Wiferion
efficient wireless power

Wireless Charging System etaLINK 3000

Software and Configuration Manual

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Document

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Table 1: This document is valid for products listed below, until a new version of this document is released.

Product	SW version
etaLINK 3000 (ME, G2)	≥ 4.2
etaLINK 3000 (SE, G1)	≥ 3.4
BlueConfig	≥ 2.3

Table 2: Document history

Date	Version	Changes
06/2019	1.0	Initial version for BlueConfig v1.6 and firmware v1.11
06/2019	2.0	Changes for BlueConfig 1.7 and firmware version 2.0: Section 1.2.1 External control – extended with new functionality Section 1.2.3 Automatic configuration – added Section 2.5 Setting CAN Parameters – image updated Section 4.2.1 Mobile Electronics – Added new CAN messages, extended BMS_CHARGER_CONTROL, MOB_STATUS, MOB_STATUS_CHARGER and MOB_ERROR, **modified the gain of the temperatures (now 0.75) and derating factors (now 0.5),** MOB_SW renamed to MOB_SN and rearranged.
10/2019	3.0	Name change from Blue Inductive to Wiferion.
03/2021	4.0	Document number changed from KD0006 to KD100612 Changes for BlueConfig v1.13 and firmware v2.7/v3.8: Section 1.2: Added overview table on systems charging modes Section 1.2.3: New section automatic mode, supporting etaSTORE Type B Section 1.3.1: Added LED code for battery error and (re)sorted LED codes Chapter 2: Added/updated figures for new BlueConfig v1.12 features, Imax, automatic mode, etaSTORE CAN message setting, support for configurable CAN termination (ME G2) Section 3.1: Modified figure for CAN connector pinout Added new Section 3.2 on CAN bus termination with table and notes on configurable CAN termination for ME G1, ME G2, SE Section 4.2.1: Added examples for CAN messages BMS_CHARGER_CONTROL and BMS_DISABLE_CHARGING Troubleshooting moved to new Chapter 5 and added new points
10/2021	5.0	Changes for BlueConfig v2.2 and firmware SE v3.1 Added Section 4.2.2 - description of the SE CAN messages Added/modified LED code for AC limiting feature, battery error Added Section 2.3.1 for AC grid current limiting feature Added Section 2.6.4 for LiveView feature
02/2022	6.0	Added derating for ME heatsink temperature (Section 4.2.1, Table 19) Added signals “bad position” + “SD card” to STAT_ERROR CAN msg. Added signals I_HF derivative + I_BATT_DELTA to MOB_ERROR CAN msg. Update figures for BlueConfig; add FW update feature for specific charger by serial number
08/2022	7.0	Simplify tables for ME and SE CAN messages

This document was originally written in English.

Reference Documents:
KD0004/KD100895 Wireless charging system etaLINK 3000 - Operating instructions

Contents

1 Software and Configuration

1.1 Software

The embedded software (firmware) in the power electronics controls the operation of the charger. As soon as communication between the stationary and mobile electronics is available (the stationary and mobile coils are facing each other) charging will commence immediately. As soon as the coils are moved away from each other, the charging process stops automatically. The charging characteristics or charging curve, can be freely configured, allowing the charger to be used with multiple different battery technologies.

1.2 Charging Parameters

The etaLINK 3000 system can be configured to operate in a number of different modes:

- Live mode: Externally controlled via the CAN bus
- Static mode: Internally controlled using the stored charging parameters.
- Automatic mode: Internally controlled charging process with all parameters being automatically configured. This mode is available for charging Wiferion's etaSTORE Type B battery system.

The selected mode and configuration parameters are stored in the mobile electronics (ME). Configuration of the charging system is described in Section 2. The following Table 3 provides a brief overview on the system's three main operation modes.

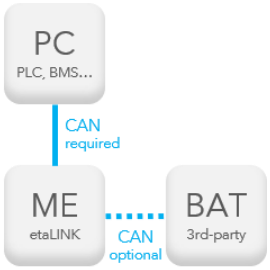
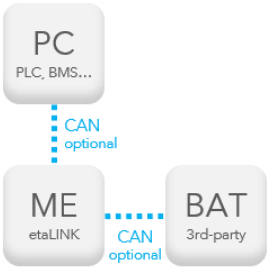
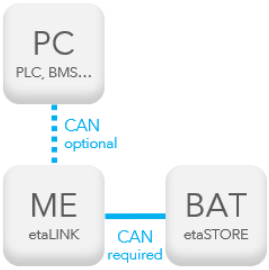
⚠ WARNING!

EXPLOSION AND FIRE HAZARD!

Incorrect parameters may cause damage to the battery and/or charging system. The result may be an explosion or fire!

- Make sure that the entered battery parameters correspond to the battery connected.
- The product may be used for lithium-ion batteries of any kind, but only with a battery management system (BMS) that monitors the current and voltage and, on detecting a fault, disconnects the battery from the charging device!

Table 3: Summary of the available charging modes and corresponding characteristics. (ME) mobile electronics, (BAT) battery

	LIVE MODE	STATIC MODE	AUTOMATIC MODE
Behaviour	▶ external device takes over control of charger (Section 1.2.1)	▶ charger controls CC-CV phase (Section 1.2.2)	▶ charger controls CC-CV phase (Section 1.2.3)
Battery type	all	all	etaSTORE
CAN bus	required	optional	required
CAN bus topology			
Required settings	▶ CAN bit rate ▶ BMS type = "Generic" (Section 2.4.1)	▶ CAN bit rate ▶ BMS type = "no external control" (Section 2.4.2) ▶ Battery parameters	▶ CAN bit rate ▶ BMS type = "Generic" or "etaSTORE" (Section 2.4.3)
Optional settings	▶ Advanced CAN ID settings (Section 2.5) ▶ Let charger take over CC-CV phase control via CAN bus message (Section 1.2.1)	▶ Advanced CAN ID settings (Section 2.5) ▶ Include pre-charge phase (Section 2.4.2) ▶ Include 2nd CV phase	▶ Advanced CAN ID settings (Section 2.5) ▶ Static and/or dynamic I_{Charge} limiting (Section 1.2.3) ▶ Pass non-standard CAN IDs of battery to charger

1.2.1 Live Mode – Externally Controlled via CAN Bus

In this case, an external device (e.g., BMS, PLC, Embedded PC) communicates in the form of a CAN bus message (BMS_CHARGER_CONTROL), the reference current (I_{Charge}) and the maximum permitted voltage (U_{Max}) to the mobile electronics. The charger delivers I_{Charge} and switches off immediately if the measured battery voltage reaches U_{Max}. The external device takes over all control phases and must switch between constant current (CC) and constant voltage (CV) if required. The structure of the CAN message is described in Section 4.2.1, Table 13.

As of firmware version 2.0, the BMS_CHARGER_CONTROL message (see Table 13) has been extended to include the charge voltage (U_{Charge}). If this signal is present (non-zero), the charger takes over all necessary CC-CV control. It will automatically switch to constant voltage mode when U_{Charge} is reached and stop charging once the charging current falls below 5% of I_{Charge} (I_{Min} = I_{Charge} 0.05) during the CC phase. Charging will restart when the battery voltage is 1 V lower than the charge voltage ($U_{Restart}$ = U_{Charge} – 1V).

1.2.2 Static Mode – Internally Controlled via Parameters Stored in Mobile Electronics

In this case all control is performed by the charger using the charging parameters configured and stored in the mobile electronics. The charger progresses automatically through the charging phases until charging is complete. There are several configurations available for different charging options.

1.2.2.1 Constant Current – Constant Voltage (CC-CV)

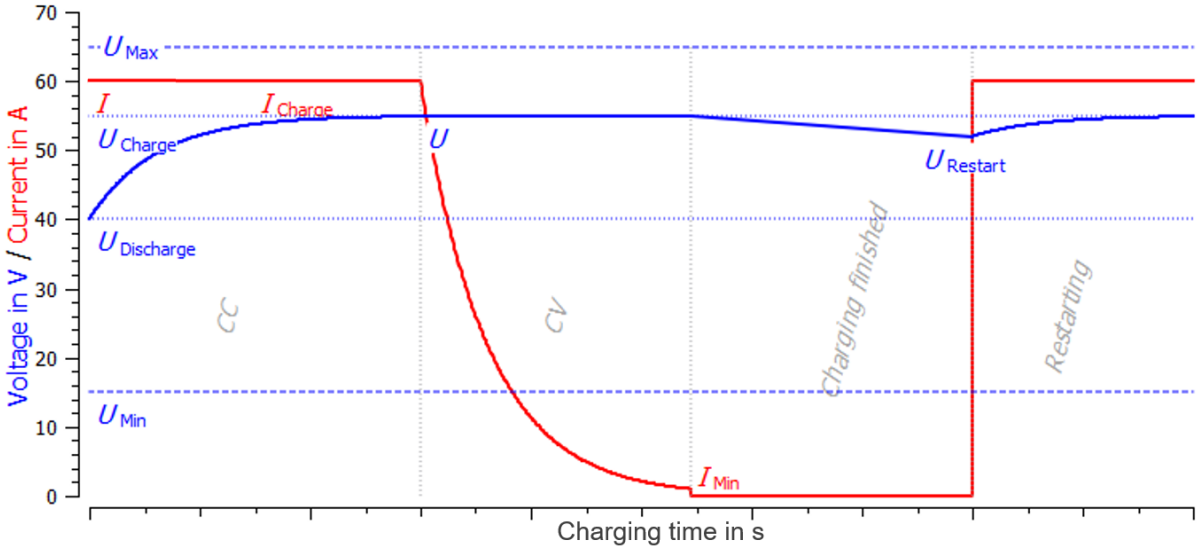


Figure 1: CC-CV charging characteristics

The normal configuration corresponds to a simple set of constant-current constant-voltage characteristics (see CC-CV characteristics in Figure 1). This configuration is marked by two phases. The constant current phase charges the battery with a constant current (I_{Charge}) until the final charging voltage (U_{Charge}) is reached. This marks the beginning of the constant voltage phase, which keeps the voltage constant until the current falls below a defined value (I_{Min}), ending the charging process. This configuration requires the parameters shown in Table 4.

Table 4: Parameters required for CC-CV charging.

Name	Brief description	Detailed description
U_{Min}	Absolute minimum battery voltage	Under this voltage level charging is stopped and an error message generated
U_{Max}	Absolute maximum battery voltage	Above this voltage level charging is stopped and an error message generated.
U_{Charge}	Battery charge voltage	Reference voltage for the constant voltage phase. The battery will be charged to this voltage.
I_{Charge}	Charging current during constant current phase	Maximum charging current used to charge the battery during the constant current phase.
I_{Min}	Cut-off current during the constant voltage phase	If the current falls below I_{Min} during the constant voltage phase, charging is stopped, and the battery has been charged successfully.
$U_{Restart}$	Charge restart voltage	If the battery voltage falls below this level a new charge process will commence.

1.2.2.2 Optional Extra Constant-Current Pre-Charge Phase

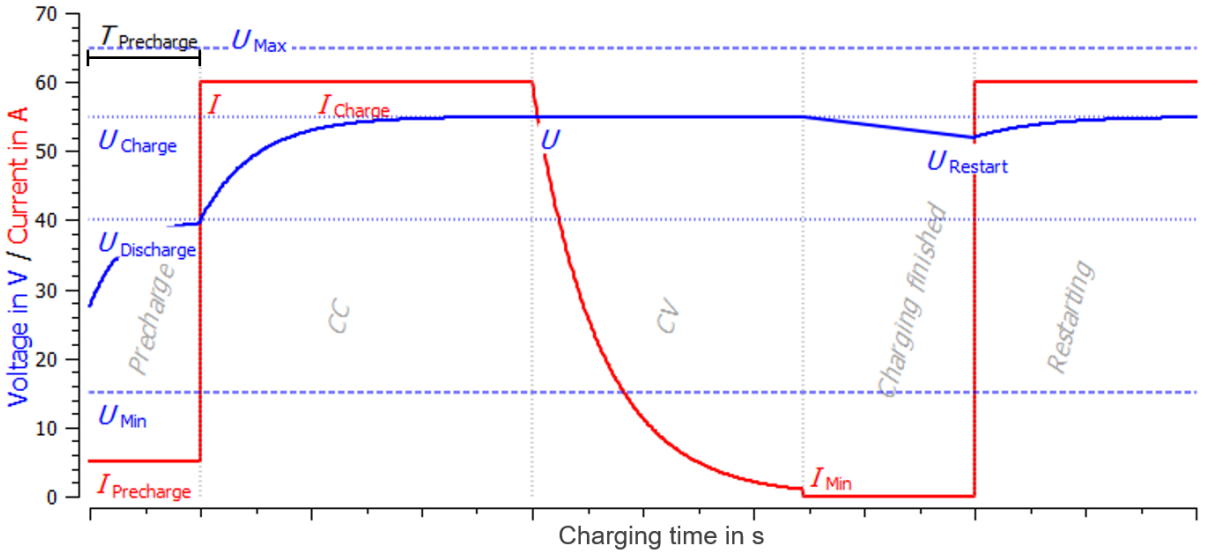


Figure 2: CC-CV charging characteristics with pre-charge phase

The optional pre-charge phase is used to gently charge a deeply discharged battery. This is activated when the battery voltage is below the discharge voltage ($U_{Discharge}$). This phase is left if the battery voltage rises above $U_{Discharge}$ or the time $T_{Precharge}$ is exceeded. If, however, the battery voltage is less than the absolute minimum voltage (U_{Min}), charging will not start. In addition to the parameters defined above, extra parameters must be configured as shown in Table 5.

