MasterShunt

ENHANCED BATTERY MONITOR

EN	USER'S AND INSTALLATION MANUAL
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MASTERVOLT
THE POWER TO BE INDEPENDENT

TABLE OF CONTENTS:

1 GENERAL INFORMATION

1.1 USE OF THIS MANUAL

This manual serves as a guideline for the safe and effective operation, maintenance and possible correction of minor malfunctions of the *MasterShunt*.

This manual is valid for the following models:

Description	Part number
MasterShunt	77020110

Every person who works on or with the *MasterShunt* must be completely familiar with the contents of this manual, and must follow the instructions contained herein carefully.

Installation and work on the *MasterShunt* must only be carried out by qualified, authorised and trained personnel, consistent with the locally applicable standards and taking into consideration the safety guidelines and measures. See Chapter 2 ´Safety guidelines and measures´.

Read the entire manual before installing and using the MasterShunt. Keep the manual at a safe location for future reference.

1.2 WARRANTY

Mastervolt assures the product warranty of the *MasterShunt* during two years after purchase, on the condition that the product is installed and used according to the instructions in this manual.

Installation or use not according to these instructions may result in under performance, damage or failure of the product and may void this warranty. The warranty is limited to the cost of repair and/or replacement of the product. Costs for labour or shipping are not covered by this warranty.

1.3 LIABILITY

Mastervolt cannot be held liable for:

- Consequential damage resulting from the use of the *MasterShunt*.
- Possible errors in the included manual and the consequences of these.
- Use that is inconsistent with the purpose of the product.

CAREFUL!
Never remove the type number plate.

Important technical information required for service, maintenance and secondary delivery of parts can be derived from the type number plate.

1.4 CHANGES TO THE MASTERSHUNT

Changes to the *MasterShunt* may be carried out only after obtaining the written permission of Mastervolt.

2 SAFETY GUIDELINES AND MEASURES

2.1 WARNINGS AND SYMBOLS

Safety instructions and warnings are marked in this manual by the following pictograms:

CAREFUL!
Special data, restrictions and rules with regard to preventing damage.

WARNING
A WARNING refers to possible injury to the user or significant material damage to the *MasterShunt* if the user does not (carefully) follow the procedures.

NOTE
A procedure, circumstance, etc. which deserves extra attention.

2.2 USE FOR INTENDED PURPOSE

The *MasterShunt* is constructed according to applicable safety guidelines.

Use the *MasterShunt* only:

- in a technical correct condition;
- in a closed, well-ventilated room, protected against rain, moist, dust and condensation;
- observing the instructions in the user's manual.

WARNING
Never use the *MasterShunt* in locations where there is danger of gas or dust explosion or potentially flammable products.

2.3 ORGANIZATIONAL MEASURES

The user must always:

- have access to the user's manual;
- be familiar with the contents of this manual, especially the safety guidelines and measures.

2.4 MAINTENANCE AND REPAIR

If the electrical installation is switched off during maintenance and/or repair activities, it should be secured against unexpected and unintentional switching on:

- switch off all charging systems;
- switch off the connection with the batteries;
- be sure that third parties cannot reverse the measures taken.

If maintenance and repairs are required, only use original spare parts.

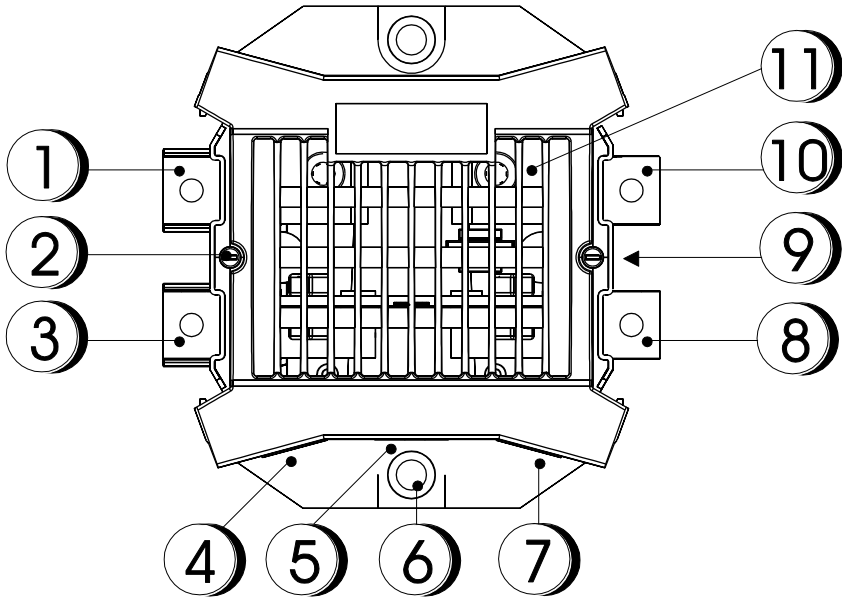
2.5 GENERAL SAFETY AND INSTALLATION PRECAUTIONS

- Connection and protection must be done in accordance with local standards.
- Do not work on the *MasterShunt* or system if it is still connected to a current source. Only allow changes in your electrical system to be carried out by qualified electricians.
- Check the wiring at least once a year. Defects such as loose connections, burned cables etc. must be corrected immediately.

2.6 WARNING REGARDING BATTERY USE

Excessive battery discharge and/or high charging voltages can cause serious damage to batteries. Do not exceed the recommended limits of battery discharge level. Avoid short circuiting batteries, as this may result in explosion and fire hazard. Installation of the batteries and adjustments to the *MasterShunt* should only be undertaken by authorised personnel!

3 OPERATION



1. Positive battery pole at battery side
2. Fastening screw on both sides (turn 90 degrees to loosen top)
3. Negative battery pole at battery side
4. MasterBus connector
5. Temperature sensor connector
6. Mounting hole for M8 socket screw
7. MasterBus connector
8. Negative battery pole at load side
9. Flashing communication LED (on both sides)
10. Positive battery pole at load side
11. Bus bar or optional Internal fuse

Figure 1 : Overview of the *MasterShunt*

3.1 INTRODUCTION

The Mastervolt *MasterShunt* provides extended information about the status of your battery bank. This information includes reading voltage, current, Ah used, time remaining and remaining capacity in rates.

3.2 MONITORING YOUR BATTERY BANK

Your battery bank is monitored in the most accurate way, i.e. by measuring the voltage and the (dis)charge current by means of a shunt. Important is the time factor included in the measurements. This enables the *MasterShunt* to determine the state of charge very precisely.

3.3 FEATURES

- Monitoring of a battery or battery bank (12/24/48V DC)
- Easy installation
- Can be installed in parallel for larger systems
- Shunt (precise measuring of the battery bank)
- State of charge
- Automatic calculation of Charge Efficiency Factor
- Extensive historical data
- MasterBus network support
- Optional integrated main system fuse in positive DC line either ANL or T-Fuse
- Solid housing of the shunt with isolation of the DC connections.
- Masterconnect
- Smart MasterBus powering

3.4 COMMUNICATION LEDS

The *MasterShunt* features two LEDs, between the DC connectors at the load side and battery side (see also Figure 1). These two green LEDs blink together in three modes:

Mode	Blinking	Meaning
1	Simultaneously short, 10 second intervals	No MasterBus activity
2	Simultaneously, other than 10 second intervals	MasterBus activity
3	Alternately, regular intervals of half a second	Alarm situation

4 INSTALLATION

WARNING
During installation and commissioning of the *MasterShunt*, the Safety Guidelines and Measures are always applicable. See Chapter 2 ‘Safety guidelines and measures’.

CAREFUL!
Wrong connections may cause damage to the *MasterShunt* and other equipment as well, which is not covered by warranty!

NOTE
For correct measurements the *MasterShunt* must be placed *closest possible* to the batteries.

NOTE
Optionally a fuse can be placed inside the *MasterShunt* to make your installation safer, see Section 4.5. Otherwise make sure to place fuses on other places in your installation to guarantee its safety.

4.1 SYSTEM EXAMPLES

Figure 2 shows an example of the MasterShunt in combination with a charger and a distribution panel. Note the position of the charger at the load side and the MasterBus cables between the MasterBus devices.

4.2 THINGS YOU NEED FOR INSTALLATION

In the box:

- MasterShunt
- MasterBus cable, 6 metres
- Terminator for MasterBus network
- Temperature sensor to fasten on top of the battery
- Two translucent end pieces
- Four DC cones
- One translucent mid piece for connection to another MasterConnect device.
- Four M8 bolts with washer to fasten the DC wiring.

Tools and materials:

- A cross-head screw driver
- 2 mm and 5 mm flat blade screwdrivers.
- Hexagonal socket wrench size 6 mm
- Two heavy duty battery cables shortest possible, finished with cable lugs. Cable thickness must be in accordance with the electrical installation.

A complete set of spanners, pliers and wrenches may be helpful during the installation of the *MasterShunt*.

CAREFUL!
Use isolated tools!!

