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BLUE POWER

Lynx Ion + Shunt 350/600
24V/180Ah Lithium Ion Batteries

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1   SAFETY INSTRUCTIONS

1.1   In general

Please read the documentation supplied with this product first, so that you are familiar with the safety signs and directions before using the product.
This product is designed and tested in accordance with international standards. The equipment should be used for the designated application only.

⚠ **WARNING: DANGER OF ELECTRICAL SHOCK**
The product is used in combination with a permanent energy source (battery). Even if the equipment is switched off.

The product contains no internal user-serviceable parts. Do not remove the front panel and do not put the product into operation unless all panels are fitted. All maintenance should be performed by qualified personnel.

Never use the product at sites where gas or dust explosions could occur. Refer to the specifications provided by the manufacturer of the battery to ensure that the battery is suitable for use with this product. The battery manufacturer's safety instructions should always be observed.

⚠ **WARNING: do not lift heavy objects unassisted.**

1.2   Installation

Read the installation instructions before commencing installation activities.

- Ensure that the connection cables are provided with fuses and circuit breakers. Never replace a protective device by a component of a different type. Refer to the manual for the correct part.

- Check before switching the device on whether the available voltage source conforms to the configuration settings of the product as described in the manual.

- Ensure that the equipment is used under the correct operating conditions. Never operate it in a wet or dusty environment.

- Ensure that there is always sufficient free space around the product for ventilation, and that ventilation openings are not blocked.

- Install the product in a heatproof environment. Ensure therefore that there are no chemicals, plastic parts, curtains or other textiles, etc.in the immediate vicinity of the equipment.

1.3   Transport and storage

On storage or transport of the product, ensure that the battery leads are disconnected.

No liability can be accepted for damage in transit if the equipment is not transported in its original packaging.

Store the product in a dry environment; the storage temperature should range from –20°C to 55°C.

1.3.1   General storage instructions of Lithium-Ion batteries

The best way to store Lithium-ion batteries is at a State-Of-Charge (SOC) of 60%.

Check the voltage of the stored Lithium-Ion battery module periodically. If the voltage is dropped below the cut off level, recharge it. The battery management system (BMS) electronics always have a leakage current which will eventually empty the battery. The weekly consumption of the BMS inside a Victron Energy Lithium-ion battery, when not connected to the Lynx Ion + Shunt, is approximately 2Wh.

1.3.2   Storage instructions of a complete system (Lithium-Ion batteries with Lynx Ion + Shunt)

Lithium batteries will permanently be damaged when fully drained. The system has a small self-discharge which needs to be taken into account when storing the system.

When storing a complete system, make sure that the Lynx Ion + Shunt is set in standby mode (for instructions see chapter 6).

- Standby consumption 24V Systems: 73mW for the Lynx Ion + Shunt (standby).

- Standby consumption 48V systems: 139mW for the Lynx Ion + Shunt (standby).

Two calculation examples:

- A fully charged single 24V battery module connected to a Lynx Ion + Shunt which is in standby will last approximately **2570 days**. The same system, but then automatically switched to standby mode due to under voltage will last approximately **128 days**.

- A fully charged 48V system with two batteries in series, connected to a Lynx Ion + Shunt which is in standby will last approximately **2700 days**. The same system which has automatically disconnected and switched to standby mode due to under voltage will last approximately **135 days**.

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2 DESCRIPTION

Key features of the Victron Energy Lithium-Ion battery system.

- Easy installation and usage;
- Integrated safety contactor used as second level protection;
- Active and passive balancing control capabilities (depending on battery module);
- Separate CAN-Bus between user and BMS CAN-Bus network;
- I/O interface for connection with different chargers and loads;

2.1 System components

- One or more **24V LFP Lithium-Ion batteries**.
- The **Lynx Distributor**. A modular DC distribution system with fuses.
- The **Lynx Ion + Shunt** is the battery management system (BMS) that controls the batteries.
- The **Lynx Distributor**. A modular DC distribution system with fuses.
- Optionally, the **Color Control GX**, a digital control panel.

2.1.1 Battery Management System

Each battery module comes with an integrated battery management system (BMS). This is an intelligent electronic module (slave BMS) that measures all cell voltages, temperatures and controls the balancing. Each slave BMS has an intelligent balancing system that allows balancing on battery cell and module level. The battery modules communicate by CAN-Bus with the Lynx Ion + Shunt (master BMS). The status of the battery modules are collected and monitored. If the measured values from a battery module exceed the limit, the Lynx Ion + Shunt will automatically take action to protect the connected battery modules.

2.1.2 Safety

The Lynx Ion + Shunt is the safety and control unit of the system. It protects the connected battery modules against over-charging, over-discharging, over-temperature and under-temperature. The Lynx Ion + Shunt also take care of the balancing on battery cell and module level. In order to guarantee a safe operation of the system, a safety contactor is implemented that can disconnect the batteries from the chargers and loads when necessary.

2.1.3 User interface: Color Control GX

The Color Control GX is a digital control panel for the system.

3   INSTALLATION

⚠ This product may only be installed by a qualified electrical engineer.

3.1   Safety precautions

1. Be careful when using metal tools in the vicinity of batteries. Dropping a metal tool onto a battery might cause a short-circuit and possibly an explosion.
2. Always use isolated tools when working with batteries.
3. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a battery. A battery can produce a short-circuit current high enough to melt such items, leading to severe burns.

3.2   Location

The product must be installed in a dry and well-ventilated area, as close as possible to the batteries.

⚠ **Excessively high ambient temperature will result in a reduced battery lifetime.**

The interior of the Lynx components must remain easily accessible after installation.

Try and keep the distance between the Lynx components and the battery to a minimum in order to minimize cable voltage losses.

⚠ For safety purposes, this product should be installed in a heat-resistant environment. You should prevent the presence of e.g. chemicals, synthetic components, curtains or other textiles, etc., in the immediate vicinity.

3.3   Mounting

The Lynx system must be mounted on a wall. Every Lynx is provided with holes for mounting. See Appendix B.

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3.4 Connecting the Lithium-Ion battery system

3.4.1 Connecting the battery power connections

Connect the input Distributor (optional), Lynx Ion + Shunt and output Distributor (optional) together like in the picture below.

Procedure

1. First remove all fronts from the Lynx components.
2. Connect each Lynx to each other from left to right.
3. Mount the Lynx system to the wall.
4. Connect all chargers and loads to the right side of the Lynx Ion + Shunt.
5. Connect all the batteries to the left side of the Lynx Ion + Shunt.

> ⚠ **If multiple batteries are connected in parallel they can be fused individually in the Distributor on the battery side (left side).**

Lynx Distributor   **Lynx Ion + Shunt**
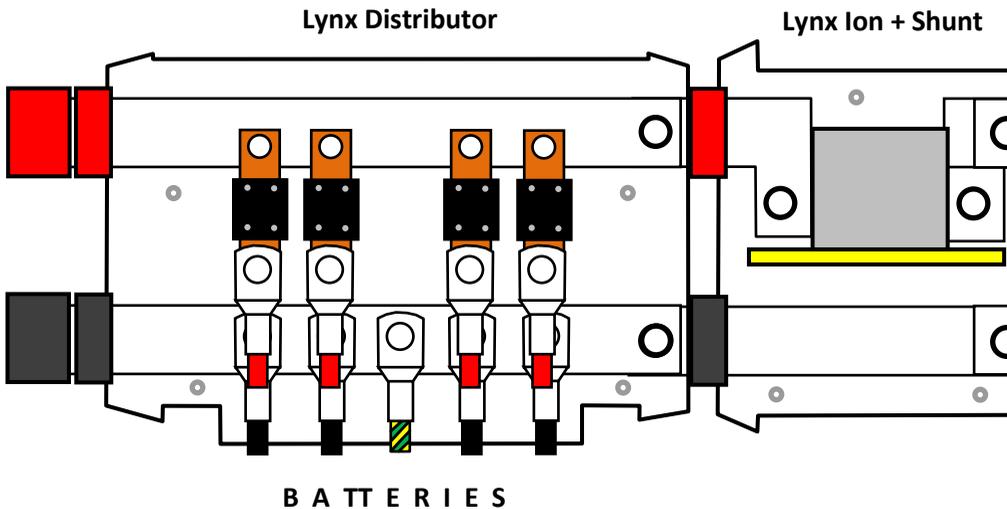
B A T T E R I E S

> ⚠ **WARNING: Never connect loads and chargers directly to the batteries. This can permanently damage the batteries.**

3.4.2 Installing Fuses

Fuses must be installed on both the battery side and load/charger side of the Lynx Ion + Shunt.

