

Advanced Mobile Power Systems

Lithium batteries with internal BMS and safety shutdown

AMPS

100Ah & 120Ah

12-24-36-48 V

Series operation

E13 Type approved



LiFePO₄ 90 - 160 Ah
(Larger available)
12.8V (nominal).

Lithium deep cycle battery.
Automotive applications

SUPER-B

90Ah



AMPS

Taking the mystery
out of lithium batteries
on vehicles

Ah capacity	Maximum Continuous Charge	Maximum Continuous Discharge	Intermittent (30 sec) Discharge	Size mm L-W-H	Weight Kg	Part Nos	rrp EX Vat
100	0.5C=50A	1C=100 A	2C=200A	323-173-218	15	LD12100	£ 1000.00
120	0.45C=50A	1C=120 A	2C=240A	407-174-208	17	LD12120	£ 1250.00

The numbers in red can be increased x the number of batteries in a battery bank

AMPSystems general approach and mission:

AMPS has been setup to focus on a few Lithium batteries which are suitable for easy installation and use in vehicles and boats. It ensure a simple understanding and installation technique for safety, reliable and a long fruitful life for lithium batteries.

Lithium batteries general overview.

The advantages of lithium batteries are well known over conventional batteries. They are superior on every level - everyone wants them, however, installing them on vehicles/boats, up to now, was not that simple and required a lot of knowledge because of fears of expensive damage as lithium has a very specific envelope for their charging and discharging curves. Failure to operate within these parameters will reduce the performance ability and life of the battery and (Amps internal BMS safety system will switch the battery off in event of misuse). It may even destroy the battery and even cause a lot of expensive damage. This fear has led to many people backing off from the whole idea of lithium batteries. We aim to ally these fears and show that these batteries are safe and easy to install. For many years people have wanted a simple / easy solution to installing lithium batteries in the automotive industry. This includes: commercial vehicles, campervans, caravans, military, police and ambulances.

However, due to the specific incompatibility with charging voltages and currents on board the vehicles (exacerbated by the new Euro 6+ vehicle's engines with smart alternator technology) and the requirements of the battery. The two things simply could not safely be brought together without a very elaborate intermediary system linked into a BMS for the lithium battery. All these fears are now overcome; today we have lithium batteries with built in BMS and automatic shutdown systems that take care of the cell safety and extreme faults that may be presented to a lithium battery. With the simple addition of a Sterling Battery to Battery charger the correct voltage and current profile is provided to the battery from the vehicle's alternator with no integration fuss. This means, when your alternator voltage is low, the battery to battery charger increases the voltage and when your alternator's voltage is too high the battery to battery charger decreases it. Also, when you have too much current, the battery to battery charger reduces the current, thus, presenting

the lithium battery with its ideal safe voltage and current requirements. This has never been so important than with the modern Euro 5/6 vehicle applications. The first, all in one - simple to install - package that removes all fears with this technology for application on vehicles.

Key installation points and advantages power performance: Because a 100Ah lithium battery allows total access to the full 100Ah as opposed to a normal lead acid 100Ah battery which realistically only allows access to 50% - about 50Ah. Therefore, you get the equivalent of 2 x 100Ah standard batteries to 1 lithium.

Battery weight: Battery size to battery size lithium is about 1/2 the weight of a conventional lead acid battery. However, because you get 2x the power from the same battery in fact a lithium battery is about 1/4 the weight - power for power.

Matching battery to requirements: A lithium battery with built in BMS and safety shutdowns has, by definition, internal safety shutdown limits - in overload, over charge, over temperature, over voltage etc. In the event of exceeding the safety specifications, a lithium battery will switch off and cool down or wait until the offending voltages are removed. The battery is an electronically controlled device and should be thought of as a Ferrari as opposed to a tractor (lead acid). The safety limits are therefore your benefit to ensure the life and performance of the battery. Exceeding these limits will result in the battery shutting down and cooling down. In the event of these limits being exceeded, in order to avoid disappointment in the product, you must be honest to yourself (and us) about the usage of the product. That way, we can either recommend the lower cost AMPS or the more expensive Super B. Or, simply, tell you we cannot help. Much rather have that conversation than letting you down on the system.

Charge performance: a lithium battery can charge much faster and fuller. I.e. when a normal lead acid battery is reaching its capacity the power intake tapers off very quickly. Not so much with lithium it can sustain the charge curve for much longer. It also holds its output voltage longer ensuring maximum performance for the products attached to the battery. This is indicated by a C rating where, for example, a 100Ah battery with a continuous charge rate of 0.5C (where C is the capacity of the battery) then 0.5C x 100A would be 50A continuous charge the more expensive batteries would have 1C charge rates.

