OPERATING MANUAL

Battery- Monitor BLS / BLS-Set

Thank you for buying the Battery Monitor BLS. This digital unit is state of the art in Battery monitoring.

Battery monitor:

On the large, illuminated display you can read:

- the current state of charge
- charge and discharge currents
- the battery voltage
- the remaining operating time until the adjustable capacity alarm of the main battery
- the voltage of up to 2 additional batteries

You have the possibility of adjusting an alarm threshold

- if the capacity of the main battery falls below a certain threshold
- when a voltage threshold is exceeded or an undervoltage occurs

The battery monitor BLS constantly monitors the voltage and current of the main battery and detects the full charge as well as its complete discharge. The values for battery capacity and charging efficiency (CEF) are adjusted at each cycle to provide the most accurate capacity indication possible.

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1 General Information

1.1 Purpose

The battery monitor BLS can only be operated with low voltage DC 8-32V in conjunction with the shunt SHE-300. It is designed for use on yachts and may only be operated in closed rooms that are protected from rain, humidity, dust and condensation. Never use the battery monitor in places where there is a risk of explosion due to gas or dust. The battery monitor is not suitable for outdoor installation.

1.2 Scope of delivery

- Battery Monitor BLS
- 3 Plug-in terminals (MVSTB 2,5- 2- and 3-and 9-pole)
- 2 fuse holder ASH1 incl. fuse FSS 1A
- This operating manual

Optional parts (to be ordered separately):

- SHUNT SHE 300 (included in BLS-Set) Order-No.: 0 7003 0300
- Temperature probe Temp-BT Order-No.: 0 5900 3000
- Battery Charger Interface ACE-LIN Order-No.: 0 8000 4975

1.3 Warranty

Warranty is granted for a period of two years from the date of purchase. Defects as a result Material or manufacturing defects are eliminated free of charge if:

- The device is sent to the manufacturer free of charge.
- The proof of purchase is enclosed
- The device has been treated and used as intended.
- No foreign spare parts have been installed or interference has been made.

Excluded from the guarantee are damages caused by:

- Overvoltage at the inputs or incorrect connection
- Liquids spilled into the device or oxidation due to condensation
- Lightning strike

Not covered by the warranty are consequential costs and natural wear.

When asserting claims under warranty and warranty, a detailed description of the defect is essential. Detailed instructions facilitate and speed up the processing. Please understand that we cannot accept shipments that are not free.

1.4 Disclaimer

Both the compliance with the operating instructions and the conditions and methods for installation, operation, use and maintenance of the battery monitor BLS cannot be monitored by philippi electrical systems gmbh. Therefore, we assume no responsibility or liability for any loss, damage or expense resulting from improper installation or improper operation.

1.5 Quality assurance

During production and assembly, the devices undergo several checks and tests. Fabrication, checks and tests are carried out according to established protocols. Each device has its own serial number. Never remove the nameplate. The assembly and the test of all devices are carried out completely in our facilities.

2. Safety instructions

- It must not be changed on the device, otherwise it will go out CE mark
- The battery monitor may only be connected by qualified electricians.
- Disconnect the battery leads before connecting the battery monitor.
- Pay attention to the correct polarity of the batteries!
- The power supply to the monitor and shunt must be protected.
- **This device is not intended for use by children.**

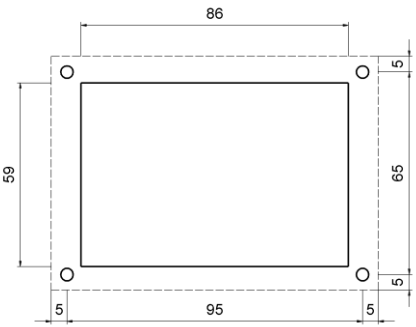
The present installation and operating instructions are part of the component delivery. It must - well important for subsequent maintenance - well kept and passed on to any subsequent owners of the device.

