of acceptable quality and the failure does not amount to a major failure.

1. We warrant that on delivery to you, the Goods shall:
 - (a) Substantially conform with their description on the Offroad Living or AllSpark website or official eBay Store. No guarantees are given for any information re-produced by wholesaler, resellers or any other related or unrelated third party other than those given in official Offroad Living or AllSpark documentation; and
 - (b) Be free from material defects in design, material and workmanship; and
 - (c) Be reasonably fit for the purpose for which they are intended to be used.

2. In addition to any rights you have at law, we provide you with a 30-day limited warranty to repair or replace the Goods (at our option) subject to the following conditions:
 - (a) The warranty covers defects in materials and workmanship only;
 - (b) You may only claim under this warranty if all parts of the Goods are maintained in accordance with any recommendations, if any, which we have conveyed to you, including via any instructions manuals maintained on our Website or by the manufacturer.
 - (c) You may only claim on this warranty if you have complied with all of the terms of the Agreement and any other reasonable requirements, we ask you to comply with;
 - (d) You may not claim on this warranty to the extent any costs, loss or damage to the Goods arise as a result or in connection with fair wear and tear of the Goods or your own negligence, wilful damage or act or omission;
 - (e) If, during the period commencing on the day you receive delivery of the Goods (and such delivery will be deemed to have occurred on the earlier of any recorded delivery by any third party delivery service or the expected delivery period identified on our website or eBay store or from an authorised reseller) and ending 30 days later, you notify us that Goods you have ordered are defective; then
 - (f) We will, at our option, either:
 - (1) Repair the Goods; or
 - (2) Replace the Goods.
 - (g) We will cover the costs of the return shipping costs of the Goods to our nominated address (only if purchased directly from us – this is not applicable if purchase through a reseller) and for the replacement or repaired Goods to be delivered to you if the Goods are found to be defective. If not found to be defective the shipping costs will be borne by the purchaser.

3. In addition to any rights you have at law, and our warranty set out in the preceding clause, we grant you a further warranty to repair or replace the Goods (at our option) on the following conditions:
 - (a) The warranty will only apply if we receive a notice of a claim by you on or more than 30 days after the date of delivery to you, and prior to the expiry of 48 months (limited to 24 months for commercial or industrial use) for personal or recreational use only from the date of delivery to you;
 - (b) The warranty covers defects in materials and workmanship only;
 - (c) You may only claim under this warranty if all parts of the Goods are maintained in accordance with any recommendations, if any, which we have conveyed to you,

including via any instruction manuals maintained on our Website or by the manufacturer and in this user manual;

- (d) You may only claim on this warranty if you have complied with all of the terms of the Agreement and any other reasonable requirements, we ask you to comply with;
 - (e) You may not claim on this warranty to the extent any costs, loss or damage to the Goods arise as a result or in connection with fair wear and tear of the Goods or your own negligence or act or omission. Damage due to any attempt to open the battery, rain, fire, explosion, hail, vandalism or theft are not covered under warranty and any claim as such will be rejected.
 - (f) A battery reaching the end of its useful life due to wear and tear is not covered by warranty. All batteries have a limited number of cycles and amp hours that they can provide and whilst one user may get 10+ years from a battery with lighter use, another user may wear out a battery within the warranty period with heavy use or high continuous current applications;
 - (g) You will be solely responsible for the delivery of the Goods to and from our nominated address.
4. No Goods will be accepted for return, repair or replacement under this warranty without our prior written consent.

The warranty program outlined within is the only warranty applicable to AllSpark Lithium Iron Phosphate batteries and covers all the warranty obligations by the manufacturer and purchaser. There is no other warranty, other than those described in this document or the Offroad Living terms and conditions of sale. Any implied warranty of fitness for a particular purpose on this unit is limited in duration to the duration of this warranty.

Additional technical conditions of warranty are outlined below:

- The warranty does not extend to subsequent purchasers or other users other than for OEM applications authorised by Offroad Living contract agreements
- Do not use for aviation battery applications. They have not been designed or tested for this application.
- This warranty does not extend to batteries used in any residential or commercial system sold with "Tariff Adjustment Program" usage intent
- No AllSpark product shall be used for medical devices that are for life preserving applications
- AllSpark batteries are warranted for parallel use and to increase the overall usable capacity. They shall not be used to increase the continuous output current of more than 100% of any individual battery in the battery bank
- Only our 100ah battery with 200A/500A BMS is warranted for under bonnet use only. All other battery models are not warranted for engine bay installation. This battery is suitable for jump starting of all 12v engine applications. All other models are not suitable for cranking applications
- All LiFePO4 batteries in the AllSpark range will power a 2000w inverter from a single battery. Additional batteries can be connected in parallel for extra run time capacity
- Chargers used that do not meet the requirements outline above in this user manual may damage your battery and void your warranty
- Failure to charge the battery during long periods of storage or with a parasitic power draw as outline in the above user manual may cause irreversible damage and will not be covered under this warranty.

12. Contact information

Any first contact relating to warranty shall be directed to the initial place of purchase. If purchased directly from Offroad Living, please contact us by email at warranty@offroadliving.com.au or 0411060000 by phone.

Goods to be returned for any warranty related claim must be authorised first and once approved, sent to Unit 4, No. 1 Winton Road, Joondalup WA 6027