

MASTERVOLT

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

MASS COMBI

12/1600-60; 12/2200-100; 24/1800-35; 24/2600-60

SINE WAVE INVERTER/CHARGER COMBINATION
WITH GENERATOR / MAINS SUPPORT



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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 Mass Combi.

It is therefore obligatory that every person who works on or with the Mass Combi must be completely familiar with the contents of this manual, and that he/she carefully follows the instructions contained herein.

Installation of, and work on the Mass Combi, 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 has 44 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 user's 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.

The guarantee is limited to the costs of repair and/or replacement of the product. Costs for installation labor or shipping of the defective parts are not covered by this guarantee.

1.3 VALIDITY OF THIS MANUAL

Copyright © 2015 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.

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

This manual is only valid for the following models:

| Part number | Description |
|-------------|-------------------------------|
| 36011600 | Mass Combi 12/1600-60 / 230V |
| 36012200 | Mass Combi 12/2200-100 / 230V |
| 36021800 | Mass Combi 24/1800-35 / 230V |
| 36022600 | Mass Combi 24/2600-60 / 230V |

For other models see other manuals available on our website: www.mastervolt.com

1.4 QUALITY

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

1.5 LIABILITY

Mastervolt can accept no liability for:

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

1.6 IDENTIFICATION LABEL

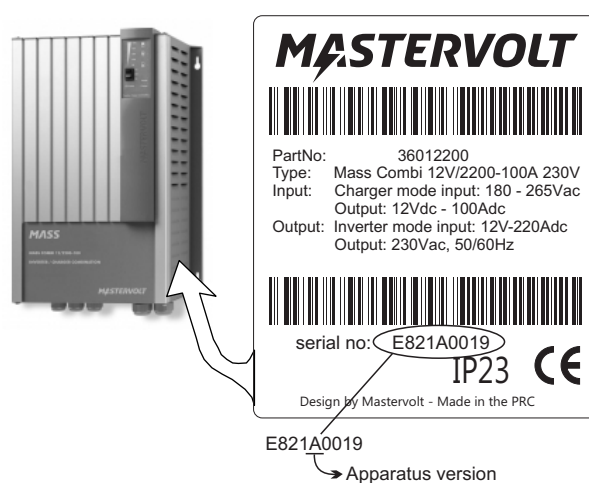


Figure 1: Identification label

The identification label is located at the right-hand side of the Mass Combi (see figure 1). Important technical information required for service, maintenance & secondary delivery of parts can be derived from the identification label.



CAUTION!

Never remove the identification label.

1.7 CHANGES TO THE MASS COMBI

Changes to the Mass Combi may be carried out only after obtaining the written permission of Mastervolt. This is not applicable for DIP-switches (see chapter 6) which are used for making user settings.

2 SAFETY GUIDELINES AND MEASURES

2.1 WARNINGS AND SYMBOLS

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



A procedure, circumstance, etc which deserves extra attention.



CAUTION!

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 charger if the user does not (carefully) follow the procedures.

2.2 USE FOR INTENDED PURPOSE

- 1 The Mass Combi is constructed as per the applicable safety-technical guidelines.
- 2 Use the Mass Combi only:
 - for the charging of lead acid batteries and the supply of users attached to these batteries, in permanent systems;
 - for the conversion of a DC voltage from a battery to an AC voltage.
 - connected to a dedicated double pole circuit breaker and earth leakage switch.
 - with a fuse, protecting the wiring between Mass Combi and battery;
 - 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 Mass Combi in situations where there is danger of gas or dust explosion or potentially flammable products!

- 3 Use of the Mass Combi 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 & REPAIR

- 1 If the Mass Combi is switched off during maintenance and/or repair activities, it should be secured against unexpected and unintentional switching on:
 - remove the AC supply
 - remove the connection to the batteries
 - be sure that third parties cannot reverse the measures taken.
- 2 If maintenance and repairs are required, use only original spare parts.

2.5 GENERAL SAFETY AND INSTALLATION PRECAUTIONS

- Do not expose the Mass Combi to rain, snow, spray, moisture, excessive pollution and condensing circumstances. To reduce risk of fire hazard, do not cover or obstruct the ventilation openings. Do not install the Mass Combi in a non-ventilated area, overheating may result.
- The Mass Combi must be provided with an equipment-grounding conductor to the AC-input ground terminal. Grounding and all other wiring must comply with local codes and ordinances.
- In case of fire, you must use the fire extinguisher which is appropriate for electrical equipment.
- Short circuiting or reversing polarity will lead to serious damage to batteries, Mass Combi and the wiring. Fuses between the batteries and the Mass Combi can not prevent damage caused by reversed polarity and the warranty will be void.
- Protect the DC wiring with a fuse, according to the guidelines in this manual.
- Connection and protection must be done in accordance with local standards.
- Do not work on the Mass Combi or system if it is still connected to a power source. Only allow changes in your electrical system to be carried out by qualified electricians.
- Check the wiring and connections at least once a year. Defects such as loose connections, burned cables etc. must be corrected immediately.

- Do not touch the equipment when wet or if your hands are clammy.
- Not only the batteries, but the Mass Combi as well can become a projectile if your transport is involved in an accident! Ensure adequate and secure mounting and always use suitable handling equipment for transportation.
- Except for the connection compartment, see section 5.5, the cabinet of the Mass Combi must not be opened. There are no serviceable parts inside the cabinet. Only qualified, authorized and trained electrician installers are authorized to open the connection compartment.

2.6 WARNING REGARDING LIFE SUPPORT APPLICATIONS

The Mass Combi products are not sold for applications in any medical equipment intended for use as a component of any life support system unless a specific written agreement pertaining to such intended use is executed between the manufacturer and Mastervolt. Such agreement will require the equipment manufacturer either to contract additional reliability testing of the Mass Combi parts and/or to commit to undertake such testing as a part of the manufacturing process. In addition the manufacturer must agree to indemnify and not hold Mastervolt responsible for any claims arising from the use of the Mass Combi parts in the life support equipment.

2.7 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 discharge level of your batteries. Avoid short circuiting batteries, as this may result in explosion and fire hazard. Installation of the batteries and adjustments of the Mass Combi should only be undertaken by authorised personnel!

3 HOW IT WORKS

This chapter describes the various applications of the Mass Combi series from Mastervolt.

The Mastervolt Mass Combi is a battery charger, a powerful sine wave inverter and an AC transfer system in one compact enclosure. The three-step Plus charging method guarantees that the batteries are always charged 100%. The pure sine wave inverter assures that the AC output voltage is perfectly reliable even when limited external AC power is available. External AC power can be supplied by a public grid or a generator. DC power can be delivered by charged batteries.

3.1 THE BATTERY CHARGER

The built-in battery charger is electronically controlled. It is designed for optimal recharging of both wet cell, gel cell and AGM deep cycle batteries. Battery charging is accomplished in three automatic stages: BULK, ABSORPTION and FLOAT. With an external AC source connected, the Mass Combi charger also serves the functions of an AC to DC converter to supply DC loads which are connected to the battery. Simple, automatic operation is made possible by the microprocessor that is the brain of the inverter/charger combination. In most cases, the unit is left on and no attention or maintenance is required.

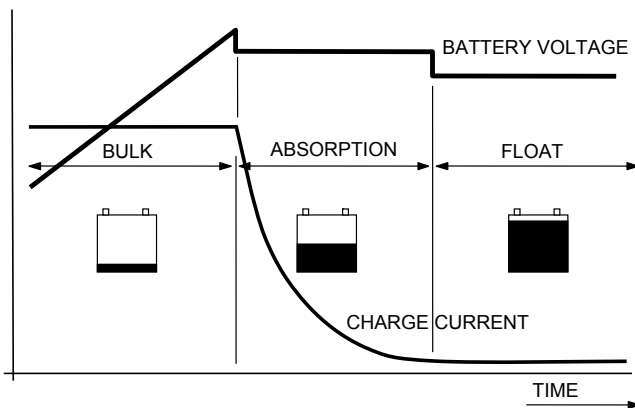


Figure 2: Three step charge system

3.1.1 Three step Plus charge system

See figure 2. The first step of the three step Plus charge system is the BULK phase, in which the output current of the charger is 100%, and the greater part of the capacity of the battery is rapidly charged. The current charges the batteries and gradually the voltage rises to the absorption voltage of 14.4V (12V models) or 28.8V (24V models) @ 25°C / 77°F.

The duration of this phase depends on the ration of battery to charger capacity, and naturally also on the degree to which the batteries were discharged to begin with.

The bulk phase is followed by the absorption phase. Absorption charging starts when the voltage on the batteries has reached 14.4V (12V models) / 28.8V (24V models) @ 25°C / 77°F, and ends when the battery is completely full. Battery voltage remains constant at 14.25V (12V models) / 28.5V (24V models) @ 25°C / 77°F throughout this stage, and the charge current depends on the degree to which the battery was initially discharged, the battery type, the ambient temperature, and so on. With a wet cell battery this stage lasts some four hours, with gel and AGM around three. Once the battery is 100% full, the Mastervolt charger automatically switches over to the float phase.

During the float phase the Mass Combi switches to 13.25V (12V models) or 26.5V (24V models) @ 25°C / 77°F and stabilises this voltage to maintain the batteries in an optimum condition. Connected DC loads are powered directly by the charger. If the load is higher than charger capacity, the required additional power comes from the battery, which will be progressively discharged until the charger automatically switches back to the bulk phase. Once consumption decreases, the charger goes back to normal operation of the three-step charge system.

As the Mass Combi is equipped with a three-step Plus charge system, the batteries can also remain connected to the Mass Combi in winter. One hour every 12 days the charger automatically switches to absorption to keep the battery running properly and prolong its life span. The three-step Plus charge system is also safe for all the connected equipment.

See also section 9.5 for detailed characteristics of the three step Plus charge system.

3.1.2 Temperature compensated charging

The Mass Combi is delivered with a battery temperature sensor. By installing this battery temperature sensor the charge voltages are automatically adapted for deviating temperatures.

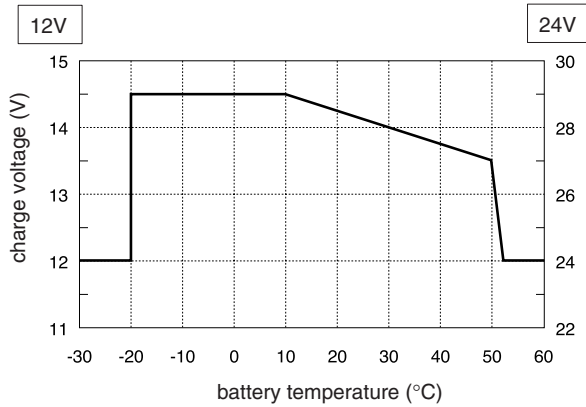


Figure 3: Temperature compensated charging

See figure 3. When the battery temperature is low, the charge voltage increases. On the other hand, when the battery temperature is high, the charge voltage is decreased. Over charge and gassing are prevented this way. This will extend the life of your batteries.

See section 5.8 to connect the battery temperature sensor.

3.1.3 Connection of a second battery

The Mass Combi is equipped with second charge output which can be used to give a maintenance charge to a small battery set like a starter battery Maximum output current: 5 Amps.

Output voltage: same as the main charger.

See section 5.8 for connection.

3.2 THE INVERTER

3.2.1 General

The inverter provides voltage and frequency regulated AC power from a battery bank. Fast acting electronic circuits protect the inverter against extreme overloads, low and high battery voltage and overheating of the inverter.

Considerable momentary surge power is available for starting-up electric motors. High efficiency insures long battery usage between recharges. A built in energy saving feature can reduce battery power consumption when the inverter is unloaded.

3.2.2 Energy saving mode (selectable)

In the inverter mode the Mass Combi has a built-in automatic energy saving feature that reduces battery power consumption when no load is present on the "SHORT BREAK" output. Response from idle is instant. In most cases the operation is not noticeable. Four modes can be set by means of DIP-switches, see chapter 6.

The inverter of the Mass Combi can operate in one of the following modes (table below):

| Mode | Explanation |
|--------------|--|
| High power | The energy saving mode is switched off. The inverter is fully operating and the output voltage is 230V AC. This is the default setting. |
| Idle 40VA | With a connected load less than 40VA or 150VA, the inverter reduces the output voltage to almost zero. The Mass Combi scans the "SHORT BREAK" outlet with pulses of 230V every 2½ seconds. When it detects a load that is larger than 40VA or 150VA, it switches on the inverter automatically. Small loads such as clocks in VCR's or micro waves are most likely not to work on this mode. |
| Idle 150VA | |
| Economy mode | The inverter reduces the output voltage to 208VAC if the connected load drops below 250VA. The output voltage will return to 230VAC if the connected load rises above 250 VA. Small loads as clocks in VCR's and micro waves will perform equal whether the inverter is running in the economy state or is on. The energy saving from your batteries is approximately 10%. |

For detailed specifications see section 9.1 "DC no load power consumption"

Table 1: Mass Combi energy saving modes

3.3 OPERATION MODES

The Mass Combi is not just a combination of an inverter and a battery charger. It has many additional features which can be used to increase the total available AC power, even when external AC power is limited.

3.3.1 Basic operation

When there is no external AC power available, the inverter of the Mass Combi provides AC power on the "SHORT BREAK" output from the batteries. There is no AC power available on the "POWER" output. Now the Mass Combi is in "Inverter mode". See figure 4.

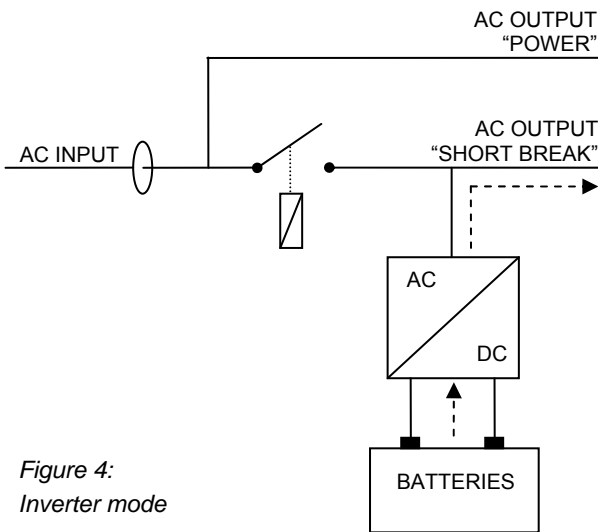


Figure 4:
Inverter mode

When external AC power comes available, the transfer relay switches on. See figure 5. Both outputs as well as the battery charger are supplied by the external AC power. The batteries are recharged now. Now the Mass Combi is in "Charger mode".

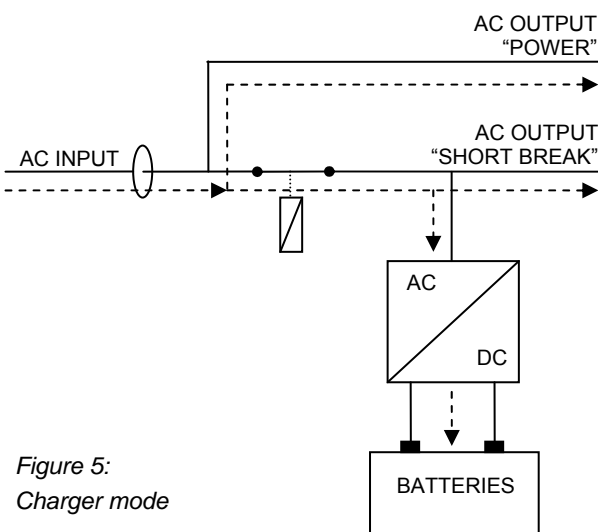


Figure 5:
Charger mode

3.3.2 The transfer switch

The Mass Combi has two AC-outputs available;

- SHORT BREAK output. The "SHORT BREAK" output switches between the AC-input and the output of the inverter. The AC input has the highest priority. In principle, AC-power is always available on this output. However during a switchover the loads connected to this output are not supplied with AC-power for a very short period of time (short break). It is the ideal output for loads that need continuous AC-power
- POWER output. This output is always internally connected to the AC-input. It is therefore only available when an external AC-source like shore power, a generator or an outlet is present. Larger loads like a hot water boiler, electric cooking appliance or washing machine should be connected to this output

3.3.3 Power sharing function (selectable)

If the available power at the AC-input is limited, and the load connected to the AC output increases, the external AC circuit breaker may trip if nothing is done. To avoid this, the Mass Combi can automatically reduce the battery charger output, and thus the AC power consumption. This *Power sharing* feature constantly senses the incoming AC current which is used to supply both the battery charger and the appliances connected to the AC outputs.