3. Installation

3.1. Monitor

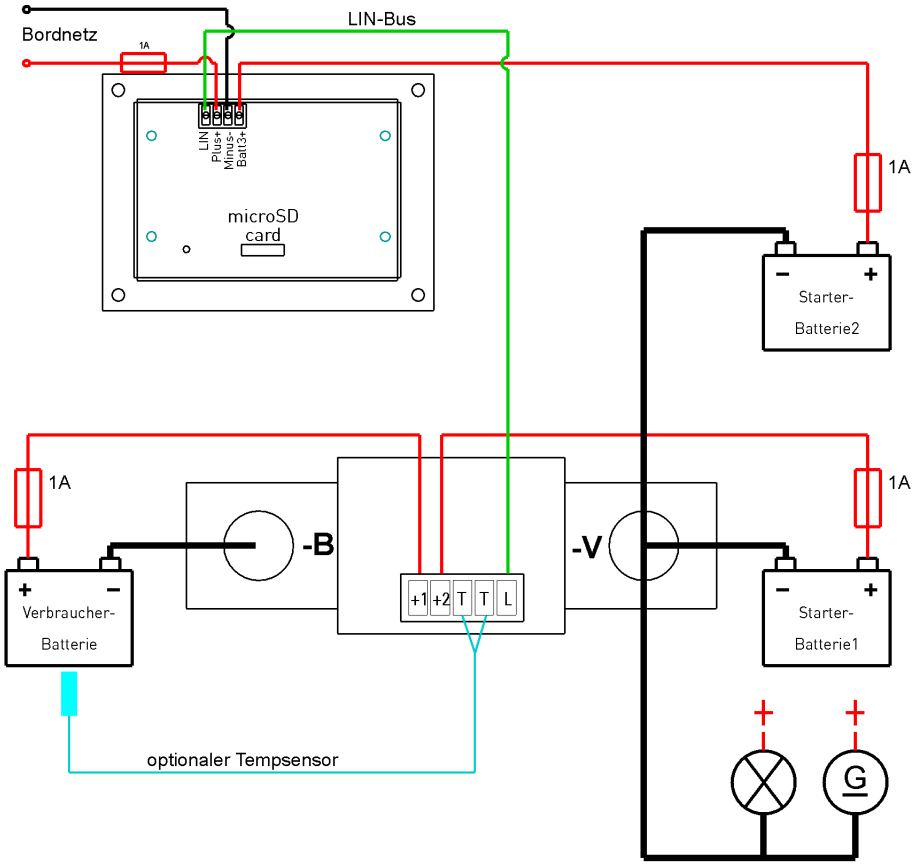
Install the monitor in a protected, dry and well-visible place so that it can be read at any time. The cut-out is 86 x 59 mm, the required minimum depth is 40mm. On the back side there is a 4-pin terminal for the power supply of the monitor and the communication line to the shunt SHE.

On the back side, a software update can be uploaded to the monitor via a micro SD card.



The power supply of the monitor can be interrupted at any time without losing battery status data, as these are stored in the shunt SHE 300.

Therefore, the shunt SHE 300 should permanently be connected to the battery. If the monitor is switched off, the shunt SHE goes into sleep mode and the current consumption of the shunt drops to 2 mA. This does not represent a special load for the battery. If the battery system remains for more than 3 months without charge, the shunt should also be disconnected from the battery.
The following figure gives an overview of the connection of the monitor and the shunt SHE 300. The LIN bus connecting cable between the monitor and the shunt takes place via a 1-core cable. This can also consist of any or existing line. The cable cross-section should be min. 1mm² and max. 1.5 mm².



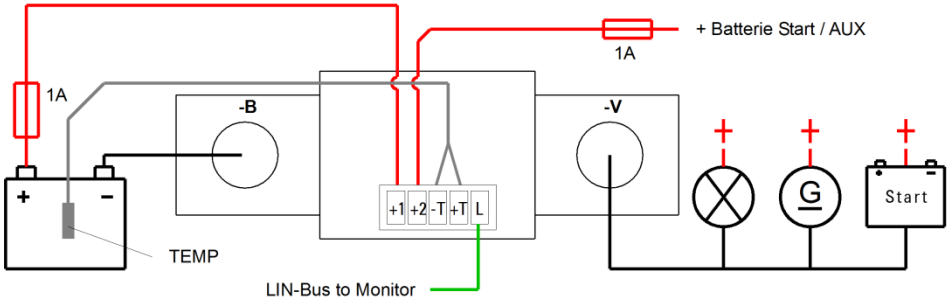
3.2. Shunt

Mount the Shunt SHE 300 in a protected, dry place as close as possible to the battery. The shunt must be connected to the **NEGATIVE** path of the battery.

Install the active shunt SHE 300 as close as possible to the service battery. Avoid however, that the shunt has contact with the plus connection of the batteries. Connect the B- marked side of the shunt to the negative terminal of the main battery with a short, thick cable (35-70 mm²). Connect the negative pole of the up to two starter batteries to the side of the shunt marked V-.