⚠️ **The total value of the fuses in the Distributor on the load/charger side (right side) may not exceed the maximum current of the safety contactor (an equal load ratio can be added depending on the application). For the Lynx Ion + Shunt 350 this is 350A and for the Lynx Ion + Shunt 600 this is 600A.**

On the battery side (left), the fuses are functional as short-circuit protection. It is recommended that this value is between 300A and 500A on each connection depending on how many batteries are connected.

Fuse types: MEGA-fuse. Use 32V fuses for 24V systems and use 58V for 48V systems.

3.4.3   Parallel connection of batteries

- Be sure that the battery state-of-charge is equal for each battery. If the batteries are new, they have an equal state-of-charge.
- Keep wire lengths exactly the same. Otherwise imbalance occurs.

Batteries can be connected to the Distributor or as a parallel battery string like in the figure below.

Example of parallel connection of batteries with the same cable lengths:
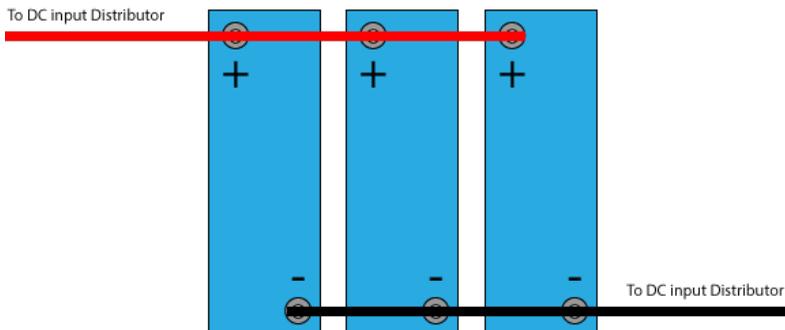
3.4.4   Series connection of batteries

The maximum battery in series is 2. This is because the maximum voltage on the input of the Lynx Ion + Shunt is 60 VDC.

- Be sure that the battery state-of-charge is equal for each battery. If the batteries are new, they have an equal state-of-charge.

Example of series connection of two batteries:

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To DC input Distributor
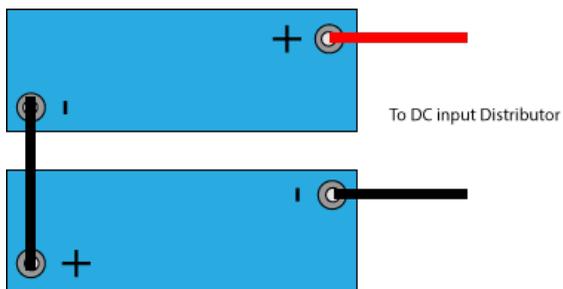
3.4.5 Connecting the BMS CAN-Bus network

To connect the BMS CAN-Bus communication network you will need:

- CAT5 cable with RJ45 connectors;
- Two termination resistors (supplied with the Lynx Ion + Shunt);

Procedure
1. Use connection 'A' of the Lynx Ion + Shunt, top left pair of RJ45 connectors. Connect the other end of the CAT5 cable to the first battery.
2. Then connect it to the second battery (if there is one) with the next CAT5 cable.
3. Repeat this until all batteries are connected.
4. Place a termination resistor in the last connected battery.
5. Place the other termination resistor in the Lynx Ion + Shunt, connection 'A'.

⚠️ **Always use machine manufactured full wired RJ45 patch cables.**

Connect the network as following:
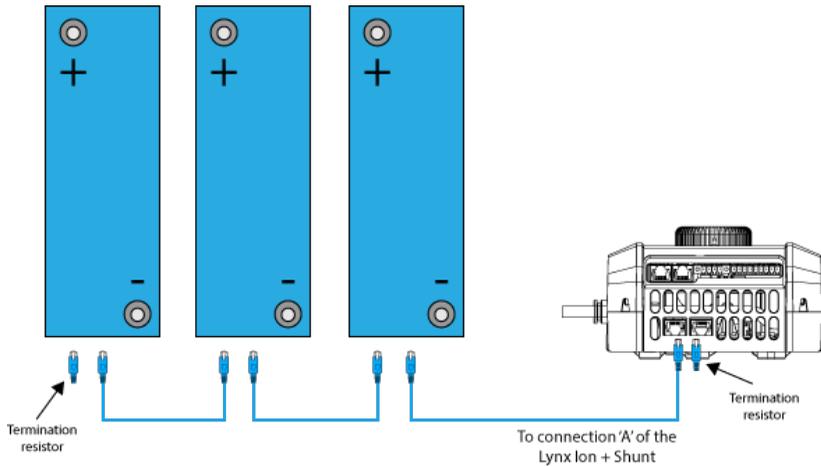
Do not forget the termination resistors at the ends of the CAN-Bus network.

3.4.6 Connecting to VE.CAN network

Use connection 'D' of the Lynx Ion + Shunt, the pair of RJ-45 sockets at lower left, for connection to VE.CAN network. For details see the Victron Energy communication white paper.

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3.4.7   Connecting the Allow-to-charge and Allow-to-discharge

! **The Allow-to-charge and Allow-to-discharge are very important. They control the chargers and loads in the system.**

There are two important functionalities in the Lithium-Ion battery system.

1.   All chargers need to stop charging if the batteries are fully charged.
2.   All loads need to stop discharging if the batteries are empty.

This kind of functionality of the system can be achieved by using the allow-to-charge and allow-to-discharge of the Lynx Ion + Shunt.

- When the battery is fully charged the allow-to-charge contact is opened and charging has to stop.
- When the battery is fully discharged the allow-to-discharge contact is opened and discharging has to stop.

If charging or discharging is not stopped the safety contactor will be opened to make sure the batteries are protected.

See appendix A, connection 'C' for the connections of the allow-to-charge and allow-to-discharge contacts.

3.4.8   External status output

The external status output can be used for external indication similar as the status LED on the front of the Lynx Ion + Shunt.

Connect a status indicator to connector 'C' pin 8 and 9. This output uses +12VDC.
See appendix A for the connections details.

3.4.9   External START-button

It is possible to connect an external START-button. This must be connected to pin 7 of connector 'C'. This pin must be switched to GND of the system (pin 9 of connector 'C '). It has the same functionality as the START-button on the front of the Lynx Ion + Shunt.

! **Use a momentary switch button for this.**

For example a Bulgin MPI002/TE/BL/12 which has a momentary switch and LED function integrated.

3.4.10   Auxiliary power output

The auxiliary power output can be used to power a bilge pump or to power the CCGX. This output will also be powered when the Lynx Ion + Shunt is in fail safe state.

See appendix A, connection 'B' pin 1 and 2 for details.

3.4.11   External Safety Contactor

See chapter 4 for details.

> ⚠️ **The external safety contactor output can also be used as an alarm output. If the internal contactor is opened this contact is set LOW (0V) else it is HIGH (system voltage).**

3.4.12   Connecting a Victron Energy Color Control GX (CCGX)

For monitoring and control of the lithium-ion battery system, a CCGX can be used.

Power connection:
The power of the CCGX can be connected to the Auxiliary power output of the Lynx Ion + Shunt. This has the advantage that it will be powered all times, even when in fail safe.

Connect the power to pin 1 (+) and pin 2 (GND) of connector 'B'. See appendix A for details.

VE.CAN connection:
The data is send by VE.CAN to the CCGX. Connect the VE.CAN connection of the CCGX to connector 'D' of the Lynx Ion + Shunt. See appendix A for details.

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3.5   Using the Lynx Ion + Shunt with currents above 600A

The internal safety contactor in the Lynx Ion + Shunt is specified for 350A or 600A maximum continuous current (check the type 350 or 600 on the front of the Lynx Ion + Shunt). For higher current please contact your dealer.

There are two options to install an external safety contactor:
- Use an external contactor with a 12VDC coil and connect it inside the Lynx Ion + Shunt.
- Use an external contactor with a coil voltage equal to the battery system voltage (24V or 48V) and use the External Safety Contact I/O (connector 'B' pin 3 and 4).

Gigavac contactors are recommended because of their low coil power use. Also the Gigavac contactors do not need an extinguishing diode. For use with other contactors like Albright always use an extinguishing diode.

Contactors which are tested: Gigavac GX16, GX46, GX56, GX66 series.

Contactor Type	12VDC (Recommended)	24VDC	48VDC
Gigavac GX16 600A*	GX16BEB	GX16CEB	GX16FEB
Gigavac GX46 600A	GX46BDB	GX46CDB	GX46FDB
Gigavac GX56 600A	GX56BDB	GX56CDB	GX56FDB
Gigavac GX66 600A	GX66BDB	GX66CDB	GX66FDB

*With the GX16 and GX66 series the coil contact must be connected with a Deutsch connector (Gigavac order number: 0697).