Table 5: Extra parameters for constant current pre-charge phase

Name	Brief description	Detailed description
$U_{Discharge}$	Battery discharge voltage	The pre-charge phase is activated when the battery voltage is below this value
$I_{Precharge}$	Charging current in the pre-charge phase	This is the maximum charging current during the pre-charge phase.
$T_{Precharge}$	Maximum duration of the pre-charge phase	Maximum time within the pre-charge phase. If the discharge voltage could not be reached within this time, charging is stopped and an error message will be shown.

1.2.2.3 Optional extra Constant-Voltage Post-Charge Phase

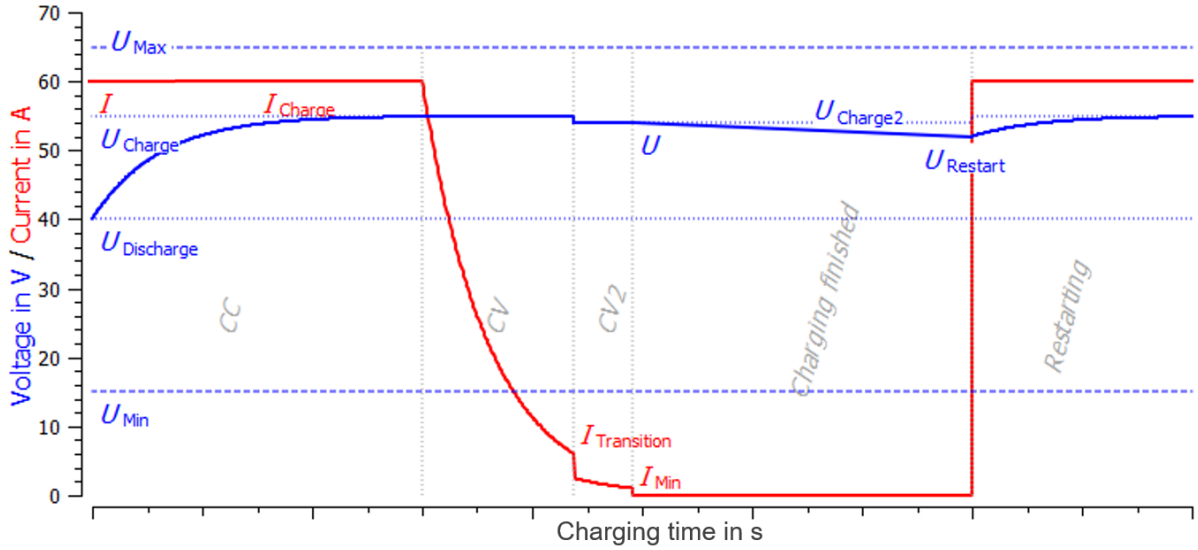


Figure 3: CC-CV charging characteristics with second CV phase

The optional second constant voltage phase is activated after the normal constant voltage phase when the charging current falls below a configurable level ($I_{Transition}$). A different reference voltage ($U_{Charge2}$) can be specified within this second phase. Charging continues until the charge current falls below I_{Min}. The extra parameters required are shown in Table 6.

Table 6: Extra parameters for the second constant voltage phase

Name	Brief description	Detailed description
$U_{Charge2}$	Reference voltage for the second CV phase	This is the reference voltage that is to be used in the second CV phase.
$I_{Transition}$	Transition current between first and second CV phase	Under this defined current level, the transition is made from the first to the second CV phase.

1.2.3 Automatic Mode – Automatic Configuration for etaSTORE Batteries

NOTE

Automatic charger configuration requires the following:

- CAN connection between the mobile electronics and the battery system
- etaSTORE Type B battery and the ME have matching CAN configuration (see Section 2.5)
- The BMS type option for the mobile electronics is configured as "Generic" (default) or "etaSTORE Type B" (see Sections 2.4.1 and 1.2.3).

The charger will automatically configure the charging parameters when the CAN bus of the mobile electronics is connected to an etaSTORE Type B battery system. The charger will then automatically deliver the maximal allowed charge current per module at any given time during the charging process, considering the module temperature, current and voltage. Charging automatically starts in the standard CC charging phase, followed by the charging end phase similar to a standard CV phase (see Figure 4). During the CV phase, the module current is halved every time the module voltage reaches 28.4 V, down to 2 A per parallel module. The maximum charging current can be limited by setting I_{Charge}, statically or dynamically (see Section 1.2.3.2). If other charging parameters are required, then the BMS Type should be set to "No external control" (static mode) and the parameters entered manually.

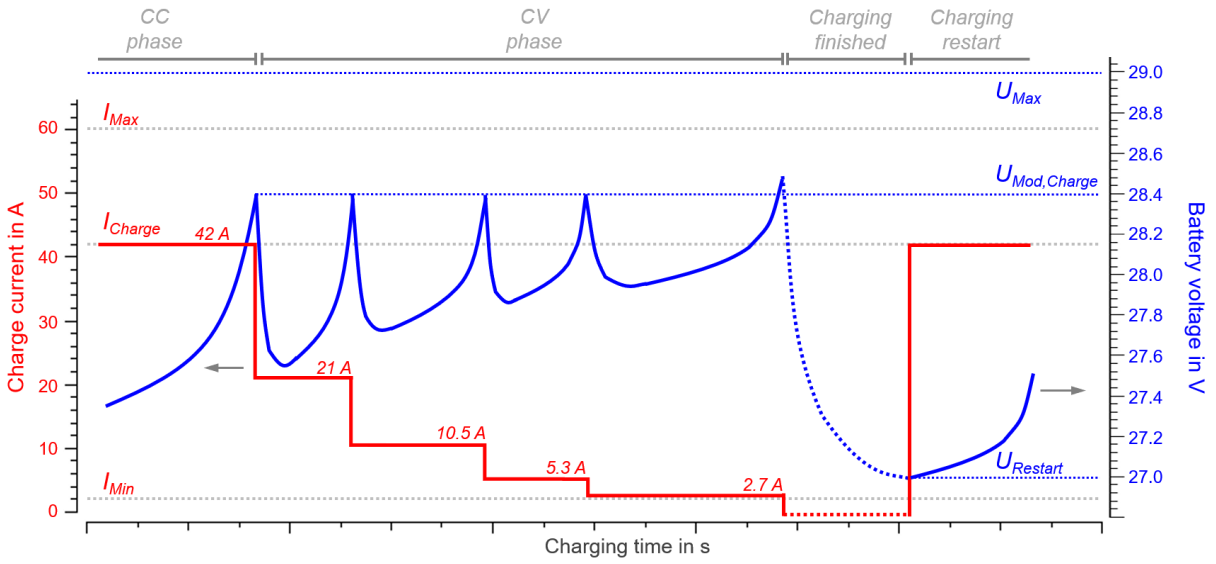


Figure 4: Illustration of charging characteristics of an etaSTORE Type B battery in automatic configuration.

1.2.3.1 Typical Charging Process

A typical charging process in automatic mode includes the following steps:

- Based on the number of modules connected in series (N_s) and parallel (N_p), the charging current (I_{Charge}) for the battery pack is set to N_p × 42 A (see Table 7).
- CC phase: The maximum module current is controlled depending on the module and FET temperatures as well as the charging phase (see Figure 5).
- CV phase: If the maximum battery module voltage U_{Mod} or cell voltage U_{Cell} exceeds a defined threshold ($U_{Mod} \geq U_{Mod,Charge} = 28.4$ V, $U_{Cell} \geq U_{Cell,Charge} = 3.6$ V), the average module current is halved. The current decimation repeats until the average module current falls below 3 A at which the charger keeps charging until the battery enters the fully charged state (see Figure 4).

If the module voltage or average module current fall below 28 V or 2 A respectively, the charge current is linearly increased. Also note, that for batteries featuring state of charge values close to 100 %, the average charge current can be initially lower than 42 A.

Table 7: Automatically configured parameters for the etaSTORE Type B battery system.

Name	Brief description	Detailed description
U_{Charge}	Battery charge voltage	Not normally used in automatic mode as each module voltage is controlled to $U_{Mod,Charge}$ and cell voltages to $U_{Cell,Charge}$, however the charger voltage is set to 29.0 V × N_s which will cause a standard CV phase if there is significant voltage drop between the charger and the battery modules.
U_{Max}	Absolute maximum charger voltage	Above this voltage (29.0 V × N_s + 0.5 V) charging is stopped and an error is generated.
$U_{Restart}$	Restarting voltage	If the battery is in active mode and the module voltage falls below 27 V and the cell voltage falls below 3.4 V a new charge process will commence.
$U_{Mod,Charge}$	Charge voltage etaSTORE Type B battery module	If the maximum module voltage exceeds $U_{Mod,Charge}$ = 28.4 V, the charging end-phase is entered and I_{Charge} will be successively halved.
$U_{Cell,Charge}$	Charge voltage etaSTORE Type B battery cell	If the maximum cell voltage exceeds $U_{Cell,Charge}$ = 3.6 V, the CV phase is entered and I_{Charge} will be successively halved.
I_{Charge}	Charging current during CC phase	Number of modules in parallel x 42.0 A. Limited to 60 A.
I_{Min}	Minimal average module current during the CV phase	During the CV phase the avg. module charging current is controlled such that $I_{Charge} > I_{Min}$ = 2 A
I_{Max}	The maximum charging current	The charger delivers a maximum charging current of 60 A. The maximum module charge current of etaSTORE Type B batteries is limited to 42 A
N_s	Number of modules connected in series	The maximum allowed value for N_s = 2.
N_p	Number of modules connected in parallel	The maximum allowed value for N_p = 20

NOTE

- There must be an even number of battery modules when the Type B batteries are connected in series. The charger will not charge an uneven number of series connected modules.

1.2.3.2 Charger Current Limiting in Automatic Mode

The etaLINK 3000 charger charges etaSTORE batteries at the maximal possible rate. However, if I_{Charge} needs to be limited to a lower value, two options are provided:

- **Static I_{Charge} limiting** – For this option the BMS Type needs to be changed from "Generic" to "etaSTORE Type B" via BlueConfig (Section 2.4.3). Specifying I_{Max} sets a constant maximum charge current limit for future charging processes. Use this option to limit the charging current permanently, for example to protect external hardware/cables etc.
- **Dynamic I_{Charge} limiting** – This option allows the adaptive change of I_{Max} throughout the charging process. Therefore, byte 2 and 3 of CAN message BMS_CHARGER_CONTROL (reference current, see Table 13) need to be sent representing the corresponding limiting current I_{Max}. In this case all other signals of CAN message BMS_CHARGER_CONTROL will be ignored. An example use of this option is to dynamically limit the maximum charging power.

1.2.3.3 Battery Temperature Management in Automatic Mode

In automatic mode, the charger continuously monitors the module and FET temperatures of the etaSTORE batteries. The charger automatically adjusts the charge current to ensure safe operation within the battery's temperature limits. Figure 5 illustrates the implemented charge current derating profiles as a function of temperature.

NOTE

etaLINK 3000`s power derating for safe operation at elevated temperature is only provided in combination with etaSTORE Type B batteries. Please note that,

- a CAN connection between the mobile electronics and the battery system is required,
- the operating range for the charging of Type B batteries is 10…40 °C and that
- etaSTORE Type B batteries will not be charged at module temperatures below 0 °C and above 60 °C.

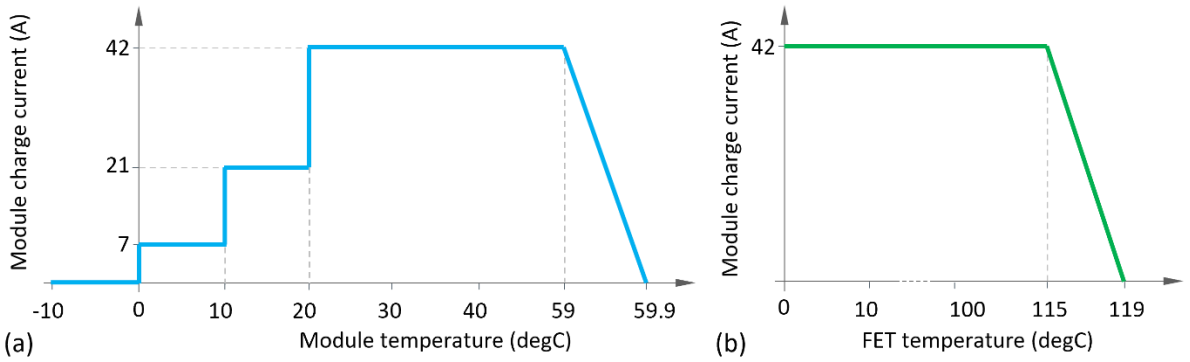


Figure 5: Charge current derating profiles as a function of (a) module and (b) FET temperature.

1.3 Status Indicators

The LEDs **(a)** of the stationary electronics indicate the operating status. Each of these LEDs can have one of the following states:

- OFF
- ON
- flashing fast - (ON/OFF 0.5 s)
- flashing slow - (ON/OFF 1 s)

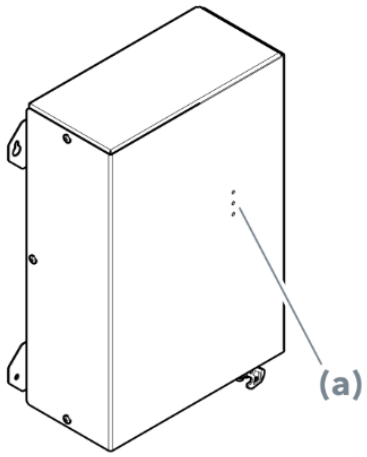


Figure 6: LED status signals

Basic LED Signals

- Green ON: Power transferring.
- Yellow: System warning, power is still transferred.
- Red ON: System error, no power is transferred.