Note: If the main battery consists of several parallel-connected batteries, their common negative inlet-pole must be connected to the B- marked side of the shunt. The negative cable of the starter battery must be connected to the other side (V-) of the shunt. We recommend to install a ground bus bar, so that all negative connections of the load, charging devices and the negative poles of the starter batteries are combined. This ground bus bar has to be connected to the V-connection of the shunt.
Connect the measuring lead of the shunt to the positive terminal of the main battery via an inline fuse holder (1A). This line is used to measure the voltage of the main battery and at the same time to supply the shunt with power.

It is important, that no further cables are connected between connection B- and the NEGATIVE battery pole, since otherwise not all currents will be detected and the battery management will not be able to work correctly.
All lines of the electrical system including the connecting cable to the starter battery must be connected to the V- side of the shunt SHE 300.



supervised battery bank

loads, charging sources, Starter-Battery

After applying the operating voltage at pin +1, the shunt goes into operation and indicates the operating status via the integrated **LED**:

- Fast flashing during firmware update of the Shunt SHE
- Flash every 1 sec. Normal operation
- Flash every 5 sec. Sleep Mode when monitor off

At the shunt following connections are available at the 5 pol. connector:

1: Battery voltage measuring lead (+1) and simultaneously power supply for shunt
This cable is essential for the shunt function and should only be disconnected in winter storage in order to allow a complete recording of the battery capacity. Due to the very low power consumption in sleep mode, the shunt does not put any additional load on the battery.

2: Voltage (+2) second battery group
Optional connection of a voltage measurement of a second battery group (starter battery), this is then displayed as a second battery group on the monitor.

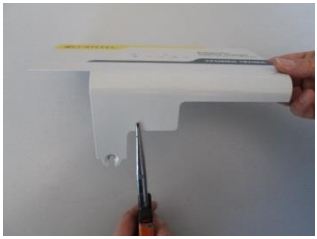
3: T-: Minus temperature sensor (brown wire) T +: Plus temperature sensor (blue wire)
Optional temperature sensor (Temp-BT) for recording the battery temperature. The temperature sensor should be fixed on the outside of the housing of the battery. The temperature sensor has no active influence on the capacity calculation or charge, it is for information only.

4: LIN Bus communication with display
The BLS monitor communicates with the Shunt SHE 300 and the ACE charger via this cable

3.3. Interface ACE-LIN (optional part)

To connect the BLS monitor to an ACE charger, an ACE-LIN interface must be inserted in the ACE charger. For the ACE 12/60 and ACE 24/30 models, the integrated monitor must be removed and replaced with the ACE-LIN interface.
Removal of the front charger cover and preparation of the cable gland.


Remove cover


Break out the metal tongue with a pair of flat-nose pliers


Inserting the rubber cable grommet


Insert the cover and the cable

Inserting the interface board ACE-LIN

Make sure the ACE charger is disconnected from the AC mains before starting work.

After removing the front cover, the setting of the DIP switches must be adjusted for operation with the CAE-LIN interface.
The ACE chargers are equipped with DIP switches to individually adapt the charging characteristic to the batteries. Only if the DIP switches of the charger are set to ABCD = "1111", the charging characteristic can be set from the monitor BLS. Then it is also possible to set a user-defined characteristic. Otherwise, the characteristic set via the DIP switch applies.

For electrical connection of the interface board, the 16-pin connector of the ribbon cable must be plugged into the matching red connector on the main board of the ACE charger.

The interface board is held in place by three plastic clips on the case.

Wiring LIN line to monitor BLS / Shunt SHE

The communication port "LIN" of the interface ACE-LIN is connected to the connection "LIN" of the shunt SHE 300 and the monitor BLS via a 1-wire connection cable. This can be decided according to

the local installation conditions. The order of the devices on the "LIN" line does not matter. Since the "LIN" connection on the interface ACE-LIN is duplicated, it is advisable to connect a LIN cable from the monitor to the charger and the other from the charger to the shunt. The ideal conductor cross-section for the "LIN" cable is 1mm².

IMPORTANT: The monitor, the shunt and the charger must have the same negative potential, ie be connected to a common minus point (battery negative).

