Technical Handbook

Easy Blade & Easy Block

Application Specific Batteries

Content

Legal notice

Original Instruction Manual

Nürnberger Straße 65
86720 Nördlingen
Germany

https://www.varta-ag.com/de/

Tel.: 0049 9081 240 86 60
power@varta-storage.com

Version 4

Date: June 2022

About this manual

Please read this manual and instructions carefully before attempting to use this battery in your application. It contains important information, to ensure problem free performance of your batteries. Damage to the battery howsoever caused is not covered under the warranty.

Please ensure that you have the latest version of all technical materials by downloaded from below link:

www.varta-ag.com/asb

1 Caution/Warning statements

1.1 General safety signs

Symbol	Meaning
	Prohibition symbols are circular, showing a black pictogram on a white background surrounded by a red edge with a crossbar.
	Warning signs are triangular, showing a black symbol and edge on a yellow background.
	Environmental regulations are information on statutory requirements, which have to be complied with, especially during disposal.

1.2 General hazard sources

If the following instructions for handling the device are not observed, this might lead to personal injury or damage to the battery or your device, for which VARTA Storage GmbH will accept no liability. VARTA cannot control the environment where the battery is deployed and the following are not covered by the warranty: physical damage, electrical interference, moisture ingress, deliberate or repeated short circuit or failure conditions, electrical conditions which trigger the fuse protection etc.

a. Danger of electrical voltage

⚠ WARNING

Contact with electrical voltage!

Risk of fatal injury from electric shock!

- ➡ Keep the module always sealed.
- ➡ Pay attention to any damage of electrical equipment! Eliminate defects immediately!
- ➡ Do not open the module.
- ➡ Do not connect the modules in serial only in parallel.
- ➡ Do not connect the module or charger in reverse polarity.

	➡ You are not allowed to disconnect the module in active mode. Hot-plugging or hot-swapping is not allowed in active mode! There is a risk of short circuit between the battery modules. Only in shut-down mode old or damaged modules can be replaced with new modules. Even modules with new cell chemistries are supported if available in the future.

b. Danger from water

	**⚠ WARNING** **Entry of water or other liquids into the module!** Possible mortal danger and material damage! ➡ Do not use water for cleaning the module. ➡ Never place containers with fluids (beverage containers and the like) on electrical systems. ➡ Do not clean the system with agents containing acid, lye or solvents.

c. Danger from wrong handling

	**ATTENTION** **Ensure proper handling!** Risk of material damage, because of wrong handling. ➡ The relative humidity must not exceed 95%.

d. Danger from heat

	**ATTENTION** **Insufficient ventilation of the system!** Overheating of the system possible! ➡ Keep the ventilation openings clear. ➡ Ensure sufficient ventilation.
	**ATTENTION** **Heat input due to direct sunlight or devices emitting heat!** Overheating and damage of the system possible! ➡ Protect the system against direct sunlight. ➡ Do not use fan heaters or the like near the module.

1.3 Safety overview of Battery Management System (BMS)

The battery contains three levels of safety, which is controlled by the BMS.

Level 1 Protection for over-voltage/ under-voltage / over-current / short-circuit / over-temperature / under-temperature. It is controlled by the BMS software and is non-permanent.

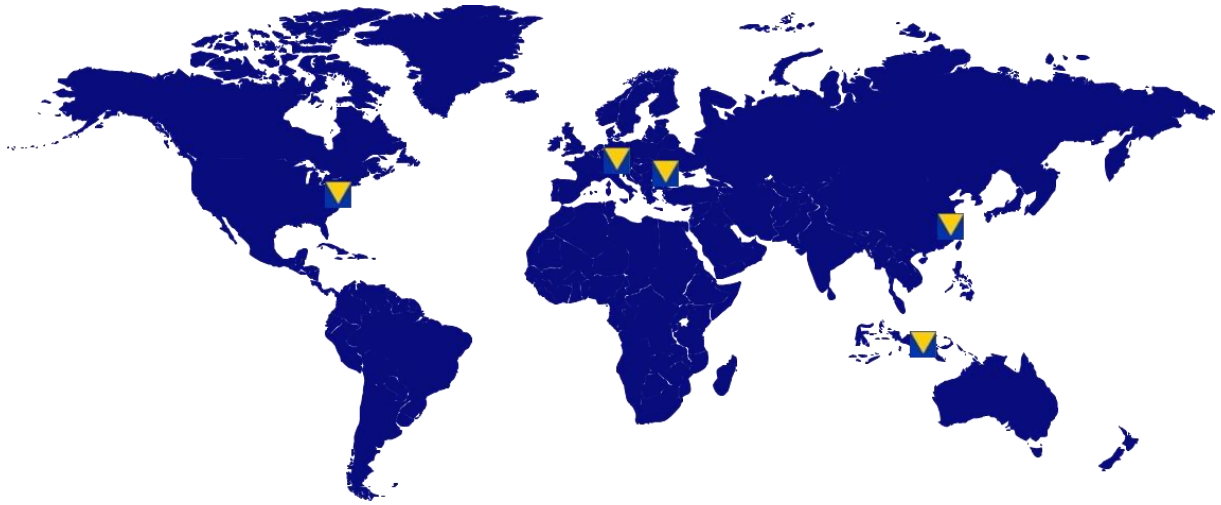
Level 2 Protection for over-voltage/ under-voltage / over-current / short-circuit / over-temperature/ under-temperature. It is controlled by the BMS software and is permanent.

Level 3 Protection (passive) with current fuse on board.

1.4 Certification

The battery is qualified acc. to UN Recommendations on the Transportation of Dangerous Goods, UN Manual of Test and Criteria, Part III, subsection 38.3 (ST/SG/AC.10/11/Rev. 5). The battery is qualified acc. to IEC 62133-2:2017. Additionally, the Easy Blade 36 V and 48 V is qualified acc. to UL2595 and IEC 60335.

2 Contact Details



To sample, buy or discuss any of the products in the Application Specific Batteries range:

USA	EUROPE	ASIA
Varta Microbattery, Inc. 555 Theodore Fremd Ave Suite C-304 Rye, NY 10605, USA asb@varta-storage.com Tel: +1 (914) 592-2500 www.varta-ag.com/asb	**Avnet Abacus** Mr. Timothy Parker timothy.parker@avnet-abacus.eu Tel: +44 1628 512 904 Mo: +44 7768 396 697 www.avnet-abacus.eu	**VARTA Microbattery Pte. Ltd.** 300, Tampines Avenue 5, #05-01 Tampines Junction, 529653 Singapore Tel +65 6 260 58 01 Fax +65 6 260 58 12
Arrow Electronics, Inc. 9201 E. Dry Creek Rd Centennial, CO 80112, USA Mr. Timothy Ross tbr@arrow.com Tel: +1 (303) 645-8806 Mob: +1 (847) 302-5214 www.arrow.com	**Arrow Europe** Mr. Christian Schmidt cschmidt@arroweurope.com Tel: +49 6102 5030 8262 www.arrow.com	**VARTA Microbattery Pte. Ltd.** Room 1702-3, 17/F., Fullerton Centre 19 Hung to Road, Kwun Tong Tel +852 28 98 83 73 Fax +852 28 97 76 09
		VARTA Microbattery Japan K.K Kyobashi Y'SUS Bldg, 3F. 1-6-12, Kyobashi, Chuo-Ku Tokyo 104-0031, Japan Tel +81 3 35 67 81 71 Fax +81 3 35 67 81 75
		VARTA Microbattery Pte. Ltd. 3F, No 85, Xinhu 1st Rd. Neihu Dist. Taipei 11, Taiwan Tel +886 233 931 557 Fax: +886 233 931 556

For more information visit our website www.varta-ag.com/asb

3 Introduction of ASB

Application Specific Batteries (ASB) is VARTA's new range of lithium-rechargeable battery products from VARTA Storage GmbH, offering products in the voltage range of 24V – 48V for modern systems and applications.

We offer a growing range of battery packs that are immediately available for high-energy or high-power applications. All ASB battery packs are fitted with an electronic battery management system (BMS) with protection against unsafe conditions. All cells used comply with the requirements of the safety standard UL1642 and the packs in this handbook are certified to additional safety standard IEC62133-2:2017 as well as UN38.3 requirements for transportation.

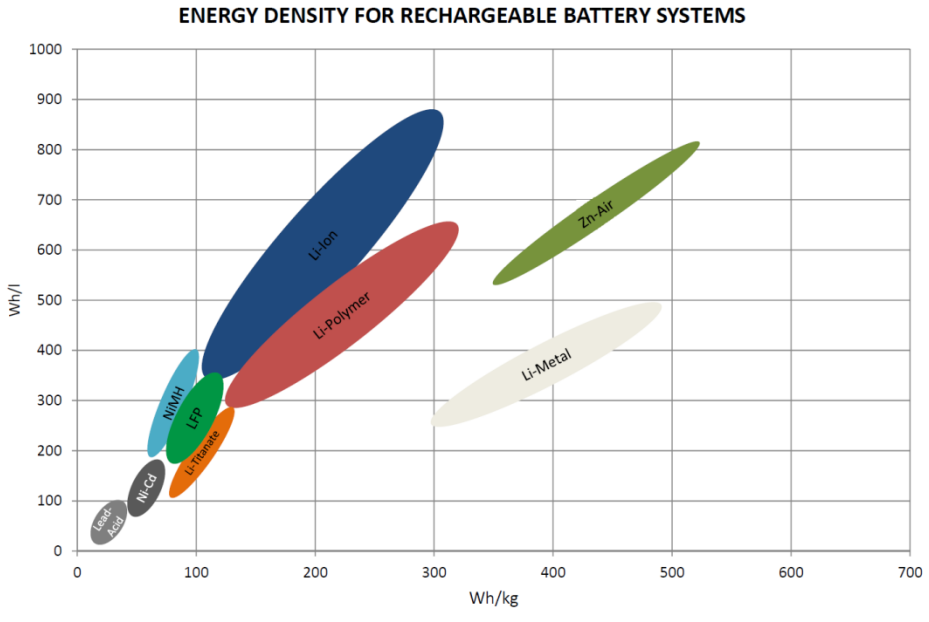
SYSTEM HIGHLIGHTS OF VARTA STORAGE ASB RANGE:

▶ Excellent energy density	▶ Zero maintenance requirements
▶ Different form factors	▶ Low self-discharge and wide temperature range
▶ ~24V, ~36V and ~48V versions	▶ Up to 40kWh systems using modular approach
▶ IEC62133-2:2017 certification	▶ Mechanical stacking/locking design
▶ CAN Bus Communications (CANopen)	▶ ISO9001 certified for design and manufacture
▶ Excellent cycle life (see PI-Sheet)	▶ 2-year manufacturer's limited warranty

Comparison of different rechargeable battery systems regarding their energy densities

3.1 Definitions and standards

BASICS



Unless otherwise stated the technical values and definitions are based on room temperature conditions (RT = 22°C ± 3°C).

