

BATTERY STATUS PROCESSOR



SAMLEX EUROPE[®] B.V.

Battery Status Processor

Model No.

BSP - 500

BSP - 1200

User Manual

Please read this manual before operating your BSP

BSP: User Manual

V1.0.0

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About the software

This document applies to the version of software V1.4.0 or higher of the BSP. It is possible to check the software with the menu "Information on the system" or update it with the latest version available on "www.studer-innotec.com/support".

Legal Notice

The use of Samlex devices is the responsibility of the customer in all cases. Samlex reserves the right to make any modification to the product without prior notice.

Product recycling

The BSP conforms to the European directive 2002/95/EC on hazardous substances and does not contain the following elements: lead, cadmium, mercury, hexavalent chrome, PBB or PBDE.



To dispose of this product, please use the service for the collection of electrical waste and observe all applicable obligations according to the place of purchase.

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1. Introduction

The BSP (Battery Status Processor) is designed to monitor lead-acid batteries used with inverter-chargers of the Xtender range. An advanced algorithm provides the battery state of charge in real time in order to best optimize its use.

The BSP offers voltage measurement for 12, 24 and 48 V nominal batteries as well as current measurement with a resistive shunt. Thanks to the Xtender communication bus, the BSP is able to communicate with the other devices of the system. The remote control RCC-02/-03 makes it possible to configure the BSP and to display the values that it measures. The remote control enables also the use of the datalogger and the communication through RS-232. More than this, the Xtender inverters can react to various data in the BSP.

1.1. General ideas over batteries

The lead-acid batteries are energy storage with a complex behaviour. They consist of 2 Volt (V) nominal cells in series to reach the required voltage. Due to different physical phenomenons they can show, depending on the conditions, a behaviour quite far from the reservoir that simply fills up and empties out. This is the reason why the battery state of charge is complex to determine and why a lead-acid battery monitor is not as precise as, say, a petrol gauge.

The different phenomenons that affect a battery are described here below.

1.1.1. Defining the capacity

The battery capacity is defined as the quantity of electrical charge that a full battery can supply at given current before reaching a certain voltage. The unit generally used is the Ampere-hour (Ah). An ideal battery of 100 Ah will for instance supply 10 Amperes (A) in 10 hours or 1 A in 100 hours.

The capacity is usually given for a new battery, at 20 °C, with a discharge down to 1.8 V per cell (10.8 V for 12 V nominal, 21.6 for 24 V and 42.3 V for 48 V). The time of discharge is given by the letter C followed by the duration in hours, like C10 for 10 hours.

To make them reach the given capacity, the manufacturers charge their batteries according to standard procedures (for instance as per the norm IEC-60896-11). This kind of charge can last up to many tens of hours at very high voltages, which is rather far from normal conditions of use. This is why the real available capacity is lower than what is given by the manufacturer.

1.1.2. Capacity and temperature

The capacity varies according to the temperature of the active substance of the battery. A decrease of the temperature will lead to a decrease of the capacity.

1.1.3. Capacity and cells imbalance

Despite the fact that always the same current goes through the 2 V cells of a battery, factory differences, even small, might make their state of charge uneven. In case of imbalance, the most discharged cell determines the end of discharge.

Therefore the cells in series must always be of the same model and have the same history of use. One of the objectives of the absorption and equalization steps is to even out the charge of the cells in series.

1.1.4. Capacity and discharge current

The capacity goes down when it comes to big discharge currents. The active substance in the battery needs time to spread into the cells and a quick discharge will lead to a capacity decrease.

To convert the capacity from a discharge duration to another, one can use Peukert formula.

$$C = C_{ref} \cdot \left(\frac{I}{I_{ref}} \right)^{n_{peukert}}$$

The coefficient $n_{peukert}$ varies from a battery to another and is around 1.25. C_{ref} and I_{ref} corresponds to a capacity at a known current.

Discharge speed	Capacity at C10
C3	0.74
C20	1.19
C50	1.50
C100	1.78

Table 1.1. Capacity report with a Peukert coefficient of 1.25

1.1.5. Capacity over the battery lifetime

The capacity decreases along the charge-discharge cycles. The deep discharges have a particularly negative impact. High ambient temperatures lower also the lifetime.

2. Conventions

2.1. Symboles



This symbol is used to indicate the presence of a dangerous voltage that is sufficient to constitute a risk of electric shock.



This symbol is used to indicate a risk of material damage.



This symbol is used to indicate information that is important or which serves to optimize your system.

2.2. Regarding the parameters

All values mentioned hereafter, followed by a parameter number indicate that this value may be modified using the RCC-02/-03 remote control. In general, the default values are not mentioned and are replaced by a parameter number in the following format: {xxxx}. The default values for this parameter are specified in the defaults parameter table Chapter 11: “ *Factory setting values* ” (p. 25) .