4. Setup

To access the settings, please press the gear icon in the lower right corner of the main screen

4.1 Access (PIN) to setup

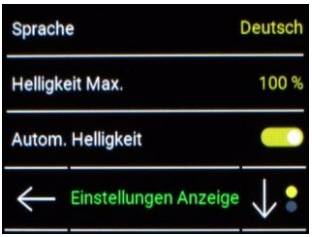
Subsequently, the query of the PIN, which is "1234" in the delivery state, appears.

After successful entry with subsequent confirmation
"OK" will take you to the settings menu.
The following settings can be made by pressing the respective symbol:
1. Display settings
2. Battery Management settings
3. Charger settings
4. Alarm settings

4.2 Display

After pressing the "Display" symbol, the adjacent image appears. The following settings can now be made:

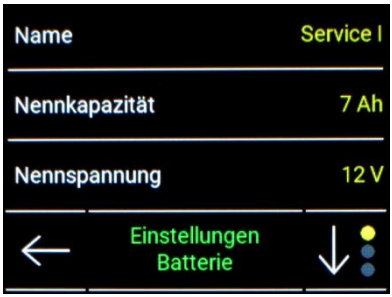
- Language German / French / English
- Brightness max. 20 - 100%
- Brightness Auto ON / OFF
- Auto stand by OFF / x s / min.
- Change PIN



4.3 Battery-Management

For proper operation, the following data must be set during commissioning:

If the battery was not fully charged at this time, it is imperative to fully charge it, to synchronize the display with the battery level.



- name
- nominal capacity of the battery (Section 5.3)
- nominal voltage of the battery group (Section 5.4)
- Battery type (Section 5.6)
- Ah efficiency (CEF) (Section 5.9)
- Peukert exponent (Section 5.10)
- Cycle depth (Section 5.11)
- Shunt info
- Name 2/3:

4.3.1 Designation

This name is displayed in the battery symbol of the display and is used for easier assignment.

4.3.2 Nominal capacity

The rated capacity of the battery (1-9999 Ah) is set here. To obtain a reasonable accuracy of the remaining time function as well as the percentage charge display, the capacity of the battery must be set.
Please note that the capacity of the battery should only be adjusted, when the batteries are 100% charged, as this will set the capacity indicator to 100% and all internal counters to 0.
If the battery was not fully charged at this time, it is imperative to synchronize the display with the battery`s state of charge.

4.3.3 Rated voltage

Please set the rated voltage 12 or 24V of the battery group so that the capacity calculation can be performed properly.

4.3.4 Battery type

To adjust the "Battery Low" and "Battery Full" detection, the type of battery used [GEL, ACID, AGM, Lithium] must be entered.

4.3.5 Ah Efficiency (CEF)

Each battery has an Ah efficiency. This means, that more amp hours must be loaded into the battery than can be taken. The efficiencies of lead batteries are between 80% and 95%. If the CEF deteriorates below 70% during operation, this basically means that the battery has reached the end of its service life and needs to be replaced. The factory default is 95%. The CEF is automatically adjusted in operation by means of a moving averaging over the last 4 cycles.

4.3.6 Cycle depth

The cycle depth indicates by what% value a battery must be discharged and charged for a charge cycle to be counted. For starter batteries should be a value between 10-20% and for GEL batteries can be set up to 50%. The value represents the cycle life of the battery, i. How much can the battery be discharged without reducing its life.

4.3.7 Peukert coefficient

The capacity of lead-acid batteries is usually stated for a 20-hour discharge. This means, for example, that a 100 amp-hour battery can deliver 5 amps for 20 hours before the battery runs out. If the discharge current is higher, for example 10 amperes, then the battery is unable to deliver the full 100 ampere hours. In this case, the battery voltage drops below the lower limit of 10.8V for 12V batteries before the battery has delivered its rated capacity.
This relationship can be mathematically determined with the Peukert equation.
In the residual time function, this equation is used to adjust the remaining time at high discharge rates. Under normal circumstances, the Peukert exponent need not be changed.
Usually, for lead batteries, unless different values are available, the Peukert exponent is set to 1.27, for lithium systems to 1.02.

4.3.8 Designation +2

This name is displayed in the battery symbol of the additional battery and is used for unique assignment.

4.3.9 Designation +3

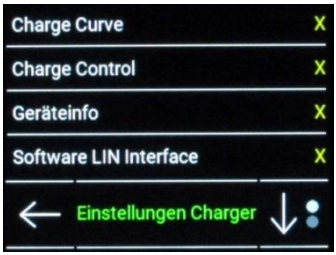
This name is displayed in the battery symbol of the additional battery and is used for unique assignment.