VOLTAGE DEFINITIONS

Open Circuit Voltage (OCV):

is the difference of electrical potential between two terminals of a device when disconnected from any circuit, dependent on battery model, temperature, storage duration and state of charge.

End of Discharge Voltage (EoD):

The voltage at the end of discharging depending on discharge rate and temperature.

End of Charge Voltage (EoC) should also be referenced from the individual specifications.

CAPACITY DEFINITIONS

The capacity C of a cell is defined by the discharge current I and the discharge

time t: C = I * t

I = constant discharge current

t = duration from the beginning of discharge until the end of discharge voltage is reached

Nominal Capacity: The nominal capacity C denotes the capacity amount in Ah (Ampère hours) that the battery can deliver at the 5h discharge rate (0.2 C). The reference temperature is +22°C ± 3°C, if not otherwise stated and the final discharge voltage will also be stated.

Available Capacity:

Factors which affect the available capacity are:

- Rate of discharge
- End of discharge voltage
- Ambient temperature
- State of charge
- Battery age
- Cycle history of the battery

At higher than usual discharge rates the available capacity is accordingly reduced.

CURRENT DEFINITIONS

Charge and discharge rates may be given as multiples of the rated capacity (C) in amperes (A) with the term C.

Example:

Rated Capacity C = 1000 mAh

0.1 C = 100 mA, 1 C (A) = 1000 mA

Nominal Discharge Current:

The nominal discharge current of an ASB battery is the 5-hour discharge current (0.2 C). It is the current at which the nominal capacity of a cell is discharged in 5 hours.

I = C/t = C/5 = 0.2 C when t = 5 h

3.2 General design and application criteria

Choose the best suitable battery from our range of ASB batteries according to your needs relating to the specific application and its corresponding planned operation conditions.

The most important criteria for the type-selection are these:

- Required minimum operating time
- Charging rates required vs. calendar life target
- Max. and average current drain
- Min. and max. voltage of operation
- Operating temperature range
- Mechanical properties
- Available space
- Environmental conditions

All ASB batteries are equipped with our specially selected and carefully designed safety electronic modules (BMS) which prevent the risks of hazards due to any foreseeable abuse / misuse. Nevertheless, it is required that any application is designed so that the battery may operate within its normal specification without the safety features being triggered by end-user behaviour.

3.3 Features

VARTA Storage ASB batteries are first choice for a number of modern high-tech products in fields such as robotics, automated guided vehicles (AGV), related logistics and agricultural solutions and more. They provide long lasting, reliable main power, occupying a minimum of space and weight in the corresponding devices.

VARTA Storage ASB batteries fulfil the most important design-in requirements: Reliable high-power output, design flexibility with minimized space requirements and a long life.

Feature	Advantage	Customer Benefit
UN38.3 certified	Approved for transport	Supplier's test summary available
IEC62133-2:2017 certified	Ready for design-in for certified applications	Reduced design-in cost
Multiple form-factors with modular design	Design flexibility	Product design convenience
Excellent overall performance	High energy and high cycle life	Lower total cost of ownership and highly satisfying over the long-term
Complete battery module solution, zero maintenance	Fit and forget design	Low cost of maintenance in the field
CAN Communications	Smart battery management, regardless of module size	Battery behaviour, charging, safety can all be controlled and monitored

4 Reference Table: Easy Blade

*Illustration only

Product	Easy Blade 24 V	Easy Blade 36 V	Easy Blade 48 V	Easy Blade 48 V (Previously version)
Order Number (VKB)	56654 799 098	56654 799 089	56654 799 092	56654 799 097
State of charge	< 30 %	< 30 %	< 30 %	< 30 %
Typical capacity (Ah)	58	44,8	29	29
Nominal voltage (V)	25.9	37	51.8	51.8
Operating temperature				
Charging	0°C to + 50°C	0°C to +50°C	0°C to + 50°C	0°C to + 50°C
Discharging	-20°C to +55°C	-20°C to +55°C	-20°C to +55°C	-20°C to +55°C
Storage	1 to 3 months at -20°C to +45°C 1 year at -20 °C to +24 °C	1 to 3 months at -20°C to +45°C 1 year at -20 °C to +24 °C	1 to 3 months at -20°C to +45°C 1 year at -20 °C to +24 °C	1 to 3 months at -20°C to +45°C 1 year at -20 °C to +24 °C
Life expectance (typical) at	0.5 C/ 0.5 C, 22°C ± 2°C	0.5 C/ 0.5 C, 22°C ± 2°C	0.5 C/ 0.5 C, 22°C ± 2°C	0.5 C/ 0.5 C, 22°C ± 2°C
No. of cycles (on Cmin)	1,200 (80%)	1,200 (80%)	1,200 (80%)	1,200 (80%)
Miscellaneous				
NTC	Yes	Yes	Yes	Yes
Certification	UN38.3 IEC62133-2:2017	UN38.3 IEC62133-2:2017 UL2595 IEC60335	UN38.3 IEC62133-2:2017 UL2595 IEC60335	UN38.3 IEC62133-2:2017

5 Reference Table: Easy Block

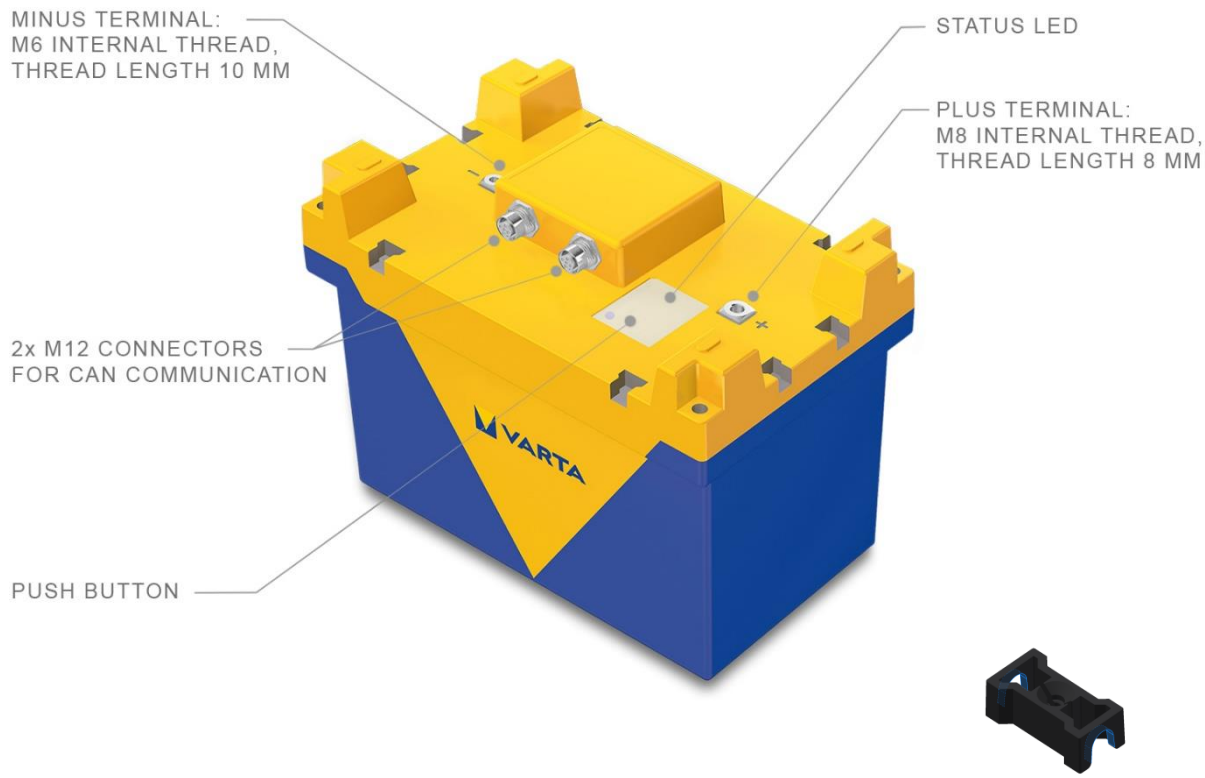
*Illustration only

Product	Easy Block 24 V	Easy Block 48 V
Order Number (VKB)	56650 764 099	56650 764 098
State of charge	< 30 %	< 30 %
Typical capacity (Ah)	22.8	11.4
Nominal voltage (V)	25.6	51.2
Operating temperature		
Charging	0°C to +50°C	0°C to +50°C
Discharging	-20°C to +60°C	-20°C to +60°C
Storage	1 to 3 months at -20°C to +45°C 1 year at -20 °C to +24 °C	1 to 3 months at -20°C to +45°C 1 year at -20 °C to +24 °C
Life expectance (typical) at	0.9 C/ 0.9 C, 22°C ± 2°C	0.9 C/ 0.9 C, 22°C ± 2°C
No. of cycles (on Cmin)	4,000 (80%) 10,000 (60%)	4,000 (80%) 10,000 (60%)
Miscellaneous		
NTC	Yes	Yes
Certification	UN38.3 IEC62133-2:2017	UN38.3 IEC62133-2:2017

6 Description of the Battery

6.1 Easy Blade

6.2 Easy Block



6.3 Included in the box

Two module connectors (including the two screws) will be delivered together with the battery. (See 7.1)

6.4 Additional systems requirements

a. Power cable

Power cables are not provided by VARTA as requirements differ in all use cases. These are available from our distributors. See contact details on page 8. VARTA recommends using an M6 screw type for the negative terminal and an M8 screw type for the positive terminal. For connection of the modules an additional bus bar or wires with cable lug are needed.

b. Communication cable

The communication cable is not provided by VARTA. These are available from our distributors. See contact details on page 8. VARTA recommends to use Tyco Amphenol LTW 12-05BMIA-SL8001 or similar. See page 39 for the wire drawing.

c. CAN termination resistor

The CAN termination resistor is not provided by VARTA. These are available from our distributors. See contact details on page 8. VARTA recommends using Phoenix Contact 1507816 or similar.

