

External load/energy management, eng

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A External load/energy management

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1 External load/energy management, e.g. with HEMS

1.1 Introduction

The "Energy Control" wallbox charging station is used for charging plug-In-hybrid or electric vehicles. Several "Energy Control" wallboxes can be operated on the system network. This enables the monitoring of power distribution of up to 16 wallboxes.

In the following documentation, these "Energy Control" wallboxes will simply be called wallboxes.

For external load/energy management, the wallboxes are networked with an external control system (e. g. HEMS) via a RS485 bus. The external control system takes over the management (leader) of this system and communicates with all connected wallboxes (follower). The external control system takes over the strategy for energy distribution.

This procedure enables, e.g., the incorporation of solar energy into the charging process of an electric vehicle.

HEMS Home Energy Management System

1.2 Checklist

All of the points listed below are necessary for a trouble-free installation and start-up:

- Configuration of the external control system (according to manufacturer's description),
- Specification as follower wallbox (in each wallbox),
- Setting of the bus ID (in each wallbox),
- Setting of the maximum and minimum charging current (in each wallbox),
- Wiring of the power supply and bus system, Avoid single-sided phase loading!
- Activating the bus termination (in external control system and last wallbox).

1.3 Prerequisites

In order to establish a system with external load/energy management, an external control system and at least one wallbox are required. A maximum of 16 wallboxes can be networked. The external control system is the leader and all wallboxes have to be configured as followers. A plug-in hybrid or electric vehicle can be charged on each of these wallboxes. To have a reliable power supply, the overall output of the system must be configured such that at least 6 A is available for each wallbox. Otherwise, load requests, in the event of an overload for a requested output, will be delayed until the current charging process has completed, and free capacity is available.

► **Note**
 The documentation "Safety instructions," "Installation instructions," and "Operating manual" for the "Energy Control" wallbox must be read carefully and heeded.

These documents are available online:
<https://Wallbox.heidelberg.com/>

! **Caution - Single-sided phase load**
 If in a system network of wallboxes (with load/energy management) several vehicles are charged single-phase at the same time, there can be an unfavorable current distribution among the phases. Therefore, the wallboxes must be connected with alternating phase sequence.
 First wallbox L1, L2, L3.
 Second wallbox L2, L3, L1.
 Third wallbox L3, L1, L2.
 Fourth wallbox again L1, L2, L3, etc.

1.4 Bus topology

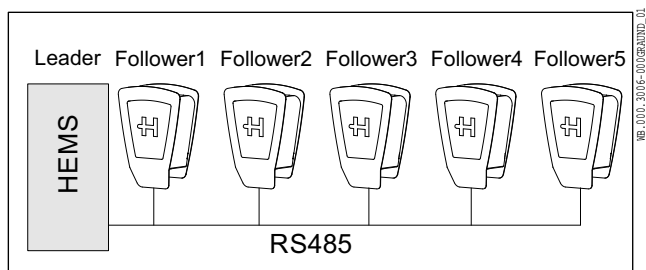


Fig. 1 Example: bus system with HEMS and 5 wallboxes.

The bus system used to connect the wallboxes is a RS485 field bus. Modbus-RTU is used as the protocol. The system consists of an external control system (e.g. HEMS), which is configured as leader, and at least one wallbox that is configured as a follower. Up to 16 wallboxes configured as followers can communicate with the external control system (leader).

The total current available is distributed by the leader across the whole system. A minimum charge current (default 6 A) and a maximum charge current (default 6 A) is preconfigured for each wallbox.

1.5 Configuration of the wallboxes

In order to operate the system network of wallboxes, the individual wallboxes must be preconfigured. This configuration is done with various rotary and microswitches.

