

**Blue Smart IP67 Charger**

**12/7**

**24/5**

**12/13**

**24/8**

**12/17**

**24/12**

**12/25**

## Safety instructions



- Always provide proper ventilation during charging.
- Avoid covering the charger.
- Never try to charge non-rechargeable - or frozen batteries.
- Never place the charger on top of the battery when charging.
- Prevent sparks close to the battery. A battery being charged could emit explosive gasses.
- Battery acid is corrosive. Rinse immediately with water if acid comes into contact with skin.
- **This appliance is not designed for use by young children or people who cannot read or understand the manual unless they are under the supervision of a responsible person to ensure that they can use the battery charger safely. Children should be supervised to ensure that they do not play with the appliance**
- Connection to the mains supply must be in accordance with the national regulations for electrical installations. In case of a damaged supply cord please contact the manufacturer or your service agent.
- The battery terminal not connected to the chassis has to be connected first. The other connection is to be made to the chassis, remote from the battery and fuel line. The battery charger is then to be connected to the supply mains.
- After charging, disconnect the battery charger from the supply mains. Then remove the chassis connection and then the battery connection.

## 1. Quick user guide

The Blue Smart IP67 chargers will charge and maintain lead-acid and Li-ion batteries, and supply users connected to the battery. In addition, the models with suffix (1+Si) feature a second current limited output which is always powered as long as 230VAC is present on the input. This output can for example be used to prevent starting of a vehicle before unplugging the battery charger (start interrupt function).



### Blue Smart version

Set-up, monitor and update the charger (add new features when they become available) using Apple and Android smartphones, tablets or other devices with the VictronConnect App.

VictronConnect is available to users of Windows PCs, macOS X, iOS and Android phones, as well as tablets.

### **Installation and instructions for use**

1. The battery charger must be installed in a well-ventilated area close to the battery (but, due to possible corrosive gasses not above the battery!)
2. Connect the ring terminals to the battery: the minus cable (black) to the minus (–) pole of the battery, the plus cable (red) to the plus (+) pole of the battery.
3. Plug the AC mains cable into the wall socket. The charge cycle will now start.

### **Two LEDs for status indication**

Yellow LED: bulk charge (blinking fast), absorption (blinking slow), float (solid), storage (off)

Green LED: power on

### **Safety regulations and measures**

1. Install the charger according to the stated instructions
2. Connections and safety features must be executed according to the locally applicable regulations.
3. Warning: do not attempt to charge non-rechargeable batteries.
4. Warning: a BMS (Battery Management System) may be required to charge a Li-ion battery.
5. This appliance is not intended for use by persons with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children should be supervised to ensure that they do not play with the appliance.
6. The charger is designed for lead-acid and Li-ion batteries 14-225Ah. Do not use for any other purpose.



## 2. 'Must know' features and facts

### 2.1 Ultra high efficiency "green" battery charger

With up to 95% efficiency, these chargers generate up to four times less heat when compared to the industry standard. And once the battery is fully charged, power consumption reduces to 0.5 Watt, some five to ten times better than the industry standard.

### 2.2 Durable, safe and silent

- Low thermal stress on the electronic components.
- Protection against ingress of dust, water and chemicals.
- Protection against overheating: the output current will reduce as temperature increases up to 60°C, but the charger will not fail.
- The chargers are totally silent: no cooling fan or any other moving parts.

### 2.3 Reverse polarity protected

In case of wrong polarity connection, the external ATO blade fuse will blow. Check the polarity of the cable and check the correct value before replacing the fuse.

### 2.4 Recovery function for fully discharged batteries

Most reverse polarity protected chargers will not recognize, and therefore not recharge a battery which has been discharged to zero or nearly zero Volts. The *Blue Smart IP67 Charger* however will attempt to recharge a fully discharged battery with low current and resume normal charging once sufficient voltage has developed across the battery terminals.

### 2.5 Temperature compensated charging

The optimal charge voltage of a lead-acid battery varies inversely with temperature. The *Blue Smart IP67 Charger* measures ambient temperature during the test phase and compensates for temperature during the charge process. The temperature is measured again when the charger is in low current mode during float or storage. Special settings for a cold or hot environment are therefore not needed.

## 2.6 Adaptive Battery Management

Lead-acid batteries should be charged in three stages, which are [1] *bulk or constant-current charge*, [2] *absorption or topping charge* and [3] *float charge*.

Several hours of absorption charge are needed to fully charge the battery and prevent early failure to sulfation<sup>1</sup>.

The relatively high voltage during absorption does however accelerate aging due to grid corrosion on the positive plates.

*Adaptive Battery Management* limits corrosion by reducing absorption time when possible, that is: when charging a battery that is already (nearly) fully charged.

