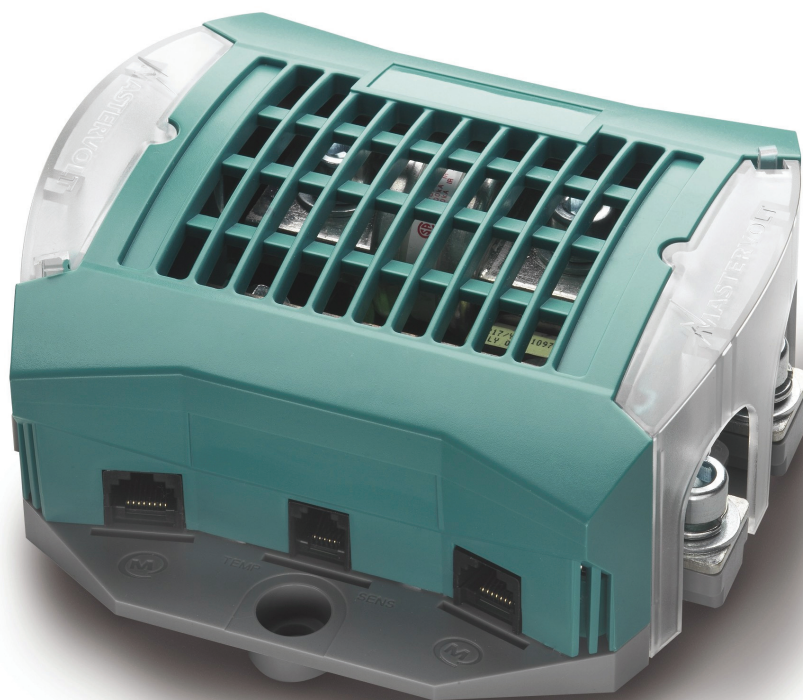




USERS MANUAL / GEBRUIKERSHANDLEIDING
BETRIEBSANLEITUNG / MANUEL D'UTILISATION
MANUAL DE UTILIZACION / INSTRUZIONI PER L'USO

MasterShunt 500

ENHANCED BATTERY MONITOR WITH INTEGRATED MAIN FUSE



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QUICK REVIEW

The **MasterShunt** is a battery monitor. It provides battery information and power to the MasterBus network.

A read out device like the MasterView Easy (showing a part of the MasterShunt monitoring menu below) or a pc with MasterAdjust software can be used to show the battery information.

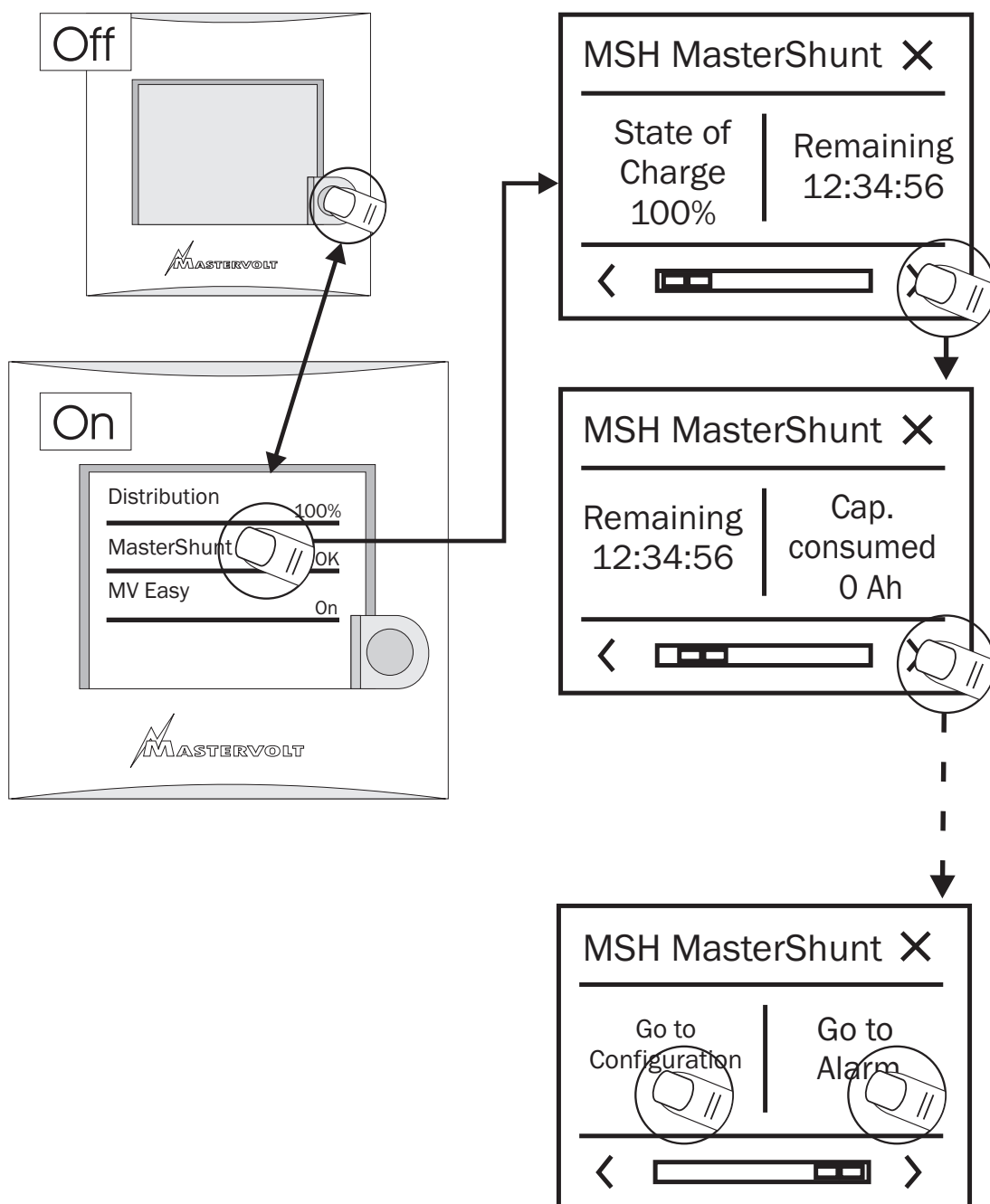
The battery monitoring functions are divided over different menus:

The main menu shows the battery state.

The historical menu shows the data from previous charging cycles.

The configuration menu enables you to alter MasterShunt settings.

The alarm messages menu shows the alarm messages and their state.



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v 3.2 June 2009

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1 GENERAL INFORMATION

1.1 USE OF THIS MANUAL

Copyright © 2009 Mastervolt. All rights reserved.
Reproduction, transfer, distribution or storage of part or all of the contents in this document in any form without the prior written permission of Mastervolt is prohibited.

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	77020100

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

Installation of, and work on the *MasterShunt*, may be carried out only by qualified, authorised and trained personnel, consistent with the locally applicable standards and taking into consideration the safety guidelines and measures (chapter 2 of this manual). Keep this manual at a secure place!
The English version includes 28 pages.

1.2 GUARANTEE SPECIFICATIONS

Mastervolt guarantees that this unit has been built according to the legally applicable standards and specifications. Should work take place which is not in accordance with the guidelines, instructions and specifications contained in this users manual, then damage may occur and/or the unit may not fulfil its specifications. All of these matters may mean that the guarantee becomes invalid.



CAREFUL!

Additional warranty agreements, like “Mastervolt system warranty” may contain restrictions which forbid resetting of historical data, as described in chapter 11.

1.3 QUALITY

During their production and prior to their delivery, all of our units are exhaustively tested and inspected. The standard guarantee period is two years.

1.4 VALIDITY OF THIS MANUAL

All of the specifications, provisions and instructions contained in this manual apply solely to standard versions of the *MasterShunt* delivered by Mastervolt.