1.3.1 LED Status Codes

Events that the LEDs cannot signal can be read out via the CAN interface (see Section 4).

Table 8: LED error codes.

Green	Yellow	Red	Event
Slow	Off	Off	Standby (mains connected, no communication with mobile side).
Fast	Off	Off	Battery full. Communication with mobile side OK, but no power transfer.
On	Off	Off	Charging.
Off	Slow	Off	Warning AC limiting CAN bus error.
On	Slow	Off	Inadequate coil positioning, reduced power transfer.
Fast	Fast	Off	Mains voltage / mains power derating.

Green	Yellow	Red	Event
On	Fast	Off	Increased temperature on stationary or mobile side, reduced power.
On	On	Off	Mobile side warning. Fan defect, MOSFET temperature difference.
Off	Off	On	Battery temperature off limits or battery configuration error.
Slow	Off	On	Grid fault (overvoltage/undervoltage … DC bus).
Fast	Off	On	Inadequate coil positioning, no power transfer.
Off	Slow	On	Charger ID allocation error.
Fast	Slow	On	Defective coil(s) (no resonance detected).
Off	Fast	On	AC limiting configuration error.
Slow	Fast	On	CAN communication error on mobile side.
Fast	Fast	On	Stationary electronics switched OFF due to high temperature.
Off	On	On	Software updating.
Slow	On	On	Stationary electronics fault.
Fast	On	On	Mobile side fault (including battery errors).
Off	Slow	Slow	Device in bootloader.
Off	On	Slow	Authentication error

2 Configuration Software BlueConfig

The software BlueConfig allows the configuration of the mobile and stationary electronics via the CAN bus.

If internal control is required (static mode), the mobile electronics must first be configured for the installed battery system before charging. On a preconfigured or externally controlled system (live/automatic mode), this configuration step is not necessary.

NOTE

The software may only be configured by qualified personnel under the guidance of an authorized person.

2.1 Installation

The configuration software supports the following operating systems:

- Windows 7,8 and 10 (32/64 bit)

Please contact Wiferion for the latest version of "BlueConfig". After successful installation, the computer can be linked to both the mobile and stationary electronics.

⚠ CAUTION!

DANGER OF BURNS!

The housings of the system components may be hot.

- Do not touch the housing and leave them to cool before working on the system.

1. Before launching BlueConfig, first connect the CAN adapter to the computer.
2. Connect the CAN adapter to the electronics to be configured.
3. Make sure that charging cannot start (the mobile and stationary coils are not facing each other).
4. Ensure that the electronics is powered.

NOTE

BlueConfig only supports the following CAN to USB adapters:

- CAN adapter VN1600 series from Vector Informatik GmbH
- CAN adapter CANUSB from LAWICEL AB
- CAN adapter PCAN-USB from Peak-System Technik GmbH
- CAN adapter Kvaser Leaf Light from Kvaser Europe AB

⚠ CAUTION!

Charging must be prevented while the software is being configured or updated.

2.2 Connecting to the Electronics

1. Launch BlueConfig.
2. Make sure that the tab “CAN Adapter” **(a)** is prominent (see Figure 7).
3. All connected and available CAN adapters appear on the drop-down list **(b)**.
4. Make sure you have set the correct bit rate **(c)**. The standard bit rate is 500 kbit/s. Click “Connect” **(d)** to connect to the electronics.
5. If the CAN adapter does not appear on the port list, make sure that it has been plugged in correctly. “Refresh” **(e)** searches for new CAN adapters and updates the list **(b)**.

   ↳ A successful connection can be recognised by the status message (Figure 8) showing the device type at the bottom right. If no device could be detected, make sure that the CAN adapter has been connected properly to the electronics and that the device is switched ON, or refer to Chapter 5.

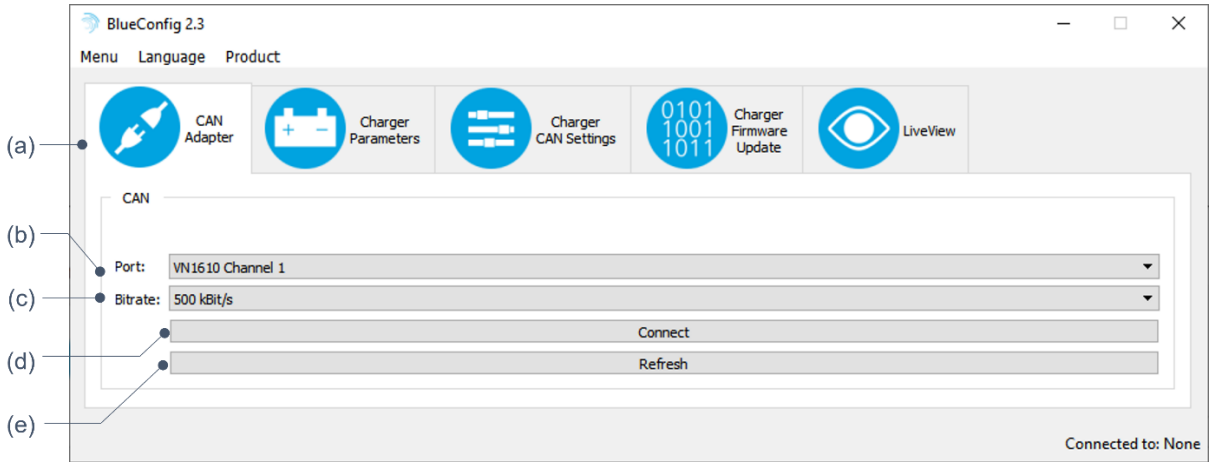


Figure 7: “BlueConfig” interface

Figure 8: Example for possible status messages, shown on connection to Wiferion’s charging systems or batteries. (a) Version firmware, (b) version bootloader, (c) version firmware etaSTORE battery system

2.3 Stationary Electronics Parameters

The relevant settings for the stationary electronics can be set via the software application BlueConfig. In case several stationary devices need to operate in parallel on the same CAN bus, it is possible to set a dedicated Charger ID for each device ("Charger CAN Settings" tab, also see Section 2.5). As of firmware version 2.8, the stationary electronics will handle ID conflicts by automatically allocating the next free ID (if no free IDs are left the "Charger ID allocation error" will be set).

NOTE

When changing the Charger ID (XX) of the stationary electronics, the corresponding CAN message IDs will change according to pattern 0x1FFEXXyz (see Section 4.2.2 for details).

Besides the option for updating the firmware of the stationary device (tab "Charger Firmware Update", see Section 2.6), it is also possible to change the CAN bit rate (tab "Charger CAN Settings").

2.3.1 AC Grid Current Limiting

As of BlueConfig v2.2 and SE firmware v2.8, the maximal AC grid current $I_{ac,max}$ can be limited via tab "Charger Parameters" (see Figure 9). The main options are:

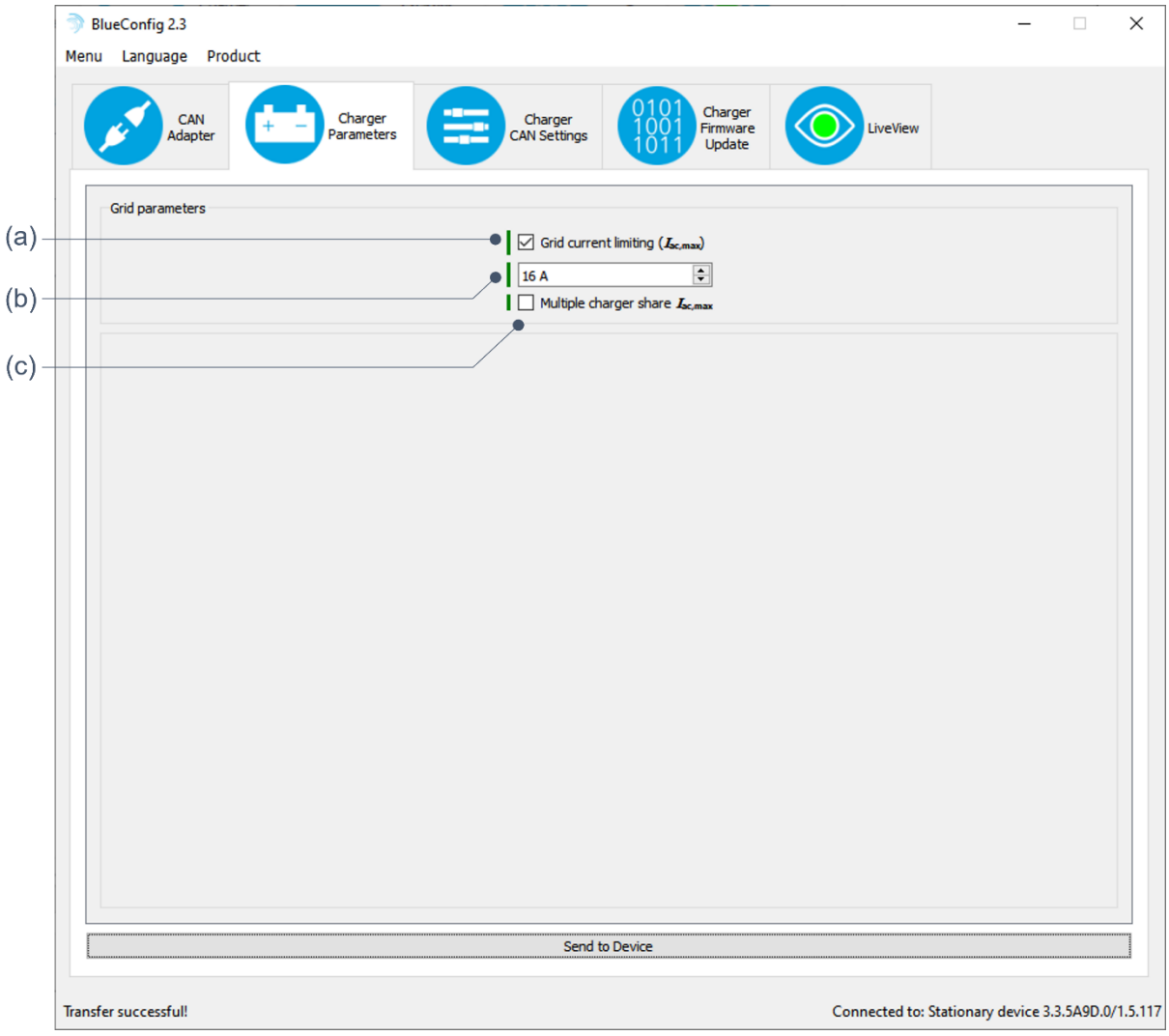


Figure 9: AC grid current limiting option for stationary electronics

- **Grid current limiting** - By default checkbox **(a)** for $I_{ac,max}$ is unchecked, such that the charger uses the maximal available grid current $I_{ac,max}$ of ca. 16 A. If checked, the $I_{ac,max}$ value can be set/limited via dialog box **(b)** and applies to the this particular charger.
- **Multiple chargers setting -** If checkbox **(c)** is checked, the charger monitors the CAN bus for other similarly configured devices. Each device connected to the CAN bus becomes a member of an "AC limiting group", sharing the available AC grid current. Depending on the maximum number N_{max} of stationary electronics connected as well as the number of devices that actually want to charge N_{charge}, each charger dynamically calculates the allowed AC gird current I_{ac} according to $I_{ac} = I_{ac,max} / N_{charge}$. In this case, the value $I_{ac,max}$ set via dialog box **(b)** represents the maximal allowed grid current of the "AC limiting group", i.e., for all connected chargers.

The multiple charger setting involves several implications, which shall be exemplified in the following.

(1) **AC current calculation** - For example, if four stationary electronics are configured to share a maximal grid current of $I_{ac,max} = 16$ A, each device is entitled to use $16 / 4 = 4$ A, if all four ($N_{charge} = 4$) chargers charge simultaneously. In case only two systems ($N_{charge} = 2$) charge at the same time, the AC current available for each of the two chargers becomes 8 A etc.

(2) **Configuration error** - Stationary electronics, which are connected to an AC limiting group, but are not configured to share $I_{ac,max}$, will enter the error state "AC limiting configuration error" (see Section 1.3.1 for LED code) and stop charging.

(3) **ID allocation error** - If a charger detects more than 15 other devices on the same CAN bus, the unit enters the error state "Charger ID allocation error" (see Section 1.3.1 for LED code). The unit will remain in error state until a free ID can be allocated.

(4) **CAN bus error** - In case a member of an AC limiting group disconnects from the shared CAN bus, the allowed grid current for all members of the group will decrease to $I_{ac} = I_{ac,max} / N_{max}$, with N_{max} being the maximal detected number of members during the system´s uptime. For example, if four devices are configured to share $I_{ac,max} = 16$ A (and are initially connected via CAN) and one device disconnects from the group, all four chargers are now only allowed to use a fixed maximal grid current of $I_{ac} = 16 / 4 = 4$ A, regardless if only a single unit of the group actually wants to charge. In such circumstance, all group members will display the "Warning AC limiting CAN bus error" via their status LEDs (Section 1.3.1) indicating subpar charging performance. The value for N_{max} will be reset after a system restart to allow for a new AC limiting group formation.

NOTE

- When using the multiple chargers setting, configured stationary electronics must be added one after another to the shared CAN bus.
- Note, that with the AC limiting features engaged, the charger might charge your battery system at a reduced rate, indicated via the charger's status LEDs (Section 1.3, "Mains voltage / mains power derating").