1.5.1 S1, configuration of maximum charging current

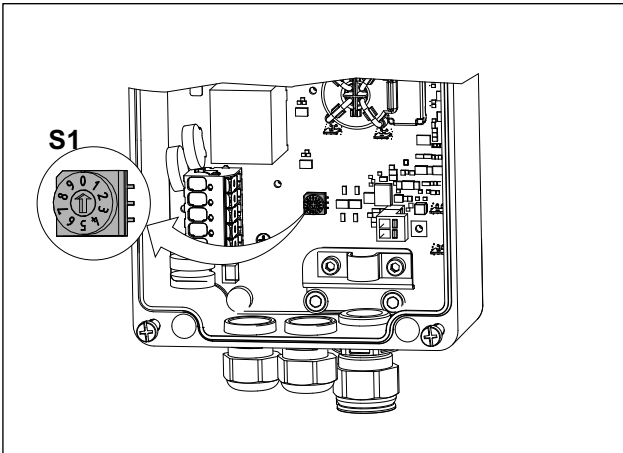


Fig. 2 Rotary switch S1

The rotary switch S1 is used to set the maximum charging current from 6 to 16 A.

0	6 A (default setting, delivery state)
1	8 A
2	10 A
3	12 A
4	14 A
5 ... 9	16 A

1.5.2 Overview of the rotary and microswitches

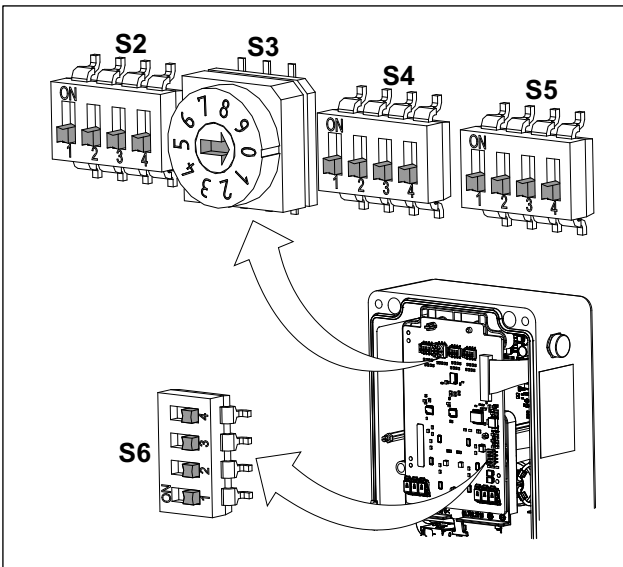


Fig. 3 All rotary and microswitches in OFF position

S2	Configuration of bus ID 16
S3	Setting for minimum charging current
S4	Configuration of bus ID 1 to 15
S5	Setting for leader or follower, front illumination
S6	Bus termination ON/OFF

1.5.3 S3, configuration of minimum charging current

With the rotary switch S3 (Fig. 3), you can set the minimum charging current from 6 to 16 A.

0	6 A (default setting, delivery state)
1	8 A
2	10 A
3	12 A
4	14 A
5 ... 9	16 A

If there is less than the set current available for the wallbox in question, no charging will take place.

1.5.4 S5, configuration as follower wallbox and setting for front illumination

The front illumination setting is made with the S5/1 microswitch (Fig. 3).

The illumination behavior only affects status messages.

Error messages always light up steadily.

This setting is only effective if a vehicle is connected.

S5/1	
ON	Front illumination lights up steadily
OFF	Front illumination goes out after 5 min.

Tab. 1

The setting as a follower wallbox is made using the S5/4 microswitch (Fig. 3).

S5/4	
ON	Leader
OFF	Follower

Tab. 2

The switches S5/2 and S5/3 are not required for all follower wallboxes. These switches must be on OFF.

1.5.5 S4, configuration of bus ID of follower wallboxes 1 to 15

The microswitches of S4 (Fig. 3) are used to assign the bus ID of the follower wallboxes from 1 to 15. To be observed:

- no duplicate bus IDs may be assigned,
- the bus ID "0" may not be used.

