

PC Configuration toolbox

**LIBAL C-BMS CREATOR™**

# LiBAL c-BMS CREATOR™ content



- Physical Connection
- System architecture
- Basic functions in **LiBAL c-BMS CREATOR™**
  - Communication connection
  - Service (Boot loading)
  - Configuration
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    - Charger configuration
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    - Custom data processing (Post Processor)
    - CAN configuration
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    - SOC OCV settings
  - Live view
    - Control , cell and pack temperature data
    - Logging

# Physical Connection

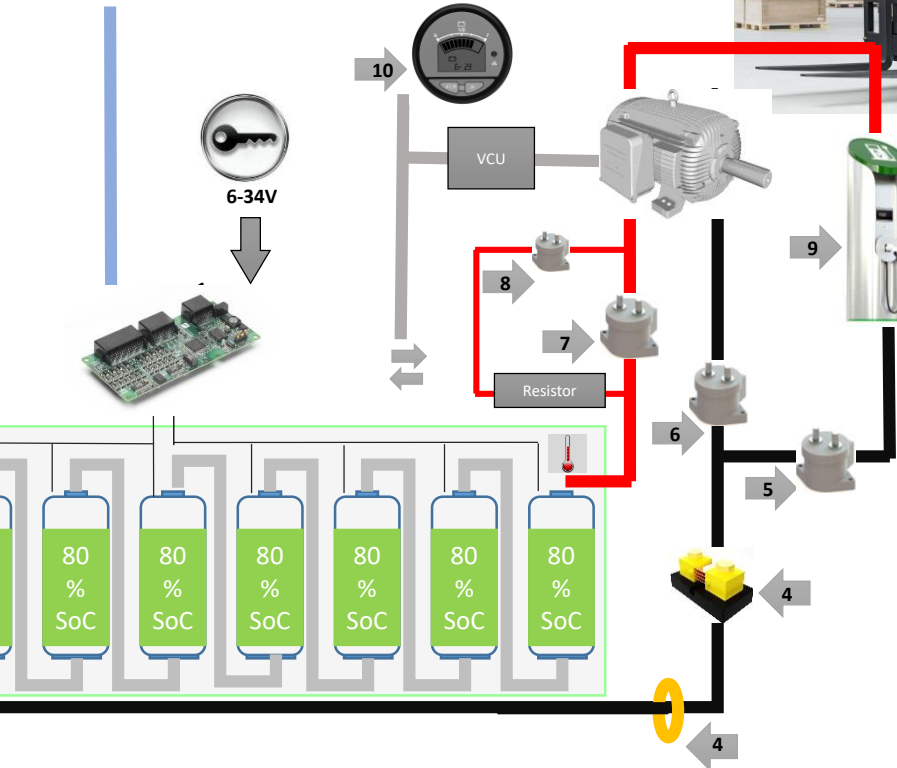
- The c-BMS CREATOR license is supplied as a "Softkey" that contains both licence key and the PC software
- The softkey is locked to a licensed PC.
- Along with the CREATOR license 5 hours of application support is offered free of charge (remote)
- The connection to the PC is done with a PeakCAN adapter:



# System overview

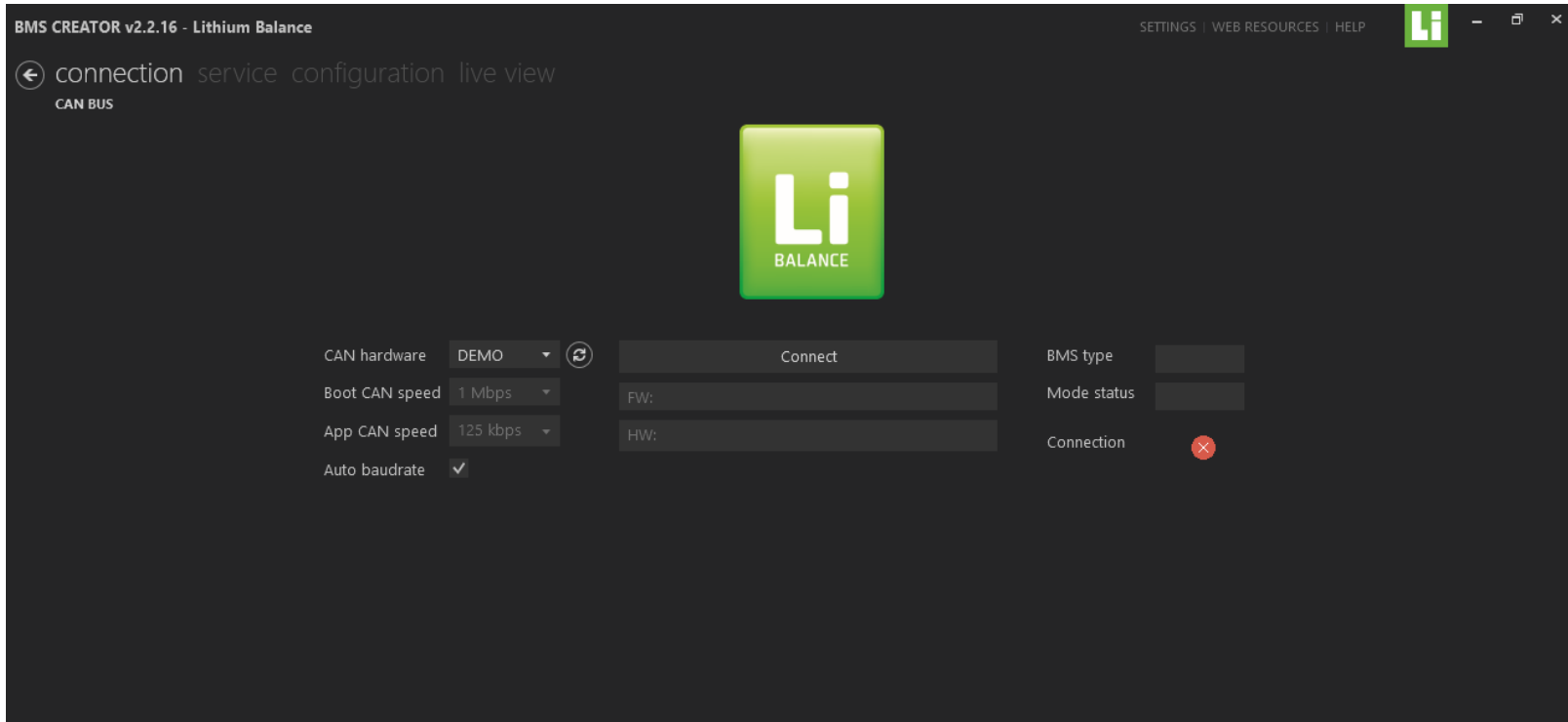


11 BMS Creator™



- 1. C-BMS24
  - 2.
  - 3. BATTERY PACK
  - 4. SHUNT/HAL
  - 5. CHARGE CONTACTOR
  - 6. HV- MAIN CONTACTOR
  - 7. HV+ MAIN CONTACTOR
  - 8. PRE CHARGE CONTACTOR
  - 9. CHARGER (CAN or PWM)
  - 10. CAN DISPLAY
  - 11. DIAGNOSTIC TOOL
- 
- HV +
  - HV -
  - CELL MONITORING
  - TEMPERATURE MONITORING
  - CAN 1
  - CAN 2
  - INPUT SIGNALS
  - OUTPUT SIGNALS
  - KEY SWITCH

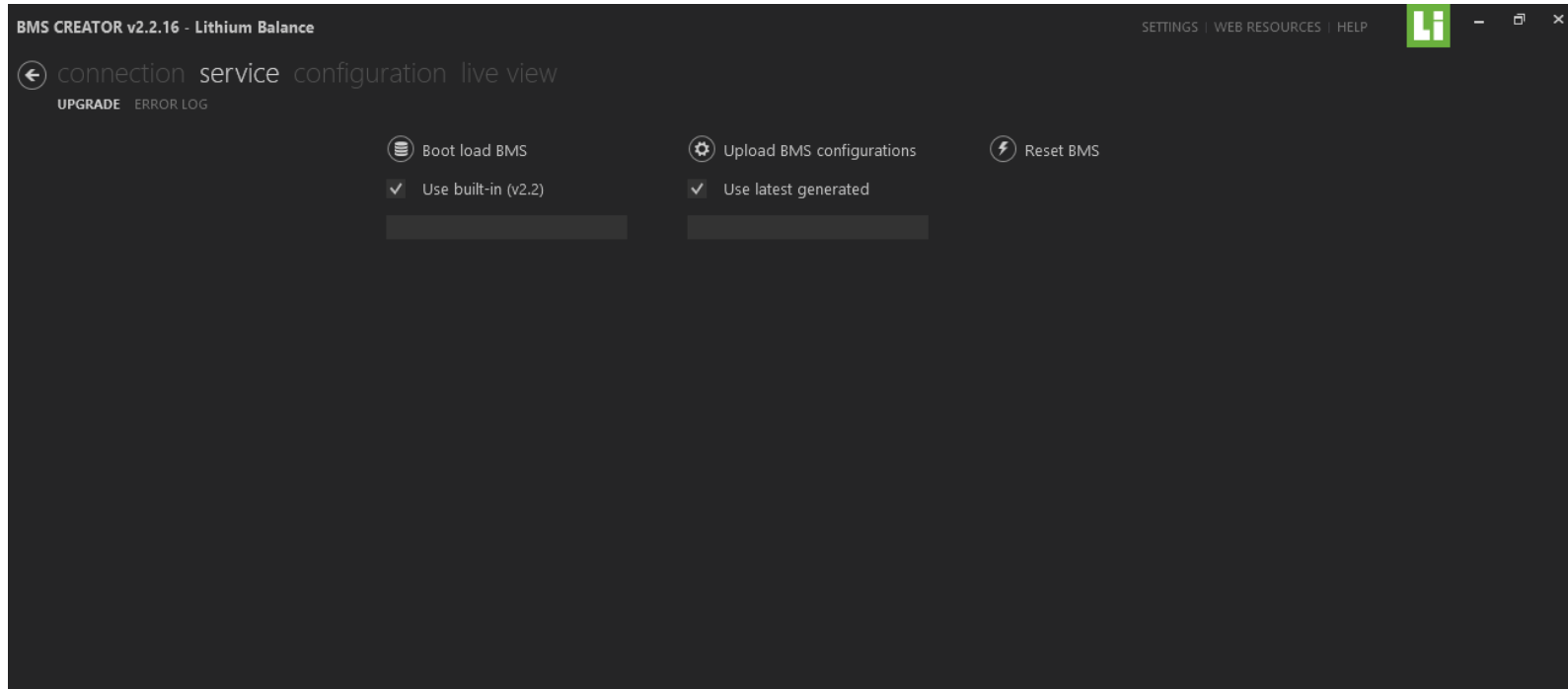
# Communication Connection



The battery designer is able to:

- Connect/Disconnect the BMS from the PC.
- Check the type of BMS connected, its Hardware serial number & the firmware version.
- Possible to check the connection status of the BMS & PC