3. Warranty and liability

3.1. Warranty and liability

During production and assembling, each BSP gets several controls and tests. They are carried out in full respect of fixed procedures. Each BSP is given a serial number allowing a perfect follow-up of the controls, in conformity with the specific data of every device. For this reason, it is very important to never remove the descriptive sticker bearing the serial number. The production, the assembling and the tests of each BSP are entirely carried out in our factory in Sion (CH). The warranty of this product depends on strictly following the instructions in this manual. The warranty period for the BSP is 2 years.

3.2. Exclusion of warranty

No warranty will be applied for damages caused by handling, operation or actions that are not described in this manual. Damages arisen from the following events are not covered by the warranty:

- Overvoltage on the device (Applying a voltage higher than ? Vdc).
- Reverse polarity while connecting the battery.
- Liquid in the device or oxidation due to condensation.
- Failures due to a fall or to a mechanical shock.
- Modifications made without the explicit authorization of Samlex .
- Nuts or screws partially or insufficiently tight during installation or maintenance.
- Damages due to atmospheric overvoltage (lightning).
- Damages due to transport or improper packaging.
- Disappearing of original marking items.

3.3. Exclusion of liability

Installation, commissioning, use and maintenance of this device can not be supervised by the company Samlex. For this reason, we do not accept any liability for the damages, the costs or the losses generated either by an installation that is not conforming to the prescriptions, by a defectuous operation or by a poor maintenance. The use of this device is under the responsibility of the end-user. This device is neither designed nor guaranteed for the supply of life support applications or any other critical application with potential risks for human beings or for the environment. We shall assume no liability for patent infringement or other third party rights involved in the use of this device.

4. Safety precautions

4.1. Generalities

Do read carefully all safety instructions before proceeding to the installation and commissioning of the device. Not respecting these instructions might constitute a lethal physical danger but can also damage the functionalities of the device. Therefore do keep this manual close to the device.



Do, for any installation, follow strictly the local and national norms and regulations in force.

4.2. Warnings



Danger of electrical shock!

- This device is used together with a permanent energy source (battery bank) and can also receive an alternative source at its input. Before any handling it is then necessary to disconnect all energy sources from the device.
- Even when the device has been disconnected from its supply source, there might remain a dangerous voltage at the outputs. To avoid any accident, it is necessary, after disconnection, to wait at least 30 seconds before operating on the device.
- Never use this device in a place where explosions might occur. Do refer to the indications of the battery manufacturer to ensure of the compatibility of the battery with the device. The safety instructions of the battery manufacturer have to be followed strictly too!
- Wherever the installation, the person in charge of installation and commissioning must know perfectly the safety measures and the prescriptions in force in the country. Therefore, the whole maintenance must be carried out by a qualified staff.
- All components connected to this device must be conform to the laws and regulations in force. The persons without a written authorization from Samlex are forbidden to do any change, modification or repair whatsoever. Regarding authorized modifications and replacements, only genuine components shall be used.
- This device is meant for a use only indoor and must under no circumstances stand in the rain, the snow or any other humid or dusty environment.
- In case of use in motor vehicles this device must also be protected against vibrations by absorbing components.

4.3. Precautions after the use of batteries

Lead acid batteries with liquid electrolyte produce a highly explosive gas during normal operation. No source of spark or of fire should be present in the closeness of the batteries. The batteries must be installed in a well-ventilated space and mounted so as to avoid accidental short circuits while connecting them.



Never charge frozen batteries!

During any work on batteries, a second person must be present in case a problem occurs that requires assistance. There should be within reach enough fresh water and soap for an immediate washing of the

skin or the eyes in case of accidental contact with acid. Should it happen, they must be washed carefully during at least 15 minutes with cold water. It is then necessary to immediately consult a doctor. The acid of a battery can be neutralized with baking powder. A fair quantity of baking powder must be kept available on that purpose. During work with metallic tools close to the batteries, a particular attention is required. Tool like screwdrivers, spanners open-end etc... can generate short circuits. The sparks arisen from short circuits can lead to the explosion of a battery. During work on the batteries, all personal metallic items like rings, watches with metallic strap, earrings must be removed. The current supplied by the batteries in short circuit is strong enough to melt the metal and to cause serious burns.

