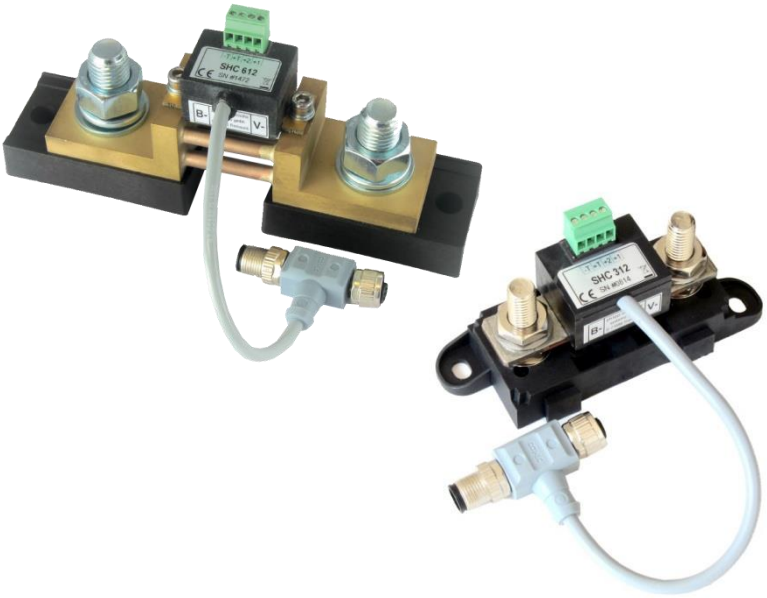
INSTRUCTION MANUAL

BATTERY MANAGEMENT SHUNT SHC



The SHC 312 / 612 battery management shunts records all charging and discharging currents and the voltage of the battery. After initial synchronization they`re able to calculate the battery status thereby. The battery is constantly monitored for full charge, a critical state of charge and complete discharge. The connection to the philippi P-BUS is made via an M12 T-connector.

philippi elektrische systeme gmbh
Neckaraue 19
D-71686 Remseck am Neckar

www. philippi-online.de
info@philippi-online.de
Tel: +49 (0)7146/8744-0, Fax-22

1. General Information

1.1 Purpose

The SHC battery management shunts can only be used for low voltages DC 8-60V in conjunction with the P-BUS. They are designed for use on yachts or in motor homes and may only be operated in enclosed spaces protected from rain, moisture, dust and condensation. Never use SHC battery management shunts in places where there is a risk of explosion from gas or dust. The SHC battery management shunts are not suitable for outdoor installation.

1.2 Content

- Battery Management Shunt SHC
- Pluggable terminal 4pol.
- ASH1 fuse holder with FSS 1A fuse
- This instruction manual (The document is available for download in colour on our website. www.philippi-online.de

Optional accessories (not included in the delivery):

- Temperature sensor Temp-BT order no.: 059003000

1.3 Warranty

philippi elektrische systeme gmbh grants a two year limited and non-transferable warranty for the delivered devices. Defects resulting from material or manufacturing defects will be repaired 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 external parts have been installed or interventions have been carried out.

The warranty does not cover damage caused:

- by overvoltage at the inputs, or polarity reversal
- by liquids which entered the device
- by Oxidation by condensation
- from Lightning strike

The warranty does not cover consequential costs and natural wear and tear. A detailed description of the defect is essential when asserting claims under warranty. Detailed notes facilitate and speed up the processing. Please understand that we cannot accept shipments which are not sent to us free of charge.

1.4 Exclusion of liability

Both the observance of the operating instructions as well as the conditions and methods for the installation, operation, use and maintenance of the shunt SHC cannot be monitored by *philippi elektrische systeme gmbh.* Therefore, we assume no responsibility and liability for losses, damages or costs resulting from faulty installation and improper operation.

1.5 Quality Management

During production and assembly, the devices undergo several checks and tests. Manufacturing, controls and tests are carried out according to established protocols. Each SHC shunt has its own serial number. Do not remove the label. The assembly and testing of all SHC shunts are carried out completely at our company in Remseck am Neckar.

