

Pulse Battery Manual



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1.0 About Full Spectrum Power

Full Spectrum Power Pulse® batteries are the finest lightweight batteries available. Batteries with this level of performance and track record of wins, championships, and rock solid reliability have been developed and are manufactured with the utmost quality and design perfection and not by accident. The engineering and assembly methods used in creating Full Spectrum Power products are the result of years of close cooperation with the best race teams in the business.

Full Spectrum Power pioneered the use of Lithium-based lightweight batteries in motorsports applications. Batteries with this level of performance and rock solid reliability are manufactured with the utmost quality and design perfection in mind. Precision does not happen by accident; the engineering and assembly methods used in creating Full Spectrum Power products are the result of years of close cooperation with the best race teams in the business. Our track record of wins and championships attest that Full Spectrum Power Pulse® batteries are the finest lightweight batteries available.

We use only the finest quality materials in the design and manufacture of our batteries: A123 Systems Cells, a Valox case, pure brass terminals, and an Integrated Protection Circuit. Full Spectrum Power lightweight batteries are designed and manufactured in our Virginia facility, and undergo total quality management inspection--not just a cursory check after production.

Full Spectrum Power is a dedicated lightweight battery business, with a singular focus on producing the world's best lightweight batteries. This focus and dedication has been rewarded with awards, wins, and championships. Our products and designs have been proven in the harshest possible environments.

2.0 About Our Technology

Full Spectrum Power Pulse® batteries are available in sizes to fit a wide variety of applications. Please visit www.fullspectrumpower.com to find the correct battery for your specific application. While we offer many different sizes and configurations of lightweight batteries, they all share certain design elements that extend their effective lifespan, make them light and powerful, and make them safe for you, your vehicle, and the environment.

Full Spectrum Power Pulse® batteries belong to the lithium ion family, using the Nanophosphate® LiFePO4 chemistry, specifically. Batteries using this chemistry are light, powerful, and safe. Lithium ion batteries outperform their lead-acid based counterparts in multiple measures, including performance and longevity. They also

require different maintenance procedures, and the following information will help to illustrate how to best care for and maintain your battery. This manual will describe what goes in to a Full Spectrum Power Pulse® battery, how it should perform, what its limitations are, and what you can do to ensure that your Full Spectrum Power Pulse® battery lasts for years to come. If there are any questions that you have about our products that are not answered in this manual, please visit www.fullspectrumpower.com for additional information.

2.1 Cells

At the core of every Full Spectrum Power Pulse® battery are A123 Systems Nanophosphate® cells. These are the most advanced cells available within the LiFePO4 chemistry family. We determined that A123 Systems Nanophosphate® cells were the optimum choice after our testing revealed them to be particularly suited for a start battery application--like our Pulse® batteries. No other LiFePO4-based cell offers the combination of lightweight, power output, safety, and reliability that the A123 Systems Nanophosphate® cells provide. Be sure to look for the A123 Systems logo on products claiming to use this technology. **If you don't see the logo, they aren't using the A123 Systems cell.**

2.2 Case

Every Pulse® battery uses an injection molded case, made of a Valox® composite resin. This material is substantially stronger than standard ABS plastic in torsional resistance, as well as impact resistance. It also has a much higher heat and fire rating than standard ABS plastic, which is the substance commonly used in battery case construction. This means that your battery will be much more likely to survive extremely harsh environments like the Baja 500, 24 Hours of LeMans, and other similar real-world tests of product endurance and reliability.

2.3 Integrated Protection Circuit

While high power and lightweight are the most obvious and noticeable characteristics of the Pulse batteries, the safety component should not be undervalued. All Full Spectrum Power Pulse® batteries have passed test protocol UNDOT 38.3. This is the gold standard of safety testing for lithium batteries around the world. The test identification number is available upon request

This level of safety is the result of the years we have spent focusing on engineering expertise and component selection including A123 Systems Nanophosphate® cells, the Valox® case, and our Integrated Protection Circuit. The Integrated Protection

Circuit provides an automatic current cutoff in case of a short circuit or forced discharge. In the event of a short circuit or forced discharge, the battery will cease to function until the short circuit condition is remedied; this protects you, your battery, and your vehicle from potential hazard. The completion of UNDOT 38.3 testing certifies that the Pulse® batteries are deemed safe for all manner of commercial shipping, including air shipping, without the need for hazardous materials or Class 9 markings or training. **No other battery offers this combination of lightweight, power, and safety.**

3.0 Charging Your Battery

Charging your Full Spectrum Power Pulse® battery is straightforward and simple. We have compiled the following information to further simplify the process, and **it is extremely important that this manual be read prior to using your new battery.** The following sections explain how to keep your Full Spectrum Power Pulse® battery fully charged and ready for use. If any of this information is unclear, please visit www.fullspectrumpower.com for more information.