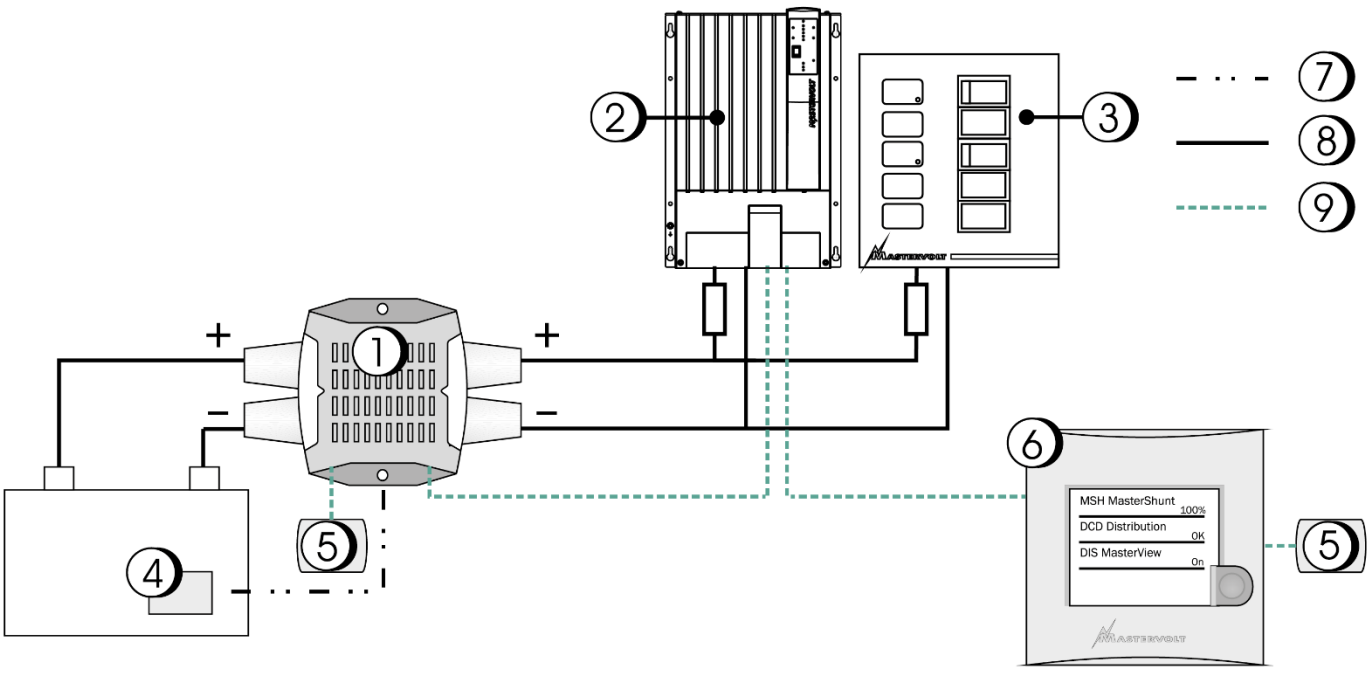


Figure 2 : System example 1

1 MasterShunt
2 Charger
3 Switchboard
4 Temperature sensor on battery
5 Terminator for MasterBus
6 MasterView Easy display
7 Temperature sensor wiring
8 DC wiring
9 MasterBus wiring

4.3 BASIC INSTALLATION STEP BY STEP

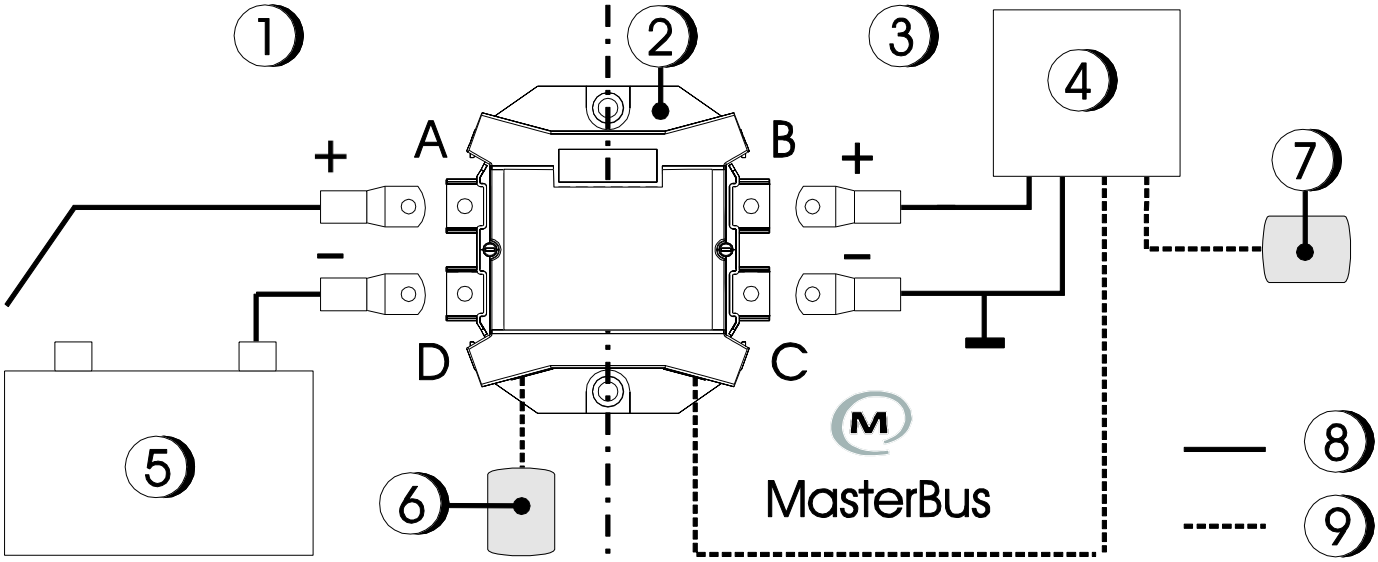


Figure 3 : Installation of the *MasterShunt*

1 Battery side
2 MasterShunt
3 Load side
4 Charger and battery load
5 Battery bank
6 Terminator for MasterBus
7 Terminator for MasterBus
8 DC wiring
9 MasterBus wiring

1. Disconnect the electrical power:
   - Switch off all consumers,
   - Switch off all charging systems.
   - Disconnect the battery poles, first the positive pole.
   - Check with a suitable voltmeter whether the entire DC installation is voltage free.

NOTE
Remember to put the cones around the cables before connecting!

2. Position the *MasterShunt* between the battery and the load/ charger.
3. Connect the loose positive battery cable to the upper left connection (A) and the positive load cable to the upper right connection (B).
4. Connect the negative battery cable to (D) and the negative load cable to (C).
   - Use cable lugs to accomplish sufficient electrical contact between the wiring and the *MasterShunt*.
   - The recommended tightening torque is 15-20 Nm.

NOTE
The charger must be connected at the load side of the MasterShunt!

CAREFUL!
Leave the positive battery cable disconnected from the battery.

4.4 MASTERBUS WIRING

Connect two or more MasterBus devices with MasterBus cable. Put a MasterBus terminator at both ends of the network. See Chapter 14 ‘MasterBus’ for more information.

NOTE
Always place a terminator at both ends of the MasterBus network.

4.5 PLACING A FUSE INSIDE

By default the *MasterShunt* is equipped with a busbar inside:

- Busbar MSH500-III (Part number 77020150)

You can choose to replace the busbar with one of the following fuses:

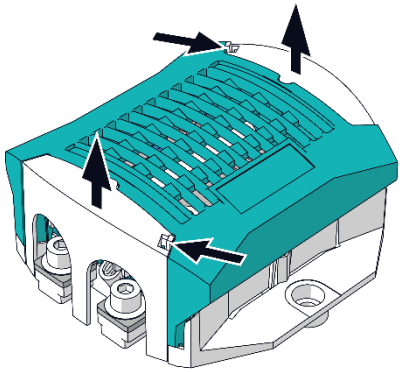
- T-500A fuse (Part number 77049000).
- ANL fuse (See section 12.7 for part numbers)

This will make your installation safer. Another option is to place a fuse elsewhere in your installation.

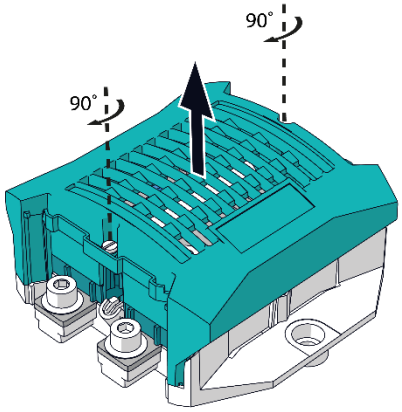
NOTE
Always have the selected fuse checked by qualified personnel to prevent any unnecessary fuse melts when going fully operational.

Follow the steps on the next page to replace the busbar with a fuse.

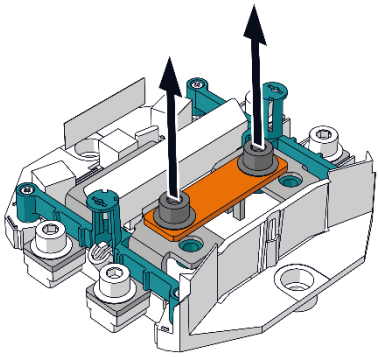
1. Disconnect the electrical power:
   - Switch off all consumers.
   - Switch off all charging systems.
   - Disconnect the positive battery poles.
2. Remove the two transparent covers.



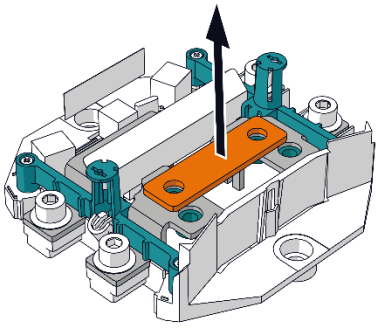
3. Unlock and remove upper casing.



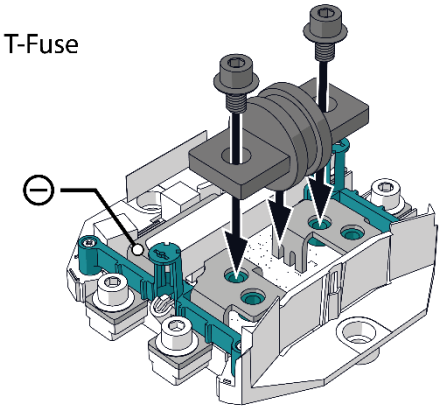
4. Remove the two bolts.



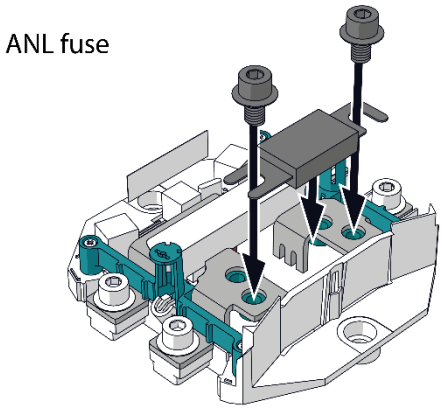
5. Take out the busbar. Mind possible hot parts!



6. Place a T-fuse or an ANL fuse and fasten with the two removed bolts from step 4 (torque 15-20 Nm).



WARNING
When installing the T-fuse make sure it does not make any contact with the negative pole inside the *MasterShunt*, see ⊖.