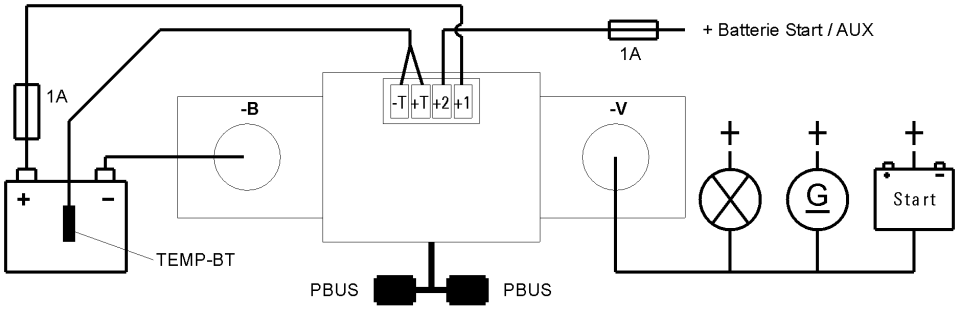
2. Safety References

- unauthorized changes to the equipment will invalidate the CE sign
- the installation of the SHC may be made only by electrical specialists.
- before connection of the SHC the battery terminals must be clamped.
- Important! Pay attention to the correct polarity of the batteries!

The assembly and operating instruction is a component of the SHC package. It must be kept (for reference). Importantly: - for later maintenance work - and for the use of subsequent owners of the equipment.

3. Mounting and Installation

Mount the Shunt SHC in a protected, dry place as close as possible to the battery. The shunt must be connected to the **NEGATIVE (!)** line of the battery.



Monitored battery bank

Loads, sources, starter batteries

On the top of the shunt SHC there`s a 4 pole connector with following terminals:

1: T-: Negative of temperature sensor (blue braid)
2: T+: Positive of temperature sensor (black braid)
Optional temperature sensor *Temp-BT* to measure the battery temperature is available. The temperature sensor should be fixed to the outside of the battery housing. The temperature sensor has no active influence on the capacity calculation or charging, it is only used to obtain information.

3: Voltage (+2) supervision of a second battery or partial voltage of a 24V / 48V battery

a) Optional connection of a voltage measurement of a second battery (starter battery), which is then displayed as a second battery on the PSM.
b) Partial voltage of a 24V or 48V battery group for monitoring the uniform state of charge of batteries connected in series. The battery group is displayed in red if half the partial voltage of a 24V or 48V battery connected in series deviates by more than 2% from the total voltage. In this case, the batteries must be checked for cell circuit or an uneven state of charge.

4: Battery measuring lead (+1) and power supply for the shunt

This line is absolutely necessary for the shunt to work properly and should only be disconnected during winter storage to ensure that the battery capacity can be recorded completely. Due to the very low current consumption, the shunt does not put an additional strain on the battery.

4. Setup of the PSM

The following data must be set during commissioning to ensure proper functioning:

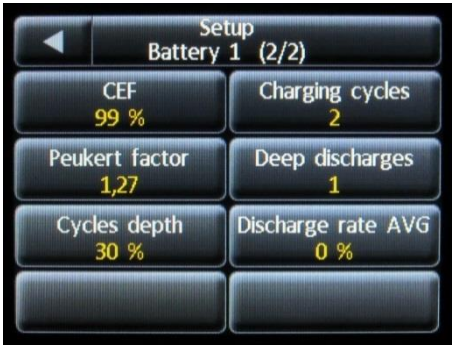
- Nominal capacity of the battery (1-9999Ah) (chap. 5.3)
- Nominal voltage[12, 24, 36, 48V] of the battery group (chap. 5.4)

If the battery was not fully charged at this time, it is absolutely necessary to synchronize the display again with the fully charged battery.

A setup submenu is available for each shunt connected.

