POWER-SONIC
TRUSTED BATTERY SOLUTIONS

PSL-FP SERIES

Medical | Solar | Wind | Mobility | Data Center | Transport | Sport & Recreation | Utility

PSL-FP-IFP30135185EC 3.2V 50AH ENERGY CELL

Rechargeable Lithium Cell
PSL FP – Lithium Iron Phosphate Series

CELL FEATURES

- Super safe lithium iron phosphate (LiFePO4) chemistry reducing the risk of explosion or combustion due to high impact, over-charging or short circuits
- Construct custom battery design by placing two or more cells in parallel and/or series
- Fast charging and low self-discharge rate
- Durable steel case material

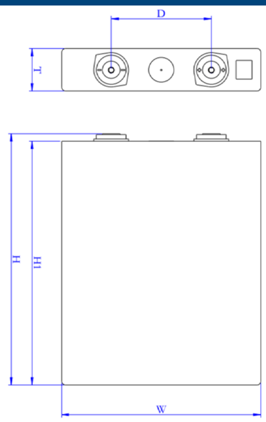
APPROVALS

UN38.3 PASSED Transport Safety Certified | bsi. ISO 9001 Quality Management

- UL 1642 certified
- UN 38.3 certified
- ISO9001:2015 - Quality management systems

DIMENSIONS: inch (mm)

Laser Weld Terminal:
H: 7.40in (188mm)
H1: 7.08in (180mm)
D: 2.66in (67.5mm)
W: 5.31in (135mm)
T: 1.15in (29.3mm)
Screw Bolt Terminal:
H: 7.80in (198mm)
H1: 7.08in (180mm)
D: 2.66in (67.5mm)
W: 5.31in (135mm)
T: 1.15in (29.3mm)



GLOBAL HEADQUARTERS
(USA AND INTERNATIONAL EXCLUDING EMEA)
Power-Sonic Corporation
365 Cabela Dr Suite 300,
Reno, Nevada 89523
USA
T: +1 619 661 2020
E: customer-service@power-sonic.com

POWER-SONIC EMEA
(EMEA – EUROPE, MIDDLE EAST AND AFRICA)
Smitspol 4, 3861 RS Nijkerk,
The Netherlands
T NL: + 31 33 7410 700
T UK: + 44 1268 560 686
T FR: + 33 344 32 18 17
E: salesEMEA@power-sonic.com

LITHIUM ENERGY CELL

The PSL-FP-IFP30135185EC is an energy cell. Energy cells are designed to deliver sustained current over a long period of time, making them ideal for use in cyclic applications.

PERFORMANCE SPECIFICATIONS

Nominal Voltage	3.2 V
Rated Capacity	50 AH
Stored Energy	160 Wh
Cycle Life (@DOD100%)	2000 Cycles
Approximate Weight	3.08 lbs (1.4 kg)
Internal Resistance	≤0.7 mΩ
Max Charge Current	50 A/1C
Max Discharge Current	150 A/3C
Charge Cut-off Voltage	3.65 V
Recommended Discharge Cut-Off Voltage	2.5 V
Operating Temperature Range	
Charge	32°F (0°C) to 131°F (55°C)
Discharge	-4°F (-20°C) to 131°F (55°C)
Recommended	59°F (15°C) to 95°F (35°C)
Temperature Limit	Cell skin temperature cannot exceed 65°C
Standard Charging Method	0.5C constant current charge to 3.65V, then constant voltage charge until the charge current declines to 0.05C
Life Expectancy (years)	5 years at one cycle per day
Dimensional Tolerances	+/- .04 in. (+/- 1 mm) for all dimensions
Terminal Type	M6 Screw Bolt or Laser Weld Plate

STORAGE SPECIFICATIONS

	1 Month	3 Months	6 Months
Retention*	90%	85%	80%
Recovery*	95%	90%	85%

*Cell stored at 77°F (25°C) with 50% SOC.
Storage temperature should be 14°F (-10°C) to 86°F (30°C) with 45-85%RH. It is recommended to store cells at 25°C and between 3.2 and 3.4V for long term storage.

