peblar ROCKSOLID CHARGERS

Load balancing with Peblar

Explanation about different load balancing strategies and options

Reference: Load_balancing_Peblar_R02

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Load balancing options

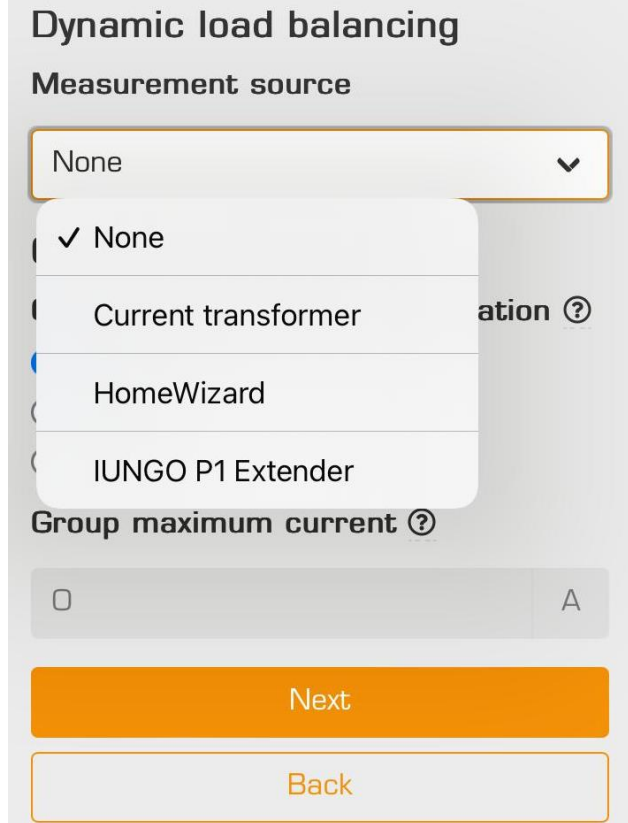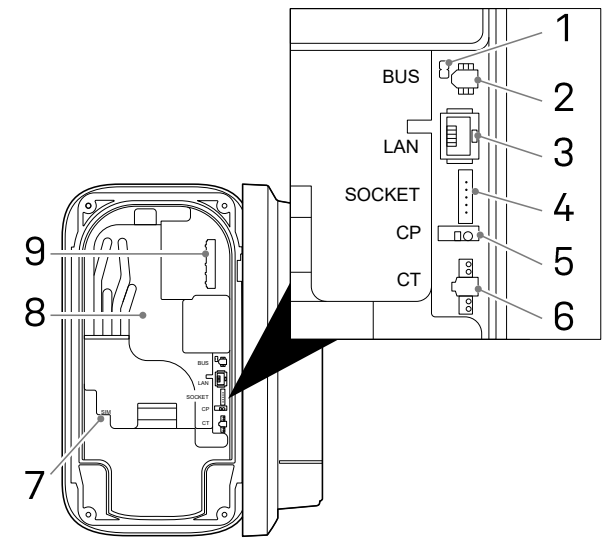There are multiple ways of performing load balancing:

1. Dynamic load balancing: ensure that the maximum household current will not be exceeded

2. Group load balancing: ensure that a group of chargers will not exceed the maximum group current

3. **(Future firmware release)** Dynamic group load balancing: combination of 1) and 2), where the input for load balancing is used to determine the setpoint for the group

1. Dynamic load balancing

- Dynamic load balancing is also called Blackout Protection at Peblar
  - Internal abbreviation is BoP