The following data can also be set for optimum function:

- Alarm capacity is preset to 50%. (chap. 5.5)
- Battery type [GEL, Lead-acid, AGM, Lithium, INDIV] (chap. 5.6).
- Capacity threshold for generator start (chap. 5.7)
- Capacity threshold for generator stop (chap. 5.8)
- Charge Efficiency Factor (CEF), the default setting is 95%. (chap. 5.9)
- Peukert exponent, the default setting is 1.27 (chap. 5.10)
- Cycle depth. Starter batteries 10-20%, GEL batteries 50% (chap. 5.11).
- Alarm threshold (Alarm U) for U2. The default setting is 11.5 V. (chap. 5.16)



4.1 Description

The name of the selected battery is shown and can be changed if desired to one from a list that is displayed when the button is pressed. The selected name is displayed in the corresponding battery symbol on the Battery page for ease of identification.

4.2 Nominal capacity

The nominal capacity of the battery (1-9999Ah) is set here. In order to obtain a reasonable accuracy of the remaining time function and the percentage charge display, the capacity of the installed battery must be set.
Please note that the capacity of the battery should only be set if the batteries are 100% charged, as during this procedure the capacity display is set to 100% and all internal counters are set to 0.
If the battery was not fully charged at this time it is absolutely necessary to synchronize the display with the battery fully charged.

4.3 Nominal voltage

Please set the nominal voltage [12, 24, 36, 48V] of the battery bank to allow proper capacity calculation.

4.4 Alarm capacity

The system monitor generates an alarm (the battery symbol on the battery page appears in red) when the battery falls below the set capacity threshold.
The alarm threshold for the alarm capacity is preset to 50%. For a typical application, this value is adequate, but the alarm threshold can be set according to the requirements of the application.

4.5 Information

The hardware type (e. g. Shunt SHC312), its software version (V030) and the serial number of the device will be displayed.

4.6 Generator On

Capacity threshold for starting the generator at a relay module CMR4. See also chap. 6.5

4.7 Generator Off

Capacity threshold for the generator stop on a CMR4 relay module. See also chap. 6.5

4.8 Battery type

To optimally adjust the parameter for the "empty battery" detection, the type of battery used must be entered. [GEL, Lead acid, AGM, Lithium, INDIV].

4.9 Charge Efficiency Factor (CEF)

Each battery has a Charge Efficiency Factor (CEF). This means that more amp-hours must be charged into the battery than can be removed. The efficiency of lead-acid batteries is between 80% and 95%. If the CEF deteriorates below 70% during operation, this basically means, that the battery has reached the end of its life span and must be replaced. The factory default setting is 95%. The CEF is automatically adjusted during operation by means of a moving average over the last 4 cycles.

4.10 Peukert factor

The capacity of lead-acid batteries is usually specified 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 is completely discharged. If the discharge current is higher, e. g. 10 amps, the battery is not able to supply the full 100 ampere-hours. In this case, the battery voltage drops below the lower limit of 10.8 V for 12V batteries before the battery has delivered its rated capacity.
This correlation can be mathematically determined using the Peukert equation.
For the remaining time function, this equation is used to adjust the remaining time at high discharge rates. Under normal circumstances, the Peukert factor does not need to be changed.

4.11 Cycle depth

The cycle depth is the depth of discharge required to be reached for one cycle to be counted. For a starter battery this value should be adjusted to 10-20% and for cycling batteries a value of 50% is recommended.
This value represents the cycle strength of the battery, i.e. how much can the battery be discharged without reducing the life span.

4.12 Charging cycles

A cycle is counted when the battery is discharged by the capacity set at the cyclical depth (5.11) and then recharged.
With the number of cycles, you`re able to estimate the life of your battery. Standard starter batteries have a lifetime of 30-50 cycles, a lifetime of up to 300 cycles can be expected when a modern charger is used together with cycle batteries. These values are only to be achieved with proper care and deteriorate rapidly in case of ill treatment.

4.13 Deep discharges

Each complete discharge up to the voltage lower limit (approx. 11V) is considered as a deep discharge. Deep discharges should be avoided, as they will damage the battery and lead to a premature loss of capacity and a reduction in the lifetime of most battery types. If, nevertheless, a deep discharge occurs, the battery must be recharged immediately in order to avoid further damage.

4.14 Discharge rate AVG

The average discharge depth indicates the residual capacity value, which has averaged the battery group in the past 10 cycles. The cycle load of the battery can be read from this and a conclusion can be derived for the battery life.