POWERSONIC
TRUSTED BATTERY SOLUTIONS

PSL-FP SERIES

PSL-FP-IFP30135185EC 3.2V 50 AH ENERGY CELL

Rechargeable Lithium Cell
PSL FP – Lithium Iron Phosphate Series

CAPACITY SPECIFICATIONS

Item	Test Method and Condition	Result
Rated Capacity 0.5C	Capacity measured with discharge current of 0.5C with 2.5V cut-off voltage after the standard charge.	53Ah
Rated Capacity 1C	Capacity measured with discharge current of 1C with 2.5V cut-off voltage after the standard charge.	50Ah
Rated Capacity 2C	Capacity measured with discharge current of 2C with 2.5V cut-off voltage after the standard charge.	48Ah
Rated Capacity 3C	Capacity measured with discharge current of 3C with 2.5V cut-off voltage after the standard charge.	45Ah
Cycle Life	Temperature: 23+/-5°C Charge: 1C Constant Current to 3.65V, then Constant Voltage to 0.05C cut off Discharge: 1C discharge to 2.5V 80% or more of first cycle capacity at 1C discharge	2000 times
Initial Impedance	Internal resistance measured at AC 1KHz at 50% charge	≤0.7 mΩ

Standard environmental test condition:
Unless otherwise specified, all tests stated in this Product Specification are conducted at:
Temperature: 23+/-5°C
Humidity: 65+/-20% RH

CHARGING SPECIFICATIONS

Charging Current:
Charging current should be less than the maximum charge current specified within this product specification. Charging with higher current than recommended may cause damage to the cell's electrical, mechanical, and safety performance, and could lead to heat generation or leakage of electrolyte.

Charging Voltage:
Charging voltage should be less than the maximum charge voltage specified within this product specification. Charging beyond 3.7V, which is the absolute maximum voltage, is strictly prohibited. The charger shall be designed to comply with this condition. Charging with higher voltage than maximum may cause damage to the cell's electrical, mechanical, and safety performance, and could lead to heat generation or leakage of electrolyte.

Charging Temperature:
The cell should be charged within 32°F (0°C) to 113°F (45°C).

Reverse Charging:
Reverse charging is prohibited. The cell is required to be connected correctly. The polarity has to be confirmed prior to wiring. If the cell is not connected properly, the cell cannot be charged. Reverse polarity charging may cause degradation of the cell's performance, overall damage to the cell, which could lead to heat generation or leakage of electrolyte.

PSL-FP-IFP30135185EC 3.2V 50 AH ENERGY CELL

Rechargeable Lithium Cell
PSL FP – Lithium Iron Phosphate Series

DISCHARGING SPECIFICATIONS

Discharging Current:
Discharging current should be less than the maximum discharge current specified within this product specification. Discharging with higher current than recommended may reduce the capacity of the cell and could cause the cell to over-heat.

Discharging Temperature:
The cell should be charged within -4°F (-20°C) to 140°F (60°C).

Over Discharging:
In order to prevent over-discharging, the cell should be charged periodically, as over-discharging may cause decreased cell performance. In the event that a cell has been over-discharged below 2V, care must be taken to bring the cell out of the over-discharged state. Charging should start with a low current (0.01C) for 15 - 30 minutes, i.e. pre-charging, before rapid charging starts. The rapid charging shall begin after the individual cell voltage has been reached above 3V per cell within 15 - 30 minutes that can be determined with the use of an appropriate timer for pre-charging. In case the individual cell voltage does not rise to 3V within the pre-charging time, then the charger shall have functions to stop further charging and display the cell is at abnormal state.