Life expectancy / economics: An average AGM battery would claim 1000 cycles, however, in the real world of deep discharge cycles this is simply far from reality. The cycles for a lead acid diminish dramatically on depth of discharge and speed of recharge (they dry up if charged fast). The battery may be good for 1000 cycles at 10% charge, however, on a domestic system which has a heavy discharge regime of 60% and fast 1C recharge + that figure would collapse to more like 400. A lithium battery with a 1C rating is not as affected with cycles vs depth of discharge. The reality is lithium would last over 20 times longer than your average AGM in deep domestic / discharge fast charge conditions experienced on vehicles and marine use.

The Safety, warranty and handling guidelines: This battery has a 5 year guarantee as long as the product is correctly installed.

What to look for between different lithium batteries and what is safe for me.

There are many different lithium battery configurations available to the public. What should you be looking for in a simple installation?

1) The battery should have a good integrated BMS (battery management system) offering a good C charge and discharge ability (C = the capacity of the battery). At least 0.5- 1C+ continuous rating would be desirable. However, watch out for things like C1 this is actually 0.1C. Look for the C after the number, not before. Also, be careful where some companies claim a C rating and, on deeper examination, it is not a continuous C rating. It looks much better than it really is. Always get the continuous ratings, the maximum ratings are relatively meaningless unless they are followed by a time frame. I.e. to claim a 3C maximum one would expect to see for "30 seconds" to qualify that figure, otherwise the figure means nothing. This is even more meaningless on the charging side.

2) Ensure the battery has the ability to shut itself off. In the event of an overcharge / overheat / over voltages etc. the battery can actually shut itself down, This is vitally important.

Can I simply purchase a lithium battery and add it to my vehicle / campervan? The simple answer is NO. not without adding extra equipment. Lithium batteries must be charged correctly as they need to get the desired voltages and current to charge them safely and fully. These voltages are not available on modern vehicles especially with euro 6+ engines and would easily result in massive battery damage and possibly a fire if the battery was not adequately protected. However, Sterling Power make a range of battery to battery chargers which can be easily connected to the battery input to control both the voltages and the current limiting into the battery ensuring safe fast charging from your vehicle/boat system.

Selecting your ideal battery system , selecting between the lower cost and lower performance AMPSystem batteries or the more expensive Super B.

Selecting your best battery and battery to battery charger for your application: Things which you must take into consideration:

1) **Cost**, obviously cost is a major factor, we offer 2 main lithium battery types - one almost 2 x the cost of the other. You can imagine there is a difference in the battery technology and application. There is no point fitting the expensive super B battery if the lower cost AMPSystem battery will do the job and vice versa. It is important to think about the following points to establish where the crossover line is between the low cost battery versus the more expensive version. Both are good batteries more expensive offers aspects that could be crucial to your system.

2) **Your maximum charge rate:** this is a key feature, for example, a very low cost lithium battery has about a 0.3C charge rate (on a 100A battery that is 30A max charge) the low cost AMPSystems is 0.5C (50A on a 100A battery) the super B is 1C which is 100A on a 100Ah battery). If you want to utilise the maximum charge rate on a single battery installation then obviously the super B is the unit to go on. If, however, you can fit more than 1 battery (AMPSystem version) then if you can fit 2 batteries then the charge rate is still 0.5C but 0.5C of 200Ah is still 100A.

3) **Chassis weight:** Check the vehicle chassis weight to make sure you are not overshooting the maximum weight of the chassis from the batteries. This can be especially important on ambulances / caravans and camper vans where the unit build could be very close to the chassis weight, the good news is that lithium batteries are much lighter than the lead acid equivalency about 1/2 the weight for physical size to size and about 1/4 the weight for the power to power.

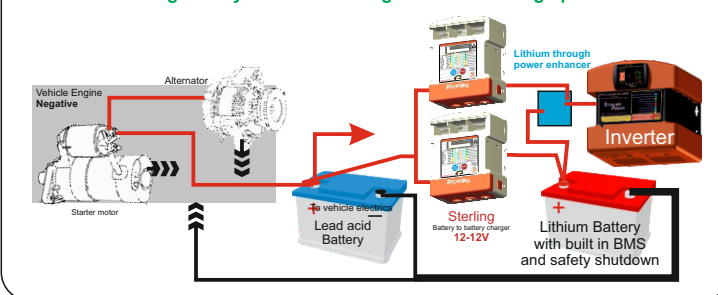
4) **Your expectations from the power saved from the battery.** A normal lead acid battery only delivers about 50% of the 100Ah as useful power. As the lithium gives 100% of the power as useful power so 1 x lithium = 2 x lead acid for power. The

AMPSystem or Super B can be paralleled up with as many batteries as you wish. If you wish to series the batteries the AMPSystem batteries are limited to 48V the super B is 1150V.