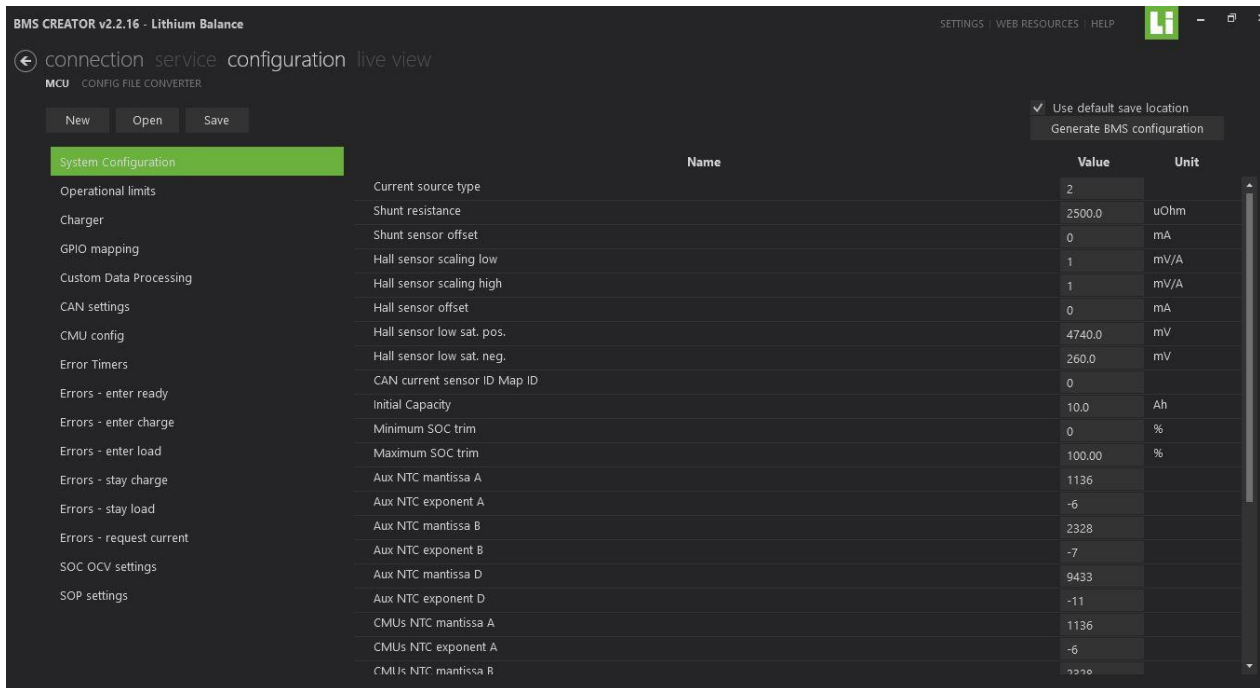
# Service



The battery designer is able to

- Bootload the BMS with proper Bootloading files. This is useful while upgrading to new versions of software.
- Upload previously saved BMS configuration file onto the BMS.
- Reset the BMS
- Read and save error logs.

# Configuration



- In Configuration tab it is able to
- Select new configuration.
  - Open previously saved configuration & Save current configuration.
  - Convert the old version configuration file into the new version which is compatible with the current software version.
  - Generate BMS configuration which can be then written onto the BMS.

The configuration page enables the user to completely configure the BMS.

# System Configuration



In System configuration tab it is possible to

- Configure Current sensor type and its value. The c-BMS supports 2 current sensor types
  1. Shunt Resistor
  2. Hall Effect Sensor
- Calibrate the sensor as required
- Configure Pack capacity
- SOC Trimming
- Calibrate the Auxiliary Temperature sensor & also the PCB temperature values.
- Calibrate the SOH SOC

The screenshot displays the BMS CREATOR v2.2.16 - Lithium Balance software interface. The 'System Configuration' tab is selected, showing a list of parameters to be configured. The parameters are organized into categories on the left, and the main area shows a table of settings.

Name	Value	Unit
Operational limits		
Current source type	2	
Charger		
Shunt resistance	2500.0	uOhm
Shunt sensor offset	0	mA
GPIO mapping		
Hall sensor scaling low	1	mV/A
Custom Data Processing		
Hall sensor scaling high	1	mV/A
CAN settings		
Hall sensor offset	0	mA
CMU config		
Hall sensor low sat. pos.	4740.0	mV
Error Timers		
Hall sensor low sat. neg.	260.0	mV
Errors - enter ready		
CAN current sensor ID Map ID	0	
Errors - enter charge		
Initial Capacity	10.0	Ah
Errors - enter load		
Minimum SOC trim	0	%
Errors - stay charge		
Maximum SOC trim	100.00	%
Errors - stay load		
Aux NTC mantissa A	1136	
Errors - request current		
Aux NTC exponent A	-6	
SOC OCV settings		
Aux NTC mantissa B	2328	
SOP settings		
Aux NTC exponent B	-7	
Aux NTC mantissa D	9433	
Aux NTC exponent D	-11	
CMUs NTC mantissa A	1136	
CMUs NTC exponent A	-6	
CMUs NTC mantissa B	2328	
CMUs NTC exponent B	-7	



# Operational Limits



BMS CREATOR v2.2.16 - Lithium Balance

connection service configuration live view

MCU CONFIG FILE CONVERTER

New Open Save

System Configuration

Operational limits

Name	Value	Unit
Min. cell voltage	2800.0	mV
Max. cell voltage	3650.0	mV
Min. cell temperature	0	°C
Max. cell temperature	40	°C
Max. i2t	5000	A^2s
Max. contactor break curr.	500.00	mA
Max. precharge end curr.	200.00	mA
Max. contactor retries	2	
Contactor off timeout	2.0	sec
Precharge timeout	10.0	sec
Contactor retry timeout	2.0	sec
Temp. sensors enabled	1	Bits
Temp. sensors allocated for cells	1	Bits
Min. temp. channel 1	2	°C
Min. temp. channel 2	2	°C
Min. temp. channel 3	2	°C
Min. temp. channel 4	2	°C
Min. temp. channel 5	2	°C
Min. temp. channel 6	2	°C
Max. temp. channel 1	45	°C
Max. temp. channel 2	45	°C

Use default save location  
Generate BMS configuration

Operational limits can be configured:

- Configure the voltage thresholds for the cell like Min. & Max. cell voltage thresholds.
- Configure the temperature thresholds for the cell like Min. & Max. cell temperature thresholds.
- Configure Contactor settings like max. Contactor break current & Max. precharge end current etc. for proper & safe operation of the contactor.
- Configure the number of temperature sensors required & min. & max. values for each temperature channel.
- Configure the amount current allowed in & out of the system depending on the temperature & SOC values
- Configure balancing thresholds

# Charger configuration



BMS CREATOR v2.2.16 - Lithium Balance

SETTINGS | WEB RESOURCES | HELP

connection · service · configuration · live view

MCU CONFIG FILE CONVERTER

New Open Save

Use default save location  
Generate BMS configuration

	Name	Value	Unit
System Configuration			
Operational limits	Charge complete deadband I	100	mA
Charger	Charge complete deadband V	10.0	mV
	CAN Charge enabled	1	
GPIO mapping	CAN Charge Max. V	90.0	V
Custom Data Processing	PWM Charge enabled	0	
CAN settings	PWM signal inverted	1	
CMU config	PWM Min. duty	15	%
Error Timers	PWM Max. duty	85	%
Errors - enter ready	PWM output I deadband	0	A
Errors - enter charge	Cell voltage target	3600.0	mV
Errors - enter load	Allowed charge current deadband	1	A
Errors - stay charge	Max. charge current	5.0	A
Errors - stay load	PID constant Kp	2.000	
Errors - request current	PID constant Ki	0.000	
SOC OCV settings	PID constant Kd	0.000	
SOP settings			

In the Charger tab it is possible to configure

- Charge complete dead bands which will allow BMS to know whether the charging is complete.
- Select whether the charger is CAN or PWM charger.
- For PWM charger, it allows to configure the Min & Max duty cycles etc.
- Set Max. Charge voltage, Current & Cell max. voltage
- Set the control system parameters like Kp, Ki & Kd.

# GPIO Mapping

BMS CREATOR v2.2.16 - Lithium Balance

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MCU CONFIG FILE CONVERTER

New Open Save

Use default save location  
Generate BMS configuration

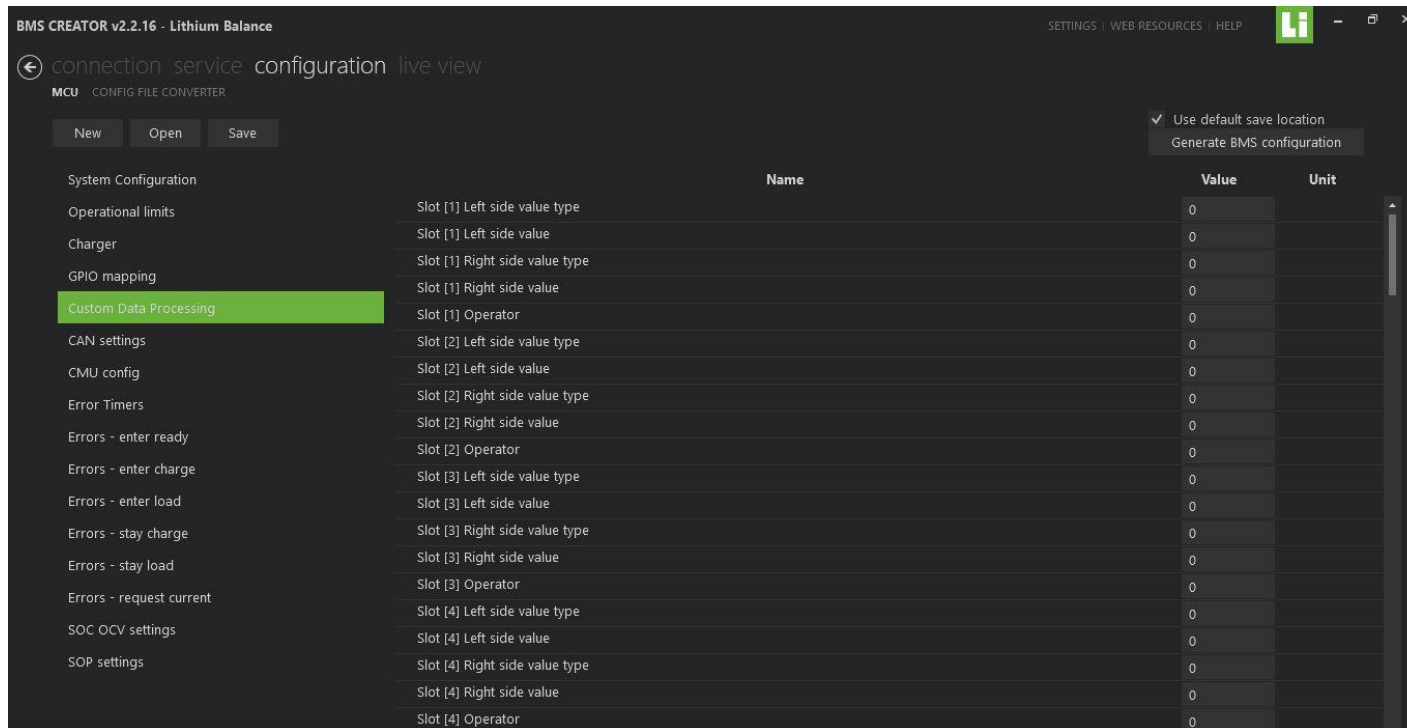
	Name	Value	Unit
System Configuration			
Operational limits	Request load active	1	IO
Charger	Request charge active	2	IO
GPIO mapping	Request combined active	0	IO
Custom Data Processing	Load negative feedback	0	IO
CAN settings	Precharge feedback	0	IO
CMU config	Charge negative feedback	0	IO
Error Timers	Load positive feedback	4	IO
Errors - enter ready	Load negative	6	IO
Errors - enter charge	Precharge	0	IO
Errors - enter load	Charge negative	7	IO
Errors - stay charge	Load positive	5	IO
Errors - stay load	Activate sleep	0	IO
Errors - request current	Activate balancing	3	IO
SOC OCV settings			
SOP settings			

The contactors are the electromechanical switches, which potentially will isolate the battery pack. These contactors are controlled by the BMS through a set of General purpose input output ports called GPIOs. The c-BMS supports 4 digital inputs & 4 GPIO. This window allows the user to configure the GPIO settings as required.