DECLARATION OF CONFORMITY



IMPORTER : Samlex Europe B.V.
ADDRESS : ARIS VAN BROEKWEG 15
1507 BA ZAANDAM
The Netherlands

Declares that the following products:

PRODUCT TYPE : Battery Status Processor
BRAND : Samlex

BSP 500, BSP 1200

Standards to which conformity is declared:

- EN61000-6-1
- EN61000-6-3
- EN61000-3-2
- EN55022
- EN55014

Signed : Marcel van Veen

Date: 21 February 2011



Authority : Managing Director

6. Dimensions

6.1. Views of different sides with dimensions

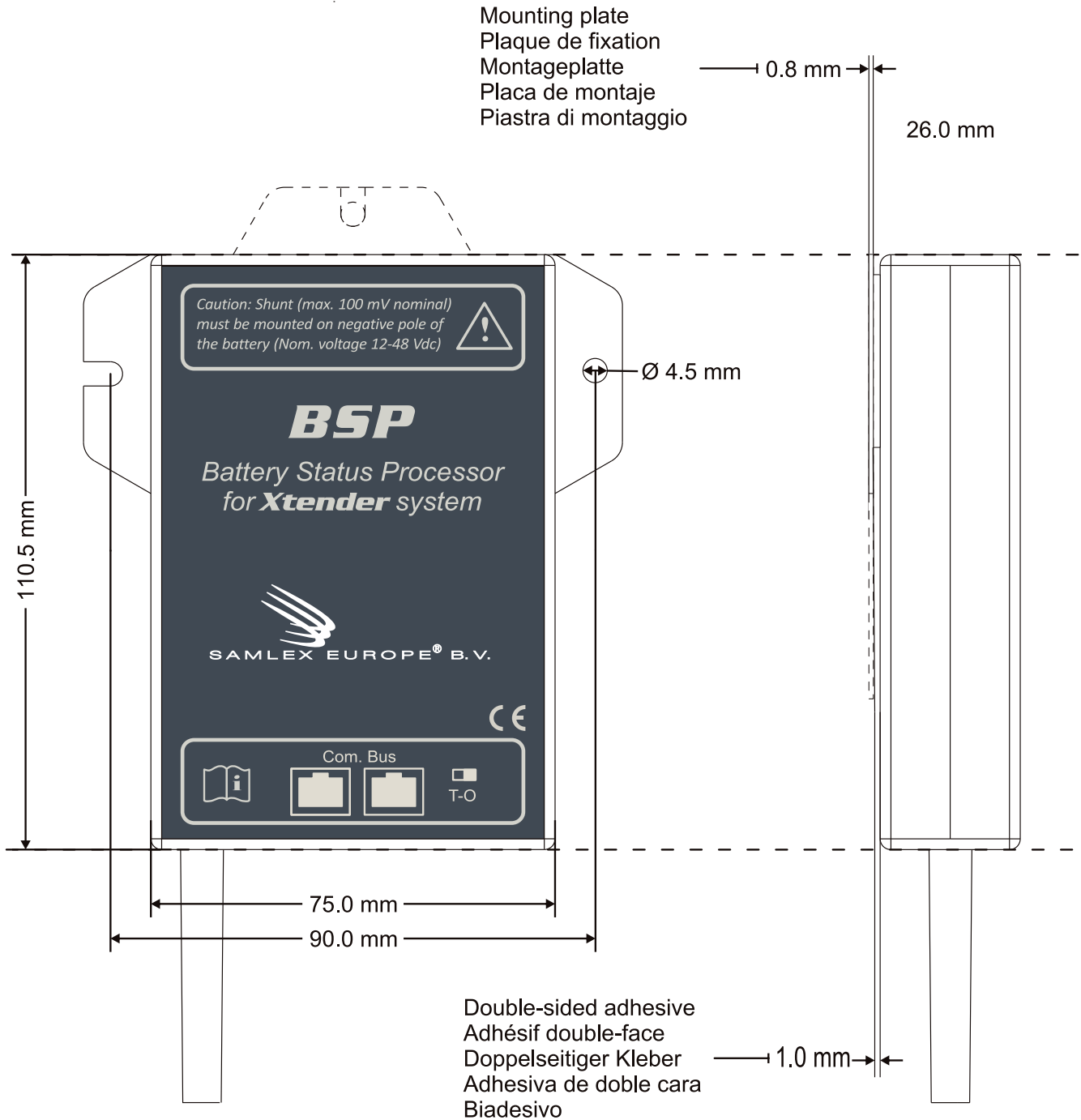


Figure 6.1. Views of different sides with dimensions

6.2. Exploded view

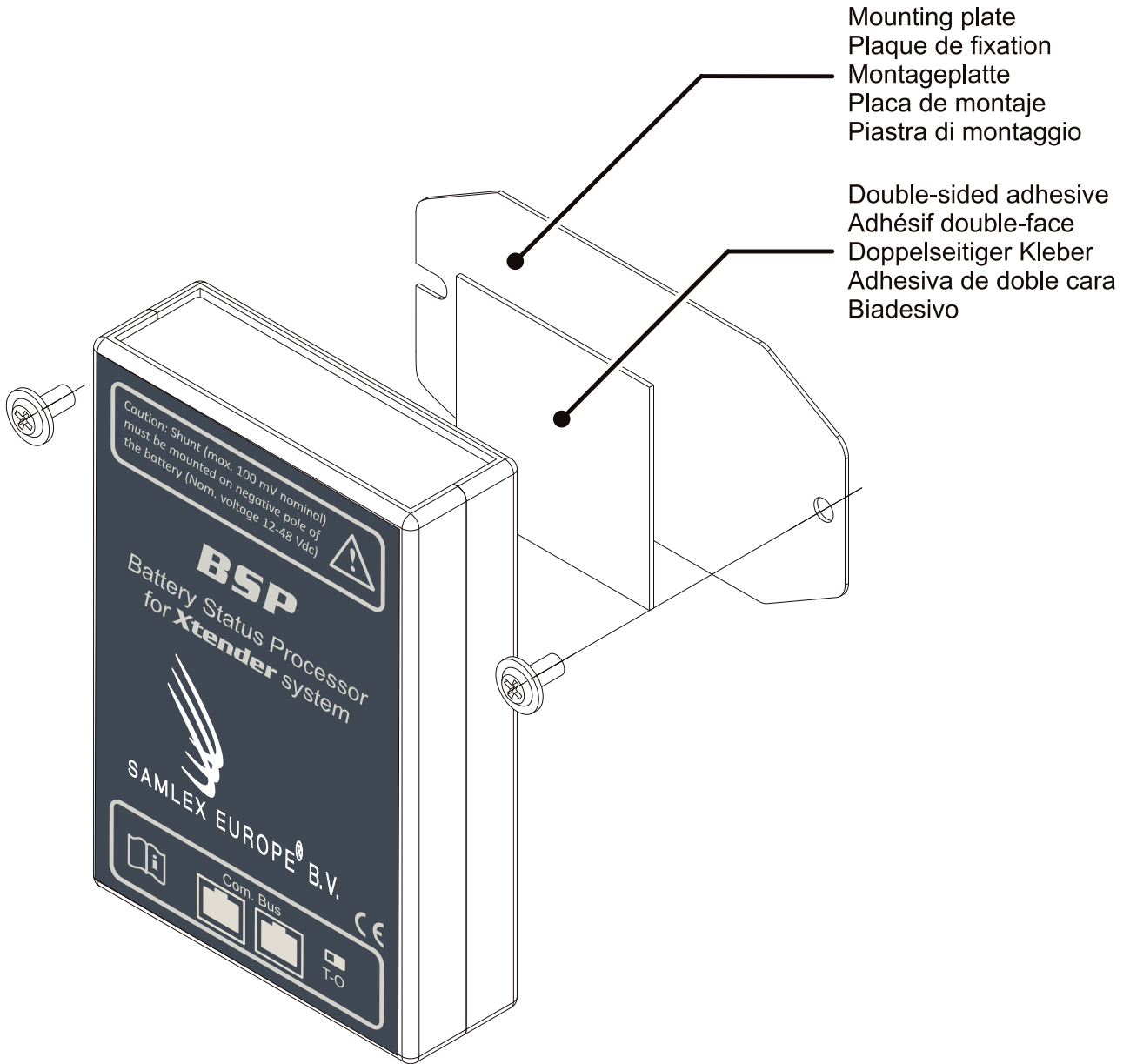


Figure 6.2. Exploded view

7. Installation

The BSP must be mounted as close as possible to the battery. In this way, the measurement perturbations are minimized and the temperature sensor integrated in the box gives a more accurate measure of the battery temperature.