Below an overview of how to connect the external contactor to the busbar.
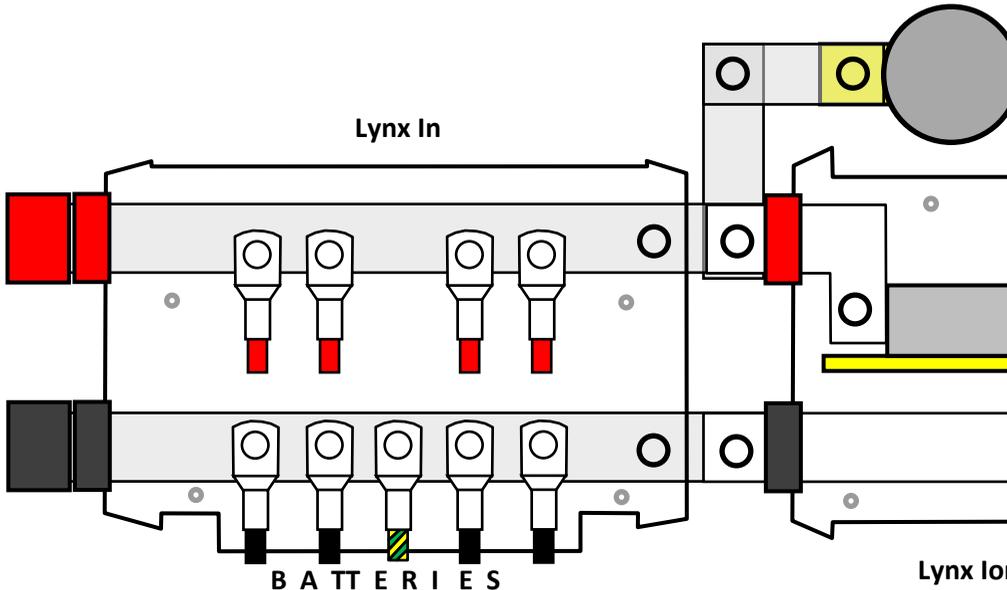
⚠️ **When using an external connector, the control wires of the internal contactor must always be disconnected.**

The internal safety contactor wires in blue connector on the upper right. See photo below. Make sure to isolate the end of these wires so they cannot damage the Lynx Ion + Shunt. It is not necessary to remove the internal safety contactor itself.

Remove wires
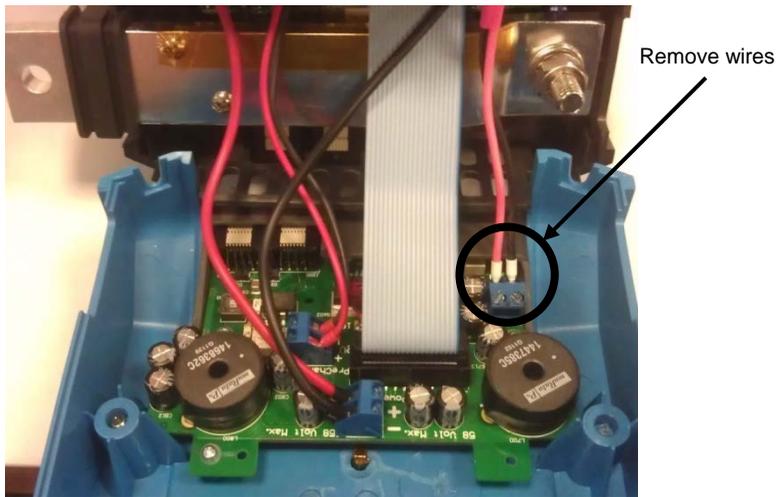
To connect the coil of the external connector it is important to check which coil voltage it has.

Coil voltage	Remarks
12VDC	Connect to the right blue connector inside the Lynx Ion + Shunt. Same as where the internal contactor was connected. Check '+' and '-'.
24VDC	Can only be used when connecting to a 24V system. Must be connected to the external contactor connection (connector 'B' pin 3 and 4).
48VDC	Can only be used when connecting to a 48V system. Must be connected to the external contactor connection (connector 'B' pin 3 and 4).

Check appendix A for the references of the connections.

⚠️ **If connecting an external contactor to connector 'B' always check if the coil voltage of the contactor is equal to the system voltage and check if an extinguishing diode is needed.**

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4 CONNECTING A MULTI OR QUATTRO

## 4.1 Connection of a Victron Energy Multi or Quattro inverter/charger

The Multi and Quattro need to stop charging when the batteries are fully charged and stop discharging when the batteries are empty. To achieve this, the allow-to-charge and allow-to-discharge signal contacts of the Lynx Ion + Shunt are used.

See the switching boundaries document for details about the switching levels for your specific battery.

4.2 Connecting the allow-to-charge and allow-to-discharge

4.2.1 Connecting 1 Multi or Quattro
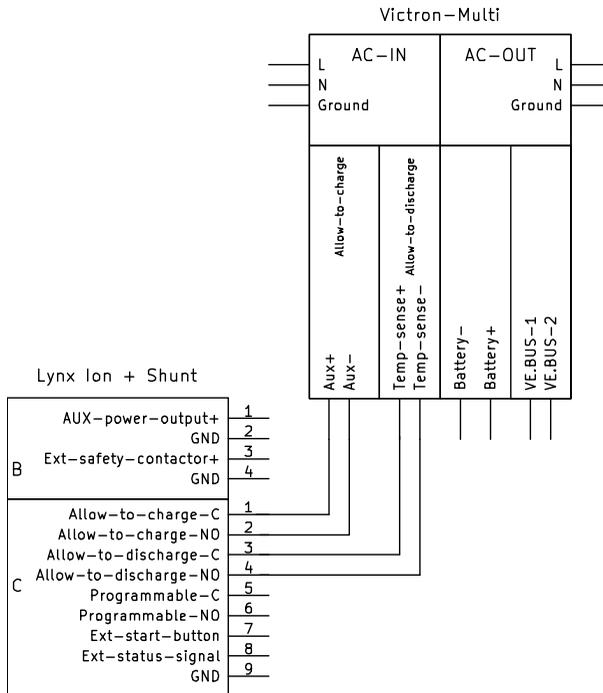
4.2.2 Connecting 2 or more Multis or Quattros

If 2 or more Multis or Quattros are connected to the Lynx Ion + Shunt then an additional relay needs to be installed to extend the Allow-to-charge and Allow-to-discharge contacts.

Example: 2 Multis

The Allow-to-charge and Allow-to-discharge will be extended by a relay with 2 separate contacts to control two Multis or Quattros.

Schematic view of the relay that can be used:
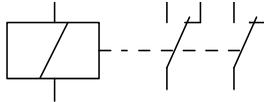
NOTE: It is also possible to use separate relays to get the required additional contacts.

Below a schematic view of the setup:
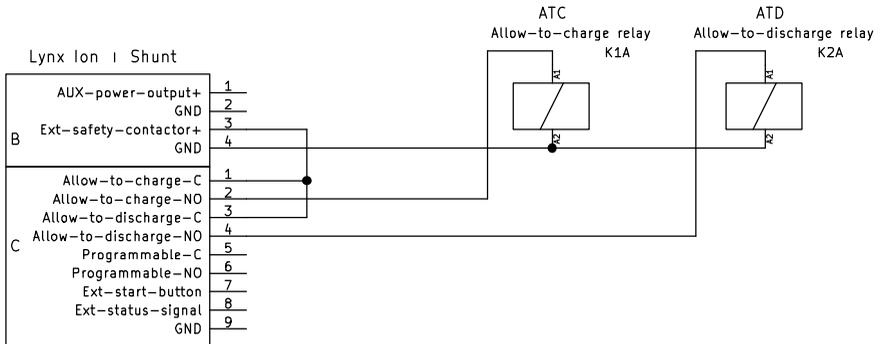
Overview of the relay contacts connected to the Multis.
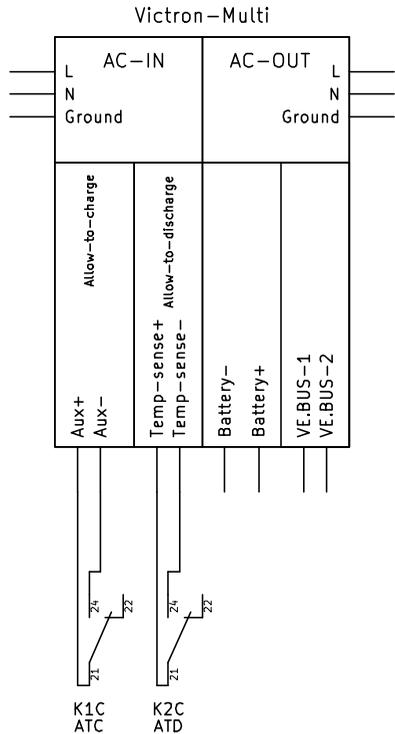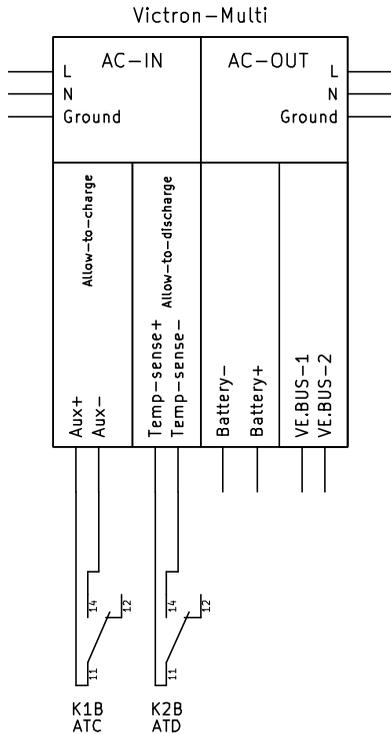
In this schematic relay K1 is the Allow-to-charge and K2 the Allow-to-discharge. The letters 'B' and 'C' are the different contacts within that specific relay.