Bus-ID	S4/1	S4/2	S4/3	S4/4
0	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	ON
2	OFF	OFF	ON	OFF
3	OFF	OFF	ON	ON
4	OFF	ON	OFF	OFF
5	OFF	ON	OFF	ON
6	OFF	ON	ON	OFF
7	OFF	ON	ON	ON
8	ON	OFF	OFF	OFF
9	ON	OFF	OFF	ON
10	ON	OFF	ON	OFF
11	ON	OFF	ON	ON

Bus-ID	S4/1	S4/2	S4/3	S4/4
12	ON	ON	OFF	OFF
13	ON	ON	OFF	ON
14	ON	ON	ON	OFF
15	ON	ON	ON	ON

Tab. 3

1.5.6 S2, configuration of bus ID 16

Bus-ID	S2/1	S2/2	S2/3	S2/4
16	OFF	OFF	OFF	ON

Tab. 4

In the wallbox configured for bus ID 16, microswitch S4 is inoperative.

1.6 Installation of the bus system

For the cabling of the bus system, a shielded bus line (e.g. CAT6a) must be used. The total length of the field bus may not exceed 500 m. It must be ensured that the shields of the bus lines are attached securely to the shield supports provided.

The bus system can be installed in two different ways:

1.6.1 Bus system in line wiring

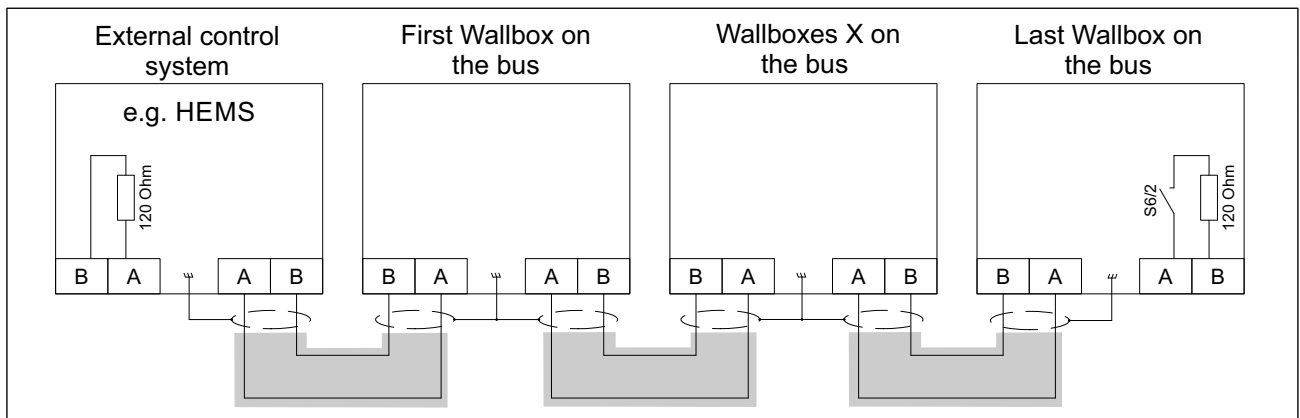


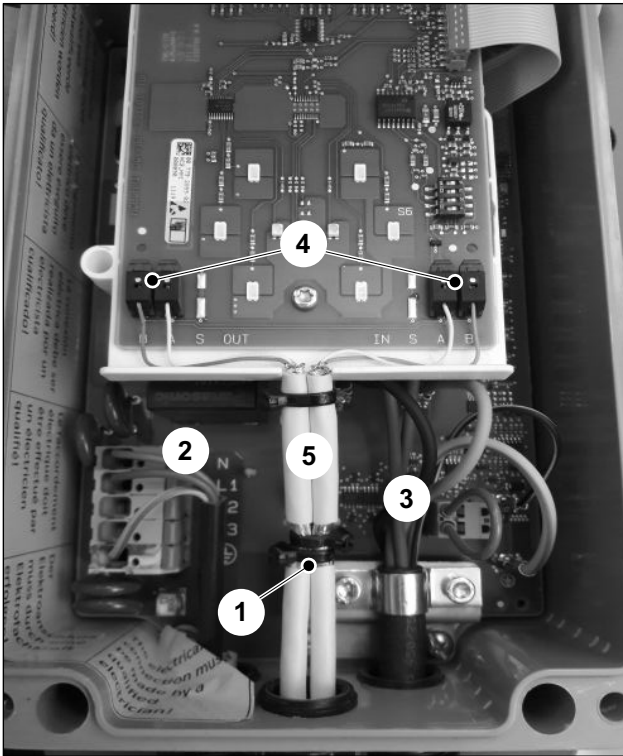
Fig. 4 Example of a line wiring

For the line wiring, the bus line is laid directly from the external control system to the first wallbox and then to the next wallbox. Only two wires are used for each bus line.