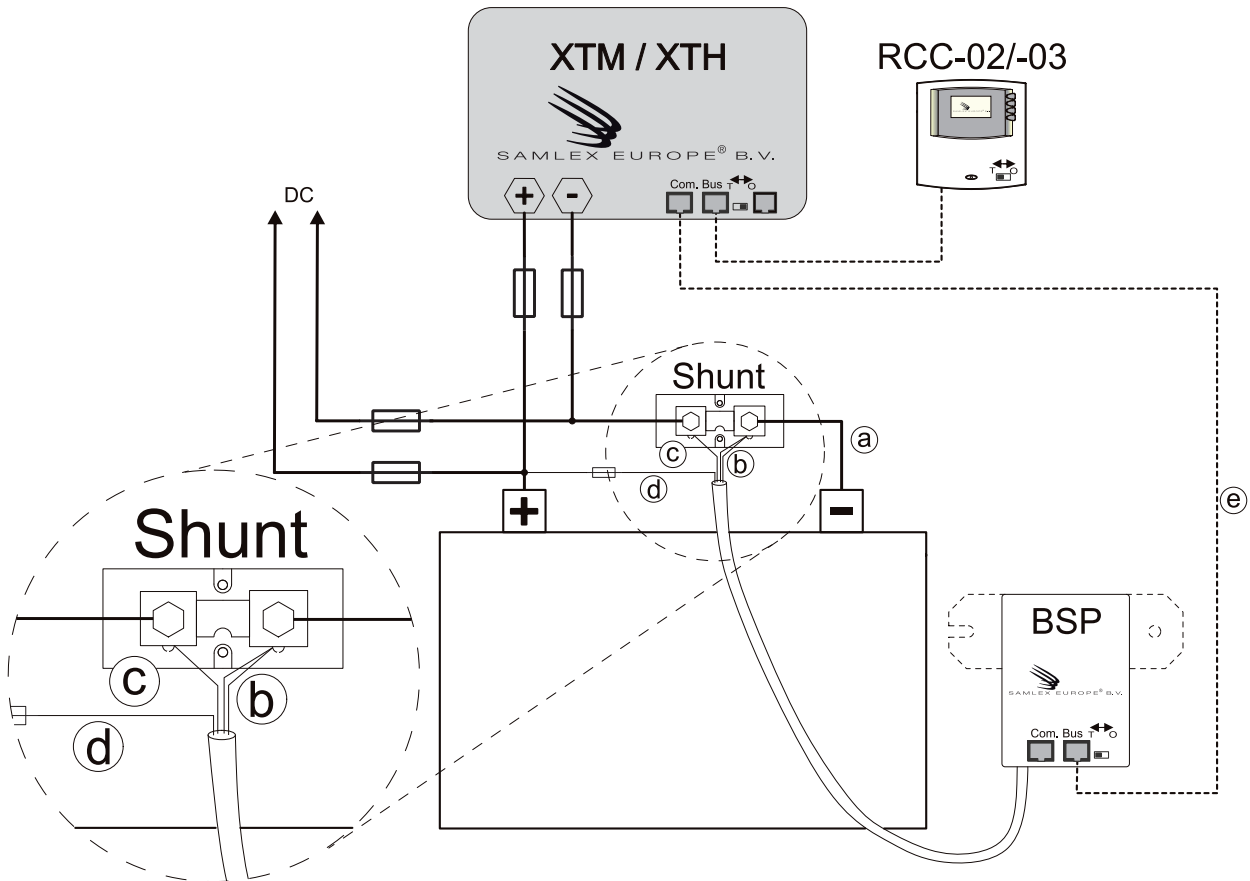


Figure 7.1. Connecting schematic of the BSP

7.1. Mounting

Ideally the BSP is stuck directly to the battery. It can also be mounted close to the battery by means of the fixing plate supplied with (see Figure 6.2 (p. 15)).

The direct mounting on the battery offers a more precise measurement of the battery temperature. While changing the battery bank, the BSP will have to be stuck again with a new double-side adhesive.



The BSP must be mounted so as to avoid any contact with acid from the battery. It should be taken care of fixing it vertically with the communication bus connectors downwards.

7.2. Shunt mounting

The shunt supplied with the device allows the measurement of the battery current. It must imperatively be installed in series with the negative terminal of the battery. The connection (a) of the Figure 7.1 must be as short as possible. For a good operating of the charge estimating algorithm, all the current must go through the shunt. No other conductive component shall be connected to the negative terminal of the battery.



The shunt must be exclusively mounted on the negative terminal of the battery.

7.3. Cabling

The cabling schematic is available on Figure 7.1. The cabling procedure is as follows:

1. Connect the shunt to the negative terminal of the battery (a).
2. Connect the crimped terminal on the white and yellow wires of the BSP cable to the measuring screw on the negative terminal of the battery (b).
3. Connect the terminal of the green wire of the BSP cable to the measuring screw of the shunt, inverter and charge side (c).
4. Connect the red wire with a fuse to the positive terminal of the battery (d).



It might happen while connecting the red wire to the battery that a spark is generated by the surge current of the device's internal power supply. No damage is likely to happen.

5. Connect the inverter(s), the solar regulators and any other DC charge to the second bolt of the shunt, for the negative and the positive terminal of the battery (e).
6. Connect the communication cable in the devices chain and activate the linkend, if necessary (f). For more information see the Section 7.4.

7.4. Connecting the communication bus

The devices of the Xtender range are equipped with a owned communication bus for data exchange, configuration and updating of the system. Connection is being made by linking the devices with the communication cables. One gets then a bus online where a linkend must be activated on the devices on each end, to obtain the configuration of the Figure 7.2 .