# Custom Data Processing

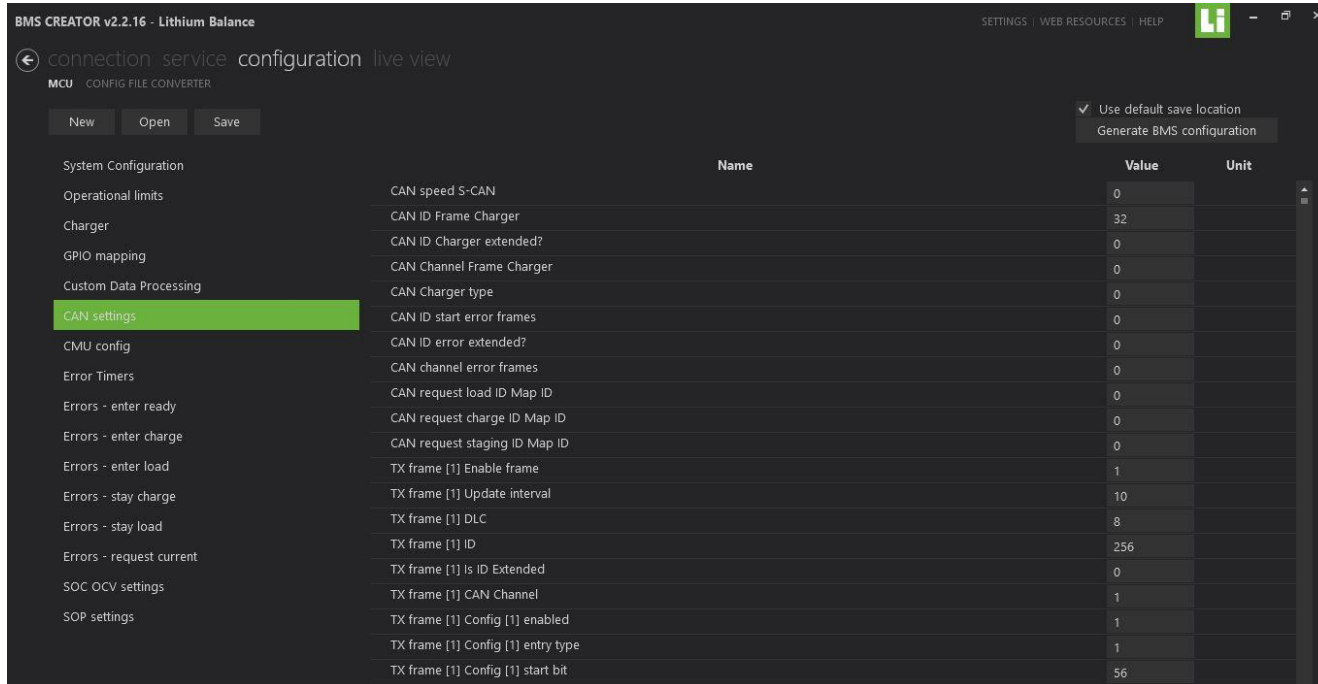


The custom data processor, also known as post processor allows the data that is received in either RAW form or in some other form to be converted to a usable format that can be directly passed to other systems. This includes maths functions like ADD, SUB, MUL & DIV and also logical functions like AND, OR, NOT etc. It also helps to scale the data to the right format & value.



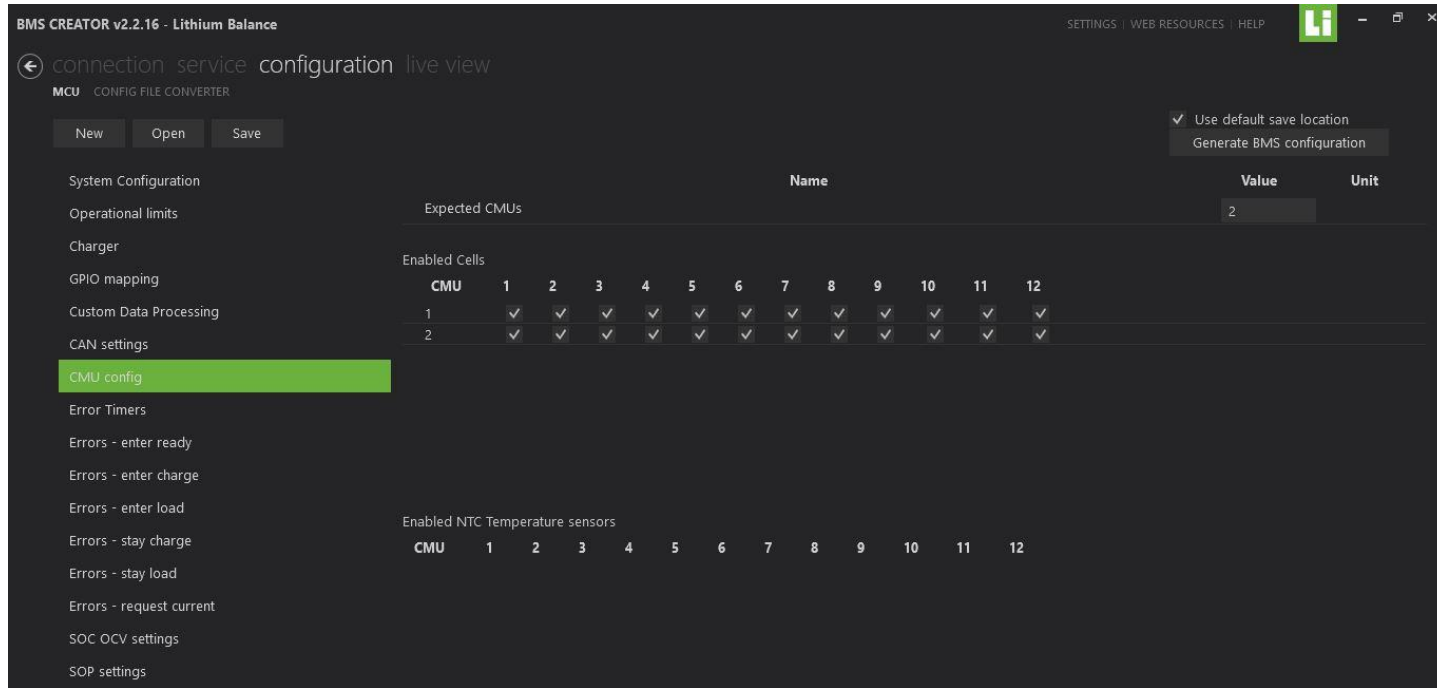
- Here the user is able to
- Configure the left side value type and its value
  - Configure the right side value type and its value
  - Select the operator.
  - It allows this data to be used on CAN

