Power Module Distribution Principle

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Star Charge®

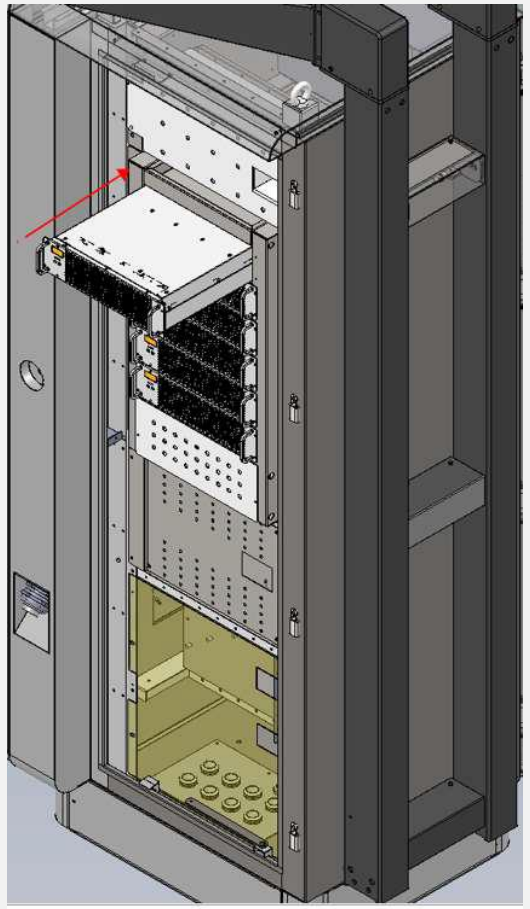
General

Some of our DC charger products has multiple charger connectors and support simultaneous charging. Since the charger is usually equipped with multiple power modules inside the charger cabinet, the charger has a control algorithm to distribute power modules to multiple connectors in case of simultaneous charging scenario. This slides describe this power distribution principle.

To simply the explanation, the Titan 180KW (equipped with 6 power module) is taken as an example.

Overview of Titan180KW

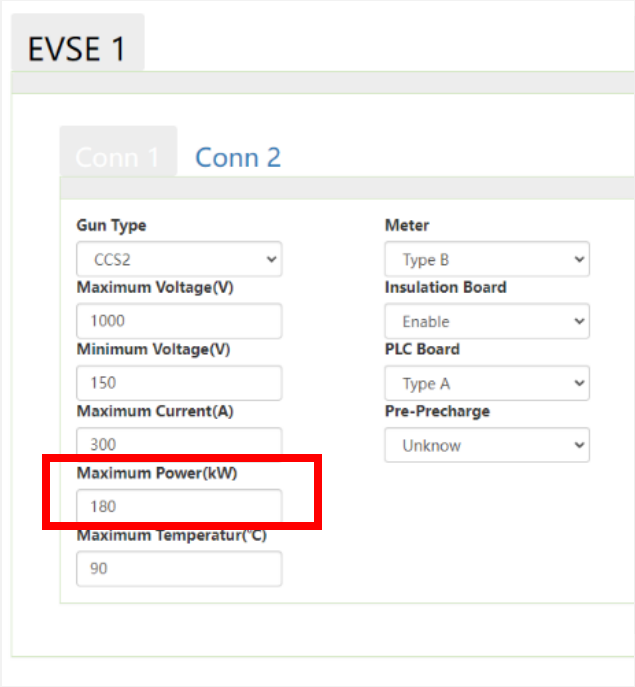
- High power factor > 95%
- Dual CCS2 connectors (each could be up to 180kW)
- Equipped with 6 power modules (each module 30kW)
- Simultaneous charging with two connectors
- Automatic and dynamic distribution of power module to each connector)
- Wide output voltage 200-1000V
- Rated output current 200A