1.5 LIABILITY

Mastervolt can accept no liability for:

- consequential damage due to use of the *MasterShunt*;
- possible errors in the manuals and the results thereof.



CAREFUL!

Never remove the type number plate.

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

1.6 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.



A procedure, circumstance, etc which deserves extra attention.

2.2 USE FOR INTENDED PURPOSE

- 1 The *MasterShunt* is constructed as per the applicable safety-technical guidelines.
- 2 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 users manual.

**WARNING**

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

- 3 Use of the *MasterShunt* other than mentioned in point 2 is not considered to be consistent with the intended purpose. Mastervolt is not liable for any damage resulting from the above.

2.3 ORGANIZATIONAL MEASURES

The user must always:

- have access to the user's manual;
- be familiar with the contents of this manual. This applies in particular to chapter 2, Safety Guidelines and Measures.

2.4 MAINTENANCE AND REPAIR

- 1 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.
- 2 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 THE USE OF BATTERIES.

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 of the *MasterShunt* should only be undertaken by authorised personnel!

3 OPERATION

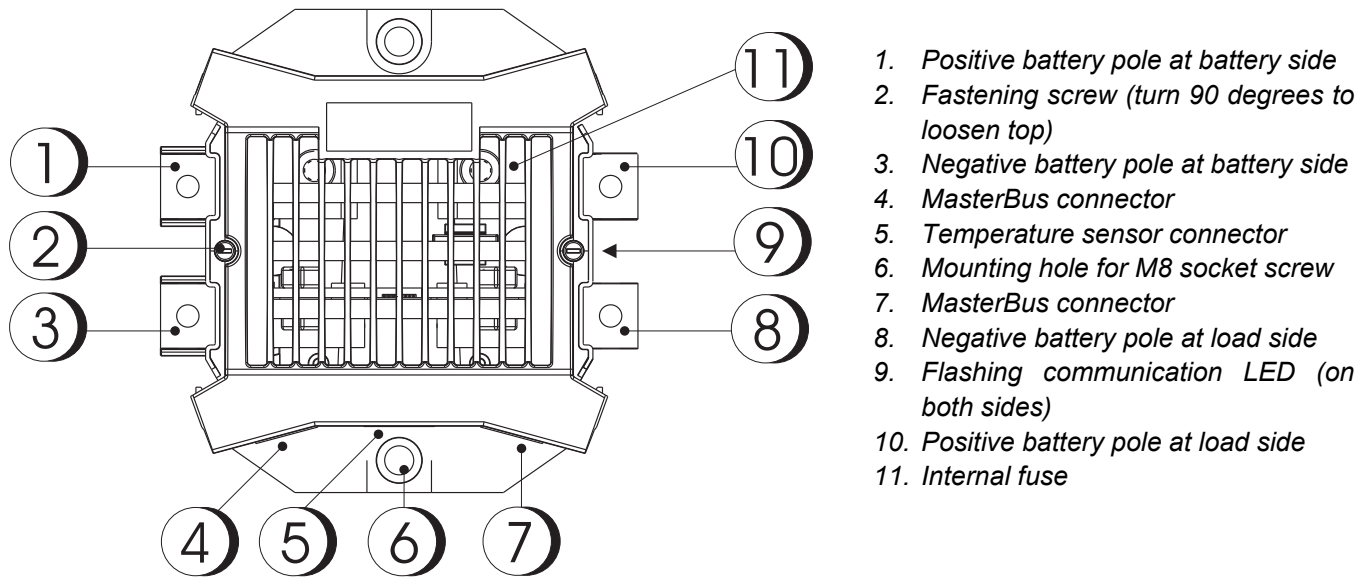


Figure 1: Overview of the MasterShunt

3.1 INTRODUCTION

The Mastervolt *MasterShunt* provides extended information about the status of your batteries. This information includes reading voltage, current, Ah, time remaining and remaining capacity in percentage terms.

3.2 MONITORING YOUR BATTERY SET

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 (Refer to chapter 4 for more information on how MasterBus works)
- Integrated main system fuse in positive DC line
- Solid housing of the shunt with isolation of the DC connections.

3.4 MASTERBUS DISPLAYS

Mastervolt offers several ways of displaying your MasterBus data. Shown is the MasterView Easy panel.



Figure 2: MasterView Easy panel

The MasterView Easy can be connected to one or more MasterShunts or any other MasterBus product for monitoring and control.

Another way of displaying and setting values is the MasterAdjust software, shown for MasterShunt application.

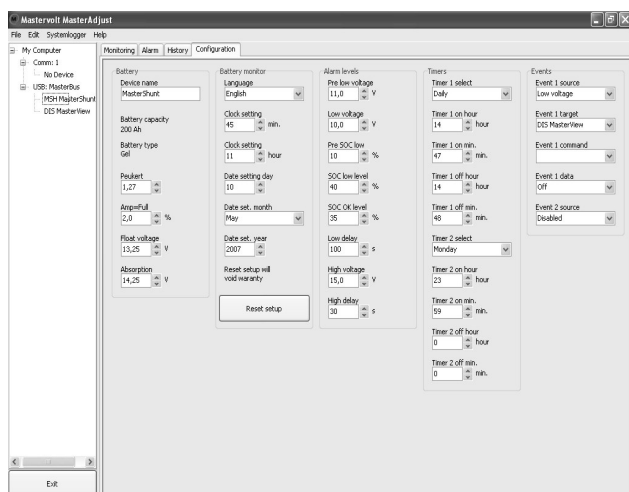


Figure 3: MasterAdjust software

3.5 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 MASTERBUS

4.1 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.

4.2 EVENT BASED PROGRAMMING

Event based programming 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 9 for alarm messages and chapter 12 for information regarding events.

4.3 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.

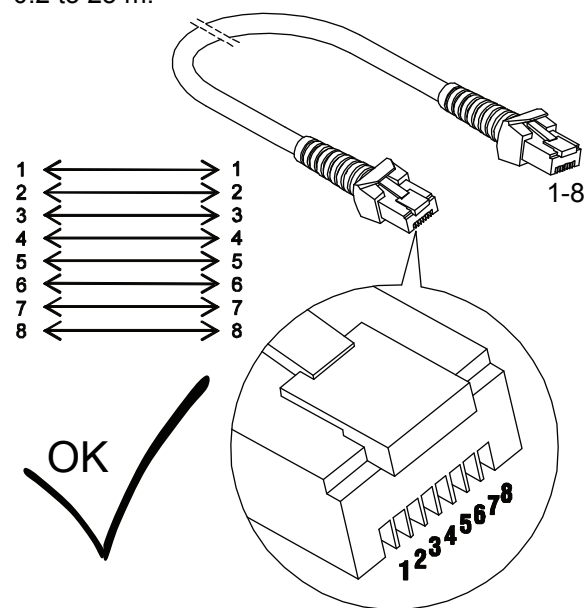


Figure 4: MasterBus cable

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

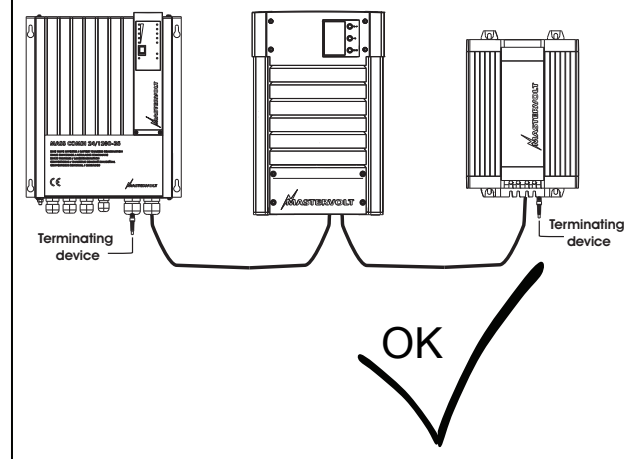


Figure 5: Two terminators

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.