# CAN configuration



- The c-BMS offers completely configurable CAN.
- It supports both standard & extended i.e. 11-bit & 29-bit CAN messages.
- It has 20 Transmit (Tx) & Receive (Rx) frames each containing 10 messages. This allows most of the data to be configured.
- The c-BMS creator v2.2 also allows CAN based charge & discharge commands which can enable automatic mode changing of the BMS.

# CMU Configuration



This window allows the user to

- Select the number of cells connected to each CMU.

# Error Timers



BMS CREATOR v2.2.16 - Lithium Balance

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connection service configuration live view

MCU CONFIG FILE CONVERTER

New Open Save

Use default save location  
Generate BMS configuration

	Name	Value	Unit
System Configuration	Over Current IN/OUT alarms	2.0	s
Operational limits	Balancing alarms	1.0	s
Charger	CMU communication alarm	10.0	s
GPIO mapping	Cell over/under voltage alarms	5.0	s
Custom Data Processing	AUX temperature alarms	1.0	s
CAN settings	Cell temperature sensor alarms	3.0	s
CMU config	Cell over/under temperature alarms	5.0	s

Error Timers

Errors - enter ready

Errors - enter charge

Errors - enter load

Errors - stay charge

Errors - stay load

Errors - request current

SOC OCV settings

SOP settings

Here the user is able to

- Set the time the BMS will wait before showing any alarm if there is any error in the system like, Over current IN/OUT, Balancing alarms etc.

# Error handling per BMS mode



BMS CREATOR v2.2.16 - Lithium Balance

connection service configuration live view

MCU CONFIG FILE CONVERTER

New Open Save

System Configuration

Operational limits

Charger

GPIO mapping

Custom Data Processing

CAN settings

CMU config

Error Timers

Errors - enter ready

Errors - enter charge

Errors - enter load

Errors - stay charge

Errors - stay load

Errors - request current

SOC OCV settings

SOP settings

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Use default save location

Generate BMS configuration

Name	Value	Unit
Severity error 1	2	
Code error 1	2000	
Severity error 2	2	
Code error 2	2001	
Severity error 3	2	
Code error 3	2004	
Severity error 4	2	
Code error 4	2005	
Severity error 5	2	
Code error 5	2015	
Severity error 6	2	
Code error 6	2016	
Severity error 7	2	
Code error 7	2017	
Severity error 8	2	
Code error 8	2021	
Severity error 9	2	
Code error 9	2022	
Severity error 10	2	
Code error 10	2023	

- The purpose of these windows is to set the priority of each error that occurs in each mode like entering into Ready, charge or Load mode or in staying in these modes
- Every operation in the BMS is associated with an error code & once that error occurs, the BMS checks the priority against that error code
- Depending on the priority, the BMS takes suitable actions like just popping up to error or else completely disconnect the battery pack.