4.2 Reset of the counter of cycles, number of deep discharges and average cycle depth

If a new set of batteries is installed, the number of Charging Cycles and Deep Discharges must be reset to zero. By pressing the appropriate buttons and then entering the PIN (default 1234), the counters are reset.

4.16 AlarmU (only for voltage measurement of 2nd battery)

If a voltage> 1V is present at the terminal for the 2nd battery voltage on the shunt SHC, this is reported as another battery. An alarm threshold (alarm U) can be defined for this voltage monitoring / battery.

The default setting for the alarm threshold is 11.5 volts and the alarm is delayed. If the battery is strongly discharged, the voltage alarm can be set somewhat lower, for example to 10.8 volts. If battery banks with higher nominal voltages (for example 24 V) are connected, then the thresholds must be adapted accordingly.

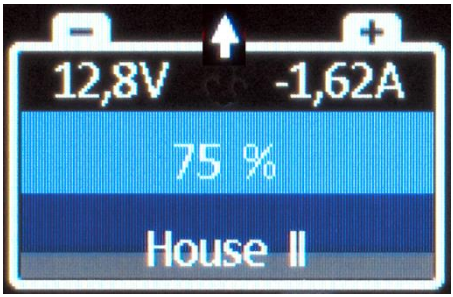
5. Operation

The shunt provides the following data to the P-BUS for display:

- charge / discharge current, battery voltage, current capacity in% or Ah
- expected remaining time until the capacity alarm
- expected charging time in charging mode
- battery temperature via ext. Sensor (Temp-BT)
- Alarm "Capacity" / "Battery 20%" / "Battery empty" / "Overvoltage"
- number of cycles, deep discharges and average discharge depth

At the PSM, the determined battery data are shown as follows:

Battery voltage Charge-/Discharge current



Light blue: usable capacity up to the set capacity alarm

Dark blue: the theoretically available capacity until the battery is fully discharged

Grey: unusable capacity

A negative sign before the amperage means that the battery is discharged. If the value is positive, the battery is charged.

The message "Not synchronized" appears when the Shunt SHC is restarted and the displayed capacity value is not yet true. Then the battery group connected to the Shunt SHC must be charged with a charger so that the capacity indicator can be synchronized with the battery. The message then disappears automatically.

If the battery capacity drops below the set threshold, a warning will appear in the display. The remaining capacity is displayed in orange and the battery symbol is shown in red.

5.1 Detection of full charge

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

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 discharged 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 4 minutes, the current capacity value is reset to 100%.
The values for the other battery types are adapted to battery chemistry.

5.2 Detection of the non-usable portion of battery capacity

If the battery voltage drops prematurely, depending on the load, under certain voltage thresholds, the charging state is automatically set to 20% or to 0% when the battery is fully discharged.
If possible, the unavailable capacity (difference between nominal capacity and removed capacity) is determined and displayed as a grey area.
This grey area can be used as an indicator for the aging of the battery during normal discharges smaller C10 (current less than nominal capacity / 10).
For high current loads in the range greater than C5 (for example electric boats (current greater nominal capacity / 5)) this is to be regarded as an indicator of the usual reduced capacity at high loads.
The detection of the unavailable capacity is only possible if the battery reaches the first discharge limit (depending on battery type & load, under approx. Battery voltage <11.5 V)

If the battery is never discharged to this first discharge limit, this detection cannot take place and is emitted by a 100% intact battery.

We therefore recommend to do this every year at the start of the season in order to determine the performance of the battery system.
See the note in chapter 6d.

5.3 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 expected charging time is displayed until the batteries are charged to about 95%. The maximum value during a discharge is 99.9 hours (> 4 days). The remaining time is automatically corrected with regard to the Peukert function.

5.4 Calculation of the current charge status

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

5.5 Control of an external generator

To control a generator as a function of the battery capacity, the system monitor PSM can be used in conjunction with a relay module CMR4

The generator start-up contact is controlled by all battery management shunts SHC connected in the system. For this, the generator start / stop values in the battery setup must be adjusted (see also 5.7 and 5.8).