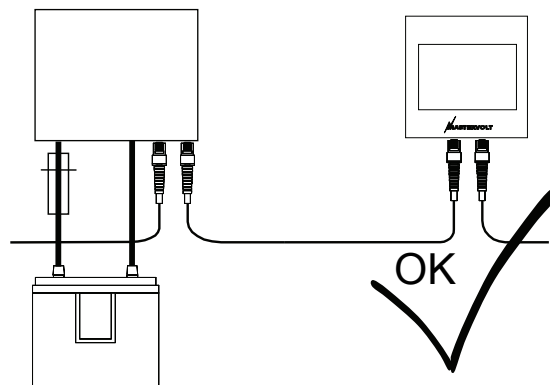


Figure 6: Power supply

Do not make ring networks.

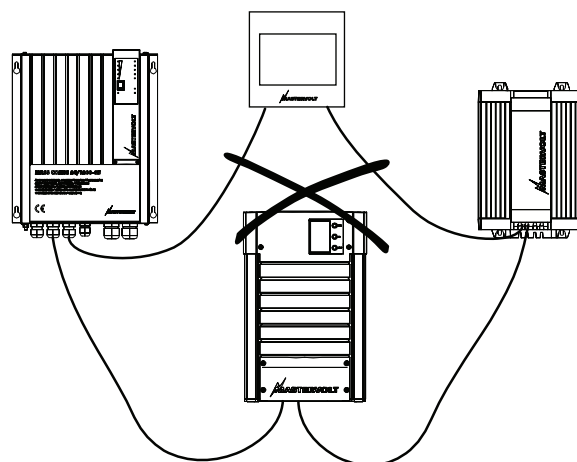


Figure 7: No ring networks

Do not make T-connections in the network.

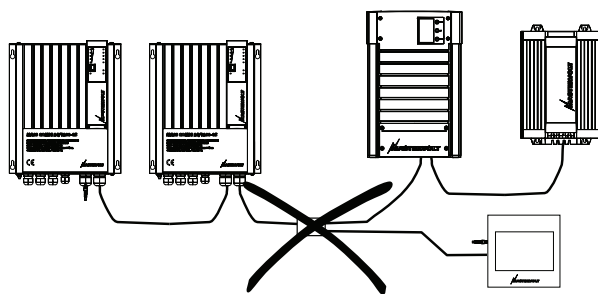


Figure 8: No T-connections

5 INSTALLATION



WARNING

During installation and commissioning of the MasterShunt, the Safety Guidelines and Measures are applicable at all times. See chapter 2 of this manual.



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.

5.1 THINGS YOU NEED FOR INSTALLATION

Tools:

- ☐ A cross-head screw driver
- ☐ 2 mm and 5 mm flat blade screwdrivers.
- ☐ Hexagonal socket wrench size 6 mm

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



CAREFUL!

Use isolated tools!

Materials needed:

- ☒ 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.
- ☐ Two heavy duty battery cables shortest possible, finished with cable lugs. Mastervolt advises to use 70 mm² cables on both the battery side and load side of the MasterShunt. In an extended system with long cable runs the cable size can be increased to 95 mm². In systems with lower maximum currents (<300A) the cable cross section can be smaller, yet at least 25 mm². Cable thickness must be in accordance with the electrical installation.

5.2 INSTALLATION STEP BY STEP

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.

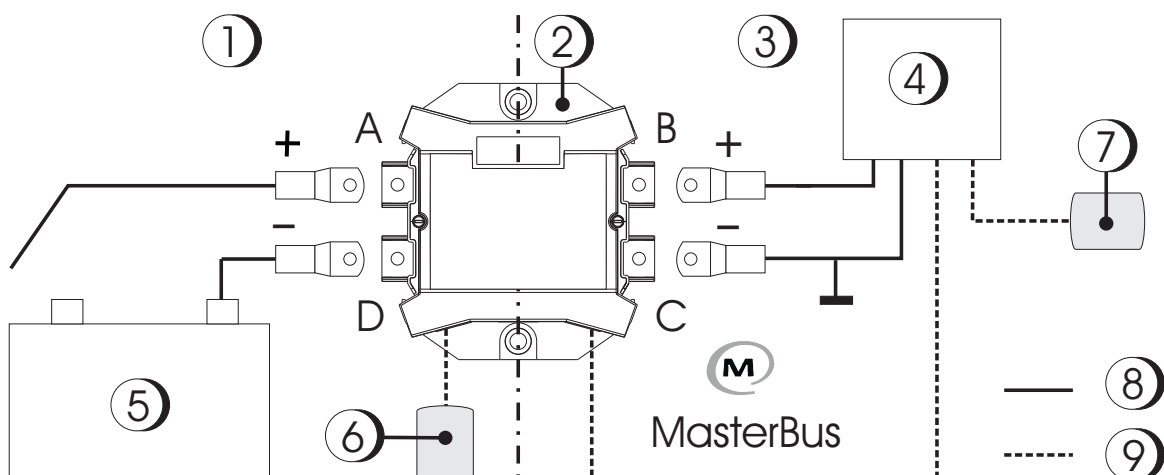


Figure 9: Installation of the MasterShunt

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

DC wiring



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

Step 1 Position the MasterShunt between the battery and the load/ charger.
Connect the loose positive battery cable to the upper left connection(A) and the positive load cable to the upper right connection(B).

Step 2 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.

MasterBus wiring (see figure 9)

Connect two or more MasterBus devices with MasterBus cable. Put two MasterBus terminators at the two ends of the network. Refer to section 4.2 for further details on how to set up a MasterBus network.



NOTE:
Always place two terminators at both ends of the MasterBus network.

5.3 COMMISSIONING

Check if all wiring is OK. Then:

- (Re)connect the positive battery cable.
- Proceed with chapter 6, "FIRST START UP"

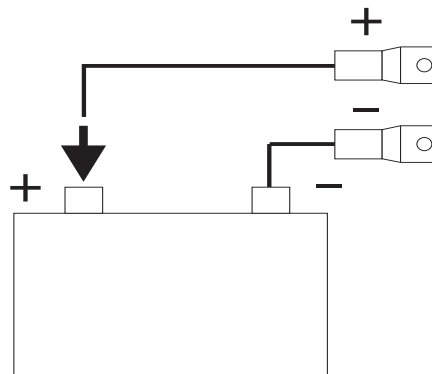


Figure 10: Commissioning

5.4 SYSTEM EXAMPLES

Figure 11 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.