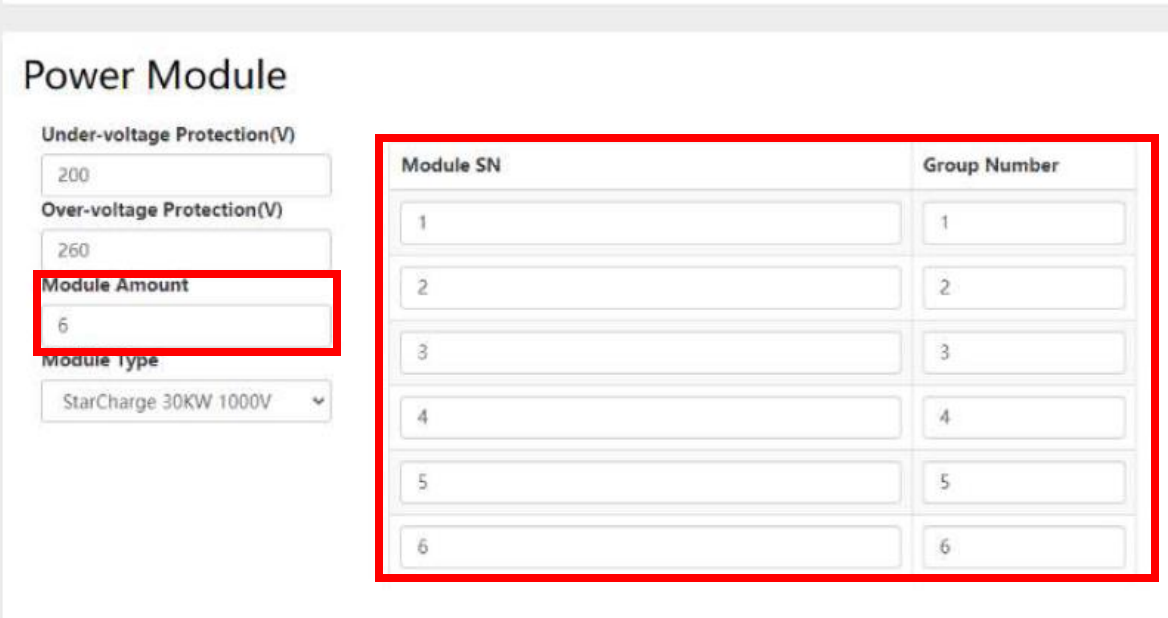


Titan’ s Default Setting of Output

In the default setting, all 6 power modules are activated for power output. In addition, each connector doesn’ t have power limitation and can provide up to 180kW power. The following description is based on this default setting.

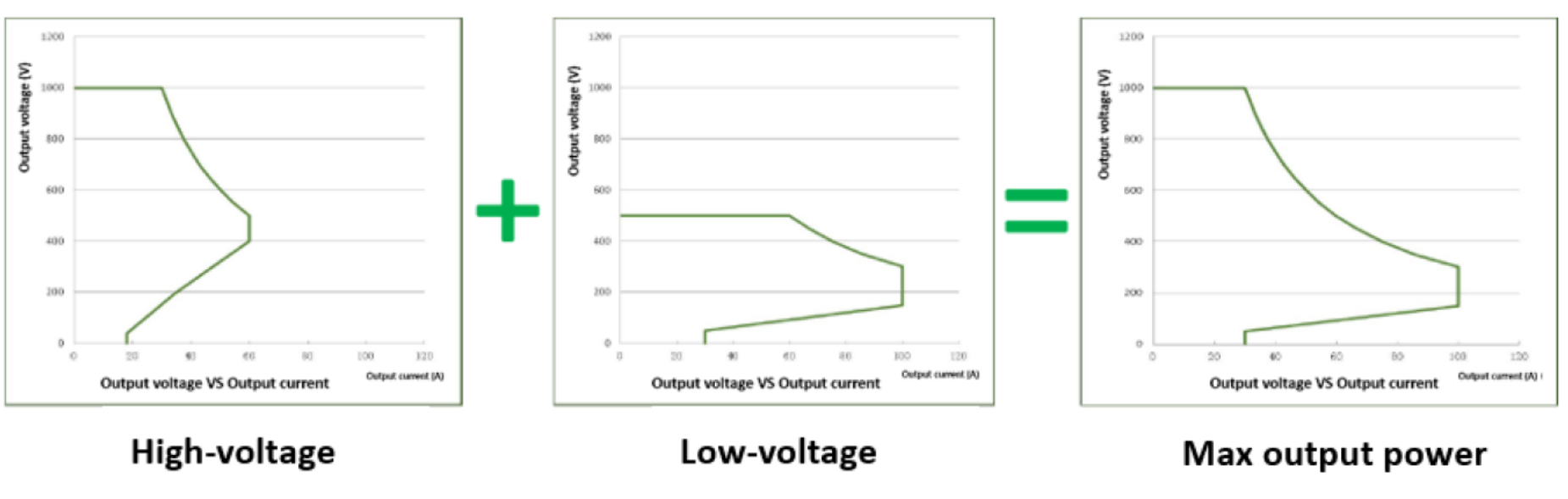
Besides the default setting, user can also modify the setting to reduce the number of activated power module or limit the output power of each connector. This is not within the scope of this description.





