

Replacing SLA with Lithium in Intruder Alarm Systems

Replacing Sealed Lead Acid with Lithium Batteries in Intruder Alarm Systems

General

There's been a lot of debate whether it is advisable to replace a **Sealed Lead Acid** battery with a **Lithium** battery in Intruder Alarm Systems. This considering that intruder systems are generally developed for use with **Sealed Lead Acid** batteries for backup power purposes. Opinions differ mostly because of individuals not being totally familiar with the latest trends in Lithium Battery manufacturing processes and/or the pros and cons of the two battery types. The following is a brief overview of Lithium Battery technology, indicating that a Sealed Lead Acid battery can be replaced with a "**equivalent**" Lithium battery. *Note – emphasis on equivalent.*

Lithium Battery Cell Chemistry

There are a few different types of Lithium battery chemistries available on the market today, but for the purposes of this article, we will only concentrate on 3. The chart below reflects some of the important characteristics for each chemistry.

<u>Chemistry</u>	<u>Nominal Voltage</u>	<u>Energy Density</u>	<u>Cycle Life</u>	<u>Working Temp.</u>	<u>Safety</u>	<u>Environmental</u>	<u>Cost based on cycle life x wh of SLA</u>
LiFePO ₄	3.2V	>120 wh/kg	>2000	-0-60 °C	Safe	Good	0.15-0.25 lower than SLA
LiMn _x Ni _y Co ₂ O ₂	3.7V	>160 wh/kg	>500	-20 - 40 °C	Unsafe without BMS, better than LiCo	OK	1.5-2.0
LiCoO ₂	3.7V	>200 wh/kg	> 500	-20 - 60 °C	Unsafe without BMS	OK	1.5-2.0

In comparison - Sealed Lead Acid battery

Lead acid	2.10V	> 35wh/kg	>200	-20 - 40°C	Safe	Not good	1
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Based on **Energy Density** and **Cycle Life** is it evident that Lithium batteries are much more efficient than Lead Acid batteries and over a period of use, become more cost effective.

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Lithium Battery - Construction

Like with Sealed Lead Acid (SLA) batteries, Lithium batteries also consist of multiple cells, connected in series and/or parallel, depending on operational Voltage and Capacity required.

Li-FePO4 Lithium batteries are predominately constructed using one of the following cell package types:

Cylindrical Cell



Pouch Cell



Performance wise there is very little difference between the two. However, with cylindrical cells there is more space between individual cells which is a big advantage in terms of heat dissipation between cells.

A 12Volt **SLA** battery consists of 6 cells, connected in series, and the physical size of each cell will dictate the battery's Capacity ($6 \times 2.1V = 12.6V$). With an equivalent **Li-FePO4** battery only 4 cells, connected in series, is required to get to the same operational voltage ($4 \times 3.2V = 12.8V$). With Lithium batteries it is not uncommon for multiple cells to be connected parallel, to increase battery capacity.

Lithium Battery - Safety

There is a perception that Lithium batteries are more dangerous than Sealed Lead Acid batteries. The fact is, the one is as explosive as the other when subjected to excessive heat and could cause the same amount of structural and/or bodily harm when physically damaged.

From an **operational safety** point of view a Lithium battery is safer than an SLA battery. This is because, as a standard, Lithium batteries have a built-in Battery Management System (**BMS**) which monitors the health and temperature of cells within the battery. The BMS also balances the energy across all the cells during charging and discharging ensuring maximum life and performance of the battery.

Lithium Battery - Charging

Lithium-ion batteries are typically charged in two stages:

- Stage 1, **Constant Current** - During this stage the battery's Voltage will slowly rise until it reaches the 'absorb' Voltage of 14.6V. At this stage the battery is about 90% full.
- Stage 2, **Constant Voltage** - To fill the battery the rest of the way. During this stage the battery's current draw will slowly taper off. Once the current drops to around 5% – 10% of the Ah rating of the battery it is at 100% State-Of-Charge (**SoC**).

