Huawei Data Center Facility Solutions



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Foreword

- With the advent of the cloud computing and big data era, the power density of data centers is increasing, which poses higher requirements on data center reliability, energy saving, and maintainability.
- This chapter describes the challenges of data centers, Huawei's overall data center solution, and how Huawei resolves the hot spot issues of data centers and further improves data center efficiency.

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Objectives

On completion of this course, you will be able to:

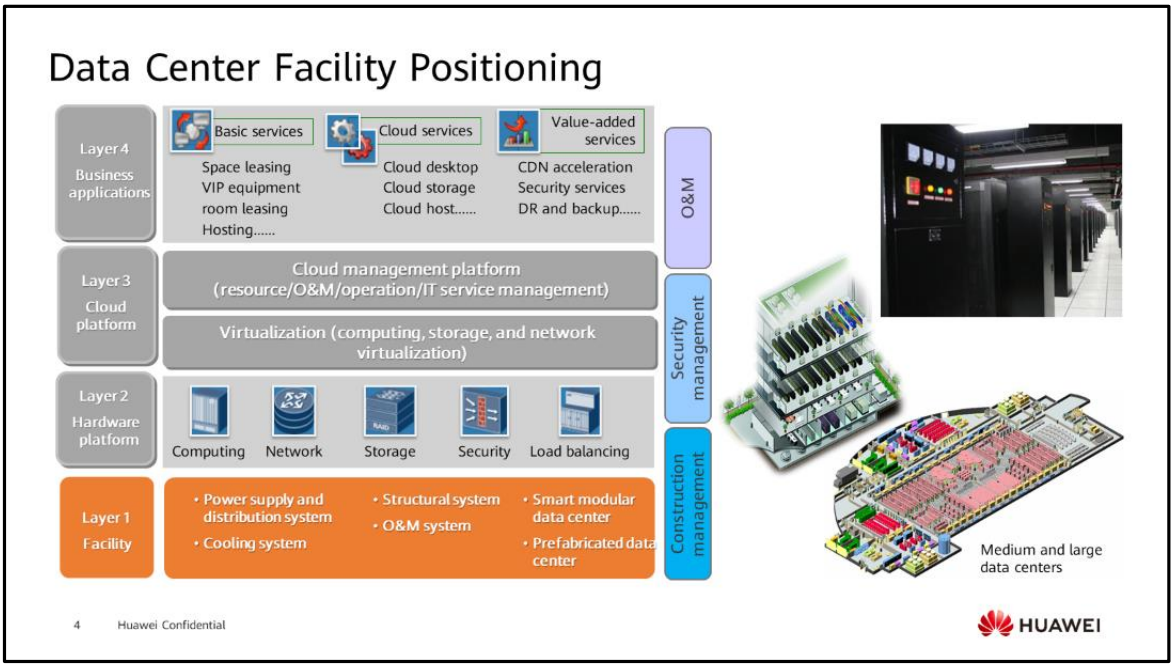
- Get familiar with the trends and challenges in the data center industry.
- Understand Huawei data center construction concepts and solutions.

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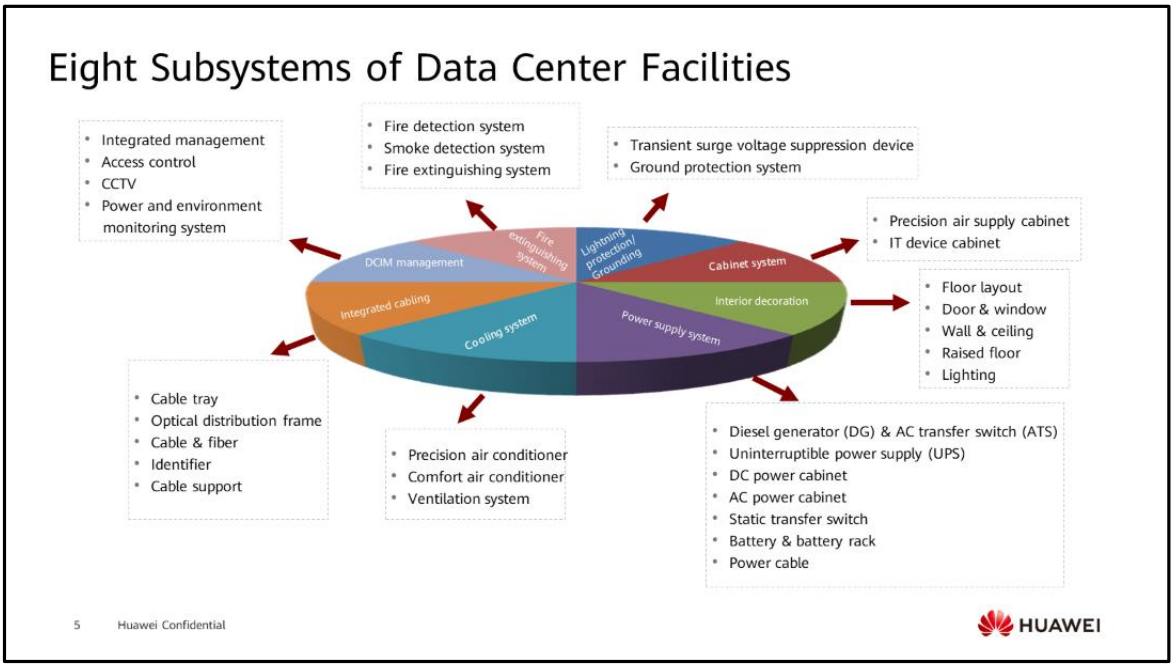
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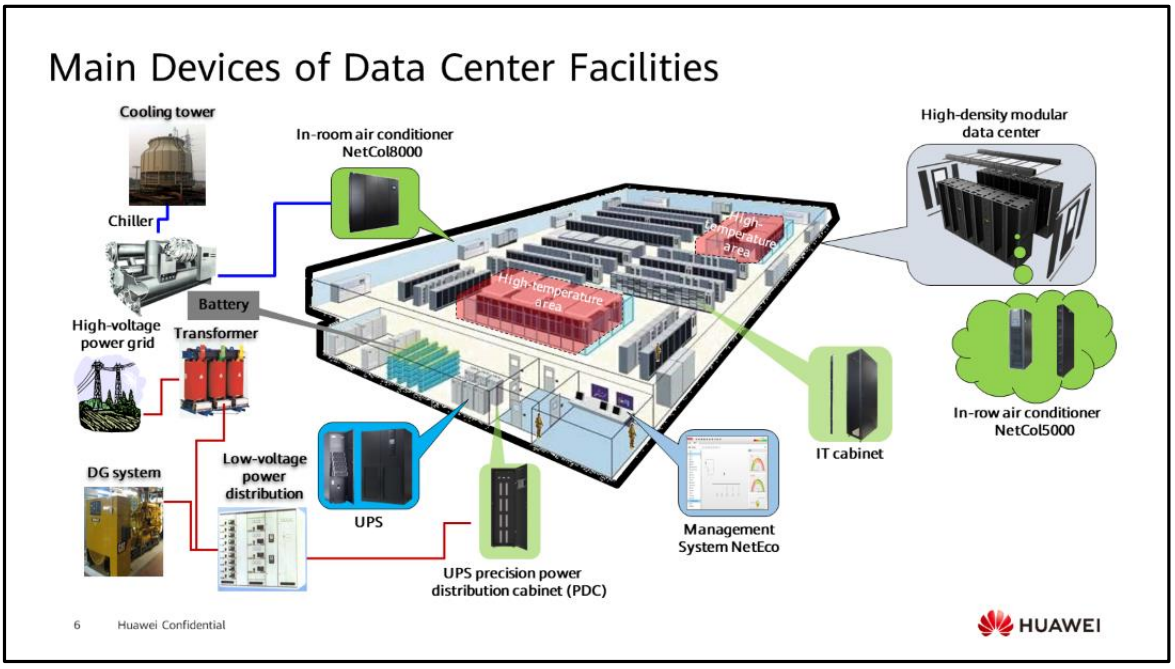
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- The data center facilities mentioned in this document are located at the layer 1 of the data center and provide power and cooling for data center devices, serving as the heart of the entire data center.



- As we all know, the data center site facilities are an integration of many subsystems. This figure shows Huawei's definition of multiple subsystems at the layer 1 of the data center facilities. We can see that the infrastructure is divided into eight subsystems.
- Power supply system: It includes the DG, ATS, UPS, DC cabinet, AC cabinet, static transfer switch, battery, battery rack, and power cables.
- Cooling system: It includes the precision air conditioner, comfort air conditioner, and ventilation system.
- The other six subsystems include the interior decoration, cabinet system, surge protection/grounding, fire extinguishing system, integrated cabling, and integration management, which will not be described in detail here.
- We find that the eight subsystems defined here put much emphasis on products, for example, speaking of the power distribution system, we tend to emphasize the DG, ATS, and UPS under the system. However, data center construction is a site engineering project. To meet a certain function or meet a certain user requirement, we must consider from the perspective of the system. A single device or the stacking of some devices cannot meet the requirement. We must consider the combination, connection and relationship of devices, with the corresponding system design and installation. In this way, a certain requirement can be met.



- This section describes the main systems and devices in a large data center using chilled water air conditioners.

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Development History of Data Centers



Requirements of cloud computing, big data, and artificial intelligence (AI) on layer 1: **fast deployment** and **efficient energy saving** to ensure **reliable service running**

Fast Construction – Large-Scale Cloud Data Centers and Short Rollout Period	High Energy Consumption – Reducing Energy Consumption Is Reducing O&M Costs	High Density – A More Efficient Heat Dissipation Solution Is Required
• Number of cabinets: dozens -> thousands • Number of devices: thousands -> tens of thousands • In such a large scale, it takes 2 to 3 years to deploy layer 1 in the traditional solution. However, layer 1 must be built within one year for service rollout.	• Internet Data Centers (IDCs) account for 1.5% of the global power consumption, about 30 billion W, which is equivalent to the output power of 30 nuclear power plants. • Electricity fee account for 70% of the data center operation costs. • Electricity fee is more expensive than hardware.	• Baidu: 4.5 kW -> 6 kW -> 13 kW • Alibaba: 4.2 kW -> 7.5 kW -> 8 kW • Tencent: 4.5 kW -> 8 kW -> 15 kW • Supercomputing data center: over 20 kW

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- Information technology iteration drives the evolution of the layer 1 architecture. In the intelligent era, flexible and efficient data centers are required.

Challenges to Traditional Data Centers

Traditional data centers cannot meet the requirements of the intelligent era.

Long construction period



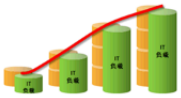
2 years
Average construction period



120 days
Average commissioning time

*Remarks: The data is for a data center with 1000 racks

Poor flexibility



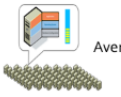
- Power supply and cooling capacity
- IT load

Horizontal capacity expansion: scale;
Vertical capacity expansion: density.

Low efficiency



> 2.0
PUE



< 50%
Average resource utilization

Poor management



61%
Lack of qualified O&M personnel*



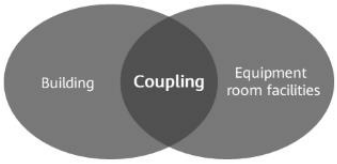
7 x 24 h
Onsite attendance/ Manual inspection

*Data source: Uptime 2019

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Challenge 1: Complex Data Center Construction and Long Construction Period

Difficult planning





Difficult engineering management

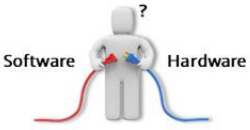




Unclear responsibility matrix, time- and labor-consuming coordination

Difficult to ensure progress and quality

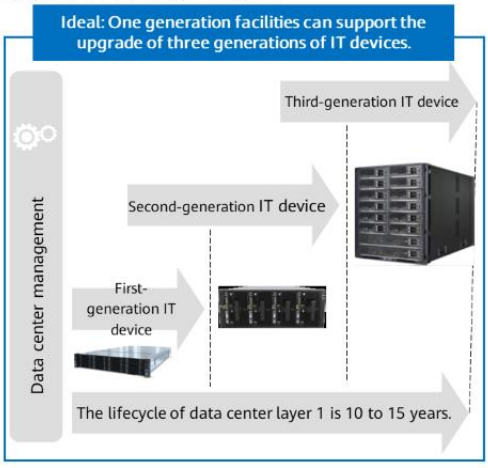


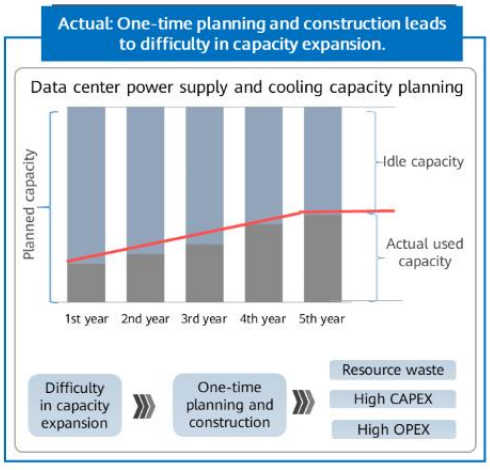


Non-unified interface

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Challenge 2: One-time Planning and Construction, High Initial Investment

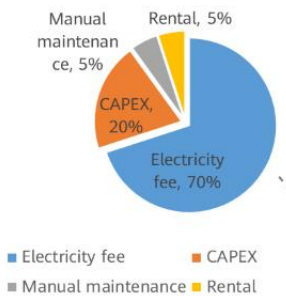


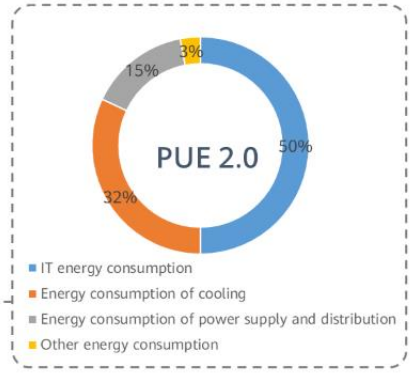


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Challenge 3: High Energy Consumption Throughout the Data Center Lifecycle

10-year operational cost of a large data center





High energy consumption, more than 50% of which is not monitored

High average annual electricity fee per cabinet (PUE 2.0)

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Challenge 4: Time- and Labor-Consuming Data Center O&M





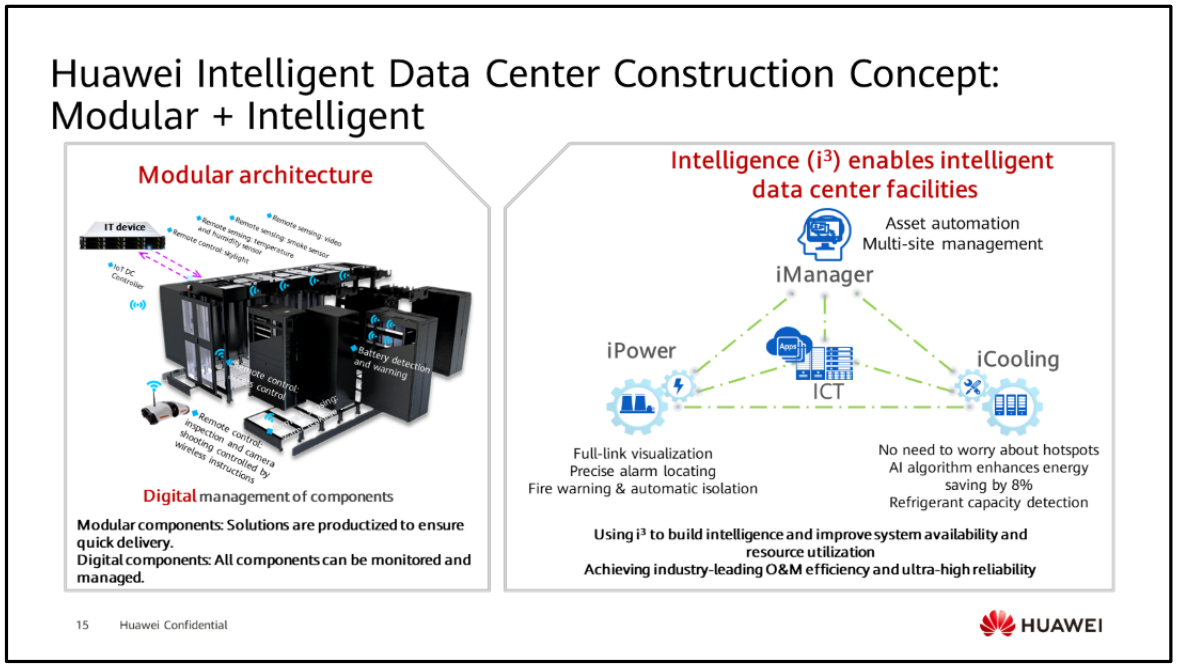
Assets and capacity resources are managed by traditional tables, which is **labor-consuming, time-consuming, passive, and error-prone**, and cannot meet the automatic management requirements of large data centers.

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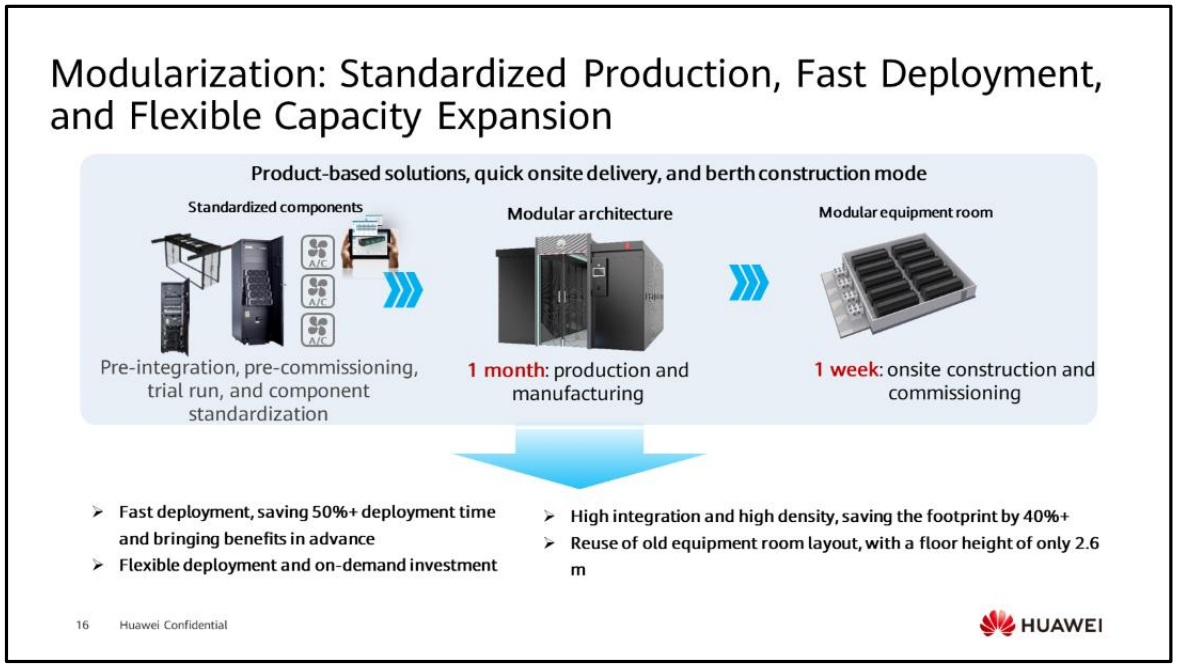
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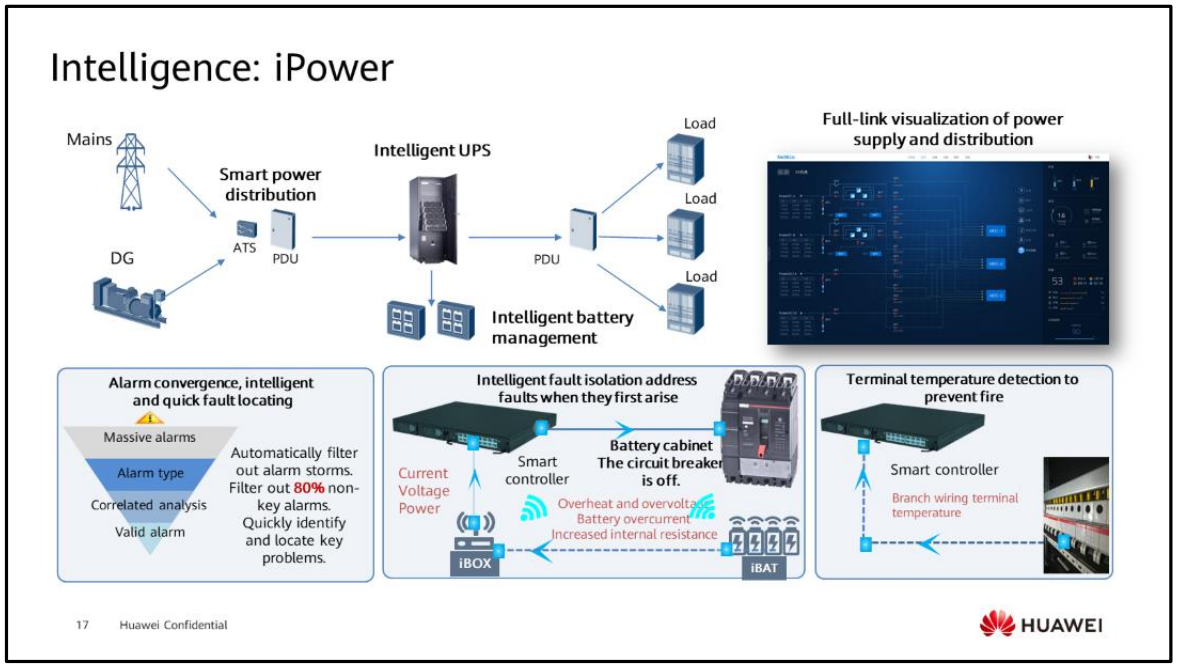
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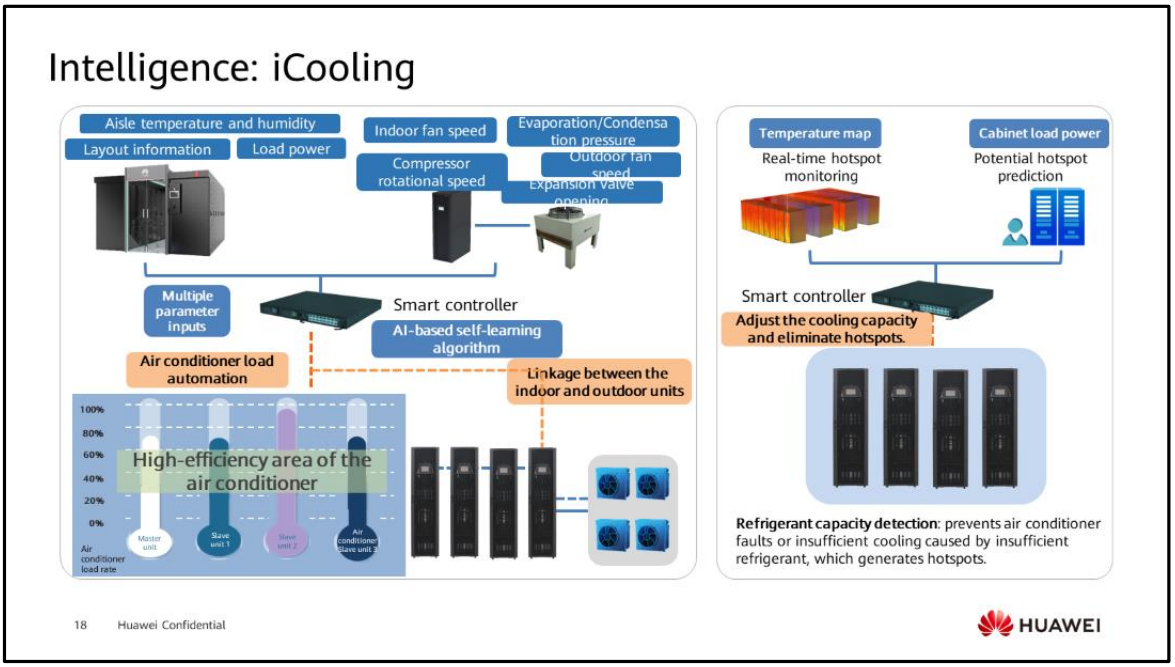
- Modularization: Components are modularized. Solutions are productized to ensure quick delivery. Components are digitalized. All components can be monitored and managed.
- Intelligence: For core subsystems (power distribution, cooling, and management systems), Huawei proposes iPower (intelligent power supply and distribution management), iCooling (intelligent cooling), and iManager (intelligent O&M). i3 is used to build intelligence, improve system availability and resource utilization, and achieve industry-leading O&M efficiency and ultra-high reliability.



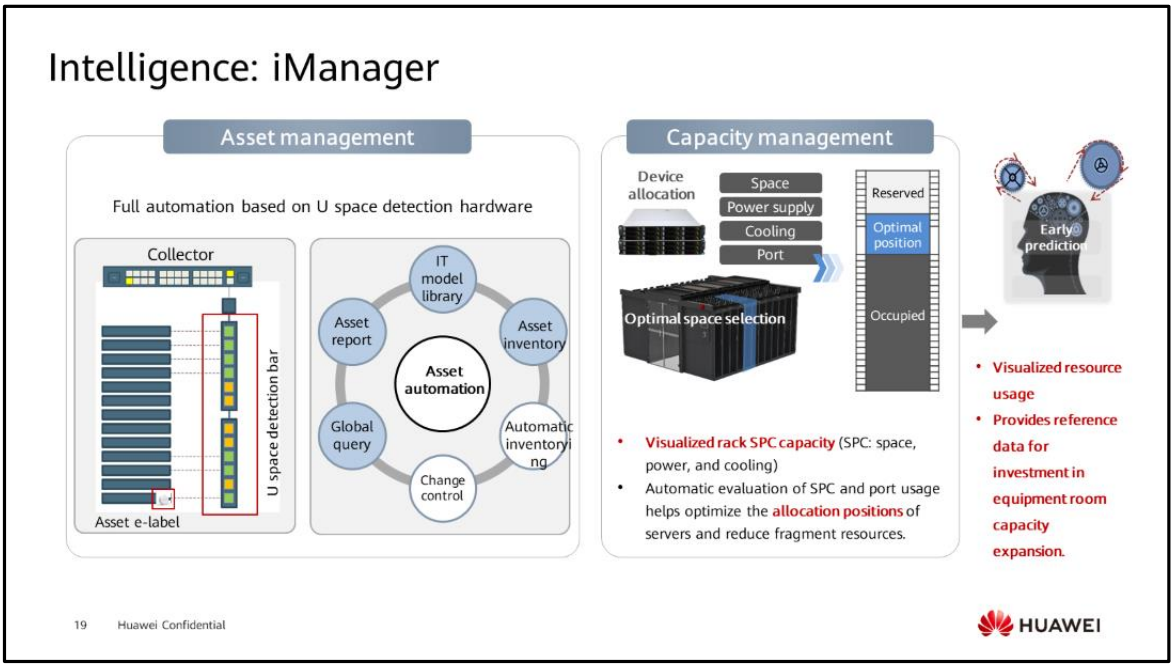
- The smart module adopts a fully modular architecture and features standardized production, fast deployment, and flexible capacity expansion, reducing investment risks. The solution is productized, and all components are standardized, pre-commissioned, and pre-assembled. The berth construction mode meets the requirements for fast onsite delivery, saving more than 50% deployment time compared with the traditional construction mode.
- GuoFuGuangQi: 43 smart modules (602 IT cabinets) are successfully delivered in two months (phase 1 delivery).
- Reconstruction of level-2 branches of China Construction Bank in Guangdong: The footprint is reduced by 50%. Wuxi Unicom: The PSTN equipment room is reconstructed to a distributed IDC with a height of 2.8 m.



- The iPower intelligent power supply and distribution management can display the entire power supply link (visualized power supply link). In this way, if the power supply of a device is faulty, we can directly locate the fault in the power supply link. In addition, we have performed alarm convergence. For a common data center, when the mains fails, the PDF and loads generate an alarm for one mains supply. However, there is only one root cause for all alarms. In this case, the iPower can intelligently analyze the alarms, and filter out the root alarm greatly reducing the time for O&M personnel to locate faults.
- The biggest potential risk of a data center is fire caused by high temperature. Generally, a fire is caused by poor contact or high contact resistance. Therefore, the iPower integrates the online temperature monitoring function for branches. It can detect the temperature of each branch terminal in real time, generate an alarm when the terminal temperature is too high, and intelligently cut off the branch to prevent device faults and service interruption caused by high temperature.



- The iCooling supports intelligent linkage. First, the indoor and outdoor units are intelligently linked. The iCooling can intelligently adjust the running status of the indoor and outdoor units to ensure that the overall power consumption of the indoor and outdoor units is at the highest efficiency point and reduce the cooling power consumption. The iCooling can also control the linkage of the air conditioners inside the smart module to coordinate the cooling capacity of each air conditioner, adjust the running status of a single air conditioner to ensure that each air conditioner is in the optimal efficiency range, and reduce the overall cooling power consumption. The two linkages can reduce the overall power consumption of the cooling system of the smart module by 8%. Second, the iCooling supports the linkage of the 3D map, load, and cooling system. By detecting the temperature data at each position of the smart module, the iCooling establishes a visible temperature model for the smart module. When a partial hotspot occurs in the equipment room, the control system controls the air conditioners in the hotspot area to increase the cooling capacity and eliminate the hotspots. When the load inside the smart module increases, the cooling capacity of the entire cooling system can be immediately increased to ensure that the cooling process is not delayed and the temperature inside the smart module is stable.
- Quick elimination of hotspots: The smart controller identifies real-time hotspots, predicts potential hotspots, and adjusts the air conditioner load in the corresponding area to keep the temperature field stable and avoid hotspots. The iCooling is intelligent. It supports full-link visualization for cooling of the entire module and a single air conditioner. In addition, the air conditioner supports refrigerant detection. It detects the refrigerant capacity of each air conditioner in real time and generates an alarm when the capacity is insufficient. This prevents high temperature in the equipment room and device damage caused by insufficient refrigerant.



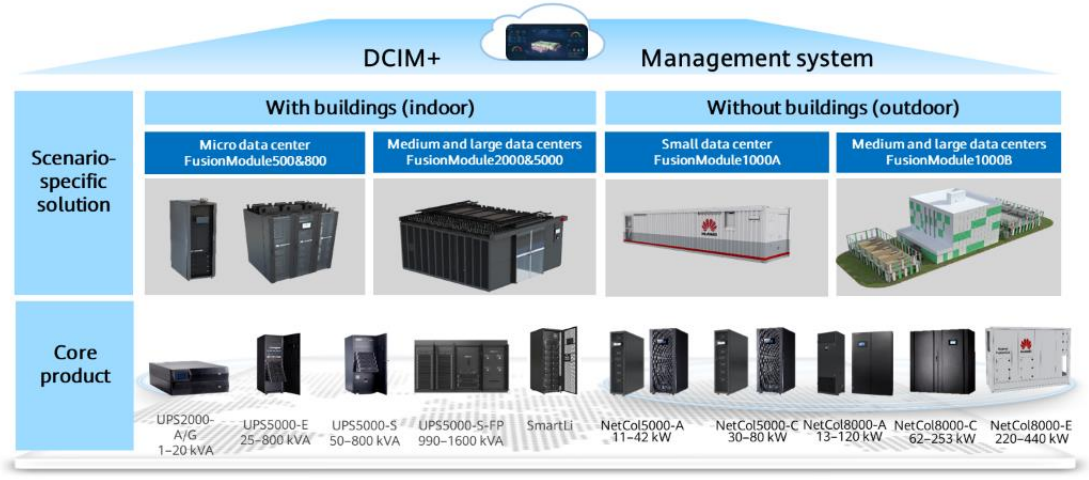
- We know that the lifecycle of a data center is generally 10 years. During this period, the traditional manual management mode is inefficient and error-prone due to service adjustment, O&M personnel position adjustment, replacement of old and new IT devices, and device location change. During service expansion, management personnel do not have data support for information such as equipment room SPC and ports. As a result, they cannot make effective decisions, causing resource waste.
- Huawei iManager U space asset management function can automatically detect asset status and generate asset reports to implement intelligent management of assets throughout the lifecycle. When assets are allocated, the iManager can intelligently recommend the optimal position based on factors such as power distribution, cooling, and space capacity (showing the process of asset allocation and removal).
- The iManager intelligent O&M management can implement capacity visualization, including the power distribution capacity, cooling capacity, and cabinet space capacity.

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Panorama of Huawei Data Center Products



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Feature 1: Multiple Power Supply and Distribution Modes

Solution 1
Integrated UPS, supporting a maximum of 125 kW IT load (single module)






Integrated UPS

Single-cabinet integration:
- UPS input and output
- IT power distribution x 48
- Air conditioner power distribution x 8
- Lighting x 3

1–2 cabinet space saved

Solution 2
UPS + integrated PDF, supporting a maximum of 145 kW IT load (single module)






UPS Integrated PDF

Integrated PDF:
- IT power distribution x 48
- Air conditioner power distribution x 8
- Lighting x 3

Air conditioner power distribution box (PDB) saved

Solution 3
UPS + precision PDF, supporting a maximum of 235 kW IT load (single module)






UPS Precision PDF

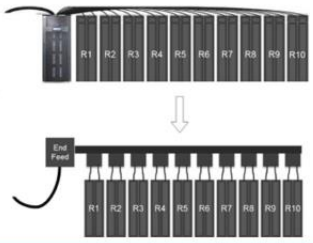
Precision PDF:
- IT power distribution x 144 (maximum)

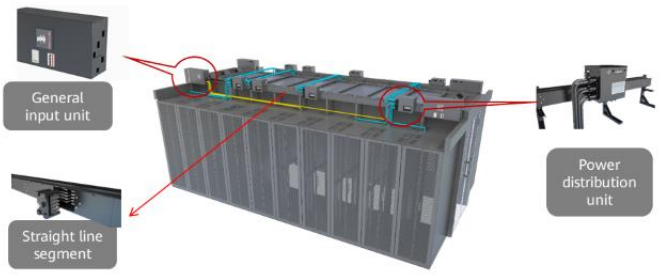
An independent air conditioner PDB is required.

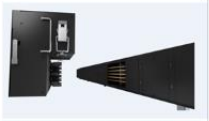
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Feature 2: Intelligent Busway Power Distribution

- **100 kW/20 cabinets: The installation time can be reduced by 20%.**
- **Wireless extra-low voltage + smart busbar = The installation time can be reduced by 70%.**
- **One or two cabinets** are saved, and new cabinets and services can be added.
- The busbar transmission loss is low. A 100 kW module can save **2600 kWh/year**.







Power distribution unit online maintenance, simplifying O&M



Hot swapping and online maintenance



Simple busway assembly and quick deployment

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Feature 3: Huawei SmartLi High-Efficiency Energy Storage Solution

SmartLi lithium battery solution



Product model	SmartLi
Cathode material	LFP
Nominal voltage	512 V DC

Features and advantages

Reliable

- Lithium iron phosphate (LFP) cell, the most secure cell in the industry
- Long service life, two to three times the lifecycle of lead-acid batteries
- Three-layer battery management system (BMS)

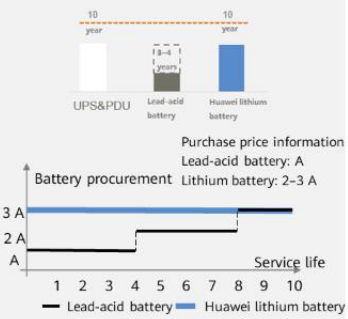
Efficient

- The unique active current sharing technology enables the cross current of combined cabinets to be less than 2% and allows old and new battery cabinets to be used together.
- 70% less footprint than lead-acid batteries, improving the cabinet delivery rate

Simple

- Modular design, allowing common O&M personnel to complete replacement within 5 minutes

The total investment in lithium batteries throughout the lifecycle of a data center is the same as that in lead-acid batteries.



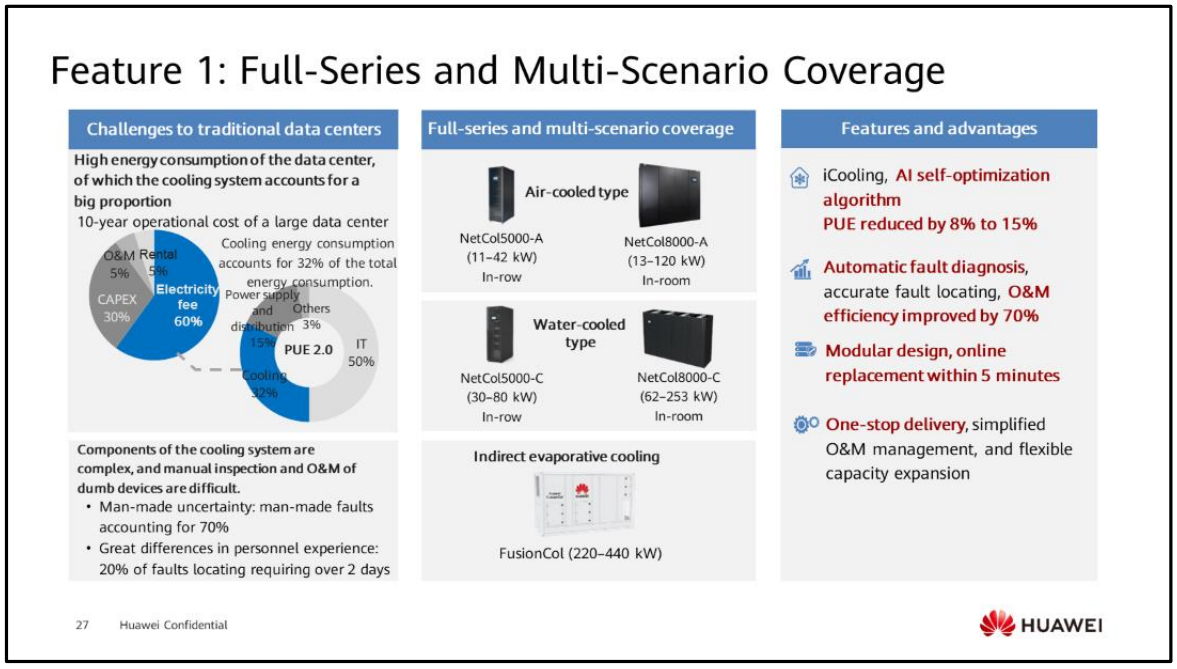
Note: For batteries with the same capacity, the investment in battery replacement and installation is not included.

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- Configuration description:
- Applicable to smart module B. Air conditioners and lighting power distribution are deployed outside the PDF.
- The IT route circuits support a maximum of four groups of power distribution modules. Each group has twenty-four 40 A circuit breakers, connecting to a maximum of 48 cabinets.
- IT main input supports single- and dual-MCCBs with 400 A, 250 A, or 160 A current and a maximum of 235 kW power.
- During configuration, it is recommended that two circuit breakers be reserved for redundancy.

Feature 2: Converged and Innovative AHU Solution

FusionCol (AHU)

- Cooling capacity: 220/440 kW
- IP rating: IP54



Maximum usage of natural cooling sources under three working conditions:

- Dry mode: air-to-air heat exchange
- Wet mode: air-to-air heat exchange + spray
- Hybrid mode: air-to-air heat exchange + spray + auxiliary cooling

Customer benefits

Reliable

- Redundancy design for key components (such as fans, water pumps, and heat exchanger cores) to ensure that component faults do not affect the running of the entire system

Efficient

- AHU@iCooling energy saving algorithm for system optimization, PUE 1.26@Sydney
- Efficient space usage solution saving the footprint by 20% compared with the traditional solution

Simple

- Preinstallation and pretests in factories for fast onsite delivery, with deployment time shortened by 50%
- Unique automatic fault diagnosis, fast fault locating, making maintenance faster and easier

US$52,000 electricity fees saved per year for the Optus project in Sydney



Project working conditions: 150 cabinets, 5 kW/rack, N+1 configuration for cooling, 220 kW single terminal air conditioner

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Feature 3: Local Cooling + Aisle Containment



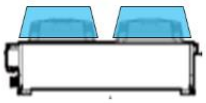
NetCol5000-A/C



High height difference design

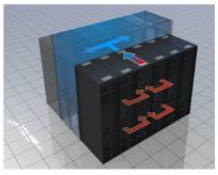
The height difference between the indoor and outdoor units of the air conditioner can reach:
+30 m (outdoor unit on the top)
–8 m (outdoor unit at the bottom)
Meets the installation height difference requirements. (for 42 kW air conditioners)

Noise-reduction cover



The outdoor unit noise is as low as 55 dB(A). (for 42 kW air conditioners)

Parameter	Description
Input voltage	380–415/3/50, 380–415/3/60
Compressor type	DC frequency-converting scroll compressor
Airflow mode	Horizontal airflow
Fan type	EC fan
Cooling capacity	25/42 kW
Air volume	5000/8600 m^3/h
Dimensions (H x W x D)	2000 mm x 300 mm x 1100 mm 2000 mm x 600 mm x 1100 mm



- The cooling system is productized. The model of aisle containment + in-row air conditioner is easy to construct. The simulation precision is high and the model can be easily replicated.
- The requirements for the equipment room layout, module size, and onsite engineering quality are low. The cooling effect is easy to evaluate and does not depend on the construction precision.
- High-density scenarios are supported, without the risks of partial hotspots.

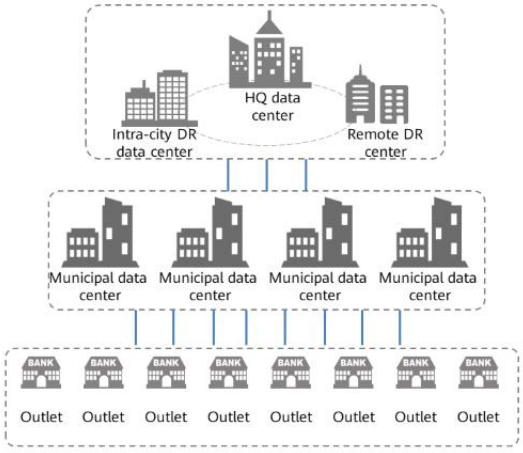
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Feature 1: Centralized Management of Multiple Data Centers On the Entire Network





- **State-owned banks and multinational enterprises**: a large number of outlets, equipment rooms distributed at different layers
- **Broadcasts, postal services, and confidential services**: a small equipment room scale, scattered outlets
- **Governments, schools, and hospitals**: Outlets are centralized but distributed on different layers.

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Feature 2: Process-based Management and Intelligent Inspection

Inspection route planning



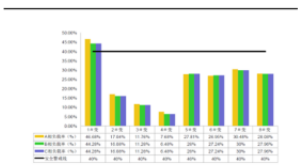
- Customized inspection route: QR code bound to inspection devices/areas, editable inspection sequence
- Scheduled and automatic generation of inspection tasks
- Automatic receiving of inspection tasks by mobile phone app

QR code-based mobile inspection



- Device bar codes/QR code scanning to get device information and inspection items
- Inspection data automatically filled in by using the NetEco
- Proactive notification and record for device inspection status

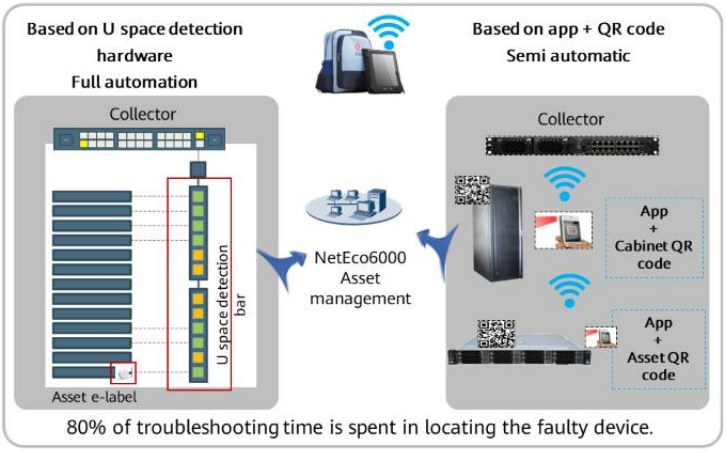
One-click inspection report



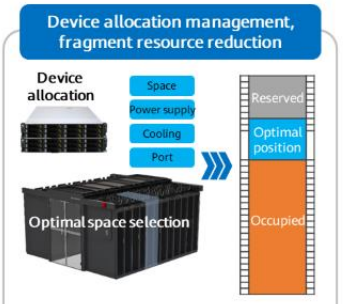
- Inspection result submission
- One-click generation for inspection reports, automatic assessment on inspection health status

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Feature 3: Asset Capacity Management



80% of troubleshooting time is spent in locating the faulty device.



- **Visualized rack SPC capacity**
- Automatic evaluation of SPC and port usage helps optimize the **allocation positions** of servers and reduce fragment resources.

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Quiz

1. (Single) Which subsystem affects the PUE most in the data center design?
   A. Power supply and distribution system
   B. Refrigeration system
   C. Decoration system
   D. Building system

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- Answer: B

Summary

- This chapter mainly describes
  - Composition of the data center infrastructure and functions of each subsystem;
  - What are the trends and challenges in the data center industry.
  - Huawei data center construction concept and Huawei data center solution.

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Thank you.

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每个组织，构建万物互联的智能世界。

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Introduction to Modular Data Center Solution FusionModule2000/5000



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Foreword

- This chapter describes the configurations and hardware of the FusionModule2000 and FusionModule5000 in indoor scenarios data center solution.

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Objectives

On completion of this course, you will able to:

- Have a basic understanding about Huawei FusionModule2000/5000.
- Understand the application scenarios of the FusionModule2000/5000.
- Get familiar with the hardware of each subsystem of the FusionModule2000/5000.

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Contents

1. FusionModule2000/5000 Product Description
2. FusionModule2000/5000 Application Scenarios
3. FusionModule2000/5000 Hardware

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Product Positioning

- The FusionModule2000 adopts an air cooled cooling system and is mainly used for small- and medium-sized data centers. The FusionModule5000 adopts the water cooled cooling system and applies to medium- and large-sized data centers.
- The smart module features simple design, strong building adaptability, and low requirements for equipment room height and reconstruction. It applies to telecom and financial central equipment rooms, as well as core equipment rooms for government, energy, power, transportation, ISP, and large enterprises.



FusionModule2000
(Adopts air cooled air conditioners)



FusionModule5000
(Adopts chilled water air conditioners)

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- The FusionModule2000 uses air cooled in-row air conditioners. The FusionModule5000 uses chilled water in-row air conditioners.

Solutions

- Based on the smart module structure, the following solutions are available:



Single-row aisle containment

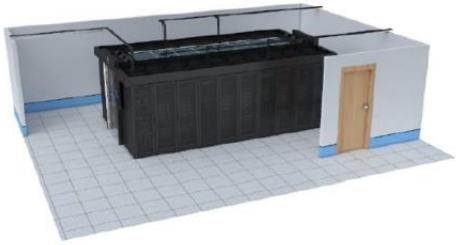


Dual-row aisle containment

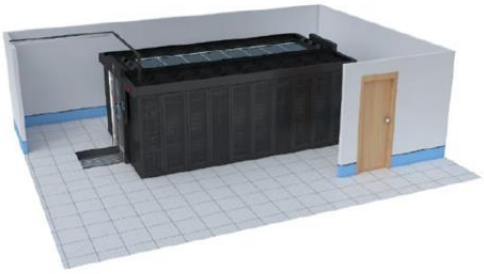
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Solutions

- Based on the smart module application scenarios, the following solutions are available:



Without a raised floor



With a raised floor

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- Typically, overhead cabling and overhead piping
- Typically, overhead cabling and underfloor/overhead piping, bottom cabling and underfloor/overhead piping

Contents

1. FusionModule2000/5000 Product Description
2. **FusionModule2000/5000 Application Scenarios**
3. FusionModule2000/5000 Hardware

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FusionModule2000/5000 Application Scenarios



Smart module A (batteries deployed inside the module)



Smart module A (batteries deployed outside the module)



Smart module B (precision power distribution frame)



Smart module B (integrated power distribution frame)



Smart module B (new main way)

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- The FusionModule5000 only supports the smart module B scenario. The UPS and batteries are deployed outside the smart module, the smart cooling product is deployed inside the smart module, and the smart module has a precision power distribution frame (PDF) or new main way (NMW).

Typical Configuration of the FusionModule2000

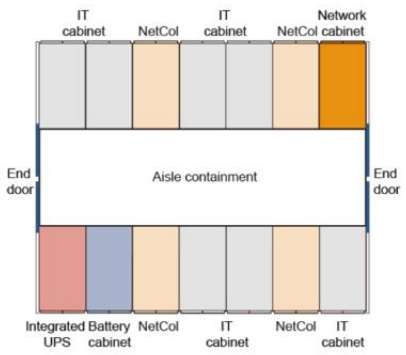
Smart Module Scenario	Inside Smart Module	Outside Smart Module	Power Distribution Specifications
Smart module A (batteries deployed inside the module)	Integrated UPS, smart cooling product, battery, cabinet, aisle, and mechanical parts	-	• Configured with 25 kW power modules: 48 power distribution routes for IT equipment and 8 power distribution routes for smart cooling products • The 50 kVA and 125 kVA racks have one molded case circuit breaker (MCCB) input and two automatic transfer switch (ATS) inputs respectively. • Supports a maximum of 50 kW/125 kW IT loads. • Supports a maximum of (2+1) or (5+1) 25 kW modules.
Smart module A (batteries deployed outside the module)	Integrated UPS, smart cooling product, cabinet, aisle, and mechanical parts	Battery	
Smart module B (integrated PDF)	Integrated PDF, smart cooling product, cabinet, aisle, and mechanical parts	UPS and battery	160 A/250 A power input (IT input circuit breaker and smart cooling product input circuit breaker); supports 48 power distribution routes for IT equipment, 8 power distribution routes for smart cooling products, and 1 power distribution route for lighting; supports 95 kW/148.5 kW IT loads.
Smart module B (precision PDF)	Precision PDF, smart cooling product, cabinet, aisle, and mechanical parts	UPS, battery, and power distribution box (PDB) for smart cooling products	160 A/250 A/400 A power input; supports maximum 144 power distribution routes for IT equipment and 95 kW/148.5 kW/235 kW IT loads.
Smart module B (NMW)	NMW, smart cooling product, cabinet, aisle, and mechanical parts	UPS, battery, and PDB for smart cooling products	250 A/400 A power input; supports 123 kW/198 kW IT loads.

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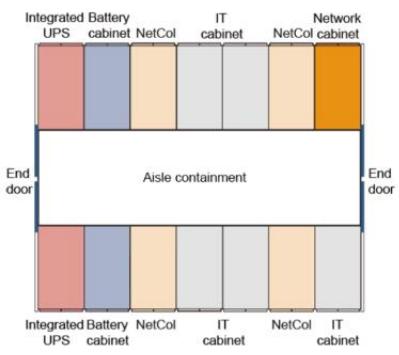
Typical Configuration of the FusionModule2000 Smart Module A (1)

- For smart module A, the integrated UPS is deployed inside the module and batteries can be deployed inside or outside the module.

Batteries deployed inside, N+1 scenario



Batteries deployed inside, 2N scenario



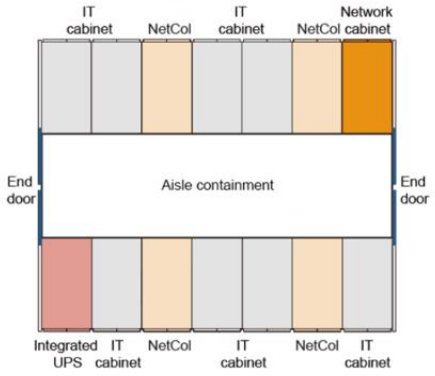
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- Key points: In the N+1 scenario, the UPS and battery cabinet are deployed in one row. The UPS is deployed at the end of the row, and the battery cabinet is installed close to the UPS. In the 2N scenario, the UPS and battery cabinet are deployed in two rows.

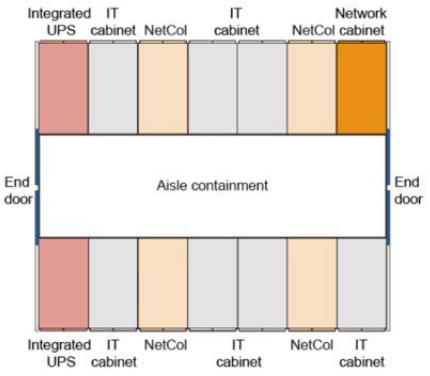
Typical Configuration of the FusionModule2000 Smart Module A (2)

- For smart module A, the integrated UPS is deployed inside the module and batteries can be deployed inside or outside the module.

Batteries deployed outside, N+1 scenario



Batteries deployed outside, 2N scenario



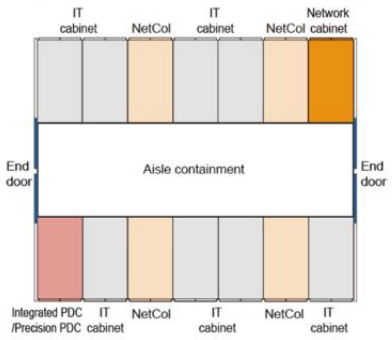
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- Key points: In the N+1 scenario, the UPS is deployed in one row and at the end of the row. In the 2N scenario, UPSs are deployed in two rows.

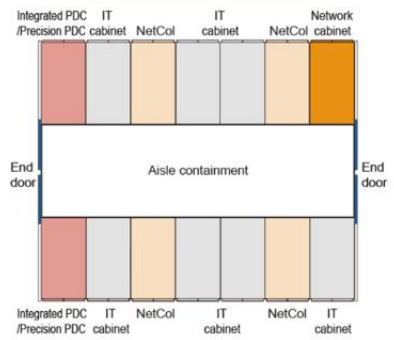
Typical Configuration of the FusionModule2000 Smart Module B (1)

- For smart module B, the UPS is deployed outside the module. Power supply and distribution supports the integrated PDF, precision PDF, and NMW.

Integrated PDF/precision PDF, N+1 scenario



Integrated PDF/precision PDF, 2N scenario



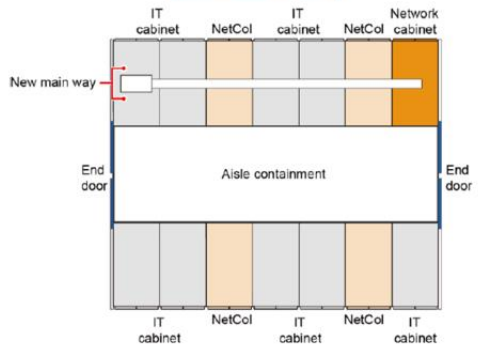
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- Key points: For smart module B, the UPS and batteries are deployed outside the module, and the integrated PDF or precision PDF is deployed inside the module.

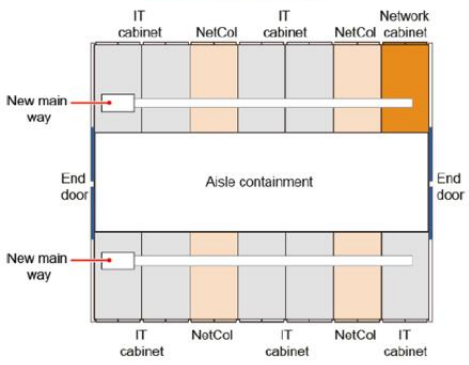
Typical Configuration of the FusionModule2000 Smart Module B (2)

- For smart module B, the UPS is deployed outside the module. Power supply and distribution supports the integrated PDF, precision PDF, and NMW.

NMW, N+1 scenario



NMW, 2N scenario

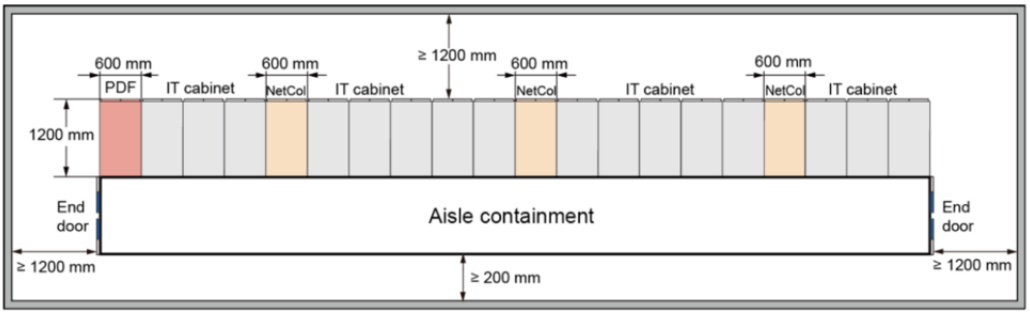


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- Key points: In the NMW scenario, the UPS and batteries are deployed outside the module, and the power is supplied to the. The NMW inside the module supplies power to the cabinets inside the module. The NMW is deployed on the top of the smart module, saving one or two cabinet space.

FusionModule5000 Typical Configuration (1)

- Smart module B scenario: The UPS and batteries are deployed outside the smart module, the smart cooling product is deployed inside the smart module, and the smart module has a precision PDF or NMW.



Floor plan of a single-row 1200 mm wide aisle containment (precision PDF)

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- The UPS and batteries of the FusionModule5000 are deployed outside the smart module. The precision PDF and NMW can be deployed inside the smart module. The figure uses the precision PDF as an example to describe the layout.

FusionModule5000 Typical Configuration (2)

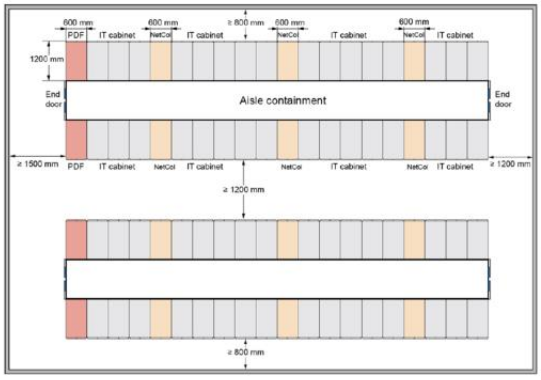
- Smart module B scenario: The UPS and batteries are deployed outside the smart module, the smart cooling product is deployed inside the smart module, and the smart module has a precision PDF or NMW.

Item	Technical Specifications
Number of IT cabinets	6–24
Equipment room space	• In the scenario where the NMW is deployed, the minimum floor height is 2.8 m when 2.0 m IT cabinets are deployed, 3.0 m when 2.2 m IT cabinets are deployed, and 3.3 m when 2.5 m IT cabinets are deployed. • In the scenario where the NMW is not deployed, the minimum floor height is 2.6 m when 2.0 m IT cabinets are deployed, 2.8 m when 2.2 m IT cabinets are deployed, and 3.1 m when 2.5 m IT cabinets are deployed.
Cooling	• NetCol5000-C030&032 in-row chilled water smart cooling product • NetCol5000-C065&080 in-row chilled water smart cooling product
Power distribution	Smart module B: precision PDF/NMW
Aisle	1200 mm wide single-row cold or hot aisle containment

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FusionModule5000 Typical Configuration (1)

- Smart module B scenario: The UPS and batteries are deployed outside the smart module, the smart cooling product is deployed inside the smart module, and the smart module has a precision PDF or NMW.



Floor plan of a dual-row 1200 mm wide aisle containment (precision PDF)

Item	Technical Specifications
Number of IT cabinets	6–48 (maximum 24 cabinets in N+1 scenario; maximum 48 cabinets in 2N scenario; maximum module length: ≤ 15 m)
Equipment room space	• In the scenario where the NMW is deployed, the minimum floor height is 2.8 m when 2.0 m IT cabinets are deployed, 3.0 m when 2.2 m IT cabinets are deployed, and 3.3 m when 2.5 m IT cabinets are deployed. • In the scenario where the NMW is not deployed, the minimum floor height is 2.6 m when 2.0 m IT cabinets are deployed, 2.8 m when 2.2 m IT cabinets are deployed, and 3.1 m when 2.5 m IT cabinets are deployed.
Cooling	• NetCol5000-C030&032 in-row chilled water smart cooling product • NetCol5000-C065&080 in-row chilled water smart cooling product
Power distribution	Smart module B: precision PDF/NMW
Aisle	1200 mm wide dual-row cold or hot aisle containment

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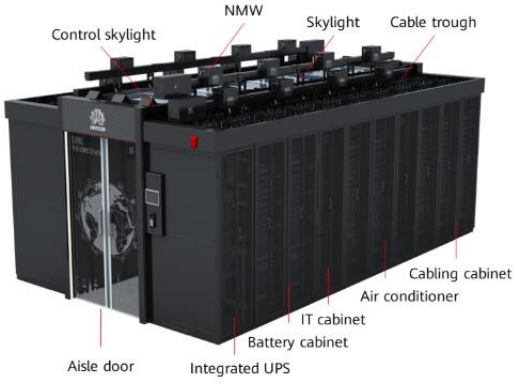
- The UPS and batteries of the FusionModule5000 are deployed outside the smart module. The precision PDF and NMW can be deployed inside the smart module. The figure uses the precision PDF as an example to describe the layout. There are two types of systems: N+1 system and 2N system.

Contents

1. FusionModule2000/5000 Product Description
2. FusionModule2000/5000 Application Scenarios
3. **FusionModule2000/5000 Hardware**
   - Power Supply and Distribution System
   - Cabinet Aisle System
   - Cooling System
   - Intelligent Management System
   - Surge Protection and Grounding System
   - Integrated Cabling System

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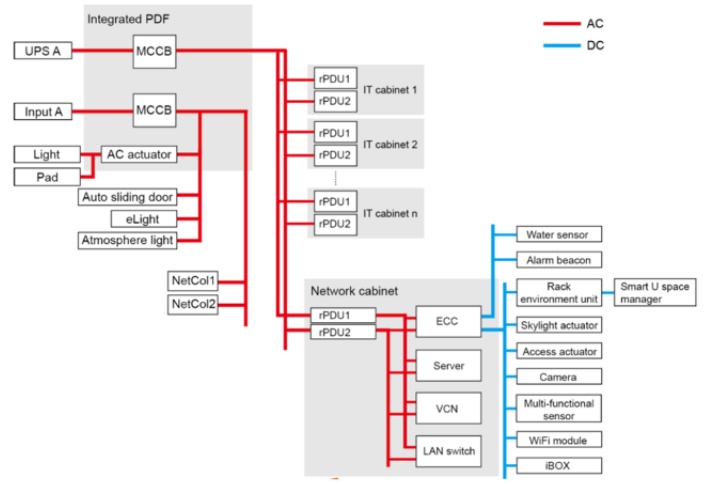
FusionModule2000/5000 System Composition



① Power supply and distribution system: integrated UPS cabinet/integrated PDF/modular precision PDF/NMW and battery cabinet
② Cooling system: air cooled/chilled water in-row air conditioner
③ Structural system: cabinet, skylight, end doors, cable troughs, side panels, bases, and accessories
④ Monitoring system: ECC800, cameras, and multi-functional sensors
⑤ Management system: NetEco
⑥ Integrated cabling system: internal power and signal cables
⑦ Auxiliary fire extinguishing system

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Power Supply and Distribution System - System Architecture



- Note: The figure on the left shows the power distribution system architecture of the N+1 system (integrated PDF).
- The smart module has different application scenarios (smart module A and smart module B), different redundancy configurations (N+1 and 2N), and different power distribution devices (integrated UPS, precision PDF, and NMW). The power distribution architecture varies depending on the scenario. For details about the architecture of each scenario, see the product documentation.

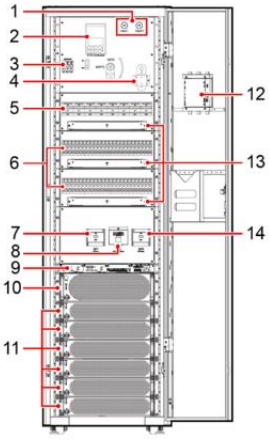
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- As shown in the figure, the input power is supplied to the integrated UPS and split into two inputs. One power input is converted by the UPS and then supplied to the rack power distribution unit (rPDU). The other power input is distributed to air conditioners and lights before the UPS.
- The devices in the network cabinet are the monitoring system of the smart module.

Power Supply and Distribution System - Integrated UPS (1)



Integrated UPS



Layout

(1) Power input status indicators
(2) ATS
(3) Lighting circuit breaker
(4) ATS handle installation slot
(5) Air conditioner power distribution circuit breakers
(6) IT load circuit breakers
(7) UPS input switch
(8) UPS maintenance bypass switch
(9) Control module
(10) Bypass module
(11) 25 kVA power modules
(12) Monitoring display unit (MDU)
(13) Power distribution monitoring board
(14) UPS output circuit breaker

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Power Supply and Distribution System - Integrated UPS (2)

- Integrated UPS configuration and technical specifications:

Switch	Module Quantity	Power Architecture	System Capacity	System Power Distribution	UPS Power Distribution	Power Distribution Subrack	IT Power Distribution Switch Capacity	Air Conditioner Branch Power Distribution Switch Capacity
MCCB (50 kW)	1	2N	25 kW	250 A	3 x 160 A/3P	Hot-swappable switch	24 x 10 A/1P or 24 x 16 A/1P or 24 x 20 A/1P or 24 x 32 A/1P or 24 x 40 A/1P or 24 x 63 A/1P	8 x 10 A/3P or 8 x 16 A/3P or 8 x 20 A/3P or 8 x 32 A/3P or 8 x 40 A/3P or 8 x 63 A/3P
	2	N+1 (single supply)						
	2	2N	50 kW					
	3	N+1 (single supply)						
MCCB (125 kW)	3	2N	75 kW	400 A	3 x 250 A/3P	Hot-swappable switch	48 x 10 A/1P or 48 x 16 A/1P or 48 x 20 A/1P or 48 x 32 A/1P or 48 x 40 A/1P or 48 x 63 A/1P	8 x 10 A/3P or 8 x 16 A/3P or 8 x 20 A/3P or 8 x 32 A/3P or 8 x 40 A/3P or 8 x 63 A/3P
	4	N+1 (single supply)						
	4	2N	100 kW					
	5	N+1 (single supply)						
	5	2N	125 kW					
	6	N+1 (single supply)						
ATS (50 kW)	3	N+1 (dual supplies)	50 kW	250 A	3 x 160 A/3P	Non-hot-swappable switch	48 x 40 A/1P	8 x 40 A/3P 8 x 63 A/3P
ATS (125 kW)	6	N+1 (dual supplies)	125 kW	400 A	3 x 250 A/3P	Non-hot-swappable switch	48 x 40 A/1P	8 x 40 A/3P 8 x 63 A/3P

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- Switch type: MCCB or ATS
- Different redundancy modes can be set for the same number of modules.
- Main power input: 80–280 V wide voltage range

Power Supply and Distribution System - Integrated UPS (3)

- Integrated UPS configuration and technical specifications:

Item	Technical Specifications
Power system	Three-phase, four-wire + PE 380 V AC/400 V AC/415 V AC (line voltage)
Dimensions (H x W x D)	2000 mm x 600 mm x 1200 mm 2000 mm x 600 mm x 1100 mm
Main input	80–280 V AC (phase voltage) At 0–40° C: The UPS can work at full load when the voltage is 176–280 V AC and is derated to 40% load when the voltage is 80–176 V AC.
Branch	(Optional) Hot-swappable miniature circuit breaker (MCB)
Cable routing mode	Routed in and out from the top, routed in from the bottom and out from the top For 1100 mm deep cabinets, cables can only be routed in and out from the top.
Communications protocol	Connects to the ECC800 over Modbus-TCP.
IP rating	IP20

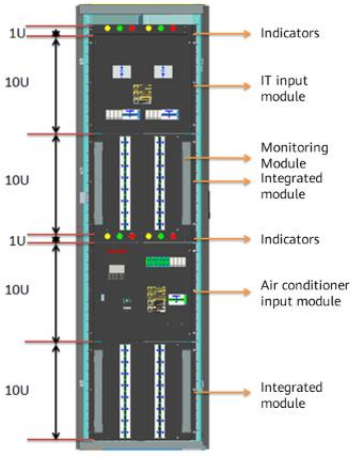
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- Switch type: MCCB or ATS
- Different redundancy modes can be set for the same number of modules.
- Main power input: 80–280 V wide voltage range

Power Supply and Distribution System - Integrated PDF (1)



Integrated PDF



Layout

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- Configuration description:
- The PDF is applicable to smart module B without the UPS and batteries.
- IT load total input capacity 250 A, output route 2 x 24 x 40 A/1P (During configuration, it is recommended that two circuit breakers be reserved for redundancy.)
- Air conditioner total input capacity 250 A/160 A, supports two configurations: two MCCB inputs (used when there are two mains supplies and air conditioners adopt dual inputs) and single MCCB input (used when there is one mains supply and air conditioners adopt single input). If the total input is 250 A, only single input is supported. For output routes, see the preceding table.

Power Supply and Distribution System - Integrated PDF (2)

Item	Technical Specifications (Applicable to Smart Module B)
Rated operating voltage	380 V AC/400 V AC/415 V AC
Dimensions (H x W x D)	• Basic dimensions: 2000 mm x 600 mm x 1100 mm, 2000 mm x 600 mm x 1200 mm • Extended dimensions: 2200 mm x 600 mm x 1200 mm (with a top frame)
Maintenance mode	Operated from the front and maintained from the rear
Weight	≤ 350 kg
Installation mode	Installed on an ESD floor or concrete floor
Cable routing mode	Routed in and out from the top, routed in from the bottom and out from the top For 1100 mm deep cabinets, cables can only be routed in and out from the top.
IP rating	IP20
Maximum power	N+1/2N: 145 kW
Total air conditioner input	Single/dual-supply: 250 A (145 kW)
	Single/dual-supply: 160 A (95 kW)

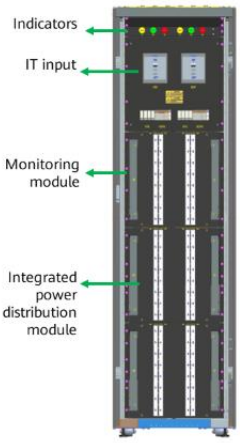
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- Configuration description:
- The PDF is applicable to smart module B without the UPS and batteries.
- IT load total input capacity 250 A, output route 2 x 24 x 40 A/1P (During configuration, it is recommended that two circuit breakers be reserved for redundancy.)
- Air conditioner total input capacity 250 A/160 A, supports two configurations: two MCCB inputs (used when there are two mains supplies and air conditioners adopt dual inputs) and single MCCB input (used when there is one mains supply and air conditioners adopt single input). If the total input is 250 A, only single input is supported. For output routes, see the preceding table.

Power Supply and Distribution System - Precision PDF



Precision PDF

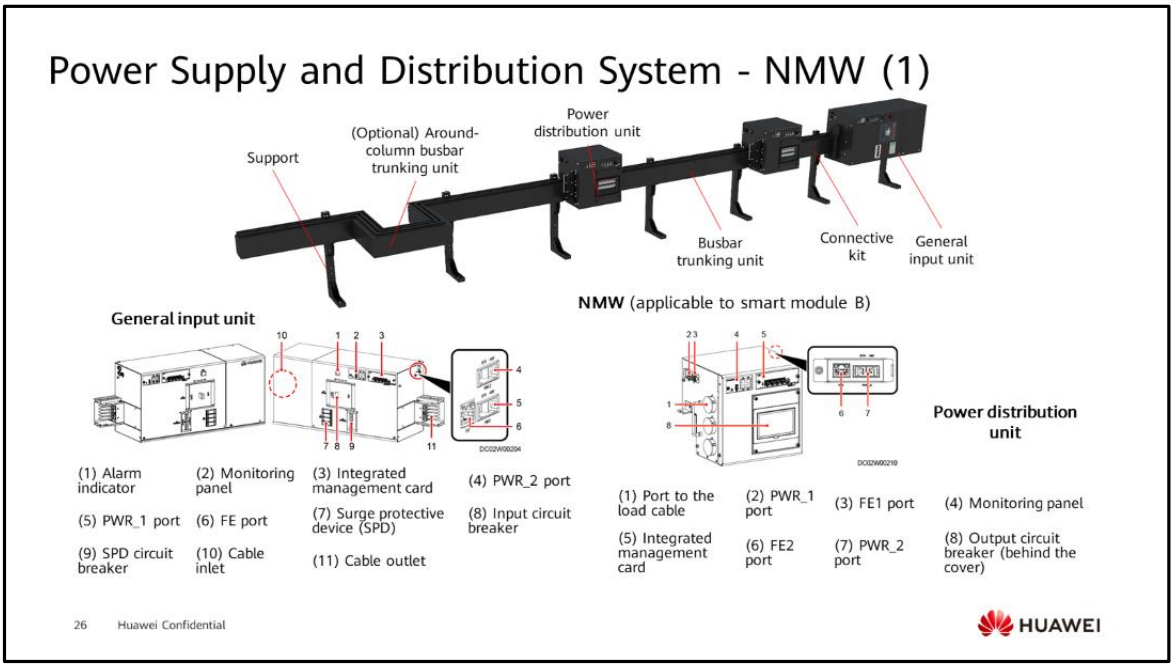


Layout

Item	Technical Specifications (Applicable to Smart Module B)
Dimensions (H x W x D, mm)	• Basic dimensions: 2000 x 600 x 1100 and 2000 x 600 x 1200 • Extended dimensions: 2200 (with a top frame) x 600 x 1200
Weight (kg)	< 400
Rated operating voltage (V)	380/400/415
Rated insulation voltage (V)	690
Rated frequency (Hz)	50/60
Rated operating current (A)	400/250/160
Enclosure IP rating	IP20
Output switch	• 40 A single-phase, maximum 144 routes (single-phase) • (Optional) Hot-swappable MCB

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- Configuration description:
- The PDF is applicable to smart module B. Air conditioner and lighting power distribution is deployed outside the PDF.
- The IT route circuits support a maximum of four groups of power distribution modules. Each group has twenty-four 40 A circuit breakers, connecting to a maximum of 48 cabinets.
- IT main input supports single- and dual-MCCBs with 400 A, 250 A, or 160 A current and a maximum of 235 kW power.
- During configuration, it is recommended that two circuit breakers be reserved for redundancy.



- The rated current of the general input unit is 250 A/400 A. The general input unit integrates the cable inlet switch and level C SPD, and provides the intelligent detection function. It can detect the voltage, current, active power, reactive power, power factor, electric energy, harmonic, and key node temperature.
- The 16 A/1P, 40 A/1P, 63 A/1P, 16 A/3P, and 40 A/3P MCBs can be used as branch switches of the power distribution unit. The hot-swappable MCB base can be flexibly configured. The power distribution unit is horizontally inserted into the busbar trunking unit and integrates the intelligent detection function.
- 1200 mm or 407 mm long, applicable to the column scenario; The space-saving flexible configuration supports a maximum of three power distribution units for a 1200 mm wide busbar trunking unit. The capacity can be expanded and adjusted flexibly with power on. The power density of a single cabinet is increased from 7 kW/cabinet to 21 kW/cabinet.
- The NMW supports the FE bus, which can implement the FE ring network. If any device fails, the system can work normally.
- Monitors the status of the cable inlet switch, SPD, and SPD switch in real time, and detects the electrical parameters, including the total input voltage, current, frequency, active power, reactive power, electricity, power factor, harmonic, neutral wire current, neutral-ground voltage, and key node temperature. Users can set two thresholds for a parameter. If the parameter is beyond its thresholds, a light alarm is raised.

Power Supply and Distribution System - NMW (2)

- NMW technical specifications

Item	Technical Specifications
Power system	Three-phase four-wire + PE
Rated operating voltage	380 V AC/400 V AC/415 V AC
Rated operating current at 40° C	250 A/400 A
Input switch	• 1 x 250 A/3P MCCB • 1 x 400 A/3P MCCB
Output switch	6 x 40 A/1P MCB
Rated transient withstand current	10 kA, 1s
Rated frequency	50 Hz/60 Hz
IP rating	IP30
Cable routing mode	Routed in from the end
Cable connection capacity	• 250 A rated current: 4 x 95 mm^2 + 1 x 50 mm^2 • 400 A rated current: 4 x 185 mm^2 + 1 x 95 mm^2

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- The rated current of the general input unit is 250 A/400 A. The general input unit integrates the cable inlet switch and level C SPD, and provides the intelligent detection function. It can detect the voltage, current, active power, reactive power, power factor, electric energy, harmonic, and key node temperature.
- The 16 A/1P, 40 A/1P, 63 A/1P, 16 A/3P, and 40 A/3P MCBs can be used as branch switches of the power distribution unit. The hot-swappable MCB base can be flexibly configured. The power distribution unit is horizontally inserted into the busbar trunking unit and integrates the intelligent detection function.
- 1200 mm or 407 mm long, applicable to the column scenario; The space-saving flexible configuration supports a maximum of three power distribution units for a 1200 mm wide busbar trunking unit. The capacity can be expanded and adjusted flexibly with power on. The power density of a single cabinet is increased from 7 kW/cabinet to 21 kW/cabinet.
- The NMW supports the FE bus, which can implement the FE ring network. If any device fails, the system can work normally.
- Monitors the status of the cable inlet switch, SPD, and SPD switch in real time, and detects the electrical parameters, including the total input voltage, current, frequency, active power, reactive power, electricity, power factor, harmonic, neutral wire current, neutral-ground voltage, and key node temperature. Users can set two thresholds for a parameter. If the parameter is beyond its thresholds, a light alarm is raised.

Power Supply and Distribution System - NMW (3)

- Monitoring parameters for the NMW

Item	Technical Specifications
Main power input	Detects the voltage, current, active power, reactive power, power factor, electric energy, harmonic, and key node temperature.
Branch power output	Detects the branch/loop current, load percentage, active power, apparent power, electric energy, and key node temperature.

- NMW highlights

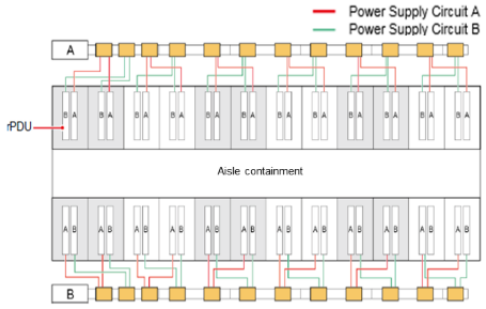
Item	Highlight
High efficiency and fast delivery	Space saving: saves the IT cabinet space.
	Easy maintenance: shortens maintenance time.
	Easy capacity expansion: expands capacity by adding busbar trunking units.
Secure, reliable, and flexible O&M	Reliability: uses a foolproof structure with installation position marks and spacing measures.
	Easy O&M: can be easily maintained as the NMW is highly reliable and allows users to replace power distribution units; can be maintained from the aisle.
	Installation: shortens installation time.
Intelligent monitoring and flexible management	Easy to network through an FE port to implement teleindication, telemetering, and teleadjusting.
	Flexible to manage and monitor the PUE and maintenance.

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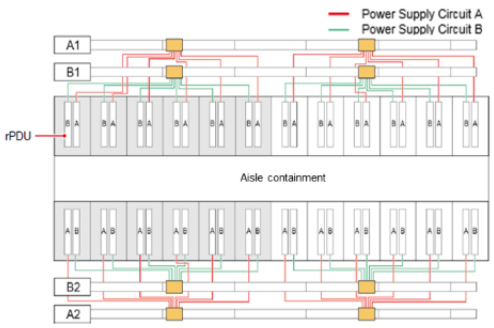
- The rated current of the general input unit is 250 A/400 A. The general input unit integrates the cable inlet switch and level C SPD, and provides the intelligent detection function. It can detect the voltage, current, active power, reactive power, power factor, electric energy, harmonic, and key node temperature.
- The 16 A/1P, 40 A/1P, 63 A/1P, 16 A/3P, and 40 A/3P MCBs can be used as branch switches of the power distribution unit. The hot-swappable MCB base can be flexibly configured. The power distribution unit is horizontally inserted into the busbar trunking unit and integrates the intelligent detection function.
- 1200 mm or 407 mm long, applicable to the column scenario; The space-saving flexible configuration supports a maximum of three power distribution units for a 1200 mm wide busbar trunking unit. The capacity can be expanded and adjusted flexibly with power on. The power density of a single cabinet is increased from 7 kW/cabinet to 21 kW/cabinet.
- The NMW supports the FE bus, which can implement the FE ring network. If any device fails, the system can work normally.
- Monitors the status of the cable inlet switch, SPD, and SPD switch in real time, and detects the electrical parameters, including the total input voltage, current, frequency, active power, reactive power, electricity, power factor, harmonic, neutral wire current, neutral-ground voltage, and key node temperature. Users can set two thresholds for a parameter. If the parameter is beyond its thresholds, a light alarm is raised.

Power Supply and Distribution System - NMW (3)

- Power distribution diagram of the NMW



N+1 system power distribution diagram

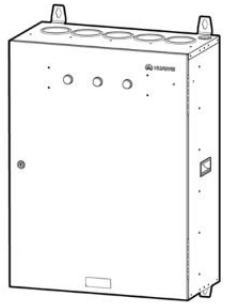


2N system power distribution diagram

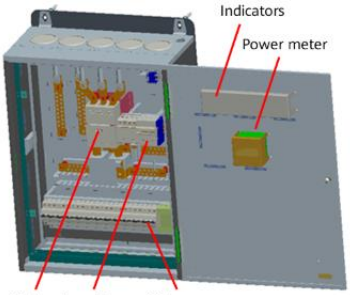
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- N+1 dual-row with two busbar trunking units: In this scenario, each trunking unit supplies power only to the cabinets in the same row. The adjacent power distribution unit supplies power to the rPDUs. Configure one general input unit at the end of each row.
- 2N dual-row with four busbar trunking units: In this scenario, each row of cabinets exclusively uses two busbar trunking units, and cables do not need to be routed across skylights. Configure two general input units at the end of each row.

Power Supply and Distribution System - Smart Cooling Product PDB



Smart cooling product (precision air conditioner) PDB



Item	Technical Specifications (Applicable to Smart Module B)
Rated operating voltage	380 V/400 V/415 V
Rated frequency	50 Hz/60 Hz
Rated operating current	160 A/250 A/400 A
Input switch	160 A/3P MCCB, 250 A/3P MCCB, 400 A/3P MCCB
Output switch	• Rated current 160 A 8 x 40 A/3P + 2 x 10 A/1P + 1 x 32 A/1P MCBs • Rated current: 250 A/400 A 8 x 63 A/3P + 2 x 10 A/1P + 1 x 32 A/1P MCBs
IP rating	IP20
Installation mode	Wall-mounted

The smart cooling product PDB can supply power to smart cooling products and aisle lighting in the precision PDF or NMW scenario.

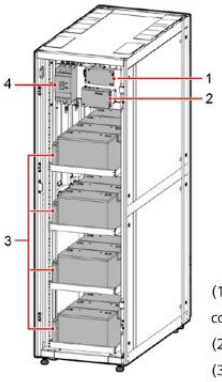
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- The smart cooling product PDB can supply power to smart cooling products and aisle lighting in the precision PDF or NMW scenario.

Power Supply and Distribution System - Battery Cabinet



Battery cabinet



Layout

(1) BIB (battery control I/O board)
(2) iBOX (CIM)
(3) Batteries
(4) Circuit breaker

Item	Technical Specifications
Dimensions (H x W x D)	• Basic dimensions: 2000 mm x 600 mm x 1100 mm • Extended dimensions: 2200 mm x 600 mm x 1100 mm (with a top frame) • Basic dimensions: 2000 mm x 600 mm x 1200 mm • Extended dimensions: 2200 mm x 600 mm x 1200 mm (with a top frame)
Color	Black (PANTONE 426C/RAL 9005)
Air channel	Front and rear air channels
Installation space	42 U available space
Installation mode	Installed on an ESD floor or concrete floor
Door opening mode	The front door is a single door, and the rear door is a double one.
Weight	128 kg (excluding batteries)
IP rating	IP20

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- The battery cabinet is used in the smart module A solution.

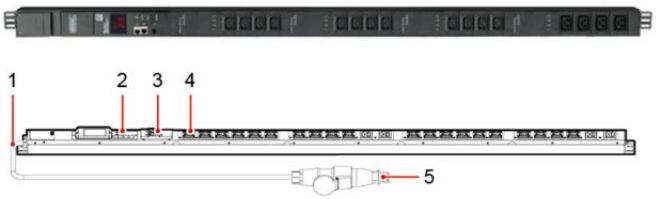
Power Supply and Distribution System - rPDU

rPDU



Full-height rPDU Half-height rPDU

(Optional) Smart rPDU



(1) Input power cable (2) Main control module (3) Hydraulic circuit breaker (4) Output sockets (5) Industrial connector

(Optional) Smart rPDU	Monitoring function
The smart rPDU accurately and effectively monitors the real-time status changes of the current, voltage, power, and electric energy of electrical devices in the data center.	Monitors the input power, voltage, current, power factor, and electric energy.
	Monitors the power, current, power factor, and electric energy of each output.

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- There are two types of PDUs: standard rPDU and optional smart rPDU.

Contents

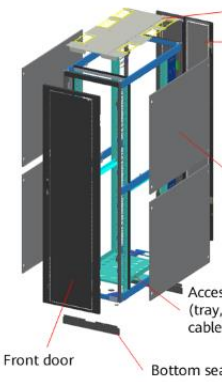
1. FusionModule2000/5000 Product Description
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3. **FusionModule2000/5000 Hardware**
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   - Cooling System
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Cabinet and Aisle System - IT Cabinet/Network Cabinet

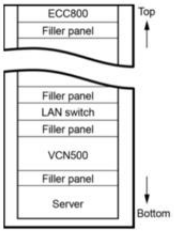


Cabinet



Layout

Layout of monitored components in the network cabinet



Cabinet Type	Specifications	
IT/Network cabinet (Standard EIA 19-inch cabinet)	H*W*D	2000 mm x 600 mm x 1200 mm (42 U)
		2000 mm x 600 mm x 1100 mm (42 U)
		2200 mm x 600 mm x 1200 mm (47 U)
		2000 mm x 800 mm x 1200 mm (42 U)
		2000 mm x 800 mm x 1100 mm (42 U)
		2200 mm x 800 mm x 1200 mm (47 U)

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- The cabinet has the following features:
- The ventilation rate of the front and rear doors is at least 70%.
- Two rPDUs can be vertically installed at the rear inside the cabinet.
- The position of each U is marked on the vertical mounting bars.
- The front and rear doors of the cabinet can be locked, and can be unlocked only by dedicated keys.
- The cabinet supports a door status sensor and electronic access control.
- The maximum static load of the cabinet is 1800 kg.

Cabinet and Aisle System - Skylight



Control skylight

Control skylights are installed on both ends of an aisle and used to install monitoring components such as the camera, multi-functional sensor, and smoke detector.

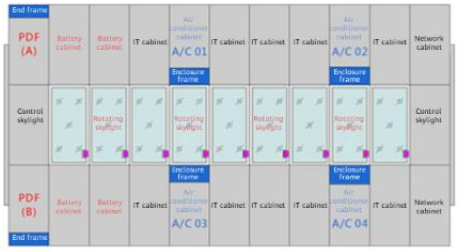


Flat or rotating skylight

A rotating skylight requires a magnetic lock but a flat skylight does not.

Skylight configuration description:

1. Install a control skylight at the end and head of a row. Install a control skylight in the middle of cabinets if there are more than 12 cabinets in a single row. (The infrared function covers about 4 m.)
2. When installing a flat skylight, note the skylight labels and ensure that electromagnets are in the same direction.
3. Install rotating skylights and flat skylights alternately in the middle of control skylights.



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- Control skylights are installed on both ends of an aisle and used to install monitoring components such as the camera, multi-functional sensor, and smoke detector.
- If the smart module is longer than 7 m, add one control skylight in the middle of the smart module for installing a multi-functional sensor or smoke detector.

Cabinet Aisle System - Aisle End Door



Sliding door

Sliding door configuration principles:

1. The sliding door can be installed only in the dual-row contained aisle.
2. The sliding door supports the pad mounting kit and access control system.
3. The appearance of an electric sliding door is the same as that of a common sliding door. Automatic door guide rails are used.



Revolving door

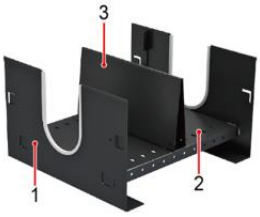
Revolving door configuration principles:

1. The revolving door can be installed only in the single-row aisle.
2. The access control system and lighting switches can be installed.

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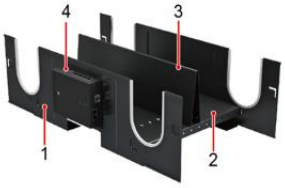
Cabinet Aisle System - Cable Trough and Cable Tray

- Cabinet cable troughs are categorized into signal cable troughs and power cable troughs, which are used to route signal cables and power cables respectively. This ensures that extra-low voltage (ELV) cables are separated from electrical cables.



(1) Side plate (2) Supporting plate (3) Partition plate

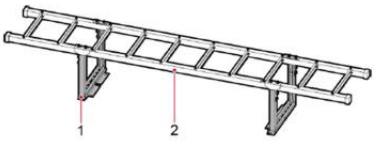
300 mm wide cable trough



(1) Side plate (2) Supporting plate (3) Partition plate

(4) Position for the smart ETH gateway

600 mm or 800 mm wide cable trough



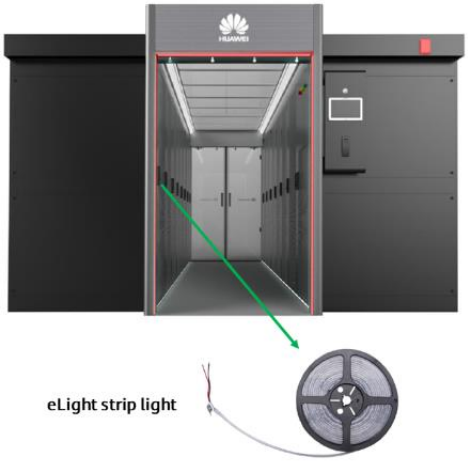
(1) Cable ladder support (2) Cable ladder

Cable tray (optional)

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- Cable tray configuration principles:
- The width of the cable trough can be 300 mm, 600 mm, or 800 mm.
- The four types of 600 mm wide cable troughs share a same BOM number and are used in two cabinets. The other two types of cable troughs share a same BOM number and are used in one cabinet.
- The cable trough is installed on the top of the cabinet. Components are clamped and tools are not required (except for an equipotential ground bolt).

Cabinet Aisle System - eLight (Optional)



Scenario	Light Color	Description
Non-associated alarm	Blue	-
Entrance	• If access control authorization succeeds, the green light blinks for 3 seconds, indicating that the door can be opened. • If access control authorization fails, the red light blinks for 3 seconds, indicating that the door cannot be opened.	Associated with the access control for an end door.
Associated alarm	Mapping between smart module alarm severities and strip light colors: • Critical alarm: red • Major alarm: orange • Minor alarm: yellow • Warning: gray No alarm: light off	Critical and major alarms are associated by default. Alarms of any severity can be associated manually. Alarms are associated with the eLight on both ends. If associated alarms of multiple severities appear, the strip light color indicates only the highest alarm severity.
eLight fault	The eLight blinks red when disconnecting from the ECC800.	-

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- Description of the eLight:
- Contains the 5.65 m LED flexible strip light, power supply, actuator, and cables.
- Connects the actuator to the COM port on the ECC800 from the nearest rPDU.
- The 2 m and 2.2 m doors use the same flexible strip light. When the 2 m door is used, the extra flexible strip lights are placed in the post and the cables are fixed to the post.
- The door must be an automatic door or a new common door. It does not apply to the simple aisle door of the carrier's version.

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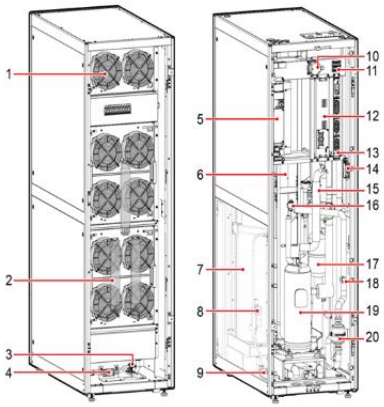
Cooling System - Air Cooled Precision Air Conditioner (1)



NetCol5000-A025



NetCol5000-A042



NetCol5000-A042 components

(1) Fan	(2) Electric heater
(3) Condensate pump	(4) Water drainage one-way valve
(5) Electrical box	(6) Evaporator
(7) Wet film humidifier	(8) Water inlet solenoid valve
(9) Humidifier pump	(10) Differential pressure switch
(11) Signal terminal block	(12) Compressor driver
(13) ELV box	(14) T/H sensor
(15) Discharge pipe	(16) Electronic expansion valve
(17) Oil separator	(18) Sight glass
(19) Compressor	(20) Filter dryer

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Cooling System - Air Cooled Precision Air Conditioner (2)

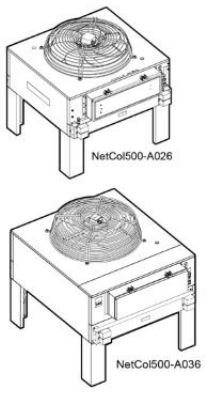
- Technical specifications of the air cooled in-row precision air conditioner:

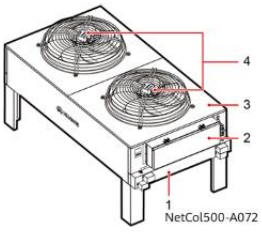
Item	NetCol5000-A025	NetCol5000-A042
Cooling mode	Air cooling	
Refrigerant	R410A	
Cooling capacity	25 kW	42 kW
Airflow mode	Horizontal airflow	
Dimensions (H x W x D)	• 2000 mm x 300 mm x 1100 mm (cabinet) • 2000 mm x 300 mm x 1200 mm (with an enclosure frame) • 2200 mm x 300 mm x 1200 mm (with a top frame and an enclosure frame)	• 2000 mm x 600 mm x 1100 mm (cabinet) • 2000 mm x 600 mm x 1200 mm (with an enclosure frame) • 2200 mm x 600 mm x 1200 mm (with a top frame and an enclosure frame)
Power supply specifications	380–415 V AC, 50 Hz/60 Hz, 3Ph+N+PE Tolerance: rated voltage –10% to +10%, rated frequency ±3 Hz	

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Cooling System - Air Cooled Precision Air Conditioner (3)

Outdoor unit





(1) Condenser (2) Electric control box

(3) Rack (4) Fans

Mapping between indoor and outdoor units

Indoor Unit	Outdoor Unit	For Short
NetCol5000-A025	NetCol500-A026SC11E0	NetCol500-A026
	NetCol500-A0265S11E0	NetCol500-A026
	NetCol500-A0365C11E0	NetCol500-A036
NetCol5000-A042	NetCol500-A0365C11E0	NetCol500-A036
	NetCol500-A0365S11E0	NetCol500-A036
	NetCol500-A0725C11E0	NetCol500-A072

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Cooling System - Chilled Water Precision Air Conditioner (1)



NetCol5000-C030 NetCol5000-C032

Item	Specifications
Power system	208–240 V AC, 1Ph, 50 Hz/60 Hz One primary power input and one standby power input
Cooling mode	Chilled water
Rated cooling capacity	30 kW/32 kW
Humidification capacity (optional)	1.5 kg/h
Airflow mode	Horizontal airflow
Fan type	EC fan
Rated air volume	5000 m^3/h, 5400 m^3/h
Air filter	G4
Dimensions (H x W x D)	2000 mm x 300 mm x 1200 mm 2000 mm x 300 mm x 1200 mm
Piping/Cabling	Bottom piping, top cabling
Outdoor ambient operating temperature	4° C to 55° C

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Cooling System - Chilled Water Precision Air Conditioner (2)


NetCol5000-C065


NetCol5000-C080

Item	Specifications
Power system	208–240 V AC, 1Ph, 50 Hz/60 Hz One primary power input and one standby power input
Cooling mode	Chilled water
Rated cooling capacity	65 kW/80 kW
Humidification capacity (optional)	3 kg/h
Airflow mode	Horizontal airflow
Fan type	EC fan
Rated air volume	10000 m^3/h/12000 m^3/h
Air filter	G4
Dimensions (H x W x D)	2000 mm x 600 mm x 1200 mm 2500 mm x 600 mm x 1200 mm
Piping/Cabling	Bottom piping, top cabling
Outdoor ambient operating temperature	4° C to 55° C

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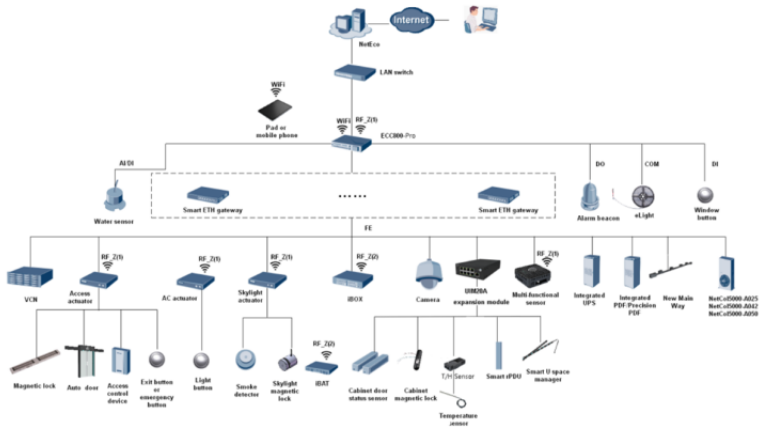
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Monitoring System Architecture

- In the single-module scenario, an ECC800 serves as the core management component to manage devices and schedule functions.
- In multi-module scenarios, the NetEco is deployed to manage multiple smart modules in a unified manner.

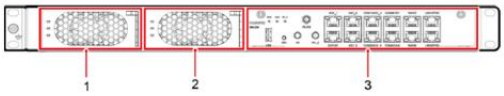


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- Each smart module provides an independent and integral interface for environment and power monitoring. This interface constantly monitors the power supply and distribution equipment, smart cooling products, T/H sensors, water sensors, smoke detectors, and video surveillance equipment inside the module. If a component fault or parameter error is detected, alarms are generated in diverse modes such as indicator light, email, and short message service (SMS). Historical data and alarm events are recorded, and all monitoring information is reported to the management platform.
- The PAD or mobile phone app can be used to query device information in real time, facilitating mobile O&M.
- To improve the reliability of the monitoring system, Ethernet ring bus networking is used for intelligent node signal transmission and sensor power supply.

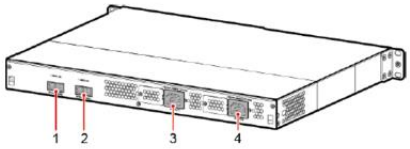
Monitoring System - ECC800-Pro

- An ECC800-Pro data center controller monitors the devices and environment in the smart module. It consists of the power supply unit (PSU) and main control module. PSUs are pluggable.



(1) Slot 1: PSU (2) Slot 2: PSU

(3) Slot 3: main control module



(1) 53.5 V DC_OUT1 (2) 53.5 V DC_OUT2 (3) AC_INPUT1

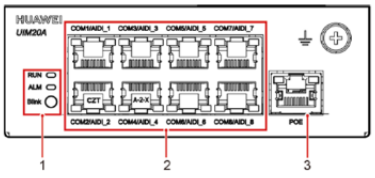
(4) AC_INPUT2

Item	Specifications
Operating temperature	–20° C to +50° C
Storage temperature	–40° C to +70° C
Relative humidity	5%–95% RH (non-condensing)
Altitude	0–4000 m (When the altitude is between 3000 m and 4000 m, the temperature decreases by 1° C for each additional 200 m.)
Dimensions (H x W x D)	43.6 mm x 442 mm x 330 mm
Weight	7.5 kg (dual PSUs + main control module)
Color	Black
Installation requirement	Can be installed in a 1 U space in a standard 19-inch cabinet

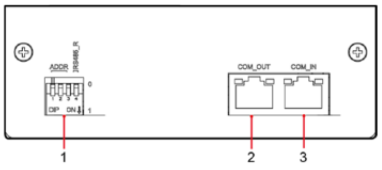
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- There are two configuration modes:
- Mode 1 (typical configuration): one PSU and one main control module
- Mode 1: two PSUs and one main control module

Monitoring System - UIM20A Expansion Module



(1) Indicators and button (2) COM1/AIDI_1–COM8/AIDI_8 (3) PoE port



(1) DIP switch (2) COM_OUT (3) COM_IN

Item	Specifications
Power input	• Power is supplied over the PoE port or RS485 port.
COM/AIDI (RJ45)	• Supports eight RS485 or AI/DI signal inputs. • Can connect to sensors such as the smoke detector, water sensor, door status sensor, and infrared sensor. • Each port can supply power. Two RJ45 ports share one 12 V DC power supply that is controlled independently. The maximum output current is 900 mA when the voltage is 12 V. (COM1/AIDI_1 and COM2/AIDI_2 form a group. COM3/AIDI_3 and COM4/AIDI_4 form a group. COM5/AIDI_5 and COM6/AIDI_6 form a group. COM7/AIDI_7 and COM8/AIDI_8 form a group.) • The 12 V DC power supply can be shut down. By default, it is connected to the ECC800-Pro through the PoE port.
DIP switch	One 4-bit DIP switch is used to set the RS485 address. OFF indicates 0, and ON indicates 1. Bit 1 indicates the least significant bit, and bit 4 indicates the most significant bit. For example, if the board address is 5, the corresponding switch settings are ON, OFF, ON, and OFF, and the corresponding binary number is 1010 (ON is 1 and OFF is 0).
COM_IN and COM_OUT (reserved)	• Used for cascading ports when the expansion module replaces the independent deployment module. • In this scenario, the eight COM or AI/DI RS485 ports on the front panel are no longer used. • Used as a southbound port.
E-label 4.0	• Supported

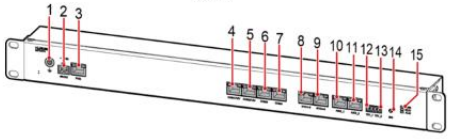
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Monitoring System - Rack Environment Unit (Optional)



Rack



(1) Ground port
(2) 48 V DC power input port
(3) PoE port
(4) COM1/12V port
(5) COM2/12V port
(6) COM3 port
(7) COM4 port
(8) NTC1–3 port
(9) NTC4–6 port
(10) AI/DI_1 port
(11) AI/DI_2 port
(12) 12V_1 port
(13) 12V_2 port
(14) BLINK button
(15) Status indicator

A rack environment unit collects and controls the environmental data of IT cabinets.

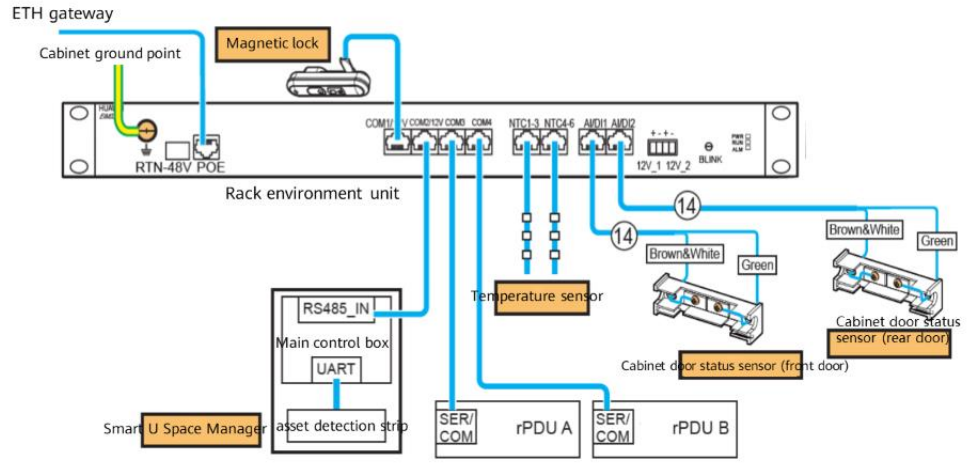
It is usually installed on the top of the rear door of the IT cabinet. Installation mode: rack-mounted

Item	Specifications
Power input	• DC input: Phoenix terminal, input voltage range: 36–60 V DC • PoE power supply: one PoE port that complies with IEEE802.3at
12 V power output	Two 12 V DC power outputs with the rated output current of 250 mA
FE port	FE communication with a communications rate of 10/100M
RS485 serial port expansion	• Four RS485 ports with the default communications rate of 9600 bit/s • Among the four RS485 ports, two support 12 V DC power output with the rated current of 400 mA. • The other two are isolated, with the default communications rate of 9600 bit/s, and do not support power output.
AI/DI input	Two active AI/DI input ports with the rated voltage of 12 V DC and rated current of 200 mA
Temperature sensor port	Two RJ45 ports to connect to six temperature sensors, each RJ45 port connecting to three temperature sensors

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Monitoring System - Networking of the Rack Environment Unit

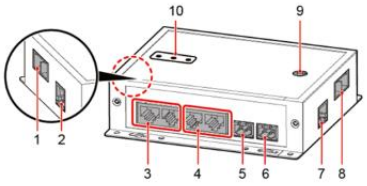


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Monitoring System - Smart ETH Gateway



Smart ETH gateway



Smart ETH gateway

(1) PWR_IN cascading power port
(2) FE_1 cascading signal port
(3) PoE_1–2 ports
(4) PoE_3–4 ports
(5) 48V_OUT1 power output port
(6) 48V_OUT2 power output port
(7) FE_2 cascading signal port
(8) PWR_OUT cascading power port
(9) BLINK button
(10) Status indicators

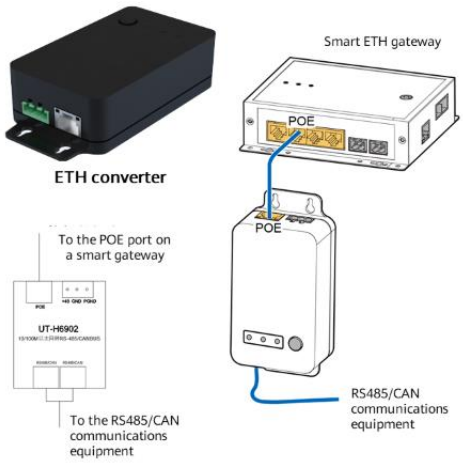
A smart ETH gateway provides 53.5 V DC power supply and FE communication expansion for the ECC800, implements PoE networking, and can be flexibly deployed in a smart module.

It is installed outside the cable trough on the top of the smart module cabinet. Installation mode: mounted on the guide rail

Item	Description
1	Six-port 10/100M Ethernet switch
2	Four network ports, supporting 802.3af/at PSE power supply
5	Storage and forwarding functions to ensure adaptivity and data integrity
6	Automatic address learning function
8	Cascading port supporting the ring network

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Monitoring System - ETH Converter



An ETH converter converts a RS485/CAN port to an FE port and provides a channel for the device to access the POE bus.

An ETH converter is installed on the magnetic cable trough. Installation mode: magnetically mounted or secured by screws

Function	Description
Communication	One FE port and one RS485/CAN port (physical port cascading supported)
DEBUG port	One RS232 port
Installation mode	Magnetically mounted or wall mounted
Indicator	Three LED indicators on the board

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Monitoring System - WiFi Module



WiFi module

The WiFi module provides WiFi signals for devices such as tablets and mobile phones to interact with the host.

It is connected to the USB port on the ECC800.

Installation mode: plugged

Item	Specifications
Wireless standard	IEEE 802.11n, IEEE 802.11g, and IEEE 802.11b
Network speed	• 11n: up to 150 Mbit/s • 11g: up to 54 Mbit/s • 11b: up to 11 Mbit/s
Frequency band	2.4–2.4835 GHz
Wireless transmission power	20 dBm (MAX EIRP)
Supported OSs	Windows 2000/Windows XP/Vista/Linux/Windows 7
Connector	USB 2.0 Hi-Speed connector
Voltage range	5.0 V DC ± 5%
Operating temperature and relative humidity	–20° C to +70° C, 10%–90% RH, non-condensing
Storage temperature and relative humidity	–40° C to +90° C, 5% RH–90% RH, non-condensing
Power	< 0.8 W

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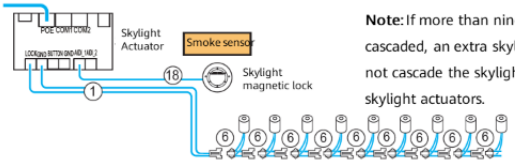
- IEEE: Institute of Electrical and Electronics Engineers

Monitoring System - Skylight Actuator



Skylight actuator

A skylight actuator controls the rotating skylights in the aisle containment of a modular data center. It controls rotating skylights in the aisle based on the alarm linkage information or the control information of the host. It receives the three-in-one sensor, smoke sensor, and equipment room fire control signals, controls skylight rotation, and supports PoE and wireless networking.
A skylight actuator is installed inside the door head of the smart module. Installation mode: mounted on the guide rail



Note: If more than nine skylight magnetic locks are cascaded, an extra skylight actuator is required. Do not cascade the skylight magnetic locks of two skylight actuators.

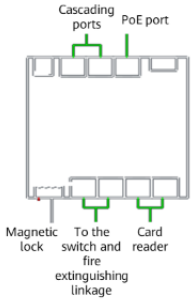
Function	Description
DI detection	Three routes to detect fire linkage signals and control the manual skylight open button, one route reserved
DO output	One 1.5 A 12 V power output to power the skylight magnetic lock
Communication	One FE port and one ZigBee wireless port, both of which are used for backup
DEBUG port	One RS232 port
4-pin DIP switch	One 4-pin DIP switch, used for setting the board address (1 by default)
ZigBee reset button	Press the button for less than 1 second to start blinking. Hold down the button for 1–5 seconds to search for a network and start networking. Hold down the button for more than 6 seconds to clear network parameters.
Alarm recording	Recording alarms
Indicator	Four LED indicators on the board

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Monitoring System - Access Actuator



Access actuator



An access actuator opens the magnetic lock by detecting the card swiping information of the card reader, exit button information, and data center fire linkage information. It provides access right management, access event record, and alarm record functions. It supports PoE and wireless networking.

An access actuator is installed inside the door head of the smart module. Installation mode: mounted on the guide rail

Function	Description
DI detection	Three routes to detect the door status sensor, door open button, and fire linkage signals
Wiegand port	Two ports to connect to two card readers at the same time
DO output	One 1.5 A 12 V output to power the electronic door lock
Communication	One FE port, one ZigBee wireless port, and one RS485 port. The FE and ZigBee ports are used for backup and the RS485 port is reserved (physical port cascading supported).
DEBUG port	One RS232 port
4-pin DIP switch	One 4-pin DIP switch, used for setting the board address (1 by default)
ZigBee networking button	Press the button for less than 1 second to start blinking. Hold down the button for 1–5 seconds to search for a network and start networking. Hold down the button for more than 6 seconds to clear network parameters.
Access control management	Access permission management, access event record, and alarm record
Indicator	Four LED indicators on the board

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Monitoring System - Access Control System

- Other components in an access control system

Fingerprint and card reader with a password keypad Access control device



(1) Fingerprint reader
(2) LED indicator

Fingerprint and card reader



(1) Fingerprint reader
(2) LED indicator

Card reader with a keypad





Magnetic lock



Coded lock (optional)



Electronic lock

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Monitoring System - Video Surveillance

The video surveillance subsystem consists of the camera and VCN (a network video recorder) and implements real-time monitoring, video storage, and video playback.

The VCN is installed in the network cabinet of the smart module. Installation mode: rack-mounted

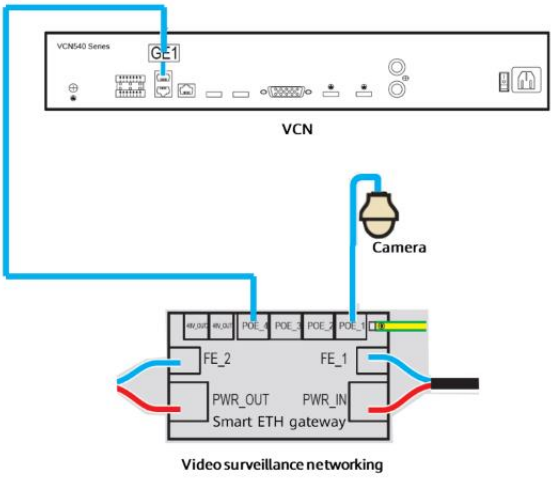
Cameras are installed on a control skylight. Installation mode: secured by screws



Camera



VCN



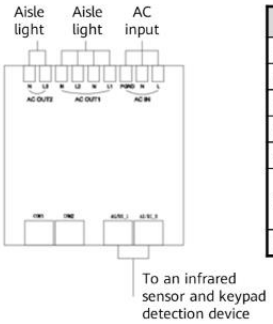
Video surveillance networking

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Monitoring System - AC Actuator



AC actuator



An AC actuator controls the lighting inside a smart module by receiving commands from the access control system or host, infrared linkage information (disabled by default), or signals from the light button. It also provides a charging port for the pad. It supports PoE and wireless networking.

An AC actuator is installed inside the door head of the smart module. Installation mode: mounted on the guide rail

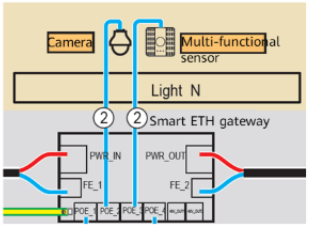
Function	Description
AC input	90–240 V AC
AC output	Two AC outputs, maximum current 5 A for each route, 90–240 V AC
Communication	One ZigBee wireless port (CC2530 of TI)
DI detection	Two routes reserved for DI detection
RS485 port	One RS485 port, not isolated (reserved)
ZigBee reset button	Press the button for less than 1 second to start blinking. Hold down the button for 1–5 seconds to search for a network and start networking. Hold down the button for more than 6 seconds to clear network parameters.
Power detection	Current, voltage, and power detection (total current and power)

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Monitoring System - Multi-Functional Sensor



Multi-functional sensor



Multi-functional sensor networking

A multi-functional sensor integrates the smoke sensor, infrared sensor, and temperature and humidity sensor and connects to the ECC800 controller system over FE or wireless communication.

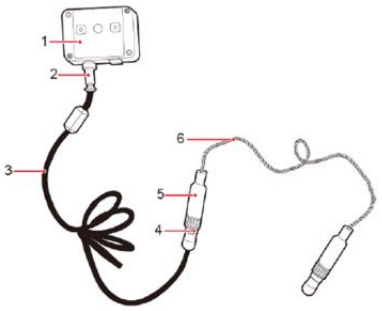
It is installed on a control skylight. Installation mode: secured by screws

Function	Description
Temperature and humidity detection	Detects the temperature and humidity.
Smoke detection	Detects the smoke density and generates alarms.
Infrared detection	Detects infrared motion and generates alarms.
4-pin DIP switch	One 4-pin DIP switch, used for setting the board address
Indicator	Three LED indicators on the component
Button	One wireless communication networking button and one smoke detector test button

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Monitoring System - Other Environment Monitoring Devices

WLDS900 water sensor



(1) Water detector (2) Conversion cable end A, connected to the water detector (3) Conversion cable (4) Conversion cable end B, connected to the water detection cable (5) Water detection cable end A, connected to the conversion cable (6) Water detection cable

Cabinet temperature sensor



Temperature and humidity sensor



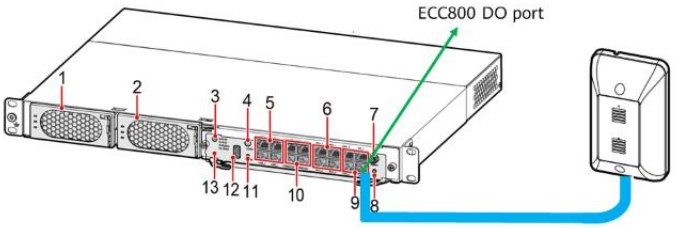
(1) Status indicator (2) RS485_IN port (3) RS485_OUT port (4) Address DIP switch

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Monitoring System - Alarm Beacon



Alarm beacon



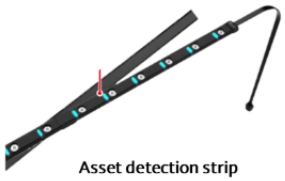
When fire or smoke is detected in a smart module data center, the alarm beacon generates an audible alarm and flashes to inform of fire and safety risks.

It is installed outside the smart module. Installation mode: mounted on a wall

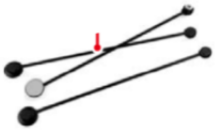
Item	Specifications
Power input	RJ45 port, input voltage: 9–16 V DC, operating current: ≤ 400 mA
Acoustic pressure	≥ 100 ± 3 dB@30 cm
Continuous operating duration	≥ 45 minutes

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Monitoring System - Smart U Space Manager (Optional)



Asset detection strip



U space e-label



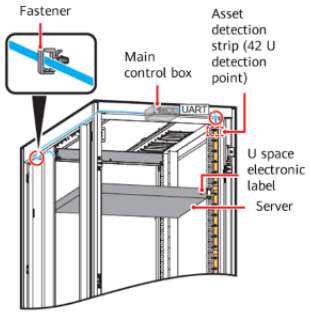
Main control box

A smart U space manager is used to manage IT assets of data centers. It automatically detects the physical locations of IT devices in data centers to implement functions such as IT asset code querying and U space usage information collection. For details about the networking, see the rack environment unit networking on the previous page.

The asset detection strip is usually installed on the left side of the front door of the cabinet. Installation mode: pasted

The U space e-label is connected to the device installation position based on the actual U space usage of the cabinet.

The main control box is usually installed on the top of the cabinet interior. Installation mode: magnetically mounted or secured by screws



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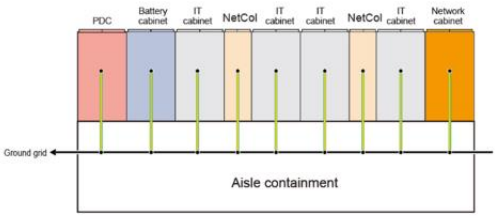
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1. FusionModule2000/5000 Product Description
2. FusionModule2000/5000 Application Scenarios
3. **FusionModule2000/5000 Hardware**
   - Power Supply and Distribution System
   - Cabinet Aisle System
   - Cooling System
   - Intelligent Management System
   - **Surge Protection and Grounding System**
   - Integrated Cabling System

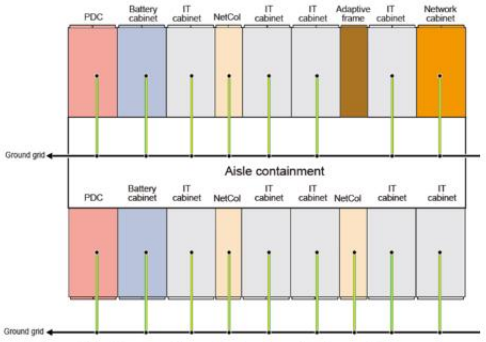
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Surge Protection and Grounding System

- Surge protection solution
  - SPDs are installed in front of the target equipment. The cable to each SPD should be short (within 0.15 m) and straight. The SPD cables are copper wires with a minimum cross-sectional area of 10 mm^2, and the ground cables to SPDs are copper cables with a minimum cross-sectional area of 16 mm^2.
- Grounding solution: Each cabinet is connected to the ground point and then to the ground bar of the data center.



M-shaped (grid) grounding solution for a single-row aisle containment



M-shaped (grid) grounding solution for a dual-row aisle containment

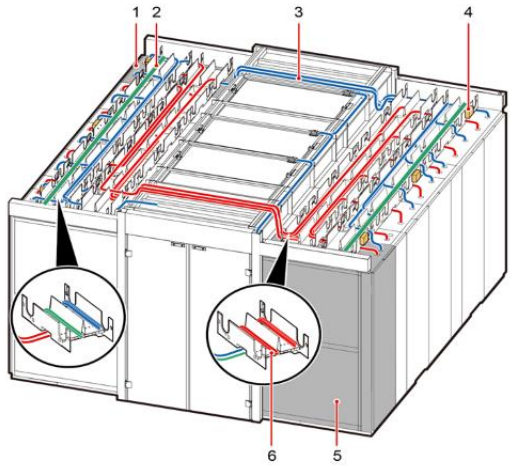
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   - Surge Protection and Grounding System
   - **Integrated Cabling System**

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Integrated Cabling System



- Cable layout principle
  - ELV cables and electrical cables are separate. The two types of cables are not routed in parallel.
  - The cabling is convenient to maintain.

(1) Network cabinet (2) Optical fiber cables (3) Signal cables

(4) Smart ETH gateway (5) PDF (6) Power cables

Note: For details about the installation, see the installation guide delivered with the device.

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- Cabling using cable troughs: Cable troughs can be installed on the top of cabinets to implement orderly cable management. There are two types of cable troughs: signal cable troughs and power cable troughs. If a dual-row aisle containment is equipped with one PDF and one network cabinet, power cables need to be routed to the other end of the module through the control skylight on the top of the PDF while signal cables need to be routed to the other end of the module through the control skylight on the top of the network cabinet.
- Cable
- The power cables include power cables to the UPS, battery cabinet, smart cooling product, and rPDU.
- The ground cables include ground cables to the PDU8000, battery cabinet, and IT cabinet.
- The monitoring cables include monitoring cables to the smart cooling product, UPS, and video devices, access control alarm cables, cables in the network cabinet, and various sensor cables.
- Cables to the fire extinguishing auxiliary components include cables to the alarm beacon and skylight actuator.

Quiz

1. (short-answer question) Which Huawei data center solution can be used in outdoor scenarios?
2. (short-answer question) What are the application scenarios of the FusionModule2000?
3. (short-answer question) What are the subsystems of the FusionModule2000?

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- Answer
- FusionModule1000
- Smart modules A and B
- Power supply and distribution system, cooling system, structural system, and monitoring system.

Summary

- This Chapter describes the subsystems of the FusionModule2000 and FusionModule5000, including the cabinet aisle system, power supply and distribution subsystem, cooling system, intelligent management system, surge protection and grounding system, and integrated cabling system. It also describes the main functions of each component.

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Thank you.

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每个组织，构建万物互联的智能世界。

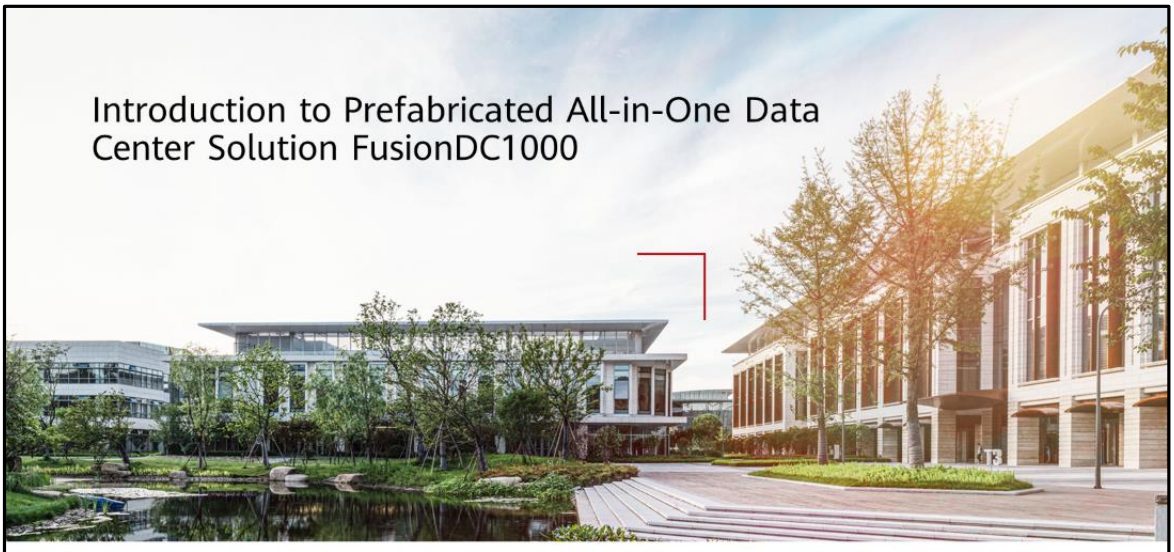
Bring digital to every person, home, and organization for a fully connected, intelligent world.

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Introduction to Prefabricated All-in-One Data Center Solution FusionDC1000



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Foreword

- This chapter describes the configurations and hardware of the FusionDC1000A outdoor scenarios.

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Objectives

On completion of this course, you will be able to:

- Have a basic understanding about the Huawei FusionDC1000 and its product positioning.
- Understand the typical configurations of the FusionDC1000A.
- Get familiar with the hardware of each FusionDC1000A subsystem.

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Contents

1. FusionDC1000 Product Description
2. FusionDC1000A Typical Configuration
3. FusionDC1000A Hardware

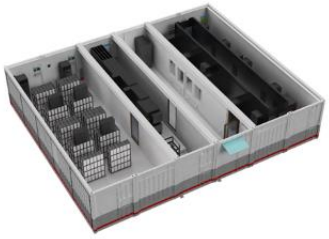
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Product Positioning

- The FusionDC1000, foundation for cloud computing in enterprise data centers, integrates power distribution, monitoring, cooling, racks, cabling, and fire extinguishing. It is characterized by good waterproof and antiseismic performances.
- The FusionDC1000 helps telecom operators and Internet operators to rapidly deploy data centers, and has unique advantages in fields such as disaster relief, military affairs, oil exploitation, survey, and enterprise data for its availability in outdoor environments.

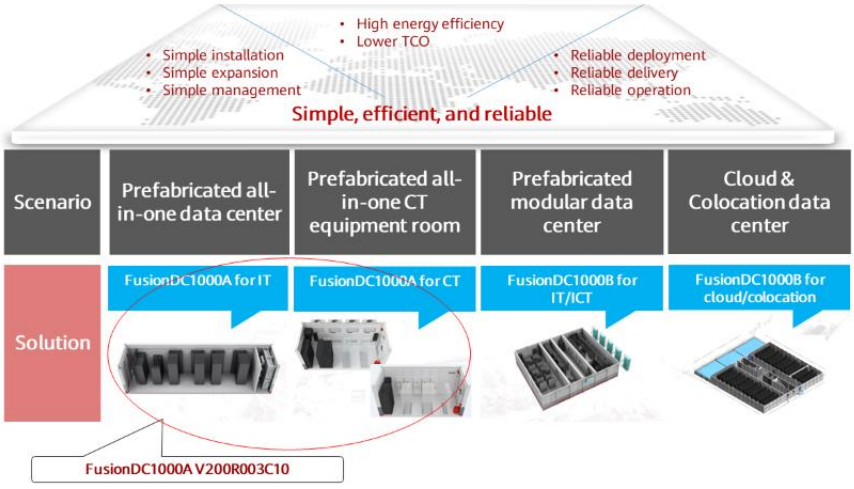


FusionDC1000A



FusionDC1000B

Prefabricated Data Center Solution Panorama



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FusionDC1000A Application Scenarios

- The FusionDC1000A is a prefabricated all-in-one data center solution that integrates the uninterruptible power supply (UPS), smart cooling product, and cabinets. It can be put into operation immediately after connecting to the tap water, power supply, and network.

Application scenarios and features

IT Equipment Room	Energy Industry	Governments	Large Enterprise	Other
• Equipment room construction and modernization • Distributed and mobile single-module deployment	• Distributed single-module deployment • Areas such as wilderness, mining areas, and deserts	• Distributed single-module deployment • Diverse environments such as industrial parks, campuses, and urban areas	• Primarily for internal use • Mobile fast deployment • High reliability class	• Distributed single-module deployment • Mostly in suburban areas • No equipment room is available



Mobile Application of FusionDC1000A



Application in an enterprise park



Application in harsh outdoor environments

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- Distributed and mobile single-module deployment applies to equipment room construction or modernization. The mobile part refers to the infrastructure. The FusionDC1000A cannot be transported with IT equipment, power modules, and batteries.
- The FusionDC1000A can be deployed as a small integrated data center (IDC) for enterprises in diverse environments such as the seaside, industrial parks, campuses, urban areas, and suburban areas to meet specific application requirements such as business blowout and capacity expansion.
- The FusionDC1000A supports distributed single-module deployment in outdoor areas such as wilderness, mining areas, and deserts to meet application requirements of the energy industry.

Contents

1. FusionDC1000 Product Description
2. **FusionDC1000A Typical Configuration**
3. FusionDC1000A Hardware

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FusionDC1000A Configuration (1)

Scenario	Category	Region	Module	Redundancy	Power	Voltage	Frequency	Working Condition	Fire Cylinder and Extinguishant	Cabinet Shock Absorption	IBAT	VESDA	rPDU
IT	Standard configuration	Outside China	40 ft	N+X	54 kW	380/400/415 V	50 Hz	Normal temperature	FM200 included	None	None	None	Basic
		Outside China	40 ft	2N	54 kW	380/400/415 V	50 Hz	Normal temperature	FM200 included	None	None	None	Basic
		In China	40 ft	N+X	54 kW	380/400/415 V	50 Hz	Normal temperature	FM200 included	None	None	None	Basic
	Advanced configuration	Outside China	40 ft	N+X	54 kW	380/400/415 V	50/60 Hz	Normal temperature	FM200 included	None	None	None	Basic
		Outside China	40 ft	2N	54 kW	380/400/415 V	50/60 Hz	Normal temperature	FM200 included	Supported	None	None	Basic
		Outside China	40 ft	2N	54 kW	380/400/415 V	50/60 Hz	Low temperature	FM200 included	Supported	None	None	Basic
		Outside China	40 ft	2N	42 kW	208 V	60 Hz	Normal temperature	FM200 included	Supported	None	None	Basic

- Note: The preceding table lists some typical configurations of the FusionDC1000A. Customization requirements are supported based on actual projects.

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- IT/CT: The IT solution is configured with the integrated UPS, server cabinet, and rack power distribution unit (rPDU). The cabinet height is 2 m. The CT solution is configured with a TP DC power system, without server cabinets or cables and terminals between the cabinets and power supply. The cabinet height is 2.2 m.
- Standard/Advanced configuration: Differs in module thickness (50/100 mm), outdoor unit compartment (grille/shutter), surge protection level (C/B), and cabinets (7 x 1100 mm deep cabinet/4 x 1200 mm deep cabinet + 3 x 1100 mm deep cabinet).
- Applicable area: The labels on components are classified into Chinese labels and English labels.
- 40 ft/20 ft: The version covers 40 ft IT-AIO and 20 ft CT-AIO.
- 208 V/380 V: different voltage systems
- 3C version/CE version: Different fire extinguishing systems. The 3C version uses Chinese-made 3C certified components, and the CE version uses CE certified components.

FusionDC1000A Typical Configuration (1)

- Aisle containment and cold and hot air isolation (380 V-N+X-standard configuration)



Outdoor unit of the precision air conditioner

Indoor unit of the 25 kW air cooled in-row precision air conditioner

Fire cylinder

Configuration specifications

Pre-fab. module: standard 40 ft pre-fab. module
Space: 8 x 42 U cabinet (1.1 m deep)
Power supply: integrated UPS x 1 + battery cabinet x 1
Backup power: 7.5 minutes at full load
Power density: 6–9 kW/cabinet
Total power: 54 kW
Cooling: in-row air cooled smart cooling product, 3+1 redundancy
Sensible cooling capacity: 25 kW per smart cooling product
Cold, hot aisle isolation and hot aisle containment

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FusionDC1000A Typical Configuration (2)

- Aisle containment and cold and hot air isolation (380 V-N+X-advanced configuration)



Configuration specifications

Pre-fab. module: standard 40 ft pre-fab. module
Space: 8 x 42 U cabinet (1.1 m & 1.2 m deep)
Power supply: integrated UPS x 1 + battery cabinet x 1
Backup power: 7.5 minutes at full load
Power density: 6–9 kW/cabinet
Total power: 54 kW
Cooling: in-row air cooled smart cooling product, 3+1 redundancy
Sensible cooling capacity: 25 kW per smart cooling product
Cold, hot aisle isolation and hot aisle containment

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- Differences between the advanced and standard configurations: The advanced configuration supports the 1.2 m deep cabinet, while the standard configuration supports only the 1.1 m deep cabinet.

FusionDC1000A Typical Configuration (3)

- Aisle containment and cold and hot air isolation (380 V-2N-standard configuration)



Outdoor unit of the precision air conditioner

Indoor unit of the 25 kW air cooled in-row precision air conditioner

Fire cylinder

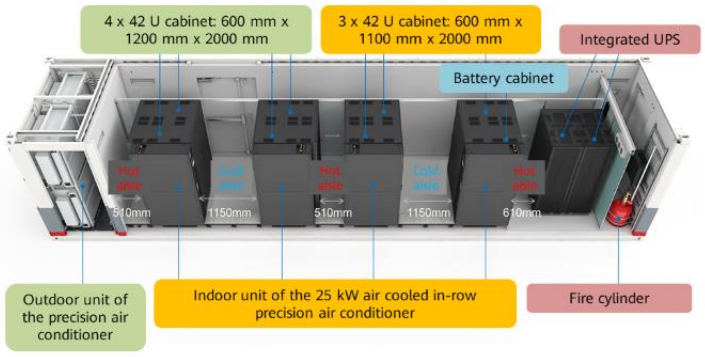
Configuration specifications

Pre-fab. module: standard 40 ft pre-fab. module
Space: 7 x 42 U cabinet (1.1 m deep)
Power supply: integrated UPS x 2 + battery cabinet x 1
Backup power: 10 minutes at full load
Power density: 6–9 kW/cabinet
Total power: 54 kW
Cooling: in-row air cooled smart cooling product, 3+1 redundancy
Sensible cooling capacity: 25 kW per smart cooling product
Cold, hot aisle isolation and hot aisle containment

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FusionDC1000A Typical Configuration (4)

- Aisle containment and cold and hot air isolation (380 V-2N-advanced configuration)



Configuration specifications

Pre-fab. module: standard 40 ft pre-fab. module
Space: 7 x 42 U cabinet (1.1 m & 1.2 m deep)
Power supply: integrated UPS x 2 + battery cabinet x 1
Backup power: 10 minutes at full load
Power density: 6–9 kW/cabinet
Total power: 54 kW
Cooling: in-row air cooled smart cooling product, 3+1 redundancy
Sensible cooling capacity: 25 kW per smart cooling product
Cold, hot aisle isolation and hot aisle containment

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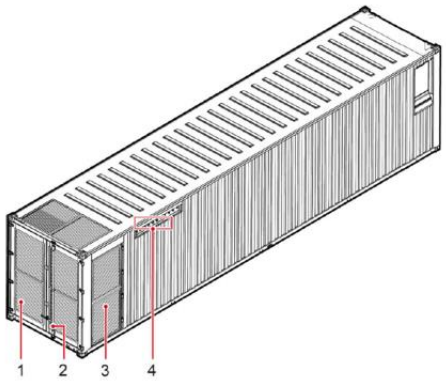
- Differences between the advanced and standard configurations: The advanced configuration supports the 1.2 m deep cabinet, while the standard configuration supports only the 1.1 m deep cabinet.

Contents

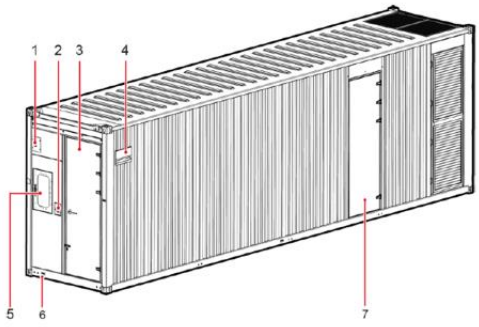
1. FusionDC1000 Product Description
2. FusionDC1000A Typical Configuration
3. **FusionDC1000A Hardware**
   - Pre-fab. Module Structural System
   - Power Supply and Distribution System
   - Cooling System
   - Intelligent Management System
   - Fire Extinguishing System
   - Surge Protection and Grounding System
   - Integrated Cabling System

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Structural System - FusionDC1000A Exterior



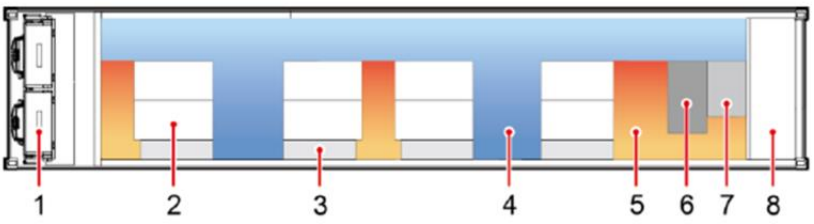
(1) End door (for maintaining outdoor units) (2) Lock rod
(3) Ventilation window for the outdoor unit compartment
(4) Pre-fab. module feeder windows



(1) External horn strobe (2) Card reader
(3) End door (main entrance) (4) Air exhaust window
(5) Fire control box (6) Ground point
(7) Emergency door

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Structural System - FusionDC1000A Interior

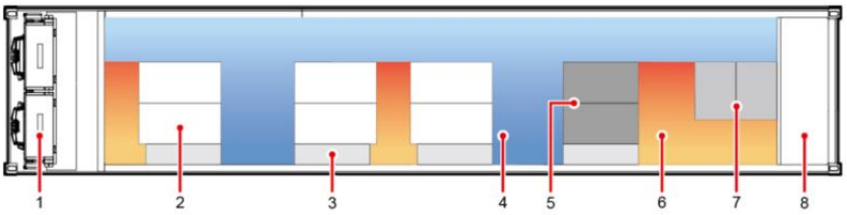


Interior of the N+X scenario

(1) Smart cooling product outdoor unit compartment
(2) IT cabinet
(3) Smart cooling product indoor unit
(4) Cold aisle
(5) Hot aisle
(6) Integrated UPS
(7) SmartLi
(8) Entrance room

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Structural System - FusionDC1000A Interior



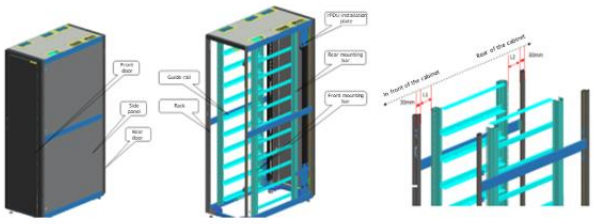
Interior of the 2N scenario

(1) Smart cooling product outdoor unit compartment
(2) IT cabinet
(3) Smart cooling product indoor unit
(4) Cold aisle
(5) Integrated UPS
(6) Hot aisle
(7) SmartLi
(8) Entrance room

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- The 2N scenario has one more integrated UPS than the N+X scenario.

Structural System - Cabinet



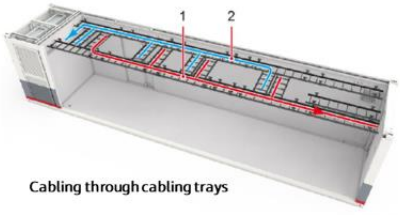
- Distance between the cabinet guide rails (21240734) on mounting bars: 700 mm/725 mm/750 mm
- The cabinet is evaluated based on the single-side vertical full-height/half-height rPDU. The rPDU is installed on the beam of the cabinet using tapping screws. No mounting plate is required.
- Basic cabinet parameters: static load ≤ 1500 kg; dynamic load ≤ 1000 kg; A 2000 mm high cabinet has 42 U high equipment space.

Scenario	Cabinet Provided	Cabinet Dimensions (H x W x D , mm)
40 ft-IT-2N-advanced configuration	Yes	2000 x 600 x 1200, 4 PCS; 2000 x 600 x 1100, 3 PCS (including one cabinet for ECC and LAN switch)
40 ft-IT-N+X-advanced configuration	Yes	2000 x 600 x 1200, 4 PCS; 2000 x 600 x 1100, 4 PCS (including one cabinet for ECC and LAN switch)
40 ft-IT-2N-standard configuration	Yes	2000 x 600 x 1200, 7 PCS (including one cabinet for ECC and LAN switch)
40 ft-IT-N+X-standard configuration	Yes	2000 x 600 x 1200, 8 PCS (including one cabinet for ECC and LAN switch)

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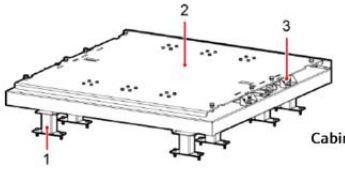
- The ventilation rate of the front and rear doors is at least 70%.
- An rPDU can be vertically installed at the rear of the cabinet.
- The position of each U is marked on the vertical mounting bars.
- The front and rear doors are locked and can be unlocked only with dedicated keys.
- The maximum static load of the cabinet is 1800 kg.

Structural System - FusionDC1000A Mechanical Parts



Cabling through cabling trays

(1) Power cable (2) Signal cable



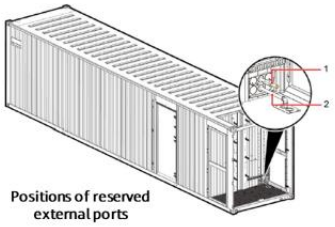
Cabinet base

(1) Supportive legs (2) Sliding platform (3) Transport fastener

Raised floor



(1) Calcium sulphate ESD floor



Positions of reserved external ports

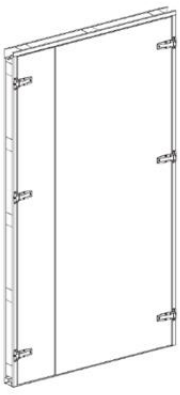
(1) Port reserved for the humidifier water refill pipe
(2) Port reserved for the condensate drainpipe

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Structural System - FusionDC1000A Mechanical Parts



900 mm wide fireproof door



1200 mm wide fireproof door

Fireproof Door	End Door (Main Entrance)	Equipment Installation Door/Emergency Door
Fire resistance time	90 minutes	
Door width	1100 mm	
Door net height	2300 mm	
IP rating	IPX5	
Anti-theft class (optional)	Class 3	
Door opening angle	≥ 120°, with a door closer	
Bearing capacity	When the door is open, the door, door frame, and mechanical parts can withstand the door weight and without permanent deformation within 48 hours with a static load of 15 kg at any part.	
Waterproof structure	The fireproof door uses rubber strips with a framework and composite adhesive to ensure the waterproof performance.	
Door opening mode	Opened inside and outside	Opened inside

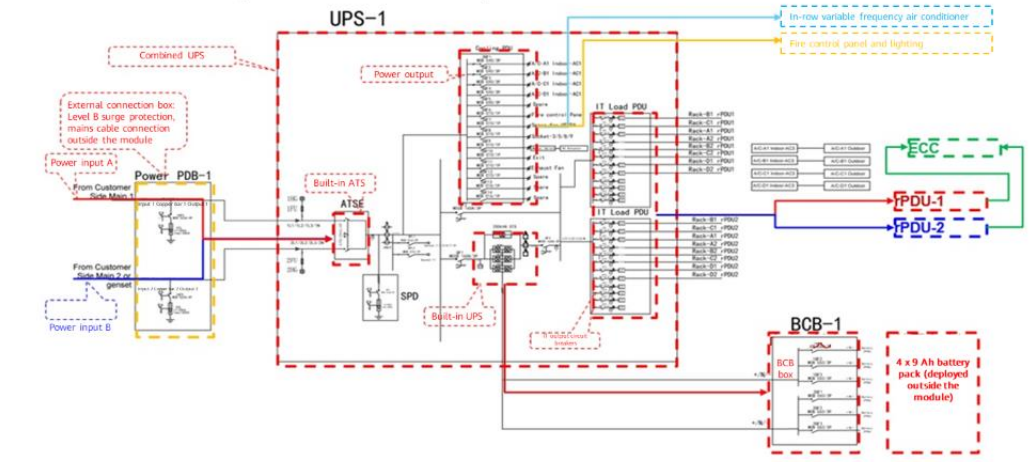
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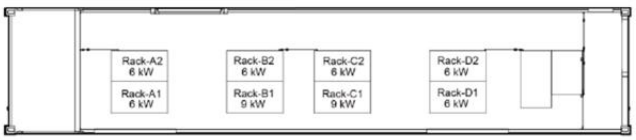
Power Supply and Distribution System - Power Distribution Architecture (N+X Scenario)



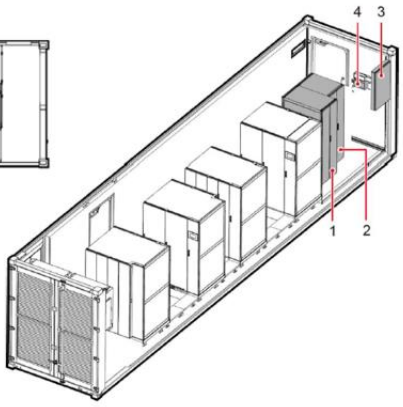
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- A total of eight 42 U IT server cabinets (six 6 kW cabinets and two 9 kW cabinets) are provided. The total power is not greater than 54 kW.
- The power supply and distribution system provides power separately for power and IT equipment, and supports 25 kW half-sized variable-frequency air conditioners, fire extinguishing devices, lights, ECC800, and other auxiliary devices inside a module. Devices, air conditioners, and the ECC800 are powered after they are combined by an ATS.
- Two 380 V/400 V/415 V, 50 Hz or 60 Hz, 250 A ATS inputs. Other voltage system inputs need to be converted by an upstream transformer.

Power Supply and Distribution System - Component Layout (N+X Scenario)



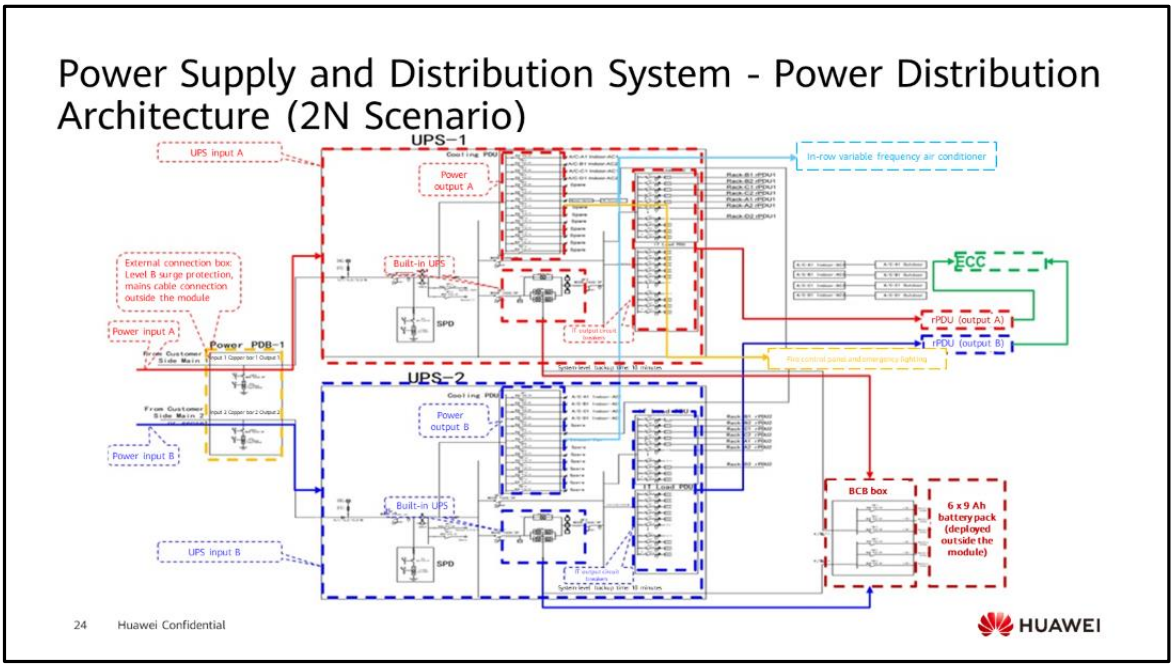
Power density distribution (N+X scenario)



(1) Integrated UPS (2) SmartLi
(3) Power PDB (4) AC power distribution box (PDB)

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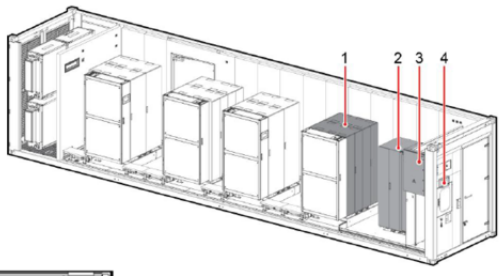
- The power PDB and AC PDB are preinstalled in the FusionDC1000A.



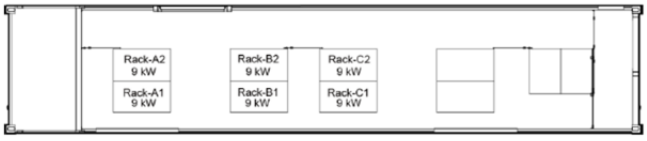
- A total of seven 42 U IT server cabinets (three 6 kW cabinets and four 9 kW cabinets) are provided. The total power is not greater than 54 kW.
- The power supply and distribution system provides power separately for power and IT equipment, and supports 25 kW half-sized variable-frequency air conditioners, fire extinguishing devices, lights, ECC800, and other auxiliary devices inside a module. Devices, air conditioners, and the ECC800 are powered in 2N mode.
- Two 380 V/400 V/415 V, 50 Hz or 60 Hz, 250 A MCCB inputs. Other voltage system inputs need to be converted by an upstream transformer.

Power Supply and Distribution System - Component Layout (2N Scenario)

- The power supply and distribution system mainly consists of the integrated UPS, power PDB, AC actuator, AC PDB, and rPDU.
- The integrated UPS supplies power to IT loads, smart cooling products, fire extinguishing devices, and lights.
- Power modules are deployed inside the integrated UPS.
- Battery packs and battery circuit breaker (BCB) boxes are installed inside the battery cabinet.



Power density distribution (2N scenario)



(1) Integrated UPS (2) SmartLi
(3) Power PDB
(4) AC PDB (inside the pre-fab. module)

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- The power PDB and AC PDB are preinstalled in the FusionDC1000A.

Power Supply and Distribution System - Integrated UPS (1)



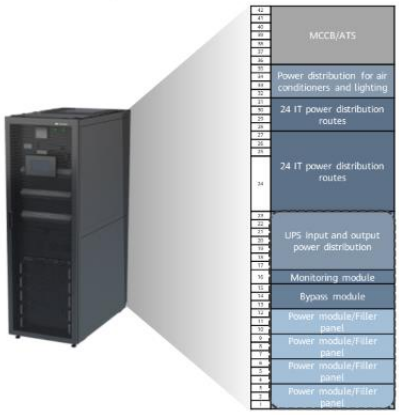
Configuration	380 V-2N Scenario	380 V-N+X Scenario
Input mode	1 x 250 A/3-pole molded case circuit breaker (MCCB)	250 A/4P ATS
Power distribution circuit breakers for UPSs	UPS input: 160 A/3-pole MCCB UPS output: 160 A/3-pole MCCB Maintenance bypass: 160 A/3-pole MCCB	
Power distribution circuit breakers for air conditioners	5 x 40 A/3-pole, 2 x 16 A/1-pole, 7 x 10 A/1-pole	
Power distribution circuit breakers for IT equipment	18 x 2 x 40 A/1-pole, 6 x 2 x 63 A/1-pole	
Dimensions (H x W x D)	2000 mm x 600 mm x 1100 mm	

Category	Item	208 V Specifications	380 V Specifications
Input	Input system	Three-phase four-wire + PE	
	Rated input voltage	208/220 V AC	380/400/415 V AC
	Input voltage range	208 V AC ± 10%	80–280 V AC (phase voltage) (When the input voltage ranges from 80–176 V AC, loads are linearly derated.)
	Input frequency range	40–70 Hz	40–70 Hz
	Input power factor	> 0.99 (full load), > 0.98 (half load)	> 0.99 (full load), > 0.98 (half load)
	Rated input current	400 A	250 A

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Power Supply and Distribution System - Integrated UPS (2)

Integrated UPS

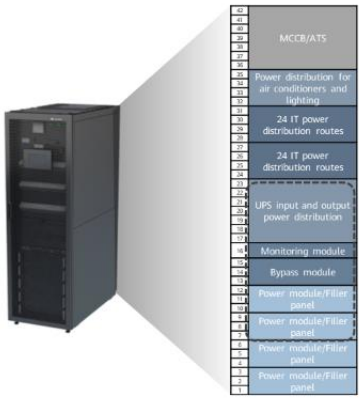


Category	Item	380 V Specifications
Output	Rated voltage	380/400/415 V AC
	Voltage distortion (linear load)	THD ≤ 1%
	Voltage distortion (non-linear load)	THD ≤ 4%
	Power factor	1
	Maximum peak factor for loads	3:1 (in compliance with the IEC 62040-3 standard)
	Overload capability	105%–110%: 60 minutes 111%–125%: 10 minutes 125%–150%: 1 minute
Battery	Number of batteries	30–40 12 V batteries can be installed. The default value is 32 (derated at 6% when 30 batteries are used).
	Battery sharing	Batteries are shared inside the same rack by default.
	Charging voltage	Equalized charging voltage: 2.35V/cell; float charging voltage: 2.25V/cell. The maximum battery capacity is 3000 Ah. The charging current is limited based on the battery capacity.