4.3.10 Device info

The serial number of the connected shunt and its software and hardware status are displayed. Via the item UPDATE, a firmware update can be added to the shunt if a corresponding file is available on the SD card.

4.4 Battery charger

The following settings can be made:
- charging characteristic
- Charge Control (control of the charging process by the charger or the battery monitor)
- Info which charger is connected (ACExx) and its software version
- Software version of the ACE-LIN interface



The current charging parameters of the set characteristic curve can be read in the 4 following fields. If the individual charging characteristic is selected, these settings can be edited:
- Maximum charging voltage (boost)
- Max. Boost duration
- maintenance charge voltage (float)
- Current threshold in% of the maximum power to change to the trickle charge

If no philippi ACE charger is connected or the charger is not supplied with mains voltage, settings can't be changed.

4.5 Alarms

A battery alarm is always displayed in the battery icon. In addition, the alarm can be issued / configured as follows:7

- optical display lighting flashes
- acoustically internal buzzer
- Relay contact potential-free relay (max 1A)

The visual and audible alarm can always be acknowledged in advance by touching the screen, or can automatically switch off after a definable time.

Alarm options:

Battery capacity alarms
A message appears on the monitor to charge the battery (battery appears red) when the battery falls below the set capacity threshold.
The alarm capacity alarm is preset to 50%. For an average application, this value is usually okay; However, the alarm can be set according to the requirements of the application.
If the state of charge continues to fall, 2 different thresholds are active: battery reserve (20%) and battery over-discharge (0%). Depending on the configuration, an alarm is triggered here.

Battery voltage alarms
If a voltage> 1V is present at the shunt at the terminal (+2) for the 2nd battery voltage, this is reported as another battery. If the battery voltage drops or exceeds the set threshold value for 30 s, an alarm can be generated.

The following settings are possible in the alarm menu:
- Optical alarm lighting flickers (on / off)
- Alarm auto off 0-255 sec (0 = always on)

The buzzer can be configured for individual alarms. Depending on the configuration, the alarm switches on for the following alarm states and remains switched on until all pending alarms have been canceled. If an alarm has been acknowledged and a new alarm is added, the buzzer will be reactivated.

Battery 1	capacity alarm	Adjustable (10 - 80%)
	battery empty (20%)	determined by battery management
	battery deep discharge (0%)	determined by battery management
	overvoltage adjustable	adjustable (14 - 32 V)
	(Over) temperature	adjustable (40 - 60 ° C)
Battery 2	undervoltage	adjustable (9-24V)
	overvoltage	adjustable (14-32V)
Battery 3	undervoltage	adjustable (9-24V)
	overvoltage	adjustable (14-32V)

The voltage alarms must necessarily be adapted for 24V batteries!

By briefly pressing the respective line, the audible alarm can be switched on or off. At long pressure (> 2s) the respective threshold value can be edited.

5. OPERATION

On the main page you can switch between the 2 main screens via the lower buttons:
battery and charger, provided that a philippi charger ACE with interface ACE-LIN is installed. Otherwise, only the battery screen is available.

The lower buttons have the following functions:

Batteries: If a shunt SHE 300 is connected, the charge status of the battery system can be read. Pressing this button switches to the battery screen.

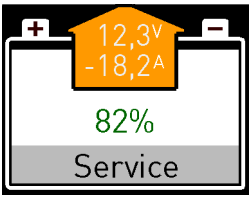
AC mains: If an ACE charger is connected, the current mains voltage is displayed. If no mains voltage is applied to the charger this will be displayed accordingly.
Pressing this key switches to the loading screen.

SETUP: Here the settings of the battery system can be made. See chapter 4.

The **battery page** displays the main battery across the shunt on the left. The arrow shows the current and battery voltage. If the arrow is green, the battery is charged, a red arrow indicates the current discharge.

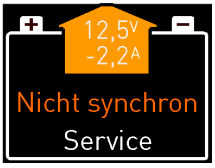
In the right section of the battery screen, up to two battery voltages of the additional batteries appear. The names and associated voltage alarm thresholds can be adjusted in the settings.

The bar height of the battery indicates the level of the battery.
The lower gray portion of the battery is the unusable portion of the nominal battery capacity detected at the last complete discharge. This proportion provides information about the state of life of the battery.