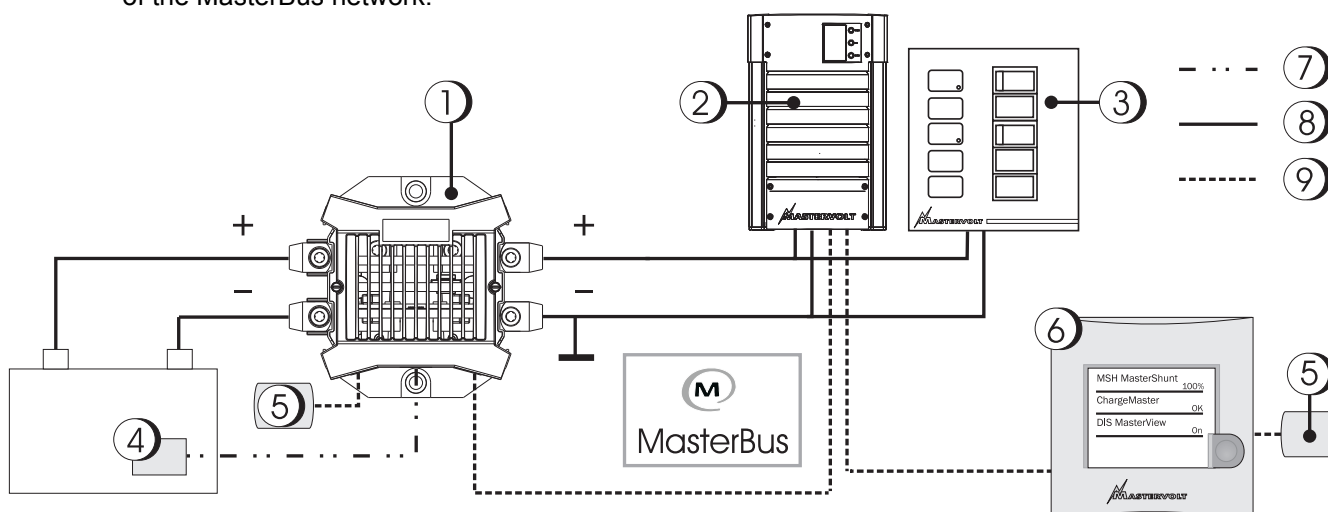


Figure 11: System example 1

1 MasterShunt
2 Charger
5 Switchboard

4 Temperature sensor on battery
5 Terminator for MasterBus
6 MasterView Easy display

7 Temperature sensor wiring
8 DC wiring
9 MasterBus wiring

5.5 REPLACING THE FUSE

Installed in the MasterShunt 500 is a T-500A fuse (Part number 77049000). If the DC current through the MasterShunt exceeds averages of above 500A during a longer period, the internal fuse will blow.

Follow the instructions carefully to replace the fuse.
Disconnect the electrical power:

- Switch off all consumers.
- Switch off all charging systems.
- Disconnect the positive battery poles.



WARNINGS

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.

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

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 very hot! Avoid burns!

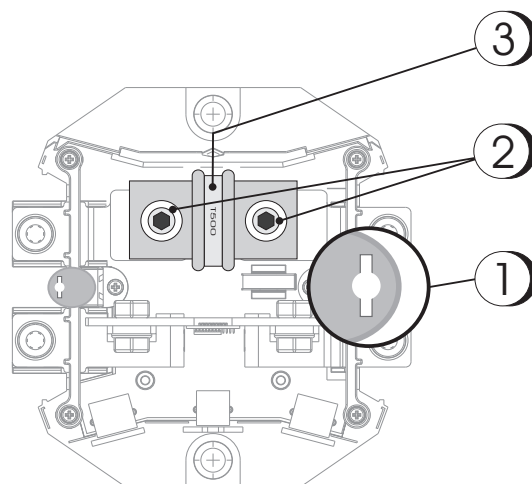


Figure 12: Internal fuse in MasterShunt

- Turn the two top screws 90 degrees to release the locking pins from the holes (1). Take off the upper casing.
- Remove the two fuse fastening bolts (2).
- Take out the fuse (3). Mind possible hot parts!
- Put the new fuse in place.
- Fasten the new fuse with the two bolts. The tightening torque should be 15-20 Nm.
- Close the casing.
- Reconnect the battery pole.
- 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 it is functioning correctly.

6 FIRST START UP

At First start up with the MasterShunt installed, MasterBus (via a MasterView display or the MasterAdjust software) will guide you through the

following settings. See the concerning manual for display navigation.

Variable	Description	Factory sett.	Range
<i>Basic set up</i>			
Language	Change the language at first start up. See chapter 5 for more instructions.	English	11 languages, see section 14.1
Battery capacity	Set the battery capacity to enable the MasterShunt calculating the state of charge.	Value from First Setup	30-10000Ah
Battery type	Three different battery types can be selected. The spiral battery belongs to the AGM batteries.	Value from First setup	Gel, AGM, Wet battery
Nominal voltage	Nominal battery voltage, set at first set up.	Value from First setup	12V ,24V, 48V
<i>Advanced mode</i>			
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 (chapter 7) or single device configuration. "I + U only: is an option to only measure the current and voltage with the MasterShunt configured as single device.	I + U only	I + U only, Single device, Parallel mode.
<i>Complete</i>			
Complete	It is still possible now to check your settings. When ready, press "Complete" to finish the first start up. If you want to alter a First start up variable afterwards, resetting the settings is necessary.		

7 PARALLEL USE

For load currents which exceed 500A, 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 13 shows the parallel configuration of two MasterShunts (3) and (4) and other products.

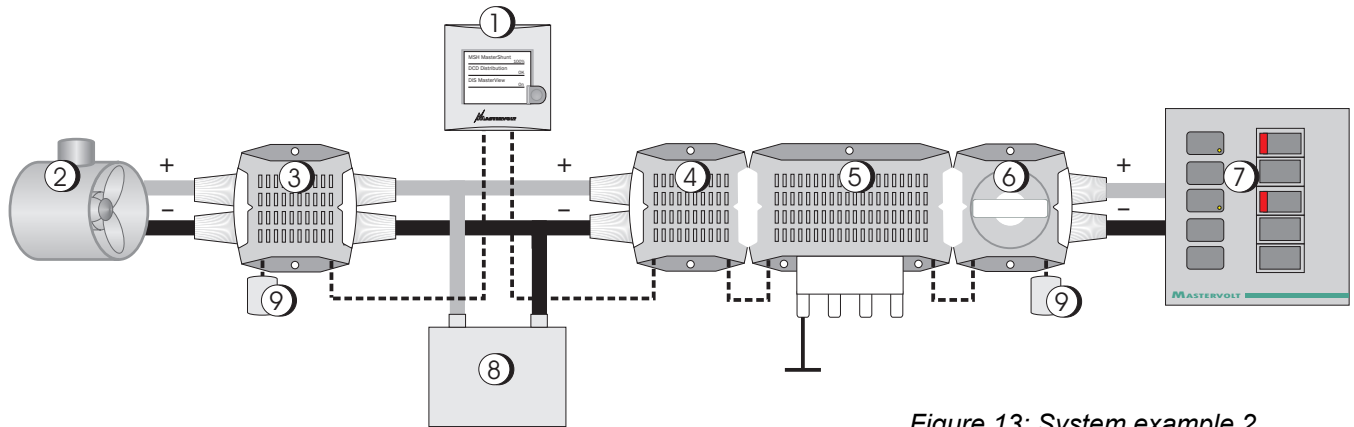


Figure 13: System example 2

1. Masterview Easy display
2. Bow thruster
3. Mastershunt in parallel 1
4. Mastershunt in parallel 2
5. DC Distribution

6. DC Switch
7. MasterView Distribution panel
8. Battery
9. MasterBus terminator

During First start up select Parallel mode on one of the MasterShunts (monitoring). Then select one or more other MasterShunt to parallel (advanced configuration), see figure 14. The measurements of

both MasterShunts are combined and shown as one MasterShunt. Renaming the MasterShunts for this purpose is recommended because the currents are shown separately, see figures 15 and 16.

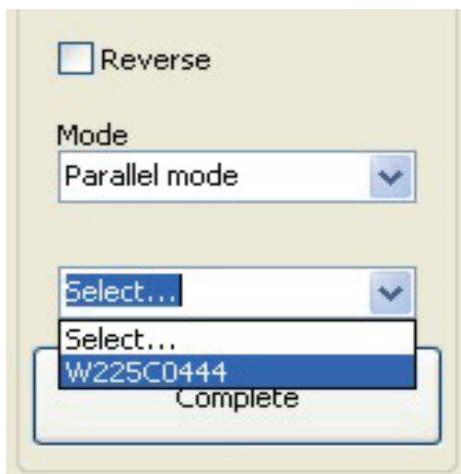


Figure 14: Parallel setting

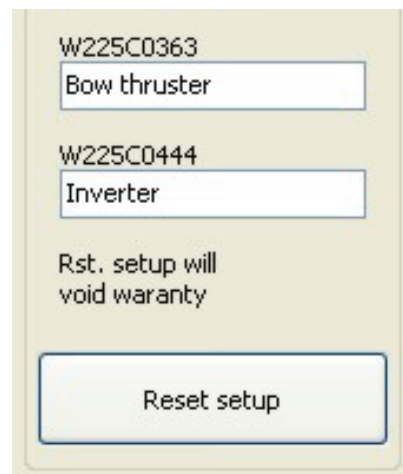


Figure 15: Renaming MasterShunts

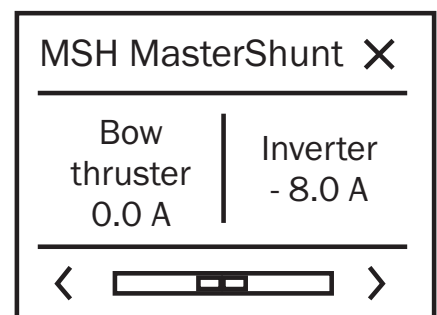


Figure 16: MasterView display

8 MONITORING MENU

The main menu 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.