- Multiple sources can be used for load balancing:
  1. split-core CT coils (current transformer): placed around the one/three phases, and connected to the CT connector **(6)** on the mainboard of Peblar
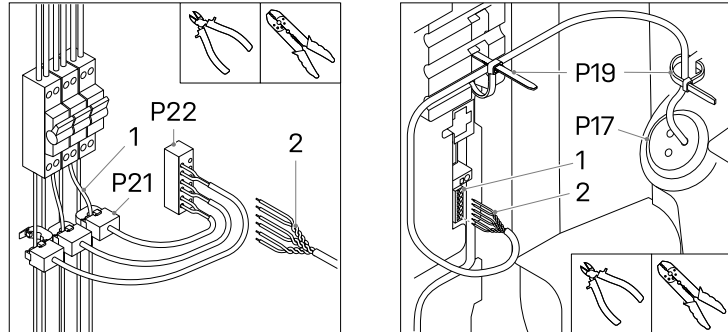
  2. HomeWizard: connected to the smart meter in your home, discovered when the Peblar is connected to the same local network (WLAN or ethernet). Does not apply for countries/fuse boxes that don't have a smart meter with commercial port
  3. IUNGO P1 extender: customer-specific, not relevant for Peblar
  4. **(Future firmware release)** Modbus TCP/IP meter: connect the meter that reads out the phase measurements to the ethernet connector **(3)** on the Peblar
  5. **(Future firmware release)** Modbus RTU meter : connect the meter that reads out the phase measurements to the RS-485 connector **(2)** on the Peblar
  6. **(Future firmware release)** a central controller uses the Modbus register or API of the Peblar to send a maximum current setpoint to the charger

Dynamic load balancing

Measurement source

None ▾

✓ None

Current transformer

HomeWizard

IUNGO P1 Extender

Group maximum current ⑦

0   A

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1. Dynamic load balancing

- Procedure during commissioning:
    1. Installer selects measurement source for dynamic load balancing. If HomeWizard or CTs are selected, they need to choose the matching/appropriate source
    2. Installer selects maximum household current

CT coils:

HomeWizard:

- Algorithm:
    - Measurement source measures the current usage per phase in the fuse box of the household
    - The Peblar calculates with how much current per phase the car is allowed to charge
    - The lowest available current of the three phases in this calculation is the current setpoint for the Peblar
    - The system can diagnose correctness of the order for the CT coils. This functionality can be turned off in the backoffice
    - **(Future Firmware release)** the installer can verify the correctness of the load balancing installation by observing the measured values of the measurement source in the web interface

1. Dynamic load balancing

Troubleshooting

- The installer/CPO can verify the correctness of the installation by:
    - Looking in the web interface/backoffice for warnings related to dynamic load balancing
    - Performing a charging session to observe expected behavior
    - **(future firmware release)** read measured current values of the measurement source in the web interface

- The charger can go to a safe fallback current when:
    - The communication with the measurement source is disrupted
    - The order of the CT coils is not matching with the prescribed order in the installation manual

- The charger can provide a lower current setpoint when:
    - The sum of the household usage plus the installation current is higher than the maximum household current
    - The EV limits the charging current (due to settings or model type)
    - The charging cable has a current limit

- The charging session is paused when:
    - The EV is full
    - The EV or backoffice pauses the charging session
    - The household usage is so high that there is no room for charging the EV (min 6A required)

- The end-user can observe in the web interface how much power per phase is being transported to the EV

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2. Group load balancing

Group load balancing can be done in multiple ways:

- Use RS-485 connector **(2)** and make a daisy chain between multiple chargers

Follower*   Follower   Leader   Follower   Follower*
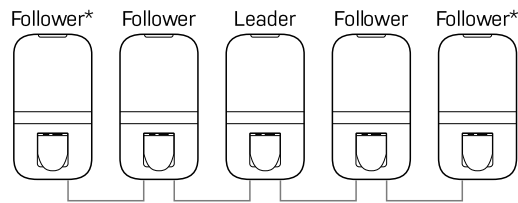
- Use OCPP protocol for this. The cloud system calculates setpoints or smart charging profiles and sends them to the chargers. The chargers will follow the maximum current setpoints of these schedules accordingly

- **(Future firmware release)** a central controller uses the Modbus register or API of the Peblar to send new maximum current setpoints to the chargers

    - In this way, a 'star-setup' is also possible, where the central controller is used to determine the setpoints for the connected chargers.