5) **Through power expectation.** This is always over looked, this impacts your battery to battery charger choice rather than your batteries. A good example for this is say, a VW campervan, where you want to charge a 100Ah lithium battery (and only have the physical room for 1 battery) from the vehicle's alternator. Remember, modern alternators are about 2000W, the 30A battery to battery charger will charge the lithium battery at about 25A and have no problems as far as charging the battery is concerned. However, you may want to fit an inverter (say a high powered one at 1500-2000W) to run a hair dryer / microwave / coffee machine. Although your 100Ah lithium battery would run 1000W for 1 hr you may not want to deplete your battery bank. You may simply wish to start your engine to through put power directly from the engine's alternator to the inverter to relieve some off the drain from the battery to run the equipment. As you have fitted 30A battery to battery charger the through power would only be 350W, however, if you had fitted a 60A battery to battery charger the through power would be 800W (lower cost AMPSystem battery would be fine).

This total can be increased by using a product called a 'Through Power Enhancer'. This allows an extra Battery to Battery charger to be used (exceeding the charge C rating of the battery bank). This bypasses the battery (so as not to overcharge the battery) but parallels up after the battery. This system can get much more through power from the vehicle's alternator without damage done to the lithium battery.

Correct way to install larger direct alternator power transfer to end product without increasing battery banks size using a 'Lithium through power enhancer'



The threshold where the Super B battery becomes more applicable is when you want to fit a 120A battery to battery charger then your through put power is more like 1400W. This greatly exceeds the rating of a 100Ah AMPSystem's battery (0.5 C rating = 50A). If you upgraded to the Super B (100Ah) battery then the larger battery to battery charger as well as having a great through power contribution would also charge the Super B battery at 100A keeping within better C rating specification. This problem becomes more acute the larger the inverter is and becomes less of a problem the larger the battery bank becomes, as the maths change. Depending on your power requirements this can be extended up to the alternator's full capacity by adding a Lithium Battery Power Enhancer and more battery to battery chargers. There is no limit for either battery type for numbers of batteries in parallel operation, however, for series operation the AMPSystem battery is up to 48V. Other key features of the **Super B**:

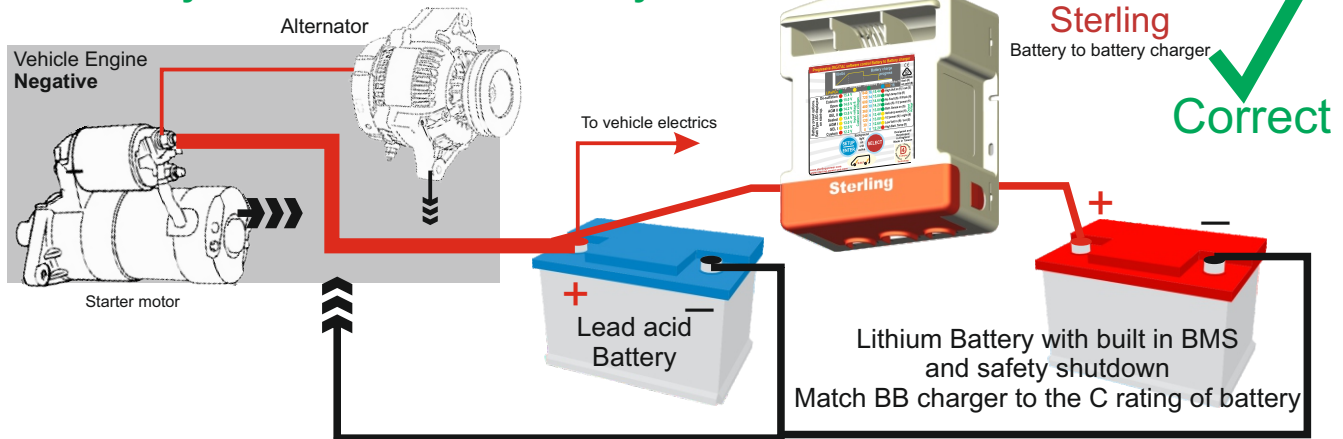
- 1) Complete internal 1C BMS and all associated safety equipment.
- 2) Internal disconnect in the event of any overload / charge or breach of any other safety concerns.
- 3) Fast continuous charger 1C i.e. at up to 90Ah, if 2 are installed then 180Ah.
- 4) Most lithium cannot charge below 0 deg C, however, this battery has been specially designed to charge as low as -30 Deg C (at a reduced charge) the charge regulator is built into the BMS.
- 5) Low internal discharge.
- 6) Bluetooth ready, can be monitored with free battery app for IOS or Android.
- 7) Truly maintenance free.
- 8) Designed to drop into a standard 90-100Ah battery box.