# SOC OCV Settings



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MCU CONFIG FILE CONVERTER

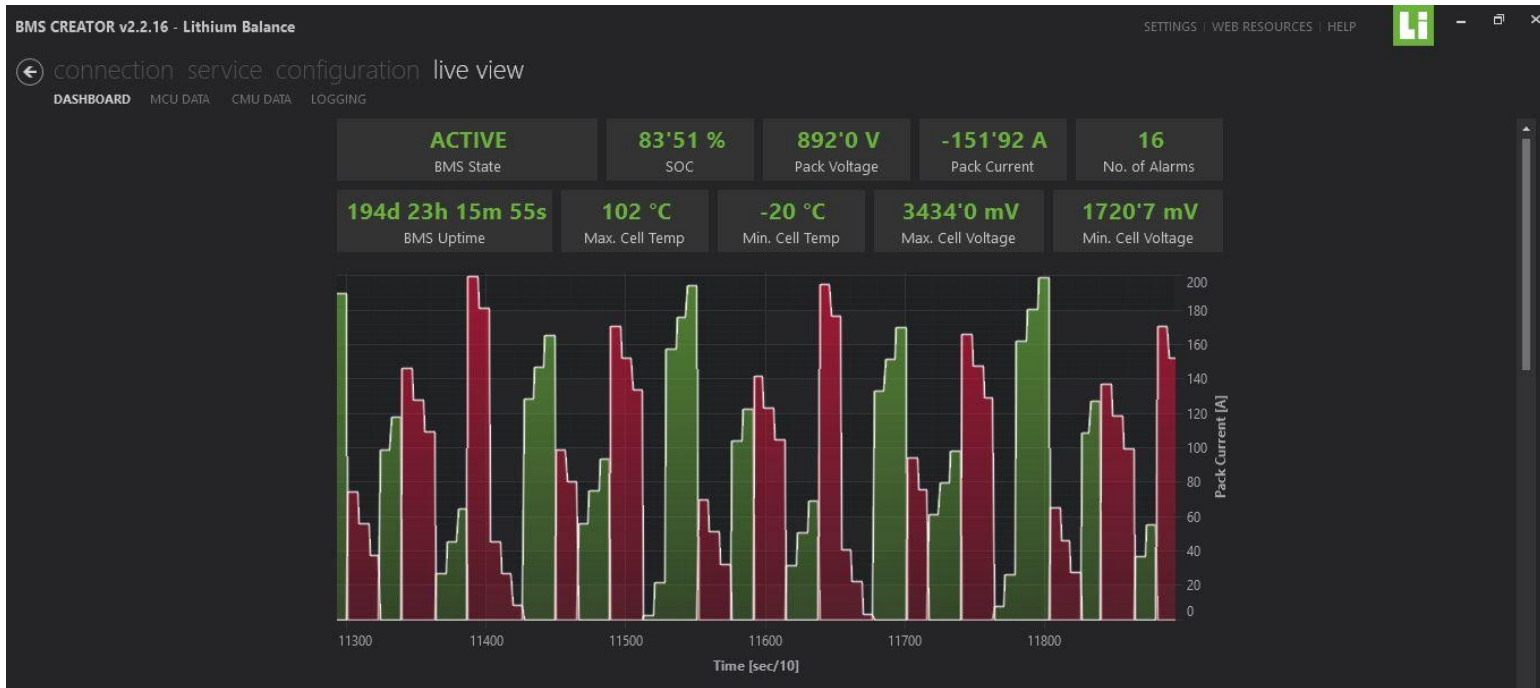
New Open Save

Use default save location  
Generate BMS configuration

	Name	Value	Unit
System Configuration	Enable data sets	0	
Operational limits	Off duration for lowest quality	5	min
Charger	Off duration for highest quality	720	min
GPIO mapping	Maximum off duration for calibration	14400	min
Custom Data Processing	Maximum quality	90.00	%
CAN settings	Data set [1] temperature	-20	deg C
CMU config	Data set [1] voltage [0]	0	mV
Error Timers	Data set [1] voltage [1]	0	mV
Errors - enter ready	Data set [1] voltage [2]	0	mV
Errors - enter charge	Data set [1] voltage [3]	0	mV
Errors - enter load	Data set [1] voltage [4]	0	mV
Errors - stay charge	Data set [1] voltage [6]	0	mV
Errors - stay load	Data set [1] voltage [7]	0	mV
Errors - request current	Data set [1] voltage [8]	0	mV
SOC OCV settings	Data set [1] voltage [9]	0	mV
SOP settings	Data set [1] voltage [10]	0	mV
	Data set [1] voltage [11]	0	mV
	Data set [1] voltage [12]	0	mV
	Data set [1] voltage [13]	0	mV

- This window allows the user to correct the SOC of the battery pack depending on the open circuit voltage (OCV) values
- These values are either supplied by the cell manufacturer or else the user needs to extrapolate these values
- The more the number of values the more accurate will be the SOC estimation.
- The software offers 100 datasets of voltages for a given temperature value depending on which the SOC is calculated.

# Live View



This window shows the complete overview of the system status and parameters like

- BMS state
- SOC, Pack voltage, Pack Current, Number of alarms, BMS uptime, Cell Min./Max. temperature & voltages
- This also shows the graph of Charging & discharging current, Min/max cell voltage & Temperature, SOC Vs Time

# Controller Data



BMS CREATOR v2.2.16 - Lithium Balance

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connection service configuration live view

DASHBOARD MCU DATA CMU DATA LOGGING

IO-1 IO-2 IO-3 IO-4 IO-5 IO-6 IO-7 IO-8 IO-9 IO-10 IO-11 IO-12 IO-13 IO-14 IO-15 IO-16

ID	MCU Measured Data	Value	Unit	ID	MCU Internal Data	Value	Unit
138	MCU AUX temperature sensor 1	22	C	32	Dynamic Current IN limit	537'1	A
139	MCU AUX temperature sensor 2	21	C	33	Dynamic Current OUT limit	216'9	A
140	MCU AUX temperature sensor 3	24	C	26	Requested Charge Current	93'6	A
141	MCU AUX temperature sensor 4	24	C	48	Charge complete? (latched)	True	
142	MCU AUX temperature sensor 5	20	C	17	Remaining Battery Pack Capacity	38325011	As
143	MCU AUX temperature sensor 6	23	C	22	Battery Pack Capacity	350'9	Ah
144	MCU AUX temperature sensor 7	20	C	1081	State of Health	21'76	%
145	MCU AUX temperature sensor 8	23	C				

Entry	Alarm	Origin	Severity	Timer Init [s]	Timer [s]
1	2025 - SYS_FB_LOAD_NEG_WELDED	26 - INTERPOLATION	2	1655'8	3941'2
2	2015 - SYS_CMU_PCB_T_NO_VALUE	1 - CPU	5	4333'5	3374'8
3	2006 - SYS_LIM_CELL_DT_NEG	30 - TASK_MONITOR	5	1149'4	39'6
4	2031 - SYS_CONTACTOR_RETRIES	9 - PACK_AND_CELL	2	5790'3	6049'9
5	2014 - SYS_CELL_T_OPEN	17 - RTC	2	1990'2	3567'3
6	2030 - SYS_PACK_V_EXT_HIGH	3 - ADC_HAL	6	2766'2	2255'6
7	2035 - SYS_PACK_Q_CALC	25 - GPIO	0	4205'0	1335'4
8	2039 - SYS_VSUPPLY_MIN	24 - CRC	6	1133'9	2603'0