3.1 Vehicle Charging System

Every Full Spectrum Power Pulse® battery is designed to work with the stock charging system on all commercially available modern vehicles, which have an operating voltage between 13.2 volts and 14.7 volts. This range of acceptable voltage should be confirmed on your vehicle prior to use. If your vehicle does not have a charging system, or if your vehicle's charging system does not operate within the above-mentioned range, this product may not be suitable for you. In such cases, please contact your dealer or Full Spectrum Power directly for suggestions.

NOTE: Your new Full Spectrum Power Pulse® battery ships in a ready-to-use state. You will not need to charge your new battery prior to installation in your vehicle. Once installed in your vehicle, the charging system will maintain the correct state of charge for your battery. Regular and frequent use of your vehicle is the best way to keep your Pulse® battery fully charged.

3.2 Maintenance Charging

If you do not use your vehicle regularly, you may find that your vehicle will drain your Pulse® battery, especially when not used for several days. All modern vehicles require some electrical power at all times- even when powered off. This is due to the need to power peripheral electronic devices including ECU memory, clock, stereo, GPS, and alarms. If your typical usage pattern includes periods of irregular use, you may need to purchase a maintenance charger for your Full Spectrum Power Pulse® battery. Similar to any other battery, the Full Spectrum Power Pulse® battery will lose charge when a load is placed on it.

NOTE: Allowing your battery to become discharged or drained beyond 10 volts will damage your battery, and is considered abuse under the terms of our warranty. It is your responsibility to make sure that this does not occur.

3.3 Balance Charging

Over time your Pulse® battery may need to be “balance charged.” This means that each cell inside the battery is charged to matching voltage levels. While this type of charging is not typical in a vehicle which is used frequently, it may still be required at some point. If you use your Pulse® battery in a total loss system, or if your vehicle places abnormal or unusual strain on your battery, the need for a balance charge will be likely. Full Spectrum Power offers a balance charger for this purpose. Full Spectrum Power will also balance charge your Pulse® battery twice free of charge, for the first 24 months from the date of purchase. You are only responsible for the shipping.

3.4 Charging Tips and Warnings

It is recommended that you disconnect your Pulse® battery when you are not going to use your vehicle for 30 days or longer. This should be considered when towing, trailering, or otherwise transporting your vehicle as well. Disconnecting your battery also is a theft deterrent, as the vehicle will not start without a connected battery. Disconnected Full Spectrum Power Pulse® batteries can sit for months without losing any noticeable capacity, and will be perfectly healthy in cold or hot weather.

NOTE: If you must use a charger on your Full Spectrum Power battery, only use a charger specifically designed for LiFePO4 batteries. Using any

charger not specifically designed for LiFePO4 batteries can damage your battery and will void your warranty.

Battery chargers designed for other types of batteries are simply not compatible with LiFePO4 chemistry. There are many reasons why this is the case;

1. The charger may not be closely regulated and will provide voltage in excess of 14.7 volts;
2. The charger may spike voltage in a de-sulphate mode, in excess of 14.7 volts;
3. The charger may not be able to measure the state of charge (SoC) of the battery, and can malfunction, damaging the battery;
4. The charger may not be able to read the correct voltage of the battery, causing it to malfunction and damaging the battery;
5. The charger may be calibrated for a different battery chemistry, causing damage to the battery.

If this is unclear in any way, please visit www.fullspectrumpower.com for more information.

4.0 Installation

Please read the following guidance on installing your new Pulse® battery **PRIOR TO ATTEMPTING INSTALLATION**. Failure to read and follow the installation instructions could void your warranty, cause serious bodily injury, or damage your vehicle. Your Pulse® battery comes from Full Spectrum Power, ready to be installed in your vehicle. There is no need to charge your new battery prior to installation.