A system without CAN communication to the Host needs two CAN termination resistors of 120 Ohm each. One CAN termination resistor has to be connected to the M12 connector of the first module and one CAN termination resistor has to be connected to the M12 connector of the last module. In this way the resistors are placed at the physical ends of the CAN bus.

Systems with CAN communication to the host only need to have one CAN termination resistor of 120 Ohm on the last module which is connected. In this case the host needs its own termination resistor.

Please make sure that the system is terminated at both physical ends of the CAN Bus!

d. Charger

We recommend VARTA approved chargers which are already programmed with compatible firmware and tested. The charger datasheets can be provided on request. (For more information on charging see chapter 13).

Description	Material number	Remark
Easy Charger – 24 V	57020101401	Easy Blade 24 V + Easy Block 24 V
Easy Charger – 36 V	57022101401	Easy Blade 36 V
Easy Charger – 48 V	57021101401	Easy Blade 48 V + Easy Block 48 V

The charging cable is not provided by VARTA. These are available from our distributors. See contact details on page 8. VARTA recommends to use TE Ampseal or similar. See page 40 for the wire drawing.

6.5 Push Button

Push the button to wake up and to shut-down the module. For more than one battery in parallel the button only needs to be pushed on one module. (See 7.4)

6.6 LED indications

The LED is able to show three different colours steady or blinking.

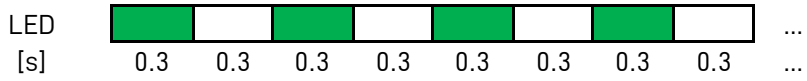
a. Switch from Deep Sleep to Active Mode

b. Switch from Active Mode to Deep Sleep

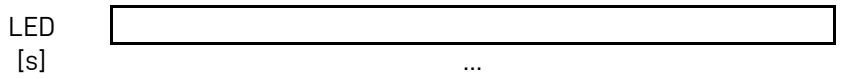
Note: As long as voltage is applied on the power terminals, the battery will continue the sequence

c. Active Mode and DSG FET or CHG FET is closed

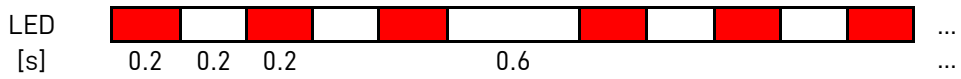
d. Active Mode and DSG FET and CHG FET opened



e. Deep Sleep



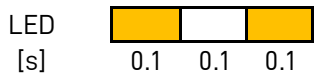
f. Irreversible error (e.g. defect fuse, defect FET,...)



g. Reversible error (e.g. over-temperature, over-current,...)

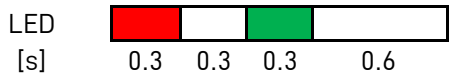
h. No valid Node ID or double Node ID detected

i. Switch to Bootloader Mode



j. Bootloader is active

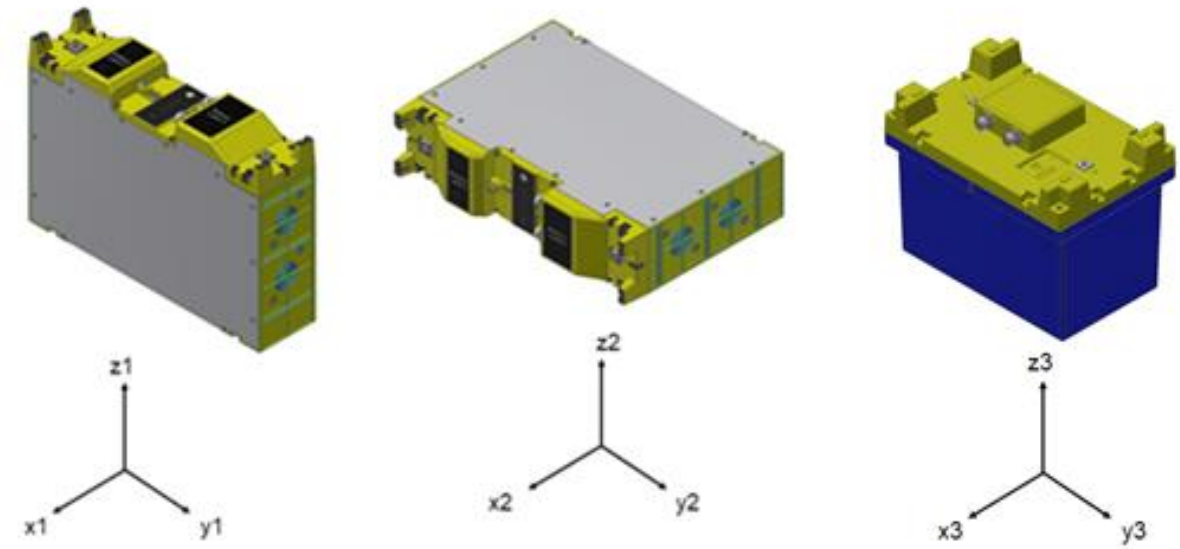
k. Node ID assignment in process



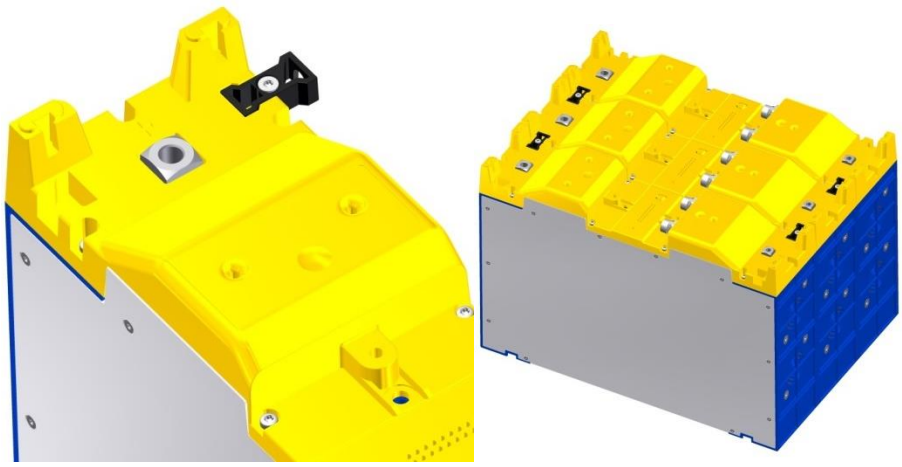
7 System Setup

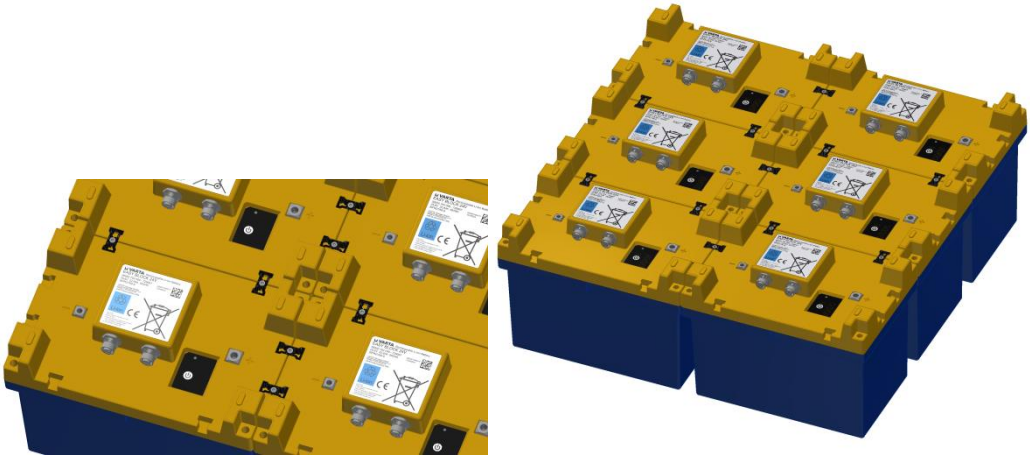
7.1 Mechanical connection

Important! When installing the module in your application, it is important to ensure that load-bearing is evenly spread. Pressure or weight in a single area, especially on the metal plate is not allowed and may cause damage to the battery and internal components. For example, it is not allowed to fix the modules with a strap or similar where all of the weight could be carried in one small area. The pressure must be spread over the whole module.



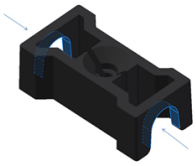
The modules can be connected in "x1" or "z2" direction for Easy Blade. For Easy Block "x3" and or "y3" directions are possible via two module connectors, shown below in black. Place the module connectors inside the recess of two modules (see below picture). The module connectors are asymmetric and have a broad and a narrow side. If the orientation of the modules is wrong (e.g. in case of serial connection of the modules), the connectors will not fit properly. When the module connector is placed, insert a screw (Screw Wuerth Wueplast W1423 3x8, TX8 or Screw EJOT Delta PT WN5454 30x8, TX10) and tighten it with a torque of max 0.16 Nm). The module connector will expand and jam in the recess.