Generator start: If the battery capacity falls below the set value, the generator start contact is activated. If several battery management shunts SHC are registered in the system, the generator starts as soon as the capacity of one of the battery management shunts drops below the respective set capacity threshold.

Generator stop: If the battery capacity exceeds the set stop value, the generator start contact is deactivated. If several battery management shunts are registered in the system, the generator stops as soon as the capacities of all battery management shunts have increased over the respectively set capacity thresholds.
If a battery management shunt cannot start or stop the generator, its capacity thresholds must be set to 0% (start) and 100% (stop).

6. Tips and Tricks

a) If the message "not synchronized" does not disappear despite 100% full charge (U> 14.0V and I <2% of nominal capacity), this can be done manually by changing the nominal battery capacity by 1 Ah.
Please check if each charging source is recognized correctly. Charge currents are always positive when all loads are switched off at the same time.

b) Battery full detection does not work. Please check the charging voltage of your battery charger / solar system or / and set the battery type to NASS to work with the lowest possible values.
Please check whether each charging source is detected in the correct direction, charging currents are always positive if all loads are switched off at the same time. This must be checked individually for each charging source. Only the shunt with the connector B- may be connected to the negative pole of the battery, nothing else!

c) Shunts SHC 312 before 2013 with ser.no. < 1308 and SHC 612 with ser.no. < 1500
If, during operation, the battery display repeatedly displays the message "Not synchronized" in the system monitor PSM, the system is overloaded with excessively high voltage fluctuations. This causes the Shunt SHC to perform an internal reset and the message "Not synchronized" appears. To avoid this effect, we recommend retrofitting an additional 470µF / 35V capacitor to the green terminal. Please pay attention to the correct polarity of the capacitor and keep the connecting wires of the capacitor as short as possible.
36 / 48V systems do not require retrofitting.

d) **Annual capacity check:** we recommend to determine the performance of the battery system at the beginning of the season in order to have the actual availability in season security.

1) Full charging of the battery system until the display shows 100% and the "non-synchronized" message has disappeared.
2) Switch off all charging devices and unload the batteries by switching on as many loads as possible, which can be operated without risk (for example, all lighting, position lamps, refrigerator, navigation). By reading the discharge current, the approximate time can be determined when the batteries are completely discharged (Rule of thumb: time in hours = half battery capacity / discharge current)
3) Supervision the battery until the 20% alarm is reached. When the alarm is reached, the display shows the proportion of unavailable capacity as a grey area in the lower segment of the battery.
4) Turn off all loads and immediately fully charge the battery. Do not leave the batteries in the unloaded state. This can damage the batteries!

ATTENTION: If the subsequent 100% charge is not guaranteed (eg due to lack of time), this test must not be carried out!

7. Trouble shooting

If the Shunt SHC on the PSM monitor does not supply any data, the correct connection to the P-BUS must be checked and whether the battery voltage is present at the connection +1.

8. Technical specifications

Operation voltage	DC 8-60 V
Consumption	5 mA @ 12 V, 3 mA @ 24 V
Shunt	0,1 m Ω
Measuring range U	0-65V, resolution 30mV, accuracy 0,25%
Measuring range U2	0-65V, resolution 30mV, accuracy 0,25%
Current rating SHC 312	300A, 600A 1 min, 1500A 0,5 s
Current range SHC 312	-300 – +300A, resolution 10mV, accuracy 0,5%
Current rating SHC 612	600A, 800A 1 min, 2500A 0,5 s
Current range SHC 612	-600 – +600A, resolution 10mV, accuracy 0,5%
Measuring range T (ext. sensor)	-20 – 80°C, resolution 1K, accuracy 1°C
Dimensions SHC 312	L 118 x W 40 x H 65 mm, Bolts 2x M10
Dimensions SHC 612	L 185 x W 44 x H 75 mm, Bolts 2x M16

9. Declaration of Conformity

CE

This device fulfills the requirements of the European regulation:
2004/108/EG “ElectroMagnetic Compatibility”
Immunity EN 61000-6-1
Emission EN 61000-6-3
The conformity to this regulation is certified by the CE - sign.

10. Disposal Note

Please take care of your local directives on waste electrical and electronic equipment.
Please use collection points for waste electrical and electronic equipment.