This window shows

- GPIO status
- Temperature data
- Current values
- The errors that are present in the system



# Cell Monitoring and Pack temperature Data

BMS CREATOR v2.2.16 - Lithium Balance

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DASHBOARD MCU DATA **CMU DATA** LOGGING

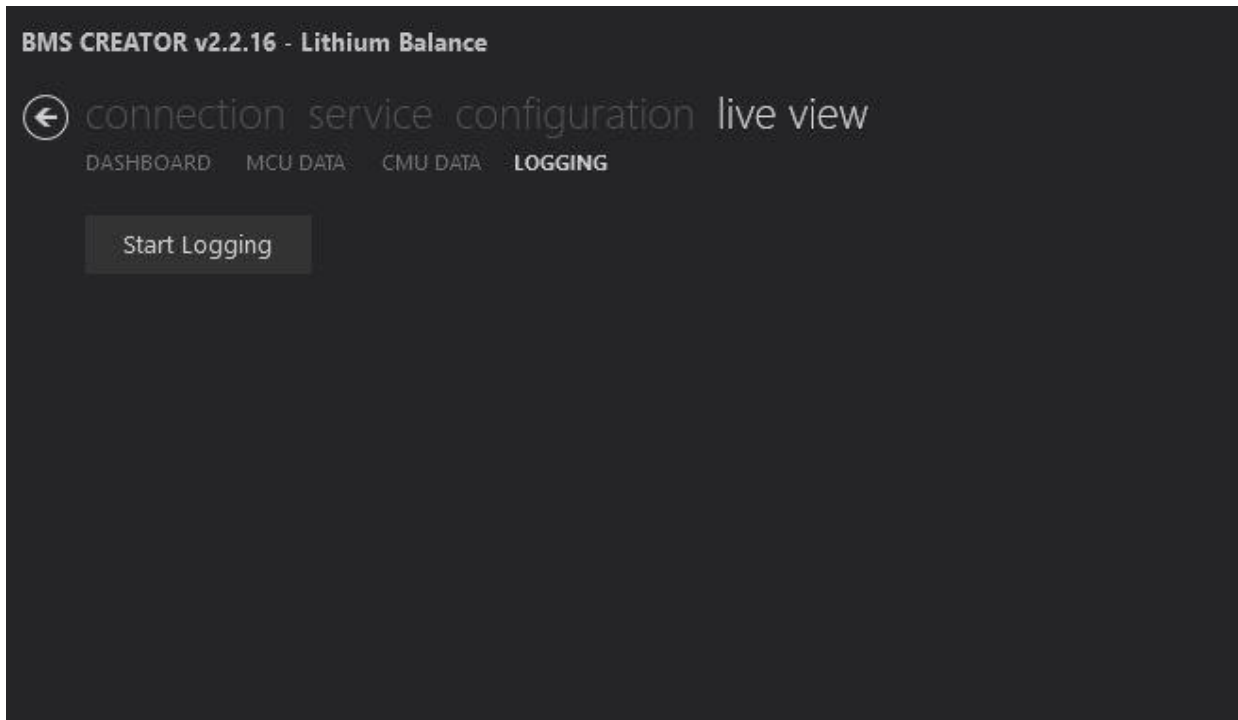
#	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9	C 10	C 11	C 12
1	3554'8	3569'2	3536'8	3589'9	3547'9	3571'0	3526'0	3523'5	3554'8	3569'2	3536'8	3589'9
2	3598'4	3549'1	3554'6	3517'3	3512'2	3592'9	3526'1	3571'6	3598'4	3549'1	3554'6	3517'3
3	3572'5	3510'5	3530'8	3522'3	3578'2	3597'9	3523'5	3583'8	3572'5	3510'5	3530'8	3522'3
4	3586'8	3520'4	3527'2	3504'6	3555'1	3574'9	3573'4	3579'7	3586'8	3520'4	3527'2	3504'6
5	3560'9	3581'9	3503'5	3509'6	3521'2	3579'9	3570'8	3591'9	3560'9	3581'9	3503'5	3509'6
6	3504'5	3561'7	3521'2	3536'9	3585'5	3501'7	3570'9	3540'0	3504'5	3561'7	3521'2	3536'9
7	3581'0	3519'2	3502'1	3526'8	3550'8	3561'5	3510'2	3524'8	3581'0	3519'2	3502'1	3526'8
8	3532'4	3584'9	3508'0	3574'9	3549'7	3556'2	3533'9	3586'8	3532'4	3584'9	3508'0	3574'9
9	3506'6	3546'3	3584'3	3579'9	3515'8	3561'1	3531'3	3599'1	3506'6	3546'3	3584'3	3579'9
10	3511'2	3589'4	3519'0	3562'6	3583'6	3549'2	3525'9	3575'4	3511'2	3589'4	3519'0	3562'6

#	T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8	T 9	T 10	T 11	T 12	PCB 1	PCB 2
1	23	24	24	23	24	23	24	23	23	23	23	23	53	53
2	24	24	23	23	24	23	24	23	24	24	24	23	52	54
3	24	24	23	23	23	24	24	23	24	23	23	23	53	52
4	24	24	23	23	23	24	24	24	23	24	23	23	53	52
5	24	24	24	23	23	23	24	24	23	23	24	23	52	53
6	23	23	24	23	23	24	23	24	23	24	23	24	53	54
7	23	24	23	24	23	24	23	23	23	24	24	23	53	52
8	24	23	24	23	24	23	24	23	24	23	23	23	52	54
9	24	23	23	24	24	23	24	23	24	24	23	23	53	54
10	24	23	24	23	24	24	23	23	23	24	24	24	52	54

The User is able to see all the cell voltage values in real time  
As well as pack temperature values in real time

# Logging



There the user can take a log of what is currently going on in the system & then use that data for fault analysis.



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**Thank You!**