Only one bus line is connected to the external control system.

Only one bus line is connected to the last wallbox.

All other wallboxes have two bus lines routed to them (Fig. 5).



- 1 Shield support for the bus lines
- 2 Connection of power supply
- 3 Wires of the charging cable
- 4 Terminals for bus wires
- 5 Bus jacking

The individual wires of the power supply unit (Fig. 5/2) and of the charging cable (Fig. 5/3) must be laid at the greatest possible distance from the bus lines.

1. Strip approx. 7 cm insulation from the bus lines.
2. Expose the respective screen for the bus lines approx. 6 cm before the jacket end for approx. 15 mm.
3. Fasten the exposed shields to the shield support with one or two cable ties (Fig. 5/1).
4. Strip two individual wires approx. 8 mm and connect these to the appropriate terminals (Fig. 5/4).
5. Cut the single wires not used off at the jacket end.

The bus lines must be jacketed between the shield support and connection board (Fig. 5/5).

Fig. 5 Cable gland for line wiring

1.6.2 Bus system with central wiring in distributor

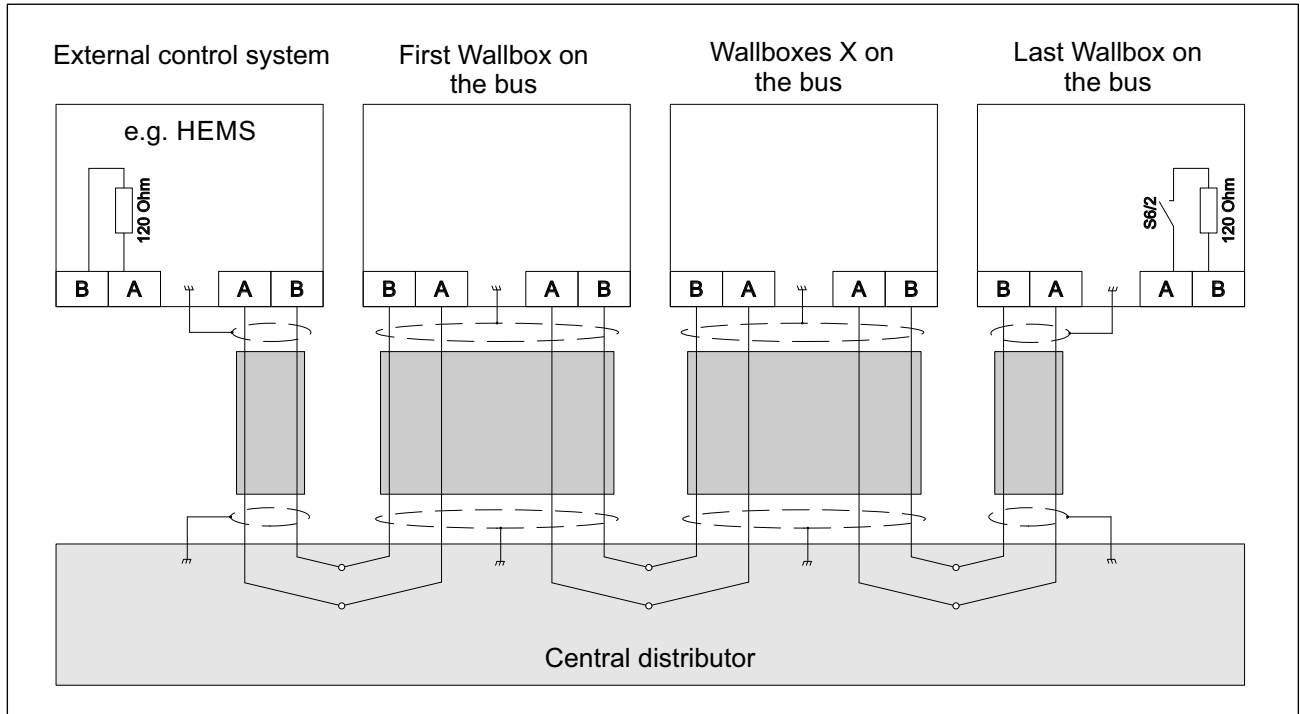
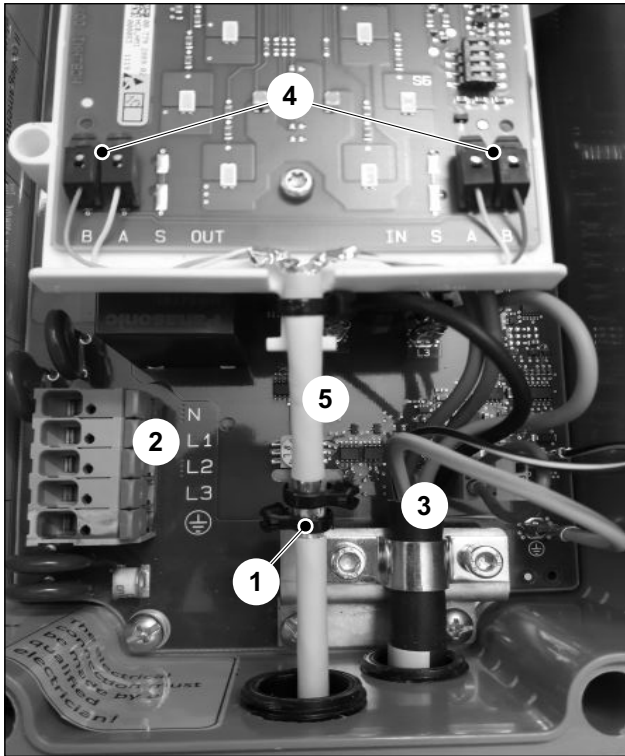