2.4 Mobile Electronics Parameters

All of the essential parameters needed to put the charging system into operation must be configured in the mobile electronics. These include the battery parameters (see Sections 2.4.1, 2.4.2 and 2.4.3) and the advanced settings (see Section 2.5). Firmware updates may also be available for the mobile electronics (see Section 2.6).

⚠ WARNING!

EXPLOSION AND FIRE HAZARD!

Incorrect parameters may cause damage to the battery and/or charging system. The result may be an explosion or fire!

- ▶ Make sure that the entered battery parameters correspond to the battery actually connected.
- ▶ The product may be used for lithium-ion batteries of any kind, but only with a battery management system (BMS) that monitors the current and voltage and, on detecting a fault, disconnects the battery from the charging device!

2.4.1 Live Mode + Automatic Mode

When the BMS type is set to Generic, the charger requires communication via the CAN bus. This can either be an external device controlling charging (live mode, Section 1.2.1) or etaSTORE Type B batteries (automatic mode, Section 1.2.3). If the extra etaSTORE Type B parameters are required, etaSTORE Type B should be set as BMS type (see Section 2.4.3).

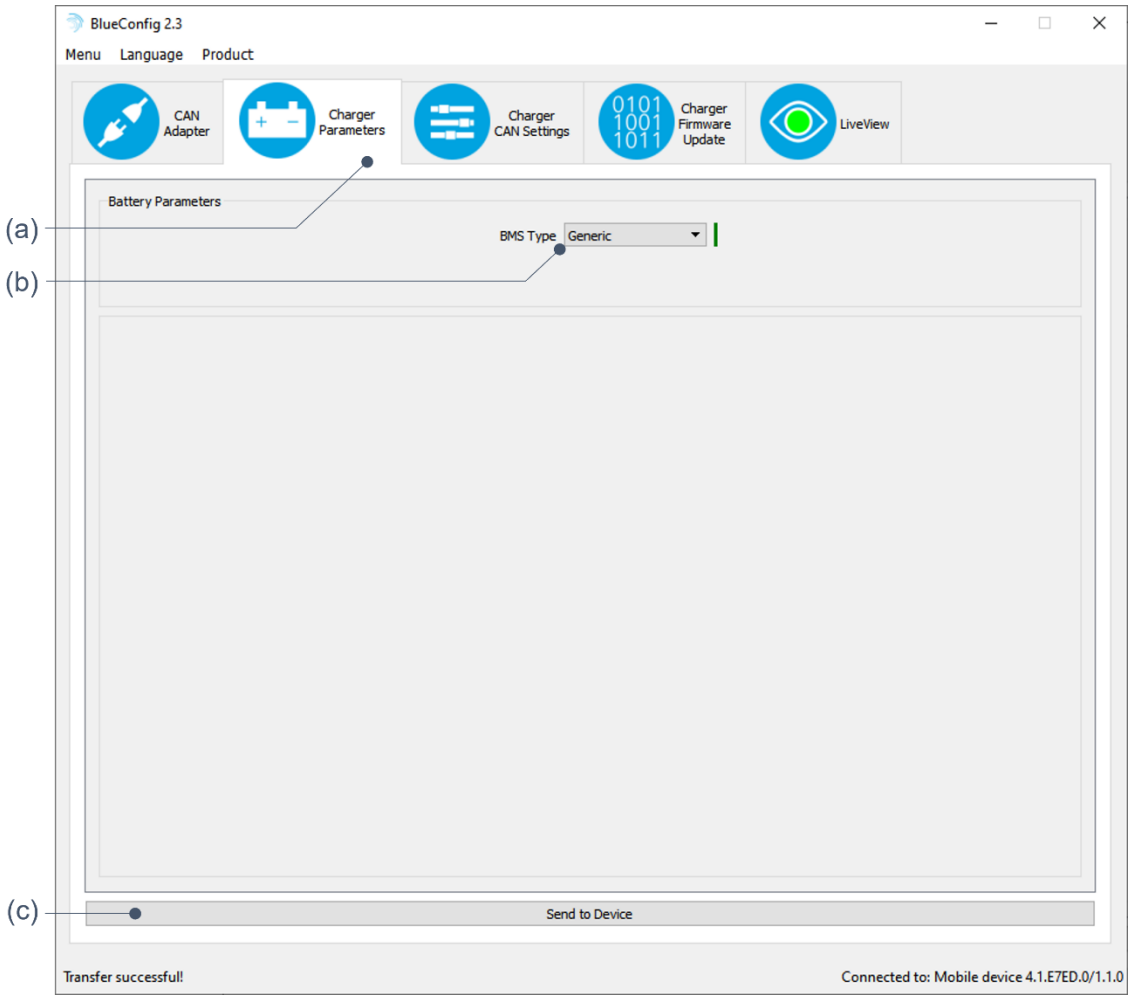


Figure 10: Configuration for the case that an external device controls charging.

1. Open the “Battery Parameters” tab **(a)**.
2. Choose “Generic” as the BMS type **(b)**.
3. A warning appears reminding you that CAN message settings may have to be (re)configured (see Section 2.5). Click “Send to Device” **(c)**. This option is available only when you have made a successful connection to the mobile electronics and you have performed step 2.

   ↳ Transfer was successful when “Transfer successful” appears on the bottom left. If the transfer was not successful, make sure that the connection to the mobile electronics is still active and there is no charging in progress.

2.4.2 Static Mode – Charging Parameters Stored in the Mobile Electronics

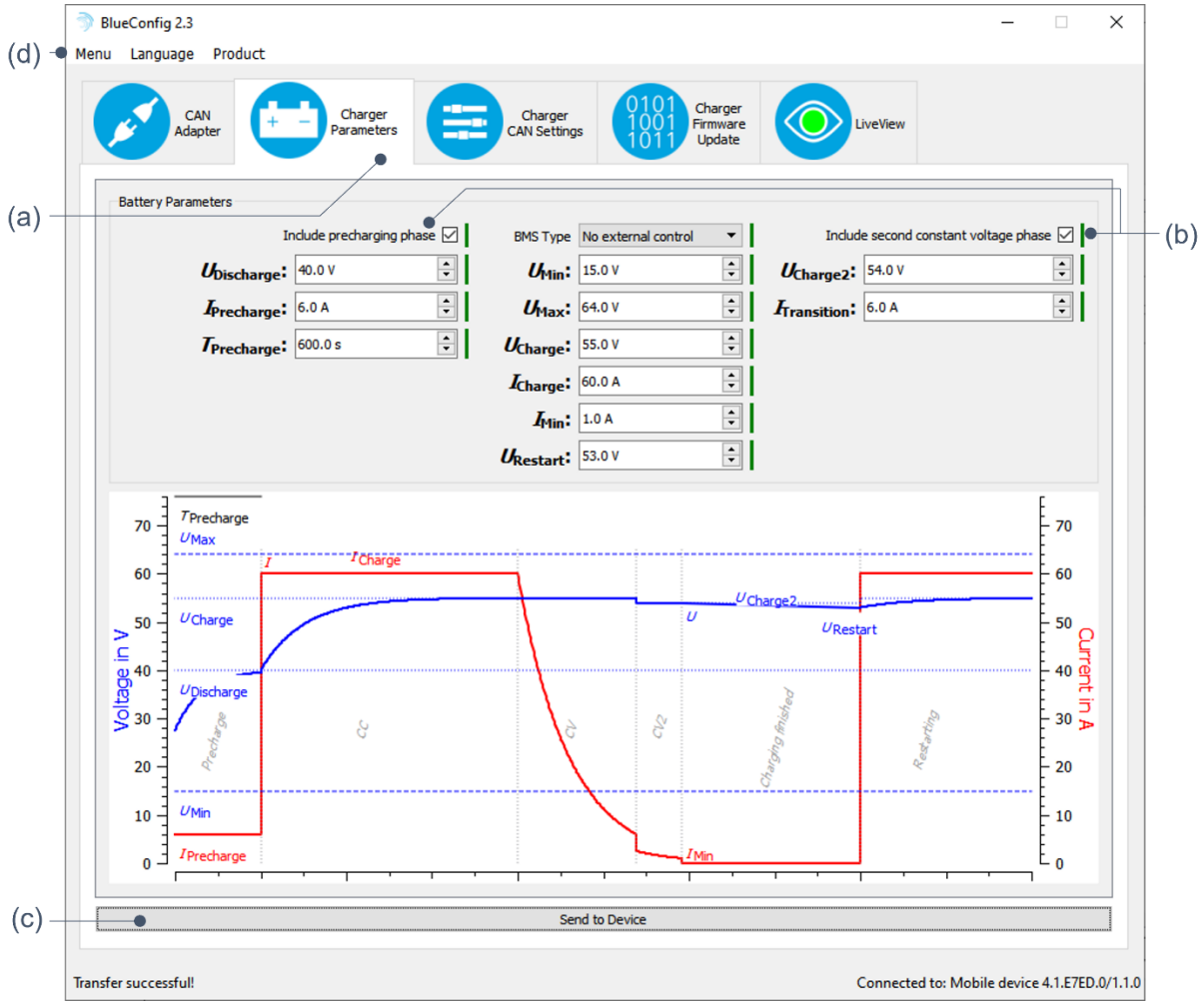


Figure 11: Charge parameter configuration of the charger.

1. Open the “Battery Parameters” tab **(a)**.
2. If you choose so, activate the optional charging phases **(b)**, and enter all the battery parameters carefully.

   ↳ Entering invalid values changes the background colour of the affected parameters to red. Check that you have entered the yellow highlighted values correctly. To the left of the input field is a marker to indicate if a value has been modified. A red mark means that the value differs from the parameter in the charger.

3. Click "Send to Device" **(c)**. This option is available only when you have made a successful connection to the mobile electronics and you have performed step 2.

   ↳ Transfer was successful when "Transfer Successful" appears on the bottom left. If the transfer was not successful, make sure that the connection to the mobile electronics is still active and there is no charging.

4. You may also click the option "Menu → Save Config File" **(d)** to save the configuration you have entered, and "Menu → Load Config File" **(d)** to reopen the saved file later.

2.4.3 Automatic Mode – etaSTORE Type B Extra Parameters

Automatic mode charging represents the default for the etaLINK charger if employed in combination with etaSTORE batteries. Advanced settings become available once the BMS type, as configurable via BlueConfig, is changed from "Generic" to "etaSTORE Type B" (see below). This setting should be used to statically limit the maximum charging current (via I_{Charge}) and or configure the non-default battery CAN IDs.

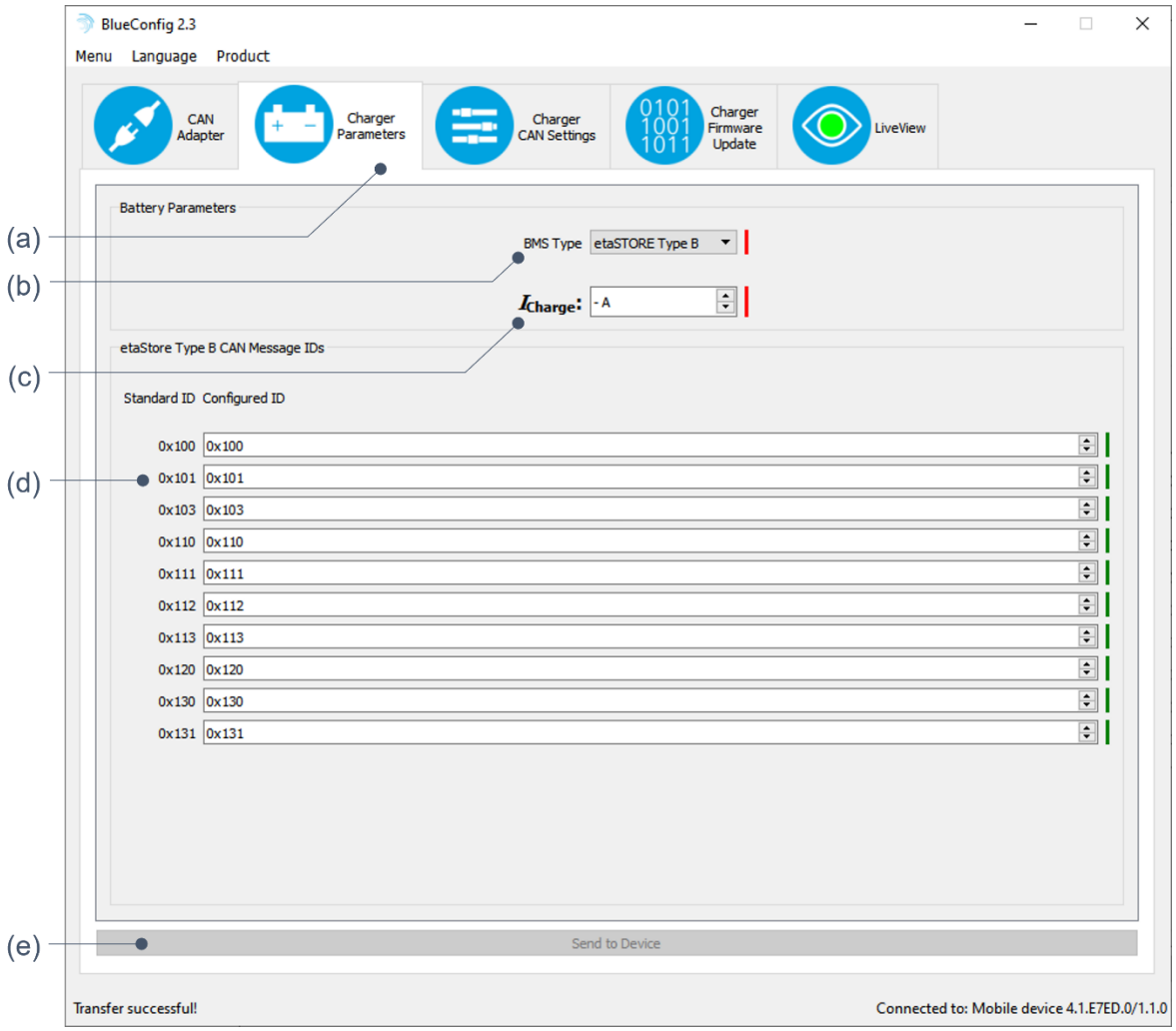


Figure 12: Configuration for automatic mode charging as available for etaSTORE batteries.