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 <i>time remaining</i> before the battery will be empty. During charging it shows "--:--:--".
Cap. consumed	<i>Capacity consumed</i> shows how many Amp-hours (Ah) have been consumed from the battery bank.
Battery [V]	Shows the measured voltage at the MasterShunt.
Battery [A]	Shows the measured current through the poles of the MasterShunt. Charging appears as positive current, discharging as negative current.
Battery [°C]/[°F]	Shows the temperature measured by the temperature sensor, connected to MasterShunt. For language setting American the temperature is displayed in °F.
Time	If you have set the <i>Time</i> , this screen shows hh:mm:ss. Refer to chapter 11 for settings.
Date	If you have set the <i>Date</i> , this screen shows yy:mm:dd. Refer to chapter 11 for settings.
Timer 1	If <i>Timer 1</i> is enabled, this screen shows the state of the timer. It can be Active or Inactive
Timer 2	See Timer 1.

9 ALARM MENU

The MasterShunt features six different alarm parameters 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 tasks. For

instance if the parameter "Battery low" has been set to 35% and the battery voltage is being discharged to this value, the alarm can trigger a generator to start and recharge the battery. See also chapter 12, Event 1 and 2.

Message	Description
<i>General</i>	
Voltage high	When the battery voltage rises above the high voltage level (15V default), the alarm function will be triggered without delay.
Fuse alarm	This function is triggered when the internal MasterShunt fuse has blown.
Battery low	This function will be triggered when the State Of Charge drops below a preset value, 35% default. At this value for instance the refrigerator can be switched off to save the battery when other systems fail to recharge it sufficiently.
Voltage low	When the battery voltage drops below a preset value, 10V default, this alarm function is triggered.
Battery pre low	To prevent the battery from draining, a SOC value above Battery low can be set (40% default). At this level for instance a generator can be started to recharge the batteries.
Voltage pre low	To prevent the battery from becoming too deeply discharged, a value above Voltage low can be set (11V default). At this event for instance a heavy consumer can be switched off.

Refer to chapter 11 for alarm settings.

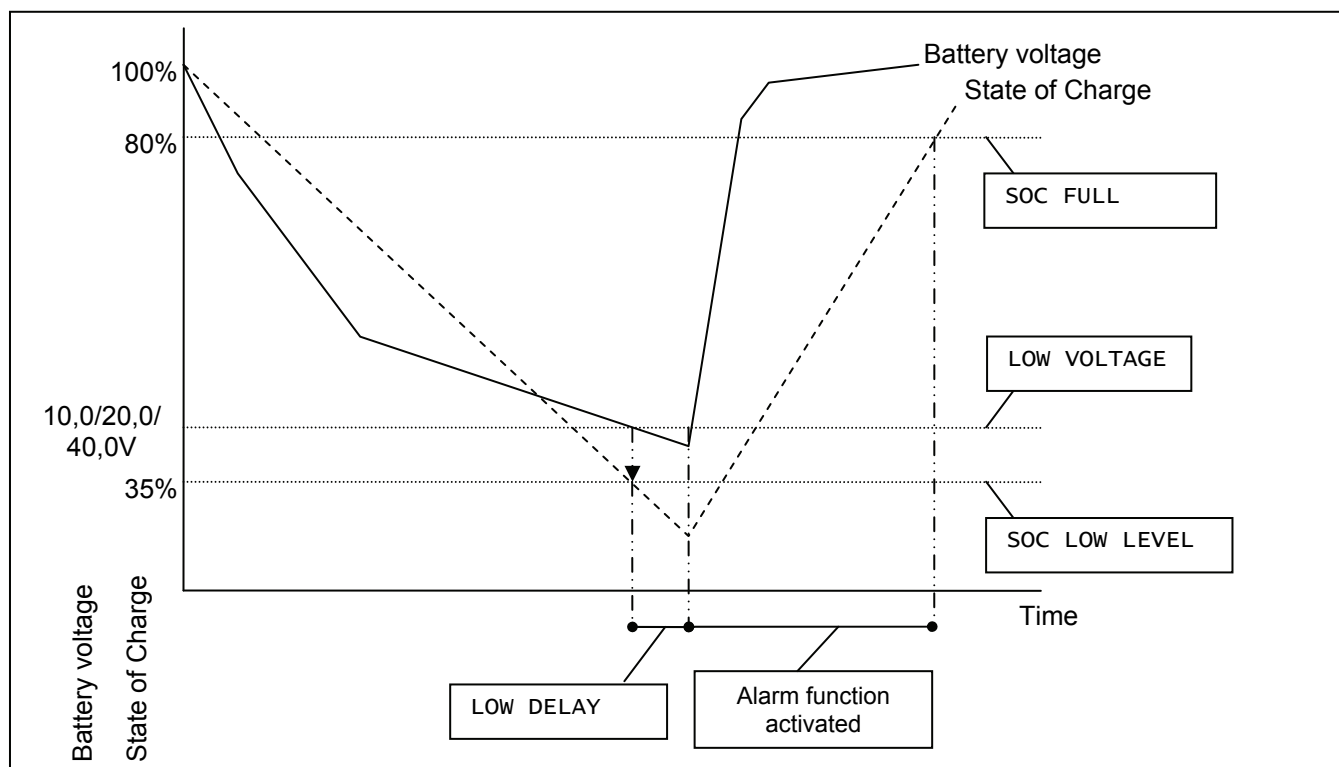


Figure 17: Battery alarm function

10 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.

Message	Description
<i>Standard hist</i>	
Days running	The total number of days since the <i>MasterShunt</i> was powered.
Days since low	This function tells you when the battery alarm was triggered for the last time. See chapter 11 for explanation of the battery alarm function.
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, at least every 30 days.
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 screen shows the number of battery abuse cycles. A large number of abuse cycles might indicate small users 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!
Discharged hours	The total number of hours (after a delay of 12 hours) when the SOC of the battery bank was below 35%. This value should be as low as possible, as batteries should be recharged immediately after a discharge.
Calculated CEF	The CEF that was calculated for the battery bank. This value is used for the calculation of the consumed Amphours and the time remaining function (chapter 7), See chapter 13.2 for explanation of the CEF.
Total consumed	The total amount of Amphours consumed from the battery bank. It is like the km counter of your car. But like a car, not only the number of km's tell something about its condition. The condition is also influenced by the way the car was treated. So it does for your batteries.
<i>Restarts</i>	
Number of resets	The number of times the setup has been reset. Factory setting = 0. See chapter 11 for instructions how to reset the setup. Resetting clears all history values except for this counter which is increased by one.
Power failures	Counts the number of times the MasterShunt has been disconnected from the battery.
<i>Averages</i>	
Avg. discharge	The average discharge of the battery bank. This value should be less than half of the installed battery capacity, else the capacity is too low.
<i>Min/max history</i>	
Lowest Ah	Shows the deepest discharge. The deepest discharge should never be below the rated capacity of the battery as specified by the battery manufacturer.
Volt at low Ah	Shows the voltage at the moment of recording the deepest discharge.
Highest voltage	Shows the highest voltage that was recorded. This voltage should never exceed the maximum charging voltage as specified by the battery manufacturer.
> 100A [s]	Total amount of seconds the current has exceeded 100A since first start up.
> 200A [s]	Total amount of seconds the current has exceeded 200A since first start up.
> 500A [s]	Total amount of seconds the current has exceeded 500A since first start up.