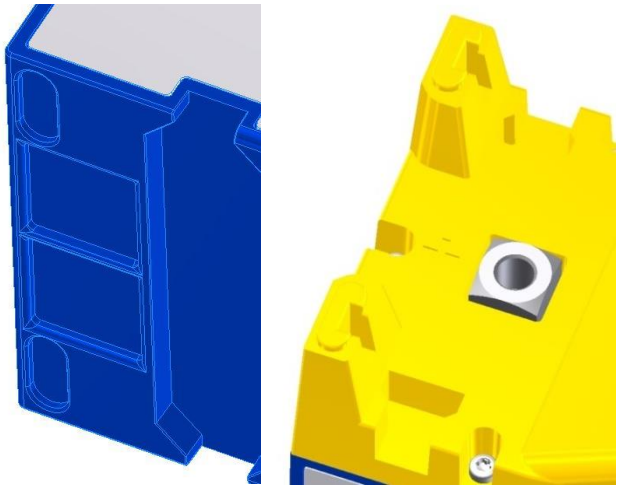


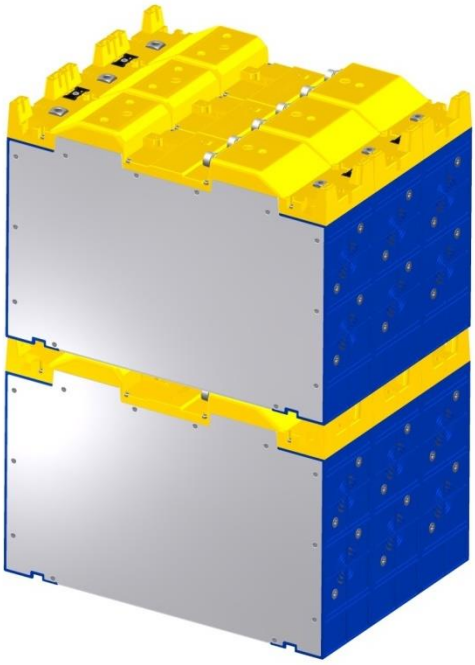
Important: The module connector will ensure correct position of the modules and add stability. The end user is responsible for creating sufficient stability of the battery system within the device with respect to the requirements of the application and variation of battery systems which can be assembled. In some cases, it is necessary to consider that additional support of the module structure should be considered in the final design of the application.

For removal of the module connector loosen the screw and remove the module connector. If the connector is stuck, use a screwdriver for pulling it out of the recess via the side opening in the connector.



The modules can be connected in z1 (Easy Blade) and z3 (Easy Block) directions. You can stack the batteries via the design features on the bottom and on the top of each module. (See picture below). Please note the stacking features are only for orientation and guidance – not for fixation. The user is responsible, to make sure that the module cannot move during operation.





Below table shows the permitted layers in a specific direction:

Direction	Maximal Layers	Comments
Z1	3 layers	To avoid too much weight
Y1	1 layer	To ensure proper ventilation
Z2	5 layers	To avoid too much weight
Y2	1 layer	To ensure proper ventilation
Z3	3 layers	To avoid too much weight

7.2 Electrical connection

It is not allowed to connect the modules in series! Only connect the battery modules in parallel. Do not mix up 24V, 36 V and 48V battery modules within a single system.

The next steps describe how to connect the battery modules in parallel.

Step 1: Minus terminal

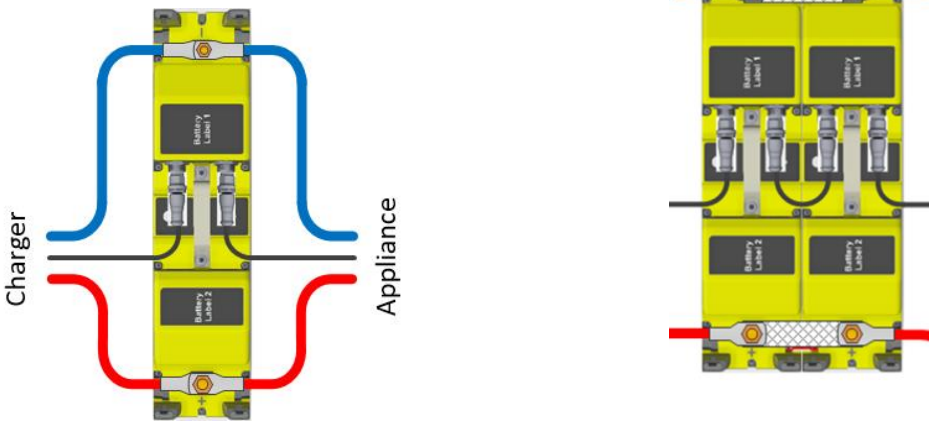
Connect the Power Minus of all modules in parallel. Tighten it with a torque of max 3.9 Nm. Please note that Power Minus is marked with the symbol -. For connection of the modules an additional busbar or wire with cable lug is needed. Please use a M6 x 16 mm screw.

Step 2: Plus terminal

Connect the Power Plus of all modules in parallel. Tighten it with a torque of max 9 Nm. Please note that Power Plus is marked with the symbol +. For connection of the modules an additional busbar or wire with cable lug is needed. Please use a M8 x 16 mm screw.

Step 3: CAN cables

Connect the CAN cables. Tighten it with a torque of max 0.6 Nm. Connect always modules next to each other (see below picture).



Step 4: CAN termination resistor

Connect the CAN termination resistor or add a CAN termination into the connector. Please make sure that the system is terminated at both physical ends of the CAN Bus.

7.3 Configuration of a system

It is necessary under the following conditions:

1. If the modules are connected the very first time.
2. If one or more modules are replaced with new module(s) in an already configured system.
3. If new modules are added to an already configured system.

Connect the batteries as described in chapter 7.1 and 7.2.

Step 1: Turn on the system by pressing the button on any battery for 3 to 5 seconds until the LEDs starts flashing orange. Alternatively, the ON/OFF signal (PIN 2) at the M12 connector can be connected to GND (PIN 3) by an external switch. LED will turn to orange (blinking).

Step 2: Press the button on any battery for at least 5s (but not longer than 10 sec.) until the LED on this battery turns red (300 ms), off (300 ms), green (300 ms) and off (600 ms) until the configuration is done (LED green). See also chapter 6.6 k.

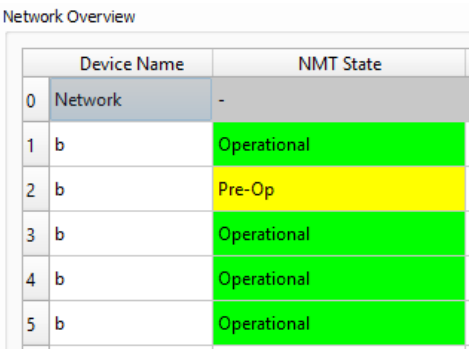
Technical details:

Each battery gets its own fixed Node ID while configuring the system. The range from 1 to 27 is reserved for fixed Node IDs, even if the system consists only of 3 batteries. Each battery sends this PDO consisting of its own value. The master sends additional PDOs with Node 27 consisting of the summary of the whole battery system.

Batteries which are not configured will not have a valid Node ID and will also not send any messages on the CAN bus. When configuring the system by pushing the button for at least 5 seconds (but not longer than 10

seconds), the batteries will determine the master of the system dependent on the highest serial number of the batteries. The Node IDs will be assigned in order of the serial numbers. When all Node IDs are assigned, the battery with Node ID 2 switches to Node ID 1 and becomes the master of the system. Because of this, there will never be an active Node ID 2 available in the system.

Example of system with four batteries in parallel:



Please switch the batteries off before adding new modules. After adding modules, start the system again. In case of orange blinking LEDs, press the push button of any battery for at least 5 seconds to reconfigure the Node IDs.

7.4 Start the battery/system

Step 1: Wake-up:

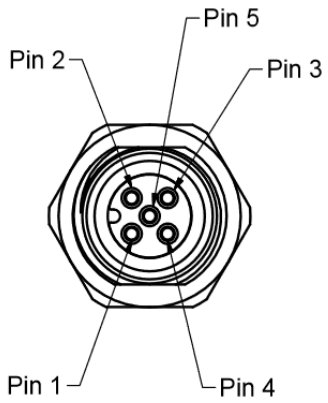
- Method 1: Push the Button (3 to 5 seconds) on one battery module (it does not matter which module) until the LED is solid green. The batteries will not turn on if the button is pushed longer than 5 seconds. This prevents turning on the battery accidentally if something blocks the button continuously.

- Method 2: Pull the ON / OFF Pin (Pin 2) of the CAN connector permanently to ground (Pin 3).

Note: Wake-Up by the external switch is prioritized. In case the battery has been turned off while the external switch was active and will be turned on again via the push button, the button only needs to be pressed for 500ms.

Please wait at least 3 seconds before turning on the battery again after turning off to ensure internal capacitors are fully discharged.

Pin-out of the M12-5 connector (female connector on the battery)



Pin 1: Wake-Up
Pin 2: ON / OFF
Pin 3: GND
Pin 4: CAN High
Pin 5: CAN Low

Note: All connectors (and all pins) are connected in parallel. The Wake-Up signal (Pin 1) is used in a system to wake up all batteries by pushing the button of any battery in the system. The ON/OFF signal (Pin 2) is used to wake up all batteries in a system by an external switch.
After Wake-Up the battery is ready for discharge. Charging is only possible if an approved VARTA CAN charger is connected, or a suitable CAN-charger has been developed under the VARTA protocol.

Step 2: Check Battery Status

- Method 1: Check if the green LED on all modules is solid green.
- Method 2: Read the Battery Status Register via CAN.

If all modules are activated, continue with Step 3.

Step 3: Discharging or Charging

- Discharging: Discharging is going to start once a load is connected to the system. Discharging is possible without CAN communication to the device.
- Charging: Connect a VARTA approved CAN charger to the system. Charging starts once there is a CAN communication between Master and charger.