NOTE

- Automatic mode is only available for Wiferion's etaSTORE batteries.
- The CAN message IDs of the etaSTORE battery system must match with the corresponding IDs of the charger as configurable in BlueConfig (see Figure 12 **(d)**).
- BlueConfig only changes the corresponding receive CAN IDs, it does not modify the CAN ID settings of the battery.

1. Open the "Battery Parameters" tab **(a)**.
2. Choose "etaSTORE Type B" as the BMS type **(b)**.
   ↳ A warning appears reminding you that CAN message settings may have to be (re)configured (see Section 2.5).
3. To statically limit the I_{Charge} set the desired maximum value in **(c)**. For dynamic limiting of I_{Charge}, please refer to Section 1.2.3.
4. In case non-standard CAN message IDs have been assigned to the etaSTORE battery system, these IDs must be communicated to the charger accordingly **(d)**.
5. Click "Send to Device" **(e)**. This option is available only when you have made a successful connection to the mobile electronics and you have performed step 2.
   ↳ Transfer was successful when "Transfer successful" appears on the bottom left. If the transfer was not successful, make sure that the connection to the mobile electronics is still active and there is no charging in progress.

2.5 Advanced CAN Settings

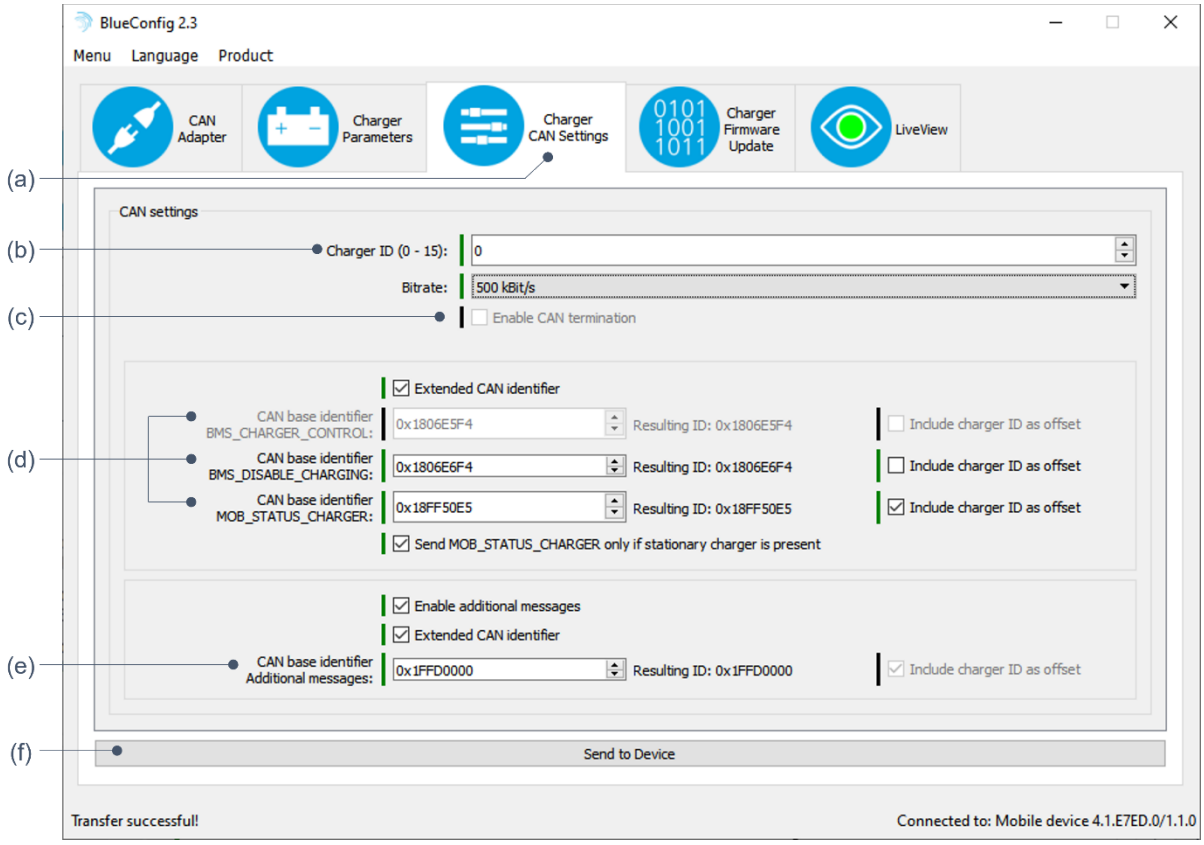


Figure 13: CAN settings

1. If an external device should control the charger, make sure that you first perform the steps listed in Section 2.4.1.
2. Open the tab “Advanced Settings” **(a)**.
3. Select a charging Charger ID **(b)** (for more information also see Section 4.2.1).
4. Optional CAN settings:
    a. For second generation mobile electronics, the CAN bus termination is configurable via checkbox **(c)** (please also see Section 3.2 for details).
    b. The corresponding checkboxes can be unchecked in case non-standard CAN IDs are required.
    c. The input fields **(d)** and **(e)** allow to set custom CAN base IDs, in case other than Wiferion’s default IDs (see Table 11, Table 12, Table 13 and Table 16) are required. The available additional message IDs **(e)** will then automatically be incremented from the actual specified root ID.
5. Click “Send to Device” **(f)**.
    ↳ A successful transfer is signalled by a message on the bottom left.
    ↳ The device is rebooted for the new CAN settings to take effect.
6. If the transfer failed, make sure that the connection is OK and the electronics are not charging.

2.6 Charger Firmware Update

If important changes become available for the software, you will be provided with an update package consisting of one or more of the following files:

- SWxxxxxx_STAT_vX.Y – firmware for the stationary electronics
- SWyyyyyy_MOB_vX.Y – firmware for the mobile electronics
- SWzzzzzz_BOOT_vX.Y – bootloader for both electronics

NOTE

If a new bootloader version is included in the update package it is recommended to update the bootloader first.

2.6.1 Update Preparations

Before updating the firmware, you must first take the following precautions:

1. Prevent charging by ensuring that the stationary and mobile coils are far apart.
2. Disconnect the electronics from the CAN bus and connect the CAN adapter directly to the electronics.
3. Do not disconnect the CAN adapter during the update.
4. Do not switch OFF the electronics or the PC during the update.
5. Install the newest BlueConfig version which should be included in the update package.
6. Backup the devices configuration to a file using BlueConfig (see Section 2.4.2 point 4).

2.6.2 Updating the Bootloader

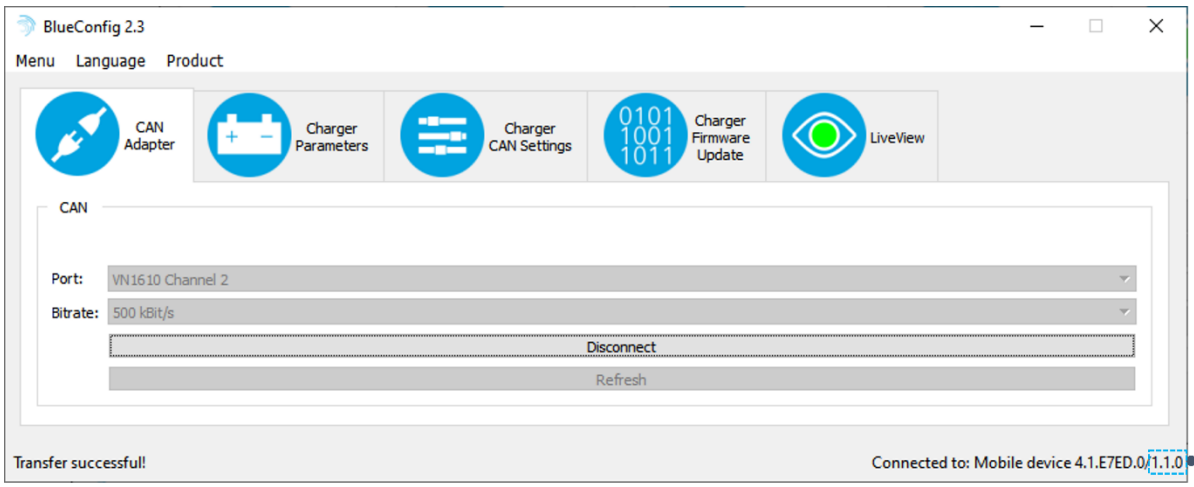


Figure 14: Checking bootloader version

1. Start BlueConfig.
2. Connect to the electronics by choosing your CAN adapter and clicking on “Connect”.
   ↳ The version of the currently installed bootloader is **(a1)**.

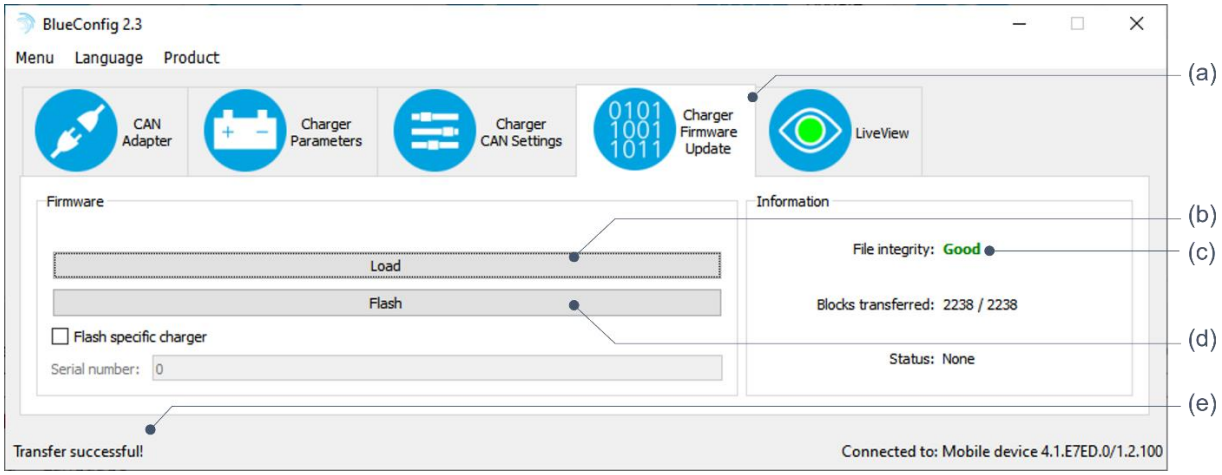


Figure 15: Updating bootloader

3. Open the tab “Charger Firmware Update” **(a)**.
4. Click “Load” and select “SWzzzzzz_BOOT_vX.Y.blu” **(b)**.
5. Make sure that the data integrity is correct **(c)**. If not, download the firmware again, or contact Wiferion.
6. Click “Flash” **(d)** and wait until the flashing process has ended.
   ↳ Successful flashing causes a corresponding message to appear on the bottom left **(e)**.
7. It may be necessary to restart the device after a bootloader update. If you are not able to reconnect again, please restart the device.