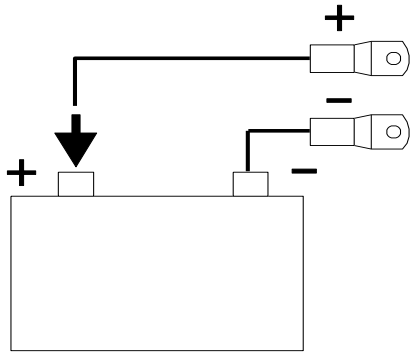


7. Fasten the fuse with the two bolts (4&7). The tightening torque should be 15-20 Nm.
8. Replace and lock the casing.
9. Reconnect the battery pole.
10. Store the removed busbar close to the *MasterShunt* for future service purposes.

4.6 COMMISIONING

Check if all wiring is OK. Then:

1. (Re)connect the positive battery cable.
2. Proceed with Chapter 5 ‘First start up’.



5 FIRST START UP

At first start up with the MasterShunt installed, MasterAdjust will guide you through the following settings.

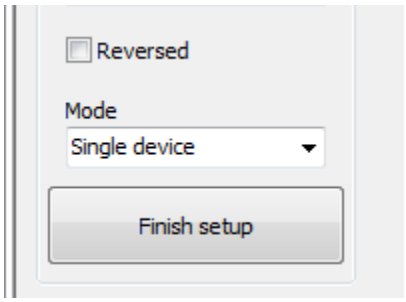


Figure 4: Advanced setup

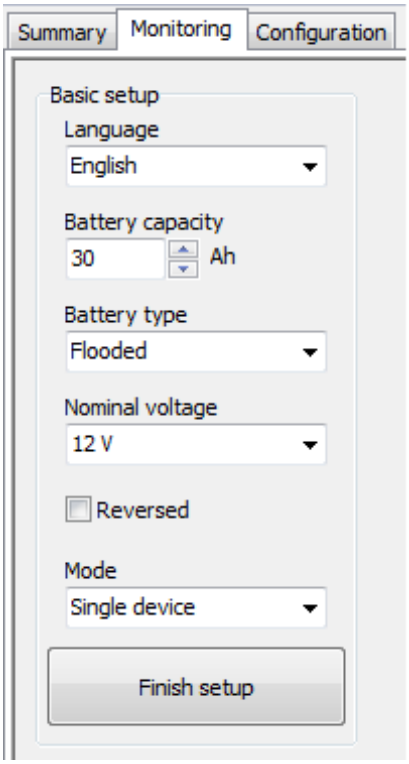


Figure 5: First start up

Variable	Description	Factory sett.	Range
Basic setup			
[Language]	Change the language at first start up. See Chapter 4 'Installation' for more instructions.	English	[English], [Nederlands], [Deutsch], [Français], [Castellano], [Italiano], [Norsk], [Svenska], [Suomi], [Dansk].
[Battery capacity]	Set the battery capacity to enable the MasterShunt calculating the state of charge.	Value from First Setup	30-10000Ah
[Battery type]	Four different battery types can be selected. The spiral battery belongs to the AGM batteries.	Value from First setup	[Flooded], [Gel], [AGM], [MLI].
[Nominal voltage]	Nominal battery voltage, set at first set up.	Value from First setup	[12V] ,[24V], [48V]
Advanced mode			
[Reverse IN/OUT]	Use this option for reversing input and output, when you installed the load at the left of the MasterShunt.	Off	Off, On
[Mode]	Use this option for parallel (see Chapter 6 'Parallel use') or single device configuration. "I + U only: is an option to only measure the current and voltage with the MasterShunt configured as single device.	Single device	[Single device], [I + U only], [Parallel mode].
Complete			
[Finish setup]	It is still possible now to check your settings. When ready, press [Finish setup] to finish the first start up. If you want to alter a first start up variable afterwards, resetting the setup is necessary.		

6 PARALLEL USE

For load currents which exceed 300A continuous current, more than one MasterShunt can be installed to monitor the same battery (bank). The MasterShunts are then configured in parallel to the battery, like shown. Figure 8 shows the parallel configuration of two MasterShunts (3) and (4) and other products.

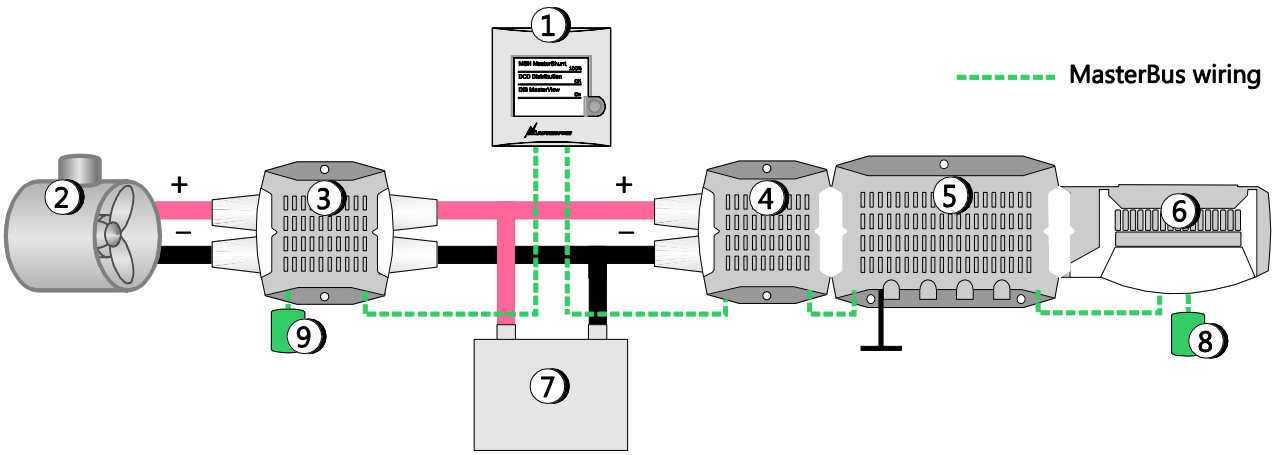


Figure 6 : System example 2

1. *Masterview Easy display*
2. *Bow thruster*
3. *Mastershunt in parallel 1, in Reversed setting*
4. *Mastershunt in parallel 2*
5. *DC Distribution 500*
6. *Digital DC 10x10A*
7. *Battery*
8. *9. MasterBus Terminator*

NOTE

When using previous versions of the MasterShunt (77020100) in combination with a current version (77020110) in parallel setup make sure to select the current version (77020110) as master and previous version (77020100) as slave.

For parallel setup of two MasterShunts, follow next steps:

- First reset any pre-used Mastershunts to factory settings;
- During First start up select Advanced mode/ Parallel mode on one of the MasterShunts, this will become the Master.
- Select the serial number(s) of the other MasterShunt(s), refer to figure 9. These MasterShunt(s) will be the slave(s).

After pressing the “Complete” button the measurements of all paralleled MasterShunts are combined and shown as one MasterShunt.

The currents however are shown separately, see Figure 9. This means, renaming the MasterShunts can be convenient (see Figure 8)

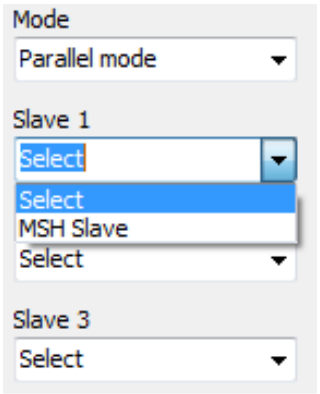


Figure 7 : Parallel setting

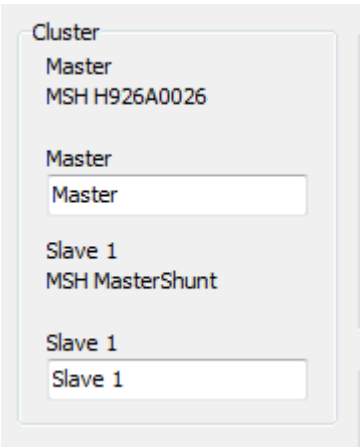


Figure 8: Renaming MasterShunts

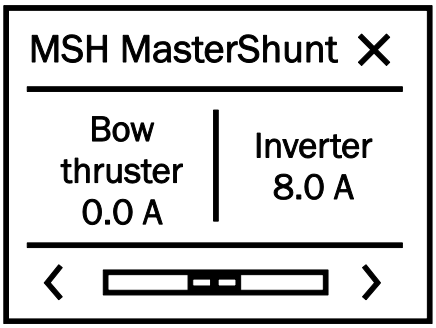


Figure 9: Masterview display

7 MONITORING MENU

The monitoring menu (Figure 10) shows the monitoring functions available with the MasterShunt. It offers a quick status overview of the battery bank. None of the displayed information can be modified at this menu

At first start up the Mastershunt Shows “--- %” SOC.

The SOC will show a valid number again when the battery bank is charged to full conditions.