11 CONFIGURATION

The Configuration Menu is used to adjust general settings like displayed language, energy save mode 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 18.

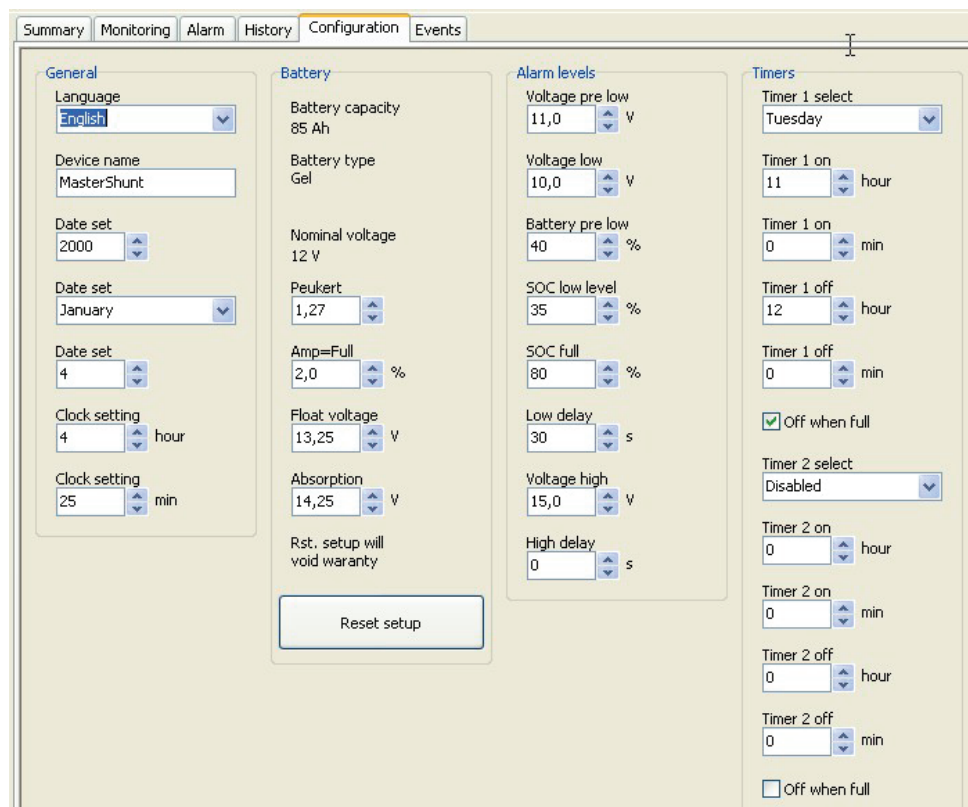


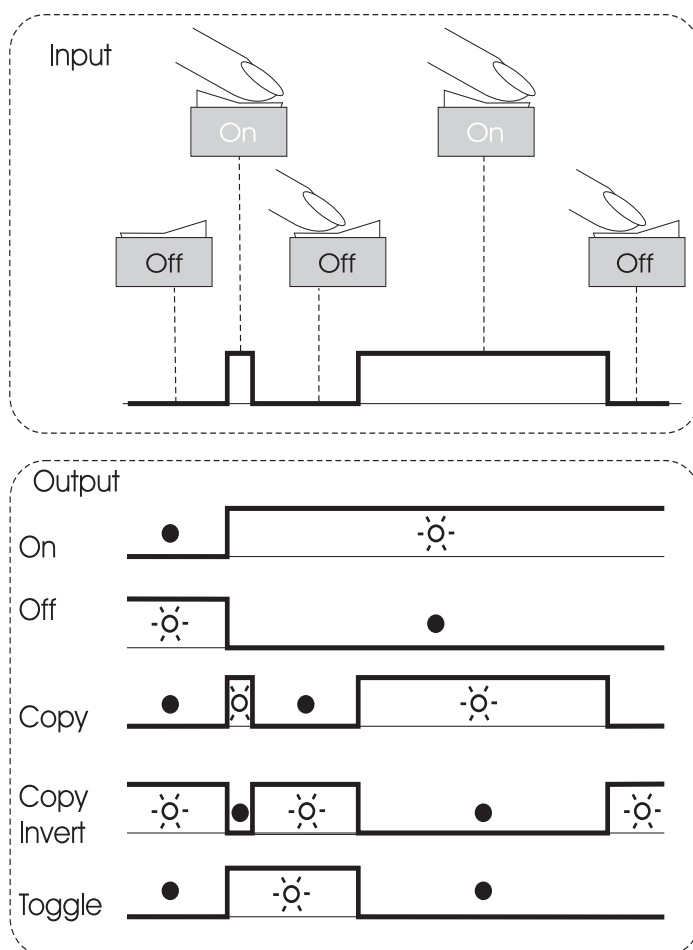
Figure 18: MasterAdjust Configuration screen

Variable	Description	Factory sett.	Range
General			
Language	Change the language after your setting at first start up. See chapter 5 for more instructions.	English	11 languages, see section 14.1
Device name	Name of the battery bank; example: POWER BANK.	MasterShunt	Any maximum 12 character name
Date set. year	Set the MasterShunt clock year.	2000	2000-2200
Date set. Month	Set the MasterShunt clock month.	January	January-December
Date setting day	Set the MasterShunt clock day.	1	1-31
Clock (hour)	Set the MasterShunt clock hour.	0	0-23
Clock (min)	Set the MasterShunt clock minute.	0	0-59
Battery			
Battery capacity	You see the battery capacity selected during FIRST START UP. Refer to chapter 6. 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 6. To change this value you need to reset the setup.	Value from First setup	Gel, AGM, Wet battery
Nominal voltage	Nominal battery voltage, set at first set up.	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.	Depends on selected battery type	1,01-1,50

Variable	Description	Factory sett.	Range
Amp=Full	Charge amps for full battery. Several parameters must be met before the MasterShunt will consider the battery fully charged. See section 12.5.	2.0%	0.1-10%
Float voltage	This voltage must be set just below the lowest float voltage of all system charging devices. Lower this value by 0.1V if your MasterShunt does not return to 100% after a long period of charging.	13.25/26.5/53.0V Wet batteries, 13.80/27.6/55.2 V Gel, AGM.	12.0-15.0V/ 24.0-30.0V/ 48-60V
Absorption	This value is set to the recommended absorption voltage.	14.4/28.8/57.6V for wet, Gel and AGM batteries.	12.0-15.0V/24.0- 30.0V/48-60V
Reset setup will void warranty	This screen warns you for the possible consequences of resetting the setup.		
Reset setup	Reset the complete setup of the MasterShunt, this will reload all default factory settings. Careful: resetting the setup voids your system warranty!		
<i>Alarm levels</i>			
Pre low voltage	To prevent the battery from becoming too deeply discharged, a value above Voltage low can be set. At Pre low voltage low for instance a generator can be started.	11.0/22.0/44.0V depending on the nominal battery voltage	10-15V/ 20-23V/ 40-60V
Low voltage	The low voltage set point marks the voltage threshold of too low battery. If the battery voltage drops below this value, the alarm function will be activated after the Low delay, see below.	10.0/20.0/40.0V depending on the nominal battery voltage	10-15V/ 20-23V/ 40-60V
Pre SOC low	Set the State Of Charge value below which the alarm function Pre SOC low will be triggered, default 40%. Note: the Pre SOC low level is higher than the SOC low level, in fact to prevent the SOC low situation.	40%	10-90%
SOC low level	Set the State Of Charge value below which the alarm function SOC low will be triggered, 35 % default.	35%	10-90%
SOC OK level	Set the State Of Charge value at which the alarm function SOC OK will be triggered, default 80%. SOC OK could be used for instance to switch off a generator.	80%	30-100%
Low delay	The "alarm delay time" can be set to delay the alarm function when the DC-voltage drops below the Low voltage set point or the SOC drops below the SOC low level. This delay prevents a false alarm as a result of a temporary voltage drop, after switching on a heavy load.	30 seconds	0-100 seconds
High voltage	When the battery voltage rises above this level, the alarm function will be triggered.	15.0/30.0/60.0V	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 high voltage 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
<i>Timers</i>			
Timer 1 Select	Select the day at which timer 1 is activated.	Disabled	Disabled, Sun..Sat, Weekend, Daily, Monthly
Timer 1 On hour	Set the hour at which timer 1 will start.	0	0...23
Timer 1 On min	Select the minute at which timer 1 will start.	0	0...59
Timer 1 Off hour	Select the hour at which timer 1 will stop.	0	0...23
Timer 1 Off min	Select the minute at which timer 1 will stop.	0	0...59
Off when full	Has for instance a generator shut off when the battery is full before timer 1 elapsed.		
Timer 2 On hour	Set the day at which timer 2 is activated, only after you enabled timer 1.	0	See timer 1
Timer 2 variables	See timer 1	0	0...23