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4.3 Configuration of a Multi or Quattro

To configure the Multi for BMS support, VEConfigure3 is necessary. See the Support & downloads section at www.victronenergy.com for more information on installing VEConfigure3 and updating the Multi to firmware version xxxx200 or higher.

1. Connect the allow-to-charge signal to the **AUX input** on the Multi or Quattro.
2. Connect the allow-to-discharge signal to **Temp sense input** on the Multi or Quattro. It is not necessary to use a temperature sensor with the Multi or Quattro, since the batteries have their own internal temperature sensors.
3. Add the Lynx Ion BMS assistant in the assistant tab (Virtual switch needs to be off).
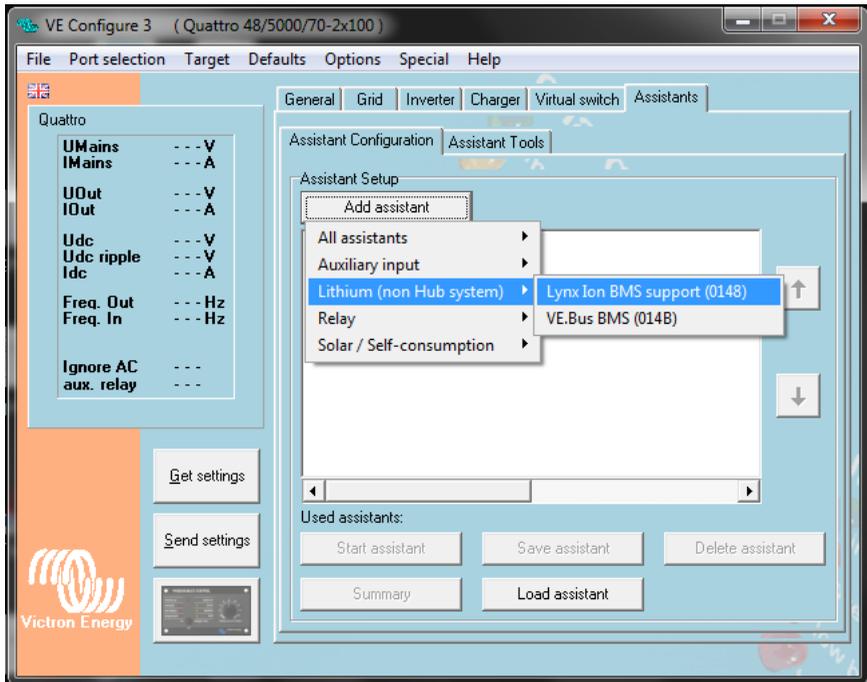
4. Configure the **Lynx-Ion BMS Support assistant** as follows:
   a. Set battery type selection to: *Change battery type as suggested.*
   b. Set BMS options to: *The BMS has separate contacts for high-cell/battery full and low-cell conditions.*
   c. Battery states inputs:
      i. Set: *The battery is full when Auxiliary 1 is open.*
      ii. Set: *The battery is empty when Temperature sense input is open.*
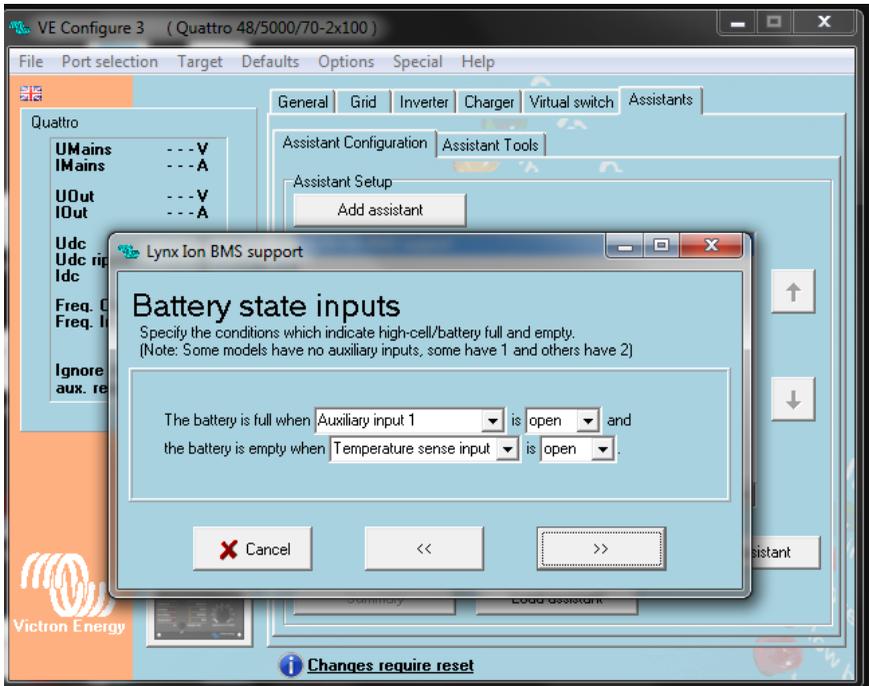
d. Set action to: *Disable charger when battery is full.* (NOT force to float).
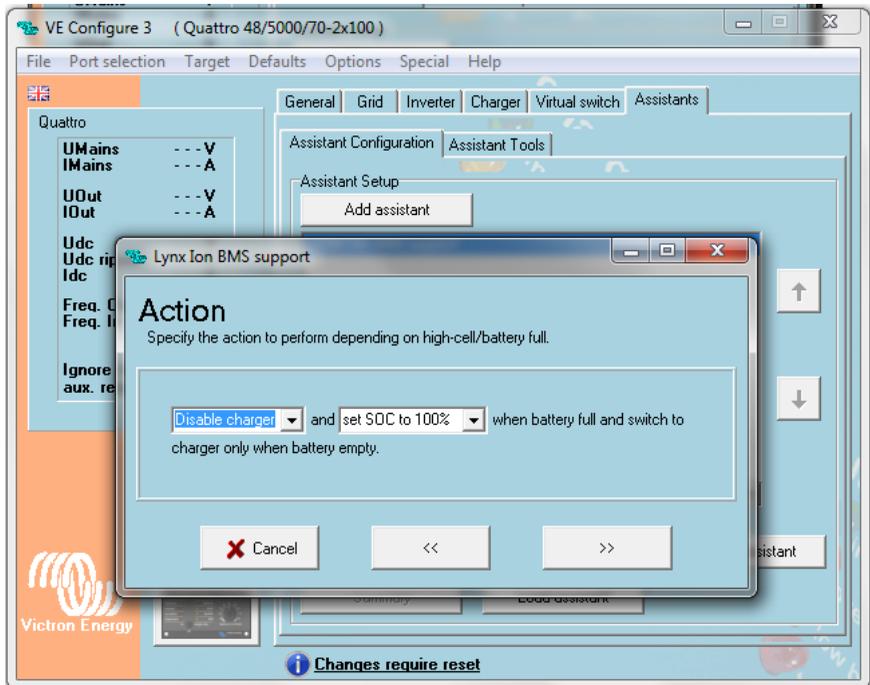
5. Go to the *charger* tab and change the settings to the following:

System voltage 48V:

System voltage 24V:

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5   COMMISSIONING

Below describes the procedure for commissioning the Lithium-Ion battery systems.