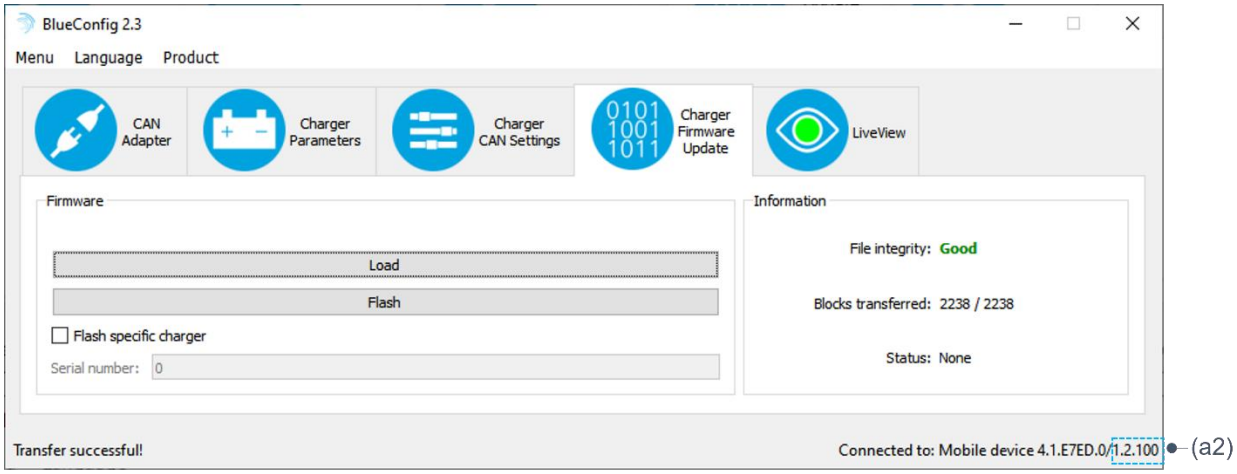


Figure 16: Checking bootloader version after update

8. Connect to the device again after updating.
9. Verify that the bootloader has been updated successfully **(a2)**.

2.6.3 Updating the Firmware

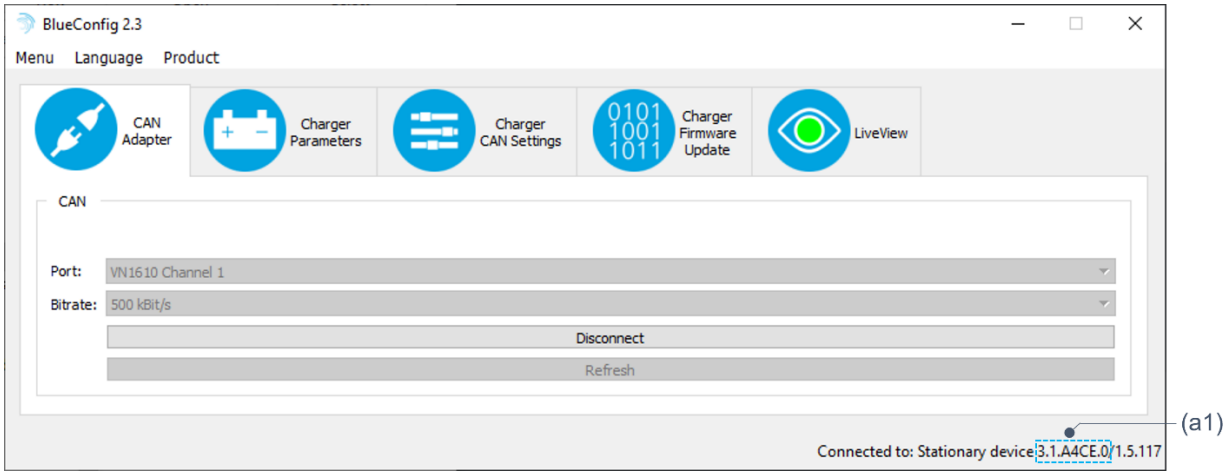


Figure 17: Checking firmware version

1. Start BlueConfig.
2. Connect to the electronics by choosing your CAN adapter and clicking on “Connect”.
3. Confirm that the currently installed firmware version is below the newly provided firmware **(a1)**.

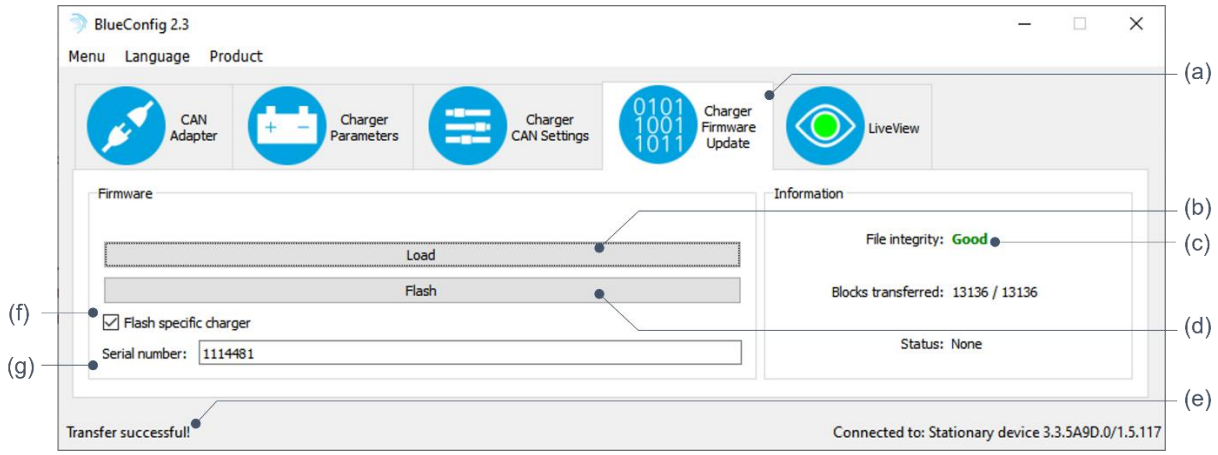


Figure 18: Updating firmware

4. Open the tab “Charger Firmware Update” **(a)**.
5. Click “Load” and select “SWxxxxxx_STAT_vX.Y.blu” or “SWyyyyyy_MOB_vX.Y.blu” depending on which device you want to update **(b)**. It is not possible to flash the wrong file accidentally.
6. Make sure that the data integrity is correct **(c)**. If not, download the firmware again, or contact Wiferion.
7. Click “Flash” **(d)** and wait until the flashing process has ended.
   ↳ Successful flashing causes a corresponding message to appear on the bottom left **(e)**.
8. In case multiple chargers are connected to the same CAN bus, updating a single device is possible by selecting check mark **(f)** and providing the corresponding serial number **(g)** (requires BlueConfig version 2.3 or higher).
9. Restart the device.

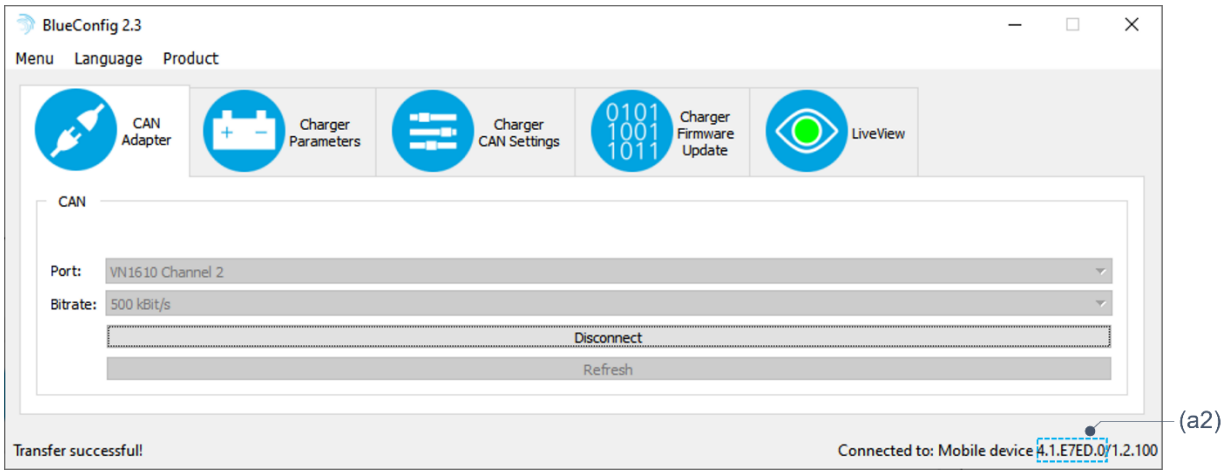


Figure 19: Checking firmware version after update

10. Connect to the device again after updating.
11. Verify that the firmware has been updated successfully **(a2)**.

2.6.4 LiveView – System-Monitoring and Logging

As of version 2.2, BlueConfig offers the LiveView feature, providing a concise overview of the most important parameters of Wiferion´s charging system including the possibility to log CAN messages. As presented in Figure 20, the feature is structured with tabs **(a)** "Overview", **(b)** "Errors" and **(c)** "Logging Filter". The CAN log includes all the messages from devices connected to the mobile electronics. CAN message logging can be started from all tabs (Figure 20, **(a)-(c)**), the log data will be saved in ASCII format.

- **Overview** – Allows for live monitoring of the most relevant charger and battery parameters. When using Wiferion's etaSTORE Type B battery system, battery parameters such as state-of-charge (SOC), module voltages and currents will be presented.
- **Errors** – Presents an updated list of error messages (set and cleared) sorted by their occurrence.
- **Logging Filter** – Allows excluding specific CAN IDs from the CAN log to be recorded.

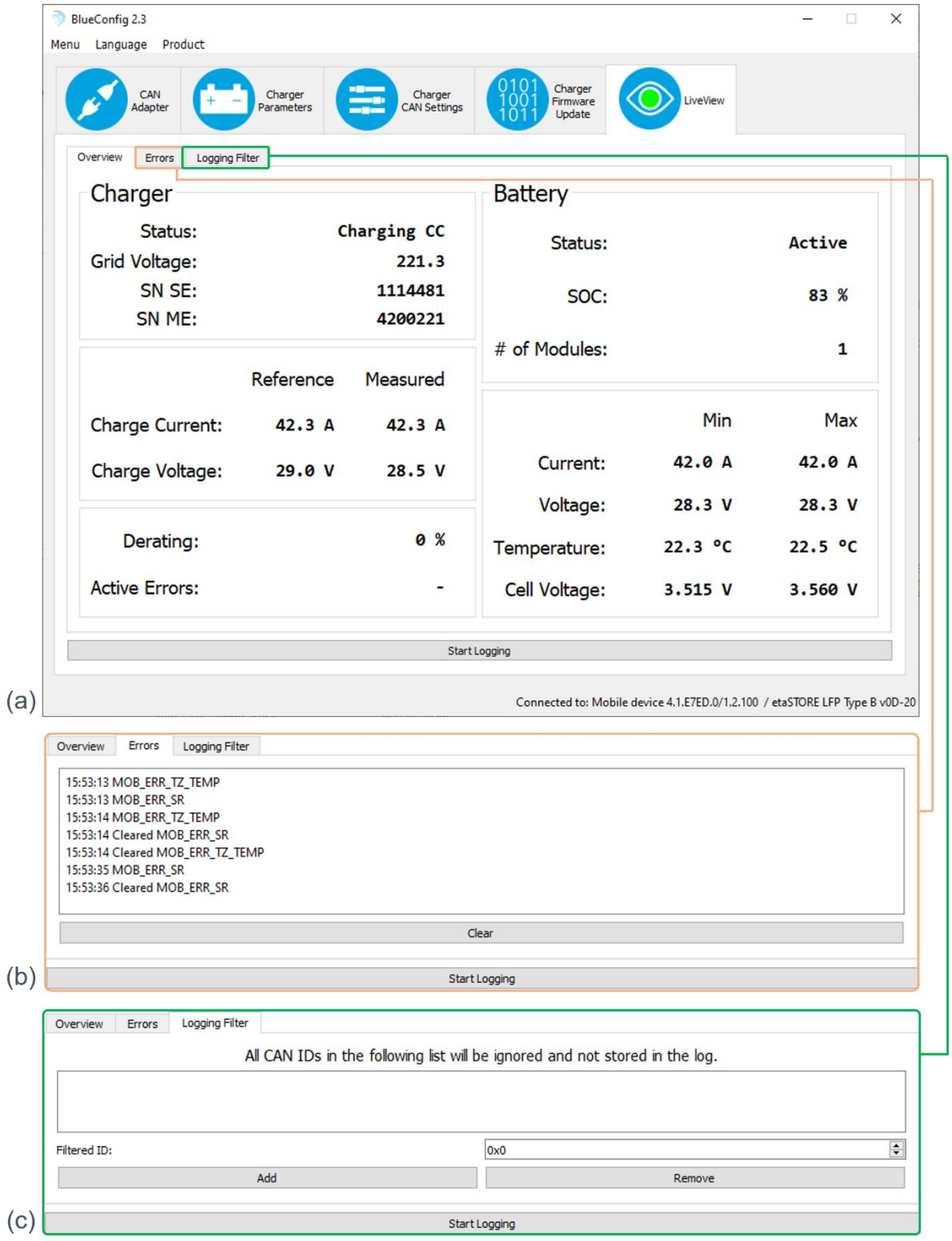


Figure 20: The LiveView panel is structured into three sub-functions: Overview, Errors and Logging Filter. For the above example in (a), an etaSTORE Type B battery is being charged (status = Charging CC) with a current of ca. 42 A. The state of charger (SOC) is reported as 83 %.

3 CAN Bus Hardware

The PC is connected to the electronics via the CAN interface. This requires a CAN-USB adapter.

3.1 CAN Pinout

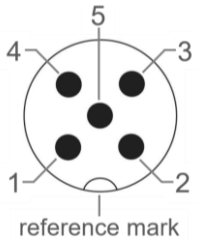


Figure 21: Pinout of the 5 pin M12 male connectors on the mobile and stationary electronics

Table 9: CAN M12 pinout – complies with CAN open CiA 303-1

PIN	Signal	Description
1	NOT CONNECTED	Optional CAN shield – may be connected externally to cable shield
2	RESERVED – do not use	
3	CAN_GND	Ground / 0 V
4	CAN_H	CAN_H bus line (dominant high)
5	CAN_L	CAN_L bus line (dominant low)

3.2 CAN Bus Termination

NOTE

The CAN bus in all components is galvanically isolated. Please refer to Table 10 for the termination details. For mobile electronics generation 2 (ME G2) devices the CAN bus termination is only configurable via BlueConfig when powered. Note, that ME G2 devices therefore require a connected external CAN terminator for SW updates.

Table 10: Possible configurations of the CAN bus termination. (SE) stationary electronics.

Device	Serial Number	Configurable	Notes
SE	0111XXXX	No	Permanently terminated with 120 Ω resistor (except model number SE03323121CA007)
ME G1	0411XXXX	No	Permanently terminated with 120 Ω resistor
ME G2	0420XXXX	Yes	Not terminated when not powered & during software initilisation phase. If powered, configurable via BlueConfig (Section 2.5, pt. 4).