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Power Supply and Distribution System - Integrated UPS (3)

Integrated UPS



Category	Item	380 V Specifications
System parameter	Display	LCD+LED
	System efficiency	≥ 96%
	Current equalization	< 5% (in parallel mode)
	Number of parallel UPSs	UPSs do not need to be connected in parallel inside the pre-fab. module.
	Cabling	Routed in and out from the top
	Noise specifications (at 25° C and standard atmospheric pressure)	54 dB at 25% load, 58 dB at 50% load, 61 dB at 75% load, and 65 dB at 100% load
Other parameters	Maintenance mode	Maintained from the front or rear
	Surge protection	Level C surge protective device (SPD)

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Power Supply and Distribution System - SmartLi (1)

SmartLi Cabinet



Category	Item	380 V Specifications
Basic parameter	Model	SmartLi-512V-80Ah
	Cell material	LFP
	Rated voltage	512Vdc
	Rated charging voltage	544Vdc
	Charging current	≤ 1C, default value 0.5C
	Rated maximum discharge current	480A continuous discharge (6C)
	Cycle life	5000 times @50%DOD
	Rated capacity	80Ah / 40.96kWh (6C)
	Weight	800kg
	Dimensions (W*D*H)	600mm*850mm*2000mm
	Self-discharge rate	≤5% (0-30℃/3 months)
	Fire extinguishing	Standard cabinet-level fire extinguishing
	Interface	FE; RS485; Dry contact
	Protection	Overtemperature, overcurrent, short circuit, overcharge, and overdischarge
	Certification	UL1642，UN38.3，IEC62619，IEC62040

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Power Supply and Distribution System - SmartLi (2)

SmartLi Cabinet



Category	Item	380 V Specifications
Environment	Storage temperature	0°C ~ 40°C
	Transport temperature	-40°C ~ 60°C
	Operating temperature	0°C ~ 40°C (The recommended operating temperature is 20~25°C.)
	Relative Humidity(RH)	5% ~ 95%
	Altitude	0~4000 m. If the altitude exceeds 1000 m, the power is derated according to EN/IEC 62040-3.

	Cell	Module	Cabinet (full cabinet)	Cabinet (half cabinet)
Configuration	cell	2 parallel 20 serial	16 battery modules (2 groups)	8 battery modules (1 group)
Capacity (6C)	＞20Ah	40Ah	80Ah	40Ah
Rated voltage	3.2Vdc	64Vdc	512Vdc	512Vdc
operating voltage range	2.5~3.4Vdc	50~68.8Vdc	400~544Vdc	400~544Vdc
Dimensions (W*D*H:mm)	21*100*140	200.5*592*157.5	600*850*2000	600*850*2000
Weight	605g	35kg	800kg	520kg

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Power Supply and Distribution System - rPDU

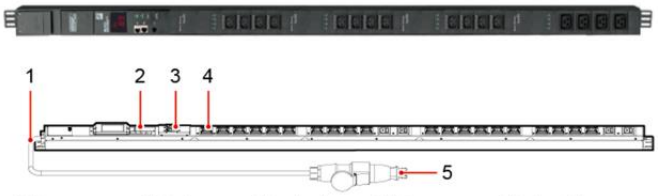
rPDU



Full-height rPDU

Half-height rPDU

Smart rPDU

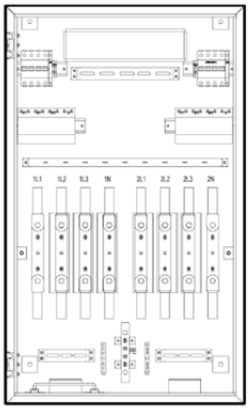


(1) Input power cable | (2) Main control module | (3) Hydraulic circuit breaker | (4) Output sockets | (5) Industrial connector

(Optional) Smart rPDU	Monitoring Function
The smart rPDU accurately and effectively monitors the real-time status changes of the current, voltage, power, and electric energy of electrical devices in a data center.	Monitors the input power, voltage, current, power factor, and electric energy.
	Monitors the power, current, power factor, and electric energy of each output.

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Power Supply and Distribution System - Power PDB



Power PDB interior

Item	Specifications
Dimensions (H x W x D)	1000 mm x 600 mm x 115 mm
Rated operating voltage	380 V/400 V/415 V
Rated frequency	50 Hz/60 Hz
Rated operating current	400 A
Input switch	Two copper bar inputs
Operating temperature	–25° C to +45° C
Operating humidity	5%–95% RH
Installation mode	Wall-mounted
Cabling	Routed in from the bottom and out from the rear

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- A power PDB serves as the general input power distribution device for a prefabricated modular data center and connects to the mains input.

Power Supply and Distribution System - AC PDB

- An AC PDB is an indoor AC power distribution box which controls power supply to devices such as the gas extinguishing controller, fresh air fan, and maintenance socket.



AC PDB

Item	Specifications
Dimensions (H x W x D)	222 mm x 300 mm x 86 mm
Rated operating voltage	220 V AC
Rated frequency	50 Hz/60 Hz
Rated operating current	25 A
Input switch	1 x 25 A/2P residual current device (RCD)
Output switch	6 x 10 A/1P
	1 x 16 A/1P RCD
Operating temperature	–5° C to +40° C
Operating humidity	5%–95% RH

- An AC PDB is an indoor AC power distribution box which controls power supply to devices such as the gas extinguishing controller, fresh air fan, and maintenance socket.

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   - Integrated Cabling System

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Cooling System - Air Cooled Precision Air Conditioner



NetCol5000-A025

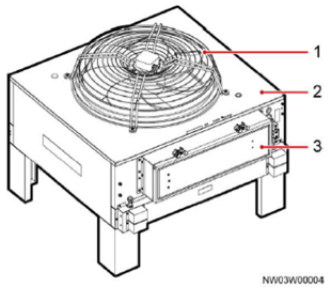
Item	NetCol5000-A025H	NetCol5000-A025
Power supply	Dual power supplies	
Cooling capacity (see the remarks)	25 kW	
Air volume	5000 m^3/h	
Maximum current (indoor unit current + outdoor unit current)	20 A	30 A
Power supply specifications	Supports the 380–415 V AC, 3PH+N+PE, 50 Hz/60 Hz power system, and applies to scenarios where the voltage range is 342–457 V and frequency range is 47–63 Hz.	
Voltage tolerance	Rated frequency ± 3 Hz	
Heating	Not supported	4 kW
Humidification	Not supported	1.5 kg/h
Piping	Top and bottom piping	
Condensate pump	Available	
Water pump lift	4 m	
Cooling mode	Air cooling	
Refrigerant	R410A	
Airflow mode	Horizontal airflow	
Dimensions (H x W x D)	2000 mm x 300 mm x 1100 mm (cabinet)	
Certification	REACH, RoHS	

In the preceding table, "Not supported" indicates that the corresponding model does not support the function.
Cooling capacity test conditions: dry bulb temperature at the air return vent: 37.8° C; wet bulb temperature at the air return vent: 20.8° C; condensing temperature: 45° C

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Cooling System - Air Cooled Precision Air Conditioner

Outdoor unit



(1) Fan (2) Rack (3) Fan driver

Outdoor unit specifications

Model	NetCol500-A0265S11E0
Power supply	380–480 V AC, 3Ph/N/PE, 50 Hz/60 Hz (If a low-temperature component is installed, the power system is 380–415 V AC, 3Ph/N/PE, 50 Hz/60 Hz.)
Maximum current for an outdoor unit	2.5 A
Air volume	12,000 m^3/h
Number of fans	1
Dimensions H x W1 (W2) x D	620 mm x 1120 (985) mm x 1094 mm
Liquid pipe outer diameter	5/8 inch (15.9 mm)
Gas pipe outer diameter	3/4 inch (19.1 mm)
Net weight (without legs)	132 kg
Storage temperature	–40° C to +70° C
Storage humidity	5%–95% RH (non-condensing)
Altitude	0–1000 m: normal use; above 1000 m: derating
a: If the upstream voltage fluctuates outside 380–480 V AC, add a voltage stabilizer; otherwise, the smart cooling product may fail to run properly due to frequent alarms.	

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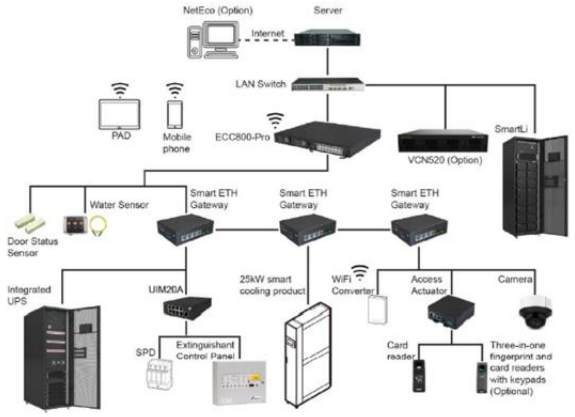
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   - Fire Extinguishing System
   - Surge Protection and Grounding System
   - Integrated Cabling System

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Monitoring System Architecture

- In the single-module scenario, an ECC800 serves as the core management component to manage devices and schedule functions.
- In multi-module scenarios, the NetEco is deployed to manage multiple smart modules in a unified manner.



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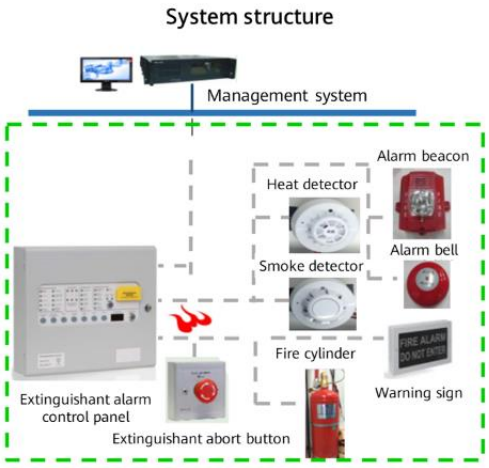
- Each smart module provides an independent and integral interface for environment and power monitoring. This interface constantly monitors devices such as the power supply and distribution equipment, smart cooling products, temperature and humidity sensors, water sensors, smoke detectors, and video surveillance equipment inside the module. If a component fault or parameter error is detected, alarms are generated in diverse modes such as indicator light, email, and short message service (SMS). Historical data and alarm events are recorded, and all monitoring information is reported to the management platform.
- The PAD or mobile phone app can be used to query device information in real time, facilitating mobile O&M.
- To improve the reliability of the monitoring system, Ethernet ring bus networking is used for intelligent node signal transmission and sensor power supply.

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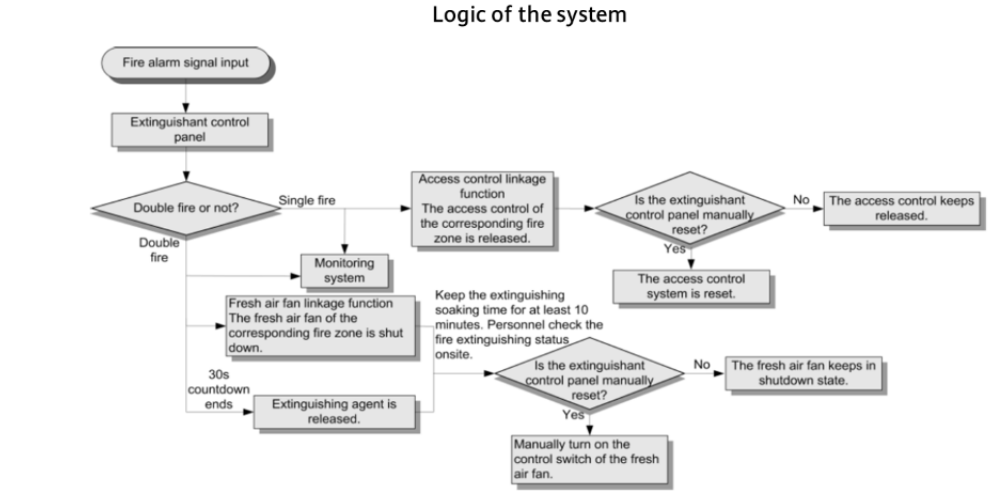
Fire Extinguishing System Architecture (1)



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- An automatic gas fire extinguishing system is used. Fire extinguishing pipes are routed through the entire pre-fab. module. Nozzles are installed in the cold and hot aisles to spray extinguishant to the entire protected zone.
- Smoke and heat detectors are installed on the top of each aisle. Alarm bells and alarm beacons are installed at the inner side of the emergency door. Gas extinguishing controllers, alarm beacons, gas release indicators, and emergency shutdown buttons are installed at the outer side of the main entrance to the pre-fab. module. Signs for the gas extinguishing system are prepared in both Chinese and English.
- A separate fire cylinder compartment is set up in the front isolated area.
- Quick customization of the single-pipe aspirating smoke detector (ASD) is supported. In standard configuration, the gas cylinder and Heptafluropropane extinguishant are provided by default and can be quickly removed by customization. Quick customization of the NOVEC1230 extinguishant for the CE version is supported.

Fire Extinguishing System Architecture (2)



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- An automatic gas fire extinguishing system is used. Fire extinguishing pipes are routed through the entire pre-fab. module. Nozzles are installed in the cold and hot aisles to spray extinguishant to the entire protected zone.
- Smoke and heat detectors are installed on the top of each aisle. Alarm bells and alarm beacons are installed at the inner side of the emergency door. Gas extinguishing controllers, alarm beacons, gas release indicators, and emergency shutdown buttons are installed at the outer side of the main entrance to the pre-fab. module. Signs for the gas extinguishing system are prepared in both Chinese and English.
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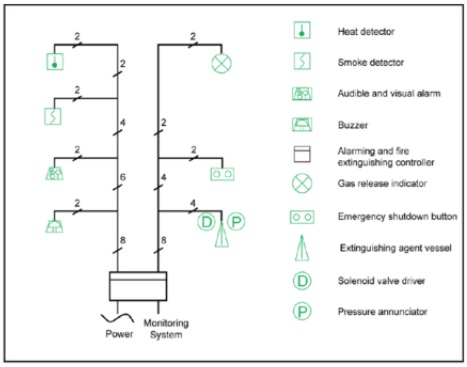
Fire Extinguishing System - Extinguishant Control Panel

Extinguishant control panel (CE version)



Item		Specifications
Input		AC input power: ≤ 120 W
		AC input voltage and frequency: 230 V AC (tolerance +10%/–15%), 50 Hz
		DC backup power voltage: 24 V
24 V power output		3 A
Capacity	Number of detector loops	Three loops. Loops 1 and 2 respectively connect to smoke detectors and heat detectors. Loop 3 is reserved by default.
	Number of detectors connected to each loop	≤ 24
Output loop current limiting		Output loop for the electrical actuator driver: ≥ 1 A Output loops for other drivers: ≤ 1 A

Conceptual diagram of the CE version fire extinguishing system

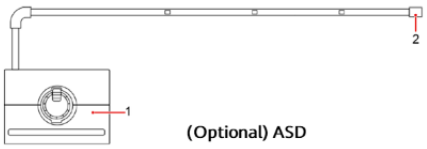


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Fire Extinguishing System - Automatic Fire Extinguisher and ASD



Heptafluoropropane automatic fire extinguisher



(Optional) ASD

(1) ASD (2) Air sampling tube plug

Item	Specifications
Dimensions	Outer diameter of the steel cylinder: 300 mm
Startup current	0.5 A
Startup voltage	24 V DC
Startup mode	Electromagnetic startup
Maximum operating pressure	3.4 MPa (at 50° C)
Storage pressure	20° C: 2.5 MPa
Cylinder volume	61 L

ASD principle:

The detection unit includes the suction pump, filter, highly-sensitive smoke detector, and precision electrical analyzer. The ASD can detect fire in the initial phase and generates alarms at an early time.

The detection unit of the ASD sucks air samples from the monitored environment through the air sampling tube to the smoke detector and works out the dust density in the air. If the dust density exceeds the preset alarm threshold, the ASD blinks and sends an alarm signal to the monitoring module.

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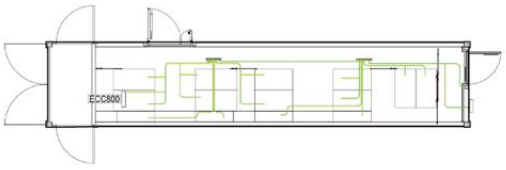
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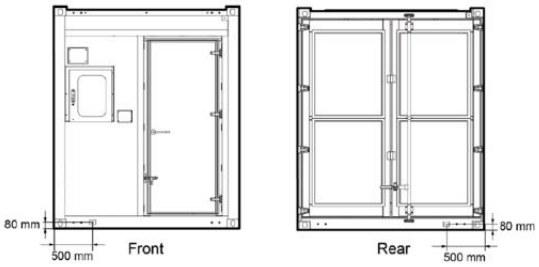
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Surge Protection and Grounding System

- Surge protection solution
  - Indoor signal ports comply with 1 kV surge protection in common mode.
  - Signal ports for cables routed out of the pre-fab. module pass the 3 kA impulse current test.
- Grounding solution



Internal grounding diagram



External ground points of a pre-fab. module

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- Internal grounding
- A main earthing terminal (MET) should be installed inside the pre-fab. module, and connected to the external ground grid through the ground downlead.
- Devices installed in the pre-fab. module should be connected to the MET through ground cables and be insulated from other metal components in the pre-fab. module.
- External grounding
- M12 bolt ground points are evenly located on the pre-fab. module exterior. Ensure that the two ground points are connected to the ground grid. There are two ground points on the pre-fab. module exterior. The ground resistance is within 10 ohms.

Contents

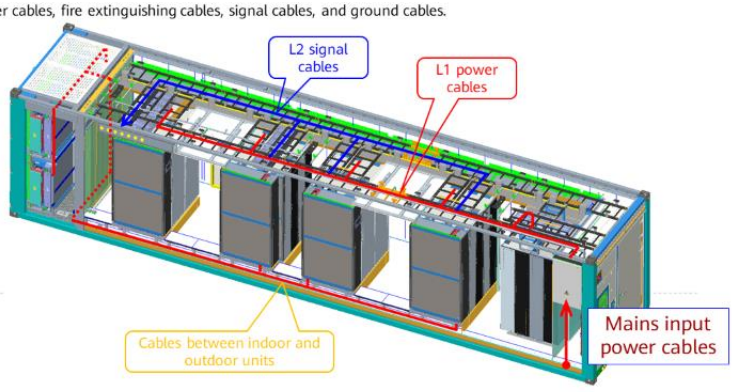
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   - **Integrated Cabling System**

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Integrated Cabling System

- The FusionDC1000 integrated cabling system consists of cable trays and various cables Cable trays on the top of a pre-fab. module are separate from cabinets, and can be moved horizontally along the width direction on the tops of pre-fab. modules.
- Electrical and ELV cables are routed separately.
- Cables for the FusionDC1000 include power cables, fire extinguishing cables, signal cables, and ground cables.

40 ft-IT cabling



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Quiz

1. (Multiple) In IT scenarios, which of the following power supply and distribution components are included in the FusionDC1000A?
   A. Lithium battery cabinet
   B. Integrated UPS
   C. Power PDB
   D. AC actuator

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- Answer: ABCD

Summary

- This Chapter describes the FusionDC1000A subsystems, including the cabinet aisle system, power supply and distribution subsystem, cooling system, intelligent management system, surge protection and grounding system, and integrated cabling system. It also describes the main functions of each component.

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Thank you.

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每个组织，构建万物互联的智能世界。

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Introduction to Smart Mini and Small Data Center Solution FusionModule500/800



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Foreword

- This chapter describes the configurations and hardware of the FusionModule500 and FusionModule800 in indoor scenarios.

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Objectives

On completion of this course, you will be able to:

- Have a basic understanding about the Huawei FusionModule500/800 and product positioning.
- Understand the typical configurations of the FusionModule500/800.
- Get familiar with the hardware of each subsystem of the FusionModule500/800.

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Contents

1. FusionModule500/800 Product Description
2. FusionModule500 Smart Mini Data Center
3. FusionModule800 Smart Small Data Center

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Product Positioning

- The FusionModule500 is a mini data center solution applied to equipment rooms with an area of about 10 m^2. It applies to equipment rooms of government vertical industry's country-level outlets, bank outlets, and small- and medium-sized enterprises.
- The FusionModule800 is a small data center solution applied to air cooled scenarios where the equipment room area is less than 40 m^2. This solution mainly applies to city-, district-, and county-level data centers of the government vertical industry, small-sized second-level branches and large-sized offices in the financial industry, and equipment rooms of small- and medium-sized enterprises.



FusionModule500

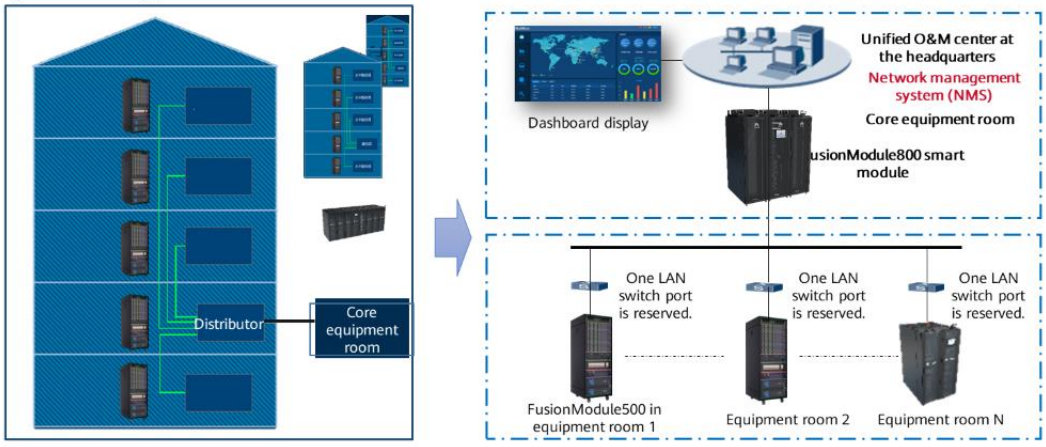


FusionModule800

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FusionModule500/800 Application Scenarios (1)

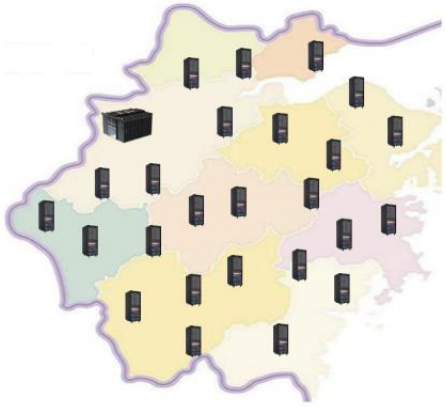
- Scenario 1: The number of equipment rooms is small and the equipment rooms are distributed in a centralized manner (such as universities, hospitals, and government buildings).

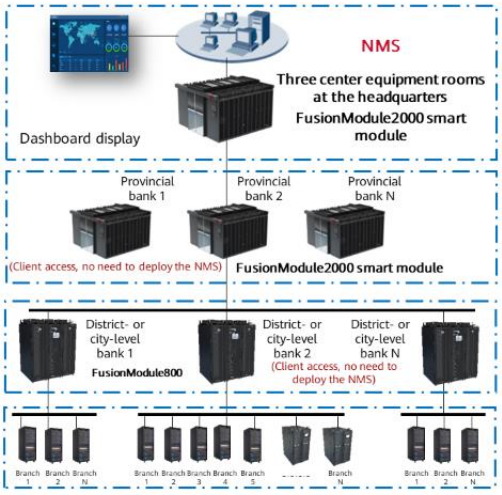


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FusionModule500/800 Application Scenarios (2)

- Scenario 2: A large number of scattered equipment rooms are distributed at multiple management levels (such as banks and multinational enterprises).





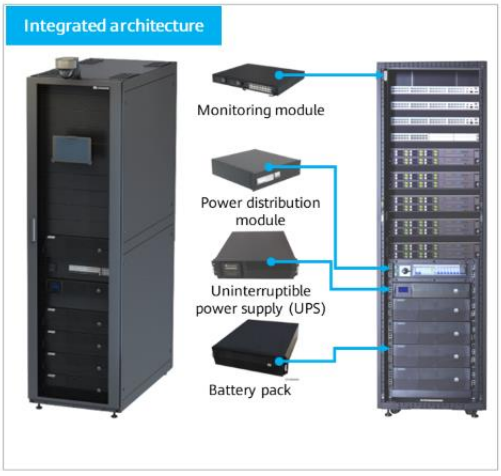
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   - FusionModule500 Typical Configuration
   - FusionModule500 Subsystem
3. FusionModule800 Smart Small Data Center

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FusionModule500 Solution Overview



- 1–2 ICT cabinets
- Natural cooling (without air conditioners)
- Recommended load power: < 3 kW
- Backup time: 15–240 minutes



Cabinet dimensions (W x D x H):
600 mm x 850 mm x 1200 mm (24 U); 600 mm x 1100 mm x 2000 mm (42 U)

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FusionModule500 Typical Configuration (1)



24 U Converged Cabinet

Item	Specifications
Cabinet dimensions (H x W x D)	1200 mm x 600 mm x 850 mm
Backup time	15–240 minutes
Power distribution	UPS2000-G, battery pack (optional)/external battery (optional), PDU5000, and rPDU
Monitoring module	ECC800e, temperature and humidity (T/H) sensor, door status sensor, smoke detector, water sensor, infrared remote control module (optional), GSM modem (optional), and LAN switch (optional)



42 U Converged Cabinet

Item	Specifications
Cabinet dimensions (H x W x D)	2000mm x600 mm x 1100 mm
Backup time	15–240 minutes
Power distribution	UPS2000-G, battery pack (optional)/external battery (optional), PDU5000, and rPDU
Monitoring module	ECC800e, T/H sensor, camera (optional), VCN (optional), door status sensor, smoke detector, water sensor, PAD (optional), WiFi converter (optional), infrared remote control module (optional), GSM modem (optional), NetEco (optional), and LAN switch (optional)

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FusionModule500 Typical Configuration (2)



Converged Cabinet + Battery cabinet



Converged Cabinet + Network cabinet



Network cabinet + Converged Cabinet + Battery cabinet



Network cabinet + Converged Cabinet + Battery cabinet + Battery cabinet

Item	Specifications
Cabinet dimensions (H x W x D)	Cabinet dimensions: 2000 mm x 600 mm x 1100 mm Network cabinet dimensions:2000 mm x 600 mm x 1100 mm x or 2000 mm x 800 mm x 1100 mm
Backup time	15~240 minutes
Power distribution	UPS2000-G, battery pack (optional)/external battery (optional), PDU5000, and rPDU
Monitoring module	ECC800e, T/H sensor (for Converged Cabinet), T/H sensor (for network cabinet, optional), camera (optional), VCN (optional), door status sensor (for Converged Cabinet), door status sensor (for network cabinet, optional), door status sensor (for battery cabinet, optional), smoke detector, water sensor, PAD (optional), WiFi converter (optional), infrared remote control module (optional), GSM modem (optional), intelligent battery monitoring system (optional), standalone AI/DI module (optional), NetEco (optional), and LAN switch (optional)

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Structural System

- The cabinet possesses the following features:
  - The ventilation rate of the cabinet perforated door is greater than or equal to 70%.
  - The cabinet houses standard 19-inch wide devices.
  - The 42 U cabinet allows the rPDU to be vertically and horizontally installed in the rear. The 24 U cabinet allows the rPDU to be horizontally installed in the rear.
  - The position of each U is marked on the vertical mounting bars.
  - The front and rear doors are locked and can be unlocked only with dedicated keys.
  - The cabinet can be installed on a base (which needs to be prepared by customers).
  - The 42 U cabinet can house ICT devices with a depth of less than or equal to 750 mm. Cables can be routed from the top or bottom. 200 cables can be routed from the top and 100 cables can be routed from the bottom.
  - The 24 U cabinet can house ICT devices with a depth of less than or equal to 600 mm. Cables can be routed from the top or bottom. 100 cables can be routed from the top or bottom of the cabinet.
  - The 600 mm wide network cabinet allows the routing of a minimum of 200 cables.
  - The 800 mm wide network cabinet allows the routing of a minimum of 400 cables.

Item	Specifications (42 U Cabinet)	Specifications (24 U Cabinet)
Color	Black	Black
Material	High-intensity class A carbon cold-rolled steel plate and zinc-coated steel plate	High-intensity class A carbon cold-rolled steel plate and zinc-coated steel plate
Air channel	Front and rear air channels	Front and rear air channels
Installation mode	Installed on a concrete floor or ESD floor	Installed on a concrete floor or ESD floor
Static load	1500 kg	1500 kg
Dynamic load	1000 kg	1000 kg
IP rating	IP20	IP20

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Power Supply and Distribution System - UPS

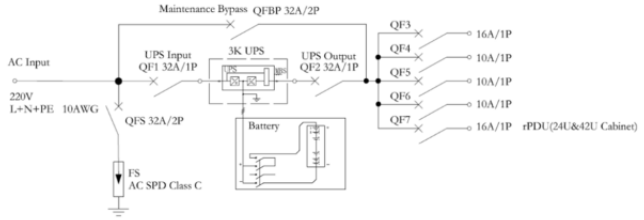
- A UPS provides uninterruptible power supply for the smart module. When the external power supply fails, the UPS uses battery strings to supply power to IT loads. There are three types of UPSs, that is, 3 kVA UPS, 6 kVA UPS, and 10 kVA UPS. A 24 U cabinet can house the 3 kVA UPS and 6 kVA UPS, and a 42 U cabinet can house the 3 kVA UPS, 6 kVA UPS, and 10 kVA UPS.



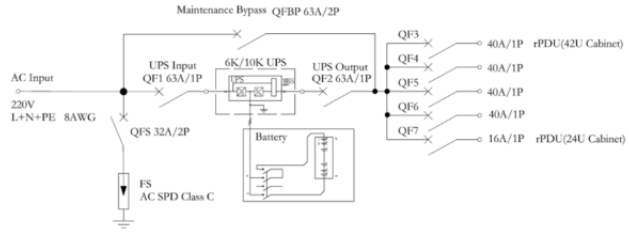
Item	Specifications (10 kVA UPS)	Specifications (6 kVA UPS)	Specifications (3 kVA UPS)
Rated power	9 kW	5.4 kW	2.7 kW
Rated input power	220 V/230 V/240 V	220 V/230 V/240 V	220 V/230 V/240 V
Rated frequency	50 Hz/60 Hz	50 Hz/60 Hz	50 Hz/60 Hz
Maximum input current	50 A	32 A	19 A
External input power distribution circuit breaker	63 A	50 A	32 A
UPS backup power	(Optional) Battery pack: • 0–4 (7 Ah/240 V) • 0–4 (9 Ah/240 V) Battery • 26 Ah/12 V • 40 Ah/12 V • 65 Ah/12 V • 100 Ah/12 V	(Optional) Battery pack: • 24 U cabinet: 0–2 (7 Ah/240 V) or 0–2 (9 Ah/240 V) battery packs • 42 U cabinet: 0–4 (7 Ah/240 V) or 0–4 (9 Ah/240 V) battery packs Battery • 26 Ah/12 V, 40 Ah/12 V, 65 Ah/12 V, 100 Ah/12 V	(Optional) Battery pack: • 24 U cabinet: 0–2 (7 Ah/240 V) or 0–2 (9 Ah/240 V) battery packs • 42 U cabinet: 0–4 (7 Ah/240 V) or 0–4 (9 Ah/240 V) battery packs Battery • 26 Ah/12 V, 40 Ah/12 V, 65 Ah/12 V, 100 Ah/12 V
Surge protection	Level D surge protective device (SPD), 5 kA in differential mode and common mode	Level D SPD, 5 kA in differential mode and common mode	Level D SPD, 5 kA in differential mode and common mode

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Power Supply and Distribution System - Power Distribution Architecture



Power distribution diagram for the 220 V single-phase system with a 3 kVA UPS



Power distribution diagram for the 220 V single-phase system with a 6 kVA/10 kVA UPS

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- The FusionModule500 has a large-capacity and a small-capacity power distribution architectures.
- Mini data centers with different capacities have different battery capacities, number of cabinets, and load power. Therefore, the switch capacities and number of cabinets are different, but the power supply architectures are the same.
- In a 24 U cabinet, the rPDU can only be installed horizontally. In a 42 U cabinet, the rPDU can be installed horizontally if a 3 kVA UPS is configured or vertically if a 6 kVA UPS or 10 kVA UPS is configured.

Power Supply and Distribution System - PDU (1)



PDU5000

rPDU technical specifications

Item	Specifications (Vertically Installed Full-Height rPDU)	Specifications (Vertically Installed Half-Height rPDU)	Specifications (Horizontally Installed 1 U rPDU)
Rated current	32 A	32 A	16 A
Input frequency	50 Hz/60 Hz	50 Hz/60 Hz	50 Hz/60 Hz
Input terminal	Cord end terminal, no input cable	Cord end terminal, no input cable	Cord end terminal, no input cable
Output terminal	IEC: 20 x C13 + 4 x C19 Chinese standard: 20 x 10 A + 4 x 16 A	IEC: 9 x C13 + 3 x C19 Chinese standard: 9 x 10 A + 3 x 16 A	IEC: 8 x C13 Chinese standard: 7 x Chinese-standard socket
Rated output current	32 A	32 A	16 A

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Power Supply and Distribution System - PDU (2)

PDU5000 technical specifications

Item	Specifications (3 kVA UPS)	Specifications (6 kVA/10 kVA UPS)
Maximum input current	32 A	63 A
Number of phases	Single-phase	Single-phase
Input frequency	50 Hz/60 Hz	50 Hz/60 Hz
Input voltage	220 V/230 V/240 V	220 V/230 V/240 V
Output frequency	50 Hz/60 Hz	50 Hz/60 Hz
UPS input	32 A/1P	63 A/1P
UPS output	32 A/1P	63 A/1P
UPS maintenance bypass	32 A/2P	63 A/2P
Output	2 x 16 A/1P + 3 x 10 A/1P	4 x 40 A/1P + 1 x 16 A/1P
Highest altitude	4000 m	4000 m
Operating temperature	–5° C to +40° C	–5° C to +40° C
Relative humidity	5%–95%	5%–95%
Storage and transportation temperature	–40° C to +70° C	–40° C to +70° C
Dimensions	430 mm x 450 mm x 130 mm	430 mm x 450 mm x 130 mm

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Power Supply and Distribution System - Battery Pack



Battery pack

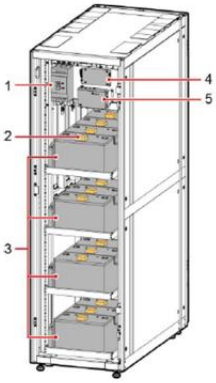
Item	Specifications (7 Ah/240 V)	Specifications (9 Ah/240 V)
Capacity (single battery pack)	7 Ah	9 Ah
Voltage (single battery pack)	240 V	240 V
Application scope	3 kVA/6 kVA/10 kVA UPS	3 kVA/6 kVA/10 kVA UPS
Dimensions (H x W x D)	130 mm x 430 mm x 685 mm	130 mm x 430 mm x 685 mm
Weight (single battery pack)	61 kg	69 kg

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- In the N+X scenario, four groups of 9 Ah battery packs are configured (each group containing two battery packs) to provide a backup time of 7.5 minutes.
- In the 2N scenario, six groups of 9 Ah battery packs are configured (each group containing two battery packs) to provide a backup time of 10 minutes.

Power Supply and Distribution System - Battery Cabinet





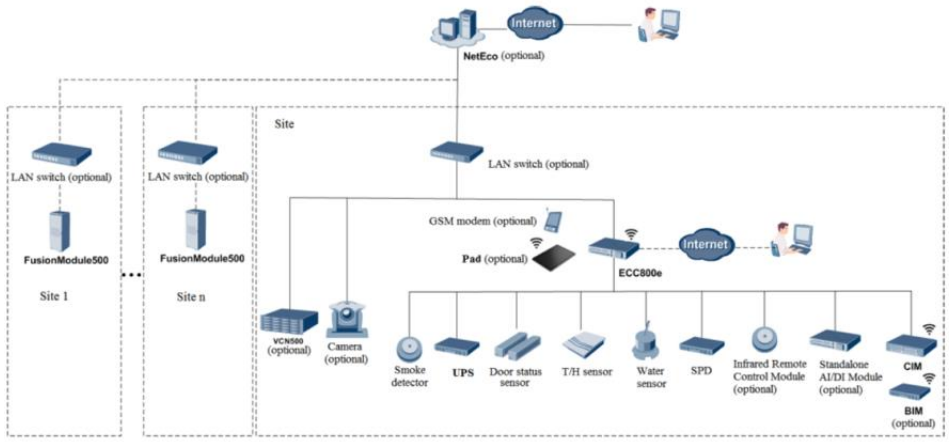
(1) Circuit breaker (2) Battery interface module (BIM) (3) Battery (4) Battery control I/O board (BIB) (5) Battery information collection module (CIM)

Item	Specifications (42 U Cabinet)
Dimensions (H x W x D)	2000 mm x 600 mm x 1100 mm
Color	Black
Material	High-intensity class A carbon cold-rolled steel plate and zinc-coated steel plate
Air channel	Front and rear air channels
Installation mode	Installed on an ESD floor or concrete floor
Weight	180 kg (without battery packs)
Door opening mode	The front door is a single door, and the rear door is a double one.
Static load	1500 kg
Dynamic load	1000 kg
IP rating	IP20

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Monitoring System - System Architecture

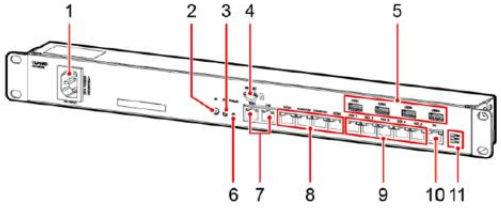
- A smart module monitoring solution consists of the collector and monitoring components. The ECC800e functions as the controller.



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- Each smart module provides an independent and integral interface for environment and power monitoring. This interface constantly monitors devices such as the power supply and distribution equipment, smart cooling products, temperature and humidity sensors, water sensors, smoke detectors, and video surveillance equipment inside the module. If a component fault or parameter error is detected, alarms are generated in diverse modes such as indicator light, email, and short message service (SMS). Historical data and alarm events are recorded, and all monitoring information is reported to the management platform.
- The PAD or mobile phone app can be used to query device information in real time, facilitating mobile O&M.
- To improve the reliability of the monitoring system, Ethernet ring bus networking is used for intelligent node signal transmission and sensor power supply.

Monitoring System - ECC800e (1)



(1) Power input port (2) IR (3) SW button
(4) Micro SD card port (5) USB ports (USB1–USB4)
(6) Default button (7) FE ports (WAN port and LAN port)
(8) RS485 ports (COM1–3/12 V) and CAN port (COM4)
(9) AI/DI_1–5 sensor input ports
(10) DO output dry contact
(11) Status indicators

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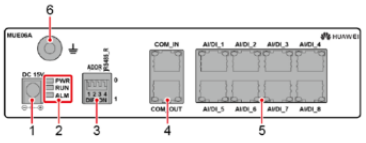
Monitoring System - ECC800e (2)

Item	Specifications
Power input	• Supports one AC input. • Rated voltage: 100–240 V AC • Rated frequency: 50 Hz/60 Hz • Maximum input current: 0.5 A
System memory	128 MB
FE port expansion	Supports one WAN port and one LAN port, with the 10/100M communications rate.
RS485 serial port expansion	• Reserves three RS485 ports with the default communications rate of 9600 bit/s. • COM2–3 ports provide 12 V DC power with a rated current of 450 mA.
AI/DI expansion (RJ45)	• Supports five AI/DI ports to connect to smoke sensors, water sensors, and temperature sensors. • Each port provides 12 V DC power with a rated current of 85 mA.
DO expansion (RJ45)	• Supports one expansion dry contact with contact point capacity of 20 W, maximum withstand voltage of 60 V DC, and rated current of 0.5 A. • Supports one active DO port with an output voltage of 12 V DC and output current of 450 mA.
USB	• After a WiFi module is installed, the ECC800e can be connected locally using the mobile phone or PAD app. • On the ECC800e, users can view the basic information about the smart module, such as the layout, resources, energy efficiency, environment, and alarms. • After a USB flash drive is installed, users can export historical data, device data, fault information, and configuration files, and export or import device configuration data and historical data.
Button	• SW: wireless network pairing button • Default: button for restoring the default IP address

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Monitoring System - Monitoring Component (ECC800)

(Optional) Standalone AI/DI module



(1) 15 V DC power input (2) Indicators (3) DIP switch
(4) Cascading ports (5) AI/DI_1 to AI/DI_8 (6) Ground point



Door status sensor

Function	Description
Door status sensor off	The door is closed.
Door status sensor on	The door is open.



Smoke detector



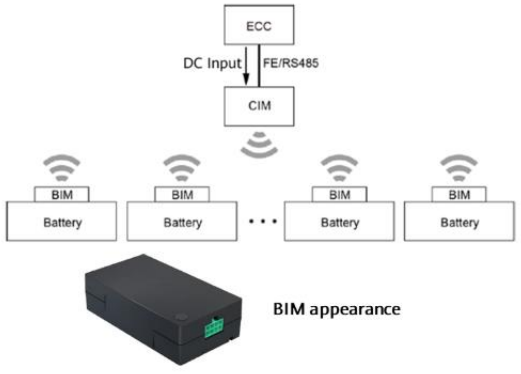
T/H sensor

Function	Description
Power-on self check	System startup and self check upon power-on
Temperature and humidity data collection	Temperature and humidity data collection
Indicator	Two LED indicators on the component
DIP switch	RS485 communications address DIP switch
Build-out resistor	Build-out resistor switch

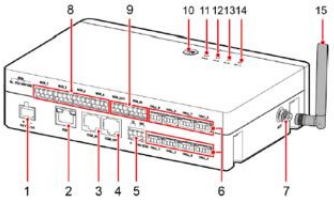
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(Optional) Monitoring System - Intelligent Battery Monitoring System

- The intelligent battery monitoring subsystem consists of the communication interface module (CIM) (CIM01C2) and battery interface module (BIM) (BIM01C3).



BIM appearance



(1) –48 V 0.5 A port (power input)
(2) PoE port
(3) COM_IN port (RS485 communication input)
(4) COM_OUT port (RS485 communication output)
(5) DI and DO ports
(6) HALL_1 to HALL_8 current monitoring ports
(7) RF_Z antenna port
(8) BCB_1 to BCB_4 ports
(9) BCB_OUT and BCB_IN ports
(10) Networking switch
(11) PWR indicator
(12) RUN indicator
(13) ALM indicator
(14) RF_Z indicator
(15) Delivered antenna

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- The CIM is an intelligent battery management module which collects wireless communication data from the downstream BIM groups, collects and analyzes the operating data of battery strings, calculates state of charge (SOC) and state of health (SOH) of batteries and battery strings, estimates the battery health status, supports battery tripping management, and uploads data to the upper-level management unit through COM or PoE ports.
- The BIM is a battery monitoring module that monitors the voltages, internal resistances, and pole temperatures of batteries.

Monitoring System - Video Surveillance

The video surveillance subsystem consists of the camera and VCN (a network video recorder) and implements real-time monitoring, video storage, and video playback.

The VCN is installed in the network cabinet of the smart module. Installation mode: rack-mounted

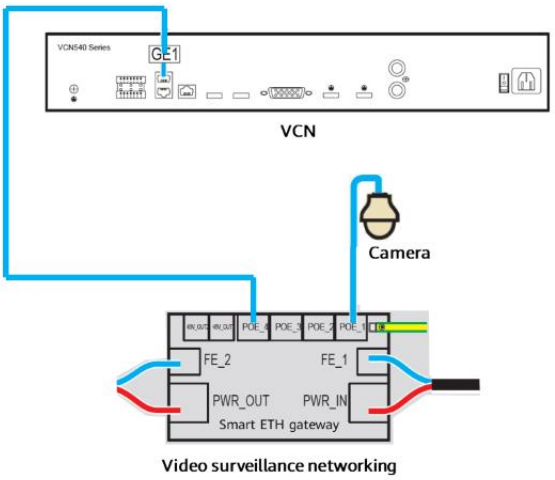
Cameras are installed on a control skylight. Installation mode: secured by screws



Camera



VCN



Video surveillance networking

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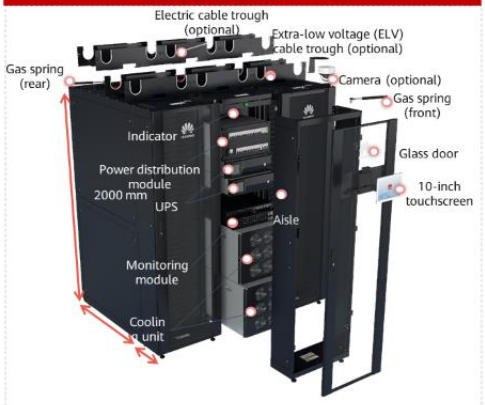
Contents

1. FusionModule500/800 Product Description
2. FusionModule500 Smart Mini Data Center
3. **FusionModule800 Smart Small Data Center**
   - FusionModule800 Solution Overview
   - FusionModule800 Typical Configuration
   - FusionModule800 Subsystem

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FusionModule800 Solution Overview

Integrated architecture



- Total number of IT cabinets (for Asia, Africa, and Europe): 0–10 (total number of cabinets: 1–12)
- Total number of IT cabinets (for Latin America): 0–6 (total number of cabinets: 1–8)
- Rack-mounted cooling unit: 12.5 kW per unit
- Hot and cold aisle containment: The cold aisle is 250 mm wide and the hot aisle is 1100 mm wide. All cabinets have no side panels except battery cabinets.
- Maximum IT power: ≤ 25 kW (T1 & LT*), ≤ 21 kW (T3), ≤ 15 kW (Latin America)
- Power of a single cabinet: ≤ 7 kW (T1 & LT*), ≤ 6 kW (T3 & Latin America)



Maximum cabinet configuration: 1 ≤ N ≤ 12 (Asia, Africa, and Europe)

T1: normal temperature; LT: low temperature; T3: high temperature

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Contents

1. FusionModule500/800 Product Description
2. FusionModule500 Smart Mini Data Center
3. **FusionModule800 Smart Small Data Center**
   - FusionModule800 Solution Overview
   - FusionModule800 Typical Configuration
   - FusionModule800 Subsystem

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FusionModule800 Typical Configuration (1)

IT load	≤ 8.5 kW (T1 & LT) ≤ 7 kW (T3)	≤ 8.5 kW (T1 & LT) ≤ 7 kW (T3)	8.5–17 kW (T1 & LT) 7–14 kW (T3)	8.5–17 kW (T1 & LT) 7–14 kW (T3)
	Typical configuration 1	Typical configuration 2	Typical configuration 3	Typical configuration 4





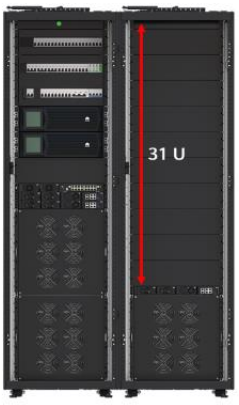




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FusionModule800 Typical Configuration (2)

IT load	17–25 kW (T1 & LT) 14–21 kW (T3)	≤ 8.5 kW (T1 & LT) ≤ 7 kW (T3)	8.5–17 kW (T1 & LT) 7–14 kW (T3)
	Typical configuration 5	Typical configuration 6	Typical configuration 7







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FusionModule800 Typical Configuration (3)

Load Power	≤ 8.5 kW (T1 & LT) ≤ 7 kW (T3)		8.5–17 kW (T1 & LT) 7–14 kW (T3)		17–25 kW (T1 & LT) 14–21 kW (T3)	≤ 8.5 kW (T1 & LT) ≤ 7 kW (T3)	8.5–17 kW (T1 & LT) 7–14 kW (T3)
Aisle Type	Hot and cold aisle containment						
UPS Configuration (kVA)	10+0	10+10	20+0	20+20	20 x 2+0	10+10	20+20
Cooling Configuration	1+0	1+1	2+0	2+0	3+0	1+1	2+0
Number of Cooling units	0	1	1	1	1	1	1
Smart Power Distribution	No	No	No	No	No	Yes	Yes
Number of Power Inputs	Single-input for typical configuration (ATS is optional)						
Number of IT Power Distribution Outputs	4	12	12	12	20	12	12
Standard Configuration	Temperature sensor, smoke sensor, SMS alarm, mobile phone app, PAD, intelligent lock, and ECC800						
Optional	ATS, (intelligent/non-intelligent), rPDU, video surveillance system, backup power, iBattery, IT cabinet, mobile phone remote app, network cabinet, water sensor (rope type)						
Remarks	Cooling units are non-redundant.		Cooling units are non-redundant.	Cooling units are non-redundant.	Cooling units are non-redundant.		Cooling units are non-redundant.
Scenario	Class C equipment room		Class C equipment room	Class C equipment room	Class C equipment room		Class C equipment room

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Contents

1. FusionModule500/800 Product Description
2. FusionModule500 Smart Mini Data Center
3. **FusionModule800 Smart Small Data Center**
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   - FusionModule800 Typical Configuration
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Structural System - Cabinet

- The cabinets used in a smart module are classified into the IT cabinet, battery cabinet, Converged Cabinet, and network cabinet.

IT cabinet



Converged Cabinet



Item	Technical Specifications
Dimensions (H x W x D)	• IT cabinet: 2000 mm x 600 mm x 1350 mm • Converged Cabinet: 2000 mm x 600 mm x 1350 mm • Battery cabinet (deployed inside the aisle containment): 2000 mm x 600 mm x 1350 mm • Battery cabinet (deployed outside the aisle containment): 2000 mm x 600 mm x 1100 mm/1200 mm • Network cabinet: 2000 mm x 800 mm x 1350 mm
Color	Black
Material	High-intensity class A carbon cold-rolled steel plate and zinc-coated steel plate
Air channel	Front and rear air channels
Space inside the IT cabinet and network cabinet	• Each cabinet provides 42 U available space. • The cabinet depth for devices is 750 mm upon delivery. • Positions for vertically installing two PDU2000s are provided at the rear of the cabinet.
Installation mode	Installed on a concrete floor or ESD floor.
Static load	1500 kg
Dynamic load	1000 kg
IP rating	IP20

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Structural System - Single-Row Hot/Cold Aisle Containment



(1) IT cabinets (2) Camera mounting kit on the enclosed framework
(3) Gas spring
(4) Side sealing plate (5) Battery cabinet (6) Electronic lock
(7) Converged Cabinet



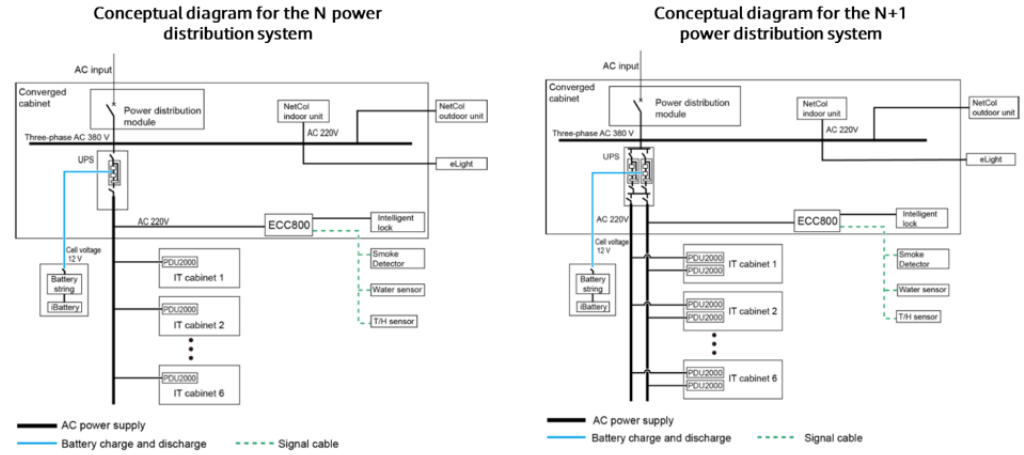
Front and rear doors



Cable trough

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Power Supply and Distribution System - Power Distribution Architecture



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- The power distribution architecture of the FusionModule800 consists of the N system and N+1 system.
- Small data centers with different capacities have different battery capacities, number of cabinets, and load power. Therefore, the switch capacities and number of cabinets are different, but the power supply architectures are the same.

Power Supply and Distribution System - Power Distribution Module



Indicator module		Power distribution module	PDU1	PDU2	PDU3	PDU4	PDU5	PDU6	Power distribution module	ATS module
Height	1 U	Height	3 U	6 U	6 U	6 U+3 U	6 U+4 U	6 U+3 U	Height	8 U
Typical configuration	BC1–BC7	IT loop	4	12	12	20	12	120 V: 8 208 V: 8	IT loop	N/A
Latin America	ATO 6, 7, 8	Main switch	63 A	100 A	100 A	125 A	100 A	None	Main switch	125 A
		Supports the maintenance bypass.								
		IT load	≤ 8.5 kW	≤ 8.5 kW	≤ 8.5 kW or ≤ 17 kW	≤ 25 kW	≤ 17 kW or ≤ 8.5 kW	≤ 7.5 kW or ≤ 15 kW	IT load	N/A
		Cooling switch	1	2	3	4	3	3	Cooling switch	N/A
		Typical configuration	BC1	BC2	BC3/4	BC5	BC6/7	Latin America	Optional	
		Non-smart power distribution					Smart power distribution	For Latin America only		

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- All power distribution modules have a main switch except the Latin America version.
- All power distribution modules support Level C surge protection. Those installed in the Converged Cabinets have indicators. The 3 U, 6 U, and 9 U power distribution subracks house cooling unit switches, and 10 U intelligent power distribution subracks house ABB switches.

Power Supply and Distribution System - UPS



10 kVA/20 kVA

Specifications	10 kVA	20 kVA
Maximum Efficiency of the UPS	10 kVA (94.5%)	20 kVA (95%)
Input Voltage Range	Three-phase 138–485 V AC	
Surge Protection	Level C SPD	
Height	2 U	3 U
Output Power Factor	0.9	0.9
Noise of a Single UPS	< 55 dB (with a denoising module)	< 55 dB (with a denoising module)
Installation Mode	Rack-mounted	
Certification	CE, CB, TUV efficiency test, TLC, RoHS, REACH, WEEE, antiseismic (YD5096), and CQC energy saving certification	

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Power Supply and Distribution System - Battery Solution



Battery pack-9 Ah

Item	Specifications
Capacity (single battery pack)	9 Ah
Voltage (single battery pack)	240 V
Application scope	10 kVA/20 kVA
Dimensions (H x W x D)	130 mm x 430 mm x 685 mm
Weight (single battery pack)	69 kg (9 Ah)



Item	Specifications
Dimensions (H x W x D)	Deployed inside the data center module: 2000 mm x 600 mm x 1350 mm, cabinet quantity: ≤ 2 Deployed outside the data center module: 2000 mm x 600 mm x 1100 mm (1200 mm)
Battery capacity	Shoto 26 Ah/40 Ah/65 Ah/100 Ah
Number of batteries in a single cabinet	40 PCS (26 Ah/40 Ah) or 20 PCS (65 Ah/100 Ah)
Door opening mode	The front door is a single door, and the rear door is a single one.
Static load	1500 kg
Weight	Deployed inside the data center module: 160 kg; deployed outside the data center module: 140 kg (excluding batteries)
IP rating	IP20
Backup time	15 to 240 minutes (with an ATS), 15 or 30 minutes (without an ATS)



Battery rack

Battery capacity:
Shoto 26 Ah/40 Ah/65 Ah/100 Ah

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Cooling System - Indoor Unit



Indoor unit exterior

Item	Specifications
Outdoor unit operating temperature	–20° C to +45° C (normal temperature), –40° C to +45° C (low temperature), –10° C to +55° C (high temperature)
Height distance between indoor and outdoor units	–8 m to 30 m
Maximum equivalent length of the one-way pipe	≤ 80 m
Drainage requirements	The distance between the upper drainage of the water pump and the cabinet installation floor should not exceed 4 m.
Piping and cabling	Top and bottom piping and cabling
Certification	Normal temperature–model for Asia, Africa, and Europe: REACH, RoHS, CE, CCC, and CQC Normal temperature–model for Latin America: REACH, RoHS, and CB Low temperature–model for Asia, Africa, and Europe: REACH, RoHS, CE, CCC, CQC, and EAC High temperature–model for Asia, Africa, and Europe: REACH, RoHS, CE, and SASO
Indoor Unit	**Cooling-Only Indoor Unit/Indoor Unit with Heating and Humidification Function**
Power system (mains power supply)	220/230/240 V AC, 50 Hz, 1Ph+N+PE
Maximum current	Cooling-only indoor unit: 3.3 A, indoor unit with heating and humidification function: 17.3 A
Cooling mode	Air cooling (horizontal air supply)
Refrigerant	R410A
Cooling capacity	12.5 kW
Fan type	EC fan
Maximum airflow	2600 m^3/h
Condensate pump	Standard configuration
Installation mode	Rack-mounted

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Cooling System - Outdoor Unit



Exterior of the outdoor unit of a normal temperature–model



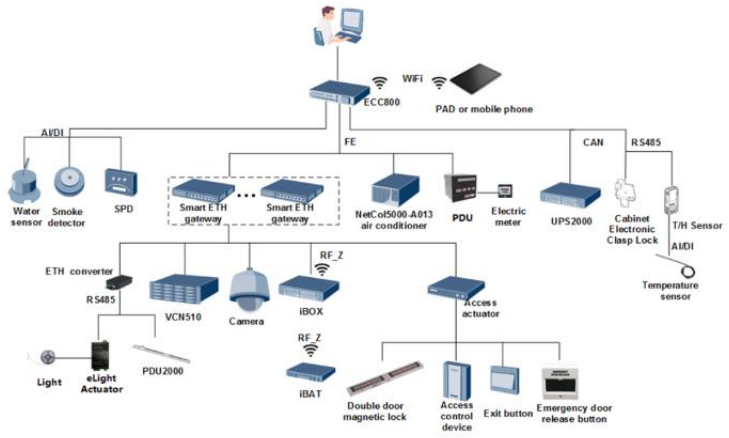
Exterior of the outdoor unit of a high temperature–model

Item	Specifications
Outdoor unit operating temperature	–20°C to +45°C (normal temperature), –40°C to +45°C (low temperature) –10°C to +55°C (high temperature)
Height distance between indoor and outdoor units	–8 m to 30 m
Maximum equivalent length of the one-way pipe	≤ 80 m
Drainage requirements	The distance between the upper drainage of the water pump and the cabinet installation floor should not exceed 4 m.
Piping and cabling	Top and bottom piping and cabling
Certification	Normal temperature–model for Asia, Africa, and Europe: REACH, RoHS, CE, CCC, and CQC Normal temperature–model for Latin America: REACH, RoHS, and CB Low temperature–model for Asia, Africa, and Europe: REACH, RoHS, CE, CCC, CQC, and EAC High temperature–model for Asia, Africa, and Europe: REACH, RoHS, CE, and SASO
Installation mode	**Rack-mounted**
Outdoor unit	Outdoor unit
Maximum operating current	Normal temperature: 24 A; high temperature: 30 A; low temperature: 30 A
Number of fans	1 (normal temperature/low temperature–model), 2 (high temperature–model)
Net weight/Gross weight	Normal temperature–model: 83 kg/99 kg, high temperature–model: 101 kg/114 kg, low temperature–model: 200 kg/250 kg
Installation mode	Floor-mounted or wall-mounted

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Monitoring System - System Architecture

- A smart module monitoring solution consists of the collector and monitoring components. The ECC800-Pro functions as the collector.

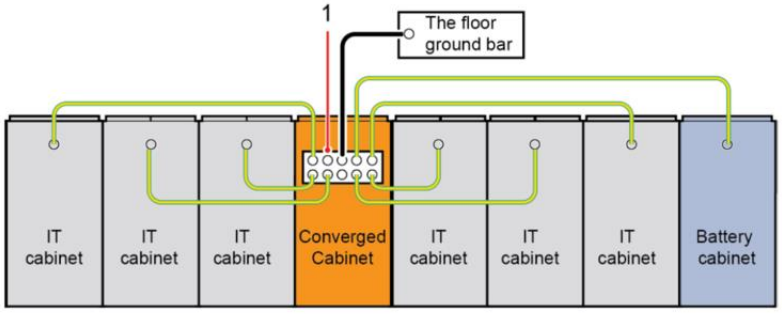


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- Each smart module provides an independent and integral interface for environment and power monitoring. This interface constantly monitors devices such as the power supply and distribution equipment, smart cooling products, temperature and humidity sensors, water sensors, smoke detectors, and video surveillance equipment inside the module. If a component fault or parameter error is detected, alarms are generated in diverse modes such as indicator light, email, and short message service (SMS). Historical data and alarm events are recorded, and all monitoring information is reported to the management platform.
- The PAD or mobile phone app can be used to query device information in real time, facilitating mobile O&M.
- To improve the reliability of the monitoring system, Ethernet ring bus networking is used for intelligent node signal transmission and sensor power supply.

Surge Protection and Grounding System

- Surge protection solution
  - The surge protection solution applies to building equipment rooms. The power distribution system is a subsystem of the building power distribution system. Class I SPDs of the power system are provided by the general low-voltage power distribution room or cabinet of the building.
- Grounding solution



(1) Main ground bar

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- Each cabinet is connected to the ground copper bar of the Converged Cabinet, and all cabinets are connected to the ground bar of the data center.

Integrated Cabling System

- Cable troughs are installed on the top of cabinets for routing cables. There are two types of cable troughs: signal cable troughs and power cable troughs.



(1) Signal cable (2) Power cable

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Quiz

1. (Multiple) Which of the following scenarios are the positioning of Huawei FusionModule500?
   A. Government vertical industry township outlets
   B. Large-sized enterprise core equipment room
   C. Bank outlets
   D. Small- and medium-sized enterprise network access

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- Answer: ACD

Summary

- This Chapter describes the subsystems of the FusionModule500 and FusionModule800, including the cabinet aisle system, power supply and distribution subsystem, cooling system, intelligent management system, surge protection and grounding system, and integrated cabling system. It also describes the main functions of each component.

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Thank you.

把数字世界带入每个人、每个家庭、
每个组织，构建万物互联的智能世界。

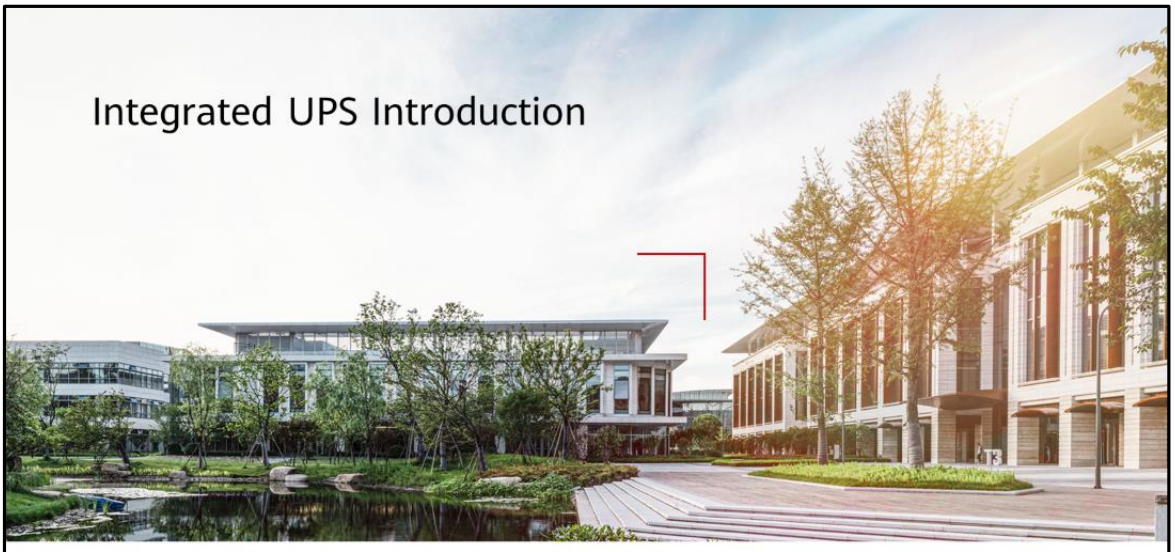
Bring digital to every person, home, and organization for a fully connected, intelligent world.

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Integrated UPS Introduction



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Foreword

- This chapter describes the basic features, advantages, appearance, internal structure, and key parameters of Huawei integrated UPS.

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Objectives

Upon completion of this course, you will be able to:

- Get familiar with the basic features and advantages of Huawei integrated UPS.
- Get familiar with the interior and exterior of Huawei integrated UPS.
- Understand the specifications of Huawei integrated UPS.

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Contents

1. Overview
2. Components
3. Specifications

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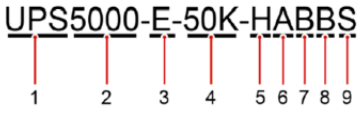
UPS5000-E-(25–125 kVA) Overview



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- The capacity of 25 kVA modules will be upgraded to 30 kVA as planned.

Naming Rule



No.	Meaning	Description
1	Product category	UPS: short for uninterruptible power system
2	Product series	5000
3	Product subcategory	E series
4	Output capacity	50K: 50 kVA; 125K: 125 kVA
5	Voltage level	H: 380 V/400 V/415 V
6	Air conditioner type	A: air-cooled
7	Input switch type	B: MCCB; S: ATS
8	Output type	B: branch power distribution
9	Configuration type	S: standard configuration

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Features - Reliable (1)

- Test Reliability



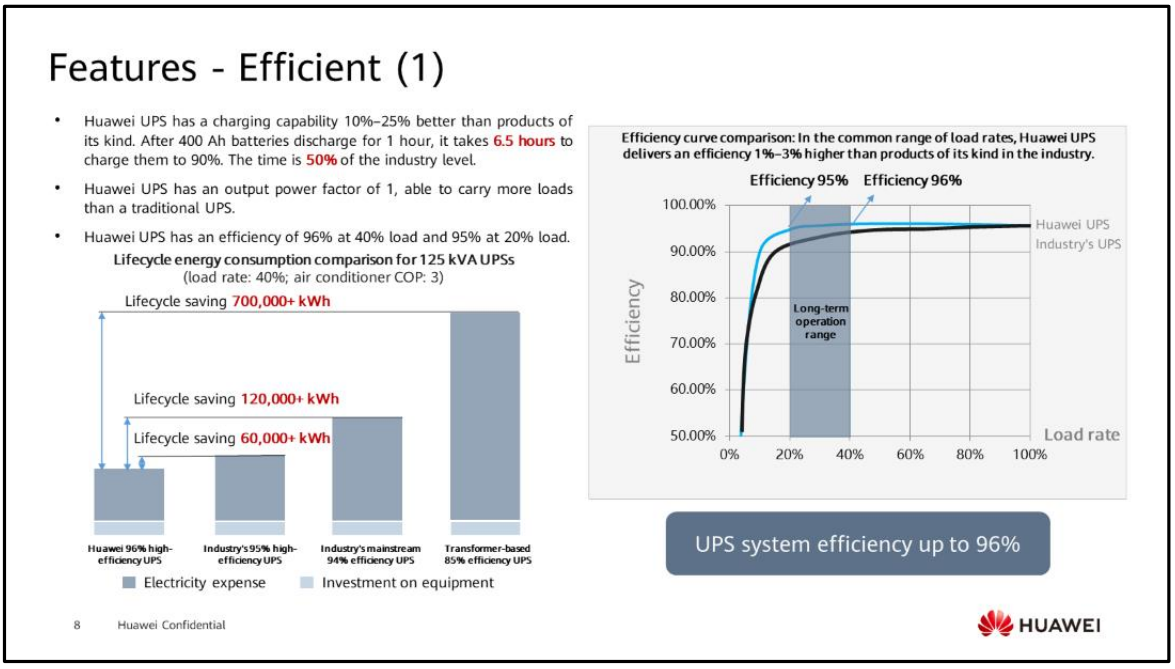
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Features - Reliable (2)

- Reliability Design
  - **Modular redundancy design:** The power module, bypass module, and ECM are hot-swappable, eliminating single points of failure.
  - **Distributed control + centralized scheduling:** Digital signal processing (DSP) technology controls power modules, and the ECM implements scheduling. Functions are decoupled to reduce logic complexity.
  - **Wide input voltage and frequency ranges:** 80–280 V AC (phase voltage), 40–70 Hz, applicable to poor power grids; extends the battery lifespan.
  - **6 kV surge protection and 5 kA lightning protection design (optional):** Huawei UPS reduces the lightning failure rate by 80%–90% compared with UPSs of its kind in the industry.
  - **High fault tolerance capability for fans:** If one fan is faulty, the UPS works at 50% load. If two fans are faulty, it works at 30% load.
  - **iBattery intelligent battery monitoring:** Proactive prevention eliminates potential faults.



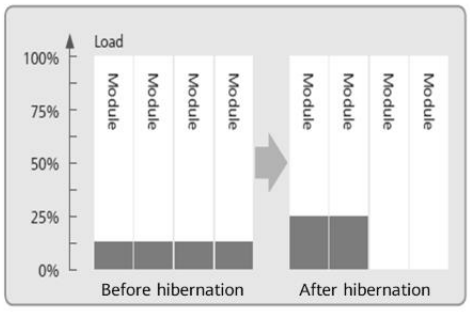
HUAWEI

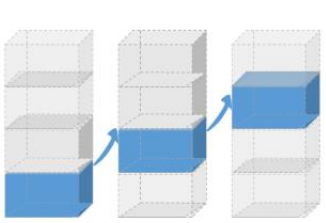


- The UPS5000-E has a high efficiency, which can reach 96% at 40% load and 95% at 20% load, reaching the industry's best level. Note that some UPSs are claimed to have high efficiency, but the actual operating efficiency is low. This is because the claimed efficiency is usually the efficiency at full load or a high load rate, not the efficiency at a low load rate. However, medium- and high-power UPSs seldom operate in standalone mode. The load rate in a parallel system is usually low. The efficiency at a low load rate is meaningful for customers. The UPS5000-E delivers high efficiency at a low load rate, which ensures that the UPS operates at a high efficiency. High efficiency naturally saves energy. Let's make a calculation. When the air conditioner cost is considered, Huawei UPS can save energy of 160,000 kWh to 50,000 kWh each year compared with a UPS with different efficiency in the industry. Compared with the legacy UPS, Huawei UPS can save energy of 320,000 kWh each year. The saving will soon be enough to buy a new UPS.

Features - Efficient (2)

Intelligent alternating hibernation technology improves low-load operation efficiency.





Intelligent alternation



Efficiency improvement comparison

When the UPS load rate is low, the module hibernation technology can be used to ensure redundancy and operation at the highest efficiency, which can **effectively improve the efficiency by more than 5%**.

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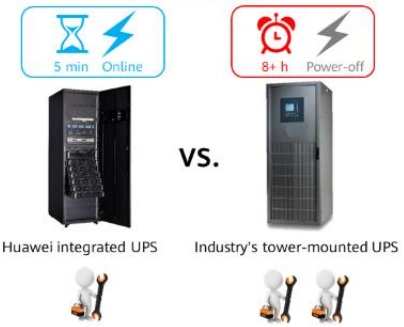
Features - Simple (1)

- Easy capacity expansion: Modules can be added to expand capacity on demand, reducing the upfront investment. There is no risk of power failure during expansion. A maximum of eight modules can be installed in a single cabinet.
- High power density design: The footprint is reduced by more than 50%. The 320 kVA UPS has a footprint of 0.51 m^2 and weighs 370 kg, saving the equipment room area.
- Front maintenance and hot-swap: The UPS cabinet can be installed and maintained after the front door is opened.

Capacity expansion is easy. The capacity per cabinet is 125 kVA, and the capacity of four cabinets connected in parallel can reach 500 kVA.



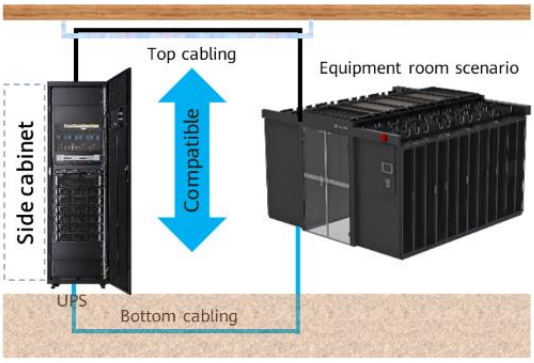
All modules are hot-swappable. It takes only 5 minutes for one person to replace a module.

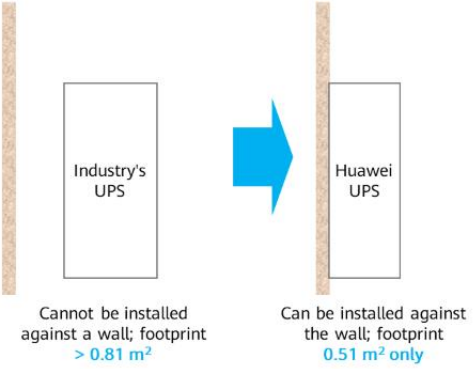


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Features - Simple (2)

- Huawei integrated UPS supports cable routing from the top or bottom, saving one side cabinet.
- The integrated UPS can be installed against a wall, saving space by about 60%.
- Integrated power supply and distribution saves one cabinet, reducing the footprint by 50%





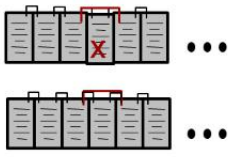
Cannot be installed against a wall; footprint > 0.81 m^2

Can be installed against the wall; footprint 0.51 m^2 only

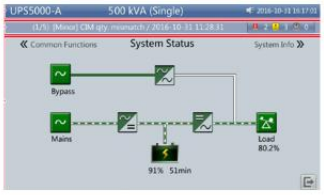
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Features - Intelligent

- The number of batteries can be adjusted. If a battery is faulty, the remaining batteries can continue to supply power to the UPS after the faulty battery is removed.
- The 7-inch color LCD touchscreen provides a graphic user interface for display and operations, with 11 languages supported.
- If both ECMs are faulty, the bypass takes over the system to ensure normal system running.
- Unified management makes O&M easy and efficient.



Battery reuse

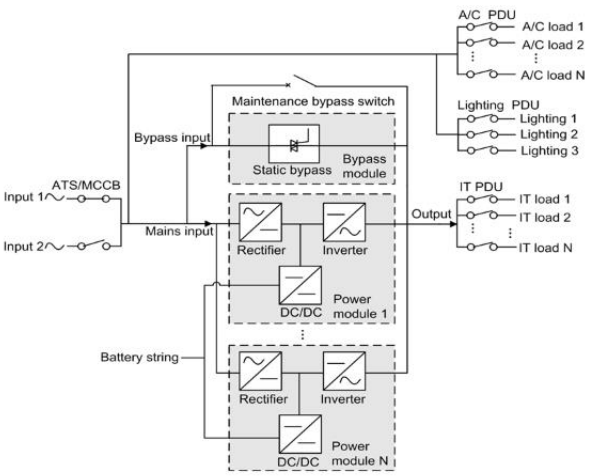


7-inch LCD screen

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Working Principles

- Rectifier functions
  - Converts AC power into DC power.
  - Implements power factor correction (PFC) and voltage boosting.
  - Reduces the pollution to the power grid.
- Inverter functions
  - Converts AC power into DC power.
  - Converts DC power supplied by batteries into AC power.
  - Provides pure AC power by high-speed operation of its switching diodes.
- Bypass functions
  - When the power module becomes faulty or fails to work properly, the UPS switches to the bypass.
  - The maintenance bypass isolates the UPS to ensure safety and power continuity during maintenance.
- Charger function
  - Charges batteries when the AC input is normal.



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- The rectifier is a circuit that converts AC into DC to provide stable DC power for the inverter. In addition, the rectifier increases the input power factor up to 1, which reduces the pollution to the electric grid.
- The inverter converts DC power into AC power. It converts DC power from batteries into AC power for loads when a mains outage occurs. It also converts DC power from the boost circuit of the rectifier into pure AC power for loads by high-speed operation of switching diodes.
- Bypass: When the power module becomes faulty or fails to work properly, for example, due to overtemperature or overload, the UPS switches to the bypass automatically. You can also manually switch the UPS to the bypass mode.
- Maintenance bypass: one or more power circuits that isolate the UPS to ensure safety and/or continuous power supply for loads during maintenance. If the maintenance bypass circuit breaker is switched on, the primary or backup power is supplied to loads without any protection.
- Batteries supply DC power to the inverter to ensure continuous power supply when a mains outage occurs. Typically, the battery voltage is 2 V, 6 V, or 12 V. UPSs often use 12 V storage batteries. Storage batteries are connected in serial or parallel to provide required DC current and backup time.

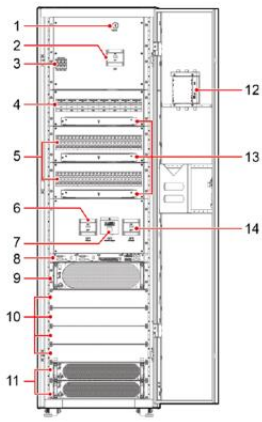
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1. Overview
2. **Components**
3. Specifications

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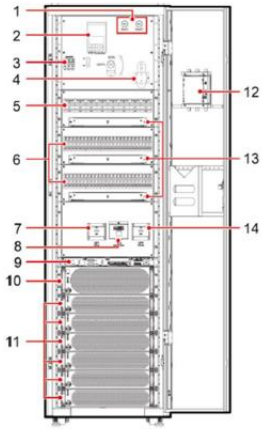
Appearance

UPS5000-E-50K-HABBS front view



(1) Power input status indicator
(2) Input circuit breaker
(3) Lighting circuit breaker
(4) Power circuit breakers for smart cooling products
(5) IT load circuit breakers
(6) UPS input switch
(7) UPS maintenance bypass switch
(8) Control module
(9) Bypass module
(10) Filler panels
(11) Power modules
(12) Monitoring display unit (MDU)
(13) Power distribution monitoring boards
(14) UPS output circuit breaker

UPS5000-E-125K-HASBS front view



(1) Power input status indicator
(2) ATS
(3) Lighting circuit breaker
(4) ATS handle installation slot
(5) Power circuit breakers for smart cooling products
(6) IT load circuit breakers
(7) UPS input switch
(8) UPS maintenance bypass switch
(9) Control module
(10) Bypass module
(11) Power modules
(12) MDU
(13) Power distribution monitoring boards
(14) UPS output circuit breaker

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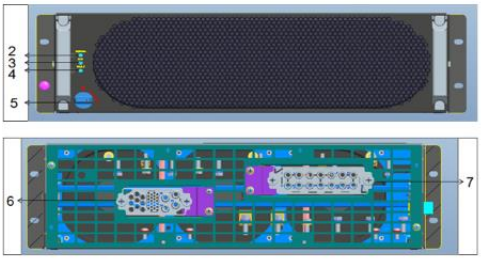
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Power Module

- The power module consists of a PFC rectifier and inverter. The power module performs AC/DC or DC/DC conversion on the mains and battery inputs, and stabilizes the bus voltage. The inverter (DC/AC) converts the inputs into sine wave outputs.



(1) Positioning lock (2) Running indicator
(3) Alarm indicator (4) Fault indicator
(5) Ready switch (6) Output port
(7) Input port

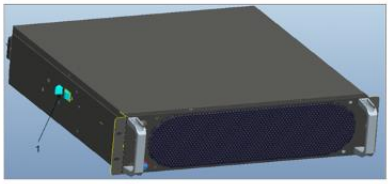


- Dimensions (H x W x D): 86 mm x 442 mm x 620 mm
- Weight: < 21 kg
- Rated output capacity: 25 kVA/25 kW
- Power density: 17.2 W/inch^3

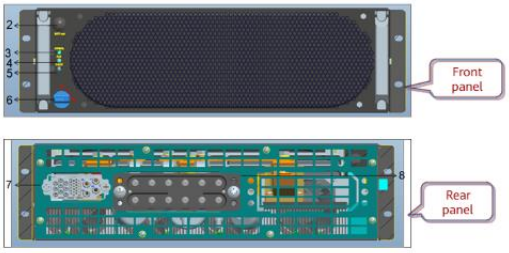
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Bypass Module

- The bypass module works in the following conditions:
  - The ECO mode is used and the bypass voltage is within the specified range.
  - The power module overload times out.
  - Both active and standby ECMs are abnormal.
  - The system runs abnormally.



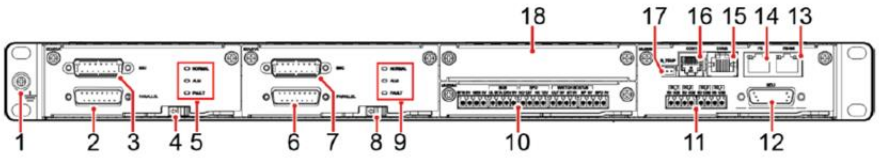
(1) Positioning lock (2) Battery cold start button
(3) Running indicator (4) Alarm indicator
(5) Fault indicator (6) Ready switch
(7) Signal port (8) Input and output ports



- Dimensions (H x W x D): 130 mm x 442 mm x 500 mm
- Weight: < 25 kg
- Maximum output power: 125 kW

Control Module

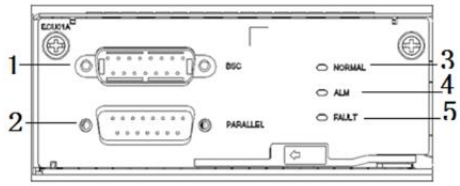
- In a standard configuration, the control module consists of two ECMs, one dry contact card, and one monitoring interface card from left to right. The four cards are hot swappable. One subrack is reserved above the dry contact card. A backfeed protection card or dry contact extended card can be inserted into the subrack.



(1) Ground terminal (2) Parallel port 1 (3) BSC port 1 (4) ECM 1 ready switch
(5) ECM 1 indicators (6) Parallel port 2 (7) BSC port 2 (8) ECM 2 ready switch
(9) ECM 2 indicators (10) Dry contact card (11) Dry contact ports (12) MDU port
(13) RS485 port (14) FE port (15) COM2 port (16) COM1 port
(17) Battery temperature sensor port (18) Optional card subrack cover

Control Module: ECM

- The control module consists of two ECMs that work in active/standby mode. Each ECM provides two ports, that is, a BSC port in the upper part and a reserved parallel port in the lower part. The ECM processes intra-cabinet and inter-cabinet signals and status information, and transfers the information to the monitoring module.



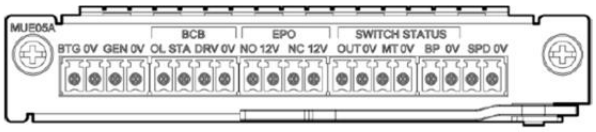
(1) BSC port
(2) Parallel port 1
(3) Running indicator
(4) Alarm indicator
(5) Fault indicator

Silkscreen	Description
PARALLEL	The PARALLEL port transmits signals between cabinets connected in parallel.
BSC	• The BSC port is used in a dual-bus system to synchronize output frequencies and phases between systems, ensuring that two buses can switch with each other. • The BSC cables are hot-swappable.

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Control Module - Dry Contact Card (1)

- The dry contact card allows the UPS to detect and manage the switch status of the battery system (including the external battery switch) and implement remote emergency power-off (EPO).



Port Silkscreen	Signal Description	Status Description	Initial Status
BTG	Port for monitoring battery grounding failures	• Closed: There is a battery grounding failure. • Open: There is no battery grounding failure.	Open
0V	Signal ground		
GEN	Port for detecting the diesel generator (DG) mode	• Closed: DG mode • Open: non-DG mode	Open
0V	Signal ground		
BCB_OL	Port for monitoring the battery circuit breaker (BCB)	• Grounded: The BCB is connected. • Disconnected: The BCB is not connected.	Grounding
BCB_STA	Port for monitoring the BCB status	• Closed: The battery circuit breaker is ON. • Open: The battery circuit breaker is OFF.	Open

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- A dry contact takes effect only after you set it in the monitoring system. You need to disable unused dry contacts.
- Set the EPO port to NO or NC as required.
- If multiple UPSs are connected in parallel, connect all used dry contact signals to each UPS.
- Signal cables must be double-insulated twisted cables. If the cable length is 25–50 m, the cross-sectional area is 0.5 mm2 to 1.5 mm2.

Control Module - Dry Contact Card (2)

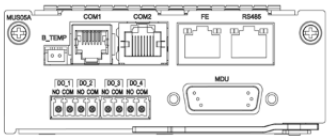
Port Silkscreen	Signal Description	Signal Description	Initial Status
BCB_DRV	Port for controlling BCB trip. When the voltage is +12 V, the BCB trips	• 0 V: The BCB has not tripped. • 12 V: The BCB has tripped.	0V
BCB_0V	Signal ground		
EPO_NO	EPO port. If the NO port is connected to the EPO_12V port, EPO is triggered.	Closing the EPO port triggers EPO.	Open
EPO_12V	+12V		
EPO_NC	EPO port. If the NC port is disconnected from the EPO_12V port, EPO is triggered.	Opening the EPO port triggers EPO.	Closed
EPO_12V	+12V		
SWITCH STATUS_ OUT	Port for monitoring the UPS output circuit breaker	• Closed: The UPS output circuit breaker is ON. • Open: The UPS output circuit breaker is OFF.	Closed
SWITCH STATUS_ 0V	Signal ground		
SWITCH STATUS_ MT	Port for monitoring the maintenance switch	• Open: The maintenance switch is ON. • Closed: The maintenance switch is OFF.	Open
SWITCHSTATUS_ 0V	Signal ground		
SWI CH STATUS_BP	Port for monitoring the bypass input circuit breaker	• Closed: The bypass input circuit breaker is ON. • Open: The bypass input circuit breaker is OFF.	Closed
SWITCH STATUS_ 0V	Signal ground		
SPD	Port for monitoring the input AC SPD	• Closed: The input AC SPD is normal. • Open: The input AC SPD fails.	Closed
0V	Signal ground		

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Control Module - Monitoring Interface Card

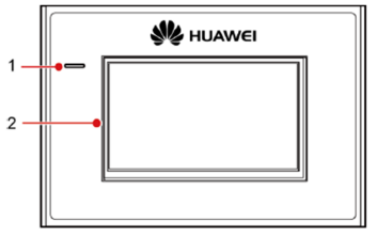
- The monitoring interface card provides external ports as well as monitoring and control functions for the MDU. The ports include the ambient T/H sensor port, FE port, battery temperature monitoring port, and network management port. The MDU monitors the UPS, allows users to set parameters, delivers commands, reports system information, and displays key UPS information and parameters on the LCD.

Port	Silkscreen	Signal Description
DO_1	DO_1_NO	Each DO has one of the following five meanings: battery mode, bypass mode, low battery voltage, major alarm, or minor alarm.
	DO_1_COM	
DO_2	DO_2_NO	
	DO_2_ COM	
DO_3	DO_3_NO	
	DO_3_ COM	
DO_4	DO_4_NO	
	DO_4_ COM	
DB26	MDU	DB26, containing FE, RS485, I2C, and CAN signals
Battery temperature	B_TEMP	Connects to an indoor battery temperature sensor with a negative temperature coefficient (NTC) resistor.
Southbound communications port 2	COM2	Connects to a southbound device, such as the battery monitor unit (BMU).
Southbound communications port 1	COM1	Two-wire port connecting to an ambient temperature and humidity (T/H) sensor
Network port	FE	Network port
Northbound communications port	RS485	Two-wire port connecting to a northbound network management system (NMS)



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MDU (1)



(1) Status indicator (2) LCD touchscreen

Status	Color	Meaning
On	Red	A critical alarm is generated, and the buzzer buzzes continuously.
	Yellow	A minor alarm is generated, and the buzzer buzzes intermittently (2 Hz).
	Green	The UPS is running properly or a warning is generated.
Off	None	The MDU is powered off.

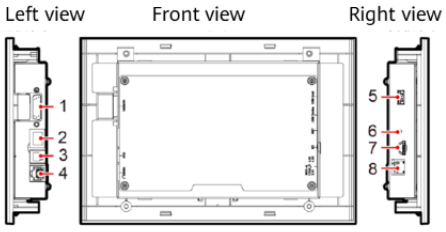
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- The indicator on the LCD panel is yellow when the bypass supplies power in non-ECO mode.

MDU (2)

- The MDU allows you to control the UPS, view the running status and alarms, and set parameters.

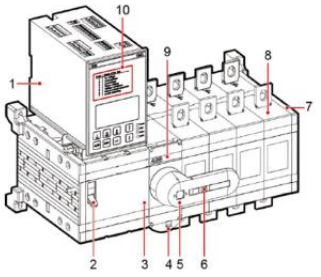
No.	Port Name	Description
1	MUS05A (DB26)	Connects to the MDU and monitoring interface card.
2	FE	Network port
3	CAN	Reserved
4	RS485_1	Reserved
5	USB Host	• After installing the WiFi module, connect the WiFi module to the UPS using the app on the mobile phone to obtain the initial startup password. • Connects to a USB flash drive to import or export the configuration file, export run logs, and upgrade software.
6	RST	Restart switch for the MDU.
7	SD	Reserved
8	DIP switch	Implements specific functions by using the DIP switch and specific buttons; controls the CAN communication resistor in a parallel system.



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ATS

- ATS controller
  - The ATS controller allows you to monitor the ATS status in real time and set ATS system parameters.
- Motor/Manual selection lever
  - M (Motor) indicates the electric mode, and Man. (Manual) indicates the manual mode.
- ATS handle installation slot
  - Flip the Motor/Manual selection lever to the Manual (Man.) position before inserting the handle into the ATS handle slot. After the handle is inserted, the ATS controller enters the manual mode.
- Handle locking latch
  - Before switching the ATS from the manual mode to the electric mode, push downwards the handle locking latch and then remove the handle.
  - After removing the handle, flip the Motor/Manual selection lever to the Motor (M) position.



(1) Controller
(2) Motor/Manual selection lever
(3) Motor operation mechanism
(4) Manual locking latch
(5) Manual operation handle
(6) Handle buckle
(7) Position for auxiliary contacts
(8) Transfer switch
(9) Operating mechanism
(10) Alarm ID description

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1. Overview
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3. **Specifications**

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Technical Specifications (1)

- Physical specifications

Item	Specifications
Cable routing mode	Routed in and out from the top Routed in and out from the bottom (tail frame configured)
IP rating	IP20
Dimensions (H x W x D)	2000 mm x 600 mm x 1100 mm
Communication function	Dry contacts, RS485, and SNMP

- Environmental specifications

Item	Specifications
Operating temperature	0–40°C
Storage temperature	–40°C to +70°C
Relative humidity	5%–95% RH (non-condensing)
Altitude	0 m–1000 m. The UPS power is derated as described in IEC 62040-3 when the altitude is greater than 1000 m. The upper limit of the altitude is 4000 m.

- Mains input electrical specifications

Item	Specifications
Input system	Three-phase four-wire + PE
Rated input voltage	380 V AC/400 V AC/415 V AC (line-to-line voltage)
Input voltage range	80–280 V AC (phase voltage) 0–40° C environment: not derated when the voltage is 176–280 V; linearly derated to 40% load when the voltage is 176–80 V
Input frequency range	40–70 Hz
Input power factor	> 0.99 (full load); > 0.98 (half load)
THDi	≤ 3% (linear load; maximum: 3%); ≤ 5% (non-linear load; maximum: 5%)

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Technical Specifications (2)

- Bypass input electrical specifications

Item	Specifications
Input system	Three-phase four-wire + PE
Rated input voltage	380 V AC/400 V AC/415 V AC (line-to-line voltage)
Input frequency range	50/60 Hz ±6 Hz (adjustable with a tolerance of 0.5–6 Hz, ±2 Hz by default)

- System electrical specifications

Item	Specifications
System efficiency	96% (linear load)
Current equalization specification	5%

- Battery

Item	Specifications
Battery voltage	360–528 V DC (30–44 batteries, 32 by default; derated by 6% when there are 30 batteries)
Battery management	Intelligent battery management
Cold start	If a mains outage occurs, batteries can start the UPS to supply power to loads.
Charging voltage	• Equalized charging voltage: 2.3–2.4 V/cell, 2.35 V/cell by default (30–42 batteries); 2.3–2.35 V/cell, 2.35 V/cell by default (44 batteries) • Float charging voltage: 2.23–2.3 V/cell; 2.25 V/cell by default (30–44 batteries)

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Technical Specifications (3)

- Output electrical specifications

Item	Specifications
Output system	Three-phase four-wire + PE
Voltage	380 V AC/400 V AC/415 V AC (line voltage)
Regulated voltage precision	±1% (balanced load)
Output power factor	1
Transfer time	• Uninterruptible transfer: 0 ms • Interruptible transfer: ≤ 20 ms
Output voltage imbalance	Voltage imbalance: ±3%; phase imbalance: 120 ± 2°
Overload capability	Inverter overload capability: • 100% < Load ≤ 110%: transfer to bypass mode after 60 minutes • 110% < load ≤ 125%: transfer to bypass mode after 10 minutes (tolerance: 0.1 minutes) • 125% < Load ≤ 150%: transfer to bypass mode after 1 minute • Load > 150% or a short circuit occurs: run for 200 ms
Derating coefficient of output circuit breakers	• 40 A circuit breaker: 0.75 • 63 A circuit breaker: 0.7

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Quiz

1. (Single) What does the letter E stand for in the UPS5000-E-125K-HASBS?
   A. 208 V voltage system
   B. E series modular UPS
   C. The input switch is ATS
   D. The input switch is MCCB

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- Answer: B

Summary

- This chapter describes the basic features, advantages, appearance, internal structure, and key parameters of Huawei integrated UPS. The appearance, structure, and key parameters of the Huawei integrated UPS in most important part.

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Thank you.

把数字世界带入每个人、每个家庭、
每个组织，构建万物互联的智能世界。

Bring digital to every person, home, and organization for a fully connected, intelligent world.

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FusionModule2000 Installation



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Foreword

- This chapter describes the installation process and key check points of Huawei modular data center FusionModule2000.

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Objectives

On completion of this course, you will be able to:

- Understand the installation scenarios of Huawei FusionModule2000.
- Be familiar with the installation process and key points of Huawei FusionModule2000.
- Understand the installation acceptance items of the FusionModule2000.

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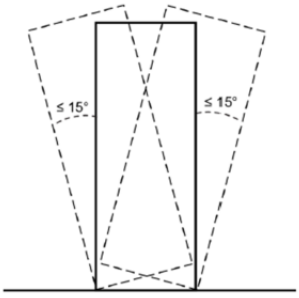
Contents

1. Preparation Before Installation
2. Key Installation Points
3. Installation Acceptance Items

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Precautions for Transportation

- Only trained personnel are allowed to move devices. Use a pallet truck to move the device with its case down from the truck. The forks must be properly positioned to ensure that the device does not topple.
- Choose railways, sea, or a road with good condition during transportation. No excessive tilt or jolt is allowed during the transportation, and the maximum tolerance of the tilting angle during loading and unloading is 15 degrees, as shown in the right figure.
- To avoid toppling, use a rope to secure the device case to the pallet truck before moving it, and assign persons to watch out the device during movement.
- Move the cabinet with caution. Any bumping or falling may damage the device.
- Move the device close to the installation site before unpacking. Unpacking the device with caution to avoid scratching or bumping. Take down the device from the pallet only immediately before installation.



Tilting angle of a cabinet

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Precautions for Placing

- Place the cartons in sequence based on the carton numbers, as shown in the following figure.



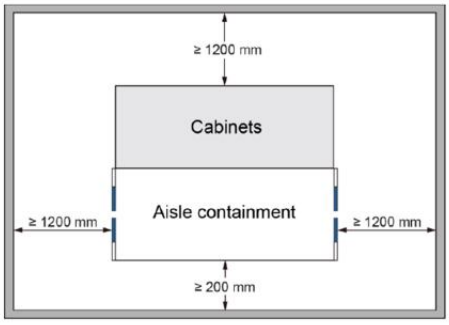
Note: The devices are numbered on the package. Place the devices in the sequence of the numbers. Install the devices in the sequence of the numbers to ensure that all the components are installed.

Place all components properly.

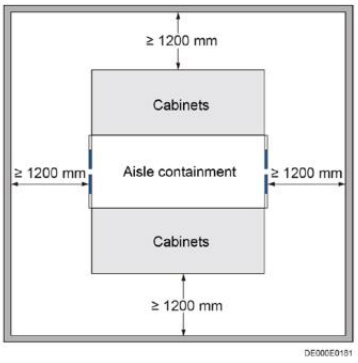
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Installation Site Requirements

- Based on the smart module application scenarios, the following solutions are available.



Single-row scenario

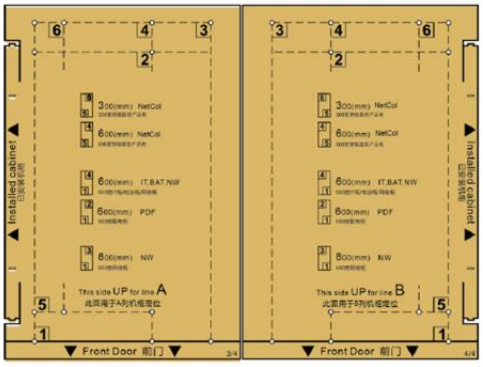


Dual-row scenario

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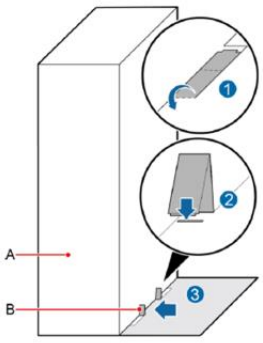
Tools (1)

- Tools delivered with the device



Marking-off template

Usage of marking-off templates

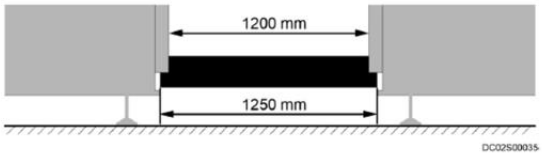


(A) Properly located cabinet (B) Marking-off template edgefolds

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Tools (2)

- Aisle check tool dimension description:
  - Longer-side length: check whether the distance between the cabinet frames in two rows of cabinets is 1250 mm.
  - Shorter-side length: check whether the distance between the doors in two rows of cabinets is 1200 mm.



Aisle check tool

Note: When checking the height, ensure that the floor levelness meets engineering requirements (floor levelness tolerance: 3 mm/2000 mm).

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Tools and Instruments

Appearance, Specifications, and Name						
Protective gloves	Marker	Measuring tape (5 m)	Level	Flat-head screwdriver	Step ladder (2 m)	Phillips screwdriver
						
Phase sequence meter	Adjustable wrench (6")	Socket wrench M4/M6/M8/M12	Hex key	Box-end wrench M6/M8/M12	Torque wrench (28 mm)	Solid wrench (12#/13#/18#)
						
Cotton cloth	Labels	Electric screwdriver	Hand drill	Hammer drill (Φ16)	Heat gun	Laser locator
						
Utility knife	Impact tool	Electrician's knife	Insulation tape	Needle-nose pliers	Diagonal pliers	RJ45 crimping tool
						

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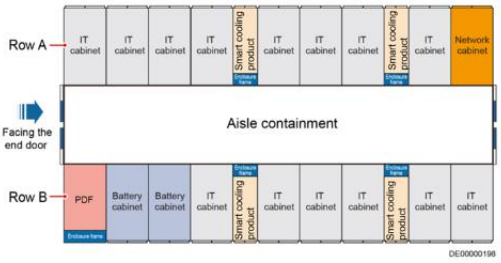
Tools and Instruments

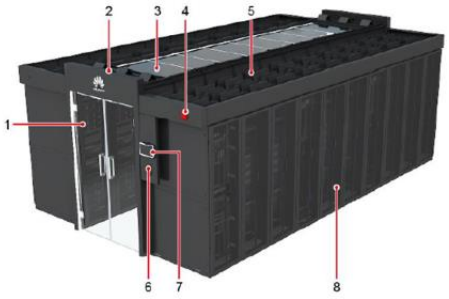
Appearance, Specifications, and Name						
Crimping tool	Wire stripper	Hydraulic pliers	Wire clipper	Cable tie	Multimeter	Electroprobe
						
Brush	Claw hammer	Vacuum cleaner	Hacksaw	Handsaw	Right angle	Heat shrink tubing
						
Network cable tester	Rubber mallet	Adjustable socket screwdriver	Flashlight	Clamp meter	Manual forklift truck	Diesel forklift truck
						
Lifting rope (bearing capacity ≥ 400 kg)	Lever (bearing capacity ≥ 400 kg)	-	-	-	-	-
						

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Installation Scenario (1)

- Power Supply and Distribution Cabinet Scenario (Dual-Row)



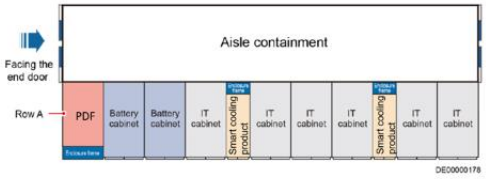


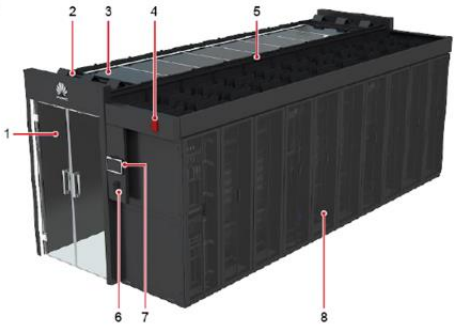
(1) End door (2) Control skylight (3) Flat or rotating skylight (4) Alarm beacon (5) Cable trough (6) Access controller (7) PAD (8) Cabinet

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Installation Scenario (2)

- Power Supply and Distribution Cabinet Scenario (Single-Row)



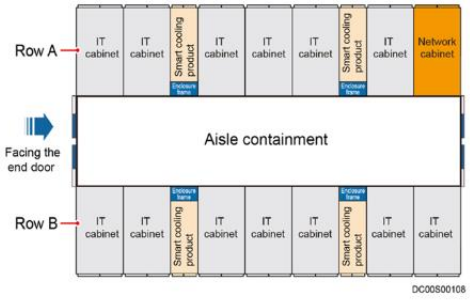


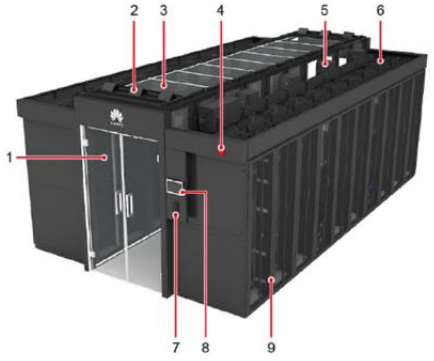
(1) End door (2) Control skylight (3) Flat or rotating skylight (4) Alarm beacon (5) Cable trough (6) Access controller (7) PAD (8) Cabinet

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Installation Scenario (3)

- New Main Way (NMW) Scenario (Dual-Row)

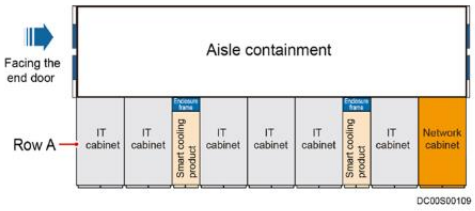


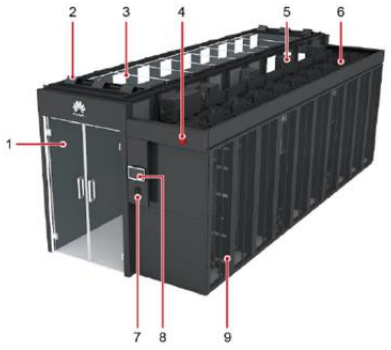


(1) End door (2) Control skylight (3) Flat or rotating skylight
(4) Alarm beacon (5) NMW (6) Cable trough
(7) Access controller (8) PAD (9) Cabinet

Installation Scenario (4)

- NMS Scenario (Single-Row)





(1) End door (2) Control skylight (3) Flat or rotating skylight (4) Alarm beacon (5) NMW (6) Cable trough (7) Access controller (8) PAD (9) Cabinet

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Contents

1. Preparation Before Installation
2. **Key Installation Points**
   - Installation Process
   - Power Supply and Distribution Devices
   - Structure System
   - Cooling System
   - Monitoring Devices
3. Installation Acceptance Items

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Installation Process

Material stacking and installation site survey → **Material receiving and placement** → **Installation tool preparation** → **Training before installation** → **Installation and guide** → **Site cleaning**

Perform site survey based on the survey guide. Pay attention to aisle, door, elevator, and material placing rules.



Transportation and unpacking tools:
1. Manual forklift truck and so on

Installation tools:
1. Phillips screwdriver
2. Small-sized flat-head screwdriver
3. Open-end wrench

Emphasize construction safety. Provide training in the installation process, documents and tools. Provide channels for help.

Install the smart module based on the process specified in the one-page installation guide, and connect cables based on the cabling diagram in package 0.

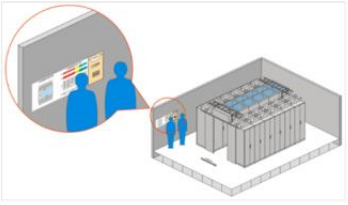
Checking the installation: Check whether the cabinets and skylights are properly installed, whether gaps between parallel cabinets are even, whether electric and extra-low voltage (ELV) cables separately routed and tightly bound, and whether end doors are smoothly opened and closed.

Package 0

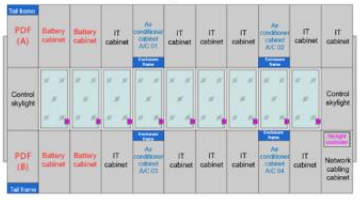


Package 0 contains installation guide tools, such as the one-page installation guide and layout.

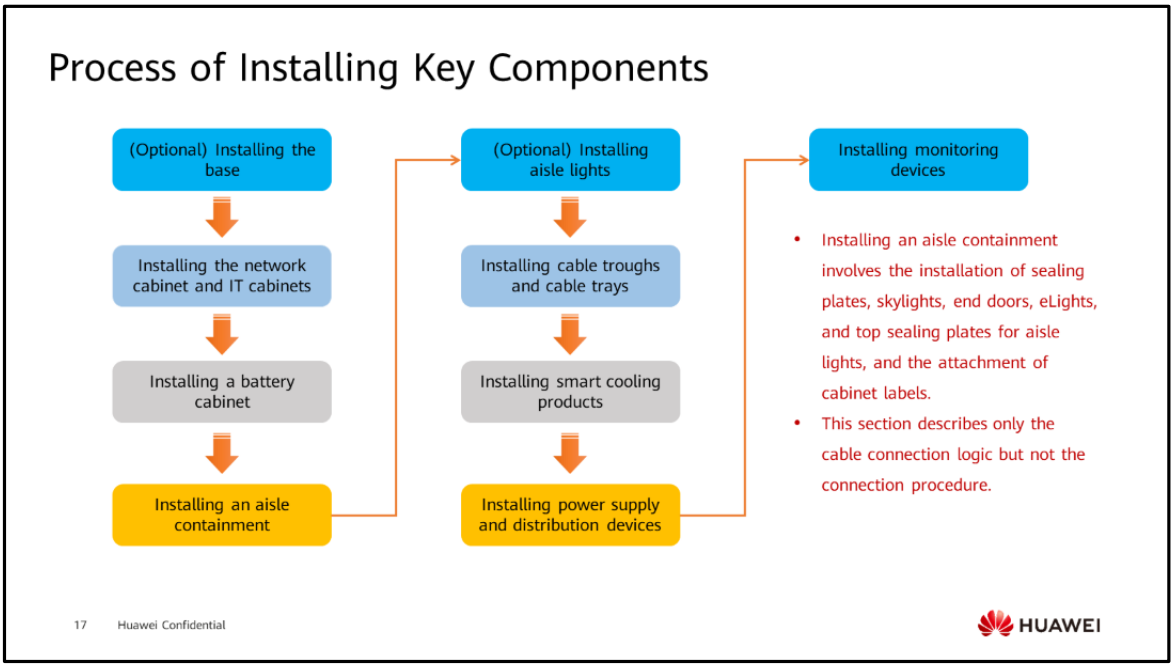
One-page installation guide



Layout



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- Non-standard scenarios (such as the scenario with a column) and cable connections are not described here.

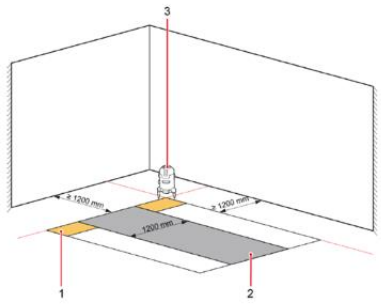
Contents

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   - Power Supply and Distribution Devices
   - Cooling System
   - Monitoring Devices
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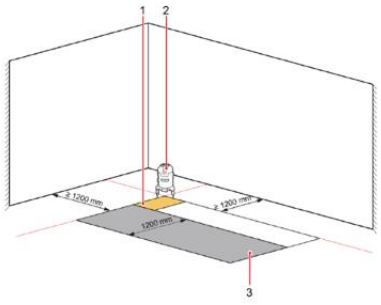
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Smart Module Layout Requirements

1. Determine the installation position for the smart module based on the onsite engineering layout diagram.
2. Use a laser locator to mark two lines that are perpendicular to each other in a corner of the planned installation position.
3. Place one corner of the marking-off template at the crossing point of the perpendicular lines to determine the position for an end cabinet. Use a marker to mark the outline of the marking-off template and the mounting holes for the cabinet on the floor.



(1) Marking-off template (2) Aisle sealing (3) Laser locator

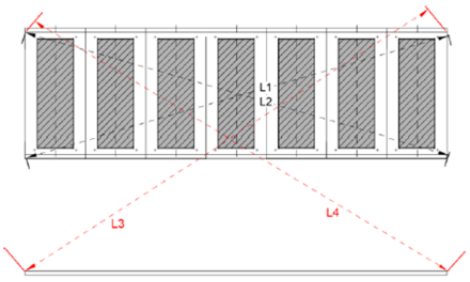


(1) Marking-off template (2) Laser locator (3) Aisle sealing

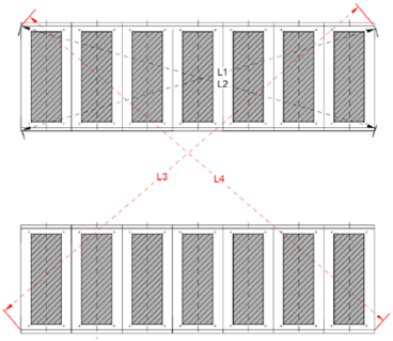
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(Optional) Installing Bases (1)

- Note
  - If there are bases, install smart cooling products first. If there are no bases, install cabinets from the end cabinet in sequence.
  - To ensure accurate positioning, you are advised to determine base locations using a laser locator before installing bases.
  - |L1–L2| ≤ 5 mm; |L3–L4| ≤ 5 mm



Single-row base layout



Dual-row base layout

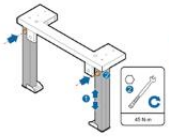
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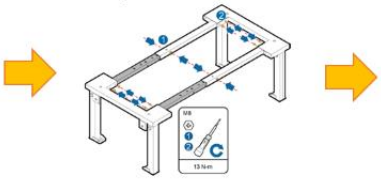
- Assume that each row of cabinets is configured with N bases:
  - If N is less than 5, you can install all the bases at a time. After installation, check that the total length of each row of bases is the sum of nominal widths of all bases (tolerance: –3 mm to 0 mm).
  - If N is greater than or equal to 5, you are advised to install five bases at a time. After installation, check that the total length of the bases is the sum of nominal widths of all bases (tolerance: –3 mm to 0 mm). After installing five bases, check whether the total length of the five bases and the difference between their diagonal lengths meet the requirements.
  - If the difference meets the requirements, tighten the bolts and continue to install next five bases. If the difference does not meet the requirements, adjust the bases to meet the requirements before tightening the bolts to prevent bases from being secured in a parallelogram or trapezoid shape.

(Optional) Installing Bases (2)

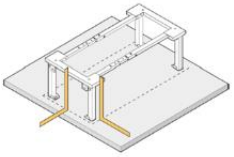


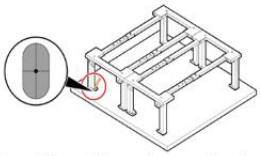
Step 1 Adjust the base height.



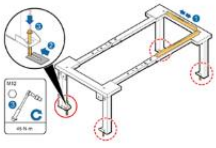


Step 2 Assemble the base.

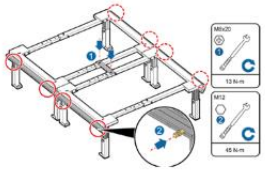




Step 3 Use a right angle to position the end cabinet base, and ensure that the outline of the upper surface of the base aligns with the cabinet bottom outline on the floor.
Step 4 Use the end cabinet base as the reference and place other cabinet bases.
Step 5 Check that the installation position meets the requirements.
Step 6 Use a marker to mark hole positions.



Step 7 Tighten the expansion bolts.



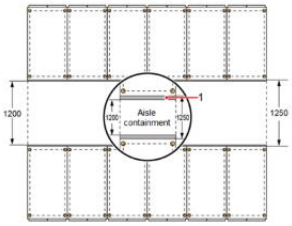
Step 8 Secure other bases in the same way.
Step 9 Connect all bases using connecting plates.
Step 10 Secure the floor holder to the base using screws.

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Installing the Network Cabinet, IT Cabinet, and Battery Cabinet (1)



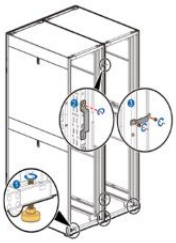
1. **Move the cabinet.**



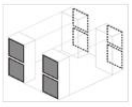
2. Determine the cabinet installation position using an ink fountain or a laser marking instrument, and drill holes and adjust distances between aisles using tools.

Note:

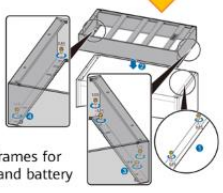
- During cabinet installation, place cabinets without the side panel inside the aisle and cabinets with the side panel on the end of the row.
- After leveling the cabinet, make sure that the top of the 2000 mm high cabinet is 2000 mm±3 mm away from the floor.
- Adjust distances between aisles using tools.



3. Adjust the cabinet height through leveling feet, and combine cabinets using connecting plates on the front and rear door frames.



4. The IT cabinet supports side panels 0, 2, and 4.
   - Side panel 0 can be configured only on the head and end of the row.
   - Side panel 2 can be configured only on one side of each cabinet.
   - Side panel 4 can be configured on all sides of each cabinet.



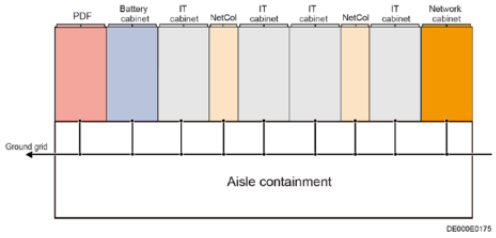
5. Install top frames for IT cabinets and battery cabinets.

6. Ground the cabinets.
   - Cabinets are grounded by cables connected from the main ground bar to the nearby ground grid.

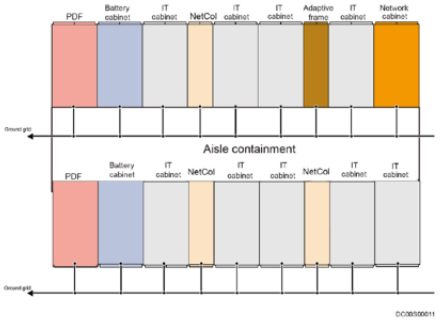
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Installing the Network Cabinet, IT Cabinet, and Battery Cabinet (2)

- Cabinet grounding



M-type grounding diagram (single-row scenario)



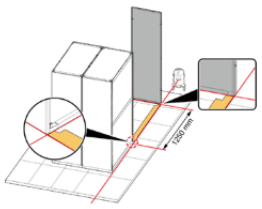
M-type grounding diagram (dual-row scenario)

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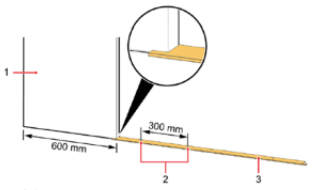
- Each cabinet is connected to a ground point, and all cabinets are connected to the ground bar in the data center.
- During the installation, install the ground cable first to improve security.

Installing an Aisle Containment – Installing Sealing Plates

- (Single-Row Scenario) Installing Sealing Plates

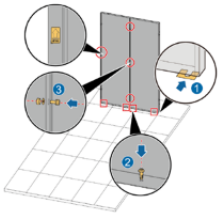


1. Determine the positions for installing sealing plates.



(1) 600 mm wide sealing plate
(2) Mounting holes for a 600 mm wide sealing plate
(3) Check tool

2. Determine the mounting holes for sealing plates.



3. Install sealing plates.

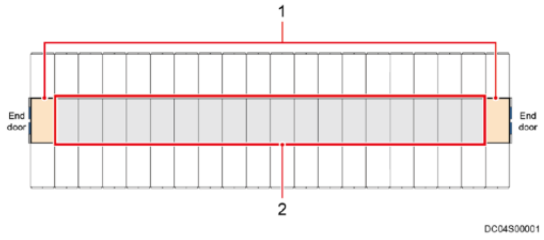
Note: If the distance between the sealing plate and the wall is less than 300 mm, adjust the installation sequence of the aisle containment.

1. Secure the sealing plates and skylight connective plates for the end cabinet in each row.
2. Secure the sealing plates to the floor.
3. Install the skylights.
4. Install other sealing plates and skylights in the same way.

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Installing an Aisle Containment – Installing Skylights (1)

- Aisle Skylight Layout



(1) Control skylights (2) Rotating skylights or flat skylights

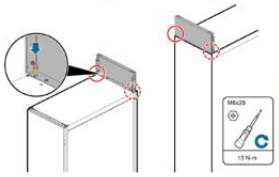
Note:

1. If the number of cabinets in one row is greater than 12, the number of control skylights is 3. Apart from the end door positions near the two ends, install a control skylight in the middle of the aisle.
2. Exercise caution when moving and securing skylights. Do not trample on them.
3. Place skylights in the correct direction based on the label on the skylights.

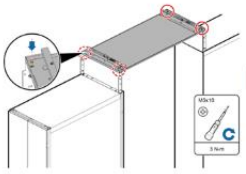
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Installing an Aisle Containment – Installing Skylights (2)

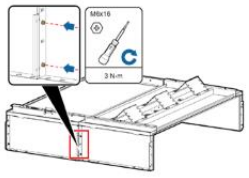
1. Install skylight connective plates.



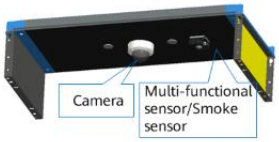
2. Secure the skylight to the support plate.



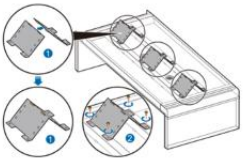
3. Secure adjacent skylights.



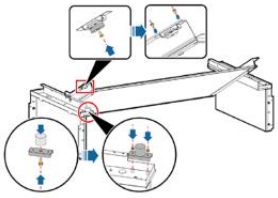
4. Install the camera, multi-functional sensor, and smoke sensor under the control skylight using screws.



5. Install a baffle to separate electric and ELV power cables when routing the cables on the control skylight.



6. Install a skylight magnetic lock.



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Installing an Aisle Containment – Installing End Doors

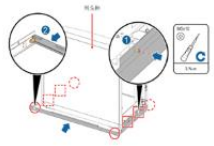
- Pre-installation checklist

No.	Check Item	Result
1	The cabinets have been leveled. If there is a height deviation, its absolute value does not exceed 3 mm.	☐ Passed ☐ Failed
2	The distance between cabinet doors inside the dual-row aisle containment is 1200 mm (tolerance: ±3 mm). The distance between cabinet doors and sealing plates inside the single-row aisle containment is 1225 mm (tolerance: ±3 mm).	☐ Passed ☐ Failed
3	The cabinets in both rows at the ends of the dual-row aisle containment are placed with a front-backward deviation no greater than 1.5 mm. The cabinets and sealing plates at the ends of the single-row aisle containment are placed with a front-backward deviation no greater than 1.5 mm.	☐ Passed ☐ Failed
4	The height deviation between the floor surface and base top is within 3 mm, and no deviation is preferred.	☐ Passed ☐ Failed

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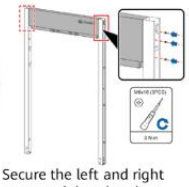
(Optional) Installing an Aisle Containment - Installing Revolving Doors

Install the bottom sealing plates.



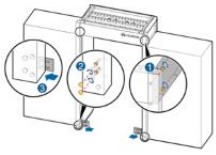
1. Install bottom sealing plates for the end cabinets.

Assemble the door frame.



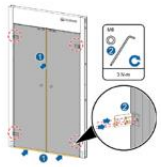
2. Secure the left and right posts and door header.

Install the door frame.



3. Install the entire door frame, and secure the top to the skylight connective plates and the bottom to the cabinet.

Install door panels.



4. Secure the door panel and posts using four hinges.

Install door boxes.



5. Secure the door box to the side post on the top of the cabinet.

Install the PAD mounting kit.



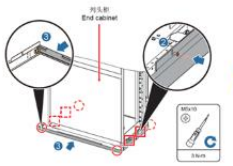
Note:

1. Before installing the door boxes, check whether the eLight needs to be installed. If the eLight needs to be installed, install it first and then perform the following steps.
2. In case of 1100 mm cabinet scenario, the 1100 mm door box separately delivered is used, the 1200 mm door box packaged in the door materials is abandoned.

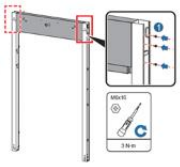
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(Optional) Installing an Aisle Containment - Installing Sliding Doors

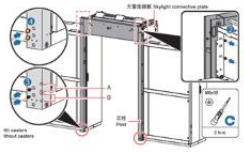
Install the bottom sealing plates.



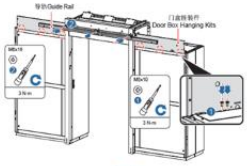
Install the posts and door header.



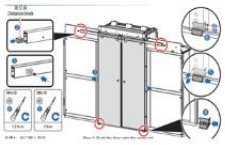
Install the posts and door header to the cabinet.



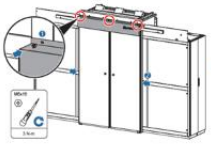
Install the door box hanging kits and the guide rail.



Install glass doors.



Install the door header.



Install door boxes.



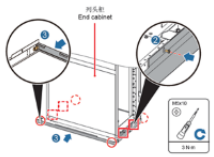
Install the PAD mounting kit.



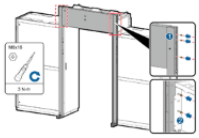
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(Optional) Installing an Aisle Containment - Installing an Electric Sliding Door

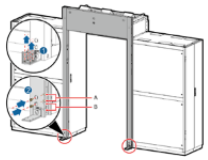
Install the bottom sealing plates.



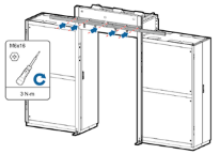
Install the internal door frame.



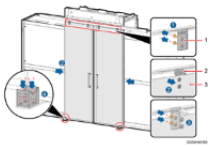
Install the posts and door header to the cabinet.



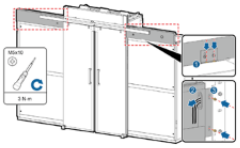
Install the door box hanging kits and the guide rail.



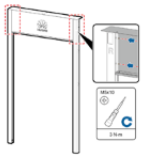
Install glass doors.



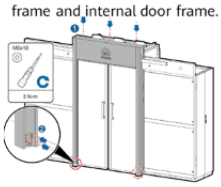
Install the internal door box.



Assemble the external door frame.



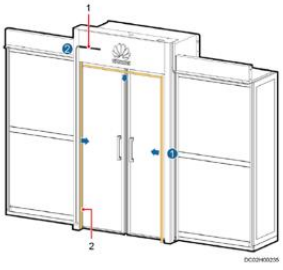
Assemble the external door frame and internal door frame.



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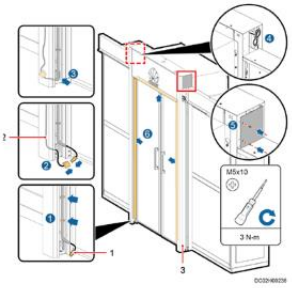
(Optional) Installing an Aisle Containment - Installing the eLight

Remove the white rubber panels and place the strip light cable.



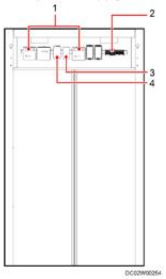
(1) Light strip extension cable (2) Rubber panel

Install the strip light and connect the cable.



(1) Strip light terminal
(2) Strip light extension cable
(3) Right post

Positions of the eLight actuator and power supply



(1) AC actuator (2) Upstream fuse
(3) eLight actuator
(4) eLight power supply

Note:
1. Ensure that there is no gap between the joints at both ends of the top rubber panel.
2. Before installing the eLight, ensure that the sliding door, revolving door, or auto door has been installed.
3. The eLight is installed in the door frame of the sliding door, revolving door, or auto door.

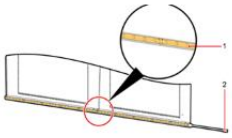
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(Optional) Installing an Aisle Containment - Installing an Atmosphere Light

Install the strip light into the buckle.

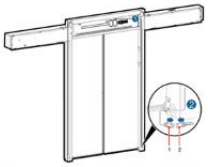


Attach the buckle to the bottom of the cabinet.



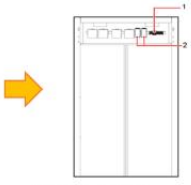
(1) Atmosphere light (2) Strip light terminal

Place the strip light cable and connect the strip light cable.



(1) Cable connector (2) Strip light terminal

Connect cables to the atmosphere light system.

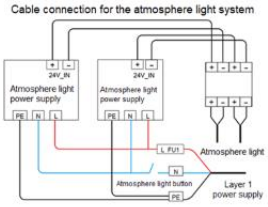


(1) Upstream fuse
(2) Atmosphere light power supply

Note:

- If the aisle length is shorter than or equal to 7500 mm, only one atmosphere light is required. Cut it into two segments of the same length to share one atmosphere light power supply.
- If the aisle length is longer than 7500 mm, two atmosphere lights are required. Cut them to a proper length and use two atmosphere light power supplies.

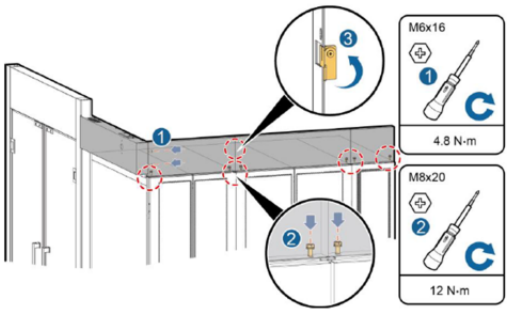
Cable connection for the atmosphere light system



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Installing an Aisle Containment - Installing Top Sealing Plates for the Smart Module

- Top sealing plates are used to decorate the smart module and installed on the top of the cabinets that are away from the aisle containment.
- The top sealing plates can be 300 mm, 600 mm, or 800 mm wide. They are installed on the top of cabinets of the respective width.
- Install appropriate top sealing plates based on the actual cabinet dimensions.



Step 1 Secure the top sealing plates to the end door mechanical part.

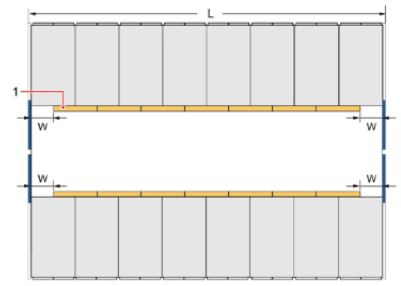
Step 2 Install the top sealing plates on the cabinets.

Step 3 Rotate the locking latch to secure two top sealing plates.

Step 4 Install all the top sealing plates on the cabinets in sequence.

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(Optional) Installing an Aisle Containment - Installing Aisle Lights



Aisle lighting layout

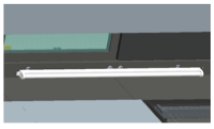
Note:

- A light tube is 600 mm long.
- Number of light tubes in a row *N* (rounded down) = Aisle length L/Light tube length
- If the light tubes cannot cover the entire length of the aisle, reserve the same installation distance (W) at both ends of the aisle: W = (L – 600 x *N*)/2.
- A maximum of 13 aisle lights can be connected in series. If the number exceeds 13, they should be installed in different groups.
- Redundant light tubes are delivered.
- Grouping rule: Set an equal number of lights in each group if possible and ensure that the light cables are routed out of the nearby cable holes in skylight plates.

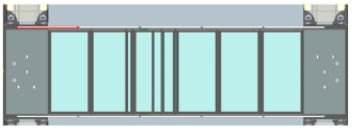
Install the LED light support.



Install the light tube.



Connect light tubes in sequence.



LED light cable hole



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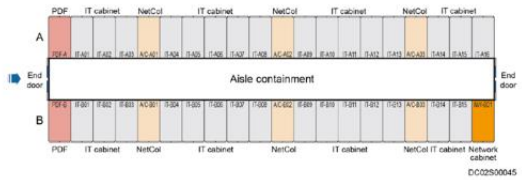
Installing an Aisle Containment - Attaching Cabinet Labels

- Rules for naming cabinets in the smart module: cabinet type - row in which the cabinet is located - sequence number

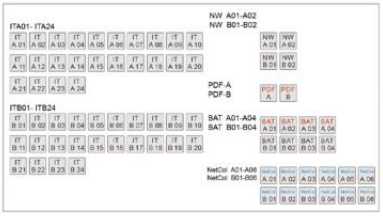
Category	Letter/Digit	Description
Cabinet type	IT	IT cabinet
	NW	Network cabinet
	PDF	Power distribution frame
	BAT	Battery cabinet
	NetCol	Smart cooling product
Row in which the cabinet is located	A	Row A
	B	Row B
Sequence number	01–24	Sequence number of each type of cabinets



(1) Label attaching position imprint
(2) Skylight connective plate



Label naming



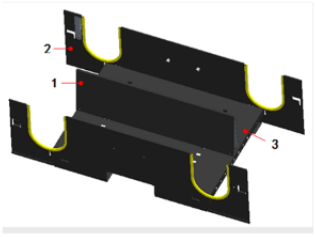
Cabinet label

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Installing Cable Troughs and Cable Trays (1)

- Cable tray configuration principles:

1. Cable troughs are available in three widths: 300 mm, 600 mm, and 800 mm. Install 300 mm, 600 mm, and 800 mm wide cable troughs on the top of 300 mm, 600 mm, and 800 mm wide cabinets respectively.
2. Install two cable troughs on the top of the end cabinet (PDF) first, and then install the cable troughs along the aisle.



(1) Partition plate (2) Support (3) Tray

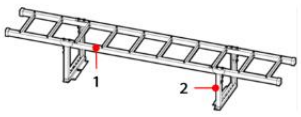
Note:

- Typically, end panels are installed only on cable troughs of cabinets at the two ends of an aisle.
- A red end panel indicates that the corresponding cable trough is for power cables, and a blue end panel for signal cables.
- Generally, the power cable trough is located close to the aisle containment, and the signal cable trough is located far away from the aisle containment.

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Installing Cable Troughs and Cable Trays (2)

Cable tray components



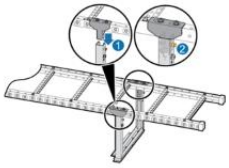
(1) Cable ladder (2) Support

Installing a support

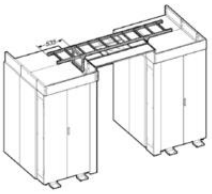


Use M6x16 screws to secure the supports to the top of cabinets (red boxes in the figure).

Installing the cable ladder (clamped without tools)

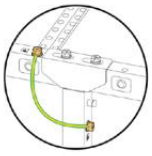


Installed cable tray



Cable tray configuration principles:

1. The cable tray is not configured in standard configuration.
2. The cable tray is configured when more than 12 cabinets are installed in a single row or a large number of cables are routed.



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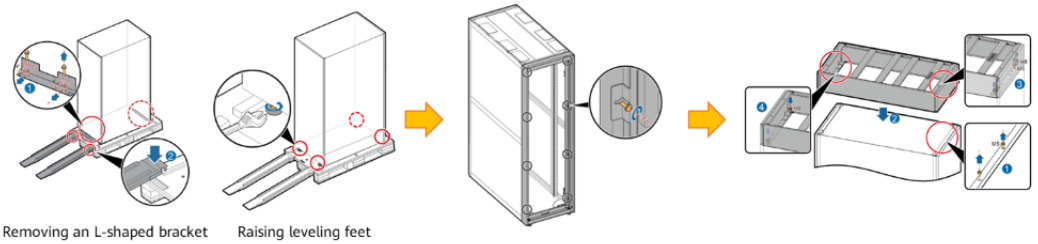
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2. **Key Installation Points**
   - Installation Process
   - Structure System
   - **Power Supply and Distribution Devices**
   - Cooling System
   - Monitoring Devices
3. Installation Acceptance Items

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Installing Power Supply and Distribution Devices - Installing the PDF and UPS

- Precautions for transportation:
  - Check the exterior of the PDF and check whether the PDF is damaged during transportation. If any damage is found, notify the carrier immediately.
  - Check that the fittings comply with the packing list. If some fittings are missing or do not comply with the packing list, record the information and contact your local Huawei office immediately.



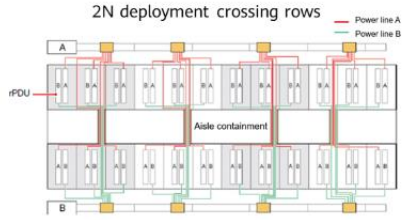
Removing an L-shaped bracket Raising leveling feet

1. Move the PDF. **2. Install an enclosure frame.** **3. Install a top frame.**

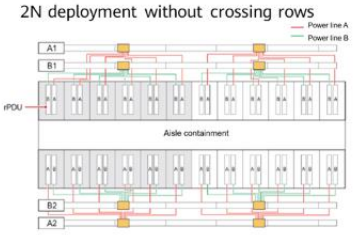
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Installing Power Supply and Distribution Devices - Installing the NMW

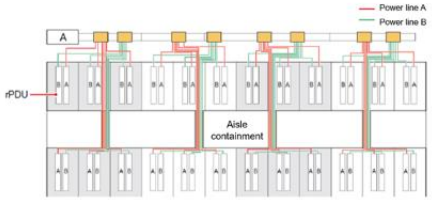
2N deployment crossing rows



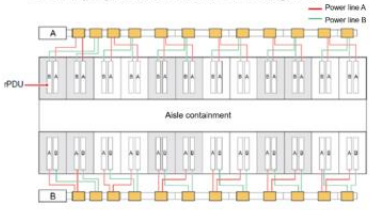
2N deployment without crossing rows



N+1 deployment crossing rows



N+1 deployment without crossing rows



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Installing Power Supply and Distribution Devices - Installing Batteries

- Observe the following precautions when installing batteries:
  - Except for necessary functional parts, wrap the exposed metal parts of tools such as Phillips screwdrivers and wrenches with at least two layers of insulation tape.
  - Wrap the OT terminal of a cable with insulation tape, and remove the tape when the cable is placed in position and the terminal connection is verified.
  - Leave one break point disconnected when connecting batteries on each layer, and connect the break point on each layer after other cables are connected.
  - Tighten screws to prevent sparks generated upon power-on.
  - Only qualified technicians can connect battery cables.
  - Ensure that all the safety measures have been taken before installation.
  - Ensure that the circuit breakers in the battery circuit breaker (BCB) box are OFF during installation.
  - Never short-circuit the two poles of a battery when handling or installing batteries.

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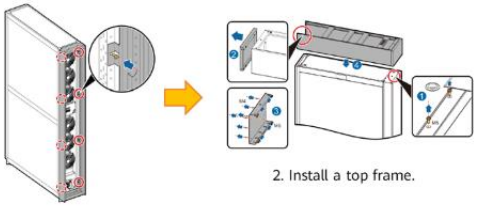
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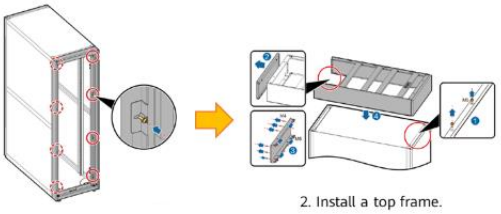
Installing Smart Cooling Products

- Installing the NetCol5000-A025 smart cooling product
  - If there are bases, install smart cooling products on the bases.
  - The equivalent length of a single pipe is less than or equal to 80 m.
  - If the outdoor unit is higher than the indoor unit, the vertical height difference is less than or equal to 20 m. When the indoor unit is higher than the outdoor unit, the vertical height difference is less than or equal to 5 m.



1. Install an enclosure frame.
2. Install a top frame.

- Installing the NetCol5000-A050 smart cooling product
  - The equivalent length of a single pipe is less than or equal to 100 m. If the outdoor unit is higher than the indoor unit, the vertical height difference is less than or equal to 30 m. When the indoor unit is higher than the outdoor unit, the vertical height difference is less than or equal to 8 m.



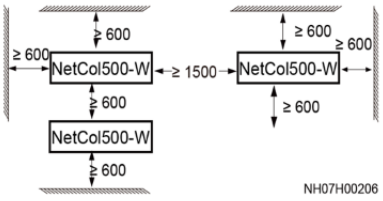
1. Install an enclosure frame.
2. Install a top frame.

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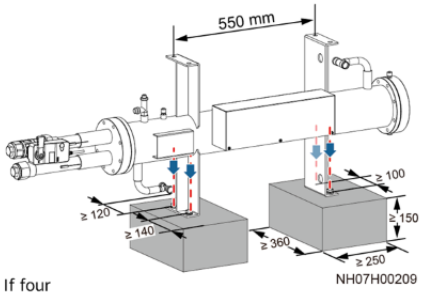
Installing a Water-Cooled Module (NetCol500-W055)

- Installation environment: enclosed indoor environment in which the temperature and humidity can be controlled within the ranges of 4°C to 45°C and 5% RH to 90% RH respectively. If the indoor installation position is ventilated, it should be more than 5 km away from the sea or pollution sources (such as salt lakes, chemical plants, mineral plants, thermal power plants, and coal mines).

Scenario 1: Top view of horizontally installed modules



Scenario 2: Horizontal installation on a concrete base



Scenario 3: Stack scenario

- A maximum of four layers of water-cooled modules can be stacked. If four layers are stacked, the minimum height of the installation space is 3 m.
- Use the bolts in the fitting bag to secure the mounting holes (4 PCS).

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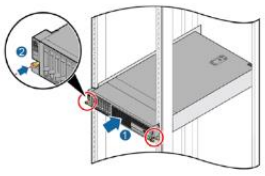
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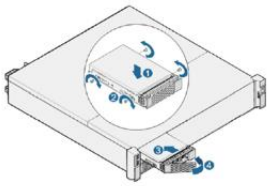
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Installing Devices in the Network Cabinet

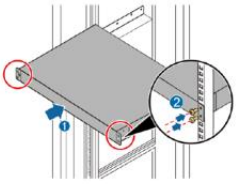
1. Install the server.



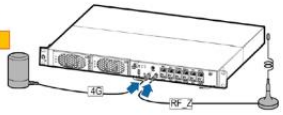
2. Install the VCN.



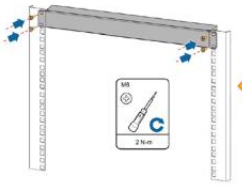
3. Install the LAN switch.



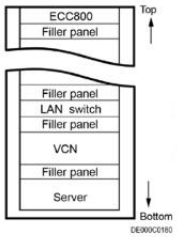
4. Install the ECC800-Pro.



5. Install a rack environment unit.



Device layout in the network cabinet



Note:

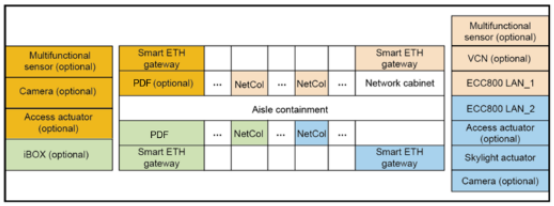
1. Before connecting power cables for the device, use the ground cable delivered with the device to connect the device ground point to the cabinet ground point close to the device mounting holes.
2. The server uses dual power supplies. Connect the two power cables to different rPDUs.
3. By default, the VCN is delivered without a disk. After the VCN is delivered to the site, install hard disks as required and then install the VCN in the network cabinet.

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Layout of Smart ETH Gateways (Dual-Row Scenario) (1)

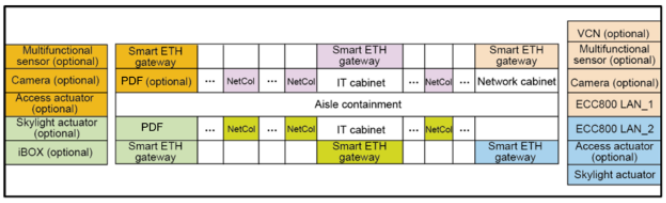
- Scenario 1

Scenario	Rules for Deploying Smart ETH Gateways
• Rack environment unit or UIM20A expansion module not deployed • Module length ≤ 7 m and the number of smart cooling products ≤ 4	Deploy 1 PCS for each end cabinet in the smart module, not for other cabinets. A total of 4 PCS should be deployed.



- Scenario 2

Scenario	Rules for Deploying Smart ETH Gateways
• Rack environment unit or UIM20A expansion module not deployed • Module length > 7 m or the number of smart cooling products > 4	• Deploy 1 PCS for each end cabinet and IT cabinet in the middle in the smart module, not for other cabinets. A total of 6 PCS should be deployed.

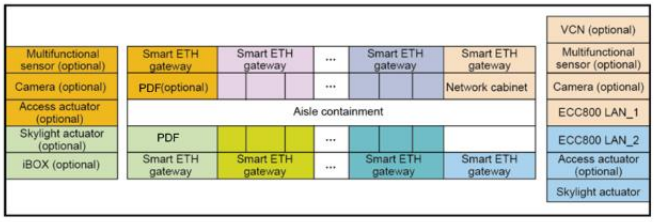


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Layout of Smart ETH Gateways (Dual-Row Scenario) (2)

- Scenario 3

Scenario	Rules for Deploying Smart ETH Gateways
• Rack environment unit or UIM20A expansion module deployed	Deploy 1 PCS for each end cabinet and 1 PCS for every three cabinets among other cabinets in the smart module.

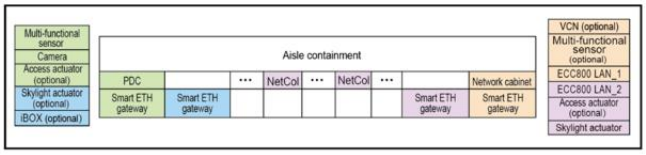


- Note:
  - When the smart module is 4 m long or less, no multi-functional sensor is deployed in the network cabinet.
  - When the smart module is longer than 7 m, deploy one multi-functional sensor in the middle of the smart module aisle (one more control skylight is deployed). The multi-functional sensor can be connected to any smart ETH gateway in the middle.

Layout of Smart ETH Gateways (Single-Row Scenario) (1)

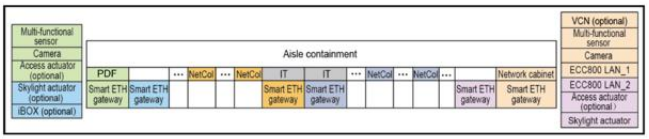
- Scenario 1

Scenario	Rules for Deploying Smart ETH Gateways
• Rack environment unit or UIM20A expansion module not deployed • Module length ≤ 7 m and the number of smart cooling products ≤ 4	Deploy 2 PCS for each end cabinet in the smart module, not for other cabinets. A total of 4 PCS should be deployed.



- Scenario 2

Scenario	Rules for Deploying Smart ETH Gateways
• Rack environment unit or UIM20A expansion module not deployed • Module length > 7 m or the number of smart cooling products > 4	Deploy 2 PCS for each end cabinet and IT cabinet in the middle in the smart module, not for other cabinets. A total of 6 PCS should be deployed.

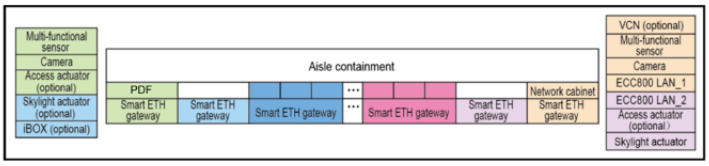


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Layout of Smart ETH Gateways (Single-Row Scenario) (2)

- Scenario 3

Scenario	Rules for Deploying Smart ETH Gateways
• Rack environment unit or UIM20A expansion module deployed	Deploy 2 PCS for each end cabinet and 1 PCS for every three cabinets among other cabinets in the smart module.

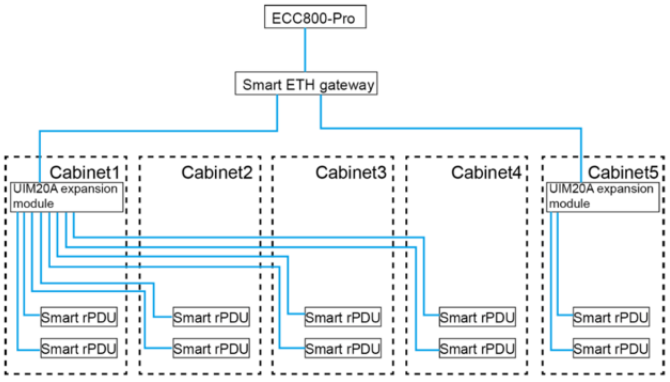


- Note:
  - When the smart module is 4 m long or less, no multi-functional sensor is deployed in the network cabinet.
  - When the smart module is longer than 7 m, deploy one multi-functional sensor in the middle of the smart module aisle (one more control skylight is deployed). The multi-functional sensor can be connected to any smart ETH gateway in the middle.

UIM20A Expansion Module Configuration Principles

- Standard scenario
  - Each cabinet is equipped with one UIM20A expansion module.
  - Each cabinet contains two or more types of smart components, including the smart U space manager, smart rPDU, cabinet electronic lock, and T/H sensor.
- One-to-four scenario
  - Four cabinets share one UIM20A expansion module.
  - Each cabinet contains only one type of smart device. The port for connecting the smart device to the UIM20A expansion module must meet the requirements of physical connection modes 1 to 4 in the UIM20A expansion module one-to-four scenario.

Cable connections (using a smart rPDU as an example)



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1. Preparation Before Installation
2. Key Installation Points
3. Installation Acceptance Items

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Installation Acceptance Items (1)

- Cabinet installation checklist

No.	Check Item	Result
1	The cabinets are placed according to the equipment room layout diagram.	☐ Passed ☐ Failed
2	The height deviation of all cabinets and the depth deviation of adjacent cabinets are less than 5 mm.	☐ Passed ☐ Failed
3	All bolts are tightened, especially the bolts used for electrical connection. Flat washers and spring washers are installed properly.	☐ Passed ☐ Failed
4	The cabinet is clean and complies with dustproof requirements.	☐ Passed ☐ Failed
5	The paint on the cabinet exterior is intact. If paint flakes off, repaint that area to avoid corrosion.	☐ Passed ☐ Failed
6	The cabinet door and lock work properly.	☐ Passed ☐ Failed
7	Labels are correct, clear, and complete.	☐ Passed ☐ Failed
8	There is no foreign matter such as adhesive tape, cable ties, paper, or packing materials left around the cabinet.	☐ Passed ☐ Failed
9	The cabinet filler panels are in proper positions so that the cold aisle and hot aisle are isolated.	☐ Passed ☐ Failed

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Installation Acceptance Items (1)

- Aisle containment installation checklist

No.	Check Item	Result
1	All components of the aisle containment are installed.	☐ Passed ☐ Failed
2	The end doors can be opened and closed smoothly.	☐ Passed ☐ Failed
3	The gap between end doors is even.	☐ Passed ☐ Failed
4	After the end door is closed, the rubber strip in the middle seals the gap properly.	☐ Passed ☐ Failed
5	After the double revolving door is closed, the height deviation of the two door panels is less than 5 mm.	☐ Passed ☐ Failed
6	The rotating skylights work smoothly.	☐ Passed ☐ Failed
7	The end planes of skylight connective plates are flush with each other.	☐ Passed ☐ Failed
8	The skylight electromagnet firmly suctions the skylight when the power is on, and the skylight drops naturally when the power is off.	☐ Passed ☐ Failed
9	Labels are correct, clear, and complete.	☐ Passed ☐ Failed
10	There is no foreign matter such as adhesive tape, cable ties, paper, or packing materials left in and around the aisle.	☐ Passed ☐ Failed

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Installation Acceptance Items (2)

- Cable installation checklist

No.	Check Item	Result
1	All cable joints are secured properly, especially the cable joints between network cables and cables inside cabinets.	☐ Passed ☐ Failed
2	Exposed parts near the wiring terminals and lugs are wrapped with PVC insulation tape or heat shrink tubing.	☐ Passed ☐ Failed
3	All wiring terminals are securely installed with flat washers and spring washers and are in good contact.	☐ Passed ☐ Failed
4	Cables are bound neatly, and cable ties are secured evenly and properly in the same direction.	☐ Passed ☐ Failed
5	Cables are properly routed for ease of maintenance and capacity expansion.	☐ Passed ☐ Failed
6	All labels at the cable ends are clear.	☐ Passed ☐ Failed
7	Excess sections of cable ties are neatly cut.	☐ Passed ☐ Failed
8	There is no unnecessary adhesive tape or cable tie on cables.	☐ Passed ☐ Failed

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Installation Acceptance Items (2)

- Electrical installation checklist

No.	Check Item	Result
1	All ground cables are copper cables with diameters meeting the requirements. No switch or fuse is installed at the middle of a ground cable, and no short-circuit occurs.	☐ Passed ☐ Failed
2	The ground cables, AC power cables, and internal cables are correctly connected and screws are secured. No short circuit occurs during power input or output.	☐ Passed ☐ Failed
3	The ground cables and power cables have no redundant length or coiling.	☐ Passed ☐ Failed
4	Lugs for power cables and ground cables are soldered or crimped securely.	☐ Passed ☐ Failed
5	Power and ground cables are bundled and separated from other cables.	☐ Passed ☐ Failed
6	The exterior of each battery is intact without any scratch, dent, or crack.	☐ Passed ☐ Failed
7	The shell of each battery is clean without any leakage trace.	☐ Passed ☐ Failed
8	The wiring terminals on each battery stand properly without any impact marks or damage trace, and the poles are not covered with any acid substances.	☐ Passed ☐ Failed
9	The pressure relief valve of each battery is not deformed and there are no liquid leaks.	☐ Passed ☐ Failed
10	Battery cables are correctly connected, and the terminal voltages of battery strings are normal.	☐ Passed ☐ Failed
11	DIP switches on devices are correctly set.	☐ Passed ☐ Failed

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Quiz

1. (Single) When installing the FusionModule2000 in a single-row scenario, what is the minimum distance between the aisle containment and the wall?

   A. 200 mm

   B. 600 mm

   C. 800 mm

   D. 1200 mm

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- Answer: A

Summary

- This chapter describes the installation process and key check points of Huawei modular data center FusionModule2000.

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Thank you.

把数字世界带入每个人、每个家庭、
每个组织，构建万物互联的智能世界。

Bring digital to every person, home, and organization for a fully connected, intelligent world.

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Application of VRLA Batteries



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Foreword

- This chapter describes the application scenarios, charging and discharging features, storage and management methods of lead-acid batteries in a data center, key points in installation.

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Objectives

On completion of this course, you will be able to:

- Understand the application scenarios of VRLA batteries in Huawei data centers.
- Understand the charge and discharge characteristics of VRLA batteries.
- Understand the storage management methods of VRLA batteries.
- Understand the key installation points and operation management methods of VRLA batteries.

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Contents

1. Application Scenarios
2. Technical Specifications and Characteristic Curves
3. Storage Management
4. Installation
5. Operation Management

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Product Description

- VRLA batteries feature stable voltage, low cost, and easy use and maintenance, and therefore are widely used. Although various new types of batteries are emerging, VRLA batteries will still be used in data centers and other fields such as electric power and rail transport to serve as main backup power and energy storage equipment.
- In data center scenarios, VRLA batteries can be classified into the following types based on the UPS configuration mode.

Category	Power Range	Application Scenario	Common Battery Configuration	Indoor/Outdoor
Small-capacity UPS	≤ 20 kVA	PC, terminal, workstation, server, ATM, network system, office equipment, medical system, monitoring system, communication system, etc.	12 V battery pack/battery box (string)	Indoor/Outdoor
Medium-capacity UPS	20 kVA–200 kVA	Financial securities centers, large medical instruments and equipment, MIS equipment rooms, and computer workstations, etc.	12 V/2 V battery string	Indoor
Large-capacity UPS	> 200 kVA	Large data centers for financial securities centers, telecom hubs, etc.	12 V/2 V battery string	Indoor

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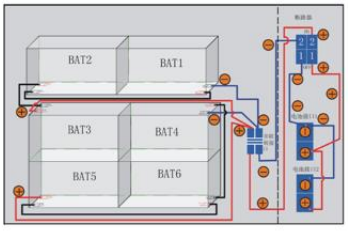
- The smart module development is divided into three phases:
- Combination of loose parts: Devices from multiple vendors are assembled onsite, and software and hardware interfaces are customized.
- Product-based integration: one supplier, prefabrication, and unified software and hardware interfaces
- Intelligent convergence: All products are digitalized and intelligently controlled in a unified manner to implement inter-system interconnection.