5.1   Procedure

Use the following procedure to verify the systems functionality:
Check the firmware version of the Lynx Ion + Shunt:
- ❑ The Lynx Ion + Shunt firmware version is updated to the latest release found on the https://professional.victronenergy.com/ website.

Check that there are no loads or chargers connected directly to the batteries:
- ❑ The power cables from the battery goes directly to the Lynx Ion + Shunt, and there are no other power cables present.

Check for each and every charger in the system that it is controlled by the allow-to-charge:
- ❑ Make sure the battery is not fully charged. The allow-to-charge indicator on the Ion Control or Color Control GX shows **Yes**.
- ❑ Make sure the charger is charging by reading the battery current from the Ion Control or Color Control GX. This has to be a positive number (for example 10.5A).
- ❑ Disconnect one wire from the allow-to-charge (connector 'C', pin 1).
- ❑ Check that all chargers stopped charging by reading the battery current from the Ion Control or Color Control GX. This has to be 0A or a negative number (discharging).

Check for each and every load in the system that it is controlled by the allow-to discharge:
- ❑ Make sure the battery is not completely empty. The allow-to-discharge indicator on the Ion Control or Color Control GX shows **Yes**.
- ❑ Make sure the loads are consuming some energy by reading the battery current from the Ion Control or Color Control GX. This has to be a negative number (for example -10.5A).
- ❑ Disconnect one wire from the allow-to-discharge (connector 'C', pin 3).
- ❑ Check that all loads stopped consuming energy by reading the battery current from the Ion Control or Color Control GX. This has to be less then -0.5A or a positive number (charging).

Check system ready for use:
- ❑ Make sure that the batteries are fully charged the first time by checking if the battery State-Of-Charge is around the 100% by reading this from the Ion Control or Color Control GX (the first time it will indicate a '-' which means that the SOC is not valid).

6   FIRST POWER UP

Other than below procedure, no configuration is needed. The battery configuration is automatically recognized.

6.1   Power up procedure

1. Make sure that all energy consumers are switched off before starting up the system.
2. The Lynx Ion + Shunt will pre-charge the system before closing the safety contactor.
3. Press the START-button on the front of the Lynx Ion + Shunt to start the system.
4. The system is pre-charging now. The safety contactor is closed as soon as the voltage rises above 90% of the battery voltage.
5. If the status LED is continuously on, then the system is running and ready for use.

⚠️ **The Lynx Ion + Shunt will not start if there is more than 10A drawn by the system during pre-charging. The pre-charge fuse will blow when this is the case.**

6.2   Power down/reset procedure

Lynx Ion + Shunt to standby mode:
1. Press and hold the START-button until the Lynx Ion + Shunt goes into standby mode (status LED off).
2. Now the safety contactor is open and the batteries are disconnected from the system.

Reset Lynx Ion + Shunt from fail safe state:
1. Press the START-button for 1 second.
2. The system will now restart.

6.3   Automatic power-up

The Lynx Ion + Shunt will automatically power-up from standby if a charge voltage is supplied on the output for more than 20 seconds.

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7   LED INDICATIONS

7.1   Lynx Ion + Shunt status LED indications

Status LED state	Description
Off	System is in standby mode. Press START button to start up the system
Blinking fast	Initialization
On	Running
Blinking	Balancing active
Flashing/beeping 1 time	Battery initialization error
Flashing/beeping 2 times	No batteries connected
Flashing/beeping 3 times	Unknown battery connected / battery connected to a running system.
Flashing/beeping 4 times	Different types of batteries connected
Flashing/beeping 5 times	Number of connected batteries incorrect
Flashing/beeping 6 times	N.A.
Flashing/beeping 7 times	Battery measure error occurred
Flashing/beeping 8 times	Internal calculation error
Flashing/beeping 9 times	Number of batteries in series incorrect
Flashing/beeping 10 times	Number of batteries incorrect (only used when using static number of battery configuration)
Flashing/beeping 11 times	Not used
Flashing/beeping 12 times	Not used
Flashing/beeping 13 times	Over voltage
Flashing/beeping 14 times	Under voltage
Flashing/beeping 15 times	Over temperature
Flashing/beeping 16 times	Under temperature
Flashing/beeping 17 times	ADC data error
Blinking/beepingfast	Battery BMS error (slave)
Flashing 3 times (no beeping)	Battery BMS warning (slave)
Flashing/beeping 18 times	Pre-Charge error
Flashing/beeping 19 times	Safety contactor error
Flashing 2 times (no beeping)	Over current error on External status or external safety contactor output (appendix A connector B)

Details and solutions of these error codes can be found in chapter 11 Troubleshooting.

7.2 Battery LED indications

Battery status LED	
State	Description
On	BMS Running
Toggle slow	Balancing / BMS stopped
Toggle fast	BMS Error

Battery BMSCAN-Bus error LED	
State	Description
Off	No error in CAN-Bus
Single flash	CAN-Bus passive error
On	CAN-Bus bus-off

Battery BMS CAN-Bus status LED	
State	Description
On	CAN-Bus operational
Toggle slow	CAN-Bus pre-operational
Single flash	CAN-Bus stopped

8 SWITCHING BOUNDARIES

8.1 Lithium-Ion LFP Battery module

When a Lithium-Ion LFP battery module is connected to the Lynx Ion + Shunt the following switching boundaries are used:

State of Charge				
A	B	C	D	E
0%				100%

State	Description	Condition	
		Close	**Open**
A	The batteries are discharged too low. The safety contactor will open. *In a correct functional system this should never occur.*	When all cell voltages are between 2,60V and 3,62V.	When one of the cell voltages is below 2,60V for 20 sec.
B	The batteries are discharged. The allow-to-discharge signal contact will open. Only charging is allowed.	When the lowest battery cell voltage rises above 3,25V for 10 sec.	When one battery cell voltage drops below 2,80V for 10 sec.
C	OK. The allow-to-charge and the allow-to-discharge contacts are closed.		
D	The batteries are full. The allow-to-charge contact will open. Only discharging is allowed.	When the highest battery cell voltage drops below 3,42V for 10 sec.	When one battery cell voltage reaches 3,52V for 10 sec.
E	The batteries are almost over charged. The safety contactor will open. *In a correct functional system this should never occur.*	When all cell voltages are between 2,6V and 3,62V.	When one of the cell voltages is above 3,62V for 20 sec.

8.2   Temperature boundaries

The Lynx Ion + Shunt constantly monitors the battery temperatures, and protects them according below rules. In case the temperature is outside the limits, it will first signal the chargers and/or loads via the allow-to-charge and allow-to-discharge contacts. It will open the safety contactor if there is no response. In that case you will see the status LED blinking in the specified error code (see chapter 10 for details). Press the START-button to restart the system.

8.2.1   High temperature signals
- Stop charging and discharging at +60°C (allow-to-charge and allow-to-discharge contacts open)
- Charge and discharge alarm at +65°C (safety contactor open)

8.2.2   Low temperature signals
- Stop charging at 0°C (allow-to-charge contact open)
- Stop discharging at -20°C (allow-to-discharge contact open)

8.2.3   Alarm temperatures
- Charging alarm at -5°C and current >5% of the system capacity (safety contactor open). Example: 2x180Ah batteries in parallel -> 2 * 180Ah * 5% = 18A.
- Discharging alarm at -25°C and current < -10% of the system capacity (safety contactor open) Example: 2x180Ah batteries in parallel -> 2 * 180Ah * 10% = 36A.

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9   UPDATING FIRMWARE

9.1   Updating by USB

Needed tools:
- Latest firmware for the Lynx Ion;
- A mini-USB to USB-A cable;

9.2   Procedure:

1. Connect the USB cable to the Lynx Ion as below and connect the other side of the cable to a windows PC.

Mini-USB connection
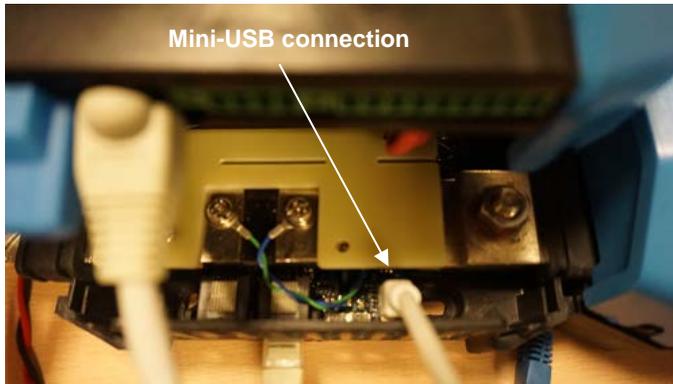
2. Now hold the START key pressed until the system starts-up (status LED is blinking fast) and the status LED is continuously on.
3. Now release the START key.
4. The status LED is blinking slow and on the PC a mass storage device will be added with the name "Lynx-Ion X.X".
5. Delete the "firmware.bin" file from the disk.
6. Now drag the new firmware file (*.bin) to the disk.
7. If it is done copying, remove the USB cable from the Lynx Ion.
8. Wait until the status LED goes off.
9. Now the firmware update is complete.
10. Restart the system with the START key. (NOTE: try 2 times)

NOTE: Supported OS: Windows 7, 8, 10

9.3 Updating by VE.CAN

Only from firmware version 2.00 can be updated by VUP and VE Power setup.