After a power reset of the Mastershunt the SOC will also show --%

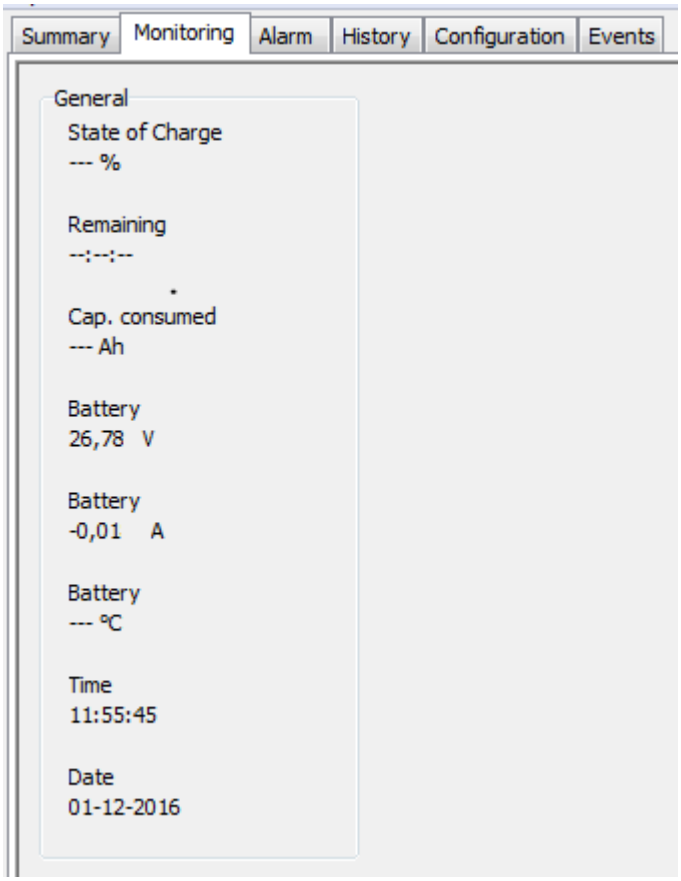


Figure 10 : Monitoring menu

Message	Description
[State Of Charge [%]]	This readout shows the actual amount of energy left in the battery, related to the battery capacity you selected.
[Remaining [hh:mm:ss]]	The *time remaining* before the battery will be empty. Maximum value: 480 hrs (20 days). Under 24 hrs it shows hh:mm:ss, above that dd:hh. During charging it shows “--:--:--“. This value depends on the current drawn.
[Cap. Consumed]	*Capacity consumed* shows how many Amp-hours (Ah) have been consumed from the battery bank.
[Battery]	Shows the measured voltage at the MasterShunt.
[Battery]	Shows the measured current through the poles of the MasterShunt. Charging appears as positive current, discharging as negative current.
[Battery]	Shows the temperature measured by the temperature sensor, connected to MasterShunt. If a charger has been connected to the MasterShunt, this temperature sensor will be relevant for charge voltage correction!
[Time]	If you have set the [Time], this screen shows hh:mm:ss. Refer to Chapter 10 ‘Configuration’ for settings.
[Date]	If you have set the [Date], this screen shows dd:mm:yyyy. Refer to Chapter 10 ‘Configuration’ for settings.

8 ALARM MENU

The MasterShunt features six different alarm parameters (Figure 11) which can be configured to custom chosen values. If the alarm conditions are met, i.e. if the chosen value has been reached, the MasterBus based alarm function can trigger different events. For instance if the parameter “Battery low” has been set to 35% and the battery SOC is being discharged to this value, the alarm can trigger a generator to start and recharge the battery. See Chapter 11 ‘Events’: Event 1 and 2.

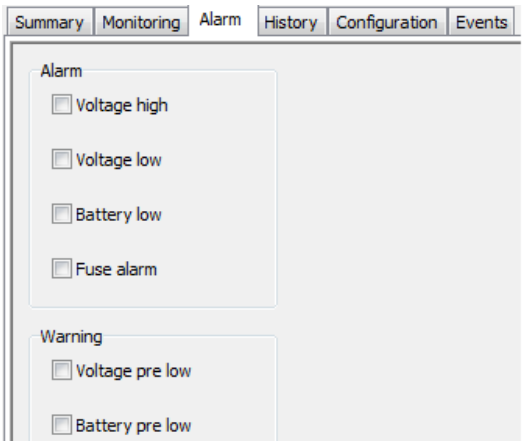


Figure 11 : Alarm menu

Message	Description
[Alarm]	
[Voltage high]	When the battery voltage rises above the high voltage level (15V default value), the alarm function will be raised with the set High delay time.
[Voltage low]	If the battery voltage drops below a preset value (10V default) this alarm is raised (after the set Low delay time).
[Battery low]	This function will be triggered when the State Of Charge (SOC) drops below a preset value(35% default).
[Fuse alarm]	This alarm is raised when the internal MasterShunt fuse is blown.
[Warning]	
[Voltage pre low]	To prevent the battery from becoming discharged too deeply, a value above Voltage low can be set (11V default).
[Battery pre low]	To prevent the battery from draining, a SOC value above Battery low can be set (40% default).

Refer to Chapter 10 ‘Configuration’ for alarm settings

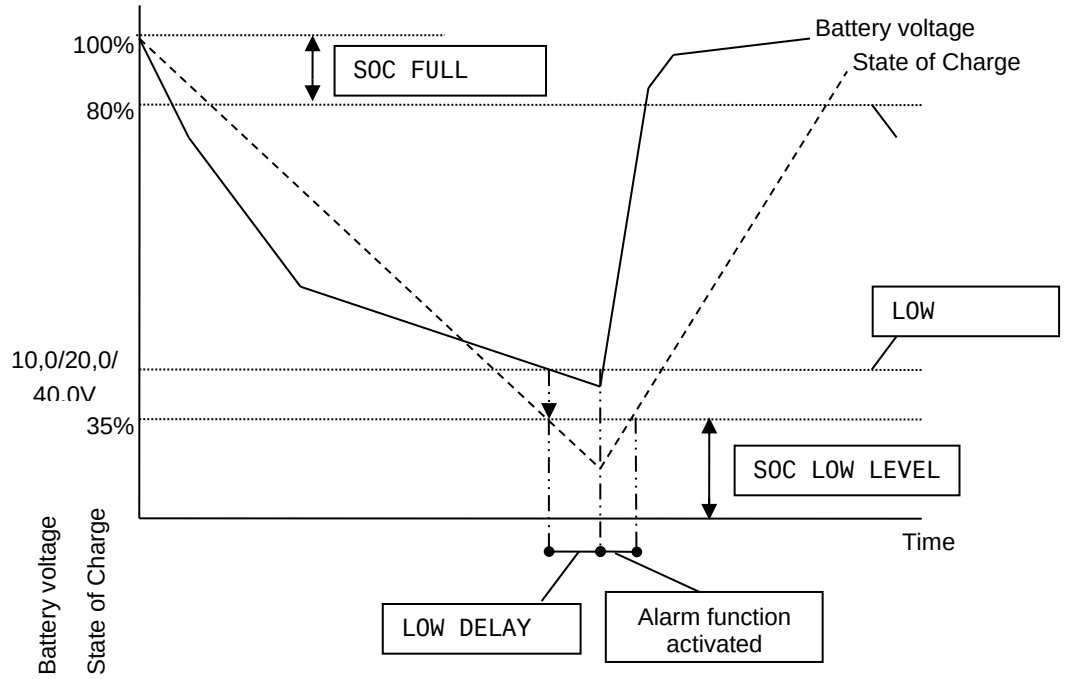


Figure 12 : Battery alarm function

9 HISTORY MENU

To know the history of your battery bank can be very useful. It will help you to check if the battery capacity suits the application and when the battery needs to be replaced. For this you need to know the number of battery charging cycles and the efficiency (C.E.F.) of the battery. The memory back up system of the *MasterShunt* saves this data even if the battery was completely discharged or disconnected.

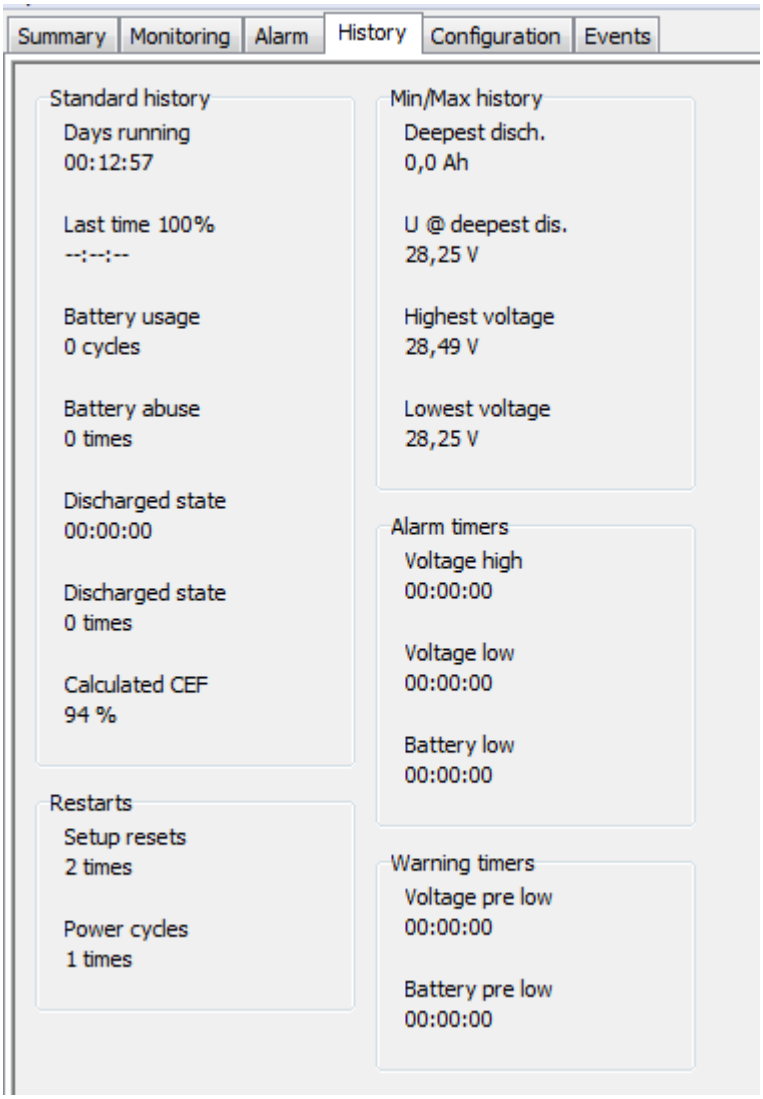


Figure 13 : History menu

Message	Description
[Standard history]	
[Days running]	The total number of days since the MasterShunt was powered.
[Last time 100%]	The number of days since the battery bank was charged up to 100% for the last time. To prevent damage the batteries must be charged to the full 100% regularly.
[Battery usage]	The total number of charging cycles of the battery bank.
[Battery abuse]	Slow and deep discharges below the battery's end voltage can reduce the expected lifetime of your batteries dramatically. This item shows the number of battery abuse cycles. A large number of abuse cycles might indicate small loads that stayed connected during a long period (for instance during wintertime). Get your electrical installation examined by a qualified installer if abuse cycles happen more than once!