Application Scenarios of Battery Packs

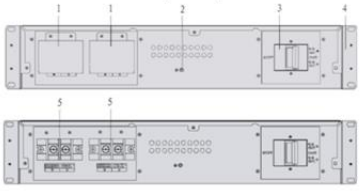
Appearance



Interior



Backplane port



(1) Battery pack busbar
(2) Ground nut
(3) 2-pole circuit breaker
(4) Mounting ear
(5) Battery pack busbar



FusionModule500 battery pack application

ESS-36 V 7 Ah (12 V) x 2 - BPVBB battery pack

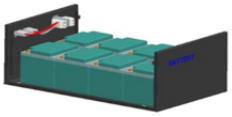
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Application Scenarios of Battery Boxes

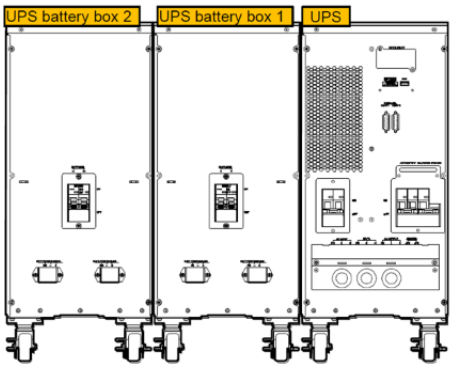
Battery pack



Interior



ESS-96 V 40 Ah (12 V) x 1 - BBNBB battery box

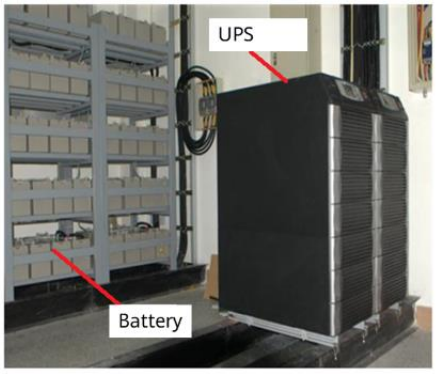


UPS2000-A battery box application

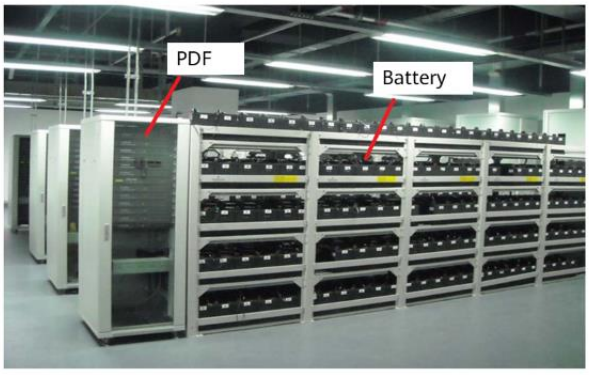
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Application Scenarios of Battery Racks

- Application in medium and large data centers



UPS battery strings for medium data centers



UPS battery strings for large data centers

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Technical Specifications (1)

- Rated capacity: refers to the nominal capacity, which indicates the minimum capacity that can be discharged according to industrial standards.
- Actual capacity: refers to the capacity that can be discharged after the fully charged battery is discharged to the specified end-of-discharge (EOD) voltage under certain discharge conditions. The unit is Ah or Wh.
- Rated voltage: refers to the approximate value used to identify the voltage of a battery type. For example, the rated voltage of a single VRLA battery is 2 V.
- Open-circuit voltage: refers to the terminal voltage of a battery in the open-circuit state. The open-circuit voltage of a battery is equal to the electric potential difference between the positive electrode and the negative electrode when the battery is open-circuited (that is, when no current passes through the two electrodes).
- Equalized charging: During the use of batteries, battery voltages are unbalanced due to the individual difference and temperature difference of batteries. To avoid the deterioration of this imbalance trend, the charge voltage of the battery string needs to be increased to activate the batteries. In this way, characteristics of each battery in the battery string are balanced.

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- Actual capacity: To set a unified condition, several discharge rates are set based on the battery structure features and usage. The most common discharge rates are 20-hour, 10-hour, and 2-hour (for UPS power systems), which are represented by C20, C10, and C2. C indicates the battery capacity, and the number following C indicates the number of hours for the battery to discharge to the specified voltage at a certain current. Therefore, the rated discharge current can be obtained by dividing the capacity by the number of hours. That is to say, the nominal discharge currents of batteries with the same capacity but different discharge rates are quite different.
- The equalized charge voltage used by Huawei is 2.35 V/cell.

Technical Specifications (2)

- Float charging: To balance the capacity loss caused by battery self-discharge, batteries need to be charged at a constant voltage for a long time. The float charge voltage used by Huawei is 2.25 V/cell.
- EOD voltage: indicates the voltage when a battery is used up. If the voltage decreases due to continuous discharging, the battery will be damaged. EOD voltage is the protection voltage set to prevent battery overdischarge. When the voltage reaches the value, the discharging should be terminated.
- Depth of discharge (DOD): indicates the percentage of battery discharge capacity to rated battery capacity. Generally, when the discharge capacity of a battery exceeds 80% of its rated capacity, it is considered that DOD is achieved.
- Temperature compensation coefficient: Ambient temperature affects battery charge status to some extent. To ensure that batteries are fully charged, a coefficient is required for correction. This coefficient is called temperature compensation coefficient. The default value is –3.3 mV/cell℃. The temperature compensation range is 5℃ to 45℃.

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Technical Specifications (3)

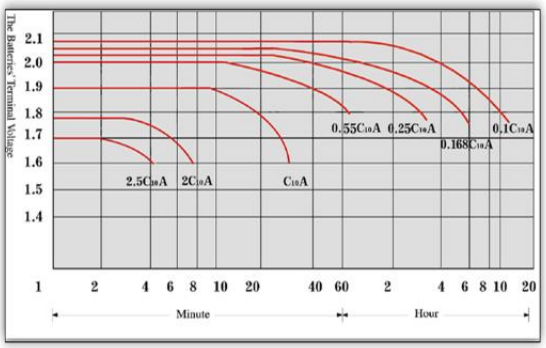
- Design life: indicates the expected battery life calculated based on the plate corrosion, electrolyte loss, safety valve aging rate, and sealant aging rate under standard conditions during battery design.
- Float charge life: indicates the life of a battery before it fails to meet specific performance requirements in specific float charging scenarios.
- Cycle life: indicates the number of charge and discharge cycles of a battery before it fails to meet specific performance requirements in specific cycle scenarios.
- Self-discharge: If a battery is not used for a long time, the battery power is reduced. This phenomenon is called self-discharge. The main reason of self-discharge is the irreversible reaction inside the battery, which leads to the loss of battery capacity.

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- Irreversible reactions can be classified into the following types:
  - Irreversible reaction between the positive electrode and the electrolyte
  - Irreversible reaction between the negative electrode and the electrolyte
  - Irreversible reaction caused by impurities in the electrolyte
  - Irreversible reactions caused by micro short circuits caused by impurities produced during manufacturing

Relationship Between the Rated Capacity and Actual Capacity

- The following lists the battery capacity that should be provided under standard test conditions.
  - The ambient temperature is 25℃, the cut-off voltage is 1.8 V, and the discharge current is 0.1C10.
  - The discharge duration is 10 hours.



Notes:

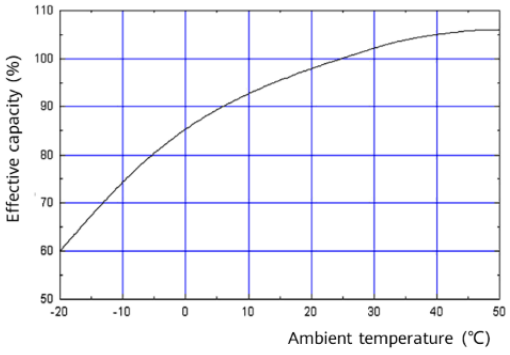
- If the discharge current is 20 A, the battery can discharge for 4 hours, and the discharged capacity is 80 Ah.
- If the discharge current is 25 A, the battery can discharge for 3 hours, and the discharge capacity is 75 Ah.
- If the discharge current is 55 A, the battery can discharge for less than 1 hour, and the discharge capacity is less than 55 Ah.

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- If a VRLA battery with a rated capacity of 100 Ah is discharged at 10 A at 25℃ and the EOD voltage is set to 1.8 V, the battery can be discharged for 10 hours.
  - If the discharge current is 20 A, the battery can discharge for 4 hours, and the discharged capacity is 80 Ah.
  - If the discharge current is 25 A, the battery can discharge for 3 hours, and the discharge capacity is 75 Ah.
  - If the discharge current is 55 A, the battery can discharge for less than 1 hour, and the discharge capacity is less than 55 Ah.

Effect of Temperature on Battery Capacity

- The effective discharge capacity decreases as the temperature decreases.
  - C25 = Ct/[1 + K x (t – 25)]
  - t: ambient temperature during discharging
  - C25: capacity at 25℃
  - Ct: actual capacity when the temperature is *t*
  - 10HR discharge: K = 0.006/℃
  - 5HR discharge: K = 0.007/℃
  - 3HR discharge: K = 0.008/℃
  - 1HR discharge: K = 0.01/℃

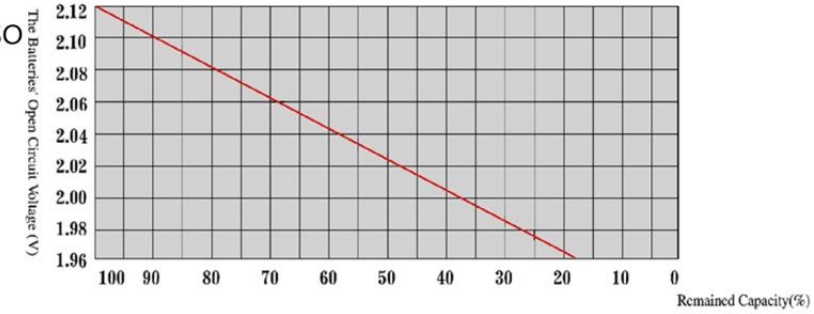


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- HR: discharge rate. It is an expression of the discharge system.

Relationship Between the Battery Open-Circuit Voltage and SOC

- There is a linear relationship between the battery open-circuit voltage and the state of charge (SOC).
- The SO

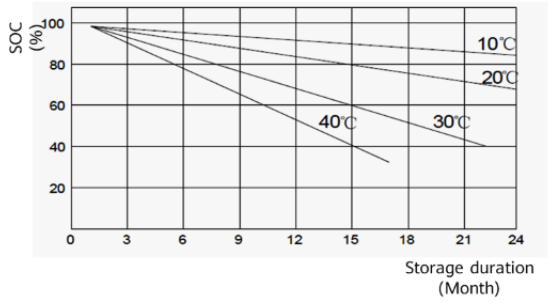


A common open-circuit voltage curve of VRLA batteries

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Relationship Between the Battery Self-Discharge Rate and Temperature

- The self-discharge capacity increases as the storage duration increases.
- The self-discharge rate increases as the storage temperature increases.



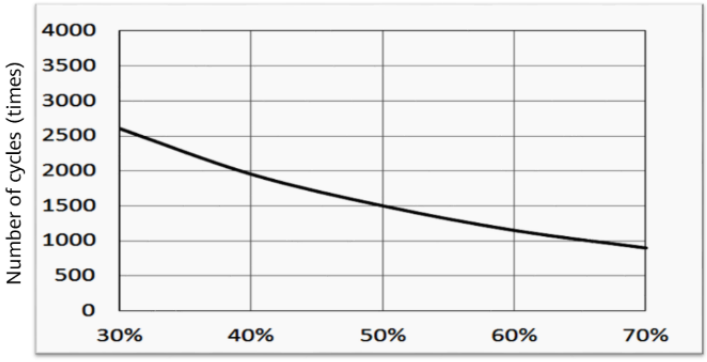
A common self-discharge curve of VRLA batteries

The figure on the left shows the self-discharge rate of VRLA batteries when the ambient temperature is 10℃, 20℃, 30℃, and 40℃. The self-discharge rate increases as the ambient temperature increases.

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Relationship Between Battery Cycle Life and DOD

- The cycle life is shortened as the DOD increases.



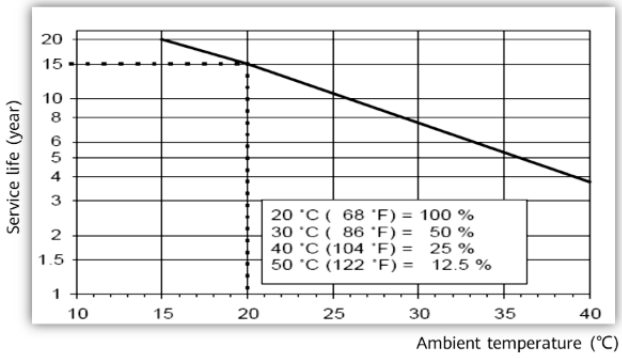
Cycle life curve of VRLA batteries (using DCB-500 as an example)

The figure on the left shows the relationship between the DOD and the number of cycles. The number of cycles is negatively correlated with the DOD.

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Relationship Between the Battery Float Charge Life and Temperature

- The float charge life is shortened as the discharge ambient temperature increases.



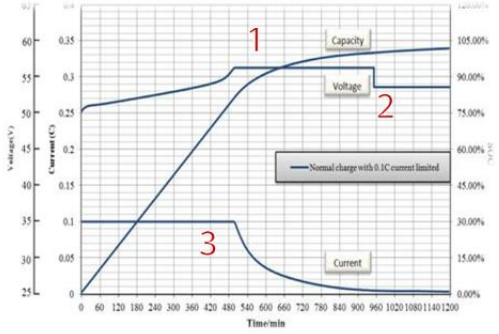
A common float charge life curve of VRLA batteries

The figure on the left shows the service life of VRLA batteries when the ambient temperature is 20℃, 30℃, 40℃, and 50℃.

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Battery Charge Characteristic Curve

- To prevent a large amount of heat generated due to excessive current, the current is limited during charging.
- To prevent excessive gas generated due to excessive voltage, the voltage is limited during charging.



A common charge curve of VRLA batteries

The figure on the left shows the charge voltage curve and charge current curve of VRLA batteries when the DOD is 100% and 50%.

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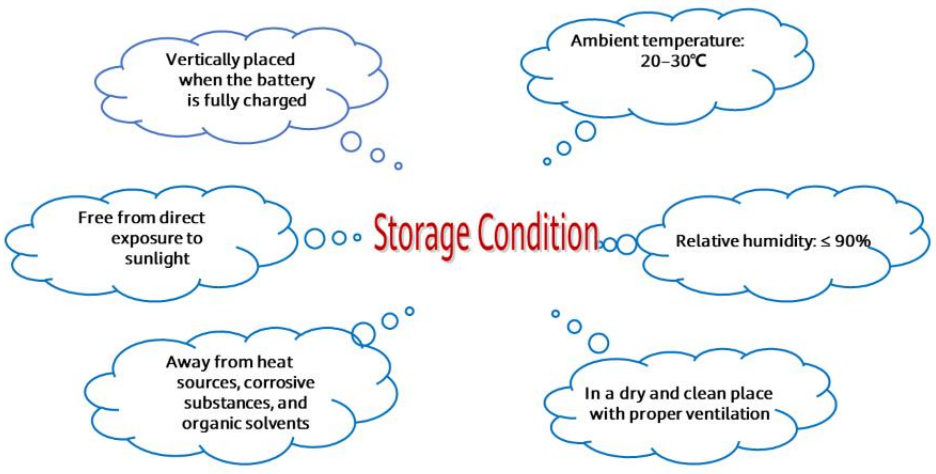
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VRLA Battery Warehousing

- Two restrictions
  - When the HQ and each supply center warehouse purchase VRLA batteries, the purchase date must be within three months after the battery recharge date.
  - VRLA batteries must enter the warehouse within six months after the production date.
- Three marks
  - Clear production date labels must be attached to the outer package of VRLA batteries.
  - For purchased VRLA batteries that have been recharged, ask the supplier to mark the recharge date and update the next recharge date.
- Three cautions
  - For VRLA batteries installed in a device or integrated equipment, the discharging circuit switches of the batteries should be turned off before storage. No leakage current is allowed.
  - Transport and move VRLA batteries gently and do not damage them.
  - Place VRLA batteries by category according to the project plan after acceptance and mark the batteries.

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Storage Conditions



Storage Risks

- **Risk 1:** The battery warranty period starts six months after the production date. If batteries are used after being stored for a long period, the warranty service may be unavailable for the batteries.
- **Risk 2:** After a battery is stored for a long time, the battery self-discharge causes irreversible sulphation inside the battery, and the battery capacity decreases. If the customer performs a discharge test according to the specification before acceptance, batteries with a capacity less than 100% of the rated capacity may fail the test.
- **Risk 3:** Long-term battery storage will increase the battery internal resistance, increasing the battery bulging probability in high-temperature areas.

Shoto Battery Type Power Grid Type	2 V AGM Batteries	12 V AGM Batteries with Front Terminals	2 V Gel Batteries	12 V Gel Batteries with Front Terminals
Class 1	3 years	2 years	3.5 years	2.5 years
Class 2	2 years	1.5 years	3 years	2 years
Class 3A	1.5 years	1.2 years	2.5 years	1.8 years
Class 3B	1 year	1 year	2 years	1.5 years
Class 4	8 months	6 months	1.5 years	1 year

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Installation Environment Requirements

- Ambient temperature range: –15°C to +45°C
- Relative humidity: ≤ 95%
- Install batteries in a clean, cool, dry, and ventilated environment. Do not install batteries in the following places:
  - Close to heat sources or exposed to direct sunlight
  - Damp areas or areas with water infiltration
  - Places exposed to dust
  - Enclosed places
  - Places in contact with corrosive and organic substances (including gas)

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Preparations for Installing VRLA Batteries

- Preparations:
  - Only trained and qualified personnel are allowed to install batteries, and they must understand safety precautions and correct operation methods of the UPS.
  - When installing batteries, comply with the UPS industry safety operation regulations, precautions, and special safety instructions for operating the UPS system and UPS batteries.
  - Insulate battery installation tools before using them. Otherwise, batteries may be short-circuited or damaged, endangering personal safety.
- Battery inspection requirements before installation:
  - Before unpacking batteries, check whether the package is intact. If there are signs of damage on the outer package, check the appearance of batteries in the case one by one to ensure that the batteries are intact.
  - After unpacking batteries, check whether the batteries and accessories are complete based on the packing list. If there is any problem, report it in a timely manner.
  - Before installation, check the battery appearance one by one. Ensure that the batteries are free from deformation, cracks, damage, acid liquid leakage, and stains. Otherwise, replace the batteries in a timely manner.
  - Carefully read the installation diagram, wiring diagram, and installation procedure diagram of the battery string.
  - Before installing batteries, ensure that the open-circuit voltage of a 12 V battery is greater than or equal to 12.60 V or that of a 2 V battery is greater than or equal to 2.10 V. If a battery fails to meet the requirements, recharge the battery.

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Installation Precautions (1)

- When installing or removing battery conductive cables (connected using a copper bar), use insulated tools and wear protective gloves. The installation tools must be insulated. Otherwise, short circuits may cause battery damage, scald, fire, or explosion.



Installation tools are not insulated.

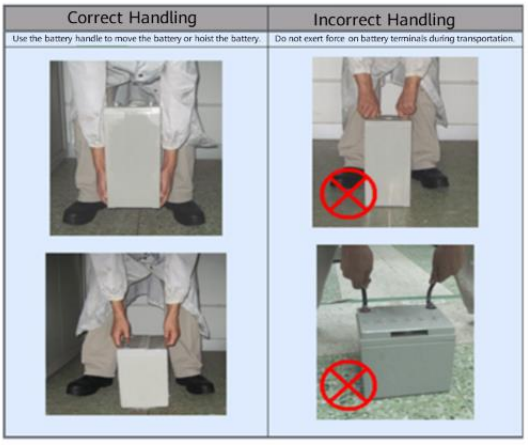


Use insulated tools to install and remove batteries.

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Installation Precautions (2)

- Move batteries gently and do not damage them, as shown in the figure.
  - Do not carry batteries by holding terminals or conducting wires. Otherwise, the batteries may be damaged.
  - Do not collide batteries or bump them against the ground when moving them. Otherwise, the batteries may be damaged.
  - Do not regard batteries as light objects. Batteries of a certain size are heavy, and sometimes may cause back pain and injury.
  - Do not pack batteries with plastic cloth that can easily generate static electricity, which may cause fire and explosion.



Installation Precautions (3)

- The distance between batteries must be greater than 10 mm to facilitate heat dissipation.
- Do not open the battery safety valve.
- Do not use batteries with different capacities, of different types and specifications, from different manufacturers, or in different batches at the same time.
  - Batteries with different capacities and of different types have different characteristics (such as internal resistance and float charge voltage). Therefore, the charge and discharge of these batteries differ greatly. If these batteries are connected in series, one battery may be overcharged or undercharged. If these batteries are connected in parallel, the charge and discharge currents will be biased, and the currents of each battery string will be inconsistent.
- If there are multiple battery strings, connect them in series and then in parallel.



Keep proper distance between batteries.

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Installation Precautions (4)

- Ensure that the surfaces of cables, copper bars, and battery terminals are clean. Check the appearance of batteries. Ensure that the batteries are free from deformation, cracks, damage, acid liquid leakage, and stains.
  - Keep battery terminals clean. Otherwise, the terminals are in poor contact with the batteries, which may cause power disconnection and charging failures.
  - Use a moist cloth instead of a dry cloth or duster to clean the battery. Otherwise, static electricity may be generated, causing fire or explosion.
  - Do not use lacquer thinner, gasoline, kerosene, volatile oil, and other organic solvents and liquid detergents for cleaning. Otherwise, the battery case may crack and electrolyte may leak.



Dirty surfaces of cables, copper bars, and battery terminals



Deformed battery Bulging battery Cracked battery

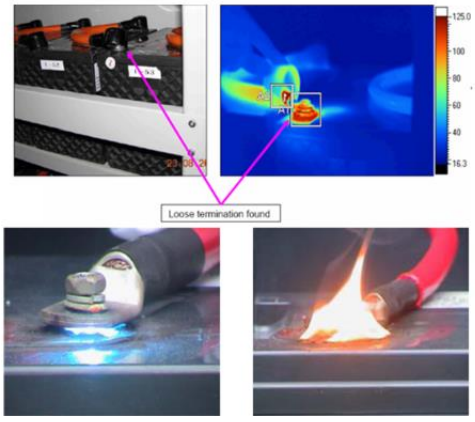
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Installation Precautions (5)

- After batteries are connected, use a torque wrench to check whether the screws on battery terminals are tightened and whether the torque meets the manufacturer's requirements. If the torque is too large or too small, the terminals may not be properly connected. Under certain conditions, arcing or heat accumulation may occur at the terminals, which may even cause fire.



Tightening battery terminals based on the torque requirements of the manufacturer

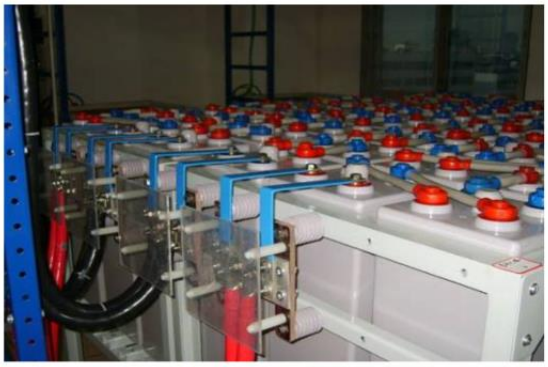


Fire resulted from arcing or heat accumulation due to loose screws on battery terminals

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Installation Precautions (6)

- The output cable of a battery string should be connected to the main equipment through the connection box or transfer terminal to prevent the battery terminal from bearing a large torque.
- Do not install batteries in an airtight battery compartment or room. The ventilation of the battery compartment must meet BS EN 50272-2 requirements. Otherwise, fire or personal injury may be caused.

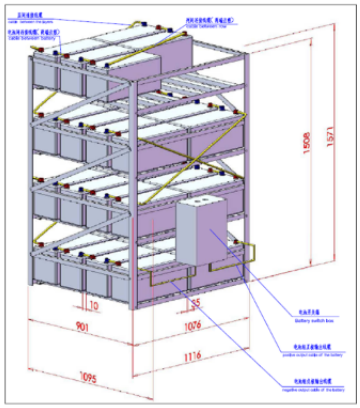


Output cables of the battery strings connecting to the main equipment through the connection box

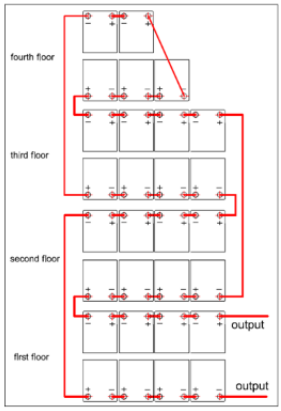
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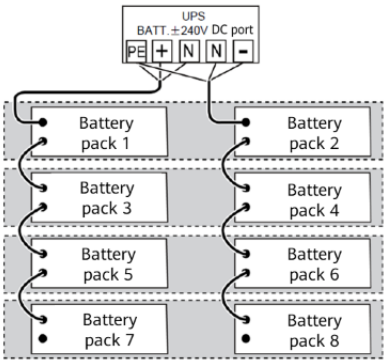
Battery Installation and Cable Connection

Installing a 348 V 150 Ah battery string



Internal wiring of a 348 V 150 Ah battery string





Connecting cables of the ESS-240V12 battery pack

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Cable Connection Checklist

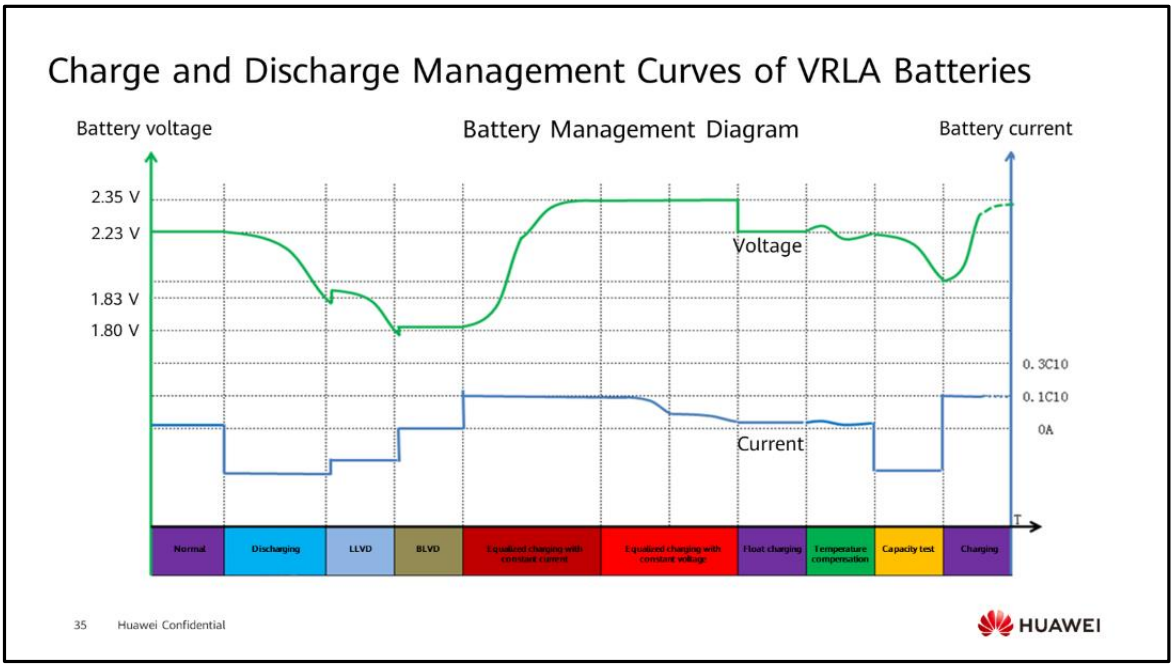
No.	Expected Result	Passed or Not
1	The installation environment and usage conditions meet the battery installation and usage requirements.	☐ Yes ☐ No
2	No crack, oil stain, bulge, or electrolyte leakage occurs on the surface of a single battery.	☐ Yes ☐ No
3	The open-circuit voltage of a single battery is greater than 2.1 V (2 V battery) or 12.6 V (12 V battery).	☐ Yes ☐ No
4	The battery string installation meets the requirements in the battery string installation diagram.	☐ Yes ☐ No
5	The open-circuit voltage of a single battery string meets the DC input requirements of the UPS system.	☐ Yes ☐ No
6	All connections on the battery string loop are reliably tightened and meet torque requirements.	☐ Yes ☐ No
7	All connections on the battery loop are tested using an infrared temperature detector or a temperature thermal imager during a battery discharge test.	☐ Yes ☐ No
8	Batteries in the same battery string have the same capacity and specifications and come from the same batch and the same manufacturer.	☐ Yes ☐ No
9	The positive and negative terminals of the battery string output correspond to the positive and negative terminals of the battery input of the battery circuit breaker (BCB) box respectively.	☐ Yes ☐ No
10	Warning signs indicating that battery terminal screws are tightened and indicating high voltage hazards are attached to the battery rack or cabinet.	☐ Yes ☐ No
11	The site is cleaned after battery installation and no conductive object is placed around batteries.	☐ Yes ☐ No

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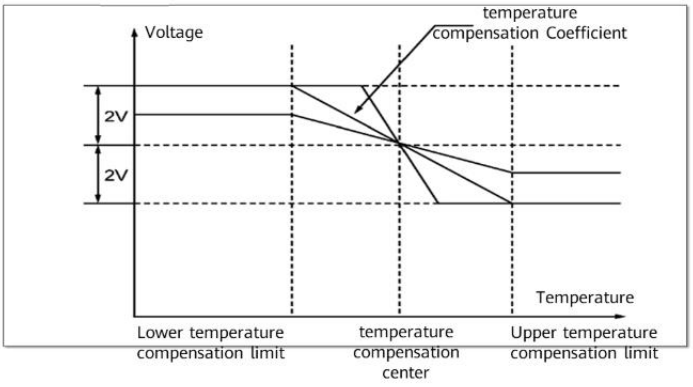
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- Normal: The battery is in float charging state.
- Discharging: When the AC input is disconnected, the battery starts to supply power to the equipment.
- BLVD: When the discharge voltage reaches the low-voltage protection threshold, the system disconnects the battery loop.
- Charging: After the AC power supply is restored, the VRLA batteries are charged. For details about the conversion between equalized charging and float charging, see the preceding figure.
- Temperature compensation: When the battery is being charged, the charge voltage is automatically adjusted based on the temperature change to achieve the optimal charging status.
- Capacity test: The customer starts the test to learn about the battery capacity status. The test process is similar to the battery discharge process. After the test is complete, the battery is charged again.

Temperature Compensation

- Temperature compensation can effectively control the risk of thermal runaway within a certain temperature range.



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- When the temperature increases, reduce the battery charge voltage.
- When the temperature decreases, increase the battery charge voltage.

Basic VRLA Battery Parameters

Parameter	Description	Default Value	Value Range
Battery type	The setting must be consistent with the actual situation.	VRLA batt.	VRLA batt., lithium batt.
Battery capacity (Ah)	Set this parameter based on the actual battery capacity. Larger difference between the configured value and the actual value results in greater impact on normal battery management, such as the determination of battery SOC, equalized charging control, float charging control, and current limiting control. Incorrect configuration may cause slow battery charging or battery damage.	100	5–3000
Number of battery strings	Specifies the number of battery strings connected in parallel.	0	0–4
Batteries in a single battery string	Specifies the number of batteries in a battery string.	0	0–300

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- Batteries can be charged in the equalized charging or float charging state. The preset equalized charge voltage is higher than the preset float charge voltage. After batteries are deeply discharged, the system automatically enters equalized charging. Float charging compensates for the loss caused by battery self-discharge and maintains the battery capacity. It can also be used to restore the battery capacity. The preset charge voltage is low.

VRLA Battery Charge Management Parameters (1)

Parameter	Description	Default Value	Value Range
Chg. cur. limiting coef. (C10)	Specifies a charge current limit. The limiting coefficient is a multiple of the battery capacity.	0.1	0.05–0.15
Cell float voltage (V/cell)	Specifies the battery float charge voltage.	2.25	2.23–2.27
Cell equalized volt. (V/cell)	Specifies the battery equalized charge voltage.	2.35	2.30–2.40
Transfer-to-equalized charging cur. coef. (C10)	When the system detects that the battery current is greater than this parameter value, batteries enter the equalized charging state.	0.05	0.02–0.08
SOC to start equalized charging (%)	If the SOC value is less than this parameter value, batteries enter the equalized charging state.	70	0–100
Automatic equalized charging	If this parameter is set to **Enable**, the UPS automatically changes the battery management status to equalized charging based on the charge current and float charging time.	Enable	Disable, Enable

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- Batteries can be charged in the equalized charging or float charging state. The preset equalized charge voltage is higher than the preset float charge voltage. After batteries are deeply discharged, the system automatically enters equalized charging. Float charging compensates for the loss caused by battery self-discharge and maintains the battery capacity. It can also be used to restore the battery capacity. The preset charge voltage is low.

VRLA Battery Charge Management Parameters (2)

Parameter	Description	Default Value	Value Range
Forced equalized charging protection time (h)	When batteries are under float charging or hibernation for a long time, enable forced equalized charging for the batteries. When the forced equalized charging time reaches this parameter value, batteries automatically transfer to float charging.	18	12–24
Equalized charging protection interval (d)	After batteries transfer from equalized charging to float charging, if the batteries do not discharge, equalized charging starts only after the float charging time exceeds **Equalized charging protection interval**. After equalized charging is complete, batteries automatically transfer to equalized charging when the non-equalized charging time exceeds **Scheduled equalized charging interval**.	7	N/A
Scheduled equalized charging interval (d)		60	30–180
Float volt. temp. comp.	If this parameter is set to **Enable**, the float charge voltage is calibrated based on the battery temperature when a battery temperature sensor is connected.	Enable	Disable, Enable
Float volt. temp. comp. coef. (mV/℃·cell)	Specifies the calibration coefficient during float charging voltage temperature compensation.	3.3	0–6
Float Chg Temp Comp Center (℃)	Specifies the reference temperature during float charging voltage temperature compensation.	25	20–30

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VRLA Battery Discharge Management Parameters (3)

Parameter	Description	Default Value	Value Range
Max. batt. dis. time (h)	Specifies the maximum battery discharge time. When the discharge time reaches this value, the UPS powers off. If the parameter is set to **0**, battery discharge protection is not implemented.	24	0–48
Sched. shallow dis. test	When certain conditions are met, the charger shuts down, and batteries supply power to loads. The system records the battery discharge data as a reference for battery capacity and lifespan.	Disable	Disable, Enable
Sched. shallow dis. test time	The shallow discharge test starts in the specified time.	06:00–12:00	00:00–06:00 06:00–12:00 12:00–18:00 18:00–24:00
Sched. shallow dis. test interval (d)	Specifies the time interval for shallow discharge tests.	60	30–90
Shallow dis. test dis. ratio (%)	Specifies the proportion of the discharge capacity to the total discharge capacity.	20	10–50

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VRLA Battery Discharge Management Parameters (4)

Parameter	Description	Default Value	Value Range
Dis. cur. 0.1C EOD (V/Cell) Dis. cur. 0.3C EOD (V/Cell) Dis. cur. 0.5C EOD (V/Cell) Dis. cur. 1.0C EOD (V/Cell)	Specifies the EOD threshold when the discharge current is 0.1C/0.3C/0.5C/1.0C. By default, **Dis. cur. 0.1C EOD (V/cell)** is set to **1.80**; **Dis. cur. 0.3C EOD (V/cell)** is set to **1.80**; **Dis. cur. 0.5C EOD (V/cell)** is set to **1.75**; **Dis. cur. 1.0C EOD (V/cell)** is set to **1.60**.	1.80	N/A
Intelligent hibernation	After this parameter is set to **Enable**, **Class 1 grid hiber. time (d)** and **Class 2 grid hiber. time (d)** are displayed, and the intelligent battery hibernation function is enabled.	Disable	Disable, Enable
Class 1 grid hiber. time (d)	Based on the power grid type, different hibernation time can be set. In hibernation mode, batteries are not charged or discharged in open-circuit mode, which prolongs the battery lifespan.	13	0–30
Class 2 grid hiber. time (d)		6	0–15

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VRLA Battery Alarm Parameter

Parameter	Description	Default Value	Value Range
Undertemp. alarm thresh. (℃)	Battery temperatures can be monitored in a timely manner. If a battery overtemperature alarm is generated, the charge current limit value decreases to 0.03 CA. Battery charging stops if a battery overtemperature protection alarm is generated (when the temperature reaches the overtemperature alarm threshold plus 3℃).	–5	–20 to +5
Overtemp. alarm thresh. (℃)		50	35–55
Backup time warning	If **Backup time warning** and **Remain. cap. warning** are set to **Enable**, an alarm is generated when a value is less than the corresponding warning threshold.	Disable	Disable, Enable
Remain. cap. warning		Disable	Disable, Enable
Backup time warn. thresh. (min)		5	3–30
Remain. cap. warn. thresh. (%)		20	5–50
Single batt. float chg. voltage deviation alarm thres. (%)	**Single batt. float chg. voltage deviation alarm thres.** and **Single batt. dis. voltage deviation alarm thres.** are used to check whether the batteries in each battery string have the same charge voltage and discharge voltage. When a value exceeds the preset value, an alarm is generated. The calculation formula is (Charge/Discharge voltage – Average voltage)/Average voltage x 100%.	10	5–30
Single batt. dis. voltage deviation alarm thres. (%)		20	10–30

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1. Application Scenarios
2. Technical Specifications and Characteristic Curves
3. Storage Management
4. Installation
5. **Operation Management**
   - Online Operation Management
   - Personnel Maintenance and Management

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Routine Maintenance: Monthly Check Items

Item	Content	Baseline	Measure
Total float charge voltage of the battery string	Measure the total float charge voltage between the positive and negative terminals of the battery string.	Battery float charge voltage x Number of batteries	Adjust the deviation value to the baseline value.
Total equalized charge voltage of the battery string	Measure the total equalized charge voltage between the positive and negative terminals of the battery string.	Battery equalized charge voltage x Number of batteries	Adjust the deviation value to the baseline value.
Battery appearance	Check whether the surface is free from leakage, bulges, and damage.	The surface is normal.	If the battery surface is abnormal, identify the causes. If the battery cannot be used properly due to the fault, replace it.
	Check whether there are dust stains.	The battery surface is clean.	Clean the dust with a cotton cloth.
	Check whether the cabinet, rack, cables, and terminals are rusty.	There is no rust.	If rust is found, remove the rust, replace the cable, and apply antirust agent.
Connection position	Check whether the screws at the connection positions are loose.	The connections are secure.	Tighten the screws according to the torque requirements.
Short-time discharge test	When a backup power supply is prepared for the UPS, discharge the batteries for a short time.	The batteries can supply power properly.	Locate the cause when an exception is identified.

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Routine Maintenance: Quarterly and Annual Check Items

- Quarterly check item
  - In addition to the monthly check items, the following check item is added.

Item	Content	Baseline	Measure
Charge voltage of each battery	Measure and record the charge voltage of each battery.	Equalized charge voltage range: 2.30–2.40 V/cell Float charge voltage range: 2.20–2.30 V/cell	If the voltage is beyond the specified range, manually charge the battery string in equalized charging mode and then switch to float charging mode.

- Annual check item
  - In addition to the quarterly check item, the following check item is added.

Item	Content	Baseline	Measure
Discharge test	When the UPS is backed up, discharge batteries to the undervoltage alarm threshold.	The discharge time is 20% shorter than the power backup time specified in the contract.	If the time is less than the reference value, perform a discharge test again after the battery string is fully charged. If the deviation still exists, contact the regional customer service personnel.

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Quiz

1. (Multiple) Which of the following factors shorten the battery life?

   A. Temperature

   B. Cycle times

   C. DOD

   D. Rated capacity

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- Answer:
- A, B, and C

Summary

- This chapter describes the application scenarios, charging and discharging features, storage and management methods of lead-acid batteries in a data center. Pay special attention to the charging and discharging characteristics of lead-acid batteries.

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Thank you.

把数字世界带入每个人、每个家庭、
每个组织，构建万物互联的智能世界。

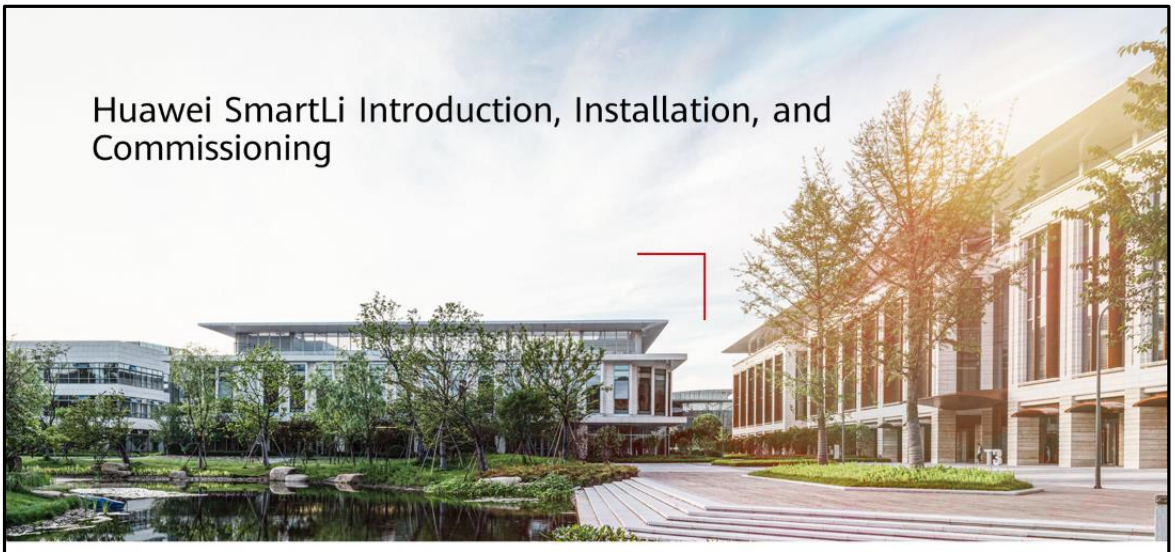
Bring digital to every person, home, and organization for a fully connected, intelligent world.

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Huawei SmartLi Introduction, Installation, and Commissioning



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Foreword

- This chapter describes the structure and basic principles of Huawei SmartLi, SmartLi installation process and key points, and SmartLi power-on commissioning procedure and operations.

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Objectives

On completion of this course, you will be able to:

- Get familiar with the structure and basic principles of Huawei SmartLi.
- Get familiar with the installation process and key installation points of Huawei SmartLi.
- Get familiar with the startup commissioning procedure and user interface operations of Huawei SmartLi.

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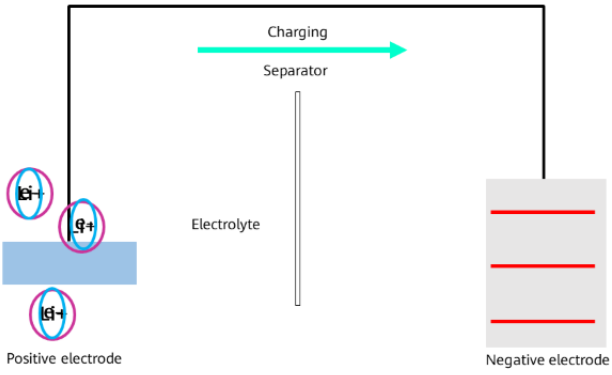
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1. SmartLi Product Description
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5. SmartLi Commissioning and Acceptance

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Li-ion Battery Working Principle (1)

- When a battery is charged, lithium ions are generated on the positive electrode and then move to the negative electrode through the electrolyte. The carbon for the negative electrode is of a layered structure which has many micropores. Lithium ions reaching the negative electrode are embedded into the micropores of the carbon layer. A larger quantity of lithium ions embedded into the micropores indicates a higher charge capacity.



Positive electrode reaction: $LiMO_y \underset{\text{Discharge}}{\overset{\text{Charge}}{\rightleftharpoons}} Li_{1-x}MO_y + xLi^+ + xe$

Negative electrode reaction: $nC + xLi^+ + xe \underset{\text{Discharge}}{\overset{\text{Charge}}{\rightleftharpoons}} Li_xC_n$

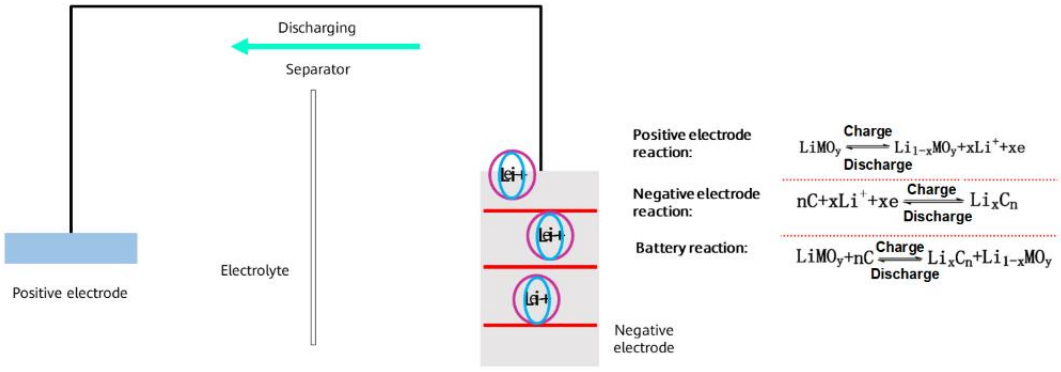
Battery reaction: $LiMO_y + nC \underset{\text{Discharge}}{\overset{\text{Charge}}{\rightleftharpoons}} Li_xC_n + Li_{1-x}MO_y$

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- Note: This slide mainly describes the moving direction of lithium ions and electrons.

Li-ion Battery Working Principle (2)

- When a battery is discharged (that is, when we use the battery), the lithium ions embedded in the carbon layer of the negative electrode move back to the positive electrode. A larger quantity of lithium ions moving back to the positive electrode indicates a higher discharge capacity.

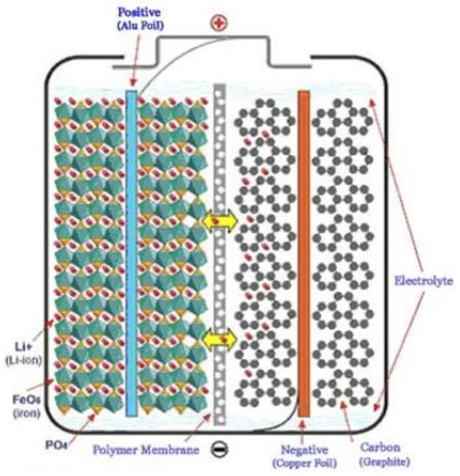


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- Note: After lithium ions reach the negative electrode, they are not lithium ions, but become alloys that combine with the negative electrode. This slide mainly describes the moving direction of ions and electrons.

Internal Structure of a Li-ion Battery

- The figure on the right shows the internal structure of a lithium-ion ferrous battery.
  - On the left is the olivine-structured LiFePO4 positive electrode, which is connected to aluminum foil.
  - In the middle is a polymer separator which separates the negative electrode from the positive electrode, allowing the passage of Li+ while stopping that of e–.
  - On the right is carbon-made negative electrode, which is connected to copper foil. The electrolyte is between the upper and lower ends of the battery. The battery is sealed by a metal shell.

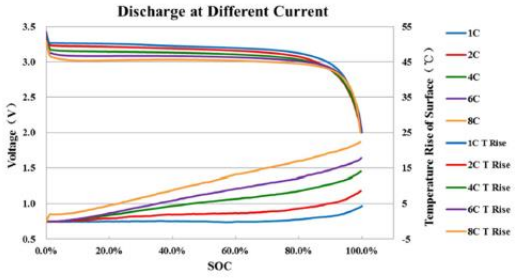


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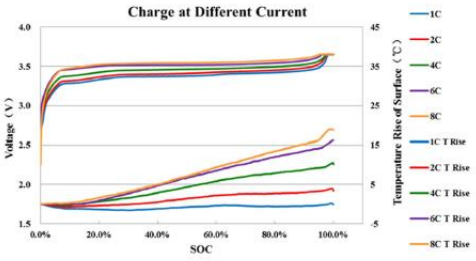
Li-ion Battery Charge and Discharge Characteristics

- The following figures show Li-ion battery charge and discharge characteristics.
- Charge and discharge plateaus: indicates a stable operating voltage range of a battery when the battery is charged or discharged under a certain charge and discharge system.
- Factors affecting charge and discharge plateaus: battery type, charge and discharge temperature, charge and discharge current

Discharge characteristic curve



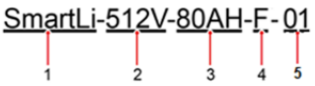
Charge characteristic curve



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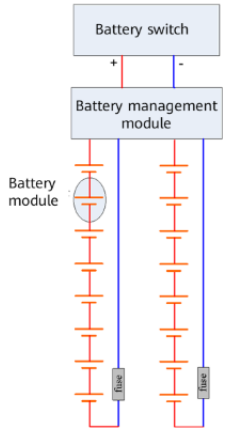
- According to the discharge characteristic curve, at the beginning of discharge, the voltage change rate varies with the discharge current: Larger discharge current leads to faster voltage drop. At the later stage of discharge, the voltage change rates in different discharge current status are similar.
- According to the discharge characteristic curve, larger discharge current leads to faster temperature rise on the battery surface.
- According to the charge characteristic curve, at the beginning of charge, the voltage change rate varies with the charge current: Larger charge current leads to faster voltage rise. At the later stage of charge, the voltage change rates in different charge current status are similar due to the effect of charge current limiting.
- According to the charge characteristic curve, larger charge current leads to faster temperature rise on the battery surface.

Naming Rule

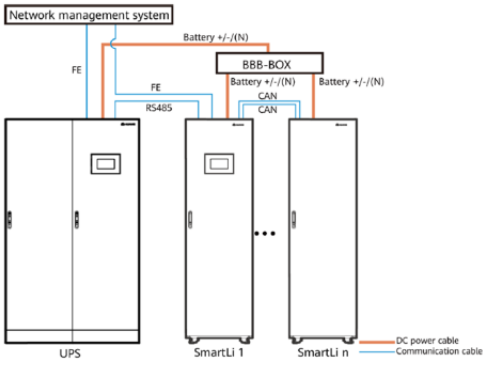


No.	Meaning	Description
1	Product category	Intelligent battery
2	Product series	512 V
3	Capacity	80AH: The battery capacity is 80 Ah.
4	Configuration type	F: with a display S: without a display
5	Product description	01: C20 lithium battery If this part is not specified, C10 lithium batteries are used.

Huawei UPS and SmartLi System Architecture



Electrical diagram of a lithium battery cabinet



UPS and lithium battery system

- The battery control unit (BCU) provides the following functions:
  - Manages all battery management units (BMUs) in a battery cabinet and collects battery information such as voltage, temperature, SOC, and SOH.
  - Detects the charge and discharge currents of battery strings to control current equalization.
  - Protects against abnormalities such as overcharge, overdischarge, overtemperature, and overcurrent, and disconnects the loop if an abnormality occurs.

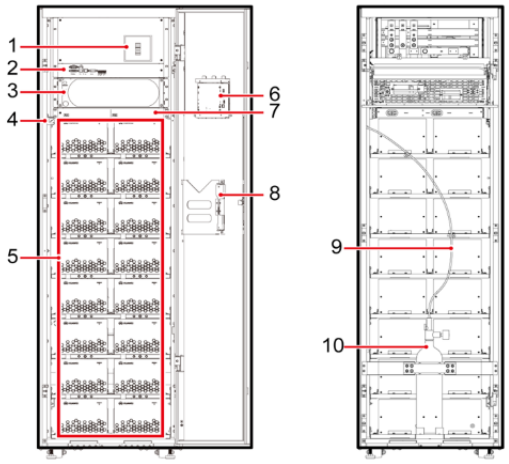
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SmartLi Overview



(1) Battery circuit breaker

(2) Monitoring unit

(3) Intelligent management module

(4) End pressure gauge

(5) Battery modules

(6) Monitoring display unit (MDU)

(7) Fuse

(8) MCCB auxiliary lever

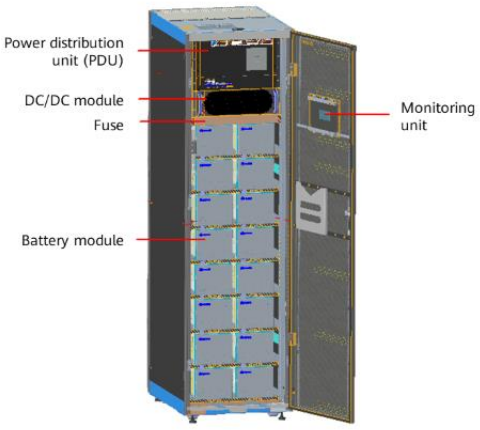
(9) Fire-trace tube

(10) Fire cylinder

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SmartLi Specifications

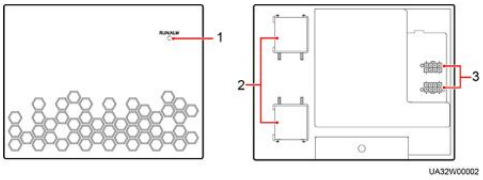
Component Picture			
Component	Electrochemical cell	Battery module	Battery cabinet
Composition	Battery cell	Two electrochemical cells connected in parallel and 20 connected in series	Two battery strings included, each consisting of eight modules
Battery capacity	> 20 Ah	40 Ah	80 Ah
Dimensions (H x W x D)	100.5 mm x 144.5 mm x 21.7 mm	158 mm x 200.5 mm x 595 mm	2000 mm x 600 mm x 850 mm
Weight	0.65 kg	35 kg	800 kg
Rated voltage	3.2 V	64 V	512 V
Operating voltage	2.5–3.4 V	51–68 V	408–544 V
Energy	> 128 Wh	2.56 kWh	40.96 kWh



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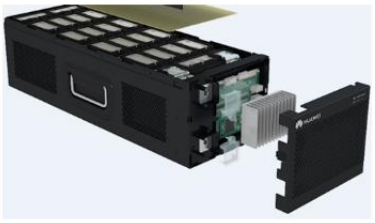
Battery Module

- Multiple battery modules can be connected in series to adjust the system voltage. All external ports of the modules are located at the front to facilitate installation and maintenance.



(1) Running indicator (2) Battery wiring terminals (3) Cascading terminals

Indicator	Status	Color	Description
Indicator	On	Green	The battery module is normal.
		Red	The battery module is faulty.
	Off	N/A	The communications cable to the battery module is not connected.



- Dimensions (H x W x D): 157 mm x 200.5 mm x 592 mm
- Weight: ≤ 35 kg
- Rated voltage: 64 V
- Rated capacity: 40 Ah
- Rated discharge current: 240 A

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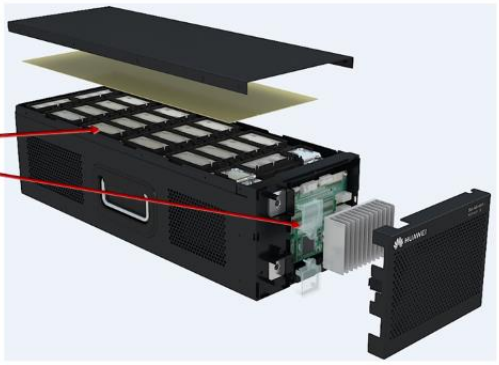
- Battery wiring terminals can be used to connect battery power cables.

Battery Module Composition

- A battery module consists of electrochemical cells and the BMU that are connected and assembled internally.
- A BMU provides the following functions:
  - Battery voltage measurement and alarm
  - Battery temperature measurement and alarm
  - Battery unit balancing
  - Communication

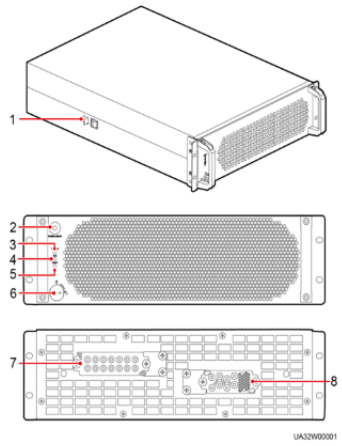
Lithium battery composition

- Module
- BMU



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Battery Management Module (1)



(1) Positioning lock (2) Power switch (3) Running indicator (4) Alarm indicator

(5) Fault indicator (6) Ready switch (7) Output ports (8) Input ports

Status	Color	Description
On	Green	The battery cabinet is working properly.
	Yellow	A minor alarm has been generated for the battery cabinet.
	Red	A critical alarm has been generated for the battery cabinet.
Off	N/A	The battery cabinet is shut down.

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Battery Management Module (2)

- BCU input/output voltage range: 400–544 V
- BCU management functions:
  - Manages all BMUs in a battery cabinet and collects battery information such as voltage, temperature, SOC, and SOH.
  - Detects the charge and discharge currents of battery strings to control current equalization.
  - Protects against abnormalities such as overcharge, overdischarge, overtemperature, and overcurrent, and disconnects the loop if an abnormality occurs.
- Dimensions (H x W x D): 130 mm x 442 mm x 550 mm
- Weight: 35 kg
- Supports swapping, battery string output current equalization adjustment, and BCU management functions.



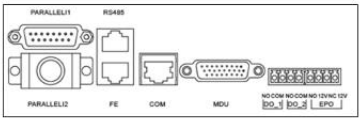


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Monitoring Module

- The monitoring module uses an independent monitoring module to monitor the operating status of each module in the system, provides an LCD, and supports centralized monitoring of the system.

Port	Silk Screen	Description
Parallel port	PARALLEL1	Parallel signal port 1 between racks
Parallel port	PARALLEL2	Parallel signal port 2 between racks
Network port	FE	Connecting to the network port on a PC
Northbound communications port	RS485	Networking
Northbound communications port	COM	Connecting to the UPS
DB26	MDU	Supports FE, RS485, I2C, CAN, and other signals.
DO_1	DO_1	Reserved
DO_2	DO_2	Reserved
EPO	NO	If the normally open (NO) port is connected to the EPO_12V port, emergency power-off (EPO) is triggered.
	12V	
	NC	If the normally closed (NC) port is disconnected from the EPO_12V port, EPO is triggered.
	12V	

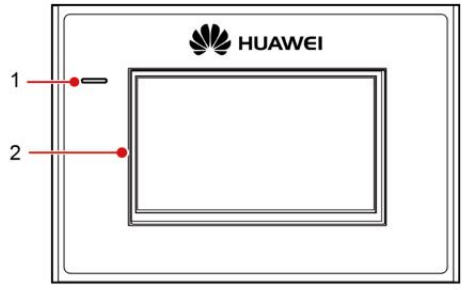




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MDU

- The MDU allows you to control SmartLi operations, view the running status and alarms, and set parameters.

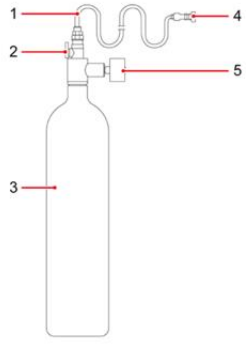


(1) Status indicator (2) LCD touchscreen

Status	Indicator Color	Description
On	Red	A critical alarm has been generated, and the buzzer buzzes continuously.
	Yellow	A minor alarm has been generated, and the buzzer buzzes intermittently at 2 Hz.
	Green	The SmartLi is running properly or a warning has been generated.
Off	N/A	The MDU is powered off.

Fire Detection and Extinguishing Equipment

- The fire detection and extinguishing equipment consists of a fire cylinder filled with extinguishant, a container valve, and a fire-trace tube that can release extinguishant. It can detect and extinguish fire at the initial stage quickly, accurately, and effectively.



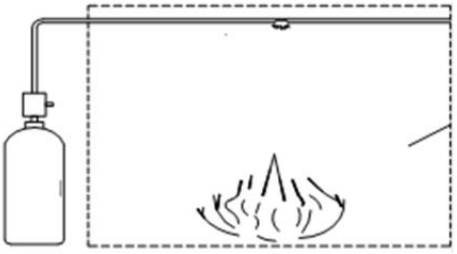
(1) Fire-trace tube

(2) Valve

(3) Pressurized container

(4) End pressure gauge

(5) Pressure gauge



A fire-trace tube is made of polyamide thermal-sensitive materials, cracks when the temperature reaches about 160° C, and extinguishes fire within 20 seconds.

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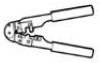
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Site Survey Before Installation

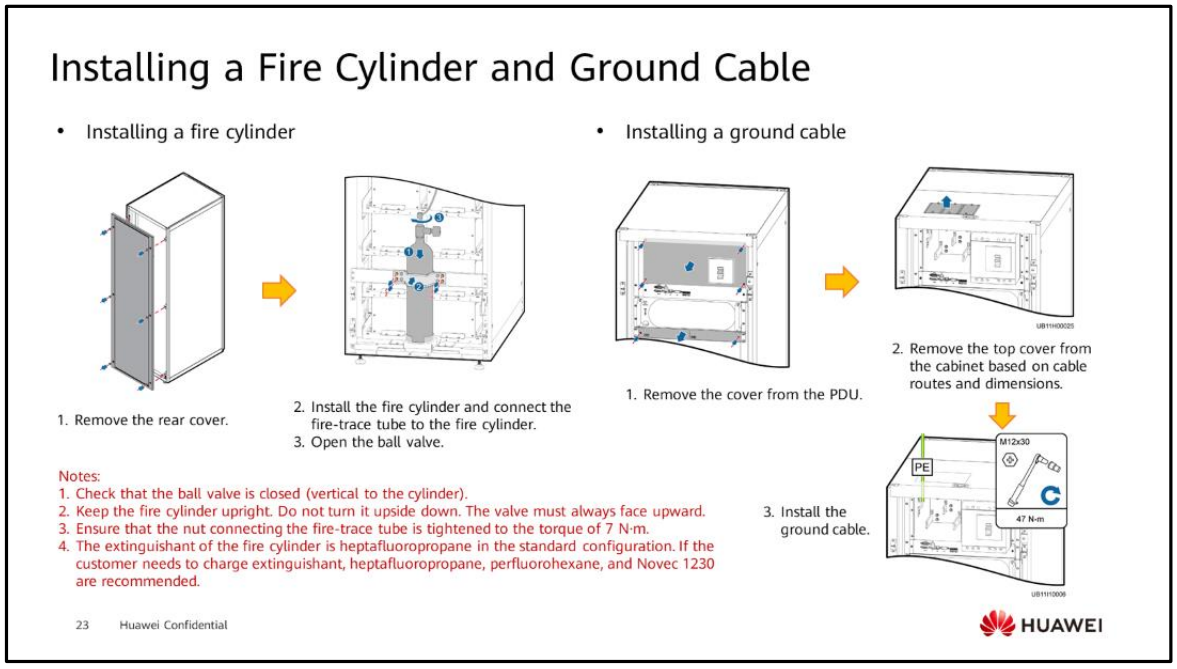
- Installation environment
  - Do not install the SmartLi in a high-temperature, low-temperature, or damp place that is beyond the technical specifications.
  - Install the SmartLi away from water sources, heat sources, and flammable or explosive materials.
  - Keep the SmartLi away from direct sunlight, dust, volatile gases, corrosive materials, and air dense with salt particles.
  - Do not install the SmartLi in environments with conductive metal scraps in the air.
- Installation clearances
  - Reserve clearances around the cabinet to facilitate operations and ventilation as follows:
  - Reserve a clearance of at least 800 mm from the front of the cabinet for ventilation and operations.
  - Reserve a clearance of at least 500 mm from the top of the cabinet for operations.
  - The SmartLi can be installed against a wall and no space needs to be reserved at the rear.
  - If an antiseismic kit is deployed, at least 500 mm space should be reserved at the rear for operations.

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Tools

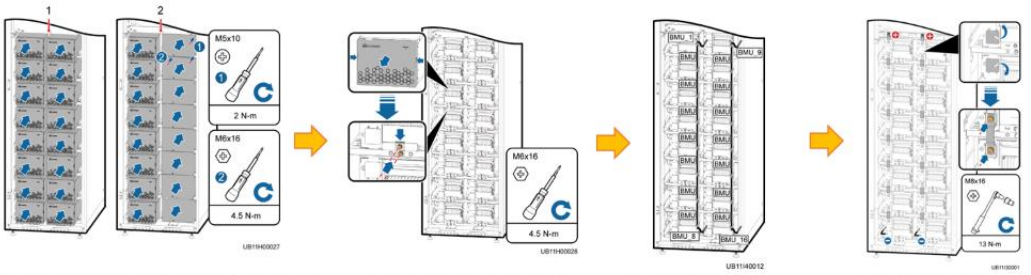
Appearance, Specifications, and Name						
Protective gloves	Marker	Measuring tape (5 m)	Rubber mallet	Utility knife	Hammer drill (Φ16)	Torque screwdriver
						
Insulated torque wrench	Diagonal pliers	RJ45 crimping tool	Wire stripper	Cable tie	Insulation gloves	Insulated protective shoes
						
Brush	Vacuum cleaner	Clamp meter	Multimeter	Network cable tester	Labels	
						
Note: This table may not list some tools required at specific sites. Site installation personnel and technical support engineers should prepare tools based on site requirements.						

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- Fire cylinders cannot be transported outside China.
- In the process of assembling and filling, ensure that the valve, container, and other parts are clean and not polluted.
- Keep the fire cylinder upright.
- Ensure that the front of the pressure gauge faces the right side of the cabinet (as shown in the figure) and that the cylinder does not interfere with the battery trays and the rear cover of the cabinet.
- Do not bend or twist the fire-trace tube or bind the tube using cable ties. Otherwise, the fire cylinder may fail.
- Hold the pipe holder close to the end to avoid bending the tube during pipe insertion.

Installing Battery Modules



1. Remove the front covers of battery modules.
2. Install battery baffle plates.
3. Install battery communications cables.
4. Open the battery terminal protective covers, and install battery copper bars and cables.

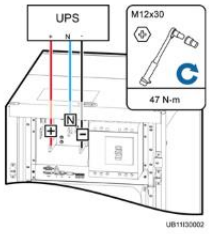
Notes:

1. Before installing battery modules, partially remove the battery management module to ensure that the loop is completely disconnected.
2. Install the battery modules from the bottom up to prevent falling over due to imbalance.

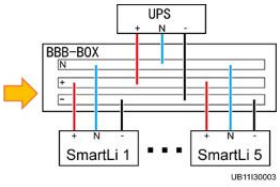
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Installing Power Cables and Connecting Communications Cables

- Installing output power cables

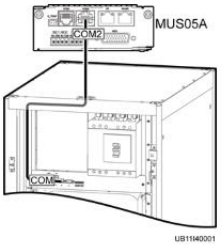


Single SmartLi



Parallel system

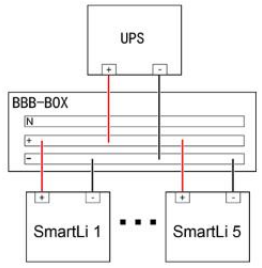
- Connecting a communications cable between the UPS and the lithium battery cabinet



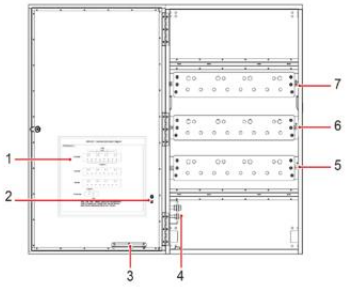


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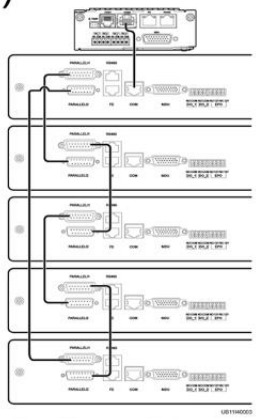
Installing Power Cables and Connecting Communications Cables (Scenarios with Combined Cabinets)



Connecting power cables between the lithium battery cabinets and the battery bus bar box (BBB box)



BBB box

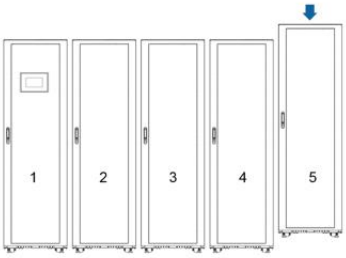


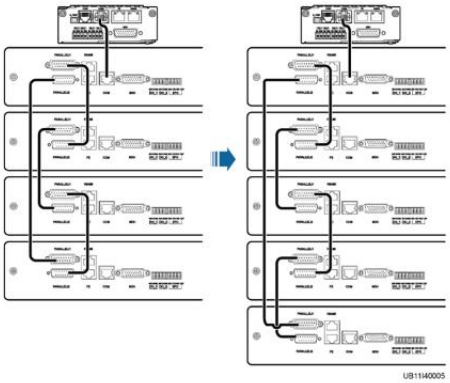
Connecting communications cables between lithium battery cabinets

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Connecting Communications Cables (Capacity Expansion Scenarios)

1. Remove the terminal from parallel port 1 on SmartLi 4 and connect the terminal to parallel port 1 on SmartLi 5. (On the monitoring module, parallel port 1 is above parallel port 2.)
2. Connect parallel port 1 on SmartLi 4 to parallel port 2 on SmartLi 5.
3. On the home screen of the LCD, choose **Settings > System Settings**, and set Battery cabinet quantity to 5.
4. Power on the new SmartLi by referring to the section "SmartLi Commissioning and Acceptance."

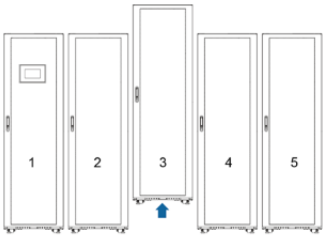


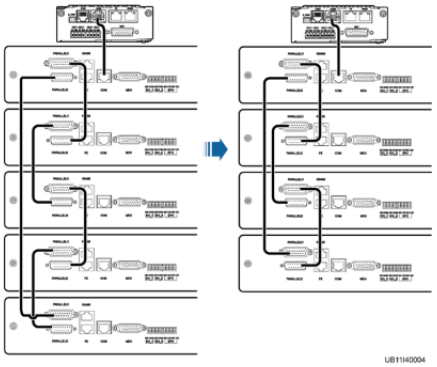


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Connecting Communications Cables: Removing a Battery Cabinet

1. Switch off the battery circuit breaker on SmartLi 3.
2. Press and hold the POWER ON/OFF button on the battery management module for more than 5 seconds.
3. Remove the parallel cable between SmartLi 3 and SmartLi 4.
4. Remove the terminal from parallel port 2 on SmartLi 3 and connect the terminal to parallel port 2 on SmartLi 4.
5. On the home screen of the LCD, choose **Settings** > **System Settings**, and set Battery cabinet quantity to 4.





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Verifying the Installation

No.	Item	Expected Result
1	Cabinet installation	The cabinets are securely installed and do not tilt due to vibration.
2	Neat arrangement	The adjacent cabinets are neatly arranged and secured with connecting kits.
3	Cable layout	Cables are routed properly as required by the customer.
4	Cable labels	Both ends of a cable are labeled. Labels are concise and easy to understand.
5	Cable ties	Cable ties are secured evenly and no burr exists.
6	Cable connections	The battery cables are securely connected. For the cables secured by screws, the spring washers are flattened.
7	Reliable grounding	The resistance between the cabinet ground bar and the equipment room ground bar is less than 0.1 ohm.
8	Battery cable connections	The SmartLi is correctly connected to the UPS.
9	Pressure gauge	The pressure gauge pointer is in the green zone and the pressure value is greater than 1.6 MPa.
10	Foreign matter cleaning inside the cabinets	The inside and outside of the cabinet are free from conductive dust or other sundries. 1. There is no foreign matter (such as copper wires and screws) on the top of the cabinet. 2. There is no foreign matter on the copper bar terminals. 3. There is no foreign matter around switch terminals. 4. There is no foreign matter on the bottom plates of the cabinet. 5. There is no foreign matter on the rear module subrack.

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LCD: Main Menu Screen

- The LCD screen is divided into three parts: status bar, alarm bar, and information area.

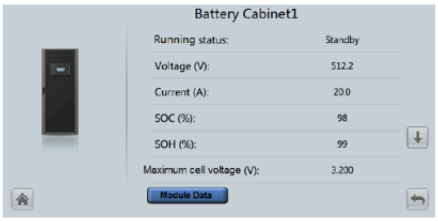


No.	Area	Description
1	Status bar	Displays the SmartLi model, current date and time, USB flash drive status, and buzzer status.
2	Alarm bar	Displays active alarms in a scrolling list and the number of active alarms based on severity. Users can tap the alarm icon to enter the active alarm screen.
3	Information area	Displays system information.

Button	Description
	Returns to the main menu.
	Scrolls the page down.
	Scrolls the page up.
	Returns to the upper-level menu.
	Logs a user out.

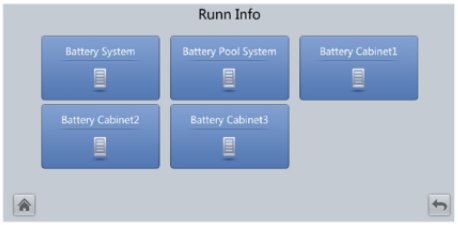
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LCD: Runn Info (1)



Battery cabinet information

Item	Description
Running status	Running status of the battery system
Voltage (V)	Battery system voltage
Current (A)	Battery system current
SOC (%)	SOC value
SOH (%)	SOH value

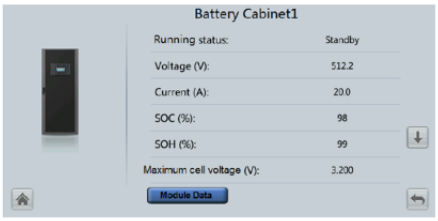


Runn Info

Item	Description
Maximum cell voltage (V)	Maximum battery cell voltage in the battery system
Minimum cell voltage (V)	Minimum battery cell voltage in the battery system
Maximum cell temperature (℃)	Maximum battery cell temperature in the battery system
Minimum cell temperature (℃)	Minimum battery cell temperature in the battery system
Discharge capacity (Ah)	Discharge capacity of the battery system
Discharge times	Discharge times of the battery system

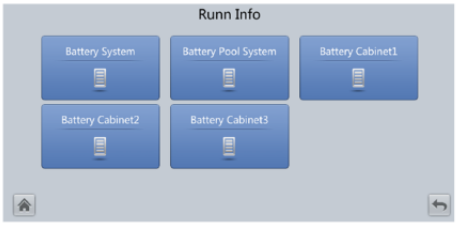
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LCD: Runn Info (2)



Battery cabinet information

Item	Description
Running status	Running status of the battery cabinet
Voltage (V)	Battery cabinet voltage
Current (A)	Battery cabinet current
SOC (%)	SOC value
SOH (%)	SOH value



Runn Info

Item	Description
Maximum cell voltage (V)	Maximum battery cell voltage in the battery cabinet
Minimum cell voltage (V)	Minimum battery cell voltage in the battery cabinet
Maximum cell temperature (℃)	Maximum battery cell temperature in the battery cabinet
Minimum cell temperature (℃)	Minimum battery cell temperature in the battery cabinet
Discharge capacity (Ah)	Discharge capacity of the battery cabinet
Discharge times	Discharge times of the battery cabinet

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LCD: Alarms and Settings

- If you have not logged in, a dialog box is displayed, asking you to enter the preset user name and password.





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LCD: Comm. Settings

Item	Description	Default Value	Value Range
IP Address allocation	Specifies the IP address allocation mode.	Automatic	Automatic, Manual
IP address	Specifies the IP address of the Ethernet.	192.168.0.10	1.0.0.0–223.255.255.255
Subnet mask	Specifies the subnet mask of the Ethernet.	255.255.255.0	0.0.0.0–255.255.255.255
Gateway	Specifies the Ethernet gateway.	192.168.0.1	1.0.0.0–223.255.255.255
RS485 port address	Specifies the address for RS485 communication.	1	1–254
RS485 port baud rate	Set this parameter based on the site requirements.	9600	4800, 9600, 19200, 115200
COM port address	Specifies the address for COM communication.	80	1–254
COM port baud rate	Set this parameter based on the site requirements.	9600	4800, 9600, 19200, 115200
ModbusTCP encryption	If Modbus TCP is used for communication, communications links are not encrypted or encrypted based on the selected encryption mode.	Disable	Disable, Enable

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- IP Address Allocation
  - If the MDU is connected to a computer over a network cable, the IP address can only be allocated manually. The IP addresses of the MDU and computer must be on the same network segment, and must be different.
  - If the MDU is connected to a computer over a LAN switch or router with the DHCP function, the IP address can be allocated manually or automatically. Manual allocation is used by default.
    - Manual: Check that the IP addresses of the MDU and computer are on the same network segment, and are different. Set the UPS IP address to be in the same subnet as the computer IP address. Perform the bitwise AND operation for the UPS IP address and the computer IP address with the subnet mask respectively. If the operation results are the same, the two IP addresses are in the same subnet.

LCD: System Settings and Settings Wizard

- System Settings

Item	Description	Default Value	Value Range
Battery cabinet quantity	Total number of battery cabinets	1	1–12

- Settings Wizard

Item	Parameter	Description
Language	English, Chinese	Set as required.
Time	Date format, YYYY-MM-DD, Time zone, Time	Set as required.
Network Param.	IP Address allocation, IP address, Subnet mask, Gateway	Set as required.
System Param.	Battery cabinet quantity	Set as required.

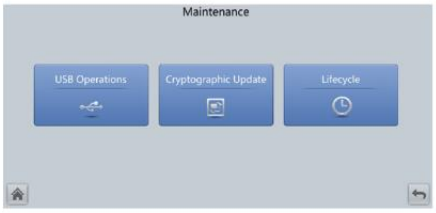
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LCD: User Settings

Item	Description	Default Value	Value Range
Language	Set as required.	Chinese	English, Chinese
Date format	Set as required.	N/A	N/A
YYYY-MM-DD	Set as required.	N/A	N/A
Time zone	Set as required.	N/A	N/A
Time	Set as required.	N/A	N/A
Password	The password can be changed.	000001	N/A
Contrast	Set as required.	6	1–10
Brightness	Set as required.	8	1–10
Saturation	Set as required.	8	1–10

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LCD: Maintenance



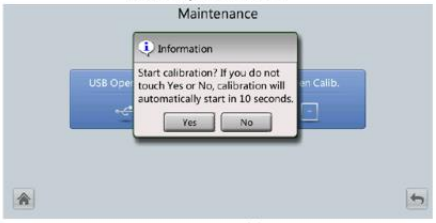
Maintenance



USB Operations 1



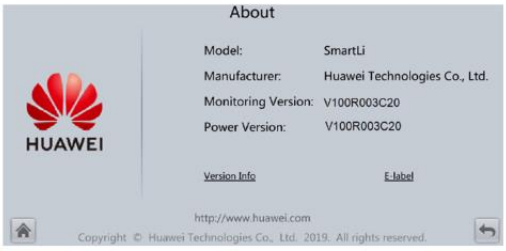
USB Operations 2



Screen Calib.

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LCD: About and Common Functions



About



Common Functions

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WebUI: Login

- **Step 1** Open the browser and choose **Tools** > **Internet Options**.
- **Step 2** Click the **Advanced** tab, check that **Use TLS 1.0** and **Use TLS 1.1** are selected, and click **OK**.
- **Step 3** Enter *https://SmartLi IP address* in the address box of the browser, select a language, set **User name** and **Password**, and click **Login**. The system supports Internet Explorer 11 and Firefox 31.0.

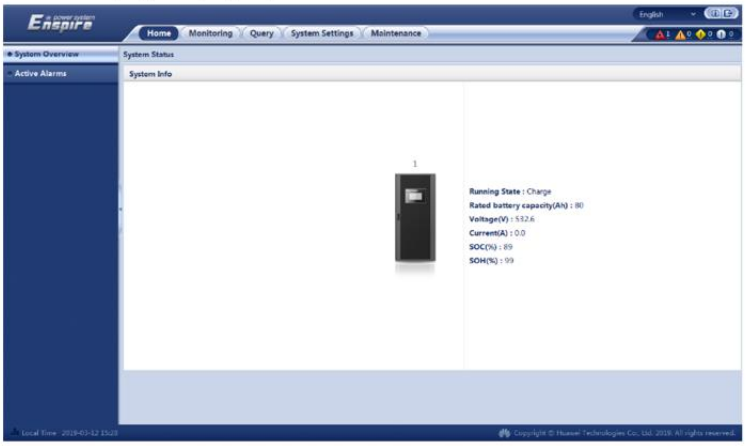
Default User	Preset Password		User Right
admin (administrator)	LCD	000001	Perform all operations on the LCD and WebUI.
	WebUI	Changeme	
operator (common user)	LCD	000001	Browse system running information, export system information (historical alarms, logs, e-labels, and fault data), rectify faults, and control the buzzer. Other control and maintenance functions that may affect system operation are unavailable and parameters cannot be set.
	WebUI	Changeme	
browser (browsing user)	WebUI	N/A	Browse system running information but cannot modify the system.

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- The preset IP address is 192.168.0.10. You can set the Ethernet IP address on the LCD. The value range is 1.0.0.0–223.255.255.255.
- If a user enters incorrect passwords for three consecutive times, the account will be locked for 5 minutes.
- After a user logs in to the WebUI, if another user logs in with the same user name, the current account will be logged out.
- Change the password after the first login to prevent unauthorized access. The password can be changed over the user management menu on the configuration page.

WebUI: Home Page (1)

- The **Home** page displays **System Overview** and **Active Alarms**.



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WebUI: Home Page (2)

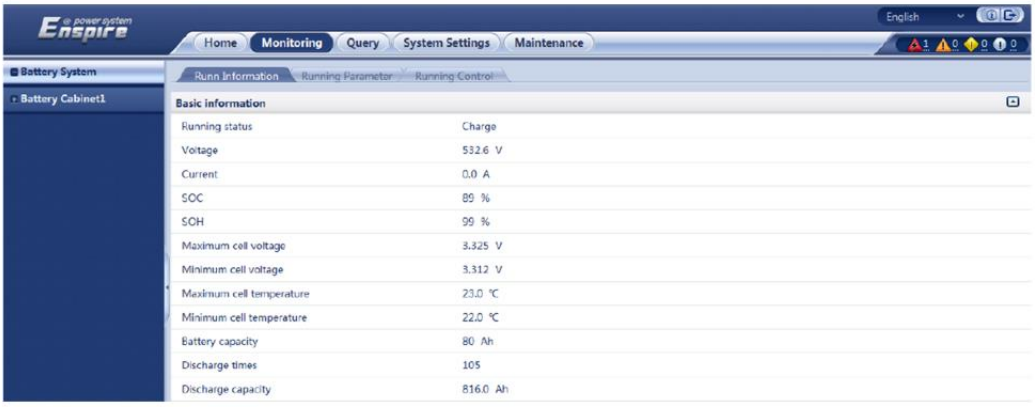
- The **Home** page displays **System Overview** and **Active Alarms**.



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WebUI: Monitoring

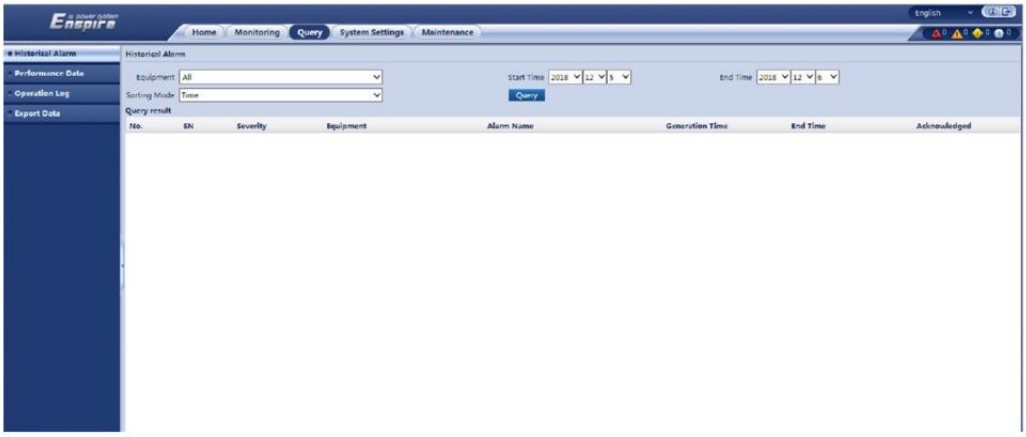
- On the home page, choose **Monitoring** to view the running information of the battery system, battery cabinet, and battery module.



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WebUI: Query (1)

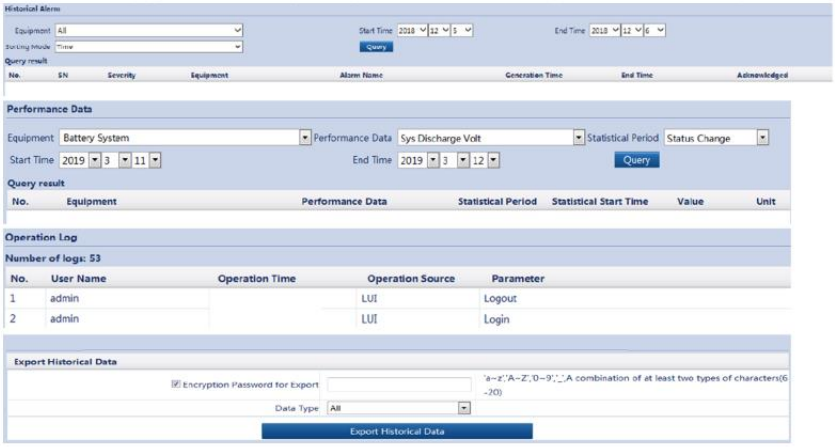
- On the home page, choose **Query** to export historical alarms, performance data, operation logs, and historical data.



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WebUI: Query (2)

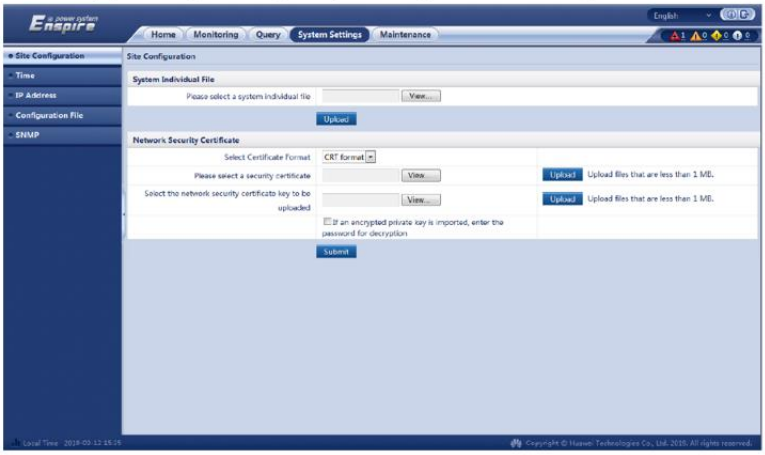
- On the home page, choose **Query** to export historical alarms, performance data, operation logs, and historical data.



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WebUI: System Settings (1)

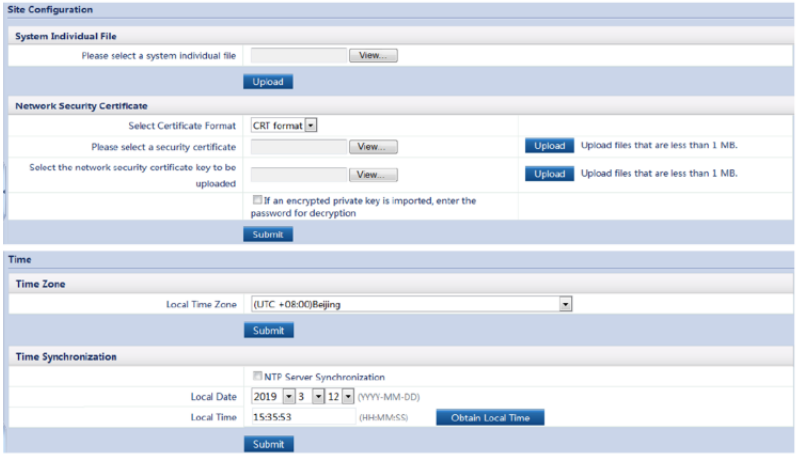
- On the home page, choose **System Settings**. The **System Settings** tab includes **Site Configuration**, **Time**, **IP Address**, **Configuration File**, and **SNMP**.



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WebUI: System Settings (2)

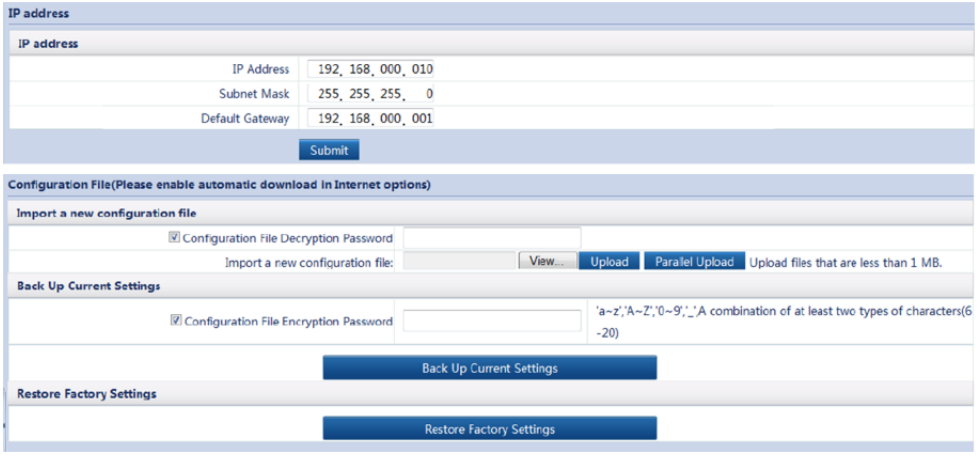
- On the home page, choose **System Settings**. The **System Settings** tab includes **Site Configuration**, **Time**, **IP Address**, **Configuration File**, and **SNMP**.



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WebUI: System Settings (3)

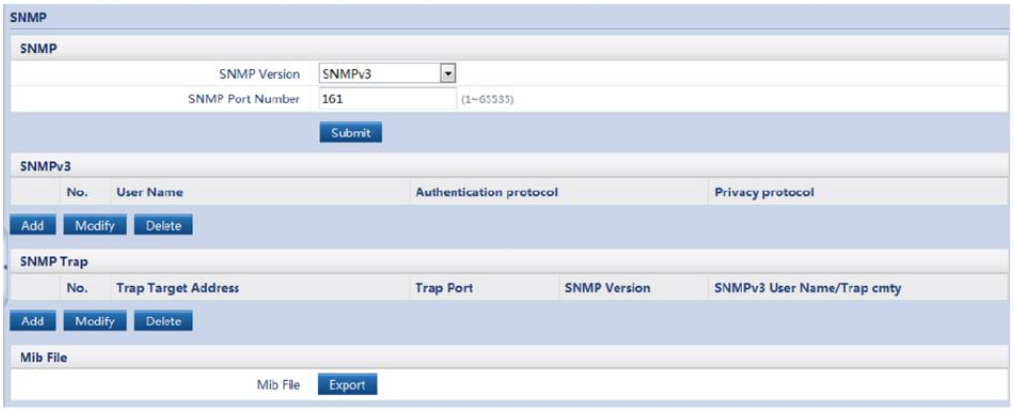
- On the home page, choose **System Settings**. The **System Settings** tab includes **Site Configuration**, **Time**, **IP Address**, **Configuration File**, and **SNMP**.



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WebUI: System Settings (4)

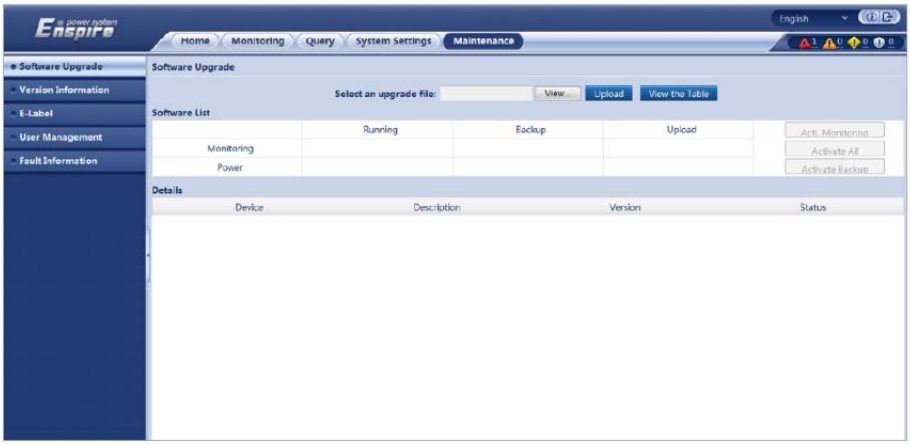
- On the home page, choose **System Settings**. The **System Settings** tab includes **Site Configuration**, **Time**, **IP Address**, **Configuration File**, and **SNMP**.



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WebUI: Maintenance (1)

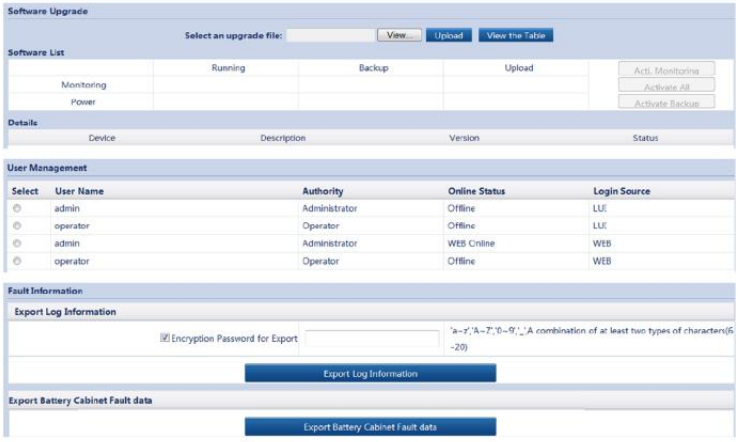
- On home page, choose **Maintenance**. The **Maintenance** tab includes **Software Upgrade**, **Version Information**, **E-Label**, **User Management**, and **Fault Information**.



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WebUI: Maintenance (2)

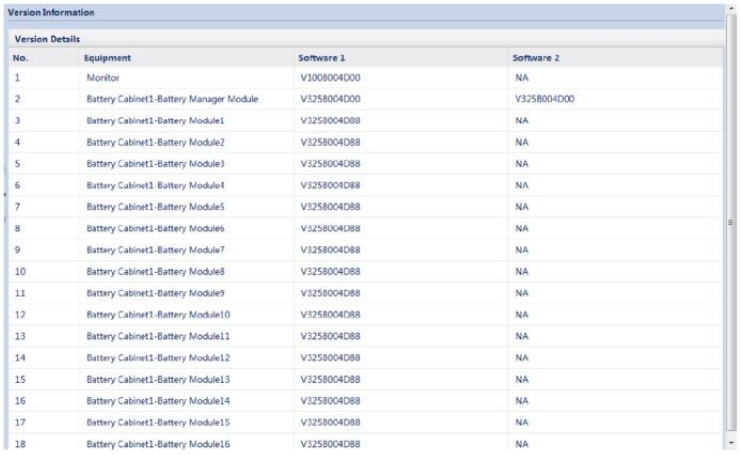
- On the home page, choose **Maintenance**. The **Maintenance** tab includes **Software Upgrade**, **Version Information**, **E-Label**, **User Management**, and **Fault Information**.



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WebUI: Maintenance (3)

- On home page, choose **Maintenance**. The **Maintenance** tab includes **Software Upgrade**, **Version Information**, **E-Label**, **User Management**, and **Fault Information**.



Version Information

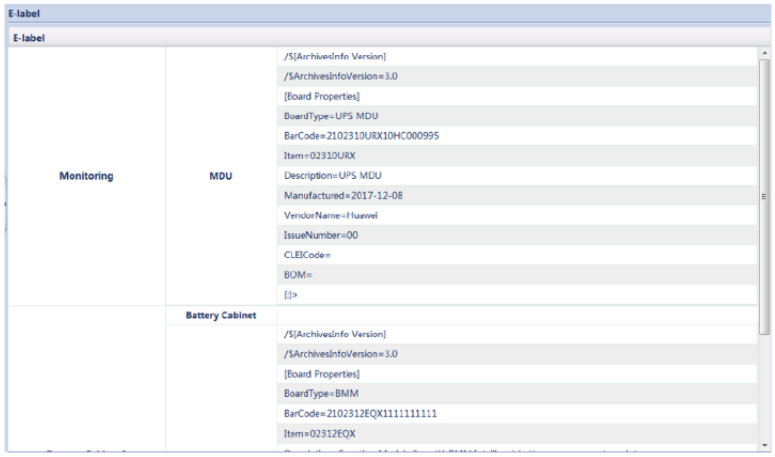
Version Details

No.	Equipment	Software 1	Software 2
1	Monitor	V1008004D00	NA
2	Battery Cabinet1-Battery Manager Module	V3258004D00	V325B004D00
3	Battery Cabinet1-Battery Module1	V3258004D88	NA
4	Battery Cabinet1-Battery Module2	V3258004D88	NA
5	Battery Cabinet1-Battery Module3	V3258004D88	NA
6	Battery Cabinet1-Battery Module4	V3258004D88	NA
7	Battery Cabinet1-Battery Module5	V3258004D88	NA
8	Battery Cabinet1-Battery Module6	V3258004D88	NA
9	Battery Cabinet1-Battery Module7	V3258004D88	NA
10	Battery Cabinet1-Battery Module8	V3258004D88	NA
11	Battery Cabinet1-Battery Module9	V3258004D88	NA
12	Battery Cabinet1-Battery Module10	V3258004D88	NA
13	Battery Cabinet1-Battery Module11	V3258004D88	NA
14	Battery Cabinet1-Battery Module12	V3258004D88	NA
15	Battery Cabinet1-Battery Module13	V3258004D88	NA
16	Battery Cabinet1-Battery Module14	V3258004D88	NA
17	Battery Cabinet1-Battery Module15	V3258004D88	NA
18	Battery Cabinet1-Battery Module16	V3258004D88	NA

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WebUI: Maintenance (4)

- On home page, choose **Maintenance**. The **Maintenance** tab includes **Software Upgrade**, **Version Information**, **E-Label**, **User Management**, and **Fault Information**.



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Power-On

1. Turn on the ready switch on the battery management module.
2. Press and hold the POWER ON/OFF button on the battery management module for more than 2 seconds. The green indicator of the battery management module blinks at 4 Hz.
3. Set the language, time, date, network parameters, and system parameters on the **Settings Wizard** screen.
4. After the green indicator of the battery management module blinks at 10 Hz and the yellow indicator is steady on, switch on the battery circuit breaker.

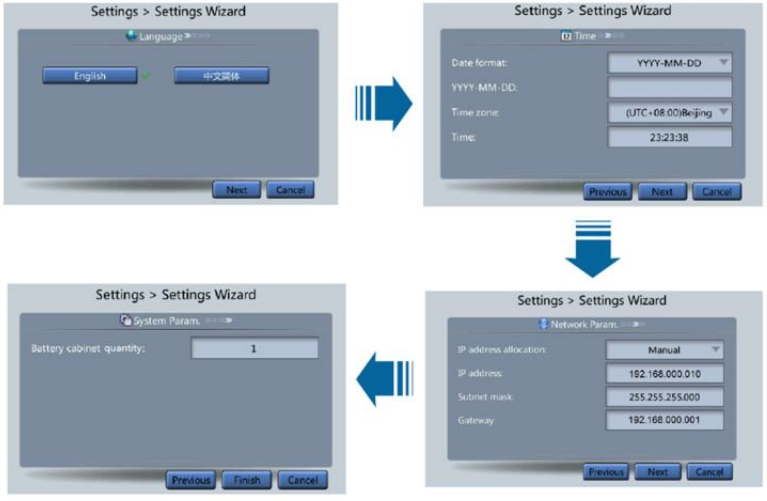
Notes:

1. If multiple battery cabinets are combined, press and hold the POWER ON/OFF button on each battery management module of the cabinets one by one for more than 2s.
2. When multiple battery cabinets are combined, if the green indicator on one battery management module blinks at 10 Hz, switch on the battery circuit breaker on any cabinet. In this case, the green indicators of all battery management modules blink (on for 1s and then off for 4s). Do not switch on the battery circuit breakers on other cabinets. After the green indicators of other battery management modules blink at 10 Hz, switch on the battery circuit breaker on each cabinet where the indicator of the battery management module blinks at 10 Hz one by one.



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Setting Parameters: Settings Wizard



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Power-Off

1. Switch off the battery circuit breaker on each parallel battery cabinet.
2. Press and hold the POWER ON/OFF button on each battery management module for more than 5s.

Notes:
If batteries are powered off and will not be charged for more than a month, remove the battery management module.
The battery management module has static power consumption. If batteries with low SOC are not charged for a long time, the batteries may be over-discharged, which has adverse impact on the battery lifespan.



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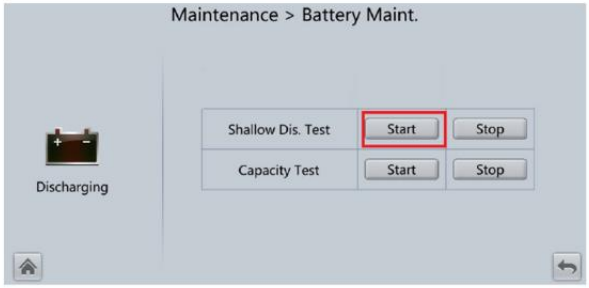
EPO and Clearing the EPO State

- EPO: Press the external switch connected to the EPO port or remove the 4-pin terminal from the EPO port.
- Clearing the EPO state
  - Clear the EPO state and ensure that the external EPO switch connected to the EPO port is not in the EPO state.
  - On the LCD, choose **Alarms** > **Clear Faults**. In the displayed dialog box, tap **Yes** to clear the EPO alarm.
  - View active alarms and ensure that the **Battery cabinet shutdown** alarm has disappeared from the alarm list.



Performing a Shallow Discharge Test

- Automatic shallow discharge test
  - On the home screen of the UPS LCD, choose **System Info** > **Settings** > **Battery Settings** and set **Sched. shallow dis. test** to **Enable**.
  - Set **Sched. shallow dis. test time** and **Sched. shallow dis. test interval** as required. After the setting is complete, the system will perform an automatic shallow discharge test based on the settings.
- Manual shallow discharge test
  - On the home screen of the UPS LCD, choose **System Info** > **Maintenance** > **Battery Maint.**
  - Tap **Start** on the right of **Shallow Dis. Test** to start a shallow discharge test.

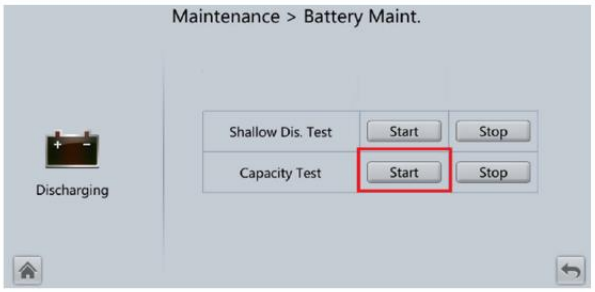


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- When the battery test is completed normally, the test data is used as common test data. Record the data obtained from the latest five tests.
- The shallow discharge test automatically stops in any of the following cases:
  - The battery discharge capacity reaches the specified value (10%–50%, 20% by default).
  - The discharge voltage reaches the warning threshold (calculated in real time).
  - The load rate fluctuation exceeds 10%.
  - An alarm is generated.

Performing a Capacity Test

- On the home screen of the UPS LCD, choose **System Info** > **Maintenance** > **Battery Maint.**
- Tap **Start** on the right of **Capacity Test** to start a capacity test.

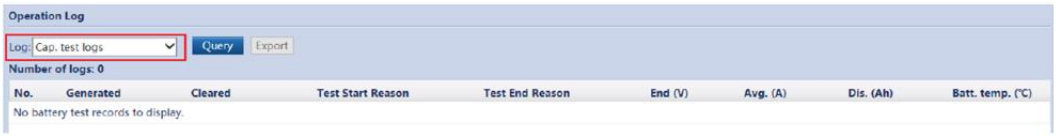


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- Before performing a capacity test, ensure that:
  - The UPS is working in normal mode; float charging or hibernation has lasted for 2 hours after the SOC reaches 100%; the load rate fluctuation is less than 10%.
  - The UPS generates no battery overtemperature, overvoltage, or overcurrent alarm. No generator is connected to the UPS.
  - The mains, batteries, charger, and discharger are normal. No overload alarm is generated.
  - The SmartLi generates no alarms related to lithium batteries.
- The capacity test automatically stops in any of the following cases:
  - The minimum electrochemical cell voltage reaches 2.65 V.
  - The load fluctuation exceeds 10%.
  - An alarm is generated.
- The test is complete when the minimum cell voltage reaches 2.65 V. The test data is obtained from the capacity test. Save the test data obtained from the latest 36 tests.

Downloading the Test Data

- On the UPS WebUI, choose **Query** > **Operation Log**, choose logs that need to be queried from the **Log** drop-down list box, and click **Query**.
- Choose logs that have been queried from the **Log** drop-down list box, and click **Export**.



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- Before performing a capacity test, ensure that:
  - The UPS is working in normal mode; float charging or hibernation has lasted for 2 hours after the SOC reaches 100%; the load rate fluctuation is less than 10%.
  - The UPS generates no battery overtemperature, overvoltage, or overcurrent alarm. No generator is connected to the UPS.
  - The mains, batteries, charger, and discharger are normal. No overload alarm is generated.
  - The SmartLi generates no alarms related to lithium batteries.
- The capacity test automatically stops in any of the following cases:
  - The minimum electrochemical cell voltage reaches 2.65 V.
  - The load fluctuation exceeds 10%.
  - An alarm is generated.
- The test is complete when the minimum cell voltage reaches 2.65 V. The test data is obtained from the capacity test. Save the test data obtained from the latest 36 tests.

Key Points for Commissioning and Acceptance

- Record the following battery parameters.

Cabinet Specifications	Voltage (V)	V	SOC	
	Maximum cell voltage	V	Minimum cell voltage	V
	Maximum cell temperature	° C	Minimum cell temperature	° C

Test Item	Result	Test Item	Result
Power-on	☐ Passed ☐ Failed	Power-off	☐ Passed ☐ Failed
Ready switch	☐ Passed ☐ Failed	Battery switch	☐ Passed ☐ Failed

Item	Description
Running status	Running status of the battery system
Voltage (V)	Battery system voltage
Current (A)	Battery system current
SOC (%)	SOC value
SOH (%)	SOH value
Maximum cell voltage (V)	Maximum battery cell voltage in the battery system
Minimum cell voltage (V)	Minimum battery cell voltage in the battery system
Maximum cell temperature (° C)	Maximum battery cell temperature in the battery system
Minimum cell temperature (° C)	Minimum battery cell temperature in the battery system
Discharge times	Discharge times of the battery system
Discharge capacity (Ah)	Discharge capacity of the battery system

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Quiz

1. (Multiple) What are the functions of Huawei SmartLi?
   A. Battery voltage measurement and alarm
   B. Battery temperature measurement and alarm
   C. Battery unit balancing
   D. Communication function

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- Answer: A, B, C, and D

Summary

- This chapter describes the structure, basic principles, installation process, key points, power-on commissioning procedure, and operations of the SmartLi.

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Thank you.

把数字世界带入每个人、每个家庭、
每个组织，构建万物互联的智能世界。

Bring digital to every person, home, and organization for a fully connected, intelligent world.

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UPS2000 Product Introduction



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Foreword

- The slides describe the UPS2000 in terms of working modes, structure, typical configurations, and excellent technical specifications.

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Objectives

On completion of this course, you will be able to:

- Get familiar with the working modes and typical configurations of the UPS2000 products.
- Get familiar with the main features and excellent technical specifications of the UPS2000 products.

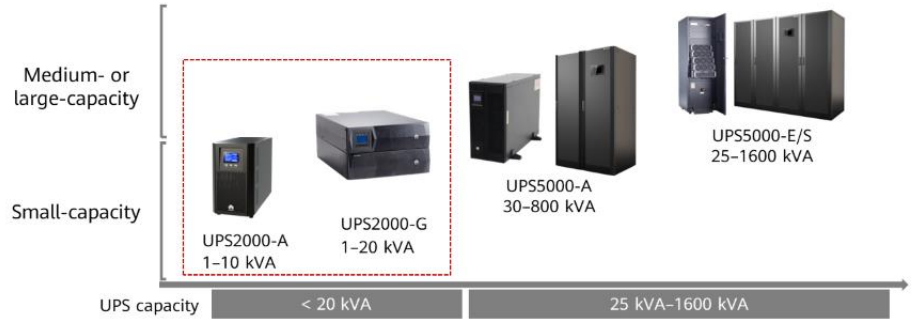
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Huawei UPS Product Portfolio



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UPS2000 Products

- UPS2000-A-(1 kVA–10 kVA)
  - Power range: 1 kVA/2 kVA/3 kVA/6 kVA/10 kVA. UPS with standard backup time have built-in batteries to provide standard backup time. UPS with long backup time require external batteries to provide long backup time.
- UPS2000-G-(1 kVA–20 kVA)
  - Power range: 1 kVA to 3 kVA. UPS with standard backup time have built-in batteries and UPS with long backup time require external battery packs. The UPS can be tower-mounted or rack-mounted.
  - Power range: 6 kVA/10 kVA/15 kVA/20 kVA. UPSs with standard and long backup time do not have built-in batteries and can be tower-mounted or rack-mounted.

UPS2000-A-(1 kVA–10 kVA)



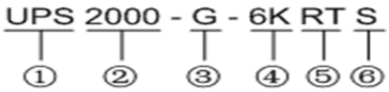
UPS2000-G-(1 kVA–20 kVA)



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- Product series: Huawei UPS2000 products are all double-conversion online UPS.

Naming Rule



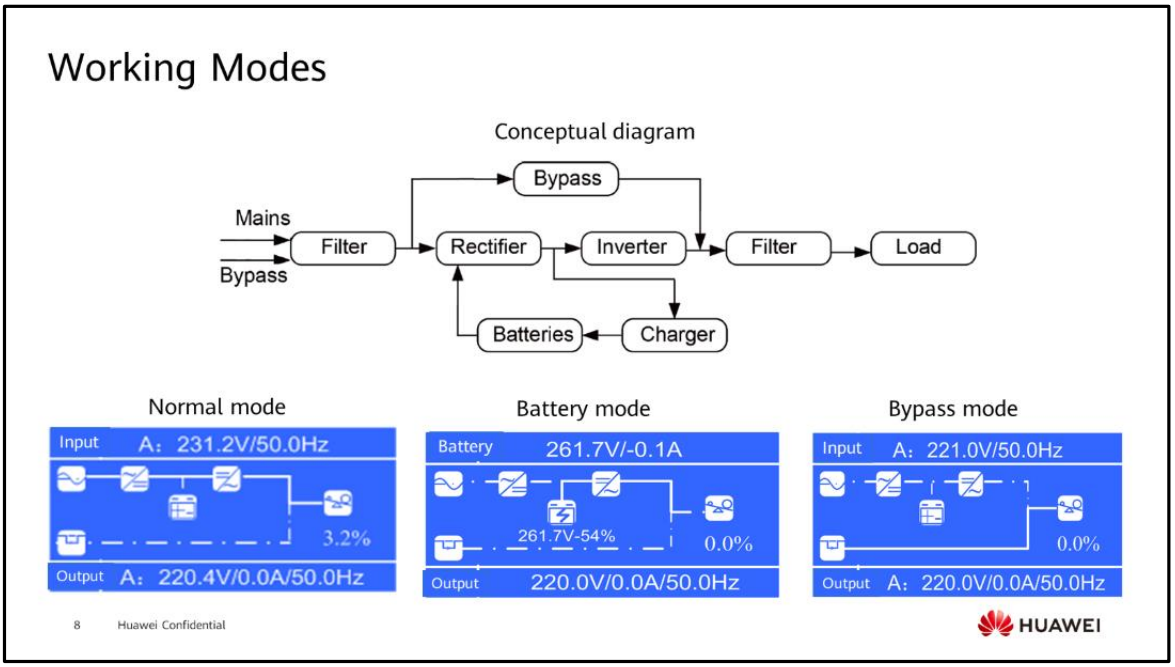
No.	Meaning	Description
①	Product category	UPS: uninterruptible power system
②	Product series	2000: S ≤ 20 kVA 5000: S > 20 kVA
③	Product subcategory	G: series name
④	Output capacity Unit: VA	6K: 6 kVA output 10K: 10 kVA output 15K: 15 kVA output 20K: 20 kVA output
⑤	Tower-mounted and rack-mounted UPS, rack-mounted UPS, tower-mounted UPS, tower-mounted modular UPS, or rack-mounted modular UPS	RT: rack-mounted and tower-mounted UPS RR: rack-mounted UPS TT: tower-mounted UPS TM: tower-mounted modular UPS RM: rack-mounted modular UPS
⑥	Built-in battery (optional)	S: standard backup time model, which provides short backup time L: long backup time model, which provides long backup time

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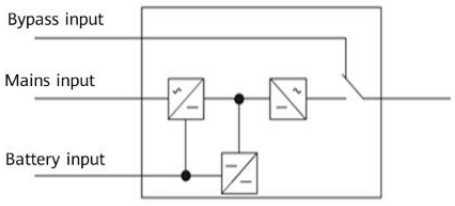
- Normal mode: When the UPS works in normal mode, the rectifier converts AC power into DC power, and then the inverter converts DC power into AC outputs with voltages of high precision and quality. The conversions protect loads from interference such as input harmonics, glitches, and voltage transients.
- Bypass mode: The UPS automatically transfers to bypass mode when it detects overtemperature, overload, or other risks that may cause inverter shutdown. The bypass supplies power to loads directly. In bypass mode, the power supply quality is not protected by the UPS and therefore is prone to outages, abnormal AC voltage waveform, and abnormal frequency.
- Battery mode: If the AC input voltage of the rectifier is abnormal, the UPS transfers from normal mode to battery mode. In this case, the rectifier shuts down, and the UPS obtains energy from batteries. The energy is converted into AC outputs by the inverter.
- ECO mode: The ECO mode is an energy saving mode, which can be set by the user. In ECO mode, the bypass takes priority over the inverter in supplying power. If the bypass fails, the UPS transfers to inverter mode in less than 20 ms. This mode improves efficiency. If the bypass voltage is within the tracking range, the bypass static switch turns on, and the bypass supplies power. If the bypass voltage is beyond the tracking voltage, the UPS transfers from bypass mode to inverter mode. In either bypass mode or inverter mode, the rectifier is enabled all the time to charge batteries over a charger.

Typical Configuration

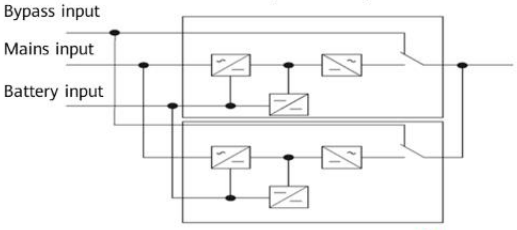
Typical configuration

Configuration	Application Scenario
Single UPS	Applies to scenarios with light load, low possibility of capacity expansion, and low requirements for system reliability.
N+X parallel system	Applies to small- and medium-sized equipment rooms or important loads. It features high availability and strong transient overload resistance capability.

Single UPS



1+1 parallel system



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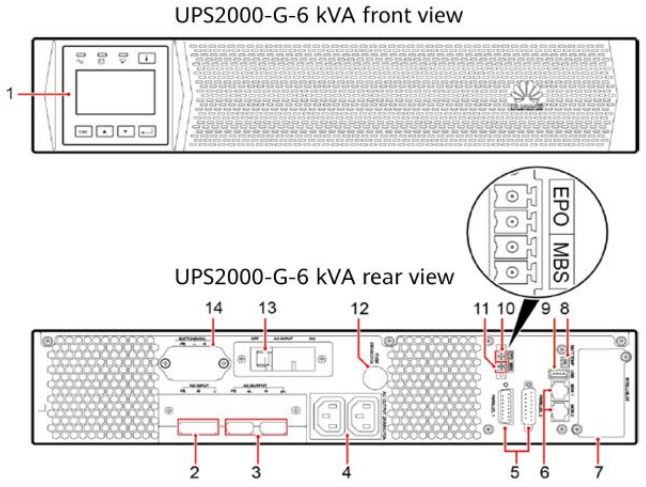
- The value of N+X is less than or equal to 4 in the preceding description. In the following N+1 description, N is less than or equal to 3.
- If the UPS works in N+1 mode, the mains input, bypass input, and AC output terminals are connected in parallel. The battery input is connected based on the site requirements. Multiple UPS can share a battery string to reduce costs (the UPS2000-G-6 kVA and UPS2000-G-10 kVA cannot share batteries) or connect to separate battery strings to improve system reliability. Multiple UPS are connected using parallel cables to synchronize UPS outputs and supply power to loads. In this case, if a UPS fails, other UPS in the parallel system continue supplying power to loads, thereby improving system availability.

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UPS2000-G-6 kVA

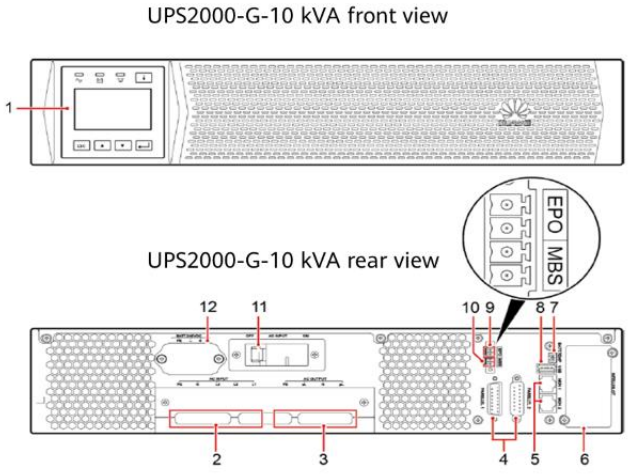


(1) Control panel | (2) AC input port | (3) AC output ports (pL and sL)
(4) Output sockets | (5) Parallel ports | (6) CAN communications ports (MON1 and MON2)
(7) Optional card slot | (8) Battery temperature sensor port | (9) USB port (protected by a security mechanism)
(10) EPO port | (11) Maintenance bypass port (MBS) | (12) Fuse base
(13) Input circuit breaker | (14) Battery port

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- UPS height: 2 U.
- Control panel: for operation and data display.
- AC input port: single-phase.
- AC output ports: single-phase.
  - sL: used for single UPS output or connected to primary loads.
  - pL: used for parallel UPS output or connected to secondary loads.
  - Power segment function (used in the single UPS scenario): When overload occurs, secondary loads are shut down first to eliminate overload and ensure power supply quality. When a power failure occurs, secondary loads are shut down first to prolong the backup time of primary loads.
- Parallel ports: connected to parallel cables for a parallel system.
- Optional card slot: The optional Modbus card, SNMP card, or dry contact card can be inserted to this slot.
- CAN communications ports (MON1 and MON2): If a Huawei power distribution unit (PDU) is combined with the UPS in parallel, the ports allow the PDU to communicate with the UPS, and the status of all switches in the PDU is displayed on the UPS.

UPS2000-G-10 kVA



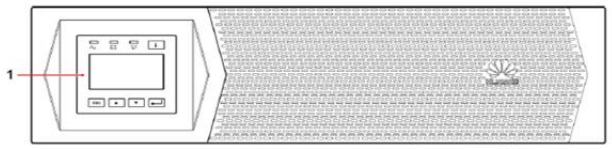
(1) Control panel	(2) AC input port	(3) AC output ports (pL and sL)
(4) Parallel ports	(5) CAN communications ports (MON1 and MON2)	(6) Optional card slot
(7) Battery temperature sensor port	(8) USB port (protected by a security mechanism)	(9) EPO port
(10) Maintenance bypass port (MBS)	(11) Input circuit breaker	(12) Battery port

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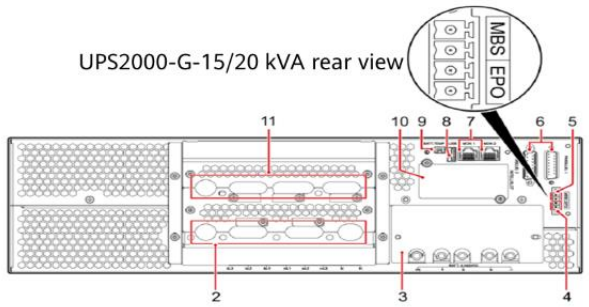
- UPS height: 2 U.
- Control panel: for operation and data display.
- AC input port: three-phase.
- AC output ports: single-phase.
  - sL: used for single UPS output or connected to primary loads.
  - pL: used for parallel UPS output or connected to secondary loads.
  - Power segment function (used in the single UPS scenario): When overload occurs, secondary loads are shut down first to eliminate overload and ensure power supply quality. When a power failure occurs, secondary loads are shut down first to prolong the backup time of primary loads.
- Parallel ports: connected to parallel cables for connecting UPSs with long backup time in parallel.
- CAN communications ports (MON1 and MON2): If a Huawei power distribution unit (PDU) is combined with the UPS in parallel, the ports allow the PDU to communicate with the UPS, and the status of all switches in the PDU is displayed on the UPS.
- Battery temperature sensor port: connects to a battery temperature sensor.

UPS2000-G-15/20 kVA

UPS2000-G-15/20 kVA front view



UPS2000-G-15/20 kVA rear view



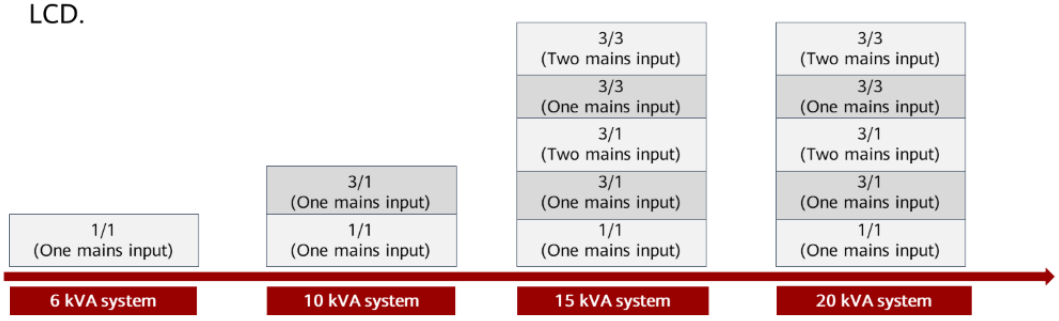
(1) Control panel	(2) AC input ports (for mains and bypass)	(3) Battery port
(4) EPO port	(5) Maintenance bypass port (MBS)	(6) Parallel ports
(7) CAN communications ports (MON1 and MON2)	(8) USB port (protected by a security mechanism)	(9) Battery temperature sensor port
(10) Optional card slot	(11) AC output ports (pL and sL)	

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- UPS height: 3 U.
- Control panel: for operation and data display.
- AC input ports: three-phase, different ports for mains and bypass.
- AC output ports: three-phase.
    - sL: used for single UPS output or connected to primary loads.
    - pL: used for parallel UPS output or connected to secondary loads.
    - Power segment function (used in the single UPS scenario): When overload occurs, secondary loads are shut down first to eliminate overload and ensure power supply quality. When a power failure occurs, secondary loads are shut down first to prolong the backup time of primary loads.
- Parallel ports: connected to parallel cables for connecting UPSs with long backup time in parallel
- CAN communications ports (MON1 and MON2): If a Huawei power distribution unit (PDU) is combined with the UPS in parallel, the ports allow the PDU to communicate with the UPS, and the status of all switches in the PDU is displayed on the UPS.
- Battery temperature sensor port: connects to a battery temperature sensor.

Output System

- Physical conversion between different systems is implemented by using short-circuit copper bars delivered with the UPS.
- The UPS is adaptive to the power grid input, and the output is adjusted over the LCD.



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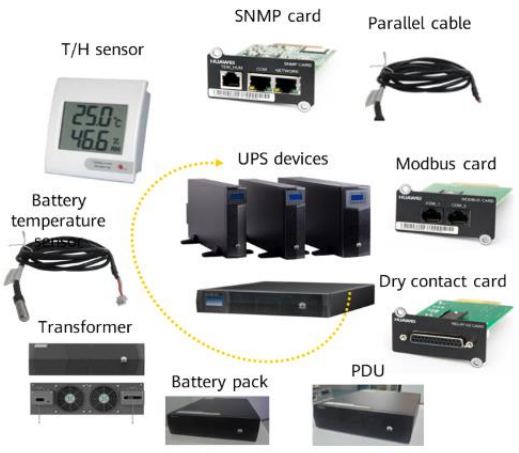
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Optional Components

Category		Component	Description
Standard configuration	UPS device	6/10kVA UPS	Standard backup time model and long backup time model.
		15/20 kVA UPS	Long backup time model.
Optional components	Power distribution components	Standard battery pack	240 V, 7 Ah/9 Ah.
		3/1 PDU	Three-phase input single-phase output parallel PDU.
		3/3 PDU	Three-phase input three-phase output parallel PDU.
		6/10 kVA transformer	2:1:1
	Optional card and sensor	SNMP/Modbus/c Dry contact ard	SNMP/Web monitoring management Provides the RS485 protocol. Provides the inputs and outputs of dry contact signals.
		Battery temperature sensor	Monitors the battery temperature.
		Temperature and humidity (T/H) sensor	Monitors the ambient temperature and humidity.
		Parallel cable	Used in a parallel system.



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- Magnetic ring:Optimizes the performance of the TN-C power distribution system in a parallel system.

Battery Pack (1)



Battery pack



The battery wiring terminal of the 6 kVA/10 kVA UPS is a PP45 terminal.



The battery wiring terminal of the 15 kVA/20 kVA UPS is an OT terminal.



Short power backup time (battery pack)



Long power backup time (battery rack)

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Battery Pack (2)

Battery pack (240 V/7 Ah) specifications for power backup (6 kVA UPS; calculated based on 94% battery efficiency)

Load Rate	Load (W)	One Battery Pack (min)	Two Battery Packs (min)	Three Battery Packs (min)	Four Battery Packs (min)
100%	5400	6	19	29	46
80%	4320	9	25	43	57
50%	2700	19	46	68	92
30%	1620	36	77	120	174

Battery pack (240 V/9 Ah) specifications for power backup (10 kVA UPS; calculated based on 94% battery efficiency)

Load Rate	Load (W)	One Battery Pack (min)	Two Battery Packs (min)	Three Battery Packs (min)	Four Battery Packs (min)
100%	9000	4	12	23	32
80%	7200	7	17	29	44
50%	4500	12	32	53	70
30%	2700	26	57	88	125

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- This section describes the battery backup time of the UPS in the standard configuration, which can be used as a reference and estimation in a project. In the standard configuration, Huawei standard battery packs are used, without extra battery strings.
- Due to the discharge characteristics of lead-acid batteries, the discharge time does not change linearly with the battery capacity. For example, when one battery pack is used for a 6 kV UPS and the load rate is 100%, the discharge time is 6 minutes. However, when two battery packs are used in the same scenario, the discharge time is 19 minutes. That is, the discharge time is about three times of the original time after the battery capacity is doubled.
- The discharge characteristic of lead-acid batteries is that the discharge capacity decreases as the discharge current increases. You need to pay attention to this characteristic when estimating the configuration items.

Battery Pack (2)

Battery pack (240 V/9 Ah) specifications for power backup (15 kVA UPS; calculated based on 94% battery efficiency)

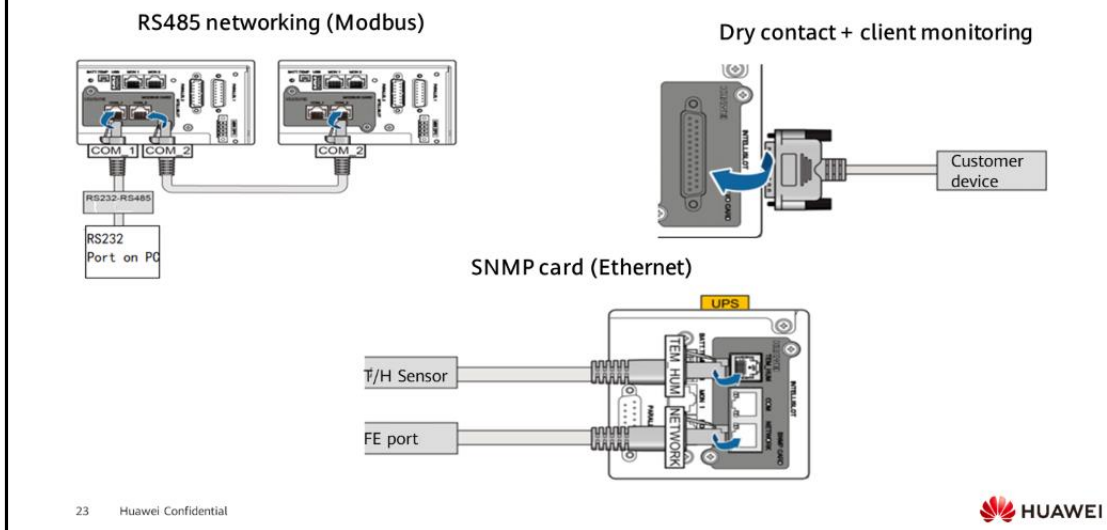
Load Rate	Load (W)	Two Battery Packs (min)	Four Battery Packs (min)	Six Battery Packs (min)	Eight Battery Packs (min)
100%	13,500	7	19	32	48
80%	10,800	9	26	44	57
50%	6750	18	48	70	96
30%	4050	35	79	125	171

Battery pack (240 V/9 Ah) specifications for power backup (20 kVA UPS; calculated based on 94% battery efficiency)

Load Rate	Load (W)	Two Battery Packs (min)	Four Battery Packs (min)	Six Battery Packs (min)	Eight Battery Packs (min)
100%	18,000	4	12	23	32
80%	14,400	7	17	29	44
50%	9000	12	32	53	70
30%	5400	26	57	88	125

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Monitoring Card



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- A single UPS is connected to a PC using a USB cable and monitored by the NetEco 1000U.
- One card monitors the entire parallel system. Only one optional communications card is required to monitor the entire parallel system.

PDU (1)

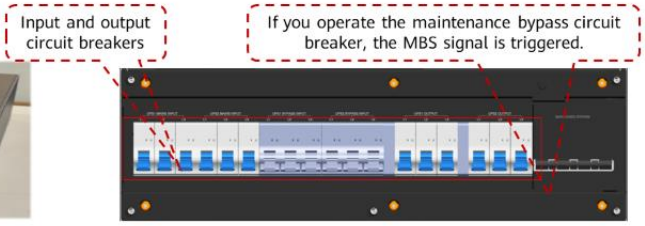
- Highlights:
  - Distributes input and output power for two UPS connected in parallel.
  - Provides a centralized maintenance bypass for a single UPS or a parallel system.
  - Reports the voltage of each PDU route to the UPS.

Model	Applicable To
PDC-0038V4ACIOA	15 kVA/20 kVA UPS (three-phase input three-phase output)
PDC-0091V2ACIOA	6 kVA/10 kVA/15 kVA/20 kVA UPS (three-phase input single-phase output, single-phase input single-phase output)

PDU front view



Front panel of the PDU (excluding the logo panel)

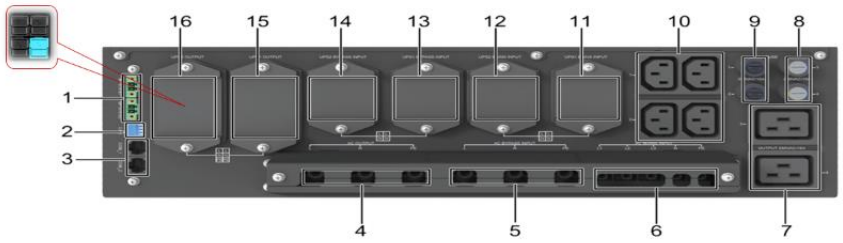


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- This section uses PDC-0038V4ACIOA as an example. The working principle of PDC-0091V2ACIOA is the same as that of PDC-0038V4ACIOA, but the cable connection methods are different.

PDU (2)

Ports on the rear panel of the PDU



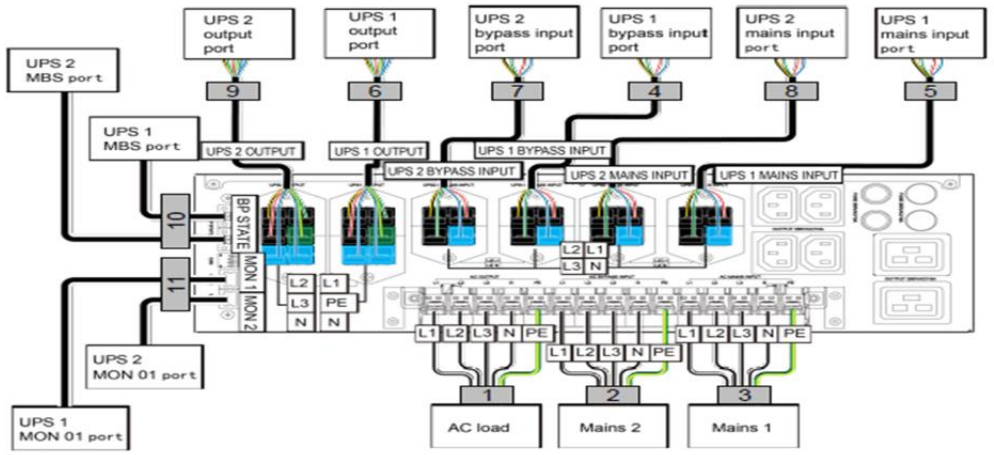
(1) Maintenance bypass port	(2) DIP switch	(3) Voltage monitoring ports	(4) Output ports
(5) Bypass input ports	(6) Mains input ports	(7) Output socket 1 (250 V AC/15 A)	(8) Output socket 1 fuses
(9) Output socket 2 fuses	(10) Output socket 2 (250 V AC/10 A)	(11) UPS 1 mains input port (under the cover)	(12) UPS 2 mains input port (under the cover)
(13) UPS 1 bypass input port (under the cover)	(14) UPS 2 bypass input port (under the cover)	(15) UPS 1 output port (under the cover)	(16) UPS 2 output port (under the cover)

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- DIP switch: If there are multiple parallel systems (that is, multiple PDUs), each PDU must have its own address.

PDU (3)

PDC-0038V4ACIOA electrical connection



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- The preceding figure shows the cable connections when the main input and bypass input use different power sources. When the main input and bypass input share a power source, connect the mains input to AC BYPASS INPUT (AC MAINS INPUT is not connected).

Isolation Transformer (1)

- Highlights
  - Implements electrical isolation for the UPS outputs.
  - The transformer turn ratio is 2:1:1, which converts one 220 V output into two 110 V outputs. Therefore, two voltage systems can be provided.
- Two models
  - 6 kVA isolation transformer and 10 kVA isolation transformer.
  - Correspond to 6 kVA and 10 kVA UPS.
- Configuration principle
  - 15 kVA three-phase output three-phase input: three 6 kVA isolation transformers.
  - 20 kVA three-phase output three-phase input: three 10 kVA isolation transformers.
  - 15/20 kVA single-phase output: two 10 kVA isolation transformers.



1. Output port 2. Output port

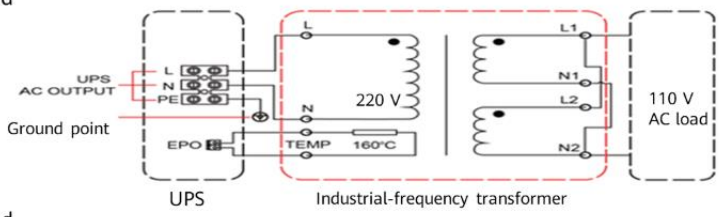
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- The isolation transformer is single-phase.

Isolation Transformer (2)

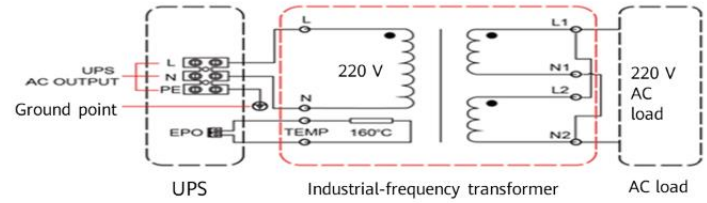
- The input voltage is 220 V, and the output voltage is 110 V.

2:1 connection mode



- The input voltage is 220 V, and the output voltage is 220 V.

1:1 connection mode



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Contents

1. Model Description
2. Working Logic
3. Product Structure
4. **Product Specifications**

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UPS2000-G-(6 kVA–20 kVA) Specifications (1)

- Physical specifications

Item	6 kVA	10 kVA	15 kVA	20 kVA
Dimensions (H x W x D)	430 mm x 86 mm x 615 mm		430 mm x 130 mm x 757 mm	
Weight	14 kg	16 kg	32 kg	32 kg

- Environmental specifications

Item	6 kVA	10 kVA	15 kVA	20 kVA
Operating temperature	0–40° C			
Relative humidity	0%–95% (non-condensing)			
Altitude	1000 m (without derating) When the altitude ranges from 1000 m to 4000 m, the output power derates based on IEC 62040-3. (The output power derates by 1% for each additional 100 m.)			
Storage and transportation temperatures	–40° C to +70° C (battery pack: –20° C to +40° C)			

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UPS2000-G-(6 kVA–20 kVA) Specifications (2)

Main input electrical specifications

Specifications	6 kVA	10 kVA	15 kVA	20 kVA
Input power cable	1 Ph (L/N) + PE, single-phase input	1 Ph (L/N) + PE, single-phase input 3 Ph (L1/L2/L3/N) + PE, three-phase input	1 Ph (L/N) + PE, single-phase input 3 Ph (L1/L2/L3/N) + PE, three-phase input	
Rated input voltage	220 V AC/230 V AC/240 V AC	Single-phase: 220 V AC/230 V AC/240 V AC Three-phase: 380 V AC/400 V AC/415 V AC	Single-phase: 220 V AC/230 V AC/240 V AC Three-phase: 380 V AC/400 V AC/415 V AC	
Input voltage range	80–280 V AC (When the voltage ranges from 80 V AC to 176 V AC, loads are linearly derated to 40%–100%.)	Single-phase: 80–280 V AC (When the voltage ranges from 80 V AC to 176 V AC, loads are linearly derated to 40%–100%.) Three-phase: same as the UPS2000-G-15 kVA/20 kVA.	Single-phase: 80–280 V AC (When the voltage ranges from 80 V AC to 176 V AC, loads are linearly derated to 40%–100%.) Three-phase: 138–485 V AC (When the voltage ranges from 138 V AC to 305 V AC, loads are linearly derated to 40%–100%.)	
No-load loss	< 54 W	< 90 W	< 180 W	
Dual power inputs	Unavailable	Unavailable	Available	
Startup voltage range	120–280 V AC			
Generator input capacity	Minimum: 1.5 times of the rated UPS capacity			

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- The UPS supports a wide input voltage range (80–280 V) and frequency range, which reduces battery transfer times, eliminates areas with high fault risks, reduces battery charge and discharge times, and prolongs the battery service life.
- Low no-load loss means high UPS efficiency. The UPS2000 is the first batch of UPSs that have passed the Energy Star certification in the industry. The maximum efficiency of the 6 kVA, 10 kVA, and 15 kVA/20 kVA models is 94%, 94.5%, and 95%, respectively. The actual working efficiency of the UPS fluctuates with the UPS load rate and is a dynamic value.
- The initial load rate of the generator is about 80%, so the generator input capacity should be 1.5 times of the rated UPS capacity for redundancy. The rated UPS capacity refers to the UPS output capacity. The battery charge power also needs to be considered for the UPS input.

UPS2000-G-(6 kVA–20 kVA) Specifications (3)

- Bypass input electrical specifications

Specifications	6 kVA	10 kVA	15 kVA	20 kVA
Bypass voltage range (configurable on the LCD)	Upper threshold: 10%, 15%, 20%, or 25% at 220 V AC			
	Upper threshold: 10%, 15%, or 20% at 230 V AC			
	Upper threshold: 10% or 15% at 240 V AC			
	Lower threshold: 10%, 20%, 30%, 40%, 50%, or 60%			
Bypass frequency range	Maximum ± 6 Hz (configurable on the LCD)			
Bypass overload capability	When the UPS works continuously at a load rate of less than 125%, the input switch may trip in advance. When the load rate is within 125%–150%, the UPS disconnects the output after 1 minute, and the input switch may trip in advance. When the load rate is greater than or equal to 150%, the UPS disconnects the output after 100 ms, and the input switch may trip in advance.			
Input mode	The main input and bypass input share a power source.		The main input and bypass input share a power source. The main input and bypass input use different power sources.	

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- Bypass frequency range: Within this range, the bypass works properly, and the UPS can transfer from normal mode to bypass mode. If the bypass frequency exceeds this range, the UPS cannot transfer to bypass mode.

UPS2000-G-(6 kVA–20 kVA) Specifications (4)

- Output electrical specifications

Specifications	6 kVA	10 kVA	15 kVA	20 kVA
Rated capacity	6 kVA	10 kVA	15 kVA	20 kVA
Output power factor	0.9			
Rated output voltage	220 V AC/230 V AC/240 V AC (single-phase output; a voltage system can be selected by setting a voltage level on the LCD.)		380 V AC/400 V AC/415 V AC (three-phase output; a voltage system can be selected by setting a voltage level on the LCD.) 220 V AC/230 V AC/240 V AC (single-phase output; a voltage system can be selected by setting a voltage level on the LCD.)	
Output voltage precision	±1%			
THDv	< 4% (non-linear load); < 2% (resistive load)			
Overload capability	In normal mode, when the load rate ranges from 105% to 125%, the UPS transfers to bypass mode in 5 minutes if the bypass is normal, or disconnects the output if the bypass is abnormal. In normal mode, when the load rate ranges from 125% to 150%, the UPS transfers to bypass mode in 1 minute if the bypass is normal, or disconnects the output if the bypass is abnormal. In normal mode, when the load rate is greater than or equal to 150%, the UPS transfers to bypass mode in 100 ms if the bypass is normal, or disconnects the output if the bypass is abnormal.			

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- THD: refers to total harmonic distortion, which measures the deviation of a signal from the original signal or standard signal during transmission. In an ideal amplifier, the output waveform should be the same as the input waveform except for amplification. In practice, however, the output waveform cannot be identical with the input waveform. This phenomenon is called distortion.
- Overload capability: If the UPS works in normal mode and is overloaded, the UPS transfers to bypass mode. The bypass also has its own overload indicator. If the bypass is still overloaded, the UPS disconnects the output. If the bypass is not overloaded (for example, the load rate is less than 125%), the bypass can work continuously by default. However, the upstream input circuit breakers may trip in advance.

UPS2000-G-(6 kVA–20 kVA) Specifications (5)

- Output electrical specifications

Specifications	6 kVA	10 kVA	15 kVA	20 kVA
Average frequency tracking rate	0.5–2 Hz/s for a single UPS and 0.5–1 Hz/s for a parallel system			
Power segment (supported only for a single UPS)	If overloaded, the UPS disconnects the loads on pL and checks whether it is still overloaded. In battery mode, when the battery voltage is less than the preset value, the UPS disconnects the loads on pL. In battery mode, when the battery discharge time exceeds the preset value, the UPS disconnects the loads on pL.			

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- Frequency tracking: By default, the inverter output tracks the bypass input to ensure uninterrupted transfer between normal mode and bypass mode. The tracking rate is configurable. Generally, the default setting is used. If the tracking rate is too low or too high, fluctuation may occur.

UPS2000-G-(6 kVA–20 kVA) Specifications (6)

- Battery electrical specifications

Specifications	6 kVA	10 kVA	15 kVA	20 kVA
Rated battery voltage	240 V DC		±240 V DC	
Number of batteries	16–20 batteries (12 V). If the number of batteries is less than 20, the power is derated by *N*/20 (*N* is the smaller value between the numbers of batteries).		16 to 20 for each of positive and negative strings. The rated number is 20. If the number of batteries is less than 20, the power is derated by *N*/20 (*N* is the smaller value between the numbers of positive and negative strings).	
Battery string sharing in a parallel system	Not supported		Supported	
Battery deep discharge protection	The discharge time is longer than 16 hours (0–24 hours, 16 hours by default. If it is set to 0, battery discharge protection is not implemented.)			
Parallel connection	Supported. If batteries are provided by the customer, the maximum number of battery strings connected in parallel is determined by the battery manufacturer. It is recommended that no more than four battery strings be connected in parallel.			
Rated charge current	2 A ± 0.5 A for a standard backup time model 4 A ± 0.5 A for a long backup time model			
Rated charge voltage	2.35 V/cell, equalized charge voltage, which can be set on the LCD 2.25 V/cell, float charge voltage, which can be set on the LCD			

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- The number of batteries can be adjusted for this UPS. The number of batteries must be an even number for the UPS2000-G-6 kVA/10 kVA. The UPS2000-G-15 kVA/20 kVA has positive and negative battery strings, and therefore the number of batteries in a battery string is an even number.
- Note: The charge current is small. Generally, the charge current limit of the lead-acid battery for the UPS is 0.1C10. It can be estimated that the maximum battery capacity of the UPS should not exceed 40 Ah. If the battery capacity exceeds 40 Ah, the following situations may happen: If the charge time is too long and the local mains quality is poor, batteries cannot be fully charged. In this case, batteries are easily damaged. Some customers require large-capacity batteries, for example, 100 Ah battery strings. However, a 100 Ah battery string requires 10 A charge current, which is far greater than the limit. During UPS solution configuration, especially when the customer requires large-capacity battery strings, notify the customer of the impact in advance.

UPS2000-G-(6 kVA–20 kVA) Specifications (5)

ECO specifications

Item	6 kVA	10 kVA	15 kVA	20 kVA
ECO voltage range	The default value is ±10%, which can be set on the LCD. The value range is ±5% to ±10%.			
ECO frequency range	The default value is ±2 Hz, which can be set on the LCD. The maximum value is ±3 Hz.			

Parallel connection specifications

Item	6 kVA	10 kVA	15 kVA	20 kVA
Number of parallel UPSs	≤ 4			

Safety compliance and EMC

Item	Standards Compliance	Remarks
Electromagnetic compatibility	Conducted emission: IEC/EN 62040-2	N/A
	Voltage change, fluctuations, and flicker I ≤ 16 A, IEC/EN 61000-3-3; 16 A < I ≤ 75 A, IEC/EN 61000-3-11	N/A
	Harmonic interference: 16 A < I ≤75 A, IEC/EN 61000-3-12	N/A
Impact current (surge protection)	IEC/EN 60240-2 IEC/EN 61000-4-5 YD/T 1095-2000, YD/T944-2007	The AC input side meets Level D surge protection (differential mode and common mode: 5 kA and 8/20 μs).

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Quiz

1. (short-answer question) What is the difference between the pL and sL output ports of the UPS2000-G-(6 kVA–20 kVA)?
2. (short-answer question) What input and output systems does the UPS2000-G-(15 kVA–20 kVA) support?

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- 1. pL is a parallel port. In a single UPS system, pL and sL implement the power segment function. pL is for secondary loads, and sL is for primary loads.
- 2. The following systems are supported: three-phase input three-phase output, three-phase input single-phase output, and single-phase input single-phase output.

Summary

- This chapter describes the following aspects:
  - UPS2000 model description.
  - UPS2000 working logic.
  - UPS2000 product structure.
  - UPS2000 product specifications.

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Thank you.

把数字世界带入每个人、每个家庭、
每个组织，构建万物互联的智能世界。

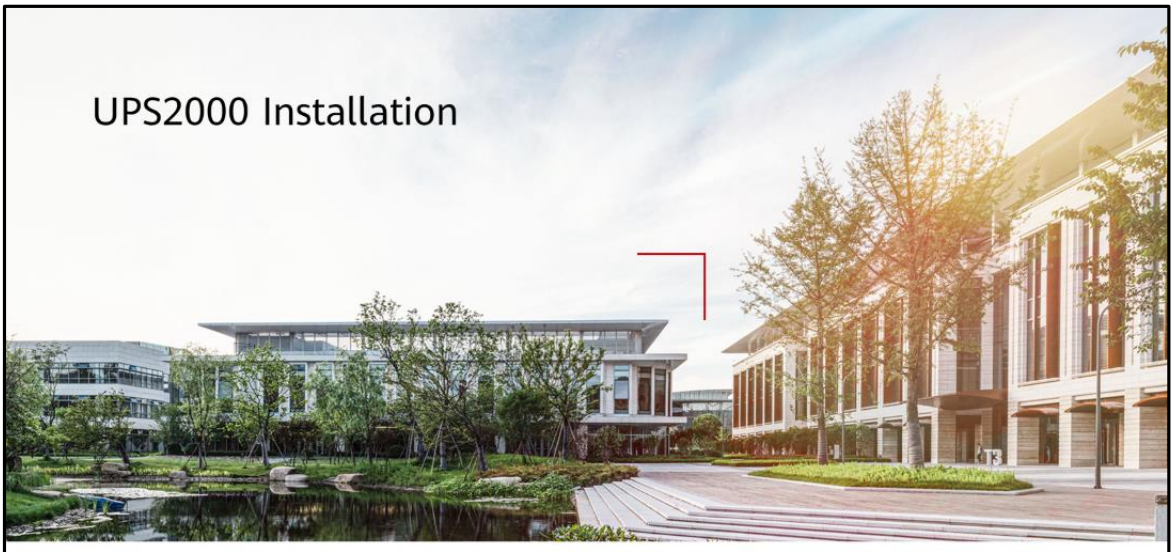
Bring digital to every person, home, and organization for a fully connected, intelligent world.

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UPS2000 Installation



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Foreword

- The slides describe how to install the UPS2000 and verify the installation.

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Objectives

On completion of this course, you will be able to:

- Install UPS2000 of different models.
- Check the engineering quality of UPS2000 of different models.

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1. Preparations
2. Installation
3. Installation Verification

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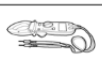
Site Planning

- Floor loading capacity
  - The floor can bear the weight of the UPS and its optional components. In the case of rack-mounted installation, ensure that the floor can also bear the weight of the rack.
- Installation environment
  - Install the UPS in an environment free of damp, dust, volatile gas, salt, and corrosive materials. Avoid direct sunlight.
  - The optimal operating temperatures for batteries are 20–30℃. Operating temperatures higher than 30℃ shorten the battery lifespan, and operating temperatures lower than 20° C reduce the battery backup time.
- Installation clearances
  - Clearances should be reserved around a cabinet for the purpose of ventilation and other operations. At least clearances of 500 mm should be reserved in front and at the rear of a cabinet for ventilation and operations.

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- Installation precautions
  - Transporting
    - Before transporting the UPS, pack it with original packaging materials to protect it from collision.
  - Preparation
    - The UPS may have condensation inside after being moved from a cold environment to a warm environment (such as an indoor environment). In this case, install the UPS after it is completely dry. Do not install the UPS in an environment with water, moisture, direct sunlight, or heaters nearby. Do not block or shield the air vents on the UPS shell.
  - Installation
    - Do not connect a device (such as a laser printer) that will overload the UPS to the output socket of the UPS. Do not connect household appliances (such as a hair drier) to the output socket of the UPS. The socket connected to the UPS must be a grounded shockproof socket and be close to the UPS for easy access.

Tools

Tool Name and Appearance				
Clamp meter	Multimeter	Labels	Phillips screwdriver (PH2 x 150 mm or PH3 x 250 mm)	Flat-head screwdriver (2 mm x 80 mm)
				
Torque screwdriver	Crimping tool	Diagonal pliers	Wire stripper	Insulation tape
				
Cotton cloth	Brush	Heat-shrink tubing	Heat gun	Electrician's knife
				
Protective gloves	ESD gloves	Insulation gloves	Hydraulic pliers	Cable tie
				

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Preparing Cables

Cables for the 6/10 kVA models

Model	Wiring Terminal	Number of Phases	Rated Voltage	Cable Cross-sectional Area
6 kVA	Input	1	220 V AC/230 V AC/240 V AC	6 mm²
	Output	1		
	Battery		240 V DC	6 mm²
10 kVA	Input	1	220 V AC/230 V AC/240 V AC	10 mm²
	Output	1		
	Input	3	380 V AC/400 V AC/415 V AC	
	Output	1	220 V AC/230 V AC/240 V AC	
	Battery		240 V DC	10 mm²

Cables for the 15/20 kVA models

Model	Wiring Terminal	Number of Phases	Rated Voltage	Cable Cross-sectional Area
15/20 kVA (three-phase input single-phase output)	Bypass	1	220 V AC/230 V AC/240 V AC	25 mm²
	Mains	3	380 V AC/400 V AC/415 V AC	10 mm²
	Battery		±240 V DC	16 mm²
	Output	1	220 V AC/230 V AC/240 V AC	25 mm²
15/20 kVA (three-phase input three-phase output)	Bypass	3	380 V AC/400 V AC/415 V AC	10 mm²
	Mains	3		
	Battery		±240 V DC	16 mm²
	Output	3	380 V AC/400 V AC/415 V AC	10 mm²

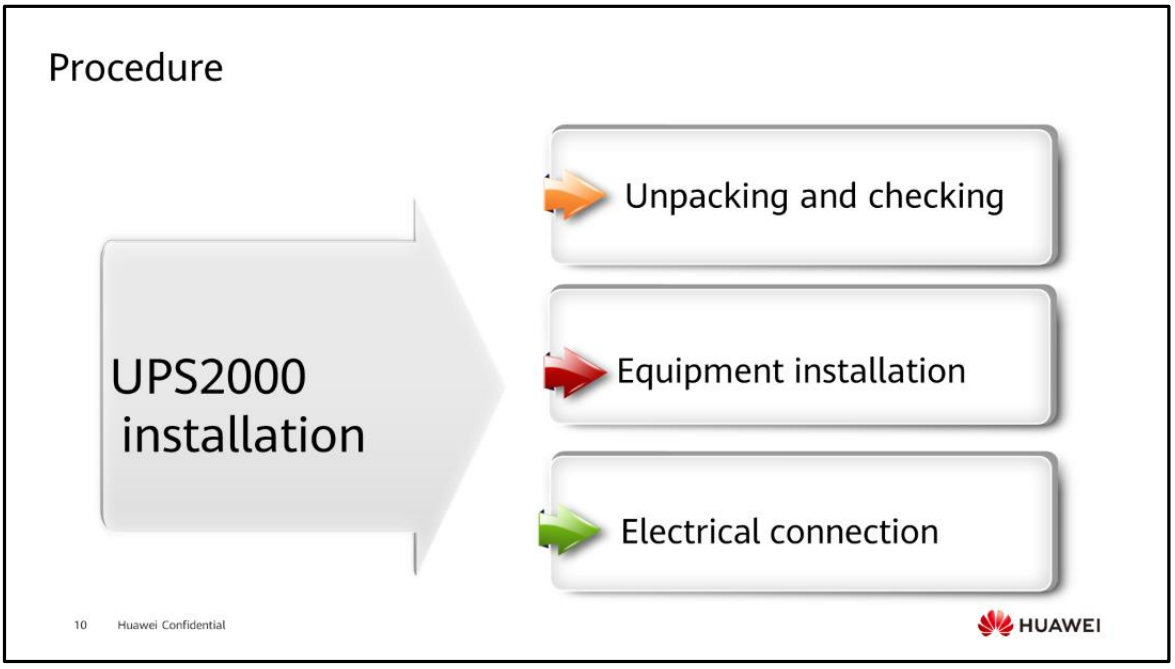
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- In the case of three-phase input, the customer must connect a three-phase input disconnector. In the case of single-phase input, it is recommended that a disconnector be added.
- The UPS can generate large leakage currents. A circuit breaker equipped with a residual current device (RCD) is not recommended. If leakage protection is required, select a recommended circuit breaker.
    - The leakage current of the 6 kVA UPS is less than or equal to 100 mA. The leakage current of the 10 kVA UPS is less than or equal to 200 mA. The leakage current of the 15 kVA/20 kVA UPS is less than or equal to 500 mA.
    - When selecting an earth leakage circuit breaker, consider the leakage current of the UPS and downstream loads.
- Battery cables should not be longer than 10 m.
- You can install linked circuit breakers for both the N wire and L wire. No independent circuit breaker is allowed for only the N wire.
- For the 15 kVA/20 kVA UPS, use AC PE cables with a cross-sectional area of 25 mm2 and M6 OT terminals that are 90° bent and have a cross-sectional area of 25 mm2.