4 CAN Bus Protocol

4.1 Bus Specifications

- Version: CAN 2.0b
- Sample point: 83%
- All messages use extended 29-bit identifiers - configurable.
- Standard bit rate: 500 kbit/s - configurable

4.2 Bus Protocol

- The parameters are in Motorola format (big-endian, high byte first).
- All messages are 8 bytes long (DLC = 8).

4.2.1 Mobile Electronics

The mobile electronics features a CAN interface that, depending on the configuration, is essential for the charging system's operations. If an external device is to control the charging system in live mode (see Section 2.4.1) the charging parameters must be communicated to the device via CAN. In this case, it is necessary that the CAN settings are checked on the mobile electronics and, if necessary, edited.

NOTE

If more than one mobile electronics module is connected to the same CAN bus, it is important that each unit is assigned its own Charger ID. The "XX" in the following message descriptions corresponds to the Charger ID that can be set using BlueConfig. Refer to Section 2.5 on how to set the Charger ID.

When the mobile electronics is configured to be controlled in live mode (e.g., by a BMS, PLC, Embedded PC) the CAN message "BMS_CHARGER_CONTROL" must be sent at 1 s intervals. This message contains the charging parameters (see Table 13). Table 11 presents an overview of the available CAN messages of the mobile electronics.

NOTE

- The CAN message BMS_CHARGER_CONTROL must be received by the charger in live mode.
- The optional CAN message BMS_DISABLE_CHARGING can be used to prevent charging.
- All other messages are transmitted by the mobile electronics.

Table 11: Overview of the CAN messages on the mobile electronics.

Message ID	Message Name	Description	Transmit / Receive Period
0x18FF50E5+XX	MOB_STATUS_CHARGER	Summary ME charging status	TX 1 s*
0x1806E5F4+XX	BMS_CHARGER_CONTROL	Charging reference parameters	RX 1 s
0x1806E6F4+XX	BMS_DISABLE_CHARGING	Disable charging	RX 1 s
0x1FFDXX00	Reserved		
0x1FFDXX01	MOB_SN	Serial number and HW version ME	TX 1 s
0x1FFDXX02	MOB_TEMP	Temperatures	TX 1 s
0x1FFDXX03	MOB_TEMP_2	Temperatures	TX 1 s
0x1FFDXX04	MOB_ERROR	Error bits	TX 0.1 s
0x1FFDXX05	Reserved		
0x1FFDXX06	MOB_STAT_SN	Serial number and HW version of connected SE	TX 1 s
0x1FFDXX07	MOB_SW	SW version of ME	TX 1 s
0x1FFDXX08	Reserved		
0x1FFDXX09	MOB_CONFIG	Configuration of ME	TX 1 s
0x1FFDXX0A	Reserved		
0x1FFDXX0B			
0x1FFDXX0C			
0x1FFDXX0F			
0x1FFDXX10	MOB_STAT_STATUS	Status of connected SE	TX 1 s**
0x1FFDXX11	MOB_STAT_SW	SW version of connected SE	TX 1 s**
0x1FFDXX13	MOB_STAT_TEMP	Temperatures of connected SE	TX 1 s**
0x1FFDXX14	MOB_STAT_TEMP_2	Temperatures of connected SE	TX 1 s**
0x1FFDXX15	Reserved		

*Will only be transmitted when a SE is present. This behaviour can be reconfigured in BlueConfig.
**Will only be transmitted when a SE is present with a minimum firmware version of 2.0.

The CAN message MOB_STATUS_CHARGER contains a summary of all relevant parameters regarding the charger (see Table 12). This message is sent by the mobile electronics when the communication with the stationary electronics is valid. It can be reconfigured in BlueConfig in order to send this message independent of the stationary electronics (see Section 2.5).

NOTE

The following CAN ID range is reserved for the operation of the charging system:
0x1FFC0000 – 0x1FFFFFFF

Table 12: MOB_STATUS_CHARGER – Summary charger status

0x18FF50E5 +XX	Bit	Signal	Info
Byte 0	0-7	Output_Voltage (high byte)	Gain: 0.1 V, offset: 0, signed Example: 456 = 45.6 V
Byte 1	0-7	Output_Voltage (low byte)	
Byte 2	0-7	Output_Current (high byte)	Gain: 0.1 A, offset: 0, signed Example: 321 = 32.1 A
Byte 3	0-7	Output_Current (low byte)	
Byte 4-6	0-7	Reserved	
Byte 7	0-3	MOB_CHARGER_STATE	Charger state 0: Idle 1: Charging 2: Charging constant current 3: Charging constant voltage 4: Charging pre-charge 5: Charging second constant voltage 6: Battery full 7: Stopped 8: Error
	4-7	Reserved	

The CAN message BMS_CHARGER_CONTROL controls the charger (see Table 13).

Table 13: BMS_CHARGER_CONTROL - Charging parameters

0x1806E5F4 +XX	Parameter	Info
Byte 0	Maximum battery voltage (high byte)	Gain: 0.1 V, offset: 0, signed Example: 552 = 55.2 V
Byte 1	Maximum battery voltage (low byte)	
Byte 2	Reference current (high byte)	Gain: 0.1 A, offset: 0, signed Example: 601 = 60.1 A
Byte 3	Reference current (low byte)	
Byte 4	Reference voltage (high byte)	Gain: 0.1 V, offset: 0, signed **If set to a non-zero value, the CV phase will be performed by the charger (see Section 1.2.1).**
Byte 5	Reference voltage (low byte)	
Byte 6	Reserved (send all zeros)	
Byte 7		

- Example CAN message: **External device** controls CC and CV phases

Table 14: Example BMS_CHARGER_CONTROL CAN bus message, for the case in which an external device takes over the CC and CV control. Note, the corresponding gain/scaling factors that apply for this message.

BMS_CHARGER_CONTROL								
CAN message ID	MAX_VOLTAGE 580 = 58 V / 0.1		CHARGE_CURRENT 600 = 60 A / 0.1		CHARGE_VOLTAGE 0 = 0 / 0.1 V		RESERVED 0	
0x1806E5F4+XX	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	02	44	02	58	00	00	00	00

- Example CAN message: **etaLINK charger** performs CV phase

Table 15: Example BMS_CHARGER_CONTROL CAN bus message, for which the etaLINK charger performs the CV phase. Note, the corresponding gain/scaling factors that apply for this message.

BMS_CHARGER_CONTROL								
CAN message ID	MAX_VOLTAGE 580 = 58 V / 0.1		CHARGE_CURRENT 600 = 60 A / 0.1		CHARGE_VOLTAGE 480 = 48 V / 0.1		RESERVED 0	
0x1806E5F4+XX	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	02	44	02	58	01	E0	00	00

If the message BMS_DISABLE_CHARGING is received and contains the value 0xAA in the first byte, charging is stopped and the signal "Charger state" in MOB_STATUS_CHARGER changes to "Stopped" (see Table 16 for details). Any other value is ignored by the charger. Charging is re-enabled if a value other than 0xAA is received or the message is not received for more than 3 seconds.

Table 16: BMS_DISABLE_CHARGING – Disable the charging process

0x1806E6F4 +XX	Parameter	Info
Byte 0	Signature	Send 0xAA to disable charging
Byte 1-7	Reserved	Send all zeros

- Example CAN message to **disable charging**

Table 17: Example CAN message to disable the charging process.

BMS_DISABLE_CHARGING								
CAN message ID	BMS_DISABLE _CHARGING 170	RESERVED 0						
0x1806E6F4+XX	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	AA	00	00	00	00	00	00	00

The three messages "MOB_STATUS_CHARGER", "BMS_CHARGER_CONTROL" and "BMS_DISABLE_CHARGING" can be edited using BlueConfig. Extended identifiers are used by default with the IDs listed above. These, however, can be configured by the user within a reserved range. Moreover, the Charger ID may be added as an offset to the CAN message ID. Refer to Section 2.5 on how to configure these messages.

If more information is desired the following messages are also available on the bus. These messages are sent continuously regardless of charger status. The placeholder XX in the message IDs represent the corresponding Charger ID.

Table 18: MOB_SN

0x1FFDXX01	Parameter	Info
Byte 0	Serial number (high)	32-bit serial number as shown on the identification label
Byte 1	Serial number (high)	
Byte 2	Serial number (low)	
Byte 3	Serial number (low)	
Byte 4-7	Reserved	

Table 19: MOB_TEMP

0x1FFDXX02	Parameter	Derating limits	Info
Byte 0-4	Reserved		
Byte 5	Heatsink temperature	70 °C to 75 °C (ME Gen. 2)	Temperature in °C Gain: 0.75, offset -40, unsigned, Min: -40 °C, Max: 150 °C Example: 86 = 24.5 °C 0xFF = Invalid value
Byte 6-7	Reserved		

Table 20: MOB_TEMP_2

0x1FFDXX03	Parameter	Derating limits	Info
Byte 0	Reserved		
Byte 1	Mobile coil temperature	85 °C to 95 °C	Temperature in °C Gain: 0.75, offset -40, unsigned, Max: 150 °C Example: 86 = 24.5 °C 0xFF = Invalid value
Byte 2	Reserved		
Byte 3	Temperature at HF1 terminal of ME	80 °C to 85 °C and 15 K < ΔT < 20 K with ΔT being the difference (T_{max} - T_{min}) between the max. and min. temperature measured at terminals HF1, HF2, Batt (+) and Batt (-)	Temperature in °C Gain: 0.75, offset -40, unsigned, Min: -40, Max: 150 °C Example: 86 = 24.5 °C 0xFF = Invalid value
Byte 4	Temperature at HF2 terminal of ME		
Byte 5	Temperature at Battery (+) terminal of ME		
Byte 6	Temperature at Battery (-) terminal of ME		
Byte 7	Reserved		

Table 21: MOB_ERROR – Error and warning bits.

0x1FFD XX04	Bit	Signal	Info
Byte 0	0-7	Reserved	
Byte 1	0-2	Reserved	
	3	MOB_ERR_TEMP_E	Charging disabled due to overtemperature
	4-7	Reserved	
Byte 2	0	MOB_ERR_COMMS_TIMEOUT	Invalid communication with SE
	1	MOB_ERR_COMMS_CRC	
	2-4	Reserved	
	5	MOB_ERR_BATT_TEMP	Battery temperature out of limits
	6	MOB_ERR_SW_MAXTIME_PRECHARGE	Time exceeded during the optional pre-charge phase (see Table 5).
	7	MOB_ERR_BATT_E	Voltage and/or temperature errors reported by the BMS
Byte 3	0	MOB_ERR_CAN_TIMEOUT	Required CAN msg. not received in less than 3x msg. periods
	1-7	Reserved	
Byte 4	0-7	Reserved	
Byte 5	0	MOB_STAT_ERR_U_GRID_E	SE grid error
	1-7	Reserved	
Byte 6	0	MOB_STAT_ERR_COIL	Coil not connected to SE
	1-2	Reserved	
	3	MOB_STAT_ERR_TEMP_E	SE overtemperature
	4-5	Reserved	
	6	MOB_STAT_ERR_BADPOSITIONING	No charging due to bad coil positioning (too far)
	7	Reserved	
Byte 7	0	MOB_WARN_FAN_E	Fan RPM < 3000 RPM
	1	MOB_WARN_DERATING_TEMP_E	Delivered current limited due to temperature derating
	2	MOB_WARN_DERATING_BATT	Charge current limited due to temperature derating
	3	MOB_STAT_WARN_POSITION_E	Battery current is limited due to poor positioning (too close)
	4	MOB_WARN_CAN_DISABLE_CHARGING	Charging disabled via CAN
	5	MOB_STAT_WARN_DERATING_U_GRID	Power derating due to grid voltage
	6	MOB_STAT_WARN_DERATING_P_GRID	Derating due to max. power
	7	MOB_STAT_WARN_DERATING_TEMP_E	SE temperature derating

NOTE

If no communication with the stationary electronics is in progress (i.e., mobile electronics not in charging position) the mobile electronics will report an IrDA timeout error (byte 2, bit 0).

Table 22: MOB_STAT_SN

0x1FFDXX06	Parameter	Info
Byte 0	Serial number (high)	32-bit serial number of the current stationary electronics
Byte 1	Serial number (high)	
Byte 2	Serial number (low)	
Byte 3	Serial number (low)	
Byte 4-7	Reserved	

Note: This data is only valid when communication with the stationary electronics is valid

Table 23: MOB_SW – Software version of the mobile electronics

0x1FFDXX07	Parameter	Info
Byte 0	Revision number (high byte)	Revision number (C)
Byte 1	Revision number (low byte)	
Byte 2	Bit 0–3: Minor version	Minor version (B)
	Bit 4–7: Major version	Major version (A)
Byte 3-7	Reserved	

Note: The software version read by BlueConfig is in the format "A.B.C.D.", with D being reserved for internal use.

Table 24: MOB_CONFIG

0x1FFDXX09	Parameter	Info
Byte 0	Reference charge current (high byte)	Gain: 0.02 A, offset 0, unsigned Example: 3123 = 62.46 A
Byte 1	Bit 4–7: Reference charge current (low nibble)	
	Bit 0–3: Reference charge voltage (high nibble)	Gain: 0.02 V, offset 0, unsigned Example: 2575 = 51.5 V
Byte 2	Reference charge voltage (low byte)	
Byte 3	BMS Type	0x0: None 0x1: Generic 0x2: SCiB 0x3: Reserved 0x4: etaSTORE Type B 0xFF: Unknown
Byte 4-7	Reserved	

Table 25: MOB_STAT_STATUS

0x1FFDXX10	Parameter	Info
Byte 0-5	Reserved	
Byte 6	Grid RMS voltage (high byte)	Gain: 0.01 V, offset 0, unsigned Example 23123 = 231.23 V
Byte 7	Grid RMS voltage (low byte)	

Table 26: MOB_STAT_SW – Software version of the stationary electronics

0x1FFDXX11	Parameter	Info
Byte 0	Revision number high byte	Revision number (C)
Byte 1	Revision number low byte	
Byte 2	Bit 0–3: Minor version	Minor version (B)
	Bit 4–7: Major version	Major version (A)
Byte 3-7	Reserved	

Note: The software version read by BlueConfig is in the format "A.B.C.D", with D being reserved for internal use.