Fig. 6 Example of central wiring

For the central wiring, a bus line is routed from the external control system and each wallbox to a distributor. There, the bus lines must be wired using terminal strips.

With central wiring, four wires are used for each bus line. Exception: external control system and last wall-box in the system network. There, only two wires are used.

The shields of the individual bus lines must be connected in the central distributor.



- 1 Shield support for the bus line
- 2 Connection of power supply
- 3 Wires of the charging cable
- 4 Terminals for bus wires
- 5 Bus jacketing

The individual wires of the power supply unit (Fig. 7/2) and of the charging cable (Fig. 7/3) must be laid at the greatest possible distance from the bus line.

1. Strip approx. 7 cm insulation from the bus line.
2. Expose the shield of the bus line approx. 6 cm before the jacket end for approx. 15 mm.
3. Fasten the exposed shield to the shield support with one or two cable ties (Fig. 7/1).
4. Strip four individual wires approx. 8 mm and connect these to the appropriate terminals (Fig. 7/4).
5. Cut the single wires not used off at the jacket end.

The bus line must be jacketed between the shield support and connection board (Fig. 7/5).

Fig. 7 Cable routings for central wiring

1.6.3 S6, configuration of bus termination

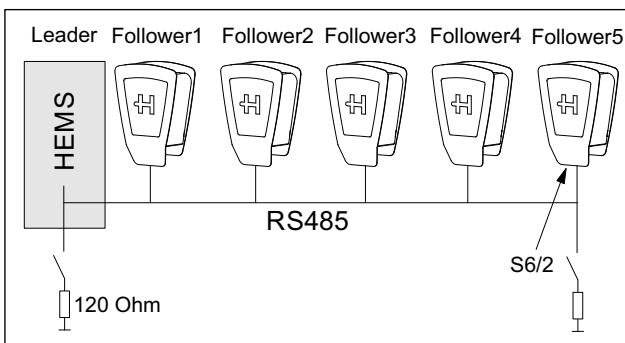


Fig. 8 Bus terminal resistors

The first and last members on the RS485 bus must have terminating resistors.

For the last follower wallbox, this is done by switching an installed terminating resistor through the microswitch S6/2 (Fig. 3).

Switches S6/1, S6/3 and S6/4 are not used. These switches must be on OFF.