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2. **Installation**
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   - Unpacking and Checking
   - Equipment Installation
   - Electrical Connection
3. Installation Verification

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- Unpacking and checking:
  - Check whether the equipment is intact based on the product list. If any damage is found, notify the carrier immediately.
- Equipment installation:
  - Rack-mounted installation
  - Tower-mounted installation
- Electrical connection:
  - Switch off the AC input circuit breakers at the rear of the UPS and the upstream AC circuit breakers of the UPS.
  - Remove the AC input and output terminal cover from the UPS.
  - Connect AC output power cables, AC input power cables, and battery cables in sequence. If there is a parallel system, connect parallel communication cables.
  - Reinstall the AC input and output terminal cover on the UPS.

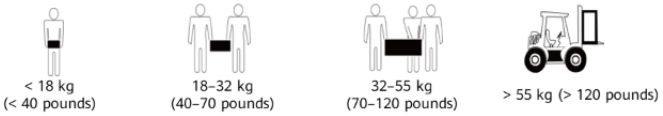
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Transportation, Unpacking, and Checking

- Transportation Requirements
- Procedure



  - Verify that the UPS packaging is intact. If any damage is found, notify the carrier immediately.
  - Transport the equipment to the specified position.
  - Remove the outer packaging.
  - Check whether the equipment is intact.
    - Visually inspect that the UPS is not damaged during transportation. If any damage is found, notify the carrier immediately.
    - Check the UPS bar code (on the top of the UPS) and ensure that it complies with the order. If any discrepancy is found, contact the local Huawei office immediately.

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- Notes:
  - Do not transport the equipment by holding its mounting ears, front panel, wiring terminal cover, or control panel.
  - The battery pack and transformer are heavy. Therefore, at least two persons are required to move them. Exercise caution when moving battery packs. If battery packs fall, fire may be caused. Remove rings, watches, and other metal objects before moving battery packs.
  - Move the cabinet with caution. Any bumping or falling may damage the equipment. After placing the equipment, unpack it carefully to prevent scratches.

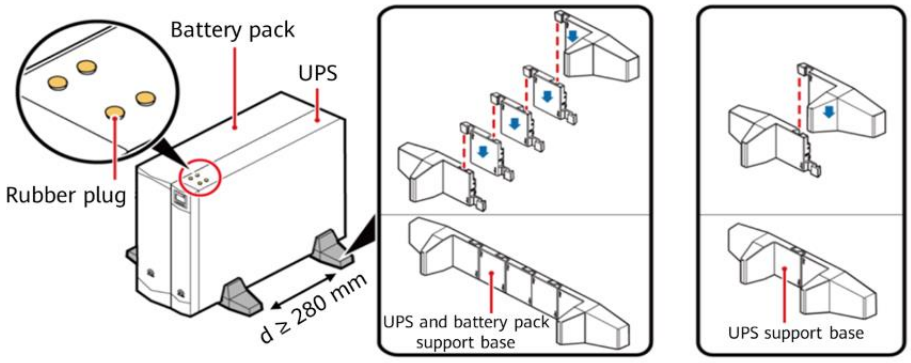
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Tower-mounted Installation

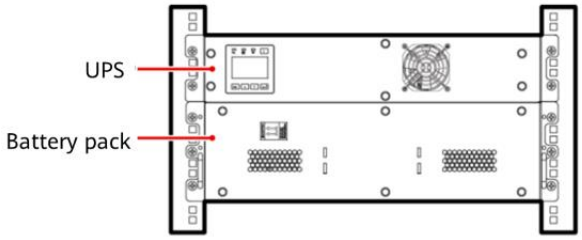
- Tower-mounted installation



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Rack-mounted Installation

- Rack-mounted installation



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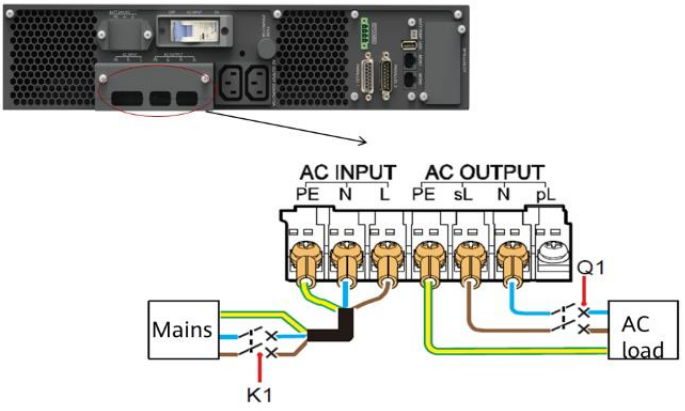
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UPS2000-G-6 kVA

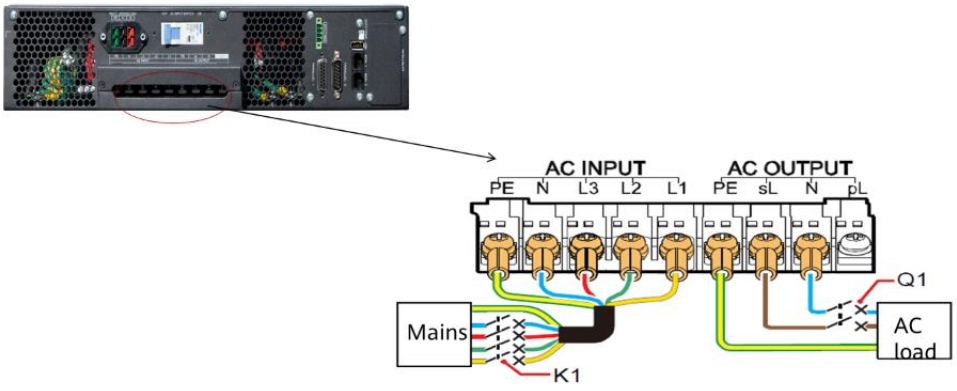
- Single-phase input single-phase output



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UPS2000-G-10 kVA

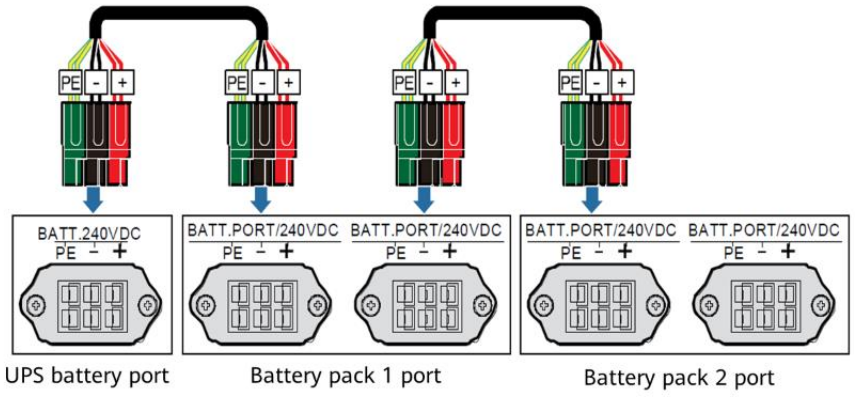
- Three-phase input single-phase output



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- This model also supports single-phase input single-phase output. The working principle is the same as that of the UPS2000-G-15 kVA/20 kVA and is not displayed here.

Connecting Battery Packs to the UPS2000-G-(6 kVA–10 kVA)

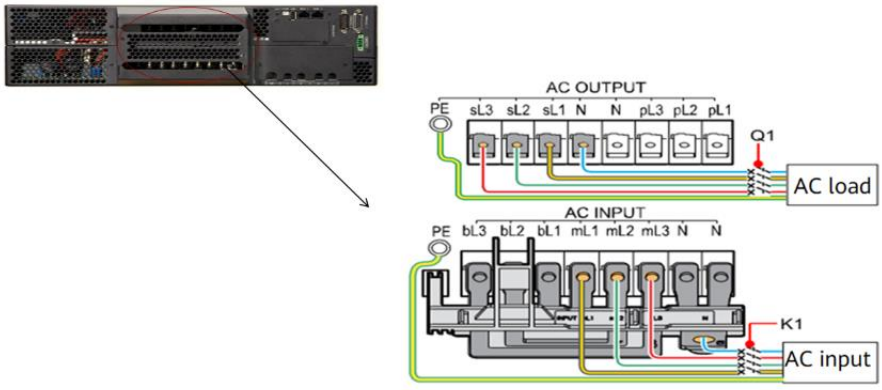


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- The two ports of a battery pack are connected. As shown in the preceding figure, ports of the two battery packs are connected.

UPS2000-G-(15 kVA–20 kVA) (1)

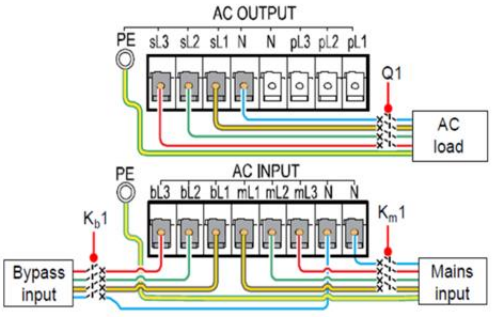
- Three-phase input three-phase output, one power source



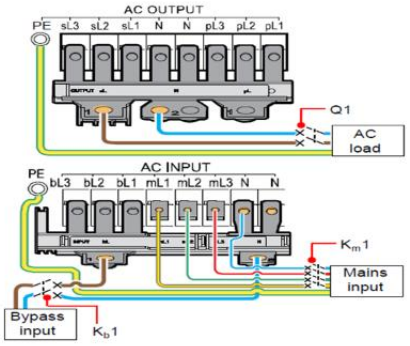
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UPS2000-G-(15 kVA–20 kVA) (2)

- Three-phase input three-phase output, two power sources



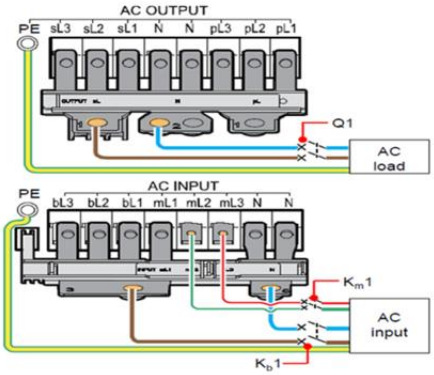
- Three-phase input single-phase output, two power sources



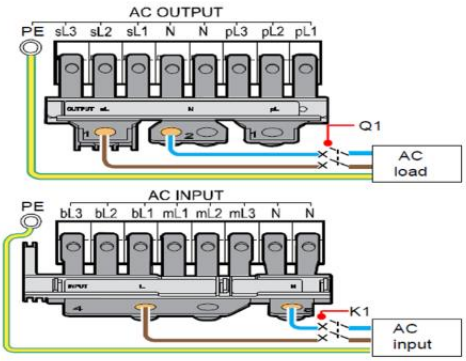
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UPS2000-G-(15 kVA–20 kVA) (3)

- Three-phase input single-phase output, one power source



- Single-phase input single-phase output, one power source

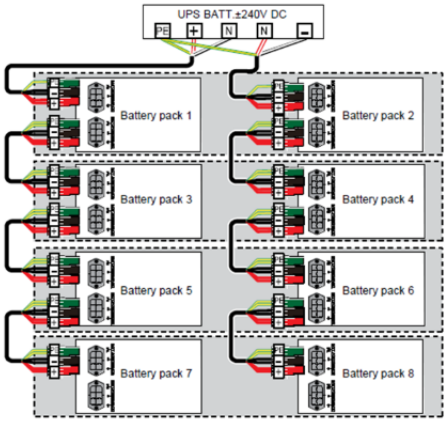


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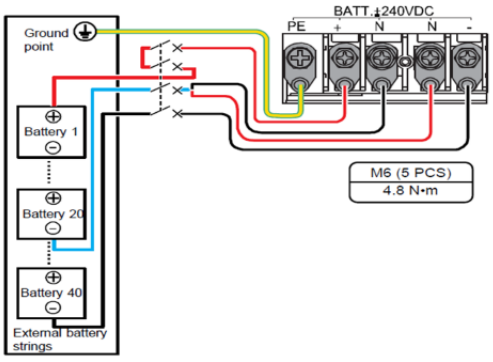
- Pay special attention to the cable connection for three-phase input single-phase output. The output is single-phase, and the three output phases are connected in parallel. If the bypass input three phases are not short-circuited, the UPS will be short-circuited and damaged upon power-on.

Connecting Batteries to the UPS2000-G-(15 kVA–20 kVA)

- Connecting battery packs



- Connecting battery strings



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- The UPS2000-G-15KRTL/20KRTL can connect to an external battery string (40 batteries in the standard configuration, and an even number of 32 to 40 batteries are supported). The neutral wire is connected to the middle point of the battery string. For example, if there are 40 batteries, the neutral wire is connected to the negative terminal of the twentieth battery.
- When an external battery string is connected, install a DC circuit breaker (63 A, 600 V DC) between the battery string and the UPS. Connect the positive terminals of the battery string and the UPS in series using two terminals of the DC circuit breaker.

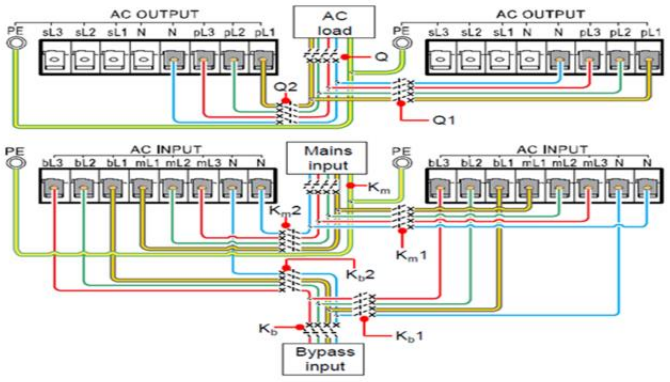
Contents

1. Preparations
2. **Installation**
   - Procedure
   - Unpacking and Checking
   - Mechanical Installation
   - Electrical Connection
     - Parallel System
3. Installation Verification

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Connecting Parallel Cables for the UPS2000-G-(15 kVA–20 kVA)

- Parallel system wiring diagram of the UPS2000-G-15 kVA/20 kVA (three-phase input three-phase output, two power sources)



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- The preceding figure shows only the connections of the mains and bypass input and output cables. You are advised to configure battery cables for each UPS separately.
- The parallel cable connection for the UPS2000-G-6 kVA/10 kVA (applicable to relatively few scenarios) is the same as that for the UPS2000-G-15 kVA/20 kVA and is not described here.
- The preceding figure does not show the connection of parallel control cables, which should be connected in actual scenarios.

Contents

1. Preparations
2. Installation
3. Installation Verification

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Installation Verification

Installation verification checklist

No.	Item	Acceptance Criterion
01	Cable routing	Cables are routed properly according to engineering requirements.
02	Cable connections	Input power cables, output power cables, and battery cables are tightened to specified torque using a torque wrench, connected correctly, and free of damage.
03	Cable connections for USB ports and network ports	Cables to USB ports and network ports are connected correctly and securely.
04	Labels	Both ends of a cable are labeled. Labels are concise and easy to understand.
05	Ground cable connections	The UPS ground cable is securely connected to the equipment room ground bar. Use a multimeter to measure the resistance between the UPS ground cable and the equipment room ground bar. The resistance is less than 0.1 ohm.
06	Distances between cable ties	Distances between cable ties are the same, and no burr exists.
07	Operating environment	The inside and outside of the cabinet are free from conductive dust or other sundries.

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- Purpose: To verify that the UPS is installed based on engineering specifications and that the UPS does not experience any faults during operation due to incorrect installation.
- Prerequisites: The UPS is installed properly. All input cables, output cables, and dry contact signal cables are connected properly.
- Installation verification is very important, especially for power cables, monitoring signal cables, and ground cables. If power cables are short-circuited or loosely connected, the UPS may not run properly. If monitoring signals are in poor contact or incorrectly connected, the monitoring system cannot display the UPS running data. In addition, improper grounding will endanger personal safety. Therefore, pay special attention to and strictly perform the installation verification.

Quiz

1. (short-answer question) What input and output systems does the UPS2000-G-(15 kVA–20 kVA) support?
2. (T or F) Is the number of batteries supported by the UPS2000-G-(15 kVA–20 kVA) the same as that supported by the UPS2000-G-10 kVA?

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- 1. The following systems are supported: three-phase input three-phase output, three-phase input single-phase output, and single-phase input single-phase output.
- 2. No.

Summary

- This chapter describes the following aspects:
  - UPS2000 installation preparations.
  - UPS2000 installation procedure, including unpacking and checking, mechanical installation, electrical connection.
  - UPS2000 installation verification.

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Thank you.

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每个组织，构建万物互联的智能世界。

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UPS2000 LCD Operations and Commissioning



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Foreword

- The slides describe the LCD operations and commissioning of the UPS2000, including parameter settings and common operations.

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Objectives

On completion of this course, you will be able to:

- Get familiar with the UPS2000 menu operations.
- Get familiar with the UPS2000 commissioning procedure.
- Understand how to commission and accept the UPS2000.

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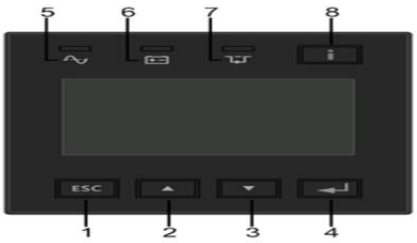
Contents

1. LCD Operations
   - LCD Description
   - Menu Description
2. Commissioning

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LCD Description

Panel



(1) Back/Shutdown button
(2) Up button
(3) Down button
(4) Enter/Startup/Mute/Battery Self-Check button
(5) Mains indicator
(6) Battery indicator
(7) Bypass indicator
(8) Fault indicator/INFO button

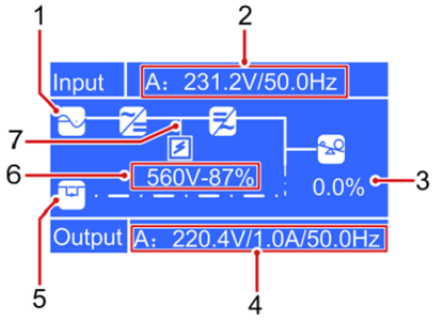
Indicators

Indicator	Color	Status	Description
Mains indicator	Green	On	The UPS is working in normal mode.
		Off	The UPS is not working in normal mode.
Battery indicator	Yellow	On	The UPS is working in battery mode.
		Off	The UPS is not working in battery mode.
		Blinking	The battery capacity is less than 25%.
Bypass indicator	Yellow	On	The UPS is working in bypass mode.
		Off	The UPS is not working in bypass mode.
Fault indicator/INFO button	Red	On	The UPS is faulty.
	Red	Blinking	An alarm has been generated for the UPS.
	Green	On	The UPS is running properly.

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Startup Screen

Startup screen



(1) Normal mode (The solid line indicates normal mode. The dotted line indicates non-normal mode.)

(2) Input voltage and frequency

(3) Load

(4) Output voltage, output current, and output frequency

(5) Bypass mode (The solid line indicates bypass mode. The dotted line indicates non-bypass mode.)

(6) Battery voltage and capacity displayed during charge; battery discharge time and capacity displayed during discharge

(7) Battery mode (The solid line indicates that the battery is in charge or discharge state. The dotted line indicates non-battery mode.)

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Contents

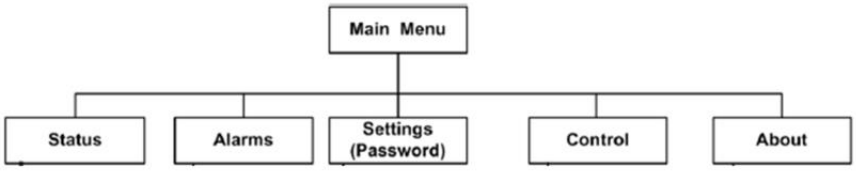
1. LCD Operations
   - LCD Description
   - Menu Description
2. Commissioning

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Menu Structure

- The main menu is divided into five parts:
  - **Status**: displays the mains and bypass status, battery status, and output voltage and current.
  - **Alarms**: displays the active alarms and historical alarms, and allows you to clear alarms.
  - **Settings (Password)**: includes **Basic Settings**, **System Parameters**, and **Battery Parameters**.
  - **Control**: allows you to power on and off the UPS, synchronize parallel parameters, and reset the password.
  - **About**: displays information about the UPS model, such as the version number.

Main menu structure



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Status (1)

Mains Input screen:



Battery Status screen:

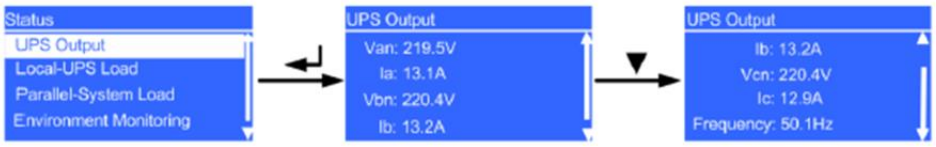


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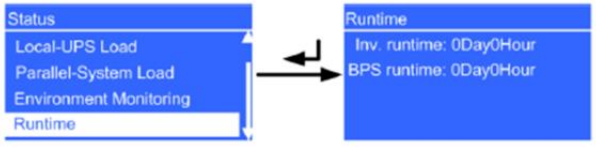
- Mains Input:
  - Van, Vbn, and Vcn: mains input phase voltages (Voltage is displayed in the case of single-phase input.).
  - Frequency: mains input frequency.
  - Vab, Vbc, and Vca: mains input line voltages (The parameters are not displayed in the case of single-phase input.).
- Battery Status:
  - Battery voltage: battery string voltage (Positive and negative battery string voltages are displayed in the case of the 15 kVA/20 kVA models.)
  - Battery current: Positive and negative battery string currents are displayed in the case of the 15 kVA/20 kVA models. + is displayed during battery charge, and – is displayed during battery discharge.
  - Status: The battery status is NA (battery not connected or reversely connected), Equalized charging, Float charging, Hibernating, or Discharging.
  - Capacity: remaining battery capacity
  - Backup time: estimated backup time. The value is NA Min during battery charge.

Status (2)

- UPS Output screen:



- Runtime screen:

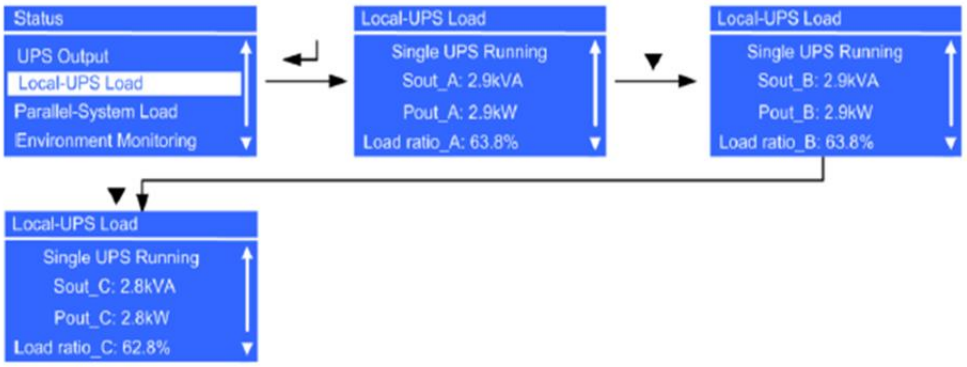


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- UPS Output:
  - Van, Vbn, and Vcn: UPS output phase voltages (Voltage is displayed in the case of single-phase output.).
  - Ia, Ib, and Ic: UPS output phase currents (Current is displayed in the case of single-phase output.).
  - Frequency: UPS output frequency.
- Runtime:
  - Inv. runtime: time during which the UPS runs in inverter output mode.
  - BPS runtime: time during which the UPS runs in bypass mode.

Status (3)

- **Local-UPS Load** screen:

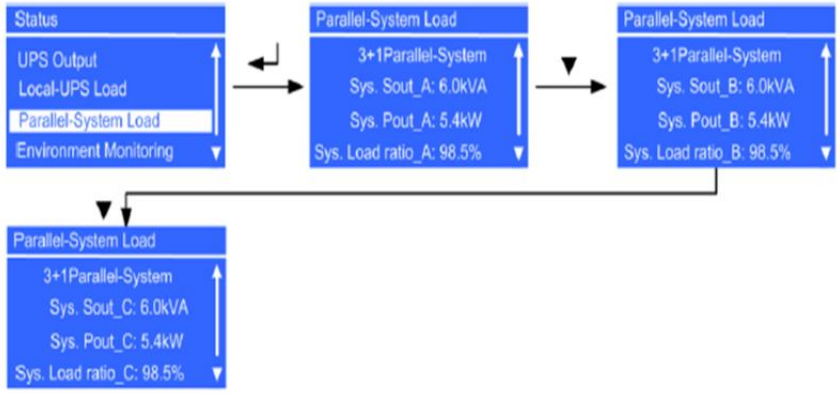


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- Local-UPS Load
  - Single UPS Running: A single UPS is running.
  - Sout_A, Sout_ B, and Sout_C: apparent power of each phase of the UPS (Sout is displayed in the case of single-phase output.)
  - Pout_A, Pout_ B, and Pout_C: output active power of each phase of the UPS (Pout is displayed in the case of single-phase output.)
  - Load ratio_A, Load ratio_B, and Load ratio_C: load ratio of each phase of the UPS (Load ratio is displayed in the case of single-phase output.)

Status (4)

- **Parallel-System Load** screen:



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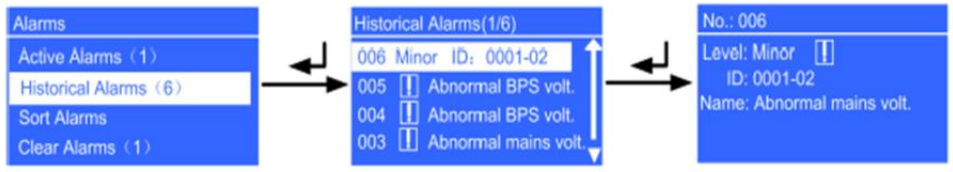
- Parallel-System Load:
  - N+X Parallel-System: A parallel system is running. X (range: 0–3) indicates the number of redundant UPS; N (range: 1–4) indicates the number of requisite UPS (total number of UPS minus X). The total number of UPS is automatically identified by the system.
  - Sys. Sout_A, Sys. Sout_ B, and Sys. Sout_C: apparent power of each phase in the parallel system (Sys. Sout is displayed in the case of single-phase output. This item is unavailable in single UPS mode.)
  - Sys. Pout_A, Sys. Pout_ B, and Sys. Pout_C: output active power of each phase in the parallel system (Sys. Pout is displayed in the case of single-phase output. This item is unavailable in single UPS mode.)
  - Sys. Load ratio_A, Sys. Load ratio_B, and Sys. Load ratio_C: load ratio of each phase in the parallel system (Sys. Load ratio is displayed in the case of single-phase output. This item is unavailable in single UPS mode.)
- Note: Parallel system information is not displayed in single UPS mode.

Alarms

Active Alarms screen:



Historical Alarms screen:

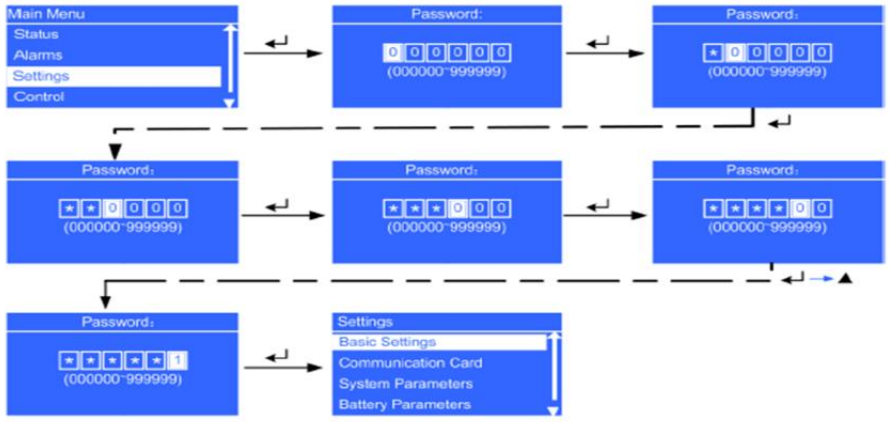


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- Historical Alarms displays the historical alarm information, such as the alarm serial number, severity, ID, and name.

Settings (1)

Entering the **Settings** screen:

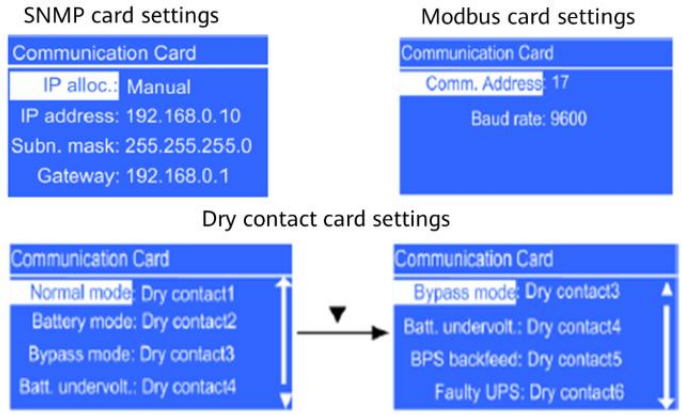


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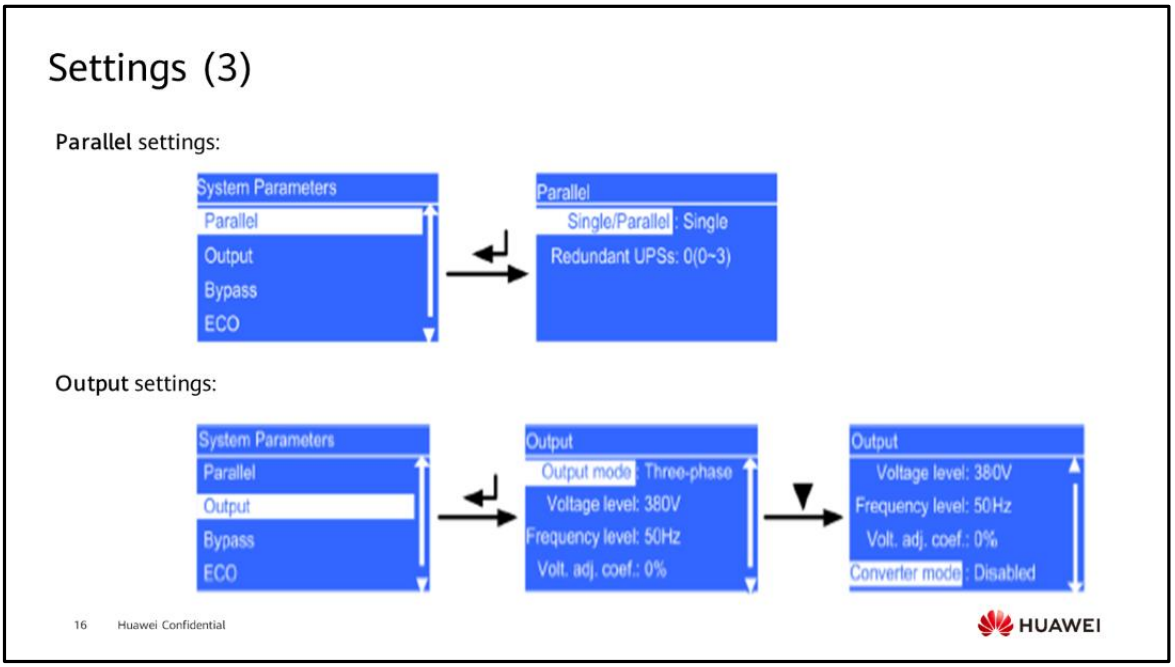
- Basic Settings:
  - Language: supports languages including Chinese, English (preset), Turkish, French, and Russian.
  - Change Password: Choose Settings > Basic Settings > Change Password. The preset password is 000001. The password allows you to enter the Settings screen.

Settings (2)

- Optional card settings:



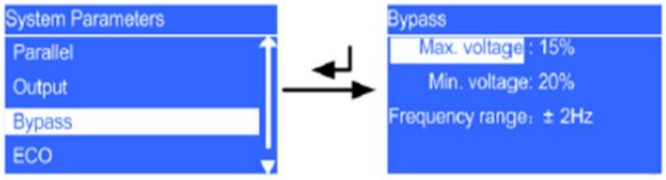
- SNMP card settings:
  - IP alloc.: IP addresses are automatically allocated in DHCP mode. The values include Manual and Automatic. The default value is Manual. After the allocating mode is set to Automatic, an Allocating dialog box is displayed on the screen. If allocation succeeds, the new IP address is displayed. If allocation fails, the IP address restores to the default one: 192.168.0.10. If the allocating mode is set to Automatic, you can only query the IP address but cannot set the IP address manually.
  - IP address: specifies the IP address of the SNMP card. The value ranges from 0.0.0.0 to 255.255.255.255. The default value is 192.168.0.10.
  - Subn. mask: specifies the subnet mask of the SNMP card. The value ranges from 0.0.0.0 to 255.255.255.255. The default value is 255.255.255.0.
  - Gateway: specifies the gateway of the SNMP card. The value ranges from 0.0.0.0 to 255.255.255.255. The default value is 192.168.0.1.
- Modbus card settings:
  - Comm. Address: specifies the communications address for the Modbus card over the DIP switch on the Modbus card. The value cannot be set on the LCD.
  - Baud rate: specifies the baud rate for the Modbus card over the DIP switch on the Modbus card. The value cannot be set on the LCD.



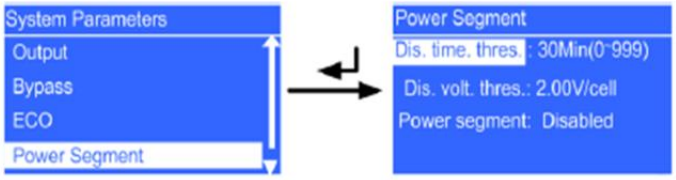
- Parallel:
  - Single/Parallel: specifies the UPS working in single UPS or parallel mode. The values include Single and Parallel. The default value is Single. This parameter is configurable only after the inverter is shut down.
  - Redundant UPS: specifies the number of redundant UPS. The value ranges from 0 to 3. The default value is 0. This parameter is configurable only after the inverter is shut down.
- Output:
  - Output mode: specifies the system output mode. This parameter is not configurable for the 6 kVA/10 kVA models. The default value is Single-phase. The value is configurable for the 15 kVA/20 kVA models. The values include Single-phase and Three-phase. The default value is Three-phase. The input mode is identified automatically by the system. This parameter is configurable only after the inverter is shut down.
  - Voltage level: specifies the output voltage level of the system. In the case of single-phase output, set Voltage level to 220V (default), 230V, or 240V; in the case of three-phase output, set Voltage level to 380V (default), 400V, or 415V. After you change the voltage level, the upper threshold for bypass voltage is restored to the default value 15%. This parameter is configurable only after the inverter is shut down.

Settings (4)

- Bypass settings:



- Power Segment settings:

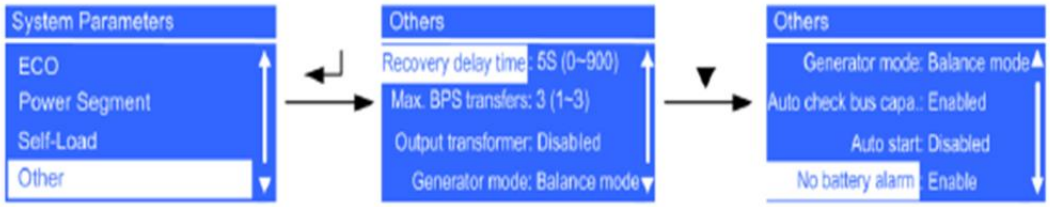


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- Bypass:
  - Max. voltage: specifies the upper threshold for the bypass voltage. When the difference between the bypass voltage and the rated output voltage exceeds this value, the system determines that the bypass voltage is abnormal, and the bypass is unavailable. The Max. voltage parameter is associated with the system voltage level. The default value is 15%. This parameter is configurable only after the inverter is shut down.
  - Min. voltage: specifies the lower threshold for the bypass voltage. When the difference between the bypass voltage and the rated output voltage exceeds this value, the system determines that the bypass voltage is abnormal, and the bypass is unavailable. The default value is 20%. This parameter is configurable only after the inverter is shut down.
  - Frequency range: specifies the bypass frequency range. When the difference between the bypass input frequency and the rated frequency exceeds this value, the system determines that the bypass frequency is abnormal, and the bypass is unavailable. The Frequency range parameter is associated with the ECO frequency range and must be greater than the current ECO frequency range. The values include ± 0.5Hz, ± 1Hz, ± 2Hz, ± 3Hz, ± 4Hz, ± 5Hz, and ± 6Hz. The default value is ± 2Hz. This parameter is configurable only after the inverter is shut down.

Settings (5)

- Other settings

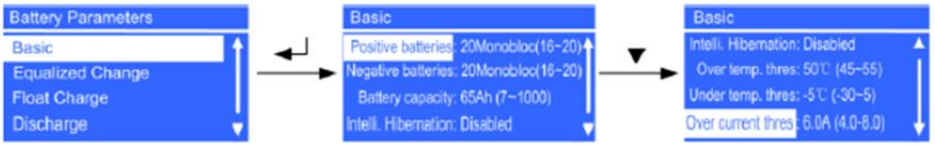


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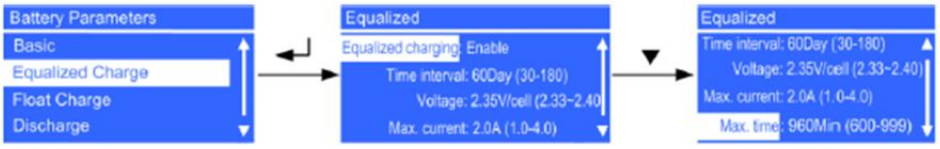
- Other
  - Recovery delay time: specifies the delay time for the UPS to transfer from battery mode to normal mode when the mains recovers. The value ranges from 0S to 900S. The default value is 5S. This parameter is configurable only after the inverter is shut down.
  - Max. BPS transfers: specifies the maximum number of transfers between inverter mode and bypass mode within 30 minutes. The value ranges from 1 to 3. The default value is 3. When the number of bypass transfers exceeds this parameter value, the UPS keeps running is bypass mode (in ECO mode, the UPS keeps running in inverter mode). This parameter is configurable only after the inverter is shut down. Do not set the UPS to ECO mode when the UPS connects to an isolated transformer.
  - Output transformer: If an output transformer is connected, set the parameter to Enabled; otherwise, set it to Disabled. The values include Disabled and Enabled. The default value is Disabled. This parameter is configurable only after the inverter is shut down. When connecting an isolation transformer to the system output, connect the UPS output load to the pL terminal and disable the power segment function. Do not set the UPS to ECO mode when the UPS connects to an isolated transformer.

Settings (6)

Battery Parameters settings:

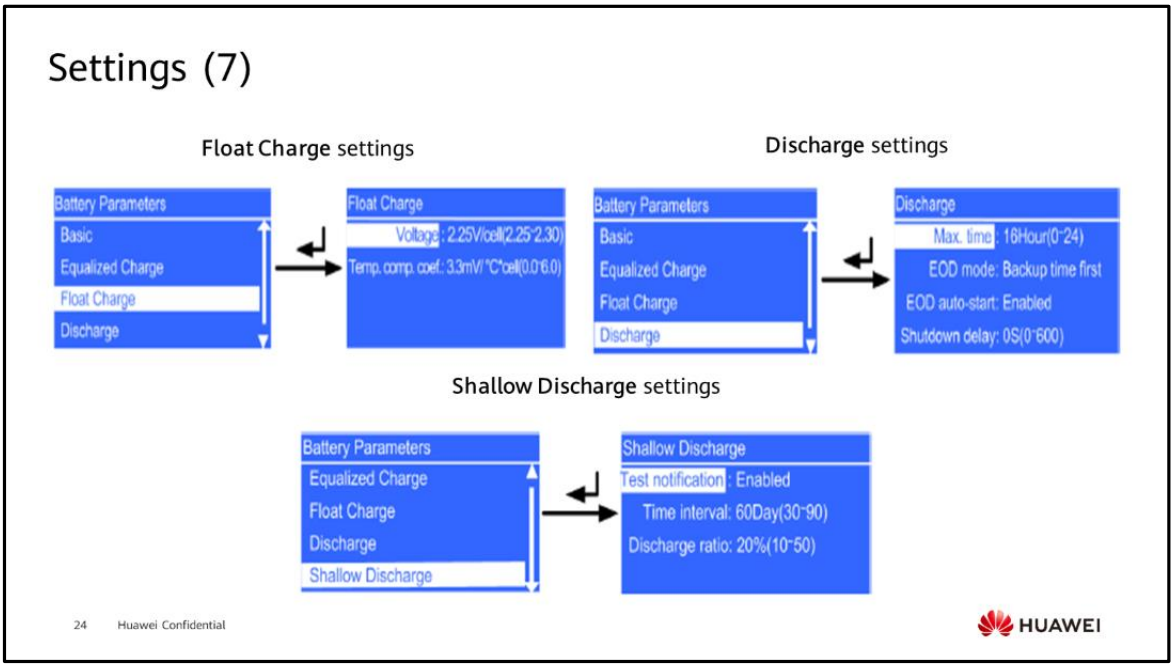


Equalized Charge settings:



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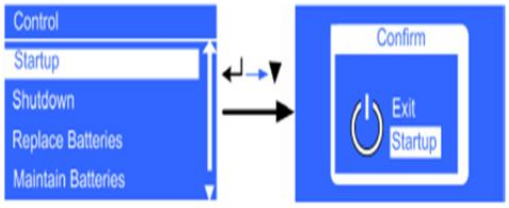
- Note:
  - The number of batteries set on the LCD should be the same as the actual configured number. If batteries are added or removed, change the related parameters on the LCD simultaneously. Battery lifespan will be shortened if the value on the LCD is lower than the actual number, or electrolyte leakage may occur if the value is larger.
  - The 6 kVA/10 kVA UPSs cannot share battery strings.
  - When a 15 kVA/20 kVA UPS parallel system shares a battery string, set the same battery string capacity and charge current for each UPS.
  - Battery capacity (Ah) = (Capacity of a single battery string x Number of parallel battery strings)/Number of parallel UPSs sharing a battery string. Maximum charge current of parallel UPSs (Ah) = (0.1 x Capacity of a single battery string x Number of parallel battery strings)/Number of parallel UPSs sharing a battery string. If the calculated maximum charge current is greater than 4 A, set the charge current to 4 A. Use two UPSs sharing a 65 Ah battery string as an example. If the calculated battery capacity is (65 x 1)/2 = 32.5, set it to 32 Ah. If the calculated maximum current is (0.1 x 65 x 1)/2 = 3.25, set the charge current to 3.0 A.
  - When a single 15 kVA/20 kVA UPS contains two battery packs, the maximum charge current must be less than or equal to 2.0 A.



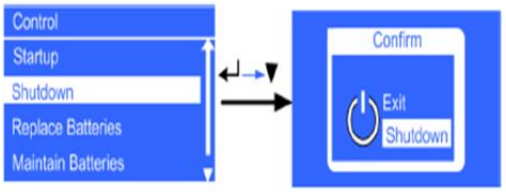
- Float Charge:
  - Voltage: specifies the float charge voltage for batteries. The value ranges from 2.25V/cell to 2.30V/cell. The default value is 2.25V/cell. The parameter is configurable in any mode.
  - Temp. comp. coef.: specifies the coefficient for correcting the float voltage based on the battery temperature when a battery temperature sensor is connected. The value ranges from 0.0mV/°C*cell–6.0mV/°C*cell. The default value is 3.3mV/°C*cell. The parameter is configurable in any mode.
- Discharge:
  - Max. time: specifies the maximum discharge time. When the discharge time reaches the value, the system powers off. The value ranges from 0Hour to 24Hour. The default value is 16Hour. If you set the value to 0Hour, the discharge time is not limited. This parameter is configurable in non-battery mode. If you expect the battery discharge time to be greater than 24 hours, set the parameter to 0Hour. Otherwise, the system may power off.
  - If you set the parameter to 0Hour, the battery may remain in the small-current discharge state according to the proportion of the battery capacity to the load power, which affects the battery lifespan.
  - EOD mode: determines the backup time. The options are as follows: Backup time first (the system runtime is preferentially ensured to prolong the running of key services and the backup time is long), Batt. protect first (batteries are protected first to prolong the battery lifespan), and Balanced mode. The default value is Backup time first.

Control (1)

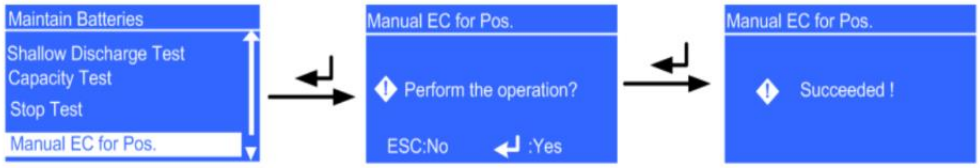
Startup screen



Shutdown screen



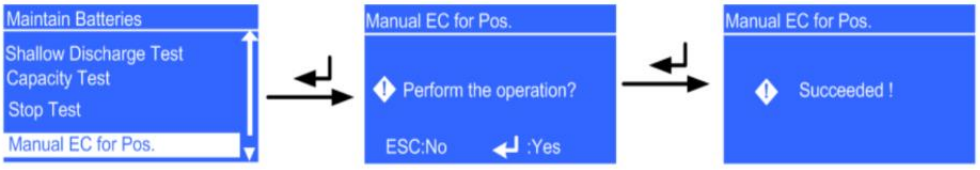
Manual battery tests



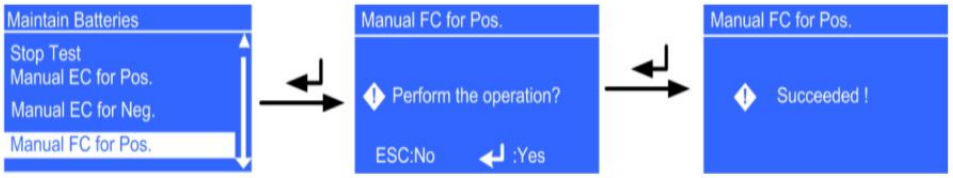
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Control (2)

Switching to equalized charging manually



Switching to float charging manually

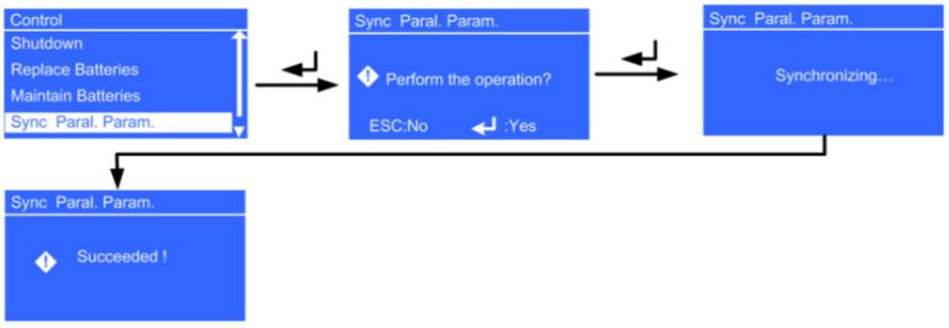


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- Perform equalized charging on batteries forcibly. For the 6 kVA and 10 kVA UPSs, perform equalized charging on batteries manually. For the 15 kVA and 20 kVA UPSs, manually switch batteries in positive groups to float charging and batteries in negative groups to equalized charging respectively.
- Perform float charging on batteries forcibly. For the 6 kVA and 10 kVA UPSs, perform float charging on batteries manually. For the 15 kVA and 20 kVA UPSs, manually switch batteries in positive groups to float charging and batteries in negative groups to equalized charging respectively.
- The preceding two operations are performed during battery maintenance to check whether equalized charging and float charging can be properly switched and whether the charge voltage is proper.

Control (3)

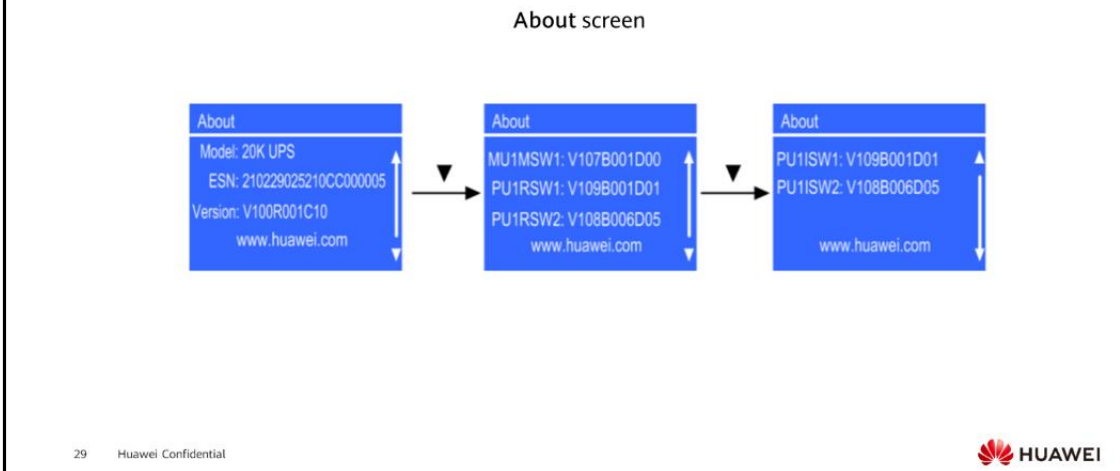
Synchronizing parallel parameters



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- This menu allows you to synchronize parameters of the local UPS to the other UPSs in the parallel system. Parameters of the UPSs working in inverter mode cannot be synchronized.

About Screen



- The About screen allows you to view the UPS model, ESN, and version.
- About:
  - Model: displays the UPS model (20K UPS).
  - ESN: displays the ESN of the UPS.
  - Version: displays the UPS firmware version.
  - MU1MSW1, PU1RSW1, PU1RSW2, PU1ISW1, and PU1ISW2 indicate the software versions of components. If a component does not exist, the software version is displayed as NA. The 6 kVA/10 kVA models do not have PU1ISW1 and PU1ISW2.

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Commissioning Process

- Startup (using mains)
  - Check before power-on.
  - Switch on the external battery circuit breaker or connect the battery cable properly.
  - Switch on the upstream AC input circuit breakers for the UPS.
  - Perform the initial configuration.
  - Perform startup operations.
  - Check that the system output is normal.
  - Switch on the output circuit breaker.
  - Start loads.
- Startup (using batteries)
  - Check before power-on.
  - Switch on the external battery circuit breaker or connect the battery cable properly.
  - Perform the initial configuration.
  - Perform startup operations.
  - Check that the system output is normal.
  - Switch on the output circuit breaker.
  - Start loads.
- Power-off
  - Shut down loads.
  - Perform shutdown operations.
  - Switch off the upstream input and output circuit breakers for the UPS.
  - Disconnect batteries.

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- UPS startup/shutdown: If the UPS is started for the first time, set parameters such as the output voltage, frequency, and battery based on site requirements.

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Checking Before Power-On

- Key check points
  - The input and output are not short-circuited, the input power phase sequence is correct, and terminals are securely connected.
  - Check battery cable connections and voltage: The positive and negative battery terminals are correctly connected and the battery string is correctly connected to the UPS. The mains input voltage ranges from 120 V AC to 280 V AC (after the UPS is powered on, the mains input voltage ranges from 80 V AC to 280 V AC). The battery voltage range is as follows: (Number of batteries x 10.8 V DC) to 280 V DC.
  - Input circuit breakers and load circuit breakers are OFF.
  - Parallel cables in a parallel system are properly connected.
  - Grounding is reliable and the voltage difference between the neutral wire and the ground cable is less than 5 V AC.

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- AC power cable colors comply with local regulations.
- The input and output are not short-circuited.
- Cables and terminals are securely connected.
- Battery cables and terminals are connected correctly, and voltages comply with industry standards.
- The UPS is properly connected to battery strings.
- Input circuit breakers and load circuit breakers are OFF.
- Power cables and signal cables are correctly identified.
- The phase sequence of the input power is correct.
- Cables are neatly routed and securely bound.
- Devices are installed and cables are routed in ways that facilitate modification, capacity expansion, and maintenance.
- Parallel cables in a parallel system are properly connected.
- The UPS is properly grounded.
- The voltage difference between the neutral wire and the ground cable is less than 5 V AC.
- The mains input voltage ranges from 120 V AC to 280 V AC (after the UPS is powered on, the mains input voltage ranges from 80 V AC to 280 V AC). The battery voltage range is as follows: (Number of batteries x 10.8 V DC) to 280 V DC.

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Starting a UPS

- Starting the UPS using mains
  - Switch on the external battery circuit breaker (if any) or connect battery cables.
  - Switch on the mains and bypass AC input circuit breakers. The initialization screen is displayed.
  - The UPS enters bypass mode. The sL terminal delivers bypass voltages, and the pL terminal delivers no voltage.
  - Set the output voltage system, voltage, frequency, and battery parameters.
  - Start the UPS in normal mode.
  - After you ensure that the UPS runs properly, switch on the AC output circuit breaker to start the loads.

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- Notes:
  - The number of batteries set on the LCD should be the same as the actual configured number. If batteries are added or removed, change the related parameters on the LCD simultaneously. Battery lifespan will be shortened if the value on the LCD is lower than the actual number, or electrolyte leakage may occur if the value is larger.
  - If the output system is three-phase input three-phase output, set the output system to three-phase. In the three-phase input single-phase output and single-phase input single-phase output modes, set the output mode to single-phase.
  - Set the voltage level and frequency level based on the rated voltage and frequency. For single-phase output, the voltage level can be set to 220 V (default), 230 V, or 240 V. For three-phase output, the value can be 380 V (default), 400 V, or 415 V.
  - Battery parameters are configurable in non-battery mode.
  - Set the number of positive (negative) battery strings. The value ranges from 16 to 20. The default value is 20.
  - Set the battery capacity to the total capacity of all battery strings. The value ranges from 7 Ah to 1000 Ah. The default value is 65 Ah.
- The procedure for battery cold startup is similar to that for mains startup.

Shutting Down a Single UPS

- Shut down loads.
- Perform shutdown operations on the UPS. The inverter shuts down, and the UPS transfers to bypass mode.
- Switch off the mains and bypass AC input circuit breakers, and the output circuit breaker. After all indicators turn off and fans stop, the UPS shuts down, and the loads power off.
- Switch off the external battery circuit breaker (if any) or disconnect battery cables.

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- Note: The startup sequence is different from the shutdown sequence. To protect loads, start the UPS from the front to the rear and shut down the UPS from the rear to the front based on the current flow direction.

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Starting a Parallel System

- Starting the system using mains:
  - Switch on the external battery circuit breakers (if any) or connect battery cables.
  - Switch on the mains and bypass AC input circuit breakers, and UPS AC output circuit breakers. The initialization screen is displayed. The parallel system supplies no power.
  - Set the UPS output voltage system, voltage, frequency, battery, and parallel parameters.
  - Synchronize parallel parameters to ensure that all UPS have the same parameters.
  - Perform startup operations on each UPS. The UPS parallel system transfers to normal mode.
  - After checking that the parallel system runs properly, switch on the general output circuit breaker (provided by the customer) and branch output circuit breakers (provided by the customer), and start loads one by one.

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- Notes:
  - When a 15 kVA/20 kVA UPS parallel system shares a battery string, set the same battery string capacity and charge current for each UPS.
  - Before starting the parallel system, ensure that the external output circuit breaker on each UPS is switched on and parallel cables are connected.
  - Check that parallel system parameters have been synchronized.
  - In a UPS 4+0 parallel system, the four parallel output power cables of each UPS must be of the same length (1 meter or longer), and be connected together at the remote end.
  - If the TN-C power distribution system is deployed in parallel, install four magnetic rings on the PE cable of each UPS, and use cable ties to bind the four magnetic rings and secure them close to each other.
  - Before starting a parallel system, ensure that all circuit breakers on the output side are OFF, and do not start loads.
  - To prevent triggering overload protection, start the loads with higher power and then loads with lower power.

Shutting Down a Parallel System

- Shut down loads.
- Perform shutdown operations on each UPS in the parallel system. All UPS shut down the inverters and transfer to bypass mode.
- Switch off the main and bypass AC input circuit breakers and AC output circuit breakers. After all indicators turn off and fans stop, the UPS shut down, and the loads power off.
- Switch off the external battery circuit breaker for each UPS or the general battery circuit breaker (when all UPSs share a battery string). If no external battery circuit breaker is configured, disconnect battery power cables from each UPS.

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- Perform shutdown operations on each UPS in the parallel system. All UPS shut down the inverters and transfer to bypass mode. If there are three UPSs, you need to operate them one by one. After you operate the last UPS, the parallel system transfers to bypass mode. If the operation is interrupted, the parallel system still works in normal mode.
- To shut down one UPS in the parallel system, perform shutdown operations twice on the UPS. Otherwise, the operations are invalid.

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Commissioning and Acceptance (1)

- Acceptance before power-on

Purpose: To verify that the UPS is ready for power-on. (This is very important and the following items need to be checked carefully.)		
Prerequisites: The UPS is installed properly. All input cables, output cables, and dry contact signal cables are connected properly.		
No.	**Item**	**Acceptance Criterion**
01	Connections of AC input and output cables	AC input and output cables are correctly connected according to the labels on the UPS.
02	Battery terminals	Battery terminals are correctly connected to prevent accidents.
03	Connections between the UPS and battery strings	The positive terminal of the UPS connects to the positive terminal (+) of the battery string; the negative terminal of the UPS connects to the negative terminal (–) the battery string.
04	Input and output cables	The input and output cables are not short-circuited. Short circuits can be detected using a multimeter.
05	Circuit breaker status	All circuit breakers are OFF.

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- Commissioning and acceptance aim to ensure that the UPS runs properly and that all functions are normal and meet requirements. Check the items one by one according to the checklist and make records as the input for the next O&M step. If a certain function of the UPS is abnormal, you need to identify it in this phase. Otherwise, there will be great potential risks, which will bring great challenges to the normal running and O&M of the equipment.

Commissioning and Acceptance (2)

- Acceptance of functions and performance of a single UPS

Purpose: To verify that the performance and functions of a single UPS are consistent with the actual situation.		
Prerequisites: The UPS has been started.		
No.	**Item**	**Acceptance Criterion**
01	Output voltage precision	The output voltage precision is within ±5%.
02	UPS working mode transfer after the mains input is disconnected	The UPS transfers to battery mode, and an alarm is generated.
03	UPS working mode transfer after the mains input is reconnected	The UPS transfers to normal mode, and the alarm is cleared.
04	UPS working mode transfer after the inverter is manually shut down	The UPS transfers to bypass mode.
05	UPS working mode transfer after the inverter is manually started	The UPS transfers to inverter mode.
06	LCD display	The LCD displays information normally without chromatic aberration or missing characters.
07	Parameter settings	The voltage system, frequency, battery capacity, number of batteries, and charge current are correctly set.
08	Alarms	There is no active alarm. The UPS runs properly and indicators work properly.

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Quiz

1. (short-answer question) How to power on a single UPS?
2. (short-answer question) During delivery acceptance, which items should be checked before power-on?

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- Answer to question 1:
  - Switch on the external battery circuit breaker (if any) or connect battery cables.
  - Switch on the mains and bypass AC input circuit breakers. The initialization screen is displayed.
  - The UPS enters bypass mode. The sL terminal delivers bypass voltages, and the pL terminal delivers no voltage.
  - Set the output voltage system, voltage, frequency, and battery parameters.
  - Start the UPS in normal mode.
  - After you ensure that the UPS runs properly, switch on the AC output circuit breaker to start the loads.
- Answer to question 2:
  - Check cable connections and ensure that terminals are securely connected. Check that the input and output cables are not short-circuited.
  - Battery cables and terminals are connected correctly, and voltages comply with industry standards.
  - The UPS is properly connected to battery strings.
  - Input circuit breakers and load circuit breakers are OFF.

Summary

- This chapter describes the following aspects:
  - UPS2000 menu description and LCD parameters setting.
  - UPS2000 commissioning process, including checking before power-on, commissioning a single UPS, commissioning a parallel system and acceptance.

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Thank you.

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每个组织，构建万物互联的智能世界。

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UPS5000 Product Introduction



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Foreword

- The slides describe the UPS5000 in terms of technical highlights, appearance, working principles, core components, typical configurations, and technical specifications.

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Objectives

On completion of this course, you will be able to:

- Get familiar with the main features of the UPS5000 products.
- Get familiar with the core components of the UPS5000 products.
- Get familiar with the working principles of the UPS5000 products.
- Get familiar with the typical configurations of the UPS5000 products.
- Get familiar with the technical specifications of the UPS5000 products.

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Contents

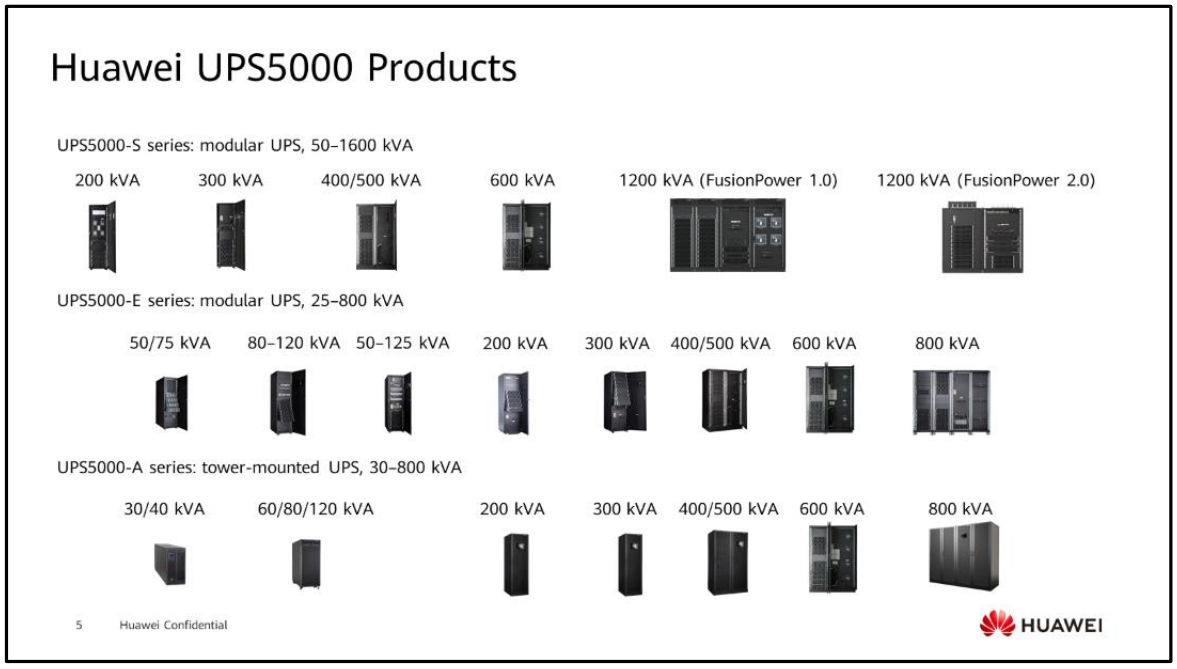
1. Model Description
2. Highlights
3. Working Logic
4. Product Structure
5. Typical Configuration
6. Product Specifications

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Huawei UPS Product Portfolio



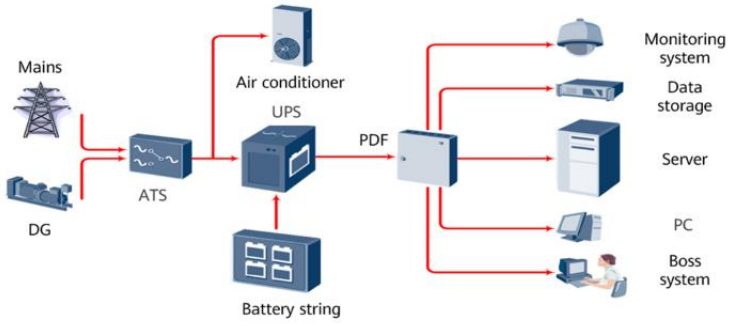
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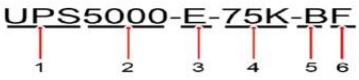
- The module efficiency of the UPS5000-A and UPS5000-E is 96%, and that of the UPS5000-S is 97%.
- FusionPower 1.0: The module is a 50 kVA high-efficiency module. A 1200 kVA UPS has four cabinets, and a 1600 kVA UPS has six cabinets.
- FusionPower 2.0: The module is a 100 kVA module, and a 1200 kVA UPS has two cabinets.

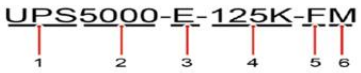
Overview

- The UPS5000-E, AC power supply, ATS, and batteries form a power supply solution for a large data center. The following figure shows the solution for a typical large data center.

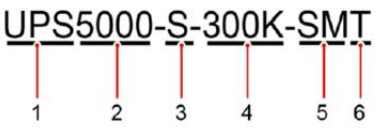


Naming Rule





No.	Meaning	Description
1	Product category	UPS: uninterruptible power system
2	Product series	5000
3	Product subcategory	E: E series
4	Output capacity	75K: 75 kVA output
		125K: 125 kVA output
5, 6	Configuration type	B and F: built-in batteries; full configuration
		F and M: full configuration; modular design



No.	Meaning	Description
1	Product category	UPS: uninterruptible power system
2	Product series	5000
3	Product subcategory	E: E series; S: S series; A: A series
4	Output capacity	300K: 300 kVA output
5	Configuration type	SM: standard configuration
		FM: full configuration
6	Cabling	Top cabling (only the UPS5000-S-300K-SMT model has the T label)

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- The naming rule on the left indicates that the UPS module is 25 kVA, and the naming rule on the right indicates that the UPS module is 50 kVA or 60 kVA. Modules with different capacity have slightly different appearances. The main difference is the number of modules.
- The UPS5000-E/S is a modular model, and the UPS5000-S is a high-efficiency model. The UPS5000-A is a tower-mounted model.
- The UPS5000-E and UPS5000-A have the same appearance but different software and different power module version. The UPS5000-E supports modular design while the UPS5000-A does not. The UPS5000-A-(30 kVA–120 kVA) is unique with special appearances, as shown in page 19.

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Simple

- Easy capacity expansion
  - On-demand capacity expansion without excessive investment at the initial stage of construction; stable capacity expansion without power failure risks



Power module



UPS5000-E-800 kVA

- Easy maintenance
  - The UPS5000 is maintained from the front and hot-swappable. It is easy to install and maintain with the front door opened.
  - Hot-swappable components:
    - Power module
    - Bypass module
    - ECM
    - Dry contact card
    - Dry contact extended card
    - Backfeed protection card
    - Monitoring card



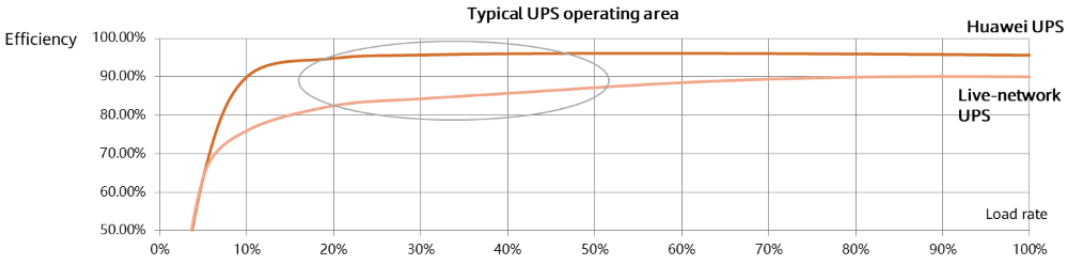
Online maintenance

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- The UPS5000-E features ease of use thanks to modular design. The first advantage of modular design is easy and stable capacity expansion without power failure risks. You only need to reserve areas for power distribution in advance. The second advantage of modular design is easy maintenance. All devices are prone to damage. Therefore, the reliability design principle is as follows: Fault risks should be minimized. However, if a fault occurs, services should not be affected; if services are affected, they should be quickly restored. Quick problem solving shows ease of use and reliability. For a modular UPS, if a module is faulty, you only need to take out the faulty module and replace it. Maintenance personnel can perform maintenance after receiving simple training. This is different from traditional tower-mounted UPSs which need to be maintained by professional technical personnel from the manufacturer. Except power units, Huawei's modular design also applies to other components. For example, ECM and communications cards are also supported hot-swappable.

Efficient

- High efficiency in a wide load range
  - In a parallel system, the load rate ranges from 20% to 30%.
  - The efficiency of Huawei UPS can reach 96% when the load rate is 40%.
  - The efficiency of Huawei UPS can reach 95% when the load rate is 20%.



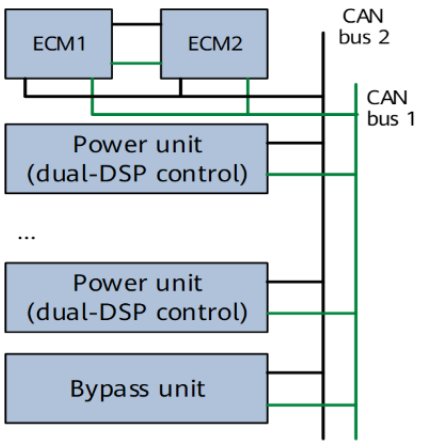
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- The UPS5000-E has high efficiency. It can reach 96% when the load rate is 40% and 95% when the load rate is 20%, which is the same as the optimal level in the industry. Note that UPS of some other brands are claimed to have high efficiency, but the actual operating efficiency is low. This is because the claimed efficiency is usually the efficiency at full load or high load rate, not the efficiency at low load rate. However, medium- and high-power UPS seldom operate in single-UPS mode, and generally the load rate is low in a parallel system. Only the efficiency in this case makes sense to the customer. The UPS5000-E features high efficiency at low load rate and ensures high actual efficiency for the customer's UPS power supply system, which saves energy.

Reliable

- Modular design and redundancy design eliminate single points of failure.
- Distributed control and centralized scheduling are adopted.
- The UPS adapts to poor power grids thanks to wide input voltage and frequency ranges, prolonging the battery service life.
- 6 kV and 5 kA surge protection can be configured.
- High fault tolerance capability for fans: If one fan is faulty, the UPS5000 works at 50% load rate. If two fans are faulty, the UPS5000 works at 30% load rate.

Huawei: distributed control + centralized scheduling

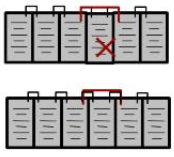


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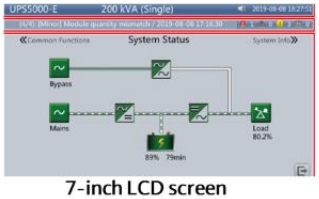
- Modular design and redundancy design: The power module, bypass module, and ECM are hot-swappable, eliminating single points of failure.
- Distributed control and centralized scheduling: The UPS5000 is controlled by digital signal processors (DSPs) in the power module and scheduled by the ECMs. Functions are decoupled to reduce the logic complexity.
- Wide input voltage and frequency ranges: 138–485 V, 40 –70 Hz, applicable to poor power grids, prolonging the battery service life.
- 6 kV and 5 kA surge protection design (optional): reduces the lightning strike rate by 80% to 90% compared with similar UPSs in the industry.
- Surge protection: 4 kV surge protection in a standard configuration
- The preceding contents describe design reliability. The following describes test reliability.

Intelligent

- The number of batteries can be adjusted.
- Various monitoring cards are optional. Built-in SNMP, Modbus, and dry contact cards are provided in a standard configuration.
- A 7-inch color LCD touchscreen is available with full-graphic display and operation, and 11 languages are supported.
- If both ECMs are faulty, the bypass takes over the system to ensure normal system running.



Battery reuse



7-inch LCD screen

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- The number of batteries can be adjusted. If a battery is faulty, the remaining batteries can continue to supply power to the UPS5000 after the faulty battery is removed.
- Various monitoring cards are optional. Built-in SNMP, Modbus, and dry contact cards are provided in a standard configuration. Only one network cable is required for UPS networking management.
- The NetEco 1000U integrated monitoring platform is used to display the UPS5000 running status in real time.
- A 7-inch color LCD touchscreen is available with full-graphic display and operation, and 11 languages are supported.
- Battery configuration (See specific product manuals for customized products.)
  - UPS5000-S series: 360–600 V DC (30–50 batteries optional, 40 batteries by default) If there are 36 or 39 batteries, the output power is derated to 0.9. If there are 30 to 35 batteries, the output power is derated to 0.8.
  - UPS5000-E series: 360–528 V DC (30–44 batteries optional, 40 batteries by default). If there are 36 or 38 batteries, the output power is not derated; if there are 34 batteries, the output power is derated to 0.9; if there are 30 or 32 batteries, the output power is derated to 0.8.
  - The UPS supports 30 to 44 batteries and is configured with 32 batteries by default. The positive and negative battery strings respectively contain 16 batteries. If 30 batteries are configured, the power is derated to 94% (25 kVA modules).

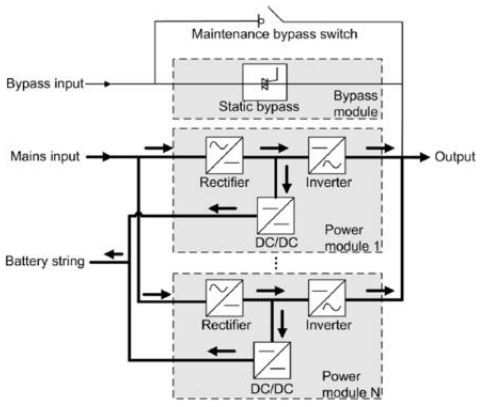
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5. Typical Configuration
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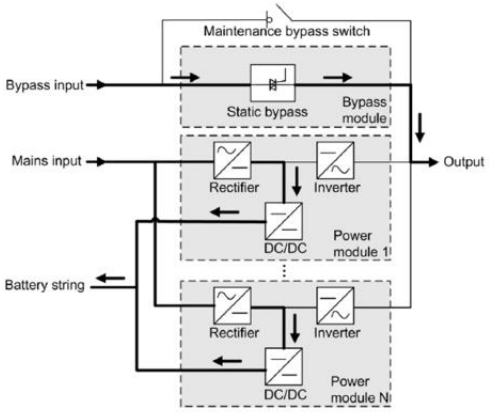
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Working Mode (1)

UPS conceptual diagram in normal mode



UPS conceptual diagram in bypass mode

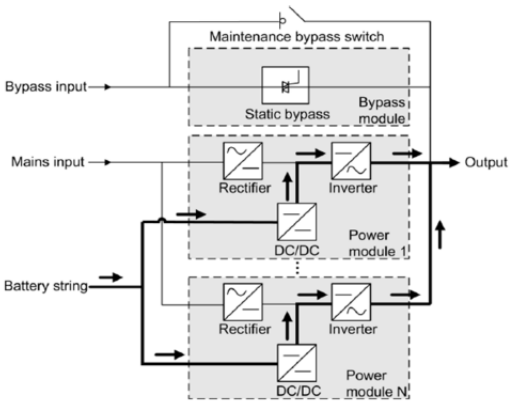


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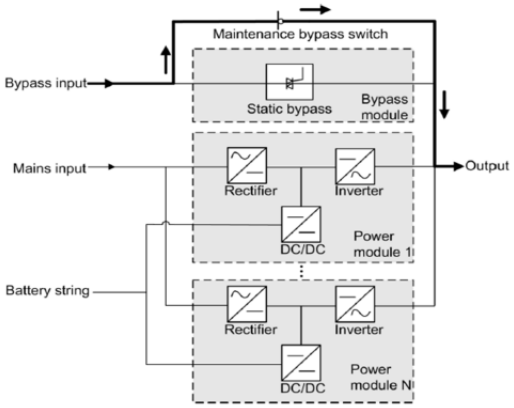
- Normal mode: In normal mode, the rectifier converts AC power into DC power. Then the inverter converts DC power into AC output. The two conversions ensure high-precision and high-quality output voltages, protecting loads from interferences such as input harmonics, glitches, and voltage transients.
- Bypass mode: The UPS automatically transfers to bypass mode when it detects power module overtemperature, overload, or other faults that may cause inverter shutdown. In bypass mode, loads are powered by the bypass module. The bypass power supply is not protected by the UPS and therefore is prone to the mains outage, abnormal AC voltage waveform, or abnormal frequency.

Working Mode (2)

UPS conceptual diagram in battery mode

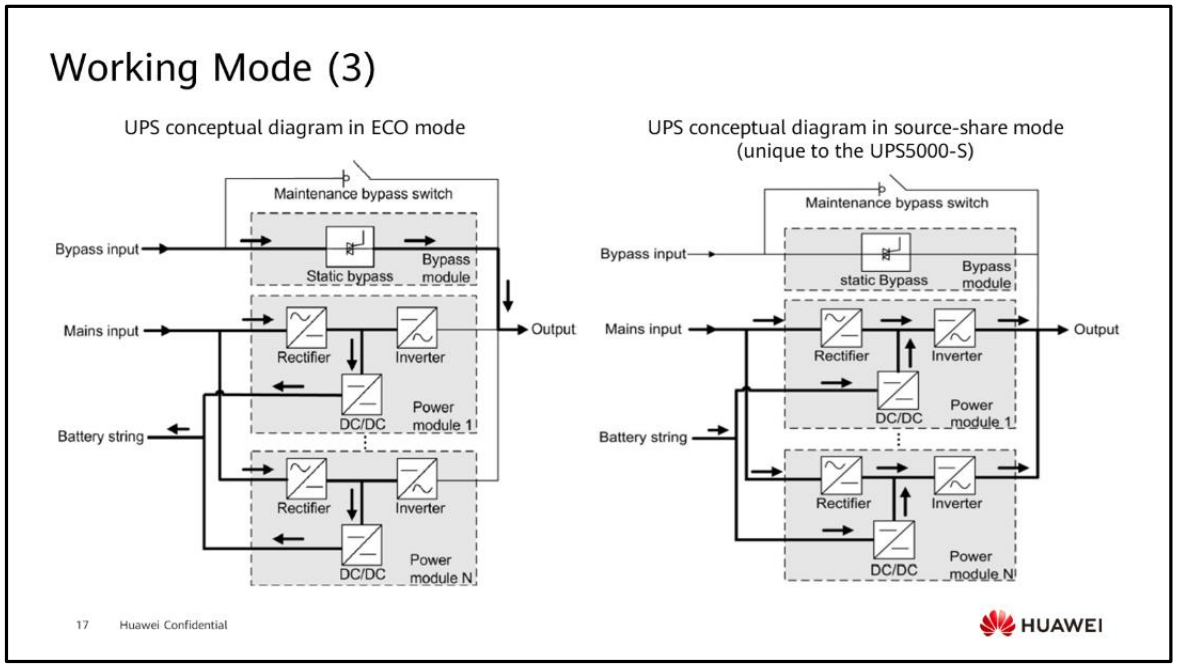


UPS conceptual diagram in maintenance bypass mode



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- Battery mode: If the mains input or the rectifier is abnormal, the UPS transfers to battery mode. The power module obtains DC power from batteries, and the power is converted into AC output by the inverter.
- Maintenance bypass mode: When the UPS works in maintenance bypass mode, the current flows through the maintenance bypass instead of the power module, and you can maintain circuits inside the cabinet.

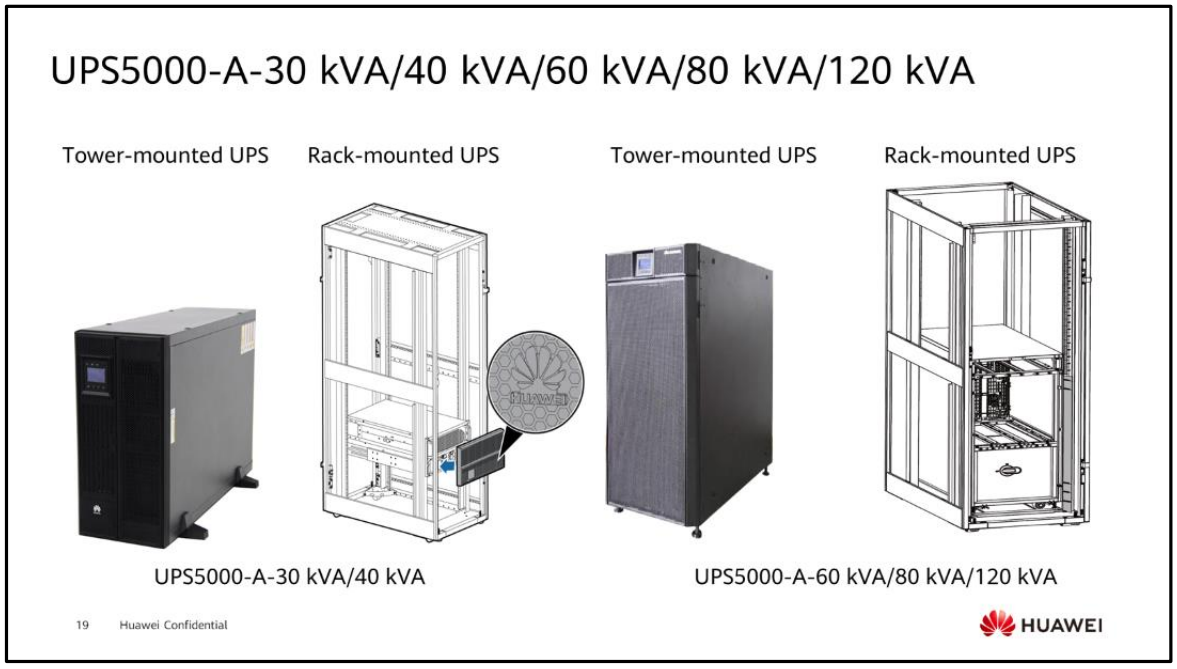


- ECO mode: ECO refers to economic control operation. This mode can be configured on the LCD or WebUI. In ECO mode, when the bypass input is within the ECO voltage and frequency ranges and other ECO power supply conditions are met, the UPS works in bypass mode and the inverter is in standby state. When the bypass source voltage is beyond the ECO voltage range, the UPS transfers from bypass mode to inverter mode. In bypass mode or inverter mode, the rectifier keeps working and charges batteries using a charger. This mode improves efficiency.
- Source-share mode: If the UPS works properly and the AC input power of the rectifier is insufficient, the UPS transfers to source-share mode. In this case, the power module obtains energy from both the mains and batteries, and the energy is converted into AC outputs by the inverter. Note that this mode is unique to the UPS5000-S. Other working modes are available in other UPS models.

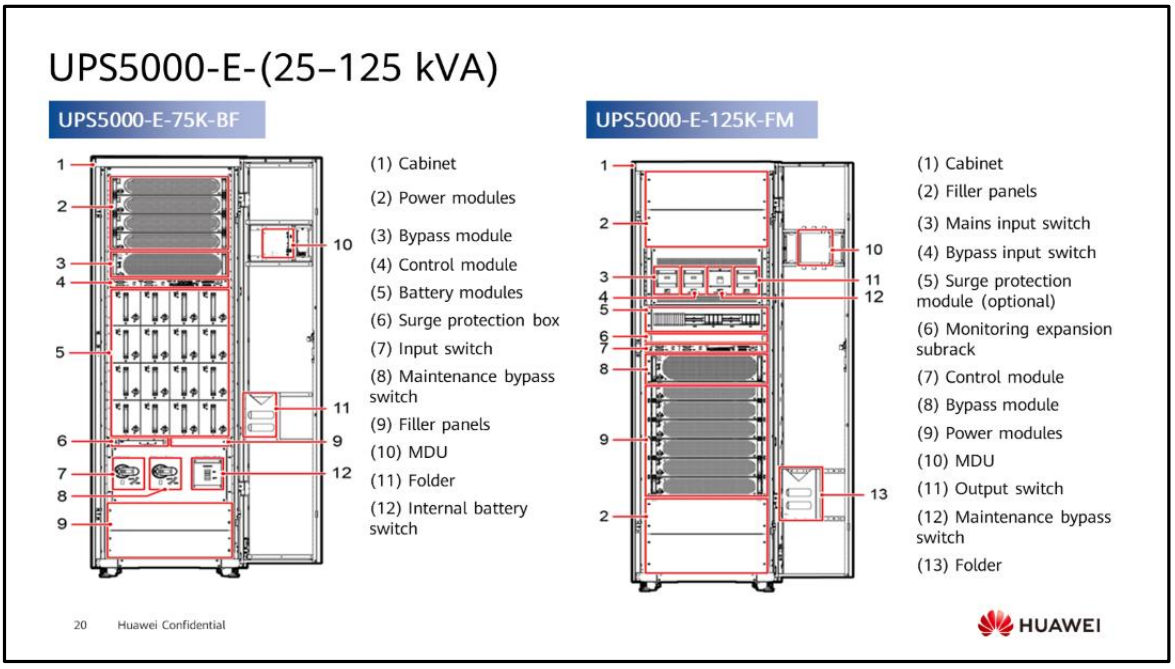
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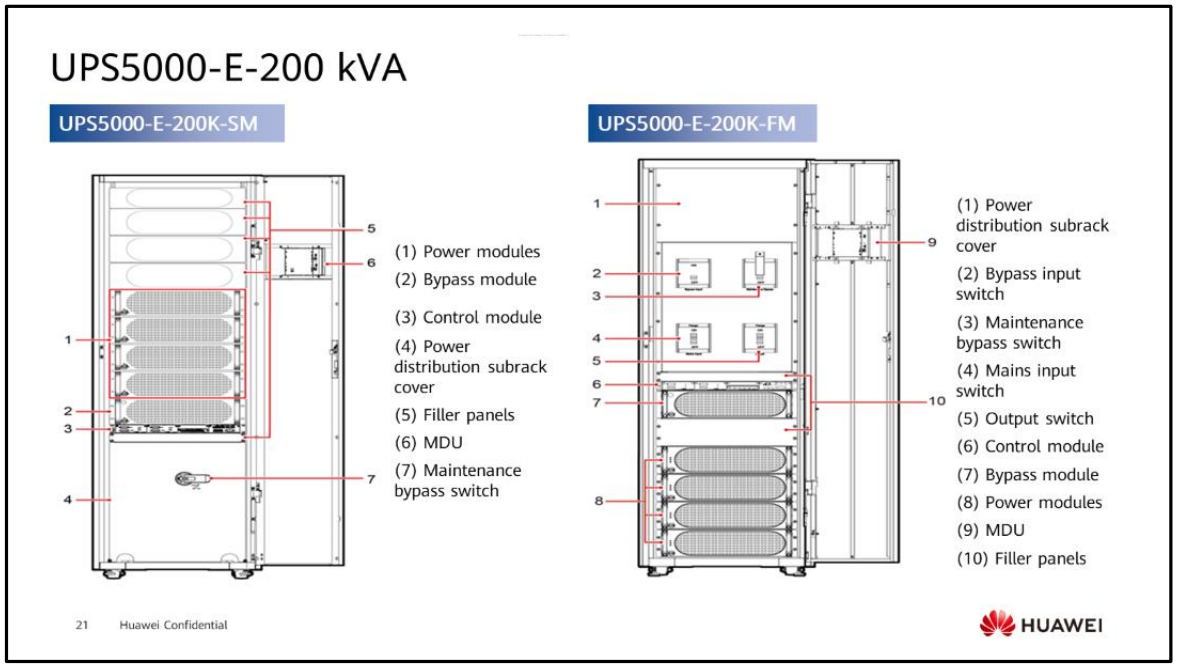
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- The UPS5000-A-30 kVA and UPS5000-A-40 kVA have one built-in power module. A 40 kVA power module can be used as a 30 kVA module of the UPS5000-A-30 kVA by software settings.
- The UPS5000-A-60 kVA and UPS5000-A-80 kVA have two modules, and the preceding rule applies.
- The UPS5000-A-120 kVA has three modules.
- All the preceding models contain bypass modules.



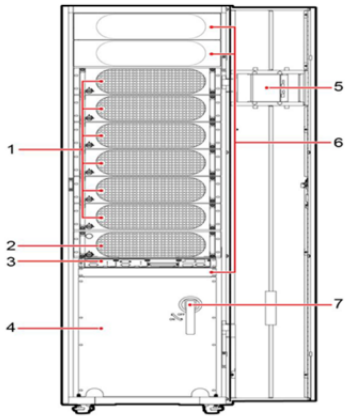
- The module capacity is 25 kVA.
- The figure on the left shows the UPS5000-E-75K-BF in full configuration with 3+1 modules.
- The figure on the right shows the UPS5000-E-125K-FM in full configuration with 5+1 modules.



- The following shows high-power models. The UPS5000-A, UPS5000-E, and UPS5000-S have the same appearance. The UPS5000-A is tower-mounted and non-modular. The UPS5000-E is modular and delivers standard efficiency. The UPS5000-S is modular and delivers high efficiency. The module capacity is 50 kVA.

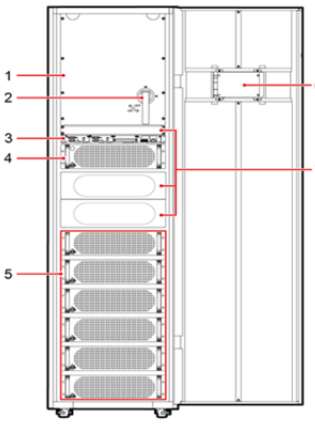
UPS5000-E-300 kVA

UPS5000-E-300K-SM



(1) Power modules
(2) Bypass module
(3) Control module
(4) Power distribution subrack cover
(5) MDU
(6) Filler panels
(7) Maintenance bypass switch

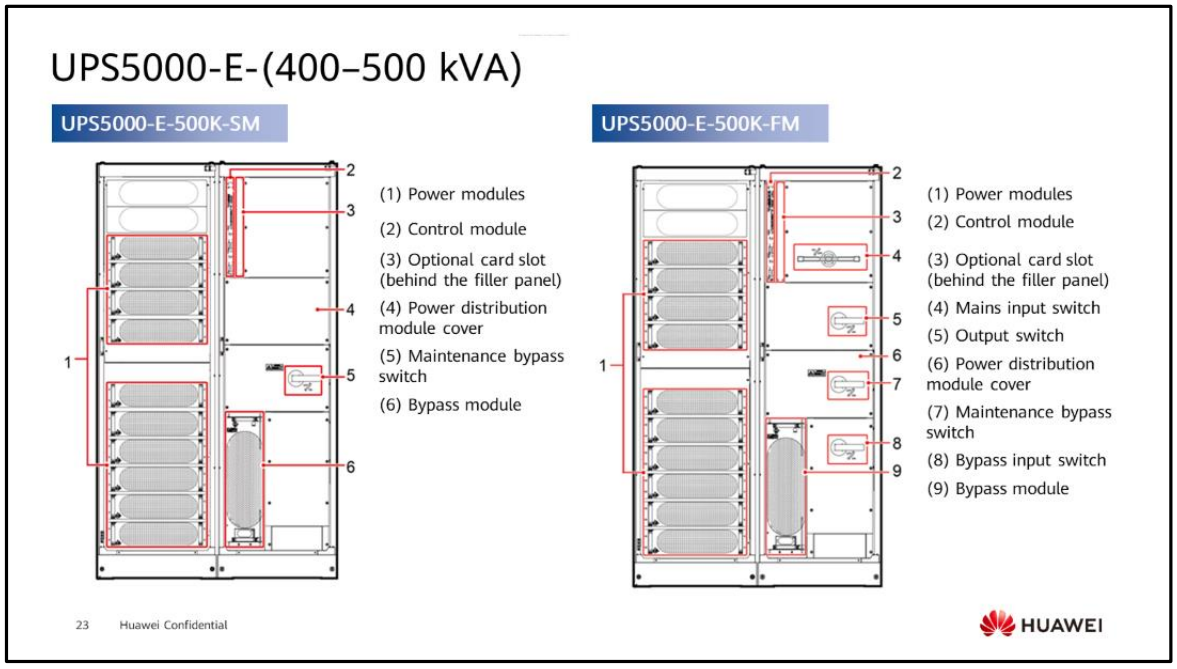
UPS5000-E-300K-SMT



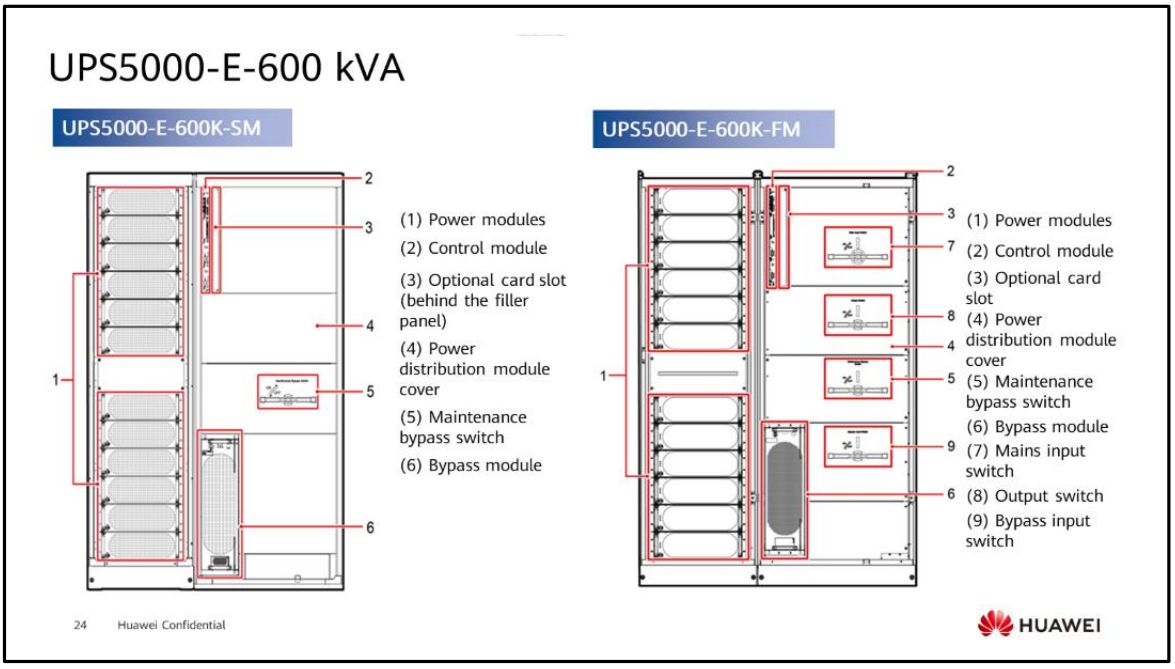
(1) Power distribution subrack cover
(2) Maintenance bypass switch
(3) Control module
(4) Bypass module
(5) Power modules
(6) MDU
(7) Filler panels

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- Cables of the UPS5000-E-300K-SM can be routed in only from the bottom. Cables of the UPS5000-E-300K-SMT are routed in from the top.



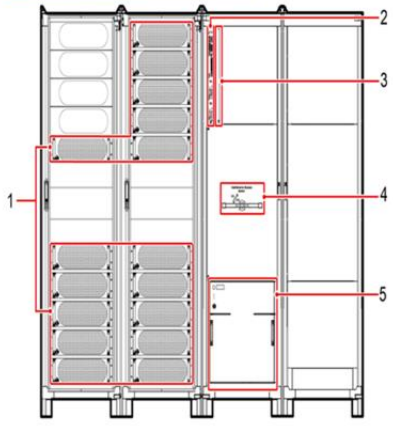
- The UPS5000-E-(400–500 kVA) includes UPS5000-E-400 kVA and UPS5000-E-500 kVA. Here, the UPS5000-E-500 kVA is used as an example. The UPS5000-E-400 kVA has two fewer power modules than the UPS5000-E-500 kVA.



- The cabinet dimensions of the UPS5000-E-600 kVA are different from those of the UPS5000-E-400 kVA and UPS5000-E-500 kVA. The power distribution frame (PDF) of the UPS5000-E-600 kVA model shown in the right figure is wider.

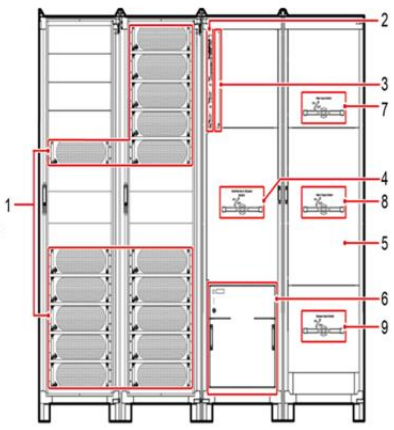
UPS5000-E-800 kVA

UPS5000-E-800K-SM



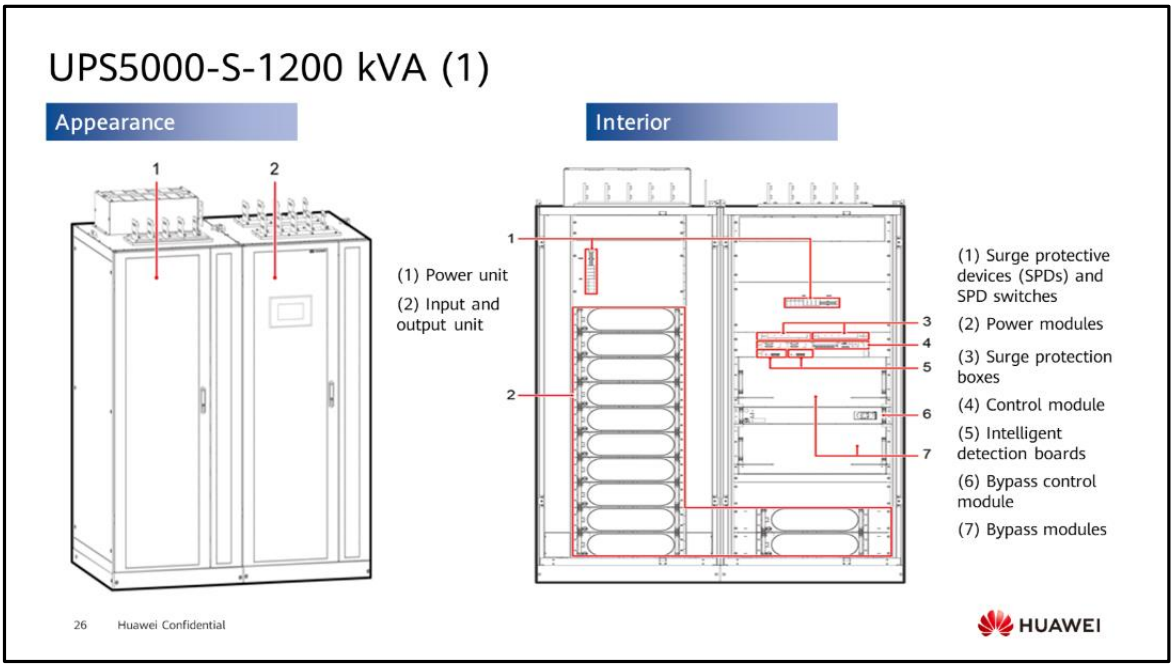
(1) Power modules
(2) Control module
(3) Optional card slot (behind the filler panel)
(4) Maintenance bypass switch
(5) Bypass module

UPS5000-E-800K-FM



(1) Power modules
(2) Control module
(3) Optional card slot
(4) Maintenance bypass switch
(5) Power distribution module cover
(6) Bypass module
(7) Mains input switch
(8) Output switch
(9) Bypass input switch

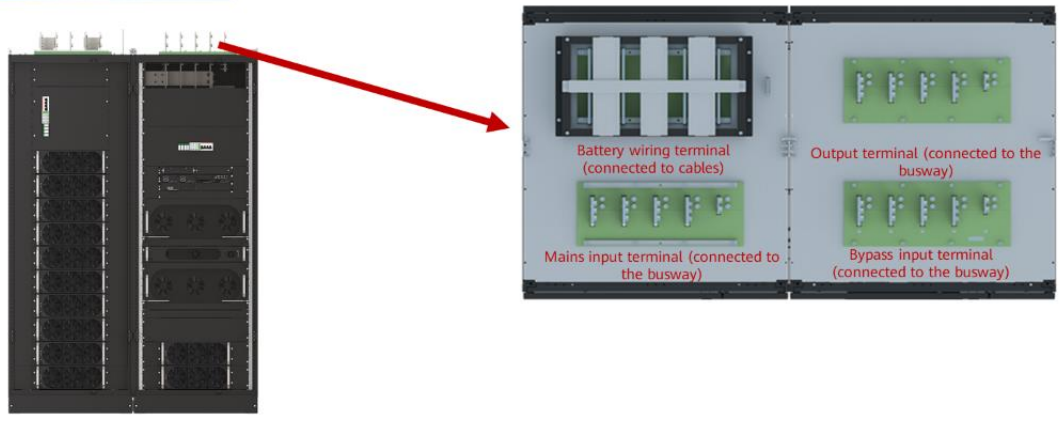
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- The differences between this model and other low-power models are as follows:
  - Power module: 100 kVA
  - Cable connection: The input and output cables of this model are connected using the busway, and batteries are connected using cables.
  - Bypass module: The bypass of this model consists of two bypass modules and a bypass control module. Each of the two bypass modules has a capacity of 600 kVA. The bypass modules are controlled independently by the bypass control module.
  - Intelligent detection board: monitors the busbar temperature of the power unit, bypass unit, and maintenance bypass unit, monitors the Boolean values inside the cabinets, communicates with the MDU and other intelligent detection boards, and controls indicators.

UPS5000-S-1200 kVA (2)

Wiring terminal



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- The AC input and output cables on the top are connected to the dense busway by default. A cable adapter can also be configured. Battery terminals are connected to cables.
- The system can be installed onsite no matter whether the mains input and bypass input share the same power source. The copper bar for the single power source is delivered with the UPS.
- A cabling cabinet can be configured. Cables can be routed in from the bottom.

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Core Components

Item		Description
Rack		Houses devices.
Power module		Converts power.
Bypass module		Provides bypass output when the power module is abnormal.
Power distribution module		Distributes input and output power.
Monitoring subsystem	MDU	Provides an LCD.
	ECM subrack	Houses monitoring modules.
	Control module	Controls intra-rack and inter-rack system running, and reports the system status information to other monitoring modules.
	Dry contact card	Enables the UPS to manage the battery system, provides alarm signals for external devices, and implements remote emergency power-off (EPO).
	Monitoring interface card	Monitors the UPS status, delivers emergency commands, reports system information, and displays the UPS key information and parameters on the LCD.

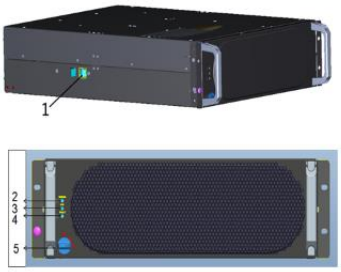
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Power Module (1)

- The power module consists of a power factor correction (PFC) rectifier and an inverter. It performs AC/DC or DC/DC conversion on the mains and battery inputs, and stabilizes the bus voltage. The inverter converts the DC inputs into AC sine wave outputs.

Power module types

Capacity	Dimensions (W x D x H, mm)	Weight (kg)
25 kVA/25 kW	442 x 620 x 86	< 21
50 kVA/50 kW	442 x 620 x 130	< 35
60 kVA/54 kW	442 x 620 x 130	< 35
100 kVA/100 kW	442 x 750 x 130	< 55



(1) Positioning lock
(2) Running indicator
(3) Alarm indicator
(4) Fault indicator
(5) In-position switch

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- Indicator description
  - Running indicator
    - Steady on (green): The inverter supplies power.
    - Blinking slowly (green): The inverter is on standby (blinking at 0.5 Hz, on for 1s and then off for 1s), or the inverter is not started (blinking at 0.2 Hz, on for 2.5s and then off for 2.5s).
    - Blinking fast: The module is not configured, the inverter or rectifier ARM software is being upgraded, or the inverter FPGA software is being upgraded (blinking at 4 Hz, on for 0.125s and off for 0.125s).
    - Off: The rectifier FPGA software is being upgraded.
  - Alarm indicator
    - Steady on (yellow): A minor alarm is generated for the inverter or rectifier.
    - Off: No minor alarm is generated for the inverter and rectifier, or the rectifier FPGA software is being upgraded.
  - Fault indicator
    - Steady on: A critical alarm is generated for the inverter or rectifier.
    - Off: No critical alarm is generated for the inverter and rectifier, or the rectifier FPGA software is being upgraded.

Power Module (2)

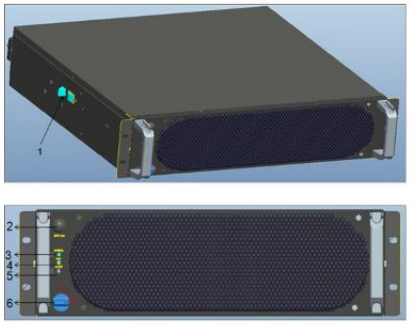
- Note: The 50 kVA modules of the UPS5000-S and UPS5000-E have the same appearance but different internal logic. They cannot be interchanged. You can distinguish them only by their model numbers.
  - The UPS5000-E module delivers standard efficiency. The model number is PM50K-V4S.
  - The UPS5000-S module delivers high efficiency. The model number is PM50K-V4H.
- There are three types of power modules for different scenarios.
  - The 25 kVA module is mainly used in 125 kVA and lower-power scenarios. The low-power configuration solution is more safe and cost-effective.
  - The 50 kVA module is mainly used in the medium-power range.
  - The 100 kVA module is mainly used in megawatt-level scenarios to save footprint.

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Bypass Module

- The UPS works in bypass mode under the following circumstances:
  - If the UPS is set to ECO mode and the bypass voltage is within the specified range, the UPS works in bypass mode preferentially.
  - The power module overload times out.
  - If both active and standby ECM are abnormal, the UPS transfers to bypass mode.
  - The system runs abnormally.
  - The UPS is transferred to bypass mode manually.

Bypass Module Capacity (kVA)	Dimensions (W x H x D, mm)	Weight (kg)
200	442 x 130 x 500	19
300	442 x 130 x 500	19
400	200 x 600 x 600	50
500/600	200 x 600 x 600	50



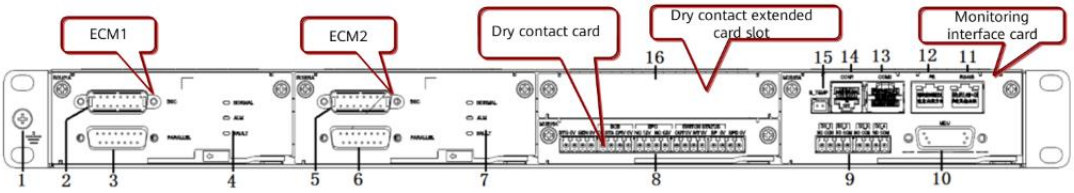
(1) Positioning lock (2) Cold-start button (3) Running indicator (4) Alarm indicator (5) Fault indicator (6) In-position switch

HUAWEI

- Indicator description
  - Running indicator
    - Steady on (green): The bypass supplies power.
    - Blinking slowly (green): The bypass has no output (blinking at 0.2 Hz, on for 2.5s and then off for 2.5s).
    - Blinking fast (green): The bypass is not configured or the ARM software is being upgraded (blinking fast at 4 Hz, on for 0.125s and then off for 0.125s).
    - Off: The bypass FPGA software is being upgraded.
  - Alarm indicator
    - Steady on (yellow): A minor alarm is generated for the bypass.
    - Off: No minor alarm is generated for the bypass, or the FPGA software is being upgraded.
  - Fault indicator
    - Steady on (red): A critical alarm is generated for the bypass.
    - Off: No critical alarm is generated for the bypass, or the FPGA software is being upgraded.

Control Module

- The control module in a standard configuration contains two ECM, one dry contact card, and one monitoring interface card from left to right.
- The four cards are hot-swappable.
- A subrack is reserved above the dry contact card. A backfeed protection card or dry contact extended card can be configured based on the actual installation and usage.



(1) Ground terminal (2) BSC port 1 (3) Parallel port 1 (4) Indicators
(5) BSC port 2 (6) Parallel port 2 (7) Indicators (8) Dry contact card
(9) Dry contact ports (10) MDU port (11) RS485 port (12) FE port
(13) COM2 port (14) COM1 port (15) Battery temperature sensor port (16) Optional card slot cover

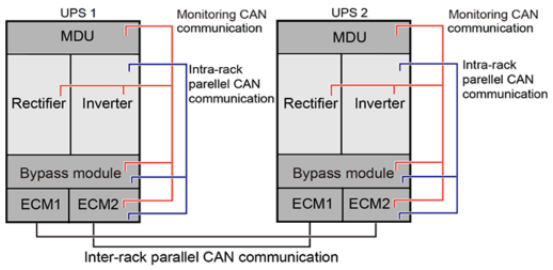
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- The control modules of the UPS5000-A-30 kVA/40 kVA/60 kVA/80 kVA/120 kVA have different appearances but the same functions. Card positions are different among these models. Control modules of other UPS5000-E/S/A models are the same.

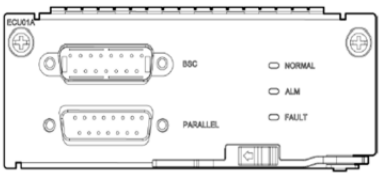
ECM

- As a control interface for the entire system, the ECM communicates with each module and provides a bus for communication between the dry contact card and the system control card. The ECM ensures equalized output currents between modules so that load power is equally shared.
- The ECM provides three types of CAN communication: monitoring CAN communication, intra-rack parallel CAN communication, and inter-rack parallel CAN communication.

Logical connections for CAN communication



ECM

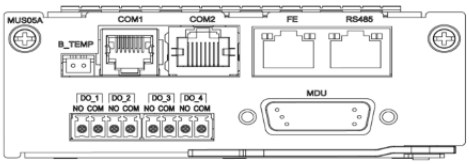


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- ECM functions
  - The ECM provides module working status information to the monitoring system.
  - The ECM controls the running of a single UPS and a parallel system, and reports the UPS status information to other monitoring modules.
- Indicator description
  - NORMAL
    - Steady on (green): The ECM is the active ECM.
    - Blinking at 0.5 Hz (green): The ECM is the standby ECM and is ready.
    - Off: The ECM is not ready or the FPGA of the ECM is being upgraded.
    - Blinking at 4 Hz: The ARM of the ECM is being upgraded or is not configured.
  - ALM
    - Steady on (yellow): A minor alarm is generated for the ECM, but the ECM does not need to be replaced.
    - Off: No minor alarm is generated for the ECM or the ARM of the ECM is being upgraded.

Monitoring Interface Card

- The monitoring interface card provides external ports as well as monitoring and control functions for the MDU.
- The monitoring interface card provides the ambient temperature and humidity (T/H) sensor port, iBattery port, FE port, battery temperature monitoring port, and network management port.

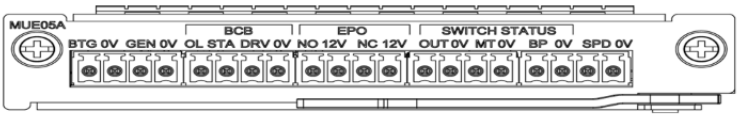


Port	Silk Screen	Signal Description
DO_1	DO_1_NO	Each DO has one of the following five meanings: battery mode, bypass mode, low battery voltage, major alarm, or minor alarm.
	DO_1_COM	
DO_2	DO_2_NO	
	DO_2_COM	
DO_3	DO_3_NO	
	DO_3_COM	
DO_4	DO_4_NO	
	DO_4_COM	
DB26	MDU	DB26, containing FE, RS485, I2C, and CAN signals.
Battery temperature	B_TEMP	Connects to the indoor battery temperature sensor with a negative temperature coefficient (NTC) resistor.
Southbound communications port 2	COM2	Connects to a southbound device, such as the battery monitor unit (BMU).
Southbound communications port 1	COM1	Two-wire port connecting to an ambient T/H sensor
Network port	FE	Network port
Northbound communications port	RS485	Two-wire port connecting to a northbound network management device

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- The monitoring interface card provides the ambient T/H sensor port, iBattery port, FE port, battery temperature monitoring port, and network management port.
- Notes:
  - The FE port resembles the RS485 port. Therefore, follow the silk screens when you connect communications cables. If you mistake the RS485 port as the FE port during cable connection, the WebUI communication fails. If you mistake the FE port as the RS485 port during cable connection, RS485 communication fails.
  - Dry contact signals take effect after you set them. Disable unused dry contact signals on the monitoring system.
  - When multiple UPS are connected in parallel, all dry contact signals to be used need to connect to each UPS.

Dry Contact Card



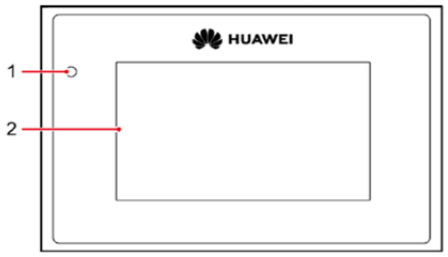
Silk Screen	Signal Description	Status Description	Initial Status
BCB_OL	Port for monitoring the battery circuit breaker (BCB) box	Grounded: BCB box connected Disconnected: BCB box not connected	Grounding
BCB_STA	Port for monitoring the BCB status	Closed: The BCB is ON. Open: The BCB is OFF.	Open
BCB_DRV	Port for controlling BCB trip. When the voltage is +12 V, the BCB trips.	0 V: BCB not tripped 12 V: BCB tripped	0V
BCB_0V	Signal ground		
EPO_NO	If the normally open (NO) port is connected to the EPO_12V port, EPO is triggered.	Closing the EPO port triggers EPO.	Open
EPO_12V	+12 V		
EPO_NC	If the normally closed (NC) port is disconnected from the EPO_12V port, EPO is triggered.	Opening the EPO port triggers EPO.	Closed
EPO_12V	+12 V		

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- The dry contact card allows the UPS to detect and manage the switch status of the battery system (including the external battery switch) and implement remote EPO.
- The BCB box is an optional component. If it is used, the battery status (connected or disconnected) can be detected through the corresponding port. If the UPS is configured with an EPO switch, the battery switch box trips when EPO is triggered.
- Use of EPO terminals: The UPS provides NO and NC ports. Either of the ports can be connected to an external switch.
- When an extra UPS input and output PDF is configured, SWITCH STATUS ports can be used to display the switch status of the PDF on the LCD. Note that the ports are for external switches. If the UPS is fully configured, the corresponding switches have been configured for the UPS and do not correspond to the SWITCH STATUS ports on the dry contact card because they have been associated in the internal system.
    - (MT, 0V): port for monitoring the status of an external maintenance bypass switch
    - (OUT, 0V): port for monitoring the status of an external output switch
    - (BP, 0V): port for monitoring the status of an external bypass input switch
    - (SPD, 0V): port for monitoring the status of the input AC SPD
- (BTG, 0V): port for monitoring battery grounding failures
- (GEN, 0V): port for monitoring signals in DG mode

MDU

MDU panel



(1) Status indicator (2) LCD

Indicator status

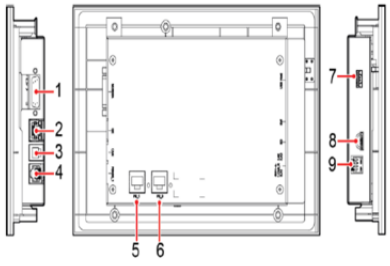
Status	Indicator Color	Description
On	Red	A critical alarm has been generated, and the buzzer buzzes continuously.
	Yellow	A minor alarm has been generated, and the buzzer buzzes intermittently.
	Green	The UPS is running properly or a warning has been generated.
Off	N/A	The LCD is powered off.

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- Function: The MDU allows you to control UPS operations, view the running status and alarms, and set parameters.
- Note that the MDU panels of the UPS5000A-30 kVA/40 kVA/60 kVA/80 kVA/120 kVA are not touchscreens and similar to that of the UPS2000-G-20 kVA.
- MDU: monitor display unit
- Note: The indicator on the LCD is yellow when the bypass supplies power in non-ECO mode.

MDU

MDU panel ports



Port description

No.	Port	Description
1	MUS05A (DB26)	Connects to the MDU and monitoring interface card.
2	FE	Network port
3	CAN	Reserved
4	RS485_1	Reserved
5	USB Host	After installing the WiFi module, connect the WiFi module to the UPS using the app on the mobile phone to obtain the initial startup password. Connects to a USB flash drive to import or export the configuration file, export run logs, and upgrade software.
6	RST	Restart switch for the MDU
7	SD	Reserved
8	DIP switch	Implements specific functions together with specific buttons; controls the CAN communication build-out resistor in a parallel system.

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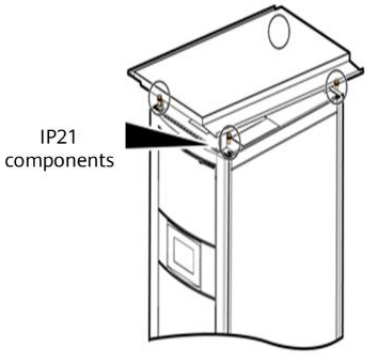
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4. **Product Structure**
   - Appearance
   - Core Components
   - Optional Components
5. Typical Configuration
6. Product Specifications

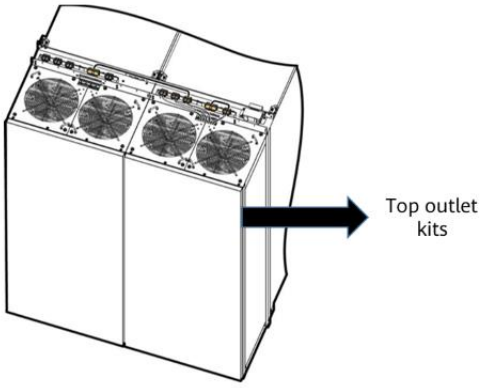
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Optional Components (1)

- IP21 components: prevent water from dropping into the cabinet, protecting the cabinet to IP21.



- Top outlet kits: enhance heat dissipation and allow the UPS to be installed against a wall.



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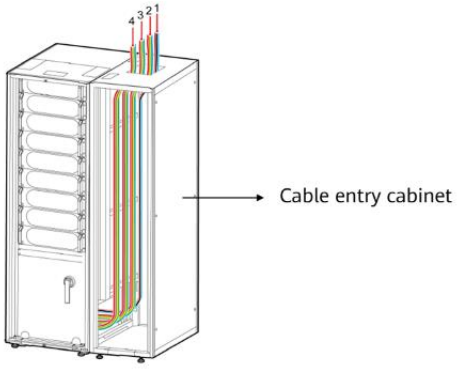
- IP21 component description:
  - The standard protection level of the UPS5000-E is IP20. If you want to improve the protection level to IP21, you need to configure the IP21 components.
- Top outlet kit description:
  - In a standard configuration, fans of the UPS5000-E are installed inside the cabinets. Therefore, the distance between the rear of the cabinets and the wall must be at least 500 mm. If the UPS needs to be installed against a wall, you need to install the top outlet kits.
  - Note: If IP21 components are configured, the top air-flow cabinet cannot be installed.
  - The cabinet has two models: 600 mm wide (with a fan transit unit) and 800 mm wide. The thickness is 350 mm.

Optional Components (2)

- Antiseismic kits: reinforce a cabinet so that the cabinet can resist intensity 9 earthquakes.



- Cable entry cabinet: supports bottom cabling.

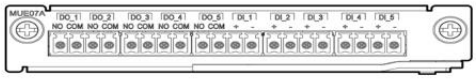


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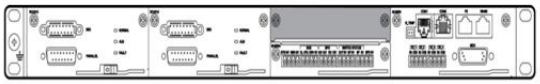
Optional Components (3)

- Dry contact extended card: provides extended monitoring ports, including five relay output ports and five input ports.

Dry contact extended card

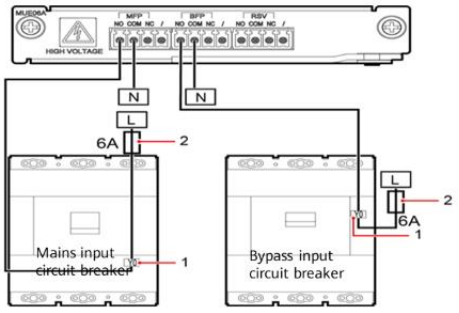


Installation position



- Backfeed protection card: detects and protects against mains and bypass backfeed.

Backfeed protection card



(1) Shunt release (2) 6 A fuse

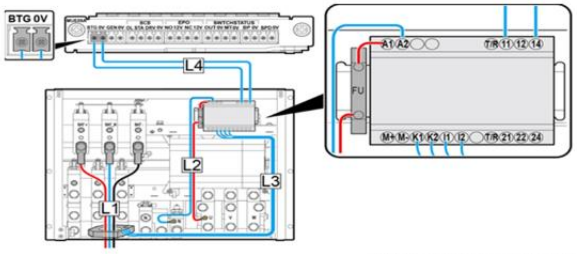
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- Dry contact extended card
  - Provides five relay output dry contact signals and five dry contact input signals.
  - DO_1–DO_5 can indicate critical alarms, minor alarms, bypass mode, battery mode, low battery voltage, DG control, and other status. DO_1 indicates low battery voltage by default and others are reserved. DI_1 and DI_2 are used for door status alarm and water alarm detection. All DIs are reserved.
  - Users can flexibly set DO based on actual requirements.
  - For dry contact outputs, the rated DC voltage and current are 24 V DC and 0.6 A and the maximum values are 30 V DC and 1.0 A. The rated AC voltage and current are 24 V AC and 0.6 A and the maximum values are 30 V AC and 1.0 A. During cable connection, ensure that the voltage and current do not exceed these maximum values.
  - You need to enable the corresponding ports on the LCD. Otherwise, the ports cannot be used.

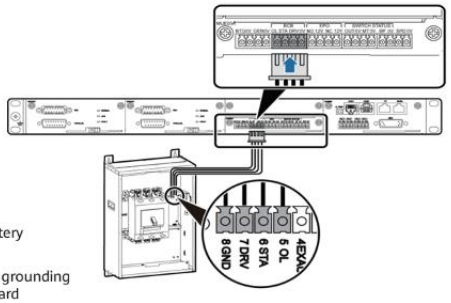
Optional Components (4)

- Battery grounding failure detector: detects current leakage and generates an alarm; detects whether battery grounding is faulty; generates an alarm when the ground leakage current exceeds the preset value.
- BCB box: controls the connection between battery strings and the UPS, and supports overload protection, short circuit protection, and remote trip control.

Battery grounding failure detector



BCB box



L1: power cables for batteries

L2: AC input power cables for the battery grounding failure detector

L3: signal cables between the battery grounding failure detector and the AC current transformer

L4: signal cables between the battery grounding failure detector and the dry contact card

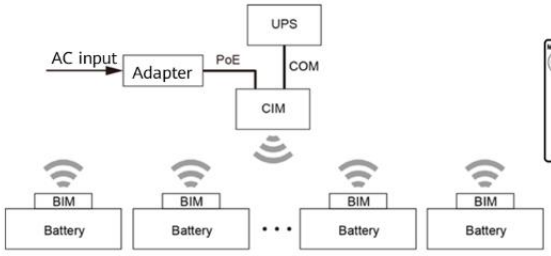
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- Battery grounding failure detector:
  - Protects equipment and prevents fire if it is used with a remote trip switch device.
  - One signal cable of the battery grounding failure detector connects to the AC current transformer, and the other signal cable connects to the corresponding port on the dry contact card. The battery grounding failure detector obtains AC power over power cables and sends battery grounding failure information obtained from the AC current transformer to the dry contact card.
  - The initial status of the BTG and 0V ports is open. If the status is closed, the battery grounding is faulty. If the status is open, the battery grounding is normal.
  - The A1 port on the battery grounding failure detector connects to the UPS output port U over a fuse. The ground cable must be placed outside the AC current transformer coil.

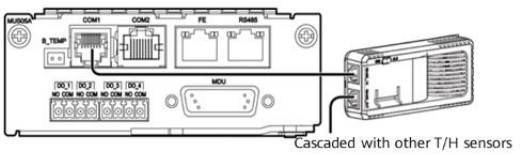
Optional Components (5)

- iBattery: collects battery information, including the voltage, internal resistance, pole temperature, the state of charge (SOC), and state of health (SOH) of each battery.
- T/H sensor: ambient temperature and humidity collection board.

iBattery architecture



T/H sensor



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- iBattery
  - The intelligent battery monitoring system consists of the communication interface module (CIM) and battery interface module (BIM).
  - The CIM is an intelligent battery management module which collects wireless communication data from the downstream BIM groups, collects and analyzes the operating data of battery strings, calculates SOC and SOH of batteries and battery strings, estimates the battery SOH, manages battery tripping, and uploads data to the upper-level management unit through the COM or PoE port.
  - The BIM is an intelligent battery monitoring module that monitors the voltage, internal resistance, and pole temperature of each battery.
  - One CIM supports a maximum of 300 BIMs, and manages BIMs for a maximum of four battery strings.

Optional Components (6)

- Surge protection box and subrack
  - Improve the UPS surge protection capability. Install a subrack when a surge protection box is used. The position for installing the surge protection box subrack and ECM extended subrack is the same, and therefore the two types of subracks cannot be used simultaneously.
- ECM extended subrack
  - Installed when the UPS is equipped with a backfeed protection card and dry contact extended card. The position for installing the surge protection box subrack and ECM extended subrack is the same, and therefore the two types of subracks cannot be used simultaneously.
- Parallel cable
  - Connects UPS in parallel.
- BSC cable
  - Transmits bus synchronization signals in a dual-bus system.

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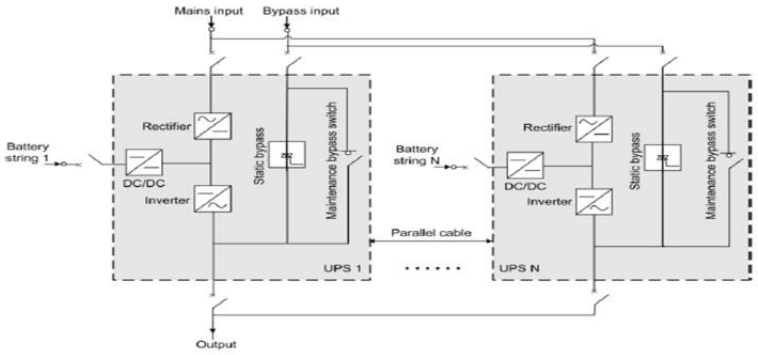
Single UPS

- The UPS uses a modular design. It uses multiple power modules connected in parallel to deliver a high loading capacity. If one power module is faulty, other power modules continue working. If loads are light, the UPS provides redundant capacity even if only a single UPS is operating, which ensures high reliability.
- Supplies power to common loads.

Parallel System

- Supplies power to small- and medium-sized equipment rooms or important loads. It features high reliability and strong transient overload resistance capability.

Conceptual diagram of an N+X parallel system



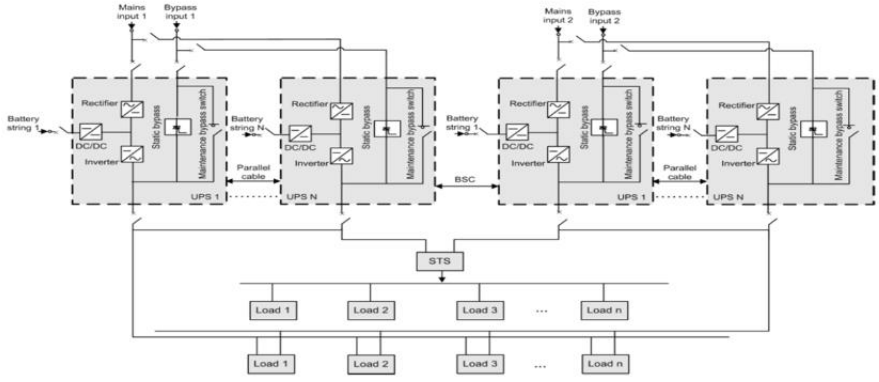
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- In a parallel system, mains input, bypass input, and AC output terminals of UPS are connected in parallel. ECM on different UPS are connected over parallel cables to synchronize UPS outputs to supply power to loads. If a single UPS fails, other UPS continue supplying power to loads, which ensures system reliability.

Dual-Bus System

- Supplies power to important loads in large- and medium-sized equipment rooms, data centers, and other places that require high reliability.

Conceptual diagram of a dual-bus system



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- A dual-bus system has advantages of common parallel systems, and is free from single points of failure.
- A dual-bus system consists of two independent UPS systems. Each UPS system consists of one UPS or multiple UPS connected in parallel. Of the two UPS systems, one is a master system, and the other is a slave system. The dual-bus system is highly reliable and is suitable for loads with multiple input terminals. The UPS systems work in inverter mode or bypass mode.

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Product Specifications (Using the UPS5000-E as an Example) (1)

- Physical specifications

Item	400 kVA	500 kVA	600 kVA
Cabling	Cables can be routed in from the top or bottom.		
IP rating	IP20 (IP21 is optional.)		
Dimensions (H x W x D)	2000 mm x 1200 mm x 850 mm		2000 mm x 1400 mm x 850 mm
Communication	Dry contacts, RS485, and SNMP		
Weight	SM: 670 kg FM: 710 kg	SM: 810 kg FM: 830 kg	SM: 1040 kg FM: 1090 kg

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Product Specifications (2)

- Environmental specifications

Item	400 kVA	500 kVA	600 kVA
Operating temperature	0–40° C		
Storage temperature	–40° C to +70° C		
Relative humidity	0–95% (non-condensing)		
Altitude	0–1000 m When the altitude is greater than 1000 m, the power is derated as described in IEC 62040-3. The upper limit of the altitude is 4000 m.		

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- Altitude: When the altitude increases, the air becomes thin. This deteriorates the heat dissipation performance of the UPS. In addition, the sealed components inside the UPS bulge. Therefore, the UPS power needs to be derated.

Product Specifications (3)

- Mains input electrical specifications

Item	400 kVA	500 kVA	600 kVA
Input system	Three-phase four-wire + PE		
Rated input voltage	380 V AC/400 V AC/415 V AC (line voltage)		
Input voltage range	80–280 V AC (phase voltage) At 40° C: The UPS can work at full load when the voltage is 187–280 V AC, and is derated to 40% load when the voltage is 187–80 V AC. At 30° C: The UPS can work at full load when the voltage is 176–280 V AC, and is derated to 40% load when the voltage is 176–80 V AC.		
Input frequency range	40–70 Hz		
Rated frequency	50 Hz/60 Hz		
Input power factor	> 0.99 (full load); > 0.98 (half load)		
THDi	< 3% (linear full load); < 5% (non-linear load)		

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- When the voltage is low, if the output remains unchanged, the corresponding current increases. As a result, the heat increases sharply. Therefore, the power needs to be derated.
- THDi: This parameter indicates the pollution of the UPS to the power grid. A smaller value is preferred.

Product Specifications (4)

- Bypass input electrical specifications

Item	400 kVA	500 kVA	600 kVA
Rated input voltage	380 V AC/400 V AC/415 V AC (line voltage)		
Input system	Three-phase four-wire + PE		
Input frequency range	50/60 Hz ± 6 Hz (adjustable, 0.5–6 Hz, ± 2 Hz by default)		
Bypass synchronization tracking range	50 Hz/60 Hz ± 6 Hz		
Input mode	The mains input and bypass input share a power source or use different power sources.		

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- Bypass input frequency range: If the bypass input frequency exceeds this range, the bypass is unavailable. If the inverter is faulty or overloaded, the UPS will break down. In this way, the bypass protects loads.

Product Specifications (5)

- Output electrical specifications

Item	400 kVA	500 kVA	600 kVA
Output system	Three-phase four-wire + PE		
Voltage	380 V AC/400 V AC/415 V AC ± 1% (line voltage)		
Frequency	In normal mode, the frequency is synchronous with the bypass input frequency. In battery mode, the frequency is 50 Hz or 60 Hz (tolerance: ± 0.25%).		
THDv	< 1% (linear full load); < 4% (non-linear full load)		
Output power factor	1		
Transfer time	0 ms		
Overload capability	Inverter overload capability: 105% < load ≤ 110%: transfer to bypass mode after 60 minutes 110% < load ≤ 125%: transfer to bypass mode after 10 minutes 125% < load ≤ 150%: transfer to bypass mode after 1 minute Load > 150%: transfer to bypass mode after 200 ms		

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- In normal mode, the inverter output frequency is synchronous with the bypass input frequency. If the bypass frequency exceeds the preset range, the bypass is unavailable.
- THD: refers to total harmonic distortion, which measures the deviation of a signal from the original signal or standard signal during transmission. In an ideal amplifier, the output waveform should be the same as the input waveform except for amplification. In practice, however, the output waveform cannot be identical with the input waveform. This phenomenon is called distortion.
- Overload capability: If the UPS works in normal mode and is overloaded, the UPS transfers to bypass mode. The bypass also has its own overload limit. If the bypass is still overloaded, the UPS disconnects the output. If the bypass is not overloaded, the bypass can work continuously by default. However, the upstream input circuit breakers may trip in advance. Note that the overload capability of the bypass is closely related to the temperature. That is, the overload capability varies according to the temperature. The overload capability decreases as the temperature increases.

Product Specifications (6)

- Battery electrical specifications

Item	400 kVA	500 kVA	600 kVA
Battery voltage	360–528 V DC (30–44 batteries, 40 batteries by default). If there are 36 or 38 batteries, the output power is not derated; if there are 34 batteries, the output power is derated to 0.9; if there are 30 or 32 batteries, the output power is derated to 0.8.)		
Battery management	Intelligent battery management		
One-click cold start	If a mains outage occurs, batteries can start the UPS to supply power to loads.		
Charger output power	Under rated conditions, the maximum charge power of a module is 5 kW.		
Battery string sharing	Battery string sharing is supported in a parallel system. No battery string is shared by default.		
Charge voltage	Equalized charge voltage: 2.3–2.4 V/cell. The default voltage is 2.35 V/cell. Float charge voltage: 2.23–2.3 V/cell. The default voltage is 2.25 V/cell.		

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- Notes:
  - A neutral wire is required for the UPS5000-A/E batteries to divide the entire battery string into positive and negative battery strings. The number of batteries in the positive battery string must be the same as that in the negative battery string. Therefore, the number of batteries must be an even number.
  - A neutral wire is not required for the UPS5000-S because the internal logic is optimized. The number of batteries can be an odd number or even number within the specified range.

Quiz

1. (T or F) Do the UPS5000-E-400 kVA and UPS5000-E-300 kVA have the same power module model but different bypass module models?
2. (T or F) Do all UPS5000-E models support cable routing from the top or bottom?

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- Question 1: Yes.
- Question 2: No. The UPS5000-E-300K-SMT supports cable routing only from the top.

Summary

- This chapter describes the following aspects:
  - UPS5000 model description.
  - UPS5000 product highlights.
  - UPS5000 working logic.
  - UPS5000 product structure, including appearance, core components and optional components.
  - UPS5000 typical configuration and product specifications.

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Thank you.

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每个组织，构建万物互联的智能世界。

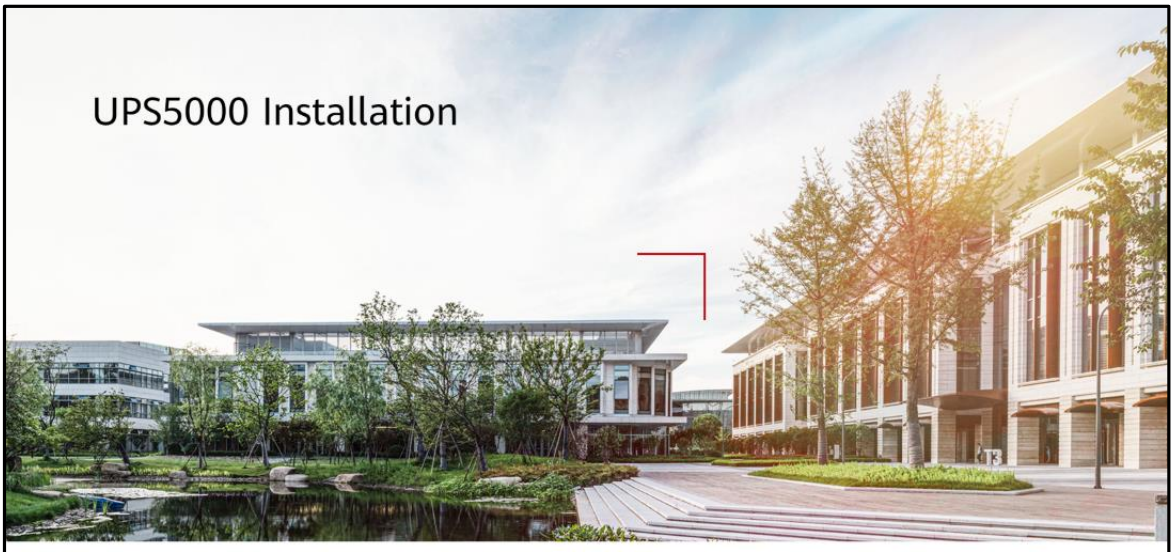
Bring digital to every person, home, and organization for a fully connected, intelligent world.

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UPS5000 Installation



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Foreword

- The slides describe how to install the UPS5000 and verify the installation.

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Objectives

On completion of this course, you will be able to:

- Get familiar with the installation of the UPS5000.
- Get familiar with the engineering quality check and acceptance for the UPS5000.

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Contents

1. Preparations
2. Installation
3. Installation Verification

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Site Survey Before Installation

- Load bearing
  - Ensure that the floor or installation base can bear the weight of the UPS5000, batteries, and battery racks.
- Installation environment
  - Keep the UPS far away from water, heat sources, and flammable and explosive substances. Install the UPS in an environment free of dust, volatile gas, salt, and corrosive materials. Avoid direct sunlight.
  - Do not install the UPS in environments with conductive metal scraps in the air.
- Installation clearances
  - Reserve a clearance of at least 800 mm from the front of the cabinet for ventilation and operations.
  - Reserve a clearance of at least 500 mm from the top of the cabinet for operations.
  - If no top air-flow cabinet is available, reserve a clearance of at least 500 mm at the rear for ventilation. If operations need to be performed at the rear, reserve a clearance of at least 800 mm.

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- Installation environment:
  - Do not install the UPS in a high-temperature, low-temperature, or damp place that is beyond the technical specifications.
  - The optimal operating temperatures for valve-regulated lead-acid (VRLA) batteries are 20–30°C. Operating temperatures higher than 30°C shorten the battery lifespan, and operating temperatures lower than 20°C reduce the battery backup time.
- Installation clearances:
  - If a top air-flow cabinet is deployed, the UPS can be installed against a wall and no space needs to be reserved at the rear. If no top air-flow cabinet is deployed, at least 500 mm space should be reserved at the rear for ventilation. If the UPS needs to be operated at the rear, at least 800 mm space should be reserved for operations.

Installation Tool Preparation

Appearance, Specifications, and Name				
Clamp meter	Multimeter	Labels	Phillips screwdriver (M3–M6, M8)	Flat-head screwdriver (2 mm x 80 mm)
				
Torque screwdriver	Crimping tool	Diagonal pliers	Wire stripper	Insulation tape
Cotton cloth	Brush	Heat-shrink tubing	Heat gun	Electrician's knife
				
Protective gloves	ESD gloves	Insulation gloves	Hydraulic pliers	Cable tie
				
Hammer drill	Rubber mallet	Electric pallet truck	Manual pallet truck	Step ladder
				

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- In addition, an insulated adjustable wrench and an insulated torque wrench are required.

Preparing Power Cables

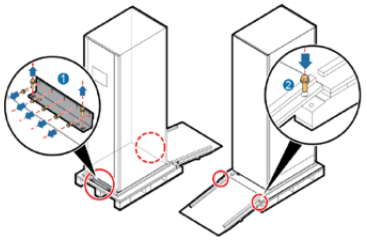
Item	UPS5000-E-200K-SM		
Mains input	Mains input current (A)	355	
	Recommended cable cross-sectional area (mm^2)	L1, L2, L3, N	2 x (4 x 95)
		PE	95
Bypass input	Bypass input current (A)	304	
	Recommended cable cross-sectional area (mm^2)	L1, L2, L3, N	2 x (4 x 95)
		PE	95
Output	Output current	304	
	Recommended cable cross-sectional area (mm^2)	L1, L2, L3, N	2 x (4 x 95)
		PE	95
Battery input	Nominal battery discharge current (A)	439	
	Maximum battery discharge current (A)	525	
	Recommended cable cross-sectional area (mm^2)	+, –, N	2 x (3 x 120)
		PE	120

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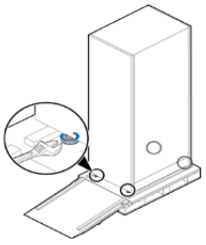
- The currents listed in the table are measured at a rated voltage of 380 V (line voltage). If the rated voltage is 400 V, multiply the currents by 0.95; if the rated voltage is 415 V, multiply the currents by 0.92.
- When the primary loads are non-linear loads, increase the cross-sectional areas of the neutral wires to 1.5–1.7 times.
- The nominal battery discharge current refers to the current of forty 12 V batteries at 480 V in standard configuration.
- The maximum battery discharge current refers to the current when forty 12 V batteries in standard configuration, that is, two hundred and forty 2 V battery cells (1.67 V/cell), stop discharging.
- The battery cable specifications are selected based on 40 batteries by default and compatible with application scenarios with 30–44 batteries.
- When the mains input and bypass input share a power source, configure input power cables as main input power cables.
- It is recommended that the AC power cable of the 200 kVA UPS be no longer than 30 m and the DC power cable be no longer than 40 m.

Transportation, Unpacking, and Checking

- Use a pallet truck to transport the UPS to the installation position.
- Check that the UPS package is intact.
- Hold the sliding plate steadily, cut and remove the binding strap, put down the sliding plate gently, and remove the package.
- After confirming that the UPS is intact, remove the L-shaped bracket that secures the UPS and the pallet, and secure the sliding plate to the pallet using the two M12 bolts that you have removed. (The screws must be tightened. Otherwise, the sliding plate may shift when you remove the UPS.)
- Raise the four anchor bolts to the highest position using an adjustable wrench.
- Move the UPS over its castors to the installation position.



Removing an L-shaped bracket



Raising anchor bolts

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- Notes:
  - To prevent the UPS from falling over, secure it to a pallet truck using ropes before moving it.
  - Move the UPS with caution. Any bumping or falling may damage the UPS. After placing the case in the installation position, unpack it with caution to prevent scratches. Keep the UPS steady during unpacking.
  - If the UPS installation environment is in poor condition and the UPS needs to be stored for a long time after it is unpacked, take measures to prevent dust. It is recommended that the UPS be wrapped with the original plastic coat.
- Check that the UPS is intact:
  - Visually inspect the UPS appearance for shipping damage. If any damage is found, notify the carrier immediately.
  - Check that the equipment and fittings are correct and complete according to the packing list. If some fittings are missing or do not comply with the packing list, record the information and contact your local Huawei office immediately.
  - Check the tiltwatch label.

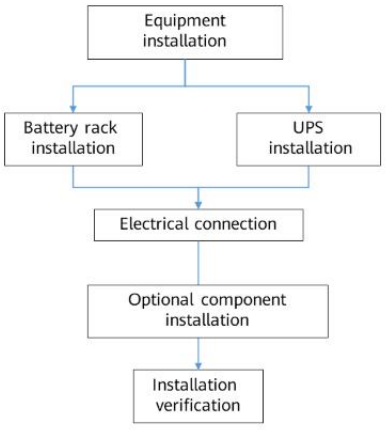
Contents

1. Preparations
2. **Installation**
   - Installation Process
   - Installing a Single UPS
   - Installing a Parallel System
3. Installation Verification

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Installation Process

- Installation
  - Install the UPS and battery system.
  - Separately install UPSs in a parallel system.
- Electrical connection
  - Includes connections of power cables and signal cables.
  - Cables must be connected in order and securely.
- Installation Verification
  - Checking after installation is mandatory.



Installation Process

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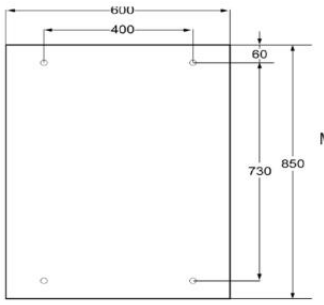
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   - Installing a Parallel System
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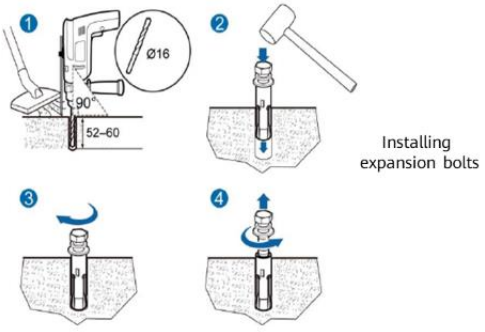
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Installing a UPS Cabinet (1)

- Determine the cabinet installation position. Draw mounting holes in the installation position according to the diagram.
- Use a hammer drill to drill holes for installing expansion bolts and then install four expansion bolts in the holes.
- Wheel the cabinet to the installation position.



Mounting holes



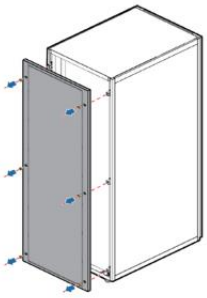
Installing expansion bolts

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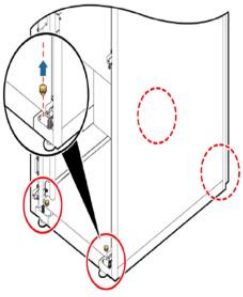
- This section uses the 200 kVA UPS as an example. The installation of other models is similar. Strictly follow the installation SOP when installing the UPS.
- To install expansion bolts, perform the following steps:
  - Drill holes into the concrete floor using a hammer drill. The hole depth ranges from 52 mm to 60 mm.
  - Partially tighten the expansion bolts and vertically insert them into the holes. Knock the expansion bolts using a rubber mallet until the expansion sleeves are fully inserted into the holes.
  - Partially tighten the expansion bolts.
  - Remove the bolts, spring washers, and flat washers.
- The figure shows the secured installation. If non-secured installation is required, push the UPS to the installation position and lower the four leveling feet at the bottom of the cabinet using a wrench until all the four castors at the bottom hang in the air and the leveling feet fully support the cabinet. Check the cabinet levelness using a level. If the cabinet is not leveled, adjust the leveling feet.
- If secured installation is required based on non-secured installation, expansion bolts need to be installed. Therefore, the cabinet must be leveled in advance.

Installing a UPS Cabinet (2)

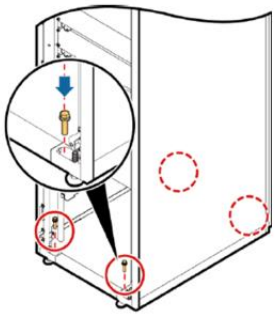
- Remove the rear cover from the cabinet and open the front door.
- Remove the four plugs (two at the front and two at the rear) from the bottom of the cabinet.
- Insert four M12x115 expansion bolts into the expansion bolt holes in the floor, and tighten the expansion bolts.



Removing the rear cover



Removing plugs



Tightening expansion bolts

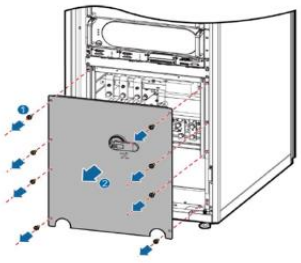
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- If there are two or more cabinets for a UPS, they can be transported in different batches and then combined during installation. When separating cabinets, remove the busbars and connecting kits between cabinets. Keep the busbars (copper bars) and connecting kits properly.

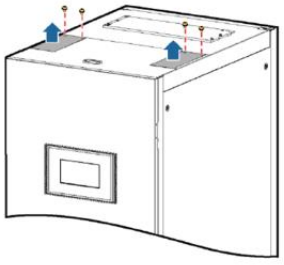
Electrical Connections: Power Cables (1)

- Top cabling
  - When the maintenance bypass switch is OFF, open the front door and remove the front cover from the power distribution subrack.
  - Remove the covers from the top of the cabinet.
  - Connect ground cables.

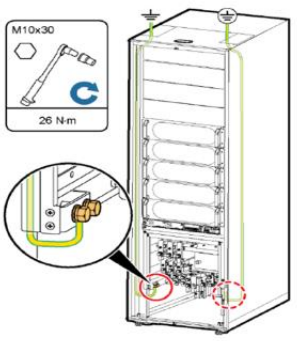
Removing the cover



Removing the cable covers from the top of the cabinet



Connecting ground cables

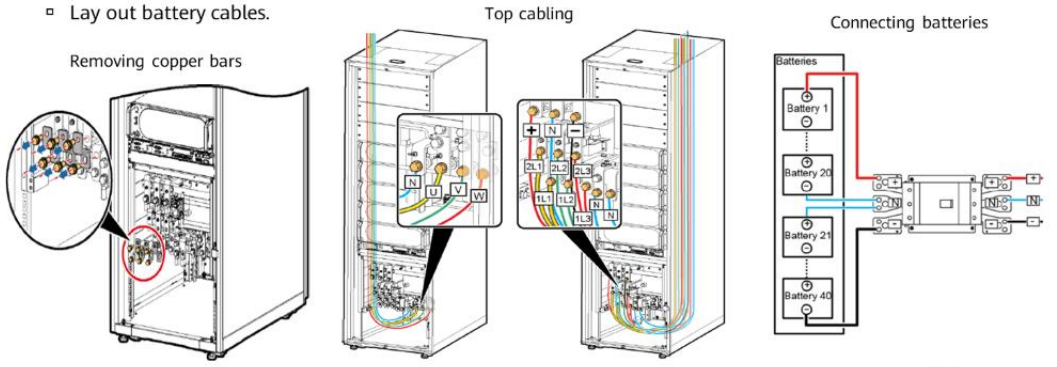


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- Notes:
  - Route cables from inside out.
  - Before connecting cables, ensure that all UPS upstream input switches are OFF.
  - You need to prepare OT terminals onsite. The length of the copper wire should be the same as that of the part of the OT terminal that covers the conductor.
  - The FusionPower series uses busways for input and output, which are connected using copper bars. For other UPS models, cables are used for input and output.
-  : internal equipotential bonding label.
-  : protection grounding label.

Electrical Connections: Power Cables (2)

- Top cabling
  - Lay out input and output power cables, and remove the copper bar between the main input and bypass input wiring terminals (the main input and bypass input use different power sources).
  - Lay out battery cables.

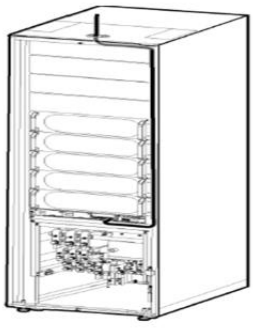


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- When the main input and bypass input share a power source, you do not need to remove the copper bar between the mains input and bypass input wiring terminals or connect the bypass input power cable.
- Connecting batteries: A neutral wire is routed from the middle of the positive and negative battery strings. Take a battery string consisting of 40 batteries for example. The battery neutral wire is routed from the middle of positive and negative battery strings, each consisting of 20 batteries.
  - Note: The UPS5000-S batteries have no neutral wire.
- U, V, and W indicate output power cables.
- L1, L2, L3, and N indicate input power cables.
- +, –, and N indicate battery cables.