So why choose lithium battery system?

For the same size battery enjoy:

- 1) Approximately 2 x the effective power by size, 4 x effective power, by weight.
- 2) Full Ah rating as opposed to 50% from lead acid.
- 3) Up to 20 times + battery life at 0.5C charge.
- 4) Lowest cost battery (by far) when lifespan integrated into the equation.

Correct way to install a lithium battery



You must fit a Battery to Battery charger because it will offer the lithium the correct charge voltage and current for safe and reliable operation. It will fix the following problems: 1) Low voltage: when the voltage is low the battery to battery charger will boost the voltage up to the correct safe voltage required by the lithium battery. 2) High input voltage, with high input voltage the battery to battery charger will reduce the input voltage to the correct voltage for the lithium battery. 3) Float voltage, when the lithium battery is full the battery to battery charger will reduce the input voltage to a lower safe float voltage for the lithium battery, thus, preventing over charging. 4) Current limit: The battery to battery charger is current limiting and, even if your alternator is 200A, if you have a 50A battery to battery charger only 50A will be allowed into your battery and so over charging is avoided and the life and safety of the battery is preserved.

Advanced Mobile Power Systems
100 Ah Lithium Battery: Pt: AL12100

E13 10R00-10R05-14430-00

Advanced Mobile Power Systems
120 Ah Lithium Battery: Pt: AL12120

E13 10R00-10R05-14429-00

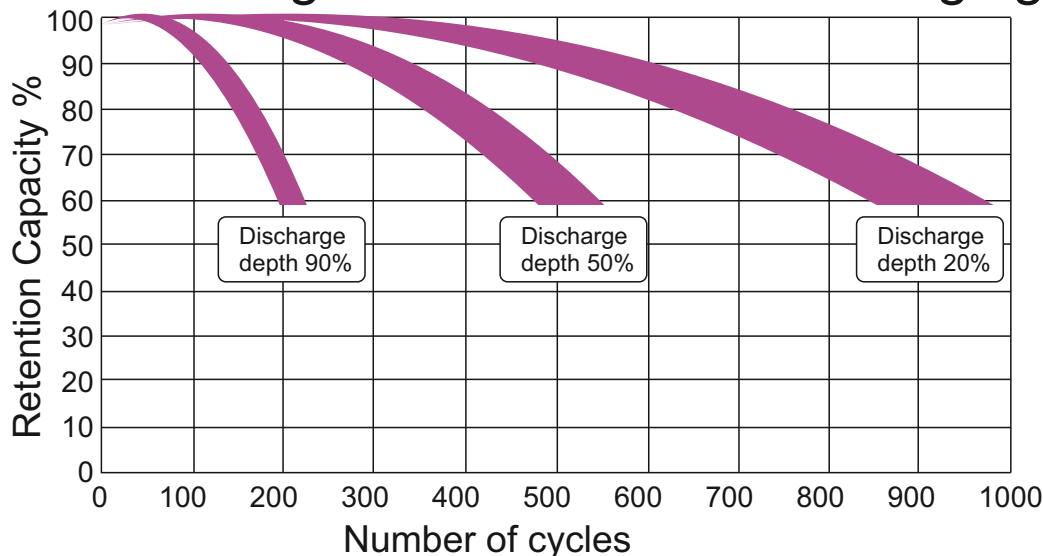


AMPSystem and Super B specifications

	AMPSystem 100 AH	AMPSystem 120 AH	Super-B 90 AH	Super-B 160 AH
LiFePO ₄ (Lithium Iron Phosphate)	x	x	x	x
Integrated BMS (Battery Management system)	x	x	x	x
Safety internal disengage system	x	x	x	x
Integrated overload protection	x	x	x	x
Integrated over voltage protection	x	x	x	x
integrated over temperature protection	x	x	x	x
Adaptive cell balancing	x	x	x	x
E marked typed approved for vehicles	x	x		
True maintenance free	x	x	x	x
EMC: Emissions EN61000-6-3	x	x	x	x
Sterling Bat to Bat charger required for charging	x	x	x	x
IEC 62281 Safety during transport	x	x	x	x
Parallel connection quantity unlimited	x	x	x	x
12 volt operation	x	x	x	x
Series/ string operation 4 x 12 v = 48 V max	x	x		x
Continuous charge rate 1C			x	x
Continuous charge rate 0.45-0.5C	x	x		
Continuous discharge rate 2 C			x	x
Continuous discharge rate 1 C	x	x		
10 sec discharge rate 3.5 C			x	x
10 sec discharge rate 2C	x	x		
CAN/LIN/ Bluetooth interface battery monitoring			x	x
Battery Monitoring and history storage			x	x
Battery monitor app for IOS and Android			x	x
Operating temperature -40 to 65 deg c			x	x
Operating temperature -20 to 60 deg c 01C	x	x		
Lloyds registered			x	x
IEC 62133			x	x
IEC 62619			x	x
UN38.3 Classification class9 lithium batteries	x	x	x	x
Com s (Rj45):CAN(J1939) CI-Bus (LIN),MNEA2000			x	x