## 2.7 Storage mode: less corrosion of the positive plates

Even the lower float charge voltage that follows the absorption period will cause grid corrosion. It is therefore essential to reduce the charge voltage even further when the battery remains connected to the charger during more than 48 hours.

## 2.8 Reconditioning

A lead-acid battery that has been insufficiently charged or has been left discharged during days or weeks will deteriorate due to sulfation<sup>1</sup>. If caught in time, sulfation can sometimes be partially reversed by charging the battery with low current up to a higher voltage.

Remarks:

- a) Reconditioning should be applied only occasionally to flat plate VRLA (gel and AGM) batteries because the resulting gassing will dry out the electrolyte.
- b) Cylindrical cell VRLA batteries build more internal pressure before gassing and will therefore lose less water when subjected to reconditioning. Some manufacturers of cylindrical cell batteries therefore recommend the reconditioning setting in case of cyclic application.
- c) Reconditioning can be applied to flooded batteries to "equalise" the cells and to prevent acid stratification.
- d) Some battery charger manufactures recommend pulse charging to reverse sulfation. However, most battery experts agree that there is no conclusive proof that pulse charging works any better than constant voltage charging. This is confirmed by our own tests.

## 2.9 Lithium-ion (LiFePO<sub>4</sub>) batteries

Li-ion batteries do not suffer from sulfation.

But Li-ion batteries are very sensitive to under voltage or over voltage<sup>2</sup>.

Li-ion batteries therefore often have integrated cell balancing and under voltage protection (UVP) circuitry.

Some reverse polarity protected chargers will not recognize a battery when the UVP has tripped.

The *Blue Smart Charger* will however automatically reset the UVP and start charging.

### Important note:

**NEVER attempt to charge a Li-ion battery when its temperature is below 0°C.**

## 2.10 Low current mode

Some lead acid batteries can overheat if charged with a current exceeding 0.3C (C is the capacity in Ah. A 12Ah battery for example should not be charged with a current exceeding  $0.3 \times 12 = 4A$ ). The low current mode (charge current limited to 4A or less, see technical specifications) should therefore be used to charge low capacity lead-acid batteries.

<sup>1</sup> For more information about batteries, please refer to our book 'Energy Unlimited'

### 3. Charge algorithms

#### 3.1 Smart charge algorithm with optional reconditioning for lead-acid batteries

Charge voltages at room temperature:

MODE	ABS V	FLOAT V	STORAGE V	RECONDITION Max V@% of Inom
NORMAL	14.4	13.8	13.2	16.2@8%, max 1h
HIGH	14.7	13.8	13.2	16.5@8%, max 1h
LI-ION	14.2	13.5	13.5	n. a.

*For 24V chargers: multiply all voltage values by 2.*

NORMAL (14.4V): recommended for flooded flat plate lead antimony batteries (starter batteries), flat plate gel and AGM batteries.

HIGH (14.7V): recommended for flooded lead calcium batteries, Optima spiral cell batteries and Odyssey batteries.

#### State of the art microprocessor controlled charge algorithm

##### Adaptive 5-stage charge characteristic: bulk – absorption – recondition - float – storage

The Blue Smart IP67 charger features a microprocessor controlled 'adaptive' battery management system. The 'adaptive' feature will automatically optimise the process relative to the way the battery is being used.

##### 1. BULK

Charges the battery with maximum current until absorption voltage is reached. The battery will then be about 80% charged and is ready for use.

##### 2. ABS - Absorption

Charges the battery at constant voltage and with decreasing current until it is fully charged.

See table above for absorption voltage at room temperature.

*Adaptive battery management:*

*The absorption time is short (minimum 30 minutes) if the*



*battery was (nearly) fully charged and increases to 8 hours in case of a deeply discharged battery.*

### 3. RECONDITION

Optional reconditioning for deeply discharged lead-acid batteries.

Reconditioning is applicable to the charge algorithms NORMAL and HIGH and can be selected with the App on your smartphone.

When in RECONDITION mode the battery will be charged with low current up to a higher voltage at the end of the absorption phase.

During reconditioning the maximum current is equal to 8% of the nominal current until the maximum voltage is reached. Reconditioning is terminated after one hour or when the maximum voltage is reached, whichever comes first. *See table.*

*Example:*

*For a 12/7 charger: the recondition current is  $7 \times 0.08 = 0.56A$*

### 4. FLOAT

Keeps the battery at constant voltage and fully charged.

### 5. STORAGE

Keeps the battery at reduced constant voltage to limit gassing and corrosion of the positive plates.

Slow self-discharge is prevented by an automatic weekly refresh of the battery with a short absorption charge.

## 3.2 Lithium-ion (LiFePO<sub>4</sub>) batteries

**When charging a Lithium-ion battery, the *Blue Smart IP67 Charger* uses a specific charging algorithm for Lithium-ion batteries, to ensure optimum performance. *Select LI-ION with the app on your smart phone.***

## 3.3 When a load is connected to the battery

A load can be applied to the battery while charging, as long as the current draw is much lower than the rated output of the battery charger.