The *Power Sharing level* should be set to match the value of the external circuit breaker, which protects the incoming AC power. For instance, when the external AC power is limited by a 6A fuse, the *Power Sharing level* must be set to 6A.

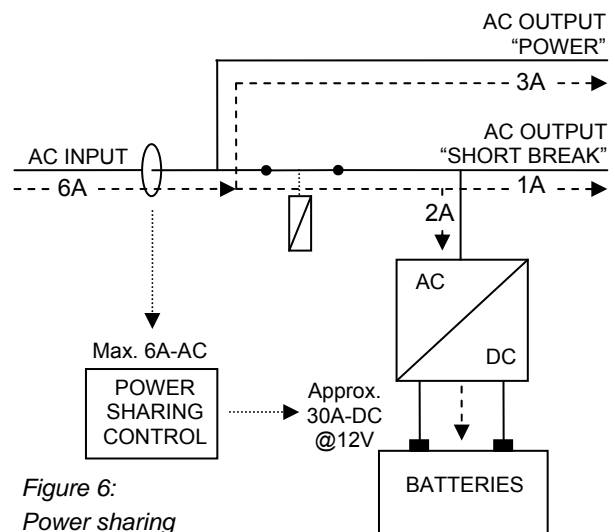


Figure 6:
Power sharing

See figure 6.

Here the *Power Sharing level* is set to a 6 Amps while the AC outputs consume a total of 1 + 3 = 4 Amps. This

means that only $6 - 4 = 2$ Amps is left over for charging. With 12V batteries this will result in a maximum charge current of approx. 30A DC

By default the *Power Sharing level* is set to 25 Amps. It can be adjusted by means of the DIP-switches locally on the Mass Combi (see section 6.2.1). However, we recommend the use of an optional remote control panel, like the Remote APC or Masterlink MICC. With this remote panel you can select the available shore current (fuse) of each marina or camping site in a very easy way.

When the total connected AC load reaches the level of the Power Sharing setting (6A), there will be no power left over to charge the battery. This means that the charge current of the Mass Combi will be reduced to 0A. See figure 7.

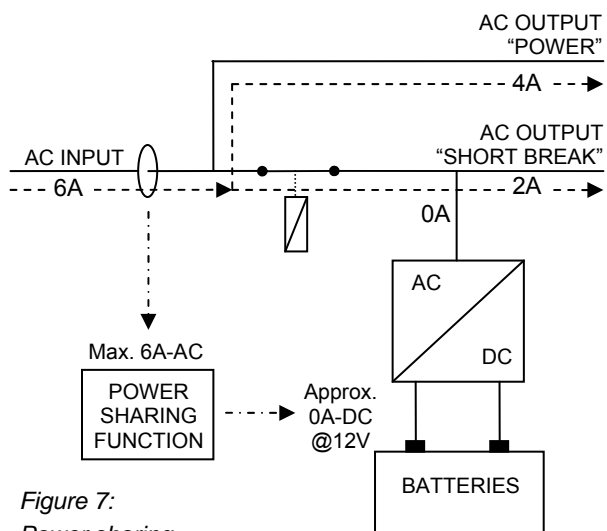


Figure 7:
Power sharing

3.3.4 Generator / mains support function (selectable)

If the demand for AC power still increases, the external AC circuit breaker may still trip if nothing is done. This problem can be solved by the *Generator / mains support function*. If the total demand for energy exceeds the maximum external power supply, energy can be added to the AC outputs "POWER" and "SHORT BREAK" by means of the inverter. This appliance can be automatically connected in parallel with the external power supply.

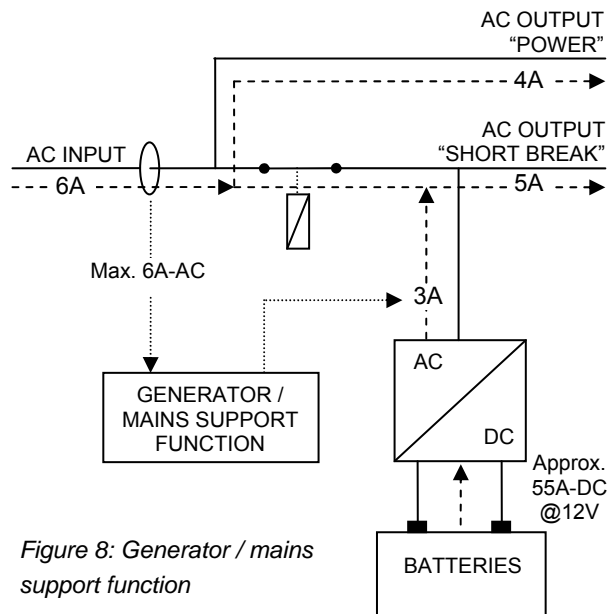


Figure 8: Generator / mains support function

See figure 8

Here the AC-input is still limited to 6 Amps. This is not enough to supply the total load ($4 + 5A = 9A$) connected to the AC outputs.

When the *Generator / mains support function* is enabled, the inverter will supply the remaining $9 - 6 = 3A$. This means that the restricted amount of external AC power will be compensated by energy which is stored in the batteries.

Later, when the AC load has dropped below the setting of the Power sharing function again, the battery charger of the Mass Combi will commence to recharge the batteries. For safety reasons the transfer relay is immediately switched off when incoming AC power fails in operation so that there will never be a high voltage on the shore cable inlet when it is not connected.

By default the *Generator / mains support function* is disabled. It can be enabled by means of the DIP-switches (see section 6.2.3)

3.3.5 Power support function (selectable)

As explained above, when the *Generator / mains support function* is enabled, the inverter will operate in parallel with the external AC power source. This means that energy from the batteries is added to the AC-output only. Under no circumstance AC power from the inverter can be fed back into the AC grid. Please mind that several countries maintain different standards with regard to AC-sources operating in parallel with the AC-grid. This may mean that in some situations the use of the *Generator / mains support function* is not allowed. Please acquaint yourself with local standards on this issue. Never use the *Generator / mains support function* if this is not allowed!

If the use of the *Generator / mains support function* is not allowed, the *Power support function* can be used instead

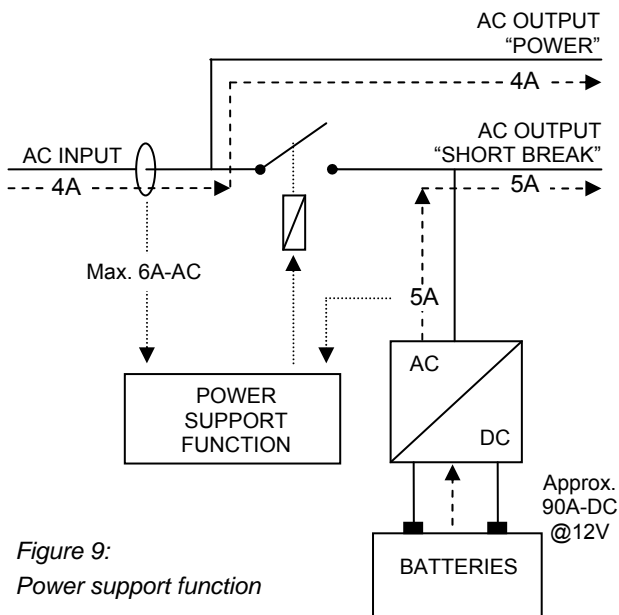


Figure 9:
Power support function

See figure 9

The AC-input is still limited to 6 Amps. This is not enough to supply the total load (4 + 5A = 9A) connected to the AC outputs.

Now when the *Power support function* is enabled, the transfer relay will open. When opened, the external power source will deliver 4A to supply the load connected to the "POWER" output only, while the inverter will deliver 9 Amps for the load connected to the "SHORT BREAK" output.

Please note that if the power consumption of the "POWER" output exceeds the setting of the power support function, the external AC fuse will still trip

If the total current from the "POWER"-output and "SHORT BREAK"-output is less then the *Power support* setting during approx. 10 minutes, the Mass Combi connects the "SHORT BREAK" output back to the AC-input again

The charger commences charging again when the load reduces further and the total current drops below the *Power sharing* setting.

By default the *Power support function* is disabled. It can be enabled by means of the DIP-switches (see section 6.2.2)



NOTE! You can either choose the *Generator / mains support function* or the *Power support function*, not both simultaneously.

3.3.6 Summary of the AC operation modes

| Function | DIP-switch* | What is it used for? | How is this achieved? |
|---------------------------|-------------|---|--|
| Power Sharing | B-SW3 | To protect the incoming AC from overload | By reducing the charge current and thus the AC input current. |
| Generator / Mains support | B-SW5 | To deliver more AC power than available from the incoming AC. | The AC output of the inverter is connected in parallel with the incoming AC. This means that energy from the batteries is added to the incoming AC. |
| Power support | B-SW4 | To deliver more AC power than available from the incoming AC. | The load which is connected to the "POWER"-output is supplied by the incoming AC, while the SHORT BREAK output is connected to the output of the inverter. |

Table 2: Overview of the AC operation modes

* see chapter 6 for adjustment of the DIP-switches

3.4 PARALLEL OPERATION

If the inverter power is not sufficient, yet another identical Mass Combi can be connected in parallel to double both the inverter power and the charge power. With two units in parallel the total inverter power conversion will be equally divided between the two units. To achieve this, one of the units must be configured by means of a DIP-switch setting as 'master' and the other as 'slave'. See figure 10. Once the configuration is established the master tells the slave apparatus what to do. This communication is done by the use of a modular communication cable between the two units.



CAUTION!

Only two units of the Mass Combi 12/2200-100 or Mass Combi 24/2600-60 can be connected in parallel.

Parallel operation of two units of the Mass Combi 12/1600-60 or Mass Combi 24/1800-35 is not possible.

See section 5.8.2 for connection and settings.

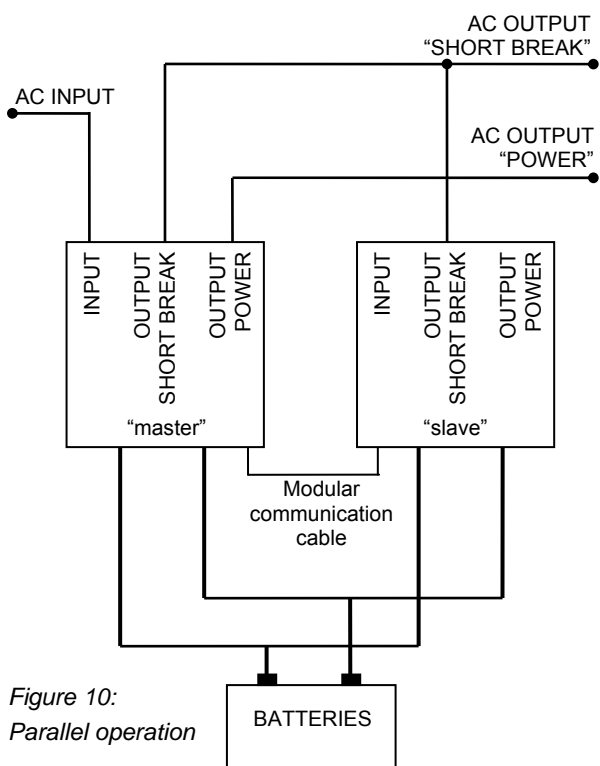


Figure 10: Parallel operation

3.5 REMOTE MONITORING

Mastervolt offers several possibilities for remote monitoring and control of the Mass Combi.

There are three remote panels available for the Mass Combi. The *Inverter Charger Control (ICC)* panel and the *AC Power Control (APC)* panel are specially designed for the Mass Combi. The *Mass Inverter Charger Control (MICC)* is a universal panel.

The remote panels are connected to the Mass Combi via a modular communication cable with two RJ 12 connectors. The maximum length of communication cable should not exceed 15m/49ft.

The Mass Combi can also be connected to the *MasterBus* network by means of the *MasterBus Combi interface*. See chapter 10 for ordering information.

Note that it is not possible to connect all panels and the *MasterBus Combi interface* at the same time. You should choose one of the following options:

- No remote monitoring at all;
- Remote panel ICC only;
- Remote panels APC and ICC;
- Masterlink MICC panel only;
- MasterBus Combi interface only.

3.5.1 Remote panel ICC



Figure 11: Remote panel ICC

The ICC panel provides the same functions as the user panel on the Mass Combi. However, with this remote panel you have the convenience to operate the Mass Combi remotely.

3.5.2 Remote panel APC



Figure 12: Remote panel APC

The APC panel has extended functions such as setting remotely the Power sharing value and monitoring your “AC-load”.

3.5.3 Masterlink MICC panel

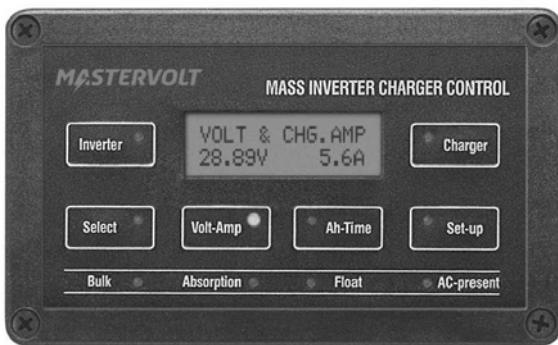


Figure 13: Masterlink MICC panel

The Masterlink MICC panel (art. no 70403105) is a digital remote panel that has additional features compared to the ICC and APC panel. This control panel is not only a remote control panel to switch on and off your Mass Combi but also a battery consumption meter for read-out of the exact state-of-charge of your battery by means of a shunt (included with the delivery of the Masterlink MICC). When the battery is reaching a low voltage set point or a low state-of-charge an alarm can be raised. This can be used to start the generator.

The information provided includes reading voltage, current, consumed Ah, time remaining and remaining capacity as a percentage of the maximum available battery capacity. A well-lit LCD screen also displays direct online data or historical information. A protective back box, easy to install, is included as standard for protecting the electronic components.

3.5.4 MasterBus-Combi interface



Figure 14: MasterBus-Combi interface

With the MasterBus – Combi interface you can connect your Mass Combi to the MasterBus network: a fully decentralized data network for communication between the different Mastervolt system devices such as the inverter, battery charger, generator, batteries and many more. This enables monitoring and configuration with a MasterView display or the MasterAdjust software.