12 EVENTS

Variable	Description	Fact sett.	Range
Events			
Event 1 source	Select an event to serve as Event 1. For example battery pre low can trigger a generator to start or the back light of the MasterView Easy to become red.	Disabled	Disabled, Pre low voltage, Low voltage, Pre low battery, Low battery, High voltage, Battery full, Batt 20%, Batt 40%, Batt 60%, Batt 80%, Charging, Timer 1, Timer 2.
Event 1 target	Select a device in your system to perform a task if Event 1 takes place. For example a MasterView display could be selected if it is in your power system.	Select...	Selectable targets are system dependent.
Event 1 command	Select a command, depending on the device you chose.	Select...	Selectable targets are system dependent.
Event 1 data	Data is linked to the command, see figure 19. It defines how an event target behaves upon changes of the event source.	Off	Off, On, Copy, Copy Invert, Toggle.
Event 2 source	This screen appears after enabling Event 1. Select an event to serve as Event 2. For factory settings and ranges see Event 1.	Disabled	See Timer 1



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.

Figure 19: Explanation of the function Event data

13 ADDITIONAL INFORMATION

13.1 BATTERY ALARM FUNCTION

The *MasterShunt* continuously monitors the state of charge of the batteries. If the State Of Charge 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 9.

13.2 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 function and the State Of Charge (SOC).

13.3 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 describes the effect of different discharge rates on battery capacity and 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 the state of charge (SOC).

Normally it is not necessary to change the Peukert exponent. It will only be necessary if traction batteries e.g. on a fork lift, are used. See chapter 11 to adjust the Peukert exponent.

13.4 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 battery is considered to be fully charged if one of the following four 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.
- 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)

13.5 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 $200 \times 2.0\% = 4$ 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.

13.6 REPLACEMENT OF BATTERIES

Refer to chapter 5 (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.

13.7 FUSE CHARACTERISTIC

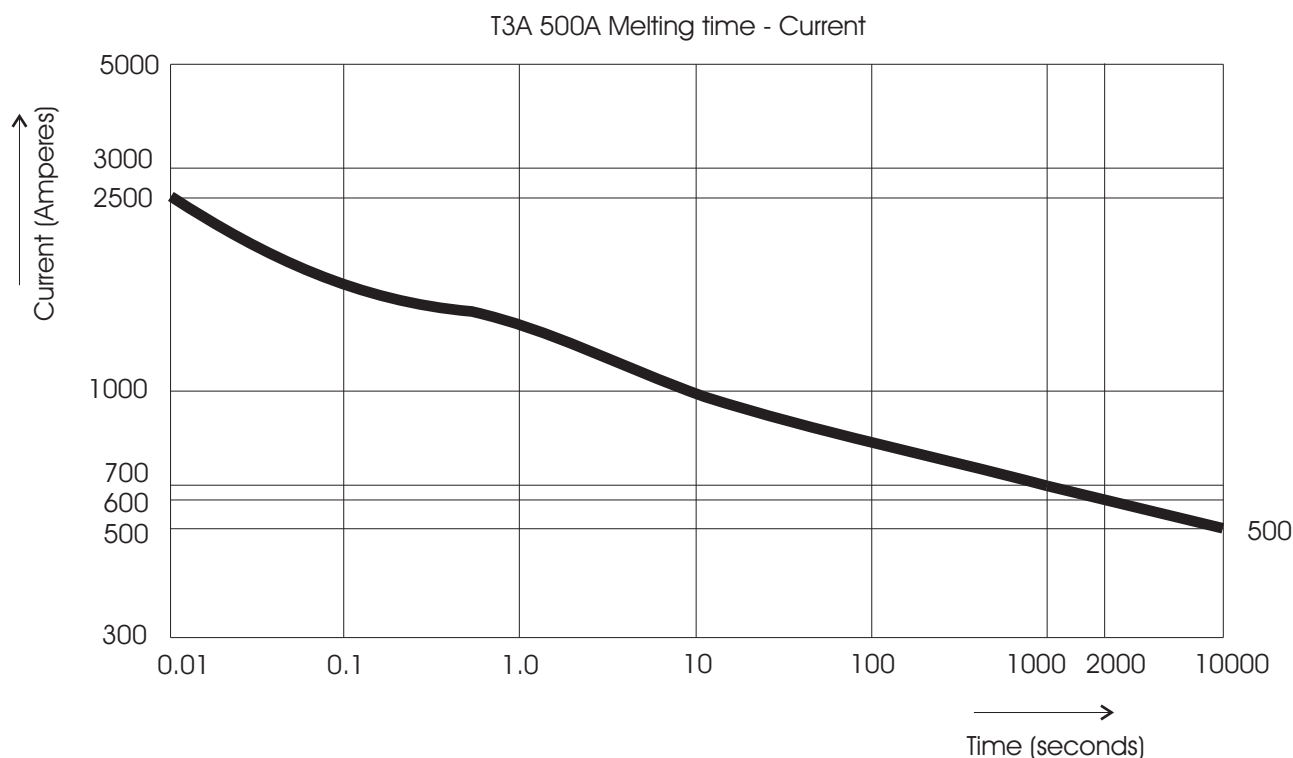


Figure 20: Melting time of the fuse included, measured at 25°C (77°F), derating 5% / 10°C (3% / 10 °F)

13.8 ORDERING INFORMATION

Part number	Description
77020100	MasterShunt
77020200	DC Distribution
77010300	MasterView Easy
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
77049000*	T-Fuse 500A, internal fuse for the MasterShunt 500

* 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, battery terminals and Mastervision switchboards.