BATTERY PROTECTION/MONITORING REQUIREMENTS

The cell(s) need to be connected to a Protective Circuit Module (PCM) or Battery Management System (BMS). The PCM/BMS must have function(s) to prevent over-charging, over-discharging, and over-current to maintain the safety and overall performance of the cells. Please note that over current can happen by an external short circuit.

Overcharging:
The PCM/BMS must be programmed to stop charging if the cell reaches 3.7V. Over-current protection must be set at specified maximum continuous rating outlined in this specification.

Over-discharging:
The PCM/BMS must be programmed to stop discharging when the cell reaches 2V. Over-current protection must be set at specified maximum continuous rating outlined in this specification.

WARNINGS

Short Circuit:
Please use enough insulation layers between wiring and the cell to prevent short circuits within the battery pack.

Disassembly:
Never disassemble the cell. Disassembling may cause an internal short circuit, which may cause gas emission, fire, or other problems.
Do not puncture the cell. The electrolyte inside the cell is harmful if it comes into contact with the skin or eyes. In the event the electrolyte comes into contact with skin or eyes, it is recommended to immediately flush the electrolyte with fresh water and seek medical attention.

Warning:
Do not place cell in fire. This may cause the cell to overheat and explode.
Do no immerse the cell into liquids (water, etc.).
Do not use a damaged cell.

Replacement:
If a cell needs to be replaced, please contact Power Sonic. End users should not replace cells.

FURTHER INFORMATION

Please refer to our website **www.power-sonic.com** or email us at **technical-support@power-sonic.com** for a complete range of useful downloads, such as product catalogs, material safety data sheets (MSDS), ISO certification, etc.

POWER PS SONIC
TRUSTED BATTERY SOLUTIONS

WHITE PAPER

HOW TO CHARGE LITHIUM IRON PHOSPHATE (LIFEPO4) BATTERIES

If you've recently purchased or are researching lithium iron phosphate batteries (referred to lithium or LiFePO4 in this white paper), you know they provide more cycles, an even distribution of power delivery, and weigh less than a comparable sealed lead acid (SLA) battery. Did you know they can also charge four times faster than SLA? But exactly how do you charge a lithium battery, anyway?

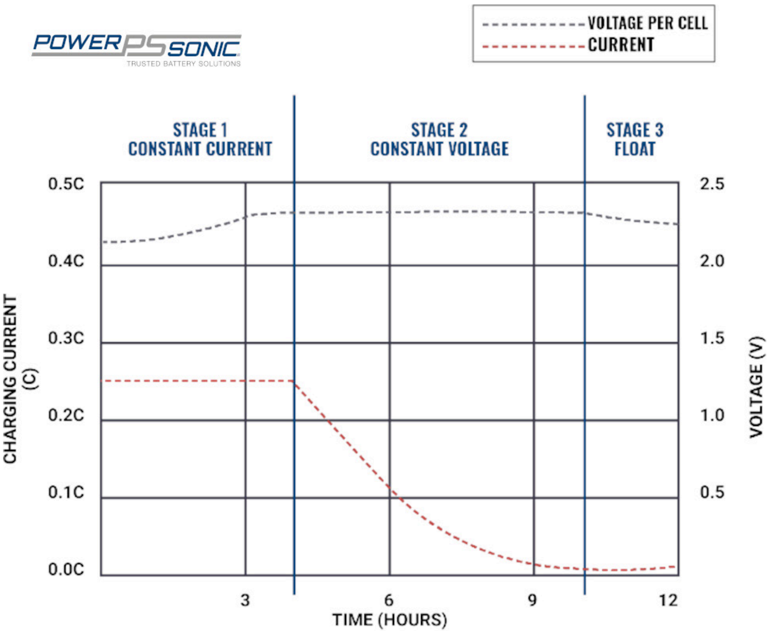
Power Sonic recommends you select a charger designed for the chemistry of your battery. This means we recommend using a lithium charger when charging lithium batteries.

CAN A LEAD ACID CHARGER CHARGE A LITHIUM BATTERY?

