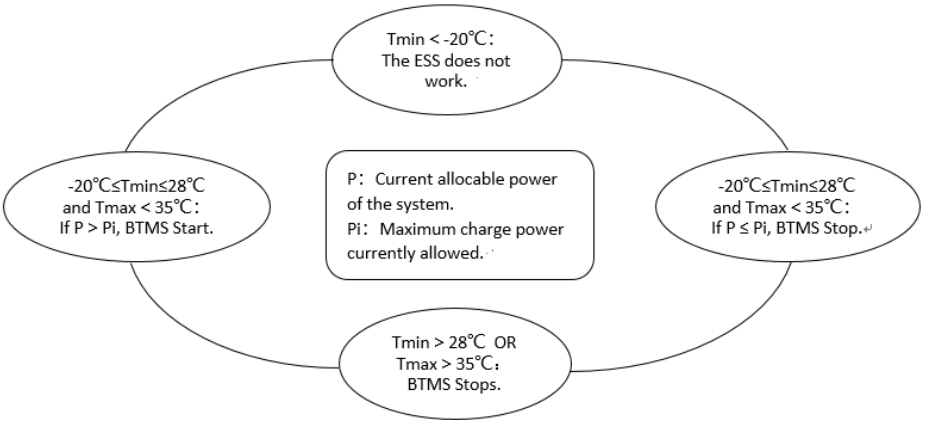
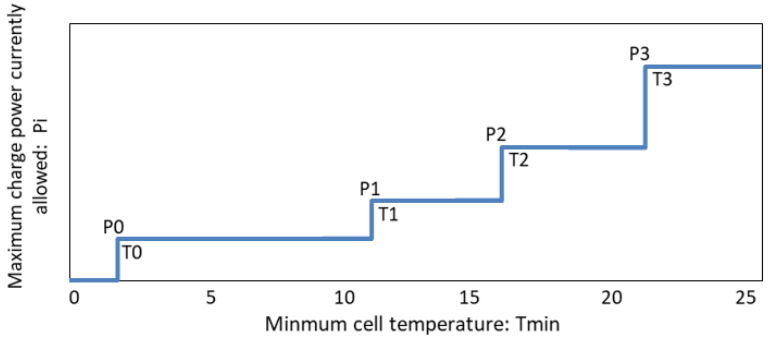
Upgraded Application Note
Huawei Smart String ESS LUNA2000-7/14/21-S1 Battery Thermal Management System – Smart Heating System