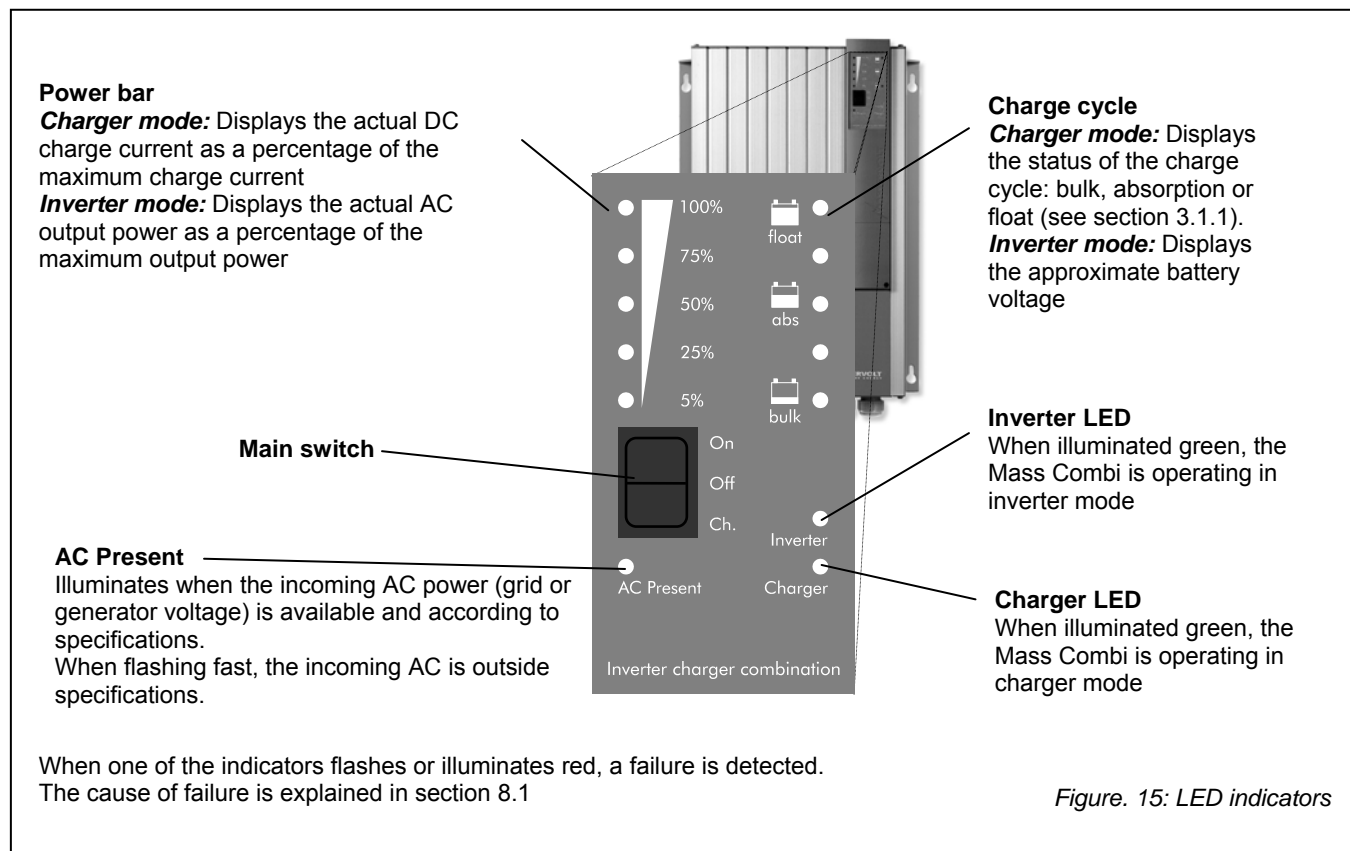
3.6 ALARM CONTACTS

The Mass Combi is equipped with an integrated alarm function. External equipment can be controlled by the potential free contacts of this alarm (see section 5.8.3). The maximum switch current of the relay is 1A. By default the relay will be activated when the DC-voltage is out of range, after a delay of 30 seconds. See table below. Other functions can be programmed by means of MasterAdjust software via the MasterBus – Combi interface

| Nominal voltage: | 12V | 24V |
|--------------------|-------|-------|
| Under voltage ON: | 10.0V | 20.0V |
| Under voltage OFF: | 11.0V | 22.0V |
| Over voltage ON: | 16.0V | 32.0V |
| Over voltage OFF: | 15.5V | 31.0V |

Table 3

4 OPERATION



The Mass Combi is a fully automatic inverter / charger system. Under normal circumstances there is no need for adjustment or operation besides switching on and off.



If two Mass Combis are installed in parallel, the slave unit will only operate properly after the master unit was switched on first.



WARNING

Never disconnect any of the wiring during operation of the Mass Combi

4.1 INDICATORS

See figure 15. The operation of the Mass Combi is displayed by means of LED indicators at the front side of the housing. If the Mass Combi is activated and as long as none of the red indicators are illuminated, no failure is detected and the unit is operating normally.

4.2 SWITCHING ON AND OFF

The only control on the Mass Combi itself is the main switch (see figure 15) on the front of the unit. This switch controls On, Off and Ch. (Charger only)

4.2.1 Switching on

The Mass Combi can be activated by switching the main switch to the "ON" position.

If you use a remote control panel, press the on/off button on the remote control panel.

After switching on expect a 3-5 seconds delay before the unit is activated. The LED-indicators will blink several times, indicating the installed software version (see section 8.2 for explanation).

If AC power is available on the AC input and within the specified limits, the Mass Combi will switch to Charger Mode and will commence to charge the batteries. At the same time the internal transfer relay will pass the AC power to the AC output "SHORT BREAK".

If the AC power from the external AC-source is unavailable or outside the specified limits, the unit will come on as an inverter. Inverter overload protection, built-in idle mode circuitry, transfer switching, power sharing and battery charger regulation will all function automatically.

4.2.2 Switching Off

Move the main switch to the “Off” position to switch off the Mass Combi. If you use a remote control panel, press the on/off button on the remote control panel. The Mass Combi stops and all the indicators go off. The “Short” break output is disconnected and will become powerless.



WARNING

Switching off the Mass Combi with the main switch on the front of the cabinet does not cut off the connection to the batteries or the AC-source. Therefore the “POWER” output is still active



NOTE! When the main switch is in the “Off”-position, it overrides the remote control panel. In this off state it is not possible to start the Mass Combi remotely.

4.2.3 Switching Ch. (Charger only)

When the main switch is set to the “Ch.”-position, the Mass Combi is only able to work as a charger. This means that the inverter mode is disabled. This setting is useful if you want to keep your batteries charged and maintained in case you are away i.e. in the winter time. Now your batteries are spared when the incoming AC-source fails in operation.

4.3 PROTECTIONS

The Mass Combi is protected against overload, short circuit, over heating and under and over voltage. The user can detect failures from the local user panel or from one of the (optional) remote control panels by means of the indicators.

See section 8.1 for explanation of this readout.



CAUTION!

The Mass Combi is not protected against reversing polarity of the DC-input, AC voltage on the DC-input and serious over voltage (>265VAC) on the AC-input or AC-outputs.

4.3.1 Transfer switch overload protection

The transfer switch of the Mass Combi is protected against overload and short circuit. When the current through the transfer switch of the Mass Combi is too high (see figure 35) the thermal fuse (figure 22) will switch off and the Mass Combi shuts down.

To correct this situation, proceed as follows:

- 1 Move the main switch of the Mass Combi to the “OFF”-position.
- 2 Disconnect the Mass Combi from any power source. Disconnect all loads from the Mass Combi.
- 3 Investigate the cause of failure of the thermal fuse like overload or short-circuits.
- 4 Refer to section 5.5 to open the connection compartment
- 5 Wait for at least two minutes and then reset the thermal fuse by pushing the button inside the connection compartment (see figure 16).

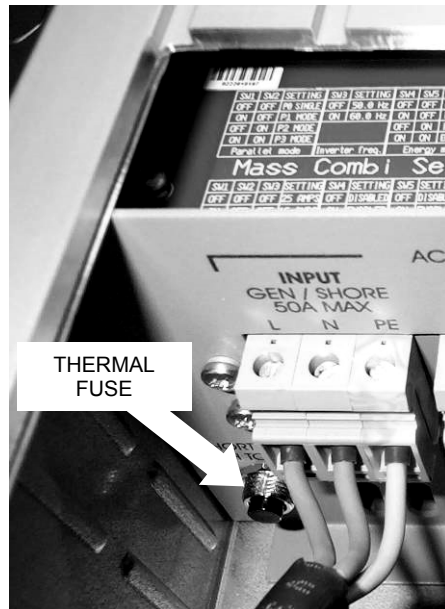


Figure 16: Reset of the thermal fuse

- 6 Close the connection compartment again.
- 7 Connect the Mass Combi to the power sources again.
- 8 Switch on the Mass Combi. (see section 4.2)

4.3.2 Output overload or short circuit

In case of overload or short circuit in the inverter mode, the 100% LED of the Power bar (see figure 15) is illuminated red and the output voltage of the Mass Combi is limited. The Mass Combi shuts down if this overload or failure lasts longer than 5 seconds.

The Mass Combi will automatically restart after shutdown. After 5 failed start attempts the Mass Combi shuts down permanently, the 100% LED is lit and the Inverter LED (see figure 15) will flash. You can restart the Mass Combi only by switching the unit manually off and on with the main switch on the Mass Combi after the overload is removed or failure is solved.

4.3.3 Overheating

In the event of overheating the Mass Combi shuts down (see section 8.1 for illumination of indicator lights). The Mass Combi is automatically powered up again when the temperature drops below the factory default threshold.

Overheating is most likely caused by:

- heavy or non-resistive loads operating for a longer time
- high ambient temperature
- disrupted air flow (dust or too less space)

4.3.4 Under and over voltage

The AC-input of the Mass Combi is, within limits, protected against over and under voltage. See specifications in section 9.2. The Mass Combi will switch to inverter mode if the AC-input voltage is out of operating range and will switch back if the AC-input voltage is present again.

The DC-input of the Mass Combi is also, within limits, protected against over and under voltage. See specifications in section 9.1. The Mass Combi switches off if the DC-input voltage is out of range.

4.4 MAINTENANCE

No specific maintenance is required. If necessary, use a soft clean cloth to clean the Mass Combi. Never use any liquids, acids and/or scourers.

4.5 PROBLEM SOLVING

Refer to chapter 8 if a problem occurs.

5 INSTALLATION

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

5.1 UNPACKING

In addition to the Mass Combi the delivery includes:

- a battery temperature sensor;
- this user's manual.

Optionally included:

- MasterBus - Combi interface (p/n 77030475) or
- Remote panel ICC (p/n 70405000) or
- Remote panel APC (p/n 70405010)

After unpacking, check the contents for possible damage. Do not use the product if it is damaged. If in doubt, contact your supplier.

Check from the identification label (see section 1.6) whether the battery voltage is the same as the DC-input voltage of the Mass Combi (e.g. 24V battery set for a 24V input voltage). Also check that the AC output voltage and output power of the Mass Combi satisfies loading requirements.

5.2 ENVIRONMENT

Obey the following stipulations during installation:

- The Mass Combi is designed for indoor use only.
- Ambient temperature: 0 ... 60°C / 32°F ... 140°F; (power derating above 25°C / 104°F to decrease the internal heat sink temperature)
- Humidity: 0-95% non-condensing
- Mount the Mass Combi on a solid surface, with the connecting cables downwards.
- Make sure that the hot air produced during operation can be discharged. The Mass Combi must be mounted in such a way that obstruction of the airflow through the ventilation openings will be prevented.
- No objects must be located within a distance of 10 cm / 4 inch around the Mass Combi. See also section 5.7.
- Do not locate the Mass Combi in the same compartment as the batteries.
- Do not install the Mass Combi straight above the batteries because of possible corrosive sulphur fumes

5.3 WIRING

The wiring is connected inside the connection compartment. If necessary, the wiring can be fed from the top to the bottom side of the cabinet along the back of the cabinet.

Always feed the wiring through the cable glands of the cabinet, and then connect the wiring to the terminals. Fix the phase line wire to terminal L, the neutral wire to terminal N and the ground wire to terminal PE.

5.3.1 AC-wiring

For a safe installation the correct wire cross section must be applied. Don't use a cross section that is smaller than indicated. See table below to select the appropriate cross section for the AC wiring:

| AC-Current | Minimum cross section: | |
|------------|------------------------|--------|
| | in mm ² | AWG |
| 15-20 Amp | 2.5 mm ² | AWG 13 |
| 20-32 Amp | 4 mm ² | AWG 11 |
| 32-48 Amp | 6 mm ² | AWG 9 |

Recommended wire colours (refer to local standards):

- 230V AC installations:

| Wire color | Meaning | Must be connected to: |
|----------------|---------|-----------------------|
| Brown or black | Phase | L1 |
| Blue | Neutral | N |
| Green/Yellow | Earth | PE / GND |

The maximum current passing the Mass Combi must be limited. Therefore the AC-input must be protected by a fuse, as specified below.

| Model Mass Combi | Maximum rating of the AC input fuse |
|------------------|-------------------------------------|
| All models | 50A |

5.3.2 DC wiring

Keep in mind that high current will pass through the DC wiring. Keep the cable length as short as possible, this will keep the system efficiency as high as possible. The recommended minimum cross section for battery cables up to 3m / 10ft length is:

| Model Mass Combi | DC Cable cross section: |
|--------------------|----------------------------|
| 12/1600-60 / 230V | 50mm ² / AWG0 |
| 12/2200-100 / 230V | 70mm ² / AWG2/0 |
| 24/1800-35 / 230V | 35mm ² / AWG2 |
| 24/2600-60 / 230V | 50mm ² / AWG0 |

Use cable lugs terminals on the ends of the wires. These lugs should be crimped with a proper crimping tool. Use the following wire colours for DC wiring (refer to local standards):

| Wire color | Meaning | Must be connected to: |
|------------|----------|-----------------------|
| Red | Positive | + (POS) |
| Black | Negative | - (NEG) |

Lay the positive and negative cables next to each other to limit the electromagnetic field around the cables. The negative cable should be connected directly to the negative post of the battery bank or the ground side of a current shunt. Do not use the chassis frame or hull of the ship as the negative conductor. Tighten connections securely (15 - 20 Nm / 130 - 175 In-Lbs.). The positive battery cable must be fused according to local applicable standards and connected to the positive post of the battery bank.

See section 9.1 Specifications for recommended fuses.

The fuse with the fuse-holder is available from your local Mastervolt distributor or Customer Service Representative.

5.3.3 AC safety grounding



WARNING

The ground wire offers protection only if the cabinet of the Mass Combi is connected to the safety ground. Connect the earth terminal (PE / GND) to the hull or the chassis.



CAUTION!

For safe installation it is necessary to:

- connect the neutral conductor (N) of the AC output to the earth (PE / GND), only during inverter operation of the Mass Combi;
- insert a Residual Current Device (earth leakage switch) of 30mA in AC output "SHORT BREAK" of the Mass Combi.
- Insert a Residual Current Device (earth leakage switch) of 30mA in AC input of the Mass Combi.

Refer to local standards on these issues!

For safety purposes the neutral conductor (N) of the AC output must be connected to the earth (PE / GND) when the Mass Combi is in inverter operation. When utility power is available on the AC input, and the Mass Combi is in charger mode, this connection must be disabled again.

In some applications automatic connection between the neutral conductor (N) and earth (PE / GND) is not required or acceptable. Therefore the automatic connection between the neutral conductor (N) and earth (PE / GND) is disabled by default

To enable this automatic connection, see section 6.1.5

5.4 THINGS YOU NEED

Make sure you have all the parts you need to install the Mass Combi:

- Mass Combi (included)
- Battery temperature sensor with cable and plug (included);
- AC wiring. Double insulated three wire cable with wire colours according to the locally applicable standards. The applicable length and wire diameter depend on the electrical installation. See section 5.3.1;
- DC-wiring to connect the DC connections of the Mass Combi to the DC-distribution; see section 5.3.2;
- DC-fuse holder with a DC-fuse, to be integrated in the positive DC-cable. For specifications see section 5.3.2;
- Screws / bolts (Ø 6mm) (with plugs) to mount the cabinet to a surface. Use mounting materials which are suitable to carry the weight of the Mass Combi;
- Batteries. Refer to section 9.1 for specifications;
- Appropriate and reliable cable terminals, cable lugs, battery terminals and cord end terminals;
- In case of Parallel operation (section 3.4): Modular communication cable 8 pole (maximum length 15m) for communication between the two Mass Combi's. See figure 20.

We recommend as a minimum tool kit:

- Socket wrench 13mm to fix the DC-input (battery) cables
- Flat blade screw driver 1.0 x 4.0 mm to fix the screw terminals
- Tools to fix the screws / bolts (Ø 6mm) with plugs to mount the cabinets to a surface
- Philips screw driver to open the connection area of the Mass Combi

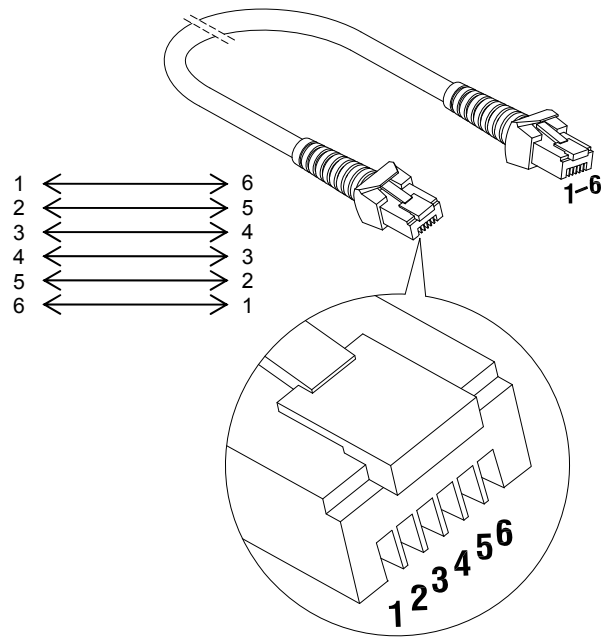


Figure 19: Modular communication cable, 6 pole, cross wired. For connection of remote control panels

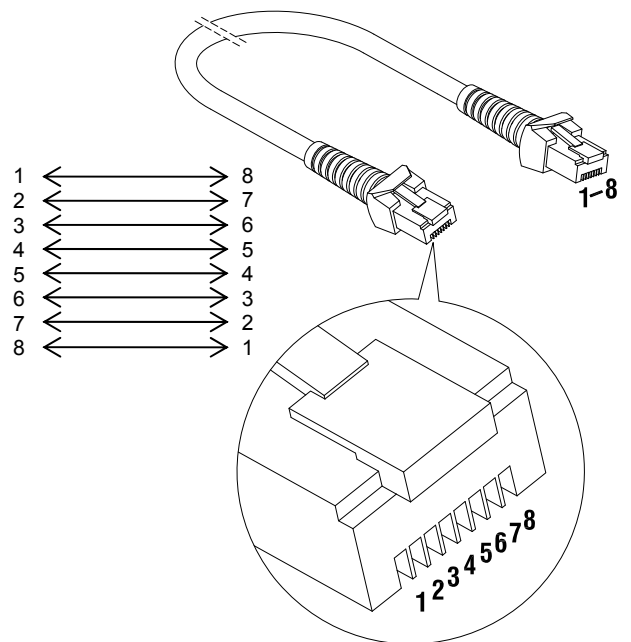


Figure 20: Modular communication cable, 8 pole, cross wired. For communication between two Mass Combi's (parallel operation)

5.5 REMOVAL OF THE FRONT PANEL

See figure 21. Steps:

- 1 Loosen the two Phillips screws that secure the front cover plate for two turns.
- 2 Slide the front cover plate from the cabinet (downwards).