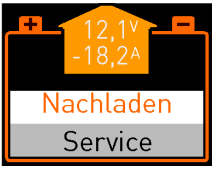


With a short press on the battery icon can appear between the ads
- capacity in% - capacity in AH - remaining time - battery temperature - change. Alternatively, the following error messages appear:

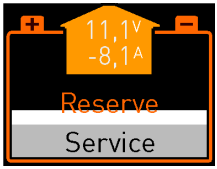
"Not synchronized"
The shunt has been restarted and the displayed capacity value does not yet correspond to the true capacity level. Then, the battery group connected to the shunt must be fully charged with a charger, so that the capacity indicator can synchronize with the state of charge of the battery. The message then goes off automatically.



"Recharge battery"
the battery capacity has fallen below the set warning threshold. In order to achieve a long life of the batteries, the charging process should be initiated at the next opportunity.

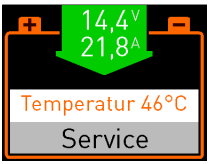


"Reserve"
the battery capacity has max. 20% remaining capacity and must be charged immediately to prevent the harmful deep discharge

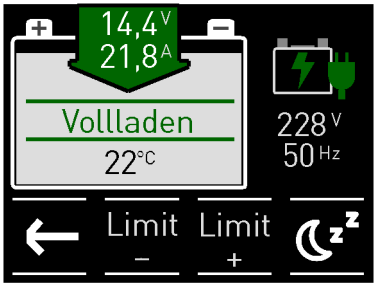


"Battery empty"
the battery is completely discharged and all consumers must be shut down and the charge must be promptly initiated to prevent further damage to the battery

"Temperature"
the battery temperature is out of range



The **charge screen** shows the operating status of the active philippi charger ACE. If the charger ACE is disconnected from the mains or if no charger is connected, the screen is not active and cannot be selected.



The green arrow shows the current charging current and the charging voltage. The battery icon displays the current charge phase (charge / charge / maintain) and battery temperature. To the right of the battery, the voltage measured by the charger and its frequency are displayed.

The side buttons have the following function:
LIMIT +/-: In order to adjust the charging current to the battery system or a weakly secured shore connection, the charging current can be adjusted in 10%. The minimum value is 40%.

Night-Mode: With the devices with active fan it can be switched off to allow a noiseless operation. The max. Charging current is limited to the thermal conditions of the charger. This feature is automatically disabled after 8 hours.

5.1 Battery history

Long press (2 seconds) on the battery icon will show more information about battery usage:

- Number of charge cycles
- number of deep discharges
- Average discharge depth
- Dead (unusable) capacity
- Battery usage
- maximum charging current *
- maximum discharge current *
- Minimum voltage *
- maximum voltage *
- Lowest temperature*
- Highest temperature*

 * Values determined from a 45 s interval)

5.1.1 Charging cycles

A cycle is counted when the battery has been discharged by the capacity set at the cycle depth and then recharged.
With the number of cycles they are able to estimate the life of your battery. Standard starter batteries have a lifespan of 30-50 cycles, while cycle batteries have a lifespan of up to 300 cycles if a modern battery charger is used. These values can only be achieved with proper care and deteriorate rapidly in case of mistreatment.

5.1.2 Deep discharges

Every complete discharge up to the lower voltage limit (9-11.5 V depending on the load) is considered a deep discharge. Deep discharges should be avoided at all costs as they damage the battery and premature capacity loss and lifetime reduction are expected for most battery types. However, should a deep discharge occur, the battery must be recharged immediately to avoid further damage.

5.1.3 Mean depth of discharge

The average depth of discharge indicates the amount of capacity by which the battery group was discharged on average in the past 10 cycles. From this it is possible to read the cycle load of the battery and to deduce a conclusion on the battery life.

5.1.4 Reset the counters

If a new battery pack is used, the number of cycles, the deep discharges on and the total capacity counter must be set to zero. To do this, the upper battery "000" key must be pressed and subsequently confirmed by PIN entry (PIN Default 1234). The Min / Max counters can be reset by pressing the lower "000" key followed by the PIN entry (PIN Default 1234).

5.2 Function of battery capacity calculation

Here are some notes on the function of the battery capacity calculation.