As you will learn in this white paper, there are many similarities in the charging profiles of SLA and lithium. However, extra caution should be exercised when using SLA chargers to charge lithium batteries as they can damage, under charge, or reduce the capacity of the lithium battery over time. There are many differences when comparing lithium and SLA batteries.

SEALED LEAD ACID (SLA) BATTERY CHARGING PROFILE

Let's go back to the basics of how to charge a sealed lead acid battery. The most common charging method is a three-stage approach: the initial charge (constant current), the saturation topping charge (constant voltage), and the float charge.



Stage 1, as shown above, the current is limited to avoid damage to the battery. The rate of change in voltage continually changes during Stage 1 eventually beginning to plateau when the full charge voltage limit is approached. The constant current/Stage 1 portion of the charge is crucial before moving onto the next stage. Stage 1 charging is typically done at 10%-30% (0.1C to 0.3C) current of the capacity rating of the battery or less.

Stage 2, constant voltage, begins when the voltage reaches the voltage limit (14.7V for fast charging SLA batteries). During this stage, the current draw gradually decreases as the topping charge of the battery continues. This stage terminates when the current falls below 5% of the battery's rated capacity. The last stage, the float charge, is necessary to keep the battery from self-discharging and losing capacity.

If the battery is being used in a standby application, the float charge is necessary to ensure the battery is at full capacity when the battery is called upon to discharge. In an application where the battery is in storage, float charging keeps the SLA battery at 100% State of Charge (SOC), which is necessary to prevent sulfating of the battery that therefore prevents damage to the plates of the battery.

GLOBAL HEADQUARTERS
(USA AND INTERNATIONAL EXCLUDING EMEA)
Power-Sonic Corporation
365 Cabela Dr Suite 300,
Reno, Nevada 89523
USA
T: +1 619 661 2020
E: customer-service@power-sonic.com

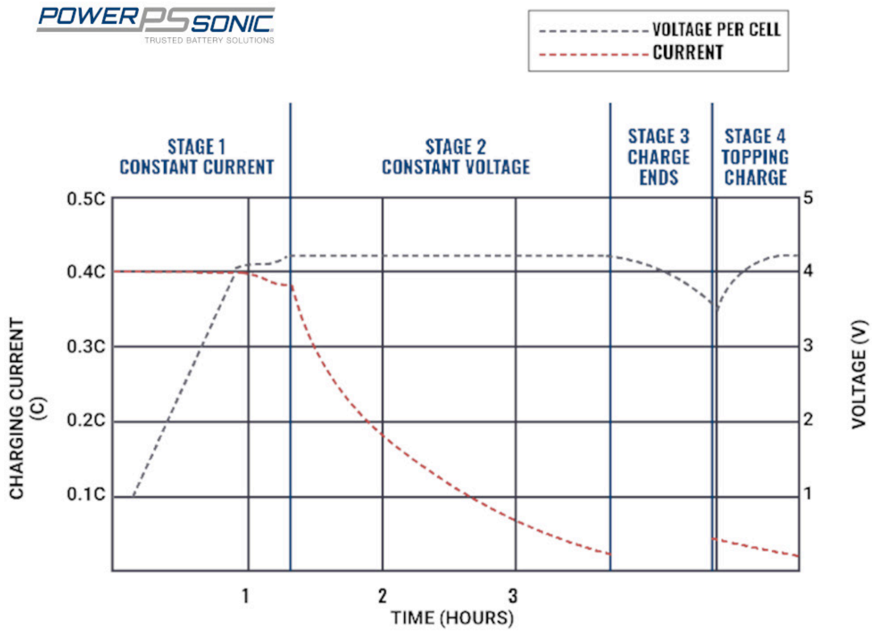
POWER-SONIC EMEA
(EMEA - EUROPE, MIDDLE EAST AND AFRICA)
Smitspol 4, 3861 RS Nijkerk,
The Netherlands
T NL: + 31 33 7410 700
T UK: + 44 1268 560 686
T FR: + 33 344 32 18 17
E: salesEMEA@power-sonic.com