Each device is equipped with a switch offering to choose between open "O" or terminated "T". The devices at the end of the line must be set on "T" and all the others on "O".



A wrong setting of the linkends can lead to an erratic running of the installation or impede its updating.

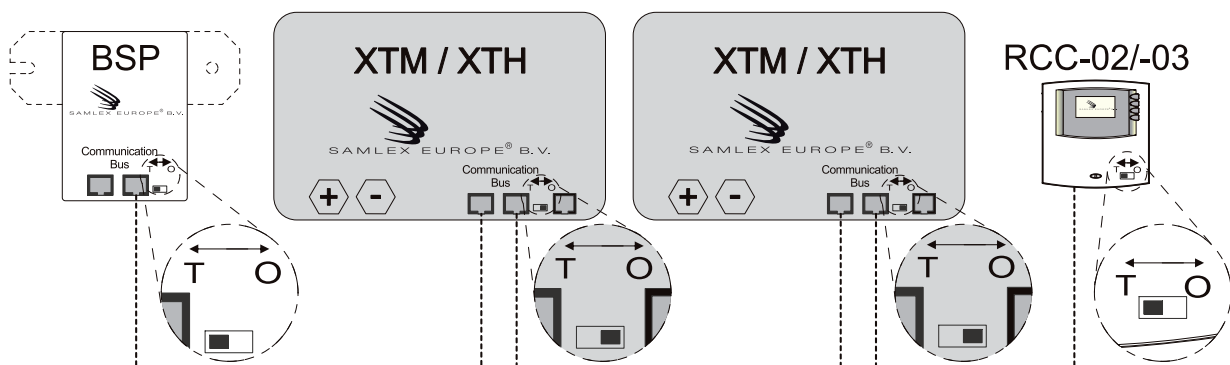


Figure 7.2. The communication bus online of the system Xtender

8. Quick Start guide

You will find in this chapter the procedure to follow in order to configure the BSP during installation. For the major part of the systems this is good enough. For a full list of the parameters that can be set do refer to Chapter 10.

8.1. Choosing the battery capacity

The battery capacity must be configured. The manufacturer gives it at various discharge times (see Section 1.1.1). If several capacities at different times are supplied, the discharge time in 10 hours (C10) must be chosen because these are the reference conditions for the state of charge calculation.

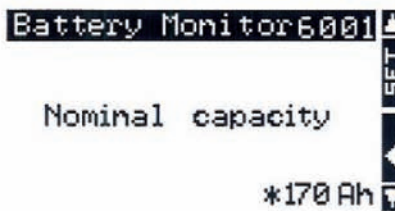
From the initial display of the RCC and by means of the keys UP and DOWN, move to the configuration menu of the BSP parameters, then push SET.



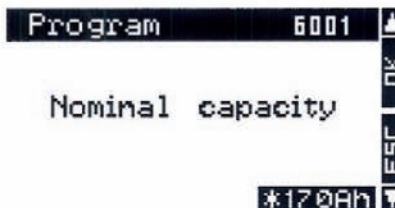
To modify the parameter "Battery Capacity" {6001}, move with the arrows UP and DOWN to the general menu.



Then push on SET to enter the menu. With the arrow DOWN, move to the parameter "Battery Capacity".



To modify its value push on SET. The value turns in reverse video.



Change the value for the one of your battery with the keys UP and DOWN. Confirm by pushing on SET.

Then, configure the parameter "Nominal Discharge Time(C-rating)" {6002} the same way as for the battery capacity.

8.2. Choosing the shunt

If you are using a shunt supplied with the BSP-500, the BSP is configured for it and you can go directly to the next section.

Otherwise, the measuring shunt must be configured. The shunts are meant to supply a measuring nominal voltage at a nominal current. If you use the shunt supplied with the BSP-1200, the nominal current is 1200 A at 50 mV. If you use your own shunt, the current and the nominal voltage are given by the manufacturer and are often printed on the shunt.

The parameters "Nominal Current of the shunt" {6017} and "Nominal Voltage of the shunt" {6018} of the advanced menu enable to configure the BSP for a given shunt.

8.3. Reset the battery history to zero

If you install the BSP for the first time or if the battery has been changed, you must reset the battery history to zero, by means of the parameter {6003}.

9. Display of the state of the battery

On installations with a BSP, the view over information on the battery of the Figure 9.1 is added to the RCC.

In area (A), four values of the BSP are displayed. The symbol of the battery in (B) gives an quick overview of the state of charge (SoC). The direction of the current is given in (C). An arrow upwards means the charge, downwards, the discharge.