9.4 Hard-reset and boot loader button

Button A:

This is the hard reset button. It resets the Lynx Ion independent of software.

Button B:

If incorrect software is programmed, this button can be used to startup the boot loader again. Button can also be used to go to boot loader directly. If the device is in sleep mode and then the button is pressed for 2 seconds, device will start up in boot loader mode. This way the device is not required first to start up in normal mode.

NOTE: when device has been in boot loader mode, new software has been loaded or not, first press the Start button for 3 seconds to get it out of boot loader mode.

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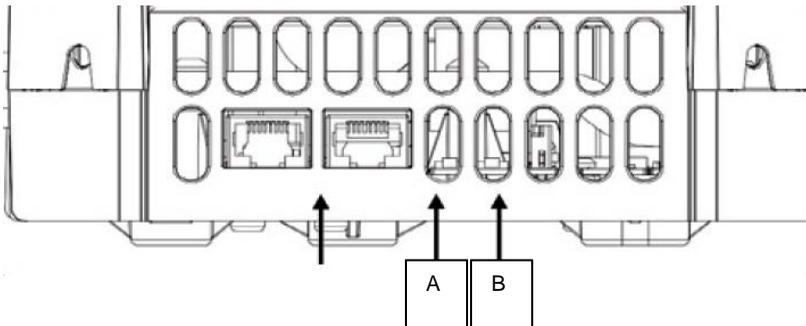
10 TROUBLESHOOTING

10.1   Common startup procedure failures

Most components and connections are checked automatically during the startup procedure of the Lynx Ion + Shunt. The sequence of the startup procedure is:

1. User presses START-button, Lynx Ion + Shunt awakes from sleep and starts its startup procedure
2. The status LED starts blinking fast (green), and will be blinking for the rest of the startup procedure.
3. The Lynx-Ion + Shunt starts pre-charging, with max. 10A.
4. The safety contactor is closed as soon as the voltage on the output side rises above 90% of the battery voltage. If the voltage on the output has not reached this level within 10 seconds, the pre-charge error will occur, error 18. To solve, disconnect all loads during power-up.
5. The Lynx Ion + Shunt checks communication with the batteries. If it cannot communicate properly, one of the following errors might occur: Battery initialization (Error 1), No batteries (Error 2), Different types of batteries (Error 4), Battery measure errors occurred (Error 7). Procedure to follow on error:
    a. Make sure that RJ45 terminators are inserted on both ends of the BMS CAN-Bus network
    b. Make sure that RJ45 cables are ok
    c. LEDs on batteries are normally lit during power up procedure. If they are not:
        i.   Measure the voltage on pin 3 and 6 of the BMS CAN-Bus network. It should be more than 12V, if it is not, contact Victron service.
6. After it has successfully established communication with the batteries, the Lynx Ion + Shunt checks the configuration of the batteries: how many in series and parallel. If incorrect, the following errors may occur: Nr of batteries in series (Error 9), Nr of batteries incorrect (Error 10). If these errors occur, double check the installation, especially the RJ45 wiring between the batteries and the Lynx Ion + Shunt.
7. The system is running: the status LED on the Lynx Ion + Shunt stops blinking and is lit continuously.

If at any moment an error occurs, the startup procedure stops. The LED and the buzzer will indicate the error number for 10 minutes. After that the Lynx Ion + Shunt goes back to sleep. The Ion Control and/or Color Control GX can also be used to find the error number: it shows the last four error codes.

10.2   How to solve Over voltage errors (Error 13)

This error is raised when the Lynx Ion + Shunt is not able to stop all chargers by opening the Allow-to-charge contact. Make sure that all chargers only charge when the Allow-to-charge contact is closed. Note that Quattros and Multis are configured to switch to 'Disable charger' when the Allow-to-charge contact opens.

10.3 How to solve Under voltage errors (Error 14)

The Under voltage error is raised when the lowest cell voltage drops below the absolute minimum, which can occur for two reasons:

1. The Lynx Ion + Shunt cannot disconnect all loads with its Allow-to-discharge contact. Double check wiring of the Allow-to-discharge contact and check that all the loads are disconnected when the contact is open.
2. The Lynx Ion + Shunt can disconnect all loads, but the system has been left on and unattended for a long time. In that case the standby current of Lynx Ion + Shunt has drained the batteries.

10.4 Troubleshooting table

Firmware version 2.00 and higher.

Error number	Status LED state	Description	Solution in case of error
-	Off	System is in standby mode. Press START button to start up the system.	
-	Blinking fast	Initializing.	
-	On	Running.	
-	Blinking	Balancing active.	
1	Flashing/beeping 1 time	Battery initialization error.	Solution: Check the BMS CAN-Bus network: - Are all batteries connected properly to the network? - Is the CAN-Bus terminated with termination resistors? - Are only the same type of batteries connected?
2	Flashing/beeping 2 times	No batteries connected	Solution: Check the BMS CAN-Bus network: - Are all batteries connected properly to the network? - Is the CAN-Bus terminated with termination resistors? - Are only the same type of batteries connected?

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3	Flashing/beeping 3 times	Unknown battery connected / battery connected to a running system.	Solution: Check the BMS CAN-Bus network: - Are all batteries connected properly to the network? - Is the CAN-Bus terminated with termination resistors? - Are only the same type of batteries connected?
4	Flashing/beeping 4 times	Different types of batteries connected	Check if only the same type of batteries are connected.
5	Flashing/beeping 5 times	Not implemented.	
6	Flashing/beeping 6 times	Not implemented.	
7	Flashing/beeping 7 times	Battery measure error occurred at start-up.	System didn't receive all the battery information at start-up. Solution: Check the BMS CAN-Bus network: - Are all batteries connected properly to the network? - Is the CAN-Bus terminated with termination resistors?
8	Flashing/beeping 8 times	Not implemented.	
9	Flashing/beeping 9 times	Number of batteries in series incorrect	Cause: The bus voltage is not equal to the number of batteries in series. For example, a 48V system cannot have 1 battery. Solution: Check the BMS CAN-Bus network: - Are all batteries connected properly to the network? - Is the CAN-Bus terminated with termination resistors?
10	Flashing/beeping 10 times	Number of batteries incorrect	Cause: - The detected number of batteries is not corresponding with the detected batteries in series times the batteries in parallel. Solution: Check the BMS CAN-Bus network: - Are all batteries connected properly to the network? - Is the CAN-Bus terminated with termination resistors?

11	Flashing/beeping 11 times	Hardware failure contactor	Detection of a contactor failed. Cause: Batteries voltage is not the same as the Charger/Load voltage. Solution: - Check the contactor wiring inside of the Lynx Ion + shunt. - Contact your supplier.
12	Flashing/beeping 12 times	Watchdog	Only listed in last error report. Contact your supplier.
13	Flashing/beeping 13 times	Over voltage	Cause: - An over voltage occurs when one of the battery cells in the system is above the 3,62V for more than 20 seconds. Solution: - Make sure that all the chargers stop charging by using the allow-to-charge contact. Check the wiring of the allow-to-charge contact and test if the functionality works for every charger separately.
14	Flashing/beeping 14 times	Under voltage	Cause: - an under voltage occurs when one of the cell voltages in the system is below 2,60V for 20 sec. Solution: - Make sure that all loads stop with discharging by using the allow-to-discharge contact. Check the wiring of the allow-to-discharge contact and test if the functionality works for every load separately.
15	Flashing/beeping 15 times	Over temperature	Cause: - an over temperature occurs when one of the battery temperatures in the system is higher than 65°C. Solution: - Make sure that the battery temperature stays below 65°C degrees. NOTE: The allowed-to-charge and Allowed-to-discharge are switched at different temperatures. See manual for exact switching values.