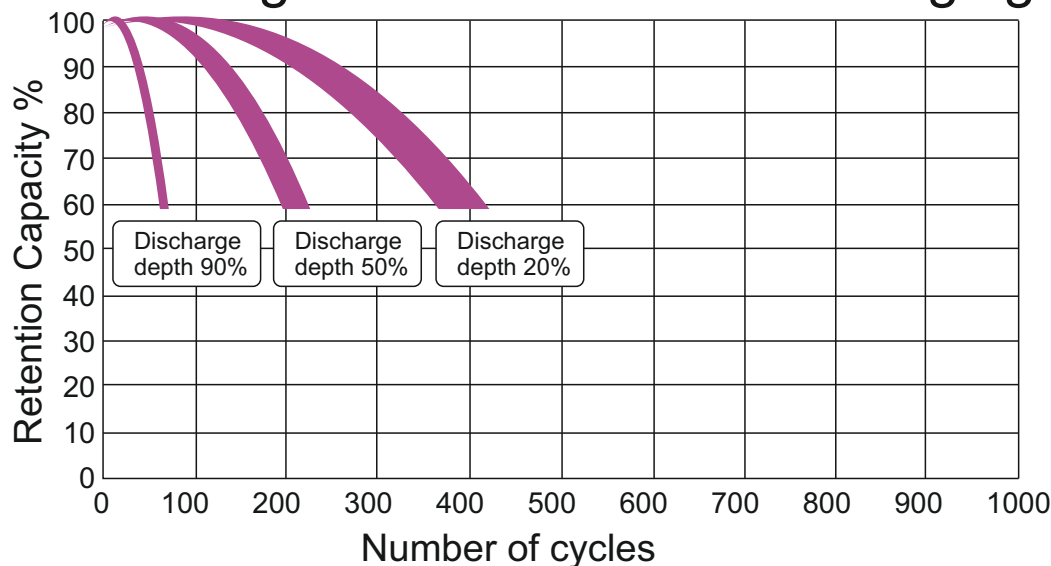
Battery name	Amp Hr cap	Weight kg	Size	Part number
AMPsystem	100	15	323 x 173 x H218	AL12100
AMPsystem	120	17	407 x 174 x H208	AL12120
Super-B	90	12.5	353 x 175 x H190	SB1290

Average lead acid at 0.1 C charging



The above graph is the figures the lead acid battery manufacturers would like you to see and hope you don't understand. The problem being the 0.1 C charge rate may be good in the laboratory but is not a realistic figure in real life for fast charging applications. This is why customers are expecting 1000 cycles, which easily equates to 10 years worth of operational work with 100 cycles per year. This is more than the average boater or campervan operator would ever use but well within emergency vehicle applications. Whereas I am sure these graphs are factual for a 0.1C charge environment (i.e. 10% of the Ah capacity this equates to a 100Ah battery charging at 10A). This is a totally unrealistic restriction in the environment which Sterling Power customers operate where our customers want to recharge batteries in 1 hr not 10 hours. The restriction on the above graph of 0.1C is perfect to preserve the life of the battery but not good for fuel costs and engine running hours. This unrealistic figure makes the graph look good, however, in the real world of commercial vehicles and marine where modern vehicles have alternators of 140-240A (not 10-20A alternators) then a real world charge rate of 1C+ is a much more realistic figure, with this, the performance of the lead acid batteries dramatically reduce and falls much more into line with what people actually experience, see below.

Average lead acid at 1.0 C charging



Compare the cycles from a lithium battery at 1C charge rate against the more realistic lead acid cycles at 1C. Note the cycle scale on the lithium is 10000 cycle where the lead acid scale is only 1000 cycles, the lithium is approximately 20 times greater life expectancy.

Average Lithium 1.0 C charging