The connectors for the battery, the AC and the remote panel are now visible. See figure 22



WARNING

The front panel may never be removed while the Mass Combi is still connected to a power source!

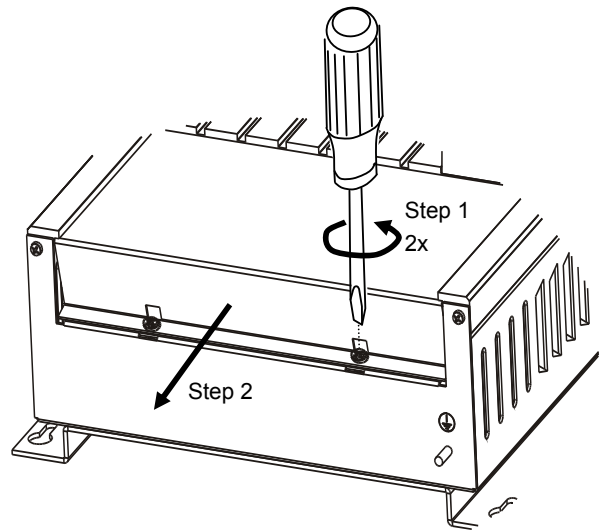


Figure 21

5.6 OVERVIEW CONNECTION COMPARTMENT

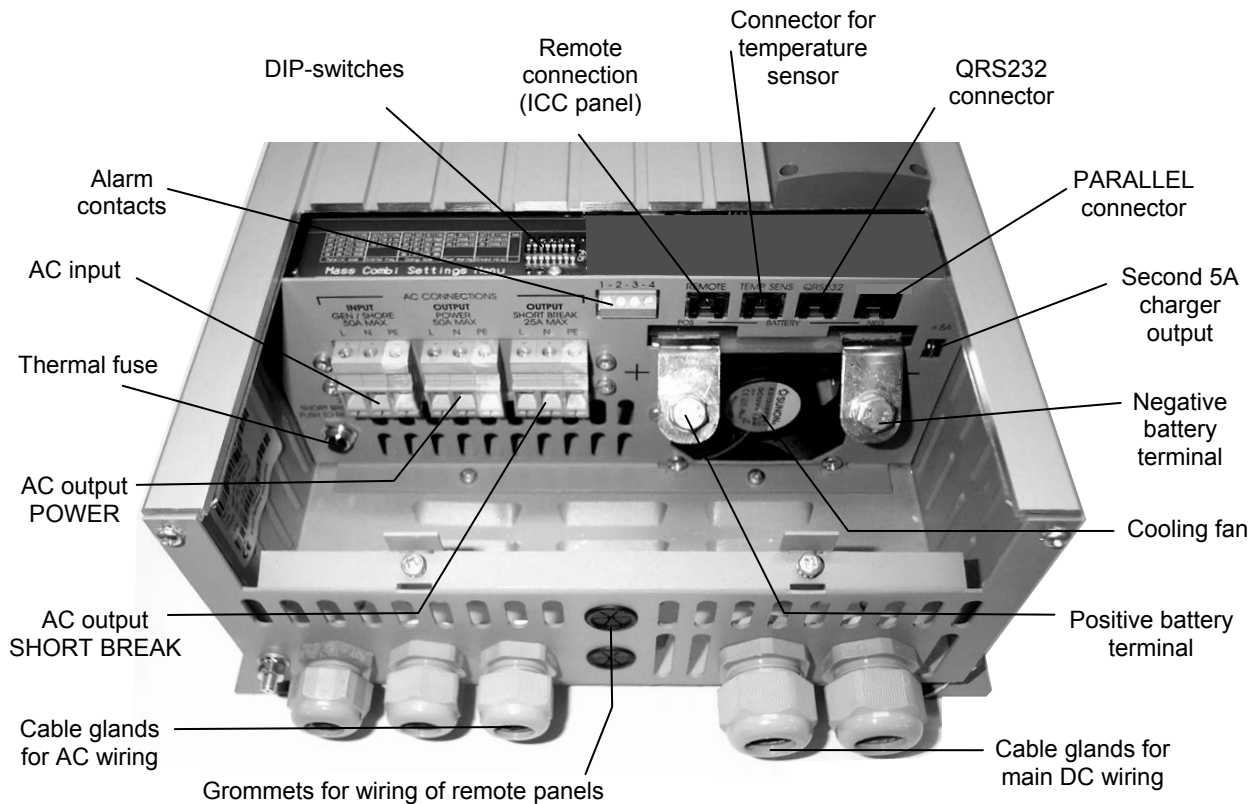


Figure 22: Overview connection compartment

5.7 MOUNTING OF THE CABINET

M6 bolts can be used for the mounting of the cabinet.

Take the following steps to mount the cabinet:

- 1 Determine for the four mounting spots on the basis of the outline drawings (see section 9.4);
- 2 Screw the topmost bolts somewhat into the wall;
- 3 Hang the cabinet with its key holes over the two bolts and screw these bolts finger tight, so that some shifting is still possible;
- 4 Place the two lowermost bolts;
- 5 Fasten all bolts securely.

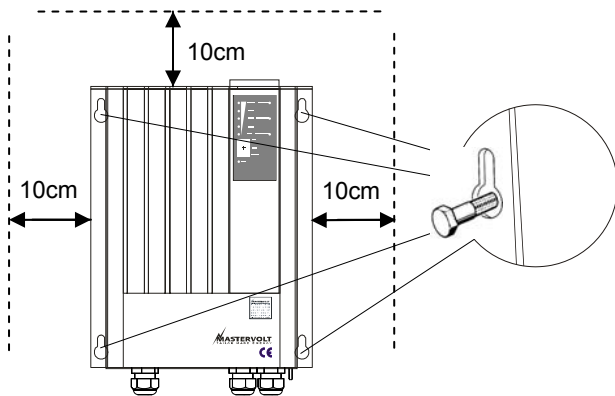


Figure 23: mounting of the cabinet

5.8 WIRING INSTRUCTIONS



WARNING

Let installation work be done by a licensed electrician. Before beginning with the connection of the wiring, make the AC distribution as well as the DC distribution voltage free. Move the main switch (see figure 15) to the "Off"-position.



CAUTION!

Short circuiting or reversing polarity may lead to serious damage to the batteries, the Mass Combi, the wiring and/or the terminal connections. Fuses between the batteries and the Mass Combi can not prevent damage caused by reversed polarity. The damage as a result of reverse polarity is not covered by the warranty.



CAUTION!

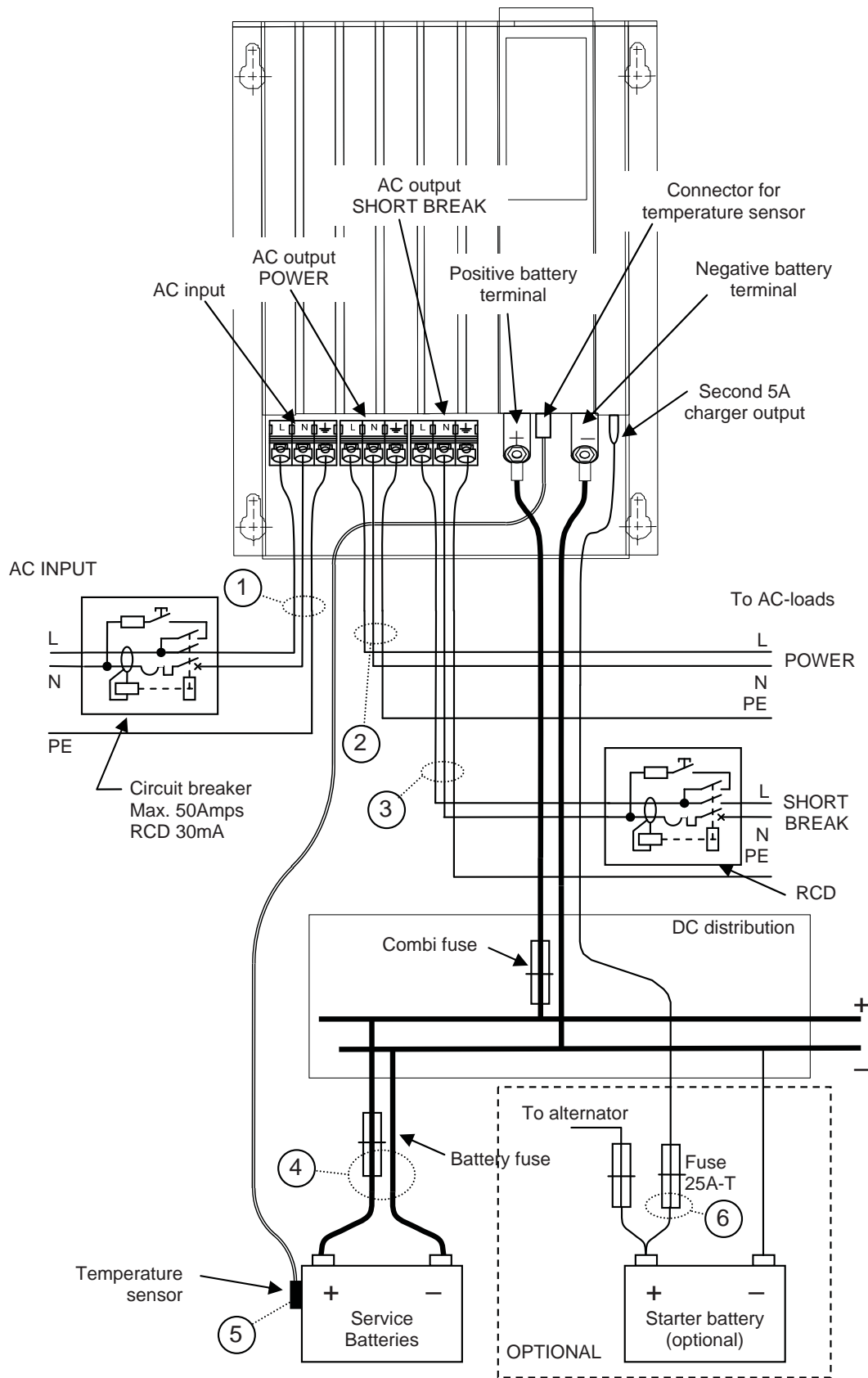
Too-thin cables and/or loose connections can cause dangerous overheating of the cables and/or terminals. Therefore tighten all connections well, in order to limit transition resistance as far as possible. Use cables of the correct size



NOTE!

Feed the cables through the cable glands of the cabinet before you fix the cable lugs to the wire ends.

Continue with section 5.8.1 for wiring instructions of one Mass Combi in stand-alone operation or section 5.8.2 for wiring instructions of two Mass Combi's in parallel operation.



This schematic is to illustrate the general placement of the Mass Combi in a circuit. It is not meant to provide detailed wiring instructions for any particular electrical installation.

Figure 24: installation drawing for one Mass Combi (stand-alone operation)

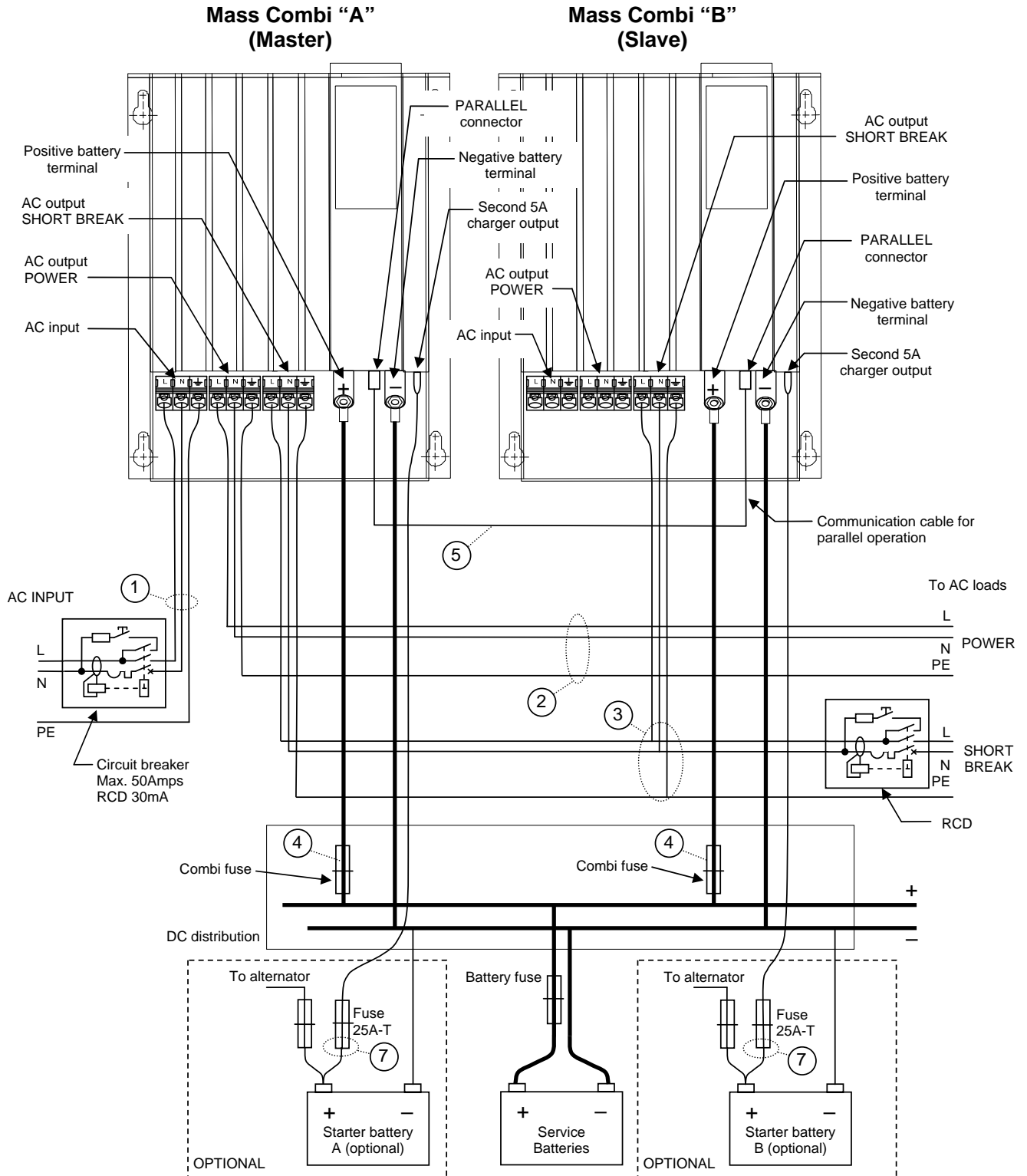
5.8.1 Wiring instructions for one Mass Combi (stand alone operation)

See figure 24.