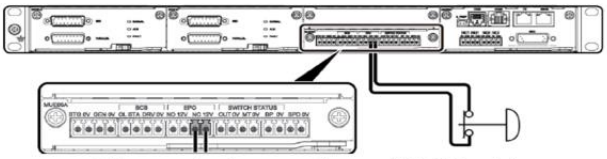
Electrical Connections: Control Cables

- Top cabling
  - Route the control cables for the left subrack along the left side of the cabinet and the control cables for the right subrack along the right side of the cabinet, and then bind the cables to the cabinet.

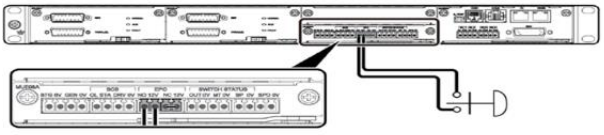


Connecting a control cable

Cable connection for a normally closed (NC) EPO switch



Cable connection for a normally open (NO) EPO switch

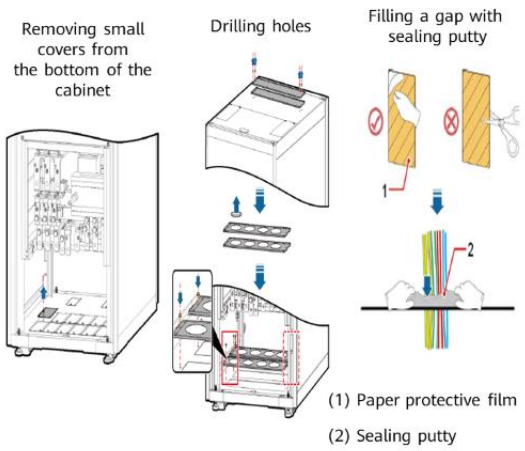


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- Control cables include communications cables and dry contact signal cables. The preceding figures show the cabling modes.
- Notes:
  - Huawei does not provide the emergency power-off (EPO) button or cable. Prepare them before installation.
  - Equip the EPO button with a protective cover to prevent misoperations, and protect the cable with a protective tube.
  - Triggering EPO will shut down the rectifier, inverter, charger, and static bypass, but does not disconnect the UPS mains input. To power off the UPS completely, turn off the upstream input switch when you trigger EPO.
  - When you use the NC status, remove the jumper between EPO_NC and EPO_12V first. When you turn off the EPO switch, EPO is triggered.
  - When you use the NO status, ensure that the jumper is connected between EPO_NC and EPO_12V. When you turn on the EPO switch, EPO is triggered.

Electrical Connections: Power Cables (1)

- Bottom cabling
  - Open the front door, and remove the front cover from the power distribution subrack.
  - Determine the cabling mode.
    - Remove small covers for routing cables.
    - Drill holes on the large covers for routing cables.
      - Remove the control cable covers and the small covers at the bottom.
      - Remove the two large covers from the top of the cabinet, drill holes, and install them on the positions where the small covers were placed.

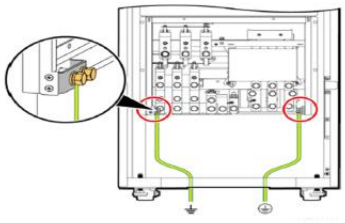


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- Notes:
  - The number of holes to be drilled is for reference only.
  - If holes are drilled for routing cables, attach grommet strips on the hole edges to protect cables.
  - In the scenarios where holes are drilled or covers are removed for routing cables, use sealing putty to fill in the gaps between the cables and the cabinets after routing cables and checking cable connections.

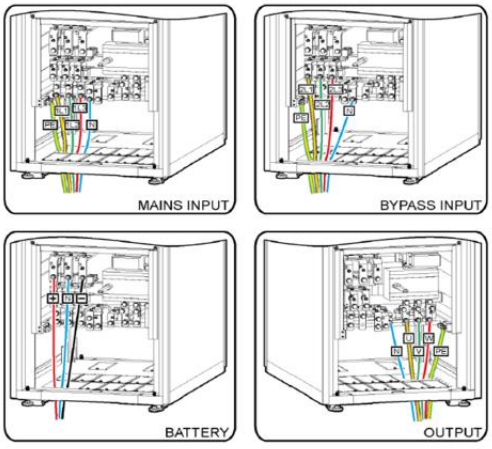
Electrical Connections: Power Cables (2)

- Bottom cabling
  - Connect ground cables.
  - Route power cables (the main input and bypass input use different power sources).
    - Remove the copper bar between the mains and bypass input wiring terminals. This section describes cable routing after the small covers are removed.



Grounding

Routing power cables from the bottom of the cabinet



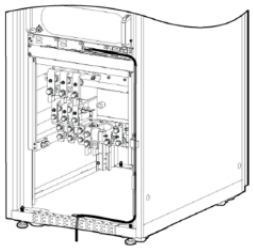
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- When the main input and bypass input share a power source, you do not need to remove the copper bar between the main input and bypass input wiring terminals or connect the bypass input power cable.

Electrical Connections: Control Cables

- Bottom cabling
  - Route the control cables for the left subrack along the left side of the cabinet and the control cables for the right subrack along the right side of the cabinet, and then bind the cables to the cabinet.

Connecting control cables



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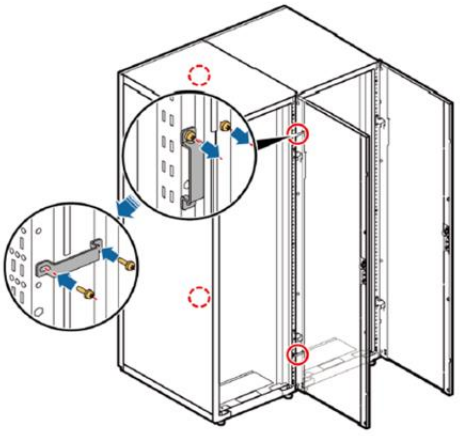
1. Preparations
2. **Installation**
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   - **Installing a Parallel System**
3. Installation Verification

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Mechanical Installation

- Install the UPS one by one in a parallel system by following the method of installing a single UPS.
- Remove the screws from the connecting kits at the front and rear of the cabinet, route the connecting kits through the reserved holes, connect the two UPS, and tighten the screws.

Installing connecting kits



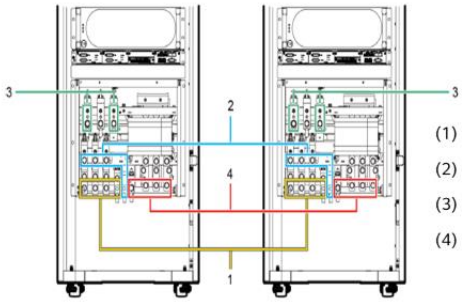
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- Note: The installation positions of connecting kits for different UPS models are different. Connecting kits are required for connecting UPS of different models. This slide uses the UPS5000-E-200K-SM as an example.

Connecting Power Cables

- Ground each UPS in a parallel system separately, and connect power cables and battery cables by following the method of installing a single UPS.
- Connect cables for the parallel system based on site requirements.

Cable connections for a 1+1 parallel system



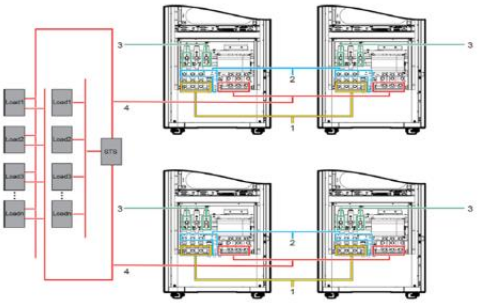
(1) Mains input

(2) Bypass input

(3) Battery input

(4) Output

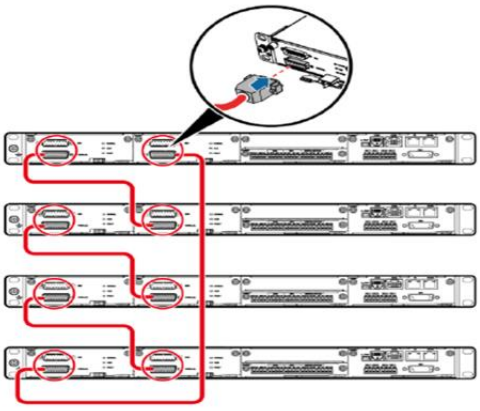
Cable connections for a dual-bus parallel system



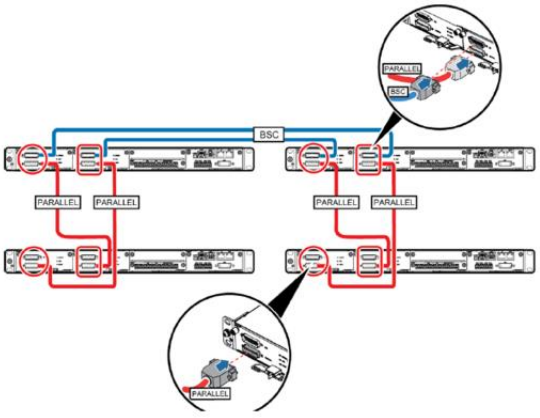
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Connecting Control Cables

Parallel cable connections in an N+X system



Parallel cable connections in a dual-bus parallel system



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Contents

1. Preparations
2. Installation
3. Installation Verification

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Installation Verification (1)

Checklist

Item	Acceptance Criterion
UPS installation	The UPS is securely installed and does not tilt due to vibration.
Neat arrangement	The UPS and its adjacent cabinets are neatly arranged and secured with connecting kits.
Cable layout	Cables are routed properly as required by the customer.
Cable labels	Both ends of a cable are labeled. Labels are concise and easy to understand.
Cable ties	Cable ties are secured evenly and no burr exists.
Cable connections	The input, output, and battery cables are securely connected. For the cables secured by screws, the spring washers are flattened.
Reliable grounding	The resistance between the UPS ground bar and the equipment room ground bar is less than 0.1 ohm.
AC phase sequence	For a single UPS, the mains input, bypass input, and output phase sequences are correct. For a parallel system, the phase sequences of each UPS are consistent.
Battery cable connections	The battery strings are correctly connected to the UPS.
Foreign matter cleaning inside the cabinet	The inside and outside of the cabinet are free from conductive dust or other sundries. There is no foreign matter (such as copper wires and screws) on the top of the cabinet, on the copper bar terminals, near the switch terminals, on the bottom plate of the cabinet, or on the rear module subrack.

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- Purpose: To ensure that no fault is caused by improper installation when the UPS is operating
- Prerequisites: The power system is properly installed. Input and output power cables, communications cables, dry contact signal cables, and parallel cables are connected.
- Note: Pay special attention to the last three items. If any problem occurs, the UPS may be damaged.

Installation Verification (2)

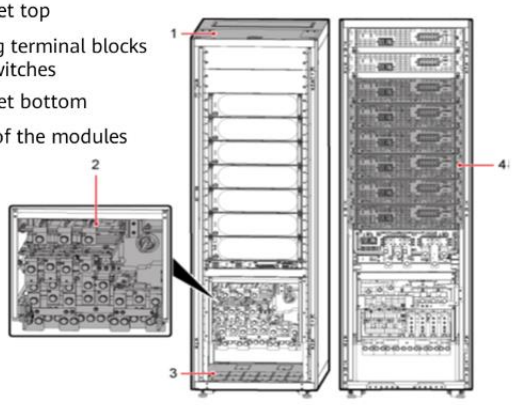
Positions for checking foreign matter (UPS5000-E-300K-SM)

(1) Cabinet top

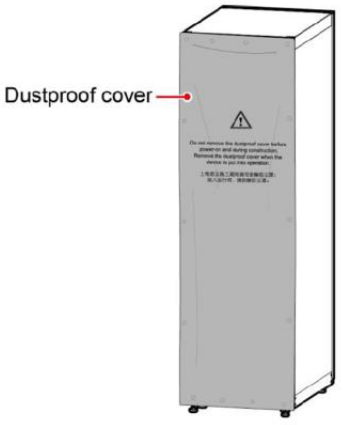
(2) Wiring terminal blocks and switches

(3) Cabinet bottom

(4) Rear of the modules



Dustproof cover



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- Notes:
  - After verifying the installation, reinstall all the covers.
  - If the cabinet is not powered on after installation, use a dustproof cover to prevent dust accumulation inside the cabinet. Do not remove the dustproof cover before powering on the cabinet.

Quiz

1. (short-answer question) How do I connect parallel cables for a parallel system?
2. (short-answer question) What are the steps of UPS installation?

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- Answer to question 1: Cables of each UPS are connected in a loop.
- Answer to question 2:
- Preparations
  - Check that the UPS is intact and the UPS model is correct.
  - Check that environment requirements are met.
- Installation
  - Install the UPS and battery system.
  - Separately install UPS in a parallel system.
- Electrical connection
  - Includes connections of power cables and signal cables.
  - Cables must be connected in order and securely.
- Installation Verification
  - Checking after installation is mandatory.

Summary

- This chapter describes the following aspects:
  - UPS5000 installation preparations.
  - UPS5000 installation procedure, including installing a single UPS and installing a parallel system.
  - UPS5000 installation verification.

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Thank you.

把数字世界带入每个人、每个家庭、
每个组织，构建万物互联的智能世界。

Bring digital to every person, home, and organization for a fully connected, intelligent world.

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UPS5000 LCD Operations and Commissioning



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Foreword

- The slides describe the LCD operations and commissioning of the UPS5000, including parameter settings and common operations.

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Objectives

On completion of this course, you will be able to:

- Get familiar with the menu operations of the UPS5000.
- Get familiar with the commissioning procedure of the UPS5000.
- Get familiar with the commissioning and acceptance of the UPS5000.

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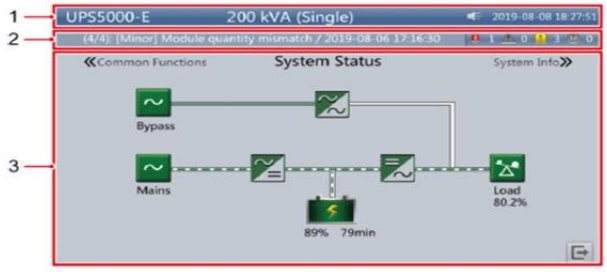
Contents

1. LCD Operations
2. Commissioning

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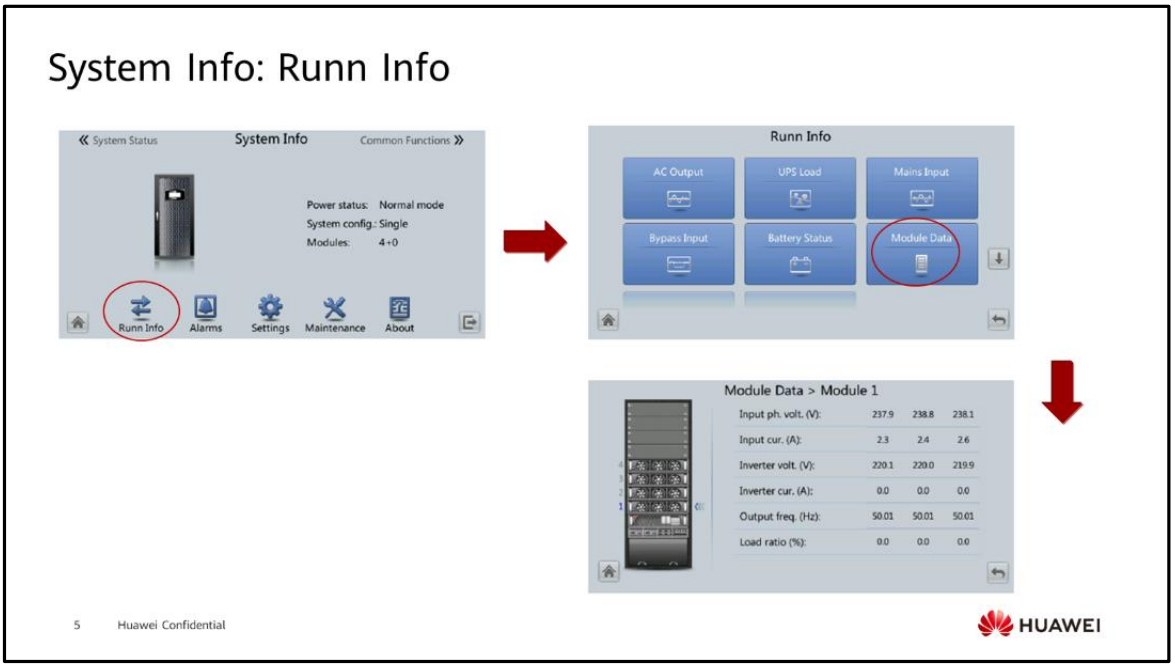
Main Menu

Main menu



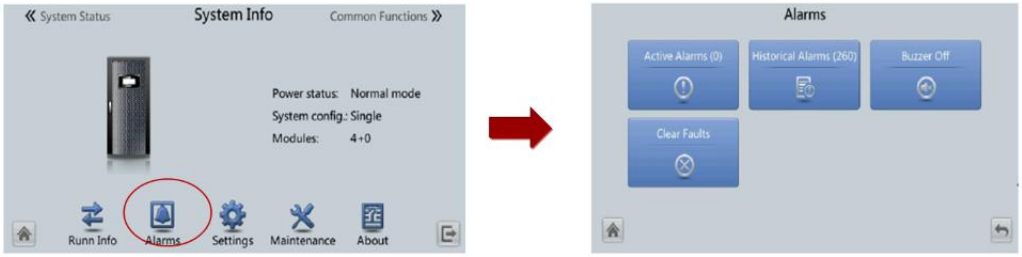
1	Status bar	Provides the system model, capacity, configuration, current date and time, USB flash drive status, and buzzer status.
2	Alarm bar	Displays active alarms in a scrolling list and the number of active alarms based on severity. Users can tap the alarm icon to enter the active alarm screen.
3	Information area	Displays the current power flow and key information about loads and batteries. Tap icons for **Bypass**, **Mains**, **Battery**, and **Load** to view details.

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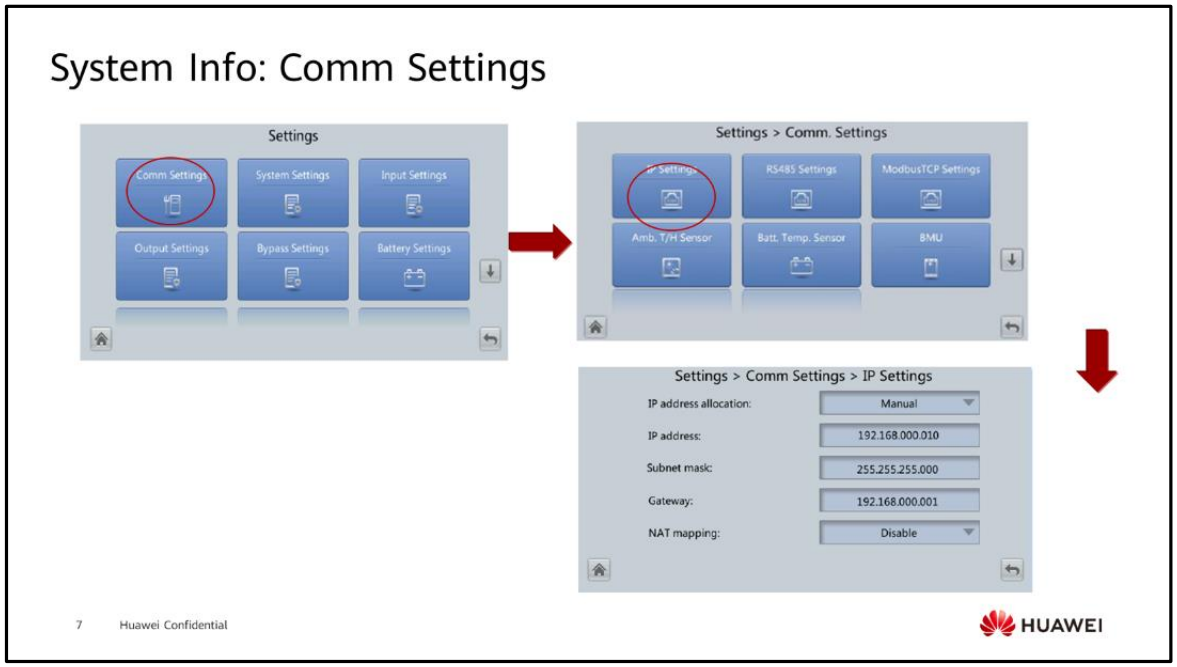
- Menu description
  - AC Output: displays Phase voltage (V), Line voltage (V), Phase current (A), Frequency (Hz), and Power factor.
  - UPS Load: displays Active power (kW), Apparent power (kVA), Reactive power (kvar), and Load ratio (%).
  - Mains Input: displays Phase voltage (V), Line voltage (V), Phase current (A), Frequency (Hz), and Power factor.
  - Bypass Input: displays Phase voltage (V), Line voltage (V), Phase current (A), Frequency (Hz), and Power factor.
  - Battery Status: displays Battery Status (charging and discharging), Voltage (V), Current (A), Temperature (°C), Remaining cap. (%), Backup time (min), SOH (state of health), Maximum Cell Temperature (°C) (only for lithium batteries), and Min Cell Temperature (°C) (only for lithium batteries).

System Info: Alarms

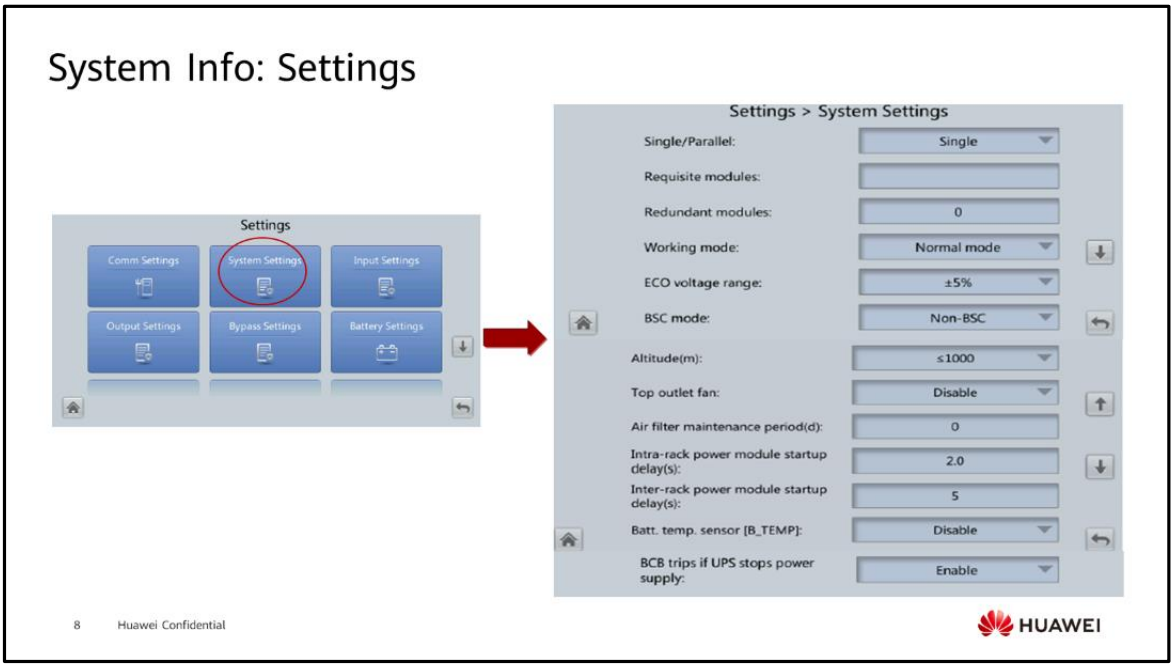


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- Active Alarms: displays the alarm severity, alarm name, alarm ID, location, and generation time.
- Historical Alarms: displays the alarm severity, alarm name, alarm ID, location, generation time, and clearance time.
- Clear Faults: Most alarms are automatically cleared after faults are rectified. However, some major alarms are not automatically cleared after faults are rectified. Engineers need to manually clear these alarms to ensure security.



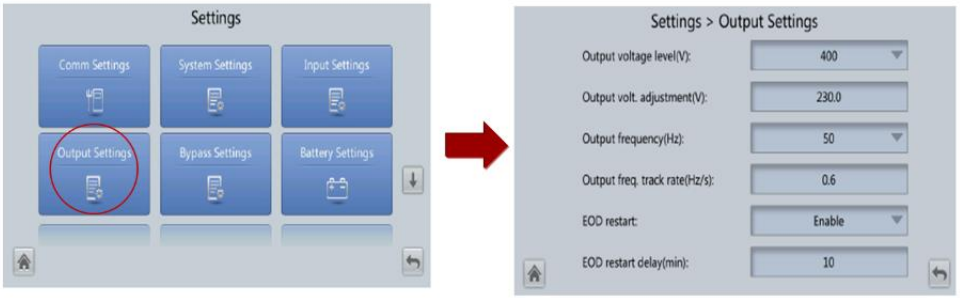
- IP Settings
  - IP address allocation: If the MDU is connected to a computer over a network cable, the IP address can only be allocated manually. The IP addresses of the MDU and computer must be on the same network segment, and must be different. If the MDU is connected to a computer over a LAN switch or router with the DHCP function, the IP address can be allocated manually or automatically. IP address allocation is set to Manual by default.
- RS485 Settings: This parameter is set only when the UPS communicates with third-party monitoring software. RS485 Settings includes Address, Baud rate, Parity mode, and Stop bit.
- The ambient temperature and humidity (T/H) sensor, battery temperature sensor, and battery monitor unit (BMU) are southbound devices and communicate over serial ports. The Amb. T/H Sensor, Batt. Temp. Sensor, and BMU parameters include Start address and Quantity.
- Note: The battery system in the upper right figure is lead-acid battery. If the battery system is SmartLi, Batt. Temp. Sensor and BMU disappear, and Battery System is displayed.



- Single/Parallel: specifies whether the UPS works in single mode or parallel mode. Requisite modules: matches the capacity of the entire system.
- Redundant modules: This parameter is set based on the load power and redundancy requirements.
- Working mode: specifies the UPS working mode. Normal mode, ECO, Self-load mode, or Converter mode can be set. By default, Normal mode is used.
- ECO voltage range: In ECO mode, when the difference between the bypass voltage and the rated voltage is greater than the specified value, the system determines that the ECO voltage is abnormal and transfers to inverter mode.

- BSC mode:
    - If the system is a dual-bus system, this parameter is set to Standard BSC.
    - After setting this parameter to Standard BSC, you need to set the two UPS systems in the dual-bus system to BSC master system and BSC slave system respectively in the BSC master/slave system setting. (The two UPS systems cannot be BSC master systems or BSC slave systems at the same time. If you need to change the settings in the future, perform operations under the guidance of maintenance engineers.)

System Info: Output Settings



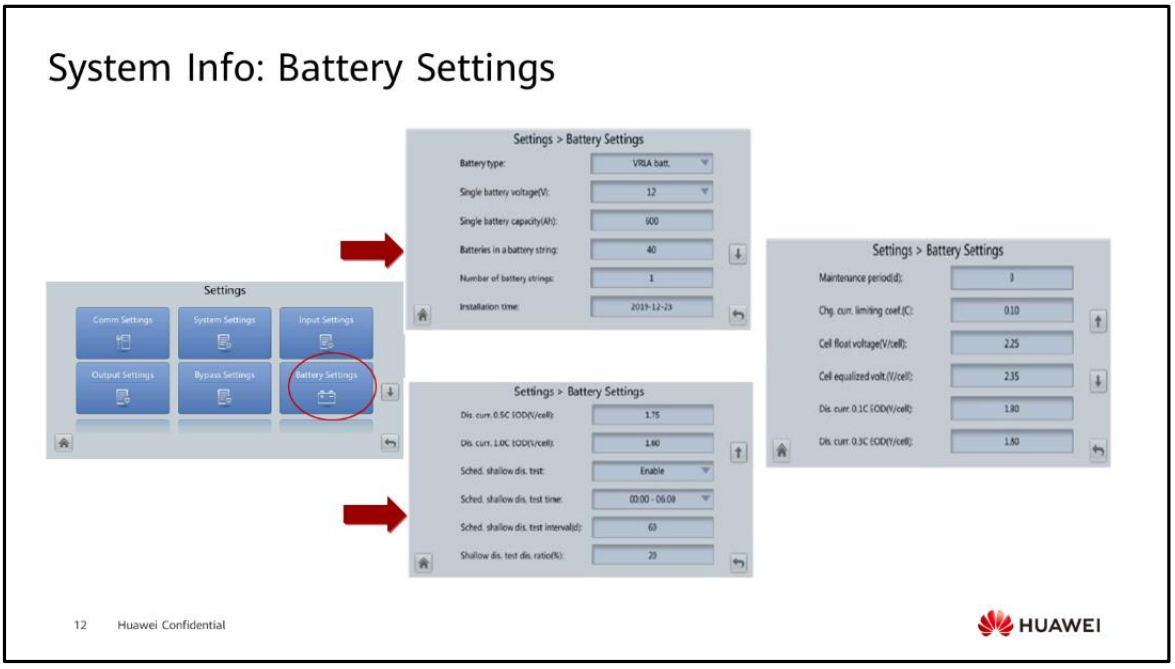
- Output voltage level(V): specifies the output voltage level of the system. This parameter can be set only when the inverter is shut down. After you change the voltage level, the upper limit of the bypass voltage restores to the default value.
- Output volt. adjustment(V): The output voltage can be slightly adjusted based on the onsite power distribution condition to ensure a minimum difference between the output voltage and the bypass voltage and to facilitate uninterruptible power supply when the UPS transfers from normal mode to bypass mode.
- Output frequency(Hz): specifies the output frequency level of the system.
- Output freq. track rate(Hz/s): This parameter can be adjusted based on site requirements. If the output frequency track rate is slow, the inverter frequency is different from the bypass frequency when the bypass frequency changes. If the output is overloaded or the inverter is faulty, an interruption (less than 20 ms) occurs when the UPS transfers from normal mode to bypass mode. If the output frequency track rate is fast, the inverter frequency may be unstable.
- EOD restart: The UPS transfers to battery mode when the mains becomes abnormal. If this parameter is set to Enable, when the UPS powers off because batteries reach the end-of-discharge (EOD) threshold and the bypass is unavailable, the UPS will restart as soon as the mains resumes. If this parameter is set to Disable, you need to manually rectify the fault and then start the UPS, or you can set this parameter to Enable.
- EOD restart delay(min): When EOD restart is set to Enable and the input power to the UPS recovers after power-off due to battery EOD, the UPS starts supplying power when the time reaches the preset EOD restart delay.

System Info: Bypass Settings



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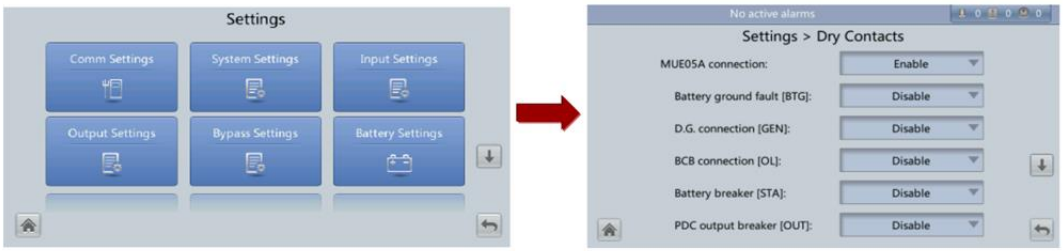
- Maximum bypass voltage: When the difference between the bypass voltage and the rated voltage exceeds this value, the system determines that the bypass voltage is abnormal, and the bypass is unavailable.
- Minimum bypass voltage: When the difference between the bypass voltage and the rated voltage exceeds this value, the system determines that the bypass voltage is abnormal, and the bypass is unavailable.
- Bypass frequency range (Hz). When the difference between the bypass input frequency and the rated frequency is greater than this value, the system determines that the bypass frequency is abnormal, and the bypass is unavailable.



- Battery parameter settings are critical to battery maintenance, battery lifespan, and UPS discharge time. When you set battery parameters, note the following:
  - Battery string sharing is unavailable when Single/Parallel is set to Single.
  - Battery string sharing affects the actual charge current and the estimated discharge time. Incorrect setting will cause a high or low charge current, which tends to damage batteries. An incorrect estimated discharge time may cause a data backup failure.
  - When you set parameters, ensure the following: Dis. curr. 0.1C EOD ≥ Dis. curr. 0.3C EOD ≥ Dis. curr. 0.5C EOD ≥ Dis. curr. 1.0C EOD.
  - A cell consists of electrodes and electrolyte and is the basic unit of a battery. Each cell has a nominal voltage of 2 V. A battery is a module consisting of a single cell or multiple cells assembled in a shell. Each battery has a nominal voltage of 2 V, 6 V, or 12 V.
- Battery parameters:
  - Battery type: VRLA batt. Note: If the battery type is SmartLi, you only need to set Sched. shallow dis. test, Sched. shallow dis. test time, Sched. shallow dis. test interval, and Shallow dis. test dis. ratio. Other parameters are automatically identified by the system and do not need to be set.
  - Single battery voltage: specifies the voltage of each battery connected in series in a battery string.
  - Single battery capacity: specifies the capacity of each battery connected in

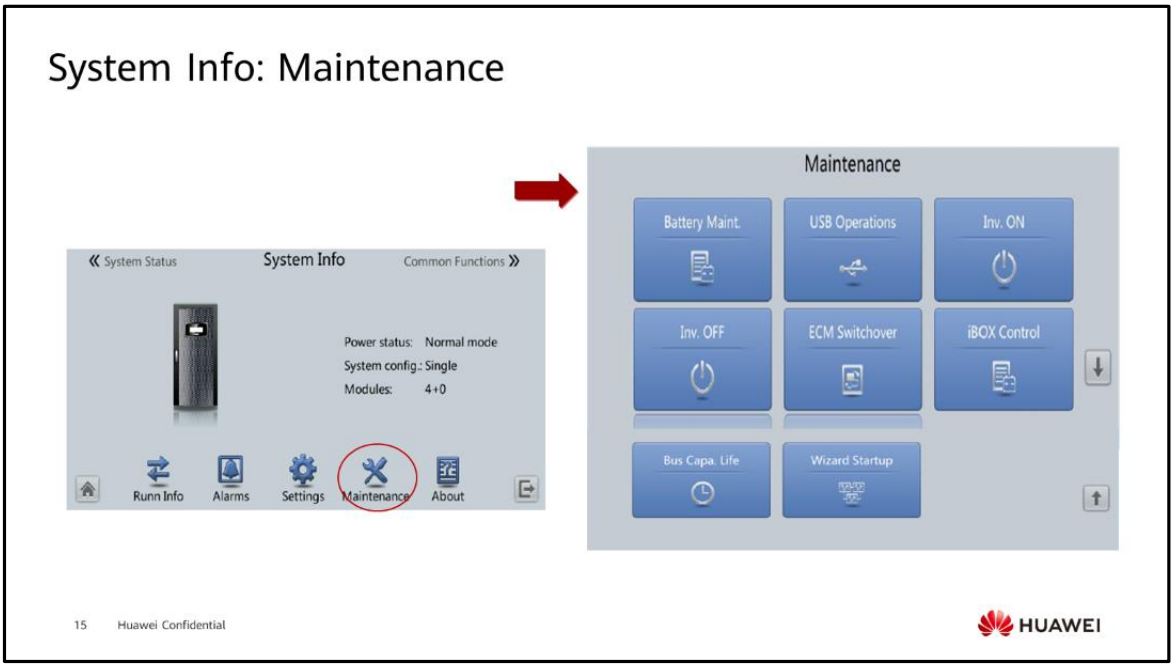
System Info: Dry Contact Set

- Before setting the dry contact data, set **MUE05A connection** to **Enable**. If a backfeed protection card is configured, set **MUE06A connection** to **Enable**.
- If an optional component is not configured, set the corresponding parameter to **Disable** to prevent misoperations.



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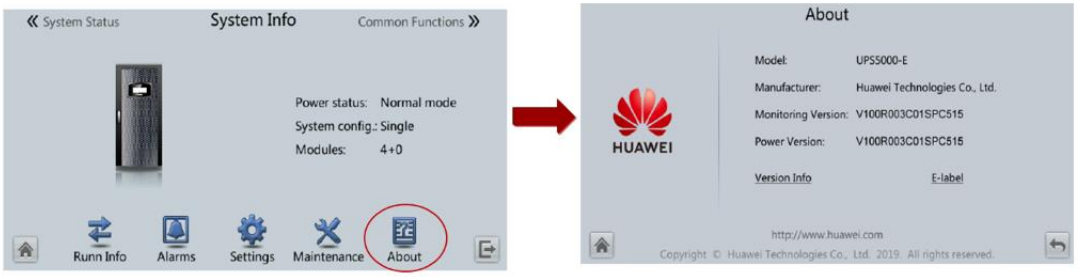
- Notes:
  - When you configure dry contacts, you need to set associated dry contacts. Otherwise, the UPS may not run properly.
  - When you disable a dry contact card, the related dry contact signals are disabled.
  - Dry contact signals are displayed on the screen only when you enable the corresponding dry contact card.
  - When a dry contact card is not connected or some dry contacts of a dry contact card are not used, disable the card or the unused dry contacts on the screen to prevent false alarms.
- Dry contact settings involve the following four dry contact cards:
  - Dry contact card (MUE05A): provides dry contact signals for the battery grounding failure detector, DG, BCB, and PDF.
  - Backfeed protection card (MUE06A): provides backfeed protection signals. You only need to enable or disable the card.
  - Monitoring interface card (MUS05A): provides four configurable system output dry contact signals.
  - Dry contact extended card (MUE07A): currently provides five input and five output signals.



- Battery Maint.: Perform battery maintenance when no alarm is generated on the UPS. Otherwise, power output may fail. A proportion of battery capacity discharges during battery maintenance. This reduces the discharge time before the next charge.
    - Forced Equalized Charging: allows you to perform equalized charging on batteries forcibly.
    - Shallow Dis. Test: allows you to partially discharge batteries. A shallow discharge test is conducted to test the battery loop reliability and short-time discharge capacity when the batteries have not been discharged for a long time.
    - Capacity Test: allows you to fully discharge batteries. A deep discharge test is conducted to obtain the battery discharge performance data.
- USB Operations: allows you to export Fault Data and perform Export Config., Upgrade Software, BSP Upgrade, and Import Config.
- Inv. ON: allows you to start the inverter manually.
- Inv. OFF: allows you to shut down the inverter manually.
- ECM Switchover: If an ECM to be maintained is still working, perform ECM switchover (a dialog box is displayed for you to confirm this operation). After the switchover is complete, ensure that the ECM to be maintained is in standby state (that is, the green indicator is blinking) and then maintain it.

System Info: About

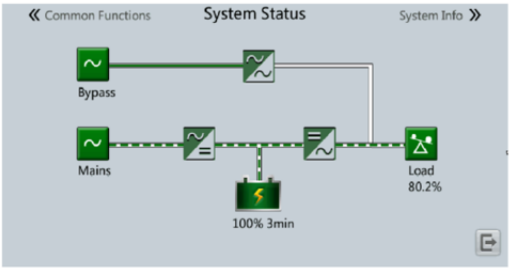
- On the **System Info** screen, tap **About** to view **Model**, **Manufacturer**, **Monitoring Version**, and **Power Version**. To view the detailed version information, tap **Version Info**.



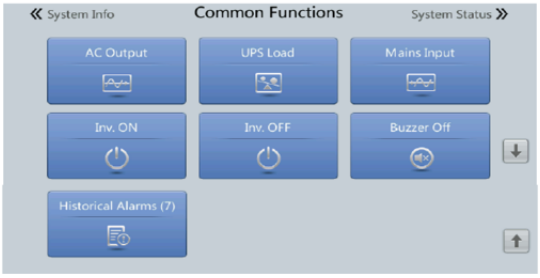
System Status and Common Functions

- On the **System Status** screen, you can view the data and information related to the mains input, bypass input, load, and battery by tapping corresponding icons.

System Status



Common Functions



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1. LCD Operations
2. **Commissioning**
   - Checking Before Power-On
   - Commissioning Process
   - Commissioning and Acceptance

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Checking Before Power-On

- Prerequisites
  - The UPS has been installed, electrical connections are finished, and the installation and connections have been verified.

No.	Item
01	Check that the UPS input switch, bypass switch, output switch, maintenance bypass switch, and battery circuit breaker are all OFF.
02	Check that the load switches are OFF, and the loads have shut down.
03	Check that the UPS input live wires and neutral wire are connected correctly, live wires are connected in a correct sequence, no short circuit occurs between the live wires and the ground cable, and the UPS output has no short circuit. **Check cable connections. If cables are not correctly connected, the UPS may be damaged upon power-on.**
04	Use a multimeter to measure the AC voltage of the upstream mains and bypass input switches. The AC input voltage must be 304–478 V AC. Otherwise, you need to start the UPS in non-mains mode.
05	Use a multimeter to measure the DC voltage of the upstream battery switch on the UPS to ensure that battery cables are correctly connected.

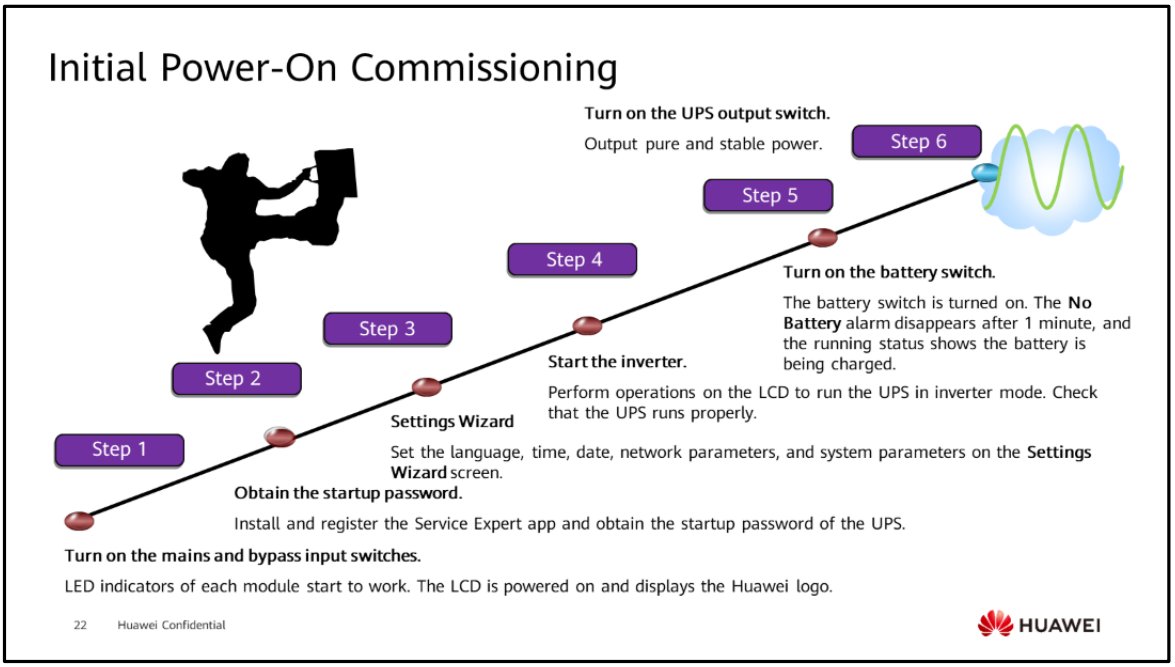
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- Objective: To ensure that the UPS system meets the electrical power-on conditions.

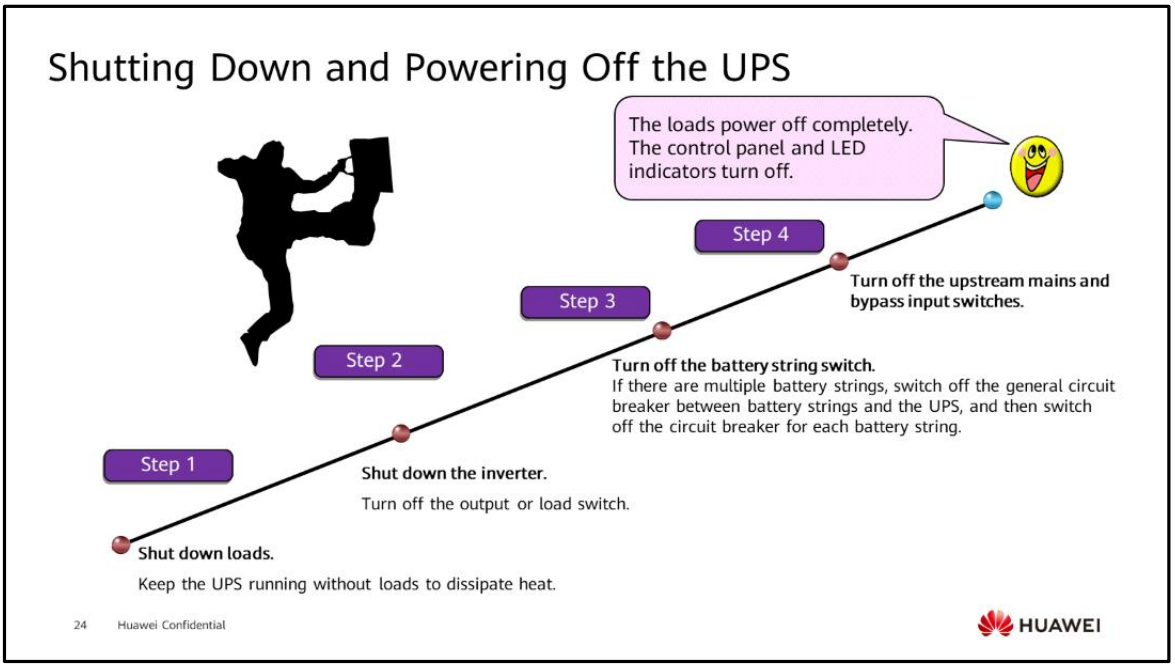
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- Commissioning of a single UPS is used as an example.
- Notes:
  - Settings Wizard
    - Set Single/Parallel after double check. Incorrect settings may affect the normal UPS operation.
    - Output voltage level refers to the line voltage level. Set it based on site requirements.
    - Set Output frequency (Hz) correctly. Otherwise, loads may be affected and the UPS may not work properly.
    - Battery parameter settings are critical to battery maintenance, battery lifespan, and UPS discharge time.
    - Set the time and date correctly. Incorrect time and date will cause false fault analysis during maintenance or repair, affecting the normal operation.
    - After network parameters are set, connect the UPS to the network to ensure that maintenance personnel can manage or control the UPS remotely. If you do not need remote management, retain the default network parameter settings.

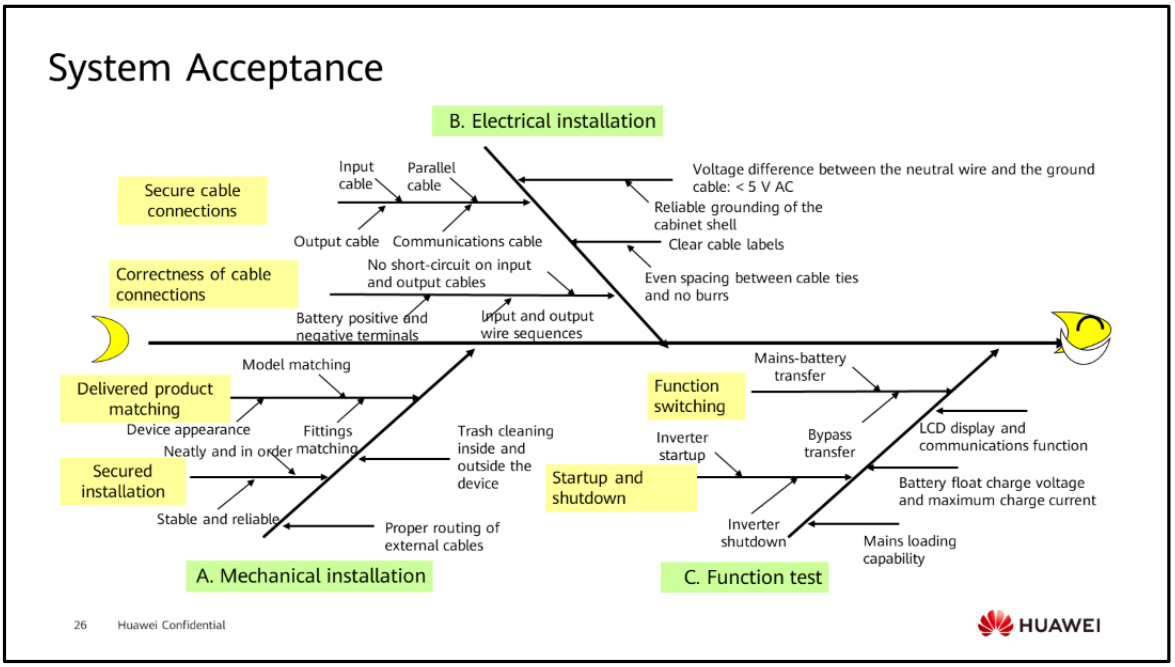


- If the bypass is normal, the UPS transfers to bypass mode after the inverter is shut down; if the bypass is abnormal, the UPS supplies no power after the inverter is shut down. Before shutting down the UPS, ensure that all loads have been shut down.

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   - **Commissioning and Acceptance**

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- System acceptance can be analyzed from the following three aspects:
  - Mechanical installation
  - Electrical installation
  - Function test

Key Acceptance Points (1)

Mechanical installation acceptance

Item	Acceptance Criterion
Equipment model and quantity	The model and quantity of the equipment installed onsite are consistent with those in the BOQ.
UPS installation	The UPS is securely installed and does not tilt due to vibration.
Neat arrangement	The UPS and its adjacent cabinets are neatly arranged and secured with connecting kits.

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- The preceding items are included in equipment acceptance.

Key Acceptance Points (2)

Electrical installation acceptance

Item	Acceptance Criterion
Cable layout	Cables are routed properly and meet customer requirements.
Cable labels	Both ends of a cable are labeled. Labels are concise and easy to understand.
Cable ties	Cable ties are secured evenly and no burr exists.
Cable through-current	Power cables meet the through-current requirements.
Cable connections	The input, output, and battery cables are securely connected. For the cables secured by screws, the spring washers are flattened.
Reliable grounding	The resistance between the UPS ground bar and the equipment room ground bar is less than 1 ohm.
AC phase sequence	For a single UPS, the main input phase sequence, bypass input phase sequence, and output phase sequence are correct. In a parallel system, the phase sequences of all UPS must be the same.
Battery cable connections	The battery strings are correctly connected to the UPS.

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- The preceding items are included in electrical installation acceptance.

Key Acceptance Points (3)

Function test acceptance

Item	Acceptance Criterion
Fan running	The fans are running properly.
LCD display	The LCD displays information normally without chromatic aberration or missing characters.
Parameter settings	The voltage mode, frequency, battery capacity, and number of cells are correctly set.
Alarms	No active alarm exists and the UPS is operating properly.
UPS load rate	The UPS load rate does not exceed 80%.
Disconnecting mains input	After the mains input is disconnected, the UPS transfers to battery mode.
Recovering mains input	After the mains input recovers, the UPS transfers to normal mode.
Shutting down the inverter	After the inverter is shut down, the UPS transfers to bypass mode.
Restarting the inverter	After the inverter is restarted, the UPS transfers to normal mode.
Current balancing	The current imbalance of a parallel system is less than 5%.

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- The preceding items are included in function test acceptance.

Quiz

1. (short-answer question) Which aspects require delivery acceptance?
2. (short-answer question) During delivery acceptance, which items should be checked before power-on?

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- Answer to question 1: mechanical installation, electrical connection, and function test
- Answer to question 2:
  - Check that the UPS input switch, bypass switch, output switch, maintenance bypass switch, and battery circuit breaker are all OFF.
  - Check that the load switches are OFF, and the loads have shut down.
  - Check that the UPS input live wires and neutral wire are connected correctly, live wires are connected in a correct sequence, no short circuit occurs between the live wires and the ground cable, and the UPS output has no short circuit.
  - Check cable connections. If cables are not correctly connected, the UPS may be damaged upon power-on.
  - Use a multimeter to measure the AC voltage of the upstream mains and bypass input switches. The AC input voltage must be 304–478 V AC. Otherwise, you need to start the UPS in non-mains mode.
  - Use a multimeter to measure the DC voltage of the upstream battery switch on the UPS. Ensure that the battery string voltage meets the requirements in the specifications table to prevent incorrect battery cable connections.

Summary

- This chapter describes the following aspects:
  - UPS5000 menu description and LCD parameters setting.
  - UPS5000 commissioning process, including checking before power-on, commissioning a single UPS and acceptance.

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Thank you.

把数字世界带入每个人、每个家庭、
每个组织，构建万物互联的智能世界。

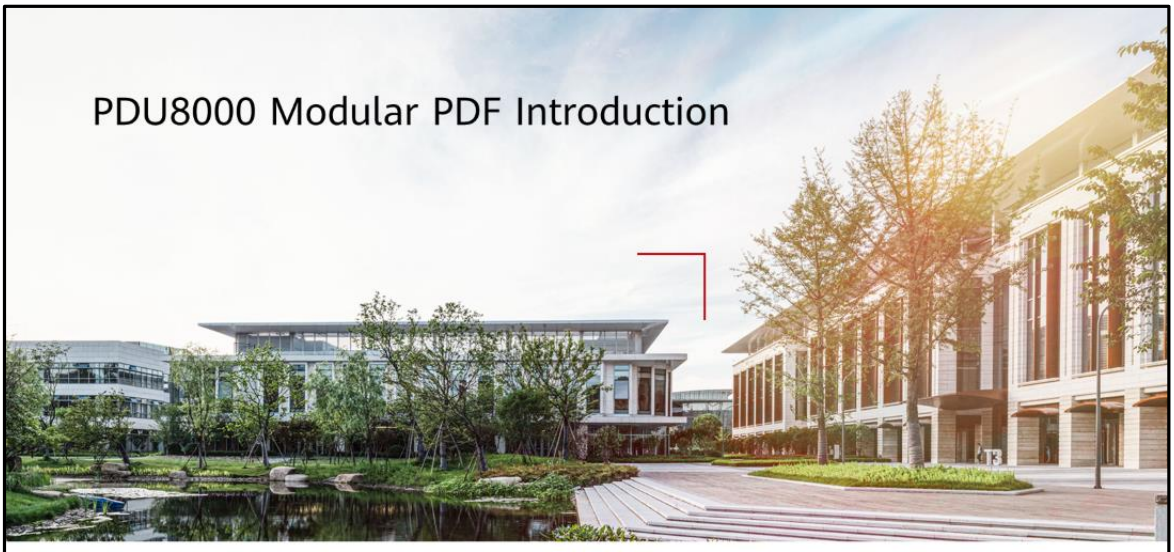
Bring digital to every person, home, and organization for a fully connected, intelligent world.

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PDU8000 Modular PDF Introduction



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Foreword

- The slides describe PDU8000 modular power distribution frames (PDFs), including the UPS modular PDF, modular precision PDF, and modular integrated PDF, as well as their application scenarios, structures, and working principles.

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Objectives

On completion of this course, you will be able to:

- Get familiar with the application scenarios of the PDU8000 modular PDF.
- Get familiar with the structures of the PDU8000 modular PDF.
- Get familiar with the working principles of the PDU8000 modular PDF.
- Get familiar with the commissioning processes of the PDU8000 modular PDF.

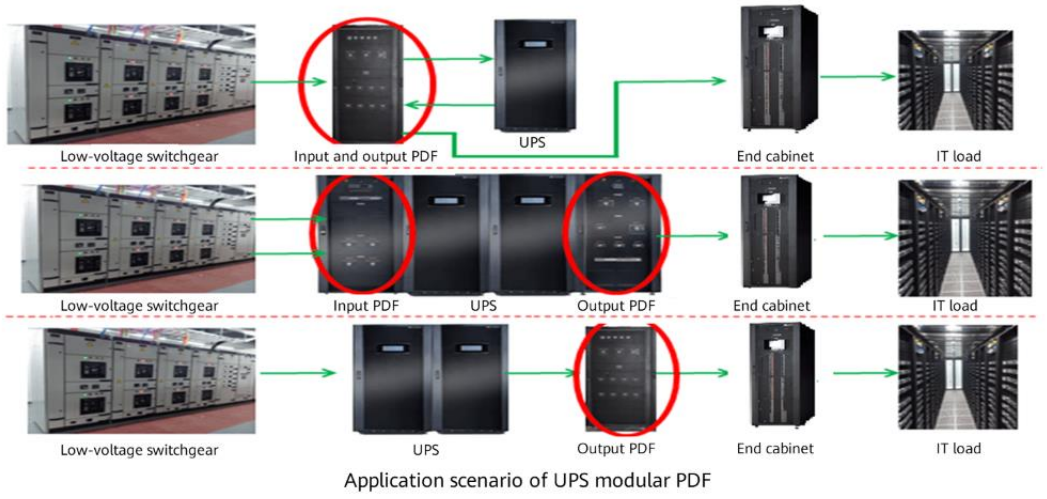
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Typical Application Scenarios



Application scenario of UPS modular PDF

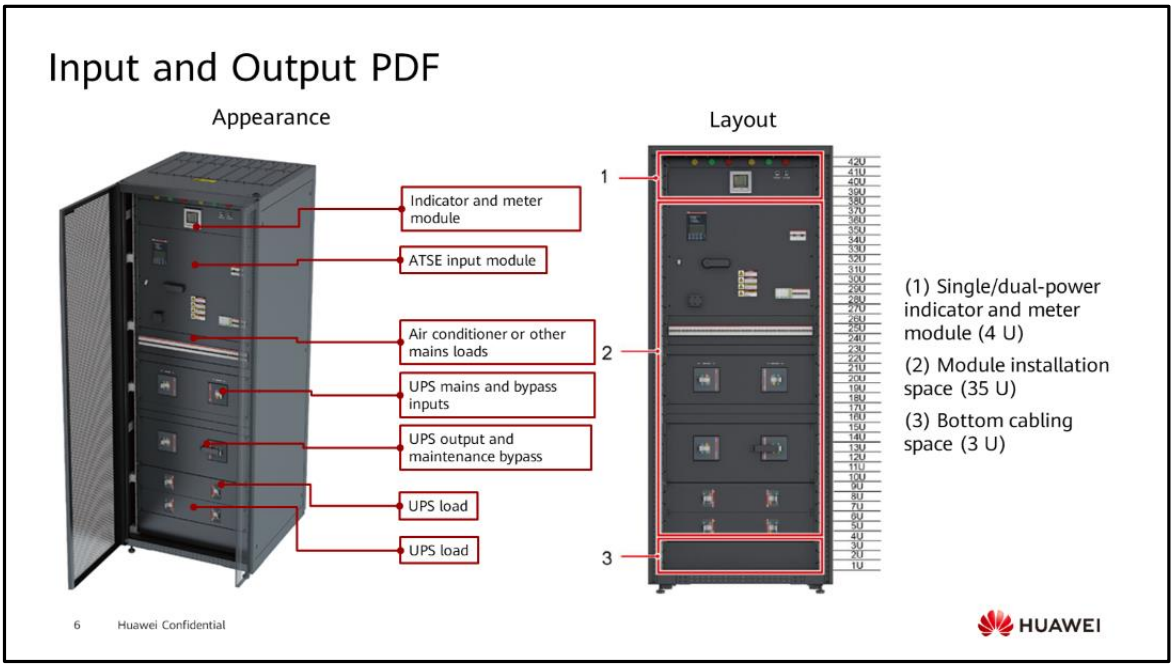
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- UPS modular PDF are classified into three types: input and output PDF, input PDF, and output PDF.

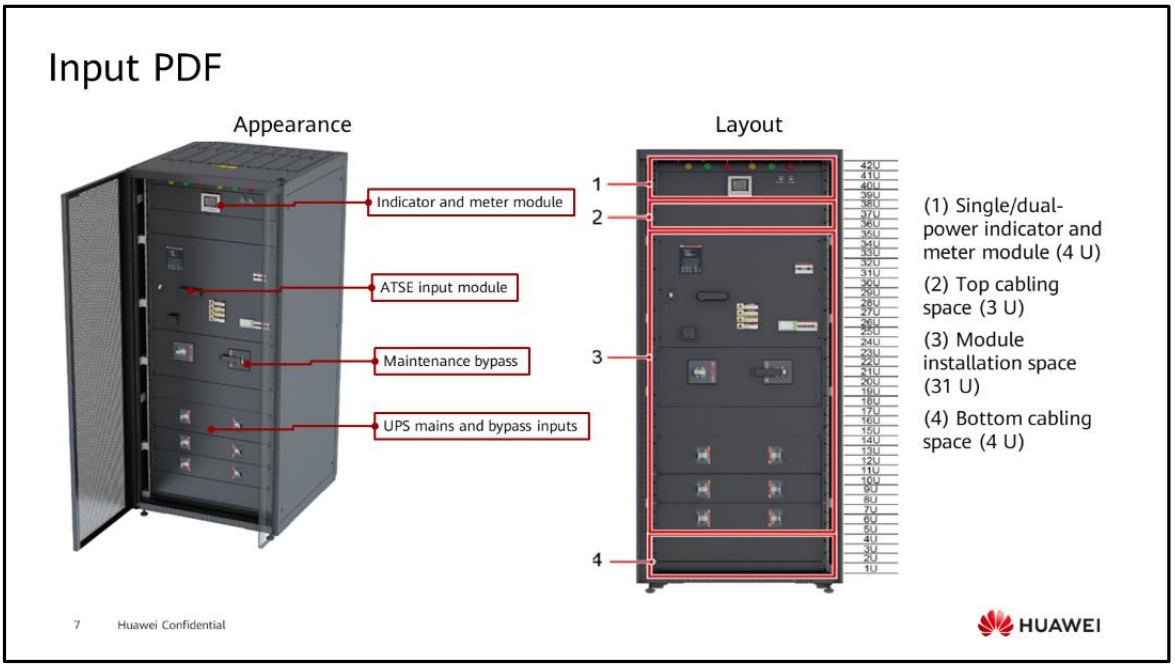
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- User module configuration:
  - The input module can be an ATSE input module or an MCCB input module. If an ATS input module is used, use a dual-power indicator and meter module. If an MCCB input module is used, use a single-power indicator and meter module.
- Technical specifications:
  - Dimensions (H x W x D): 2000 mm x 800 mm x 850 mm
  - Input module capacity (ATS): 400 A/630 A/800 A/1250 A/1600 A
  - Input module capacity (single MCCB): 400 A/630 A/800 A/1250 A
  - Output module capacity (MCCB): 160 A/250 A/400 A/630 A/800 A
  - Output module capacity (MCB): total capacity 500 A; 63 A/3P x 12 configuration
  - Surge protection level: Level C (Class II)
  - Cabling mode: top entry and top exit, or bottom entry and bottom exit



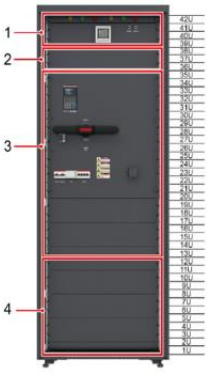
- The input module can be an ATS input module or an MCCB input module. If an ATSE input module is used, use a dual-power indicator and meter module. If an MCCB input module is used, use a single-power indicator and meter module.

Combined Input PDF

Appearance



Layout (master cabinet)



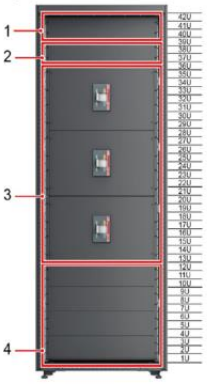
(1) Single/dual-power indicator and meter module (4 U)

(2) Top cabling space (3 U)

(3) Module installation space (23 U)

(4) Space for combined cabinets (12 U)

Layout (slave cabinet)



(1) Filler panel (4 U)

(2) Top cabling space (3 U)

(3) Module installation space (24 U)

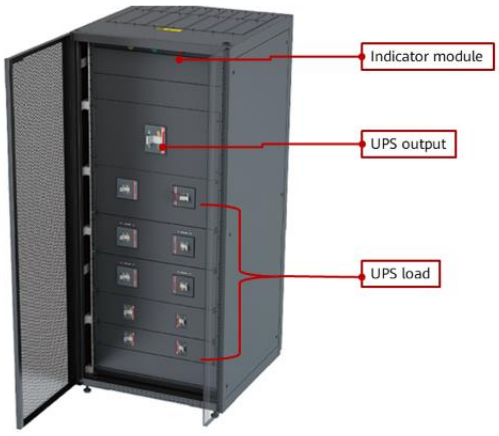
(4) Space for combined cabinets (12 U)

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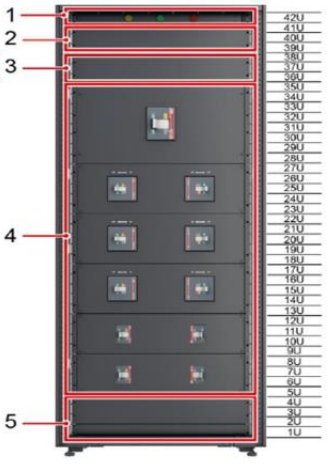
- The cabinet combination solution can be adopted when one cabinet does not meet the capacity requirement.

Output PDF

Appearance



Layout



(1) Single-power indicator module (1 U)

(2) Filler panel (3 U)

(3) Top cabling space (3 U)

(3) Module installation space (31 U)

(4) Bottom cabling space (4 U)

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Single-Power Indicator and Meter Module

- The single-power indicator and meter module is used in a scenario with a single power input. It provides three-phase power indicators, measures the current, voltage, harmonic, and frequency of the vertical bus of the mains input, and provides external secondary ports for the PDF.



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Dual-Power Indicator and Meter Module

- The dual-power indicator and meter module is used in a scenario with dual power inputs. It provides three-phase power indicators for each route, measures the current, voltage, harmonic, and frequency of the vertical bus of the ATSE, and provides external secondary ports for the PDF.



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MCCB Input Module

- The MCCB input module can have the current range of 400 A to 1250 A. It serves as the general input module of the UPS PDF and provides the following functions:
  - Receives power and provides power for downstream branches.
  - Provides overload and short-circuit protection for circuits.
  - Uses a level C surge protective device (SPD) to provide surge protection for the PDF.
  - Uses a current transformer to convert large current into the current that can be measured by an electric meter.



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ATS Input module

- The ATSE input module can have the current range of 400 A to 1600 A. It serves as the general input module of the UPS PDF and provides the following functions:
  - Receives power and provides power for downstream branches.
  - Uses a level C SPD to provide surge protection for the PDF.
  - Uses a current transformer to convert large current into the current that can be measured by an electric meter.



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MCB Output Module

- The MCB output module has twelve 63 A/3P loops. Its main functions are to distribute power and provide overload and short-circuit protection for circuits.



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MCCB Output Module

- The MCCB output module can have the current range of 160 A to 800 A. An output module with the rated current of 630 A or less has two loops. An output module with the rated current of more than 630 A has only one loop. Its main functions are to distribute power and provide overload and short-circuit protection for circuits.



MCCB output module with the rated current ≤ 630 A

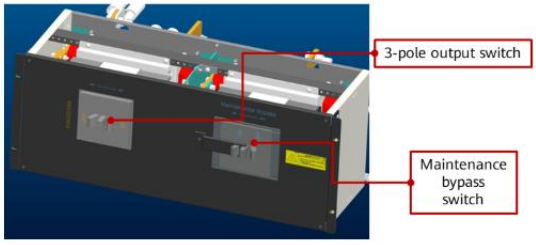


MCCB output module with the rated current > 630 A

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Maintenance Bypass Module

- The maintenance bypass module can have the current range of 160 A to 800 A. A maintenance bypass module with the rated current of 630 A or lower provides a maintenance bypass switch and a 3-pole output switch. A maintenance bypass module with the rated current of more than 630 A provides only one maintenance bypass switch.



Maintenance bypass module with the rated current ≤ 630 A



MCCB output module with the rated current > 630 A

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- The maintenance bypass switch connects the mains input bus to the UPS output bus. When the UPS is working properly, the maintenance bypass switch is OFF. Turn on the switch only when the UPS is faulty and requires maintenance. Similar to the MCCB output module, the 3-pole output switch distributes power and provides overload and short-circuit protection.

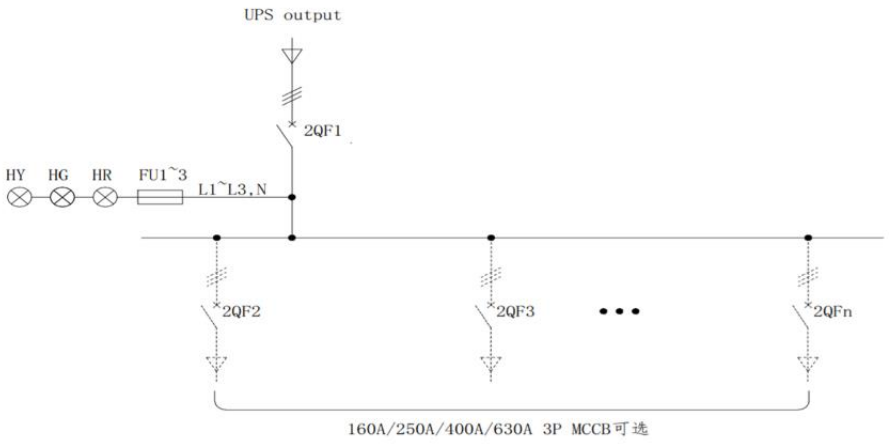
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Electrical Diagram of the Output PDF

Electrical diagram of the output PDF

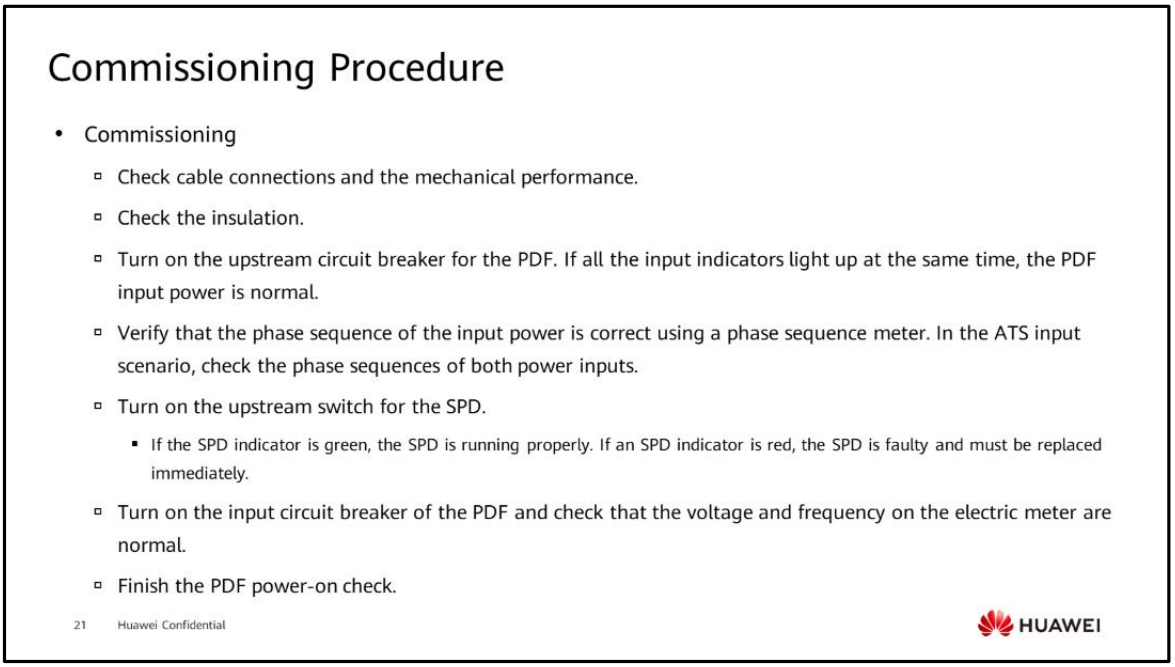


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- Check cable connections and the mechanical performance.
  - Check that cables are connected correctly outside the PDF. Check that all bolts are secured for cables and tighten a bolt if it is loose.
  - Check that ground cables are properly connected.
  - (Optional) Switch on and off all circuit breakers and the ATS three times. Ensure that they can be switched on and off smoothly.
- Check the insulation.
  - Switch off the circuit breaker QFS for the SPD in the input module of the PDF, and switch on other circuit breakers.
  - (Optional) Flip the ATS to I or II.
  - Check that the insulation resistances of the power distribution devices and feed circuit are no less than 0.5 megohms.
  - After checking, switch off all the circuit breakers.

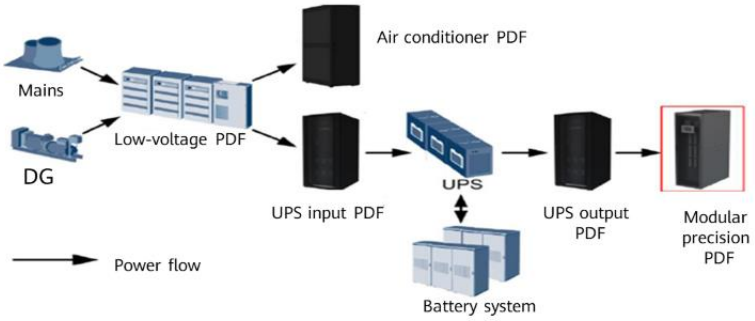
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Positioning

- The modular precision PDF is mainly used for power distribution and electric parameter measurement. It provides precision electricity management for critical loads in building or prefabricated data centers.



Positioning of the modular precision PDF

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- The PDU8000 modular precision PDF is equipped with a smart precision monitoring system. It provides comprehensive functions for power distribution, electrical parameter measurement, and alarm reporting.
- Features
  - Efficient and economical: Highly integrated in a unified architecture; easy to expand and back up thanks to a modular design, and can be maintained from the front and rear; small footprint (H x W x D: 2000 mm x 600 mm x 1200 mm), saving land costs, enabling flexible deployment, and reducing delivery costs; compatible with cabinets of low to high power density
  - Secure and reliable: Certified by CCC and CE; passed high/low temperature reliability tests; hot-swap of monitoring boards and isolation of electrical circuits from ELV circuits, ensuring electrical reliability
  - Intelligent monitoring: Strong networking capability for teleindication, telemetry, and teleadjusting; intelligent measurement and monitoring; real-time monitoring and alarm reporting

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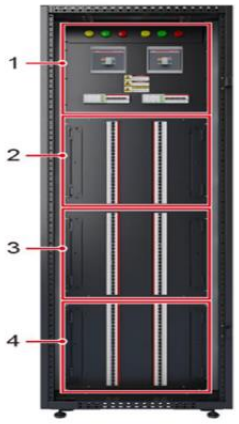
Appearance

Precision PDF with a single input



(1) Input module
(2) Output module 1
(3) Output module 2
(4) Output module 3

Precision PDF with dual inputs



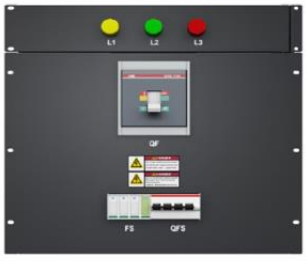
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- In this example, all of three output modules are configured.
- The cabinet height is 42 U. The height of the input module and output modules is 10.5 U. The number of output MCBs is determined based on customer requirements.
- The MCBs can be single-phase or three-phase 16 A/20 A/32 A/40 A and support up to 144 single-phase routes or 48 three-phase routes.
- A maximum of three output modules are supported.

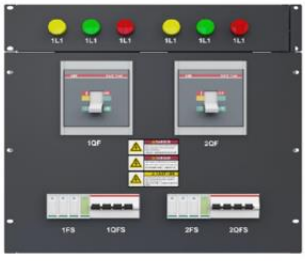
MCCB Input Module

- Functions
  - Provides overload and short circuit protection.
  - Collects currents.
  - Provides level C surge protection.

Single MCCB input unit



Dual MCCB input unit

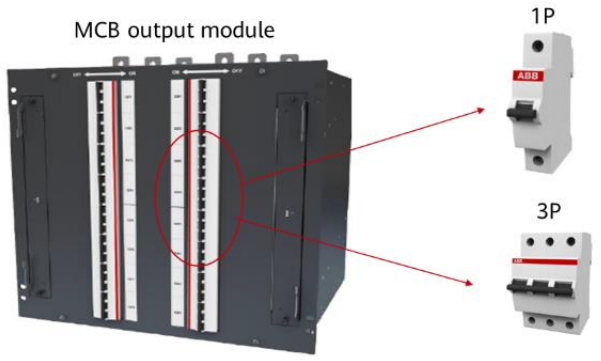


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- Input capacity: 400 A/250 A/160 A

MCB Output Module

- Functions
  - Distributes power, and provides overload and short-circuit protection.



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- The MCBs can be 16 A/20 A/32 A/40 A single-phase or three-phase.

Monitoring Module

- The monitoring module is used to display and monitor electrical parameters. It consists of the monitor display unit (MDU), monitoring board, and signal cables.

MDU



Monitoring board



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- Functions of the monitoring board
  - Collects parameters such as circuit breaker status, and voltages and currents of the main and branch routes.
  - Calculates the main route electric energy, frequency, voltage, current, active power, and reactive power based on the collected parameters.
- Functions of the MDU
  - Allows users to set PDF parameters and view the PDF operating status and alarms.
  - Upgrades software.
- Indicators on the MDU
  - Red: A critical alarm has been generated, and the buzzer buzzes.
  - Yellow: A major alarm has been generated, and the buzzer buzzes at an interval of 0.5s.
  - Green: A warning has been generated, or the MDU is running properly.
  - Off: The MDU is powered off.

Monitoring Module - MDU (1)

MDU rear view

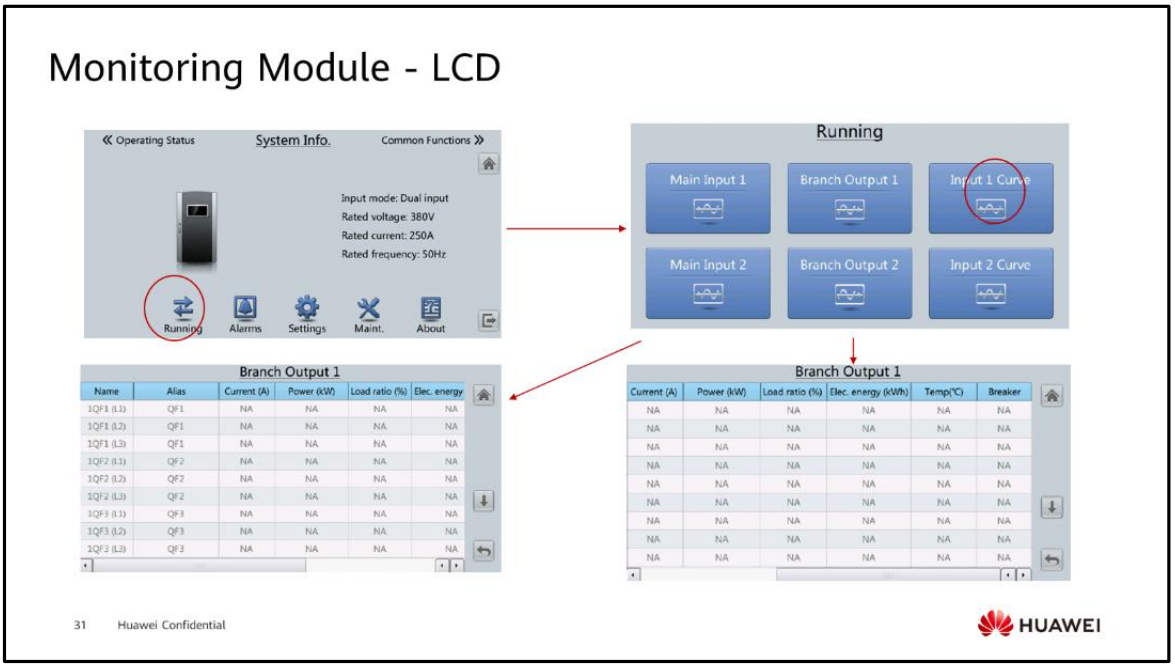


MDU port description

No.	Port	Description
1	MUS05A	Internal port
2	FE	Network port connecting to the management system when SNMP is used
3	CAN	Internal communications and power supply port for the MDU LCD
4	RS485_1	Northbound serial port connecting to the management system when Modbus is used
5	USB Host	USB host port
6	RST	Used for resetting the MDU
7	SD	Used for installing an SD card
8	SW1–4	DIP switch: By setting the toggle switches in different combinations, you can clear historical alarms, clear logs, and restore factory default settings.

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- In typical application scenarios, the MDU connects to a Huawei network management system (NMS) over an FE port. If a third-party NMS is used, the MDU can connect to the third-party NMS over an RS485_1 port or an FE port, depending on the protocol supported by the third-party NMS.



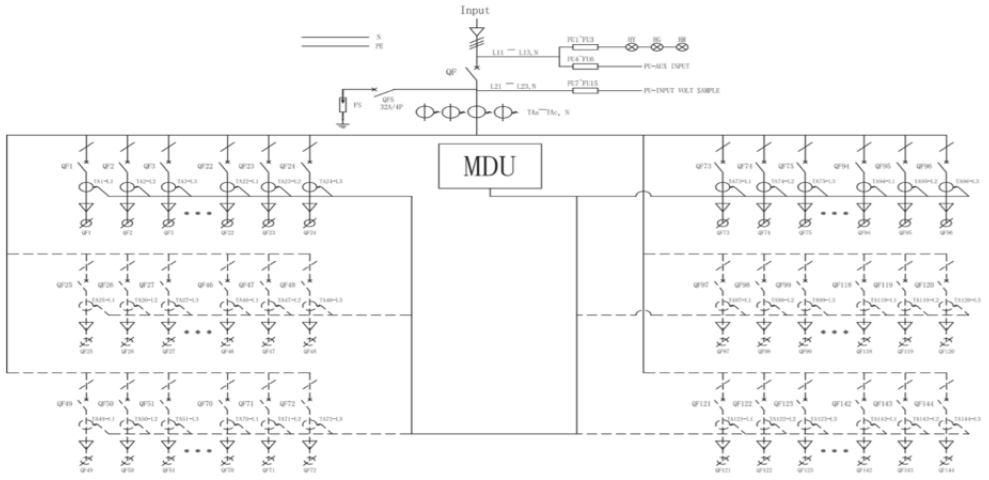
- The preceding figures show the information about one output. You can find that the product displays the detailed information about each output, including the current, power, load rate, and electric energy in a period of time.

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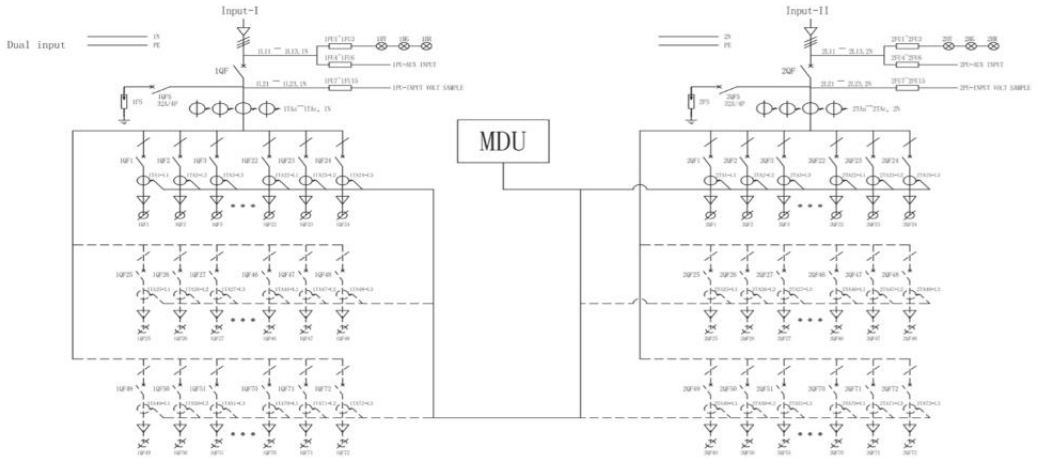
Electrical Diagram of the Precision PDF (Single Input)



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- In the figure, the diagonal lines indicate single-phase power cables and signal cables connect to the MDU.
- Mains input MCCBs 1QF and 2QF can be 400 A/3P, 250 A/3P, or 160 A/3P.
- Output MCBs can be 40 A/3P, 32 A/3P, 20 A/3P, 16 A/3P, 32 A/1P, or 16 A/1P.
- Up to three output power distribution modules can be configured. The modules shown in dotted lines are optional.

Electrical Diagram of the Precision PDF (Dual Inputs)



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- In the figure, the diagonal lines indicate single-phase power cables, and signal cables connect to the MDU.
- Mains input MCCBs 1QF and 2QF can be 400 A/3P, 250 A/3P, or 160 A/3P.
- Output MCB can be 40 A/3P, 32 A/3P, 20 A/3P, 16 A/3P, 32 A/1P, or 16 A/1P.
- Up to three output power distribution modules can be configured. The modules shown in dotted lines are optional.

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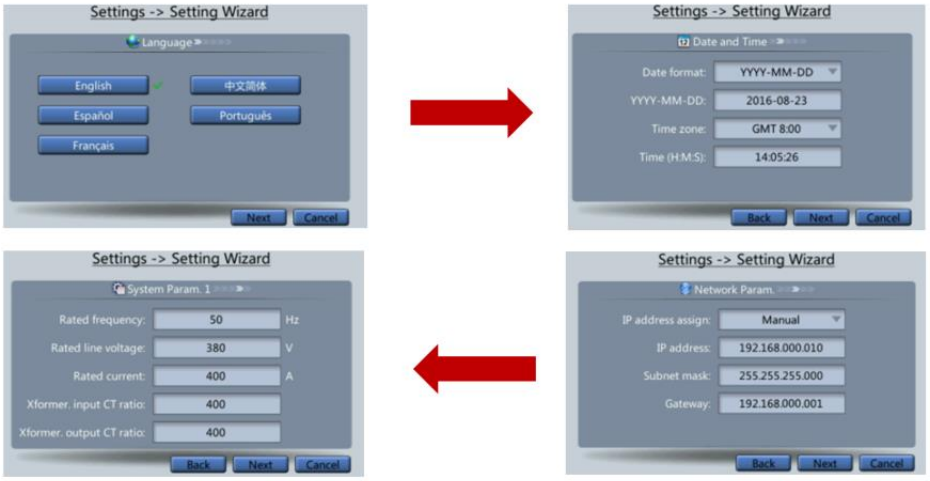
Commissioning Procedure

- Switch on the SPD circuit breaker.
  - If the indicator of an SPD module is green, the SPD module is running properly. If the indicator is red, the SPD module has failed and must be promptly replaced.
- Switch on the external power input circuit breaker to power on the PDF.
- After the MDU screen is started, perform the following operations:
  - If this is the initial startup, set the language, time, date, network parameters, and system parameters by using Setting Wizard.
  - If this is not the first startup and these parameters have been set before, the system uses the existing settings by default.
- If no abnormal alarm is displayed on the LCD, perform the subsequent operations. If abnormal alarms are displayed, clear all the alarms.
- Turn on the input switch in the PDF.
- Switch on the output circuit breakers (except the reserved circuit breakers) in the PDF one by one to power on the corresponding devices.

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- Notes:
  - The power-on commissioning personnel must be at least two qualified electricians. One performs operations while the other monitors the operations. Irrelevant persons should be warned off.
  - User types are classified into admin and operator. User admin has higher operation rights than user operator.
  - Powering off the PDF disconnects the power supply to the downstream devices. Exercise caution with this operation when the PDF is supplying power to a working system.
  - If the power indicator on the front panel of the PDF lights up, the PDF is powered on properly.
- Power off the PDF.
  - Switch off the output circuit breakers in the PDF.
  - Switch off the input circuit breakers in the PDF.
  - Switch off the external power input circuit breakers.

Power-On Commissioning Procedure - Setting Wizard



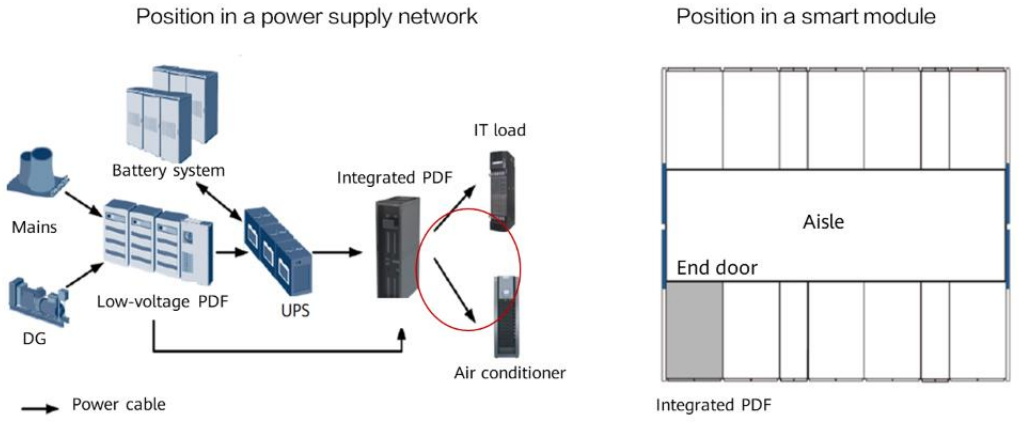
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Positioning



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- The integrated PDF is an intelligent AC power distribution cabinet specially designed for small- and medium-sized modular data center solutions. It integrates the power distribution units for air conditioners and IT equipment, and features a small footprint, low cost, and high integration. It is widely used in the power supply and distribution system of small- and medium-sized modular data centers. When the load power is small, the power distribution functions for air conditioners and IT equipment can be integrated in the cabinet to save installation space and reduce costs.
- The integrated PDF provides power supply to air conditioners and IT equipment in a modular data center.

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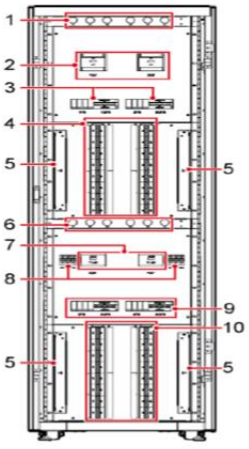
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Appearance and Structure

Appearance



Structure



(1) Power input indicators for IT equipment

(2) Power input circuit breakers for IT equipment

(3) SPD and SPD circuit breaker for IT equipment

(4) Power output circuit breakers for IT equipment

(5) Power distribution monitoring board

(6) Power input indicators for air conditioners

(7) Power input circuit breakers for air conditioners

(8) Power output circuit breakers for lighting

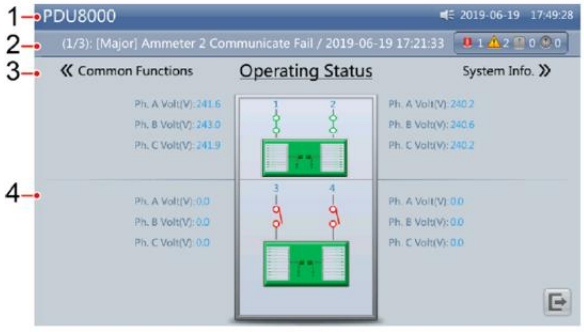
(9) SPD and SPD circuit breaker for air conditioners

(10) Power output circuit breakers for air conditioners

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MDU Panel

- The main screen consists of a status bar, alarm bar, menu bar, and information area.



(1) Status bar
(2) Alarm bar
(3) Menu bar
(4) Information area

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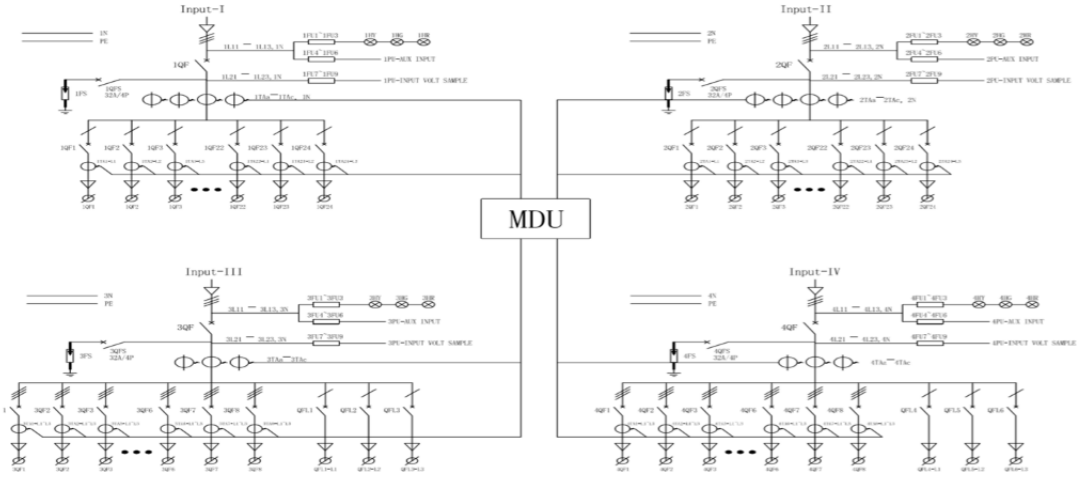
- The working principles of the indicators and ports on the MDU panel are the same as those of the modular precision PDF.
- The MDU also displays the status of each output, which is basically the same as the precision PDF.

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Electrical Diagram of the Integrated PDF



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- IT input MCCBs 1QF and 2QF are 160 A/3P. Air conditioner input MCCBs 3QF and 4QF are 160 A/3P.
- IT output MCBs (1QF1–1QF23, 2QF1–2QF23) are 40 A/1P, and 1QF24 and 2QF24 are 10 A/1P.
- Air conditioner output MCBs (3QF1–3QF8, 4QF1–4QF8) are 40 A/3P.
- Lighting circuit breakers QFL1–QFL6 are all 10 A/1P.

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Commissioning Procedure

- Switch on all SPD circuit breakers.
- Switch on the external power input circuit breaker to power on the PDF.
- After the MDU is started, you can set the language, time, date, network parameters, and system parameters on the Setting Wizard screen.

Setting Wizard

Language, time, and date	Set as required.
Network parameter – IP address assign	Automatic (DHCP)
System parameters – Rated frequency and rated line voltage	Set as required.

- After quick settings are complete, clear any alarms displayed on the monitoring screen.
- Turn on the input switch in the PDF.
- Switch on the output circuit breakers in the PDF in sequence to power on the corresponding devices and check whether the monitoring parameters on the display screen are correct.

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- If the indicator of an SPD module is green, the SPD module is running properly. If the indicator is red, the SPD module is faulty and must be promptly replaced.

Quiz

1. (short-answer question) What modules does the PDU8000 UPS modular PDF consist of?
2. (T or F) Can the modular precision PDF display detailed information about each output, such as the circuit breaker status, current, and voltage?

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- Meter module, MCCB input module, ATS input module, MCCB output module, MCB output module, and maintenance bypass module.
- Yes

Summary

- This chapter describes the following aspects:
  - UPS Modular PDF product introduction, including positioning, structure, working principle, commissioning.
  - Modular Precision PDF product introduction, including positioning, structure, working principle, commissioning.
  - Modular Integrated PDF product introduction, including positioning, structure, working principle, commissioning.

Thank you.

把数字世界带入每个人、每个家庭、
每个组织，构建万物互联的智能世界。

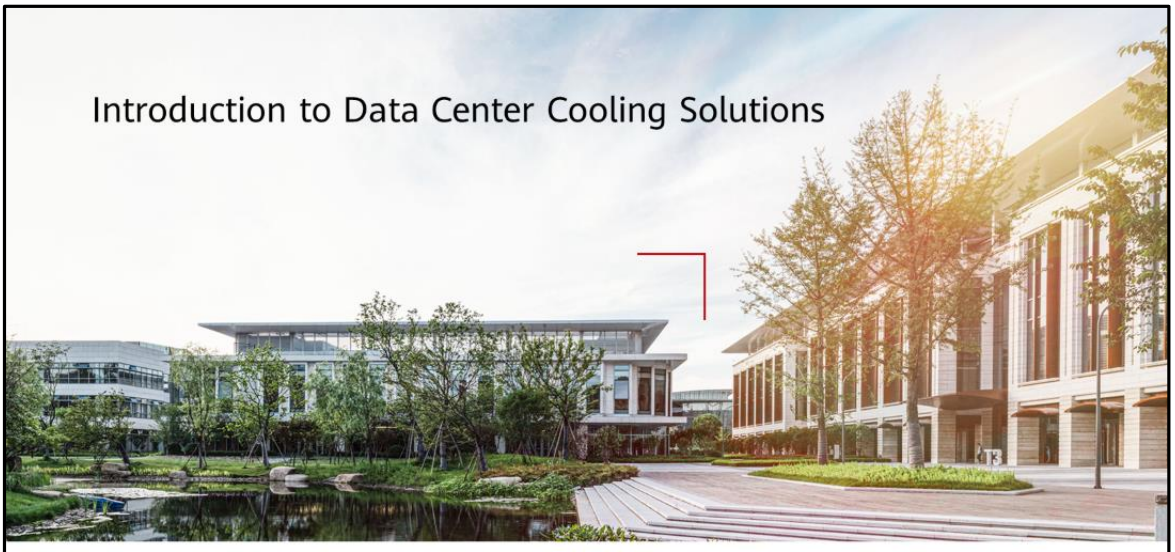
Bring digital to every person, home, and organization for a fully connected, intelligent world.

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Introduction to Data Center Cooling Solutions



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Foreword

- In the environment where cloud computing is used, data centers will develop towards virtualization and high density, and face wider and more frequent loads. Compared with the traditional static data centers, new data centers pose a series of challenges to the cooling technology.
- This course describes the challenges faced by the data center cooling system, its development trend, mainstream cooling solutions, and Huawei solutions.

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Objectives

On completion of this course, you will be able to:

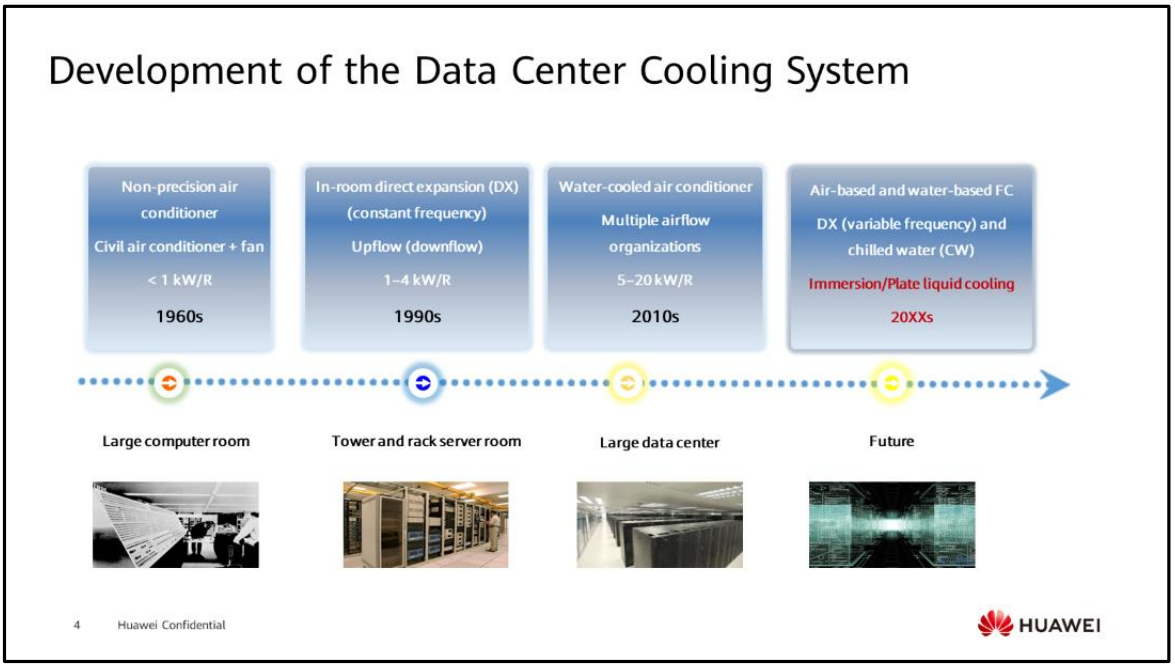
- Understand the challenges faced by the data center cooling system.
- Understand the development trend of the data center cooling system.
- Understand the solution and application of the air conditioner cooling source system.
- Understand the solution and application of the air conditioner air supply system.
- Understand the solution and application of free cooling (FC).
- Master Huawei data center cooling system solutions.

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   - Industry Trends of the Data Center Cooling System
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3. Huawei Smart Cooling Solutions

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- Technical trends:
  - Non-precision air conditioner (extensive air supply) – In-room air conditioner with upward/downward air supply (large space air supply) – In-row air conditioner (aisle containment with horizontal air supply) – Environment control (chip cooling and ultra-low heating chips)

Challenge 1: High Energy Consumption Through Data Center Life Cycle, of Which the Cooling System Accounts for a Big Proportion

Energy consumption of global data centers

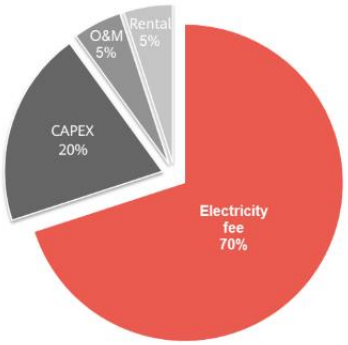


1 = 8x

Annual energy consumption of global data centers
400G kWh

Source: Global Electric Power Report 2018, Forbes

Electricity fees account for 70% in the 10-year lifecycle.
PUE = 2.0



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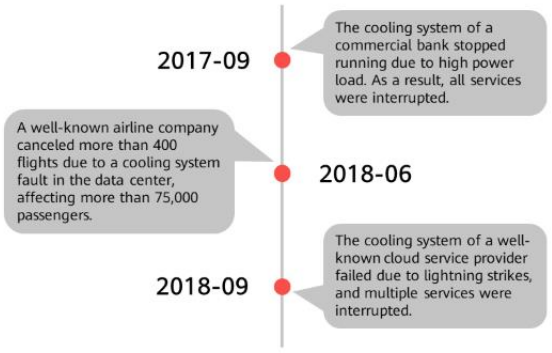
- Annual energy consumption of global data centers = Annual energy yield of Three Gorges Power Plant x 8

Challenge 2: High Integration of Data Center Services, Great Loss Caused by Hotspot Faults

Data center power density trend



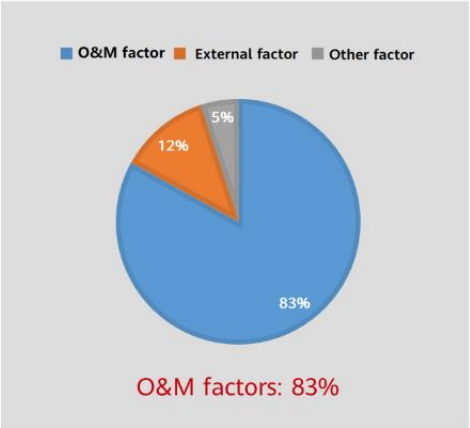
Cases of data center cooling system accidents

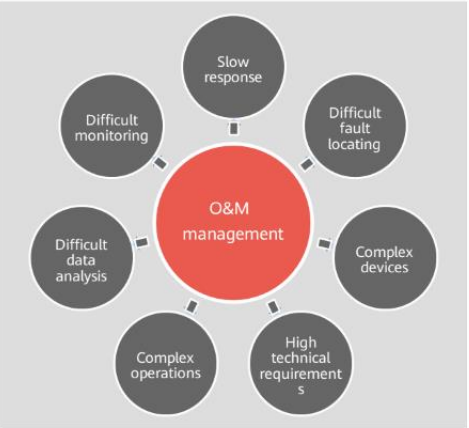


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- Accidents caused by air conditioners: According to Arrhenius equation, electronic components degrade by 50% in terms of reliability for rise of temperature by each 10° C.

Challenge 3: Difficult O&M Management, the Main Cause for Faults





Source: 365 Data Centers

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- Traditional O&M depends too much on the professionalism of O&M personnel and has high requirements on their professional skills.

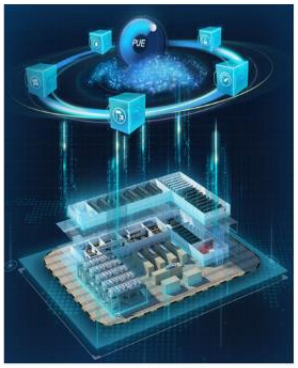
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Cloud + AI - Data Centers Enter a New Energy-Saving Era

- Under given climate conditions and service SLA, the deep neural network automatically infers system parameters under the optimal PUE to achieve the optimal energy efficiency of the data center.



Cloud

(2) Data governance

Select **19+2** PUE feature parameters from massive data.

(3) Model training

PUE prediction accuracy: **99.5%@0.005**

Local

(1) Data collection

700+ data collection points, monitoring the running status of the cooling system in real time

(4) Inference and decision-making

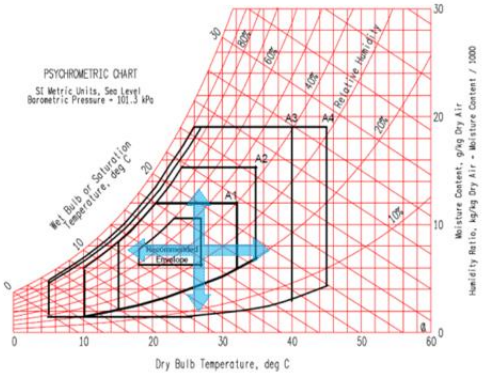
Minimum inference period: 1 hour

Energy saving effect: 8% to 15%

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Higher Inlet and Outlet Water Temperatures Are the Trend of Large Data Center Cooling

IT equipment work scope trend



Temperature and humidity change trend

	2004	2008	2011
Floor temperature	20°C	18°C	15°C
Top temperature	25°C	27°C	32°C
Floor humidity	40%	DP: 5.5°C	20%
Top humidity	55%	60% & DP: 15°C	80% & DP: 17°C

- In 2015, ASHRAE 90.4 pointed out that almost all servers meet the A2 working condition, and a few servers even support the A3 and A4 working conditions.
- IT equipment improves the weather resistance to ambient temperature and humidity and accepts higher air intake temperatures, making high-temperature CW a trend.

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- A direct factor in the use of high-temperature CW is the improvement of materials and optimization of control modes, which makes the IT air intake operating range wider.

Evaporative Cooling System Becomes the Main Solution (1)

Item	Indirect Evaporative Cooling Solution	Direct Evaporative Cooling Solution	Rotary Wheel Air Conditioner	Air-Cooled FC CW Solution
PUE	**≤ 1.2, highest**	1.28, high	1.2, high	1.34, relatively high
Energy saving	**Highest.** Secondary heat exchange, FC, only fan motor and water pump consuming power, highest energy saving	High. Direct FC, fan and humidifier running for a long time, high overall efficiency	High, secondary heat exchange, FC, and energy consumption of fans, water pumps, and rotary wheels.	Relatively high. Indirect FC of chillers for heat exchange, short FC time in the whole year, indoor fan and water pump consuming power, high overall energy saving
Water consumption	Relatively high	Relatively high	Relatively low (using a high-pressure micro-mist humidifier)	**Low**
Requirement on the quality of outdoor air	Relative low. Indirect heat exchange, indoor and outdoor air circulation completely isolated, only primary filtration needed	Very high. As outdoor air is directly sent into the indoor, air purification and anti-corrosion treatment are needed.	Relatively low. Indirect heat exchange. Certain cross contamination exists because indoor and outdoor air cannot be completely isolated due to the honeycomb structure of the rotary wheel.	Basically no requirement
Requirement on the building structure	Yes, large installation space needed for bulky equipment due to low efficiency of indirect air heat exchange	Yes, certain installation space needed due to bulky equipment	Yes, large installation space needed for bulky equipment due to low efficiency of indirect air heat exchange	**No special requirements**

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- Heat absorption of evaporating water minimizes the ambient air temperature, creating conditions for maximizing the use of outdoor FC sources. During the use of FC, only the running fans consume power. This method reduces energy consumption for cooling and optimize the PUE.

Evaporative Cooling System Becomes the Main Solution

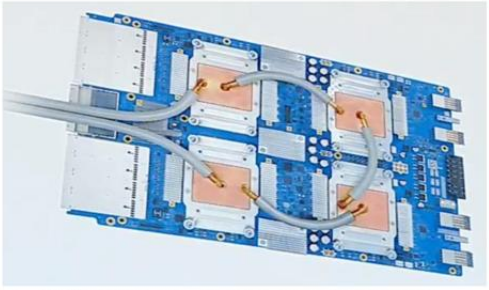
Item	Indirect Evaporative Cooling Solution	Direct Evaporative Cooling Solution	Rotary Wheel Air Conditioner	Air-Cooled FC CW Solution
Investment cost	High. The integrated unit has components such as air heat exchanger, adiabatic humidifier, fan, and compressor.	Relatively high. The integrated unit has components such as adiabatic humidifier, fan, and compressor.	Very high. The integrated unit has an air heat exchanger, adiabatic humidifier, fan, and compressor. The rotary wheel and high-pressure micro-mist humidifier are expensive.	Relatively low
Construction convenience	Simple construction and installation, involving only construction of the unit and air duct and connection of water and electricity supplies	Simple construction and installation, involving only construction of the unit and air duct and connection of water and electricity supplies	Simple construction and installation, involving only construction of the unit and air duct and connection of water and electricity supplies	Complex engineering system, involving the outdoor unit, indoor air conditioner, and pipe connection, and many components, complex construction
Applicable scenario	New building preferred, design and planning with the building	New building preferred, design and planning with the building	New building preferred, design and planning with the building	**Applicable to most scenarios**
Maintenance cost	Relatively low	High	Relatively low	Low

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- Heat absorption of evaporating water minimizes the ambient air temperature, creating conditions for maximizing the use of outdoor FC sources. During the use of FC, only the running fans consume power. This method reduces energy consumption for cooling and optimize the PUE.

Liquid Cooling System Is Widely Used in High-Density Solutions

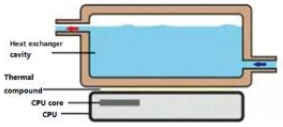
Google AI processors use the liquid cooling mode.



- In 2018, Google released the next-generation AI dedicated processor – Tensor Processor Unit (TPU) 3.0, which delivers **8-fold** performance compared with TPU 2.0 and supports up to 1000 trillion FLOPS.
- The traditional air cooling mode cannot meet heat dissipation requirements. The **liquid cooling mode** is used instead.

Three types of liquid cooling systems

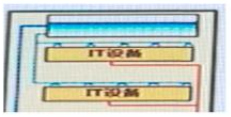
Cold plate liquid cooling



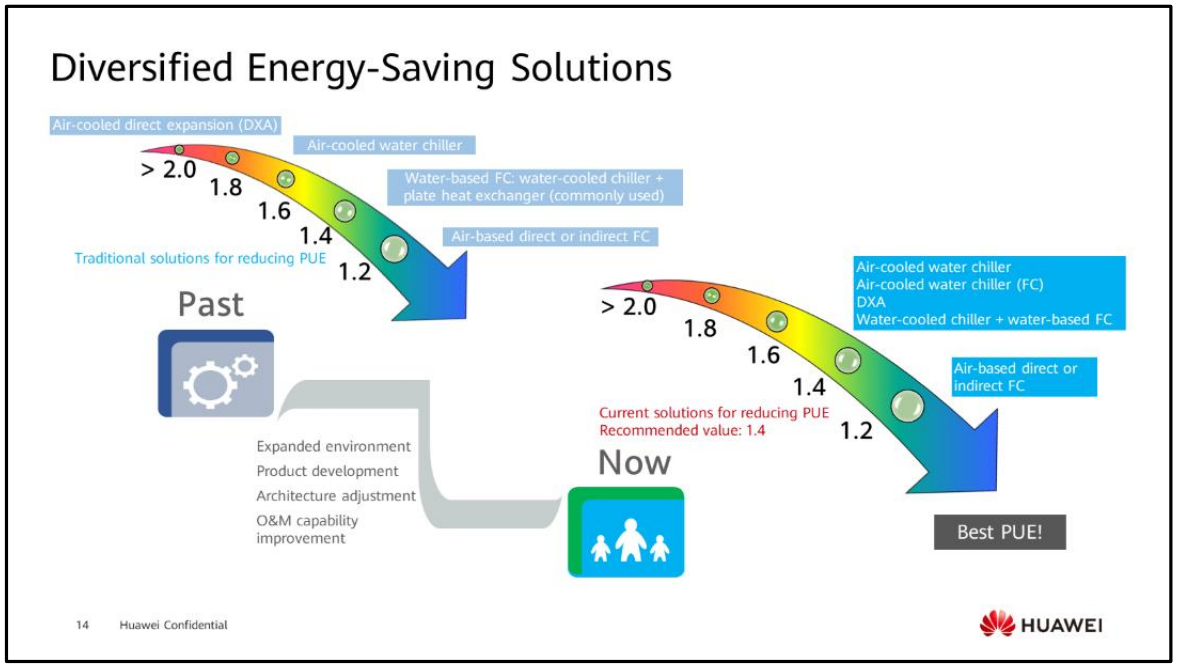
Immersion liquid cooling



Spray liquid cooling



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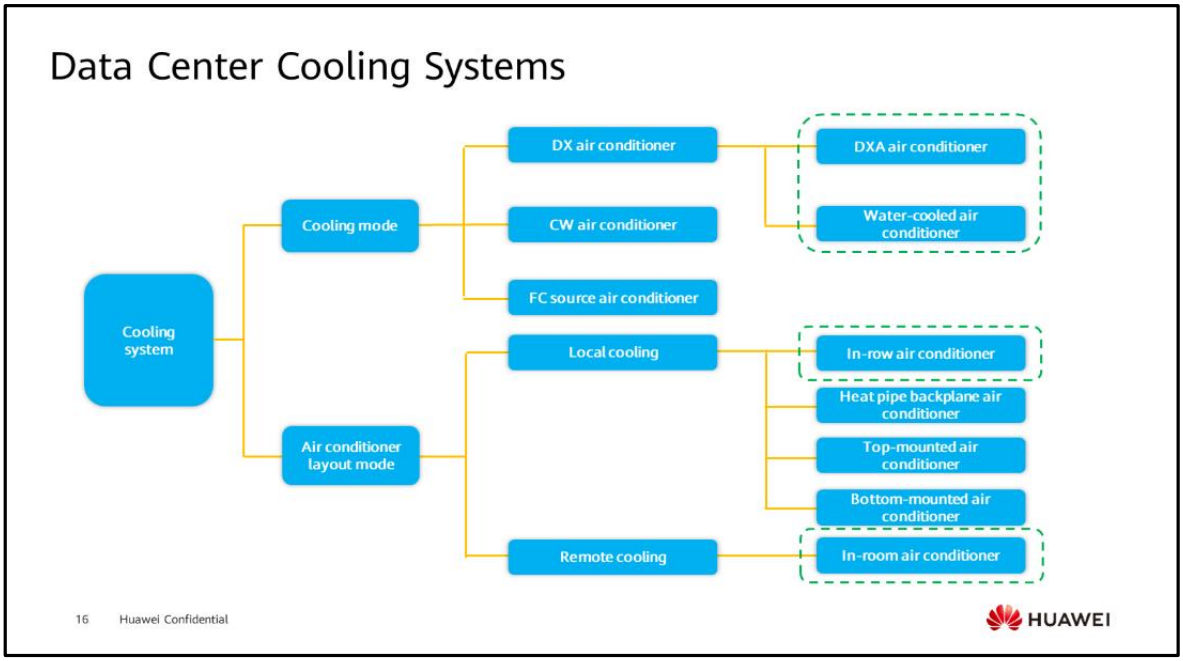


- The energy saving solution is selected based on the total cost of ownership (TCO).
- The PUE cannot be too low. It is not comprehensive if only the energy consumption is considered.

Contents

1. Challenges and Industry Trends of the Data Center Cooling System
2. **Data Center Cooling System Solutions**
3. Huawei Smart Cooling Solutions

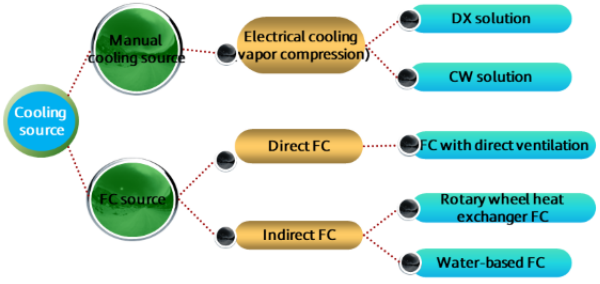
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- Classification of data center cooling systems:
- From the perspective of cooling mode, it can be classified into DX, CW, and FC.
- From the perspective of air conditioner layout modes, the cooling system can be classified into remote cooling and local cooling. In-row air conditioners have the highest market recognition and technical level among local cooling systems. Currently, there are a large number of large-scale application cases.

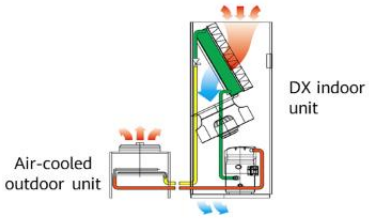
Cooling System Cooling Source Solution

- Classification of cooling source systems
  - Any substances with cooling and dehumidification functions can be used as cooling sources for air conditioners on condition that the substances are safe, economical, and environmentally friendly. In general, there are two types of cooling sources for air conditioners: free and manual cooling sources.
  - Manual cooling source solutions: DX cooling solution and CW cooling solution; FC source solutions: direct ventilation, rotary wheel heat exchange, and water-based heat exchange



Data Center Cooling System Solution - DX Air Conditioning System

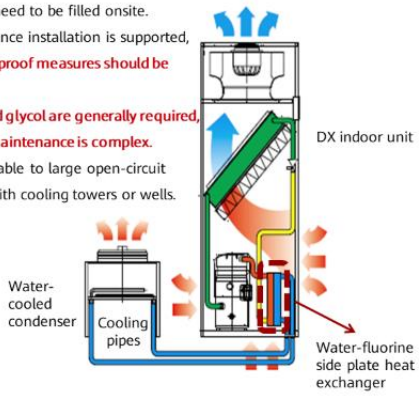
DXA



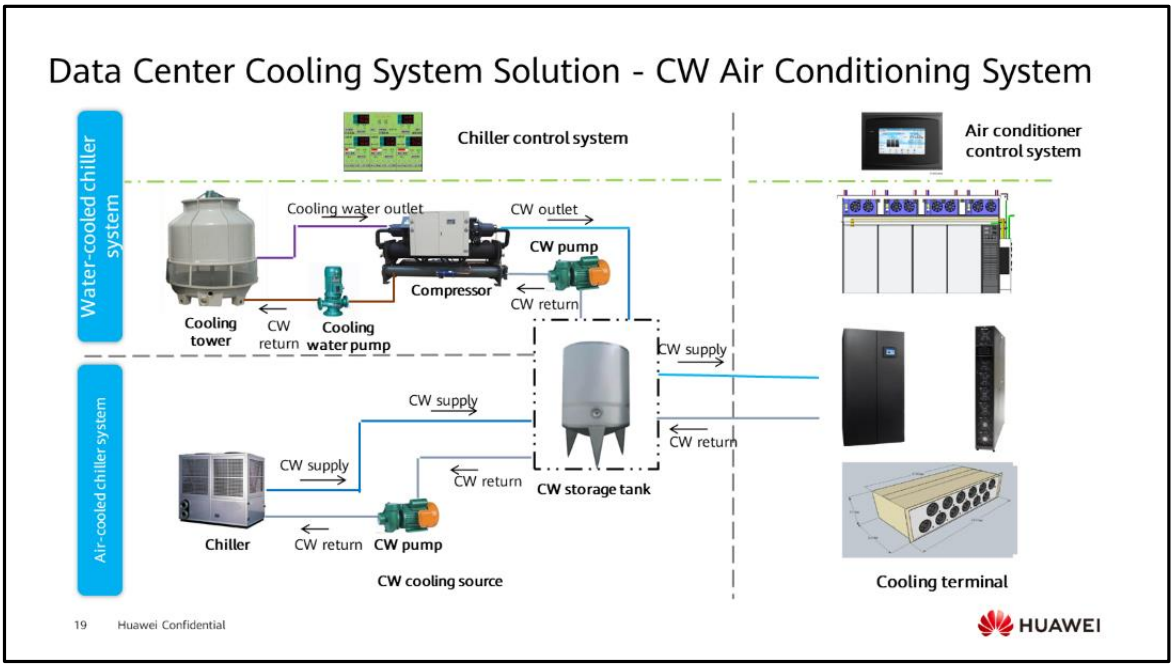
- Easy to install, no need for water system energy-saving construction and maintenance costs
- Relatively small and independent cooling cycle, easy to maintain
- Applicable to areas with insufficient water sources and places without cooling water systems
- **Not applicable to large data centers due to lower cooling energy efficiency than that of chillers**
- **The installation distance cannot be too long. Otherwise, the cooling loss is large.**

DXW

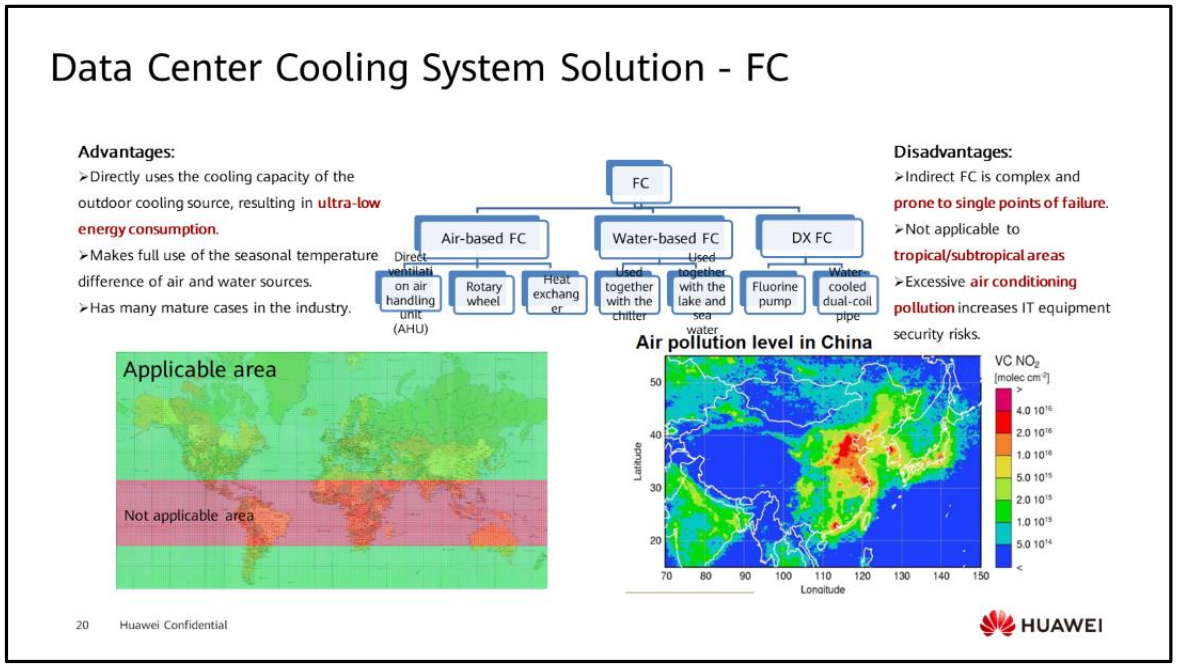
- Refrigerant is filled before delivery and does not need to be filled onsite.
- Long-distance installation is supported, **but waterproof measures should be taken.**
- **Water and glycol are generally required, and the maintenance is complex.**
- It is applicable to large open-circuit systems with cooling towers or wells.



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- Water-cooled chiller system:
- Consists of the air conditioner, CW pump, water-cooled chiller, cooling water pump, cooling tower, water tank, and other related components.
- Air-cooled chiller system:
- Consists of the air conditioner, CW pump, air-cooled chiller, water tank, and other related components.

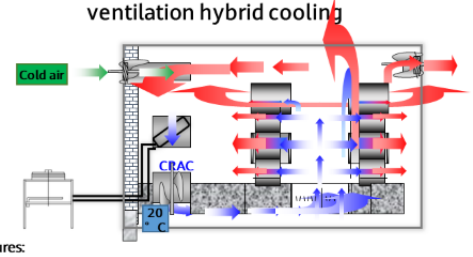


- FC has the following advantages:
  - Directly uses the cooling capacity of the outdoor cooling source, resulting in ultra-low energy consumption.
  - Makes full use of the seasonal temperature difference of air and water sources.
  - Has many mature cases in the industry.

- FC has the following limitations:
  - Indirect FC is complex and prone to single points of failure.
  - Not applicable to tropical/subtropical areas
  - Excessive air conditioning pollution increases IT equipment security risks.

Data Center Cooling System Solution - Direct Ventilation FC

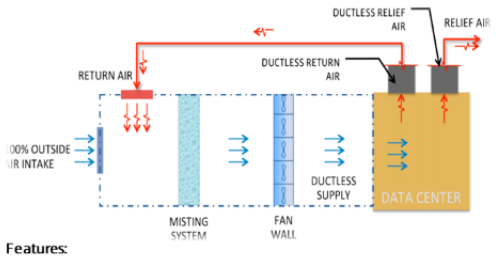
Mechanical cooling + direct ventilation hybrid cooling



Features:

- Multiple control modes, making full use of FC sources and saving energy
- Supports underfloor air supply. The indoor air conditioner is basically the same as a common air conditioner.
- Supports DX and CW mechanical cooling backup.
- **The project is complex and has high requirements on the building height and outdoor air quality.**
- **High restrictions on areas, applicable to areas where the annual average temperature is lower than 20°C**

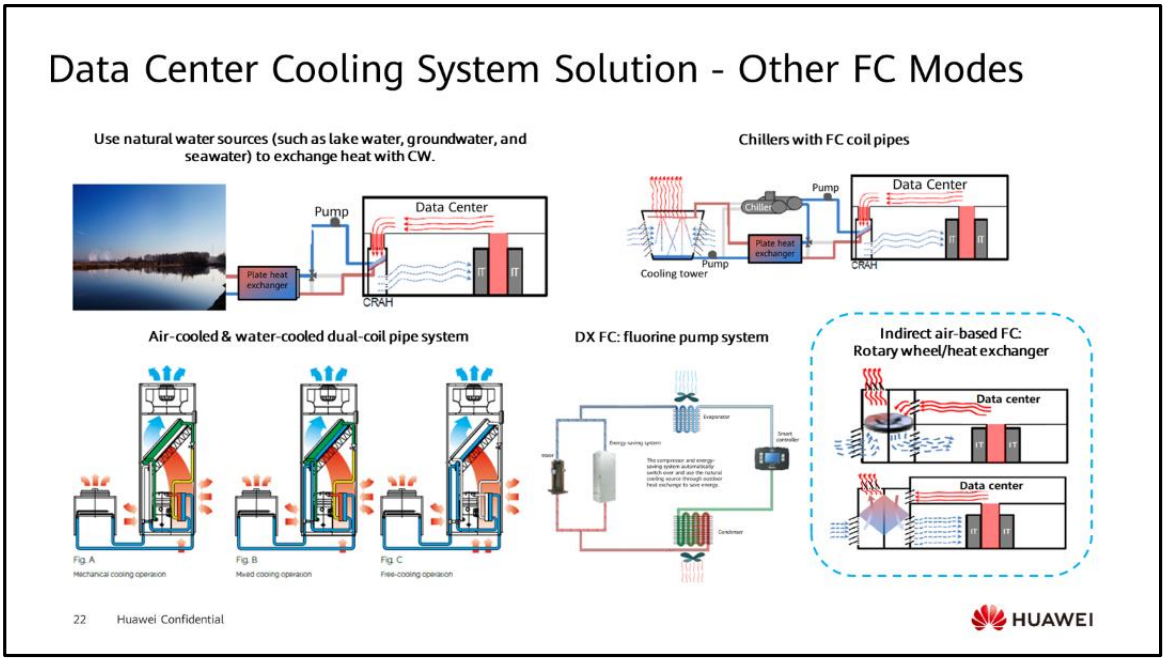
Direct ventilation FC



Features:

- Makes full use of FC sources, improving efficiency and saving energy. The PUE is close to 1.
- Easy O&M
- **No mechanical cooling backup**
- **The project is complex and has high requirements on the building height and outdoor air quality.**
- **Fails to meet the Tier III standards.**

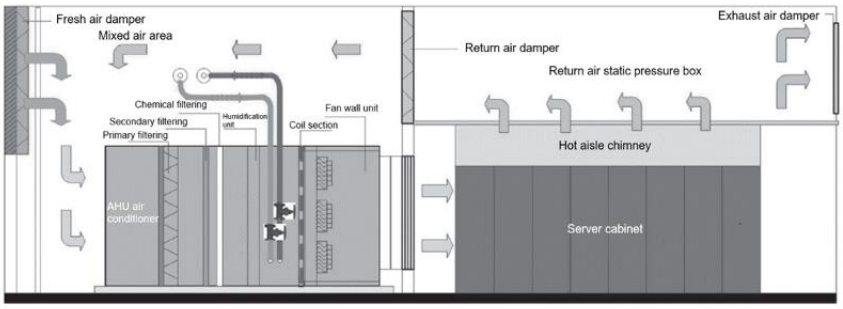
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- Heat exchange between natural water sources and CW: has high requirements on the quality of water sources and has risks of environmental damage.
- Air-cooled chiller FC: applied in some scenarios.
- Air-cooled & water-cooled dual cooling sources: applied in some scenarios.
- Fluorine pump FC: applied in some scenarios.

Data Center Cooling System Solution - Fan Wall Technology

- The fan wall system consists of the air inlet unit, humidification unit, fan wall unit, air exhaust unit, return air unit, and control unit.



AHU fan wall device group in a data center

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- In mixed-air cooling mode, outdoor cold air and hot air in the data center equipment room are mixed and then sent to the equipment room area. The mechanical cooling stops and the system works in FC mode.
- In full fresh air cooling mode, all outdoor cold air is sent to the equipment room area, and all hot air is exhausted from the equipment room. The mechanical cooling stops or partially stops. The system works in full FC mode or hybrid working mode of FC and mechanical cooling.
- In full return air mode, the outdoor fresh air inlet is disabled, and the system uses the mechanical cooling mode.
- Anti-freezing and mixed-air mode: When the outdoor temperature is low, AHU water valve and water circulation system are opened to use the hot air in the equipment room for heat exchange to increase the CW temperature within the FC requirements of the equipment room, preventing water system equipment from freezing.

Contents

1. Challenges and Industry Trends of the Data Center Cooling System
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3. **Huawei Smart Cooling Solutions**

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Typical E2E Data Center Cooling Solution





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High Efficiency, Reliability, and Simplicity of Huawei Precision Air Conditioners

Huawei Smart DC concept: using digital, intelligent, and network-based technologies to make data center efficient, reliable, and simple







Efficient

- Solution energy saving, containment + local cooling
- Group energy saving, system-level energy saving
- Unit energy saving, high efficiency of in-row air conditioners at low loads

Reliable

- 1°C vertical temperature difference, no risk of local hot spots
- Reliable output, 10%–100% continuous cooling
- Reliable operating environment: –40°C to +55°C

Simple

- Simple operation and user-friendly interactive true-color touchscreen
- Simple management and clear display of maintenance policies
- Simple maintenance

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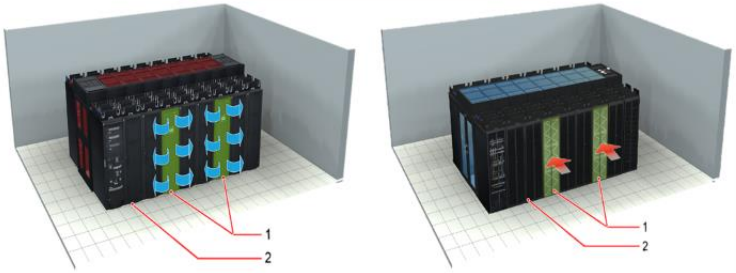
DX In-row Solution - NetCol5000-A042&025

Appearance



NetCol5000-A042H&025H

Typical application scenario



(1) Precision air conditioners (2) Data center equipment

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- Full-sized and half-sized cabinets

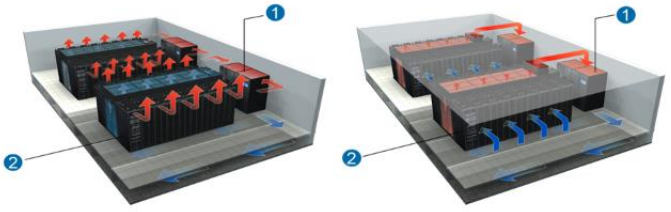
DX In-room Solution - NetCol8000-A045D&U

Appearance



NetCol8000-A045D&U

Typical application scenario



(1) Precision air conditioners (2) Data center equipment

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CW In-row Solution - NetCol5000-C030&065

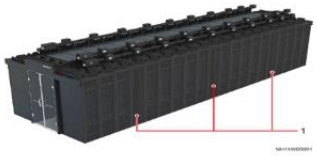
- The NetCol5000-C applies to the following scenarios.



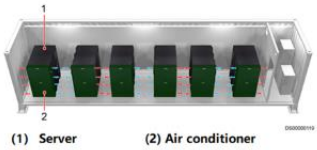
NetCol5000-C30



NetCol5000-C065



Hot aisle containment



Smart module

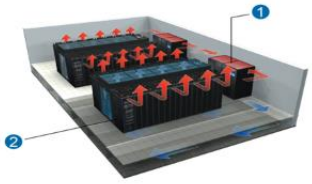
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CW In-room Solution - NetCol8000-C

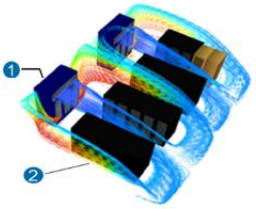
- The NetCol8000-C 2.0 typically applies to the following scenarios.



NetCol8000-C

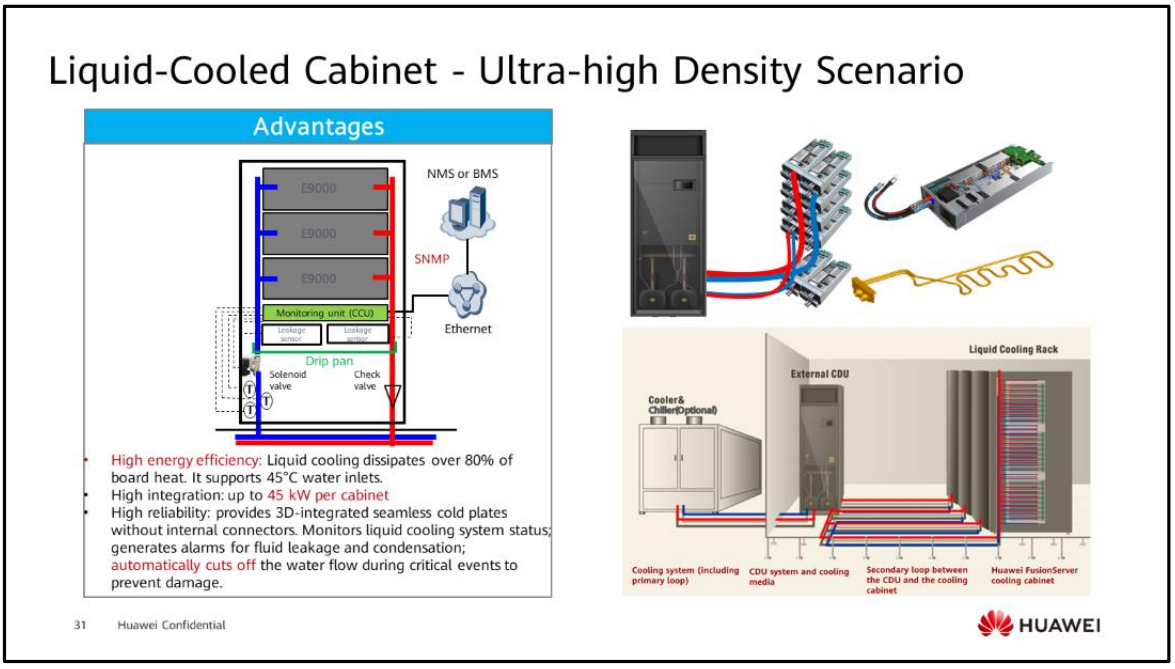


Underfloor air supply + cold aisle containment



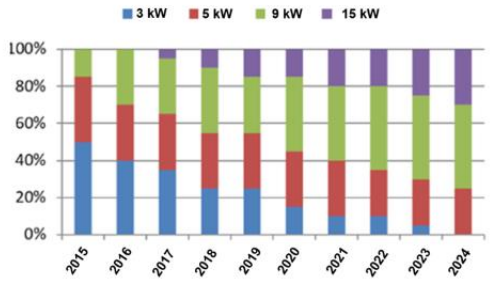
Upflow + non-aisle containment

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- Adopts the 45°C warm water cooling technology. Reliable and efficient seamless cold plates indirectly cool down main heat-generating components: CPUs and DIMMs.
- Supports up to three E9000 subracks per cabinet, with 96 2-socket nodes, and provides a maximum cooling capacity of 45 kW per cabinet.
- Liquid cooling dissipates over 80% of board heat.
- The liquid cooling solution has been successfully deployed in Poznan Supercomputing and Networking Center (PSNC) of Poland and provides efficient cooling and heat dissipation functions for PSCN's large HPC cluster that delivers a computing capability of up to 1.37 PFLOPS. Liquid cooling helps PSNC reduce electricity consumption by 3.26 million kWh per equipment room, lowering consumption by 40%.

Planning the Power Density of the Equipment Room and Adapting Cooling Measures



< 5 kW/cabinet – in-room


NetCol8000-A (13–100 kW)




NetCol8000-C (62–253 kW)

- Upflow and downflow
- Applicable to equipment rooms with low power density. It is recommended that the floor height be greater than 3.5 m.

3–30 kW/cabinet – in-row




NetCol5000-A (11–42 kW)




NetCol5000-C (30–80 kW)

- In-row + cold aisle containment, cold down equipment first, and then cold down the environment.
- Applicable to equipment rooms with high power density. It is recommended that the floor height be greater than 2.8 m.

15–30 kW/cabinet – heat pipe/cold water backplane


Heat pipe backplane


CW backplane

- No equipment room space is occupied, eliminating hot spots
- Applicable to scenarios where the space is limited and the cabinet power density is even

> 25 kW/cabinet – Liquid-cooled cabinet



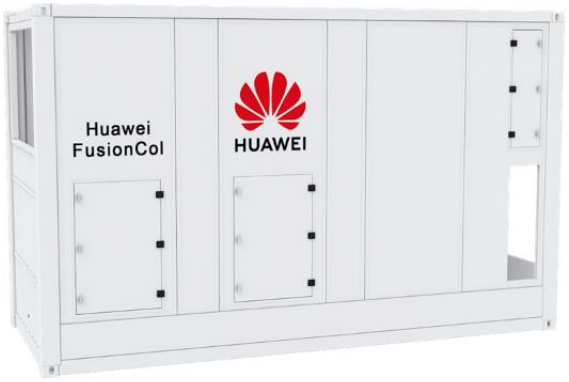


- Applicable to ultra-high-density scenarios with low power consumption
- The server needs to be customized.

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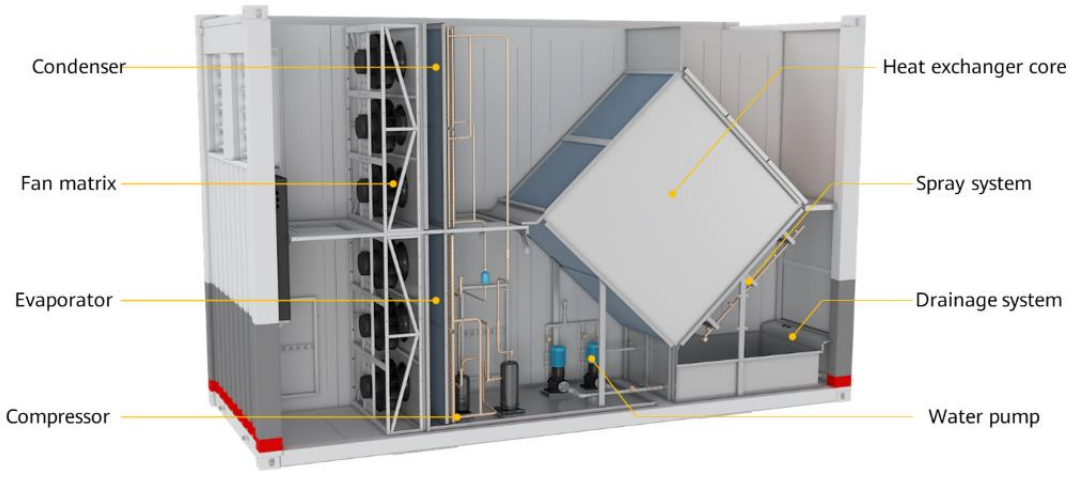
Indirect Evaporative Cooling Solution

- FusionCol – Huawei Indirect Evaporative Cooling Solution



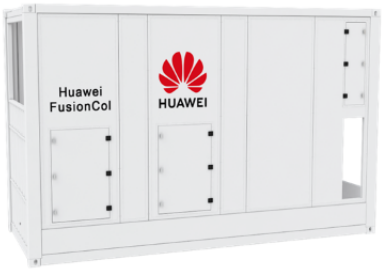
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Indirect Evaporative Cooling Solution



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Technical Specifications of Huawei Indirect Evaporative Cooling Solution



Product	FusionCol
Total cooling capacity	220 kW
Circulated air volume	55,000 m^3/h
Auxiliary cooling ratio	10%–50%
Supply air temperature and humidity	25°C/50%
Return air temperature and humidity	38°C/25%
Dimensions (L x W x H)	6058 mm x 2438 mm x 3600 mm
Net weight	8000 kg

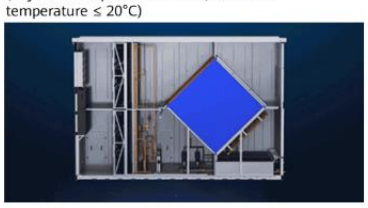
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On-Demand Switchover Among Three Working Modes, Maximizing the Use of External Cooling Sources

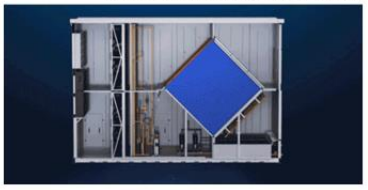
Dry mode (dry-bulb temperature ≤ 16°C)



Spray mode
(Dry-bulb temperature > 16°C; wet-bulb temperature ≤ 20°C)



Hybrid cooling mode
(20°C ≤ wet-bulb temperature ≤ 32°C)



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- Note:

Quiz

1. (Single Choice)Which of the following is an FC system?

   A. CWA air conditioning system

   B. Water-cooled CW air conditioning system

   C. DXA air conditioning system

   D. Direct ventilation air conditioning system

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- Answer: D

Summary

- This chapter describes：
  - Challenges faced by the data center cooling system and development trend of the data center cooling system
  - Then focus on the solution and application of the air conditioning cold source system and common cooling and FC solutions and their applications
  - We want you to know Huawei data center cooling system solutions

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Thank you.

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每个组织，构建万物互联的智能世界。

Bring digital to every person, home, and organization for a fully connected, intelligent world.

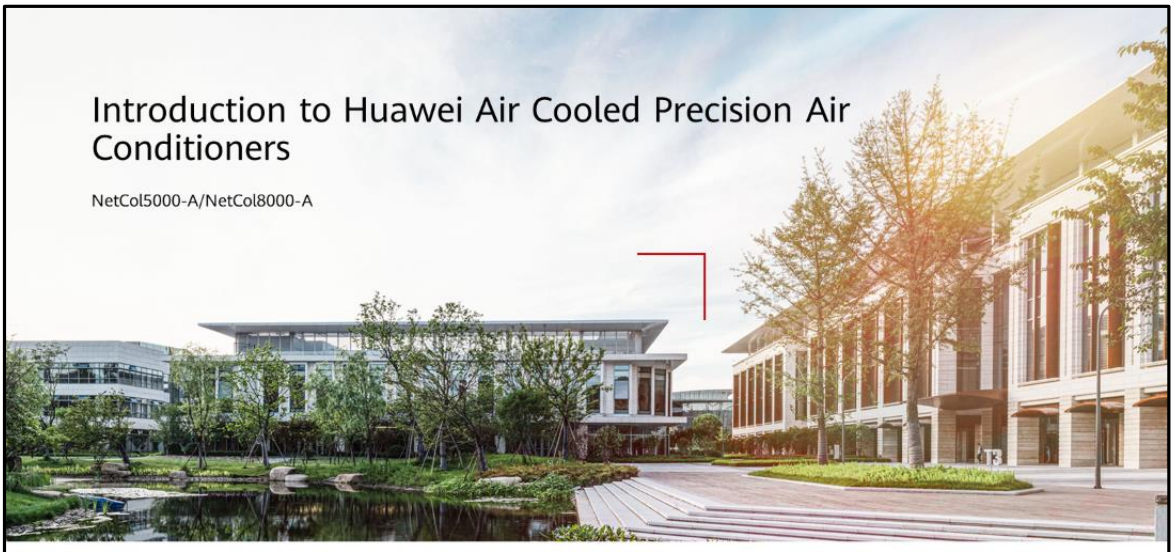
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Introduction to Huawei Air Cooled Precision Air Conditioners

NetCol5000-A/NetCol8000-A



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Foreword

- This course describes the NetCol5000 and NetCol8000 air cooled precision air conditioners in terms of the product overview, operation guide, components, commissioning, and system running process, helping you understand how to use the NetCol5000 and NetCol8000.

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Objectives

On completion of this course, you will be able to:

- Describe the internal structure and technical specifications of Huawei air cooled air conditioners.
- Distinguish the features and application scenarios of different Huawei air cooled air conditioners.
- Get familiar with the functions and basic operations of the NetCol precision air conditioner components.
- Have the basic capability of analyzing the running status of the cooling system.

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1. Product Overview
   - Huawei Precision Air Conditioner Series
   - Application Scenarios and Features
2. Cooling System Overview
3. Cooling Capacity Transfer System
4. Humidification and Drainage Regulation System
5. Electric Control System
6. Common Terms

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Huawei Precision Air Conditioner Series

NetCol5000-A **NetCol8000-A**





- Air cooled precision air conditioner (11–100 kW)

NetCol5000-A025
NetCol5000-A035
NetCol5000-A042
NetCol5000-A050
NetCol8000-A (045, 090)
NetCol8000-A (050, 100)

NetCol5000-C **NetCol8000-C**





- Chilled water precision air conditioner (30–260 kW)

NetCol5000-C030
NetCol5000-C065
NetCol8000-C (070-260)
NetCol8000-C (070, 130, 190)
NetCol8000-C (050-150)

NetCol8000-E



- Indirect evaporative cooling air conditioner (220 kW)

NetCol8000-E220

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Naming Rules for NetCol Air Conditioners

NetCol	5000	-	A	025	H	4	1	2	D	2	E	1	2	0	E	1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

1 Data Center Smart Cooling Product

2 Model Range

2000 - In-Cabinet Smart Cooling Product
5000 - In-Row Smart Cooling Product
8000 - In-Room Smart Cooling Product

3 Hyphen

4 System Type

A - Air Cooled
C - Chilled Water
F - Free Cooling
G - Glycol Cooled
H - Water Cooled + Chilled Water
T - Air Cooled + Loop Thermal Siphon

5 Mode Code

020 - Mode Code 020
021 - Mode Code 021
025 - Mode Code 025
030 - Mode Code 030
035 - Mode Code 035
040 - Mode Code 040
050 - Mode Code 050
070 - Mode Code 070

6 Air Discharge

U - Up Flow
D - Down Flow
H - Horizontal Flow

7 Power Supply

M - 380-415 V, 3 PH, 50 Hz
N - 208-230 V, 3 PH, 60 Hz
P - 220-240 V, 3 PH, 50 Hz
Q - 380 V, 3 PH, 60 Hz
R - 460-480 V, 3 PH, 60 Hz
S - 220-240 V, 1 PH, 50 Hz
T - 208-230 V, 1 PH, 60 Hz
D - 48 V DC
1 - 200-277 V, 1PH, 50/60 Hz
2 - 200-240 V, 1PH, 50/60 Hz
3 - 200-240 V, 3PH, 50/60 Hz
4 - 380-415 V, 3PH, 50/60 Hz
5 - 380-480 V, 3PH, 50/60 Hz
6 - 220 V, 1 PH, 50/60 Hz
7 - 220-240V,1PH,50/60Hz
8 - 208-240 V, 1PH, 50/60 Hz

8 Cooling System

1 - R410A Single System
2 - R410A Dual System
3 - R407C Single System
4 - R407C Dual System
A - Chilled Water with Three Way Valve
B - Chilled Water with Two Way Valve
C - Others

9 Fan Type

1 - AC Fan
2 - EC Fan
3 - DC Fan

10 Compressor Type

0 - No Compressor
N - ON-OFF
D - DC Inverter

11 Filter Grade

0 - None
1 - G3
2 - G4

12 Humidifier

0 - None
R - Infrared Humidifier
E - Electrode Humidifier

13 Re-Heating

0 - None
1 - Electric Heating 1 Level
2 - Electric Heating 2 Level

14 Monitoring

0 - No Card
1 - Web Only
2 - 485 Only
3 - Web&485

15 Sensors

0 - None
S - Smoke Temperature
F - High Temperature
B - Smoke & High Temperature

16 Packaging

D - Domestic
E - Export

17 Order Special Features

0 - None
1 - Condensate Pump

Naming rule for the NetCol5000-A25 in-row air conditioners

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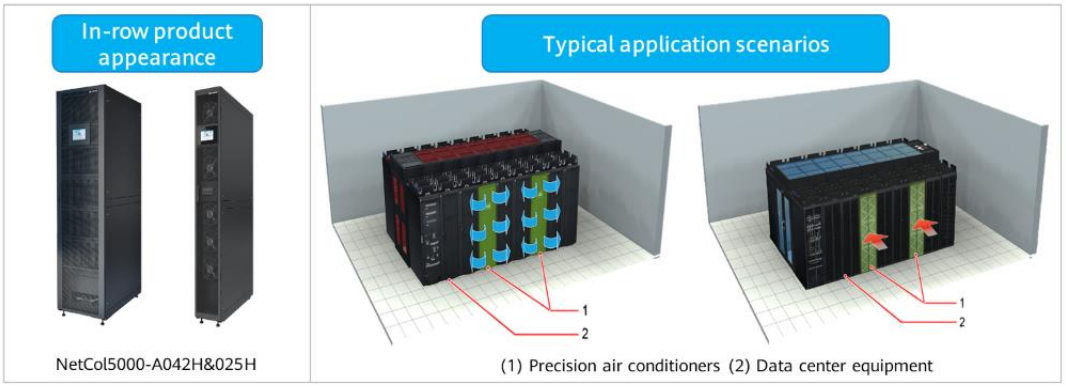
- The preceding figures show the naming rules for the indoor and outdoor units of NetCol air conditioners.