7.5 Shut-down

- Method 1: Push the Button on a module twice quickly within one second (it does not matter which module).
- Method 2: Switch off the battery with the external switch, which is connected to the ON / OFF pin in the CAN connector.

8 Power Modes

There are two conditions under which the battery enters automatically shut down mode.

8.1 Condition 1: Shut down timer and shut down current (Deadband)

If no charging / discharging below a set threshold (5A default) is detected within 3h, the single module shuts-down automatically. This 3h value and the current threshold is a default and can be changed in the CAN device settings.

The default value is 3h and the value of the shutdown timer can be set via object 0x3F00.4. The default value for the current is 5 A and can be set via object 0x3F00.5. For multi-module systems, to ensure individual modules remain in-sync, it is advised that the current thresholds for the timer function are not marginal or close to the limit of under/over current to trigger the shutdown. In such cases it could potentially bring the modules out of sync, if one module timer is triggered and another not.

Steps to follow for shutdown timer:

1. **Code for write permission:**

Write value 0x0717 to object 0x2010.1

2. **Timer value (in seconds):**

Write value to object 0x3F00.4 (e.g. 604,800 dec for 7 days)

3. **Save changed parameter permanently:**

Write 0x1c2b to object 0x2010.1

If you don´t want automatic shutdown set the timer to the maximal value, which is 74444 hours (100 months).

Steps to follow for shutdown current (Deadband):

1. **Code for write permission:**

Write value 0x0717 to object 0x2010.1

2. **Current value (in mA):**

Write value to object 0x3F00.5 (e.g. 10000 dec for 10000 mA)

3. **Save changed parameter permanently:**

Write 0x1c2b to object 0x2010.1

8.2 Condition 2: Keep power timer

Once battery is fully charged (100 % SOC), battery enters shut down mode after 5 minutes by default. This timer can be changed.

Steps to follow:

1. **Code for write permission**

Write value 0x0717 to object 0x2010.1

2. **Keep power timer (in seconds)**

Write value to object 0x3F00.9 (e.g. 360 dec for 6 minutes)

3. **Save changed parameter permanently**

Write 0x1c2b to object 0x2010.1

If you do not want automatic, keep the power timer set the timer to the maximal value, which is 0xffffffff.

9 User Specific Changeable Parameters

There is a specific area for "User Specific Changeable Parameters". These parameters can be accessed via CANopen Protocol and SDO transfer. For changing proceed the following steps:

Example:

1. **Get Write permission:**

Write "0x0717" in object 0x2010.1

2. **Change Current Value to e.g. 20A (=20,000 mA) in "Normal Temp Range":**

Write "0x4e20" in object 0x3F00.6

3. **Save values permanent in EEPROM:**

Write "0x1c2b" in object 0x2010.1

4. **Reboot battery:**

New value is valid only after reboot (switch off and on the battery).

Below objects can be configured by the customer.

Object ID	Object Description	Write permission	Save value in EEPROM	Description	Format
0x3f00.1	Configuration string customer	0x0717 in Object 0x2010.1	0x1c2b in Object 0x2010.1	String for general purpose	32byte String
0x3f00.2	Serial number customer	0x0717 in Object 0x2010.1	0x1c2b in Object 0x2010.1	Customer can add own serial number if needed	Unsigned32
0x3f00.3	Date code customer	0x0717 in Object 0x2010.1	0x1c2b in Object 0x2010.1	Customer can add own date code if needed	Unsigned16
0x3f00.4	Shut down timer	0x0717 in Object 0x2010.1	0x1c2b in Object 0x2010.1	Shutdown timer. If standby current of application is less than the values which is defined in 0x3f00.4, the battery will switch off after expiration of the shutdown timer (default 10800s)	Unsigned32
0x3f00.5	Battery discharge current system shutdown delay threshold	0x0717 in Object 0x2010.1	0x1c2b in Object 0x2010.1	Deadband for the system. (Default 5000mA).	Unsigned32

0x3f00.6	Battery charge max current normal temperature	0x0717 in Object 0x2010.1	0x1c2b in Object 0x2010.1	Max current which is allowed in normal temperature range. Please note: It cannot exceed the protection threshold of the battery.	Unsigned32
0x3f00.7	Battery charge max current high temperature	0x0717 in Object 0x2010.1	0x1c2b in Object 0x2010.1	Max current which is allowed in high temperature range. Please note: It cannot exceed the protection threshold of the battery.	Unsigned32
0x3f00.8	CAN baud rate	0x0717 in Object 0x2010.1	0x1c2b in Object 0x2010.1	Baud rate can be change via this object. Default is 250 kbit/s. Possible baud rates are 125/250/500/1000	Unsigned16
0x3f00.9	Keep power timer	0x0717 in Object 0x2010.1	0x1c2b in Object 0x2010.1	Once battery is fully charged (100 % SOC), battery enters shut down mode after 5 minutes by default. This timer can be changed via this object.	Unsigned32

10 Operation

10.1 Power gap

For Easy Blade 24 V / 48 V (56654 799 097) and Easy Block there is a power gap of around 250 ms in the transition phase from discharge mode to charge mode and vice versa. This power gap might lead to a shutdown of the end application. The power gap has to be buffered on customer side e.g. via capacitor.

For Easy Blade 36 V / 48 V (56654 799 092) there is no power gap anymore.

Products	Order number (VKB)	Power gap
Easy Blade 24 V	56654 799 098	Yes
Easy Blade 36 V	56654 799 089	No
Easy Blade 48 V	56654 799 092	No
Easy Blade 48 V	56654 799 097	Yes
Easy Block 24 V	56650 764 099	Yes
Easy Block 48 V	56650 764 098	Yes

10.2 Pre charge circuitry

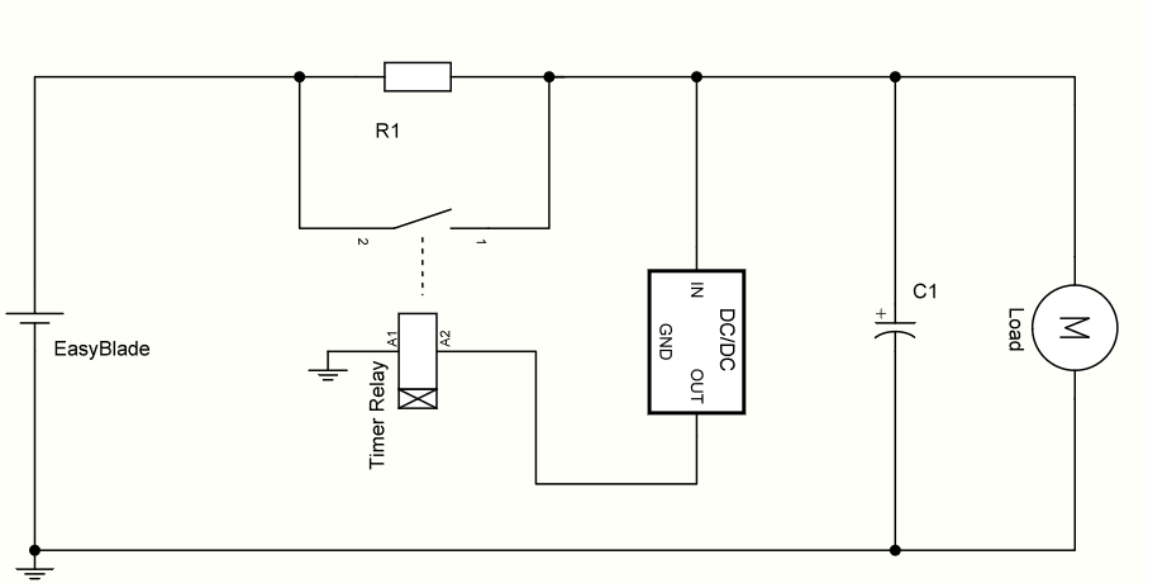
For applications with a high input capacitance, Varta recommends adding a pre-charge circuity into the device to limit the inrush currents as there is no build in pre-charge circuity in the battery. High inrush currents might trigger the short circuit protection in the Easy Blade battery which lead to a shutdown of the system during start-up.

The short circuit protection in the battery will be enabled if a current of 300A for 300µs is exceeded.

Varta recommends following pre-charge circuitries:

Option 1: Via a series resistor

The input capacitor is pre-charged via a series resistor (R1). After a defined delay, which is pre-set in the timer relay, the main power path is enabled.



Please keep the pre-charge current as low as possible to reduce the cost for the pre-charge resistor. Typical pre-charge currents are in the range of 5A-15A.

Formula to calculate the pre-charging of a capacitor:

$Uc(t)=U_0\times(1- e^{(- t/(R \times C))})$

Uc(t): Capacitor voltage after time t
U0: Battery voltage
t: time
R: resistance of pre-charge resistor
C: Input capacitance

Example for pre-charge resistor:

TE Connectivity HSC10010RJ 10Ohm (+/- 5%) 100W

Example for timer relay:

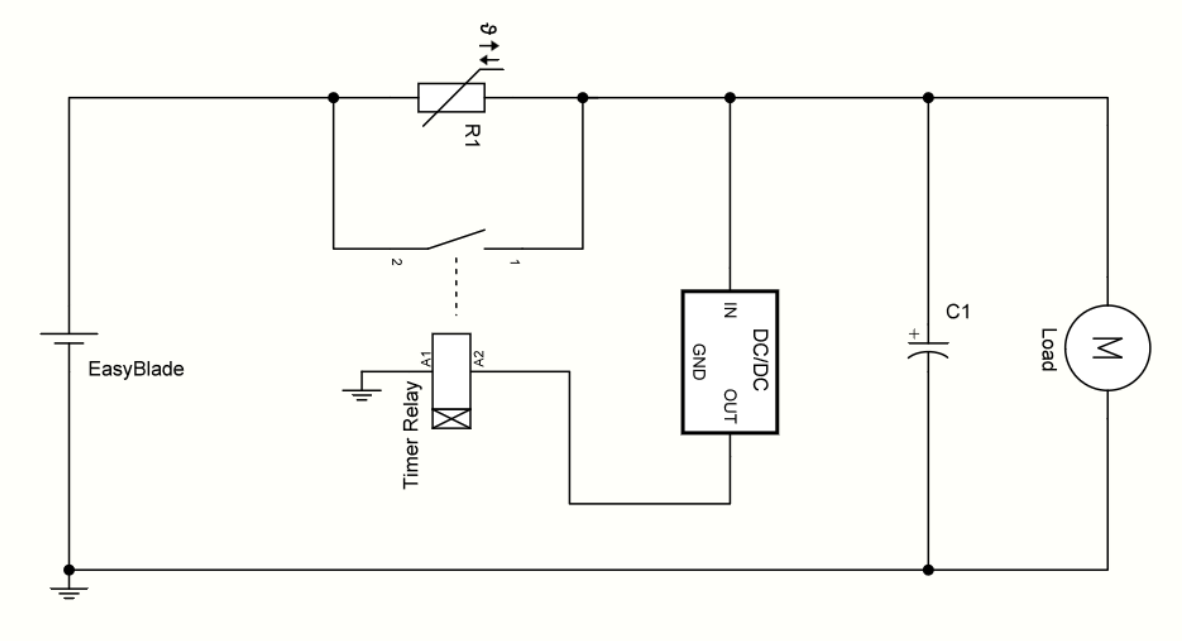
Phoenix Contact 2905814

Example for relay in main power path:

Siemens 3RT2026-1AP00

Option 2: Via NTC

The input capacitor is pre-charged via a NTC (R1).



Example for NTC:

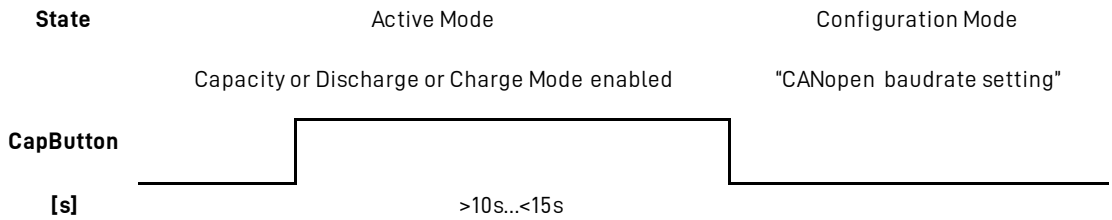
EPC B57364-S100 10Ohm, 5.1W

11 Baud Rate

There are two possible ways to change the baud rate:

11.1 Option 1: via push button

Switch into configuration mode "CANopen baudrate setting" while the BMS is in Active Mode it is possible to start this configuration mode by pressing the onBoard button a long time.

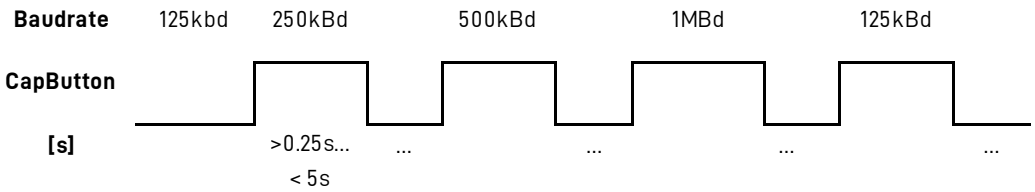


When **10s** are reached, the LED display shows short feedback to signal that the button has to be released to start the configuration If the button is released within the mentioned time range the configuration mode starts. The BMS LED display shows the state switch. The flag WARNING_REG_SET_CAN_BAUDRATE_PROCESS_ENABLE is set. The BMS waits for further key pressing to

change the baudrate setting or to finish this configuration mode. All other kinds of key pressing events (e.g. switch into DeepSleep Mode) and also events which occur on the External Signal GPIO were ignored during this configuration mode

Change baudrate during "CANopen baudrate setting"

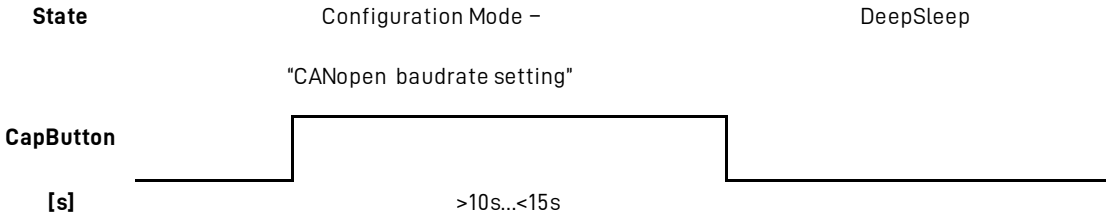
While the BMS is in the mentioned configuration mode it is possible to toggle between several baud rate settings by short pressing the onBoard button. There are 4 different fix baudrate settings possible which are changed with every key press in a Sequential rotating order e.g. if the setting was 125kBd while the configuration mode was entered, after the first press 250kBd will be selected and so on.



The actual selected baud rate is shown via the BMS LED display. This is only a preselection for an internal temporary table index during this configuration mode the CAN interface is not be influenced. CAN interface will only be reinitialized after the configuration is finished and the BMS will be restarted

Finish setting during "CANopen baudrate setting"

While the BMS is in the mentioned configuration mode it is possible to finish the configuration mode by pressing the onBoard button again for a long time.



When **10s** are reached, the LED display shows short feedback to signal that the button has to be released to store the configuration. The corresponding CAN baudrate of the last selected table index is stored into the EEPROM to can be used after the next restart from DeepSleep Mode. If this restart is desired, it has to be initiated by the user e.g. double key press or software reset via CAN.

Abort setting during "CANopen baudrate setting"

If there is no button pressed within a timeout period of **60s** the configuration mode would be aborted without any changes concerning CAN baudrate setting and without any store into EEPROM.

Battery is in configuration mode: "CANopen baudrate setting"

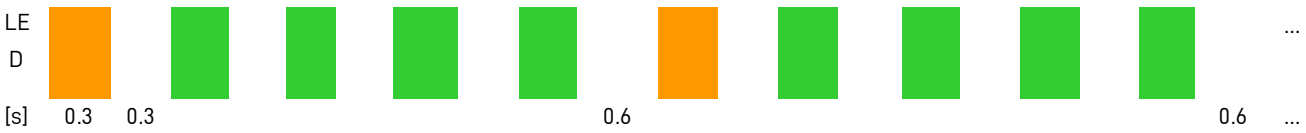
If the user has started the configuration mode: "CANopen baudrate setting" by pressing the onBoard button, feedback is given that the configuration mode is initiated. The baudrate can be selected by further user key press interaction and the LED shows which kind auf baudrate is actually selected:

- In case: **125 kBd** is selected
  LED continuous flashing: 1 x orange – 1 x green - break...

- In case: **250 kBd** is selected
  LED continuous flashing: 1 x orange - 2 x green - break ...

- In case: **500 kBd** is selected
  LED continuous flashing: 1 x orange – 3 x green - break ...

- In case: **1 MBd** is selected
  LED continuous flashing: 1 x orange - 4 x green - break ...



11.2 Option 2: via customer objects

Steps to follow:

1. **Code for write permission**

Write value 0x0717 to object 0x2010.1

2. **2.Keep power timer (in kbit/s)**

Write value to object 0x3F00.8 (e.g. 125 dec for 125 kbit/s)

3. **Save changed parameter permanently**

Write 0x1c2b to object 0x2010.1

12 Easy Blade - Cooling concept

The Easy Blade has two radial fans to cool the battery in case of increasing temperature. You can see in below spreadsheet the performance of the fans, which depends on the temperature inside the battery. There are different thresholds for charging and discharging.

Discharging:	Charging:	Fan
<30°C	<30°C	off
30°C – 35°C	30°C – 32,5°C	25 %
35°C – 40°C	32.5°C – 35°C	50 %
40°C – 45°C	35°C – 37.5°C	75 %
>45°C	>37.5°C	100 %

Please note for a good circulation, the modules need at least a distance of 5 cm between the battery and the device on both sides (fan side and opposite side). If the batteries are built in into a compartment/enclosure, please ensure fresh air circulation (from outside via slots).

13 Charging

Charge algorithm is controlled by the battery itself. Either a VARTA-approved charger can be used or also a customized charger which follows the CANopen standard and the VARTA ASB charger specification, which is available on our homepage for custom developments. Charging will not start without CAN communication.

For the Easy Charger 24 V and 36 V (charger is without any resistor) you need to implement a termination resistor at the charger end. This makes it easier to remove the charger while the bus is still terminated. The Easy Charger 48 V (ICL150058 V) includes already a selectable termination resistor. This could be used when the charger is used as on-board charger and stays connected at the system.

The termination resistor can be implemented e.g. by a Y-cable: 1 plug for the termination resistor and one plug for the charger communication. It is also an option for you to integrate an "easier" way to connect the charger to the battery and to implement the termination resistor in your own adapter.

13.1 Regenerative charging

Modules accept regenerative charging with below specified limits:

- If current is below 65A for 5s.
- If battery voltage is below:

Products	System voltage [V]
Easy Blade 24 V	29.7
Easy Blade 36 V	42.5
Easy Blade 48 V	59.5
Easy Block 24 V	29.2
Easy Block 48 V	58.4

14 Error

In case of an unexpected behaviour of the battery or if any threshold limit is violated, the battery will store an internal error event. The LED of the battery will be steady red if the operating state does not change. This means that the battery will be operating again, if the cause of the error is not present anymore and the

battery is turned off and on again. In case of a non-reversible error, the LED will blink red and the battery cannot be used anymore.

If an error occurs while charging, the charger will be commanded to shut down the charge current and the Charge FET will be opened to prevent any further charging. If an error occurs while discharging, the discharge FET will be opened to prevent any further discharging.

The battery saves the record of every individual error in the internal memory which can be read via CAN from object 0x201A sub 1 to sub 64. The history of the error which occurred can be read from object 0x2018 sub 1 to sub 16 which stores the last 16 events.