Limitations on local group load balancing using RS-485:

- Only 32 charger can be connected in one daisy chain

- Maximum length of cables for daisy chain is 1200 meter

BUS
LAN
SOCKET
CP
CT

1
2
3
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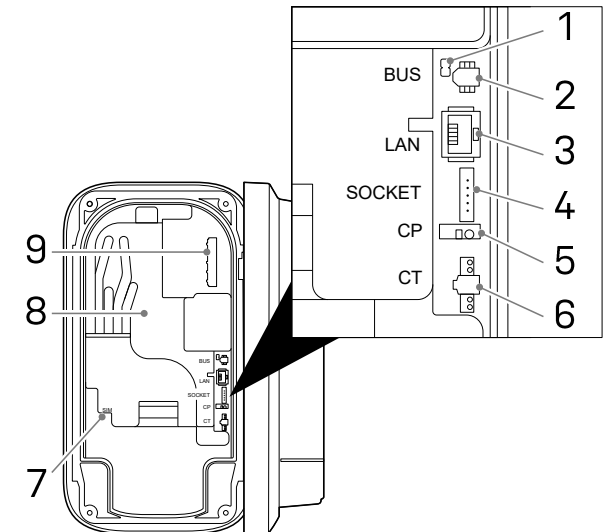
2. Group load balancing

Procedure during commissioning for local group load balancing using RS-485:

- Configure the leader first
    - Important note: only ONE leader can be present in the daisy-chain
    - Select the role as leader
    - Select the maximum group current
    - Done!

- Configure the follower afterwards:
    - Select the role as follower
    - Done!

Leader:

Group load balancing

Group load balancing configuration ⑦

○ Disabled

○ Follower

● Leader

Group maximum current ⑦

200	A

Follower:

Group load balancing

Group load balancing configuration ⑦

○ Disabled

● Follower

○ Leader

Group maximum current ⑦

0	A

2. Group load balancing

Algorithm:

- The leader will divide the available current amongst the number of chargers that are in charging state

- When a car takes less power than offered by the leader, the surplus is divided amongst the other chargers in charging state

- Phase rotation and single-phase cars are taken into account in the algorithm to ensure that no blackout can occur
    - Phase rotation = change order of L1, L2 and L3 to distribute the power more equally when single-phase cars are charging in the group

- When a follower loses connection with the leader, it only allows charging with a set fallback current

Example: 30A max in group, 16A max per charger
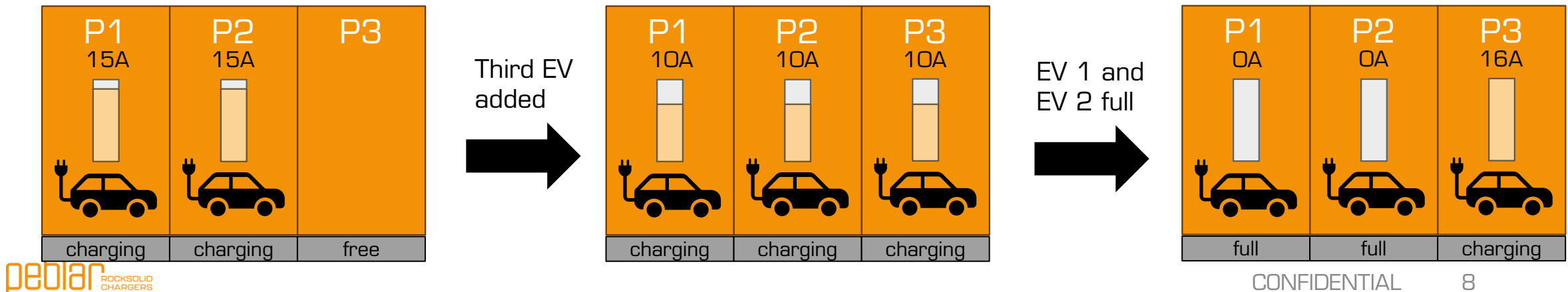
2. Group load balancing