<table>
<tr><td>[Discharged state]</td><td>This timer will start when the SOC is below the “start under level” and will stop when the SOC is above the “stop above level” (with a DOD of 100%)
<table>
<tr><th></th><th>Timer start under level</th><th>Timer stop above level</th></tr>
<tr><td>Flooded</td><td>50</td><td>60</td></tr>
<tr><td>Gel</td><td>40</td><td>50</td></tr>
<tr><td>AGM</td><td>50</td><td>60</td></tr>
<tr><td>MLI</td><td>20</td><td>30</td></tr>
</table></td></tr>
<tr><td>[Discharged state]</td><td>Counter that shows the number of times where the “start under level” has been reached.</td></tr>
<tr><td>[Calculated CEF]</td><td>See Section 12.2 for explanation of the CEF.</td></tr>
<tr><td>[Restarts]</td><td></td></tr>
<tr><td>[Setup resets]</td><td>The number of times the setup has been reset. Factory setting = 0. Resetting clears all history values except for this counter which is increased by one.</td></tr>
<tr><td>[Power cycles]</td><td>Counts the number of times the MasterShunt has been disconnected from the battery.</td></tr>
<tr><td>[Min/max history]</td><td></td></tr>
<tr><td>[Deepest disch.]</td><td>Shows the deepest discharge. The deepest discharge should never be higher than the rated capacity of the battery as specified by the battery manufacturer.</td></tr>
<tr><td>[Volt at low Ah]</td><td>Shows the voltage at the moment of recording the deepest discharge.</td></tr>
<tr><td>[Highest voltage]</td><td>Shows the highest voltage that was recorded. This voltage should never exceed the maximum charging voltage as specified by the battery manufacturer.</td></tr>
<tr><td>[Lowest voltage]</td><td>Shows the lowest voltage that was recorded. This voltage should never exceed the minimum charging voltage as specified by the battery manufacturer.</td></tr>
<tr><td>[Alarm timers]</td><td></td></tr>
<tr><td>[Voltage high]</td><td>The timer shows the total amount of time the [Voltage high] on the alarm menu was raised.</td></tr>
<tr><td>[Voltage low]</td><td>The timer shows the total amount of time the [Voltage low] on the alarm menu was raised.</td></tr>
<tr><td>[Battery low]</td><td>The timer shows the total amount of time the [Battery low] on the alarm menu was raised.</td></tr>
<tr><td>[Warning timers]</td><td></td></tr>
<tr><td>[Voltage pre low]</td><td>The timer shows the total amount of time the [Voltage pre low] on the alarm menu was raised.</td></tr>
<tr><td>[Battery pre low]</td><td>The timer shows the total amount of time the [Battery pre low] on the alarm menu was raised.</td></tr>
</table>

10 CONFIGURATION

The Configuration Menu is used to adjust general settings like displayed language alarm levels and advanced settings for your battery bank. Here you can also opt for resetting the MasterShunt to the factory settings. A MasterAdjust example is shown in figure 16.

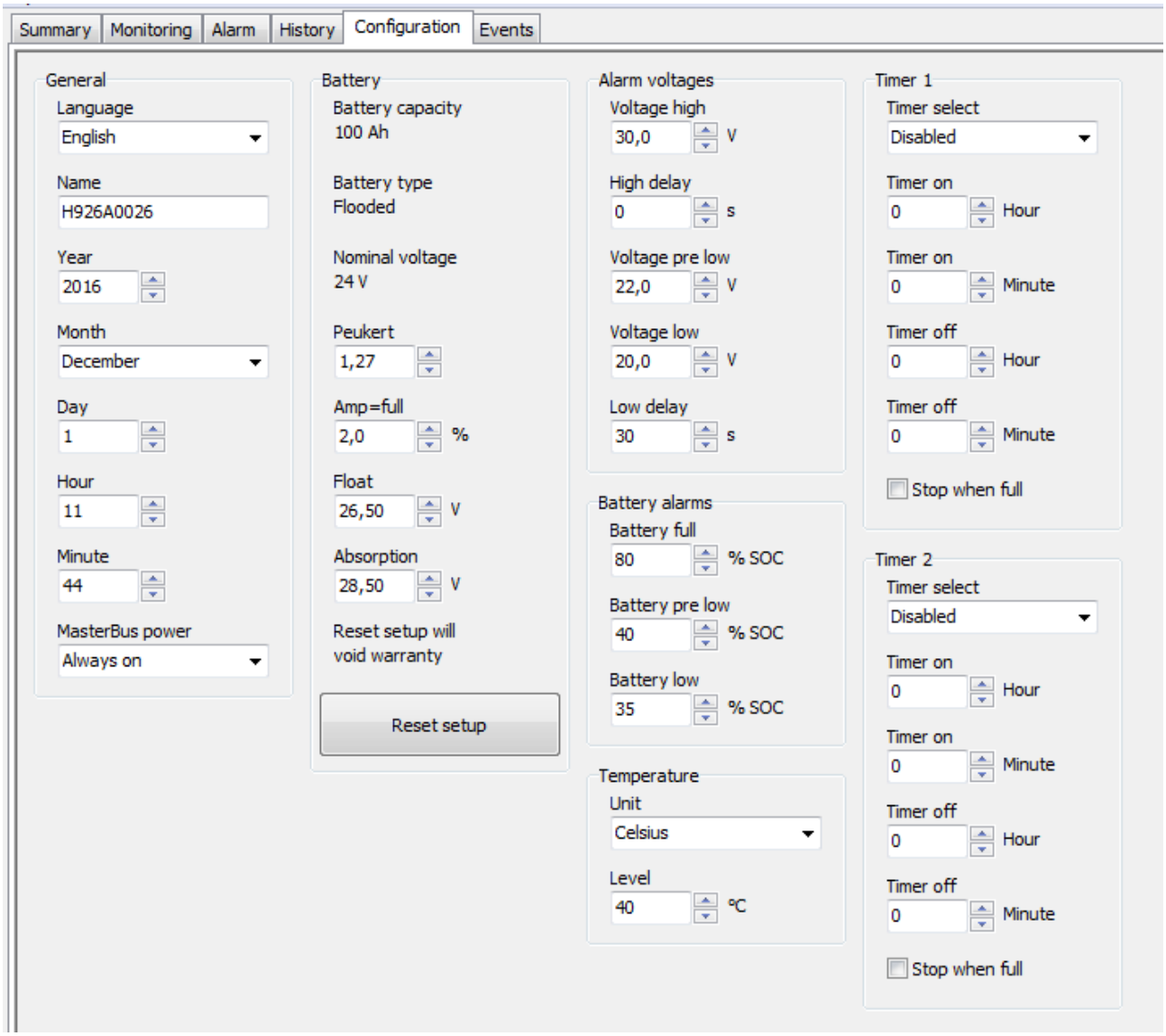


Figure 14 : MasterAdjust Configuration screen

Variable	Description	Factory setting *	Range
[General]			
[Language]	Change the language after your setting at first start up.	English	[English], [Nederlands], [Deutsch], [Français], [Castellano], [Italiano], [Norsk], [Svenska], [Suomi], [Dansk].
[Name]	Name of the battery bank; example: POWER BANK.	MasterShunt	Any maximum 12 character name .
[Year]	Set the MasterShunt clock year.	2000	2000-2135
[Month]	Set the MasterShunt clock month.	[January]	[January] <-> [December]
[Day]	Set the MasterShunt clock day.	1	1-31
[Hour]	Set the MasterShunt clock hour.	0	0-23

Variable	Description	Factory setting *	Range
[min]	Set the MasterShunt clock minute.	0	0-59
[MasterBus power]	In [smart on] mode this option will switch off Masterbuspower when main current is in between 1.0A and -1.0A for more than 24 hours and the battery voltage has dropped below the float voltage. This prevents your battery from being discharged slowly by Masterbus power.	[Always on]	[Off], [Smart on], [Always on].
[Battery]			
[Battery capacity]	You see the battery capacity selected during FIRST START UP. Refer to Chapter 5. To change this value you need to reset the setup.	Value from First Setup	30-10000Ah
[Battery type]	You see the battery type selected during FIRST START UP. Refer to Chapter 5. To change this value you need to reset the setup.	Value from First setup	[Flooded], [Gel], [AGM], [MLI].
[Nominal voltage]	Nominal battery voltage. To change this value you need to reset the setup.	Value from First setup	[12V] ,[24V], [48V]
[Peukert]	Peukert coefficient. Do not change this setting without extended knowledge of the installed batteries. See Chapter 12 'Additional information'.	Flooded: 1.27 Gel: 1.27 AGM: 1.27 Li-ion: 1.00	1,00-2,50
[Amp=Full]	Charge amps for Battery full. Several parameters must be met before the MasterShunt will consider the battery fully charged.	2.0%	0.1-10%
[Float]	This voltage must be set just below the lowest float voltage of all system charging devices at operating temperature. Float voltage is used to determine if the battery is fully charged (refer to Section 12.4).	Flooded batteries, Gel, AGM: 13.25/26.5/53.0V, Li-ion: 13.5/27.0/54.0V	12.0-15.0V/ 24.0-30.0V/ 48.0-60.0V
[Absorption]	This value is set to the recommended absorption voltage.	Flooded, Gel, AGM: 14.25/28.5/57.0V, Li-ion: 14.6/29.2/58.4V	12.0-15.0V/24.0-30.0V/48.0-60.0V
[Reset setup will void warranty]	This screen warns you for the possible consequences of your Mastervolt battery bank warranty by resetting the setup.		
[Reset setup]	Reset the complete setup of the MasterShunt, this will reload all default factory settings.		
[Alarm voltages]			
[Voltage high]	When the battery voltage rises above this level, the alarm function will be triggered.	Flooded, Gel, AGM: 15.0/30.0/60.0V, Li-ion: 15.5/31.0/62.0V	13.0-18.0/ 26.0-36.0/ 52.0-72.0V.
[High delay]	The "alarm delay time" can be set to delay the alarm function when the DC-voltage rises above the *Voltage high* set point. As high voltage is accompanied by a high risk the factory setting for high delay is 0 seconds.	0 seconds	0-60 seconds
[Voltage pre low]	Set the State Of Charge value below which the alarm function *Battery pre low* will be triggered, Note: the *Battery pre low* level is higher than *Battery low*, to prevent the *Battery low* situation.	40% Li-ion: 30%	10-90%
[Voltage low]	The low voltage set point marks the voltage threshold of low battery. If the battery voltage drops below this value, the alarm function will be activated after the Low delay, see below.	Flooded, Gel, AGM: 10.0/20.0/40.0V, Li-ion: 11.0/22.0/44.0V	10-15V/ 20-23V/ 40-60V