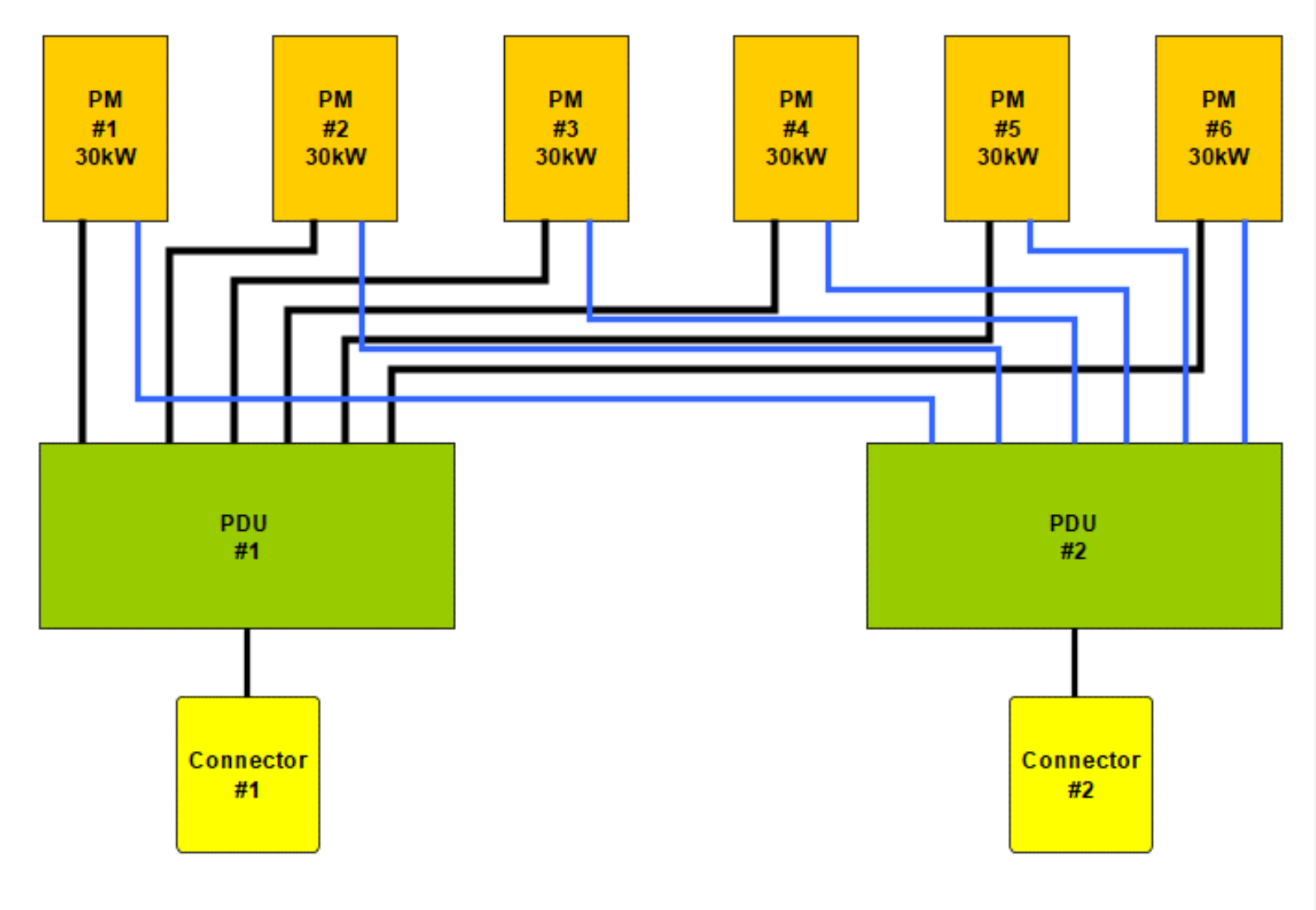
Power Module Specification

Titan 180kW uses Star Charge 30kW 1000V power module



Module	High-voltage	Low-voltage
Parameter	Value	Value
Range of output voltage	200～1000V	150～500V
Rated output voltage	1000V	500V
Rated output current	30A	60A

Power Module Topology



Calculation Principle for PM distribution

$$EV\ power\ request = 30kW \times N + r$$

N: integer quotient.

r: remainder after dividing.

The charger will first distribute N power module to the connector, if there is power module free / available, then charger will provide additional one power module to meet the rest power demand of r.

Scenario 1: Single Connector Charging

Car 1: demand 110kW
Connector 1: output 110kW

$$EV\ power\ request\ 110kW = 30kW \times 3 + 20kW$$

In this case, charger will distribute 4 power modules to connector #1 and output 110kW

Scenario 2: Dual Connectors Charging

Car 1: demand 110kW
Connector 1: output 110kW

Car 2: demand 65kW
Connector 2: output 60kW

$$EV\#1\ power\ request\ 110kW = 30kW \times 3 + 20kW$$

$$EV\#2\ power\ request\ 65kW = 30kW \times 2 + 5kW$$

In this case, charger will first distribute 3 power modules to connector #1 and 2 power modules to connector #2. Because there is only 1 power module available (6 total – 5 assigned = 1 available), the charger will compare the remainder of two EV' s power request:

20kW > 5kW, since the remainder of EV#1 is larger, so the last power module is distributed to connector #1.

Result: Connector #1 get 4 power modules

Connector #2 get 2 power modules

Scenario 3: Dual Connectors Charging

Car 1: demand 45kW