- 1 See reference ①. Connect the external AC-source to the AC-input of the Mass Combi. Integrate a fuse (value depending on the used wire diameter with a maximum of 50Amps) and a Residual Current Device (RCD) into this wiring.
- 2 See reference ②. Connect the AC-output POWER of the Mass Combi to the power distribution group.
- 3 See reference ③. Connect the output SHORT BREAK of the Mass Combi to the SHORT BREAK distribution group. Integrate a Residual Current Device (RCD) into this wiring.
- 4 See reference ④. Run the DC-cables between the DC-distribution and the Mass Combi. Connect the red cable to the plus (+) connection, the black cable to the minus (-) connection. Do not install the DC-fuse of the DC-distribution before the entire installation is completed (see chapter 7).
- 5 See reference ⑤. Attach the temperature sensor to the battery and run the cable into the Mass Combi. Link the RJ12 connector to the "TEMP.SENS"-connector (Data Bus Connections).
- 6 Option: if you want to make use of the possibility to give a maintenance charge to a small battery set (like a starter battery), run a 6mm² /AWG10 red cable with a fuse holder between the positive pole of the starter battery and Mass Combi. See reference ⑥. Fix the cable with an insulated faston to the "+5A"-connection. Integrate a 25 Amps-T fuse in this wire. The negative pole of this battery must be connected to the negative pole of the service battery.



Continue with section 5.8.3



This schematic is to illustrate the general placement of the Mass Combi in a circuit. It is not meant to provide detailed wiring instructions for any particular electrical installation.

 **NOTE:** See also section 6.1.1 for DIP-switch settings

Figure 25: installation drawing for two Mass Combi's (parallel operation). See also figure 26

5.8.2 Wiring instructions for two Mass Combi's (parallel operation)



CAUTION!

Only two units of the Mass Combi 12/2200-100 or Mass Combi 24/2600-60 can be connected in parallel.

Parallel operation of two units of the Mass Combi 12/1600-60 or Mass Combi 24/1800-35 is not possible.



CAUTION!

Only two identical units of the Mass Combi can be connected in parallel. Parallel operation with other Combi's or inverters is not possible.

In the text below the Mass Combi that is designated as "A" must be configured as Master, while the Mass Combi that is designated as "B" must be configured as Slave (see section 6.1.1 for adjustment).

| Designation: | must be configured as: |
|--------------|------------------------|
| Combi A | Master |
| Combi B | Slave |

- 1 See figure 25, reference ①. Connect the external AC-source to the "AC input" terminals of Mass Combi "A". Integrate a fuse (value depending on the used wire diameter with a maximum of 50Amps) and a Residual Current Device (RCD) into this wiring.
- 2 See reference ②. Connect the "AC output POWER" of Combi "A" to the power distribution group.
- 3 See reference ③. Connect the "AC output SHORT BREAK" of both Mass Combi "A" and Mass Combi "B" to the SHORT BREAK distribution. Beware that the L, N and PE / GND wiring may not be exchanged.
- 4 See reference ④. Run the DC-cables between the DC-distribution and each Mass Combi. Connect the red cable to the plus (+) connection, the black cable to the minus (-) connection. Do not install the DC-fuses of the DC-distribution before the entire installation is completed (see chapter 7).
- 5 See figure 26, reference ⑤. Run the modular 8-pole communication cable between Mass Combi "A" and Mass Combi "B". Connect this cable to the PARALLEL connectors.

- 6 See reference ⑥. Attach the temperature sensor to the battery and run the cable into Mass Combi "A" and connect the RJ12 connector to the "TEMP.SENS"-connector (Data Bus Connections)
- 7 Option: if you want to make use of the possibility to give a maintenance charge to a small battery set (like a starter battery), run a 6mm² /AWG10 red cable with a fuse holder between the positive pole of the starter battery and Mass Combi. See figure 25, reference ⑦. Fix the cable with an insulated faston to the "+5A"-connection. Integrate a 25 Amps-T fuse in this wire. The negative pole of this battery must be connected to the negative pole of the main battery.



Continue with section 5.8.3

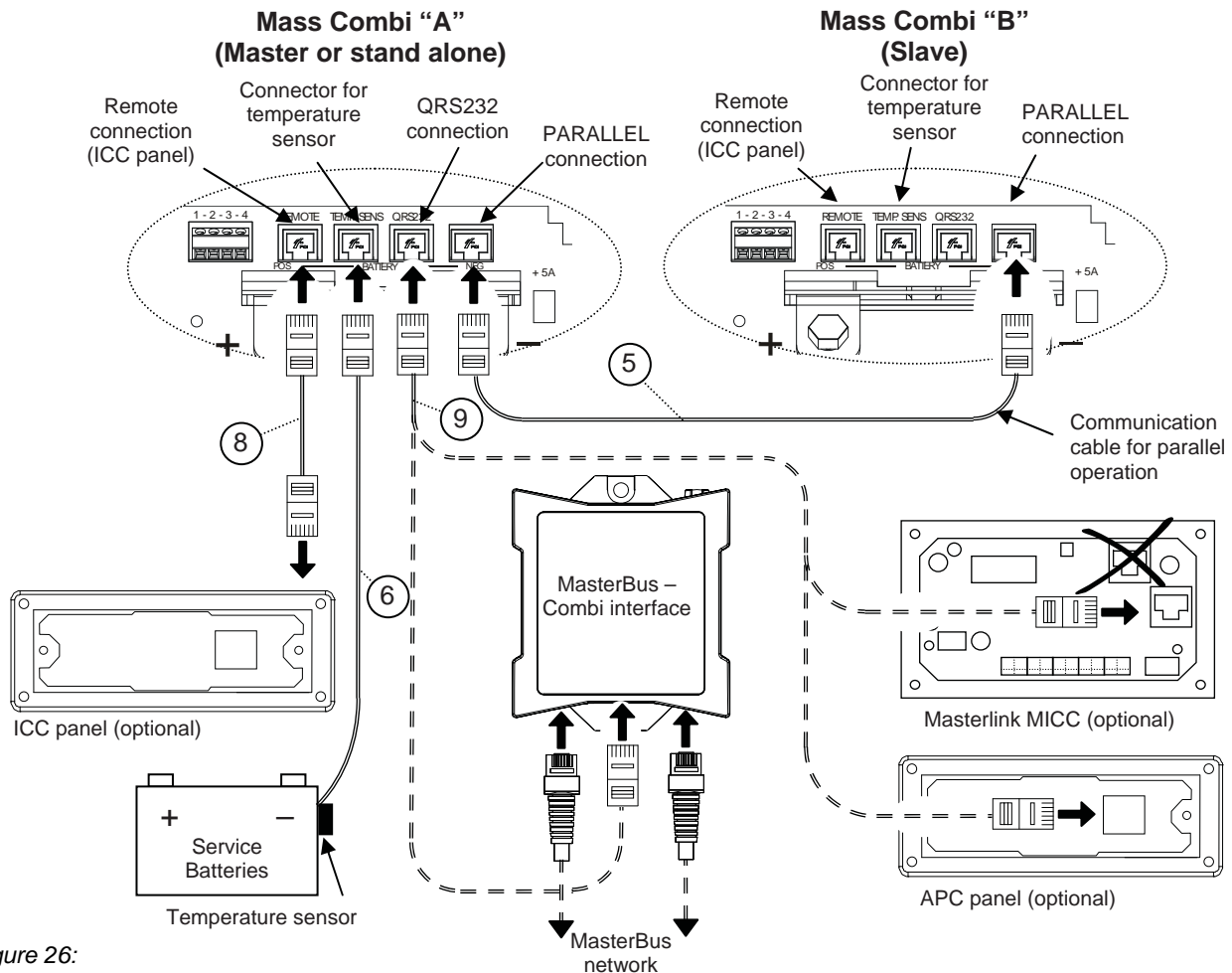


Figure 26: Connection of remote control panels, battery temperature sensors and communication cable for parallel operation

5.8.3 Interfacing (optional)

- 1 See figure 26, reference ⑧. If you want to install the ICC remote control panel, run the communication cable between Mass Combi A and the panel. Connect the RJ12 connector to the “REMOTE”-input (Data Bus Connections) of Mass Combi A.
- 2 The MasterBus – Combi interface or other panels than the ICC remote control panel must be connected to the “QRS232”-connection; reference ⑨. Refer to the applicable installation manual for detailed instructions.



NOTE

When using a Masterlink MICC remote panel:

- See section 6.2.5 for DIP-switch setting at the Mass Combi;
- See section 4.4 of the user’s manual of the Masterlink MICC to enable the Mass Combi setting.

- 3 See Figure 27. The alarm contact is switched to “Normally Open” in case of an alarm situation, see section 3.6. Maximum switching current: 1 Amp.

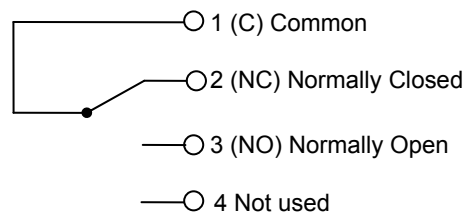
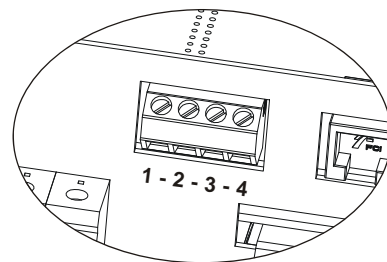


Figure 27: alarm contact

5.9 SETTINGS



Continue with chapter 6 for DIP-switch settings

6 SETTINGS

The Mass Combi is provided with two groups of DIP-switches to adjust the apparatus according to the specifications of the electrical installation. The DIP-switches are located in the connection compartment. See figure 28.



NOTE:
Adjust the DIP-switches prior to commissioning!

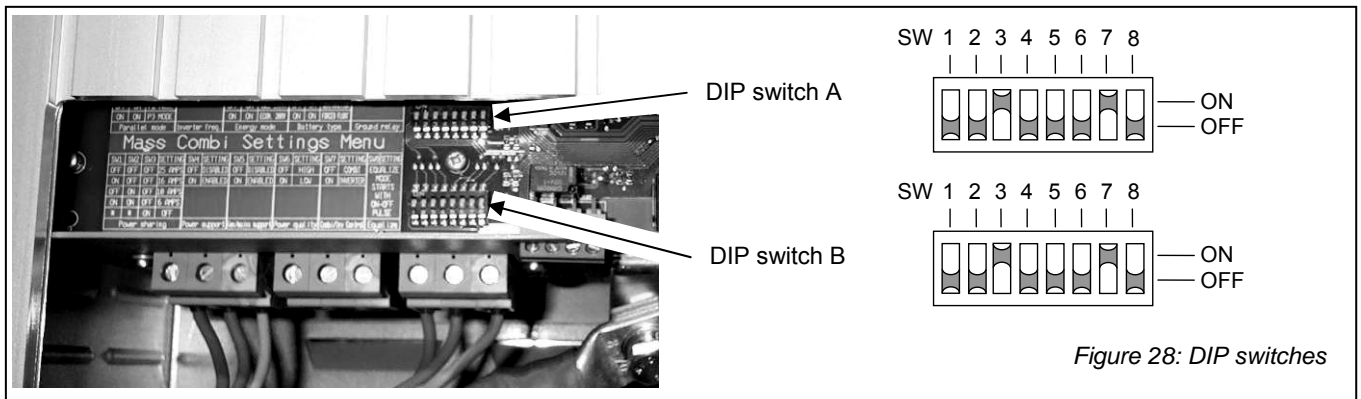


Figure 28: DIP switches

6.1 DIP SWITCH A

6.1.1 Parallel mode

| If you want... | DIP switch A | |
|--|--------------|-----|
| | SW1 | SW2 |
| to configure the Combi as Master (Combi A) then... | OFF | OFF |
| to configure the Combi as Slave (Combi B) then... | ON | ON |
| to configure the Combi as Slave (Combi B) having its own charge characteristics then... (only when both Combi A and Combi B have their own battery set) | OFF | ON |

NOTES:

- If the Combi is configured as Slave, then the settings of SW3 to SW8 of DIP switch A and SW1 to SW7 of DIP switch B are denied.
- If the charge characteristics of the Combi that is configured as Slave (Combi B) are set to follow the Master (DIP Switch A: SW1= ON) then its settings SW6 to SW7 of DIP switch A are denied.

6.1.2 Output frequency inverter

| 230V Models If you want... | DIP switch A |
|--------------------------------------|--------------|
| | SW3 |
| to set the output frequency to 50 Hz | OFF |
| to set the output frequency to 60Hz | ON |

6.1.3 Energy saving mode

See section 3.2.2 for more information.

| If you want... | DIP switch A | |
|---|--------------|-----|
| | SW4 | SW5 |
| High Power (Energy saving disabled). | OFF | OFF |
| Idle 40VA. When it detects a load that is >40VA, it switches on the output power automatically. | ON | OFF |
| Idle 150VA. When it detects a load that is >150VA, it switches on the output power automatically | OFF | ON |
| Economy 208V. The output voltage will drop to 208V as long as the connected load stays below 250VA. | ON | ON |

Note: The power saving modes “Idle 40VA” or “Idle 150VA” can only be selected with a Mass Combi operating as stand-alone unit. **These modes are not available with two Mass Combi’s in parallel operation.**

6.1.4 Battery type

The factory setting for the battery type is optimal for most installations. In some applications however, it is desirable to change this setting. Adjust the Mass Combi to the applied batteries by adjusting DIP switches SW6 and SW7.

Wrong adjustment can cause damage to your batteries which is not covered by the warranty.

The setting for traction battery should never be used with a battery bank that consists of 2V GEL cells!

| If you want... | DIP switch A | |
|---|--------------|-----|
| | SW6 | SW7 |
| Standard battery (factory setting) | OFF | OFF |
| Gel / AGM / spiral battery. During the float stage of the charging cycle the output voltage will be higher (+ 0.55V @ 12V / + 1.1V @ 24V) | ON | OFF |
| Traction battery. Charging voltage will be increased during the bulk stage (+ 0.7V) and the absorption stage (+ 0.4V) | OFF | ON |
| Constant voltage charging (Forced float). When activated, the three stage charging program is changed to a single stage program. Fixed output voltage: 13.8V (@12V) or 27.6V (@24V) | ON | ON |

6.1.5 Ground relay

For safe installation:

- A Residual Current Device (RCD) must be integrated in the wiring of the SHORT BREAK output and
- The neutral conductor (N) of the AC output of the Inverter must be connected to the safety ground (PE/GND) when the Mass Combi is working as an inverter.

The ground relay function allows you to connect the Neutral conductor (N) of the inverter output circuit to the Safety Ground (PE / GND) automatically when the Mass Combi is working as an inverter. Refer to local standards on this issue.

| If you want... | DIP switch A |
|---|--------------|
| | SW8 |
| no internal connection between the Neutral (N) and the Safety Ground (PE / GND) when the Mass Combi is working as an inverter | OFF |
| the Neutral wire (N) of the inverter output circuit connected to the Safety Ground (PE / GND) when the Mass Combi is working as an inverter and disconnected when incoming AC-power is applied (charger / transfer mode). | ON |

6.2 DIP SWITCH B

6.2.1 Power sharing function

See section 3.3.3 for more information.

| 230V Models If you want... | DIP switch B | | |
|---|--------------|-----|-----|
| | SW1 | SW2 | SW3 |
| To limit the AC-input current to 25 Amps. | OFF | OFF | OFF |
| To limit the AC-input current to 16 Amps. | ON | OFF | OFF |
| To limit the AC-input current to 10 Amps. | OFF | ON | OFF |
| To limit the AC-input current to 6 Amps. | ON | ON | OFF |
| To disable the Power sharing function. | --- | --- | ON |

6.2.2 Power Support Function

See section 3.3.5 for more information.

| If you want... | DIP switch B SW4 |
|---------------------------------------|---------------------|
| To disable the Power support function | OFF |
| To enable the Power support function | ON |

6.2.3 Generator / mains support function

See section 3.3.4 for more information.

| If you want... | DIP switch B SW5 |
|---|---------------------|
| To disable the Generator / mains support function | OFF |
| To enable the Generator / mains support function | ON |

6.2.4 Setting for Power Quality at incoming AC

If a generator with distorted output waveform (too low frequency) is used as AC source, the allowed frequency window for the incoming AC power can be enlarged.

| If you want... | DIP switch B SW6 |
|--|---------------------|
| To set the frequency window for the incoming AC power at $45\text{Hz} < f < 65\text{Hz}$ | OFF |
| To set the frequency window for the incoming AC power at $35\text{Hz} < f < 65\text{Hz}$ | ON |



CAUTION!

Adjustment of the frequency window at a too low level may cause damage to the connected AC-load. Refer to the AC-input specifications of the connected loads.