Variable	Description	Factory setting *	Range
[Low delay]	The “alarm delay time” can be set to delay the alarm function when the DC-voltage drops below the *Voltage low* set point . This delay prevents a false alarm as a result of a temporary voltage drop, after switching on heavy loads.	30 seconds	0-100 seconds
Battery Alarms			
[Battery full]	Set the State Of Charge value at which the alarm function *Battery full* will be triggered,.	100%	30-100%
[Battery pre low]	Set the State Of Charge value below which the alarm function *Battery pre low* will be triggered, Note: the *Battery pre low* level is higher than *Battery low*, to prevent the *Battery low* situation.	40% Li-ion: 30%	10-90%
[Battery low]	Set the State Of Charge value below which the alarm function *Battery low* will be triggered	35% Li-ion: 20%	10-90%
Temperature			
[Unit]	Set the unit in which the temperature is shown	Celsius	*Celsius or Fahrenheit*
[Level]	Set the temperature level to trigger an event	40*°C*	*-20°C – 70°C*
[Timer 1&2]			
[Timer Select]	Select the day at which timer 1 is activated.	Disabled	Disabled, Sun, Sat, Weekend, Daily, Monthly
[Timer On]	Set the hour at which timer 1 will start.	0	0…23
[Timer On]	Select the minute at which timer 1 will start.	0	0…59
[Timer Off]	Select the hour at which timer 1 will stop.	0	0…23
[Timer Off]	Select the minute at which timer 1 will stop.	0	0…59
[Stop when full]	Has for instance a generator stopped when the battery is full before timer 1 elapsed?		

* The factory settings for Li-ion batteries are applicable for the Mastervolt Li-ion batteries only. For other Li-ion batteries, these settings should be adjusted.

11 EVENTS

In the Events menu you can program the MasterShunt to act as an event source in your Masterbus network. Events which occur during the operation of the MasterShunt will then trigger actions from other Masterbus products.

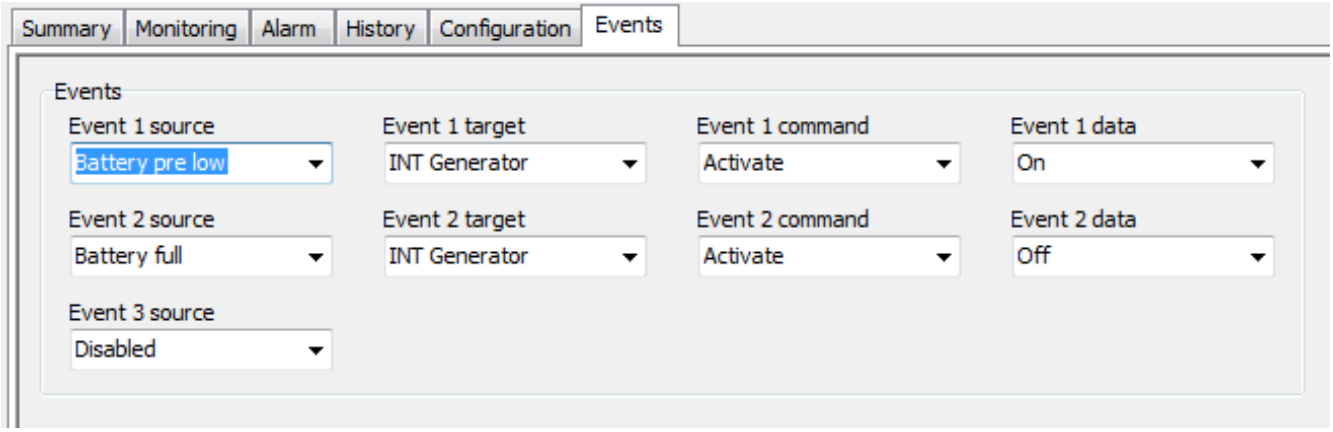


Figure 15 : Events menu

Variable	Description	Fact sett.	Range
[Events]			
Event 1 source]	Select an event to serve as Event 1. Example: [Battery pre low] can trigger a generator to start and [Battery full] can trigger it to stop.	Disabled	Refer to Section 11.1
[Event 1 target]	Select a device to perform a task if Event 1 takes place. Example: generator	Select…	System dependent.
[Event 1 command]	Select a command on the device you chose.	Select…	System dependent.
[Event 1 data]	Data is linked to the command, see figure 17.	Off	System dependent
[Event 2 source]	This screen appears after enabling Event 1. Select an event to serve as Event 2.	Disabled	

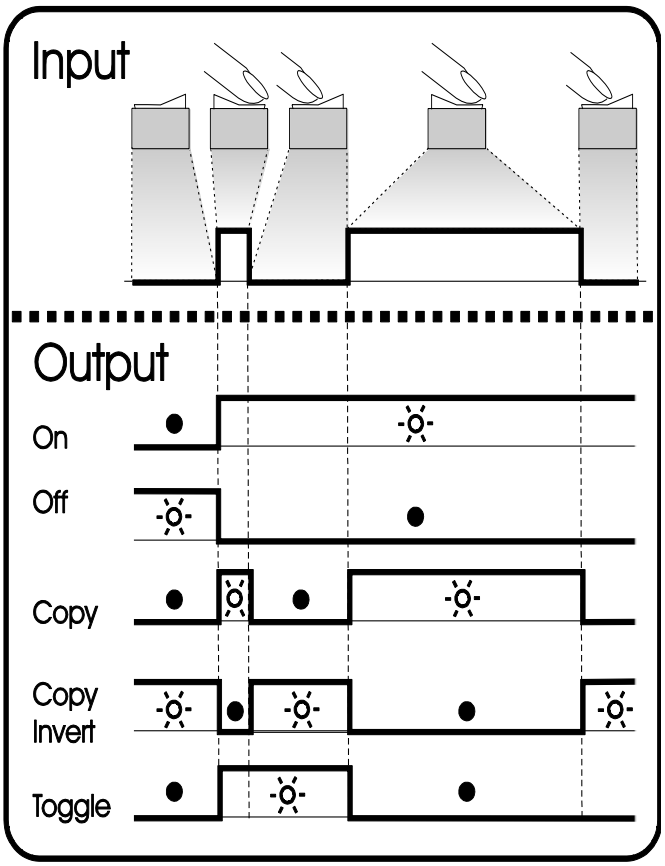


Figure 16 : Explanation of the function Event data

Input is a pulse followed by a longer signal (1/0).

This could be a short period followed by a long period of the Event source Battery low. The figure shows a pulse switch to illustrate the input.

[On] changes the status to On at the first signal.

[Off] changes the status to Off at the first signal.

[Copy] lets the status follow the input.

[Copy Invert] lets the status follow the opposite of the input.

[Toggle] changes the status at the first signal and back at the second signal. It is often used in combination with a pulse switch.

11.1 EVENTS WITH MASTERSHUNT AS EVENT SOURCE

Disabled	No events configured
[Voltage pre low, Voltage low, Voltage high, Battery pre low, Battery low, Battery full,]	Refer to Chapter 8 ‘Alarm menu’.
[Battery >20%,> 40%,> 60%,> 80%, >100%]	Battery SOC in % of capacity
[Charging]	The MasterShunt measures charging current.
[Timer 1, 2]	Refer to Chapter 10 ‘Configuration’ *Timer settings*

11.2 EVENTS WITH MASTERSHUNT AS EVENT TARGET

There are no events with the MasterShunt acting as an event target.

12 ADDITIONAL INFORMATION

12.1 BATTERY ALARM FUNCTION

The *MasterShunt* continuously monitors the batteries State Of Charge (SOC). If the SOC drops below a pre-set value or the battery voltage is either too high or too low, the alarm function is activated.

For alarm functions refer to Chapter 8 'Alarm menu'.

12.2 CHARGE EFFICIENCY FACTOR (C.E.F.)

Every battery has a total efficiency. This means that there must be more Ah charged into the battery than can be consumed. This ratio is expressed by means of the Charging Efficiency Factor (CEF). It is used to correct the calculation of the consumed Amphours and the time remaining function.

If an efficiency of 70 % has been reached, it will mean that the battery is at the end of its lifetime and needs to be replaced.

The CEF is continuously recalculated by the *MasterShunt* itself (after two recharges up to 100% with a proceeding discharges of at least 5%). This recalculated value is used for new calculations of the Amphours, the time remaining and the SOC.

12.3 PEUKERT EXPONENT

Standard batteries are rated for a 20-hour discharge. This means that a 100 Ah battery can supply 5 Amps for 20 hours before a voltage of 1,75 V/cell (i.e. 10.5V for 12V batteries / 21.0V for 24V /42.0V for 48V batteries) is reached. If the discharge current is higher, for example 10 amps, the battery will not be able to supply the full 100 Ah. In this case the voltage of 1,75 volt/cell or 10.5/21.0/42.0V is reached before the battery has supplied its full 20-h rated capacity. The maximum time battery use time in the example is approx. 8 hour i.e. 80 Ah.

The Peukert equation is $C_p = I^n t$ in which

C_p = battery capacity available with the given discharge current; I = discharge current level;

t= battery discharge time (in hours);

n = Peukert exponent = (logT2–logT1)/(logI2–logI1)

with T1,2 = battery discharge time 1,2

I1,2 = discharge current level 1,2

It describes the effect of different discharge rates on battery capacity. It can be used to calculate the real available capacity of a battery, if it is used above or below its 20 h rating. This equation is also used by the *MasterShunt* to calculate the time remaining function and SOC.

Normally it is not necessary to change the Peukert exponent. See chapter 0 to adjust the Peukert exponent.