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Huawei Air Cooled Precision Air Conditioner - NetCol5000-A042&025

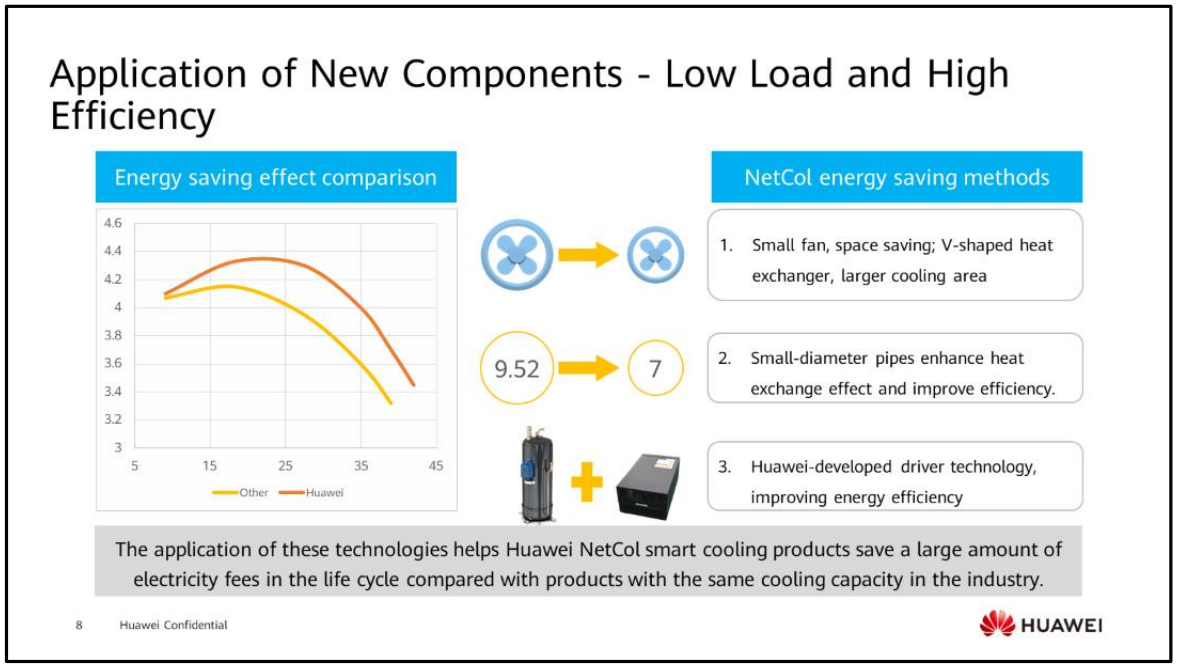


NetCol5000-A042H&025H

(1) Precision air conditioners (2) Data center equipment

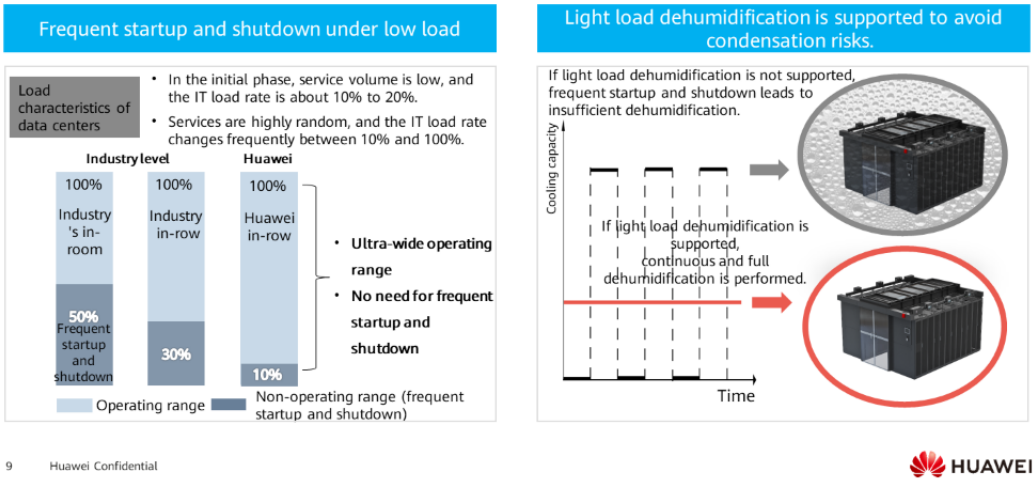
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- The NetCol5000-A in-row precision air conditioner applies to modular data centers and prefabricated modular data centers. The preceding figure shows the application scenarios of the cold aisle containment and hot aisle containment.



- For example, the total IT power is 120 kW, the simultaneity factor is 0.9, the redundancy coefficient is 1.1, and 3+1 mode is used.
- Energy saving effect comparison: Huawei 42 kW, Vertiv (original Emerson) CRV + 39 kW
- The cooling capacity of a single air conditioner is 30 kW (120/4 = 30 kW) if the IT system is 100% loaded and all air conditioners work in hot standby mode to share the load.
- Huawei air conditioner energy efficiency ratio (EER): 4.25
- Vertiv air conditioner EER: 3.85
- Annual energy consumption = IT power/EER x 8760. The electricity fee is CNY0.8/kWh.
- Electricity fee saved = Annual electricity fee of Vertiv – Annual electricity fee of Huawei = CNY20558, saving CNY205,000 in the life cycle of 10 years
- Assume that there are three air conditioners and one air conditioner works in cold standby mode at 50% IT load. The cooling capacity of a single air conditioner is 120 x 50/3 = 20 kW.
- Huawei air conditioner EER: 4.35
- Vertiv air conditioner EER: 4.13
- The annual electricity fee is reduced by CNY5840, saving CNY58,000 in the life cycle of 10 years.

Light Load Dehumidification: Reliable Dehumidification at a Minimum Load of 10%

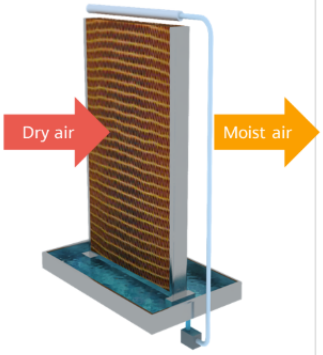


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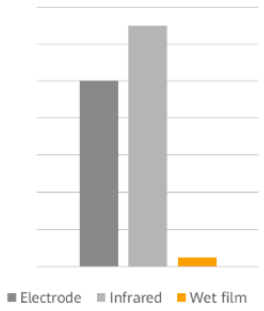
- Frequent startup and shutdown at low loads: Under low loads, the temperature fluctuates slightly. However, the compressor startup requirements are frequently met. After the compressor works for a short period of time and the cooling requirements are met, the compressor shuts down. In this way, the compressor starts and shuts down repeatedly.
- As shown in the right figure, the grey lines show that the compressor frequently starts, and the red line shows that the Huawei compressor works at a low load. Due to the frequency-converting technology, the speed of Huawei compressor can be controlled to a very low level.

Industry's Unique Wet Film Humidifier

Working principle of a wet film humidifier



Comparison of humidifier energy consumption



Advantages of wet film humidifiers

- **Energy saving and emission reduction**: Heating is not consumes less energy compared with an electrode humidifier. The total cost of operations (TCO) during the life cycle is less.
- **High adaptability**: Compared with an electrode humidifier, the wet film humidifier has lower water quality requirements and does not require additional water treatment equipment.

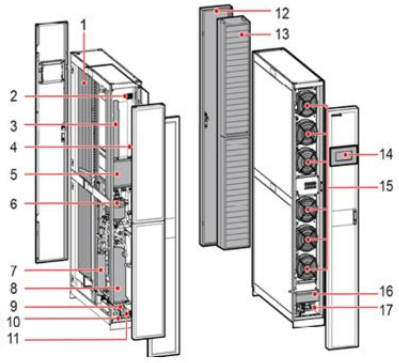
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- Currently, the wet film humidifier is recommended for Huawei air conditioners.

NetCol5000-A25 kW Components



NetCol5000-A25



NetCol5000-A25 system components

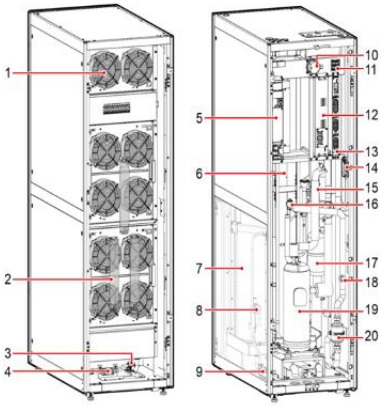
(1) Evaporator	(2) External signal terminal	(3) Electric box
(4) Extra low voltage (ELV) box	(5) Driver	(6) Humidifier cylinder
(7) Oil separator	(8) Compressor	(9) Drainpipe
(10) Refrigerant gas pipe	(11) Refrigerant liquid pipe	(12) Rear door
(13) Air filter	(14) Display	(15) Fans
(16) Water pan cover	(17) Water pump	

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NetCol5000-A42 kW Components



NetCol5000-A42



NetCol5000-A42 components

(1) Fans	(2) Electric heater
(3) Condensate pump	(4) Water drainage check valve
(5) Electric box	(6) Evaporator
(7) Wet film humidifier	(8) Water inlet electrical actuator
(9) Humidifier pump	(10) Differential pressure switch
(11) Signal terminal block	(12) Compressor driver
(13) ELV box	(14) Temperature and humidity (T/H) sensor
(15) Discharge pipe	(16) Electronic expansion valve (EEV)
(17) Oil separator	(18) Sight glass
(19) Compressor	(20) Filter dryer

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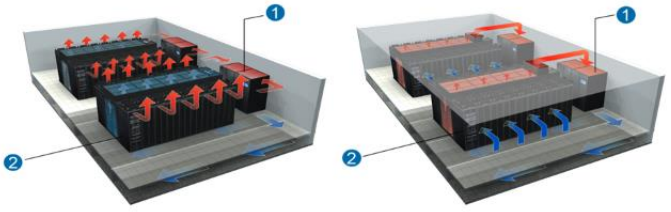
Huawei Precision Air Conditioner - NetCol8000-A045D&U

Appearance of the in-room air conditioner



NetCol8000-A045D&U

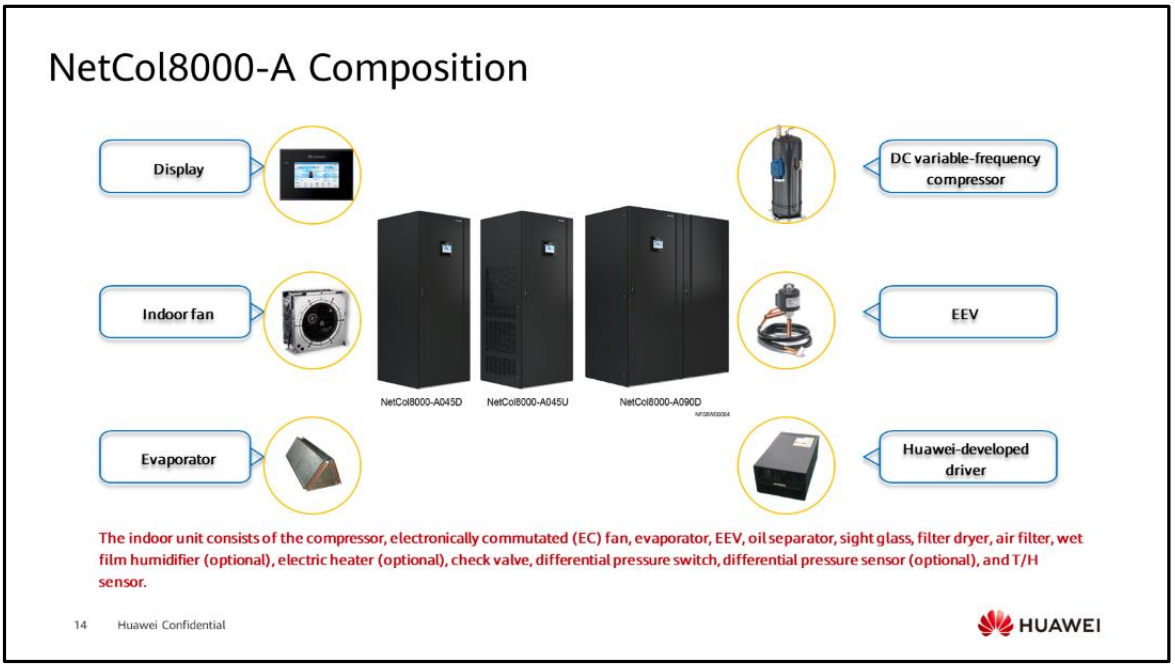
Typical application scenarios



(1) Precision air conditioners (2) Data center equipment

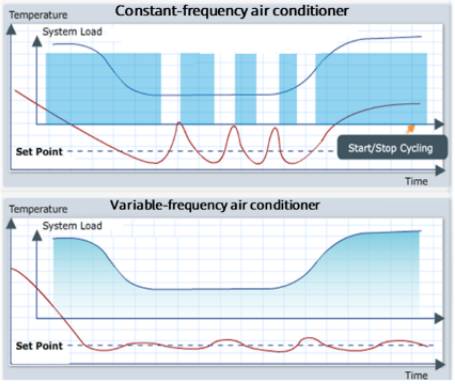
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- In the product model, D indicates the downflow unit, and U indicates the upflow unit.
- Typical application scenario: cold or hot aisle containment

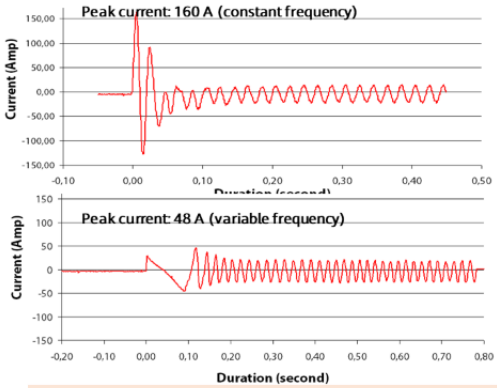


- Compressors are provided by Mitsubishi, Guangzhou.
- The compressor driver can store 10,000 fault waveforms in an SD card, which can be used to analyze the compressor fault waveforms. This is a unique feature of Huawei-developed drivers.
- The outdoor fan can reduce energy consumption at some loads. Therefore, the heat generated by the motor at some loads can be reduced, thereby reducing the long-term loss caused by overheating of the motor at full load and prolonging the fan service life.
- EEVs are provided by DANFOSS. DANFOSS EEVs have the power module feature (with a large-capacity capacitor that automatically discharges after abnormal power-off to ensure that the EEV can be closed), which is not supported by products of other vendors. If this feature is not supported, the EEV cannot be closed upon abnormal power-off. The startup logic can be started only after the valve is closed, which increases the risk of instantaneous overheat in the equipment room.
- If the EEV cannot be closed due to frequent power-off, the EEV will be stuck, which will cause the system pressure to fluctuate and the compressor fan to be burnt.

Variable-frequency Air Conditioners Support More Accurate Temperature and Humidity Control



The cooling capacity of a variable-frequency cooling system can be adjusted steplessly, and the temperature fluctuation in the equipment room is small.



The startup of a variable-frequency cooling system has a small impact on the power grid. (The peak current is 70% less than that of a constant-frequency system.) The variable-frequency cooling system can be quickly restarted after a power failure (non-timed startup).

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- As shown in the figure on the right, the fluctuation refers to the startup current fluctuation.
- Constant-frequency air conditioner:
  - When a constant-frequency cooling system does not match the load, the compressor starts or stops, causing temperature fluctuation in the equipment room.

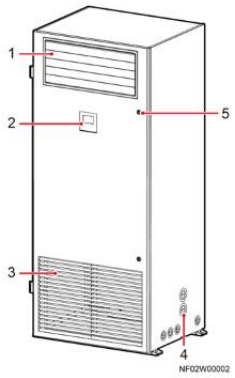
Turned Over and Lowered Fans - Quick Installation



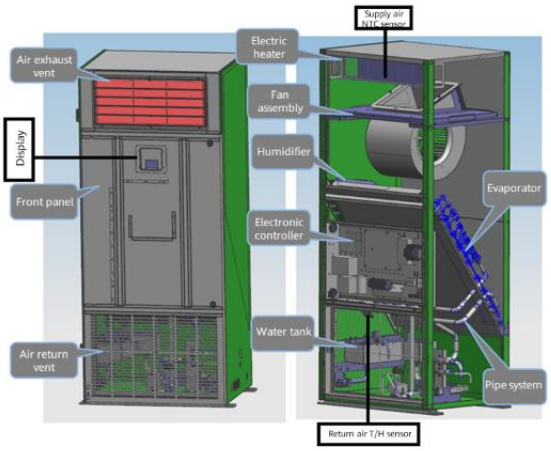
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- Quick installation reason: A dedicated mechanical structure (guide rail) is used.

Indoor Unit of the NetCol8000-A 13 kW Variable-Frequency Precision Air Conditioner



(1) Air exhaust vent (2) Display (3) Air return vent
(4) Hole (5) Keyhole

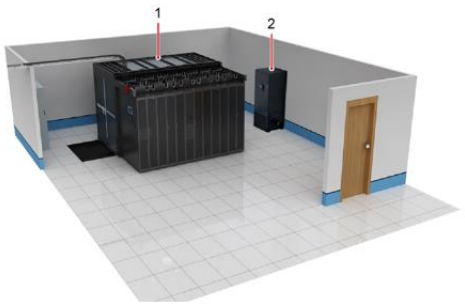


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- Used in special scenarios. The main feature is that the compressor is externally deployed and the operating noise of the air conditioner is low.

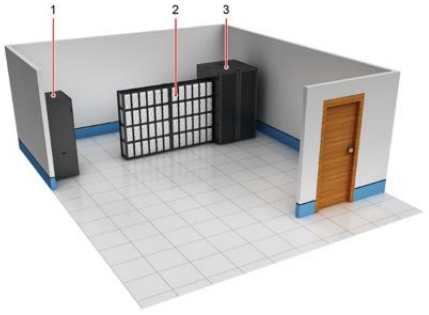
Typical Application Scenarios of the NetCol8000-A 13 kW

Small data center scenario



(1) Small smart module (2) NetCol8000-A013

Power distribution room scenario



(1) NetCol8000-A013 (2) Battery group (3) UPS

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System Composition

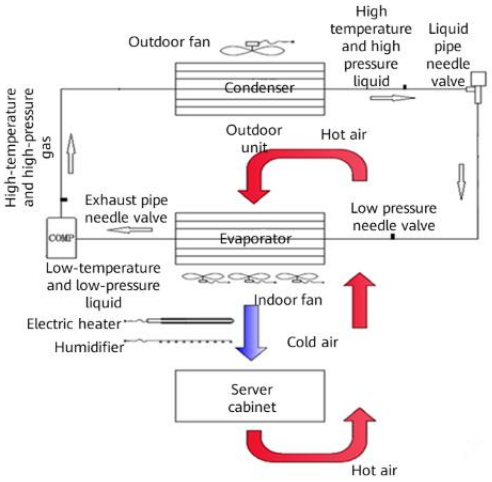


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- Cooling capacity transfer system: indoor fans and related control units
- Humidification and drainage system: humidifiers and drainage devices
- Electric control system: electric control box and related interfaces
- Cooling system: cooling-related devices and components

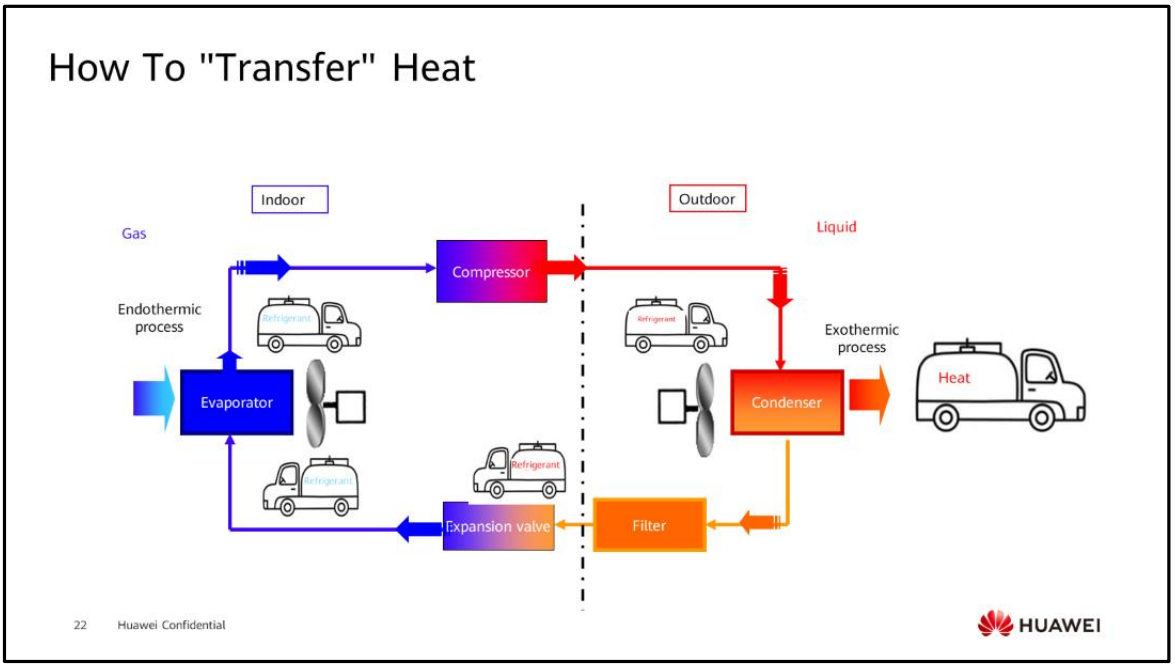
Working Principles of the Refrigeration Cycle System

- Working process of cooling
  - After absorbing the heat of cooled materials in an evaporator, liquid refrigerant vaporizes and becomes low-pressure and low-temperature steam, which is then absorbed and compressed by a compressor into high-pressure and high-temperature steam. Then the steam enters a condenser, where it releases heat under the effect of cooling materials and is condensed into high-pressure and medium-temperature liquid. After going through a throttling device, the liquid turns into low-pressure and low-temperature liquid refrigerant. The liquid refrigerant enters the evaporator again, absorbs heat, and evaporates, so as to achieve the objective of cyclic refrigeration.



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- Process 1: Compression process (adiabatic and pressurized process): This is an adiabatic and pressurized process. Only compression is performed, and no heat is transferred. Low-temperature and low-pressure steam enters the compressor and is compressed. The steam pressure increases, and the external environment works on the steam in the form of mechanical energy, the steam gets energy, and its temperature rises. The purpose of compression is to enable the refrigerant to release heat. The heat in the system can be released only when the steam temperature is higher than the external environment temperature.
- Process 2: Heat release process (isobaric pressure and heat release): The high-temperature and high-pressure steam from the compressor enters the condenser and releases heat. After the high-temperature and high-pressure steam releases heat, its temperature decreases, but its pressure remains unchanged and the steam becomes liquid refrigerant. This process is the same as water vapor becomes liquid that under atmospheric pressure.
- Process 3: Throttling process: The high-pressure refrigerant liquid at room temperature enters the throttling valve. The throttling valve is a small hole that supports dynamic adjustment. The high-pressure refrigerant liquid at room temperature passes through the small hole and enters the low-pressure and large-volume refrigerant pipe, forming the throttling effect. The refrigerant liquid pressure is reduced, and a higher speed is obtained. Because the pressure is too low, a part of the liquid is vaporized, and the refrigerant liquid temperature is reduced. Low-temperature and low-pressure gas-liquid mixture is formed. The purpose of throttling is to reduce the pressure of the refrigerant so that the boiling point of the refrigerant is lower than the indoor temperature. In this way, the refrigerant has the capability of absorbing heat and vaporization indoors.
- Process 4: Endothermic process (equal pressure process): The low-temperature low-pressure gas-liquid mixture from the throttling valve absorbs the heat of the indoor air through the evaporator to reduce the temperature of the indoor air and implement cooling. After the heat is absorbed, all liquids become gas. The principle for heat absorption is that the refrigerant boiling point is very low at low pressure. When the ambient temperature is higher than the boiling point, the heat is continuously absorbed and boiled into gas.



- Refrigerant is a heat transfer material.
- The basic principles of an air conditioner can be understood from the perspective of energy conversion:
- During refrigeration, the refrigerant or secondary refrigerant transfers indoor heat to the outdoor environment to release the heat, which reduces the indoor temperature.

Properties of Refrigerant - Cooling Capacity Transfer Medium

- Refrigerant is the fluent medium that circulates in the cooling system. It circulates between components of the system to implement energy conversion and transfer. In this way, it helps the chiller dissipate heat to the high-temperature heat source, absorb heat from the low-temperature heat source, and achieve the purpose of refrigeration.
  - High critical temperature and low solidification temperature
  - Low evaporating temperature under atmospheric pressure (a necessary condition for cryogenic refrigeration)
  - Moderate pressure
  - Large cooling capacity per unit volume
  - High thermal conductivity and low viscosity and density
  - Low adiabatic index k
  - High chemical stability
  - Low price, easy to buy, and certain water absorption capability



Huawei refrigerant R410A

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- High critical temperature and low solidification temperature is a basic requirement for refrigerant. High critical temperature makes the refrigerant easy to condense with general cooling water or air. Low solidification temperature prevents the refrigerant from being solidified under evaporating temperature, meeting the cooling requirements at a low temperature. Low evaporating temperature under atmospheric pressure is a necessary condition for cryogenic refrigeration.
- Moderate pressure: The evaporating pressure should be close to and slightly higher than the atmospheric pressure to prevent air from penetrating into the cooling system, thereby reducing the cooling capacity. The condensing pressure should not be too high (generally ≤ 12–15 times of absolute atmospheric pressure) to reduce the pressure on the cooling equipment, prevent high compression power consumption, and reduce the possibility of leakage of the high-pressure system.
- Large cooling capacity per unit volume qv ensures that when the cooling capacity is fixed, the refrigerant flow capacity and the compressor size can be reduced.
- High thermal conductivity and low viscosity and density can improve the heat transfer coefficient of each heat exchanger and reduce the flow resistance loss in the system.
- Low adiabatic index k: It can be learned from the relationship between parameters in the adiabatic process that, when the initial temperature and the compression ratio are the same, higher k will cause higher T2. Lower adiabatic index k leads to lower discharge temperature.
- High chemical stability: Refrigerant must not burn, explode, and decompose at high temperature, corrode metals, and have no chemical reaction to lubricants and do no harm to human health.
- Refrigerant should have low price and is easy to buy. In addition, refrigerant should be water-absorbent to prevent ice plugs from affecting normal operation when a small

amount of water penetrates into the cooling system.

Refrigerant Comparison

Item	R410A	R22
Chemical formula	HFC32/125 (50/50)	HCFC
Boiling point (°C)	–51.6	–40.8
Saturation pressure (at 50°C)	30.2 kgf/cm^2	18.8 kgf/cm^2
Design pressure	4.20 MPa (gauge pressure)	2.75 MPa (gauge pressure)
Refrigerant oil	Ether oil	Mineral oil
Flammability	Flammable	Flammable
Toxicity	Nontoxic	Nontoxic

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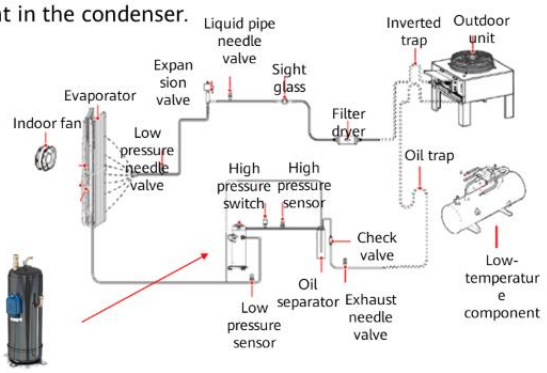
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Position and Function of the Compressor

- Compressor: The compressor is the core of the refrigeration cycle and is a power unit for refrigerant to circulate inside the system. It maintains low pressure for the refrigerant in the evaporator and high temperature and high pressure for the refrigerant in the condenser.
  - The compressor resides between the evaporator and condenser.
  - The refrigerant at the compressor outlet is in gas state.
  - Low-pressure refrigerant changes to high-pressure refrigerant after being compressed by the compressor.
  - Low-temperature refrigerant becomes high-temperature refrigerant after being compressed by the compressor.



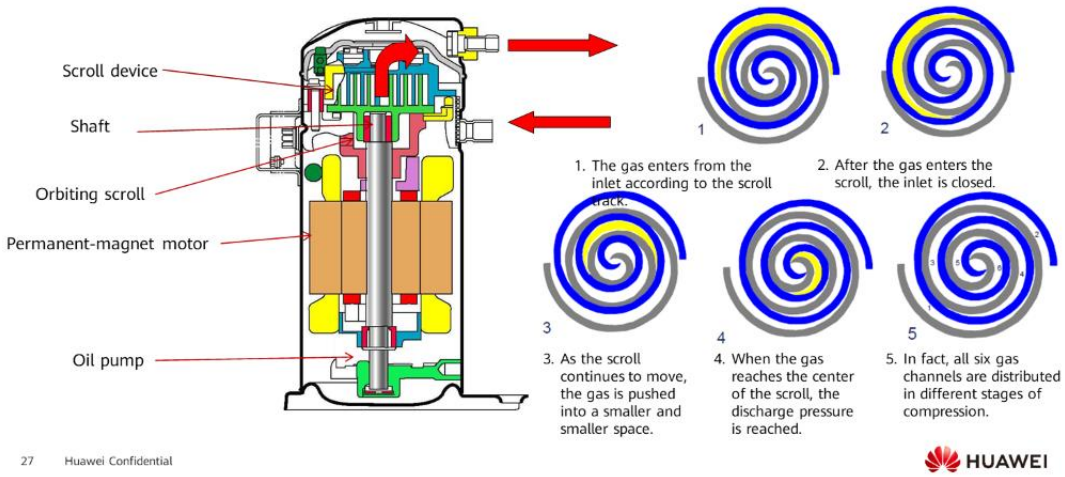
Compressor appearance

NetCol5000-A25 system diagram

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Structure and Working Process of a Scroll Compressor

- The typical refrigerant flow direction is marked by the red arrows in the figure.

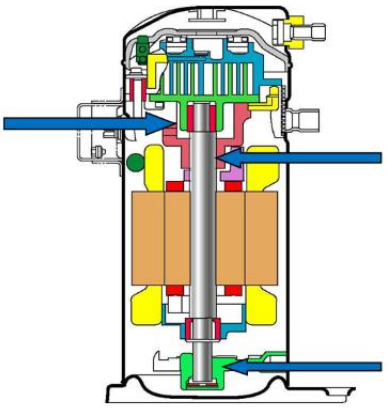


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- A scroll compressor contains an orbiting scroll and a fixed scroll. During air suction, compression, and exhaust processes, the fixed scroll is fixed onto the rack, and the orbiting scroll is driven by the eccentric shaft to orbit in the path defined by the fixed scroll. The refrigerant gas is sucked into the outer suction port of the fixed scroll due to the differential pressure and rotates around the eccentric shaft. The gas is therefore gradually compressed between the orbiting scroll and fixed scroll and then continuously discharged through the port in the center of the fixed scroll.
- The gas enters the suction pipe, cools the motor, and is pulled into the opening of the orbiting scroll and compressed toward the center.
- The outermost part is always in the suction state, and the central part is always in the exhaust state.
- Pay attention to the refrigerant flow in the compressor.

Function of Refrigerant Oil

- In a compressor, refrigerant oil is used for lubrication, sealing, cooling, and so on.
  - Lubricating refrigerant oil reduces the friction and abrasion of the compressor, thereby prolonging the service life of the compressor.
  - Sealing refrigerant oil prevents refrigerant leakage.
  - Cooling refrigerant oil takes away the heat generated during the working process when lubricating the moving parts of the compressor.
- The recommended refrigerant oil is RL32H/EMKARATE.



Note: The lubrication of the bearing is supported the oil pump at the end of the crankshaft.

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- Precautions for using refrigerant oil
- (1) Refrigerant oil of different brands cannot be used together. Otherwise, the refrigerant oil will deteriorate.
- (2) Refrigerant oil is very easy to absorb water. Tighten the refrigerant oil bottle immediately after use.
- (3) Deteriorated refrigerant oil cannot be used.
- (4) Refrigerant oil should be added before refrigerant.

Precautions for the Initial Startup of a Compressor

- Precautions for using a compressor

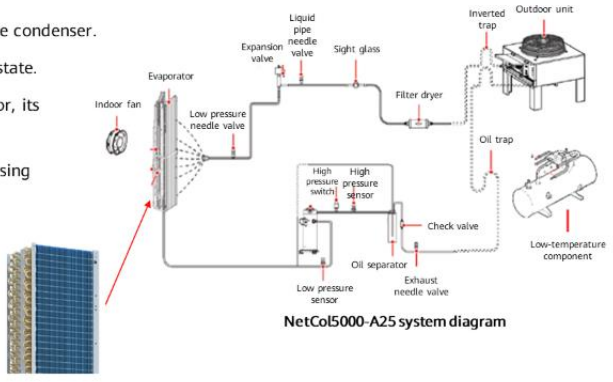


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- The purpose of heating is to ensure the oil temperature and prevent refrigerant backfeed.
- Keep the refrigerant oil temperature at the bottom of the compressor within a proper range. If the evaporating pressure is too low, the refrigerant is insufficient, or the condensing pressure is too high, high temperature may occur. In this case, the discharge temperature is also high, which may cause overheating of the system and damage the compressor motor and lubricant. If too much refrigerant is backfed, the refrigerant oil temperature at the bottom must be low, even close to the suction temperature. At this time, the system is not safe. In the low-temperature operating condition, the compressor is prone to slugging. Therefore, under the rated cooling condition, ensure that the refrigerant oil temperature at the bottom is about 50°C.

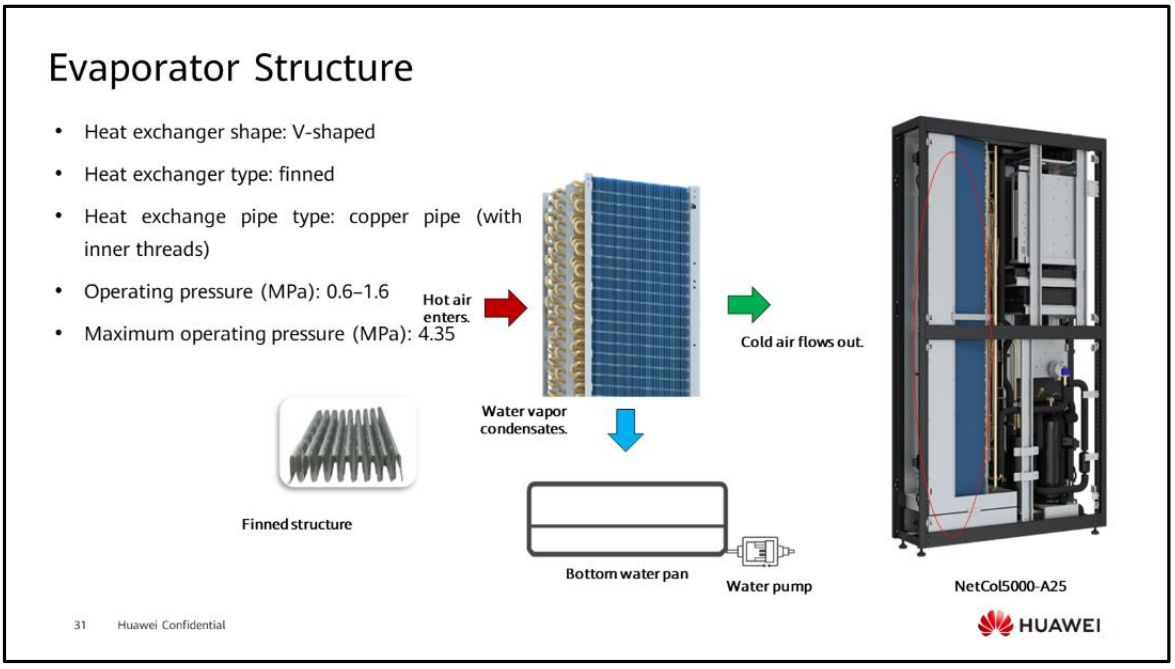
Position and Function of the Evaporator

- Evaporator: The throttled liquid refrigerant absorbs heat and vaporizes in the evaporator to realize cooling. The evaporator is the main component for heat exchange in an equipment room.
  - The evaporator is between the compressor and the condenser.
  - The refrigerant at the evaporator outlet is in gas state.
  - After the refrigerant passes through the evaporator, its pressure increases.
  - Refrigerant becomes slightly overheated after passing through the evaporator.



NetCol5000-A25 system diagram

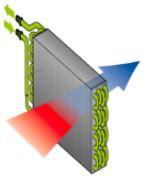
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- V-shaped heat exchangers have a larger layout area.
- Finned heat exchangers enhance heat exchange.
- Copper pipes (with inner screw threads) enhance heat exchange.
- Pipe diameter (mm): 7
- Wall thickness (mm): 0.24
- Number of rows: 4
- Heat exchange area (m2): 55.63
- Frontal area (m2): 1.04
- Operating pressure (MPa): 0.6–1.6
- Maximum operating pressure (MPa): 4.35 (operating pressure of the entire system: 0.25–4.25 MPa)

Why an Evaporator Can Be Used for Dehumidification

- Evaporation and heat absorption process of refrigerant
  - Stage 1: After throttled, the wet steam enters the evaporator, absorbs heat, and boils and vaporizes to become saturated gas.
  - Stage 2: The refrigerant continues to absorb heat and becomes overheated steam.
- Dehumidification by air refrigeration: Freeze the air below the dew point, and remove the condensed moisture.
- Cooling and dehumidification process
  - When hot air passes through the fins of the evaporator, water in the air condenses on the fins due to the decrease of temperature, and the air is dehumidified.



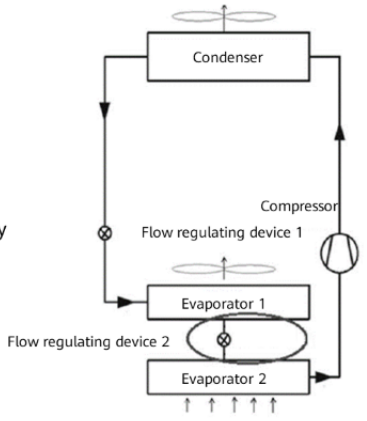
Evaporator cooling process

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- The surface temperature of the evaporator and condensation affects dehumidification.

Dehumidification Technology of Precision Air Conditioners

- Light load dehumidification 1.0
  - During the dehumidification process of the precision air conditioner, the sensible heat cooling capacity is generated. If the heat load is relatively small and no heat is added during the dehumidification process, the indoor temperature is bound to decrease.
  - The evaporator is specially designed to use the refrigerant heat as the heat compensation for the dehumidified supply air of the air conditioner. This heat compensation ode does not require extra energy consumption, and is an energy-saving constant temperature dehumidification solution.
  - Huawei NetCol5000-A025 uses this dehumidification solution.
  - Note: The light load dehumidification function is optional.



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- This function is not a standard configuration. You need to be export the specific models from the configurator.

Dehumidification Technology of Precision Air Conditioners

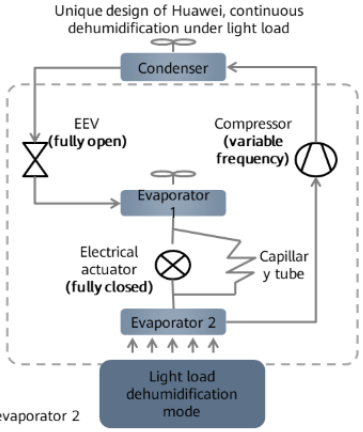
- Light load dehumidification 2.0
  - During the dehumidification process of the precision air conditioner, the sensible heat cooling capacity is generated.
  - When the load is lower than the normal output cooling capacity corresponding to the minimum rotational speed of the compressor, the opening of the flow regulating device is gradually reduced, the evaporating temperature is gradually reduced, and the enthalpy difference and flow rate of the refrigerant at the evaporator inlet and outlet are also decreased.
  - The cooling output of the compressor is decreased to implement light load dehumidification.
  - In this way, the control logic of the compressor and expansion valve is adjusted. The electronic expansion valve opening automatically decreases when the compressor rotates at a low speed. Therefore, no additional component is required.
  - No heating, heat compensation, and other additional energy consumption. It is an energy-saving constant temperature dehumidification solution.
  - Some models of Huawei NetCol5000-A042 support this technology.

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- Reduce the air volume and use an electric heater to supplement heat.
- After the air volume of a precision air conditioner decreases, the evaporating temperature decreases, and the dehumidification volume increases. In addition, low air volume is conducive to the condensation of water vapor, achieving the purpose of dehumidification. However, dehumidification of air conditioners causes sensible heat cooling capacity, which leads to the decrease of air temperature. Therefore, an extra electric heater needs to be added to supplement heat to achieve the effect of constant-temperature dehumidification.
- Add a dehumidifier.

Light Load Dehumidification of Huawei Precision Air Conditioners

- Working principle: During dehumidification, the EEV is fully open and does not perform throttling. The electrical actuator in the middle of the evaporator is closed, and the capillary tube in the middle of the evaporator performs throttling. The indoor air passes through evaporator 2 (used as an evaporator) to cool down, and then passes through evaporator 1 (used as a condenser) to warm up. The overall temperature of the indoor air passing through evaporator 1 and evaporator 2 basically remains unchanged. In this way, dehumidification can be continuously performed, and indoor humidity can be continuously reduced, thereby implementing constant-temperature dehumidification.



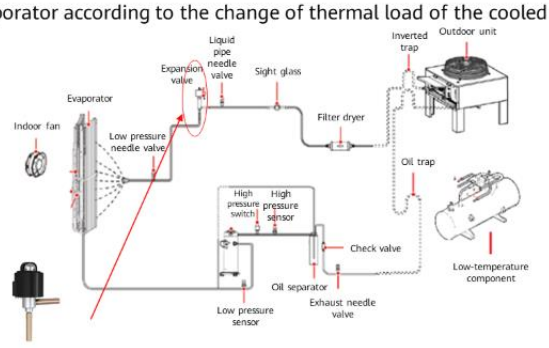
- In light load and high-humidity scenarios, the logic triggers evaporator 1 to produce heat and evaporator 2 to cool air, and the refrigeration coil performs refrigeration and heat exchange coil supplements heat. In this way, continuous dehumidification can be performed when the load is less than 10%.

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- Currently, the light load dehumidification feature applies only to half-sized air cooled DC variable frequency air conditioners. In the future, this feature will be applicable to full-sized DC variable frequency air conditioners.
- Working principle: During cooling, the EEV performs throttling, and the electrical actuator in the middle of the evaporator is fully opened without throttling, just like normal air conditioners. Evaporator 1 and evaporator 2 are connected in series, and both evaporators have cooling effect. When constant-temperature dehumidification is required, the EEV is fully open and stops throttling. The electrical actuator in the middle of the evaporator is closed, and the capillary tube in the middle of the evaporator performs throttling. After the high-temperature and high-pressure liquid refrigerant flowing out of the condenser passes through the EEV (fully open), the refrigerant is still high-temperature and high-pressure liquid. After the refrigerant flows into evaporator 1, the refrigerant temperature is higher than the ambient temperature, and the refrigerant releases heat to lower its temperature. After flowing through the throttling device in the middle of the evaporator, the liquid refrigerant turns into a low-pressure low-temperature refrigerant liquid and flows into evaporator.
- Highlight the advantages of Huawei products during the presentation.

Position and Function of Expansion Valves

- Expansion valves are used for throttling. The expansion valve is a regulating device for circular flow of refrigerant. It throttles and depressurizes high-pressure liquid refrigerant and makes the refrigerant entering the evaporator to absorb heat and evaporate under the required low pressure. In addition, the expansion valve automatically regulates the flow of the refrigerant entering the evaporator according to the change of thermal load of the cooled medium.
  - The expansion valve is between the evaporator and the condenser.
  - After the refrigerant passes through the expansion valve, the pressure decreases significantly.
  - The refrigerant changes to liquid after passing through the expansion valve.
  - A filter and a needle valve are arranged in front of the expansion valve.



EEV

NetCol5000-A25 system diagram

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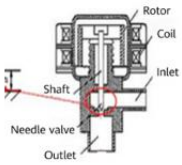
- Expansion valves are classified into thermostatic expansion valves and EEVs. The thermostatic expansion valve not only controls the liquid supply of the evaporator, but also throttles the saturated liquid refrigerant. According to its structure, the thermostatic expansion valve can be divided into two types: internal balance type and external balance type. The EEV is mainly used in the variable-frequency air conditioning system. It adjusts the liquid supply of the evaporator according to the preset program. It adapts to the development requirements of the electromechanical integration of the cooling system. It has excellent performance that the thermostatic expansion valve does not have and provides conditions for the intelligent control of the cooling system.

Expansion Valve Overview - EEV

- Working principle
  - Structure and working principle of an EEV
  - An EEV consists of a coil, rotor, valve needle, valve rod, and valve seat.
  - The following figure shows a direct action EEV. When the pulse voltage is applied to the coil in a certain sequence, the electric energy is converted into magnetic energy to drive the rotor to rotate. The rotor rotation drives the valve rod to move up and down, which causes the valve needle to move up and down. As a result, the through-flow area of the valve port changes and the flow rate is controlled.



EEV



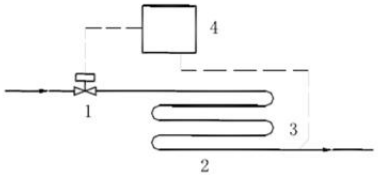
EEV structure

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- EEVs are classified into electric EEVs and electromagnetic EEVs. Electric EEVs are classified into direct action EEVs and deceleration EEVs. Currently, most EEVs are electric ones.

Control of EEVs

- The EEV uses electronic means to regulate the flow rate. The following figure shows the regulation system. The regulating devices include a temperature sensor, an electronic regulator and an EEV, which are connected by a conducting wire to transmit power signals. The regulating rule is set by the regulator. In the EEV control system, the response of the sensor, regulator, and actuator is fast.
- The regulation directions are as follows:
  - If the superheat degree is insufficient, the main control system sends a command to close the valve.
  - If the superheat degree is excessive, the main control system sends a command to open the valve.
  - To prevent over-regulation, the upper and lower limits of the expansion valve opening are set at different frequencies, and the regulation step is also limited.



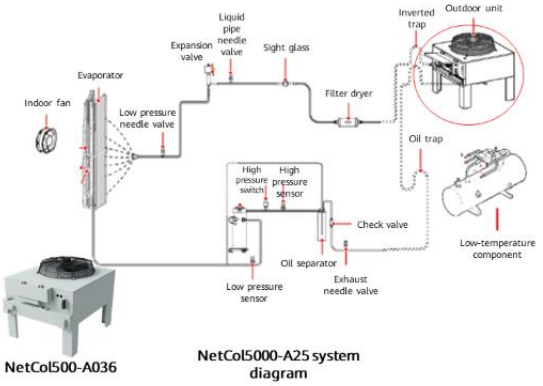
(1) EEV
(2) Evaporator
(3) Temperature sensor
(4) Electronic regulator

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- As a new type of control element, EEV is no more than a throttling device. Emphasize this during presentation.
- Increase the EEV opening to increase the refrigerant circulation amount in the system so that the compressor can be cooled and the discharge temperature can be reduced.
- Superheat degree

Position and Function of the Condenser

- Condenser: Under the effect of condensing medium, the condenser liquidizes the superheat saturated steam exhausted by the compressor. Air cooled condensers are usually used in refrigeration devices. In a condenser, refrigerant condenses inside the tubes, and air flows outside the tubes, taking away the heat released by the refrigerant.
  - The condenser is between the compressor and the expansion valve.
  - The refrigerant at the condenser outlet is liquid or liquid/gas.
  - The temperature of the refrigerant decreases significantly after passing through the condenser.
  - Refrigerant becomes mixed state after passing through the evaporator.
  - Inverted traps and oil traps are deployed before and after the condenser.



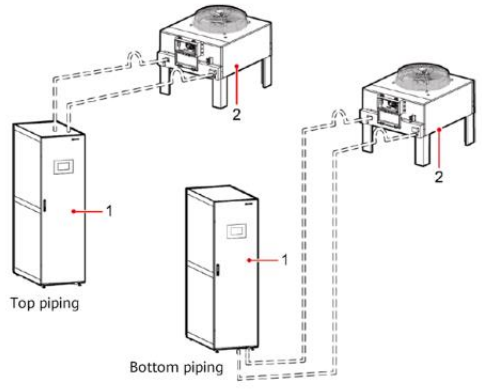
NetCol500-A036

NetCol5000-A25 system diagram

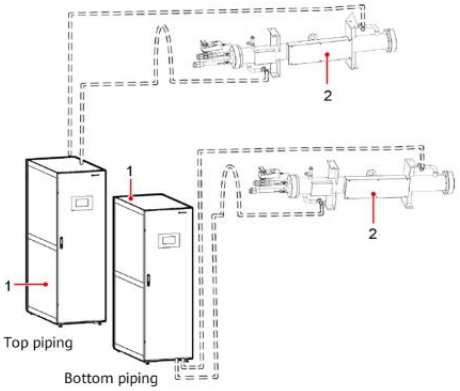
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- The function of the oil trap and inverted trap should be mentioned.

Connections Between the Indoor Unit and Outdoor Unit



(1) NetCol5000-A (2) Air cooled outdoor unit



(1) NetCol5000-A (2) Water cooled module

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- Fans absorb indoor hot air and move to the evaporator with heat transmitted to the refrigerant. The refrigerant is exhausted to the outdoor unit using the compressor, releasing heat to outdoor environments. The indoor unit and outdoor condenser are connected using refrigerant pipes in a fully sealed manner. NetCol500-A060 is used as an example of the outdoor unit.

Outdoor Unit of the Huawei Precision Air Conditioner



NetCol500-A036



NetCol500-A072

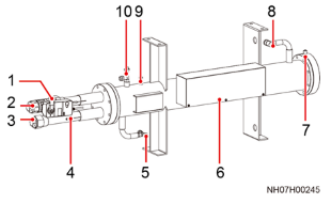
NetCol500 outdoor unit models:
NetCol500-A026SC11E0 NetCol500-A0265S11E0
NetCol500-A0325C11E0 NetCol500-A0365C11E0
NetCol500-A0365S11E0 NetCol500-A0725C11E0

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- After the outdoor unit is configured based on the indoor unit, a sunshade needs to be configured if the outdoor unit with Huawei fans and driver (BOM number: 52273187/52273190) is used in the T3 working condition and the following three conditions are met.
- a. The outdoor unit is installed horizontally.
- b. The ambient temperature exceeds 50° C.
- c. The outdoor unit is directly exposed to sunlight.
- If the preceding three conditions are met but no sunshade is configured, the air conditioner will shut down because the components are applied beyond specifications.
- 2. The outdoor unit (BOM number: 52273186/52273187/52273190) can be used in the following environments:
- a. Class A (controlled environment): indoor environments where the ambient temperature and humidity are controlled, including rooms where people live
- b. Class B (uncontrollable environment): indoor environments where the ambient temperature and humidity are not controlled or general outdoor environments with simple shielding measures where the humidity reaches 100% occasionally
- c. Class C (harsh environment): outdoor land environments or environments with simple shielding measures, which are within 3.7 km away from the sea or within 1.2 km away from a pollution source
- d. Class D (marine environment): environments within 500 m away from the coast

Water-cooled Module of the Huawei Precision Air Conditioner

- Features:
  - The water valve is pre-integrated to save onsite installation time.
  - The water-cooled module can be installed in stack mode to maximize the installation space and reduce the footprint.
  - The water-cooled module uses cooling water for heat exchange to improve the heat exchange efficiency and improve the energy efficiency of the entire system to 4.0COP.
- The NetCol500 water-cooled module consists of an electric control box, a water valve actuator, a rack, and so on. The following figure shows its components and appearance.



(1) Water valve actuator
(2) Water return pipe
(3) Water supply pipe
(4) Negative temperature coefficient (NTC) sensor
(5) Liquid pipe
(6) Electric control box
(7) Needle valve on the cooling water side
(8) Gas pipe
(9) Needle valve on the refrigerant side
(10) Safety valve

Contents

1. Product Overview
2. Cooling System Overview
   - Auxiliary Components
3. Cooling Capacity Transfer System
4. Humidification and Drainage Regulation System
5. Electric Control System
6. Common Terms

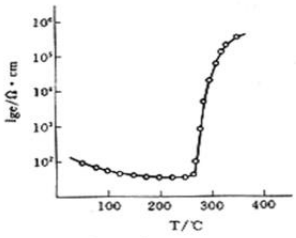
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Auxiliary Components and Functions (1)

- PTC heater
  - A positive temperature coefficient (PTC) electric heater is used, which features fast temperature rise and large heating capacity. The heating power decreases automatically after high temperature is reached. Multiple protection measures are supported. PTC electric heaters are safer, more stable, and reliable than traditional electric heating tubes.
  - Principle: The PTC thermistor is a typical semiconductor resistor with temperature sensitivity. When its temperature exceeds a certain threshold (Curie temperature), its resistance increases in a stepped mode as the temperature rises.



PTC heater



Operating curve

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Auxiliary Components and Functions (2)

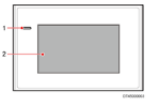
- Filter dryer and sight glass

Filter Dryer	Description
	A filter dryer of a well-known brand is used to effectively remove water and filter impurities generated during the long-term running of the cooling system, ensuring the normal running of the system.
Sight Glass	**Description**
	A sight glass allows you to observe the refrigerant flow and gas content for easy maintenance and optimization.

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Auxiliary Components and Functions (3)

- Check valve and display panel

Check Valve	Description
	A check valve of an internationally famous brand is used to effectively control gas or liquid backflow. It prevents startup with loads, reducing pipe vibration. It effectively improves unit reliability.
Display Panel	**Description**
	A 7-inch true color liquid crystal display (LCD) is used to provide a user-friendly interface to perform query, settings, monitoring, and maintenance. When only one air conditioner is running, the LCD provides logic control of its components to meet temperature and humidity requirements. When multiple units work cooperatively, the LCD optimally distributes the heat load to reduce energy consumption and provides backup to improve reliability.

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Auxiliary Components and Functions (4)

- High pressure switch and high and low pressure sensors

High and Low Pressure Sensors	Description
	A high pressure or low pressure sensor accurately collects the high and low pressure values of the cooling system and reports them to the controller, ensuring safe and stable running of the system.
High Pressure Switch	**Description**
	A high pressure switch detects the high pressure at the exhaust vent of the compressor. If the pressure reaches the preset value, the high pressure switch acts and the refrigerant system will shut down. It functions as a second line of defense (the pressure sensor is the first line of defense), improving system security and reliability.

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Auxiliary Components and Functions (5)

- Water pump and float

Water Pump	Description
	The water pump is a brushless DC pump with a maximum lift of over 4 meters.
Float Switch	**Description**
	A water level switch accurately detects the water level in the drip pan. When water level is high, the water pump works and drains water. When water level is low, the water pump stops working. The water level switch prevents water in the water pan from overflowing, protecting the pump and improving safe operation and reliability of the unit.

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Auxiliary Components and Functions (6)

- T/H sensor

Temperature Sensor	Description
	A temperature sensor is a negative temperature coefficient heat-sensitive semiconductor resistor whose resistance changes with its temperature. It is used to detect temperature.
T/H Sensor	**Description**
	A T/H sensor is mainly deployed in a cold or hot aisle to detect the ambient temperature and humidity. The temperature and humidity inside the equipment room are controlled according to the differences between the detected values and the preset values. (Set the DIP switch before installing the T/H sensor.)

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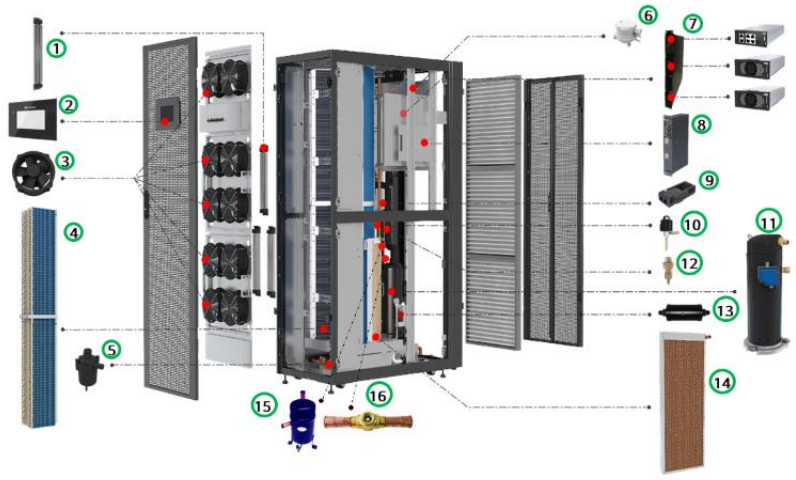
Auxiliary Components and Functions (7)

- Differential pressure switch and air filter

Differential Pressure Switch	Description
	A differential pressure switch is used to check the pressure difference between the front and rear of the air filter. It determines whether the air filter is blocked and reminds you to clean the air filter in a timely manner so that the equipment runs safely and reliably.
Air Filter	**Description**
	A filter meets customers' cleanliness requirements for data centers.

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Quiz - Name the Components



(1) Electric heater	(2) Control display
(3) Fan	(4) Evaporator
(5) Condensate pump	(6) Differential pressure switch
(7) ELV box	(8) Compressor driver
(9) T/H sensor	(10) EEV
(11) Compressor	(12) Needle valve
(13) Filter dryer	(14) Wet film humidifier
(15) Oil separator	(16) Sight glass

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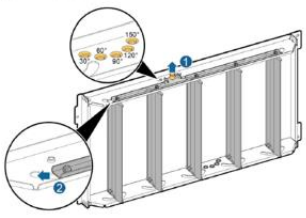
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Airflow Mode and Air Deflector of the Air Conditioner

- When the application scenario is cold or hot aisle containment, you are advised to choose **Cold aisle** if cold aisle T/H sensors are configured. Choose **Supply air** if no cold aisle T/H sensors are configured.
- When the application scenario is non-aisle containment, you are advised to choose **Return air**. Choose **Cold aisle** if cold aisle T/H sensors are configured.



Airflow mode selection



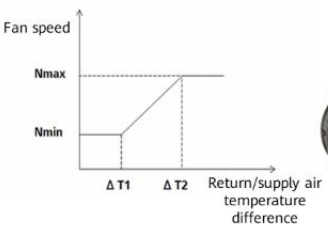
Air deflector

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- Use the in-row air conditioner as an example to describe some settings and meanings of some values.
- If users need to adjust the air flow direction, adjust the air deflector on the inner side of the front door to a proper angle based on site requirements. The air deflector supports five angles: 30°, 60°, 90°, 120°, and 150°. The default angle is 90°.

Indoor Fan Control Principle

- Indoor fan control logic:
  - The indoor fans are controlled based on the temperature difference between the return air and the supply air.
  - When the temperature difference is less than the lower limit, the fan keeps working with the minimum rotational speed allowed.
  - When the temperature difference is greater than the upper limit, the fan keeps working with the maximum rotational speed allowed.
  - When the measured temperature difference is between the upper and lower limits, the fan speed is controlled between the upper and lower limits.





Pay attention to the following coupling relationships during commissioning:

- When the compressor (including the constant-frequency compressor and variable-frequency compressor) is started, the indoor fans, outdoor fans, and the liquid pipe electrical actuator are automatically started.
- When the electric heater is started, the corresponding indoor fan is automatically started.
- When the electrode humidifier is started, the corresponding indoor fan is automatically started.

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- Indoor fans are started when the compressor cooling is required.
- T1: 5°C, T2:12°C

Aisle Containment and Layout - In-row Solution





Cold aisle containment

Containment **in front of** cabinets



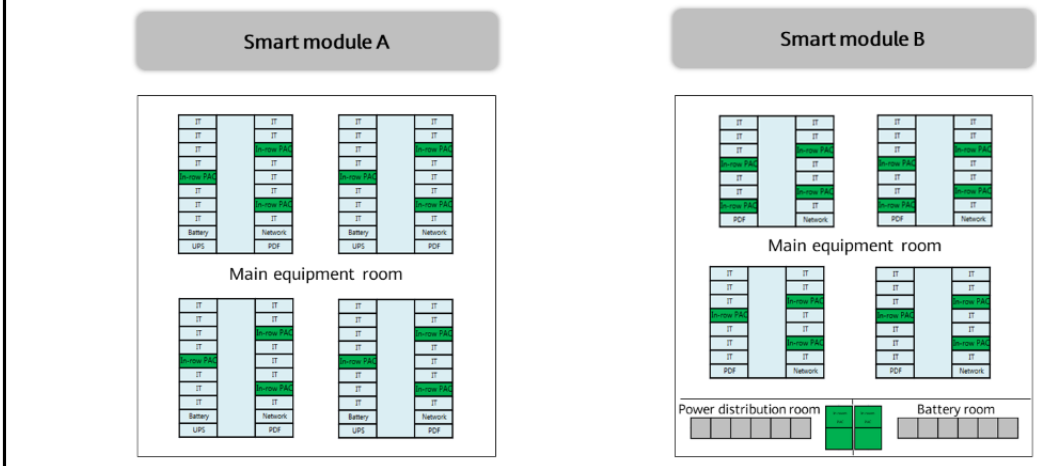
Hot aisle containment

Containment **at the rear of** cabinets

Basic number of air conditioners **+ X**

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Layout Inside the Module - In-Row Solution



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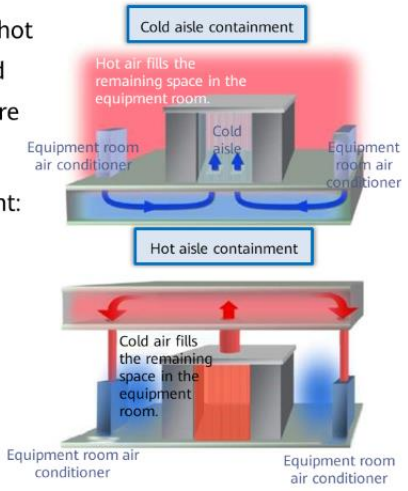
- Difference: The number of air conditioners in each module is different. Both smart module A and smart module B can meet basic requirements. Smart module B has more redundant capacity.

Aisle Containment and Layout - In-Room Solution

- Skylights and aisle doors are used to seal the cold or hot aisles in the equipment room to avoid mixing the cold and hot air. Then in-room precision air conditioners are deployed.
- Air conditioners deployed in cold/hot aisle containment:



NetCol8000-A upflow or downflow model

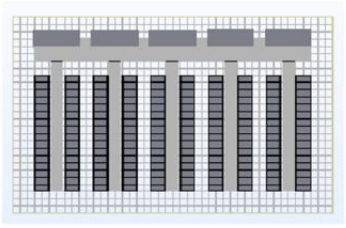


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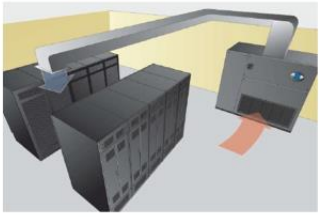
- Note: Use the in-room air conditioner as an example.

Overhead Air Supply - In-Room Solution

- In the in-room solution, overhead air supply through air ducts is used. Therefore, air ducts need to be installed. The net height of each floor in a room must be greater than or equal to 4 m.



Plan view



Airflow diagram



NetCol8000-A upflow model

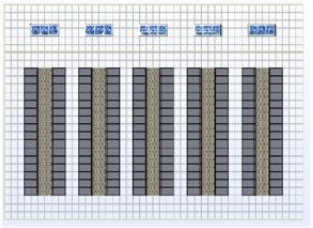
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- After deployed, the pipes of this airflow mode are hard to adjust. Loud noise will occur. Because air supply through air ducts is easy to cause local heat accumulation and forms a local overheat, the air duct is applicable to an area in which heat emission is not large and air organization requirements are not strict. The heat load of the early data center is small. Therefore, the overhead air duct is often used. However, as the cabinet power density increases, the overhead air supply through air ducts cannot meet the cooling requirements of the data center.

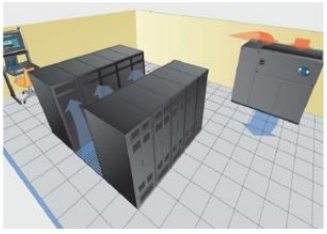
Underfloor Air Supply - In-Room Solution

- Underfloor air supply is a form of air organization that replaces overhead air supply through air ducts. It is widely used in data centers.

The underfloor air supply mode features high cooling efficiency and easy installation.



Plan view



Airflow diagram



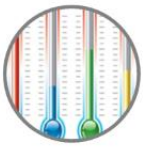
NetCol8000-A downflow model

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- The disadvantage of the underfloor air supply mode is that the floor height, cooling capacity, and air supply capacity must be designed by professional personnel. If the design is improper, the cooling efficiency is low, and the equipment room is overheated or overcooled. When the underfloor air supply mode is used, the floor height of the equipment room must meet related requirements.

Why Do We Need Large Air Volume and Small Enthalpy Difference

- Compared with a common comfort air conditioner, an air conditioner in an equipment room features large air volume and small enthalpy difference.



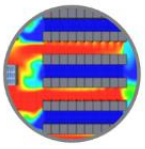
High control precision for temperature and humidity



Condensation prevention in the equipment room



High humidity uniformity requirement



Sensible heat regulation

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- The enthalpy difference of the air processed by the surface cooler is large. That means the temperature difference between the supply air and return air is large. That is, the temperature of the supply air is low. For rooms that require high temperature and humidity precision, if the temperature difference between the supply air and return air is too large, the temperature and humidity control precision decreases.
- In an environment with high humidity, if the supply air temperature is lower than the air dew point, the supply air is mixed with moisture (condensed by water vapor in the air).
- The air conditioner dedicated for the equipment room has large air volume and small enthalpy difference. The enthalpy difference is about 1/2 that of the comfort air conditioner. This is because the sensible heat accounts for the majority of the total heat load in an equipment room. Air conditioners with large air volume and small enthalpy difference can prevent the condensation.
- Air conditioners in an equipment room are equipped with humidifiers. Large fans can ensure the highest level of humidity uniformity, ensure the heat dissipation of network devices, and achieve the optimal working status.

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Working Process of the Wet Film Humidifier System

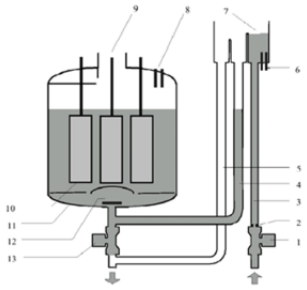
- Wet film humidifier
  - The wet film humidifier is used. The wet film, water pump, water pipe, and water pan form a loop. The return air passes through the wet film and takes away the water that evaporates naturally to increase the air humidity. Water resources can be recycled in the whole process that is safe, reliable, and free of arc failure risks. The maintenance is simple and cost-effective.



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Working Process of the Electrode Humidifier System

- Humidification process:
  - After the air conditioner receives the humidification instruction, electrical actuator 1 acts and water flows into the air conditioner.
  - The conductivity measurement electrode acts to monitor the conductivity.
  - The water enters the humidifier cylinder after passing through the water inlet pipe at the bottom and filtered by the air filter at the bottom.
  - When the high electrode signal is detected, the water inlet electrical actuator is closed, and the water inlet is complete.
  - The humidifier calculates the humidification current based on the humidification requirements and controls the humidifier electrode.

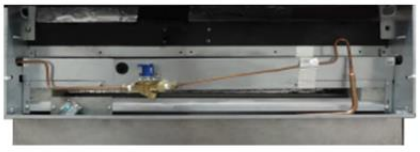


Electrode humidifier

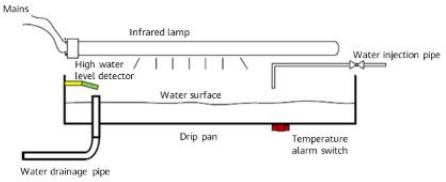
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Working Principles of the Infrared Humidifier

- Infrared humidifier
  - An infrared humidifier integrates a high-strength quartz lamp tube which emits infrared rays after being connected to power. When the infrared rays enter water, water molecules oscillate increasingly, which raises the water temperature, vaporizes the water, and implements humidification in the form of water vapor.



Electrode humidifier appearance



Schematic diagram of an electrode humidifier

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- Advantages:
- The technology is mature and has been widely accepted as a humidification solution and applied to precision air conditioners at an early stage.
- It has low requirements on water quality. Common tap water can be directly used.
- Disadvantages:
- The humidification energy consumption is high. First, the infrared lamp features high power and low efficiency. Generally, the humidification capacity of 1 kg/h consumes about 1 kW power. Second, the heat emitted by the infrared lamp increases the temperature of the surrounding air, increases the cooling load, and reduces the energy efficiency ratio of the precision air conditioner.
- The maintenance frequency is high and the cost is high. In the humidification process, when the water temperature exceeds 60° C, the calcium and magnesium ions in the water solidify and form scale, blocking the drainage port of the drip pan. Therefore, scale needs to be cleaned frequently, which consumes manpower and material resources.
- Large installation space is required. Generally, the infrared humidifier has a large size and requires large installation space. Therefore, it is generally used in in-room air conditioners and is difficult to use in in-row air conditioners.

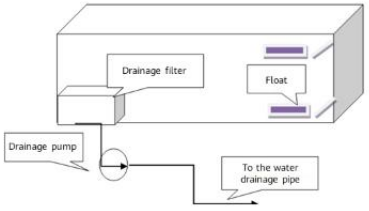
Humidification Technology Summary

Humidifier Type	Wet film humidifier	Electrode humidifier	Infrared humidifier
Humidification Principle	The water in the sprinkler on the top of the wet film permeates due to gravity and then is absorbed. When dry air passes through the wet film, water molecules absorb heat, evaporate, and turn into moist air.	After AC power is supplied to the electrodes of the storage and steam cylinder in the humidifier, the impurities in water start moving, and kinetic energy is turned into thermal energy. The generated steam is sprayed into the air flow through spray pipes and then evaporates.	Water evaporates when a highlighted infrared quartz lamp is hung above an open water pan. The generated steam spreads to the air flow that requires humidification.
Energy Consumption (Wh/kg)	15	780	700
Water Quality Requirement	Clean tap water	Clean tap water or softened water	Clean tap water
Replaced Component	Humidification module (replaced every 8 to 10 years based on the stain status)	Steam cylinder	Infrared lamp
Maintenance Interval	Once per year	Once per year	Once per year
Water Supply Utilization	30–70%	75–90%	75–90%
Advantage	No white powder, self-regulated and clean humidification, no noise, high strength, strong corrosion resistance, anti-microbial, long life cycle, small equipment size, less maintenance, and low OPEX	Key parts made of imported materials, low noise, adjustable humidification amount, and high humidification purity	Rapid humidification, no drops and bacterias, excellent control performance, simple deployment, and self-cleaning
Disadvantage	Micro-organism pollution, decreased humidification temperature	High energy consumption and operation costs, prone to scaling and difficult to clean	High energy consumption and OPEX, short life cycle, and high price

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Huawei Air Conditioner Drainage System

- Waste water of the air conditioner is the fin condensate water and water from the humidifier cylinder. The following figure shows the drainage system.



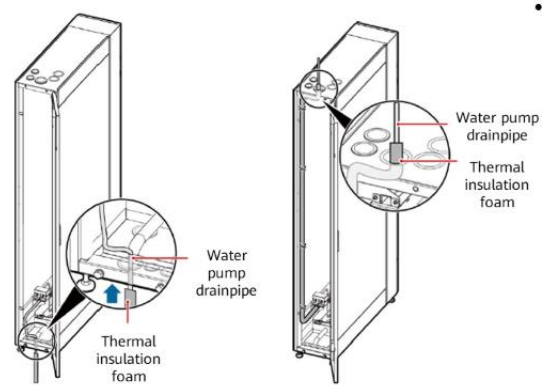
Drainage system

- The drainage system consists of a drainage pump, high and low liquid level detection floats, water pans, related ancillary pipes, and so on.

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- The 42 kW air conditioner is configured with a forcible drainage pump (standard configuration). Water can be drained from the top or bottom, and automatic drainage is supported. The 25 kW air conditioner can be configured with a drainage pump (optional) for top drainage with a maximum lift of 4 m.

Drainage Pump Working Scenarios and Technical Specifications



Downward drainpipe routing Upward drainpipe routing

- Pump technical specifications include flow rate, lift, rotational speed, efficiency, and so on.
  - The pump flow rate refers to the amount of liquid discharged per unit time.
  - The pump lift (H) is the energy added to the liquid per unit weight that flows through the pump.
  - The rotational speed refers to the rotational speed of the pump impeller per minute.
  - Pump power refers to the amount of work performed by the pump in a unit time.

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- A pump is a machine that converts the energy of a power machine or other energy source into the energy of a liquid and is used to pressurize the liquid that flows through.
- The pump flow rate refers to the amount of liquid discharged per unit time. Generally, the pump flow rate is measured by volume (Q) in the unit of m3/h, m3/s, or L/s. It can also be measured by weight (G) in the unit of t/h, t/s, or kg/s.
- The pump lift (H) is the energy added to the liquid per unit weight that flows through the pump. It is the lift height of the pump, also known as the total lift or full lift. The unit is liquid height (m). The total lift of the pump consists of two parts: absorptive lift and effluent lift.
- During operation, if the absolute pressure of the pumped liquid is reduced to the liquid vaporization pressure at the current temperature at certain part (usually the impeller blade inlet), the liquid starts to vaporize at this part, generating a large amount of steam and bubbles. When the liquid containing a large number of bubbles flows through the high pressure zone in the impeller, the high pressure liquid around the bubbles makes the bubbles to shrink sharply and rupture. At the same time as the bubbles condense and rupture, the liquid particle fills the cavity at a very high speed. In this instant, the liquid particle produces a very strong impact effect and hits the metal surface at a very high impact frequency. In serious cases, the liquid particle will break down the wall.

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Components in the Electric Control System

- Electric box for Huawei air cooled precision air conditioners
  - Detects the power supply and switches between two power inputs.
  - Controls the heavy current of the electric heater and compressor.
- ELV box for Huawei air cooled precision air conditioners
  - Converts high voltage into low voltage.
  - Controls electrical components such as fans, water pumps, and EEVs.
  - Implements the control logic of the system.



Electric box

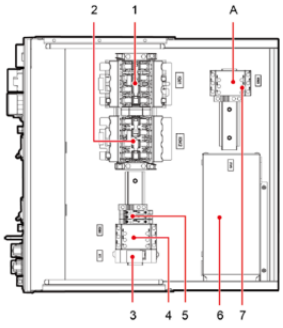


ELV box

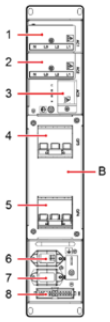
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- The 42 kW air conditioner is used as an example. The 25 kW air conditioner is similar.

Interior of the NetCol5000-A042 Electric Control Box



Side view



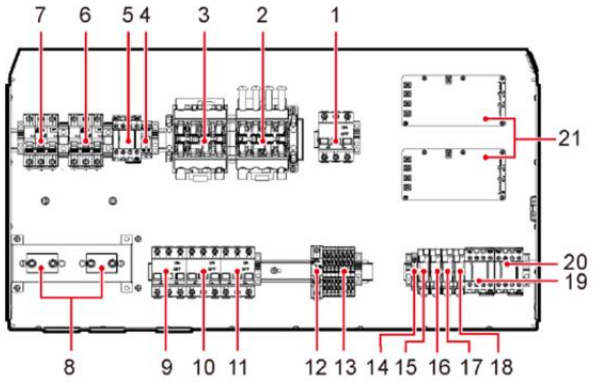
Front view

(1) Primary power supply port (AC1)
(2) Backup power supply port (AC2)
(3) Outdoor unit power port (AC3)
(4) Circuit breakers for the outdoor unit and compressor (QF3)
(5) Electric heater switch (QF4)
(6) Compressor PSU power port (X101)
(7) Electric heater power port (X102)
(8) Signal port (X103)

(1) Dual-power switch contactor (KM1) (2) Dual-power switch contactor (KM2)
(3) Oil heating belt relay (4) Electric heater contactor (KM4) (5) Fuse base
(6) Surge protection board (7) AC contactor (KM3)

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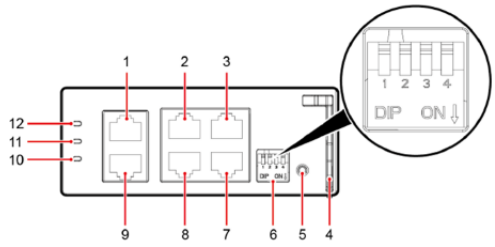
Interior of the NetCol8000-A045 Electric Control Box



(1) Liquid storage tank heating switch (optional)
(2) Dual-power switch contactor (3) Dual-power switch contactor
(4) Contactor fuse (5) AC contactor
(6) Backup power switch (7) Primary power switch
(8) Clip (9) Actuator 1 switch
(10) Actuator 2 switch (11) Indoor fan switch
(13) Power cables between the outdoor unit and low-temperature component (14) Crankcase heater fuse
(17) Crankcase heater 1 relay
(18) Crankcase heater 2 relay
(19) Electric heater 1 contactor
(20) Electric heater 2 contactor (21) Surge protection and voltage detection board

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NetCol5000-A Main Control Module



(1)FE_1 (LCD FE)
(2) CAN_IN (input port of the teamwork CAN/northbound RS485 port)
(3) RS485/12V (T/H module port)
(4) Main control module handle
(5) SW (reserved)
(6) DIP switch
(7) COM (northbound RS485 port)
(8) CAN_OUT (output port of the teamwork CAN/northbound RS485 port)
(9) FE_2 (for FE teamwork)
(10) Alarm indicator
(11) Running indicator
(12) Power indicator

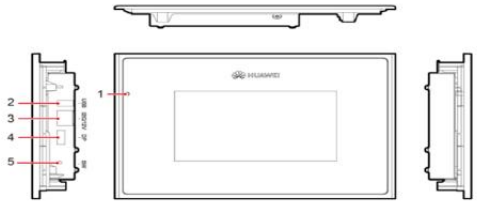
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- The teamwork network cable and monitoring network cable are connected to the main control module at the rear of the precision air conditioner.

LCD Control Panel (1)

- The controller provides a 7-inch true color touchscreen that enables man-machine interfaces for query, setting, monitoring, and maintenance.

Appearance of the LCD control panel



(1) Indicator

(2) USB, supporting the security protection mechanism

(3) 12C/12V

(4) Display port (connected to the display power cable)

(5) SW (used to restart the display)

Indicator and buzzer status description

Running Status	Indicator	Buzzer
The equipment is operating properly, or there is a warning.	Green	No buzzing
There is an unacknowledged major alarm.	Yellow	Intermittent buzzing
There is an unacknowledged critical alarm.	Red	The buzzer continuously buzzes.
Note: In the preceding conditions, the indicator blinks at a frequency of 1 Hz, that is, on for 0.5s and off for 0.5s.		

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LCD Control Panel (2)

Control panel user interface (UI)



(1) Permission status

(2) Communication status between the display and the main control board

(3) USB connection status

(4) Diagnostic mode

(5) Buzzer status

(6) Critical alarms and the number of critical alarms

(7) Major alarms and the number of major alarms

(8) Minor alarms and the number of minor alarms

(9) Warnings and the number of warnings

(10) Status bar

(11) Alarm bar

(12) Login/Logout button

(13) Teamwork control button

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Functions of the LCD Control Panel

- Controls a single unit.
- Displays the operations.
- Supports three remote functions: telemetry, teleindication, and telecontrol.
- Teamwork control: Up to 32 units can be networked for teamwork. When multiple air conditioners work cooperatively, the controller optimally distributes the heat load to reduce energy consumption and provides backup to improve reliability.
- A large space is available for recording and storing fault alarm data. Up to 1500 historical alarms can be stored.
- Provides comprehensive power monitoring functions.

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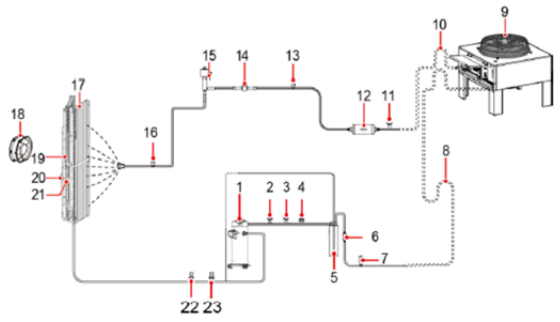
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Huawei Air Cooled Air Conditioner System (1)

- Cooling device layout: NetCol5000-A25 kW

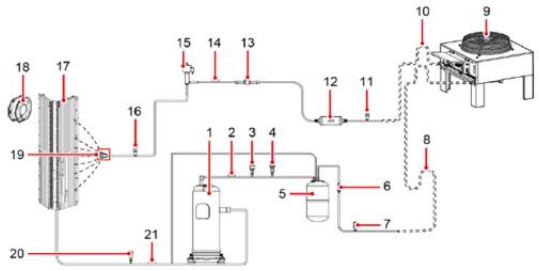


NetCol5000-A25 kW system diagram

(1) Compressor
(3) High pressure sensor
(3) Discharge temperature sensor
(4) High pressure switch
(5) Oil separator
(6) Check valve
(7) Exhaust pipe needle valve
(8) Oil trap
(9) Outdoor unit
(10) Inverted trap
(11) Liquid pipe needle valve
(12) Filter dryer
(13) Liquid pipe temperature sensor
(14) Sight glass
(15) EEV
(16) Low-pressure needle valve
(17) Evaporator
(18) Indoor fan
(19) Distributor
(20) Capillary tube
(21) Electrical actuator
(22) Suction temperature sensor
(23) Low pressure sensor

Huawei Air Cooled Air Conditioner System (2)

- Cooling device layout: NetCol5000-A42 kW

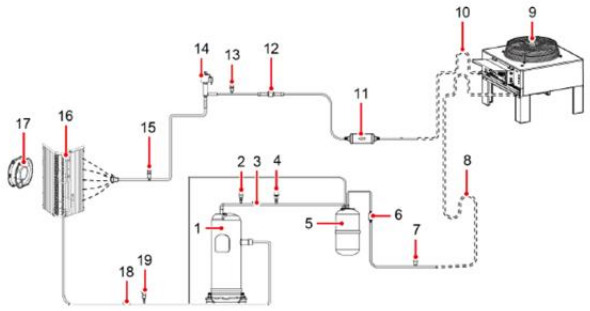


NetCol5000-A42 kW system diagram

(1) Compressor
(2) Discharge temperature sensor
(3) High pressure switch
(4) High pressure sensor
(5) Oil separator
(6) Check valve
(7) Exhaust pipe needle valve
(8) Oil trap
(9) Outdoor unit
(10) Inverted U-trap
(11) Liquid pipe needle valve
(12) Filter dryer
(13) Sight glass
(14) Liquid pipe temperature sensor
(15) EEV
(16) Low-pressure needle valve
(17) Evaporator
(18) Indoor fan
(19) Distributor
(20) Low pressure sensor
(21) Suction temperature sensor

Huawei Air Cooled Air Conditioner System (3)

- Cooling device layout: NetCol8000-A45 kW



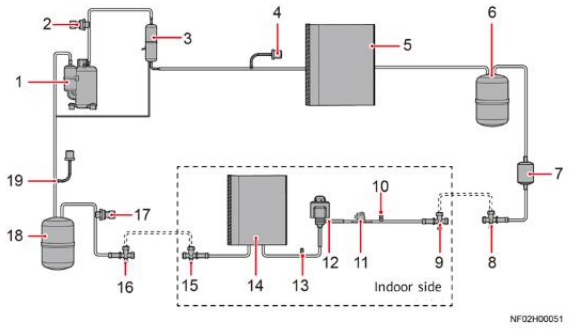
(1) Compressor
(2) High pressure sensor
(3) Discharge temperature sensor
(4) High pressure switch
(5) Oil separator
(6) Check valve
(7) Exhaust pipe needle valve
(8) Oil trap
(9) Outdoor unit
(10) Inverted U-trap
(11) Filter dryer
(12) Sight glass
(13) Liquid pipe needle valve
(14) EEV
(15) Low-pressure needle valve
(16) Evaporator
(17) Indoor fan
(18) Suction temperature sensor
(19) Low pressure sensor

NetCol8000-A45 kW system diagram

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Huawei Air Cooled Air Conditioner System (4)

- Cooling device layout: NetCol8000-A13 kW



NetCol8000-A13 kW

(1) Compressor	(2) High pressure sensor	(3) Oil separator
(4) High pressure switch	(5) Condenser	(6) Liquid storage tank of liquid pipes
(7) Filter dryer	(8) Outdoor unit liquid pipe stop valve	(9) Indoor unit liquid pipe stop valve
(10) Liquid pipe needle valve	(11) Electrical actuator	(12) EEV
(13) Low-pressure needle valve	(14) Evaporator	(15) Indoor unit gas pipe stop valve
(16) Outdoor unit gas pipe stop valve	(17) Low pressure sensor	(18) Liquid storage tank of gas pipes
(19) Low pressure switch		

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NetCol5000-A Technical Specifications - Indoor Unit

Item	Unit	NetCol5000-A025H (300 mm)	NetCol5000-A042H (600 mm)
Airflow mode	-	Horizontal airflow	Horizontal airflow
Total cooling capacity	kW	25	42
Sensible cooling capacity	kW	25	42
Air volume	m^3/h	5000	8600
Power supply	V/Ph/Hz	380–415/3/50 (60)	380–415/3/50 (60)
Refrigerant	-	R410A	R410A
Heating capacity	kW	4	6
Humidification capacity	kg/h	1.5	3
Full-load current	A	30.0 (20.0)	40.0 (46.0)
Dimensions (H x W x D)	mm	2000 x 300 x 1100	2000 x 600 x 1100
Net weight	kg	230	305

Note:
The full-load current in the red box is applicable to the indoor unit without heating function or humidifier.

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- Total cooling capacity refers to the sum of latent cooling capacity and sensible cooling capacity.
- Sensible cooling capacity, also known as sensible heat, refers to the amount of kinetic energy that increases or decreases in the absorption or exothermic process of an object. The temperature of a substance increases or decreases, but the form of the substance does not change. The heat it absorbs or releases is called sensible heat.
- The full-load current varies based on the optional configuration of heating and humidification.

NetCol500-A Technical Specifications - Outdoor Unit

Item	Unit	NetCol500-A026	NetCol500-A036	NetCol500-A072
Power supply	V/Ph/Hz	220–240/1/50	380–480/3/50 (60)	380–480/3/50 (60)
Number of fans	-	1	1	2
Liquid pipe size	mm	16	16	16
Gas pipe size	mm	19	19	22
Full-load current	A	3.3	2.5	5
Dimensions (H x W x D)	mm	1053 x 1110 x 1094	1156 x 1355 x 1094	1096 x 2185 x 1094
Net weight	kg	91	130	240

Note:
① The power supply is 380–415 V/3 Ph/50 (60) Hz if a low-temperature component is configured.
② The specific pipe diameter depends on the actual project.

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- Pay attention to the differences in the power supply mode and the number of fans.

NetCol8000-A Technical Specifications - Indoor Unit

Item	Unit	NetCol8000-A045D/U	NetCol8000-A060D/U	NetCol8000-A090D	NetCol8000-A120D
Airflow mode	-	D: downflow, U: upflow			
Working condition 1	-	Return air temperature: 35° C, relative humidity: 24%, outdoor temperature: 35° C			
Total cooling capacity	kW	45	60	90	120
Sensible cooling capacity	kW	45	60	90	120
Working condition 2	-	Return air temperature: 24° C, relative humidity: 50%, outdoor temperature: 35° C			
Total cooling capacity	kW	36	50	72	100
Sensible cooling capacity	kW	32.4	45	64.8	90
Air volume	m^3/h	11250	12500	22500	25000
Power supply	V/Ph/Hz	380–415/3 Ph/50 (60) Hz			
Heating capacity (optional)	kW	6	6	12	12
Humidification capacity (optional)	kg/h	6	6	10	10
Dimensions (H x W x D)	mm	2000 x 900 x 900	2000 x 900 x 1000	2000 x 1800 x 1000	2000 x 1800 x 1000
Net weight	kg	380	430	700	800

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- Total cooling capacity refers to the sum of latent cooling capacity and sensible cooling capacity.
- Sensible cooling capacity, also known as sensible heat, refers to the amount of kinetic energy that increases or decreases in the absorption or exothermic process of an object. The temperature of a substance increases or decreases, but the form of the substance does not change. The heat it absorbs or releases is called sensible heat.
- The full-load current varies based on the optional configuration of heating and humidification.

NetCol8000-A13 Technical Specifications

Indoor unit specifications

Item	Specifications
Refrigerant	R410A
Cooling capacity[a]	13 kW
Airflow mode	Upflow
Air volume	3600 m^3/h
Maximum current	Cooling only indoor unit (excluding the outdoor unit): 5 A Indoor unit with heating and humidification functions (excluding the outdoor unit): 26 A Outdoor unit that obtains power from the indoor unit (including the outdoor unit): 30 A
Piping	Bottom piping and side piping
Cabling	Bottom cabling and side cabling
Dimensions (H x W x D)	1886 mm x 800 mm x 664 mm
Package dimensions (H x W x D)	2050 mm x 900 mm x 765 mm
Net weight/Gross weight	153/178 kg (full configuration), 141/166 kg (cooling only)
a: The test condition is the rated working condition (indoor dry bulb: 24° C; indoor wet bulb: 17° C; outdoor dry bulb: 35° C; air outlet static pressure: 0 Pa; 10 m pipe, no height difference).	

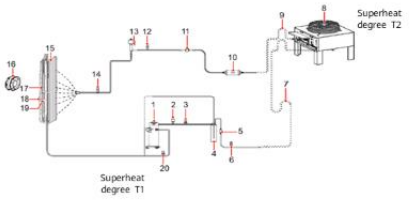
Outdoor unit specifications

Item	NetCol500-A022
Power supply specifications	220–240 V AC, 50 Hz/60 Hz, 1 Ph Voltage tolerance: –15% to +10%; frequency tolerance: ± 3 Hz
Maximum current	30 A
Number of fans	2
Net weight	117 kg
Gross weight	135 kg
Dimensions (H x W x D)	1325 mm x 903 mm x 320 mm
Package dimensions (H x W x D)	1485 mm x 1082 mm x 435 mm
IP rating	IPX4
Applicable environment	Class B
Altitude	0–4000 m (derated when the altitude is greater than 1000 m)
Certification	CQC, CE, CCC, RoHS, REACH, WEEE, SASO, and CRAA

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Common Terms of the Air Conditioning System (1)

- Superheat degree
  - Difference between the superheat temperature and saturation temperature of refrigerant under the same evaporating pressure in the refrigeration cycle
- Supercool degree
  - Difference between the refrigerant saturation temperature under the condensing pressure of the condenser and the actual refrigerant temperature at the condenser outlet Generally, the discharge pressure is regarded as the condensing pressure because the pressure drop of the condenser is smaller than that of the evaporator. The difference between the saturation refrigerant temperature under the discharge pressure and the refrigerant temperature at the condenser outlet is called supercool degree. The difference between the discharge pressure and the actual condensing pressure is small. The error caused by this approximation can be ignored.



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- Note: To ensure the safe operation of the cooling system, T1 should be carefully considered during design and related protection measures must be set to ensure the evaporation of the refrigerant at the front end and safe operation of the compressor at the rear end.
- The superheat degree T2 of the condenser should also be carefully considered to ensure good cooling of the gas refrigerant.

Common Terms of the Air Conditioning System (2)

- Condensing pressure:
  - The minimum pressure at which the refrigerant changes from gas to liquid at a given temperature
- Condensing temperature:
  - Condensing temperature Tc is the temperature at which the refrigerant vapor condenses into a liquid after being heated in the condenser. The condensing temperature cannot be detected directly. It can be obtained only by detecting the corresponding condensing pressure. High condensing temperature means high condensing pressure. If the condensing temperature is too high, the unit load is heavy, the motor is overloaded, and the cooling capacity decreases accordingly.
- Evaporating pressure:
  - Evaporating pressure is the maximum pressure when the refrigerant changes from liquid to gas at a given temperature.

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Common Terms of the Air Conditioning System (3)

- Evaporating temperature Te:
  - The temperature at which a liquid refrigerant boils and vaporizes in the evaporator The optimal evaporating temperature of an air conditioner is 5-7℃.
- Discharge temperature Td:
  - The temperature at the exhaust vent of the compressor A temperature measurement device is required to measure the discharge temperature. The discharge temperature is affected by the suction temperature and condensing temperature. When the suction temperature or condensing temperature increases, the discharge temperature increases accordingly. Therefore, the suction temperature and condensing temperature must be controlled to stabilize the discharge temperature.
- Suction temperature Ts:
  - Gas temperature of the compressor suction pipe A temperature measurement device is required to measure the suction temperature. Generally, the suction temperature T_s of an air conditioner should be about 15℃. If the suction temperature exceeds 15℃, the cooling effect is affected.

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Quiz

1. (Single Choice)Which component is not used in the NetCol5000-A42 kW?
   A. EC fan
   B. Compressor
   C. Electronic two-way valve
   D. Power supply module

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- Answer：B

Summary

- This chapter describes the following aspects:
  - Huawei Air Cooled Precision Air Conditioners Product Overview and Cooling System Overview
  - The hard part is cooling capacity transfer system and electric control system
  - And then we introduced humidification and drainage regulation system

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Thank you.

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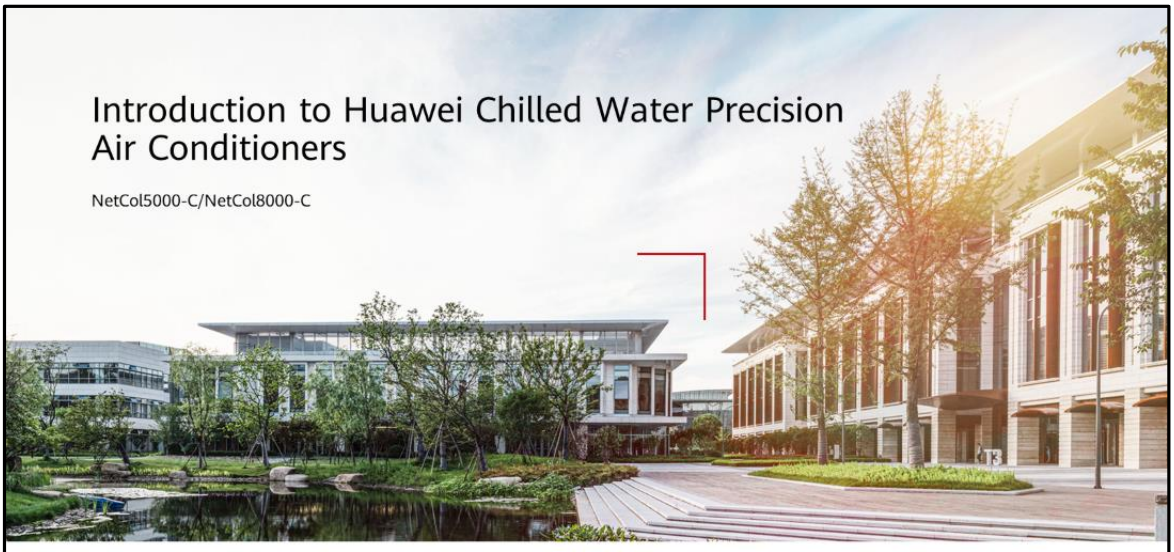
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Introduction to Huawei Chilled Water Precision Air Conditioners

NetCol5000-C/NetCol8000-C



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Foreword

- The slides describe the main components, typical application scenarios, technical specifications, and features of the NetCol5000-C /NetCol8000-C.

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Objectives

On completion of this course, you will be able to:

- Understand the basic knowledge of Huawei chilled water precision air conditioners.
- Understand the advantages of Huawei chilled water precision air conditioners.
- Understand the basic structure of Huawei chilled water precision air conditioners.
- Understand the configurations of Huawei chilled water precision air conditioners.

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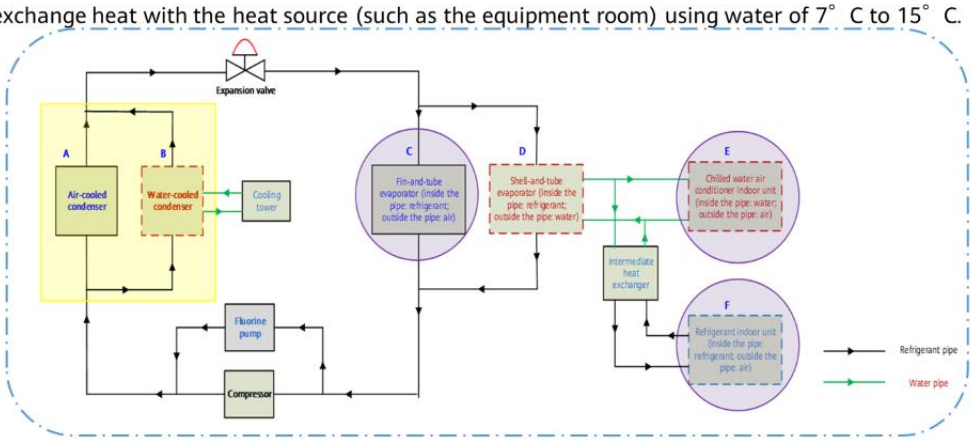
Contents

1. Overview
   - Basic Knowledge
   - Application Scenarios and Features
2. Cooling System Overview
3. Cooling Capacity Transfer System
4. Humidification and Drainage Regulation System
5. Electrical Control System
6. Technical Specifications

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Basic Knowledge: Cooling Principle

- The in-row or in-room chilled water air conditioner needs to work with the chiller to indirectly exchange heat with the heat source (such as the equipment room) using water of 7° C to 15° C.

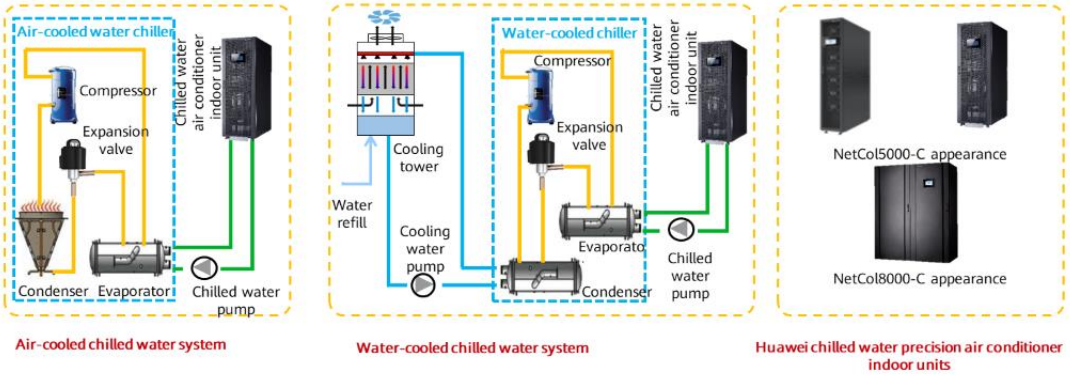


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- The chilled water precision air conditioner requires external low-temperature chilled water for cooling. (Currently, the supply water temperature of large-sized data centers is about 15° C.) The chilled water precision air conditioning system consists of chilled-water precision air conditioners, chillers, plate heat exchangers, cooling towers, chilled water pumps, cooling water pumps, pipes, and accessories. Chillers or plate heat exchangers provide low-temperature chilled water of 15° C for precision air conditioners. Chilled water pumps transfer the chilled water.

Basic Knowledge: System Structure

- Common chilled water systems and indoor units

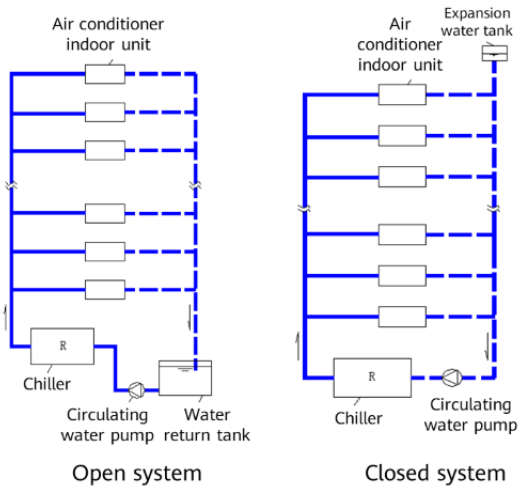


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- Water-cooled chilled water: Lack of water and poor management are common problems.
- There are a large number of devices and the installation is complex. It is not suitable for areas with insufficient water resources.
- A chilled water air conditioner indoor unit is required. Water intrusion may occur in the equipment room.
- Large-scale systems have high energy efficiency and high adaptability to free cooling.
- O&M is complex and requires professional personnel.
- A fault may affect a single unit or the entire pipeline.
- Only cooling towers are required outdoors. The footprint is small and the installation position is flexible.

Basic Knowledge: Indoor Unit System

- Chilled water system: two heat exchangers (evaporator and condenser) in the water chiller. The refrigerant in the evaporator evaporates to absorb the heat of the water. The generated water (generally 10° C) is chilled water. It is transferred to each air conditioner indoor unit through the chilled water pump. After heat exchange, the temperature changes to 15° C. Then the water returns to the evaporator. This is the circulation process.



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- An open circulating water system refers to a circulating water system (without a cooling tower) close to a big river. The circulating water is taken from the upstream of the river, experiences heat exchange through the condenser, and then returns to the downstream of the river.
- A closed circulating water system is generally used in areas with severe water shortage. A distinctive feature of a closed circulating water system is that it has a cooling tower. The circulating water circulates between the condenser and the cooling tower.
- Difference between an open system and a closed system: whether the system pumps need to work against the potential energy of water during operation.

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NetCol5000-C Overview

- The NetCol5000-C in-row chilled water precision air conditioner is a common cooling indoor unit for data centers. It usually forms a complete cooling system with chillers, water pumps, water pipes, and liquid distribution units (LDUs). The technical architecture is mature. The NetCol5000-C is especially applicable to scenarios where the power density per cabinet ranges from 6 kW to 10 kW.

- Online fan maintenance
  - Small fans are used to implement online fan maintenance, reducing maintenance time and labor costs.
- Dual power supplies
  - When the primary power supply is faulty, the backup power supply automatically takes over to ensure that the air conditioner does not shut down.
- Cooling capacity management
  - Displays the cooling capacity of an air conditioner and the cooling capacity margin of air conditioners in a smart module, and predicts the cooling capacity after the water temperature is increased.
  - Displays the cooling capacity, power consumption, and fan speed, helping O&M personnel understand the running status of the air conditioner.

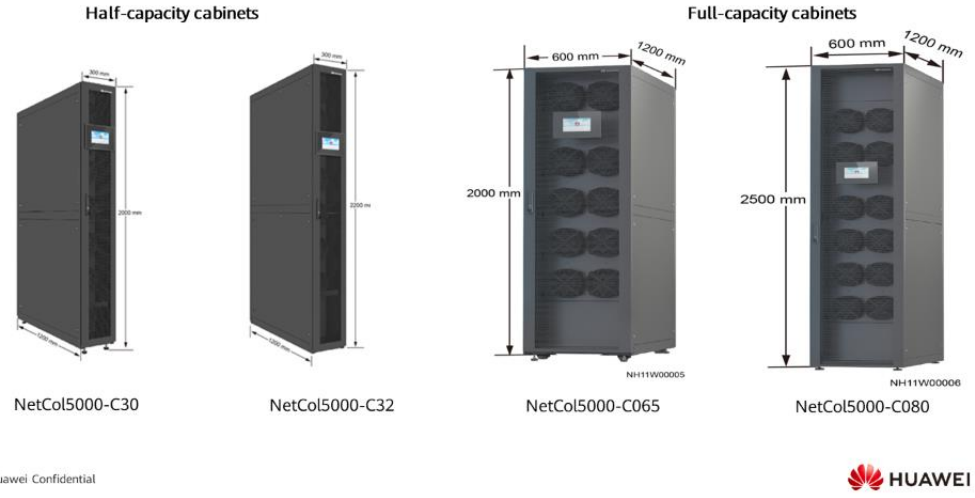


NetCol5000-C appearance

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- Two fans can be maintained online.

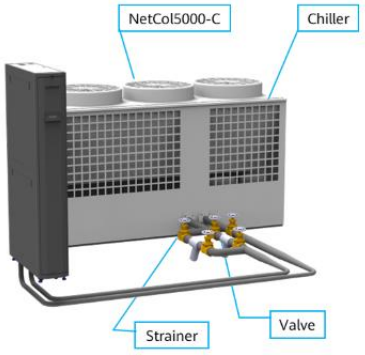
NetCol5000-C Models

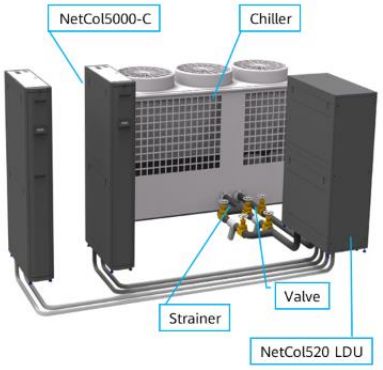


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- Two types of half-capacity cabinets and two types of full-capacity cabinets are available.

NetCol5000-C Layout

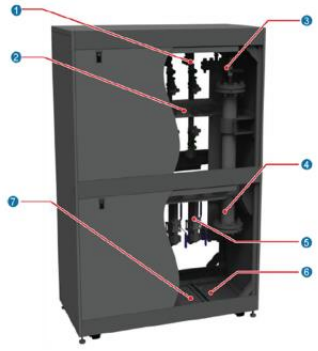




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- The NetCol5000-C is installed at the end of a data center. It exchanges heat with the air in the data center and communicates with monitoring equipment over RS485.
- The NetCol520 LDU distributes chilled water transported by the chiller. One NetCol520 supports a maximum of 12 NetCol5000-Cs.
- Note: NetCol5000-C refers to the in-row chilled water precision air conditioner. NetCol520 refers to the LDU.

NetCol520 Introduction

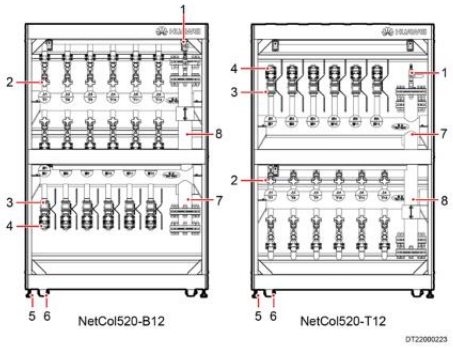


(1) Branch water return pipe (2) Main water return pipe (3) Exhaust valve

(4) Main water inlet pipe (5) Branch water inlet pipe

(6) Knock-out hole of the main water inlet pipe at the bottom

(7) Knock-out hole of the branch water inlet pipe at the bottom



(1) Exhaust valve (2) Flow balancing valve

(3) Hand valve (4) Pagoda connector and hold hoop

(5) Foot (6) Castor

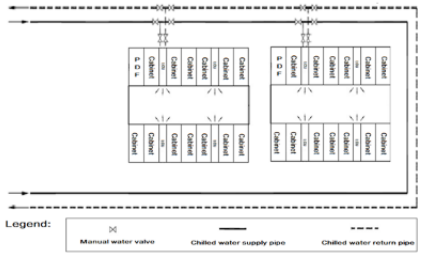
(7) Main water supply pipe (8) Main water return pipe

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In-row Air Conditioner Water System Structure (1)

- Pipe loop water system
  - The closed loop should be divided into several separate sections by valves. Valves should be deployed in a way that a section of the main pipe can be cut off for maintenance or repair. If the indoor unit water supply is cut off at one end, the other end of the main pipe supplies water. In this way, if a fault occurs at one point, the entire system is not affected and can still run properly, improving the system security. Similar to the chilled water system, the corresponding chilled water pipes are also deployed to form a loop.

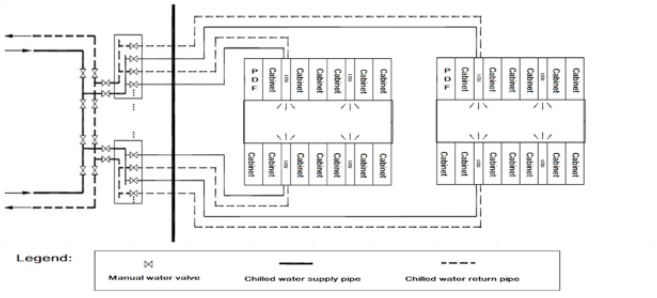
Pipe loop water system



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In-row Air Conditioner Water System Structure (2)

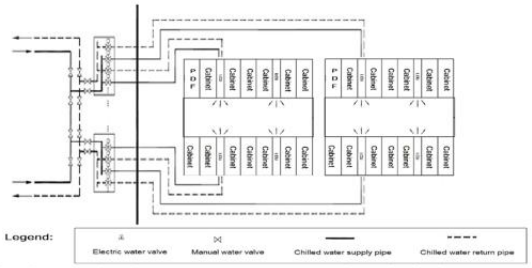
- Centralized water distribution system
  - The LDU is isolated from IT cabinets. Water supply to each LCU (of the NetCol5000-C) is centrally managed to prevent water from entering the equipment room.



Centralized water distribution system

In-row Air Conditioner Water System Structure (3)

- Centralized water distribution system + automatic shutoff of indoor unit pipes
  - The LDU is isolated from IT cabinets. The water supply to each LCU is managed in a unified manner. Each water supply branch can be automatically shut off, and the water pressure in the water system of the equipment room is low. Water leakage is not likely to occur, which effectively prevents water from entering the equipment room.
  - Online maintenance is supported. Components prone to water leakage are installed in a centralized manner and isolated from IT equipment. Water leakage in the LDU area does not affect IT equipment, facilitating maintenance. The drainage system is easy to deploy. In addition, once the LCU leaks, the water inlet and outlet valves are automatically closed to reduce the impact of water leakage on IT equipment.



Centralized water distribution system + automatic shutoff of indoor unit pipes

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NetCol5000-C Application Scenarios

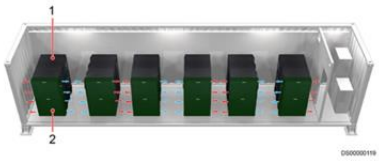
- The NetCol5000-C applies to the following scenarios:



Cold aisle containment



Hot aisle containment



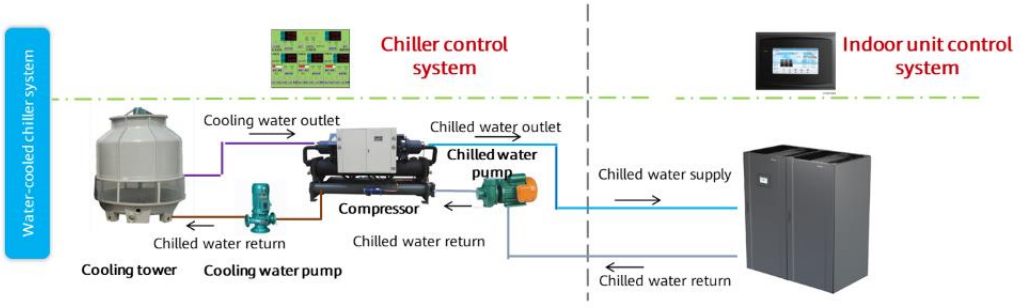
1. Server 2. NetCol5000-C

Smart module

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NetCol8000-C Overview

- The NetCol8000-C in-room chilled water precision air conditioner is a common low- and medium-density cooling indoor unit for data centers. It usually forms a complete cooling system with chillers, water pumps, and water pipes. It has been used for a long time and mature technical architecture has been developed. It is especially applicable to scenarios where the power density per cabinet is less than 5 kW.



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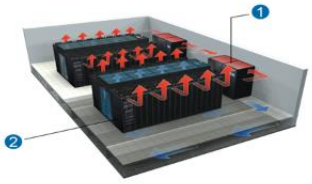
NetCol8000-C Models

Model	070D	100D/110D/130D	150D/160D/190D	220D/260D
Cooling Capacity	63.2 kW	100.2 kW/113.0 kW/126.4 kW	150.3 kW/169.5 kW/189.6 kW	226.0 kW/252.8 kW
Downflow Unit				
Model	070U	130U	190U	
Cooling Capacity	61.9 kW	123.8 kW	185.7 kW	
Upflow Unit				

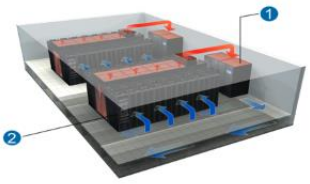
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NetCol8000-C Application Scenarios

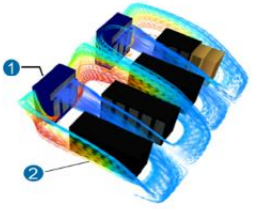
- The NetCol8000-C typically applies to the following scenarios:



Underfloor air supply + cold aisle containment



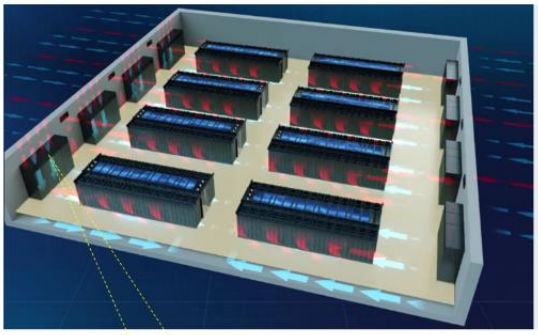
Underfloor air supply + hot aisle containment



Upflow + non-aisle containment

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NetCol8000-C Special Application Scenarios



Description:

- Free cooling with fresh air is mainly used for downflow air conditioners. It is applicable to areas (such as Seattle, Paris, and Berlin) with temperate oceanic climates or humid continental climates and can save energy by 30%.
- Also applicable to other areas where the temperature and humidity are suitable, but the energy saving effect will be reduced (10% to 20% energy can be saved).
- Free cooling with fresh air is applicable to outdoor areas with high air quality.



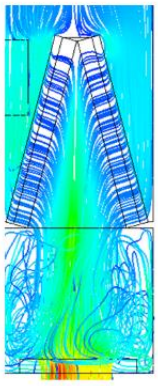
Direct free-cooling plenum

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- A direct free-cooling plenum is required for the energy-saving solution.

NetCol8000-C Features: Energy Saving

CFD simulation diagram

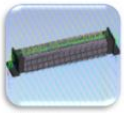




Surface cooler:
Enhances the heat exchange performance to increase the cooling capacity by about 12%.



Air filter:
Deployed horizontally to increase the windward area and reduce the wind resistance by about 50 Pa.

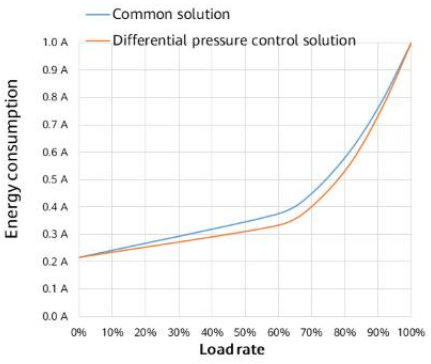


Electric heater:
Deployed properly to ensure even wind and temperature fields.



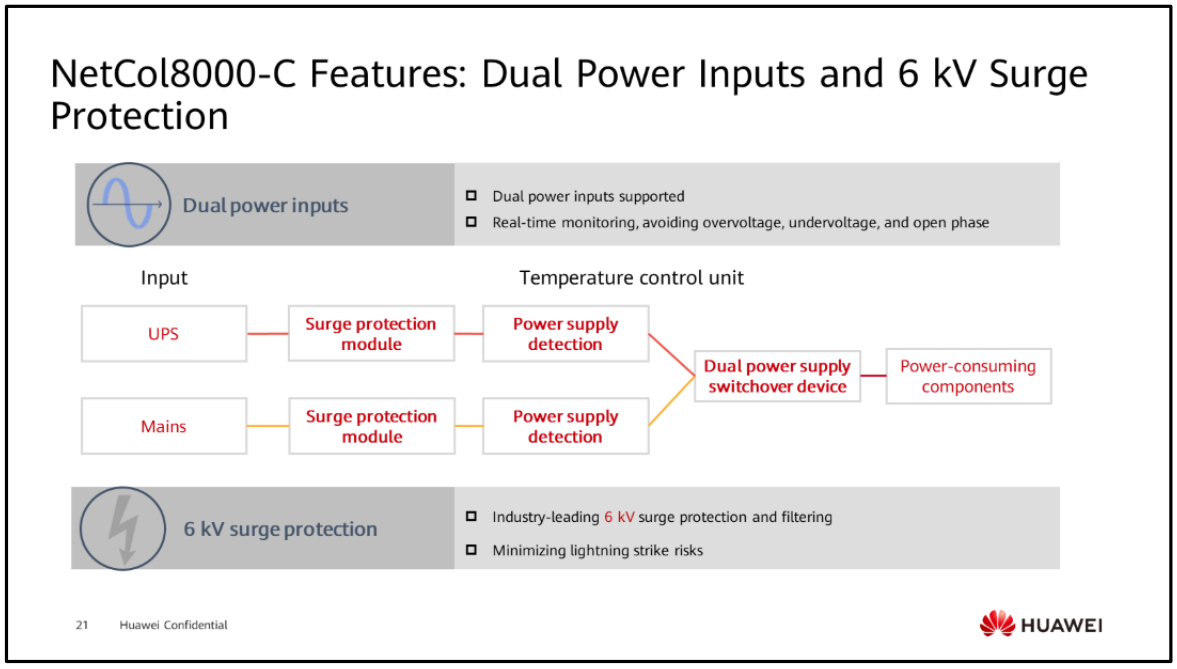
Fan:
Optimizes the flow field of the air intake and exhaust vents to reduce the wind resistance by about 20 Pa.

Energy saving comparison between the differential pressure control solution and the common solution



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- Surface cooler: type A, copper pipe with internal threads, and CFD simulation
- Air filter: The air intake vent of another brand and Huawei evaporator placed horizontally increase the windward area, reduce the wind speed of the windward area, and reduce the wind resistance by 50 Pa.
- Differential pressure control: The floor pressure difference controls the fan rotational speed and air cooling. In the case of partial hot spots, you only need to adjust the rotational speed of some air conditioner fans.



- Dual power supply switchover mode:
  - When the primary power supply is abnormal, the system automatically switches to the backup power supply. When the primary power supply recovers, the system automatically switches back to the primary power supply. Systems with single power supply or dual power supplies have been set before delivery. Therefore, you do not need to set them onsite.
- 6 kV surge protection: 4 kV surge protection is widely used in the industry.

NetCol8000-C Features: Modular Design

Easy transportation

Easy to transport using elevators and pass around corridor corners. No wall or door smashing is required.





Hot-swappable

The main control module and auxiliary power module are hot-swappable, which shortens the maintenance time and reduces the O&M difficulty.

Easy installation

The water pipe clamp connection facilitates onsite disassembly and assembly, and four person-hours can be saved for transportation and placement.





Quick fan installation

No auxiliary tool is required for installing fans. It takes about 10 minutes to install a fan, saving 70% time compared with the traditional solution.

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NetCol8000-C Features: Key Component Pre-integration



The design minimizes the workload of engineering.

- Factory pre-integration of key components
- Built-in ATS, dynamic balance valve, differential pressure controller, and prefabricated electromagnetic air damper port
- Reducing the onsite construction workload

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- Dual power supplies: This is an optional feature. An ATS is integrated in the unit, and no external ATS is required onsite.
- Electromagnetic air damper: The port is prefabricated before delivery. Standard electromagnetic air damper components are optional. You only need to assemble them onsite.
- Differential pressure control: The differential pressure controller is pre-integrated in the unit. You only need to deploy and connect the differential pressure sensor onsite.
- Balance valve: The dynamic balance valve can be configured for the unit. The valve is delivered with the product and does not need to be installed onsite.

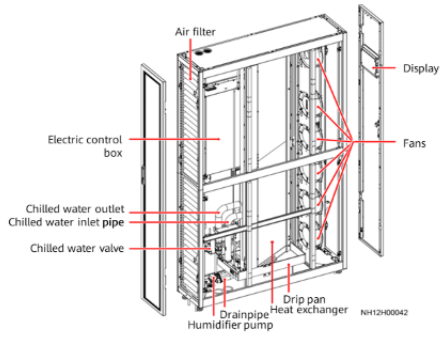
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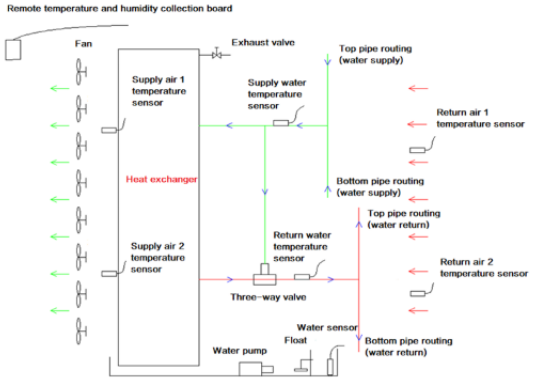
1. Overview
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NetCol5000-C Cooling System Components

- The NetCol5000-C consists of the heat exchanger, three-way valve, and pipes. The chilled water provided by the chiller passes through the heat exchanger over a pipe, and then returns to the chiller after heat exchange. Meanwhile, the indoor air is driven by the force of the fan, and is cooled when passing through the surface of the heat exchanger. In this way, the indoor air is cooled.

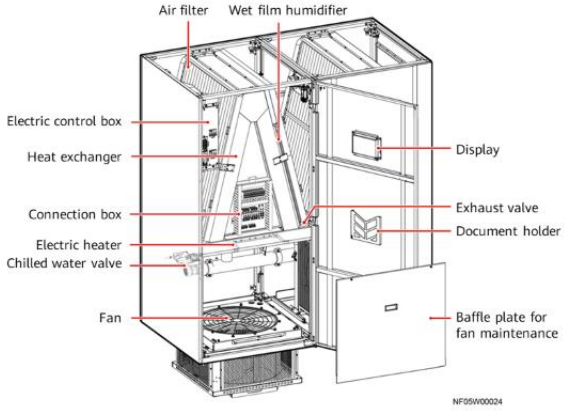


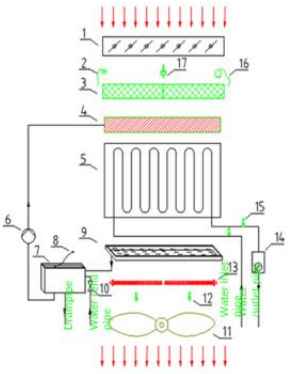


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NetCol8000-C Cooling System Components

- The following figure shows the structure of the NetCol8000-C cooling system.



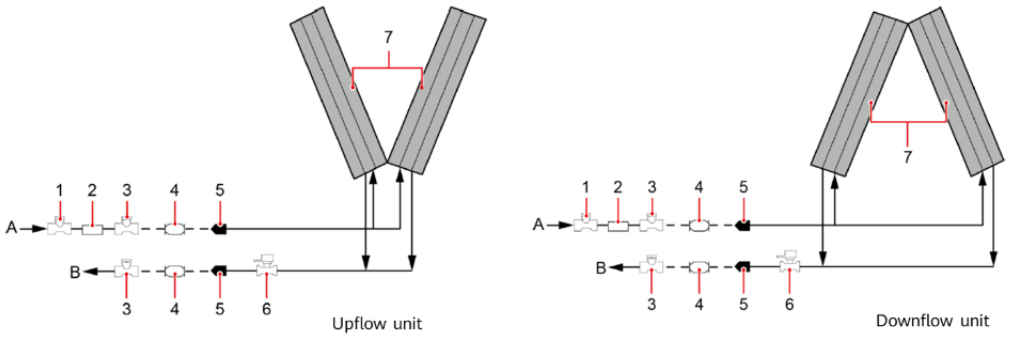


(1) Motorized damper
(2) Differential pressure switch
(3) Air filter
(4) Wet film humidifier
(5) Surface cooler
(6) Humidifier pump
(7) Humidifier water tank
(8) Float switch
(9) Drip pan
(10) Water refill solenoid valve
(11) Fan
(12) Supply air temperature sensor
(13) Electric heater
(14) Water valve
(15) Inlet and outlet water temperature sensor
(16) Micro differential pressure sensor
(17) Temperature and humidity (T/H) sensor

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Surface Cooler Layout

- Surface cooler



(A) Chilled water inlet (B) Chilled water outlet (1) Balance valve or isolation valve (2) Water filter (3) Isolation valve (4) Soft connection (5) Chilled water inlet and outlet pipe connector (6) Chilled water valve (7) Heat exchanger

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- Components 5, 6, and 7 in the figures are delivered with the product. Other components need to be purchased and installed onsite, and cannot be installed right under the cabinet.
- It is recommended that a water filter with 20 meshes and a pressure resistance of greater than 1.6 MPa be used onsite. The actual pressure resistance depends on the site requirements. A water filter is installed near the precision air conditioner on the external water inlet pipe.

Main Components of the Cooling System: Surface Cooler and Chilled Water Valve

- Surface cooler (NetCol5000-C)
  - 2 m model: I-type heat exchanger, three rows, 68 holes in a row, 14 loops, 9.52 mm pipe diameter, FPI = 14
  - 2.2 m model: I-type heat exchanger, three rows, 76 holes in a row, 14 loops, 9.52 mm pipe diameter, FPI = 14
- Surface cooler (NetCol8000-C)
- V-type heat exchanger, 4 rows in each heat exchanger
  - 42 pipes in each row, 9.52 mm pipe diameter, FPI = 14
- Chilled water valve
  - Huawei-developed water valve: actuator power supply 12 V DC
  - DN50 and DN25 valves
  - Water valve control mode: PID adjustment based on the supply/return air temperature



NetCol5000-C surface cooler



NetCol8000-C surface cooler



In-row and in-room chilled water valves

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- FPI: refers to Fins Per Inch. The heat exchanger performance is determined by the thickness and fin spacing (FPI).
- Adjustable water valve opening: The chilled water flow can be continuously adjusted based on the heat load to precisely control the temperature.

Auxiliary Components of the Cooling System

- NTC
  - One NTC sensor for return air, one for fresh air, and two for supply air
- Differential pressure switch
  - A differential pressure switch is configured for the internal circulation system to detect the pressure difference of the air filter before and after the internal circulation to determine whether the air filter is dirty or blocked. If it determines that the air filter is dirty or blocked, it reminds engineers to clean the air filter, ensuring safe and reliable running of the equipment.
  - Micro differential pressure sensor (NetCol8000-C)
    - Differential pressure control components consist of a micro differential pressure sensor and a pressure inlet tube. The measurement range of the differential pressure sensor is 0–500 Pa. A micro differential pressure sensor is used when the differential pressure control function is configured.



NTC



Differential pressure switch



Micro differential pressure sensor

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- NTC: refers to negative temperature coefficient. The resistance of an NTC thermistor and material decreases exponentially when the temperature increases. A thermistor is used to detect temperature.

Auxiliary Components of the Cooling System

- Differential pressure switch
  - Controls the air conditioner by the difference between the pressure under the floor and the pressure on the floor. It is optional for in-room air conditioners with downward air supply.
- Electric heater
  - PTC electric heater, operating voltage: 380–480 V, 50/60 Hz, heating power of a single heater: 2 kW
- T/H sensor
  - One return air T/H sensor and one fresh air T/H sensor, which are used to detect the temperature and humidity of the return air and fresh air



Differential pressure switch



Electric heater



T/H sensor

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Optional Components of the Cooling System

- Motorized damper
  - When the fan stops, the air damper is closed by using a motorized valve to prevent cooling capacity loss. It is optional for in-room air conditioners with downward air supply.
- Gravity damper
  - When the fan stops, the air damper is closed by gravity to prevent cooling capacity loss. It is optional for in-room air conditioners with overhead air supply.
- Upflow component
  - Installed on the top of an indoor unit for air volume adjustment and ventilation. It applies to diffuse air supply scenarios.



Motorized damper



Gravity damper



Upflow component

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NetCol8000-C Configurations

Optional Component	Function
Air supply cap	Upflow plenum box
Motorized/Gravity damper	Prevents cold air reflux.
Direct free-cooling plenum	Provides free cooling for fresh air.
Differential pressure control component	Energy-saving control component
T/H sensor	Monitors the temperature and humidity of a fixed point.
Water detection board	Detects equipment room water leakage.
Smoke sensor	Detects equipment room fire.
Power cable and ground cable	Air conditioner power cable and ground cable

Configuration Principles of Air Damper Components on Upflow and Downflow Units

	Motorized/Gravity damper	Direct free-cooling plenum	Differential pressure control component	Air supply cap	Remarks
Upflow unit	x	x	√ (optional in the air duct scenario)	√	√: compatible x: incompatible
Downflow unit	√	√	√	x	

Compatibility Between Air Damper Components

	Motorized/Gravity damper	Direct free-cooling plenum	Differential pressure control component	Air supply cap	Remarks
Motorized/Gravity damper	N/A	x	√	x	√: compatible x: incompatible
Direct free-cooling plenum	x	N/A	√	x	
Differential pressure control component	√	√	N/A	x	
Air supply cap	x	x	x	N/A	

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- Compatible: Optional features do not affect basic features, and they can coexist.
- Replacement: Optional features must replace basic features, and they cannot coexist.

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Main Components of the Cooling Capacity Transfer System: EC Fan

- EC centrifugal fan (NetCol5000-C)
  - Air volume: 1249.68 m^3/h, static pressure: 0 Pa
  - Rated rotational speed: 5900 ± 600 RPM (30 kW), 6500 ± 600 RPM (32 kW)
  - Operating voltage: 36–72 V DC
- EC centrifugal fan (NetCol8000-C)
  - Rated air volume: 13,500 m^3/h, static pressure: 350 Pa
  - Maximum rotational speed: 1300 RPM
  - Operating voltage: 380–480 V
- Fan control mode:
  - Default exhaust air temperature control
  - (Optional) Set the return air temperature control, temperature difference control, and differential pressure control.



NetCol5000-C fan



NetCol8000-C fan

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Aisle Containment and Layout: In-row Solution



Cold aisle containment



Hot aisle containment

Containment in front of cabinets

Containment at the rear of cabinets



Basic number of air conditioners + X

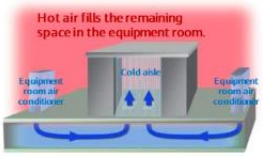
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Aisle Containment and Layout: In-room Solution

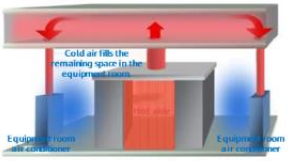
- Skylights and aisle doors are used to seal the cold or hot aisles in the equipment room to avoid mixing the cold and hot air. Then NetCol8000-Cs are deployed.
- Air conditioners deployed in cold/hot aisle containment:



NetCol8000-C upflow or downflow model



Cold aisle containment



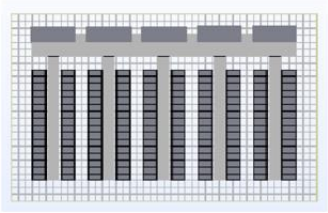
Hot aisle containment

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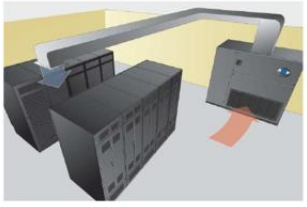
- Note: The NetCol8000-C is used as an example.

Overhead Air Supply: In-room Solution

- Applies to areas that do not generate much heat and do not have strict requirements on airflow organization. The overhead air supply mode is an organized air supply mode, in which air ducts need to be installed. The net height of a room must be at least 4 m.



Plan view



Airflow diagram



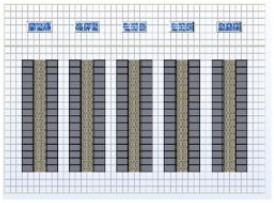
NetCol8000-C130U

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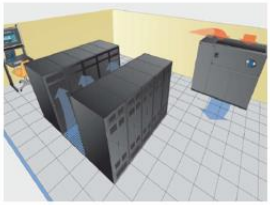
- After deployed, air ducts for overhead air supply are hard to adjust and generate excessive noise. Because air supply through air ducts is easy to cause local heat accumulation and local overheating, air ducts are applicable to areas that do not generate much heat and do not have strict requirements on airflow organization. The heat load of the early data center is small. Therefore, the overhead air duct is often used. However, as the cabinet power density increases, the overhead air supply through air ducts cannot meet the cooling requirements of the data center.

Underfloor Air Supply: In-room Solution

- The floor height, cooling capacity, and air supply volume need to be designed by professionals. Underfloor air supply is an airflow organization form that replaces the overhead air supply through air ducts. It is widely used in data centers. The underfloor air supply mode features high cooling efficiency and easy installation.



Plan view



Airflow diagram



NetCol8000-C150D/160D/190D

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- The disadvantage of the underfloor air supply mode is that the floor height, cooling capacity, and air supply capacity must be designed by professional personnel. If the design is improper, the cooling efficiency is low, and the equipment room is overheated or overcooled. When the underfloor air supply mode is used, the floor height of the equipment room must meet related requirements.

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Key Components of the Humidification System: Wet Film

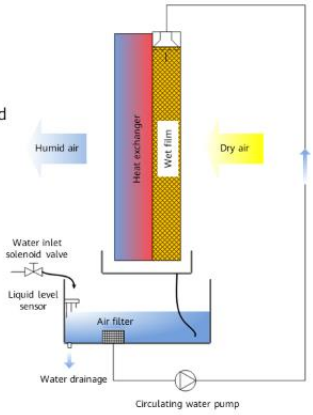
- Humidifier
  - Water penetrates downward along the wet film material to form a uniform water film. When wind passes through the wet film material, the dry air has a large area of contact with the wet film surface to achieve a large amount of water evaporation, thereby implementing humidification.
  - NetCol5000-C: organic wet film humidifier, with a humidification capacity of 1.5 kg/h and dimensions (length x width x thickness) of 260 mm x 300 mm x 34 mm
  - NetCol8000-C: organic wet film humidifier, with a humidification capacity of 3 kg/h and dimensions (length x width x thickness) of 650 mm x 240 mm x 34 mm



NetCol5000-C humidifier



NetCol8000-C humidifier



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Key Components of the Humidification System: Water Pump

- Water pump
  - Vertical distance between the highest point of the drainpipe and the water pump outlet



NetCol5000-C water pump Lift ≤ 3.5 m



NetCol8000-C water pump Lift ≤ 4 m

- Float switch
  - Checks the water level in the drip pan. If the water level is high, the water pump works and drains water. If the water level is low, the water pump stops working to prevent water overflow from the drip pan. The NetCol5000-C uses two floats. The low liquid level float acts to start the water pump, and the high liquid level float acts to report a water overflow alarm. The NetCol8000-C uses one float if a humidifier is configured.



NetCol8000-C drip pan (placed in the middle of the surface cooler)

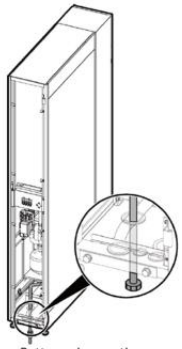


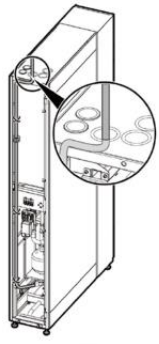
Float (placed at the bottom of the drip pan)

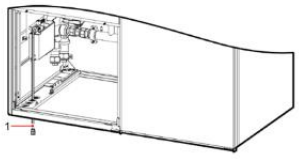
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Key Components of the Humidification System: Water Inlet Pipe

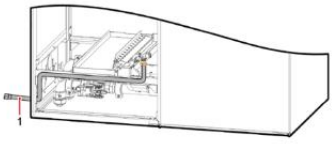
- Add a stop valve at the water inlet to facilitate maintenance. The external water pressure is between 100 kPa and 700 kPa. Ensure that the water is free of large particles.







Water inlet pipe for the downflow unit



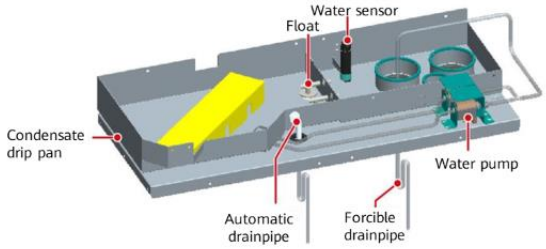
Water inlet pipe for the upflow unit

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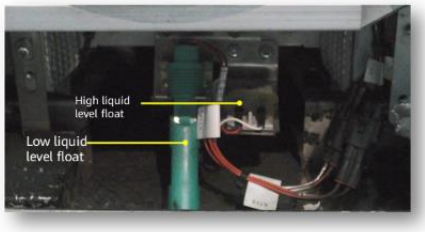
- Pump technical specifications include flow rate, lift, rotational speed, efficiency, and so on.
- The pump flow rate refers to the amount of liquid discharged per unit time.
- The pump lift (H) is the energy added to the liquid per unit weight that flows through the pump.
- The rotational speed refers to the rotational speed of the pump impeller per minute.
- Pump power refers to the amount of work performed by the pump per unit time.

Measures for Preventing Water Leakage at Huawei Chilled Water Air Conditioner Indoor Units

- Automatic drainage of condensate water is used.
- In addition, two condensate pumps and two floats are used for forcible drainage. Multiple drainage methods can be selected to ensure reliable drainage of condensate water.



Drip pan with two water pumps and two floats



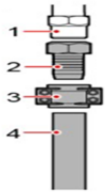
High and low liquid level floats in a drainage system

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- Working principle: If an automatic drainpipe is installed, the water in the drip pan is automatically drained from the automatic drainpipe.
- Forcible drainage: After the water volume in the drip pan reaches a certain level, the low liquid level float floats for 5 seconds, and the water pump starts. In normal cases, the water in the drip pan is completely drained within several seconds. In this case, one water pump drains water. When the high liquid level float floats, the two water pumps drain water at the same time.
- A high liquid level float and a low liquid level float are designed for forcible drainage. If the high liquid level float floats, the two water pumps work at the same time until the float drops. If the float does not drop within the specified duration, a drainage exception alarm is generated to notify maintenance personnel to prevent condensate water overflow from the drip pan.

Water Leakage Prevention Measures for Pipes and Connectors

- It is recommended that flexible hoses be used for the NetCol5000-C to reduce the number of connectors in the middle and minimize the risk of water leakage. The low-pressure braided rubber hose is recommended. The inner layer and outer layer are made of oil-resistant synthetic rubber, and the middle layer is the braided reinforced layer. The maximum operating pressure is 2.5 MPa and the temperature range is –40° C to +100° C. The hose features good corrosion resistance.
- To connect a hose to the LCU:
- Flatten the hose connection port.
  - Apply sealant to the threads of the LCU and pagoda connector, connect the internal thread of the pagoda connector to the LCU, and use a wrench to tighten the connection.
  - Connect the flat end of the hose to the pagoda connector.
  - Use a clamp to secure the joint between the hose and the pagoda connector, and use a hex key to tighten the joint.



(1) Straight connector of external threads
(2) Pagoda connector
(3) Hold hoop
(4) Hose

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Water Leakage Detection and Shutdown Measures

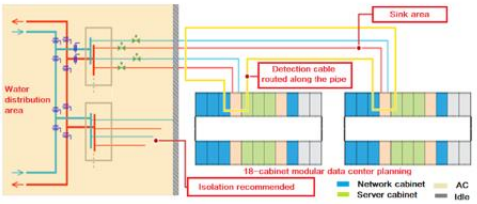
- Scenario with two water pumps
  - A high liquid level float and a low liquid level float are designed for forcible drainage. If the high liquid level float floats, the two water pumps work at the same time until the float drops. If the float does not drop within the specified duration, a drainage exception alarm is generated to notify maintenance personnel to prevent condensate water overflow from the drip pan.
- Scenario with a water sensor
  - If a water sensor is deployed at the bottom of or around the drainage area, a water leakage alarm is generated when the water sensor comes in contact with water. The precision air conditioner shuts down and the internal water valve is closed to prevent further water leakage.
- Scenario with water detection cables
  - Water detection cables are deployed in different areas of the equipment room and connected to the monitoring system to monitor water leakage in real time. In addition, the position of water leakage can be located quickly by using a water leakage locator.

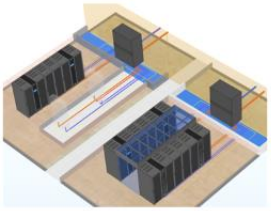
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- In principle, the preceding three solutions are optional. Generally, water pumps and water detection cables are configured.

Automatic Shutdown Logic Description

- Alarm generated by a water sensor
  - After a water sensor inside the precision air conditioner generates an alarm, the precision air conditioner shuts down due to the alarm and generates an alarm of water leakage inside the cabinet.
- Alarm generated by a water detection cable
  - After a water detection cable detects water leakage, the precision air conditioner generates an alarm but does not shut down.





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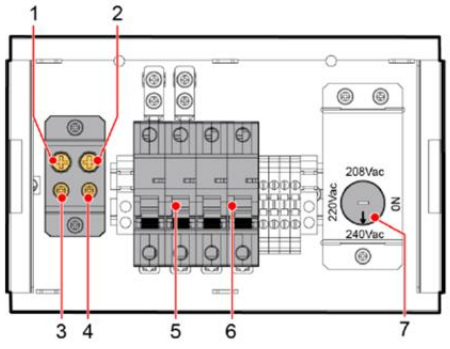
- There is still a possibility that water may enter the equipment room. For a period of time in the future, we will focus on how to select highly reliable indoor water system components, physically isolate areas prone to water leakage, properly plan water pipes and drainage logic, and provide complete monitoring and feedback loops.

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NetCol5000-C AC Input



Electrical ports on the NetCol5000-C030H7

(1) Ground screw PE1
(2) Ground screw PE2
(3) Ground screw PE3
(4) Ground screw PE4
(5) Primary power AC input switch QF1
(6) Backup power AC input switch QF2
(7) Power switch

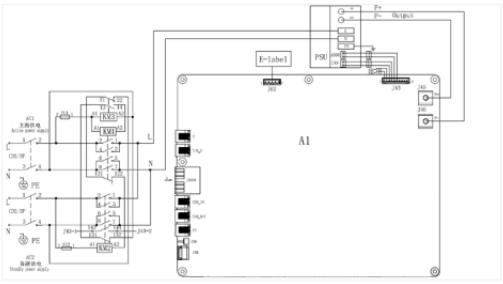
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NetCol5000-C Cooling System Control Unit

- The control unit of the NetCol5000-C consists of the PSU and main control module.
- PSU
  - Output voltage: 42–58 V DC (rated voltage: 53.5 V DC)
  - Output power: 3000 W (200–240 V AC)

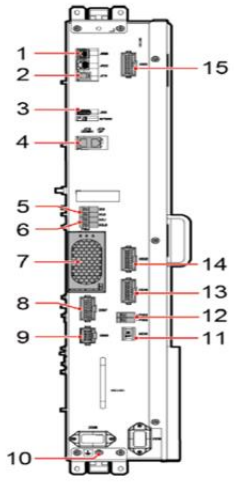


PSU



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NetCol5000-C Main Control Module



(1) T/H sensor communication port J128

(2) Display panel communications port J72

(3) Reserved USB port (unavailable currently)

(4) Teamwork communications port J73

(5) Remote switch wiring terminals X1.1 and X1.2

(6) Water sensor switch wiring terminals X2.1 and X2.2

(7) PSU

(8) Water pump and high/low liquid level float connection terminal X107

(9) Power switch connection terminal X103

(10) Ground screw PE2 of the electric control box

(11) Manual water drain switch for the humidifier

(12) Positive fan wiring terminal FAN+ and negative fan wiring terminal FAN–

(13) Humidifier water inlet/outlet valve, electrical conductivity sensor, high liquid level float, and temperature switch terminal X104

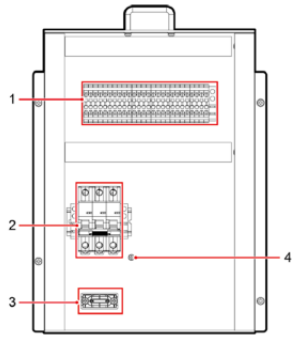
(14) Fan feedback and control terminal X102

(15) Temperature sensor wiring terminal X101

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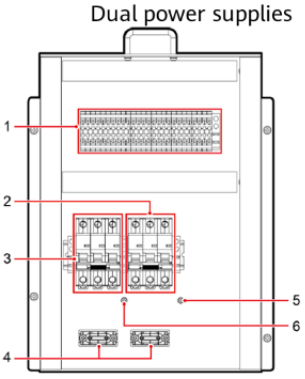
NetCol8000-C AC Input

Single power supply



(1) Signal terminal block (2) Primary power supply switch QF1
(3) Cable clip (4) Ground screw

Dual power supplies



(1) Signal terminal block (6) Primary power supply ground screw
(2) Backup power supply switch QF2
(3) Primary power supply switch QF1
(4) Cable clips (5) Backup power supply ground screw

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NetCol8000-C Cooling System Control Unit

- Control unit (NetCol8000-C)
  - Auxiliary power module: hot-swappable for installation and maintenance; supplies 24 V DC power to components in the unit.
  - Main control module: hot-swappable for installation and maintenance



Auxiliary power module



Main control module

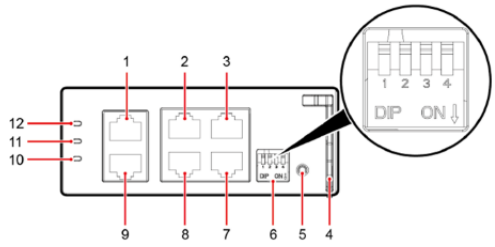


NetCol8000-C water pump

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- The main control board controls the system components based on the signals collected by the T/H sensor delivered with the precision air conditioner.

NetCol8000-C Main Control Module



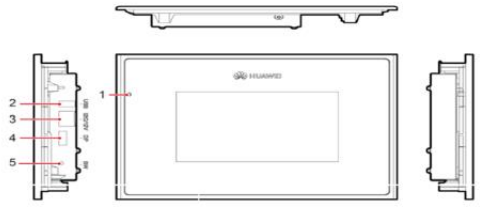
(1) FE_1 (display module FE)
(2) CAN_IN (teamwork CAN/northbound RS485 input port)
(3) RS485/12V (temperature and humidity module port)
(4) Main control module handle
(5) SW (reserved)
(6) DIP switch
(7) COM (northbound RS485 port)
(8) CAN_OUT (teamwork CAN/northbound RS485 output port)
(9) FE_2 (used for FE teamwork)
(10) Alarm indicator
(11) Running indicator
(12) Power indicator

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LCD Control Panel (1)

- The controller provides a 7-inch true color touchscreen that enables man-machine interfaces for query, setting, monitoring, and maintenance.

Appearance of the LCD control panel



(1) Indicator

(2) USB (supporting the security protection mechanism)

(3) 12C/12V

(4) Display port (connected to display panel power cable)

(5) SW (used to restart the display)

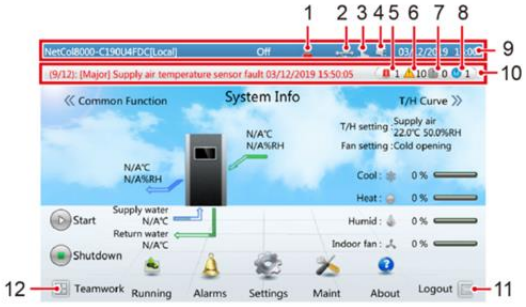
Indicator and buzzer status description

Running Status	Indicator	Buzzer
The equipment is operating properly, or there is a warning.	Green	No buzzing
There is an unacknowledged major alarm.	Yellow	Intermittent buzzing
There is an unacknowledged critical alarm.	Red	Continuous buzzing
Note: In the preceding conditions, the indicator blinks at a frequency of 1 Hz, that is, on for 0.5s and off for 0.5s.		

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- The NetCol5000-C and NetCol8000-C have the same control panel appearance, indicators, and status description.

LCD Control Panel (2)



NetCol8000-C LCD control panel interface

(1) Permission status

(2) Communication status between the display panel and the main control board

(3) USB connection status

(4) Diagnostic mode

(5) Critical alarms and the number of critical alarms

(6) Major alarms and the number of major alarms

(7) Minor alarms and the number of minor alarms

(8) Warnings and the number of warnings

(9) Status bar

(10) Alarm bar

(11) Login/Logout button

(12) Teamwork control button

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Functions of the LCD Control Panel

- Controls a single unit.
- Displays the operations.
- Supports three remote functions: telemetry, teleindication, and telecontrol.
- Teamwork control: Up to 32 units can be networked for teamwork. When multiple air conditioners work cooperatively, the controller optimally distributes the heat load to reduce energy consumption and provides backup to improve reliability.
- A large space is available for recording and storing fault alarm data. Some 1500 historical alarms can be stored.
- Provides comprehensive power monitoring functions.

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1. Overview
2. Cooling System Overview
3. Cooling Capacity Transfer System
4. Humidification and Drainage Regulation System
5. Electrical Control System
6. **Technical Specifications**

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NetCol5000-C Technical Specifications (1)

Model	Unit	NetCol5000-C030H	NetCol5000-C032H
Airflow mode	N/A	Horizontal airflow	Horizontal airflow
Total cooling capacity (1)	kW	30.0	32.0
Sensible cooling capacity	kW	30.0	32.0
Air volume	m^3/h	5000	5000
Number of fans	N/A	6	6
Power supply	V/Ph/Hz	220–240/1/50 (60)	220–240/1/50 (60)
Humidification capacity	kg/h	1.5	1.5
Full-load current	A	9.5	9.5
Dimensions (W x D x H)	mm	300 x 1200 x 2000	300 x 1200 x 2200
Net weight	kg	165	175

Note:
1. Rated working condition: The supply and return chilled water temperatures are 10° C and 15° C respectively. The return air temperature and relative humidity are 37° C and 24%.

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- Each time the water temperature increases by 1° C, the cooling capacity of the chiller increases by 2%–3%, saving more energy for the entire system. However, the cooling capacity of the indoor unit decreases, which increases the number of indoor units. Therefore, the TCO needs to be calculated to compare solutions.
- Each time the temperature difference increases by 1° C, the water flow decreases by about 15%, and the water pump investment decreases. However, the cooling capacity of the indoor unit decreases, which increases the number of indoor units.

NetCol5000-C Technical Specifications (2)

Model	Unit	NetCol5000-C065H	NetCol5000-C080H
Airflow mode	N/A	Horizontal airflow	Horizontal airflow
Total cooling capacity (1)	kW	65.0	80.0
Sensible cooling capacity	kW	65.0	80.0
Air volume	m^3/h	10,000	12,000
Number of fans	N/A	10	12
Power supply	V/Ph/Hz	220–240/1/50 (60)	220–240/1/50 (60)
Humidification capacity	kg/h	3	3
Full-load current	A	15	17
Dimensions (W x D x H)	mm	600 x 1200 x 2000	600 x 1200 x 2500
Net weight	kg	202	240

Note:
1. Rated working condition: The supply and return chilled water temperatures are 10° C and 15° C respectively. The return air temperature and relative humidity are 37° C and 24%.

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- Each time the water temperature increases by 1° C, the cooling capacity of the chiller increases by 2%–3%, saving more energy for the entire system. However, the cooling capacity of the indoor unit decreases, which increases the number of indoor units. Therefore, the TCO needs to be calculated to compare solutions.
- Each time the temperature difference increases by 1° C, the water flow decreases by about 15%, and the water pump investment decreases. However, the cooling capacity of the indoor unit decreases, which increases the number of indoor units.
- The air volume refers to the maximum air volume output by the fan.

NetCol8000-C Technical Specifications (1)

Model	Unit	NetCol8000-C070D	NetCol8000-C100D	NetCol8000-C110D	NetCol8000-C130D	NetCol8000-C150D	NetCol8000-C160D
Total cooling capacity	kW	63.2	100.2	113.0	126.4	150.3	169.5
Sensible cooling capacity	kW	51.4	83.0	94.2	102.8	124.5	141.3
Air volume	m^3/h	13,500	23,000	28,000	27,000	34,500	42,000
Power supply	V/Ph/Hz	380–415/3/50, 380–415/3/60, 440–480/3/60					
Water flow rate	L/s	3.02	4.78	5.39	6.03	7.17	8.09
Water pressure drop	kPa	62.4	70.7	85.8	85.4	77.4	94.3
Heating capacity	kW	6	12	12	12	12	12
Humidification capacity	kg/h	5	8	8	8	12	12
Full-load current	A	4.7 (15.2)	9.4 (30.4)	8.9 (29.9)	8.9 (29.9)	13.8 (34.8)	13.1 (34.1)
Dimensions (W x D x H)	mm	900 x 1000 x 2000	1800 x 1000 x 2000	1800 x 1000 x 2000	1800 x 1000 x 2000	2700 x 1000 x 2000	2700 x 1000 x 2000
Net weight	kg	340	600	615	635	880	900

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NetCol8000-C Technical Specifications (2)

Model	Unit	NetCol8000-C190D	NetCol8000-C220D	NetCol8000-C260D	NetCol8000-C070U	NetCol8000-C130U	NetCol8000-C190U
Total cooling capacity	kW	189.6	226.0	252.8	61.9	123.8	185.7
Sensible cooling capacity	kW	154.2	188.4	205.6	50.3	100.6	150.9
Air volume	m^3/h	40,500	56,000	54,000	13,200	26,400	39,600
Power supply	V/Ph/Hz	380–415/3/50, 380–415/3/60, 440–480/3/60					
Water flow rate	L/s	9.05	10.79	12.07	2.95	5.91	8.86
Water pressure drop	kPa	96.0	108.8	114.0	60.5	82.6	92.7
Heating capacity	kW	12	12	12	6	12	12
Humidification capacity	kg/h	12	12	12	5	8	12
Full-load current	A	13.1 (34.1)	17.3 (38.3)	17.3 (38.3)	4.7 (15.2)	8.9 (29.9)	13.1 (34.1)
Dimensions (W x D x H)	mm	2700 x 1000 x 2000	3600 x 1000 x 2000	3600 x 1000 x 2000	900 x 1000 x 2000	1800 x 1000 x 2000	2700 x 1000 x 2000
Net weight	kg	930	1195	1225	330	615	900

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- Note that the heating capacity and humidification capacity are different.

Quiz

1. (short-answer question) What are the features of the NetCol5000-C?
2. (short-answer question) What are the specifications of the Huawei-developed water valve actuator?

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- The NetCol5000-C features intelligent O&M, intelligent display, online fan maintenance, dual power supply, and cooling capacity management.
- Huawei-developed water valve: actuator power supply: 12 V DC; torque: 10 N·m; valve: DN50; KVS = 65. Kvs is the flow coefficient (flow capacity), indicating the water flow rate when the pressure difference between the two ends of the valve is 0.1 MPa (1 bar), the water density is 1 g/cm3, and the valve is fully open. It is an important parameter of a regulating valve, reflecting the capacity of the regulating valve. Cv = 1.167 Kv (Kv is commonly used in China and Cv is commonly used outside China.)

Summary

- This chapter describes the following aspects:
  - Overview of Huawei Chilled Water Precision Air Conditioners
  - Basic Knowledge and Application Scenarios and Features And then we introduced Cooling Capacity Transfer System
  - Humidification and Drainage Regulation System
  - Key points of this chapter is Electrical Control System and Technical Specifications

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Thank you.

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Introduction to the Huawei Modular Indirect Evaporative Cooling System

NetCol8000-E220



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Foreword

- The slides describe the Huawei modular indirect evaporation cooling system NetCol8000-E220 in terms of system composition, working mode, and technical specifications.

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Objectives

On completion of this course, you will be able to:

- Understand the NetCol8000-E220 system composition.
- Understand the working mode of the NetCol8000-E220.
- Get familiar with the technical specifications of the NetCol8000-E220.