NOTE: Before beginning this installation, turn the vehicle off and remove the key from the ignition switch and make sure the vehicle is stable and will not fall over. Remove all metallic items (i.e.: watches, rings, bracelets, other jewelry, etc.) from your person and wear safety glasses to facilitate safe installation.

1. Gain access to the battery compartment of your vehicle.
2. Carefully disconnect both the positive (RED), and negative (BLACK) cables from the battery you are replacing. With the cables now disconnected,

remove the old battery from the vehicle. Dispose of your old battery according to appropriate laws and regulations.

3. Inspect existing battery cables for corrosion, damage, or deterioration. Take special note to ensure cable insulation is not worn or damaged. Replace worn or damaged cables and related components prior to installing your new Pulse® battery.
4. Position your Pulse® battery in the battery compartment and fasten securely to the vehicle. Remove the factory-installed terminal bolts from the Pulse® battery terminals. If necessary, use the provided foam package insert to secure the battery so as to prevent it from moving while the vehicle is in motion. Orient the Pulse® battery in the same direction as your old battery.

NOTE: In many instances, your Pulse® battery will be physically smaller than the battery you are replacing. Take care to ensure that your Pulse® battery is securely mounted and will not move around the battery compartment freely. The supplied foam insert is designed for this use. If the battery is allowed to move excessively, it may short-circuit when coming in contact with vehicle hardparts.

5. With the Pulse® battery now securely fastened in place; reconnect the positive (RED) cable to the Positive (+) terminal of the Pulse® battery. Install the supplied terminal bolt. **Finger-tighten the terminal bolt only. Do NOT use a tool of any type.**

NOTE: The positive terminal will have a raised RED (+) next to the correct terminal.

6. Reconnect the negative (BLACK) cable from your engine or chassis to the negative terminal of the Pulse® battery. **Finger-tighten the terminal bolt only. Do NOT use a tool of any type.**
7. Only using a hand tool, torque both of the terminal bolts to 8 ft lbs. Do not use electric drills, impact guns, or any other power-assisted tools to install and tighten the terminal bolts.

NOTE: Use of power-assisted tools to install your Pulse® battery terminal bolts will immediately void your warranty.

8. Start vehicle engine. Allow engine to idle for 30 seconds, and then shut off.
9. Replace and secure panels removed for battery access.

5.0 Cleaning and Maintenance

Aside from the information on charging discussed in Section 3 of this manual, your Pulse® battery requires minimal care. Full Spectrum Power recommends the use of a clean damp cloth to clean your Pulse® battery. Do not use any type of oil, organic solvent, alcohol, detergent, strong acids, strong alkalis, petroleum-based solvent or ammonia solution to clean the battery. These materials may cause permanent damage to the battery and will IMMEDIATELY VOID THE WARRANTY.

6.0 Specifications

	<u>Pulse 1</u>	<u>Pulse 2</u>	<u>Pulse 3</u>
Voltage (Nominal)	13.2	13.2	13.2
Voltage (Max Operating)	14.7	14.7	14.7
Ah Capacity	2.5	5	7.5
Ah Capacity (Lead Acid Equivalent)	5	10	15
Cranking Amps	125	250	375
Continuous Discharge Amps	45	45	60
Max Charge Amps	10	20	30
Max Charge Voltage	14.7	14.7	14.7
Operating Temp	-30 °C to 55 °C	-30 °C to 55 °C	-30 °C to 55 °C
Dimensions L x W x H (Standard, Inch)	4.6 x 1.7 x 3.8	4.6 x 2.5 x 3.8	4.6 x 3.5 x 3.8
Dimensions L x W x H (Metric, Centimeter)	11.7 x 6.4 x 9.6	11.7 x 4.3 x 9.6	11.7 x 8.9 x 9.6
Weight (Standard)	16 oz	1.7 lb	2.5 lb
Weight (Metric)	460 grams	780 grams	1,145 grams

7.0 Storage

NOTE: Storing your battery is an important topic to understand. Please read this section before putting your vehicle or battery into storage, or prior to prolonged periods when the vehicle is not being used. Failure to follow these procedures could lead to a damaged battery.