12.4 STATE OF CHARGE (SOC)

The state of charge is expressed as a percentage. This value is automatically compensated by the charge efficiency factor (C.E.F.) and the Peukert exponent. When the battery is fully charged, the State of charge will be reset to 100%. A non Li-ion battery is considered to be fully charged if one of the below conditions is met,

1 Parameters below are met for at least 30 seconds:
   - All of the Ah's discharged are charged back into the battery (real counting without CEF)
   - The actual charge current is less than the setting for charge amps for full battery but more than 0A.
2 For at least 4 hours the actual battery voltage is higher than the float voltage *plus* 1.0/2.0/4.0V(at nominal battery voltage 12/24/48V)
3 For at least 8 hours the actual battery voltage is higher than the float voltage *plus* 0.3/0.6/0.9V (at nominal battery voltage 12/24/48V)
4 For at least 12 hours the actual battery voltage is higher than the float voltage *minus* 0.1/0.2/0.3V (at nominal battery voltage 12/24/48V).

12.5 AMP = FULL

This value represents the charge current below which the battery is considered to be fully charged, provided the float voltage (see chapter 11) is met as well. The percentage expresses this charge current related to the battery capacity (C20). Example: If the battery capacity is 200Ah, and this percentage is set to 2.0%, the battery is considered to be fully charged when the charge current has dropped below 200 x 2.0%,= 4 Amps. An older battery (beyond its normal lifetime) might start to consume more current when it is fully charged. Setting this value higher may be usable for old batteries which are beyond their economical life but have not been replaced yet.

12.6 REPLACEMENT OF BATTERIES

Refer to Chapter 4 'Installation' if you want to replace the batteries.

If new batteries are installed, the historical data of the old batteries needs to be erased to leave only historical data from the newly installed batteries. See Chapter 11 for information how to reset the setup. Contact your Mastervolt dealer if you have a 5 year system warranty. If necessary, do not forget to change the setting of the nominal capacity.

12.7 REPLACEMENT OF A FUSE

If a fuse is present, it is located inside the *MasterShunt*, see section 4.5. After replacement, switch on the consumers one at a time and monitor the current at each switch on. Refer to the manuals of these devices to check whether they are functioning correctly.

WARNING

Changing the internal fuse of the *MasterShunt* should be carried out by qualified personnel only!

Installation by unqualified personnel may result in major personal and material damage.

WARNING

Only replace the blown fuse by a fuse of the same rating!

WARNING

If a fuse has blown, a high current has flowed through several parts of the *MasterShunt*. As a result these parts and especially the fuse can be hot! Avoid burns!

12.8 ORDERING INFORMATION

Part number	Description
77020110*	MasterShunt
77020200	DC Distribution
41500500*	Battery temperature sensor 6m
41500800	Battery temperature sensor 15m
77030100	MasterBus USB interface, required as interface between your PC and the MasterBus network
77040000*	MasterBus terminator for the MasterBus network
77040020	MasterBus connection cable 0,2m / 0.6ft
77040050	MasterBus connection cable 0,5m / 1.6ft
77040100	MasterBus connection cable 1,0m / 3.3ft
77040300	MasterBus connection cable 3,0m / 10ft
77040600*	MasterBus connection cable 6,0m / 20ft
77041000	MasterBus connection cable 10m / 33ft
77041500	MasterBus connection cable 15m / 49ft
77042500	MasterBus connection cable 25m / 82ft
77050100	100m / 330ft MasterBus cable
77050200	50 pcs. MasterBus connectors
77050000	Complete set to assemble MasterBus cables. Delivery includes: 100m / 330ft MasterBus cable, 50 pcs. modular jacks and crimping tool
77020150*	Busbar
77049000	T-Fuse 500A
77049020	20A ANL Fuse
77049040	40A ANL Fuse
77049050	50A ANL Fuse
77049063	63A ANL Fuse
77049080	80A ANL Fuse
77049100	100A ANL Fuse
77049125	125A ANL Fuse
77049160	160A ANL Fuse
77049175	175A ANL Fuse
77049200	200A ANL Fuse
77049250	250A ANL Fuse
77049300	300A ANL Fuse
77049355	355A ANL Fuse
77049400	400A ANL Fuse
77049425	425A ANL Fuse
77049500	500A ANL Fuse

* These parts are standard included with the delivery of the *MasterShunt*

Mastervolt can offer a wide range of products for your electrical installation, including AGM batteries, GEL batteries, DC distribution kits, battery switches, battery cables and battery terminals.

See our website www.Mastervolt.com for an extensive overview of all our products and free to download software for monitoring and configuration

13 TROUBLE SHOOTING

Please contact your local Mastervolt Service Centre if you cannot correct a problem with the aid of the malfunction table below. See www.Mastervolt.com for an extended list of Mastervolt Service Centres.

Failure	Possible cause	What to do
MasterView display shows no MasterShunt	No terminating device placed at the ends of the network	MasterBus needs a terminating device on both ends of the network. Check if available (See Section 4.3).
	MasterBus network is configured as a ring network	Ring networks are not allowed. Check the connections of the network (See Section 4.3).
	T-connections in the MasterBus network	Check if T-connections are made in the network. T-connections are not allowed (See Section 4.3).
	Error in the wiring	Check the MasterBus cables and terminating devices (See Section 4.3).
	Display not set up to show all devices	Check manual of the display.
No voltage on load side of MasterShunt	Fuse blown	Investigate the cause of the blown fuse. Then replace the fuse (See Section 12.7)
No accurate time remaining function	Wrong setting of the nominal battery capacity	Correct the battery capacity setting (See Chapter 10: Battery).
State of Charge not accurate	Part of the load or the charger is connected at the battery side of the MasterShunt	Check whether all load and charger connections are at the load side of the MasterShunt (See Section 4.3).
	Wrong setting of the nominal battery capacity	Correct the battery capacity setting. See (See Chapter 10: Battery).
	Self-discharge of the batteries which was not recorded by the *MasterShunt*	Recharge the batteries for at least 24 hours.
Battery is fully charged but SOC function does not show “100%”	Charging system has not met the conditions for a fully charged battery	See Section 12.4 for an overview of the conditions for a fully charged battery.
State of Charge does not return to 100% after a long period of charging	Wrong setting of the float voltage	Lower the setting of the float voltage of the *MasterShunt* by 0.1V (See Chapter 10: Battery).
Wrong language is displayed	Wrong setting of the language at the MasterShunt	Adjust the language setting. See (See Chapter 10: Battery monitor).
	Wrong setting of the language at displaying device	Each separate connected device can have its own language setting. See user’s manual of the connected display.
Alarm function is triggered by a short time voltage dip	Wrong setting of the parameters	Set the parameters correctly (See Chapter 10: Alarm levels).
	Wrong setting of the alarm delay time.	Increase the delay time (See Chapter 10)
The communication LEDs blink alternately, indicating an alarm situation.	All failures can result in an alarm situation.	Look at your display to find out which failure needs to be corrected.

14 MASTERBUS

14.1 WHAT IS MASTERBUS?

All devices that are suitable for MasterBus are marked by the MasterBus symbol.

MasterBus is a fully decentralized data network for communication between the different Mastervolt system devices. The communication network is CAN-bus based and has proven a reliable bus system in automotive applications. MasterBus is used as power management system for all connected devices, such as the inverter, battery charger, generator and many more. This gives the possibility for communication between the connected devices, for instance to start the generator when the batteries are low.

MasterBus reduces complexity of electrical systems by reducing the amount of cables. All system components are simply chained together. Therefore each device is equipped with two MasterBus data ports. When two or more devices are connected to each other through these data ports, they form a local data network, called the MasterBus network. The results are a reduction of material costs as only a few electrical cables are needed and less installation time.

For central monitoring and control of the connected devices Mastervolt offers a wide range of panels which show full status information of your electrical system at a glance and a push of a button. Four different panels are available, from the small Mastervision compatible 120 x 65mm LCD screen up to the full colour MasterView System panel. All monitoring panels can be used for monitoring, control and configuration of all connected MasterBus equipment.

New devices can be added to the existing network in a very easy way by just extending the network. This gives the MasterBus network a high degree of flexibility for extended system configuration, not only today, but in the future as well!

Mastervolt also offers several interfaces, making even non-MasterBus devices suitable to operate in the MasterBus network. For direct communication between the MasterBus network and a product which is not from Mastervolt, the Modbus interface is recommended.

CAREFUL!
Never connect a non-MasterBus device to the MasterBus network directly! This will void warranty of all MasterBus devices connected.

14.2 EVENT BASED CONFIGURATION

Event based configuration can be very helpful in automation of your system. However it is not required for battery monitoring only.

An event is a *condition* to be met at which you want *another device* to perform a *task*.

Example: if the State of Charge of the batteries is too low, you might want to correct this situation by starting a generator to power the charger. The MasterShunt event source *Battery Low* (State of Charge is too low) can be used to start the generator.

The MasterShunt has 9 parameters (like *Battery low*) available to serve as an event source. These are the 7 alarm messages and 2 timers. See Chapter 10 for alarm messages and Chapter 11 for information regarding events.

14.3 HOW TO SET UP A MASTERBUS NETWORK

Every device that is suitable for the MasterBus network is equipped with two data ports. When two or more devices are connected to each other through these ports, they form a local data network, called the MasterBus.

Keep the following rules in mind:

Connections between the devices are made by standard straight UTP patch cables. Mastervolt can supply these cables with lengths of

0.2 to 25 m.

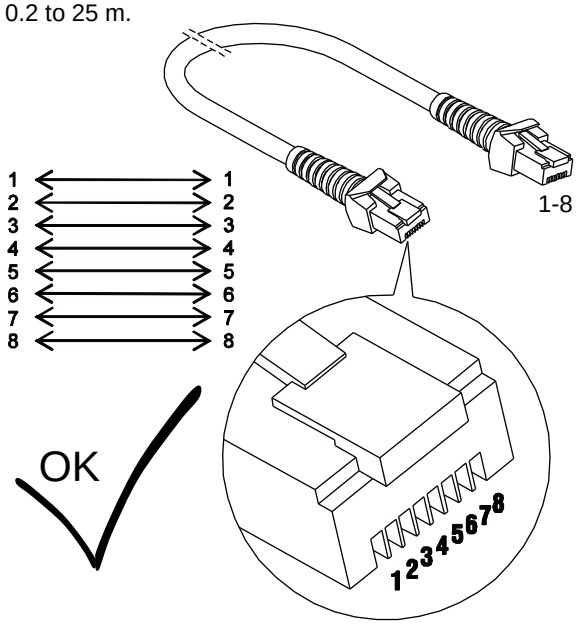


Figure 17 : MasterBus cable

As with all high speed data networks, MasterBus needs a terminating device on both ends of the network.