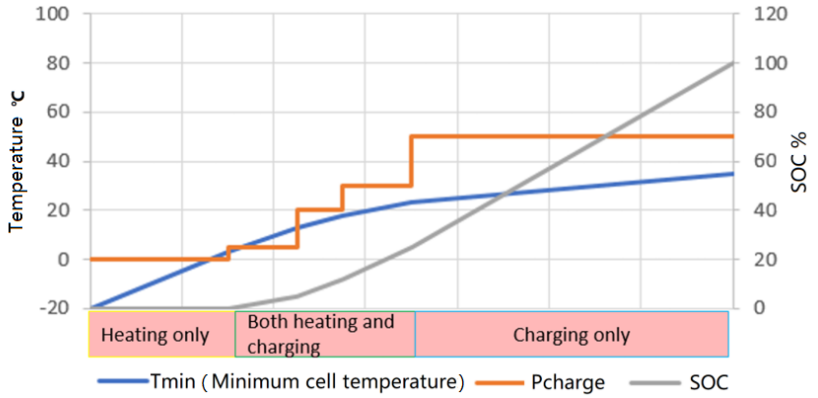
Version 1.0, Aug 2024

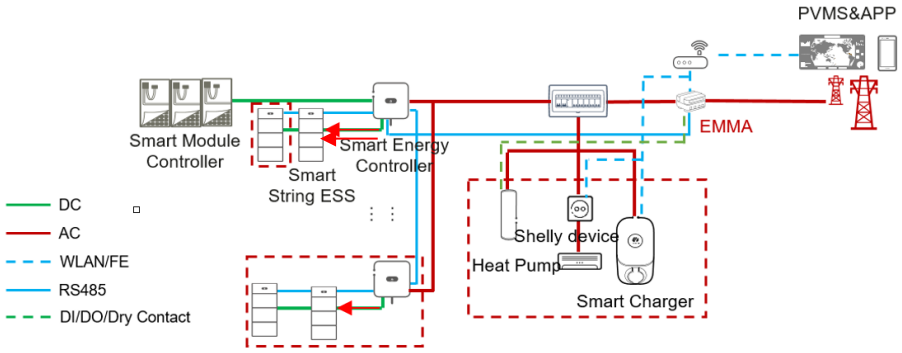
Description

In extreme low temperature scenario, the charging rate of the ESS decreases or even stops. To solve this problem, the Huawei Smart String ESS LUNA2000-7/14/21-S1 utilizes a built-in smart heating system. This document describes the smart heating system, and the information in this update is not related to logic, but related parameters and some descriptions.

Application Solution	LUNA2000-7/14/21-S1 Battery Thermal Management System (BTMS) – Smart Heating System
Solution Description	 The built-in smart heating system will increase the temperature of battery cell.
Solution Configuration	**Work Process**: Under Max Self-consumption work mode, the built-in battery thermal management unit will only consume the PV energy during the daytime (Shown below).  

Trend of each parameter in the low temperature scenario





P_bat= P_pv –P_load (The system will not stop charging battery even if the BTMS stops.)

Notes:

1. The heating film uses step-type intelligent control. The temperature at each step corresponds to the maximum allowable charge power at the first step, as shown in the following figure.
2. When P reaches Pi below the current temperature, the heating film is started to heat the ESS to the next-level temperature T1. The above process is repeated, and real-time judgment is performed at each step. If P is large enough, the temperature may be further increased until the maximum charging power is reached. On the contrary, stop heating.
3. Different conditions may lead to different Ti, which is subject to the actual situation.
4. In the low-temperature scenario, the trend of the main parameters of the ESS is shown in the figure above, which briefly shows the heating and charging status in the entire charging phase.
5. Under Max Self-consumption work mode, the built-in smart heating system will only consume the PV energy during the daytime.
6. Under Max Self-consumption work mode, the built-in smart heating system will attempt to start. If the charging power is insufficient (Require 280W per 7kWh battery module), the system automatically exits after 15s (Try again after 5 minutes).
7. Only when the battery is forced to be charged, the BTMS will consume the energy from grid in order to charge the battery, i.e. TOU or SOC Remaining Process.
8. The heating unit of each battery module can work independently. The lowest SOC will be charged firstly if the P_bat is not enough.
9. BTMS Preparation: This product uses intelligent heating unit, can automatically control the heating unit status according to different conditions.
10. **Disabling logic**: (Any of the following conditions is met)

① Battery is not at charging status (discharging or standby).

② P_bat charging power ≤ 280 W x n (n indicates the number of battery packs).

③ Minimum cell temperature in the PACK > 28°C.

④ Maximum cell temperature in the PACK > 35°C.

⑤ The power consumption of the heating unit may vary under different operating conditions, max power is 280W.

FAQ	Q&A: Will the heating unit cause the battery SOC to drop? No, the heating unit does not consume power from the cell and does not decrease the SOC. The heating unit is turned on only in the charging state, the energy is either from PV or grid under two different working mode. The heating unit is turned off once it enters into the discharging state. Q&A: How long it takes to heat up? How much energy is required? After 10 minutes of preheating， the heating unit temperature rising rate is above 0.18°C/min. The heating time within a certain temperature rise range can be roughly calculated as Estimated heating time (min) = (T_target - T_cell) / 0.18 + 10 For example, if the minimum cell temperature of battery pack is -10 ° C, it takes 77 minutes to reach 2 ° C and the heating power consumption is 0.36 kWh. (Note: The temperature rise rate and heating time of the heating unit may vary due to the influence of environmental temperature, battery temperature, and charging power, the specific heating time depends on the actual situation) Q&A: What's the charging power after heating? In that case of unrestricted power, a battery pack charges at 3500W at most when using the heating unit. When compared to other storage system without heating unit, in the winter, battery can hardly be fully charged in the daytime due to low charge power.