The best way to store your Pulse® battery is to disconnect it from the vehicle. All vehicles will draw a small amount of power from the battery while it is connected. Over time, this will drain the battery and damage it. If disconnected, with no parasitic drain from a vehicle electrical system, you should be able to store your

battery for up to a year with very little loss of capacity. Pulse® batteries will lose less than 1% of their capacity every 30 days when stored in this manner.

If you are unable to disconnect the battery from your vehicle during storage, you will need to use a maintenance charger designed to stop the battery from being drained. As discussed in section 3.2 of this manual, it is crucial that a charger specifically designed for LiFeP04 chemistry is used. Using any other type of charger could damage your battery and will void your warranty.

8.0 Definition of Terms

There are a number of terms used in this manual which may require a short explanation. In an effort to compare Full Spectrum Power lithium batteries to lead acid, AGM, or other non-lithium batteries it is important to understand how battery power and capacity is measured and rated. We use terms which are easy to understand, and provide real-world performance numbers.

Amp Hour Capacity

We rate our Pulse batteries' capacity using the term 'Amp Hour Capacity'. This measurement simulates power output over a given length of time. To easily compare this figure with other batteries, we made the decision to use a simple calculation method: One amp draw for X hours.

As an example, our Pulse® P2 will supply one amp at or above 12 volts, for 5 hours. Or, it will supply 5 amps, for one hour.

For comparison, we also supply a 'Lead Acid Equivalent' Ah Capacity. Please see the following section for a discussion of this rating.

Lead Acid Equivalent

Several companies are now providing a Lead Acid Equivalent (Called Pbeq) rating for their lithium batteries. This rating is meant to allow easy comparison between lithium and lead acid batteries' capacity. The claimed basis for this 'PBeq' rating lies with the discharge characteristics of lead acid batteries. **NOTE: We do not believe this rating to be accurate and only provide this rating as a comparison to other manufacturer's lithium batteries.**

As a general rule, a lead acid battery will supply between 30% and 50% of its actual Amp Hour capacity rating, while keeping voltage above 12 volts. So, a lead acid battery rated at nine (9) amp hours will supply between 3ah and 4.5ah when voltage must stay above 12v. In theory, since lithium batteries are much better at maintaining voltage over the same discharge cycle, *some lithium battery manufacturers are therefore tripling their actual capacity figures.*

So, while a lithium battery with a 'PBeq' rating of 15 amp hour might seem impressive, does it matter if the voltage goes down to 8v? We believe that it does, and therefore the PBeq rating is not a good way to measure battery capacity. *However, we have included the rating here, so that you can directly compare against other companies claimed capacity figures.*

Cold Cranking Amps (CCA)

We do not use CCA to rate our batteries. Unfortunately, this is not possible with any lithium battery. The CCA test protocol is specific to lead acid type batteries and the test would not be possible with a lithium battery, for the following reasons.

The test for Cold Cranking Amps (CCA) calculates the power a battery can provide, under load, at 0 °F (-18 °C). The discharge current is measured at that temperature, over a 30 second span. The battery must maintain at least 1.2 volts per cell (7.2 volts for a 12-volt battery). As an example, a 12V battery with a 600 CCA rating will provide 600 amperes for 30 seconds at 0°F before the voltage falls to 7.2V.

The reasons we do not use this test rating are related to real world testing. Your vehicle will never run or start with voltage below 10v, let alone at 7.2v. You should also never try to crank your engine over for 30 seconds continuously, as this will trip the Integrated Protection Circuit. If your vehicle has not started within five seconds of continuous cranking, something is wrong with your vehicle. Additionally, 12 volt Lithium batteries like the Pulse® can be badly damaged by allowing them to be depleted to 7.2v. Since this measure is not realistic for a lithium battery we do not provide it.

Continuous Discharge Amps

We rate our Pulse batteries' ability to supply high amounts of power over several minutes. These figures are reached according to the rating of our Integrated Protection Circuit. Continuous Discharge ratings are useful for vehicles running total loss systems.

As an example, our Pulse P2 will supply 45 amps continuously, without tripping the Integrated Protection Circuit.

Cranking Amps

We rate our Pulse batteries' engine starting ability using the term 'Cranking Amps'. We measure how much power, in amps, a battery can produce for up to 10 seconds. This measurement simulates a start sequence under difficult conditions.

As an example, our Pulse® P2 will supply 250 amps at or above 12 volts, for 10 seconds.