POWER PS SONIC
TRUSTED BATTERY SOLUTIONS

HOW TO CHARGE LITHIUM IRON PHOSPHATE (LIFEPO4) BATTERIES

LIFEPO4 BATTERY CHARGING PROFILE

A LiFePO4 battery uses the same constant current and constant voltage stages as the SLA battery. Even though these two stages are similar and perform the same function, the advantage of the LiFePO4 battery is that the rate of charge can be much higher, making the charge time much faster.



Stage 1 battery charging is typically done at 30%-100% (0.3C to 1.0C) current of the capacity rating of the battery. Stage 1 of the SLA chart above takes four hours to complete. The Stage 1 of a lithium battery can take as little as one hour to complete, making a lithium battery available for use four times faster than SLA.

Stage 2 is necessary in both chemistries to bring the battery to 100% SOC. The SLA battery takes 7 hours to complete Stage 2, whereas the lithium battery can take as little as 15 minutes. Overall, the lithium battery charges in four hours, and the SLA battery typically takes 10. In cyclic applications, the charge time is very critical. A lithium battery can be charged and discharged several times a day, whereas a lead acid battery can only be fully cycled once a day.

Where they become different in charging profiles is Stage 3. A lithium battery does not need a float charge like lead acid. In long-term storage applications, a lithium battery should not be stored at 100% SOC, and therefore can be maintained with a full cycle (charged and discharged) once every 6 - 12 months to 30% - 70% SOC.

In standby applications, since the self-discharge rate of lithium is so low, the lithium battery will deliver close to full capacity even if it has not been charged for 6 - 12 months. For longer periods of time, a charge system that provides a topping charge based on voltage is recommended.

GLOBAL HEADQUARTERS
(USA AND INTERNATIONAL EXCLUDING EMEA)
Power-Sonic Corporation
365 Cabela Dr Suite 300,
Reno, Nevada 89523
USA
T: +1 619 661 2020
E: customer-service@power-sonic.com

POWER-SONIC EMEA
(EMEA - EUROPE, MIDDLE EAST AND AFRICA)
Smitspol 4, 3861 RS Nijkerk,
The Netherlands
T NL: + 31 33 7410 700
T UK: + 44 1268 560 686
T FR: + 33 344 32 18 17
E: salesEMEA@power-sonic.com

WHITE PAPER

POWER PS SONIC
TRUSTED BATTERY SOLUTIONS

HOW TO CHARGE LITHIUM IRON PHOSPHATE (LIFEPO4) BATTERIES

LITHIUM BATTERY CHARGING CHARACTERISTICS

Voltage and current settings during charging

The full charge voltage of a 12V SLA battery is nominally around 13.1 and the full charge voltage of a 12.8V lithium battery is around 13.4. A battery will only sustain damage if the charging voltage applied is significantly higher than the full charge voltage of the battery.

This means an SLA battery should be kept below 14.7V for Stage 2 charging and below 15.2V for lithium. Float charging is only required for an SLA battery, recommended around 13.8V. Based on this, a charge voltage range between 13.8V and 14.7V is sufficient to charge any battery without causing damage. When selecting a charger for either chemistry, it is important to chose one that will stay between the limits listed above.

Chargers are selected to match the capacity of the battery to be charged, since the current used during charging is based on the capacity rating of the battery. A lithium battery can be charged as fast as 1C, whereas a lead acid battery should be kept below 0.3C. This means a 10AH lithium battery can typically be charged at 10A while a 10AH lead acid battery can be charged at 3A.

The charge cut-off current is 5% of the capacity, so the cutoff for both batteries would be 0.5A. Typically, the terminal current setting is determined by the charger.

Universal chargers will typically have a function to select the chemistry. This function chooses the optimal voltage charging range, and determines when the battery is fully charged. If it is charging a lithium battery, the charger should shut off automatically. If it is charging an SLA battery, it should switch to a float charge.