Table 27: MOB_STAT_TEMP

0x1FFDXX13	Parameter	Derating limits	Info
Byte 0-5	Reserved		
Byte 6	Heatsink temperature	Derating from 55 °C to 65 °C	Temperature in °C Gain: 0.75, offset -40, unsigned, Min: -40 °C, Max: 150 °C 0xFF = Invalid value Example 86 = 24.5 °C
Byte 7	Reserved		

Table 28: MOB_STAT_TEMP_2

0x1FFDXX14	Parameter	Derating limits	Info
Byte 0	Stationary coil temperature	Derating from 85 °C to 95 °C	Temperature in °C Gain: 0.75, offset -40, unsigned, Min: -40 °C, Max: 150 °C 0xFF = Invalid value Example 86 = 24.5 °C
Byte 1–7	Reserved		

4.2.2 Stationary Electronics

The Stationary electronics features a CAN interface which provides information on the operation of the charging system. This section documents the available CAN messages.

NOTE

If more than one stationary electronics are connected to the same CAN bus, it is important that each unit is assigned its own Charger ID. This is performed automatically with SE firmware version 3.0 and above. The "XX" in the following message descriptions corresponds to the Charger ID that can be set using BlueConfig. Refer to Section 2.5 on how to set the Charger ID.

Table 29: Overview of the CAN messages on the stationary electronics.

Message ID	Message Name	Description	Transmit / Receive Period
0x1FFEXX00	STAT_STATUS	Summary of stationary charging electronics status	TX 0.5 s
0x1FFEXX01	STAT_STATUS_2	Provides RMS grid voltage	TX 0.5 s
0x1FFEXX02	STAT_TEMP	Heatsink temperature SE	TX 1 s
0x1FFEXX03	STAT_SW	Software version of stationary electronics	TX 1 s
0x1FFEXX04	STAT_ERROR	Error bits	TX 0.1 s
0x1FFEXX05	Reserved		
0x1FFEXX06	STAT_MOB_STATUS	Summary of mobile charging electronics status	TX 0.1s
0x1FFEXX07	STAT_MOB_SW	Software version of mobile electronics	TX 1 s
0x1FFEXX08	STAT_MOB_TEMP1	Heatsink temperature ME	TX 1 s
0x1FFEXX09	Reserved		
0x1FFEXX0A			
0x1FFEXX0B			
0x1FFEXX0C			
0x1FFEXX0D			
0x1FFEXX0E			
0x1FFEXX0F	STAT_AC_LIMITING	Configuration for AC limiting feature	TX 1 s

Table 30: STAT_STATUS

0x1FFEXX00	Parameter	Info
Byte 0	State	0x0: Idle 0x1-0x7: Running 0x8: Error
Byte 1	Stationary electronics total derating	Gain: 0.5 %, offset 0, unsigned Example 79 = 39.5 % 0 % = Not derated 100 % = completely derated, charge current = 0 A
Byte 2-7	Reserved	

Table 31: STAT_STATUS_2

0x1FFEXX01	Parameter	Info
Byte 0-5	Reserved	
Byte 6	Grid RMS voltage high byte	Gain: 0.005 V, offset 0, unsigned Example 46464 = 232.32 V
Byte 7	Grid RMS voltage low byte	

Table 32: STAT_TEMP

0x1FFEXX02	Bit	Parameter	Info
Byte 0-5	0-7	Reserved	
Byte 6	0-7	Heatsink temperature SE	Temperature in °C Gain: 0.5, offset -20, unsigned Min: -20 °C, Max: 107 °C 0xFF = Invalid value Example 86 = 23 °C
Byte 7	0-7	Reserved	

Table 33: STAT_SW

0x1FFEXX03	Bit	Parameter	Info
Byte 0-6	0-7	Reserved	
Byte 7	0-3	Software SE minor version	Minor version (B)
	4-7	Software SE major version	Major version (A)

Table 34: STAT_ERROR – Error and warning bits.

0x1FFDXX04	Bit	Signal	Info
Byte 0	0-4	Reserved	
	5	STAT_ERR_U_GRID	Grid error
	6	Reserved	
	7	STAT_ERR_TEMP	Overtemperature
Byte 1	0	STAT_ERR_COMMS_TIMEOUT	IrDA communication timeout error
	1	STAT_ERR_COMMS_CRC	IrDA communication CRC error
	2	Reserved	
	4	STAT_ERR_ID_ALLOCATION	Charger ID conflict or no IDs left
	5	STAT_ERR_AC_LIMITING_CONFIG	AC limiting configuration error
	6-7	Reserved	
Byte 2	0-3	Reserved	
	4	STAT_ERR_COIL	Coil error, Coil not connected on stationary electronics
	5	STAT_ERR_BADPOSITIONING	Bad positioning error, no charging possible due to bad coil positioning (too far)
	6-7	Reserved	
Byte 3	0-7	Reserved	
Byte 4	0	Reserved	
	1	STAT_ERR_COMMS_S2P_I_BATT	Battery overcurrent ME
	2	STAT_ERR_COMMS_S2P_U_BATT	Battery overvoltage ME
	3	STAT_ERR_COMMS_S2P_U_ZK	

0x1FFDXX04	Bit	Signal	Info
	4	STAT_ERR_COMMS_S2P_TEMP	Overtemperature ME
	5	Reserved	
	6	STAT_ERR_COMMS_S2P_COMMS_TIMEOUT	IrDA communication, Timeout
	7	STAT_COMMS_S2P_BAD_ACK	IrDA communication, Bad acknowledge
Byte 5	0-1	Reserved	
	2	STAT_ERR_COMMS_S2P_CAN_ERR	CAN error ME
	3-7	Reserved	
Byte 6	0-7	Reserved	
Byte 7	0	STAT_WARN_APPARENT_POWER	Battery current derating, non-ideal working point rectification
	1	STAT_WARN_AC_LIMITING_BUS_ERR	CAN bus error between AC limiting SEs
	2	Reserved	
	3	STAT_WARN_BAD_POSITION	Subpar charging due to bad coil positioning
	4-7	Reserved	

Table 35: STAT_MOB_STATUS – Summary charger status

0x1FFEXX06	Bit	Parameter	Info
Byte 0	0-7	Reference charge current high byte	Gain: 0.02 A, offset: 0, unsigned Example: 2925 = 58.5 A
Byte 1	4-7	Reference charge current low nibble	
	0-3	Reference charge voltage high nibble	Gain: 0.02 V, offset: 0, unsigned Example: 2140 = 42.8 V
Byte 2	0-7	Reference charge voltage low byte	
Byte 3	0-1	Reserved	
	2	Mobile fan fault	0: Fan OK 1: Fan fault
	3-7	Reserved	
Byte 4	0-7	Measured charge current high byte	Gain: 0.02 A, offset: 0, unsigned Example: 2925 = 58.5 A
Byte 5	4-7	Measured charge current low nibble	
	0-3	Measured charge voltage high nibble	Gain: 0.02 V, offset: 0, unsigned Example: 2140 = 42.8 V
Byte 6	0-7	Measured charge voltage low byte	
Byte 7	0-7	Derating factor ME	Gain: 0.004, offset: 0, unsigned Example: 125 = 0.5

Table 36: STAT_MOB_SW

0x1FFEXX07	Bit	Parameter	Info
Byte 0-6	0-7	Reserved	
Byte 7	0-3	Software ME minor version	Minor version (B)
	4-7	Software ME major version	Major version (A)

Table 37: STAT_MOB_TEMP1

0x1FFEXX08	Bit	Parameter	Info
Byte 0-4	0-7	Reserved	
Byte 5	0-7	Heatsink temperature ME	Temperature in °C Gain: 0.5, offset -20, unsigned Min: -20 °C, Max: 107 °C 0xFF = Invalid value Example 86 = 23 °C
Byte 6 - 7	0-7	Reserved	

Table 38: STAT_AC_LIMITING

0x1FFEXX0F	Bit	Parameter	Info
Byte 0	0-7	Maximal allowed AC grid current	Gain: 1 A, offset: 0, unsigned Example: 16 = 16 A
Byte 1	0-3	Reserved	
	4-7	Maximal detected number of SEs	N_{max} is incremented once (member) SEs are added to the group; N_{max} is reset after hard reset
Byte 2	0	En-/disable AC grid current limiting	0 = off, 1 = on
	1	Configure SE to share $I_{ac,max}$	Multiple charger form a group, sharing $I_{ac,max}$ (see Section 2.3.1)
	2	Reserved	
	3-7	Number of SEs wanting to charge	N_{charge} (see Section 2.3.1)

5 Troubleshooting

5.1 No Device Connection Using BlueConfig

- **Coil communication –** In order to connect to the mobile or stationary electronics via the software application BlueConfig, the stationary and mobile charging coils must be out of their optical communication range, i.e., the coils must not face each other.
- **Power supply –** Please note, that the stationary and/or mobile electronics must be stably supplied with power (SE: 230 V, grid power; ME: >16 V, 4 W) throughout the entire flashing process. For the mobile electronics, please measure the supply voltage directly at the +/- terminals to test if the required power supply rating is met.
- **CAN bit rate –** Please ensure, that the set CAN bit rate is configured correctly. The default is bit rate is 500 kbit/s.
- **CAN termination –** Please ensure, that the CAN bus connection for both the stationary and mobile electronics are correctly terminated by 120 Ω resistors.

5.2 No Charge Current

- **CAN ID settings –** If the control via an external device is desired (see "live mode" Section 1.2.1, Section 2.4.1) you might need to (re-)configure the CAN ID settings in the "Advanced Settings" tab in BlueConfig (see Section 2.5). Please match the set CAN values with the IDs used by the external device. In case you are charging Wiferion's etaSTORE batteries ("Automatic mode") and configured the charger to BMS type "etaSTORE Type B", please ensure, that the CAN message IDs sent by the battery system match with the IDs as expected by the mobile electronics (see Section 2.4.3).
- **CAN messages –** If in "live mode" (BMS type set to "Generic"), please ensure to send the relevant CAN messages (BMS_CHARGER_CONTROL, Section 4.2.1) with a cycle time of 1 s or shorter. Also, make sure to not send unwillingly the CAN message BMS_DISABLE_CHARGING.

5.3 Delivered Charge Current Less than requested

There are several reasons why the delivered charging current may be lower than the desired charging current:

- **Coil distance –** Stationary and mobile coils are too close to each other. If the coils are too close to each other, the system cannot deliver the full charging current. An LED code (see Table 8) on the stationary electronics will be shown and a warning bit will be set (MOB_ERROR byte 7, bit 3). The minimum distance for full power depends on the coil type (please refer to the corresponding data sheet). Different distances apply for other coil designs. Please refer to the datasheet of each specific coil. If the coils are too far apart, charging may occur for a few seconds before stopping. If the position is not corrected this will repeat with an increasing time between retries up to 10 s between retries. The maximum distance is dependent on the coil design, alignment, and battery voltage. Decreasing the battery voltage increases the tolerance to misalignment.
- **Temperature derating –** Several temperatures at various locations in the system are being monitored during charging. If one of these temperatures reaches its derating limit the system will not deliver the full charging current. The system will derate its output current linearly until it reaches its shutoff temperature. These limits are detailed in the descriptions of the CAN messages in Section 4.2.1 as well as in Section 1.2.3 for the case of an automatically configured system. During derating an LED code (see Table 8) will be shown on the stationary electronics.

The amount of derating in percent is reported via CAN message MOB_TEMP_2 (see Table 20) and the warning "Temperature derating" will be set in the CAN message MOB_ERROR.

- **Power derating –** The output power of the system is limited to approximately 3.3 kW. At high battery voltages (> ca. 55 V) the full 60 A may not be delivered as it will exceed the maximum power limit. As soon as the battery voltage decreases, the full current will be available. Power derating is shown as an LED code (see Table 8) on the stationary electronics. Power derating is also shown in the CAN messages MOB_STATUS byte 7 bit 5 (Grid derating) and MOB_ERROR byte 7 bit 6 (Power derating).
- **Grid voltage derating –** The grid side input current is limited to 16 A. The charger will derate its output if the grid voltage is too low in order to stay within the 16 A limit. As soon as the grid voltage recovers the full power will be available again. Derating due to grid voltage is shown as an LED code (see Table 8) on the stationary electronics. Grid voltage derating is also shown in the CAN messages MOB_STATUS byte 7 bit 5 (Grid derating) and MOB_ERROR byte 7 bit 5 (Grid voltage derating).

5.4 Software Update Failed

- **Power supply –** Please note, that the stationary and/or mobile electronics must be stably supplied with power (SE: 230 V, grid power, ME: >16 V, 4 W) throughout the entire flashing process.
- **Coil communication –** For flashing a new firmware to the mobile or stationary electronics, the stationary and mobile charging coils must be out of their optical communication range, i.e., the coils must not face each other.
- **IrDA connector –** Please ensure, that all the connectors regarding the CAN and IrDA communication are connected stably to all devices.
- **Computing resources –** Depending on the client's hardware specification, the flashing process may demand considerable computing resources. In such cases, please ensure that BlueConfig is the only actively running application during the flashing process.

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