Reconditioning is not possible when a load is connected to the battery.

Remarks:

- a) Disconnect all loads before attempting to recharge a very weak or fully discharged lead-acid battery. Loads may be reconnected once the bulk phase has started.
- b) Disconnect all loads before attempting to recharge a Li-ion battery when the under voltage protection (UVP) of the Li-ion battery has tripped. Loads may be reconnected once the bulk phase has started.

### 3.4 Triggering a new charge cycle

A new charge cycle will start when:

- a) The charger has reached float or storage, and, due to a load, current increases up to maximum current during more than four seconds.
- b) The AC supply has been disconnected and reconnected.

### 3.5 Estimating charge time

A lead-acid battery is about 80% charged at the beginning of the absorption period.

The time **T** to 80% charged can be calculated as follows:

$$T = Ah / I$$

Where:

**I** is the charge current (= charger output minus load current).

**Ah** is the amount of Ah to be charged.

A full absorption period of up to 8 hours is needed to charge the battery to 100%.

Example:

Charge time to 80% of a fully discharged 100Ah battery when charged with a 10A *Blue Smart Charger*:  $T = 100 / 10 = 10$  hours

Charge time to 100%:  $10 + 8 = 18$  hours.

A Li-ion battery is more than 95% charged at the beginning of the absorption period, and reaches 100% charge after approximately 30 minutes absorption charge.



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### **3.6 High internal resistance**

When a battery reaches the end of its cycle- or float life, or when it dies prematurely due to sulfation or corrosion, capacity will dramatically drop and internal resistance will increase. The charger will not recognise such a battery during the test phase (it could as well be a nearly fully charged battery).

A very short bulk phase when charging a supposedly discharged battery does however indicate that the battery has reached the end of its useful life.

Remark: sulfation can sometimes be partially reversed by repeated application of the RECONDITION MODE.

### **3.7 Can be used as a power supply**

The charger will supply DC loads when no battery is connected.

## 4. Technical specifications

Blue Smart IP67 Charger	12V 7/13/17/25 A	24V 5/8/12 A
Input voltage	230 VAC	
Standby power consumption	0.5W	
Charge voltage 'absorption'	Normal: 14.4 V, High: 14.7 V Lithium-ion: 14.2 V	Normal: 28.8 V, High: 29.4 V Lithium-ion: 28.4 V
Charge voltage 'float'	Normal: 13.8 V, High: 13.8 V Lithium-ion: 13.5 V	Normal: 27.6 V, High: 27.4 V Lithium-ion: 27.0 V
Charge voltage 'storage'	Normal: 13.2 V, High: 13.2 V Lithium-ion: 13.5 V	Normal: 26.4 V, High: 26.4 V Lithium-ion: 27.0 V
Charge current	7 / 13 / 17 / 25 A	5 / 8 / 12 A
Charge current in low current mode	2 / 4 / 6 / 10 A	2 / 3 / 4 A
Charge characteristic	5-stage adaptive	
Temperature compensation (lead-acid batteries only)	16 mV/°C	32 mV/°C
Can be used as power supply	Yes	
Protection	Reverse reverse polarity (fuse), Output short circuit Over temperature	
DC fuse, internal and not replaceable	n.a / n.a. / 25 / 35 A	n.a. / 15 / 20 A
DC fuse in DC cable – ATO blade (A)	20 A (12/25: no fuse)	20 / 10 / 15 A
Operating temp. range	-20 to +60°C (full rated output up to 40°C),	
Humidity	Up to 100%	
Start interrupt option (Si)	Short circuit proof, current limit 0.5A, Output voltage: max one volt lower than main output	
Bluetooth	Frequency: 2402 – 2480 MHz / Power: -4dBm	
<b>ENCLOSURE</b>		
Material & Colour	Aluminium (blue RAL 5012)	
Battery-connection	Black and red cable with M8 ring terminal 12/7, 12/13, 24/5 - 1.4 m    12/17, 12/25, 24/8, 24/12 – 1.0 m	
230 V AC-connection	Cable of 1.5 meter with CEE 7/7, BS 1363 plug (UK) or AS/NZS 3112 plug	
Protection category	IP67	
Weight	12/7, 12/13, 24/5: 1.8kg 12/17, 12/25, 24/8, 24/12: 2.4kg	
Dimensions (h x w x d)	12/7, 12/13, 24/5: 85 x 211 x 60 mm 12/17, 12/25, 24/8, 24/12: 99 x 219 x 65 mm	
<b>STANDARDS</b>		
Safety	EN 60335-1, EN 60335-2-29	
Emission	EN 55014-1, EN 61000-3-2	
Immunity	EN 55014-2, EN 61000-3-3	



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