16	Flashing/beeping 16 times	Under temperature	Cause: - an under temperature occurs when one of the battery temperatures in the system is lower than -5°C when charging and -25°C when discharging. Solution: - Make sure the battery temperature is above -5°C when charging and above -25°C when discharging. NOTE: The allowed-to-charge and Allowed-to-discharge are switched at different temperatures. See manual for exact switching values.
17	Flashing/beeping 17 times	ADC data error	Contact your supplier.
23	Blinking/beeping fast	Battery BMS error (slave)	Cause: - Battery has internal damage to the electronics, moister or mechanical. Solution: Contact your supplier.
-	Flashing 3 times (no beeping)	Battery BMS warning (slave)	Contact your supplier.
18	Flashing/beeping 18 times	Pre-Charge error	The system cannot pre-charge the DC-bus. Cause: - The current drawn from the system when pre-charging is higher than 10A. Solution: - Make sure that all loads are not drawing more than 10A when pre-charging. - Check the pre-charge fuse in the Lynx Ion.
19	Flashing/beeping 19 times	Safety contactor error	Cause: Batteries voltage is not the same as the Charger/Load voltage. Solution: - Check the contactor wiring inside of the Lynx Ion + shunt. - Contact your supplier.

-	Flashing 2 times (no beeping)	Over current error on External status or external safety contactor output (appendix A connector B)	Cause: - There is too much current drawn or a short circuit on one of the two outputs. Solution: - Remove the short circuit or lower the load current then the outputs will recover automatically.

11 MAINTENANCE

The Lynx Ion + Shunt does not require specific maintenance. It will suffice to check all connections once a year. Avoid moisture and oil/soot/vapors, and keep the device clean.

12 TECHNICAL SPECIFICATIONSLYNX ION + SHUNT

Below the technical data of the Lynx Ion + Shunt:

| General	Lynx Ion + Shunt 350	Lynx Ion + Shunt 600
Maximum number of batteries in series	2 (= 48 V)	
Maximum number of batteries in parallel	48	
Supply voltage range	9 ... 60 VDC	
Standby mode	73 mW @ 26,2 V and 138 mW @ 52,4 V	
Active mode	8,7 W	
Main safety contactor current continuous	350 A	600 A
IO		
Aux. output	5 A (output voltage = battery voltage), short circuit protection	
External safety contactor	5 A (output voltage = battery voltage), short circuit protection	
Allow-to-charge	0.8A @ 60 VDC, potential free	
Allow-to-discharge	0.8A @ 60 VDC, potential free	
Programmable contact	0.8A @ 60 VDC, potential free	
External status signal	12 V / 140 mA	
Enclosure		
Material	ABS	
Dimensions	185 x 165 x 85 mm	
Weight	2,0 kg	
Enviromental		
Operating temperature range	-20 °C to 50°C	
Humidity	Max. 95% (non-condensing)	
Protection class	IP22	IP20
Standards		
EMC: Emission	EN-IEC 61000-6-3:2007/A1:2011/C11:2012	
EMC: Immunity	EN-IEC 61000-6-1:2007	
Low voltage directive	EN 60335-1:2012/AC:2014	
RoHs	EN 50581:2012	

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13 TECHNICAL SPECIFICATIONSLFP BATTERIES

Below the technical data of the Lithium-Ion LFP batteries:

|	Lithium-ion 24V 100Ah 2.6kWh battery	Lithium-ion 24V 180Ah 4.75kWh battery
Technology	Lithium iron phosphate (LiFePo4)	Lithium iron phosphate (LiFePo4)
Nominal voltage	26,4V	26,4V
Nominal capacity	100Ah	180Ah
Nominal power	2,6kWh	4,75kWh
Weight	30kg	55kg
Power/Weight ratio	86Wh/kg	86Wh/kg
Dimensions (lxwxh)	592x154x278mm	623x193x351mm
Charge/Discharge		
Charge cut-off voltage at 0.05C	28,8V	28,8V
Discharge cut-off voltage	20V	20V
Recommended charge/discharge current	30A (0,3C)	54A (0,3C)
Maximum charge current (1C)	100A	180A
Maximum discharge current (1.5C)	150A	270A
Pulse discharge current (10s)	500A	1000A
Cycle Life @80% DOD (0.3C)	3000	3000
Configuration		
Series configuration	Yes, up to 2 (more in series on request)	Yes, up to 2 (more in series on request)
Parallel configuration	Yes, easy up to 10 (more parallel on request)	Yes, easy up to 10 (more parallel on request)
Environmental		
Operating temp. charge	0~45°C	0~45°C
Operating temp. discharge	-20~55°C	-20~55°C
Storage temp.	-20~45°C	-20~45°C
Standards		
EMC: Emission	EN-IEC 61000-6-3:2007/A1:2011/C11:2012	
EMC: Immunity	EN-IEC 61000-6-1:2007	
Low voltage directive	EN 60335-1:2012/AC:2014	

# APPENDIX A: OVERVIEW LYNX ION + SHUNT

Bottom view

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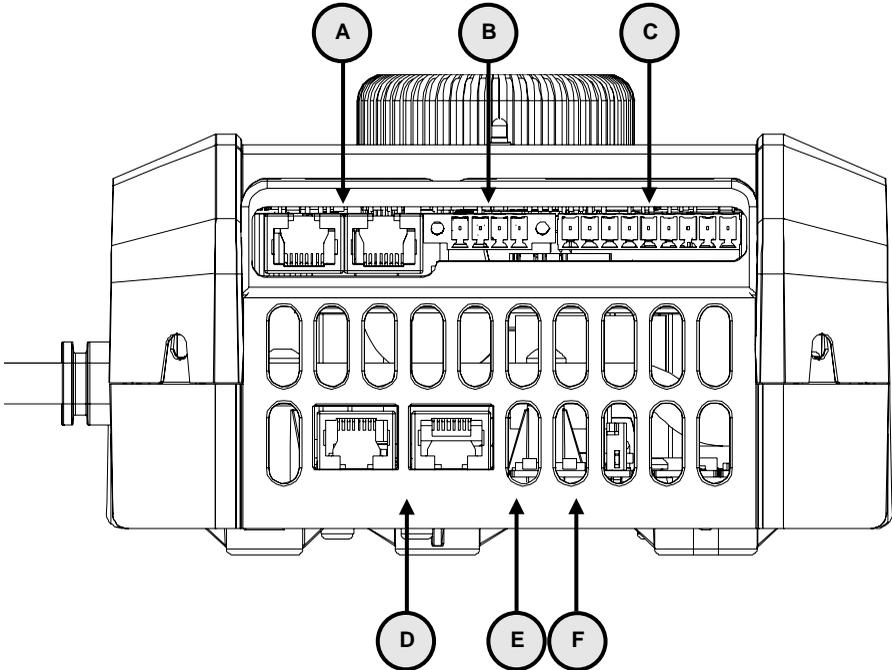
Front view
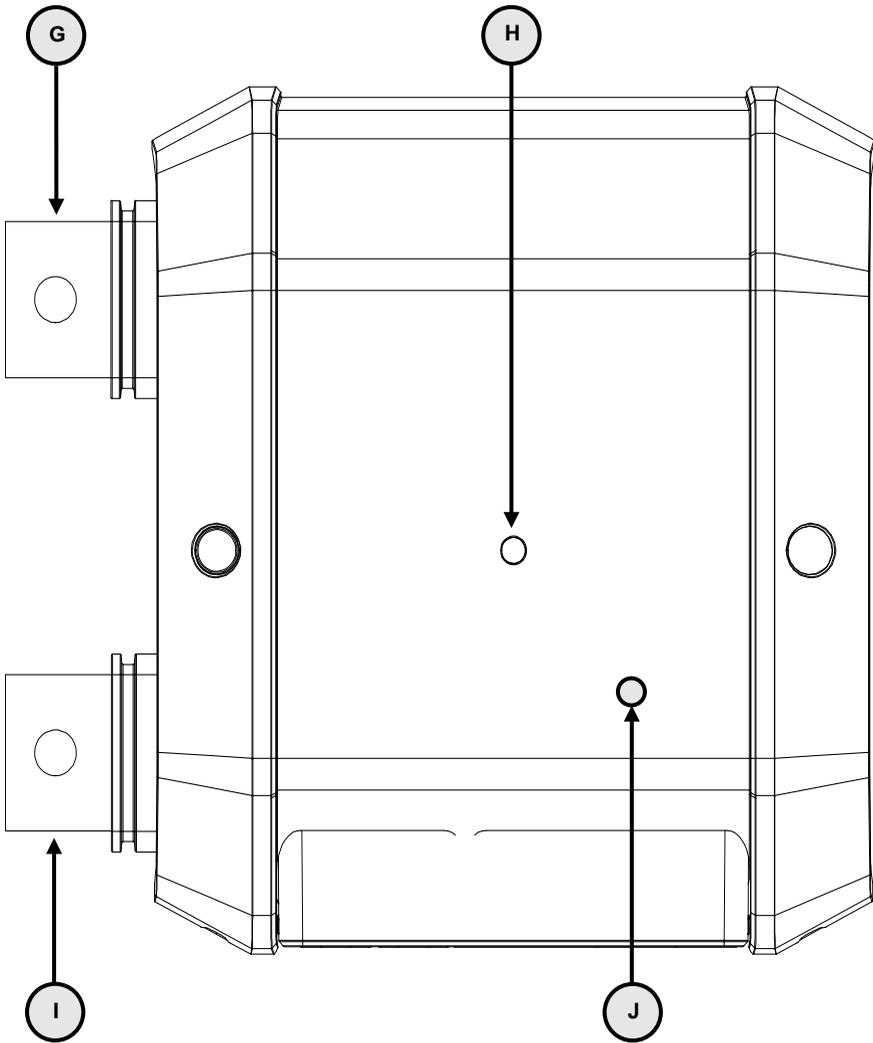
Connector B and C zoomed view