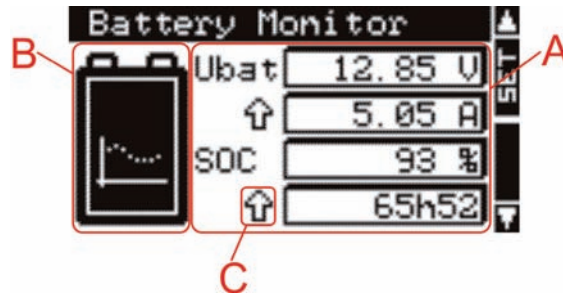


Figure 9.1. View of the state of the battery

9.1. Graph of the state of charge history

It is possible to see the battery state of charge of the last 5 days on the RCC. On that purpose, from the view over the battery information, you enter in selection mode with the key SET. The battery is then selected as on the Figure 9.2. The key SET allows then to display the graph.

The graph of the state of charge of the Figure 9.3 is then displayed. On the horizontal scale are today and the last 4 days. The graduations indicate every hour from midnight to midnight. Each horizontal pixel means one hour. The vertical axis gives the state of charge of the battery. The graduations mean 20, 40, 60, 80 and 100 % and one pixel means 2 %.

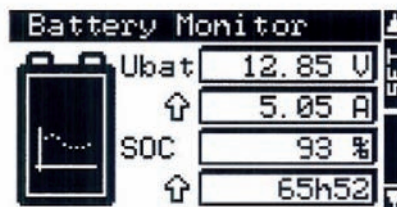


Figure 9.2. View with selected battery

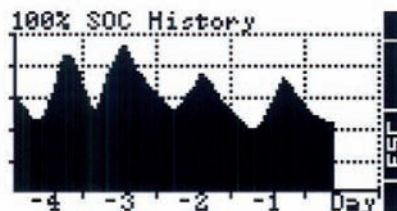


Figure 9.3. View of the state of charge history graph

9.2. Values to display

It is possible to modify the values to display on the battery view. For that, from the basic view of the Figure 9.1 push on SET. The battery is then selected as on the Figure 9.2. Go to the first value displayed with the key

DOWN. The keys UP and DOWN allow going to the field to configure. With the key SET, enter the menu corresponding to the value to display.

Then, choose the value to display by means of UP and DOWN and push on SET to validate.

At any time, to quit, use the key ESC that will bring you to the previous view.

The values available are the following:

Name of the value	Unit	Description
Battery voltage	V	-
Battery current	A	-
State of Charge	%	-
Power	W	-
Time to go	hh:mm	During charging, this value indicates the time before the battery charge reaches 100 %. During discharging, it indicates the time before it reaches 0 %. This value is calculated on basis of the present current. What it gives is an indication. A variable energy consumption has of course a big impact on this value.
Temperature	°C	Temperature measured by the BSP.
Relative capacity	-	Ratio between the effective capacity of the battery and its nominal capacity.
Ah charged today	Ah	Charge supplied to the battery from midnight until now.
Ah discharged today	Ah	Charge supplied by the battery from midnight until now.
Ah charged yesterday	Ah	-
Ah discharged yesterday	Ah	-
Total kAh charged	kAh	Charge supplied to the battery from the last reset to zero of the battery history. See "Reset to zero of the battery history {6003}" (p. 22) .
Total kAh discharged	kAh	Charge supplied by the battery from the last reset to zero of the battery history.
Total time	Days	Time since the last reset of the battery history.
Charge counting on the user side	Ah	This value offers to the user a charge and discharge measurement according to his needs. This counter, as the following three, can be reset to zero by means of the parameter "Reset to zero the counters on user side {6031}" (p. 24).
Discharge counting on the user side	Ah	-
Duration of the counting on the user side	Hours	-

Table 9.1. Capacity ratio with Peukert coefficient of 1.25

10. Setting of the parameters

A full list of accessible parameters can be found in Chapter 11 (p. 25).

10.1. Generalities

The configuration is carried out on the RCC by means of the BSP parameters menu. Generally the settings described in Chapter 8: “*Quick Start guide*” (p. 18) are enough for a good operation of the BSP. It is however possible to modify many other parameters described in this chapter.

10.2. Levels of use and of accessibility

The functions described below correspond to the level EXPERT. As per the user level selected, the access to all these functions might not be possible. Do refer to the chapter user level setting in the remote control manual for more information about this matter.

10.1. General menu {6000}

The parameters for a basic configuration of the BSP are in this menu.

10.1.1. Nominal capacity {6001}

Battery nominal capacity. It is given for the nominal discharge time defined by the parameter {6002}.

10.1.2. Nominal discharge time (C-rating) {6002}

Discharge time used to give the battery nominal capacity of the parameter {6001}.