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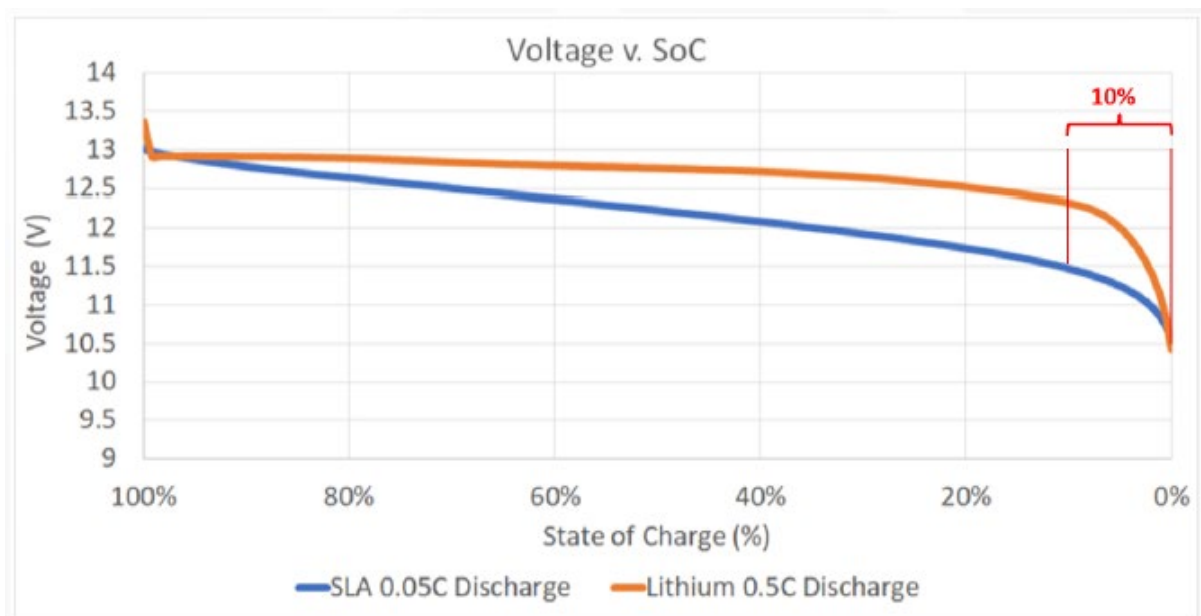
Considering in general that **Intruder Alarm Systems** have a Charging Voltage ranging from 13.6 to 13.9 Volts, an Alarm System will fully charge a **Li-FePO4** Lithium battery.

Furthermore, unlike with **SLA** batteries, Lithium batteries do not need to be fully charged to remain in good health. In fact, our tests have shown that charging a Lithium battery to a slightly lower voltage (ie 13.8v), results in significantly longer lifespan.

Lithium Battery – Discharging

Intruder Alarm Systems (making use of SLA battery type) are designed to present/communicate a **Battery-Low** condition at around 11.5 Volt (10% SoC) and will cut-out (*power down*) when the battery voltage reaches around 10.5 Volt (0% SoC) during a Mains failure. The purpose of the **Battery-Low** warning is to provide Users and Remote Monitoring Stations with sufficient time ($\pm$ 1 hour) to make alternative arrangements before total system failure.

In the case of Lithium batteries, as can be seen from the “State-of-Discharge chart” below it is evident that by the time a **Li-FePO4** battery voltage gets to 11.5Volt that battery has less than 2.5% capacity left, resulting in only a few minutes warning time. This might be seen as a dis-advantage in remote and high-risk sites.



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Conclusion

Replacing **SLA** batteries of an **Intruder Alarm System** with an equivalent **Li-FePO4 Lithium** battery has the following advantages & disadvantages.

Advantages

- 1) **Li-FePO4** batteries last up to 10 times longer than **SLA** batteries.
- 2) Most **SLA** battery chargers can be used to charge a **Li-FePO4** battery.
- 3) The fact that a **SLA** battery charger's Voltage is lower than what is normally used to charge a **Li-FePO4** battery, results in an extend life for a **Lithium** battery.
- 4) Because **Li-FePO4** batteries deliver constant power, up to around 20% State-of-Charge (SoC), the Intruder Alarm Systems battery's operating time is extended by more than 15%.
- 5) Operational wise **Li-FePO4** batteries are safer than **SLA** batteries, because of their built-in BMS.

Disadvantages

- 1) Due to the battery voltage threshold used by Intruder Alarm Systems (designed for SLA batteries) to announce a **Battery-Low** condition, external circuitry and an additional zone input would be required to fulfil this purpose when using a **Li-FePO4** battery.

Compatibility

In general, the Uniross Lithium battery is compatible with the vast majority of Intruder Alarm Systems on the market today. We have tested and can confirm that the following brands of Intruder Alarms are definitely compatible with Uniross Lithium batteries:

- DSC
- Texecom
- Paradox
- IHS
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