5.2.1 Detection of full charge

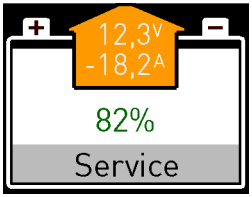
A battery is considered fully charged (100%) if the following conditions are met, depending on the type of battery [GEL, ACID, AGM, Lithium].

e.g. for lead acid batteries:
1) the charging voltage is maintained (13.4 V) and
2) the charging current has dropped below 2% of the set battery capacity and
3) the charged capacity is greater than the previous withdrawn capacity.
or
1) the charging voltage is maintained (14.0 V) and
2) the charging current has fallen below 1% of the set battery capacity

If the parameters are met for 3 minutes, the value for the current capacity is reset to 100%. For the other battery types, values adapted to the battery chemistry apply.

5.2.2 Detection of the unusable portion of battery capacity

If the battery voltage prematurely falls below certain voltage thresholds depending on the load, the charge state is automatically set to 20% or, if fully discharged, to 0%.



If possible, the unavailable capacity (difference between nominal capacity and withdrawn capacity) is determined and displayed as a gray area.
This gray area can be used as an indicator for the aging of the battery during normal discharges of less than C10 (current less rated capacity / 10).
For high current loads in the range above C5 (e.g., electric boats (current greater than rated capacity / 5)) this should be taken as an indicator of the usual reduced capacity at high loads.
Unavailable capacity detection is only possible if the battery has reached the first discharge limit (depending on battery type & load, below approx. Battery voltage <11.5 V)
If the battery is never discharged to this first discharge limit, this detection can not take place and it is assumed that the battery is 100% intact.

We therefore recommend that you do this once a year at the start of the season to determine the performance of the battery system.

5.2.3 Remaining time calculation

The remaining time is the time that the main battery can still be used with the current power consumption until the capacity alarm is reached.
During charging, the estimated charging time is displayed until the batteries are about 95% charged. The maximum value during a discharge process is 99.9 hours (> 4 days). The remaining time is automatically corrected taking into account the Peukert function.

5.2.4 Calculation of the current state of charge

During charging, the Ah efficiency of the battery (C.E.F.) is automatically taken into account in the capacity calculation. The charge current with the C.E.F. Value (in%).

6. Tips and tricks

a) a) If the message "not synchronized" despite 100% full charge (U> 14,0V and I <2% of the rated capacity) of the battery does not go out, this can be achieved manually by changing the nominal battery capacity by 1 Ah.
Please check if every charging source is recognized correctly. Charging currents are always positive when all consumers are switched off at the same time.

b) Full battery detection does not work. Please check the charging voltage of your battery charger / solar system and set the battery type to NASS to work with the lowest possible values.
Please check whether each charging source is recognized correctly. Charging currents are always positive if all consumers are switched off at the same time. This must be checked individually for each charging source. At the negative pole of the battery only the shunt with the B-connection must be connected, nothing else!!

7. Software Update

To update the monitors software, a micro SD card is required. After receiving the software, the file must be copied to the previously empty micro SD card (without folder, top level).
To update, insert the SD card into the SD card slot on the back of the monitor and disconnect the power supply from the battery monitor. Then the power is turned on and the screen shows that new software has been detected and installed automatically. During the update process the progress is displayed. If the monitor starts normally after inserting the SD card, no SD card has been detected or the software is up-to-date.

8. Technical data

Supply voltage	DC 8-32 V
Current consumption monitor	80 mA at max. Display brightness, 6 mA in sleep mode
Current consumption shunt	20 mA, 2 mA in sleep mode
Shunt	0.1 m Ω
Measuring range U1	0-35V, resolution 30mV, accuracy 0.25%
Measuring range U2	0-35V, resolution 30mV, accuracy 0.25%
Current carrying capacity	Shunt 300A, 600A 1 min, 1500A 0.5 s
Current carrying capacity relay	1A
Measuring range I, shunt	-600 - + 600A, resolution 10mV, accuracy 0.5%
Measuring range T (external sensor)	-15 - 60 ° C, resolution 1K, accuracy 1K
Dimensions monitor	L 105 x W 75 x D 40 mm
Dimensions Shunt	L 118 x W 40 x H 65 mm
Connections shunt	bolt M8

9. Declaration of conformity

This device complies with the requirements of the EU directives:
2014/30 / EC "Electromagnetic compatibility"

Immunity	EN 61000-6-1
Emitted interference	EN 61000-6-3

The conformity of the device with the o.g. The directive is confirmed by the CE mark.

10. Disposal instructions

When disposing of this device, observe the applicable local regulations and use the collection services / points for waste electrical and electronic equipment.