6.2.5 Combi/inverter control

The ON/OFF switch at the Inverter Charger Control (ICC) has a function depending on the setting of DIP-switch number 7.

When the Mass Combi is switched off by means of the main switch at the front then it is completely off (see section 4.2). However, in this off state it is not possible to start the Mass Combi remotely via the ICC remote panel. This is independent from the setting of DIP-switch number 7.

If you want to charge your batteries only and you do not want to start the inverter function when incoming AC fails, then the main switch of the Mass Combi must be set to the “Ch.” position (Charger only see section 4.2.3). In this state it is not possible to switch the Mass Combi remotely on or off. This is independent from the setting of DIP-switch number 7.

| If you want... | DIP switch B SW7 |
|---|------------------|
| To switch the Mass Combi (inverter and charger function) remotely on or off. The main switch at the front of the Mass Combi has to be set to the ON position | OFF |
| To switch the inverter function of the Mass Combi remotely on or off when AC-in fails. With this setting the charger is always active when the AC-in is available. The main switch at the front of the Mass Combi has to be set to the ON position. | ON |



NOTE:

The Mass Combi is not entirely off when the Mass Combi is switched off by means of the ICC remote panel. The no load drain is less than 5mA and is used to keep the data buses connected to the remote panels active

6.2.6 Equalize mode



WARNING

Incorrect use of the equalize mode may lead to hazardous situations



WARNING

Equalization is ONLY applicable for wet type batteries and will damage gel and AGM type batteries..



WARNING

Do not smoke; use any naked flame or other sources of ignition due to risk of explosion. Always ventilate the room were the batteries are located and equalized to clear the air..

The equalizing mode can only be started when the Mass Combi is in operation. This means that the connection compartment of the Mass Combi must be opened while connected to the mains and the batteries. Take adequate measures for protection against short circuits and electrical shocks.

During equalizing the batteries are brought into the gas state and is it possible that the permitted load voltages are exceeded. See section 9.5 for characteristics. Therefore appropriate measures must be taken, e.g. disconnect all loads from the battery and ventilate the room. For these reasons use of the equalizing mode should only be executed by trained technical engineers.

An equalizing charge can be necessary after very deep discharges and/or inadequate charges. This has to be carried out according to the specifications of the manufacturer of the batteries.

| If you want... | DIP switch B SW8 |
|----------------------------|------------------|
| To start the equalize mode | Off-On-Off pulse |

7 START-UP AFTER INSTALLATION

7.1 COMMISSIONING

**CAUTION!**

Check the polarity of all wiring before commissioning: positive connected to positive (red cables), negative connected to negative (black cables).

**NOTE:**

The DIP-switches must be adjusted prior to commissioning; see chapter 6

Follow the steps described below to switch on the Mass Combi.

- 1 Tighten all cable glands to ensure the pull relief
- 2 Check all wiring and connections
- 3 If all wiring is OK, Close the front cover plate of the connection compartment of the Mass Combi. Beware that the wiring does not obstruct the cooling fans and air flow.
- 4 Place the DC-fuse(s) of the DC-distribution to connect the batteries to the Mass Combi.

**WARNING**

When placing this fuse, a spark can occur, caused by the capacitors used in the Mass Combi. This is particularly dangerous in places with insufficient ventilation, due to the gassing of the batteries an explosion can occur and avoid having flammable materials close by.

Now the Mass Combi is ready for operation.

7.2 DECOMMISSIONING

If it is necessary to put the Mass Combi out of operation, follow the instructions in order of succession as described below:

- 1 Move the Main-switch of the Mass Combi to the "Off"-position (see figure 15).
- 2 Remove the DC-fuse(s) of the DC-distribution and/or disconnect the batteries.
- 3 Remove the AC-fuse(s) of the AC-input and/or disconnect the AC-mains.
- 4 Open the connection compartment of the Mass Combi (see section 5.5)
- 5 Check with a suitable voltage meter whether the inputs and the outputs of the Mass Combi are voltage free.
- 6 Disconnect all the wiring

Now the Mass Combi can be demounted in a safe way.

7.3 STORAGE AND TRANSPORTATION

When not installed, store the Mass Combi in the original packing, in a dry and dust free environment.

Always use the original packing for transportation. Contact your local Mastervolt Service Centre for further details if you want to return the apparatus for repair.

7.4 RE-INSTALLATION

To reinstall the Mass Combi, follow the instructions as described in chapter 5.

8 TROUBLE SHOOTING

8.1 FAULT INDICATORS

If a failure occurs, the origin of the failure is displayed by means of the LEDs at the front of the Mass Combi.

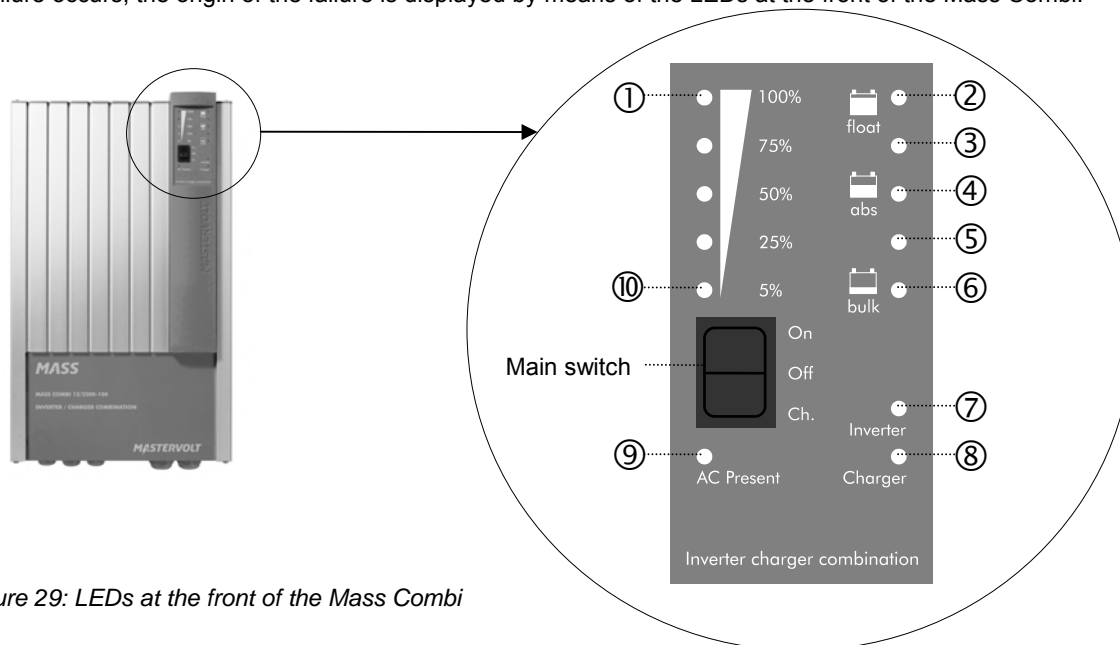


Figure 29: LEDs at the front of the Mass Combi

| Mode | Illuminating LEDs | Explanation / Possible cause | What to do |
|---------|---|--|--|
| -- | None | The Mass Combi is switched off manually. | Switch on the Mass Combi by means of the On/Off/Ch. –switch. Also check the on/off switch of the ICC remote panel |
| | | DC-fuse is blown | Investigate the cause of the failure and replace the fuse. |
| | 9 = solid green, all other LED's = off | External AC is present, but the Mass Combi is switched off by means of a remote panel | Switch on the Mass Combi by means of the remote panel |
| | 7 = solid green 8 = flashing fast red 9 = flashing fast green | Thermal fuse is blown. | Reset the thermal fuse. See section 4.3.1. |
| | 7 = solid green 9 = flashing fast green | Insufficient quality of AC-in (Shore or Generator) | Check AC wiring (Too thin and/or too long cables) Check the generator (if applied), or change setting for Power Quality at incoming AC (see section 6.2.4). |
| | 7 = solid red 9 = solid green | AC-in from Shore or Generator connected to the Short Break output. | Disconnect the AC-in cable from the Short break output. |
| | 7 = solid green 9 = solid green | Power support mode or Generator / Mains support mode active | No error |
| Charger | 2 = solid yellow 8 = solid red | Temperature Compensation (TC) error. Battery temperature too high or the temperature sensor on the battery gives an incorrect value. | Disconnect the sensor and if the LED's go off then replace the battery temperature sensor. |
| | 3 = solid yellow 8 = solid red | DC voltage error. The battery voltage is too high or too low. | Check the batteries. |

| Mode | Illuminating LEDs | Explanation / Possible cause | What to do |
|----------|--|---|---|
| | 4 = solid yellow 8 = solid red | Short circuit error. The battery voltage is far too low. The charger reduces the output current till 25% of the maximum output current. | Check the batteries and the wiring. |
| | 5 = solid yellow 8 = solid red | Overheating error. The charger current is reduced to zero in case of extreme overheating until the Mass Combi is cooled down. | Check whether the air flow of the Mass combi is blocked or whether the ambient temperature is too high. |
| | 2,3,4,5,6 = blinking yellow, 8,9 = solid green | Equalizing mode is activated | See section 6.2.6 |
| | 2 = blinking yellow 3,4,5,6 = solid yellow 8,9 = solid green | Charger runs a compensation cycle for self discharge of the batteries | Nothing. See figure 36 for charging characteristics |
| Inverter | 1 = solid yellow 7 = solid red | Overload error. The inverter is overloaded. | Reduce the connected load by switching off some equipment. |
| | 3 = solid yellow 7 = solid red | DC voltage error. The battery voltage is too high or too low. | Check the batteries and the wiring. |
| | 4 = solid yellow 7 = solid red | The inverter output voltage is less than 180V AC. | Reduce the connected load. |
| | 5 = solid yellow 7 = solid red | Overheating error. The inverter is off because of high temperature. | Reduce the connected load and let the Mass Combi cool down. |
| | 7 = flashing red | The inverter is permanently off until a manual reset by means of the main switch. | Disconnect all loads and restart the Mass Combi by switching the unit manually off and on with the main switch. |
| | 6 = flashing yellow 7 = solid green | The battery voltage is running too low, but the inverter is still on. | Check the batteries. The inverter will switch off if the battery voltage stays low |
| | 3,4,5,6 = solid yellow 7 = solid green | The battery voltage is running too high, but the inverter is still on. | Check the DC-input voltage. The inverter will switch off if the battery voltage rises too high |
| | | 2 = flashing yellow | |

Table 4: Failure codes of the Mass Combi.

If you cannot solve a problem with the aid of this table, contact your local Mastervolt Service Centre. See www.mastervolt.com. Make sure you have the following information present if you have to contact your local Mastervolt Service Center to solve a problem:

Article and serial number (See section 1.6)
Software version (See section 8.2)

8.2 SOFTWARE VERSION

The version of the installed software can be derived from the illuminating LED's on the front panel during start-up. The LED's at the left hand side represent the software version of the electronics at the AC side, while the LED's at the right hand side represent the software version of the DC side of the combi.

Proceed as follows:

- Set the main switch of the Mass Combi to the "On"-position.
- All indicators are illuminated for a second.
- Then the LED's are showing the version number of the software by flashing. Flashing one time stands for 1, flashing two times stands for 2, and so on. See example below. Here the software version of the of the electronics at the AC side is 2.05; the software version of the DC side is 1.32:
- After showing the installed software versions the Mass Combi will switch on.

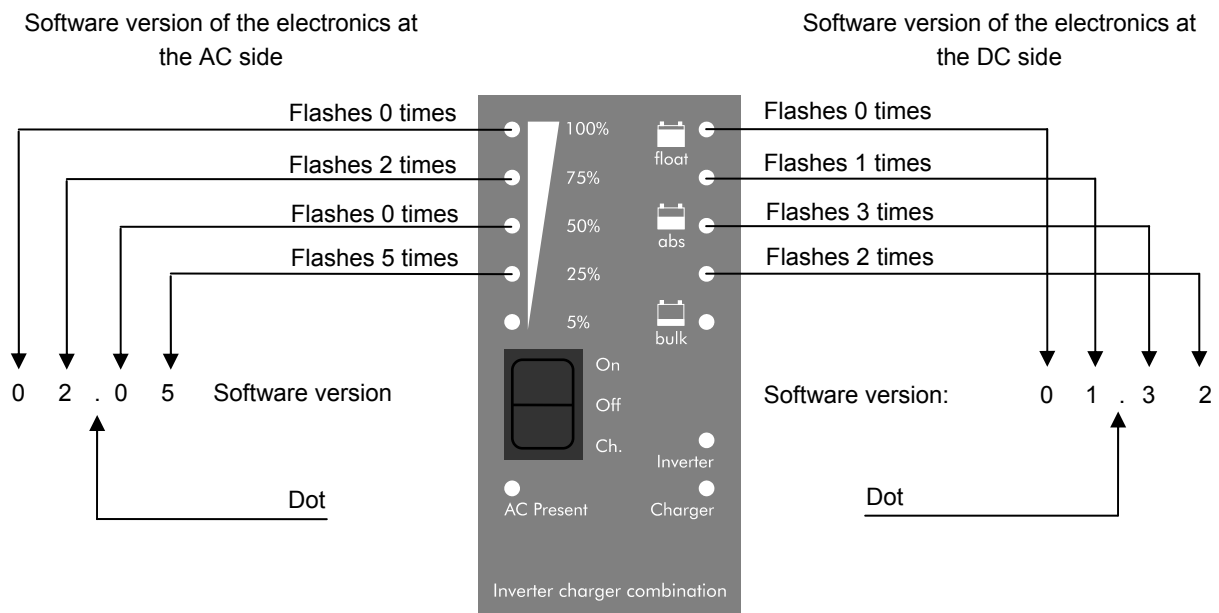


Figure 30: Representation of the software versions of the Mass Combi

9 TECHNICAL DATA

9.1 SPECIFICATIONS INVERTER

| Model Mass Combi | 12/1600-60 | 12/2200-100 | 24/1800-35 | 24/2600-60 |
|--|--|----------------------------|----------------------------|--|
| Part number | 36011600 | 36012200 | 36021800 | 36022600 |
| DC input | | | | |
| Nominal battery voltage | 12V | 12V | 24V | 24V |
| Operating input voltage range | 10.0 – 15.0V | 10.0 – 15.0V | 19.0 – 31.0V | 19.0 – 31.0V |
| Absolute maximum voltage range (No defects) | 0.0 – 16.0V | 0.0 – 16.0V | 0.0 – 32.0 V | 0.0 – 32.0 V |
| Low battery switch off* (1-30 sec delay) | 10.0V ±5% | 10.0V ±5% | 19.0V ±5% | 19.0V ±5% |
| Low battery switch on* | 11.0V ±5% | 11.0V ±5% | 22.0V ±5% | 22.0V ±5% |
| High battery switch off* (No delay) | 15.0V ±5% | 15.0V ±5% | 31.0V ±5% | 31.0V ±5% |
| High battery switch on* | 14.5V ±5% | 14.5V ±5% | 29.5V ±5% | 29.5V ±5% |
| Max. ripple allowed on DC (No defects) | 5 % RMS | 5 % RMS | 5 % RMS | 5 % RMS |
| Nominal current at full load | 160A | 220A | 90A | 130A |
| Maximum peak current | 240A | 400A | 120A | 200A |
| Recommended Fuse | 175A | 250A | 100A | 160A |
| Wire size (up to 2m/6ft) | 50mm ² / AWG0 | 70mm ² / AWG2/0 | 35mm ² / AWG2 | 50mm ² / AWG0 |
| Recommended batteries | >160Ah | >240Ah | >85Ah | >140Ah |
| DC No load power consumption | | | | |
| Off mode | 0mA | 0mA | 0mA | 0mA |
| High power mode 230V / 0A out | < 9W | < 9W | < 9W | < 9W |
| Economic mode, 208V / 0A out | < 8W | < 8W | < 8W | < 8W |
| Idle mode, 5 pulses per 2½ sec | < 0,5W | < 0,5W | < 0,5W | < 0,5W |
| AC output | | | | |
| Inverter output voltage (± 5 %) | 230V@I _{AC} ≤7.0A | 230V@I _{AC} ≤9.6A | 230V@I _{AC} ≤7.8A | 230V@I _{AC} ≤11.3A 200V@I _{AC} =10.9A |
| Wave form | True sine wave, max 5% distortion, 2½% typical | | | |
| Frequency | 50Hz/60Hz +/- 0.05% (adjustable by DIP switch) | | | |
| Maximum output power (AC-out: 230V, resistive load) | | | | |
| Cont. power inverter @T _{amb} = 25°C, cos phi = 1 | 1600W | 2150W | 1800W | 2550W |
| Cont. power inverter @T _{amb} = 40°C, cos phi = 1 | 1200W | 1800W | 1400W | 2000W |
| Surge capability (5 sec, resistive load) | 3000W | 4000W | 3000W | 4000W |
| Output power vs. ambient temperature | >25°C / 77°F derating –1.5% per °C / –2.7% per °F, Shutdown at 80°C / 176°F internal temperature. | | | |
| Efficiency (100VA up to Cont. power inverter @T _{amb} = 25°C, cos phi = 1) | ≥90% | ≥90% | ≥90% | ≥90% |
| Load power factor range | All power factors allowed | | | |
| Protections | Over temperature, overload, short circuit, AC on output, high battery, low battery. | | | |