Detailed error list can be downloaded on our homepage: www.varta-ag.com/asb

15 The CAN Protocol

Communication between all batteries in the system, the charger and the application (optional), occurs via the standardized CANopen protocol. For more detailed information about CANopen please visit the official website from "CAN in Automation" (CiA) at https://www.can-cia.org/canopen/.

At normal operation, all necessary data is transmitted via PDOs in cyclic intervals. If the application needs more information, more data can be accessed via SDO request to the master battery. Please note: Data via SDO shall not be requested during normal operation, only in service cases.

The CAN PDO list can be downloaded on our homepage: www.varta-ag.com/asb

No customized Service software is available. VARTA recommends the standard CANopen Software for debugging / read-out of CAN Objects, which is CAN Device Explorer from Emotas (https://www.emotas.de/produkte/canopen-device-explorer)

CAN EDS file is available on our website to preconfigure the CAN Device Explorer Tool. https://www.varta-ag.com/de/industrie/service/downloads

Product	Order Number (VKB)	Firmware version
Easy Blade 24 V	56654 799 096	V02.06.02.00
Easy Blade 24 V	56654 799 098	V01.20.00.00
Easy Blade 36 V	56654 799 089	V02.06.02.00
Easy Blade 48 V	56654 799 092	V02.06.02.00
Easy Blade 48 V	56654 799 097	V01.20.00.00
Easy Block 24 V	56650 764 099	V01.20.00.00
Easy Block 48 V	56650 764 098	V01.20.00.00

15.1 Communication within the battery system

All data required to operate a battery system is transferred via Process Data Objects (PDOs). Each battery transmits data in cyclic intervals with the following definition based on Node ID 1. PDOs sent by other Node IDs increase the CAN-ID, e.g. TPDO_1 sent by Node ID 4 has CAN-ID 0x184.

PDO	CAN-ID	Type	Node-ID	Data		Event
				Battery Voltage	Battery Average Current	
TPDO_1	0x181	PDO	1	uint32 [mV]	int32 [mA]	1s

PDO	CAN-ID	Type	Node-ID	Data				Event
				Max. FET Temp.	Max. Cell Temp.	Charge Voltage Req.	Charge Current Req.	
TPDO_2	0x281	PDO	1	int16 [0.1°C]	int16 [0.1°C]	uint16 [mV]	uint16 [mA]	1s

PDO	CAN-ID	Type	Node-ID	Data				Event
				Battery Cap.	Battery Full Cap.	Battery Rem. Cap.	not used	
TPDO_3	0x381	PDO	1	uint16 [mAh]	uint16 [mAh]	uint16 [mAh]		1s

PDO	CAN-ID	Type	Node-ID	Data				Event
				Information Status	Warning Status	Error Status	Charge Control Status	
TPDO_4	0x481	PDO	1	uint16	uint16	uint16	uint16	100ms

15.2 Communication sent by the battery master (for application)

The battery, which is configured as the master, sends cyclic data of the complete system. Every state of each module is summarized in TPDO_8. In this way only one PDO needs to be checked in case of monitoring the system for faults and errors.

PDO	CAN-ID	Type	Node-ID	Data		Event
				Master Voltage (Max. Battery Voltage)	Master Current (sum of all modules)	
TPDO_5	0x19B	PDO	27	uint32 [mV]	int32 [mA]	1s

PDO	CAN-ID	Type	Node-ID	Data			Event
				Max. Battery FET Temperature	Max. Battery Cell Temperature	Master Design Capacity (sum of all modules)	
TPDO_6	0x29B	PDO	27	int16 [0.1°C]	int16 [0.1°C]	uint32 [mAh]	1s

PDO	CAN-ID	Type	Node-ID	Data		Event
				Master Full Charge Capacity (sum of all modules)	Master Remaining Capacity (sum of all modules)	
TPDO_7	0x39B	PDO	27	uint32 [mAh]	uint32 [mAh]	1s

PDO	CAN-ID	Type	Node-ID	Data				Event
				Master Information Status Register	Master Warning Status Register	Master Error Status Register	Master Charge Control Status Register	
TPDO_8	0x49B	PDO	27	uint16	uint16	uint16	uint16	200ms

Battery Information Status Register	
Bit	Description (master / slave)
15	-
14	-
13	-
12	-
11	-
10	-
9	-
8	-
7	-
6	all modules / this module fully charged
5	-
4	bypass FET on
3	all modules / this module DSG FET closed
2	all modules / this module CHG FET closed
1	all modules / this module are almost empty
0	all modules / this module empty

Battery Error Status Register	
Bit	Description
15	unknown
14	module defect
13	over- or undertemperature discharge
12	over- or undertemperature charge
11	overcharge alarm
10	undercharge alarm
9	max. discharge current alarm
8	max. charge current alarm
7	charge FET error
6	discharge FET error
5	max. voltage alarm (pack)
4	shortcircuit discharge alarm
3	shortcircuit charge alarm
2	overcharge condition recuperation
1	error lock flag charge
0	error lock flag discharge

Battery Warning Status Register		
Bit	**Description**	**Detailed Description**
15	unknown	Set if other than Bit 0 - 14 warning is set. Please contact Varta in this case.
14	set node ID process enable	During start up of the systen the Node IDs are assigned automatically to the individual modules. During this period, the set node ID process enable warning is
13	-	
12	set deactivation enable	If battery is fully charged and the keep power timer has expired or if external ON/OFF switch is pressed, the battery shutsdown. The set deactivation enable warning is set prior to this.
11	can network failed	This warning is set if there is a CAN Network failure. E.g. one or more modules cannot communicate on CAN Bus.
10	-	
9	-	
8	-	
7	max charge condition recuperation	Set if battery exceeds overvoltage condition during recuperation.
6	-	
5	-	
4	over- or untertemperature charge	Set if temperature exceeds the warning limits during charging
3	over- or undertemperature discharge	Set if temperature exceeds the warning limits during discharging
2	reserve SOC	Set if reserve SoC warning limit is exceeded
1	low SOC	Set if low SoC warning limit is exceeded
0	low voltage	Set if low voltage warning limit is exceeded

Battery Charge Control Status Register		
Bit	**Description**	**Detailed Description**
15	Charger supply conditions ready	Set if HB is present AND Master_charger_control_charging_ready (Bit14) is set AND Bit12 | Bit13 | both Bits are set in RPDO1 (COB-ID 0x1e4)
14	Master charger control charging ready	Set if HB is present AND SDO Initialization sequence has finished
13	Charge FET disable temp range cells	Set if battery temperature exceeds the maximum allowed charging temperature
12	Charge Master set charger output off	Set if battery is fully charged and keep power timer has expired
11	charge max charge cell voltage request	Set if requested charge voltage is at maximum
10	charge max charge current request	Set if requested charge current is at maximum
9	-	
8	charge current high temp range	Set if battery temperature is within high temp range
7	charge current normal temp range	Set if battery temperature is within normal temp range
6	charge current low temp range	Set if battery temperature is within low temp range
5	charge current keep power	Condition1: Set if HB is present and Bit12 or Bit13 or both Bits are not yet set Condition2: Set if HB is present and battery has reached fully charged state
4	charge current enable	Set if HB is present AND SDO Initialization sequence has finished
3	-	
2	-	
1	charge voltage keep power	Condition1: Set if HB is present and Bit12 or Bit13 or both Bits are not yet set Condition2: Set if HB is present and battery has reached fully charged state
0	charge voltage enable	Seit if HB is present AND SDO Initialization sequence has finished

Register description in TPDO_8 is similar to TPDO_4 with following interpretation
Information Register: every state of each module is "anded" in this PDO and shows the summary of the system
Warning Register: bit 15...3 of every module is "ored"; bit 2..0 is calculated by master
Error Register: every state of each module is "ored" in this PDO and shows the summary of the system
Charge Control Register: every state of each module is "ored" in this PDO and shows the summary of the system

15.3 Communication sent by the battery master (for charger)

The master also sends the system requirements for charging to the charging device

				Data								
PDO	CAN-ID	Type	Node-ID	Charge Control	SoC		Charge Voltage Req.		Charge Current Req.		Battery Status	Event
TPDO_9	0x264	PDO	100	uint8	uint8	uint8	uint16 [1/256 V]		uint16 [1/16 A]		uint8	100ms
Example				0x01	0x64	0x00	0x19	0x1E	0x40	0x02	0x01	
					100%		30.097 V		36 A			

The battery master will initialize the charger to the appropriate voltage and current needed to charge the battery system. The voltage and current values requested from the charger will be sent every 100 ms. In case of a fully charged battery, the battery will set its "fully charged" flag in the battery information status register (bit 6) and opens its charge FET. When all batteries of the system are fully charged, the master sets its "fully charged" flag and sets the charger to a standby value for the time, which is defined in the object 0x3F00.9 (keep power timer). After this delay, the battery system will shut down. Please see spreadsheet below for

the batteries with fixed value in the keep power timer, which cannot be changed. For batteries, which are not fixed the value can be changed see chapter 8.2.

Products	Order number (VKB)	Keep power timer is fixed
Easy Blade 24 V	56654 799 098	Yes
Easy Blade 36 V	56654 799 089	No
Easy Blade 48 V	56654 799 092	No
Easy Blade 48 V	56654 799 097	Yes
Easy Block 24 V	56650 764 099	Yes
Easy Block 48 V	56650 764 098	Yes

16 Life Time / Safety

16.1 Lifetime

The total lifetime of lithium-ion batteries in terms of both calendar life (age) and cycle life (number of full charge/discharge events) is affected by many factors. In general, the more "gently" a battery is treated, the longer it will last and the better the lifetime will be (to a certain limit). The main factors which can negatively impact this would be extremes of temperature, sustained higher or lower temperatures and higher charge or discharge rates (especially if sustained or continuous).