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

14 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
No display function	Display has switched off	Turn on display.
	Error in the network wiring	Check wiring for errors.
MasterView display shows no MasterShunt	No powering device (like the MasterShunt) available on the MasterBus	The <i>MasterView Easy</i> must be powered by the network. This means that at least one device in the network should have powering capabilities (Section 4.2).
	Error in the wiring	Check the Masterbus cables
	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 4.2).
	MasterBus network is configured as a ring network	Ring networks are not allowed. Check the connections of the network (Section 4.2).
	T-connections in the MasterBus network	Check if T-connections are made in the network. T-connections are not allowed (see section 4.2).
	Error in the wiring	Check the MasterBus cables and terminating devices (Section 4.2).
No voltage on load side of MasterShunt	Display not set up to show all devices	Check manual of the display.
	Fuse blown	Investigate the cause of the blown fuse. Then replace the fuse (Section 5.5).
No accurate time remaining function	Wrong setting of the nominal battery capacity	Correct the battery capacity setting. See chapter 11: 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 5.2).
	Wrong setting of the nominal battery capacity	Correct the battery capacity setting. See chapter 11: Battery.
	Self discharge of the batteries which was not recorded by the <i>MasterShunt</i>	Recharge the batteries for at least 24 hours.
	First time set up not done (completely).	Enter the first set up values (see chapter 6).
Calculated Charge Efficiency Factor (CEF) is too low	New batteries installed.	Nothing (wait 5-10 cycles). After installation two charging cycles are needed to initiate the calculations. With newly installed batteries the charge efficiency may increase during the first 5-10 cycles.
	The MasterShunt Reversed setting does not correspond to the system installed.	Reset the MasterShunt and enter the Advanced menu. See figure 13 in this manual. Select Reversed if the installation is like MasterShunt (3). If it is like (4), do not change the setting.
	Batteries have been left standing without being used for a longer period	Recharge the batteries up to 100%.
Battery is fully charged but SOC function does not show "100%"	Charging system has not met the conditions for a fully charged battery	See chapter 13.4 for an overview of the conditions for a fully charged battery.

Failure	Possible cause	What to do
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 <i>MasterShunt</i> by 0.1V. See chapter 11: Battery.
Wrong language is displayed	Wrong setting of the language at the MasterShunt	Adjust the language setting. See chapter 11: 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.
	Wrong setting of the parameters	Set the parameters correctly. See chapter 11: Alarm levels.
Alarm function is triggered by a short time voltage dip	Wrong setting of the alarm delay time.	Increase the delay time. See chapter 11.
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.

15 SPECIFICATIONS

15.1 TECHNICAL SPECIFICATIONS

Model	MasterShunt
Article number	77020100
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	$\pm 0.6 \% \pm 1$ digit
Current Measurement	0-10A: <0.2A resolution, 10-100A: <0.5A resolution, 100-1000A: <5A resolution
Current accuracy	$\pm 0.8 \%$ of reading ± 1 digit
Maximum current	300A continuously 400A for 10 min. 500A for 5 min. 600A for 2 min.
Ipsc (maximum prospective short circuit fault current)	20000A circuit breaking current
Amp Hours Configuration	30-10000 Ah (5 Ah resolution)
Time remaining	0-480 hours (1 min resolution)
State of charge accuracy:	$\pm 1\%$
Readout:	By means of external display or PC screen
Available languages:	English, Nederlands, Deutsch, Francais, Castellano, Italiano, Norsk, Svenska, Suomi, Dansk, American
Supply voltage	8-60 V DC
Powering capability	Up to 3 non powering MasterBus devices
Power consumption with MasterView Easy connected / standby*	18mA(@13.6V) / 10mA(@27.2V) Normal operation mode
Dimensions	See section 15.2
Weight	1,0 kg (2.2 lbs)

15.2 DIMENSIONS

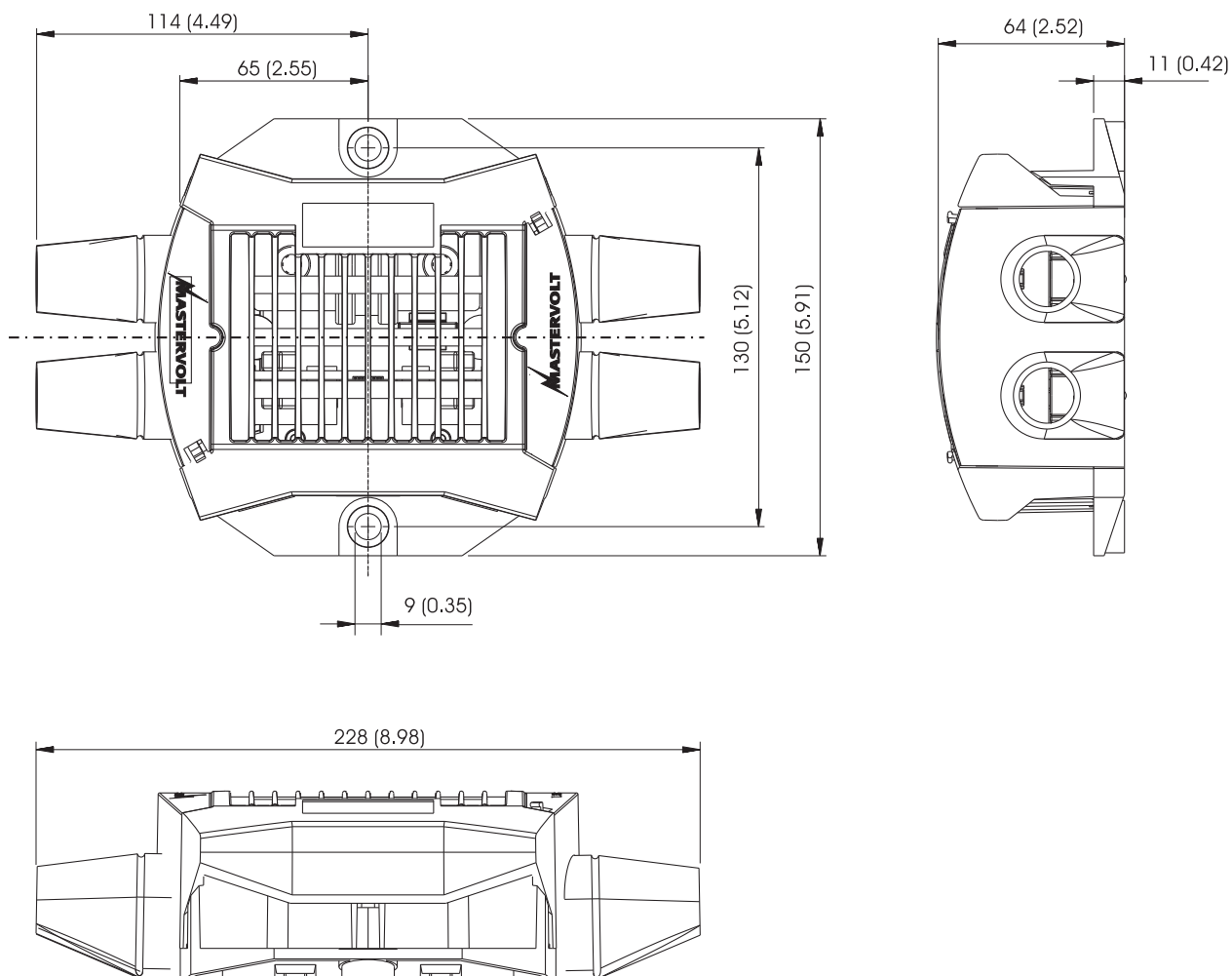


Figure 21: Dimensions in mm [inch]



NOTE: If you combine the MasterShunt with other MasterConnect devices, MasterConnect will become 130 mm 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.

16 EC DECLARATION OF CONFORMITY

Manufacturer Mastervolt
Address Snijdersbergweg 93
1105 AN Amsterdam
The Netherlands



Herewith declares that:

Product:

77020100 MasterShunt 500 (12/24/48V)

Is in conformity with the provision of the EC EMC directive 89/336/EEC and amendments 92/31/EEC, 93/68/EEC.

The following harmonised standards have been applied:

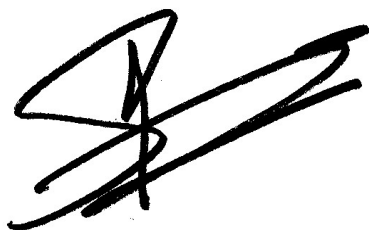
Generic emission standard: EN 50081-1:1992

Generic Immunity standard: EN 50082-1:1997

Low voltage directive 2006/95/EC, with standard:

Low voltage standard: EN 60950: 2000

Amsterdam,



P.F. Kenninck,
General Manager MASTERVOLT



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