* Adjustable by means of MasterAdjust software

9.2 SPECIFICATIONS CHARGER

| Model Mass Combi | 12/1600-60 | 12/2200-100 | 24/1800-35 | 24/2600-60 |
|-------------------------------------|-----------------------------|--------------------|-------------------|-------------------|
| AC input | | | | |
| Nominal voltage / frequency | 230V 50/60Hz | 230V 50/60Hz | 230V 50/60Hz | 230V 50/60Hz |
| Input voltage, 100 % output | 207 ... 265VAC | 207 ... 265VAC | 207 ... 265VAC | 207 ... 265VAC |
| Input voltage, reduced output power | 180 ... 207VAC | 180 ... 207VAC | 180 ... 207VAC | 180 ... 207VAC |
| Absolute maximum voltage range | 0 ... 265VAC | 0 ... 265VAC | 0 ... 265VAC | 0 ... 265VAC |
| Input frequency range | 45 ... 65Hz | 45 ... 65Hz | 45 ... 65Hz | 45 ... 65Hz |
| Absolute maximum frequency range | 0 ... 70Hz | 0 ... 70Hz | 0 ... 70Hz | 0 ... 70Hz |
| Nominal input current (@230V) | 4.5 A | 7.2 A | 5.2 A | 8.5 A |
| Input phase | Single phase, 3 wire system | | | |
| Insulation class | Class I | Class I | Class I | Class I |
| Power factor | > 0,98 | > 0,98 | > 0,98 | > 0,98 |
| Harmonic distortion THD | 3% | 3% | 3% | 3% |
| Efficiency at full output | > 85% | > 85% | > 85% | > 85% |
| No-load power consumption | < 15W | < 15W | < 15W | < 15W |

| Model Mass Combi | 12/1600-60 | 12/2200-100 | 24/1800-35 | 24/2600-60 |
|---|--|-----------------------------------|---------------------------------|---------------------------------|
| DC output | | | | |
| Nominal output voltage | 12VDC (0...15.5VDC)* | 12VDC (0...15.5VDC)* | 24VDC (0...31.0VDC)* | 24VDC (0...31.0VDC)* |
| Max. charge current @T _{amb} = 25°C | 60A @V _{DC} ≤ 14.25V | 100A @V _{DC} ≤ 14.25V | 35A @V _{DC} ≤ 28.5V | 60A @V _{DC} ≤ 28.5V |
| Max. charge current @T _{amb} = 40°C | 50A @V _{DC} ≤ 14.25V | 65A @V _{DC} ≤ 14.25V | 30A @V _{DC} ≤ 28.5V | 45A @V _{DC} ≤ 28.5V |
| Second charge output: | 5A | 5A | 5A | 5A |
| Charge characteristic | Three-step plus, fully automatic, IUoUo, Equalize | | | |
| Battery voltage sense | Automatic voltage compensation | | | |
| Protections | Short circuit (current is reduced to 25% of I-max) | | | |
| Equalize mode, max. output current: | 4A | 10A | 3A | 6A |
| Equalize mode, max. output voltage: | 15,5VDC | 15,5VDC | 31.0VDC | 31.0VDC |
| Equalize mode, maximum duration: | 6 hrs. | 6 hrs. | 6 hrs. | 6 hrs. |

| Model Mass Combi | 12/1600-60 | 12/2200-100 | 24/1800-35 | 24/2600-60 |
|----------------------------------|------------------------------|--------------------|------------------------------|-------------------|
| Factory settings | | | | |
| Return Amps* | 6% of maximum output current | | 6% of maximum output current | |
| Max bulk, abs timer* | 6 hours | 6 hours | 6 hours | 6 hours |
| Return amps timer* | 15 minutes | 15 minutes | 15 minutes | 15 minutes |
| Return to bulk voltage* | 12.80V | 12.80V | 25.60V | 25.60V |
| Return to bulk delay time* | 30 seconds | 30 seconds | 30 seconds | 30 seconds |
| Battery temperature compensation | -30mV per °C / -17mV per °F | | -60mV per °C / -33mV per °F | |

| Battery types | Flooded | Gel AGM/ Spiral | Traction ** |
|--|-----------------|------------------------|--------------------|
| Bulk | 14.40V / 28.80V | 14.40V / 28.8V | 14.60V / 29.20V |
| Charge voltage Absorption* | 14.25V / 28,50V | 14.25V / 28.50V | 14.45V / 28.90V |
| Charge voltage Float* | 13.25V / 26.50V | 13.80V / 27.20V | 13.25V / 26.50V |
| Constant voltage charging (Forced float) | 13.25V / 26.50V | 13.80V / 27.20V | 13.25V / 26.50V |

* Adjustable by means of MasterAdjust software.

** Traction max ABS/BULK time + 120min.

9.3 MISCELLANEOUS

| Switch over system | |
|---|--|
| AC transfer fuse | Yes, by means of resetable fuse |
| Reverse polarity protection | None. |
| Overheat protection | Yes, derating above 80°C / 176°F on Power Heat sink |
| Type of Transfer | Automatic |
| Type of Switch | 2 pole relay |
| Continuous rating | 25A @ 230V |
| Transfer speed | 25ms max, 10ms typical |
| Inverter synchronized to line before transfer | Yes. |
| Transfer (interruptible free) | Half seamless. |
| Power sharing mode | Yes, adjustable via DIP-switches, see section 6.2, or via the remote APC (section 3.5.2). |
| Ground relay | Ground relay included for connection of neutral of inverter to ground only at inverter mode. Standard disabled. See section 6.1.5 to enable. |
| AC cable size IN & OUTPUT | 2,5mm ² – 6 mm ² (Depending on your electrical installation) |
| Battery connections | Bolt M8 (13mm diameter). |
| Slave charger output 5 amps | Faston, is switched off in inverter mode |

| Model Mass Combi | 12/1600-60 | 12/2200-100 | 24/1800-35 | 24/2600-60 |
|---|---|---------------|---------------|---------------|
| Environmental Specifications | | | | |
| Max dimensions*** (HxWxD) in mm | 371x318x143 | 496x318x156 | 371x318x143 | 496x318x156 |
| Max dimensions*** (HxWxD) in inch | 14.6x12.5x5.6 | 19.5x12.5x6.0 | 14.6x12.5x5.6 | 19.5x12.5x6.0 |
| Weight (kg / lbs) | 7.8kg / 17lbs | 11kg / 24lbs | 7.8kg / 17lbs | 11kg / 24lbs |
| Operating temperature range | 0°C to 25 °C / 32 to 77°F | | | |
| SPECIFIED, will meet specified tolerances. | 0°C to 25 °C / 32 to 77°F | | | |
| ALLOWED, may not meet specified tolerances. | -25°C to 60°C / -13 to 140°F | | | |
| NON-OPERATING, storage. | -25°C to 85°C / -13 to 185°F | | | |
| Humidity | Max 95% relative humidity, not condensing. | | | |
| Environment class | IP 23 | | | |
| Cooling | Mix of conventional and forced air cooling, by DC fans with variable speed. | | | |
| Fan operation | The fan does operate on a temperature and load control related PWM variable speed control. DC maintenance free fan. | | | |