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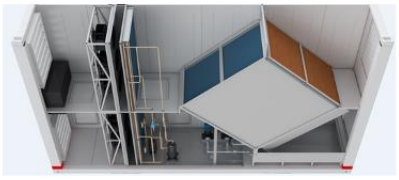
1. System Composition
   - System Structure
   - Indirect Heat Exchange Subsystem
   - Spray, Water Supply, and Drainage Subsystem
   - Mechanical Auxiliary Cooling Subsystem
   - Electric Control System
2. Working Mode
3. Technical Specifications

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System Appearance

- The modular indirect evaporative cooling system consists of the following four parts:
- Indirect heat exchange: heat exchanger core + supply fan + exhaust fan; uses outdoor fresh air to cool the indoor return air.
- Spraying: circulating water pump + spray pipe + water tank; used with the indirect heat exchange part; cools indoor return air by spraying to cool the outdoor fresh air.
- Mechanical auxiliary cooling: compressor + condenser + evaporator + electronic expansion valve + fan (shared with the indirect heat exchange part); supplements cooling.
- Water supply and drainage: water inlet pipe + drainpipe + overflow pipe + blowdown pipe + float; supplies or drains water as required.

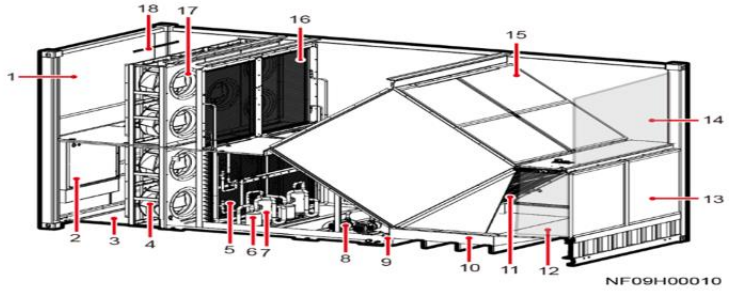




System Appearance

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System Components



System components

(1) Outdoor air exhaust vent	(2) Electric control box	(3) Indoor air supply vent	(4) Indoor air supply fan
(5) Evaporator	(6) Gas-liquid separator	(7) Compressor	(8) Water pump
(9) Water inlet and outlet electric valves	(10) Water tank	(11) Spray system	(12) Outdoor fresh air intake vent (on the side)
(13) Outdoor fresh air intake vent (at the end)	(14) Indoor air return vent	(15) Return air filter	(16) Condenser
(17) Outdoor exhaust fan	(18) Light		

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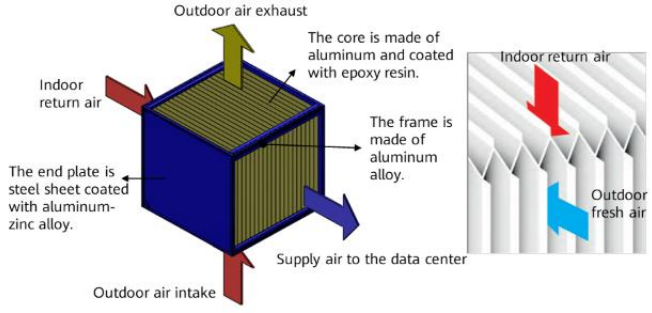
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Heat Exchanger Core

- Multiple plate heat exchangers form two independent channels. The air in the data center and the outdoor air pass through the two channels. The outdoor low-temperature air is used to cool the high-temperature air in the data center. The two channels are completely isolated to ensure that the air in the data center does not directly contact the outdoor air and that the air in the data center is clean.
- The plate heat exchanger is made of aluminum and coated with epoxy resin. The coating can enhance the anti-corrosion performance.

Structure of a heat exchanger core



Specifications of a heat exchanger core

Item	Specifications
Material	Aluminum + epoxy resin coating
Dimensions	2 x 2 x 2.24 m
Plate spacing	12 mm
Plate thickness	0.2 mm
Weight	8 x 80 = 640 kg
Design working condition	Return air temperature: 38° C; supply air temperature: 25° C; outdoor temperature: 16° C
Cooling capacity	220 kW
Efficiency	60%

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- Resistance: 278 Pa
- Channel pressure: 1000 Pa

Fan

- Five identical EC fans are used for the indoor side and outdoor side respectively.
- The EC fan saves more than 30% energy than a common fan. It supports a speed adjustment range of 30% to 100%, and the speed adjustment range is configurable.

Appearance of fans



Fan specifications

	Indoor Side	Outdoor Side
Air volume (m^3/h)	55000	55000
Wind resistance of air filters (Pa)	165 (G4)	50 (G2)
Wind resistance of finned-tube heat exchangers (Pa)	88	69
Wind resistance of air heat exchangers (Pa)	278	303
Wind resistance of spray water (Pa)	/	150
Static pressure at the air outlet (Pa)	150	50
Partial resistance (Pa)	50	50
Total wind resistance (Pa)	731	672

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- Pay attention to the static pressure at the air outlet of the indoor fan. Generally, the static pressure is designed as 8–10 Pa, and the air supply distance is 1 m.

Air Filter

- Internal circulation air filter: G4, non-woven fabric
- External circulation air filter: G2, metal aluminum mesh



Air filter specifications

	Dimensions (W x H x D) (mm)	Quantity	Filtration Accuracy
Internal circulation air filter	1124 x 945 x 46	4	G4
External circulation air filter 1	1020 x 1280 x 46	2	G2
External circulation air filter 2	490 x 1170 x 46	2	G2



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- Difference between G2 and G4: The resistance is different, and the material of the air filter is different.
- G2 (low filtering effect): The recommended final resistance is 50–100 Pa; final resistance of the differential pressure switch
- G3 (low filtering effect): The recommended final resistance is 100–200 Pa.
- G4 (low filtering effect): The recommended final resistance is 150–250 Pa.
- F7–F8 (high and medium filtering effect): 300–400 Pa

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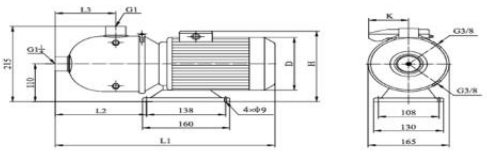
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Water Pump

- Each cooling unit is configured with two water pumps. One is active and the other is standby.
- The rated flow of the water pump is 4 m^3/h, which corresponds to 23.5 m lift, 380–415 V voltage, 50 Hz frequency, and 550 W power.
- The water pump outlet is equipped with a check valve and a water flow switch to protect the water pump.

Spray circulating pumps





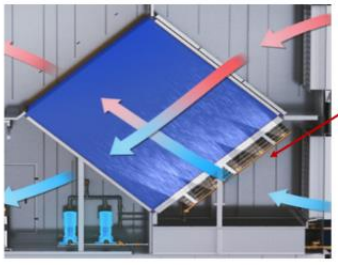
Motor	Model	Size (mm)						Weight (kg)
		L1	L2	L3	D	H	K	
Three-phase/ single-phase	CHL4-20	402	172	132	140	215/249	/96	12
	CHL4-20G	362	132	92	140	215/249	/96	12
	CHL4-30	402	172	132	140	215/249	/96	15
	CHL4-40	422	172	132	157	230/265	/100	15

Model	Driving motor		Q (m^3/h)	1	2	3	4	5	6	7
	(kW)	(hp)								
CHL4-20	0.37	0.5		19	18	17	15	12.5	10	8
CHL4-20G	0.37	0.5		19	18	17	15	12.5	10	8
CHL4-30	0.55	0.75	H (m)	28	27	26	23.5	20.5	17	13
CHL4-40	0.75	1		37.5	36	34	31	27	23	19

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Nozzle

- Solid cone nozzles are used. The port size is 1/4 inch. The flow rate is 2.05 L/min when the nozzle pressure is 0.5 bar.
- A total of 36 (6 x 6) nozzles are configured after considering the spray area, spray angle, and distance between the nozzle and the heat exchanger core.
- Metal nozzles are used. They are not prone to blockage and feature low water consumption.





Nozzle

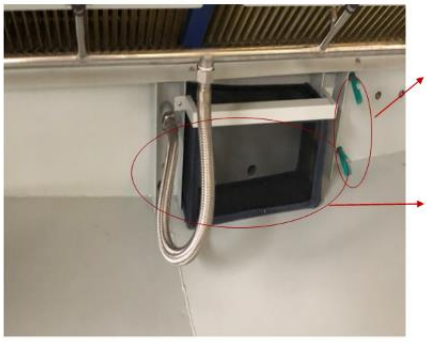


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Water Tank

- The spray water tank has a content volume of 710 L, a loading water volume of 570 L, and a spray volume of 460 L, which can meet the requirement of continuously spraying water for at least one hour.

Side view



Top view



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- The black part is the nylon strainer.

Water Refill and Drainage Logic

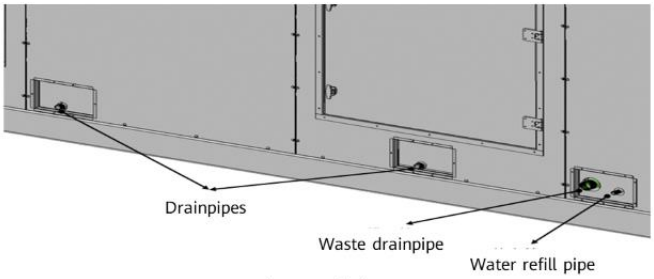
Action	Logic
Water refill	When the low liquid level float is triggered, the water refill valve is opened. When the water refill time reaches the preset value, the water refill valve is automatically closed.
Water drainage	If the high liquid level float is triggered, the drainage valve is opened. When the high liquid level float is reset, the drainage valve is closed. When the scheduled drainage logic condition is met, the drainage valve is opened. When the drainage time reaches the preset value, the drainage valve is automatically closed.

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- When the high liquid level float is faulty, the water is drained automatically by gravity. There is no drainage pump. Water refill pressure: 150–450 kPa

Pipes

- The water tank is equipped with a drain outlet at the bottom, an overflow outlet above the water tank, two strainers at the water pump inlet, a nylon strainer on the water tank, and a Y-shaped strainer on the pipe. The water pump inlet is 38 mm below the low water level switch. After the low water level switch is triggered, water can still be sprayed for 3 minutes.



External ports of the water system

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- Y-shaped strainer: 40-hole
- The specifications of the spray water refill pipe and drainpipe are DN20 and DN40 respectively. Both pipes use inner thread connectors.

Water Quality Requirements

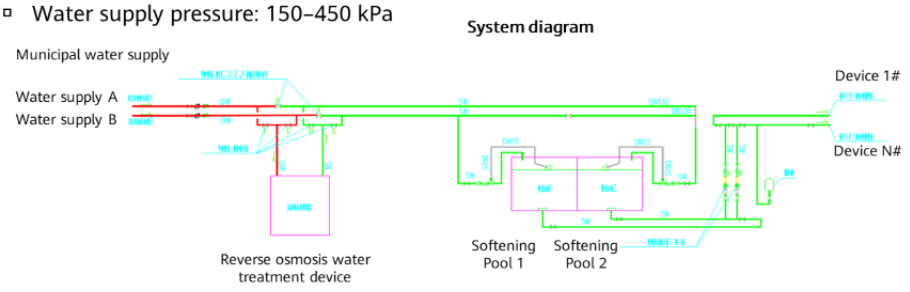
Item	Requirement
Filtration accuracy	≥ 89 μm
PH	6.5–8
Conductivity	< 400 μS/cm
Total dissolved solid (TDS)	< 260 mg/L @ 180° C
Total hardness	< 100 mg/L
Total alkalinity	$CaCO_3$: < 50mg/L
Chloride	< 20 mg/L
SiO_2	< 5 mg/L
Organic matter	< 3 mg/L

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- 89 μm: The diameter of particulates in the water cannot exceed 89 μm after filtration.
- Water quality requirements are made to prevent corrosion and scaling. High content of chlorinated substances (hypochlorous acid) and chloride ions cause pipe corrosion. Excessively high hardness and alkalinity lead to scaling, which reduces the heat exchange efficiency. These indicators must meet related requirements.
- Total hardness: Indicates the concentration of calcium and magnesium ions in water. Total hardness of drinking water cannot exceed 450 mg/L in China. Generally, the total hardness of water in southern China is less than 20 mg/L, and that in northern China is greater than or equal to 100 mg/L.
- For details, contact the water supply company.
- Conductivity: The indicator is related to the total hardness, which can be measured using a device. The required conductivity is less than 400 μS/cm. If the value is larger than 400 μS/cm, ions in the water will cause scaling.
- TDS: indicates the total number of dissolved solids in water.

Water Quality Requirements: Reverse Osmosis Water (Recommended)

- Design requirements for the reverse osmosis water treatment device
  - Water system: municipal water source → reverse osmosis water treatment device → softened water tank → softened water pressurized pump group → cooling system
  - Water supply pressure: 150–450 kPa



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- When two different solutions (pure water and salt water) are isolated by a semipermeable membrane, the pure water with lower concentration will permeate toward the salt water. The liquid level difference generated accordingly is called osmotic pressure. If enough pressure (greater than the osmotic pressure) is applied to the salt water surface, the water will flow in the opposite direction. This phenomenon is called reverse osmosis (RO).
- RO is a water purification technology using membrane separation and pressure difference. It has high degree of separation at a time and no phase change. It is also simple and efficient. The aperture of the reverse osmosis membrane is in nanometer (1 nm = 10–9 m). You cannot see an aperture this small even through a scanning electron microscope. Under a pressure higher than the osmotic pressure, the water molecules move reversely through the semipermeable RO membrane. In this way, pure water is generated, and inorganic ions, organic substances, colloids, microorganisms, and pyrogens in the water are filtered by the RO membrane.
- Valves A and B are normally closed, and valves C, D, E, and F are normally open. Valves A and B are open only when valves C, D, E, and F as well as the reverse osmosis water treatment device are in the maintenance state.

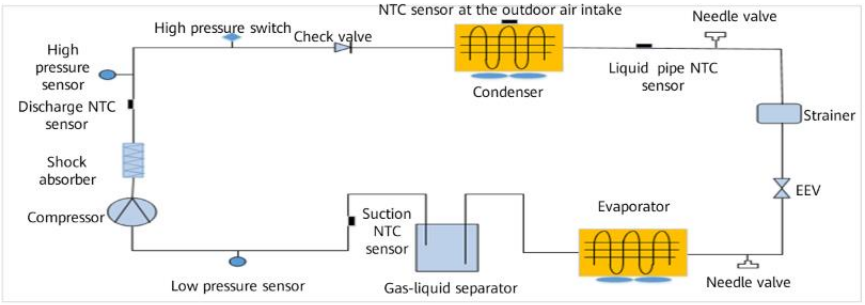
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   - Indirect Heat Exchange Subsystem
   - Spray, Water Supply, and Drainage Subsystem
   - **Mechanical Auxiliary Cooling Subsystem**
   - Electric Control System
2. Working Mode
3. Technical Specifications

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Overview of the Mechanical Auxiliary Cooling System

- The auxiliary cooling system consists of the compressor, condenser, electronic expansion valve (EEV), evaporator, and gas-liquid separator. Each unit has two DX auxiliary cooling systems.
- The suction pipe of the compressor has a low pressure sensor and a suction negative temperature coefficient (NTC) sensor, and the liquid pipe has a liquid pipe NTC sensor and a filter.
- The exhaust pipe of the compressor has a shock absorber, a check valve, a high pressure sensor, and an exhaust NTC sensor.

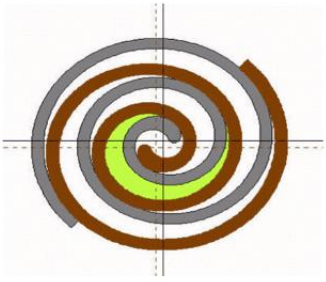


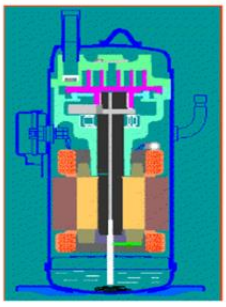
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- NTC: negative temperature coefficient, which refers to the temperature detected by a thermistor.

Compressor

- The DC variable-frequency scroll compressor is used. Each unit is configured with two compressors.





Compressor mechanical diagrams

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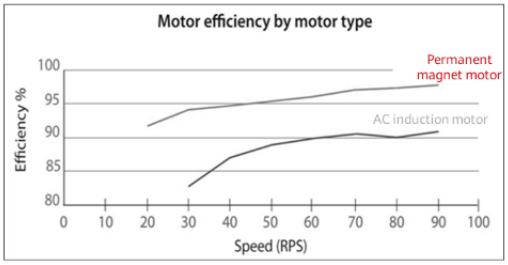
- The DC variable-frequency scroll compressor of Guangzhou Mitsubishi is used. The model is HNB78FC-YE-C, the discharge volume is 78 cm3/rev, and the rotational speed ranges from 20 rps to 120 rps. The maximum rotational speed of the compressor is limited to 100 rps.

Compressor Driver

- Principle: The frequency converter driver changes the power frequency, and the permanent-magnet synchronous motor inside the compressor drives the compressor to work. The driver features a large starting torque, high efficiency (low loss and high power factor), convenient speed adjustment, low noise, high ratio of power to volume, high reliability, and a long service life.
  - 10%–15% less energy consumption when compared with a parallel system
  - 10%+ more energy efficiency when compared with AC frequency conversion



Compressor driver

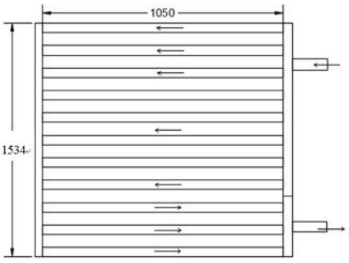


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Condenser

- The condenser uses microchannel heat exchangers, and the number of flat tubes in the first flow channel (from right to left) is 112. The number of flat tubes in the second flow channel (from left to right) is 50.
- Two condensers are configured for each unit. They are installed between the air exhaust fan and the heat exchanger core, one on the left (corresponds to system 1) and the other on the right (corresponds to system 2).

Condenser structure



Condenser appearance

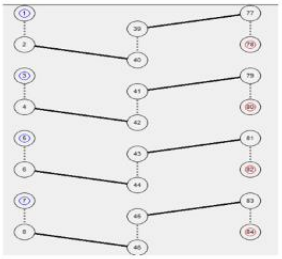


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Evaporator

- The evaporator uses a copper finned-tube heat exchanger, with a total of three rows of tubes. There are a total of 36 flow channels, and each system occupies 18 flow channels. The unit integrates the evaporators of two systems into one evaporator. The evaporator is deployed between the air supply fan and the heat exchanger core.

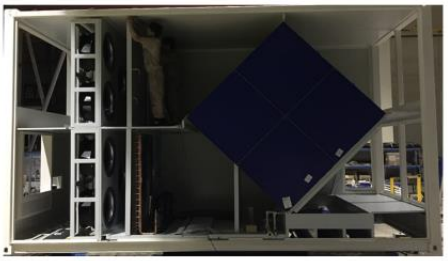
Evaporator structure



Evaporator appearance



Position of the evaporator



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- The flow channels are arranged at intervals and are numbered from top to bottom. A flow channel with an odd number belongs to system 1, and that with an even number belongs to system 2.
- The blue rings indicate the refrigerant outlets, and the red rings indicate the refrigerant inlets. (One flow channel has six tubes, and the refrigerant flows to system 1 and system 2 crosswise.)
- The evaporator is in the lower part of the figure on the right, and the condenser is in the upper part.

EEV

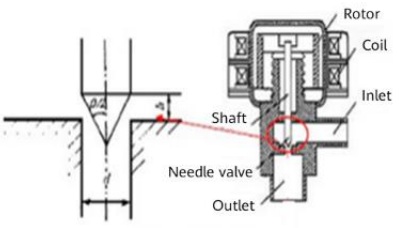
- The EEV is used. Each system is configured with one EEV.
  - The EEV collects the parameters of the cooling system to adjust the circulation area of the valve. It accurately controls the refrigerant volume of the system through a micro controller.

EEV appearance





EEV structure



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- The ETS6-40 EEV provided by Danfoss is used.

Other Cooling Components (1)

- Check valve
  - Controls gas or liquid return to prevent the compressor from starting with loads, improving the unit reliability.
- Shock absorber
  - Reduces pipe vibration to prevent pipe cracks during transportation and operation, improving the unit reliability.
- Gas-liquid separator
  - Install a gas-liquid separator on the suction pipe of the compressor to prevent liquid from returning to the compressor.



Check valve



Shock absorber



Gas-liquid separator

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Other Cooling Components (2)

- Pressure sensor
  - Each DX system is configured with one high pressure sensor and one low pressure sensor to detect the suction pressure and discharge pressure of the compressor.
- Pressure switch
  - Each DX system is configured with a high pressure switch to protect the compressor and lock the system when the pressure is too high.
- Temperature and humidity (T/H) sensor
  - One return air T/H sensor and one fresh air T/H sensor are deployed to detect the temperature and humidity of the return air and fresh air.



Pressure sensor



Pressure switch



T/H sensor

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- The function of each component needs to be expressed in one sentence.

Other Cooling Components (3)

- NTC sensor
  - One for return air, one for fresh air, and two for supply air
  - One supply air NTC sensor for the condenser in each DX system
  - One suction NTC sensor, one exhaust NTC sensor, and one liquid pipe NTC sensor in each DX system; six NTC sensors in the refrigerant system to detect temperature
- Differential pressure switch
  - A differential pressure switch is configured for the internal circulation system to detect the pressure difference of the air filter before and after the internal circulation to determine whether the air filter is dirty or blocked. If it determines that the air filter is dirty or blocked, it reminds engineers to clean the air filter, ensuring secure and reliable running of the equipment.



NTC sensor



Differential pressure switch

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- NTC: refers to negative temperature coefficient. The resistance of an NTC thermistor and material decreases exponentially when the temperature increases. A thermistor is used to detect temperature.

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AC Input

- The power supply for the compressor driver used for auxiliary cooling and that for fan/spray pump have different importance levels. Therefore, the two types of power supplies are separated. To reduce the number of UPSs and batteries, you do not need to install the UPS and batteries for the DX system in scenarios where continuous auxiliary cooling is not required.
- For the standard NetCol8000-E, to ensure the availability of the active indirect heat exchange system, the FAN branch uses dual power supplies, and the DX branch uses a single power supply, as shown in Figure 1. In some scenarios where high availability is required, the DX branch can also use dual power supplies (customization required), as shown in Figure 2.

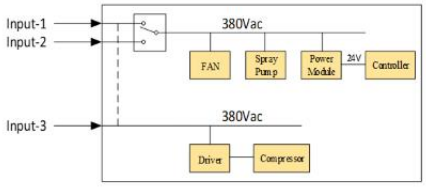


Figure 1 DX powered by single power supply

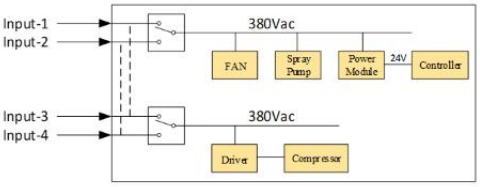
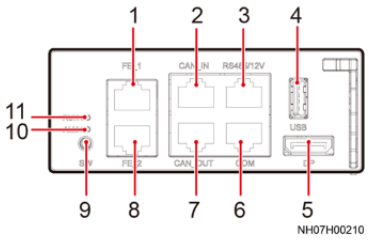


Figure 2 DX powered by dual power supplies

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- Generally, input 1 and input 2 are both connected. If one input is configured, the system can work properly but the input cannot be switched.

Main Control Module



(1) FE_1 (input/output port of the FE ring network)

(2) CAN_IN (teamwork CAN/northbound RS485 input port)

(3) RS485/12V (temperature and humidity module port)

(4) USB (USB port)

(5) DP (connected to the DMU port)

(6) COM (northbound RS485 or FE port)

(7) CAN_OUT (teamwork CAN/northbound RS485 output port)

(8) FE_2 (input/output port of the FE ring network)

(9) SW (reserved)

(10) Alarm indicator

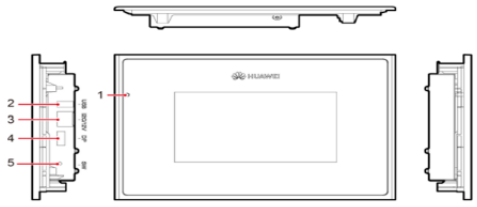
(11) Running indicator

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LCD Control Panel (1)

- The controller provides a 7-inch true color touchscreen that enables man-machine interfaces for query, setting, monitoring, and maintenance.

Appearance of the LCD control panel



(1) Indicator

(2) USB, supporting the security protection mechanism

(3) 12C/12V

(4) Display port (connected to MDU power cable)

(5) SW (used to restart the MDU)

Indicator and buzzer status description

Running Status	Indicator	Buzzer
The equipment is operating properly, or there is a warning.	Green	No buzzing
There is an unacknowledged major alarm.	Yellow	Intermittent buzzing
There is an unacknowledged critical alarm.	Red	Continuous buzzing
Note: In the preceding conditions, the indicator blinks at a frequency of 1 Hz, that is, on for 0.5s and off for 0.5s.		

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LCD Control Panel (2)

Control panel user interface (UI)



(1) Permission status

(2) Communication status between the LCD and the main control board

(3) USB connection status

(4) Diagnostic mode

(5) Buzzer status

(6) Critical alarms and the number of critical alarms

(7) Major alarms and the number of major alarms

(8) Minor alarms and the number of minor alarms

(9) Status bar

(10) Alarm bar

(11) Login/Logout button

(12) Teamwork control button

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Functions of the LCD Control Panel

- Controls a single unit.
- Displays the operations.
- Supports three remote functions: telemetry, teleindication, and telecontrol.
- Teamwork control: Up to 32 units can be networked for teamwork. When multiple air conditioners work cooperatively, the controller optimally distributes the heat load to reduce energy consumption and provides backup to improve reliability.
- A large space is available for recording and storing fault alarm data. Some 2000 historical alarms can be stored.
- Provides comprehensive power monitoring functions.

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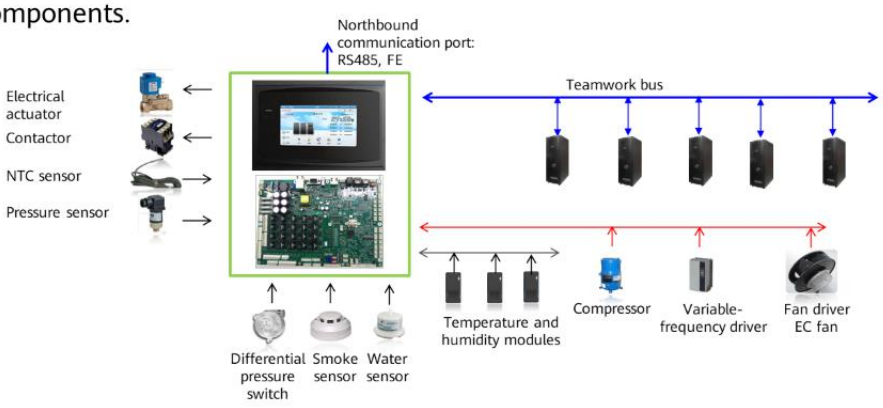
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Hardware Control Architecture

- Various hardware ports are provided to control different types of air conditioners and components.



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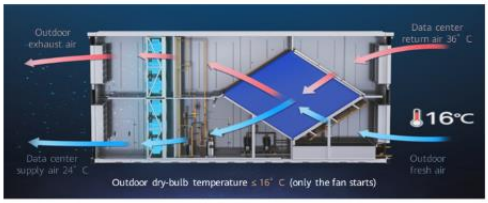
Running Mode

Running Mode	Outdoor Ambient Temperature (100% Load)	Fan	Water Pump	Compressor
Dry mode	Dry-bulb temperature ≤ 16° C	ON	OFF	OFF
Wet mode	Dry-bulb temperature > 16° C, wet-bulb temperature ≤ 19° C	ON	ON	OFF
Hybrid mode	19° C < wet-bulb temperature ≤ 34° C	ON	ON	ON

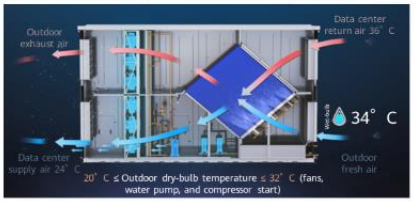
Wet mode (the fan and water pump are started)



Dry mode (only the fan is started)



Hybrid mode (the fan, water pump, and compressor are started)



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- Different cooling components are started based on the outdoor fresh air.
- How to obtain the dry-bulb and wet-bulb temperatures?

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General Specifications

Item		Specifications
Total cooling capacity/Sensible cooling capacity		220 kW
Supply air/Outdoor return air volume		55,000 m^3/h
Power supply specifications		380–415 V AC, three-phase, 50 Hz
Auxiliary cooling ratio		10%–50%
Supply air temperature/humidity		25° C/50%
Return air temperature/humidity		38° C/25%
Indoor/Outdoor air filter (EN 779)		G4/G2
Heat exchanger core type		Plate
Number of fans		Exhaust fan: 5; air supply fan: 5
Fan type		EC
Dimensions (H x W x D)	Device dimensions	3600 mm x 6058 mm x 2438 mm
	Air duct	800 mm x 5810 mm x 2020 mm x
Weight	Net weight (excluding the air duct)	Common type: net weight of 5150 kg; operating weight of 5750 kg Stacking type: net weight of 5700 kg; operating weight of 6300 kg
Installation mode		Single layer or stacked (optional)
Optional components		Air duct, differential pressure sensor, and T/H sensor

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- External residual pressure of the air supply/exhaust fan: 150 Pa/50 Pa
- Supply and return air temperature: The system capacity can reach 220 kW at the design temperatures.
- Installation mode: single layer/stacked. The structures of the two modes are different. Additional mechanical parts are required for stacking.

Specifications of the Mechanical Auxiliary Cooling System

Item	Specifications
Auxiliary cooling mode	DX
Auxiliary cooling ratio	50%
Number of compressors	2
Compressor type	Variable-frequency compressor
Throttling device	EEV
Refrigerant	R410A

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Performance Parameters

- The following table lists the cooling capacity changes with the outdoor temperature under specified indoor working conditions.

Indoor Temperature	Outdoor dry-bulb temperature (° C)	–40	–25	–15	0	16	-	-	-	-
	Outdoor wet-bulb temperature (° C)	-	-	-	-	-	19	24	29	35
Return air: 38° C/25%; supply air: 25° C/50%	Total cooling capacity (kW)	220	220	220	220	220	220	220	194	141
	Sensible cooling capacity (kW)	220	220	220	220	220	220	220	194	141
	Power (kW)	18.6	18.6	18.9	20.6	35.3	41.1	54.2	58.3	45

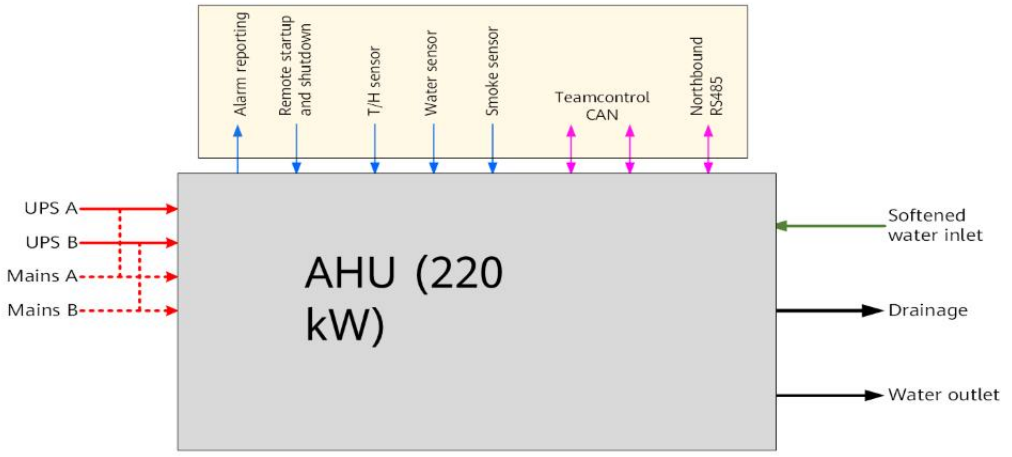
- When the altitude increases, the cooling capacity is derated. The following table lists the derating coefficients.

Altitude (m)	0	1000	1500	2000	2500	3000	3500	4000
Air volume coefficient	1	0.887	0.835	0.785	0.737	0.692	0.649	0.608
Cooling capacity coefficient	1	0.887	0.835	0.785	0.737	0.692	0.649	0.608
Note: The sensible heat ratio is always 100%.								

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- Derating: When the air density decreases, the heat exchange capability of the air per unit volume decreases. Therefore, derating is required.

External Interfaces



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External Interface Specifications (1)

Type	Item	Dimensions	Quantity
Air vent	External circulation fresh air vent (at the end)	2134 mm x 1310 mm	1
	External circulation fresh air vent (on the side)	500 mm x 1200 mm	2
	External circulation air exhaust vent	2134 mm x 1310 mm	1
	Internal circulation return air vent	2134 mm x 1310 mm	1
	Internal circulation supply air vent	800 mm x 2000 mm	1
Water pipe	Spray water refill pipe port	DN20	1
	Spray drainpipe	DN40	1
	Condensate drainpipe	DN20	2

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External Interface Specifications (2)

Type	Item	Dimensions	Quantity
Power cable	AC input L1	70 mm^2	3
	AC input L2	70 mm^2	3
	AC input L3	70 mm^2	3
	AC input N	70 mm^2	3
	PE	35 mm^2	3
Teamwork control/monitoring /external reserved ports	AHU northbound monitoring	RS485	1
	AHU teamwork control	CAN1	1
	AHU teamwork control	CAN2	1
	Remote startup and shutdown	DI_1	1
	Common alarm	DO_1	2
	T/H sensor, which can be cascaded	RS485	1
	Smoke sensor port	Input	1
	Water sensor port	Input	1

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Quiz

1. (Single Choice)Which component is not used in the NetCol8000-E220 kW?
   A. EC fan
   B. Compressor
   C. Electronic two-way valve
   D. Power supply module

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- Answer：C

Summary

- This chapter describes the following aspects:
  - Huawei Modular Indirect Evaporative Cooling System Structure and Spray, Water Supply, and Drainage Subsystem;
  - Mechanical Auxiliary Cooling Subsystem and Electric Control System;
  - Huawei Modular Indirect Evaporative Cooling System Working Mode。

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Thank you.

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每个组织，构建万物互联的智能世界。

Bring digital to every person, home, and organization for a fully connected, intelligent world.

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NetCol5000-A042 Installation and Commissioning

Key Points for Installation and Commissioning



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Foreword

- The slide describes the key installation points and power-on commissioning procedure of the NetCol5000-A042. You can learn about the key points for installing and commissioning the air conditioner by watching related videos.

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Objectives

On completion of this course, you will be able to:

- Master the key points for installing the NetCol5000-A042.
- Master the commissioning procedure of the NetCol5000-A042.

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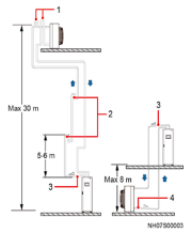
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1. Installation and Commissioning Overview
2. Key Installation Points
3. Commissioning Procedure

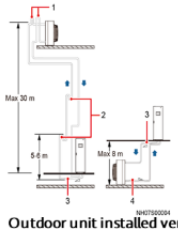
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Typical Installation Scenarios

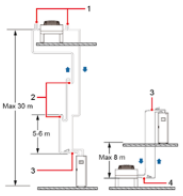
- Prerequisites:
  - A freight elevator whose load bearing capacity and dimensions meet the air conditioner transporting requirements is available.
  - The installation position is determined, and the concrete floor or ESD floor is clean and flat.
  - Environment, health, safety (EHS) requirements: Operators must wear safety helmets, protective goggles, protective shoes, and antifreeze gloves.



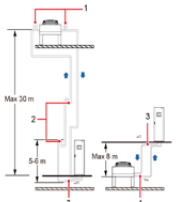
Outdoor unit installed vertically, top pipe routing



Outdoor unit installed vertically, bottom pipe routing



Outdoor unit installed horizontally, top pipe routing

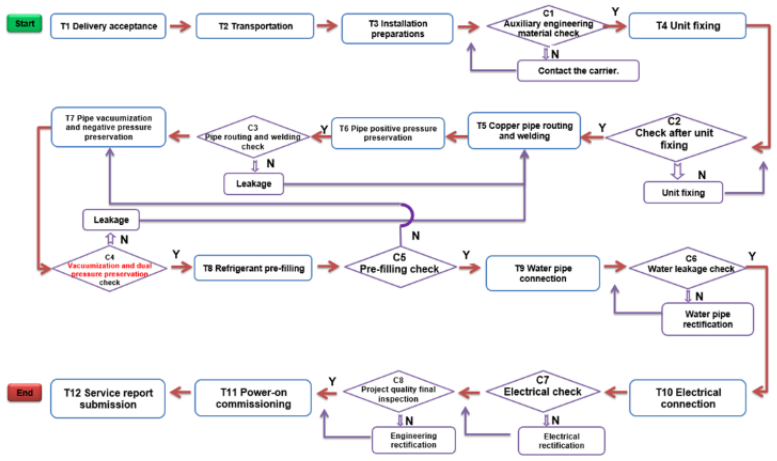


Outdoor unit installed horizontally, bottom pipe routing

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- Applicable to the NetCol5000-A042

Installation and Commissioning Process



1281 rule (TCR):
12 standard steps (Task)
8 quality control points (Check)
1 commissioning and acceptance report (Report)

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- 1281 rule (TCR):12 standard steps (Task); 8 quality control points (Check); 1 commissioning and acceptance report (Report)

Contents

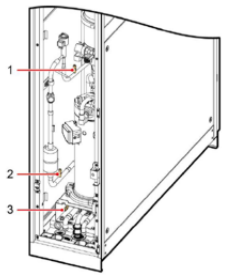
1. Installation and Commissioning Overview
2. **Key Installation Points**
3. Commissioning Procedure

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- Install controls, air ducts, and drainage ditches.

Pre-installation Check

- Check the air pressure.
  - Check whether the bonnets of the needle valves shown in the right figure are available. If yes, remove each bonnet and press the valve plug using the bonnet. If air is exhausted, the system is normal. If no air is exhausted, the system leaks.



Needle valve positions

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Material Preparation (1)

- Copper pipe
  - Determine the total equivalent length of refrigerant pipes based on site requirements and consider the resistance caused by bends. The total equivalent length equals the equivalent length of the bends plus the length of straight pipes between the indoor and outdoor units.
  - The following table lists the equivalent length of bends and other parts with pressure loss.

Copper Pipe Outer Diameter (Inch)	Equivalent Pipe Length (m)			
	45-Degree Bend	90-Degree Bend	180-Degree Bend	T-Shaped Three-Way Valve
3/8	0.12	0.2	0.4	0.6
1/2	0.14	0.25	0.5	0.65
5/8	0.17	0.3	0.6	0.7
3/4	0.2	0.35	0.7	0.8
7/8	0.24	0.42	0.8	1.2
1	0.28	0.5	1	1.3
1-1/8	0.32	0.6	1.2	1.4

The pipe parts are optional and include the following items:

Liquid pipe:

L ≤ 60 m: R410A copper pipe with an outer diameter of 5/8 inch (15.88 mm), wall thickness of 1.0 mm, and operating pressure of greater than 4.5 MPa

60 m < L ≤ 100 m: R410A copper pipe with an outer diameter of 3/4 inch (19.05 mm), wall thickness of 1.2 mm, and operating pressure of greater than 4.5 MPa

Gas pipe: R410A copper pipe with an outer diameter of 7/8 inch, wall thickness of 1.2 mm, and operating pressure of greater than or equal to 4.5 MPa

Thermal insulation foam: thickness greater than or equal to 13 mm

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- Three types of materials need to be prepared onsite: materials provided by Huawei, materials that can be purchased by the customer, and materials that need to be prepared onsite. Indications of Standard, Optional, and Engineering purchase in this document are as follows:
- Standard: standard configuration. This material is provided by Huawei, and you can find this material in the fittings delivered with equipment.
- Optional: Customers can purchase this material from Huawei or other vendors. If you have purchased the material from Huawei, you do not need to purchase it anymore.
- Engineering purchase: This material will not be delivered by Huawei, and customers need to purchase it.

Material Preparation (2)

- R410A refrigerant from name brands such as DuPont, Daikin, and Honeywell is recommended. You can verify the refrigerant authenticity in the following ways:
  - Dial the refrigerant manufacturer's hotline to confirm the refrigerant authenticity.
  - Place the refrigerant tank indoors for 24 hours. Use a point thermometer to measure the external surface temperature of the refrigerant tank, as shown by (1) in the figure, and connect a pressure gauge to the tank to measure the internal pressure, as shown by (2) in the figure. Find the saturation pressure corresponding to the measured outer surface temperature. If the difference between the saturation pressure found in the table and the measured pressure inside the tank is greater than 0.2 MPa, the refrigerant does not meet the requirements, and needs to be replaced.



Refrigerant detection

R410A Saturation Pressure Table							
Saturation Temperature	Gauge Pressure	Saturation Temperature	Gauge Pressure	Saturation Temperature	Gauge Pressure	Saturation Temperature	Gauge Pressure
10°C	0.99 MPa	17°C	1.23 MPa	24°C	1.51 MPa	31°C	1.84 MPa
11°C	1.02 MPa	18°C	1.27 MPa	25°C	1.56 MPa	32°C	1.89 MPa
12°C	1.05 MPa	19°C	1.31 MPa	26°C	1.60 MPa	33°C	1.94 MPa
13°C	1.09 MPa	20°C	1.35 MPa	27°C	1.65 MPa	34°C	1.99 MPa
14°C	1.12 MPa	21°C	1.39 MPa	28°C	1.69 MPa	35°C	2.05 MPa
15°C	1.16 MPa	22°C	1.43 MPa	29°C	1.74 MPa	36°C	2.10 MPa
16°C	1.19 MPa	23°C	1.47 MPa	30°C	1.79 MPa	-	-

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Material Preparation (3)

- Oil trap and inverted trap

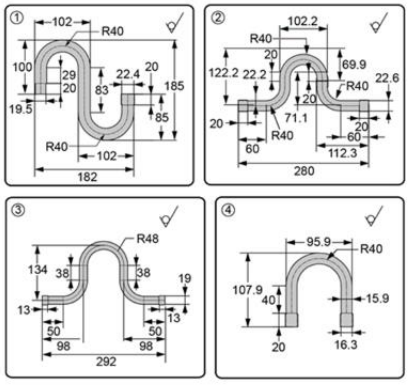
No.	Name	Configuration Description	Outer Diameter and Thickness of Copper Pipe	Technical Requirement
1	Oil trap	Optional	22.2 mm x 1.2 mm	Inner diameter at the expanded end of the copper pipe: 22.4 mm; outer diameter at the shrunk end: 19.5 mm
2	Gas pipe inverted trap	Optional	22.2 mm x 1.2 mm	Inner diameters at the two expanded ends of the copper pipe: 22.6 mm
3	Liquid pipe inverted trap	Optional	19.0 mm x 1.0 mm	Inner diameters at the two expanded ends of the copper pipe: 19.0 mm
4	Liquid pipe inverted trap	Optional	15.9 mm x 1.0 mm	Inner diameters at the two expanded ends of the copper pipe: 16.3 mm

Description

After the traps are made, verify that the surface is smooth and even, and that there is no burr at the pipe ends.

The bend angle not marked in the figure is 90 degrees.

The tolerance of the bended pipes is ±1 mm.

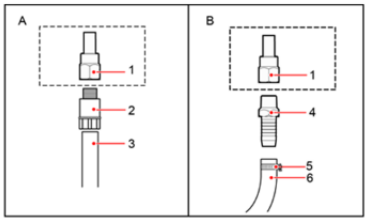


Connection of the water inlet pipe of the humidifier

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Material Preparation (4)

- Humidifier water inlet pipe and drainpipe
- Connect the pipes as follows:
  - Rigid pipe connection: Prepare rigid pipe connectors and rigid pipes shown by components 1 and 2 in method A in the following figure.
  - Hose connection: Prepare pagoda connectors and hoses shown by components 4 and 6 in method B in the following figure.



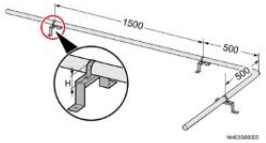
Connection of the water inlet pipe of the humidifier

(1) Internal thread connector: G 1/2 inch; delivered with the water inlet pipe	(2) Rigid pipe conversion adapter: G 1/2 inch; connected to a rigid pipe with external screw threads
(3) Rigid pipe: made of PP-R or other materials	(4) Pagoda connector: G 1/2 inch; connected to a pipe with external screw threads
(5) Hose clamp	(6) Hose: made of EPDM or other materials

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Material Preparation (5)

- The following figure shows the supports for the refrigerant pipe and water pipe. The shape of the supports may vary with site situation.
- Note:
  - The height of a U-shaped pipe clamp equals to the pipe diameter with thermal insulation foam minus 5 mm. The pipe supports are to be purchased by the customer.
  - 304 stainless steel is recommended for pipe supports and clamps.
  - Install a support every 1500 mm in the straight sections of pipes, and 500 mm away from each bending point in the turning section.



Cable Requirements (1)

Application Scenario	Name	Technical Requirement	Remarks
Indoor unit	(Optional) Power cable	Electrical power cable: 600 V/1000 V, ZA-YJV, 5 x 10 mm^2, black (five cores: brown, black, gray, blue, and yellow-green), 80 A, CE	The length depends on site survey. Dual power supplies: 2 PCS Single power supply: 1 PCS
	OT terminal	Bare crimping terminal, OT, 10 mm^2, M6, 60 A, tin plating, round ring terminal	Delivered with the device
Outdoor unit	(Optional) Power cable	Electrical power cable: 600 V/1000 V, ZA-RVV, 5 x 2.5 mm^2, black (five cores: brown, black, gray, blue, and yellow-green), 27 A, outdoor cable, CE	The length depends on site survey.
	OT terminal	Bare crimping terminal, OT, 2.5 mm^2, M6, 27 A, tin plating, 16–14 AWG, blue	Delivered with the device
	Cord end terminal	Bare crimping terminal, single-wire cord end terminal, 2.5 mm^2, 12.5 A, tin plating, insertion depth 8 mm, blue	Delivered with the device

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Cable Requirements (2)

Application Scenario	Name	Technical Requirement	Remarks
Indoor and outdoor units	(Optional) Signal cable for indoor and outdoor units	Electrical power cable, 300 V, SJTW, 3 x 16 AWG, black (three core wires: black, white, green), 10 A, shielded outdoor cable, UL	Applies to RS485 communication connection. The length depends on site survey.
	(Optional) Signal cable for indoor and outdoor units	Electrical power cable, 450 V/750 V, H07RN-F-2 x 1 mm^2, black (two core wires: brown, blue),10 A, rubber cable, VDE	Applies to dry contact connection. The length depends on site survey.
	Cord end terminal installed on a cable	Bare crimping terminal, single cord end terminal, 1.5 mm^2, 7.5 A, tin plating, insertion depth 8 mm, red	Delivered with the device
Teamwork control	(Optional) Teamwork control network cable	Symmetric twisted-pair cable, 100 ohms, enhanced category 5 cable, aluminum foil shield, 0.52 mm, 24 AWG, 8-core, four pairs of PANTONE 430U, use with Plug	1 PCS (10 m)
Water immersion	Water detection board cable	Power Cable, 5 m, 22 AWG, black (2 x T0.52 orange), (2 x 22UL1007 black), (2 x T0.52 orange)	Delivered with the device

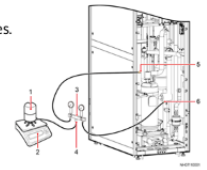
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(Optional) Refrigerant Oil

- MEL-32 refrigerant oil is recommended. It can be purchased by Huawei or by the customer after confirmed by Huawei.
- The NetCol5000-A042 has been filled with refrigerant oil for 100 m long pipes before delivery. Additional refrigerant oil is not required during onsite installation. In scenarios such as oil leakage or shortage or compressor replacement, charge additional refrigerant oil.

Requirements for Charging Refrigerant

- Charging refrigerant
  - Take off the vacuum pump after the vacuumization is complete, and replace the vacuum pump with a refrigerant vessel.
  - Slightly open the refrigerant vessel valve and loosen the connection nut of the pressure gauge. Tighten the nut when cold air escapes out of the nut.
  - Put the refrigerant vessel upside down on an electronic balance. Clear the reading on the balance.
  - Open all valves and charge refrigerant. The amount of refrigerant charged must be more than half of the total charge amount calculated and less than the total charge amount. Charge the remaining refrigerant during the power-on commissioning (preheat the refrigerant before powering on the system).
  - When the charge is complete, close the pressure gauge valves and the refrigerant vessel valves.



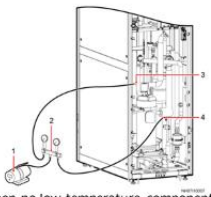
(1) Refrigerant cylinder (2) Electronic balance (3) Pressure gauge

(4) Connection nut (5) Low pressure needle valve (6) Exhaust pipe needle valve

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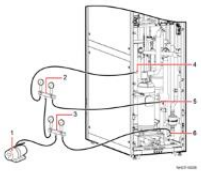
Key Installation Points - Vacuumization

- Vacuumization
  - After verifying that the cooling system does not leak, vacuumize the system until the pressure displayed on the vacuum pump is less than or equal to 60 Pa (absolute pressure), and continue to vacuumize for 30 minutes. Ensure that the reading of the pressure gauge does not change, and the sight glass water indication is dry (displayed in green).
  - After the vacuumization is complete, close all valves of the pressure gauge and the vacuum pump without disconnecting them, and preserve the pressure for 10 minutes. Ensure that the pressure of the cooling system does not exceed 90 Pa (absolute pressure).



Vacuumization when no low-temperature component is configured

(1) Vacuum pump
(2) Pressure gauge
(3) Low pressure needle valve
(4) Exhaust pipe needle valve



Vacuumization when a low-temperature component is configured

(1) Vacuum pump
(2) Pressure gauge 1
(3) Pressure gauge 2
(4) Low pressure needle valve
(5) Exhaust pipe needle valve
(6) Liquid pipe needle valve

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Key Installation Points - Pipe Blowing and Drainage

- Foreign matter drainage
- Drainage through the gas pipe (similar operations can be performed for the liquid pipe)
  - Connect one end of the rubber hose to the nitrogen cylinder with a reducing valve and connect the other end to the refrigerant gas pipe in the unit in a higher position (if the outdoor unit is higher than the indoor unit, connect the hose to the outdoor unit; otherwise, connect the hose to the indoor unit).
  - Block the other end of the refrigerant gas pipe using one hand.
  - Adjust the nitrogen reducing valve to set the nitrogen pressure to 1 MPa, and add pressure to the copper pipe.
  - Remove the hand that blocks the end of the gas pipe quickly so that the foreign matter inside the pipe can be discharged with the impact of airflow.
  - Repeat steps 2 to 4 for multiple times until no foreign matter is discharged.
  - After discharging foreign matter, remove the rubber hose that connects to the gas pipe and seal the two ends of the pipe using tape to prevent foreign matter from entering the pipe.

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- Note:
- 1. The plug cannot directly point to people during nitrogen blowing.
- 2. The end of the rubber hose that connects to the refrigerant gas or liquid pipe must have favorable sealing performance.
- 3. Direction of foreign matter drainage: Charge nitrogen from the higher end of the gas or liquid pipe and drain foreign matter from the lower end of the pipe to avoid being affected by the gravity of the foreign matter.
- 4. After foreign matter drainage, seal the two ends of the pipe properly to prevent foreign matter from entering the pipe again.

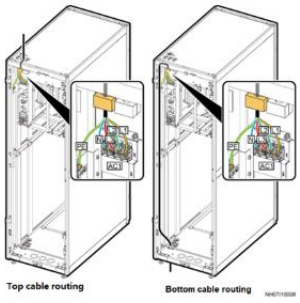
Key Installation Points - Pipe Welding

- Pipe welding
  - Before the welding, protect the needle valve (exhaust pipe needle valve) within 500 mm from the welding position by removing the valve plug or wrapping the valve with a piece of wet cloth.
  - During the welding, use a rubber hose to connect the nitrogen cylinder, which is connected to the reducing valve, to one end of the gas pipe at the indoor side to fill nitrogen at 0.03–0.05 MPa into the copper pipe. Feel that slight nitrogen flows from the welded side of the gas pipe with your hand.
  - During the welding process, avoid burning the bottom plate, top plate, and side plates, especially the thermal insulation foam, labels, water pipes, and cables.
  - During the welding process, do not expose the system pipes for over 15 minutes. Otherwise, system reliability may deteriorate.
  - To avoid leakage of ventilation channels and damage to copper pipes, seal the holes after the pipes are routed. Seal the ends of the copper pipes to prevent foreign matter from entering the refrigerant pipes.
  - Avoid bends and ensure that the indoor and outdoor units are connected with shortest pipes.

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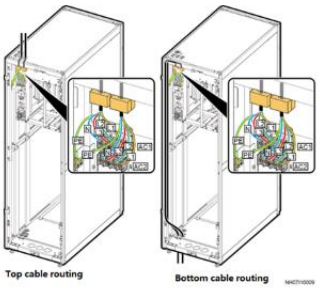
- Wrap the refrigerant pipes with thermal insulation foam.

Key Installation Points - Connecting Cables to the Indoor Unit



Connecting single-route cables to the indoor unit

Route the external power cable through the cabinet cable hole, then to the L1, L2, L3, and N ports of the AC1 terminal on the indoor unit. Connect the PE cable.



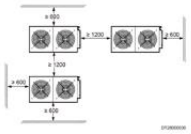
Connecting dual-route cables to the indoor unit

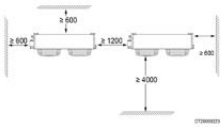
Route the external power cables through the cabinet cable holes, then to L1, L2, L3, and N ports of the AC1 and AC2 terminals on the indoor unit. Connect the PE cables.

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Key Installation Points - Outdoor Unit Space

- Key installation points for outdoor unit space
  - Horizontal installation: The following left figure shows the top view of the horizontal installation mode.
  - Vertical installation: The following right figure shows the top view of the vertical installation mode.

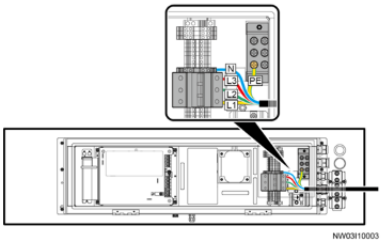




  - The shadow parts around the figures indicate obstacles, which cannot exceed 1 m. The distance between the outdoor unit and obstacles is the minimum distance. Ensure that there is no obstacle above the outdoor unit.
  - When installing the outdoor unit, ensure that the air intake and exhaust of the condenser are smooth. When installing the outdoor unit vertically, ensure that the air intake and exhaust directions of the fan are not opposite to the monsoon direction.
  - In high-temperature areas, avoid exposing the outdoor unit to direct sunshine. Take thermal insulation measures for indoor and outdoor connecting pipes.

Key Installation Points - Connecting Power Cables to the Outdoor Unit

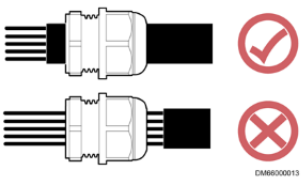
- Connecting power cables – connecting cables to the outdoor unit
  - Route the outdoor unit power cable through the cabinet cable hole, then to the L1, L2, L3, and N ports of the AC3 terminal on the indoor unit.
  - Connect the PE cable to the PE port on the right side of the AC3 terminal.



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- Connect the cables in correct phase sequence.

Key Installation Points - Electric Control Box of the Outdoor Unit



PG connector installation

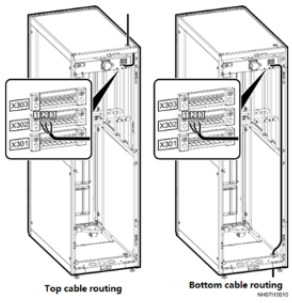
Type	Cable Name	Cable Specifications	Application Scenario
Power cable	(Optional) NetCol500-A026SC11E0 power cable	220 V–240 V: electrical power cable, 300 V, 3 x 2.5 mm^2, 21 A, three-core outdoor cable	220 V–240 V: L/N/PE Cable outer diameter: 10–13 mm
	(Optional) Power cables for other types of outdoor units	380 V–480 V: electrical power cable, 600 V/1000 V, ZA-RVV, 2.5 mm^2, 27 A, five-core outdoor cable	380 V–480 V: L1/L2/L3/N/PE Cable outer diameter: 13.0–15.0 mm
Signal cable	(Optional) Signal cable	Electrical power cable, 300 V, SJTW, 3 x 16 AWG, black (three core wires: black, white, green), 10 A, shielded outdoor cable, UL, 14170097 adapter.	Connects to a dry contact or an RS485 port. Cable outer diameter: 7–9 mm
	(Standard) Signal cable terminal	Bare crimping terminal, single cord end terminal, 1.5 mm^2, 7.5 A, tin plating, insertion depth 8 mm, red	-

Note:

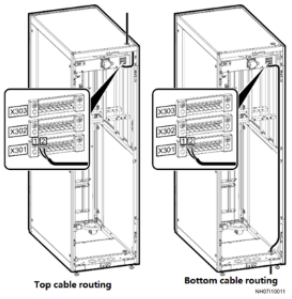
1. The PG connector for installing the outdoor unit must be tightened. Otherwise, water may enter the electric control box, which may damage the controller.
2. The screws on the electric control box of the outdoor unit must be tightened.
3. The cable diameter of the outdoor unit must be appropriate. Otherwise, the PG connector cannot be sealed, and the controller will be damaged due to water penetration.
4. The PG connector must be crimped with the insulation layer of the cable. Otherwise, the electric control box will be burnt.

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Key Installation Points - Connecting Communications Cables to the Outdoor Unit



(Connecting cables using RS485 ports) Connect the cable from ports 1, 2, and 3 on the signal terminal block X302 to ports 3, 4, and 5 on the outdoor unit.



(Connecting cables using dry contacts) Connect the cable from ports 1 and 2 on signal terminal X301 to ports 1 and 2 on the outdoor unit.

Outdoor unit signal cables can be connected to dry contacts or RS485 ports. Signal cables are connected to RS485 ports by default (the **Outdoor fan control mode** is set to **Communicate** by default). If you want to connect them to dry contacts, choose **Settings** > **System Settings** > **Outdoor Fan** and set **Outdoor fan control mode** to **Dry contact**.

Precautions

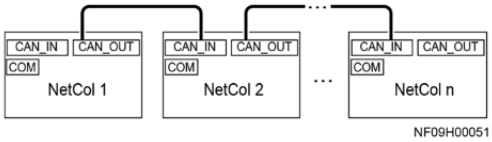
1. Electric and extra-low voltage (ELV) cables must be routed separately.

2. Shielded communications cables are used as signal cables.

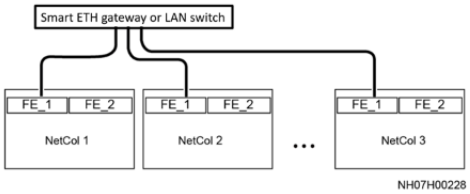
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Key Installation Points - Teamwork Control

- The unit supports two teamwork control networking modes: CAN (hand-in-hand) and FE.
- CAN teamwork networking mode: Connect the CAN_OUT port on the previous unit to the CAN_IN port on the next unit using a CAN teamwork network cable.
- FE teamwork networking mode: Connect one end of the FE network cable to the FE_1 or FE_2 port, and the other end to the LAN switch (or the PoE port on the smart ETH gateway).
- A teamwork network supports a maximum of 32 units connected in series. Any unit can be set as the master unit.



CAN teamwork networking (CAN protocol)

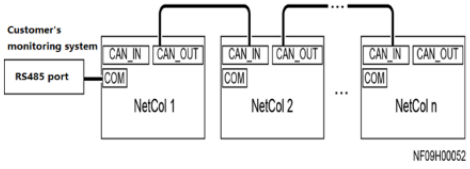


FE teamwork networking (MAC_CAN protocol)

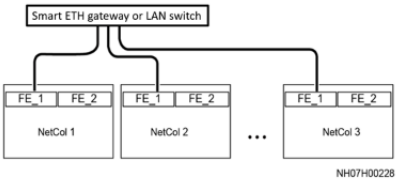
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Key Installation Points - Monitoring

- The unit supports two monitoring modes: northbound RS485 and FE. Select either mode.
- Northbound RS485 monitoring mode: If teamwork or FE networking is not used, connect the COM port on each unit to the customer's monitoring system. In CAN networking, connect the COM port on the first device in each teamwork group to the monitoring device.
- FE monitoring mode: Connect one end of the monitoring network cable (standard network cable) to the FE_1 or FE_2 port on the main control module, and the other end to the monitoring device.



Northbound RS485 monitoring (Modbus_RTU protocol)

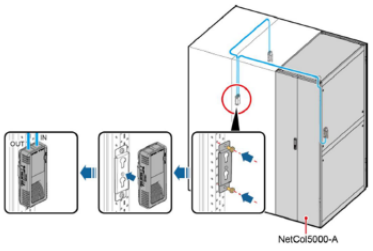


FE monitoring (Modbus_TCP protocol)

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(Optional) Key Installation Points - Connecting a T/H Sensor Outside the Cabinet

- Connect the temperature and humidity (T/H) sensors outside the cabinet and the return air T/H sensor in series. The IN port on the return air T/H sensor has been connected to the main control board. When connecting the T/H sensors outside the cabinet, connect the OUT port on the return air T/H sensor to the IN port of the next T/H sensor outside the cabinet in series.
- Each unit supports a maximum of five cold aisle T/H sensors and five hot aisle T/H sensors. You need to set the DIP switches for the T/H sensors. The following table describes the settings.



Position of the humidity sensor

Location	Display Name	Address	DIP Switch SN					
			1	2	3	4	5	6
Air return side	Air return 2 T/H sensor	1	ON	OFF	OFF	OFF	OFF	OFF
Cold aisle	Cold aisle 1 T/H sensor	11	ON	ON	OFF	ON	OFF	OFF
	Cold aisle 2 T/H sensor	12	OFF	OFF	ON	ON	OFF	OFF
	Cold aisle 3 T/H sensor	13	ON	OFF	ON	ON	OFF	OFF
	Cold aisle 4 T/H sensor	14	OFF	ON	ON	ON	OFF	OFF
	Cold aisle 5 T/H sensor	15	ON	ON	ON	ON	OFF	OFF
Hot aisle	Hot aisle 1 T/H sensor	21	ON	OFF	ON	OFF	ON	OFF
	Hot aisle 2 T/H sensor	22	OFF	ON	ON	OFF	ON	OFF
	Hot aisle 3 T/H sensor	23	ON	ON	ON	OFF	ON	OFF
	Hot aisle 4 T/H sensor	24	OFF	OFF	OFF	ON	ON	OFF
	Hot aisle 5 T/H sensor	25	ON	OFF	OFF	ON	ON	OFF

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- After the addresses are set, power on the device, choose Settings > System Settings > T/H sensor on the LCD home screen, and set the sensors in the aisles corresponding to the addresses to Enable. Otherwise, the sensors will not work.

Contents

1. Installation and Commissioning Overview
2. Key Installation Points
3. **Key Commissioning Points**

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Key Commissioning Points - Preparation Before Power-On

- Preparing for power-on
  - Verify that the air conditioner circuit breaker in the upstream PDF is OFF.
  - Verify that the input voltage meets the requirements.
  - Ensure that there is no reverse phase or open phase of the input power cable of the air conditioner. Otherwise, the air conditioner may be damaged.
  - Verify that the cables to the indoor and outdoor units are correctly connected and the L1, L2, L3, N, and PE cables are in correct phase sequence.
  - Verify that the signal cable between the indoor and outdoor units is properly connected.
  - Verify that the water sensor is properly installed.
  - If the teamwork control is adopted, ensure that the teamwork cables are correctly connected.
  - Confirm that the cables are correctly connected and DIP switches are correctly set for the T/H sensors.
  - If a humidifier is configured, ensure that the upstream water inlet valve of the humidifier is open.
  - Check that the humidifier water inlet pipe and drainpipe are correctly connected, the refrigerant pipe is connected, and refrigerant is pre-filled.
  - Confirm that the switches of Fan1 to Fan10 are in the ON position.

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Key Commissioning Points - Device Power-On

- Device power-on
  - Switch on the air conditioner switch in the upstream PDF.
  - Check whether the QF3 switch that controls the outdoor unit and the compressor and QF4 switch that controls the electric heater are ON.
  - Confirm that the switches of Fan1 to Fan10 are in the ON position.
  - When the equipment is powered on for the first time, the **Quick Settings** screen is displayed. Set the following parameters:
  - Select the language: English or Chinese
  - Select the date and time settings: date format, date, time, and time zone.
  - Select the monitoring mode.
  - Check whether the voltage is correct.
  - Tap **Settings** > **System Settings** > **T/H Sensor** to enter the **T/H Sensor** screen. You can configure the T/H control type, temperature and humidity set point.







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Key Commissioning Points - Power-On

- Tap **Start** on the home screen of the LCD.
  - If this is the first startup after power-on, the screen shown in Figure 1 is displayed. In this case, tap **Confirm**. The screen shown in Figure 2 is displayed. Go to step 2 for verification of first startup.
  - If this is not the first startup, the screen shown in Figure 3 is displayed. In this case, tap **Confirm** to start the unit.

Figure 1



Figure 2



Figure 3



Key Commissioning Points - Power-On

- Start the **Service Expert** app on the mobile phone.
- On the home screen of the app, tap **StartUp**. The screen shown in the left figure is displayed.
- Tap **Offline Activation**. The screen shown in the right figure is displayed.
- On the **Offline Activation** screen, specify **BarCode** and **Codes**, and tap **Generate PWD** to generate a startup password.
- Tap **Password** on the screen of the smart cooling product, and enter the startup password generated by the app to start the product.





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- Download the Service Expert app from the HUAWEI App Store. The app can be downloaded from Android currently. You must apply for the permission to use the app after downloading it.

Key Commissioning Points - Startup Wizard Commissioning

- Before commissioning, ensure that refrigerant has been charged.
- Tapping **No** or **Exit**, submission timeout, and system exception all result in commissioning failures. Choose **Maintenance** > **Wizard Startup** to go to the **Wizard Startup** screen.
- If the system is not configured with the electric heater and humidifier components, the electric heater and humidifier commissioning items will not appear on the screen.
- If the heating function and humidification functions are disabled, the electric heater and humidifier commissioning items cannot be selected.
- All the items are selected by default if you first enter the screen where you select commissioning items. Except that the indoor fan item is mandatory, you can clear other commissioning items that are not required.

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Key Commissioning Points - Startup Wizard Commissioning (1)



1. On the home screen, choose **Maintenance** > **Wizard Startup**, and check the startup as prompted.



2. Tap **Yes** and enter the checking screen before startup.



3. Tap **Yes** for checking items one by one according to the prompt messages on the screen.



4. Tap **Yes**. The commissioning screen is displayed. Select commissioning items based on the actual configuration. If no water is supplied to the humidifier, deselect **Humidifier commissioning**.



5. Tap **Yes** and enter the fan commissioning screen.



6. After the fan commissioning is complete, enter the electric heater commissioning screen, and read the L1, L2, and L3 currents from the clamp meter at the input end.

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Key Commissioning Points - Startup Wizard Commissioning (2)



7. After the electric heater commissioning, the humidifier commissioning screen is displayed. Check whether the humidifier pipes and the solenoid valve leak.



8. After the humidifier commissioning is complete, the condensate pump commissioning screen is displayed. Check that the condensate pump vibrates and generates operating sound.



9. After the condensate pump commissioning is complete, the cooling system commissioning screen is displayed. Check whether the electric heating belt is close to the compressor outer wall and whether there is noticeable temperature increase by touching the belt surface.







10. Check the commissioning result. The left figure shows that the commissioning is successful, and the other two figures show that the commissioning fails.

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Key Commissioning Points - Check After Startup Wizard Commissioning

Item	Result
The temperature and humidity settings are proper.	☐ Passed ☐ Failed
The thermal insulation foam of the copper pipes and the bottom plate is free of oil stains or has been cleaned.	☐ Passed ☐ Failed
The needle valve plugs are secured, and screw caps are tightened.	☐ Passed ☐ Failed
The foreign matter on the drip pan and bottom plate is cleaned up.	☐ Passed ☐ Failed
The air filter is correctly installed according to the airflow direction marked on the frame.	☐ Passed ☐ Failed

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Key Commissioning Points - Commissioning a Single Component

- On the home screen, tap **Start** and choose **Maint** > **Diagnostic Mode** > **Enter**. (If no manual operation is performed within 25s after you tap **Start**, the device will automatically run following the preset logic, and the compressor and indoor and outdoor fans will run according to the environment.)
- Change the input value of **Outdoor fan** to **50%**. After checking that the outdoor fan runs properly and no alarm is raised, change the value of **Outdoor fan** to **0%**.
- Change the value of **Indoor fan** to **90%**. After ensuring that the indoor fan runs properly and no alarm is raised, change the value of **Indoor fan** to **0%**.

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Key Commissioning Points - Commissioning a Single Component

- Adjust the compressor rotational speed to 3000 rpm.
  - On the home screen, choose **Running** > **Device Details** > **Compressor** and check that the values of **Suction pressure** and **Discharge pressure** are within the normal ranges.
  - On the home screen, choose **Running** > **Device Details** > **EEV** and check that the value of **EEV suction superheat degree** is within the normal range.
  - Charge refrigerant from the low-pressure pipe needle. Ensure that the refrigerant is charged in small amount or charged now and then if possible. The total charge amount of refrigerant must meet the requirements.
  - On the **Diagnostic Mode** screen, change the compressor input to 0 RPM.

Outdoor Ambient Temperature	Proper Discharge Pressure Range (Running > Device Details > Compressor)	Proper Suction Pressure Range (Running > Device Details > Compressor)	Proper Suction Superheat Degree (Running > Device Details > EEV)
Below 15°C	1.5 MPa–2.5 MPa	0.7 MPa–1.2 MPa	8°C–15°C
15°C–35°C	1.5 MPa–3.1 MPa		
35°C–45°C	2.5 MPa–3.8 MPa		
Above 45°C	3.1 MPa–4.15 MPa		

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Quiz

1. (Single Choice)When the compressor of NetCol5000-A is started for the first time, the crankcase heating tape needs to be preheated for more than ( ) hours.

   A. 12

   B. 8

   C. 24

   D. 10

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- Answer:A

Summary

- This chapter describes the following aspects:
  - NetCol5000-A042 Installation and Commissioning Key Points;
  - Startup Wizard Commissioning.

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Thank you.

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每个组织，构建万物互联的智能世界。

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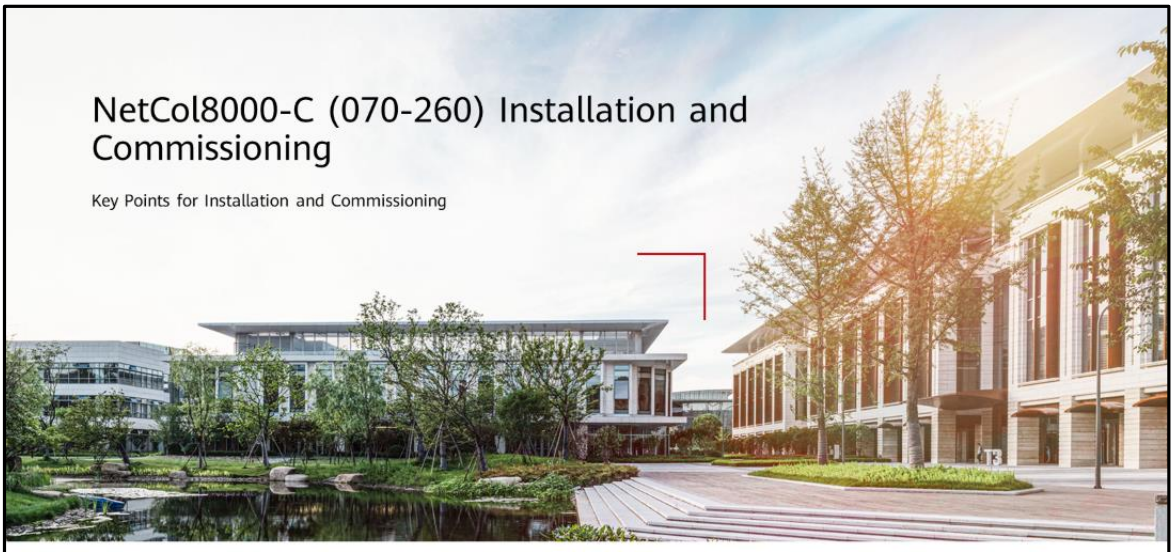
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NetCol8000-C (070-260) Installation and Commissioning

Key Points for Installation and Commissioning



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Foreword

- The slides describe the key points for installing the NetCol8000-C and the power-on commissioning procedure.

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Objectives

On completion of this course, you will be able to:

- Master the key points for installing the NetCol8000-C;
- Master the commissioning procedure of the NetCol8000-C.

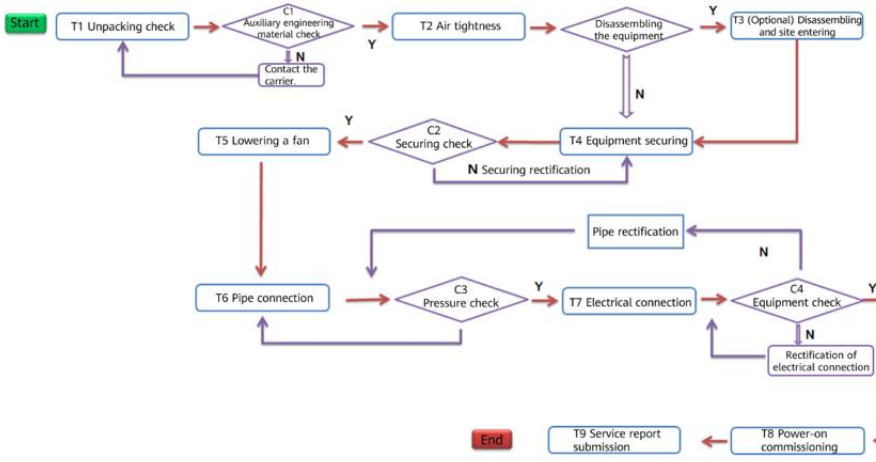
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Contents

1. Installation and Commissioning Overview
2. Key Installation Points
3. Commissioning Procedure

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Installation and Commissioning Process



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- 1281 rule (TCR):12 standard steps (Task); 8 quality control points (Check); 1 commissioning and acceptance report (Report)

Contents

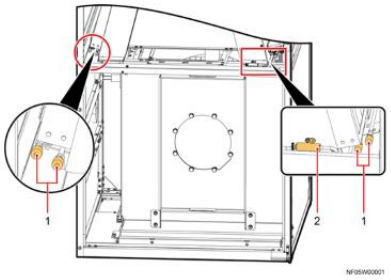
1. Installation and Commissioning Overview
2. **Key Installation Points**
3. Commissioning Procedure

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- Install controls, air ducts, and drainage ditches.

Pre-installation Check

- Check the air pressure.
  - Check whether the bonnets of the needle valves shown in the right figure are available. If yes, remove each bonnet and press the valve plug using the bonnet. If air is exhausted, the system is normal. If no air is exhausted, the system leaks.
- Follow-up procedure
  - Unscrew the fan maintenance baffle plate from the cabinet and remove the desiccant bag inside the cabinet.
  - Check that thermal insulation foam is in close contact with the pipes, there is no crack in each cutting position, and the chilled water valve is tightly wrapped by thermal insulation foam.



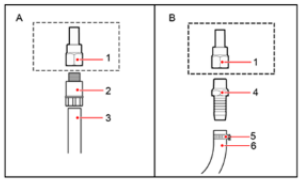
Needle valve positions

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- The device has been injected with 0.3–0.5 MPa nitrogen before delivery. Check the air pressure to determine whether the device leaks.

Materials (1)

- Humidifier water inlet pipe and drainpipe
- Connect the pipes as follows:
  - Rigid pipe connection: Prepare rigid pipe connectors and rigid pipes shown by components 1 and 2 in method A in the following figure.
  - Hose connection: Prepare pagoda connectors and hoses shown by components 4 and 6 in method B in the following figure.
- The drainpipe is routed from the bottom and connected using 3/4 inch internal threads.



Connection of the water inlet pipe of the humidifier

(1) Internal thread connector: G 1/2 inch; delivered with the water inlet pipe	(2) Rigid pipe conversion adapter: G 1/2 inch; connected to a rigid pipe with outer screw threads
(3) Rigid pipe: made of PP-R or other materials	(4) Pagoda connector: G 1/2 inch; connected to a pipe with external screw threads
(5) Hose clamp	(6) Hose: made of EPDM or other materials

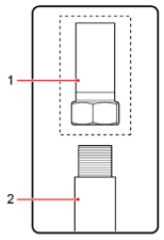
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- Pay attention to the difference between pipe diameters.

Materials (2)

- Materials – chilled water inlet and outlet pipes
  - Chilled water inlet and outlet pipes are routed from the bottom, as shown in the right figure.
  - The port in the dotted box is on the device, and component 2 needs to be purchased.

Connecting water inlet and outlet pipes

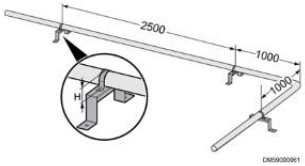


(1) G 2 inch thread connection (reserved device port)
(2) DN50 seamless steel pipe with external threads (engineering purchase)

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Materials (3)

- The following figure shows the supports for the chilled water pipe. The shape of the supports may vary with site situation.
- Note:
  - The height of a U-shaped pipe clamp equals to the pipe diameter with thermal insulation foam minus 5 mm. The pipe supports are to be purchased by the customer.
  - 304 stainless steel is recommended for pipe supports and clamps.
  - Install a support every 2500 mm in the straight sections of pipes, and 1000 mm away from each bending point in the turning section.



Cable Requirements (1)

- Specifications of cables matching the C16A switch

Application Scenario	Name	Technical Requirement	Remarks
Indoor unit	(Optional) Power cable	Electrical power cable, 600 V/1000 V, ZA-RVV, 5 x 2.5 mm^2, black (five cores: red, yellow, green, blue, black), 27 A, outdoor cable, CE	The length depends on site survey. Dual power supplies: 2 PCS; single power supply: 1 PCS There is no neutral wire for the entire system input. Cut off the blue neutral wire onsite and wrap it with insulation tape.
	(Standard configuration) M6/OT terminal of the power cable	Bare crimping terminal, OT, 2.5 mm^2, M6, 27 A, tin plating, 16–14 AWG, blue	Delivered with the device
	(Standard configuration) Cord end terminal of the power cable	Bare crimping terminal, single-wire cord end terminal, 2.5 mm^2, 12.5 A, tin plating, insertion depth 12 mm, blue	Delivered with the device
Teamwork control cable	(Standard configuration) Standard network cable	Signal cable, shielded straight through cable, 10 m, MP8-II, CC4P0.5GY(S), MP8-II, FTP	1 PCS (10 m)

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Cable Requirements (2)

- Specifications of cables matching the C25A switch

Application Scenario	Name	Technical Requirement	Remarks
Indoor unit	(Optional) Power cable	Electrical power cable, 600 V/1000 V, ZA-RVV, 5 x 4 mm^2, black (five cores: red, yellow, green, blue, black), 32 A, outdoor cable, CE	The length depends on site survey. Dual power supplies: 2 PCS; single power supply: 1 PCS There is no neutral wire for the entire system input. Cut off the blue neutral wire onsite and wrap it with insulation tape.
	(Standard configuration) M6/OT terminal of the power cable	Bare crimping terminal, OT, 6 mm^2, M6, 50 A, tin plating, 12–10 AWG, yellow	Delivered with the device
	(Standard configuration) Cord end terminal of the power cable	Bare crimping terminal, single-wire cord end terminal, 4 mm^2, 20 A, insertion depth 10 mm, gray	Delivered with the device
Teamwork control cable	(Standard configuration) Standard network cable	Signal cable, shielded straight through cable, 10 m, MP8-II, CC4P0.5GY(S), MP8-II, FTP	1 PCS (10 m)

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Cable Requirements (3)

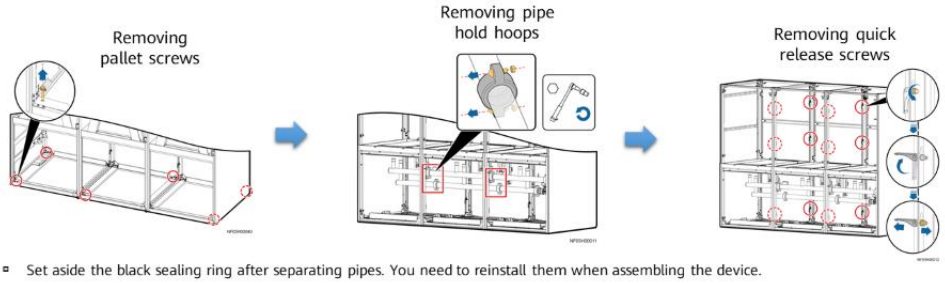
- Specifications of cables matching the C40A/C50A switch

Application Scenario	Name	Technical Requirement	Remarks
Indoor unit	(Optional) Power cable	Electrical power cable, 600 V/1000 V, ZA-RVV, 5 x 6 mm^2, black (five cores: red, yellow, green, blue, black), 46 A, outdoor cable, CE	The length depends on site survey. Dual power supplies: 2 PCS Single power supply: 1PCS There is no neutral wire for the entire system input. Cut off the blue neutral wire onsite and wrap it with insulation tape.
	(Standard configuration) M6/OT terminal of the power cable	Bare crimping terminal, OT, 6 mm^2, M6, 50 A, tin plating, 12–10 AWG, yellow	Delivered with the device
	(Standard configuration) Cord end terminal of the power cable	Common terminal, single-wire cord end terminal, 6 mm^2, length 20 mm, 30 A, insertion depth 12 mm, black	Delivered with the device
Teamwork control cable	(Standard configuration) Standard network cable	Signal cable, shielded straight through cable, 10 m, MP8-II, CC4P0.5GY(S), MP8-II, FTP	1 PCS (10 m)

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Key Installation Points - Disassembling the Device

- Disassemble the device.

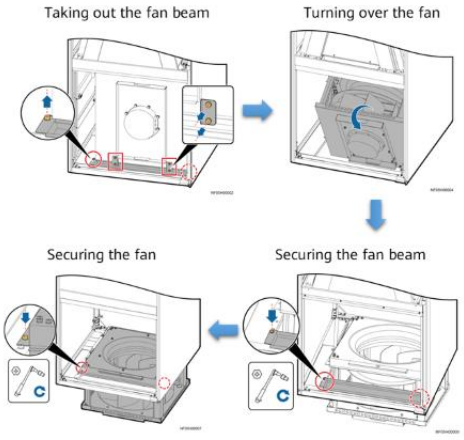


- Set aside the black sealing ring after separating pipes. You need to reinstall them when assembling the device.
- Set aside the removed screws, hold hoops, and thermal insulation foam, for they will be used during device assembling.
- Attach the thermal insulation foam to pipe joints after water is injected and air is exhausted.
- Every two modules are connected by eight quick release screws, four on the front door and four on the rear door.
- Connect the fan power cable and signal cable, and then bind them using cable ties. The marks on the terminals should remain the same before and after the disassembling.

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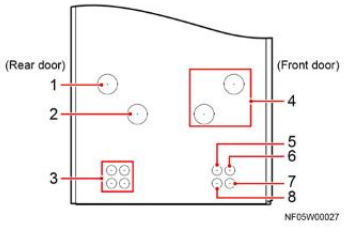
Key Installation Points - Lowering the Fan

- Key points:
  - Open the front door.
  - Unscrew and remove the fan maintenance baffle plate.
  - Remove the screws securing the fan to the fan beam, remove screws securing the fan to the cabinet, and remove the fan beam.
  - Turn the fan to 45 degrees to the device bottom, push the fan along the guide rails at both sides, and press down the fan until it is leveled.
  - Place the beam under the fan, and secure the beam to the device using screws.
  - Secure the fan to the device using screws.



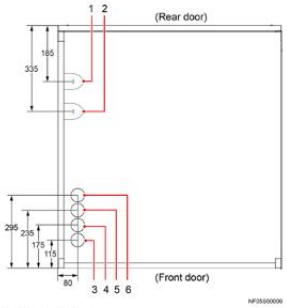
Key Installation Points - Positioning Holes for the Unit

Holes in the side plate



(1) Chilled water inlet pipe hole
(2) Chilled water outlet pipe hole
(3) Reserved
(4) Drainpipe hole
(5) Power cable hole
(6) Signal cable hole
(7) Humidifier's water inlet pipe hole
(8) Reserved

Holes in the bottom plate

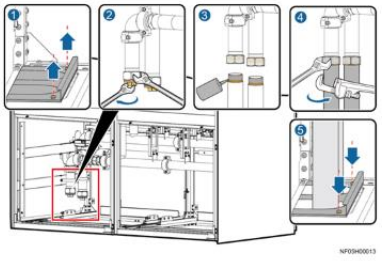


(1) Chilled water inlet pipe hole
(2) Chilled water outlet pipe hole
(3) Power cable hole
(4) Signal cable hole and the hole for the pressure tube of the micro differential pressure sensor
(5) Humidifier's water inlet pipe hole
(6) Drainpipe hole

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Key Installation Points - Connecting Chilled Water Pipes

- Connecting chilled water pipes – bottom pipe routing
  - Remove the baffle plate at the bottom of the device, and knock out the baffle plate U-shaped holes.
  - Clamp the pipe nut using a 75# open-end wrench, clamp the plug using a 36# open-end wrench, and remove the pipe plug from the water inlet pipe (to avoid deforming the pipe).
  - Apply screw thread sealant evenly on external screw threads of external pipes, and install the pipes from inside out.
  - Use a 75# open-end wrench and 18# pipe wrench to fix the pipe.
  - Install the pipe baffle plate at the bottom of the device, and wrap the pipe with thermal insulation foam.

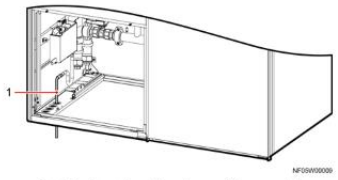


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- Note:
- Wrap thermal insulation foam around the whole pipes after pipes are connected.
- Due to the hardening property of yellow adhesive, water injection and pressure preserve should be operated 8 hours after the adapter is connected.

Key Installation Points - Connecting Other Pipes

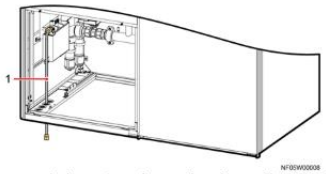
Drainpipe



1. Drainpipe (not configured)

The drainpipe must have gradients (1:100 is recommended), but no trap is allowed.
The entire drainpipe should be closely wrapped with thermal insulation foam.
Port reserved in the device: 3/4 inch port with internal threads
Onsite connection: 3/4 inch port connected to a PPR rigid pipe through external threads

Water inlet pipe of the humidifier



2. Water inlet pipe (standard configuration)

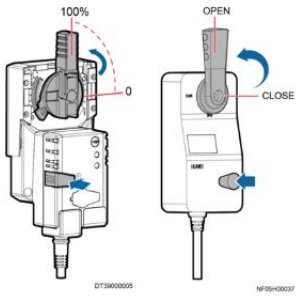
Install a stop valve at the inlet for convenient maintenance.
Port reserved in the device: G 1/2 inch port with internal threads
Onsite connection: Connect a pipe with a G 1/2 inch port and external threads to the port reserved in the device. A stop valve needs to be installed at the water inlet for convenient maintenance. The water pressure should be in the range of 100–700 kPa. The water should be free from large particles.

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Key Installation Points - Water Injection and Pressure Preservation

- Key points for water injection and pressure preservation
  - Open the general water supply valve.
  - Press the button on the side of the actuator, manually rotate the valve handle to the maximum (100% or OPEN), and check that the chilled water valve is open.
  - Slowly open the exhaust valve to let out air.
  - Adjust the air exhausting speed until no air flows out of the valve. Then close the exhaust valve.
  - Raise the water pressure in the chilled water pipe to 0.8 MPa. If no leakage occurs after 30 minutes, preserve the pressure for 24 hours. If the pressure drop is less than 0.01 MPa and there is no leakage, the pipe does not leak.
  - Release the pressure in the pipes, and manually close the chilled water valve.

Opening the chilled water valve



Purchased water valve

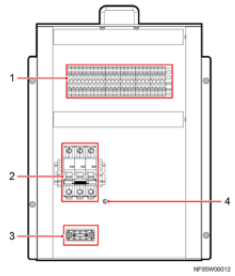
Huawei-developed water valve

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Key Installation Points - Electrical Ports

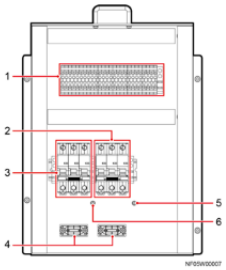
- Electrical port difference

External ports of a connection box with single power supply



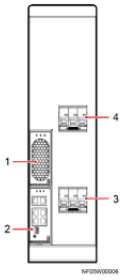
(1) Signal terminal block
(2) Active power supply QF1
(3) Cable clamp
(4) Ground screws

External ports of a connection box with dual power supplies



(1) Signal terminal block
(2) Standby power supply QF2
(3) Active power supply QF1
(4) Cable clamp
(5) Standby power supply ground screw
(6) Active power supply ground screw

External ports of the electric control box



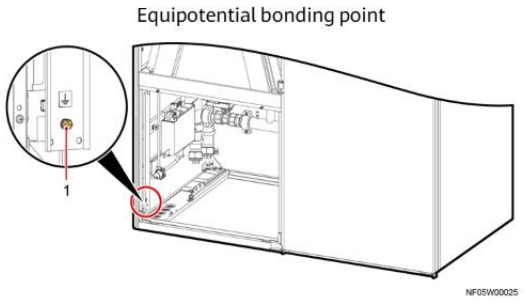
(1) Power module
(2) Main control module
(3) Electric heater switch QF3
(4) Fan switch QF4

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- Cables must be routed in through the cable clips.
- There is no neutral wire for the entire system input. Cut off the blue neutral wire onsite and wrap it with insulation tape.

Key Installation Points - Equipotential Bonding Point

- Route a ground cable from the equipotential bonding point of the device to the nearest ground point.

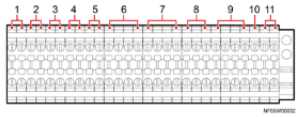


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Key Installation Points - Connecting Signal Cables (1)

- Connecting the signal cable

Wiring terminal block

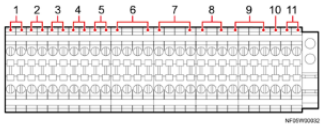


No.	Terminal Definition	Function
1	Smoke sensor wiring terminal	24 V, two lines, photoelectric smoke sensor. The signal output cables for reporting smoke alarms are connected to terminals X2.1 and X2.2. Install the smoke sensor as specified. The NetCol8000-C generates an alarm when a fire occurs.
2	Remote startup and shutdown wiring terminal	Terminals X2.3 and X2.4 can be set to remotely shut down a NetCol8000-C. Specifically, the control signal cable is routed from the ports to the monitoring room and controls the shutdown of the NetCol8000-C. The terminals are disconnected before delivery. The emergency switch for remote start/shutdown should be normally opened.
3	Common alarm 1 wiring terminal	Connects to the alarm dry contact output. When **DO associated alarm** is set to **Critical&major ALM**, the NetCol8000-C issues an alarm if a major alarm occurs. Normally Open signal dry contact output. Connection to an outdoor device is forbidden.
4	Common alarm 2 wiring terminal	Connects to the alarm dry contact output. When **DO associated alarm** is set to **Smoke&water only**, the NetCol8000-C issues an alarm if a smoke or water alarm occurs. Connects to the alarm dry contact output. When **DO associated alarm** is set to **Critical&major ALM**, the NetCol8000-C issues an alarm if a major alarm occurs. Normal Open signal dry contact output. Connection to an outdoor device is forbidden.
5	Water leakage sensor wiring terminal	Terminals X2.9 and X2.10 are connected to the water leakage sensor. When water leakage occurs, the NetCol8000-C generates an alarm.

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Key Installation Points - Connecting Signal Cables (2)

Wiring terminal block



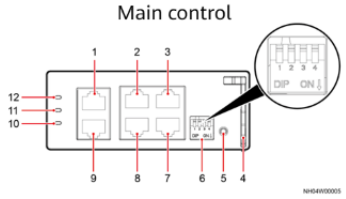
No.	Terminal Definition	Function
6	Fresh air damper YV1 wiring terminal	Terminals X2.11–X2.14 are connected to the fresh air damper actuator to control the opening of the fresh air damper. It is used together with the return air damper YV2 and the fresh air function needs to be enabled.
7	Return air damper YV2/Motorized damper YV3 wiring terminal	Return air damper YV2: Terminals X2.15–X2.18 are connected to the return air damper actuator to control the opening of the return air damper. It is used together with the fresh air damper. The fresh air needs to be enabled. Motorized damper YV3: Terminals X2.15–X2.18 are connected to the motorized damper actuator. The motorized damper needs to be enabled. Note: Use either the fresh air damper or the motorized damper.
8	Differential pressure sensor wiring terminal	Terminals X2.19–X2.21 are connected to the differential pressure sensor. The fan works in pressure control mode based on the data detected by the differential pressure sensor.
9	Water valve actuator wiring terminal	Terminals X2.22–X2.25 are connected before delivery, and do not need to be connected onsite.
10	Reserved 24 V DC wiring terminal	X2.26 is reserved.
11	Differential pressure switch terminal of the fresh air filter	Terminals X2.27–X2.28 are connected to the differential pressure switch of the fresh air filter to generate alarms when the fresh air filter is blocked.

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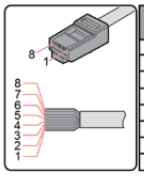
Key Installation Points - Monitoring Networking

- Teamwork networking and monitoring

Main control



If there is a need to prepare network cables onsite, refer to the following figure.



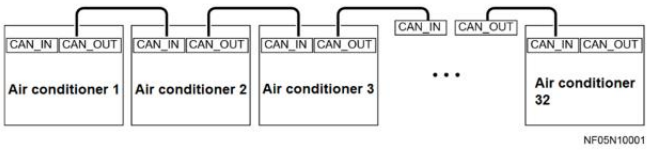
PIN	Color	CAN Teamwork Cable Signal Attribute	Northbound RS485 Signal Attribute	FE Network Cable Signal Attribute
1	White-orange	RS-485 T+(D+)	RS-485 T+(D+)	FE_TX+
2	Orange	RS-485 T- (D-)	RS-485 T- (D-)	FE_TX-
3	White-green	Reserved	Reserved	FE_RX+
4	Blue	RS-485 R+	RS-485 R+	Reserved
5	White-blue	RS-485 R-	RS-485 R-	Reserved
6	Green	Reserved	Reserved	FE_RX-
7	White-brown	CANH	Reserved	Reserved
8	Brown	CANL	Reserved	Reserved

NH07Z00001

(1) FE_1 (reserved)
(2) CAN_IN (input port of the teamwork CAN and northbound RS485 ports)
(3) RS485/12V (T/H module port)
(4) Main control module handle
(5) SW (reserved)
(6) DIP switch
(7) COM (northbound RS485 port)
(8) CAN_OUT (output port of the teamwork CAN and northbound RS485 ports)
(9) FE_2 (for FE teamwork)
(10) Alarm indicator
(11) Running indicator
(12) Power indicator

Key Installation Points - CAN Networking

- In CAN networking, one teamwork network supports a maximum of 32 air conditioners. The following figure shows the teamwork cable connections for 32 air conditioners.



DIP Switch	Default Value	Site Operations
1	OFF	Retain the default OFF state.
2	ON	When northbound RS485 hand-in-hand monitoring is used and there are more than four air conditioners, you need to turn on the monitoring group switch. Set DIP switches 2 and 3 to OFF.
3	ON	
4	OFF	This DIP switch controls the function of restoring factory defaults.

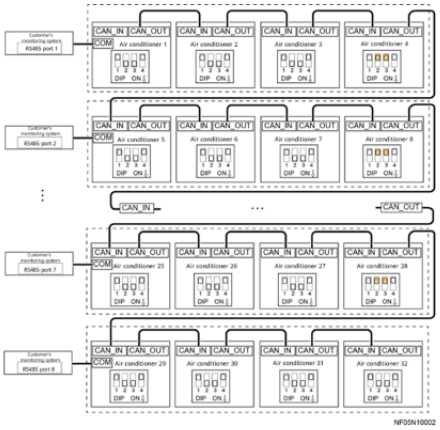
Principles of DIP switch settings

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- Set DIP switches 2 and 3 for the last air conditioner of each group (namely, air conditioner 4, air conditioner 8, ..., air conditioner 28) both to OFF, except the air conditioner 32. Retain the default settings of other DIP switches.

Key Installation Points - CAN Networking

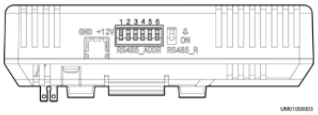
- When the host monitors air conditioners over northbound RS485 ports, it takes 3 seconds to collect all data of a single air conditioner. Therefore, the time required for collecting data from air conditioners in a group is 3 x *N* seconds.
- If the host needs more time to collect data from all air conditioners than what the host performance requires, the air conditioners can be grouped for data collection.
- For example, if the host needs to complete data collection in 12 seconds, you can group air conditioners by four. Connect the COM port of the main control module of the first air conditioner in each group to the RS485 port of the host.



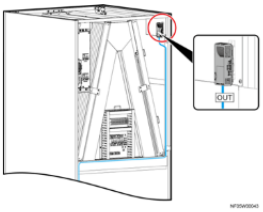
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Key Installation Points - Connecting a T/H Sensor Outside the Cabinet

Temperature and humidity (T/H) sensor



T/H sensor cable routing



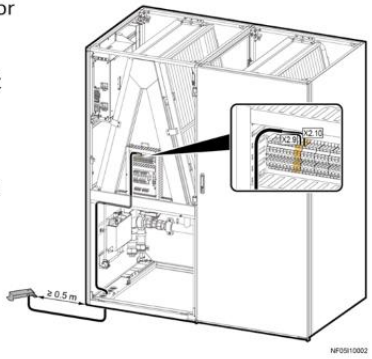
Location	Display Name	Address	DIP Switch SN					
			1	2	3	4	5	6
Air return side	Air return T/H sensor 1	1	ON	OFF	OFF	OFF	OFF	OFF
Cold aisle	Cold aisle T/H sensor 1	11	ON	ON	OFF	ON	OFF	OFF
	Cold aisle T/H sensor 2	12	OFF	OFF	ON	ON	OFF	OFF
	Cold aisle T/H sensor 3	13	ON	OFF	ON	ON	OFF	OFF
Hot aisle	Hot aisle T/H sensor 1	21	ON	OFF	ON	OFF	ON	OFF
	Hot aisle T/H sensor 2	22	OFF	ON	ON	OFF	ON	OFF
	Hot aisle T/H sensor 3	23	ON	ON	ON	OFF	ON	OFF
Direct ventilation	Fresh air T/H sensor	29	ON	OFF	ON	ON	ON	OFF
	Return air damper T/H sensor	27	ON	ON	OFF	ON	ON	OFF

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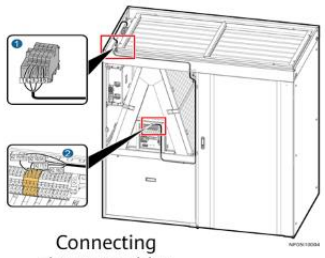
- The T/H sensors should be installed 1.5 m above the ground, and secured using cable ties or other materials.
- Keep the last RS485_R DIP switch at OFF.
- After the addresses are set, choose Settings > System Settings > T/H Sensor on the home screen and set the sensors in the aisles corresponding to the addresses to Enable. Otherwise, the sensors will not work.

Key Installation Points - Water Detection Module

- Key installation points
  - Connect one end of the two-core cable for the water leakage sensor to the water detection module.
  - Route the cable through the cable hole at the bottom, and route it along the post and beam of the device through the cable trough under the electric control box.
  - Connect the other end of the two-core cable to terminals X2.9 and X2.10 on the terminal block.
  - Secure the water leakage sensor using cable ties.

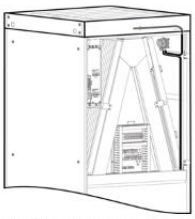


Key Installation Points - Connecting the Motorized Damper



Connecting damper cables

Securing the pressure tube



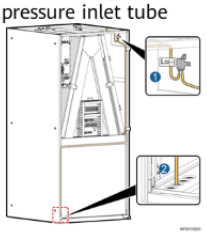
- Remove the differential pressure tube from the beam at the top of the unit before installing the damper.
- Secure the air damper on the top of the unit.
- Route the removed pressure tube of the differential pressure switch through the cable hole in the blocked damper, and secure the tube to the mounting plate of the damper using cable ties.
- Choose **Settings** > **System Settings** > **Common Settings** on the LCD screen, and set **Motorized damper** to **Enable**.

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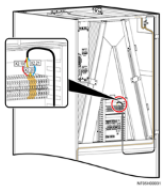
Key Installation Points - Installing Pressure Inlet Tubes

- Secure the differential pressure sensor inside the cabinet using two M3 screws, with the pressure inlet tube port facing downwards.
- Connect the shorter PU hose to the Lo (-) port above the differential pressure sensor, and secure the hose to the air return side using cable ties. (The pressure inlet is suggested to be at the middle of the unit shown in the figure. There should be two binding points adjacent to the pressure inlet. The distance between the binding point closer to the pressure inlet and the pressure inlet should not exceed 25 mm, and the distance between two binding points should be within 20–30 mm.)
- Connect the longer PU hose to the port without the Lo (-) silk screen under the differential pressure sensor, and route the hose to the outside through the cable hole at the bottom of the device. (You are advised to bind the pressure inlet to the base closest to the air conditioner at 1/2 height of the raised floor under the air supply vent, with hose end facing downwards. For details about securing the PU hose, refer to the binding requirements in step 2.)
- Connect cables to the differential pressure sensor.
- Install the fan maintenance baffle plate.

Installing a pressure inlet tube



Connecting the cable



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Post-installation Check

Item	Content	Result
Device	The device is installed properly without any tilt.	☐ Passed ☐ Failed
	The device is secured to the support using bolts.	☐ Passed ☐ Failed
	The foreign matter inside the device such as cable ties and cable cuts is cleaned up.	☐ Passed ☐ Failed
(Optional) Electric heater	The electric heater is secured reliably and steadily.	☐ Passed ☐ Failed
(Optional) Wet film humidifier	The water inlet solenoid valve is secured reliably and steadily.	☐ Passed ☐ Failed
	The humidifier pump is secured reliably and steadily.	☐ Passed ☐ Failed
	The wet film humidifier is secured reliably and steadily.	☐ Passed ☐ Failed
	The humidifier float is secured. The sheet metal fasteners for the humidifier float are secured.	☐ Passed ☐ Failed
	Pipes are connected securely without leakage.	☐ Passed ☐ Failed
Fan	Fans of a downflow unit are lowered and secured to the bottom plate of the cabinet.	☐ Passed ☐ Failed
	There is no foreign matter inside the fan.	☐ Passed ☐ Failed
Air filter	The air filter is correctly installed according to the airflow direction marked on the frame.	☐ Passed ☐ Failed
Differential pressure switch	The cable ties are securely tightened around the pressure inlet tube.	☐ Passed ☐ Failed
	There is no foreign matter in the pressure inlet tube. The pressure inlet tube shows no obvious bending.	☐ Passed ☐ Failed

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Post-installation Check (1)

Item	Content	Result
Chilled water valve	The chilled water valve and its actuator are secured reliably and steadily.	☐ Passed ☐ Failed
	The chilled water connector joints have been tightly wrapped with thermal insulation foam, and no metal or hose is exposed.	☐ Passed ☐ Failed
	Cables are securely connected to the chilled water valve and its actuator.	☐ Passed ☐ Failed
Exhaust valve	The exhaust valve is closed.	☐ Passed ☐ Failed
Drainage valve	The drainage valve is closed.	☐ Passed ☐ Failed
Pipe connection	Water has been filled and air has been exhausted.	☐ Passed ☐ Failed
	The hose clamp and cable ties of the condensate drainpipes are secured.	☐ Passed ☐ Failed
	The water inlet and outlet pipes are properly installed and secured without leakage.	☐ Passed ☐ Failed
	The water inlet and outlet pipes are routed smoothly and are not bent by a large angle.	☐ Passed ☐ Failed
	The drainpipe has a gradient (1:100 is recommended).	☐ Passed ☐ Failed
Electrical connection	The power supply voltage is the same as the rated voltage on the equipment nameplate.	☐ Passed ☐ Failed
	Cables are intact.	☐ Passed ☐ Failed
	No open or short circuit, or incorrect connection occurs in electrical loops.	☐ Passed ☐ Failed
	Power cables, signal cables, and communications cables are properly connected.	☐ Passed ☐ Failed
	The rated values of circuit breakers are correct.	☐ Passed ☐ Failed
	Relevant control cables are properly connected.	☐ Passed ☐ Failed
	All cables, connectors, and screws are secured.	☐ Passed ☐ Failed

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Post-installation Check (2)

Item	Content	Result
(Optional) Differential pressure sensor	The cable ties are securely tightened around the pressure inlet tube.	☐ Passed ☐ Failed
	There is no foreign matter in the pressure inlet tube. The pressure inlet tube shows no obvious bending.	☐ Passed ☐ Failed
	The differential pressure sensor is secured reliably and steadily.	☐ Passed ☐ Failed
	Cables are connected reliably and steadily.	☐ Passed ☐ Failed
(Optional) Motorized/Gravity damper	The damper and cabinet are secured reliably and steadily by bolts as required.	☐ Passed ☐ Failed
	(Only for motorized dampers) Cables to the damper actuator are securely connected.	☐ Passed ☐ Failed
(Optional) Water detection module	Cables to the water detection module are connected correctly and securely.	☐ Passed ☐ Failed

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1. Installation and Commissioning Overview
2. Key Installation Points
3. **Key Commissioning Points**

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Key Commissioning Points - Preparation Before Power-On

- Preparing before power-on
  - There is no phase sequence requirement for the cable connection to the device. If a five-core cable is used, cut off the neutral wire and wrap it using insulation tape.
  - Check that the AC/DC auxiliary power module and main control module are inserted properly and the latches are locked.
  - Check that the fan is lowered.
  - Check that the fan switch QF4 and electric heater switch QF3 (optional) are turned on and the device is properly grounded.
  - Verify that the input voltage meets the requirements.
  - Verify that the indoor unit power cable is connected properly.
  - Check that the water detection module has been installed.
  - If teamwork networking is required, check that the teamwork control cables are connected correctly.
  - Verify that the cable connections and DIP switch settings of the T/H sensors are correct.
  - Turn on the general switch. For a device that has two power inputs, turn on the active power switch QF1 and standby power switch QF2.

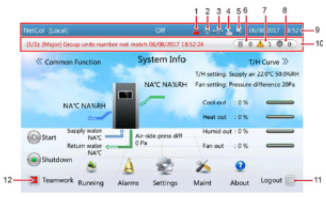
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Key Commissioning Points - Device Power-On

- Device power-on
  - Turn on the general switch, fan switch QF3, and electric heater switch QF4. For a device that has two power supplies, turn on the active power switch QF1 and standby power switch QF2.
  - After the display starts, set the language, date, time, time zone, and monitoring mode on the **Quick Settings** screen.
  - Set system parameters, communications parameters, and teamwork control parameters based on site requirements. For details, see instructions for power-on commissioning.
  - If a motorized damper is configured, choose **Settings** > **System Settings** > **Common Settings** and set **Motorized damper** to **Enable** after power-on.
  - If a differential pressure sensor is configured, after power-on, choose **Settings** > **System Settings** > **Common Settings**, and set **Air-side difference pressure sensor type** to 0–500 Pa.



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Main Screen

No.	Option	Remarks
1	Communication status between the display panel and the main control board	indicates that the display panel communicates properly with the main control board. If is displayed in this position in the status bar, the communication is abnormal.
2	USB connection status	indicates that a USB flash drive is connected to the USB port on the display panel.
3	Diagnostic mode	indicates that the system is in diagnostic mode. You can tap the icon to exit the diagnostic mode.
4	Buzzer state	The buzzer can be enabled or disabled. indicates that the buzzer is on. When the buzzer is on, it buzzes when an alarm is generated. When the buzzer is buzzing, you can tap anywhere on the screen to mute the buzzer. After the buzzer is muted, it buzzes again when a new alarm is generated. indicates that the buzzer is disabled. After the buzzer is disabled (muted), it does not buzz when an alarm is generated.
5	Critical alarms and the number of critical alarms	indicates the active critical alarms and the number of critical alarms.
6	Major alarms and the number of major alarms	indicates the active major alarms and the number of critical alarms.
7	Warnings and the number of warnings	indicates the active warnings and the number of warnings.
8	Status bar	-
9	Alarm bar	You can tap the icon on the alarm bar to go to the active alarm screen and view all active alarms.
10	Logout button	indicates that you have logged in to the system as user **admin**, and can tap the icon to log out.

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- Precautions
- Users are classified as user admin and user operator. User admin has more permissions than user operator. The preset password is 000001 for both types of users. To enter the diagnostic mode, you need to log in to the system as user admin.
- To prevent the effect of misoperation on the system, log in as user operator first before modifying parameters. Confirm with Huawei before modifying parameters which cannot be modified by user operator; otherwise, Huawei will not be liable for any consequences of the modification.
- The Service Expert app can be downloaded from Huawei app store and can run on Android.
- If optional components such as heaters or humidifiers are not configured, the system does not display the commissioning for the components, and you can skip the commissioning procedures.

Key Commissioning Points - Startup Wizard Commissioning (1)



1. On the home screen, choose **Maintenance** > **Wizard Startup**, and check the startup as prompted.



2. Tap **Yes** and enter the checking screen before startup.



3. Tap **Yes**. The commissioning screen is displayed. Select commissioning items based on the actual configuration. If no water is supplied to the humidifier, deselect **Humidifier commissioning**.



4. Tap **Yes** and enter the fan commissioning screen.



5. Commissioning succeeded.

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Key Commissioning Points - Check After Startup Wizard Commissioning

Item	Result
The thermal insulation foam of the copper pipes and the bottom plate is free of oil stains or has been cleaned.	☐ Passed ☐ Failed
The needle valve plug is secured (torque: 0.45 ± 0.05 N·m), and the valve bonnet is tightened.	☐ Passed ☐ Failed
The foreign matter on the drip pan and bottom plate is cleaned up.	☐ Passed ☐ Failed
The air filter is correctly installed according to the airflow direction marked on the frame.	☐ Passed ☐ Failed
The chilled water valve is closed.	☐ Passed ☐ Failed

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Quiz

1. (Multiple Choices)Which are optional parts of NetCol8000-C?
   A. Electric heater
   B. Differential pressure sensor
   C. Air filter
   D. Humidifier

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- Answer:abd

Summary

- This chapter describes the following aspects:
  - NetCol8000-C (070-260) Installation and Commissioning key points;
  - Startup Wizard Commissioning.

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Thank you.

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NetCol8000-E220 Installation and Commissioning

Key Points for Installation and Commissioning



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Foreword

- The slides describe the key points for installing the NetCol8000-E220 and the power-on commissioning procedure.

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Objectives

On completion of this course, you will be able to:

- Master the key installation and acceptance points of the NetCol8000-E220.
- Master the commissioning procedure of the NetCol8000-E220.

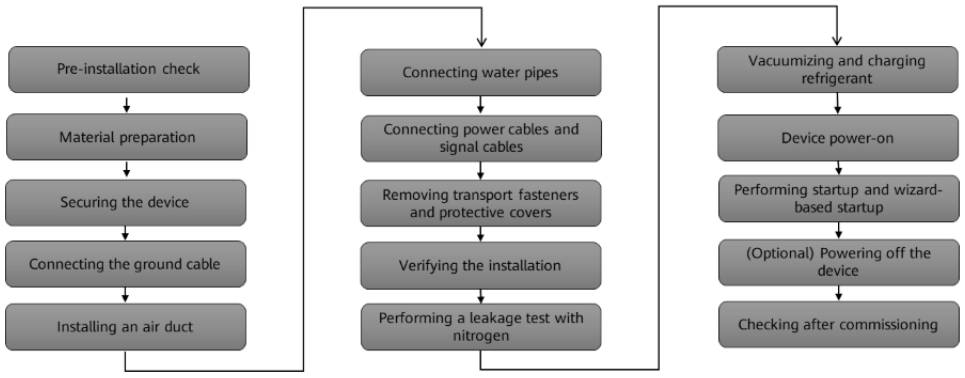
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Installation and Commissioning Process



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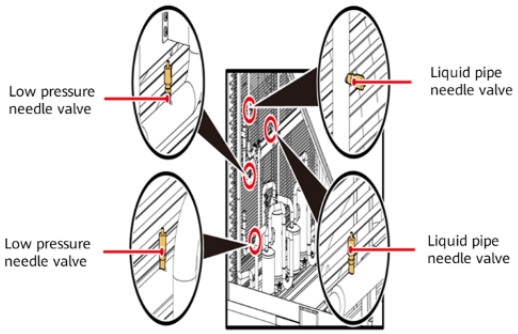
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2. **Key Installation Points**
3. Commissioning Procedure

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Pre-installation Check

- Check the air pressure of the DX system:
  - Check whether the bonnets of the needle valves shown in the right figure are available. If yes, remove each bonnet and press the valve plug using the bonnet. If air is exhausted, the system is normal. If no air is exhausted, the system leaks.



Needle valve positions

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Material Preparation (1)

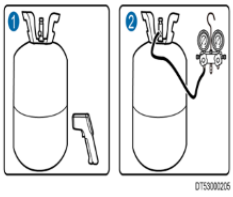
Name		Specifications	Remarks
Mandatory components	Water pipe	Spray water refill pipe: G 3/4 inch internal thread connector (DN20) Spray drainpipe: G 1-1/2 inch internal thread connector (DN40) Condensate drainpipe: G 3/4 inch internal thread connector (DN20)	Engineering purchase is required and specifications are determined based on engineering survey.
	Cable	Power cable (AC1/AC2/AC3): 70 mm^2 (L1/L2/L3/N), 2 PCS + 1 PCS (Generally, only AC1/AC2 is used. If the compressor needs to be powered separately, AC3 is required.)	Optional
		Ground cable: 35 mm^2, 2 PCS	Optional
		OT terminal: 35 mm^2, M10, 6 PCS	Standard; delivered with the product
		OT terminal: 70 mm^2, M10, 14 PCS	Standard; delivered with the product
		Cable tie: 10 PCS	Standard; delivered with the product
Optional components	Air duct	Dimensions (L x W x H): 5810 mm x 2020 mm x 800 mm	Optional
Tool		Marker, ink fountain, long leather measuring tape, crane, socket wrench, torque wrench, Phillips screwdriver, jack, steel hoisting rope, level, level gauge, hammer drill, angle ruler, claw hammer, vacuum cleaner, expansion bolt, and angle steel	

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- Three types of materials need to be prepared onsite: materials provided by Huawei, materials that can be purchased by the customer, and materials that need to be prepared onsite. Indications of Standard, Optional, and Engineering purchase in this document are as follows:
- Standard: standard configuration. This material is provided by Huawei, and you can find this material in the fittings delivered with the device.
- Optional: Customers can purchase this material from Huawei or other vendors. If you have ordered the material from Huawei, you do not need to purchase it elsewhere.
- Engineering purchase: This material will not be delivered by Huawei, and customers need to purchase it.

Material Preparation (2)

- R410A refrigerant from name brands such as DuPont, Daikin, and Honeywell are recommended. You can verify the refrigerant authenticity in the following ways:
  - Dial the refrigerant manufacturer's hotline to confirm the refrigerant authenticity.
  - Place the refrigerant tank indoors for 24 hours. Use a point thermometer to measure the external surface temperature of the refrigerant tank, as shown by (1) in the figure, and connect a pressure gauge to the tank to measure the internal pressure, as shown by (2) in the figure. Find the saturation pressure corresponding to the measured external surface temperature from the mapping table. If the deviation between the saturation pressure and the measured internal pressure is greater than 0.2 MPa, the refrigerant does not meet the requirements and needs to be replaced.



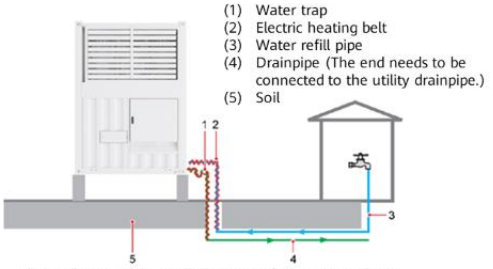
Refrigerant detection

R410A Saturation Pressure Table							
Saturation Temperature	Gauge Pressure	Saturation Temperature	Gauge Pressure	Saturation Temperature	Gauge Pressure	Saturation Temperature	Gauge Pressure
10° C	0.99 MPa	17° C	1.23 MPa	24° C	1.51 MPa	31° C	1.84 MPa
11° C	1.02 MPa	18° C	1.27 MPa	25° C	1.56 MPa	32° C	1.89 MPa
12° C	1.05 MPa	19° C	1.31 MPa	26° C	1.60 MPa	33° C	1.94 MPa
13° C	1.09 MPa	20° C	1.35 MPa	27° C	1.65 MPa	34° C	1.99 MPa
14° C	1.12 MPa	21° C	1.39 MPa	28° C	1.69 MPa	35° C	2.05 MPa
15° C	1.16 MPa	22° C	1.43 MPa	29° C	1.74 MPa	36° C	2.10 MPa
16° C	1.19 MPa	23° C	1.47 MPa	30° C	1.79 MPa	N/A	N/A

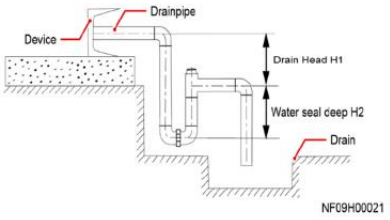
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Anti-freezing and Water Trap Requirements for Water Pipes

- In northern areas, the outdoor temperature may be lower than 0° C. Anti-freezing measures must be taken for the water inlet pipe and drainpipe.
- The water trap of a drainpipe must be designed and installed according to the requirements specified in the water trap installation diagram. The unit of P is Pa, which indicates the negative pressure inside the unit. When the device is under negative pressure: H1 = H2 ≥ P/10 + 20 mm.



Anti-freezing requirements for water pipes



Water trap requirements

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- The supply water pressure is 300–450 kPa. The external water supply equipment should be designed according to the maximum hourly water consumption in the design working conditions.
- The water is drained by gravity to the nearest floor drain (DN150 is recommended) and then to the outdoor wastewater pipe.
- In areas where the temperature is lower than 0° C in winter, wrap the outdoor part of the water inlet pipe and drainpipes with electric trace heaters and thermal insulation foam. In areas where the temperature may reach –20° C, the thermal insulation foam should be at least 30 mm thick. In areas where the temperature may reach –40° C, the thermal insulation foam should be at least 50 mm thick.
- When the device is running, the internal pressure of the device is negative (ranging from 500 Pa to 1000 Pa) because the fan blows outwards. Therefore, a water trap is required. If no water trap is available, some foreign matter will be sucked to the drip pan when no spray system is used in winter due to low temperature. A water trap is designed to prevent this from happening.
- Formula: water pressure P = ρ x g x h. Water density is 1000 kg/m3. Therefore, P/10 and 20 mm are the same dimension and can be directly added.

Key Installation Points - Connecting Power Cables

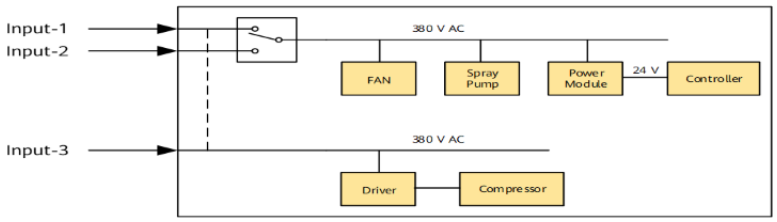


Figure 1 DX system powered by a single power supply

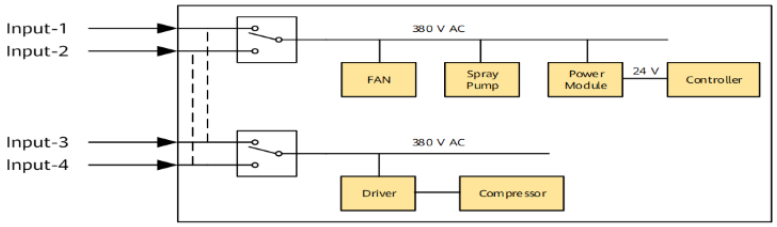


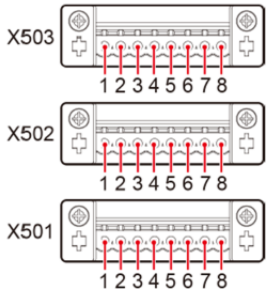
Figure 2 DX system powered by dual power supplies

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- Power cable (AC1/AC2/AC3): 70 mm2 (L1/L2/L3/N), 2 PCS + 1 PCS (Generally, only AC1/AC2 is used. If the compressor needs to be powered separately, AC3 is required.)
- The power supply for the compressor driver used for auxiliary cooling and that for fan/spray pump have different importance levels. Therefore, the two types of power supplies are separated. To reduce the number of UPSs and batteries, you do not need to install the UPS and batteries for the DX system in scenarios where continuous auxiliary cooling is not required.
- For a standard NetCol8000-E220, to ensure the availability of the active indirect heat exchange system, the FAN branch uses dual power supplies, and the DX branch uses a single power supply, as shown in Figure 1. In some scenarios where high availability is required, the DX branch can also use dual power supplies (customization required), as shown in Figure 2.

Key Installation Points - Connecting Signal Cables

External communication terminals for signals



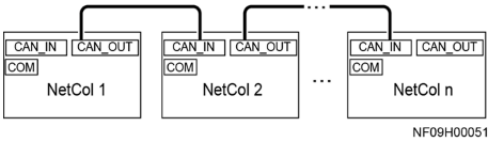
Communication terminal description

No.	X501	X502	X503
1	Smoke sensor power supply (12 V DC)	Water leakage detection - contact 1 (water leakage in the floor)+	RS485+ (calcium and magnesium ion detector and electricity meter)
2	Smoke sensor feedback	Water leakage detection - contact 1 (water leakage in the floor)–	RS485– (calcium and magnesium ion detector and electricity meter)
3	Port for remote startup and shutdown+	N/A	GND
4	Remote startup/shutdown–	N/A	12V+
5	Port 1 for reporting common alarms+	N/A	N/A
6	Port 1 for reporting common alarms–	N/A	N/A
7	Port 2 for reporting common alarms+	N/A	N/A
8	Port 2 for reporting common alarms–	N/A	N/A

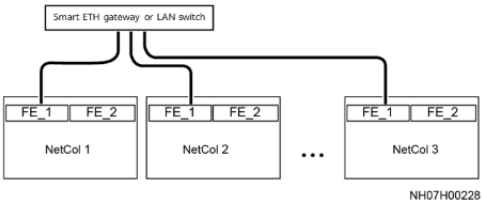
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Connecting Cables - Teamwork Control

- The unit supports two teamwork control networking modes: CAN (hand-in-hand) and FE.
- CAN teamwork networking mode: Connect the CAN_OUT port on the previous unit to the CAN_IN port on the next unit using a CAN teamwork network cable.
- FE teamwork networking mode: Connect one end of the FE network cable to the FE_1 or FE_2 port, and the other end to the LAN switch (or the PoE port on the smart ETH gateway).
- A teamwork network supports a maximum of 32 units connected in series. Any unit can be set as the master unit.



CAN teamwork networking (CAN protocol)

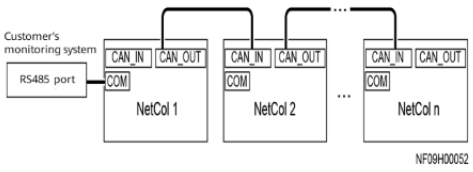


FE teamwork networking (MAC_CAN protocol)

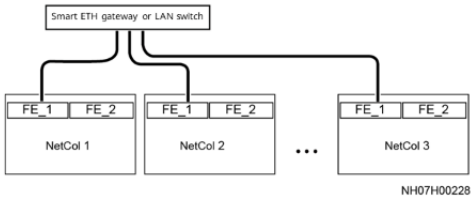
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Key Installation Points - Connecting Monitoring Cables

- The unit supports two monitoring modes: northbound RS485 and FE. Select either mode.
- Northbound RS485 monitoring mode: If teamwork or FE networking is not used, connect the COM port on each unit to the customer's monitoring system. In CAN networking, connect the COM port on the first device in each teamwork group to the monitoring device.
- FE monitoring mode: Connect one end of the monitoring network cable (standard network cable) to the FE_1 or FE_2 port on the main control module, and the other end to the monitoring device.



Northbound RS485 monitoring (Modbus_RTU protocol)

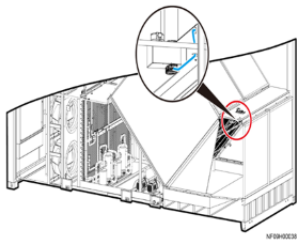


FE monitoring (Modbus_TCP protocol)

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(Optional) Key Installation Points - Connecting a T/H Sensor Outside the Cabinet

- Connect the T/H sensors outside the cabinet and the return air T/H sensor in series. The IN port on the return air T/H sensor has been connected to the main control board. When connecting the T/H sensors outside the cabinet, connect the OUT port on the return air T/H sensor to the IN port of the next T/H sensor outside the cabinet in series.
- Each unit supports a maximum of five cold aisle T/H sensors and five hot aisle T/H sensors. You need to set the DIP switches for the T/H sensors. The following table describes the settings.



Position of the humidity sensor

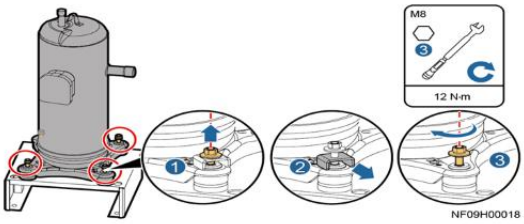
Location	Display Name	Address	DIP Switch No.					
			1	2	3	4	5	6
Air return side	Air return 2 T/H sensor	1	ON	OFF	OFF	OFF	OFF	OFF
Cold aisle	Cold aisle 1 T/H sensor	11	ON	ON	OFF	ON	OFF	OFF
	Cold aisle 2 T/H sensor	12	OFF	OFF	ON	ON	OFF	OFF
	Cold aisle 3 T/H sensor	13	ON	OFF	ON	ON	OFF	OFF
	Cold aisle 4 T/H sensor	14	OFF	ON	ON	ON	OFF	OFF
	Cold aisle 5 T/H sensor	15	ON	ON	ON	ON	OFF	OFF
Hot aisle	Hot aisle 1 T/H sensor	21	ON	OFF	ON	OFF	ON	OFF
	Hot aisle 2 T/H sensor	22	OFF	ON	ON	OFF	ON	OFF
	Hot aisle 3 T/H sensor	23	ON	ON	ON	OFF	ON	OFF
	Hot aisle 4 T/H sensor	24	OFF	OFF	OFF	ON	ON	OFF
	Hot aisle 5 T/H sensor	25	ON	OFF	OFF	ON	ON	OFF

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- After the addresses are set, power on the device, choose Settings > System Settings > T/H sensor on the LCD home screen, and set the sensors in the aisles corresponding to the addresses to Enable. Otherwise, the sensors will not work.

Key Installation Points - Removing Transport Fasteners or Protective Covers (1)

- Open maintenance door 2, loosen the transport fixing bolts of the two compressors using a 13# wrench, and remove the sheet metal fasteners.
- Tighten the bolts on the compressor using a torque wrench to a torque of 12 N·m.
- Keep the removed sheet metal fasteners properly for future transportation.

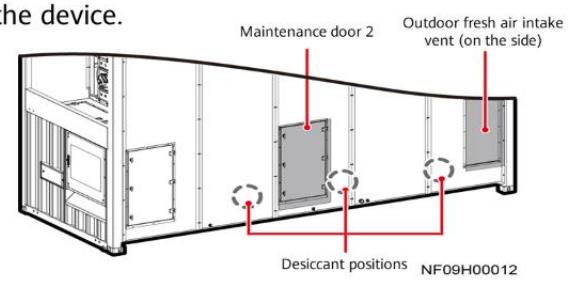


Removing the transport fasteners from the compressor

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Key Installation Points - Removing Transport Fasteners or Protective Covers (2)

- Take out the two desiccant bags from maintenance door 2.
- Remove the air filter from the outdoor fresh air intake vent and take out one desiccant bag from the device.

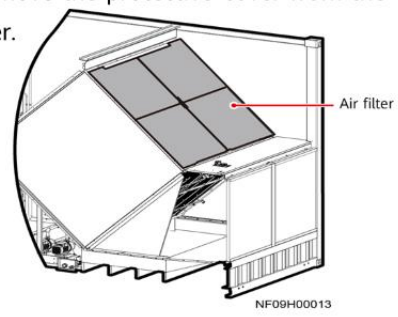


Desiccant positions

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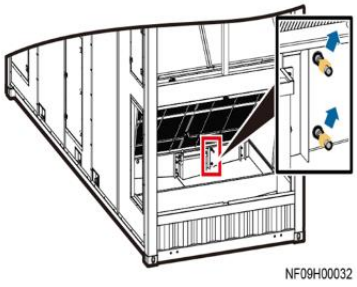
Key Installation Points - Removing Transport Fasteners or Protective Covers (3)

- Unscrew the air filter, remove the air filter, and remove the protective cover from the air filter.



Removing a protective cover

- Remove the elastic bands from the high and low liquid level floats.

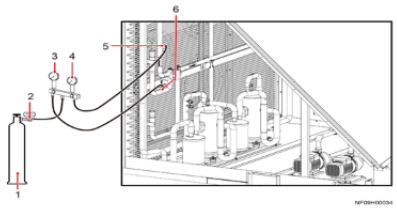


Removing elastic bands from floats

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Key Installation Points - Performing a Leakage Test with Nitrogen

- Connect the rubber hose, pressure gauges, reducing valve, and nitrogen cylinder to the device. The pressure gauges and reducing valve are closed.
- Open the pressure gauge and reducing valve to inject 3.0 MPa nitrogen (the outlet pressure of the reducing valve should not be greater than 3.0 MPa; otherwise, components may be damaged). Preserve the pressure for 24 hours. The system pressure should not decrease under the similar ambient temperature before and after the pressure preservation. If the ambient temperature changes greatly, you are advised to perform the pressure preservation test again.
- If the pressure decreases, use soapy water or a halogen leak detector to locate and repair the leakage points, especially at the welding joints, needle valves, and angle valves. If the pressure is well preserved, exhaust nitrogen from needle valves.



(1) Nitrogen cylinder (2) Reducing valve (3) Low pressure gauge

(4) High pressure gauge (5) Liquid pipe needle valve (6) Low pressure needle valve

Leakage test with nitrogen

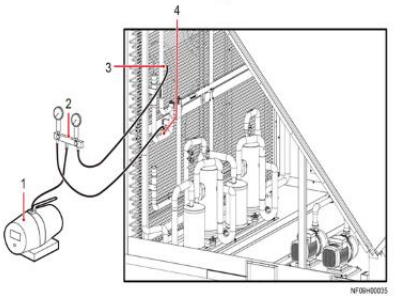
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- This product is a dual-system product. The leakage test with nitrogen should be performed for each system separately. The figure uses a single system as an example.
- All needle valve plugs must be available.
- The measuring range of a pressure gauge must be at least 4.0 MPa, and the rubber hose must withstand a pressure of at least 4.5 MPa.
- Only nitrogen can be used for pressure preservation and leakage detection.
- During pressure preservation, do not remove the rubber hose and pressure gauges; otherwise, nitrogen may leak.

Key Installation Points - Vacuumizing

- Connect the pressure gauge and vacuum pump at two positions, for example, the low pressure needle valve and liquid pipe needle valve, and start vacuumizing.
- Vacuumize the cooling system for at least 80 minutes after checking that the cooling system does not leak. The pressure displayed on the vacuum pump should be less than or equal to 60 Pa (absolute pressure). When the pressure stops dropping, pump for another 10 minutes, after which the sight glass should display green, a sign of dryness. If the minimum reading of the pressure gauge is greater than 60 Pa (absolute pressure), ensure that the pointer stays at the smallest scale of the pressure gauge during vacuumizing and preserve the pressure for 1 hour. Then check that the pressure does not increase greatly.
- After vacuumizing is complete, close all valves of the pressure gauge and the vacuum pump without disconnecting the pump, and preserve the pressure for 10 minutes. Ensure that the absolute pressure of the cooling system does not exceed 90 Pa (absolute pressure).

Vacuumizing



(1) Vacuum pump (2) Pressure gauge

(3) Liquid pipe needle valve (4) Low pressure needle valve

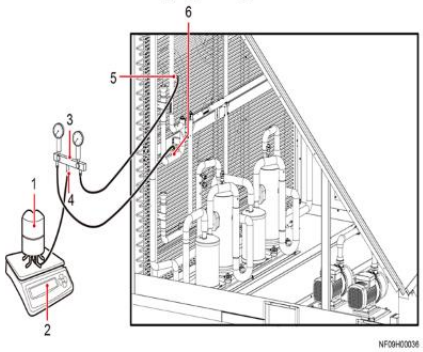
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- In the beginning, the vacuum pump makes loud noises and exhausts white smoke from the exhaust vent. After 10 minutes, if it still exhausts white smoke, observe it for another 10 minutes because the cooling system may not be sealed properly or there may be too much residual refrigerant or water in the cooling system.
- After 20 minutes, the pressure gauge pointer should be in the negative area and the vacuum pump makes small noises. Close and open the pressure gauge alternatively for several times. The position of the pressure gauge pointer and the noises made by the vacuum pump do not change. Otherwise, the cooling system may not be sealed properly.

Key Installation Points - Precharging Refrigerant

- Take off the vacuum pump from the vacuumizing device, and replace the vacuum pump with a refrigerant cylinder.
- Slightly open the refrigerant cylinder valve and slightly loosen the connection nut of the pressure gauge and rubber tube. Tighten the nut when cold air escapes out of the nut.
- Put the refrigerant cylinder upside down on the electronic balance. Clear the reading on the balance.
- Open the pressure gauge valves and refrigerant cylinder valve shown in the figure to charge refrigerant.
- 5 kg refrigerant needs to be charged for each system. If refrigerant is not charged to the total amount during precharging, charge the remaining amount of refrigerant during power-on commissioning
- After the refrigerant is charged, close all pressure gauge valves and the refrigerant cylinder valve.

Precharging refrigerant



(1) Nitrogen cylinder (2) Electronic balance (3) Pressure gauge

(4) Connection nut (5) Liquid pipe needle valve (6) Low pressure needle valve

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- Tighten the needle valve bonnets when the charge is complete. Check whether a needle valve leaks by applying soap bubbles to the valve vent or using a halogen leak detector. If it leaks, contact Huawei technical support.

Verifying the Installation (1)

Item	Content	Result
Unit	The unit is installed properly without any tilt. The foreign matter inside the cabinet such as cable ties and stubs is cleaned up.	☐ Passed ☐ Failed
Fan	Fans are secured and working properly. Rotate the blades and verify that they are not blocked by sundries.	☐ Passed ☐ Failed
Water system	The water pump is secured. The water filter is secured. Floats are secured and sheet metal fasteners are secured. Elastic bands are removed from floats, and floats move smoothly. The water inlet pipe is connected securely without leakage.	☐ Passed ☐ Failed
Drip pan	The drip pan is free of foreign matter and its filter is not blocked.	☐ Passed ☐ Failed
Differential pressure switch	The pressure inlet tube is secured with cable ties, not blocked by sundries, and not seriously bent.	☐ Passed ☐ Failed

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- Generally, the preceding items are physically checked (by visual observation and touching).

Verifying the Installation (2)

Item	Content	Result
Air filter	The protective cover of the return air filter is removed. The air filter is correctly installed according to the airflow direction marked on the frame.	☐ Passed ☐ Failed
Compressor	The sheet metal fasteners on the compressor are removed. The bolts on the compressor are tightened.	☐ Passed ☐ Failed
Electrical connection	Cables are intact and free from sharp bends. No open or short circuit, or incorrect connection occurs in electrical loops. The power cables, signal cables, teamwork control cables, and T/H sensor cables for the unit are connected as required. The rated specifications of the upstream general switch meet the maximum current requirement. All cables, connectors, and screws are secured. Devices are properly grounded. Maintenance doors are closed.	☐ Passed ☐ Failed
Pipe	All pipes are secured. All pipes are wrapped with thermal insulation foam, and the foam is intact. Water pipe joints have been sealed by sealant. The valve plug of the needle valve is tightened (torque: 0.45 ± 0.05 N·m), and the bonnet is secured. The pipes have no sharp bends.	☐ Passed ☐ Failed
Other	The desiccant in the unit is removed.	☐ Passed ☐ Failed

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- Generally, the preceding items are physically checked (by visual observation and touching).

Contents

1. Installation and Commissioning Overview
2. Key Installation Points
3. **Key Commissioning Points**

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Key Commissioning Points - Device Power-On

- Turn on the upstream PDF switch and turn on all switches of the device.
- If the system is powered on for the first time, the **Quick Settings** screen is displayed for you to set the language, date format, date, time, and time zone. You can also perform **Teamwork Settings**, **System Settings** (**Compressor cooling** and **DO association**), and **T/H Settings** (**Temperature and humidity control type**, **Temperature setpoint**, **Humidity setpoint**, **Cold aisle sensor 1–5**, and **Hot aisle sensor 1–5**). If the system is not powered on for the first time, the home screen is displayed.



Preset password: **000001**



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- After power-on, the compressor starts preheating, and generates a compressor preheat alarm. The preheating takes 12 hours. Do not start the air conditioner before the preheating is complete.
- To query the remaining preheating time, choose Running > Device Details > Compressor on the home screen.

Key Commissioning Points - Initialization Settings

Parameter	Configuration Principle	Default Value
Temperature and humidity control type	When the application scenario is cold or hot aisle containment, you are advised to choose **Cold aisle** if cold aisle T/H sensors are configured. Choose **Supply air** if no cold aisle T/H sensors are configured. When the application scenario is non-aisle containment, you are advised to choose **Return air**. Choose **Cold aisle** if cold aisle T/H sensors are configured.	Return air
Temperature setpoint	After **Temperature and humidity control type** and the temperature value under this type are set, the device performs cooling or heating based on the settings.	25.0° C
Humidity setpoint	After **Temperature and humidity control type** is set, set the humidity value under this type.	50.0% RH
Cold aisle sensor 1–5	If a T/H sensor outside the cabinet is installed, set the T/H sensor in the corresponding position to **Enable**.	Disable
Hot aisle sensor 1–5		Disable

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- Supply air and Return air: Supply air controls only the temperature at the air exhaust vent of the air conditioner, but does not control the temperature at the air return side of the air conditioner. If Supply air is used, the actual temperature is 1–2° C lower than the designed temperature. Therefore, this control mode improves reliability but does not save energy.
- Return air controls only the temperature at the air return side of the air conditioner, but does not control the temperature at the air exhaust vent. This control mode is more energy-saving but less reliable than the Supply air control mode.

Key Commissioning Points - Teamwork Settings (1)

- The following table describes how to configure a CAN teamwork group consisting of eight devices.
- **Teamwork group No.**: A teamwork network can contain a maximum of four groups, which can be numbered 1 to 4 respectively. Devices in a group must have the same teamwork group number.
- **Air conditioner address**: In a teamwork group, the air conditioner address (**1**–**32**) must be unique and the air conditioner whose address is **1** is the master unit.
- **Networking mode**: Set the networking mode to the actual networking mode.

Teamwork settings

No.	Item							
	Teamwork group No.	Air conditioner address	Enable teamwork CAN resistor	Teamwork function	Networking mode	Number of air conditioners in this group	Number of running air conditioners in this group	Rotation function
1	1	1	**Yes**	Enable	CAN network	8	6 (two standby units)	Enable
2	1	2	No	Enable	CAN network	/	/	/
3	1	3	No	Enable	CAN network	/	/	/
.....	.....	.....	.....	.....	.....	.....	.....	... ...
7	1	7	No	Enable	CAN network	/	/	/
8	1	8	**Yes**	Enable	CAN network	/	/	/

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Key Commissioning Points - Teamwork Settings (2)

- **Enable Teamwork CAN resistor**: Set this parameter in CAN networking. Set this parameter to **Yes** for the first and last (eighth) devices.
- **Number of air conditioners in this group**: Set this parameter to the number of units in a group. The value ranges from **1** to **32**.
- **Number of running air conditioners in this group**: Set the number of running air conditioners in a group. The value ranges from **1** to the total number of air conditioners in the group.
- **Rotation function**: This enables the switchover between active and standby air conditioners. It is recommended that the function be enabled when the load power is even.

Teamwork settings

No.	Item							
	Teamwork group No.	Air conditioner address	Enable teamwork CAN resistor	Teamwork function	Networking mode	Number of air conditioners in this group	Number of running air conditioners in this group	Rotation function
1	1	1	**Yes**	Enable	CAN network	8	6 (two standby units)	Enable
2	1	2	No	Enable	CAN network	/	/	/
3	1	3	No	Enable	CAN network	/	/	/
.....	.....	.....	.....	.....	.....	.....	.....	.....
7	1	7	No	Enable	CAN network	/	/	/
8	1	8	**Yes**	Enable	CAN network	/	/	/

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Key Commissioning Points - Setting Communications Parameters (1)

- Modbus RTU protocol:
  - On the home screen, choose **Settings** > **Comm Settings** > **Modbus Settings**.
  - Set **Baud rate** and **Communication address**.
  - Set **RS485 monitoring grouping**.
    - For scenarios without grouping, set this parameter to **Enable** for the last device.
    - For scenarios with grouping, set this parameter to **Enable** for the last device in each teamwork control group.

Parameter	Parameter Value	Configuration Principle
Baud rate	9600, 19200	Set **Baud rate** as required. The value should be consistent with that set on the network management system (NMS).
Communication address	1~255	Enter the communications address of the air conditioner as planned. The NMS communicates with the air conditioner using this address, and the communications addresses of two air conditioners connected to the same NMS must be different.

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- The communication parameters are set when the customer purchases only Huawei air conditioners. The DCIM system is not Huawei NetEco and is determined by the port of the third-party NMS.
- That is, the parameters need to be set only when the air conditioner communicates with the DCIM system and the DCIM system is not provided by Huawei.

Key Commissioning Points - Setting Communications Parameters (2)

- Modbus TCP protocol:
  - On the home screen, choose **Settings** > **Comm Settings** > **IP Settings**.
  - Set parameters according to the following table.
  - Tap **Submit**.
  - On the home screen, choose **Settings** > **Comm Settings** > **Modbus Settings**.
  - Set Modbus TCP parameters according to the table on the right.

Parameter	Configuration Principle
IP assigning mode	Set this parameter as planned.
IP address	Set this parameter as planned.
Subnet mask	Set this parameter as planned.
Gateway	Set this parameter as planned.

Parameter	Parameter Value	Configuration Principle
Link mode	Server, Client, Server and client	**Server**: The air conditioner works as the server and can connect to two clients for communication. **Client**: The air conditioner works as the client and can connect to a remote server for communication. **Server and client**: The air conditioner works as the server and can connect to two clients for communication. It also works as the client and can connect to a remote server for communication.
Client encryption	Enable, Disable	This parameter is configurable when **Link mode** is set to **Client**.
Server encryption	Enable, Disable	This parameter is configurable when **Link mode** is set to **Server**.
NMS IP Address	N/A	Enter the actual IP address of the NMS. This parameter is configurable when **Link mode** is set to **Client**.
NMS port number	N/A	It is recommended that you retain the default value. If you need to change the value, enter a value as required. This parameter is configurable when **Link mode** is set to **Client**.

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- When Client encryption is set to Enable, set NMS port number to 32907. When Client encryption is set to Disable, set NMS port number to 32906.
- The parameters need to be set when the customer purchases only Huawei air conditioners. The DCIM system is not Huawei NetEco, and therefore Modbus is used.

Key Commissioning Points - Setting Communications Parameters (3)

- SNMP protocol:
  - On the home screen, choose **Settings** > **Comm Settings** > **SNMP Settings**.
  - Set **SNMP Version** as required and tap **Submit**.
  - When **SNMP Version** is set to **All** or **SNMPv1&v2c**, you can set **Read Community** and **Write Community**.
  - Tap the text boxes next to **Read Community** and **Write Community**, as shown in the following figures. Set **Read Community** and **Write Community** as planned, and tap **Submit**.







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- If the DCIM system supports SNMP but is not Huawei NetEco, you need to set the parameters.

Key Commissioning Points - Setting Communications Parameters (4)

- SNMP protocol:
  - When **SNMP Version** is set to **SNMPv3**, you can tap **Add** under **SNMP V3** to add an SNMPv3 user.
  - Set **User Name**, **Auth protocol**, and **Prop protocol**, as shown in the following figure on the left. MD5 and DES protocols are not secure. It is recommended that you set **Auth protocol** to **SHA** and set **Prop protocol** to **AES**. The following operations use the recommended settings as an example.
  - Set **SHA password** and **Confirm Password** as planned.
  - Set **AES password** and **Confirm Password** as planned.





Key Commissioning Points - Setting Communications Parameters (5)

- SNMP protocol:
  - Tap the text box next to **SNMP Port**, set **SNMP port** to the actual port number, and tap **Submit**.
  - Set SNMP trap parameters.
    - Set **Trap Address** as planned and set **Trap Port** based on the actual port number.
    - If an SNMPv3 user has been configured, it is recommended that **SNMP Version** be set to **SNMPv3**.
    - If **SNMP Version** is set to **SNMPv3**, select a value for **SNMPv3 user name**.





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Key Commissioning Points - Setting Communications Parameters (6)

- Setting WiFi parameters
  - After a WiFi module is connected to the USB port on the display of the air conditioner, **WIFI Settings** are configurable.
  - On the home screen, choose **Settings** > **Comm Settings** > **WIFI Settings**.
  - Set parameters according to the following table.
  - Tap **Submit**.

Parameter	Configuration Principle
WiFi SSID	Set this parameter to the WiFi hotspot name. A mobile phone can connect to the WiFi of the air conditioner based on this name.
WiFi Password	Set this parameter to the password required for connecting a mobile phone to the WiFi of the air conditioner. There is no default WiFi password. When you enable the WiFi function for the first time, you need to set a password.
Enable WiFi	Enable the WiFi function for the air conditioner. The default status is **Disable**.

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(Optional) Key Commissioning Points - Setting Differential Pressure Control

- If a micro differential pressure sensor is installed, perform the following steps. Otherwise, skip the steps.
- On the home screen, choose **Settings** > **System Settings** > **Indoor fan**, and set **Air-side difference pressure sensor type** to 0–125 Pa.
- Set **Indoor fan control type** to **Pressure diff ctrl**.
- Modify other parameters according to the following table.

Parameter	Description	Configuration Principle
Indoor fan control type	Specifies the control type for the indoor fan.	In most cases, retain **R/S air temp diff rate ctrl**. If a micro differential pressure sensor is installed, set this parameter to **Pressure diff ctrl**.
Indoor fan pressure difference setpoint	Specifies the differential pressure control threshold.	The default value is 10 Pa.
Air-side difference pressure sensor type	Specifies the measuring range for the air-side differential pressure sensor.	There is no default value. Set it to 0–125 Pa.
Min indoor fan speed	Specifies the minimum rotational speed of the indoor fan.	The default value is 30%. You are advised to retain the default value.
Max indoor fan speed	Specifies the maximum rotational speed of the indoor fan.	The default value is 100%.

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- In normal cases, the fan speed is controlled by the temperature. If the temperature is greatly different from the preset value, the fan speed is high. If the temperature is slightly different from the preset value, the fan speed is low.
- However, in some cases, for example, if the customer load is light, the temperature of the equipment room is low. If the load is far away from the AHU, the temperature is low and the fan rotates slowly, which may cause hot spots. In this case, the customer may require the AHU to match the pressure, so that the air reaches a wider range to eliminate the hot spots.
- The sensor here is a micro differential pressure sensor, not a differential pressure sensor near the air filter. The two sensors are different.

Key Commissioning Points - Device Commissioning (1)

- Tap **Start** on the home screen of the controller.
  - If this is the first startup after power-on, the screen shown in Figure 1 is displayed. In this case, tap **Confirm**. The screen shown in Figure 2 is displayed. Go to step 2 for verification of first startup.
  - If this is not the first startup, the screen shown in Figure 3 is displayed. In this case, tap **Confirm** to start the air conditioner.

Figure 1



Figure 2



Figure 3



Key Commissioning Points - Device Commissioning (2)

- Open the Service Expert app on your mobile phone.
- On the home screen of the app, tap **StartUp**, and the screen shown in the left figure below is displayed.
- Tap **Offline Activation**. The screen shown in the right figure below is displayed.
- On the **Offline Activation** screen, specify **BarCode** and **Codes**, and tap **Generate PWD** to generate a startup password.
- Tap **Password** on the screen of the air conditioner, and enter the startup password generated by the app to start the device.





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- Download the Service Expert app from the HUAWEI AppGallery. The app can be downloaded from Android currently. You must apply for the permission to use the app after downloading it.

Key Commissioning Points - Device Commissioning (3)

- On the home screen, tap **Start** and choose **Maint** > **Diagnostic Mode** > **Enter**. (If no manual operation is performed within 25s after you tap **Start**, the device will automatically run following the preset logic, and the compressor and indoor and outdoor fans will run according to the environment.)
- Change the value of **Outdoor fan** to **50%**. After checking that the outdoor fan runs properly and no alarm is generated, change the value of **Outdoor fan** to **0%**.
- Change the value of **Indoor fan** to **90%**. After ensuring that the indoor fan runs properly and no alarm is raised, change the value of **Indoor fan** to **0%**.

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Key Commissioning Points - Device Commissioning (4)

- Adjust the compressor rotational speed to 3000 rpm.
  - On the home screen, choose **Running** > **Device Details** > **Compressor** and check that the values of **Suction pressure** and **Discharge pressure** are within the normal ranges.
  - On the home screen, choose **Running** > **Device Details** > **EEV** and check that the value of **EEV suction superheat degree** is within the normal range.
  - Charge refrigerant from the low pressure pipe needle. Ensure that the refrigerant is charged in small amount or charged now and then if possible. The total charge amount of refrigerant must meet the requirements.
  - On the **Diagnostic Mode** screen, change the compressor input to 0 rpm.

Outdoor Ambient Temperature	Proper Discharge Pressure Range (Running > Device Details > Compressor)	Proper Suction Pressure Range (Running > Device Details > Compressor)	Proper Suction Superheat Degree (Running > Device Details > EEV)
< 15° C	1.5–2.5 MPa	0.7–1.2 MPa	8–15° C
15–35° C	1.5–3.1 MPa		
35–45° C	2.5–3.8 MPa		
> 45° C	3.1–4.15 MPa		

Key Commissioning Points - Device Commissioning (5)

- Commissioning the spray system:
  - Choose **Maint** > **Diagnostic Mode** > **Enter**. Tap **Start** for the water inlet valve, and check whether the high and low floats are normal.
  - Tap **Start** for water pump 1 and water pump 2, and check whether the water inlet valve is opened properly and the nozzle works properly.
  - Tap **Start** for the drainage valve and check whether the drainage is normal.
  - After the commissioning is complete, remove the device used for charging refrigerant, and install the needle valve bonnet.
  - On the **Diagnostic Mode** screen, tap **Exit** and then **Yes** to exit the diagnostic mode.

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Checking After Commissioning

Item	Result
T03-01 Vacuumization of the Cooling System	☐ Passed ☐ Failed ☐ Exempted
T03-02 Refrigerant and Lube Oil Filling	☐ Passed ☐ Failed ☐ Exempted
T03-03 Unit Power-On	☐ Passed ☐ Failed ☐ Exempted
T03-04 Indoor Fan Operating Status	☐ Passed ☐ Failed ☐ Exempted
T03-05 Exhaust Fan Rotation	☐ Passed ☐ Failed ☐ Exempted
T03-06 Automatic Water Refill for the Water Tank	☐ Passed ☐ Failed ☐ Exempted
T03-07 Spray System Operating Status	☐ Passed ☐ Failed ☐ Exempted
T03-08 Compressor Operating Status	☐ Passed ☐ Failed ☐ Exempted
T03-09 Unit Drainage	☐ Passed ☐ Failed ☐ Exempted
T03-10 Cooling Effect	☐ Passed ☐ Failed ☐ Exempted
T03-11 Abnormal Vibration and Noise	☐ Passed ☐ Failed ☐ Exempted
T03-12 Insulation Performance for Pipes	☐ Passed ☐ Failed ☐ Exempted

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- The checking is performed one by one during device commissioning.

Quiz

1. (True or False)When performing pre-installation check, remove each bonnet and press the valve plug using the bonnet. If air is exhausted, the system is normal. If no air is exhausted, the system leaks.

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Summary

- This chapter describes the following aspects:
  - NetCol8000-E220 Installation and Overview;
  - Key Commissioning Points.

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Thank you.