When using an external control unit, the bus line must be terminated there with a 120 Ohm resistor. The manufacturer's specifications for the external control system must be heeded.

S6/2	
OFF	Bus termination inactive
ON	Bus termination active

Tab. 5

1.7 Checking load management

If all wallboxes are configured and connected properly, the load management can be started up.

► **Note**

In the process, no vehicle may be connected to any of the wallboxes.

- Establish the power supply for the external control electronics and the wallboxes beginning with the external control electronics.
- The front illumination of each wallbox then lights up for 5 min and goes out.
- The load management is now ready for operation.

1.7.1 Diagnosis of faulty communication through front illumination

In case of malfunction, e.g. faulty communication between the external control system and the follower wallbox in question, the front illumination flashes.

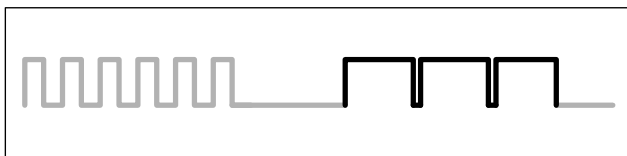


Fig. 9 Fault display

Six times flashing white, pause, three times flashing blue (90% on, 10% off), pause

This flash sequence indicates a communication error between the external control system and the follower wallbox in question.

- Check the correct execution of the bus installation.

After the fault has been eliminated and a self-test, the front illumination lights up white. The vehicle can request the charging process.

If the fault is still there, please contact the hotline.

1.7.2 Contact address/Customer Sales Representative

Hotline: +496222 82 2266

E-mail: Wallbox@heidelberg.com

1.8 Bus protocol

Communication between the external control system and the wallboxes uses the "ModBus-RTU" protocol. 10 seconds after "Power On," each individual wallbox is ready to accept a ModBus command. If the wallbox in question is in standby mode, it cannot be addressed via the ModBus.

1.8.1 ModBus connection

For the connection of the wallbox to an external control system, a RS485 bus in 2-wire design (half-duplex) is

used. The "Transmission Mode" is Modbus-RTU. The bus parameters used are:

- Baud 19200 Bit/sec,
- 8 data bits,
- 1 stop bit,
- 1 parity bit (even),
- Last significant bit sent first (LSN first).

As "Addressing Mode," only "Unicast Mode" is supported. "Broadcast Mode" is not supported.

1.8.2 Supported functions of the ModBus protocol

The wallboxes support only the following functions:

- 03 (0x03) Read Holding Register,
- 04 (0x04) Read Input Register,
- 06 (0x06) Write Holding Register,
- 16 (0x10) Write Multiple Register.

The sequence of the bytes is high byte before low byte (Motorola Format).

The sequence of the CRC check sum is low byte before high byte (Intel Format).

1.8.3 ModBus register

An overview of ModBus registers is available online at: <https://Wallbox.heidelberg.com/> with more information.

1.9 Table for checking the configurations of the follower wallboxes

In the following table, you can enter all relevant configuration/installation information.

Distribu- tor	F	L1	L2	L3	FI	Wallbox number	S1 I_{max}	S3 I_{min}	Bus-ID	S5/3 Lock	S5/4 Leader/ Follower	S6/2 Bus ter- mination
		L1	L2	L3					1	0	0	
		L2	L3	L1					2	0	0	
		L3	L1	L2					3	0	0	
		L1	L2	L3					4	0	0	
		L2	L3	L1					5	0	0	
		L3	L1	L2					6	0	0	
		L1	L2	L3					7	0	0	
		L2	L3	L1					8	0	0	
		L3	L1	L2					9	0	0	
		L1	L2	L3					10	0	0	
		L2	L3	L1					11	0	0	

Distribu- tor	F	L1	L2	L3	FI	Wallbox number	S1 I_{\max}	S3 I_{\min}	Bus-ID	S5/3 Lock	S5/4 Leader/ Follower	S6/2 Bus ter- mination
		L3	L1	L2					12	0	0	
		L1	L2	L3					13	0	0	
		L2	L3	L1					14	0	0	
		L3	L1	L2					15	0	0	
		L1	L2	L3					16	0	0	

Tab. 6