*** See also section 9.4

9.4 DIMENSIONS

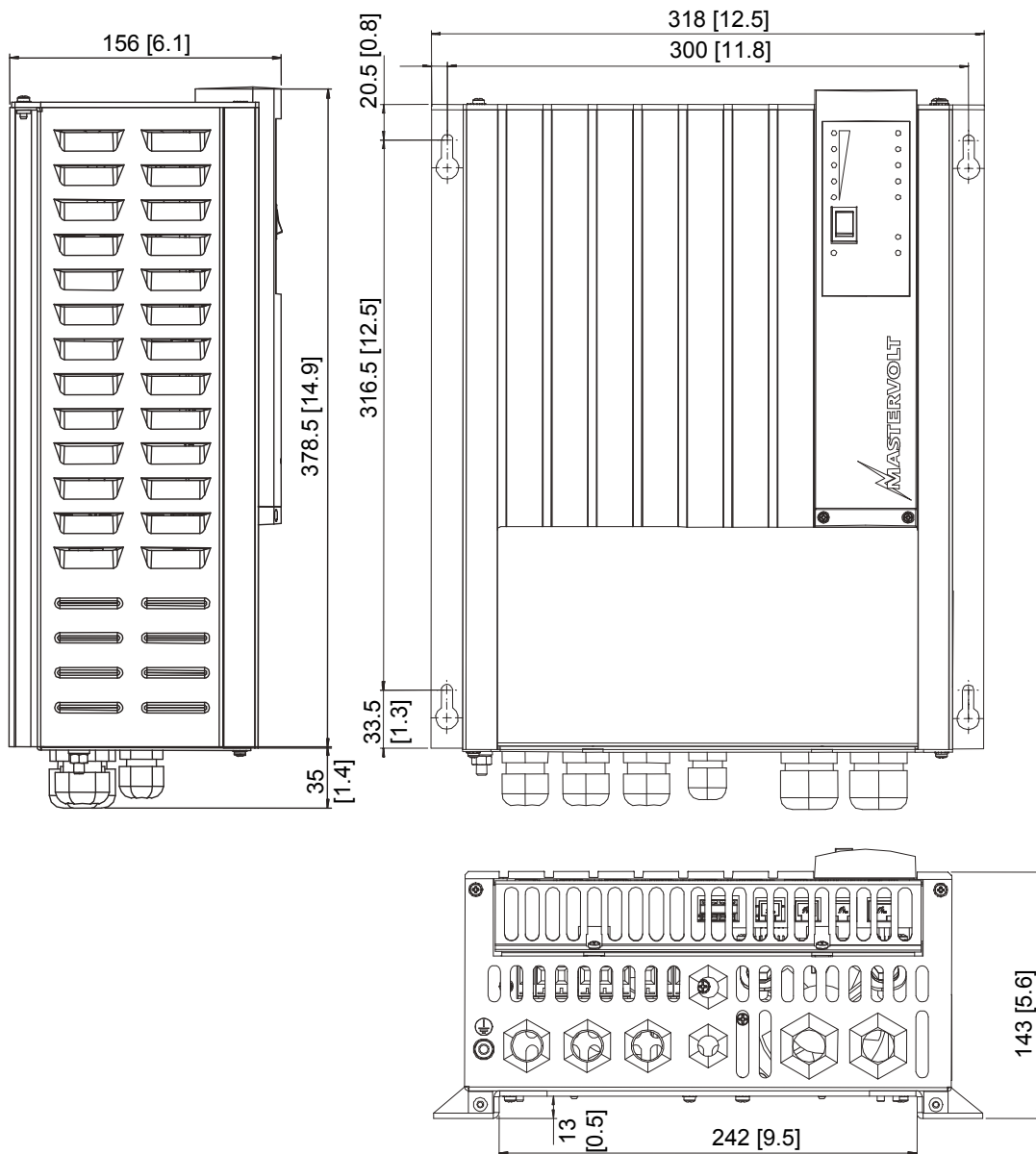


Figure 31: Dimensions in mm [inch] of the Mass Combi 12/1600-60 and 24/1800-35

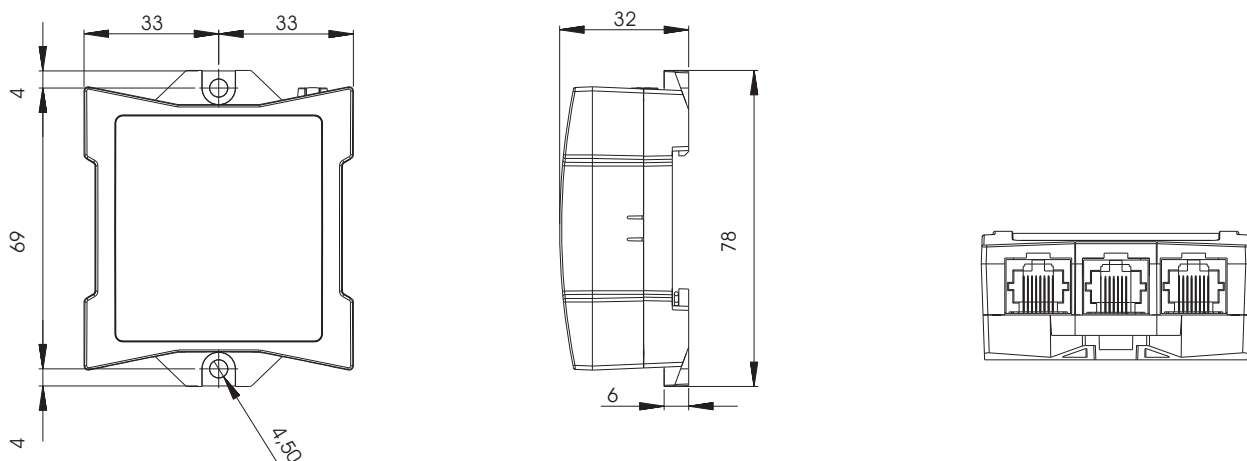


Figure 32: Dimensions in mm of the MasterBus – Combi interface

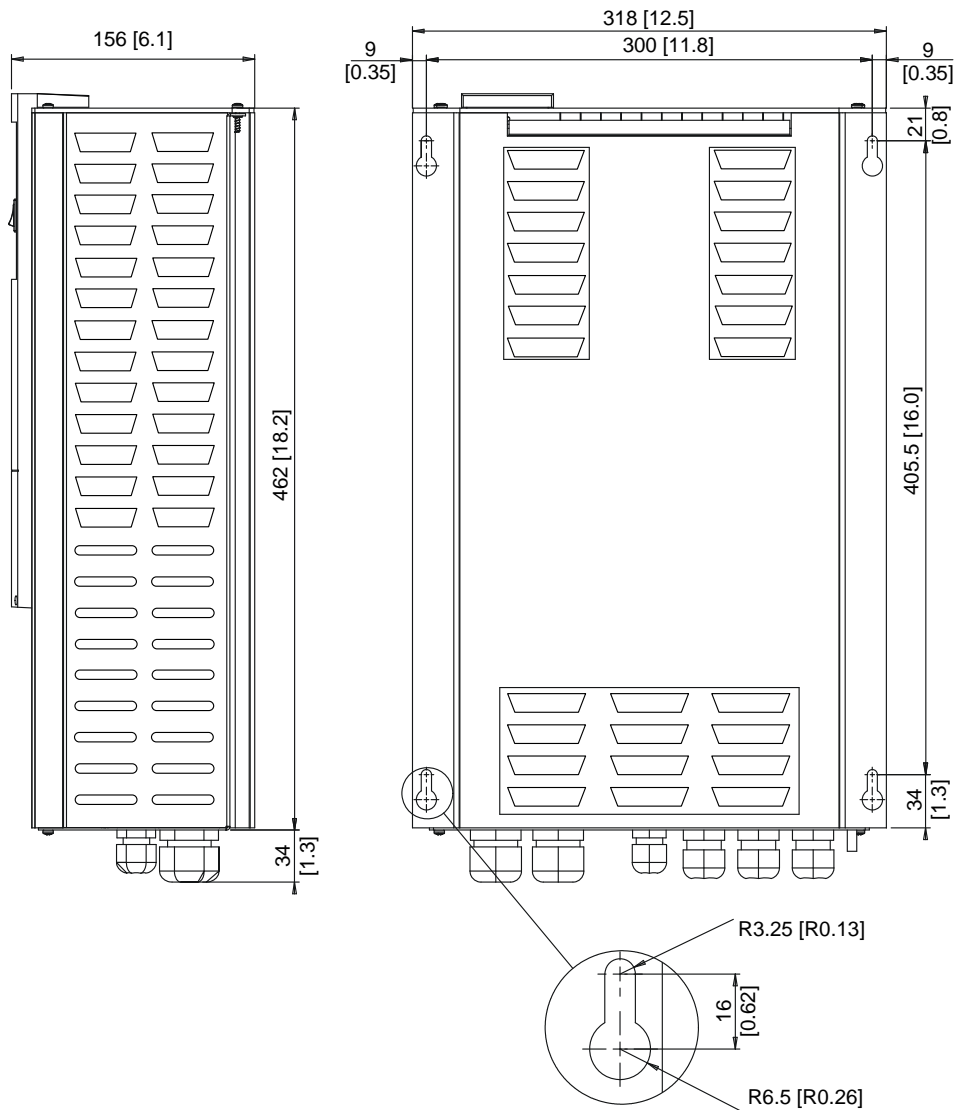


Figure 33: Dimensions in mm [inch] of the Mass Combi 12/2200-100 and 24/2600-60

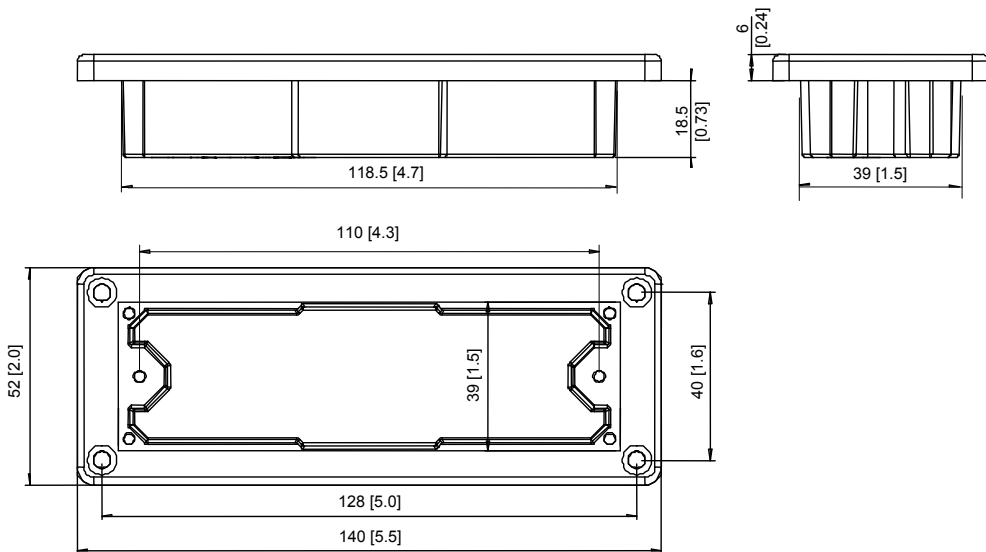


Figure 34: Dimensions in mm [inch] of the mounting box of the ICC remote panel and the APC remote panel

9.5 CHARACTERISTICS

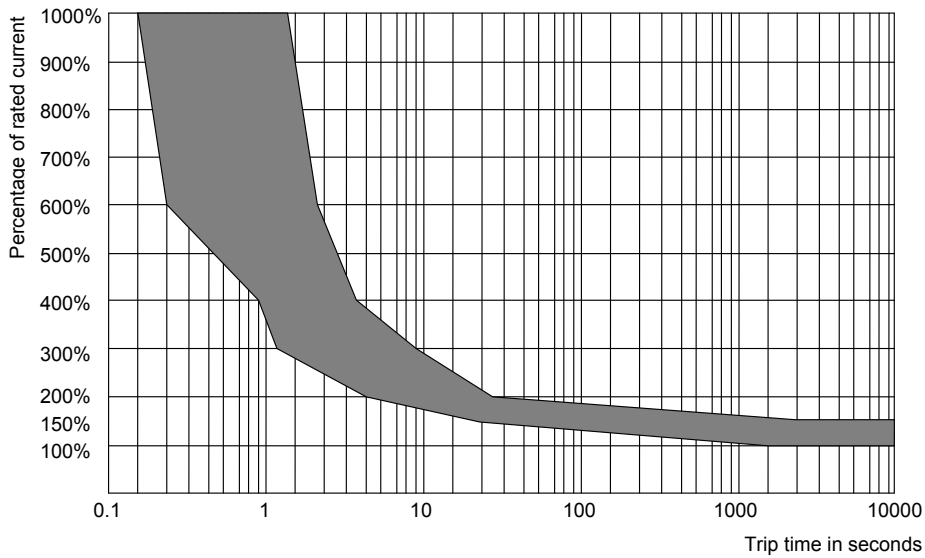


Figure 35: Switch off characteristic of the internal thermal fuse (@ 25°C / 77°F)

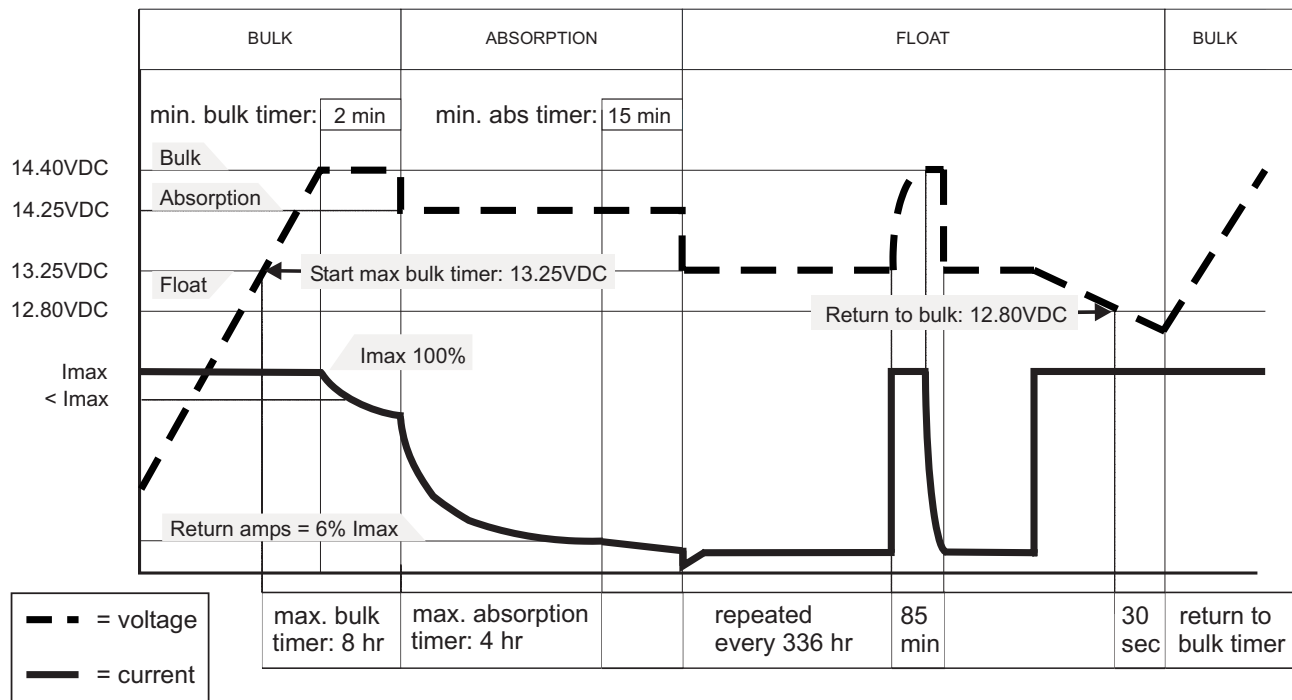


Figure 36: Charge characteristic of the three-step Plus charging method for the 12V combi (@ 25°C / 77°F)

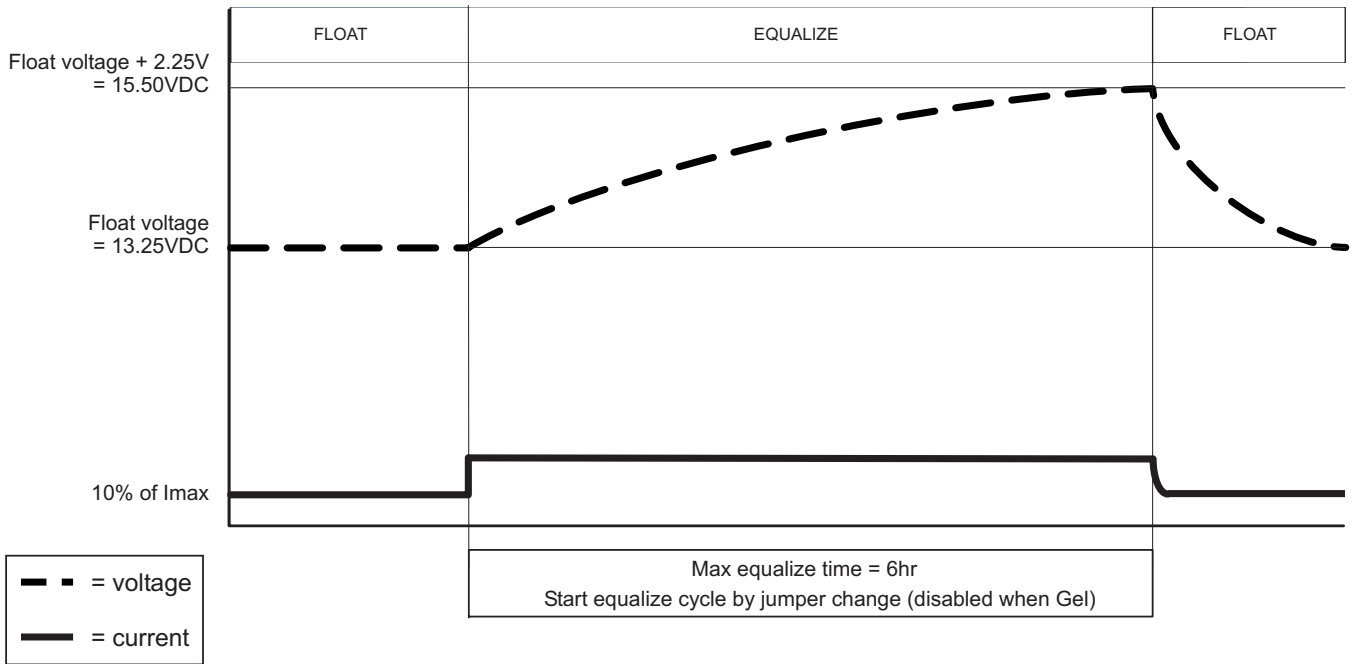


Figure 37: Charge characteristic of the equalize charge cycle, 12V Combi (see section 6.2.6) (@ 25°C / 77°F)

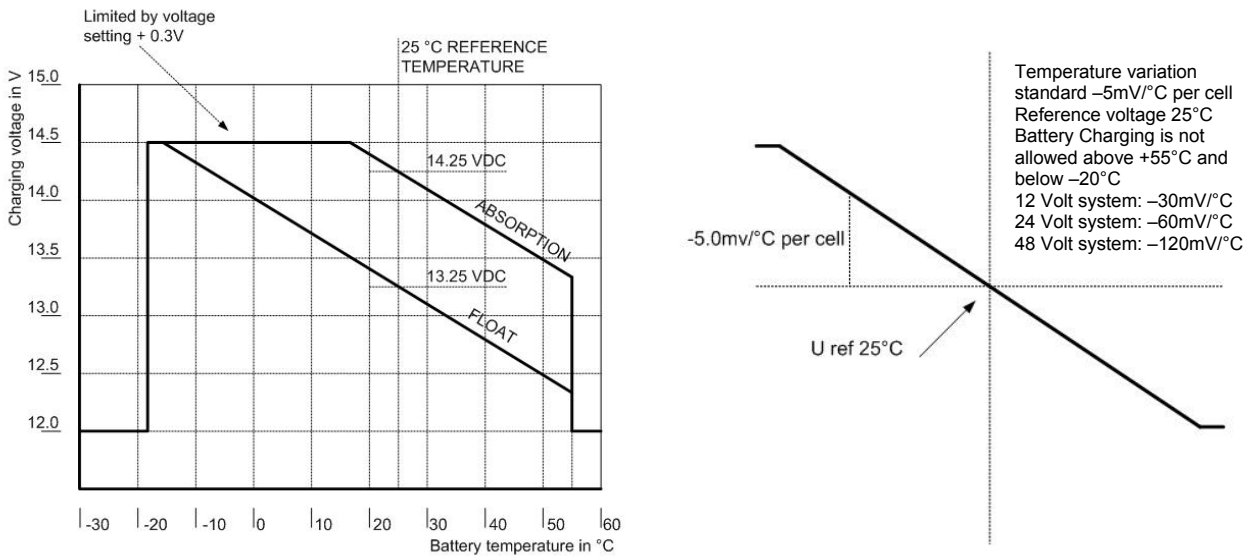


Figure 38: Temperature compensation characteristic (charge voltage versus temperature)

10 ORDERING INFORMATION

| Part number | Description |
|-------------|--|
| 6502001030 | Modular communication cable for connection of remote panels, cross wired, 6 pole, 6 meter / 19 ft |
| 6502100100 | Modular communication cable for connection of remote panels, cross wired, 6 pole, 10 meter / 33 ft |
| 6502100150 | Modular communication cable for connection of remote panels, cross wired, 6 pole, 15 meter / 49 ft |
| 130010905 | Modular communication cable for parallel operation, cross wired, 8 pole, 1 meter / 3 ft |
| 130010906 | Modular communication cable for parallel operation, cross wired, 8 pole, 5 meter / 16 ft |
| 130010910 | Modular communication cable for parallel operation, cross wired, 8 pole, 10 meter / 33 ft |
| 130010915 | Modular communication cable for parallel operation, cross wired, 8 pole, 15 meter / 49 ft |
| 41500500* | Battery temperature sensor, incl. 6 meter / 19 ft cable |
| 41500800 | Battery temperature sensor, incl. 15 meter / 49 ft cable |
| 70405000** | Inverter Charger Control (Remote ICC), See section 3.5.1 |
| 70405010** | AC Power Control Panel (Remote APC) for 230VAC installations, See section 3.5.2 |
| 70403080 | Masterlink MICC, remote control panel for Mass Combi. Features: On/Off, status read out, Power sharing setting, extended battery monitoring functions See section 3.5.3 |
| 77030475** | MasterBus – Combi interface, see section 3.5.4 |
| 77040000 | MasterBus terminating device |
| 77040020 | MasterBus connection cable (UTP patch cable), 0,2m / 0.6ft |
| 77040050 | MasterBus connection cable (UTP patch cable), 0,5m / 1.6ft |
| 77040100 | MasterBus connection cable (UTP patch cable), 1,0m / 3.3ft |
| 77040300 | MasterBus connection cable (UTP patch cable), 3,0m / 10ft |
| 77040600 | MasterBus connection cable (UTP patch cable), 6,0m / 20ft |
| 77041000 | MasterBus connection cable (UTP patch cable), 10m / 33ft |
| 77041500 | MasterBus connection cable (UTP patch cable), 15m / 49ft |
| 77042500 | MasterBus connection cable (UTP patch cable), 25m / 82ft |
| 77050100 | 100m / 330ft MasterBus cable (UTP cable) |
| 77050200 | 50 pcs. modular jacks |
| 77050000 | Complete set to assemble UTP patch cables. Delivery includes: 100m / 330ft UTP cable, 50 pcs. modular jacks and crimping tool |
| 77030100 | MasterBus – USB interface, required as interface between your PC and the MasterBus when using MasterAdjust software. |
| 77010305 | MasterView Easy, Touch screen to control and monitor all MasterBus products |
| 77010400 | MasterView System, Full-colour touch screen to control and monitor all MasterBus products |
| 701 | Battery switch 275A |
| 77049100 | ANL Fuse 100A |
| 77049160 | ANL Fuse 160A |
| 77049175 | ANL Fuse 175A |
| 77049250 | ANL Fuse 250A |
| 607006 | ANL Fuse base |
| 77020100 | MasterShunt 500, DC-distribution module for exact readout of battery voltage, charge / discharge current, and state of charge. Continuous rating: 250A, peak current: 500A |
| 77020200 | DC-Distribution 500. The Mastervolt DC Distribution offers fused DC connections to install up to four different devices. |

* These parts are standard included with the delivery of the Mass Combi

** These parts are delivered as option with the delivery of the Mass Combi

Mastervolt can offer a wide range of products for your electrical installation, including automatic AC transfer switches, remote control panels and DC distribution kits. See our website www.mastervolt.com for an extensive overview of all our products

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THE POWER TO BE INDEPENDENT

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