Lithium batteries replacing sealed lead acid in float applications

It is very common for lithium batteries to be placed in an application where an SLA battery used to be maintained on a float charge, such as a UPS system. There has been some concern, whether this is safe for lithium batteries. It is generally acceptable to use a standard constant voltage SLA charger with our lithium batteries, as long as it adheres to certain standards.

If using a constant voltage SLA charger, the charger must meet the following conditions:

- Charger must not contain a de-sulfating setting
- Fast charge voltage of 14.7V
- Recommended float charge voltage of 13.8V

As a side note, some smart or multi-stage SLA chargers have a feature that detects open circuit voltage (OCV). An over-discharged lithium battery that is in protection mode will have an OCV of 0. This type of charger would assume this battery is dead and would not try to charge it. A charger with a lithium setting will try to recover or “wake up” an over-discharged lithium battery.

GLOBAL HEADQUARTERS
(USA AND INTERNATIONAL EXCLUDING EMEA)
Power-Sonic Corporation
365 Cabela Dr Suite 300,
Reno, Nevada 89523
USA
T: +1 619 661 2020
E: customer-service@power-sonic.com

POWER-SONIC EMEA
(EMEA - EUROPE, MIDDLE EAST AND AFRICA)
Smitspol 4, 3861 RS Nijkerk,
The Netherlands
T NL: + 31 33 7410 700
T UK: + 44 1268 560 686
T FR: + 33 344 32 18 17
E: salesEMEA@power-sonic.com

WHITE PAPER

POWER PS SONIC
TRUSTED BATTERY SOLUTIONS

HOW TO CHARGE LITHIUM IRON PHOSPHATE (LIFEPO4) BATTERIES

Long term storage

If you need to keep your batteries in storage for an extended period, there are a few things to consider as the storage requirements are different for SLA and lithium batteries. There are two main reasons that storing an SLA versus a Lithium battery is different.

The first reason is that the chemistry of the battery determines the optimal SOC for storage. For an SLA battery, you want to store it as close to possible as 100% to avoid sulfating, which causes a buildup of sulfate crystals on the plates. The buildup of sulfate crystals will diminish the capacity of the battery.

For a lithium battery the structure of the positive terminal becomes unstable when depleted of electrons for long periods of time. The instability of the positive terminal can lead to permanent capacity loss. For this reason, a lithium battery should be stored near 50% SOC, which equally distributes the electrons on the positive and negative terminals.

The second influence on storage is the self-discharge rate. The high self-discharge rate of the SLA battery means that you should put it on a float charge or a trickle charge to maintain it as close as possible to 100% SOC to avoid permanent capacity loss. For a lithium battery, which has a much lower discharge rate and doesn't need to be at 100% SOC, you may be able to get away with minimal maintenance charging.

Recommended battery chargers

It is always important to match your charger to deliver the correct current and voltage for the battery you are charging. For example, you wouldn't use a 24V charger to charge a 12V battery. It is also recommended that you use a charger matched to your battery chemistry, barring the notes from above on how to use an SLA charger with a lithium battery.

If you have any questions about an existing charger's capability with one of our products, please give us a call or send us an email. We would be happy to assist you with your charging needs.

GLOBAL HEADQUARTERS
(USA AND INTERNATIONAL EXCLUDING EMEA)
Power-Sonic Corporation
365 Cabela Dr Suite 300,
Reno, Nevada 89523
USA
T: +1 619 661 2020
E: customer-service@power-sonic.com

POWER-SONIC EMEA
(EMEA - EUROPE, MIDDLE EAST AND AFRICA)
Smitspol 4, 3861 RS Nijkerk,
The Netherlands
T NL: + 31 33 7410 700
T UK: + 44 1268 560 686
T FR: + 33 344 32 18 17
E: salesEMEA@power-sonic.com