Troubleshooting

- The installer/CPO can verify the correctness of the installation by:
    - Looking in the web interface/backoffice for warnings related to group load balancing

- The charger can go to a safe fallback current when:
    - The communication with the leader is lost

- The charging session in paused when:
    - The total current is exceeding the set maximum group current limit in commissioning
    - The battery of the EV is full
    - There is no room for a newly added EV to provide the minimum charging current (6A)
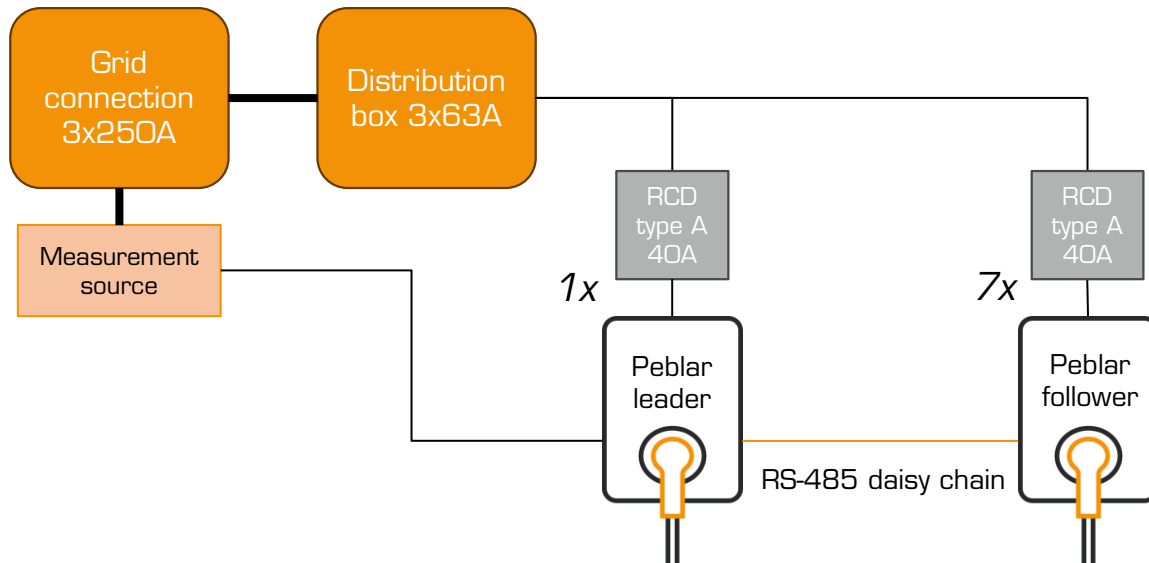
3. Dynamic group load balancing

The source for dynamic load balancing (1) is used for calculation of the facility/group max current in group load balancing (2)

Algorithm:

- Practically the same, but then with not a static setpoint for the group but a dynamic one.

- The leader determines the setpoint for the group by ensuring that both the main grid connection and the distribution box will not exceed its limit.

Example: grid connection 250A, distribution box 63A, 8 Peblars in daisy-chain

Grid connection 3x250A — Distribution box 3x63A — Measurement source — RCD type A 40A (1x) — Peblar leader — RCD type A 40A (7x) — Peblar follower — RS-485 daisy chain

Grid usage	Group usage	Action (group)	Action (Peblar)
$I_{grid} \leq 250A$	$I_{group} < 63A$	No change	No change
$I_{grid} \leq 250A$	$I_{group} = 63A$	No change	$I_{pblr} = \dfrac{I_{group}}{N}$
$I_{grid} > 250A$	$I_{group} < 63A$	$I_{group,new} = I_{group} - (I_{grid} - 250)$	$I_{pblr} = \dfrac{I_{group,new}}{N}$
$I_{grid} > 250A$	$I_{group} = 63A$	$I_{group,new} = 63 - (I_{grid} - 250)$	$I_{pblr} = \dfrac{I_{group,new}}{N}$

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