Connector 1: output 30kW

Car 2: demand 160kW

Connector 2: output 150kW

$$EV\#1\ power\ request\ 45kW = 30kW \times 1 + 15kW$$

$$EV\#2\ power\ request\ 160kW = 30kW \times 5 + 10kW$$

The charger will first try to fulfill the integer quotient. In this case it will distribute 1 power module to connector #1 and 5 power modules to connector #2.

Scenario 4: Dual Connectors Charging

Car 1: demand 110kW
Connector 1: output 90kW

Car 2: demand 160kW
Connector 2: output 90kW

$$EV\#1\ power\ request\ 110kW = 30kW \times 3 + 20kW$$

$$EV\#2\ power\ request\ 160kW = 30kW \times 5 + 10kW$$

In this case, the charger will equally distribute 3 power modules to each connector, because it will try to first fulfill the integer quotient.

The Effect of the Sequence of plugging connector on the PM distribution

In case that only connector #1 is charging, after a while, connector #2 is plugged to charge.

Once charger detects the plugging of connector #2, within 1 minute, the current power distribution will be reset and new power distribution will be established based on power request from two connectors.

The Effect of the Sequence of plugging connector on the PM distribution

In case that two connectors are charging, after a while, connector #2 is disconnected from the EV.

Once charger detects the unplugging of connector #2, it will first remain the current power distribution for 2 minutes, after that, the current power distribution will be reset and new power distribution will be established based on power request from 1 connector.

Mobile Power Grid Ecosystem

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