For Easy Blade: Charging current 1C is allowed but 0.5C is recommended for cycle life of 1200 cycles. 1C charging every time will reduce cycle life significantly for the NMC chemistry to around ~300 cycles. The temperature variation is approximately 70% capacity available at -10°C, 85% at 0°C and 100% at 25°C. Colder temperature will increase total charge time. Partial recharges are not a problem, the total number of partial recharges where, for example max charge voltage is never reached or minimum charge voltage is never reached will extend the total number beyond 1200 cycles. Shelf life: 24 months when shipped from VARTA, conservative estimate.

For Easy Block: Charging current up to 1C is allowed with negligible impact on cycle life. The temperature variation is approximately 70% capacity available at -10°C, 85% at 0°C and 100% at 25°C. Colder temperature will increase total charge time. Partial recharges are not a problem, the total number of partial recharges where, for example max charge voltage is never reached or minimum charge voltage is never reached, will extend the total number beyond 4000 cycles. Shelf life: 24 months when shipped from VARTA, conservative estimate.

16.2 Safety thresholds

<u>General for Easy Blade and Easy Block:</u>

Fuse: Siba 5005038.100 (one shot – 100A)
Short circuit protection: 300A / 0.3 ms (reacts faster than the fuse)
Discharge over-current protection 1: 65A / 5s
Discharge over-current protection 2: 85A / 50ms
Charge over-current protection 1: 65A / 5s
Charge over-current protection 2: 85A / 50ms

<u>Individual:</u>

Products	Over -voltage protection	Under-voltage protection
Easy Blade 24 V	29.75 V / 4s	18.2 V / 2s
Easy Blade 36 V	42.5 V / 4s	26 V / 2s
Easy Blade 48 V	59.5 V / 4s	36.4 V / 2s
Easy Block 24 V	30 V / 4s	16 V / 2s
Easy Block 48 V	60 V / 4s	32 V / 2s

17 FAQ

17.1 Charger / Charging

What happens if the modules in a battery system which are connected in parallel, have different states of charge (SOC)?

If the modules have different states of charge within the overall battery, then a common state of charge is triggered by discharging the modules, which have a higher state of charge. Basically, only the DSG FETs are opened when the modules are switched on (not the CHG FETs). This prevents a module with a higher state of charge from charging the modules with a lower state of charge and thus high equalizing currents from flowing between the modules. If a load is now connected, the modules are discharged from "full" to "empty" over time. This means that the CHG FETs are only closed when a module with a lower state of charge is within a maximum limit (voltage delta) from the voltage of the "fullest" module. Only at this moment is the power provided by the battery. In this way, there is an automatic balancing of the individual modules in a system.

Important: For this reason, if modules are changed within a system which have different state of charge levels, we recommend first to fully charge the pack, in order to equalize all modules. This will prevent one module being used within a system to handle high currents intended for multiple modules, which could cause a safety trip in the electronics.

Can I trickle charge the battery?

No, lithium ion has to be charged in a "constant current, constant voltage" method (CC/CV) and done so cyclically. The battery does not support trickle charging.

What is recommended for 'Fast Charge' and what is recommended for 'Cycle Life'?

Easy Blade – to achieve cycle life of 1,200 cycles and beyond, the max charge current recommended is 0.5C, discharge current of 0.5C. High charge rates will have a significant negative effect on cycle life.

Easy Block – Max charge current allowed is 1C and it will have minimal impact on lifetime, due to the different cell technology.

Do you have any recommendations for the storage/charging of these batteries?

In general, storage around room temperature / lower temperatures will be better for long-term battery life (this is applicable to all lithium batteries). For best cycle lifetime, charge rates of max. 0.5C-rate would be recommended. Higher charge rates on a continuous basis will reduce the cycle life. **For the Easy Blade**, regular charge rates >0.7C will reduce cycle life significantly. For the Easy Block, the cell technology is not so affected. It should be avoided where possible to store the batteries when empty for an extended period; they are better stored with some charge. At the shipping condition of ~25% state of charge level, we estimate

24 months storage conservatively but for such long-term storage we would always recommend a basic voltage check once per year.

17.2 CAN communication

Is it possible to change the base CANopen ID that is given to the master battery as well as all the other slave batteries?

The Node IDs in the system are fixed and not changeable outside the specified range.

Do you have any software drivers for communication/setup that are compatible with Ubuntu?

We do not have any special software. We are using standard USB to CAN Interfaces like Peak CAN Interface which is fully compatible with Linux (drivers). The software itself must be developed by the customer in this case. If you want to use an open source CANopen stack, you can try to script with python.

17.3 TPDO/SDO

TPDO7: Master Full Charge Capacity: what is the difference to TPDO6's Master Design Capacity?

Design capacity (DC) is the initial capacity of the batteries. The Full Charge capacity (FCC) is the "learned" capacity during a learning cycle. FCC / DC = SOH

How do I calculate the SOC?

Formula: RC / FCC = SOC

RC= remaining capacity
FCC = Full charge capacity
SOC = State of charge

17.4 Mechanical

For parallel mechanical connection, we'll use the "module connectors". Where can I get it?

Two module connectors and two screws are included in every box.

Does the design feature that allows connection in height also provide a mechanical lock like the module connectors do?

No, they don't lock in the same way, it is more for stability.

Do you sell copper bus bars for parallel connection of batteries?

No, but this should be possible to organize with our distributors of the ASB range. Contact details are available on our website or in the Technical Handbook.

Do you sell CAN bus cables with the correct length for connection between cells?

No, but this should be possible to organize with our distributors of the ASB range. Contact details are available on our website or in the Technical Handbook.

17.5 General

When setting parameters do the parameters need to be set on each individual module?

Yes, the parameters must be changed for all Nodes, The EDS file is valid for all batteries, but the Node ID must be adjusted accordingly.

We want to replace the batteries for charge and would like a platform that would monitor the battery level. This would recognize when the battery level had dropped below a set limit and signal that the batteries need replacing (by an operator). Is this possible to implement?

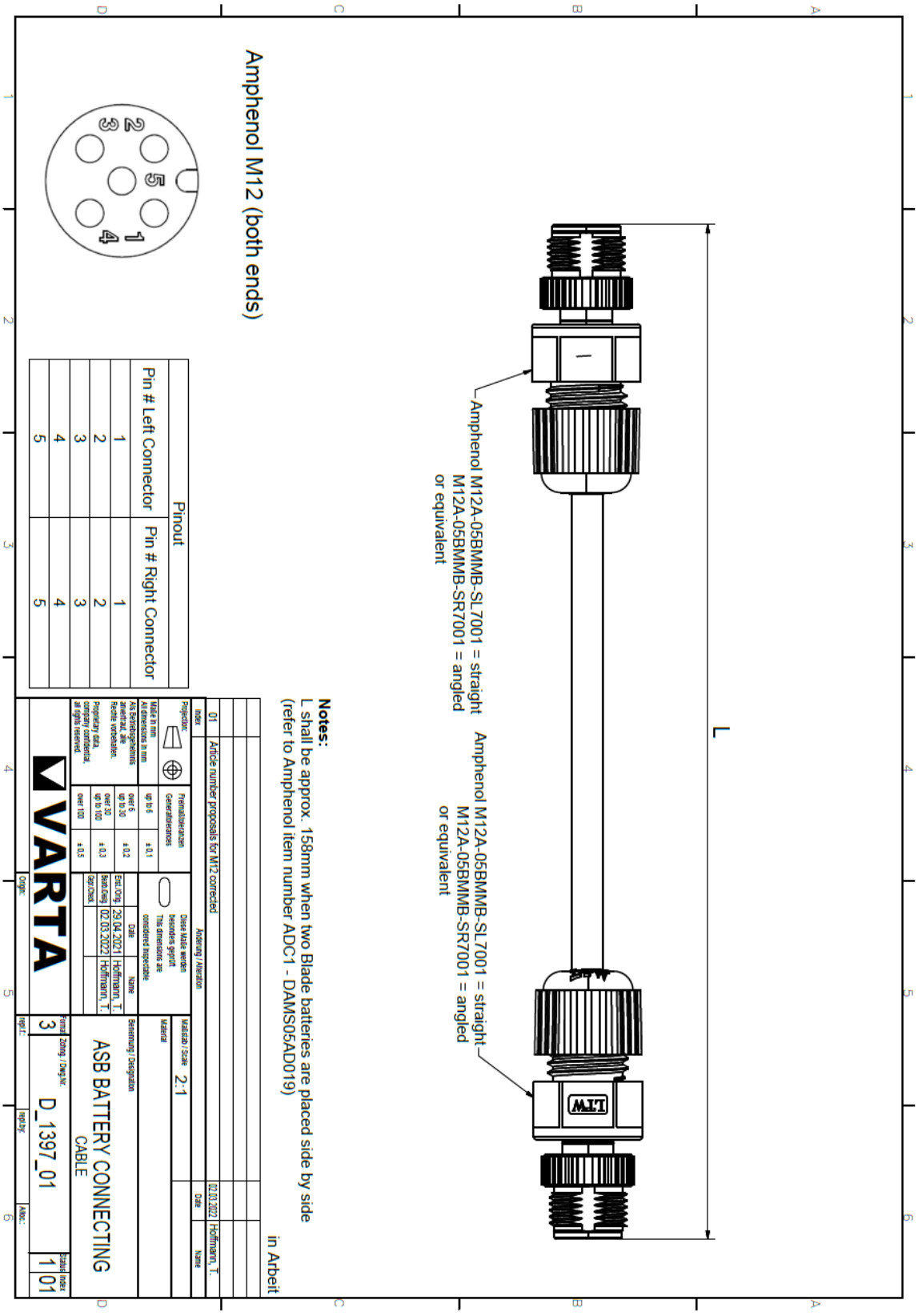
Yes, the batteries will be able to support this monitoring. We recommend you consider a proper shutdown of the system before removing or replacing and run testing before release to make sure the system configures correctly and behaves as expected in the field when replaced (and reset).

Is it possible to switch off remotely during discharge... i.e. forced shut-down option?

Not via CAN, but via the on/off switch at the CAN connector it is possible.

18 Appendix

18.1 Communication cable drawing:



18.2 Charging cable