10.1.3. Nominal current of the shunt {6017}

This parameter enables to adjust the BSP measurement to the shunt. It must be set according to the nominal voltage of the shunt (parameter {6018}). For instance for the shunt 1200 A supplied with the BSP-1200, the setting will be 1200 A and 50 mV.

10.1.4. Nominal voltage of the shunt {6018}

See parameter {6017}.

10.1.5. Reset to zero of the battery history {6003}

This parameter enables to reset to zero all counters of the Section 9.2 and the algorithm during installation on a new battery.



This parameter should normally not be used if the battery has not been changed, because then the history (total current, estimated capacity) is lost.

10.1.6. Restore the default settings {6004}

Use this parameter to restore the initial settings of the BSP.



If your installer has made some settings while commissioning your installation, this function restores his settings and not the factory ones.

10.1.7. Restore the factory settings {6005}

With this function you can find the factory settings. For each parameter, not only the factory value is restored but also the limits and the user level. This function is only accessible with the level installer.

10.2. Advanced menu {6016}

The advanced parameters for a BSP configuration.

10.2.1. Self discharge coefficient {6019}

A battery gets discharged over time even when no current is consumed. This parameter allows to take this phenomenon into account.

10.2.2. Nominal temperature {6020}

The battery parameters are specified for a given temperature, which can be set by means of this parameter.

10.2.3. Temperature coefficient {6021}

The available capacity diminishes with the decrease of the temperature. This coefficient enables to take this factor into account.

10.2.4. Factor of charge efficiency {6022}

During charging, less Ah are stored into the battery than during discharging. The ratio discharge/charge can be set with this parameter.

10.2.5. Peukert exponent {6023}

The capacity varies according to the discharge current (see Section 1.1.4). With this parameter one can set the Peukert exponent that goes along with the nominal capacity {6001} and nominal discharge time .

10.2.6. End of charge voltage threshold {6024}

See explanation at parameter {6026}.

10.2.7. End of charge current threshold {6025}

See explanation at parameter {6026}.

10.2.8. Minimum time before end of charge {6026}

This parameter with the parameters {6024} and {6025} controls the synchronization of the state of charge at 100 % end of charge.

To make it happens:

- the voltage has to be above the parameter {6024}
- the current has to be below the parameter {6025}
- and this during the period defined by the parameter {6026}

10.2.9. Force the state of charge at 0 % {6029}

This parameter enables to force the state of charge at 0 %.

10.2.10. Force the state of charge at 100 % {6030}

This parameter enables to force the state of charge at 100 %.

10.2.11. Reset to zero the counters on user side {6031}

This parameter allows to reset to zero the counters of charge, discharge and time on user side of Section 9.2.

11. Factory setting values

Level	User ref.	Parameter	Unit	12 V			24 V			48 V				
				FactoryMin	Max		FactoryMin	Max		FactoryMin	Max			
Basic	6000	Basic settings												
Basic	6001	Nominal capacity	Ah	110	20	20000	110	20	20000	110	20	20000		
Basic	6002	Nominal discharge duration (C-rating)	h	20	1	100	20	1	100	20	1	100		
Basic	6017	Nominal shunt current	A	500	10	10000	500	10	10000	500	10	10000		
Basic	6018	Nominal shunt voltage	mV	50	10	200	50	10	200	50	10	200		
Expert	6003	Reset of battery history		S	S	S	S	S	S	S	S	S		
Basic	6004	Restore default settings		S	S	S	S	S	S	S	S	S		
Inst.	6005	Restore factory settings		S	S	S	S	S	S	S	S	S		
Expert	6016	Advanced settings												
Expert	6031	Reset of user counters		S	S	S	S	S	S	S	S	S		
Expert	6019	Self-discharge rate	%/month	3	0	25	3	0	25	3	0	25		
Expert	6020	Nominal temperature	°C	20	0	40	20	0	40	20	0	40		
Expert	6021	Temperature coefficient	%cap/°C	.5	0	3	.5	0	3	.5	0	3		
Expert	6022	Charge efficiency factor	%	80	50	100	80	50	100	80	50	100		
Expert	6023	Peukert's exponent		1.25	1	1.5	1.25	1	1.5	1.25	1	1.5		
Expert	6042	Activate the end of charge synchronization	No/Yes	No	No	Yes	No	No	Yes	No	No	Yes		
Expert	6024	End of charge voltage level	V	13.2	7.98	17.52	26.4	15.96	35.04	52.8	31.92	70.08		
Expert	6025	End of charge current level	%cap	2	0	20	2	0	20	2	0	20		
Expert	6026	Minimum duration before end of charge	s	240	5	300	240	5	300	240	5	300		

Table 11.1. Factory setting values

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