Part descriptions	
A	BMS CAN-Bus connections. CAN-In, CAN-out.
B	Power out connections. Used for External status and external safety contactor.
C	Signal I/O' s
D	VE.Can CAN-Bus connections. CAN-In, CAN-out.
E	Hard-reset button.
F	Reserved button.
G	'+' connection for battery.
H	Status LED.
I	'-' connection for battery.
J	START-button.
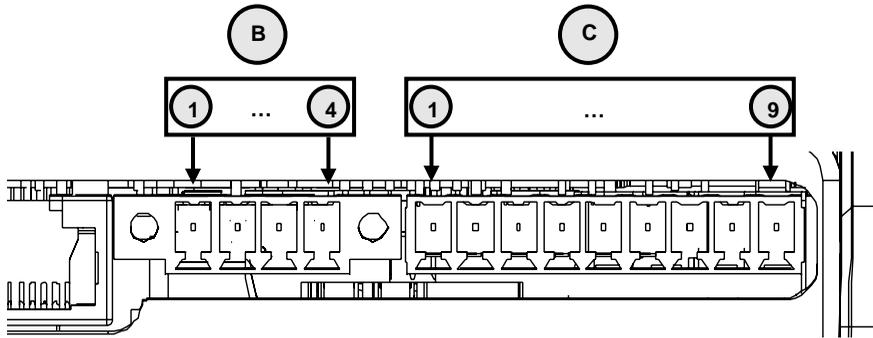
Connector pins and specifications					
Conn.	Pin	I/O	Voltage Max.	Current Max.	Purpose
B	1	Out	+ V System	5 A	Auxiliary power output
	2		GND		
	3	Out	+ V System	5 A	External safety contactor
	4		GND		
C	1		60 V	0,8A @ 60 V	Allow-to-charge
	2				
	3		60 V	0,8A @ 60 V	Allow-to-discharge
	4				
	5		60 V	0,8A @ 60 V	Programmable contact
	6				
	7	In			External START-button
	8	Out	12 V	140 mA	External status signal
	9				GND used for status signal and/or START-button

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APPENDIX B: INSIDE THE LYNX ION + SHUNT
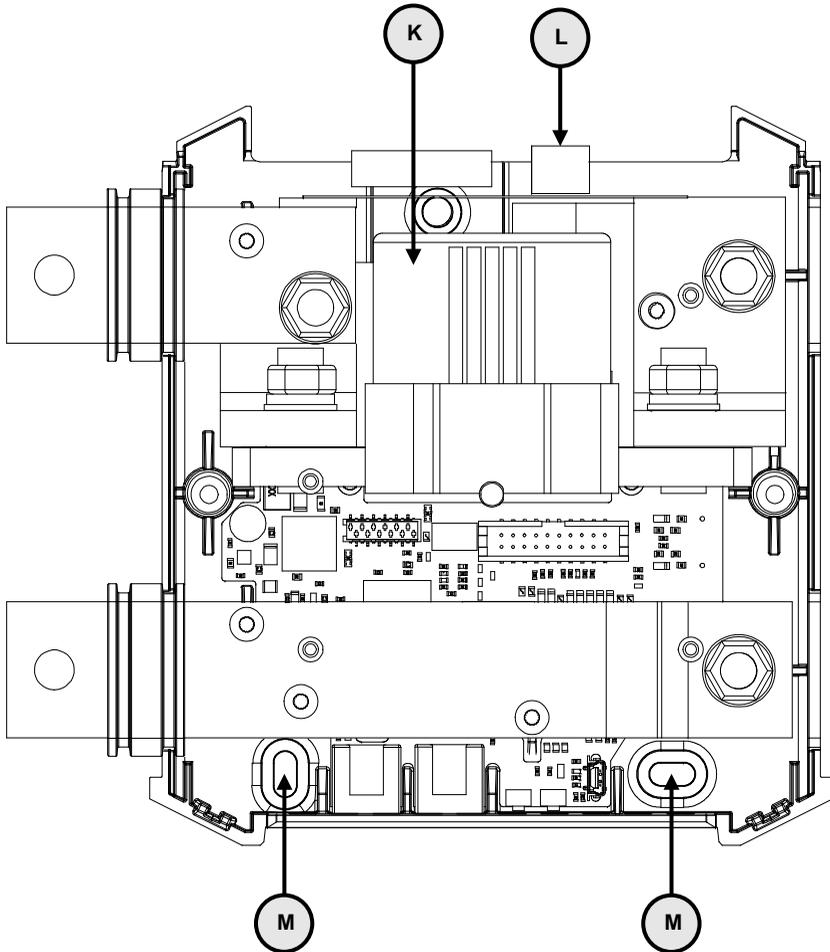
Part descriptions	
K	Safety contactor. 350A or 600A continuous
L	Pre-Charge fuse 10A
M	Mounting holes

APPENDIX C: THE LFP LITIUM-ION BATTERY

Front

Front
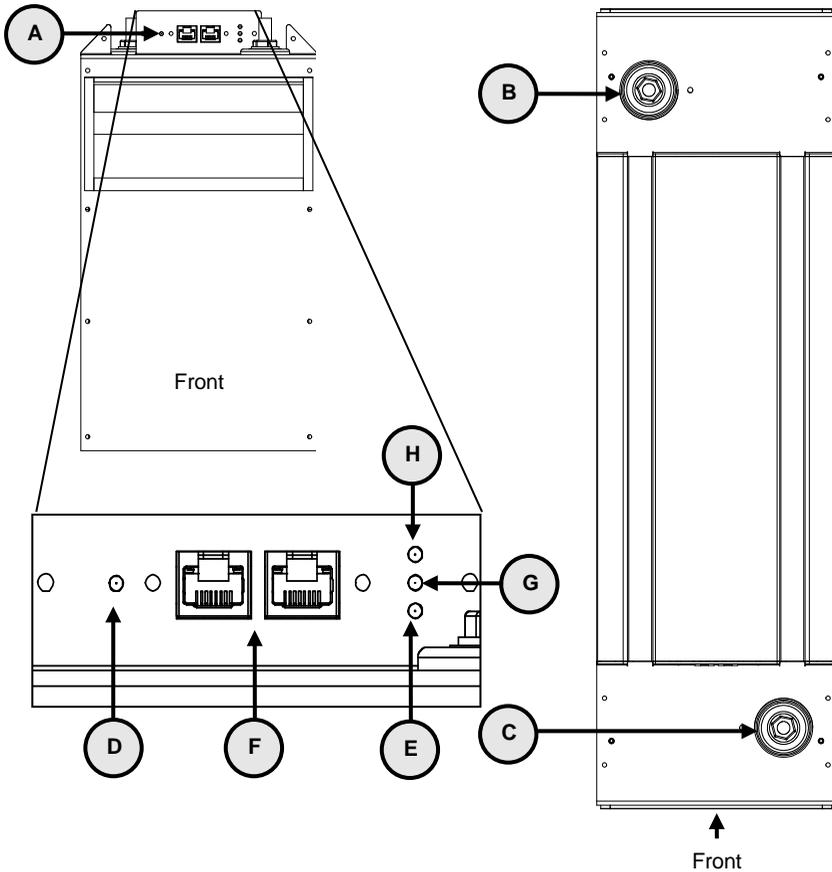
Part descriptions	
A	Connection and status panel.
B	'+' battery connection
C	'-' battery connection
D	Battery power LED
E	Battery status LED
F	BMS CAN-Bus connections
G	BMS CAN-Bus error LED
H	BMS CAN-Bus status LED

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Distributor:

Serial number:

Version : 13
Date : April 4th, 2017

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