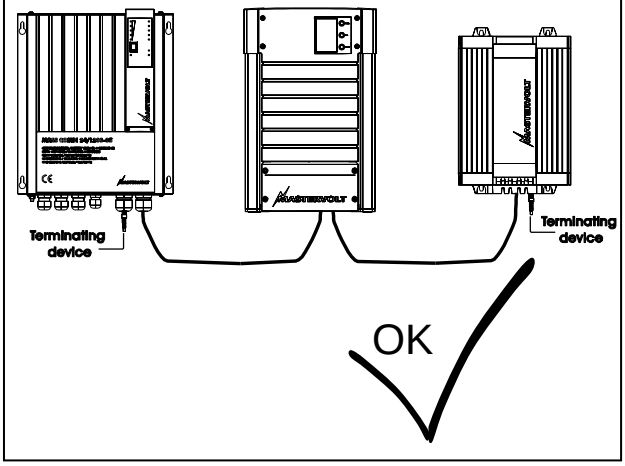


Figure 18 : Two terminators

The electric power for the network comes from the connected devices.

At least one device in the network should have powering capabilities (see specifications).

One powering device can power up to three non-powering devices.

As all powering devices are galvanically isolated, multiple powering devices are allowed.

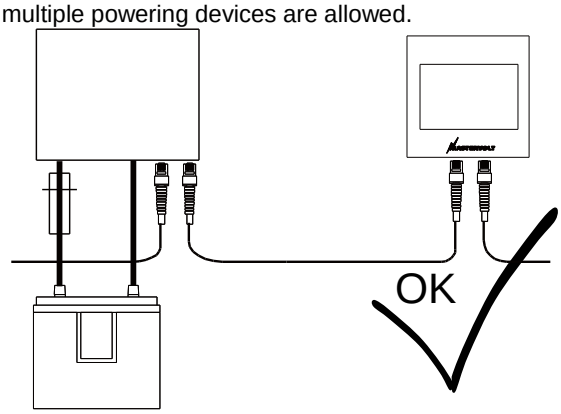


Figure 19 : Power supply

Do not make ring networks.

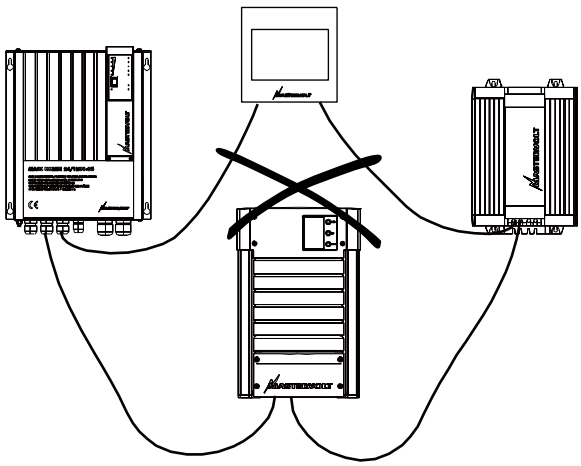


Figure 20: No ring networks

Do not make T-connections in the network.

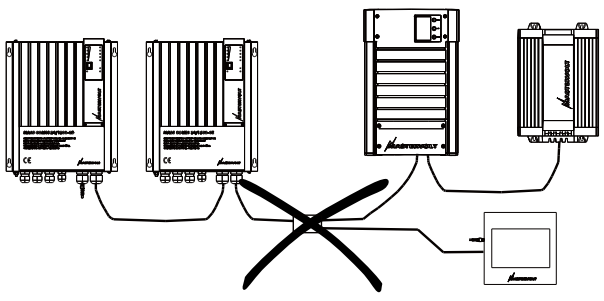


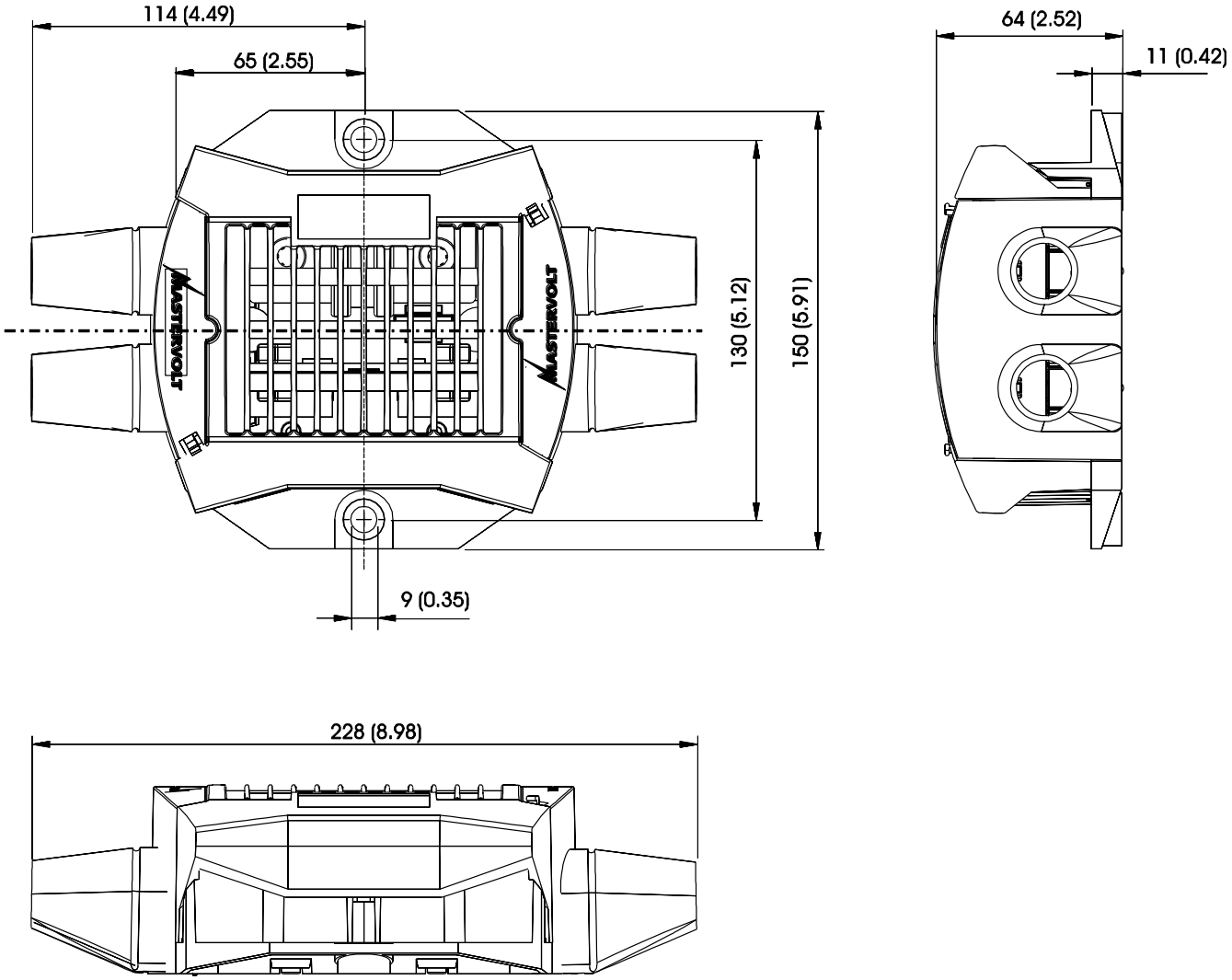
Figure 21: No T-connections

15 SPECIFICATIONS

15.1 TECHNICAL SPECIFICATIONS

Model	MasterShunt		
Article number	77020110		
Function of instrument	Battery measuring device for intelligent DC supply.		
Manufacturer	Mastervolt Amsterdam the Netherlands		
Voltage Measurement	0-60 V (0.1V resolution)		
Voltage accuracy	± 0.6 % ± 1 digit		
Current Measurement	0-10A: <0.2A resolution, 10-100A: <0.5A resolution, 100-600A: <5A resolution		
Current accuracy	± 0.8 % of reading ± 1 digit		
Maximum current (With busbar or T-fuse 500A)	300A continuously		
	400A for 10 min.		
	500A for 5 min.		
	600A for 2 min.		
Amp Hours Configuration	30-10000 Ah (5 Ah resolution)		
Time remaining	0-480 hours (1 min resolution)		
State of charge accuracy:	± 1%		
Maximum number of configurable events:	63		
Readout:	By means of external display or PC screen		
Available languages:	English, Nederlands, Deutsch, Francais, Castellano, Italiano, Norsk, Svenska, Suomi, Dansk.		
Supply voltage	8-60 V DC		
Power consumption (normal operation mode)	Masterbus power on	>23mA (@13.6V)	>13mA (@27.6V)
	Masterbus power off	10mA (@13.6V)	6mA (@27.6V)
Power consumption (Power saving mode)	Masterbus power on	>17mA (@13.6V)	>9mA (@27.6V)
	Masterbus power off	975µA (@13.6V)	800µA (@27.6V)
Dimensions	See section 15.2		
Weight	0,7 kg (1.5 lbs)		

15.2 DIMENSIONS



NOTE:

If you combine the MasterShunt with other MasterConnect devices, MasterConnect will become 130 mm [5,10 inch] longer.

NOTE:

At the bottom of the MasterShunt casing the centre to centre distances of the mounting holes and the DC fastening threads are displayed.

Correct disposal of this product (Waste Electrical & Electronic Equipment)

This product is designed and manufactured with high quality materials and components, which can be recycled and reused. When this crossed-out wheeled bin symbol is attached to a product, it means the product is covered by the European Directive 2012/19/EU.

Please be informed about the local separate collection system for electrical and electronic products.

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