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每个组织，构建万物互联的智能世界。

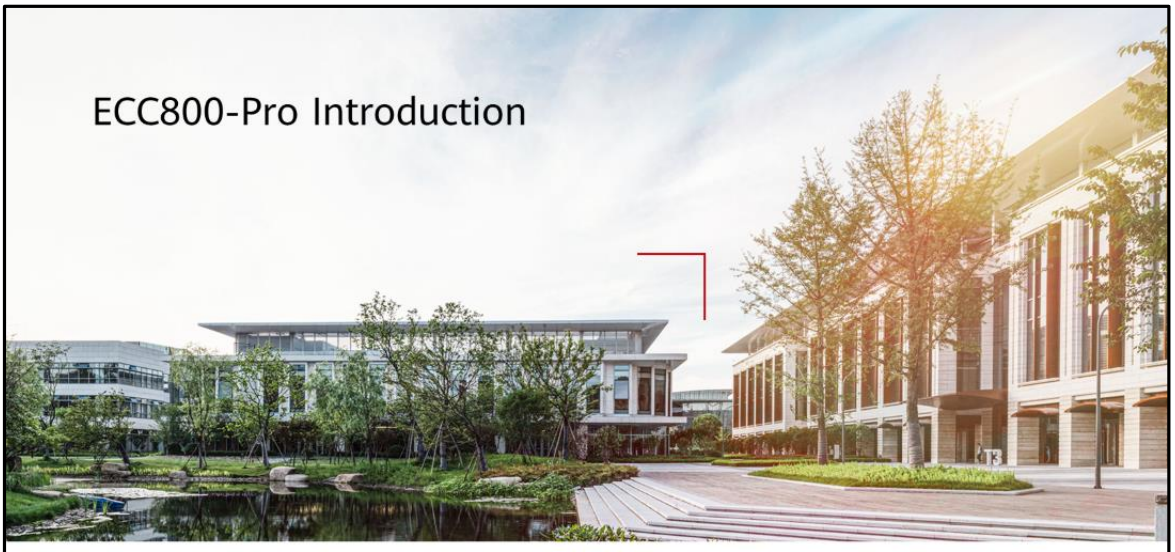
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ECC800-Pro Introduction



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Foreword

- The ECC800-Pro is the core component for the smart module local management. It is intelligent, flexible to connect, easy to maintain, and reliable. It adopts the PoE bus for expansion, and allows all intelligent monitoring devices to be flexibly deployed so that it can manage the devices in the smart module.
- The slides describe the main functions, common operations, and commissioning and maintenance methods of the ECC800-Pro.

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Objectives

Upon completion of this course, you will be able to:

- Describe the main functions of the ECC800-Pro.
- Master the power-on commissioning and common operations of the ECC800-Pro.
- Understand how to maintain the ECC800-Pro.

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Contents

1. Introduction
   - Overview and Main Features
   - User Interface
2. Commissioning and Common Operations
3. Maintenance

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Overview

- The ECC800-Pro is an intelligent equipment room environment and device monitoring system which features flexible layout, easy maintenance, and high reliability.



ECC800-Pro front panel

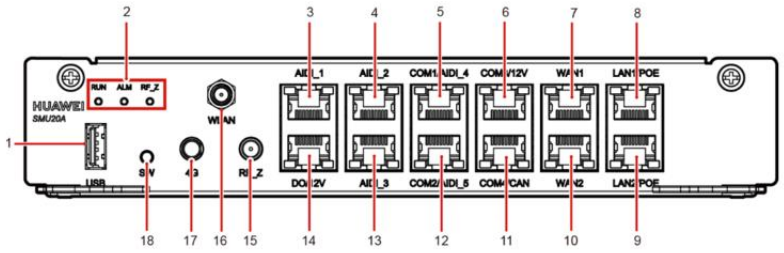


ECC800-Pro rear view

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- ECC: energy control center

ECC800-Pro Main Control Module



(1) USB	(2) Status indicators	(3) AIDI_1	(4) AIDI_2	(5) COM1/AIDI_4	(6) COM3/12V
(7) WAN1	(8) LAN1/POE	(9) LAN2/POE	(10) WAN2	(11) COM4/CAN	(12) COM2/AIDI_5
(13) AIDI_3	(14) DO/12V	(15) RF_Z	(16) WLAN	(17) 4G	(18) SW button

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- WAN port: two WAN ports, which can be connected to the management systems of two customers. The ports support autonegotiation of 10/100/1000 Mbit/s communication rates.
- LAN port: two LAN ports, which can be connected to southbound devices. The ports support autonegotiation of 10/100/1000 Mbit/s communication rates.
- RS485 serial port expansion: output voltage of 13–15 V DC (rated voltage of 14.5 V DC). Four RS485 ports are provided with the default communication rate of 9600 bit/s. COM1 to COM3 ports can provide 12 V DC power. The power supply can be switched on or off and is on by default.
- AIDI expansion (RJ45): output voltage of 13–15 V DC (rated voltage of 14.5 V DC). Five universal AIDI ports are provided for connecting to sensors such as smoke sensors, water sensors, and NTC sensors. AIDI_1 to AIDI_3 are full-function AIDI ports, and AIDI_4 to AIDI_5 are simplified AIDI ports without type identification. The power supply can be switched on or off and is on by default.
- DO expansion (RJ45): output voltage of 13–15 V DC (rated voltage of 14.5 V DC). One active DO port is provided. The power supply can be switched on or off and is on by default.
- 4G: supports a 4G module. The ECC800-Pro supports short message service (SMS) and 4G communication (supporting China Unicom and China Mobile), is compatible with 3G (WCDMA) communication, and provides a standard SIM card slot.
- USB: supports USB 2.0 and 5 V/1 A power supply. After a WiFi module is installed, connect the WiFi module to the ECC800-Pro using the app on a mobile phone or pad. Insert a USB flash drive to export historical data and configuration files or import configuration files.
- SW button: restores the default IP address, factory settings, and user information.

ECC800-Pro Features (1)

Feature	Description
Efficient	➢ Supports wireless device access. ➢ Supports multiple unlocking methods including access card, password, fingerprint, and facial recognition. ➢ Supports remote alarm notification by SMS and email. ➢ Supports PoE bus power supply and communication, providing rich bandwidth resources and high communication efficiency. ➢ Supports remote upgrade, fault data export, and configuration parameter synchronization. ➢ Supports the connection of eight access control devices and four cameras for a single smart module. ➢ Supports the cascading of a maximum of three ECC800-Pros. You can view the active alarms and PUE values of the cascaded ECC800-Pros on the WebUI of one ECC800-Pro. ➢ Collects statistics on the instantaneous PUE and average PUE of a smart module and allows you to view the energy consumption status of a smart module in real time. ➢ Supports transparent transmission over the RS485 port. The southbound component communicates with the NetEco after being connected. ➢ Supports modification of device performance parameters and query of historical performance data. ➢ Supports asset management, power management, and cooling capacity management, which helps you learn about the dynamic information changes in the smart module in a timely manner and perform effective management. ➢ Supports wizard-based deployment and commissioning.

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ECC800-Pro Features (2)

Feature	Description
Simple	➢ Supports local WiFi hotspots. After you install the WiFi module at the USB port on the ECC800-Pro, you can connect to the ECC800-Pro using the app on a mobile phone or pad to view the layout, resources, energy efficiency, environment, and alarms of the smart module. This increases availability. ➢ Supports query of device information in real time using the app on a mobile phone or pad, facilitating operation and maintenance. ➢ Supports connection of monitored NEs to the PoE bus in plug-and-play mode for auto-discovery and auto-registration, requiring no configuration. This feature enables fast delivery and high maintainability.
Reliable	➢ Supports intelligent linkage management which allows customization of linkage logic, implementing intelligent operation and maintenance. ➢ Supports dual power inputs, ensuring high reliability. ➢ Supports intelligent battery monitoring and management to monitor the voltage and internal resistance of a single battery and detect faulty batteries in a timely manner. ➢ Supports automatic functions such as fire extinguishing linkage and smoke alarm linkage. ➢ Uses PoE ring networking to reduce fault points and improve reliability. ➢ Supports cabinet-level magnetic locks, door status sensors, and temperature monitoring, improving security. ➢ Connects to the NetEco and supports SNMP to implement centralized management of multiple modules in multiple scenarios.

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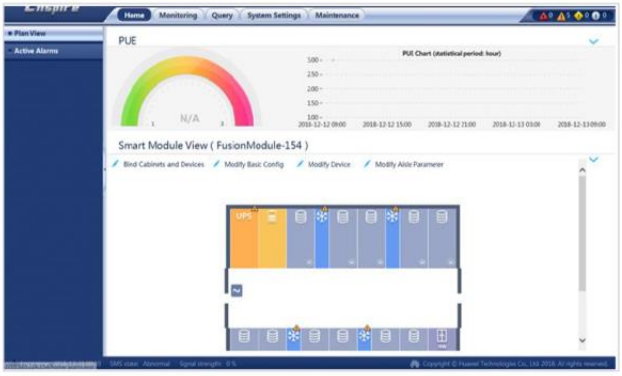
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WebUI

- During initial commissioning or daily use, you can log in to the ECC800-Pro over a PC WebUI to manage the ECC800-Pro. For data transmission security, the ECC800-Pro supports WebUI access through TLS.



ECC800-Pro WebUI

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- To log in to the ECC800-Pro WebUI, perform the following steps:
  - Connect the PC network port to the WAN1 port on the ECC800-Pro using a cable.
  - Configure the PC IP address and the WAN1 IP address in the same network segment. The default IP address of WAN1 is 192.168.8.10.
  - (Optional) Set browser parameters.
  - Enter https://monitoring IP address (such as https://192.168.8.10) in the address box of the browser, and then press Enter to enter the WebUI login page. On the login page, enter the preset user name admin and preset password Changeme, set the language, and click Log In.

ECC800-Pro WebUI Menu (1)

First-Level Menu	Second-Level Menu	Function
Home	Plan View	➢ Allows you to view and manage the layout view of devices. ➢ Allows you to view the system PUE (including the instantaneous mPUE value and average PUE value) in a dashboard and the system trend curve.
	Active Alarms	Allows you to view active alarms.
	Multi-Module Monitoring	Allows you to view the status of each cascaded ECC800-Pro.
Monitoring	System	Allows you to monitor the device running information in real time, set device running parameters, and control the device running. For example, you can set smart cooling product parameters, delete devices failing in communication, and set AI/DI device parameters.
	Power Distribution	
	Aisle	
	Cooling	
	Cabinet	
Query	Historical Alarms	Allows you to query historical alarms.
	Performance Data	Allows you to query device performance data
	Operation Log	Allows you to query operation logs.
	Access Event	Allows you to query access control events.
	Export Data	Allows you to export historical data and device data.

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ECC800-Pro WebUI Menu (2)

First-Level Menu	Second-Level Menu	Function
System Settings	System Parameters	Allows you to set the system type, site ID, and network security certificate.
		➢ Allows you to set the monitoring IP address. ➢ The default IP address of WAN_1 is 192.168.8.10. ➢ The default IP address of WAN_2 is 192.168.0.10.
		Allows you to set the time zone, time, and date.
	Access Management	Allows you to set the access users and permissions.
	Video Management	Allows you to add, modify, or delete video information.
	NMS Application	Allows you to set NetEco communications parameters. ➢ The default server IP address is 192.168.8.11. ➢ The default port number is 31220. ➢ The default IP address for link setup monitoring is WAN_1.
		Allows you to set SNMP communications parameters. ➢ The default SNMP version is SNMPv3. ➢ The default SNMP port number is 161.
		Allows you to set the transparent transmission of the device to the NetEco and install the network security certificate. By default, the transparent transmission function of the COM port is disabled. By default, security authentication is enabled.
	Device Management	Allows you to add a device and replace the security certificate for device access.
	Smart Module Cascading	Allows you to configure multi-module settings to cascade up to three ECC800-Pros.

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ECC800-Pro WebUI Menu (3)

First-Level Menu	Second-Level Menu	Function
System Settings	PUE Configuration	Allows you to set PUE parameters. By default, the PUE function is enabled.
	Linkage Control	Allows you to set PLC linkage rules.
	Alarm Parameters	Allows you to set basic alarm parameters and alarm linkage parameters.
	Performance Parameters	Allows you to enable or disable the device performance statistics function.
		Allows you to view the performance data for which the statistics function is enabled or disabled.
	Event Notification	Allows you to set alarm notification by email and SMS.
	Signal Name Modify	Allows you to modify a signal name.
Maintenance	Software Upgrade	Allows you to upgrade the software of the ECC800-Pro and its southbound devices online.
	User Management	Allows you to manage users, such as adding, modifying, and deleting users.
	Configuration File	Allows you to import and export configuration files to configure devices quickly, and restore factory settings.
	APP Obtaining	Allows you to download the app installation package by scanning the QR code.
	Parameter Sync	Synchronizes device parameters to quickly import southbound device data. Supports device replacement.
	Access Package Mgmt	Allows you to view access package information.
	Configuration Wizard	Supports the configuration wizard function and allows you to set simple parameters according to the wizard.

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ECC800-Pro Mobile Phone App and Pad App

- In addition to access over WebUI, the ECC800-Pro also supports management over app on a mobile phone or pad.



ECC800-Pro mobile phone app screen



ECC800-Pro pad app screen

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ECC800-Pro APP (1)

- The UIs of a mobile phone app and pad app are similar. The following uses a mobile phone app as an example to describe the menu functions.

Screen	Function
Home	Allows you to view the layout information of the smart module, as well as the overview of resources, energy efficiency, environment, and alarms.
iPower	Allows you to view the running status and alarm status of each branch on the full link page of the power supply and distribution system, and provides the self-diagnosis function.
iCooling	Allows you to view the cooling distribution in smart modules and operating status of components on the cooling link diagram page.

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ECC800-Pro APP (2)

Screen		Function
More	Monitor	Allows you to view details about devices under the monitoring system, power distribution, aisle, cooling, and cabinet types.
	Software Upgrade	Allows you to upgrade the software using a USB flash drive or perform local upgrade.
	Parameter Sync	Synchronizes parameters.
	iFind	Allows you to modify device names in the layout diagram, modify device position names, and deliver a blinking command to a device under iFind.
	Export Data	Allows you to export device configuration data, current configuration files, and historical data.
	Import Data	Allows you to import a configuration file.
	Performance Data	Allows you to view device performance data, such as the battery curve and battery discharge curve.
	Network Parameter	Allows you to view the network parameters of the system.
	Operation Log	Allows you to view system operation logs.
	Access Event	Allows you to view access event records.
	Asset Details	Allows you to view device asset details such as e-labels of system devices and other devices.
	Device Version Info	Allows you to check the **Software Version** and **Hardware Version** of the device.

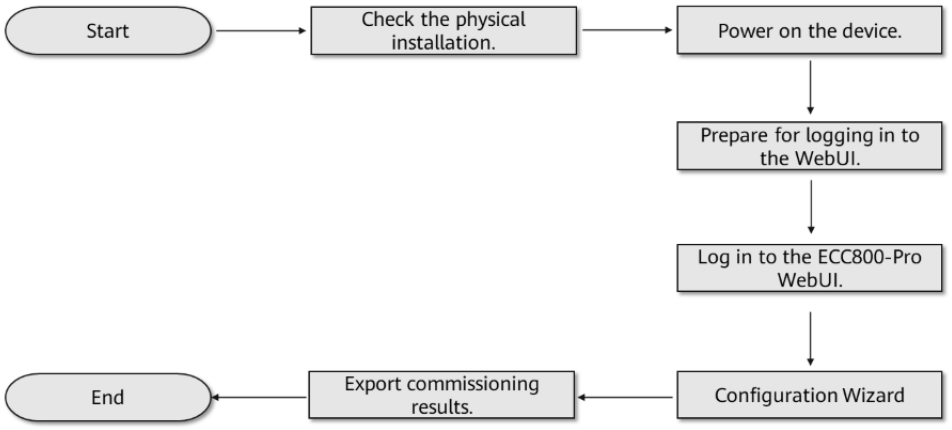
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Initial Power-On Commissioning Process



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Initial Power-On Commissioning (1)

- After the ECC800-Pro and monitoring hardware are installed, check that there is no risk. Switch on the upstream power input circuit breakers for the ECC800-Pro and various actuators to power on and start all controller components. After power-on, check that the indicators on the ECC800-Pro and monitoring hardware are normal.

Check the physical installation.

Power on the device.

- Prepare for logging in to the ECC800-Pro WebUI.
  - Open Internet Explorer and choose **Tools** > **Internet options**.
  - Click the **Advanced** tab and select **Use TLS 1.1** and **Use TLS 1.2**.
  - Click the **Connections** tab and select **LAN settings**.
  - In the **Proxy server** area, clear **Use a proxy server for your LAN**. Click **OK**.
- Use a network cable to connect the PC network port to the WAN1 port on the ECC800-Pro. Configure the PC IP address and the WAN1 IP address in the same network segment.
  - The default IP address of the WAN1 port is 192.168.8.10.

Prepare for logging in to the WebUI.

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Initial Power-On Commissioning (2)

- Log in to the ECC800-Pro WebUI.
  - Enter *https://monitoring IP address* (such as https://192.168.8.10) in the address box of the browser, and then press **Enter** to enter the WebUI login page.
  - On the login page, enter the preset user name **admin** and preset password **Changeme**, set the language, and click **Log In**.

Log in to the ECC800-Pro WebUI.



ECC800-Pro WebUI

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- Record and keep the password properly. If you forgot the password, you will be unable to log in to the WebUI. When the event notification is configured and the password retrieval mode is configured under user management, the password can be retrieved.
- An account is logged out due to timeout if no operation is performed within 10 minutes after login.
- A maximum of three users can log in to the ECC800-Pro WebUI at the same time.

Initial Power-On Commissioning (3)

- **Configuration Wizard**: The ECC800-Pro supports **Smart Module Settings**, **Basic Param Settings**, **Add Devices**, **Add Sensor**, **Plan View**, **Power Dist Settings**, **Temp Control Settings**, **Linkage Test**, **Video Settings**, and **Access Management**. Delivery engineers can commission various functions based on the site requirements.
  - Choose **Maintenance** > **Configuration Wizard**. The parameter configuration page of the configuration wizard is displayed.
  - Set parameters as prompted. For details, see the function description on the left of the page.
    - During parameter setting, click **Previous**, **Next**, or **Skip** as required.
    - If you need to exit during the setting, click **Finish** to complete the setting.
  - After the parameters are configured, click **Finish**.
  - Confirm the commissioning result. If no problem is found, enter the **Checker Name** and **Check Date**, and click **Configuration Completed**.
    - To export the configuration result, click **Export Check Result** to export a csv. file.

★Configuration Wizard

Export commissioning results.

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Setting NetEco Parameters

- When a smart module is connected to the NetEco, perform the following operations:
  - Apply for a fixed IP address to the equipment room network administrator.
  - Set the IP address, subnet mask, and default gateway on the ECC800-Pro WebUI. Choose **System Settings** > **System Parameters** > **Monitor IP** > **WAN_1**. For details, see the table "IP parameters." After the setting is complete, click **Submit**.
  - Set the NetEco communications parameters and authentication password on the ECC800-Pro WebUI. Choose **System Settings** > **NMS Application** > **NetEco** > **Communication Parameters/Set Authentication Password**. For details, see the tables "NetEco parameters" and "Setting an authentication password." After the setting is complete, click **Submit**.

IP parameters

Parameter	Default Value	Setting
IP	192.168.8.10	Set these parameters based on site requirements.
Subnet mask	255.255.255.0	
Default gateway	192.168.8.1	

NetEco parameters

Parameter	Default Value	Setting
NetEco Location	Local	Set this parameter based on the type of the connected NetEco management system. Local: NetEco Cloud: CloudOpera NetEco
Server IP	192.168.8.11	Set this parameter to the IP address of the primary NetEco server.
Port number	31220	31220
Link to the monitoring IP address	WAN_1	WAN_1 or WAN_2

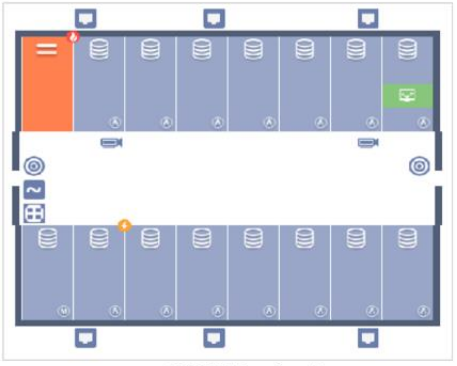
Setting an authentication password

Parameter	Default Value	Setting
Authentication password	Modifyme_123	Set these parameters based on site requirements.
Confirm authentication password	N/A	

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Creating a Smart Module Plan View

- To create a smart module plan view, you are advised to obtain or draw the planned layout of the modular data center before the creation. Perform the following steps:
  - Choose **Home** > **Plan View**. Click **Create smart module** in **Smart Module View**. The **Modify Basic Config** dialog box is displayed. Set the layout and device quantity in **Layout** and **Half-size cabinet qty./row** based on the actual smart module scenario.
  - Click **Modify Device** to create a smart module plan view.



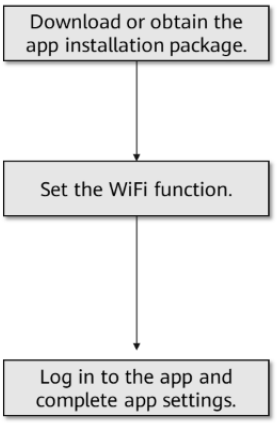
ECC800-Pro plan view

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- If there are many devices of the same type, press the BLINK button on a device for less than 1s to report the blinking status to the ECC800-Pro. The corresponding device icon in the WebUI plan view blinks. Check that the device positions and types in the plan view are consistent with the actual situation by delivering the blinking command.
- Creating a smart module view:
  - If Room monitoring is set to No, draw a smart module view.
  - If Room monitoring is set to Yes, draw an equipment room view and a smart module view.
- Modifying devices:
  - Drag the icons of registered devices and devices on the cabinet list to the corresponding positions in the layout diagram. Double-click the device icon. On the Basic Configuration page that is displayed, modify the value of Device Name. Click Exit Edit Mode to create a smart module plan view.
  - Click One-Click Layout. The power distribution devices, IT cabinets, and smart cooling products in the cabinet list are automatically deployed in the view. You need to manually deploy the icons of other registered devices and devices on the cabinet list. If the positions of devices automatically deployed are different from the actual positions, you can manually adjust the positions.

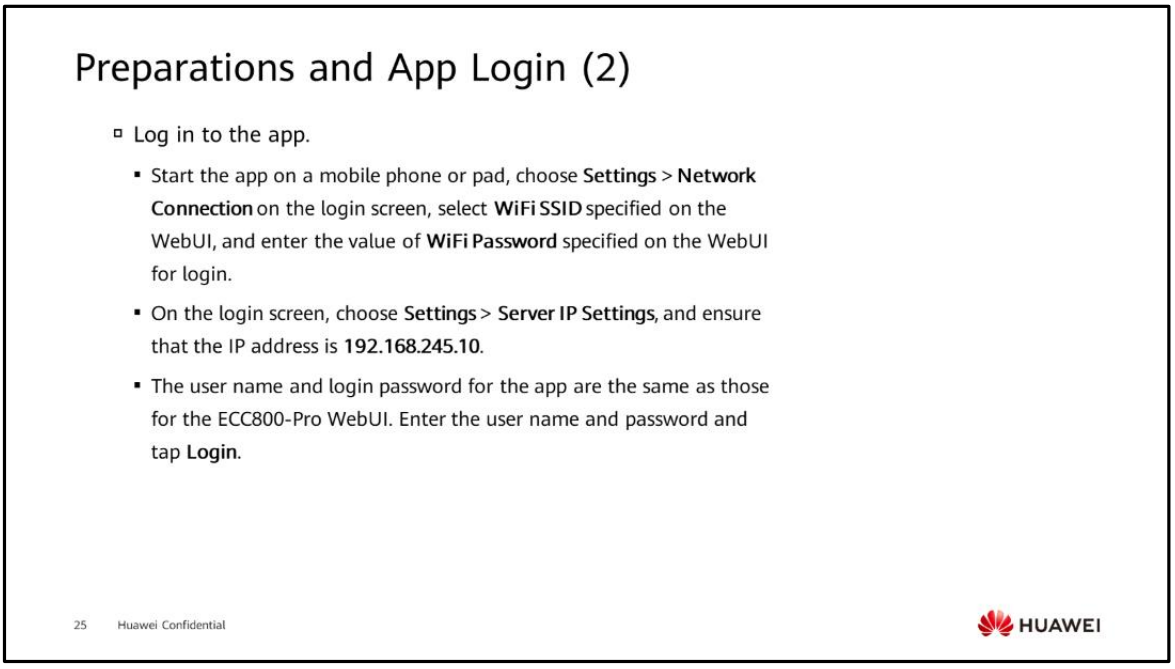
Preparations and App Login (1)

- Preparing and logging in to the app:
  - Download and obtain the app installation package.
  - Install the app. Tap the app installation file for installation. After the installation is complete, check that the app icon is displayed on the home screen of a mobile phone or pad.
  - Press and hold the SW button on the ECC800-Pro for less than 3s to enable the WiFi function.
  - Enable the WiFi function on the ECC800-Pro WebUI.
    - Choose **Monitoring** > **System** > **WiFi Converter** and click **WiFi Management**.
    - Set **Enable WiFi** to **Enable** and click **Submit**.
    - If this is the first time you enable the WiFi function, set **WiFi Password** and click **OK**.



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- Before using the app, ensure that the WiFi module has been installed.
- App operating environment requirements:
  - A mobile device must run Android 4.0 or later and is not root operating system (the operating system is not rooted).
  - A mobile device has sufficient battery reserve.
  - You have obtained the IP address of the ECC800-Pro as well as the user name and password used for WebUI login.
  - You have prepared a PC with an IP address in the same network segment as that of the ECC800-Pro, and the PC is connected to the WAN_1 port on the ECC800-Pro.
- Method of obtaining the app:
  - Log in to Huawei AppGallery (http://a.vmall.com/), search for FusionModule, and tap Download to obtain the installation package.
  - Log in to the ECC800-Pro WebUI using a PC. Choose Maintenance > App Obtaining, scan QR code, and save the app installation package to the PC or a path on a mobile storage device. Then, copy the app installation package to a mobile phone or pad.
  - When WiFi is enabled, enter https://192.168.245.10 in the address bar of the Firefox browser (version 41.0 or later) on a mobile phone or pad, and press Enter to access the ECC800-Pro WebUI. Choose Maintenance > App Obtaining and scan QR code to save the app package to a mobile phone or pad.



- Before using the app, ensure that the WiFi module has been installed.
- App operating environment requirements:
  - A mobile device must run Android 4.0 or later and is not root operating system (the operating system is not rooted).
  - A mobile device has sufficient battery reserve.
  - You have obtained the IP address of the ECC800-Pro as well as the user name and password used for WebUI login.
  - You have prepared a PC with an IP address in the same network segment as that of the ECC800-Pro, and the PC is connected to the WAN_1 port on the ECC800-Pro.
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  - When WiFi is enabled, enter https://192.168.245.10 in the address bar of the Firefox browser (version 41.0 or later) on a mobile phone or pad, and press Enter to access the ECC800-Pro WebUI. Choose Maintenance > App Obtaining and scan QR code to save the app package to a mobile phone or pad.

Managing ECC800-Pro WebUI Users (1)

- WebUI users are classified as administrators and operators. O&M personnel can modify user management parameters and add users based on site requirements.
- Modifying user management parameters:
  - Log in to the ECC800-Pro WebUI as an administrator.
  - Log in to the WebUI and choose **Maintenance** > **User Management**. The user management page is displayed.
  - Select the user to be modified and click **Modify**. On the page that is displayed, reset the login password.
  - Modify **Advance expiration notification (days)** and **Timeout Interval** for the password.
  - Select a **Password retrieval mode** (**Email** or **Short message**).



Modifying user parameters

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- Administrator: The user name is admin and password is Changeme by default. The administrator has all rights, including the rights for user management, browsing and modifying all parameters in the system, software upgrade, and data import and export.
- Operator: The user name is operator and password is Changeme by default. The operator has no rights for user management, system setting, version upgrade, running parameters and smart-module plan view editing, and internal fault information export.

Managing ECC800-Pro WebUI Users (2)

- Adding a WebUI user:
  - Log in to the WebUI and choose **Maintenance** > **User Management**. The user management page is displayed. Click **Add**.
  - Specify **User name**, **Password**, **Confirm password**, **Password validity period**, **Advance expiration notification (days)**, **Timeout Interval**, and **Password retrieval mode**, select appropriate values from the **Access right** and **Login source** drop-down list boxes, and click **Confirm**.
  - A maximum of 16 users with management rights can be created on the WebUI, and a maximum of three users can be online at the same time.



Modifying user login passwords

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- Administrator: The user name is admin and password is Changeme by default. The administrator has all rights, including the rights for user management, browsing and modifying all parameters in the system, software upgrade, and data import and export.
- Operator: The user name is operator and password is Changeme by default. The operator has no rights for user management, system setting, version upgrade, running parameters and smart-module plan view editing, and internal fault information export.

Setting and Adding Devices (1)

- Most devices can be automatically discovered by the ECC800-Pro after they are connected to the PoE port on the smart ETH gateway. This section uses the UPS5000-E as an example to describe how to manually set and add devices.
  - One end of the straight-through cable has been connected to the RS485 port on the UPS5000-E monitoring module, and the other end has been connected to the COM port on the ETH converter.
  - Set communications parameters on the UPS5000-E.
    - On the displayed screen after UPS5000-E startup, tap **System Info**. Enter the user name **admin** and password **000001** (by default).
    - Tap **Communication** and set **RS485 baud rate** to **9600**, and **RS485 address** to **1** on the **Communication** screen.



UPS5000-E parameters

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- When connecting devices, you are advised to add devices one by one to ensure that the displayed view is consistent with the actual device. If all devices have been added and powered on, only the BLINK function of the ETH converter can be used to identify the mapping between the UPS5000-E and ETH converter.

Setting and Adding Devices (2)

- Most devices can be automatically discovered by the ECC800-Pro after they are connected to the PoE port on the smart ETH gateway. This section uses the UPS5000-E as an example to describe how to manually set and add devices.
  - Add the UPS5000-E on the ECC800-Pro WebUI.
    - Choose **System Settings** > **Device Management** and click **Add Device**. The parameters for adding a device are displayed. For details, see the table "UPS5000-E parameters."
    - Click **Test Connect** to check whether the UPS5000-E connects to the ECC800-Pro properly.
    - Choose **Monitoring** > **System** > **ETH Converter Group** > **ETH Converter n** > **Running Parameters**, and set **Device name** to **ETH Converter n_Device name**.

Parameter	Setting
Device attribute	Select **UPS** from the drop-down list box.
Device Type	Select **UPS5000** from the drop-down list box.
Connect To	Select **ETH Converter n** from the drop-down list box.
Communications Port	Select **COM1/COM2** from the drop-down list box.
Device Address	**1** in this example (Enter the actual device address.)

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- When connecting devices, you are advised to add devices one by one to ensure that the displayed view is consistent with the actual device. If all devices have been added and powered on, only the BLINK function of the ETH converter can be used to identify the mapping between the UPS5000-E and ETH converter.

PUE Configuration (1)

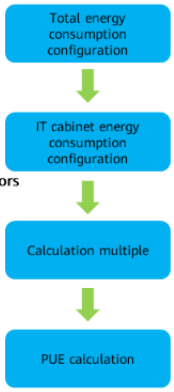
- The PUE configuration mode can be set to **Standard** and **User-defined** on the ECC800-Pro WebUI. You can enable PUE functions and select a PUE configuration mode based on requirements.
- The app automatically displays the PUE and energy consumption calculated by the ECC800-Pro.
- The ECC800-Pro connects to the NetEco over a northbound port and can upload the calculated PUE and energy consumption data to the NetEco.
- Setting the PUE mode to **Standard**:
  - Choose **System Settings** > **PUE Configuration**.
  - Ensure that **PUE function** is set to **Enable**.
  - Set **PUE configuration mode** to **Standard**, and click **Submit**.
  - View the PUE. Choose **Query** > **Performance Data** and set **Device** to **ECC800** from the drop-down list box. Set other search criteria such as **Performance Data**, **Statistics mode**, **Start Time**, and **End Time** as required, and click **Query**. You can also view the PUE in the dashboard or curve on the home page.

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- Supports user-defined settings of the PUE and energy consumption on the ECC800-Pro WebUI.
- The app automatically displays the PUE and energy consumption calculated by the ECC800-Pro.
- The ECC800-Pro connects to the NetEco over a northbound port and can upload the calculated PUE and energy consumption data to the NetEco.

PUE Configuration (2)

- Setting the PUE mode to **User-defined** (using the integrated PDU as an example):
  - Choose **System Settings** > **PUE Configuration**.
  - Ensure that **PUE function** is set to **Enable**.
  - Set **PUE configuration mode** to **User-defined**, and click **Submit**.
    - On the **Total Power Consumption Configuration** tab page, click **Add** to enter the **Total Power Consumption Configuration** page. On the **Select Device** tab page, select **Integrated PDU 1**. On the **Select Indicators** tab page, select **Total active electricity energy of PDU input**, and click **Confirm**.
    - On the **IT Cabinet Power Consumption Configuration** tab page, click **Add** to enter the **IT Cabinet Power Consumption Configuration** page. On the **Select Device** tab page, select **Integrated PDU 1**. On the **Select Indicators** tab page, select **1QF4 electricity energy**, **1QF5 electricity energy**, and **1QF6 electricity energy**, and click **Confirm**.
    - Under **Total Power Consumption Configuration** and **IT Cabinet Power Consumption Configuration**, click the edit icon on the right to modify the multiple for calculating indicators.
  - Calculate the PUE of the smart module. PUE = Increment in total system input electrical energy/Increment in total electrical energy of system IT load output
  - You can also view the PUE in the dashboard or **PUE Chart** on the home page.



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- Supports user-defined settings of the PUE and energy consumption on the ECC800-Pro WebUI.
- The app automatically displays the PUE and energy consumption calculated by the ECC800-Pro.
- The ECC800-Pro connects to the NetEco over a northbound port and can upload the calculated PUE and energy consumption data to the NetEco.

Cooling Capacity Management: Setting the iCooling Function

- The iCooling linkage function enables the smart cooling product to quickly respond to load changes and implement on-demand cooling. Based on the energy efficiency feature of the smart cooling product, the iCooling linkage function can be used to optimize and adjust multiple smart cooling products in a smart module as well as the indoor and outdoor units of a smart cooling product to achieve optimal energy efficiency without hotspots.
- Setting the iCooling function:
  - If the iCooling function is required, choose **Monitoring** > **Cooling** > **Running Parameters**. On the iCooling parameter setting page, set **Enable iCooling** to **Yes** and click **Submit** to finish the iCooling function setting.
  - Set the iCooling temperature setpoint and humidity setpoint according to the actual environment.
  - Choose **Monitoring** > **Cooling** > **Running Parameters** to access the **Temperature and Humidity Parameters** page. Set **Temperature and humidity control type** to **Cold-aisle**.



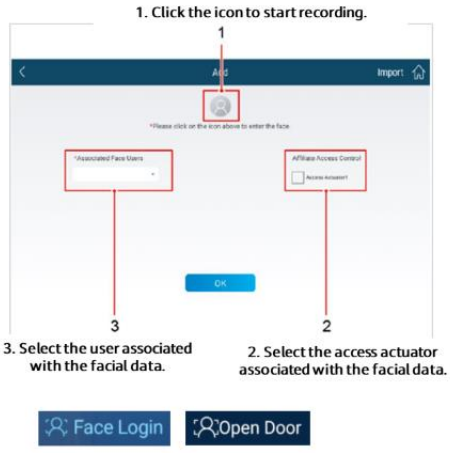
Setting the iCooling function

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- In March 2020, air cooled smart cooling products NetCol5000-A025, NetCol5000-A042, and NetCol5000-A050 support iCooling linkage.

Facial Recognition

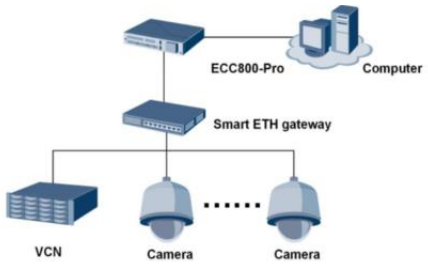
- The ECC800-Pro supports the facial recognition function to open the access control system. The facial recognition setting needs to be performed on the pad.
- Recording facial data:
  - On the main screen of the app, tap to enter the **Edit** page and select **Face Account Management**. After reading the message, tap **OK**.
  - Tap **Add** to record facial data.
  - Tap **OK** to complete the setting.
- Use either of the following methods to open the access control system using facial recognition:
  - When you want to open the access control system using facial recognition for the first time, tap **Face Login** on the FusionModule app login screen and align the face with the green circle on the screen. After facial recognition is successful, log in to the app as an administrator to open the access control system at the same time.
  - Tap **Open Door** in the upper-left corner of the FusionModule app home screen and align the face with the green circle on the screen. After facial recognition is successful, the access control system is opened.



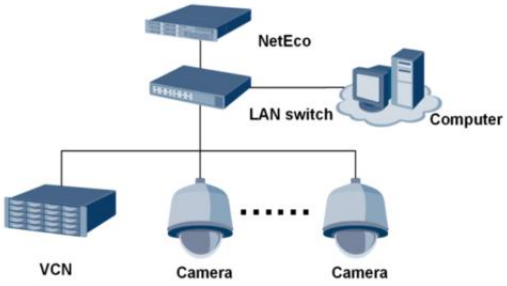
HUAWEI

Video Management (1)

- The ECC800-Pro video management scenarios are as follows.



Camera and VCN connecting to a smart ETH gateway



Camera and VCN connecting to a LAN switch

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Video Management (2)

- Smart ETH gateway networking scenario: If there are multiple smart modules and multiple VCNs, it is recommended that cameras be evenly allocated to each VCN. A maximum of four cameras can be connected in the smart ETH gateway networking scenario.
- Commissioning the IP camera (IPC6325):
  - Logging in to the camera WebUI and enabling ONVIF
    - Remove the cable between the camera and the ECC800-Pro, connect the PC to the camera, and reset the camera.
    - Open a web browser, enter **https://192.168.0.120** in the address box, and press **Enter**. Enter the default user name **admin** and default password **HuaWei123**, and click **Login**. The camera WebUI is displayed.
    - Choose **Settings** > **Network** > **Platform Connection** > **Second Protocol Parameters**, and select **Enable ONVIF**.
    - Remove the cable between the PC and the camera, and connect the PC to the ECC800-Pro and ECC800-Pro to the camera.

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- When you log in to the camera WebUI for the first time, you need to set the Internet Explorer browser, including disabling the proxy server, enabling the ActiveX control, enabling TLS 1.1, and disabling the pop-up blocker.

Video Management (3)

- Commissioning the IP camera (IPC6325):
  - Setting the IP address of the camera
    - On the ECC800-Pro WebUI, choose **System Settings** > **Video Management** and search for the camera. In the search result, select the required camera and click the link under **Link** to access and log in to the camera WebUI. Enter the preset user name **admin** and preset password **HuaWei123**, and click **Log In**.
    - Choose **Settings** > **Network** > **TCP/IP**, set **Way to obtain IPv4** to **Use the following IP address** and set an IP address for the camera. The IP address should be in the range of **192.168.248.50** to **192.168.248.199**.
  - Entering the camera or VCN information
    - Click **Add** under **Video Information**. In the **New Video Information** dialog box that is displayed, enter camera or VCN information.
    - The information includes **Name**, **External IP**, **Internal IP**, **Video Type**, and **Link**.
  - After the preceding operations are complete, you can click the link to go to the camera WebUI to view video information.

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- When you log in to the camera WebUI for the first time, you need to set the Internet Explorer browser, including disabling the proxy server, enabling the ActiveX control, enabling TLS 1.1, and disabling the pop-up blocker.

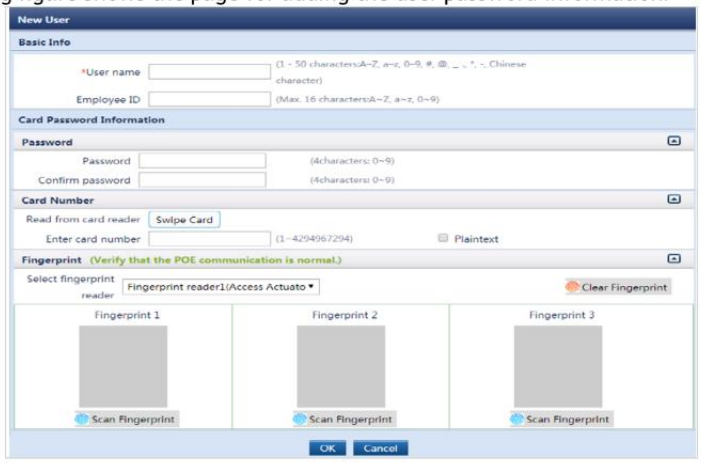
Access Control Management (1)

- The administrator can use the ECC800-Pro to create users, select the authentication mode, and manage smart module access permissions. Access users created on the ECC800-Pro WebUI can be synchronized to the NetEco.
- Set the access user management and access permission management.
  - Choose **System Settings** > **Access Management**. The **Access Management** page is displayed. The system supports the management of various access permissions through the access card, password, and fingerprint.
  - Setting the authentication mode: Click **Set Authentication Mode** to set the authorization mode of the access actuator. Select **Card**, **Fingerprint**, **Card and password**, **Card and fingerprint**, **Fingerprint and password**, **Card, password and fingerprint**, or **Card, password or fingerprint**. Select the configured access actuator and click **OK** to complete the setting.
  - Adding a user: On the **Authorization Operations** tab page, click **Add** to access the new user page. On the **Basic Info** tab page, enter **User name** and **Employee ID**.
  - Information input: On the **Password** tab page, record the password, card number (recorded directly or by swiping the card), and fingerprint.
  - Authorization: On the **Authorization Information** and **Term of Authorization** tab pages, select access users whose access permissions are to be set, and set **Authorized Device**, **Authorization Mode**, **Cabinet Lock**, **Start time**, and **End time**.
  - Synchronizing access permissions: On the **Authorization Operations** tab page, click **Synchronize to Device**, select the modified access control device, and click **Start Synchronization**.

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Access Control Management (2)

- The following figure shows the page for adding the user password information.



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- Each fingerprint needs to be recorded for three times.

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Routine Maintenance

- To ensure the normal operation of the ECC800-Pro, you need to perform routine maintenance on the PSU and main control module.

Item	Maintenance Content	Expected Result	Troubleshooting Method
PSU	AC input	Input voltage: 200–240 V AC Frequency: 45–66 Hz	If the input voltage is abnormal, check the power grid and input cable connection.
	Output voltage	Output voltage: 53.5 V DC (tolerance: ±5%)	If the output voltage is abnormal, check the load status and cable connections.
	Indicator	The indicator is steady green. It becomes red if a fault occurs.	Check the output voltage and determine whether the PSU is faulty. If the PSU is faulty, replace it.
	Fan	No abnormal noise is generated.	If abnormal noise is generated, clean the fans.
Main control module	Module indicator	The module indicator is steady green or blinking green.	If the indicator is off or other exceptions occur, rectify the fault based on the actual situation.
	Network port indicator	The green indicator is steady on, and the yellow indicator is blinking.	If the indicator status is abnormal, check the network cable connection.
General	Operating environment	Ambient temperature: –20° C to +50° C Humidity: 0%–95% RH (non-condensing)	If the humidity and temperature are abnormal, check the smart cooling product status.
	Cable connection	The cable connections are secure. The cables are intact.	Secure loose cables. Replace damaged cables.

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Common Faults and Troubleshooting (1)

- If problems are found during routine maintenance, handle them in a timely manner to ensure system security.

Item	Symptom	Possible Cause	Troubleshooting Method
PSU	The power indicator (green) is off.	The PSU has no AC input.	Check the AC input.
		The PSU is faulty.	Replace the PSU.
	The alarm indicator (yellow) is on.	Overtemperature protection has been triggered.	If the ambient temperature is too high, add smart cooling products. If the air channel is blocked, clean the air channel.
		AC input overvoltage or undervoltage protection has been triggered.	Check the AC input.
	The alarm indicator (yellow) is blinking.	Communication with the PSU is interrupted.	Clean the connector in the rear of the faulty PSU. If the fault persists, replace the ECC800-Pro subrack.
		Communication with the main control module is interrupted.	
	The alarm indicator (red) is on.	Output overvoltage protection has been triggered.	If the PSU is locked out, disconnect the AC input from the PSU, and then power on the PSU again after the indicator turns off. If the fault persists, replace the PSU.
		There is no output due to a PSU fault.	Replace the faulty PSU.

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Common Faults and Troubleshooting (2)

- If problems are found during routine maintenance, handle them in a timely manner to ensure system security.

Item	Symptom	Possible Cause	Troubleshooting Method
Main control module	The running indicator (green) is off.	The PSU has no AC input.	Check whether the green indicator on the PSU is on. If yes, the power input is normal. If no, rectify the power grid fault.
		The main control module is faulty or not securely installed.	Reinstall the main control module. If the fault persists, replace the main control module.
	The RJ45 power output indicator is off.	The corresponding port has no power output.	Energize the corresponding power port over the WebUI or network management system.
		The corresponding power port is short-circuited.	Check whether the connected load is short-circuited. If yes, rectify the fault.
	The ALM indicator (red) is on.	Faults and alarms are generated.	View current alarms on the WebUI and clear them one by one.

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Precautions for Component Replacement

- The requirements for replacing ECC800-Pro components are as follows:
  - After replacing components, log in to the WebUI and choose **Maintenance** > **Parameter Sync** to access the parameter synchronization page.
  - Click **Device type** and select the component type from the drop-down list.
  - Select the faulty device in **Source Device**, select the reserved device in **Target Device**, and click **Submit** to synchronize the configuration parameters of the faulty device to the reserved device.
  - On the **Monitoring** > **System** > **ECC800** > **Controls** tab page, select **Delete device with communication failure**, click **Submit**, and add the reserved device to the smart module view.

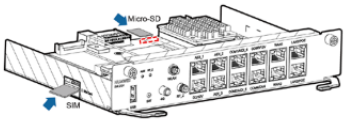
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Replacing an ECC800-Pro Main Control Module

- Use the **Back Up Current Settings** function to record the ECC800-Pro configuration information or manually record the information. Choose **Maintenance** > **Configuration File** > **Back Up Current Settings**.
- Label each cable and antenna (by taking photos or recording manually) based on the corresponding ports on the ECC800-Pro main control module.
- Remove cables, USB flash drive, USB-to-WiFi module, and antennas from the ECC800-Pro main control module.
- Loosen the captive screws on both sides of the ECC800-Pro main control module and pull the handles on both sides of the module to remove the module.
- (Optional) Remove the microSD card and SIM card from the corresponding slots of the replaced ECC800-Pro main control module, and install them in the new main control module.
- Install the new ECC800-Pro main control module in the ECC800-Pro subrack and tighten the screws on both sides of the ECC800-Pro main control module. Connect the communications cables and antennas to the ECC800-Pro main control module.
- Choose **Maintenance** > **Configuration File** and import the backup configuration file, or set parameters for the devices that connect to the ECC800-Pro to ensure normal communication.



Removing the ECC800-Pro main control module

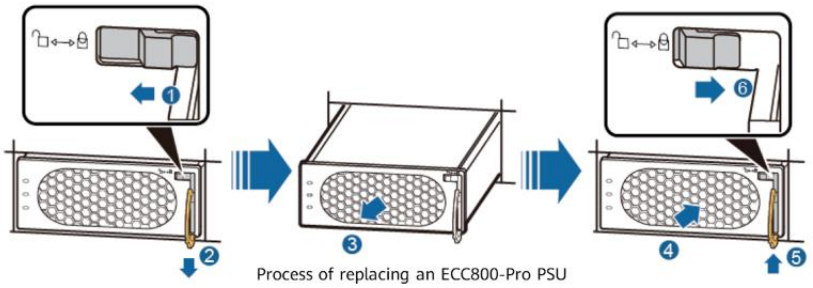


Installing the microSD card and SIM card

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Replacing an ECC800-Pro PSU

- The ECC800-Pro can be configured with two PSUs. Replace a PSU with caution to avoid misoperations.
- Push the locking latch in the upper right corner of the ECC800-Pro PSU panel leftward to open the lock.
- Pull the handle outwards to remove the PSU from the subrack.
- Gently push the new PSU into the subrack along the guide rails, and push the locking latch rightward to secure the handle.



Process of replacing an ECC800-Pro PSU

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Quiz

1. (Single) Delivery engineers can access the ECC800-Pro WebUI over the WAN1 port. The default IP address of the WAN1 port is ( ).
   A. 192.168.1.10
   B. 192.168.8.10
   C. 192.168.0.10
   D. 192.168.10.8
2. (Multiple) Which of the following display modes are supported by the ECC800-Pro? ( )
   A. WebUI
   B. Mobile app
   C. Pad app

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- Answer:
  - 1. B
  - 2. A, B, and C

Summary

- This chapter describes the following aspects:
  - Basic features and user interface of the ECC800-Pro.
  - ECC800-Pro commissioning process, common operations, and precautions.
  - Routine maintenance, troubleshooting, and parts replacement procedures of the ECC800-Pro.

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Thank you.

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每个组织，构建万物互联的智能世界。

Bring digital to every person, home, and organization for a fully connected, intelligent world.

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Huawei DCIM Management Tool Introduction

PowerEcho



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Foreword

- The slides describe the Huawei data center infrastructure management (DCIM) tool PowerEcho in terms of its deployment commissioning, system monitoring, backup and restore functions.

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Objectives

On completion of this course, you will be able to:

- Understand the relationship and differences between the PowerEcho and NetEco.
- Master the deployment commissioning function of the PowerEcho.
- Master the system monitoring function of the PowerEcho.
- Master the backup and restore functions of the PowerEcho.

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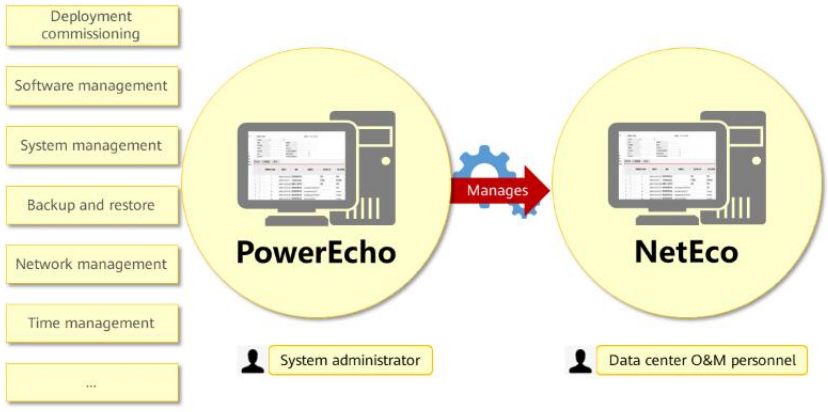
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What is PowerEcho?

- The PowerEcho is a tool used for maintaining the NetEco. It provides a unified maintenance platform and a graphical user interface (GUI) for the NetEco.

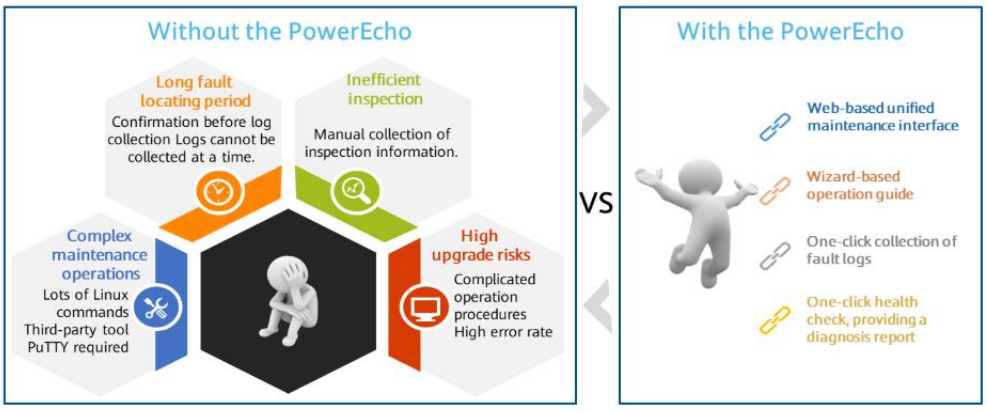


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- Developed based on CloudSOP-UniEP, the PowerEcho serves as a maintenance plane of the NetEco product. It provides functions such as deployment commissioning, software management, certificate management, system monitoring, user and password management, time management, network management, and backup and restore.
- CloudSOP-UniEP: Cloud Service Operation Platform - Union Enterprise Platform
- Developed based on CloudSOP-UniEP, the PowerEcho serves as a maintenance plane of the NetEco product. It provides functions such as deployment commissioning, software management, certificate management, system monitoring, user and password management, time management, network management, and backup and restore.
- The NetEco is a data center infrastructure management system. It can manage the following devices and subsystems in the FusionModule500, FusionModule800, FusionModule1000, FusionModule2000, FusionModule5000: air conditioners, uninterruptible power system (UPS), power distribution frames (PDFs), environment sensors, cameras, and access control devices, as well as the power transformation and distribution subsystem, chiller group control subsystem, building automation subsystem, and security subsystem.
- The NetEco provides basic and various optional network management functions, including configuration management, alarm management, asset lifecycle management, capacity management, energy efficiency management, tenant management, video management, access control management, intelligent O&M, security management, log management, and system management.

Advantages of PowerEcho

- The PowerEcho greatly simplifies the maintenance of the NetEco and brings great convenience to the data center O&M personnel.



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- PuTTY is a free SSH/Telnet program. It can be connected to a site that supports SSH/Telnet and can automatically obtain the fingerprint of the site's system.

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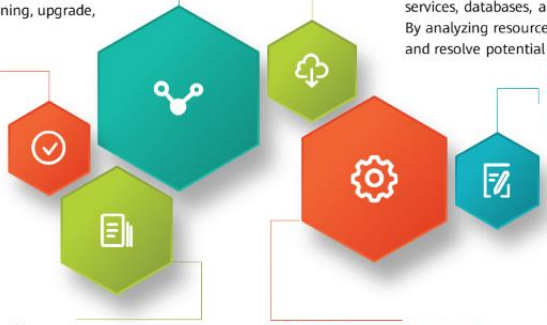
PowerEcho Functions

NetEco deployment

Provides functions such as NetEco deployment commissioning, upgrade, and uninstallation.

System monitoring

Centrally monitors resource indicators of nodes, services, databases, and processes of the NetEco. By analyzing resource indicators, you can detect and resolve potential risks in a timely manner.



Backup and restore

Backed up files can be saved to the corresponding backup server based on the preset backup server and backup file storage policy.

Network management

On the PowerEcho, you can configure the network information of each node in the system in a unified manner to ensure the normal running of the system and normal communication between nodes.

Time management

To ensure time consistency and accuracy of system nodes, configure an external clock source that uses the standard Network Time Protocol (NTP) as the NTP server. If the IP address of the NTP server is changed, modify related configurations.

Service and database management

Starts or stops product services and databases based on user requirements.

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Precautions for the PowerEcho

- All PowerEcho operations must be performed on the PowerEcho WebUI that you have logged in to. In NetEco V600R009C00, the PowerEcho login port number is 31945. The login address is **https://PowerEcho server IP address:31945**.
- The PowerEcho is a NetEco maintenance tool. It is recommended that only the administrator be granted with PowerEcho operation rights.
- The PowerEcho supports only one user **admin** who has all the operation rights on the PowerEcho WebUI. The preset password is **Changeme_123**.
- If you enter incorrect passwords of user **admin** for five consecutive times within 10 minutes, the login IP address will be locked for 10 minutes.
- If the password of user **admin** is lost, you need to reinstall the PowerEcho to restore the password.

Item	Requirements
Operating system (OS)	Windows Server 2008 or Windows 7, or later
Browser	You are advised to use the latest Chrome browser (Stable Channel version) or Firefox browser (ESR version).
Resolution	Recommended resolution: 1366 x 768 or higher; optimal resolution: 1920 x 1080

- The following table lists the PC configuration and software requirements for logging in to the PowerEcho.

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Deployment Commissioning (1)

- Before using the NetEco for the first time, you need to commission the NetEco by using the PowerEcho, and commission the PowerEcho as well, to improve the overall commissioning efficiency.
- The deployment commissioning items are as follows:

Commissioning Item	Description
Commissioning preview	Export configurations of the current system and archive them.
Change OS user passwords	Commissioning is recommended. To ensure system security, change the initial password and keep the new password properly.
Change the database user password	Commissioning is recommended. To ensure system security, change the initial password and keep the new password properly. After the modification, you need to restart the system services.
Configure the time zone and time.	•Set the node time to be the same as that of the NTP server to ensure that each node can synchronize time with the NTP server. •If the time zone of a node is different from that of the NTP server, you are advised to change the time zone to the same one. •After the modification, you need to restart the system services.
Configure NTP.	Add an NTP server to ensure time consistency between nodes.
Change the host name.	Commissioning is recommended. Set to the planned host name.
Configure the IP address.	Commissioning is recommended. Set to the planned IP address. After the modification, you need to restart the system services.

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Deployment Commissioning (2)

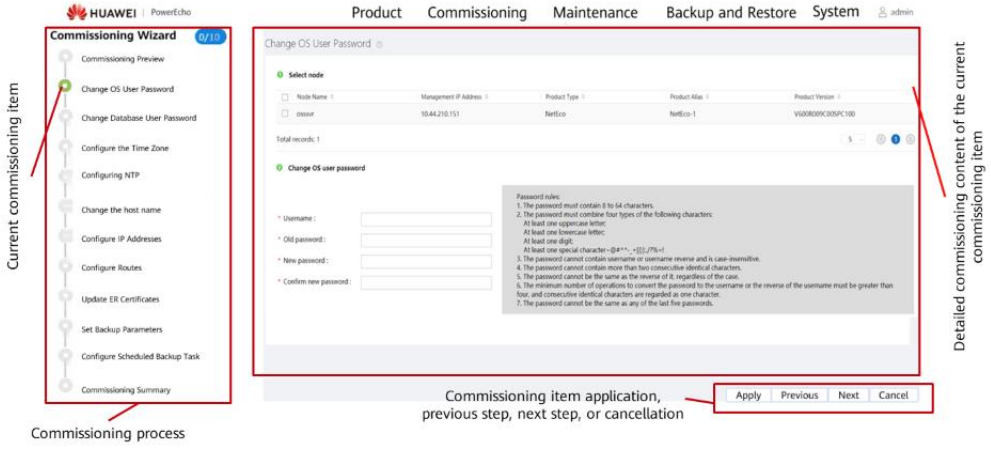
- Before using the NetEco for the first time, you need to commission the NetEco by using the PowerEcho, and commission the PowerEcho as well, to improve the overall commissioning efficiency.
- The deployment commissioning items are as follows:

Commissioning Item	Description
Configure routes.	Commissioning is recommended. Set to the planned route.
Update ER certificates.	Commissioning is recommended. To ensure communication security, apply for certificates from the CA and update the preconfigured ER certificates.
Configure backup parameters.	Commissioning is recommended. After setting backup server parameters and backup file storage policies, you can save backup files to the corresponding backup server. By default, the master server is configured as the backup server. If you want to back up the data to the local host, you are advised to use the **backupuser**. The backup path is the backup path specified by **/root directory of the backup server user/path specified in the backup parameters**, for example: **/opt/neteco_backup/**. If the data is backed up to other servers, the customer needs to provide the corresponding IP address, user name, password, and backup path.
Configure scheduled backup tasks.	Commissioning is not required. After the product planning data package is imported, the system automatically creates a scheduled backup task for the product.
Commissioning summary	Check whether any commissioning operation is missing and whether the current system configuration information is correct.

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Deployment Commissioning (3)

- The following figure shows the deployment commissioning UI.



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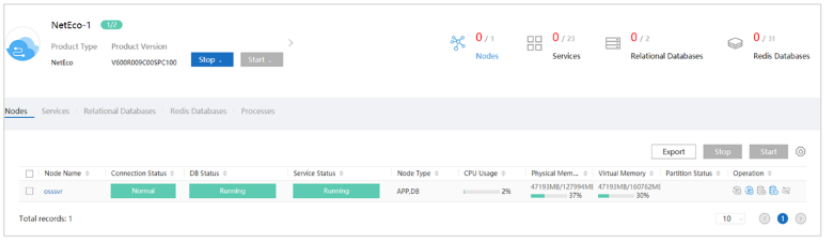
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System Monitoring - Basic Information

- After a product is installed on the PowerEcho, you can use the system monitoring function to monitor resource objects such as nodes, services, and databases of the PowerEcho and NetEco to detect and rectify exceptions in a timely manner, ensuring efficient running of servers and normal use of products.



- The PowerEcho can centrally monitor resource indicators of nodes, services, databases, and processes of the NetEco. By analyzing resource indicators, you can detect and resolve potential risks in a timely manner. The monitoring periods are as follows:

Monitored Object	Node	Service	Relational Database	Redis Database
Monitoring Period (Seconds)	60	30	180	180

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- Node: installed servers. In the single-node system scenario, the number of nodes is 1.
- Service: NetEco service functions
- Relational database: a database created on the basis of a relational model for storing persistent data, such as the GaussDB 100 database The PowerEcho monitors the disk usage of relational databases. This helps you identify and handle insufficient database space in a timely manner.
- Redis database: a high-performance key-value database for storing status-related cache data The PowerEcho monitors the memory usage of Redis databases. This helps you identify and handle insufficient memory space in a timely manner.
- In the upper-right corner of the UI, check whether abnormal resources exist for Nodes, Services, Relational Databases, or Redis Databases. In the preceding figure, the number in red indicates the number of abnormal resources, and the number in gray indicates the total number of resources.

System Monitoring - Monitoring Products (1)

- The system monitoring function monitors the status of all nodes in the PowerEcho and NetEco to detect and rectify faults in a timely manner, ensuring efficient running of node servers.
- The node status table on the right helps the administrator determine the working status of the current node based on the node status.

Object	Status	Meaning
Connection status	Normal	The node is properly connected to the PowerEcho.
	Disconnected	The node fails to connect to the PowerEcho.
Database status	N/A	The node does not have a database.
	Partially running	Some database instances on the node are not running.
	Not running	All database instances on the node are stopped.
	Running	The database instances on the node are running properly.
	Unknown	The system cannot detect the database instance status of the node.
	Starting	All database instances on the node are being started.
	Stopping	All database instances on the node are being stopped.

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- If the node status is abnormal, perform the following operations:
  - Abnormal connection status:
    - Click the abnormal node and view the space usage and process status of each disk on the details page.
    - An alarm is reported if the node status is abnormal. Rectify the fault based on the alarm information.
- Abnormal database status:
  - Partially running: An alarm is reported if the database status is abnormal. Rectify the fault based on the alarm information.
  - Not running: Some maintenance operations require that the database is not running. Determine whether the database is abnormal based on the site requirements.
  - Unknown: Collect related information and contact Huawei technical support.
  - Starting or stopping: If the service is being started or stopped for a long time, contact Huawei technical support.

System Monitoring - Monitoring Products (2)

Object	Status	Meaning
Service status	Uninstalled	The node service is not installed.
	N/A	The node does not provide services.
	Partially running	Some processes on the node are not running.
	Not running	All services on the node are stopped.
	Running	All services on the node are running.
	Unknown	The system cannot detect the service status of the node.
	Faulty	Some services on the node are faulty.
	Starting	All services on the node are being started.
	Stopping	All services on the node are being stopped.

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- Abnormal service status:
  - Partially running: On the Nodes tab page, click the node name. On the node details page, view the processes that are not running and determine whether the processes are abnormal based on the site requirements.
  - Not running: Some maintenance operations require that the service is not running. Determine whether the service is abnormal based on the site requirements.
  - Unknown or faulty: An alarm is reported when the service status is abnormal. Rectify the fault based on the alarm information.
  - Starting or stopping: The duration for starting or stopping a single service does not exceed 1 minute. If the service is in this state for a long time, contact Huawei technical support.

System Monitoring - Monitoring Products (3)

- The system monitoring function monitors the status of all services and databases (relational databases and Redis databases) in the PowerEcho and NetEco to detect and rectify faults in a timely manner and ensure the normal running of services and databases.
- The PowerEcho monitors services in the system every 30 seconds. The following table describes the service status.

Status	Meaning
Partially running	Some processes of the service are not running.
Not running	All processes of the service are stopped.
Running	All processes of the service are running.
Unknown	The system cannot detect the process status of the service.
Faulty	Some processes of the service are faulty.
Starting	All processes of the service are being started.
Stopping	All processes of the service are being stopped.

- The PowerEcho monitors the database in the system every 180 seconds. The following table describes the database status.

Status	Meaning
Not running	The database has been stopped.
Unknown	The system cannot detect the database status.
Running	The database on the node is normal.

- The PowerEcho monitors processes in the system every 30 seconds. The following table describes the process status.

Status	Meaning
Not running	The process is stopped.
Running	The process is running.
Unknown	The system cannot detect the process status.
Faulty	The process is faulty.
Starting	The process is being started.
Stopping	The process is being stopped.

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- Abnormal service status:
  - Not running: Some maintenance operations require that the service is not running. Determine whether the service is abnormal based on the site requirements.
  - Unknown: An alarm is reported when the service status is abnormal. Rectify the fault based on the alarm information.
  - Faulty: An alarm is reported when the service status is abnormal. Rectify the fault based on the alarm information.
  - Starting or stopping: The duration for starting or stopping a single service does not exceed 1 minute. If the service is in this state for a long time, contact Huawei technical support.
- Abnormal database status:
  - Not running or unknown: An alarm is reported if the database status is abnormal. Rectify the fault based on the alarm information.

System Monitoring - Modifying Monitoring Thresholds (1)

- The following table lists the resource objects whose thresholds can be set and the default monitoring thresholds.
  - X indicates the value of alarm generation threshold, Y indicates the value of alarm clearance threshold, and N indicates the overload times. Y must be less than X.

Monitored Item	Resource Object	Condition for Reporting a Resource Alarm	Condition for Clearing a Resource Alarm
Node	CPU	The CPU usage sampled every 15 seconds for N consecutive times is greater than or equal to X%. Default value: N = 40, X = 85	The CPU usage sampled at a time is less than X%. Default value: X = 85
	Physical memory	In a detection period (15 seconds), the physical memory usage is greater than or equal to X%. Default value: X = 85	The physical memory usage is less than or equal to Y%. Default value: Y = 80
	Virtual memory	In a detection period (15 seconds), the virtual memory usage is greater than or equal to X%. Default value: X = 85	The virtual memory usage is less than or equal to Y%. Default value: Y = 80
	Disk partition	In a detection period (15 seconds), the disk partition usage is greater than or equal to X%. Default value: X = 80	The disk partition usage is less than or equal to Y%. Default value: Y = 75
Relational database	Database tablespace usage	In a detection period (180 seconds), the database tablespace usage is greater than or equal to X%. Default value: X = 95	The database tablespace usage is less than or equal to Y%. Default value: Y = 85
Redis database	Memory	In a detection period (180 seconds), the memory usage is greater than or equal to X%. Default value: X = 80	The memory usage is less than or equal to Y%. Default value: Y = 70

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- The PowerEcho can report alarms when resources are abnormal. The system provides default monitoring thresholds for resource objects of nodes, relational databases, and Redis databases. When the monitored value of a resource object reaches the alarm generation threshold, the PowerEcho reports an alarm and the NetEco receives an alarm notification. If an alarm is frequently reported because the default monitoring threshold does not match the resource usage, you can modify the monitoring threshold as required.

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Backup and Restore - Basic Information

- To ensure the reliability of the PowerEcho and NetEco, you need to periodically back up the OS, application, and product data. If an exception occurs on the PowerEcho or NetEco, the backup data can restore the PowerEcho or NetEco to the status before the backup.
- Backup and restore process:
  - After a backup server is configured, product data and applications are backed up to it. The system uses the Secure File Transfer Protocol (SFTP) to transfer backup data to the backup server for storage. The backup of each type of data is independent and **does not depend on each other**.
  - If PowerEcho or NetEco data is lost or damaged, you can use the data restoration function to restore the data. Data restoration depends on each other. Before restoring upper-layer data, ensure that its lower-layer data is normal. For example, before restoring the product data, ensure that the application and OS data is normal.
- Configuration requirements

Configuration Item	Description
Database type	GaussDB 100 and Redis
OS	EulerOS
Disk space	Calculate the backup server space required by each product and PowerEcho in different network scales based on the actual situation.
Data transfer protocol	SFTP

- Backup content

Backup Item	Backup Content
Product data	Database data and **/opt/neteco/influxdb/database**
Product application	**/opt/oss/NetEco**
Database application	**/opt/zenith** (excluding dynamic service data files)

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- SFTP: Secure File Transfer Protocol.
- Application data: data that does not change in real time during system running, including product applications (such as files in the /opt/oss directory) and database applications (such as files in the /opt/redis and /opt/zenith directories)
- Product data: database data and configuration files that change in real time during system running, for example, files in the /opt/oss/envs directory
- Scheduled backup: Data is automatically backed up to the backup server at a specified time. Three backup modes are available: default scheduled backup, one-time scheduled backup, and periodic scheduled backup.
- Manual backup: Manually back up the data before a certain time point to the backup server.

Backup and Restore - Backup Policy (1)

- The recommended backup policies in different scenarios are as follows:

Scenario	Scenario Description	Backup Object
Initial installation and commissioning	After the PowerEcho and product have been installed and commissioned.	• Applications and data of the PowerEcho • Applications and data of the product
Modify major configurations	For example, after the IP address or route is changed.	• Applications and data of the product • Applications and data of the PowerEcho
	For example, after the database user password of the management node is changed.	Applications and data of the PowerEcho
Upgrade or install a patch	Before the OS is upgraded or a patch is installed.	• Applications and data of the product • Applications and data of the PowerEcho
	Before the product application is upgraded. After the product application is upgraded.	Applications and data of the product
	Before the database application is upgraded or a patch is installed. After the database application is upgraded or a patch is installed.	• Applications and data of the product • Applications and data of the PowerEcho
	Before the PowerEcho is upgraded or a patch is installed. After the PowerEcho is upgraded or a patch is installed.	Applications and data of the PowerEcho
Routine maintenance	Routine maintenance	• Applications and data of the product • Applications and data of the PowerEcho

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- Backup task execution sequence:
  - For the same product, tasks for backing up the OS and product data that are scheduled to start at the same time are executed concurrently. Other backup tasks scheduled to start at the same time are executed in serial mode, that is, the system executes the backup tasks in sequence based on their creation time.
  - For different products, tasks for backing up the PowerEcho and other data that are scheduled to start at the same time are executed in serial mode. The system executes the backup tasks in sequence based on the task creation time. Other backup tasks that are set to start at the same time are executed concurrently.

Backup and Restore - Backup Policy (2)

- Backup file storage threshold: indicates the maximum number of latest backup files that can be stored. When the number of backup files exceeds the storage threshold, the system automatically deletes the earliest backup files to ensure that the number of backup files does not exceed the threshold. The backup file storage thresholds are as follows:

Item	Number of Backup Files	Description
Product data	30	The value ranges from 1 to 100 and can be manually configured.
Product application	5	The value is unconfigurable.
Database application	5	The value is unconfigurable.
PowerEcho	3	The value ranges from 1 to 10 and can be manually configured.

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Backup and Restore - Restore Policy (1)

- The recommended restore policies in different scenarios are as follows:

Scenario	Scenario Description	Restoration Object
The physical machine (PM) is faulty.	If the management node and product node are different, the PM where the product node resides is faulty.	Product node
	If the management node and product node are the same and use the same or different database software, the PM where the node resides is faulty.	Management node and product node
The virtual machine (VM) is faulty.	If the management node and product node are different, the VM where the product node resides is faulty.	Product node
	If the management node and product node are the same and use the same or different database software, the VM where the node resides is faulty.	Management node and product node
The database is faulty.	If the management node and product node are different, the database files of the product node are damaged but the OS of the database node is running properly.	Database application of the product
	If the management node and product node are the same and use the same or different database software, the database files are damaged but the OS of the database node is running properly.	PowerEcho and product database application

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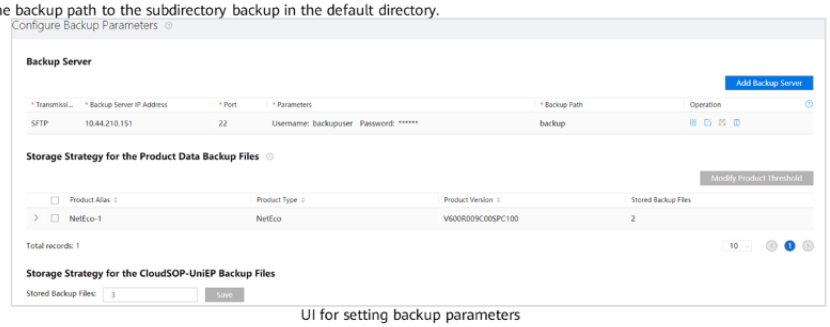
Backup and Restore - Restore Policy (2)

Scenario	Scenario Description	Restoration Object
The product application is faulty.	The product application is abnormal, but the OS of the product node is running properly.	Product application
Product data is faulty.	The database instance is running properly, but the product data is abnormal. As a result, the product cannot be used.	Product data
Upgrade or patch rollback	Database applications fail to be upgraded due to incorrect upgrade operations.	Database application
	Product applications fail to be upgraded due to incorrect upgrade operations.	Product application
The PowerEcho is faulty.	If the management node and product node are the same and use the same or different database software, the PowerEcho cannot be accessed due to a PowerEcho service or database exception.	Application and data of the PowerEcho and product

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Backup and Restore - Setting Backup Parameters

- Files are backed up to the corresponding backup server according to the preset backup policy. Configure backup server parameters and backup file storage policies before backing up data.
- A maximum of 10 backup servers can be added on the PowerEcho. If multiple backup servers are configured, the same backup files are stored on each backup server. If a backup server is faulty, other backup servers can still provide backup files for data restoration.
  - Set the backup path to the subdirectory backup in the default directory.



UI for setting backup parameters

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Backup and Restore - Backing up a Product on a Scheduled Basis

- When a product is running properly, you can create scheduled tasks for backing up its OS, applications, and data, so that the backup data is periodically saved to the backup server. If a product becomes abnormal due to misoperations or other situations, you can restore the product to the state at a certain time point.
- The backup files of the OS, application, and product data are stored on the backup server. For details about the backup file paths, see the following table. (Do not delete the backup files in these directories. Otherwise, the product cannot be restored.)

Item	Backup Path
OS	*/root directory of the backup server/path specified in the backup parameters/product name/static/timestamp/node name/OS*
Database application	*/root directory of the backup server/path specified in the backup parameters/product name/static/timestamp/node name/DB*
Product application	*/root directory of the backup server/path specified in the backup parameters/product name/static/timestamp/node name/APP*
Product data	*/root directory of the backup server/path specified in the backup parameters/product name/dynamic*

- It is recommended to manually backup PowerEcho data after initial installation of PowerEcho, before and after PowerEcho upgrade or patch installation, and before major business adjustment.

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- After the product information is imported to the PowerEcho for the first time, the PowerEcho creates a default scheduled task for backing up product data. After the product is installed and backup parameters are set, the scheduled task automatically backs up the product data at 01:00:00 every day. When a product, node, or service instance is added or deleted due to upgrade or capacity expansion, the modified data is automatically backed up in the scheduled backup task after the upgrade or capacity expansion is complete.

Backup and Restore - Restoring Products (1)

- If the product cannot be used due to misoperations or other situations, you can use the backup data to restore the database applications, product applications, and product data. If you need to restore a database application, the backup files of the database application should be available. Before the restoration, the system automatically verifies the integrity of the backup data. The restoration can be performed only after the verification is successful.
- The tasks for restoring database applications include:

Task	Operation
Restore product data	Select a product and perform operations as prompted.
Restore product nodes	Select a product, click > to expand all nodes under the product, select nodes to be restored, and perform operations as prompted.

- The tasks for restoring product applications include:

Task	Operation
Restore product data	Select a product and perform operations as prompted.
Restore product nodes	Select a product, click > to expand all nodes under the product, select nodes to be restored, and perform operations as prompted.

- The tasks for restoring product data include:

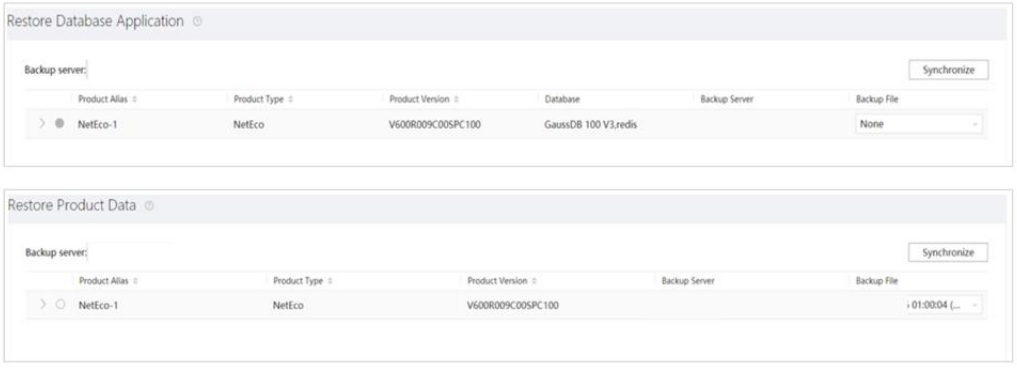
Task	Operation
Restore product data	Select a product and perform operations as prompted.
Restore services	Select a product, click > to expand all services under the product, select services to be restored, and perform operations as prompted.

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- Before a database application is restored, the PowerEcho automatically stops all NetEco services and databases on the node where the database application to be restored is located. If the services and databases cannot be stopped automatically, choose **Product** > **System Monitoring** to manually stop them. If the services or databases fail to be stopped, you need to forcibly stop them.
- Before a product application is restored, the PowerEcho automatically stops the service of the NetEco whose application is to be restored. If the service cannot be automatically stopped, choose **Product** > **System Monitoring** to manually stop it. If the service fails to be stopped, you need to forcibly stop it.
- If multiple backup servers are configured, the same backup data is stored on all backup servers during backup. Backup servers work in redundancy mode. Each backup server can provide backup data for restoration. By default, the system randomly selects one backup server. You can also select another backup server to provide backup data.
- To ensure restored data consistency, you are advised to restore the data of the entire product. Exercise caution when selecting a single service for data restoration.
- Before restoring product data, the PowerEcho automatically stops the services of the NetEco whose data is to be restored.

Backup and Restore - Restoring Products (2)

- The following show the UIs for restoring the database application and product data.



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Contents

1. PowerEcho Overview
2. PowerEcho Functions
3. **PowerEcho Main Functions**
   - Deployment Commissioning
   - System Monitoring
   - Backup and Restore
   - Other Functions

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User and Password Management

- The PowerEcho provides default users and initial passwords, and grants different operation rights to the default users. Getting familiar with these users and their rights facilitates maintenance operations. You are advised to change the passwords periodically (every three months) in compliance with password rules.
- The default user names and passwords of the OS are as follows: (To reset or retrieve the password of user **root**, you need to reinstall the OS.)

User Name	Initial Password	Description
root	Changeme_123	OS administrator. This user is used to log in to the OS of a node and is able to run all commands.
ossuser	Changeme_123	OS user. This user is created when the OS is installed. It is used to install, upgrade, and maintain the product software.
dbuser	Changeme_123	Common user. This user is created when the OS is installed. It is used to install, start, stop, and manage the Gauss or Redis database.
ossadm	Changeme_123	OS user. This user is created before the OS is installed. It is used to install, start, stop, and manage the system.
sopuser	Changeme_123	Maintenance account used to remotely log in to the management node using SSH
backupuser	Changeme_123	Backup account

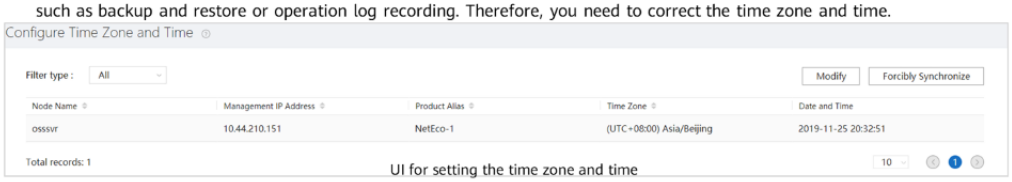
- The default user names and passwords of the NetEco Web system are as follows:
  - NetEco & PowerEcho default client: admin, Changeme_123

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- The Gauss database is an embedded database used by the management node to store service data. The Redis database caches service running data. OS user dbuser and the database user dbuser can access the Gauss database or Redis database only in a local area network (LAN). OS user dbuser and the database user dbuser have only the minimum permissions to execute their tasks.

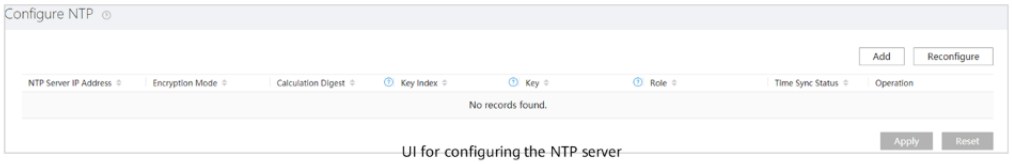
Time Management

- Changing the time zone and time: If the current time zone or time of a node is inconsistent with the local time zone or time, an error may occur during data processing or the service processing accuracy may be reduced when you perform operations such as backup and restore or operation log recording. Therefore, you need to correct the time zone and time.



UI for setting the time zone and time

- Configuring the NTP server: To ensure time consistency and accuracy of system nodes, configure an external clock source that uses the standard NTP as the NTP server. If the IP address of the NTP server is changed, modify related configurations.



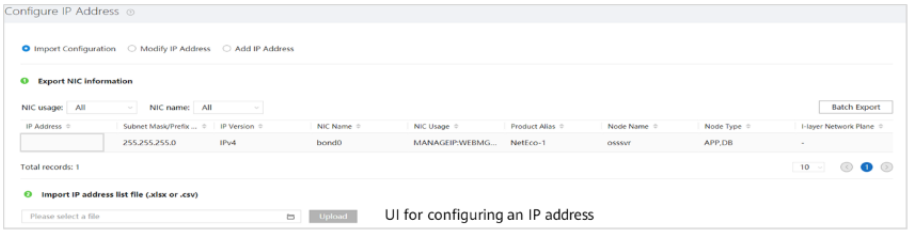
UI for configuring the NTP server

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- Forcibly synchronize the time zone and time in any of the following cases:
  - The time of the product node is inconsistent with that of the management node.
  - The time of the management node is inconsistent with that of the NTP server.
  - New product information is added.
  - An NTP server is added.
- NTP: Network Time Protocol

Network Management

- On the PowerEcho, you can configure the network information of each node in the system in a unified manner to ensure the normal running of the system and normal communication between nodes.
- Configuring an IP address: When an IP address conflict occurs on the network or the overall network plan changes (for example, an equipment room is relocated or the subnet mask is changed), change the IP address, subnet mask, and usage accordingly.
- You can also change the host name, as well as configure the network port, route, floating IP address, and southbound IP address on the PowerEcho.



UI for configuring an IP address

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- Changing the host name: To identify the meaning and function of a node on the network, you need to set a unique host name for the node.
- Configuring a network port: When the network port configuration changes (for example, an equipment room is relocated or a subnet is changed), you need to modify the network port configuration to ensure that the system runs properly. You can add a network port of a VM to the PowerEcho and then manage and maintain the network port using the PowerEcho.
- Configuring a route: When the network configuration changes (for example, an equipment room is relocated or a subnet is changed), you need to modify the route configuration to ensure that the system runs properly. If no route is configured between the system and the destination IP address, the system communicates with the destination IP address through the default route.
- Configuring a floating IP address: If the PowerEcho is deployed in cluster mode, you can configure a floating IP address for multiple nodes to prevent the system from failing to provide services due to node faults. The PowerEcho allows you to configure a floating IP address for a specified node of a product and modify or delete the added floating IP address.
- Configuring a southbound IP address: You can configure the southbound IP address based on the actual deployment scenario.

Certificate Management

- Some communication between the PowerEcho and NetEco (for example, between the client and server and between services) uses the secure SSL protocol and requires certificates. The PowerEcho supports certificate update.
- Huawei SSL certificates are preconfigured when the PowerEcho or NetEco is installed. After the PowerEcho or NetEco is installed for the first time, you can use the obtained new certificates to update the preconfigured certificates to improve the communication security of the PowerEcho or NetEco.
- Certificate principle: The SSL certificate is transmitted based on the SSL protocol and is a type of digital certificate. It is similar to the electronic copy of certificates such as the driver's license and passport and is used for identity authentication between the client and server. After the SSL encryption mechanism is used, a secure channel is established between the client and the server to ensure secure and effective communication.
- Certificate application scenarios

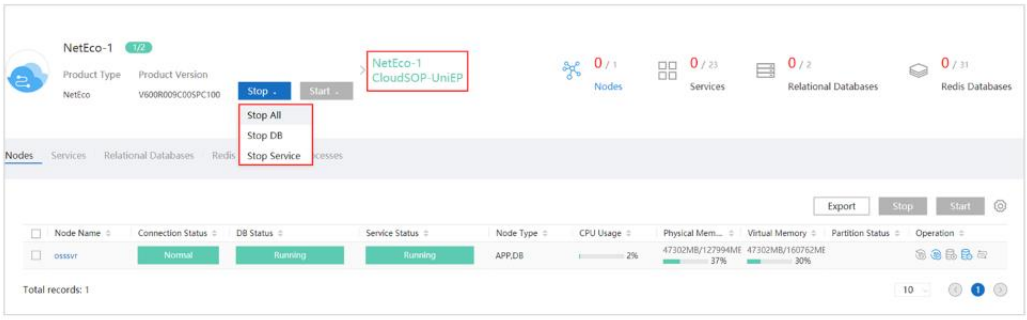
Certificate Type	Certificate	Description
Internal certificate	ER certificate	Certificate for one-way authentication when you log in to the PowerEcho or NetEco using a web browser.
	IR certificate	Certificate for two-way authentication for internal communication of the system
	CA certificate	Certificate used to issue IR certificates for the PowerEcho and NetEco.
External certificate	Southbound and northbound certificates	Certificate for the PowerEcho or NetEco to connect to an external system.

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- SSL: Secure Sockets Layer (SSL) is a security protocol that works at the socket layer. This layer exists between the TCP layer and the application layer to encrypt and decode data and authenticate concerned entities.
- HTTPS is used for the communication between the PowerEcho and NetEco internal nodes or services, the communication between the PowerEcho and the browser, or the communication between the PowerEcho and other systems, that is, the HTTP channel for security purposes. The SSL protocol is the security foundation of HTTPS.
- AES: Advanced Encryption Standard (AES) is an advanced encryption standard. It is a symmetric packet cryptographic algorithm released by the National Institute of Standards and Technology (NIST) on November 26, 2001. It is one of the most popular symmetric key encryption algorithms and is used to replace the Data Encryption Standard (DES).
- RSA: Rivest Shamir Adleman (RAS) is an asymmetric encryption algorithm. RSA is widely used in public key encryption standards and electronic commerce, and is currently the most influential public key encryption algorithm.
- DSS: Digital Signature Security Standard
- ER certificate: external route certificate
- IR certificate: internal route certificate
- CA certificate: The certificate authority (CA) is a network organization that issues certificates, authenticates certificates, and manages issued certificates.

Managing NetEco System Services

- The administrator can view, start, or stop NetEco services by using the PowerEcho.
- On the PowerEcho WebUI, click **Stop** or **Start** to stop or start databases or services.

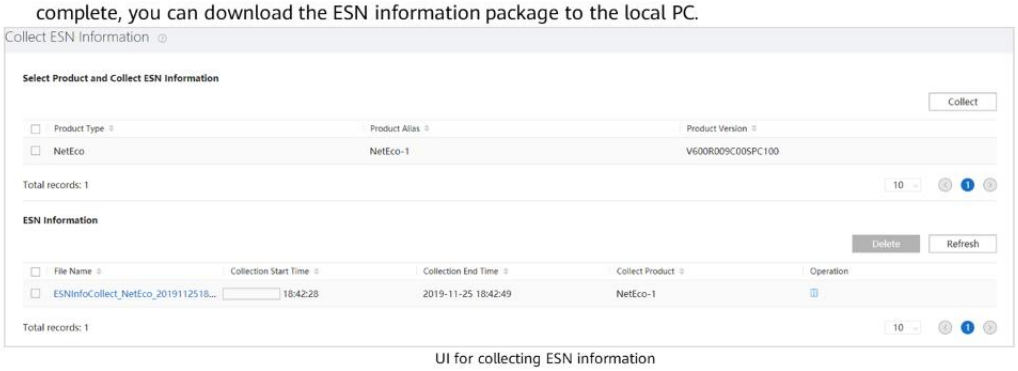


UI for starting a service

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Collecting the ESN

- Before applying for a license for a product, you need to collect the equipment serial number (ESN) of the product.
- The PowerEcho allows you to quickly collect ESN information on the WebUI. After the collection task is complete, you can download the ESN information package to the local PC.



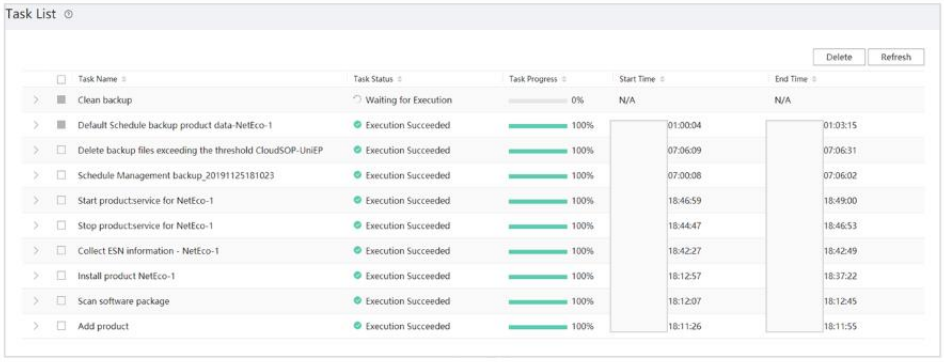
UI for collecting ESN information

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- ESN: Equipment serial number

Task Management

- If you need to obtain the execution status of a PowerEcho task or locate the cause of a task execution failure, you can use this function to view task details to locate and rectify system faults in a timely manner.
- You can click **System** > **Task List** from the main menu to view the task name, task status, task progress, start time, and end time.



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Quiz

1. (Single) Which of the following is the login IP address of the PowerEcho (NetEco V600R009) WebUI? ( )
   A. https://server IP address: 32804
   B. https://server IP address: 31943
   C. https://server IP address: 31945
   D. https://server IP address: 8204
2. (True or False) If you forget the password of user **admin** on the PowerEcho WebUI, you can retrieve the password by verifying the project code. ( )
   A. Ture
   B. False

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- Answer:
  - C.
  - B. If you forget the password of user admin for logging in to the PowerEcho WebUI, you can reset the password only by reinstalling the OS.

Summary

- This chapter describes the following aspects :
  - Basic functions and features of PowerEcho.
  - PowerEcho deployment commissioning process and precautions.
  - Common O&M functions and precautions of PowerEcho.

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Thank you.

把数字世界带入每个人、每个家庭、
每个组织，构建万物互联的智能世界。

Bring digital to every person, home, and organization for a fully connected, intelligent world.

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Huawei DCIM Product Introduction

NetEco



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Foreword

- This course describes Huawei data center infrastructure management (DCIM) system NetEco in terms of its features, architecture, application scenarios, technical specifications, and main functions.

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Objectives

On completion of this course, you will be able to:

- Describe the features of the NetEco.
- Describe the hardware components and software architecture of the NetEco.
- Describe the main functions of the NetEco.
- Describe the application scenarios of the NetEco.
- Describe the technical specifications related to the NetEco.

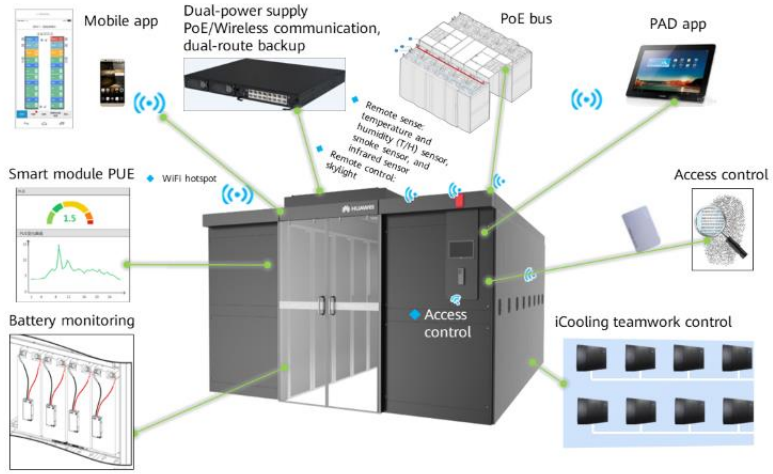
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1. Product Features
2. Software Architecture and Hardware Components
3. Product Functions
4. Application Scenarios
5. Technical Specifications

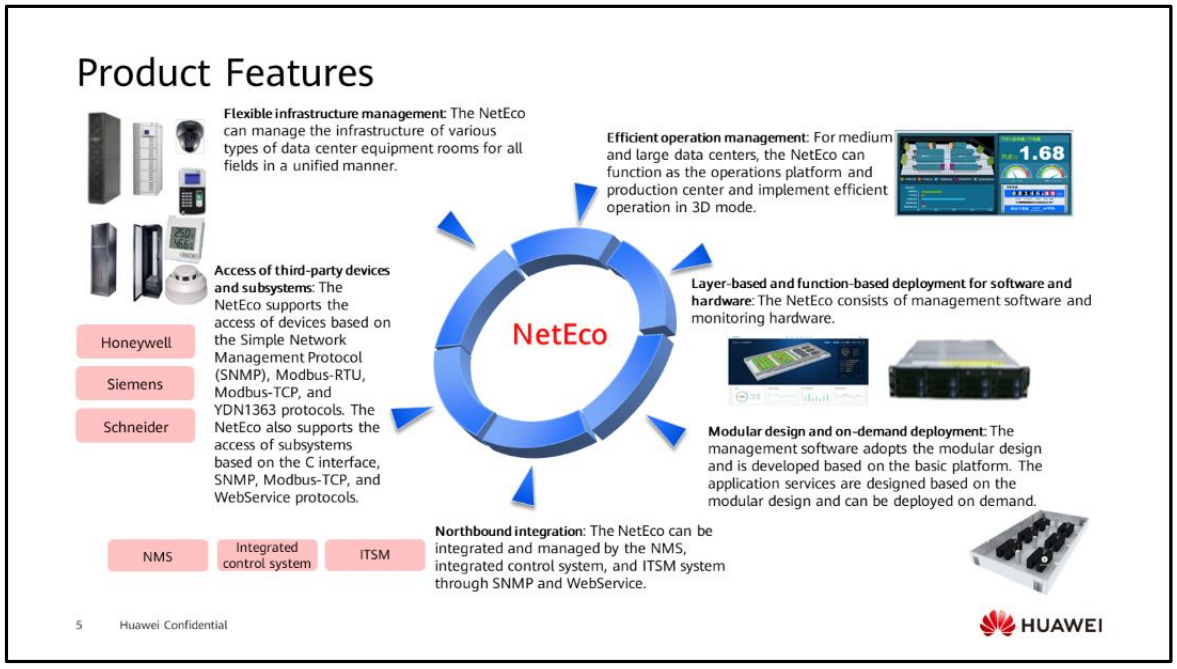
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Product Positioning



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- Huawei NetEco is a solution of the DCIM system. The modules that can be managed by the NetEco include the FusionModule500, FusionModule800, FusionModule1000A, FusionModule1000B, FusionModule2000, and FusionModule5000.
- Devices: precision air conditioner, uninterruptible power supply (UPS), power distribution unit (PDU), environment, video, access control devices, and other components
- Subsystems: power transformation and distribution subsystem, chiller group control subsystem, building automation system, security subsystem, and so on
- The NetEco provides basic and various optional network management functions, including configuration management, alarm management, asset lifecycle management, capacity management, energy efficiency management, tenant management, video management, access control management, O&M, security management, log management, and system management.
- The NetEco is the centralized operation and maintenance part of the Huawei DCIM solution. The system uses an open architecture and connects to various types of devices using device access packages.
- The NetEco provides open interfaces for third-party products or vendors and can interconnect with devices from multiple mainstream vendors.



- Honeywell: Honeywell is a diversified high-tech and manufacturing enterprise with a turnover of more than US$30 billion. Its businesses worldwide cover aviation products and services, buildings, home and industrial control technologies, automobile products, turbochargers, and special materials.
- Siemens: Siemens is one of the world's largest electrical engineering and electronics companies. Its businesses cover a wide range of areas, including cities, industries, household appliances, healthcare, and energy.
- Schneider: Schneider is a global leader in energy efficiency management. Schneider businesses cover electric power, industrial automation, infrastructure, energy saving and efficiency improvement, energy, building automation and security protection electronics, data center, and smart living space.
- NMS: network management system
- Integrated control system: Integrated control is to establish a relatively stable control center in an organization. The control center processes various information inside and outside the organization in a unified manner, detects problems, and provides solutions. In this mode, all information (including internal and external information) flows into the control center and is processed by the control center in a centralized manner. In addition, all control instructions are delivered by the control center in a unified manner.

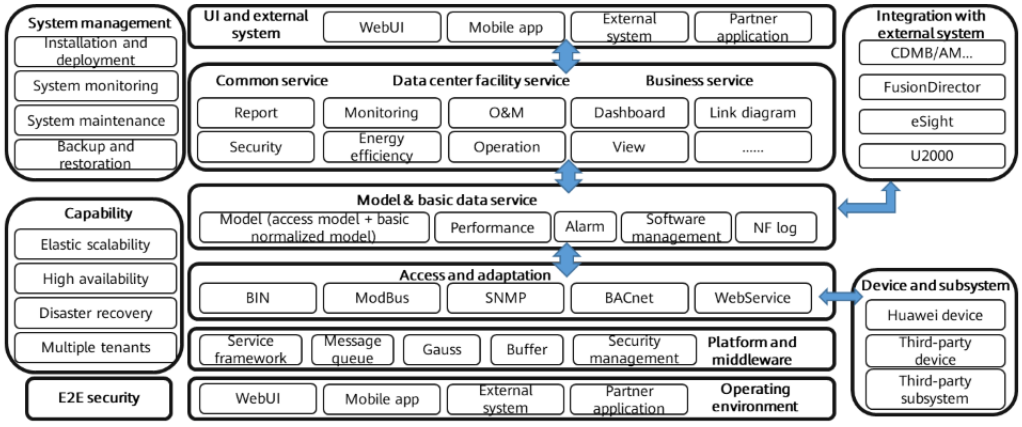
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NetEco Software Architecture

- The NetEco software uses the B/S architecture, consists of the access, public framework, application and service, and UI layers, and runs on the EulerOS. You can log in to the NetEco server on the WebUI from a terminal running the Windows operating system (OS). To ensure data transmission security, the NetEco supports encrypted transmission.



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- B/S: browser/server architecture.
- EulerOS: Huawei Euler server OS EulerOS is an enterprise-level universal Linux OS developed based on CentOS.

NetEco Hardware Components (1)

- The NetEco hardware includes the NetEco server, collector, video surveillance devices, actuators, sensors, and networking devices.



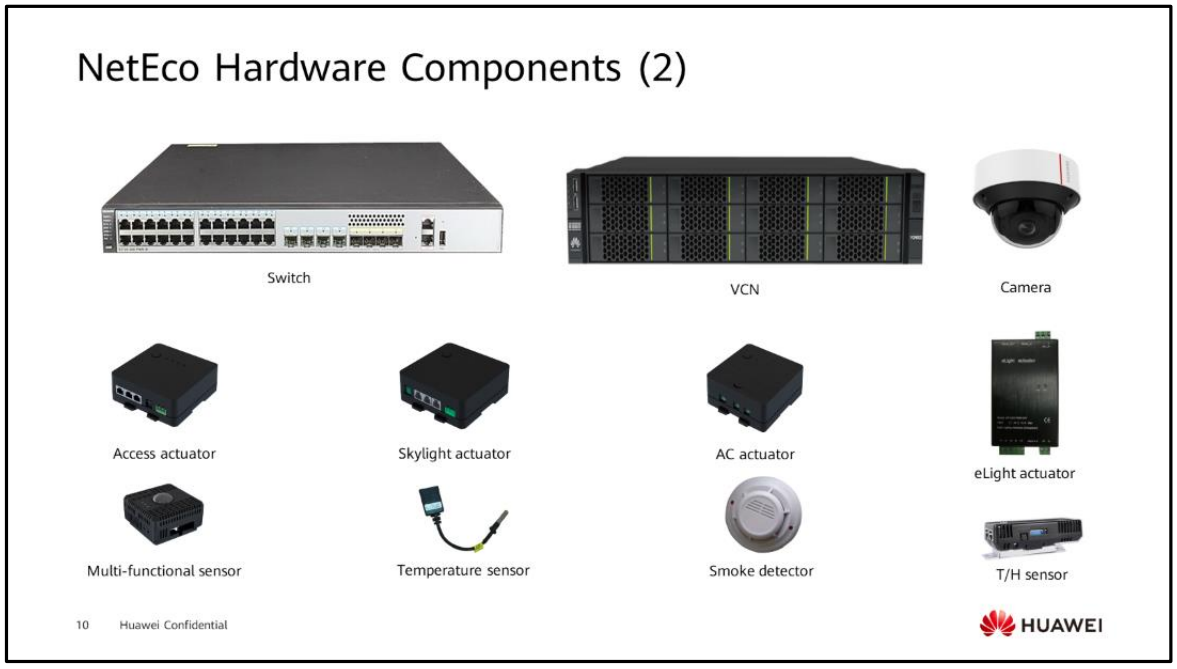
TaiShan 200 server



ECC800-Pro collector

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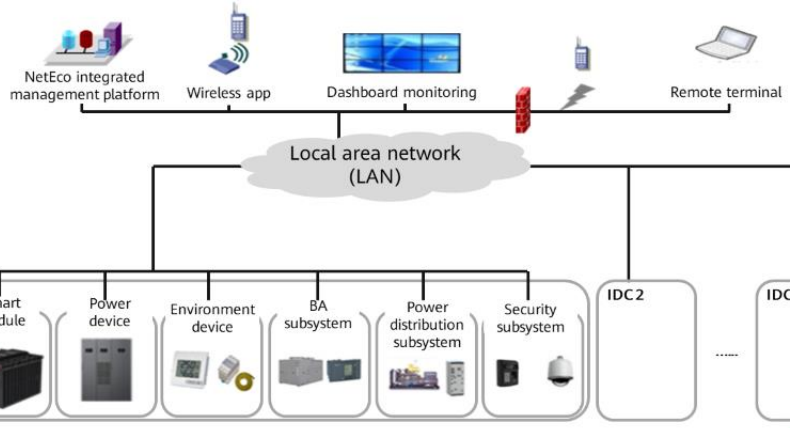
- Server: The TaiShan 200 server is a new-generation data center server based on Huawei Kunpeng processor. It features efficient computing, high security and reliability, and an open ecosystem. As the monitoring host of the NetEco management system, the TaiShan 200 server is responsible for data processing and analysis.
- Collector: The ECC800-Pro is the core component for the smart module local management. It is flexible to connect, easy to maintain, and reliable. It adopts the PoE bus for expansion, and allows monitoring devices to be flexibly deployed so that it can manage the devices in the smart module.



- Switch: A switch is a network device used to forward an electrical (optical) signal. It can provide an exclusive electrical signal channel for any two network nodes connected to the switch. The most common switch is the Ethernet switch. In the NetEco networking, Huawei switches S5320-28X-PWR-SI and S5720-28X-PWR-SI are mainly used.
- Video surveillance devices: VCNs and cameras.
- Actuator: control function-based actuators, including the access actuator, AC actuator, skylight actuator, and eLight actuator
- Sensors: monitoring function-based sensors, including the multi-functional sensor, smoke detector, temperature sensor, water sensor, and T/H sensor.

NetEco Networking Mode

- The NetEco can manage the infrastructure of a single data center or centrally manage the infrastructure of multiple data centers in different regions.



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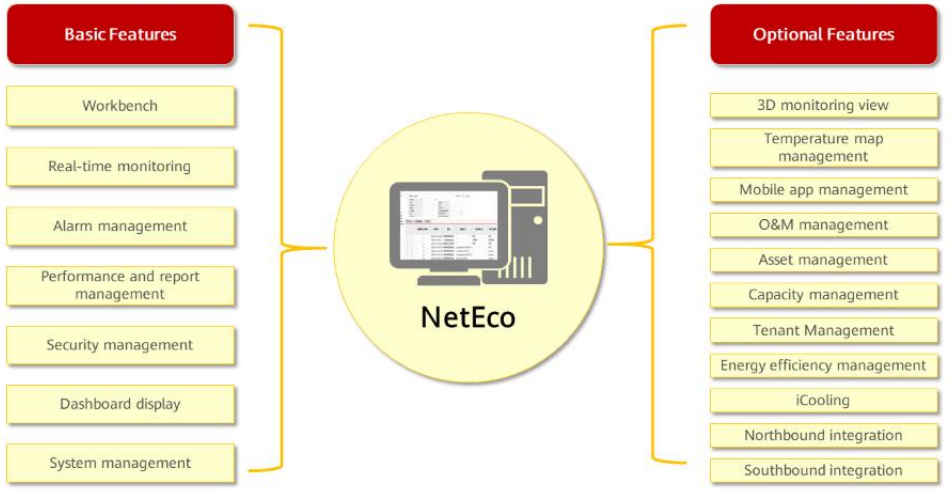
- IDC: Internet Data Center

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2. Software Architecture and Hardware Components
3. **Product Functions**
   - Basic Features
   - Optional Features
4. Application Scenarios
5. Technical Specifications

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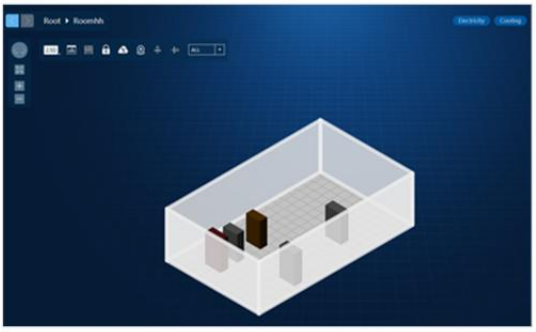
Product Functions



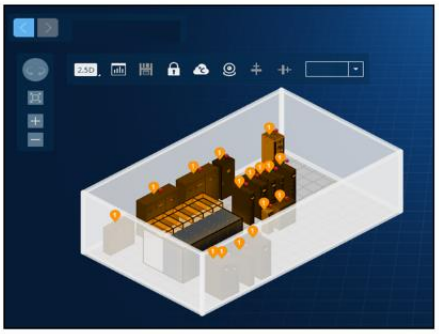
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Real-Time Monitoring - View

- Two display modes are available: 2D and 2.5D (3D view is optional). The NetEco visualizes the equipment room, smart module, and container scenarios.
  - Data Center view monitoring: provides 2.5D view and topology visualization.
  - Device view monitoring: provides multi-dimensional monitoring, energy flow diagram, cabinet view, and customized monitoring counters.



Equipment room view



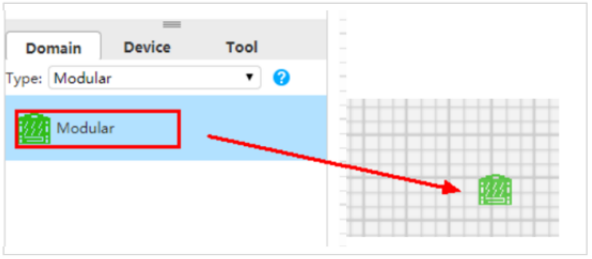
2.5D view

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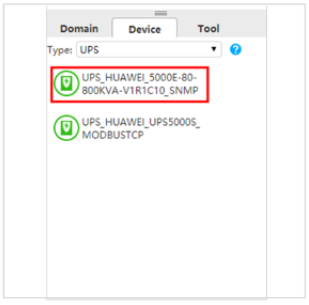
- Equipment room view monitoring:
  - 2.5D view: provides 2.5D view for different hierarchies (such as park -> building -> floor -> equipment room -> rack -> device, or park -> cluster -> container -> rack -> device) for you to quickly query information or locate faults.
  - Topology visualization: supports topology display of parks, buildings, floors, equipment rooms, smart modules, and containers as well as the display of the cooling view and power distribution view.
- Device view monitoring:
  - Multi-dimensional monitoring: manages devices by overview, alarm, signal monitoring, and monitoring view, and allows you to view the physical locations, configurations, and running status of power supply and distribution devices, cooling devices, environmental devices, access control systems, and video surveillance systems.
  - Energy flow diagram: displays the running status of the UPS, air conditioner, power distribution cabinet (PDC), chiller, diesel generator (DG), and cooling tower in an energy flow diagram.
  - Cabinet view: displays the layout of devices in a cabinet in a view.
  - Customized monitoring counters: displays key monitoring counters of devices in a table. The NetEco can monitor one counter for multiple objects or multiple counters for one object.

Real-Time Monitoring - Data Center Planning

- Data center planning is an entry for creating and connecting devices on the NetEco and is the basis of other service function modules.
- You can create, modify, and delete management domains (such as parks, buildings, equipment rooms, containers, and NetEco sites) and devices (such as DGs, chillers, PDCs, UPSs, air conditioners, and cabinets). The 2D or 3D monitoring view of a data center is implemented based on the deployment and configuration of management domains and devices in the data center planning.



Adding management domains



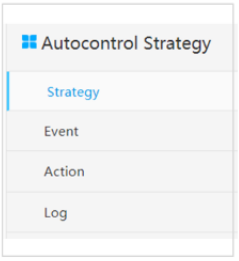
Adding devices

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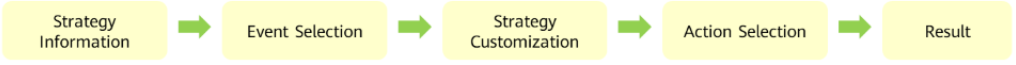
- Data center planning for management domains: You can add, delete, and modify management domains (such as parks, buildings, equipment rooms, and containers), and set the background images for parks and buildings, in which you can create and design a park or building in ShapeNode form.
- Data center planning for equipment rooms: You can construct and deploy a data center using the provided structural components (such as walls, doors, and load-bearing pillars) and basic devices (such as the power supply and distribution devices, cooling devices, and sensors). You can drag and drop a device to deploy it in an equipment room, container, or smart module.
- Data center planning for devices: You can add basic devices to management domains such as equipment rooms, containers, and buildings.
- Automatic view adaptation: After a smart module is connected to the ECC800, the NetEco automatically creates a view for the smart module.

Real-Time Monitoring - Autocontrol Strategy

- This feature allows you to flexibly customize autocontrol requirements based on the input event, autocontrol policy algorithm, and output action.
  - Event strategy customization: supports generation of an event after operation using the received alarm or generated threshold alarm and counters.
  - Counter operation event: supports generation of an event after comparison between the sum, average value, maximum value, or minimum value among multiple counters measured in the same unit for the same device and the configured threshold condition. The threshold condition includes equal, greater than, greater than or equal to, less than, equal to or less than, and not equal.
  - Autocontrol strategy customization: allows you to flexibly create autocontrol strategies based on the configured event and action output. The action corresponds to a specific device control signal. One policy implements one or more actions.
  - Strategy implementation query: provides the function of logging autocontrol strategy configurations and allows you to query the strategy implementation.



Autocontrol Strategy menu



Process of customizing an autocontrol strategy

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Alarm Management - Alarm Browsing and Notification

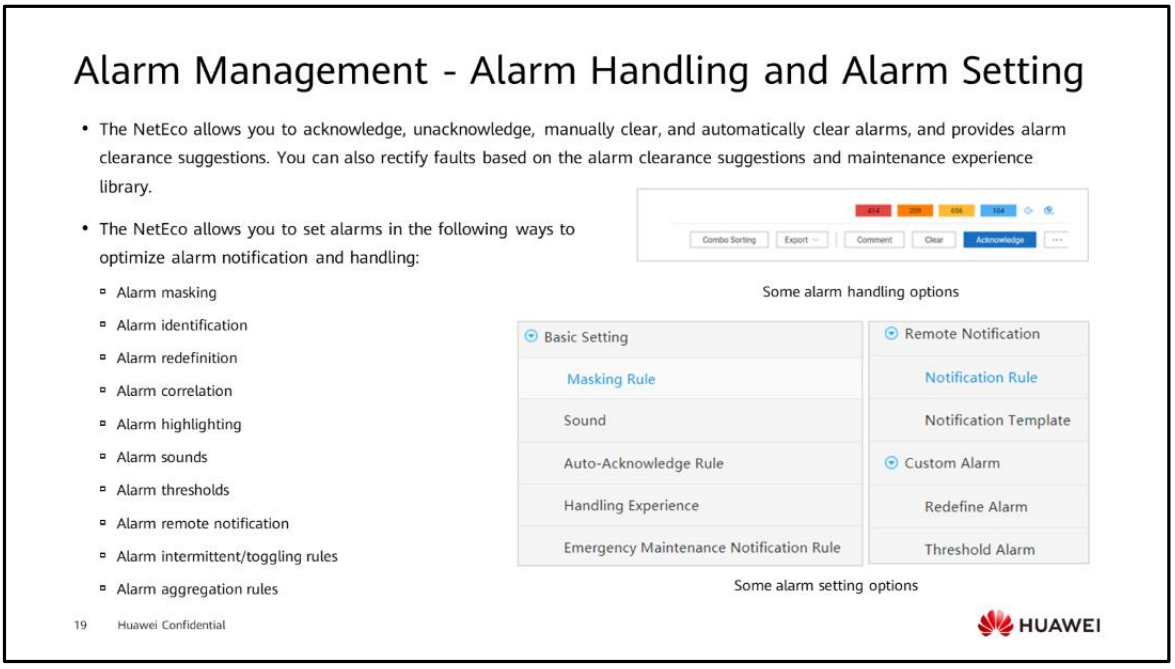
- The NetEco provides flexible alarm browsing modes, including current alarm browsing, historical alarm browsing (to ensure data security and authenticity, historical alarms cannot be edited or modified), masked alarm browsing, and redirection for alarm locating.
- Real-time alarm notification: supports real-time alarm notification by sound. You can set sound files for alarms of four severities, and set the play duration and enabling status. After alarm sounds are set and saved, the settings are applicable to all users. Alarm information can be refreshed and displayed in real time. The total number of current alarms of different severities can be displayed independently. Alarms of different severities are displayed in different colors on the topology and real-time monitoring pages.



Real-time alarm

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- Alarm severities:
  - Critical alarm: Alarms that affect the entire system, endanger normal operation of the system, and require immediate handling. If the alarms are not handled, the system may break down.
  - Major alarm: Board or circuit alarms that happen in a partial area. Alarms of this severity affect service quality of the system and need to be handled promptly. Otherwise, services will not operate properly.
  - Minor alarm: Alarms that do not affect service quality of the system. However, you need to ask maintenance personnel to locate alarm causes promptly to eliminate potential faults.
  - Warning: Potential faults that may affect system services. Handle warnings based on the actual situation.



- Alarm handling description:
  - Alarm acknowledgment: You can acknowledge alarms. After being acknowledged, the alarm status on the NetEco changes to Acknowledged. The system supports manual acknowledgment. Manual acknowledgment allows you to acknowledge selected alarms in the alarm browsing window.
  - Alarm unacknowledgment: You can unacknowledge alarms that have been acknowledged. After the operation is successful, the alarm status on the NetEco changes to Unacknowledged.
  - Manual alarm clearance: You can manually clear specified alarms on the NetEco. After the operation is successful, the alarm status on the NetEco changes to Cleared. This function is used to clear alarms that cannot be cleared automatically or acknowledged alarms that have been handled.
  - Automatic alarm clearance: When a fault on a device or NetEco is rectified, a cleared alarm is reported to the NetEco. Then the NetEco sets the status of the corresponding alarms to Cleared.
  - Alarm clearance suggestions and expert maintenance experience library: You can click the hyperlink on the alarm details page to open the online help document and view the impact of an alarm on the system, possible causes, and handling suggestions. In addition, users can view the historical fault handling in the expert maintenance experience library, and the new handling methods can be added to the expert maintenance experience library to form closed-loop management, making troubleshooting simple and traceable.

Performance and Report Management - Report

- The NetEco supports various predefined reports and allows you to customize reports and report logos based on service requirements. The data center resource usage and device running and operating status are displayed. Reports are classified into the following types:
  - Asset report: IT asset/infrastructure asset report by type, device remaining warranty period report, device remaining lifecycle report, and rack asset report
  - Capacity report: continuous U space report and capacity usage statistics report
  - Power consumption report: server power consumption report and server power consumption trend report
  - Alarm report: alarm severity statistics report
  - Resource report: type statistics report, real-time device signal inspection report, and device inventory report
  - Energy consumption report: energy consumption and energy efficiency report
- Report task management
  - Reports can be displayed in pie charts, curves, and bar charts.
  - Reports can be exported as PDF, Excel, and CSV files.
  - You can set the storage space and customize the logo.
  - Reports can be automatically sent by email at a scheduled time (configurable).



Report types

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- Report storage strategy: The following data is stored: hourly report data of the past 120 hours, daily report data of the past 190 days, weekly report data of the past 104 weeks, monthly report data of the past 24 months, quarterly report data of the past 20 quarters, and yearly report data of the past five years.
- The NetEco provides a device monitoring template for collecting key device data. After you create a device, the NetEco automatically generates data collection tasks and collects data based on the preset template. You can also customize monitoring templates as required.
  - Monitoring template setting: The collection period and storage period can be modified and saved in batches.
- The NetEco displays historical data of one specific indicator in one specific period by search criterion, such as management object or measurement object.
- Historical data query:
  - Supports query by management object, counter, and time.
  - Supports historical data display in tables or line charts.
  - Supports performance data export to an Excel file.
- Historical data recollection: The NetEco can automatically create a recollection task to obtain performance data generated during disconnection. If the automatic recollection task fails, you can manually perform the task.
- Storage strategy: The NetEco uses the InfluxDB database to store performance data. The system automatically deletes data based on the data storage strategy

of the InfluxDB database.

Security Management - Video Management

- The NetEco can connect to IP cameras for integrating into the VCN video management system.
- The NetEco supports the following functions after being integrated into the VCN video management system:
  - Camera management: allows you to manage cameras by adding, deleting, modifying, or querying their information. You need to add a camera into the system if you want to query its real-time information.
  - Real-time viewing for one camera: allows you to view the picture in one of the cameras in real time.
  - Real-time viewing for multiple cameras: allows you to view the pictures of one, four, six, eight, or nine cameras at the same time.
- Visual management can be implemented for cameras in the equipment room view.

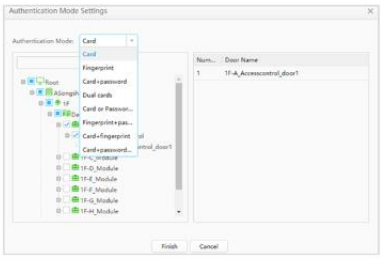


Video viewing

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Security Management - Access Control Management

- The NetEco allows you to create, configure, and manage users and access right groups, and monitors access control events.
- Access control management includes access user management, access right group management, access control management, and event monitoring.
- Diversified access authentication modes: Multiple authentication modes are supported, including card, password, fingerprint, and combination of them. The following authentication modes are supported: **Card**, **Dual cards**, **Fingerprint**, **Card + password**, **Card + fingerprint**, **Fingerprint + password**, **Card + password + fingerprint**, and **Card or Password or Fingerprint**.



Changing the NetEco access control authentication mode



Fingerprint and card reader with a keypad



Fingerprint and card reader


Card reader with a keypad

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- Access control management:
  - Access user management: You can create an access user, import users in batches, and modify, delete, and authorize users.
  - Access right group management: You can add, modify, delete, synchronize, and grant access rights.
  - Access control management: You can create, view, modify, and synchronize access control devices. The system supports remote door opening and closing, alarm generation for unauthorized door opening, and door open delay setting.
  - Event management: You can monitor various events, including access records and event records. You can view, export, and search for events. Events are saved for one year.
  - Access control management at the equipment room, channel, and cabinet levels.

Dashboard Display

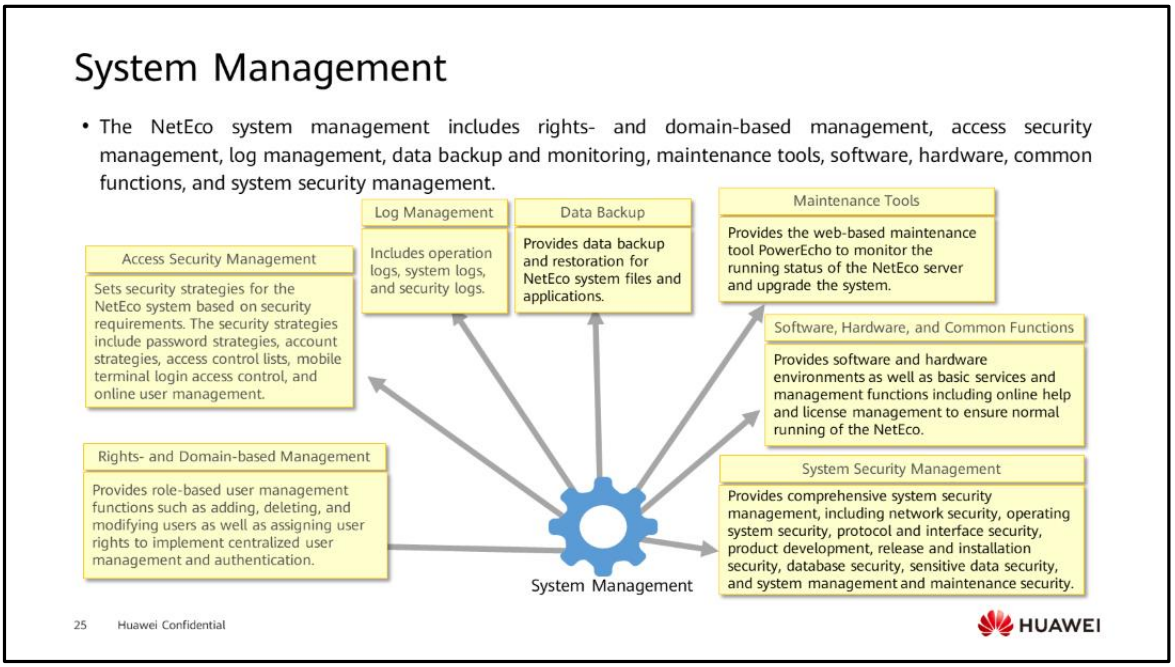
- The NetEco displays the information about key service segments such as the monitoring view, alarm, energy efficiency analysis, capacity, and battery on a dashboard.
- The following information can be displayed: monitoring view, alarm, energy efficiency analysis, capacity, and battery.
  - By default, the following resolutions are supported: 1280 x 1024, 1366 x 768, 1600 x 1200, 1680 x 1050, and 1920 x 1080.
  - The number of split screens supported is as follows: 1 x 1, 2 x 2, 3 x 3, 4 x 4, and 5 x 5.



Dashboard monitoring example

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- SOH: State of Health
- SOC: State of Charge
- Monitoring views: topology view, power transformation and distribution topology view, and chiller group control topology view
- Alarms: device alarm statistics by quantity and current alarm statistics by severity
- Energy efficiency analysis: energy consumption change curve, PUE change trend, real-time energy efficiency data, and daily energy consumption
- Capacity: real-time capacity data
- Battery: SOH, SOC, and other information of cells and battery strings



- Rights- and domain-based management:
  - Centralized user management and authentication: You can add or delete users. You can bind user roles and access strategies, and perform centralized authentication on the LDAP server.
  - Role management: You can perform role-based management. A role is a group of users who have the same management objects and operation rights. The NetEco assigns rights to roles, and then to users based on the binding relationship between roles and users. Role management allows you to assign rights to management objects by subnet and device. You can assign operation rights by network management function. You can add, delete, and modify roles, and copy operation rights and management rights of roles.

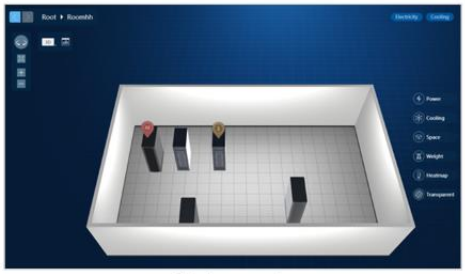
Contents

1. Product Features
2. Software Architecture and Hardware Components
3. **Product Functions**
   - Basic Features
   - Optional Features
4. Application Scenarios
5. Technical Specifications

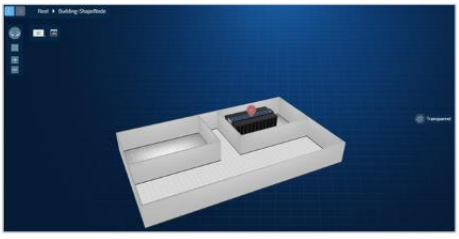
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3D Monitoring View

- The NetEco displays the real-time running status of the equipment room and devices in a 3D view.
- Operations in a 3D view: allows you to perform common operations in a 3D view, such as zooming in or out a view, fitting a view to window, and rotating a view. Allows you to make equipment room walls transparent to highlight key information.
- Centralized KPI display: displays the KPIs of the equipment room and smart module, including the capacity, energy consumption, alarms, environment parameters, and O&M index. Displays the space, power distribution, and cooling capacity of each cabinet in a 3D view. Displays the number and severity of current alarms for each device.



3D view example



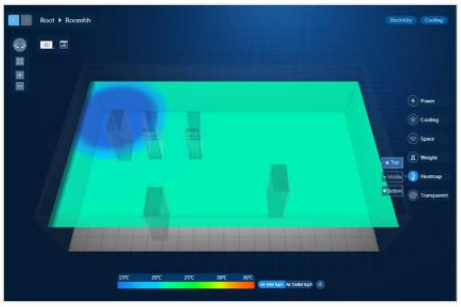
3D view example

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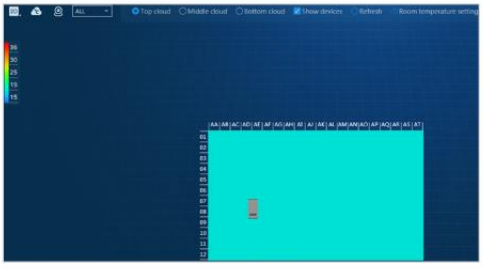
- Hierarchical 3D view:
  - Supports 3D views of various data center layers including buildings, floors, smart modules, and cabinets to display the device layout, alarm information, and running status.
  - Displays the IT devices in the cabinet and the temperatures at the front and rear of the cabinet in the cabinet 3D view.
  - Allows you to click to enter the 3D view of the next layer.
  - Allows you to click to switch between 2D, 2.5D, and 3D views.

Temperature Map Management

- The NetEco displays the overall temperature distribution of the equipment room. The temperature map can be displayed in 2D or 3D mode. Temperatures at three (upper, middle, and lower) levels of cabinets in an equipment room are globally displayed. The map displays the temperature of the point where the pointer is placed as well as the information about the device at the point. Top 5 temperature points (overheat points and supercooling points) are analyzed.



Temperature map in a 3D view



Temperature map in a 2D view

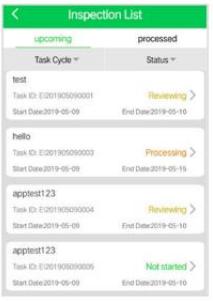
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Mobile App Management

- The NetEco supports access from a mobile app. You can view the alarms, performance, energy consumption, and resource data of the data center. In addition, the NetEco supports routine O&M such as electronic inspection, repair, and maintenance, implementing mobile, digital, and O&M.



App login screen



Electronic inspection screen



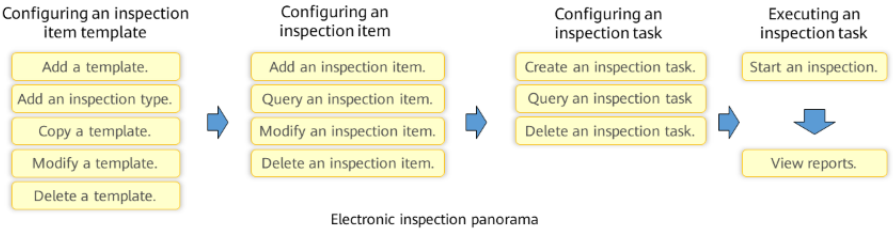
Maintenance screen

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- Management domain query
  - You can query the alarms, energy consumption, monitoring data, and resources of devices in a management domain, such as a park, equipment room, container, or smart module.
  - You can also query the PUE and energy consumption proportion of a management domain (such as a park, equipment room, container, or smart module) and analyze the PUE trends.
- Alarm viewing
  - You can view current and historical alarms and the alarm details and set automatic alarm update.
- Device monitoring
  - You can monitor the running status of devices in the power supply and distribution, cooling, rack, and environment systems and query alarm distribution, device details, and alarm details.
- Management domain information query
  - You can query the space, power, and cooling resources in a management domain created on the NetEco, such as a service equipment room, high-voltage power distribution equipment room, low-voltage power distribution equipment room, power transformation and power distribution equipment room, electric battery room, generator room, cooling room, or container.
- Security management
  - The app must be authorized by the NetEco system before it can be used. Only authorized mobile phones and tablets can be used to log in to the app.

O&M Management - Electronic Inspection

- Electronic inspection is used to achieve tool-based equipment room O&M, electronic O&M data, and paperless inspection records. The inspection data can be collected and analyzed so that you can learn the running status of the equipment room. In addition, you can perform electronic inspection using the mobile phone app. This improves O&M efficiency. The following menus are included:
  - **E-inspection**: consists of **To-Dos**, **Processed**, and **Created**, which are respectively about the work orders to be processed, processed, and created by the current user.
  - **My Notification Tasks**: You can create a notification task to periodically or manually send task notifications.
  - **My Views**: You can customize the tasks that can be viewed by default. For example, you can customize that only expired inspection tasks or inspection tasks of a certain equipment room are displayed by default.

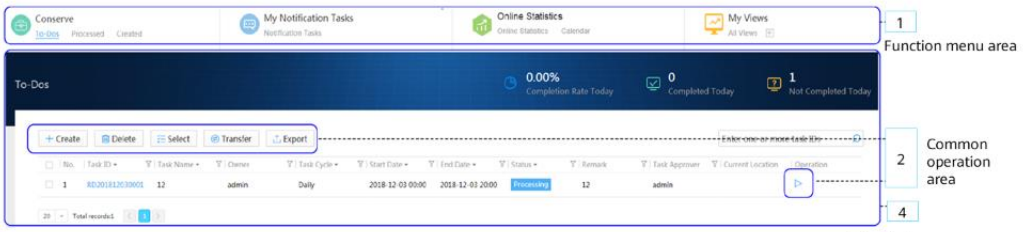


Electronic inspection panorama

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O&M Management - Maintenance

- The NetEco creates and delivers maintenance tasks to remind the responsible persons to track maintenance tasks in a timely manner so that devices can be maintained properly to ensure the normal operation of the devices. Proactively manages and controls routine maintenance operations of data center maintenance providers to improve process management quality.



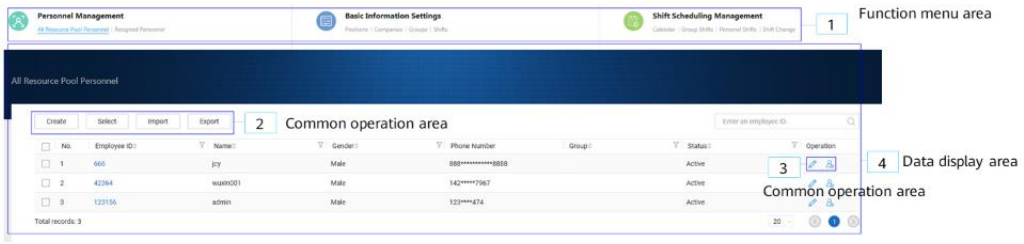
Maintenance page

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- Maintenance:
  - Allows you to quickly identify maintenance tasks that are about to expire. This saves the manpower required for following up maintenance tasks and collecting result statistics, improves O&M efficiency, and reduces O&M costs.
  - Allows you to use a mobile phone to scan the QR code to obtain the overall lifecycle information of the device, greatly reducing the pressure of frontline O&M personnel on information retrieval.
  - Automatically records the O&M information of devices in the entire lifecycle, which facilitates device maintenance and information transfer.

O&M Management - Personnel Management

- The NetEco provides personnel information, duty management, and shift scheduling management for the data center, and supports O&M plan formulation and IT-based personnel management for the data center.



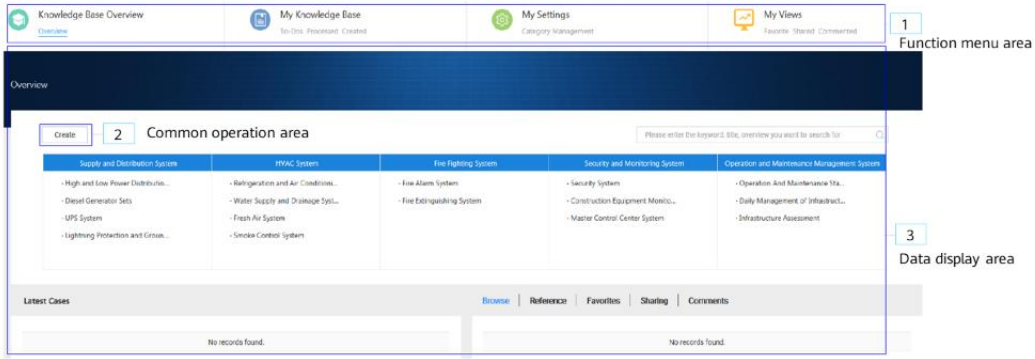
Personnel management page

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- Personnel management
  - Allows you to manage personnel information, including basic information (such as name and age), position information, contact information, and group to which O&M personnel belong.
  - Allows you to set groups and shifts based on personnel information and add O&M personnel to or remove O&M personnel from existing groups.
  - Supports shift scheduling management and provides a calendar for you to quickly view shifts and set the on-duty and off-duty time for each group.
  - Allows you to create and record the shift handover content and submit the content to the personnel on the next shift. Allows you to collect statistics on and analyze shift handover exceptions.

O&M Management - Knowledge Base Management

- The NetEco enables data center O&M knowledge and experience to be recorded, queried, and shared. It provides a knowledge base for Huawei-developed devices and a knowledge base maintained by users.



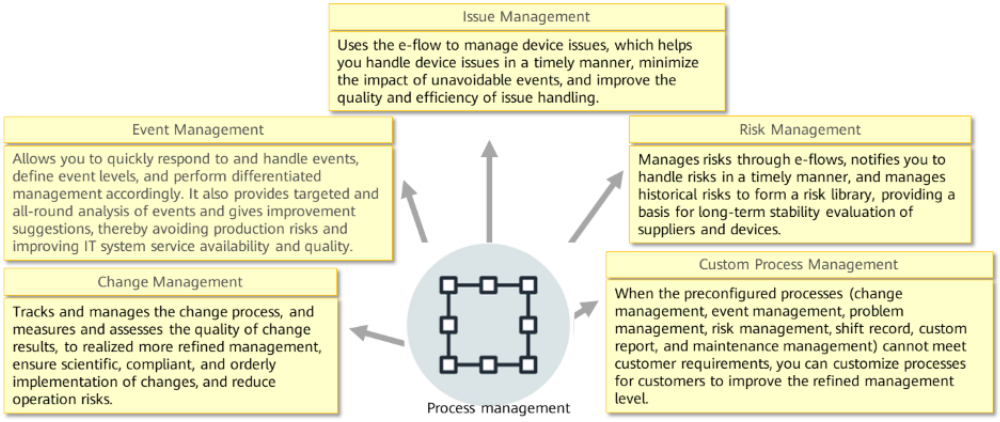
Knowledge base page

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- Knowledge base management
  - Provides guidance on troubleshooting and maintenance of Huawei-developed devices.
  - Allows you to customize O&M knowledge, upload various device operation guides and typical cases, and use the supervisor approval mechanism to control knowledge release.
  - Allows you to comment on, share, favorite, and reference O&M knowledge items, and quickly search for O&M knowledge items based on keywords.
  - Allows you to manage O&M knowledge items by group (a group provided by default, such as the power supply and distribution system or HVAC system group, or a customized group).

O&M Management - Process Management

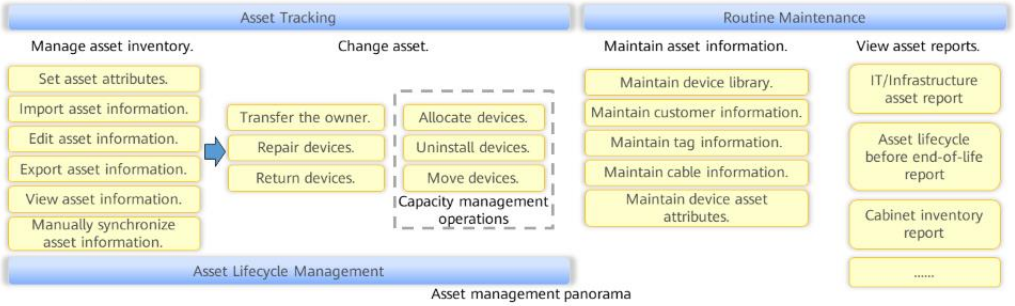
- The NetEco provides data center O&M processes such as change, event, and problem management, and supports the customization of approval procedures for a data center O&M process.



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Asset Management

- The NetEco asset management is intended for managing the data center infrastructure and IT asset. It supports asset lifecycle management, asset change management, and data center capacity management, and provides functions such as asset inventory management, asset change, asset search, and asset recording.
- The NetEco centrally monitors the lifecycle and inventory status of infrastructures, office devices, communications devices, accessories, and IT devices to optimize E2E asset usage, obtain the optimal value, and reduce costs. Getting familiar with related functions and concepts of asset management helps you monitor and manage assets efficiently, improving O&M efficiency

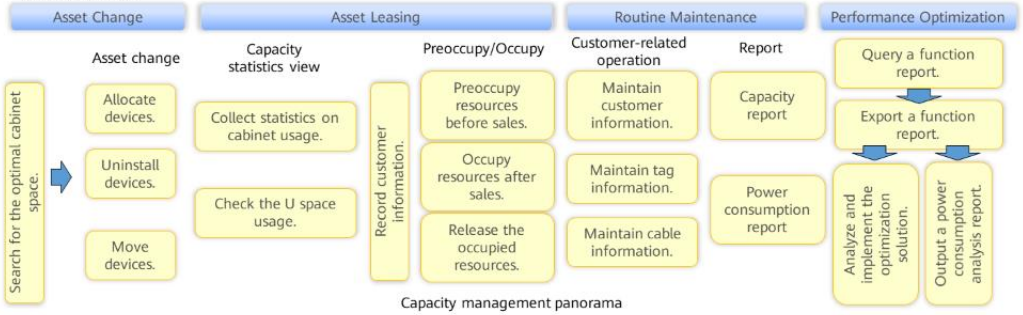


Asset management panorama

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Capacity Management

- The NetEco capacity management is intended for managing the capacity of IT devices in the data center. It allows you to view capacity report statistics, simulates device change operations, supports onsite device construction, preoccupies and occupies cabinets or U space, matches resource leasing services, and monitors server power consumption. This feature provides data support for you to achieve the equipment room energy saving target.
- When new services are required, the NetEco allows you to plan available and preferable management domains in advance. This helps users comprehensively control energy usage efficiency and reduce capacity fragmentation. Capacity management can work with leasing services and the NetEco allows for distributing cabinet/U space resources to specified tenants before and after sales. Once the resources are distributed, other tenants cannot use them.

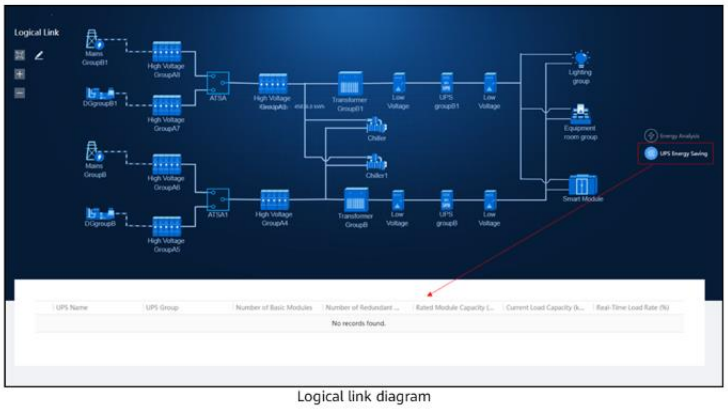


Capacity management panorama

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Energy Efficiency Management

- Energy efficiency management provides the functions of energy efficiency analysis, energy efficiency configuration, iCooling energy efficiency, and cooling capacity management. You can customize energy efficiency parameters and iCooling optimization algorithms, and collect and analyze energy efficiency data and cooling capacity data. The functions related to energy efficiency are as follows:
  - PUE calculation and display.
  - Logical link cPUE and pPUE display.
  - Energy consumption monitoring.



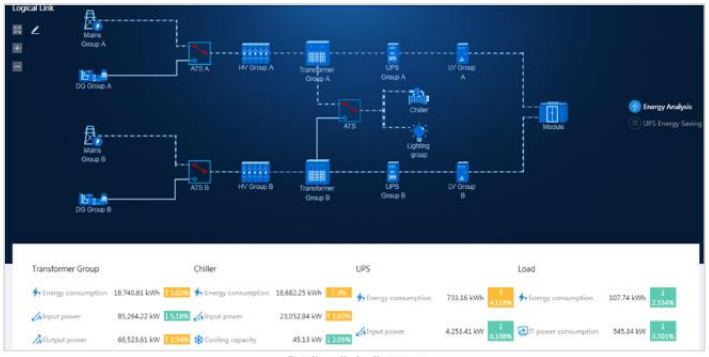
Logical link diagram

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- PUE calculation and display: The PUE of the data center is assessed by multiple indicators.
  - Multi-layer and multi-level energy consumption assessment: Energy consumption nodes can be customized in the power distribution view to collect energy consumption data for the park, floor, equipment room, smart module, container, module, NetEco site, and building. PUE can therefore be assessed by multiple indicators. PUE threshold alarms are also supported.
  - The dashboard displays the PUE and associated content: total energy consumption, IT energy consumption, DCiE, PUE, PUE trend, pPUE, cooling/power supply load coefficient, and so on.
- Logical link cPUE and pPUE display: The NetEco calculates and displays the cPUE and pPUE of the logical link in the data center, and displays abnormal energy consumption.
  - Supports the configuration of energy consumption links based on the actual designed links of the data center, and calculates and displays the cPUE of each key component group, including the transformer group, UPS group/HVDC group, and chiller; calculates and displays the pPUE of the equipment room group and smart module.
  - Provides the cPUE and pPUE reference ranges (user configurable). Displays an alarm if the cPUE or pPUE value exceeds the reference value.
  - Cooling power usage effectiveness (cPUE) is used to evaluate and analyze the energy efficiency of cooling devices in a data center. cPUE = Total power consumption of cooling devices/Power consumption of IT devices
  - Partial power usage effectiveness (pPUE) is used to evaluate and analyze the energy efficiency of partial areas or modules in a data center. pPUE = Total energy consumption of a partial area or smart module/Energy consumption of IT devices in the corresponding area or smart module.

Energy Efficiency Management - iCooling

- The NetEco supports proactive energy saving, driving energy efficiency optimization of data centers and continuously reducing energy consumption.
- Visualized and diagnosable full-link energy efficiency, identifying PUE exceptions, and specifying the energy saving improvement direction.



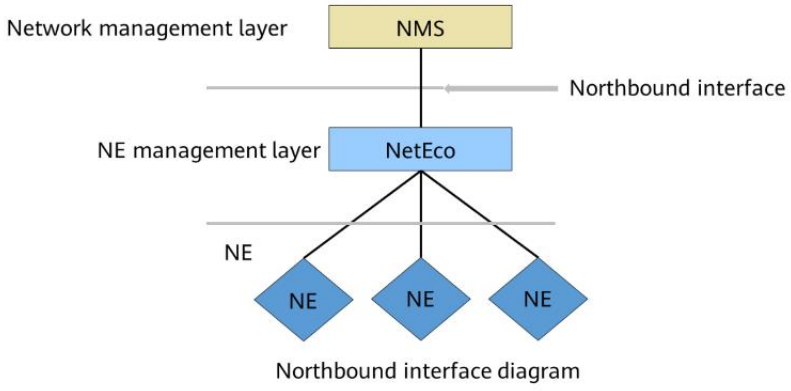
Cooling link diagram

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- iCooling energy efficiency uses the iCooling energy saving algorithm. When the iCooling energy saving mode is enabled, the energy consumption of the HVAC system of a management domain is reduced, achieving optimal energy efficiency of the HVAC system.

Northbound Integration (1)

- After configuration, the NetEco can be connected to a third-party system for management. The following northbound communication modes are supported: WebService, SNMP, and FTP.



Northbound interface diagram

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Northbound Integration (2)

Northbound Communication Type	Description	Available Data Types	Use Suggestions
WebService	The WebService northbound interface is an open interface based on the Representational State Transfer (REST) standard.	Performance data, configuration data, alarm data, inventory data, and log data	**Strongly recommended** Reason: The interconnection configuration on the NetEco side can be completed on the NetEco client. The operation is simple.
SNMP	The SNMP is an industry standard protocol that is widely used for network management.	Performance data, configuration data, and alarm data	For obtaining alarm data: **strongly recommended** For obtaining performance data and configuration data: not recommended Reason: Alarm data: The interconnection configuration can be completed only on the NetEco client. The operation is simple. In addition, when alarms change, the changes can be reported to the NMS immediately. Performance data: The indicator values of performance data are bound with object identifiers (OIDs). You need to contact Huawei technical support to customize the counter values. The operation is complex.
FTP	File Transfer Protocol NBI	Performance data, configuration data, and inventory data	Not recommended Reason: You need to manually modify the configuration file on the server to complete the interconnection configuration. In addition, the data real-time performance is low.

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- Characteristics of WebService:
  - Provides standard integration solutions for quick integration of third-party systems.
  - Requires interface authorization and supports only HTTPS-based access for security.
  - Uses JavaScript Object Notation (JSON) for data exchange. The JSON format is simple and consumes less network traffic than the XML format. In addition, data in JSON format is easy to read and write.
- Characteristics of SNMP:
  - Allows data to be transmitted between any two nodes so that the network administrator can query data on any node.
  - Uses polling mechanism to provide the most basic function set, which is applicable to small-scale, fast, and low-cost environments.
  - Requires only the user datagram protocol (UDP) that has no acknowledgement mechanism; hence, it is popular among a large number of products.
  - Supports functions of real-time alarms, current alarms, and heartbeat notification. Besides, alarms can be acknowledged, unacknowledged, or cleared.
- Characteristics of FTP:
  - Generates northbound text files (*.xml) in a unified format.
  - Periodically exports northbound text files to a specified directory on the server.
  - Ensures data integrity. That is, if a northbound performance text file fails to be generated, related data will be supplemented to the northbound

performance text file of the next period.

Southbound Integration

- After configuration, the NetEco can support the access of third-party devices or systems to manage third-party devices and subsystems.
  - Third-party devices support multiple standard protocol interfaces, including Modbus and SNMP interfaces. After the interconnection, the real-time monitoring counters and alarm information of the devices can be obtained.
  - The third-party device networking solution is generally compatible with the following two types: RS485 and FE. The FE networking solution is recommended.



Solution for a third-party device access to the FE networking

- The recommended interconnection protocols for third-party subsystems are as follows.

Third-party Subsystem	Recommended Standard Protocol/Vendor
Power distribution subsystem	Modbus-TCP/SNMP: SNMPv1, SNMPv2c, and SNMPv3 are supported. SNMPv3 is recommended.
Chiller group control and BA subsystems	Modbus-TCP and BACnet protocols
Video surveillance subsystem	Hikvision
Access control subsystem	Only Huawei-defined WebService interfaces are supported.
Power and environment subsystem	SNMP protocol, C interface, and WebService interface. SNMPv1, SNMPv2c, and SNMPv3 are supported. SNMPv3 is recommended.

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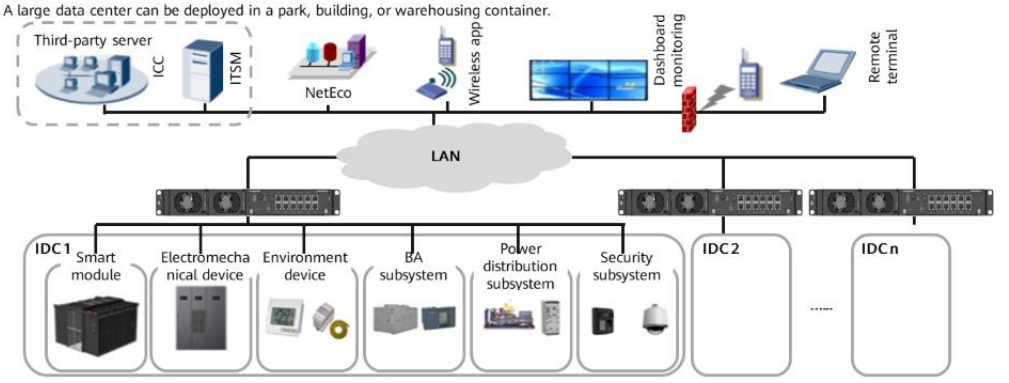
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NetEco Application Scenarios - Large Data Centers

- A large data center is one whose equipment room area is more than 2000 square meters and which manages over 20,000 monitoring points.
- A large data center solution covers various customer scenarios. It integrates the rack, power supply and distribution, cooling, fire extinguishing, building automation, video, and access control systems, and centrally manages the linked equipment and system to implement the E2E connection and convergent management for power supply and distribution, cooling, and load, thereby ensuring and efficient running of the whole data center system.
- A large data center can be deployed in a park, building, or warehousing container.

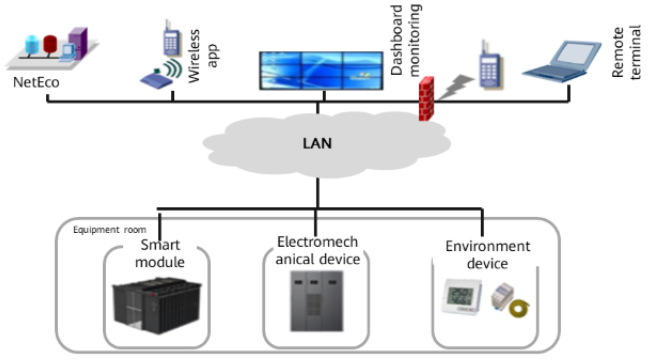


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- E2E: end-to-end
- Monitoring point: Each monitoring point is defined as a signal, such as a water sensor signal or the temperature value of a point.
- As the management system of a large data center, the NetEco has the following functions:
  - Access of complicated subsystems, such as the power distribution, chiller group control, building automation, security, and fire extinguishing
  - Hierarchical deployment of maintenance and operations
  - Integration into third-party applications and interconnection with inventory application service systems, such as integrated control, process system, and 3D visualization
  - Cross-regional central management
  - Mobile O&M

NetEco Application Scenarios - Medium Data Centers (1)

- A medium data center is one whose equipment area is from 200 square meters to 500 square meters, which manages from 10,000 to 20,000 monitoring points, and which is a smart module used in container delivery.
- Smart module deployment scenario: The management system works with the FusionModule2000 to provide a data center solution of complete features, such as the cabinet, power supply and distribution, cooling, and fire extinguishing. Through convergent management over power distribution, cooling, and IT loads, the NetEco manages the power and cooling capacity of the logical link, monitors the reliability and health status of devices prior to end-of-life, and manages the devices in a refined manner.

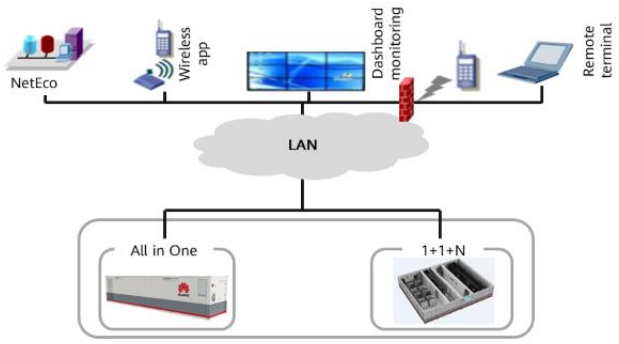


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- In this scenario, the NetEco is required to have the following functions:
  - Monitors the matched electromechanical equipment and environment parameters.
  - Supports fast deployment.
  - Supports integration with the upper-level NMS.
  - Manages the reliability and health status of devices, and supports decision making of the upper-level O&M systems.

NetEco Application Scenarios - Medium Data Centers (2)

- Container deployment scenario: The management system is used in All-in-One and 1+1+N scenarios, providing a data center solution of complete features, such as the cabinet, power supply and distribution, and fire extinguishing. Prefabricated data centers can meet the energy conservation and fast deployment requirements of industry users, such as telecom carriers and Internet carriers. Container data centers have distinctive advantages in disaster relief, military affairs, oil exploration, and enterprise data, and can be used outdoors.

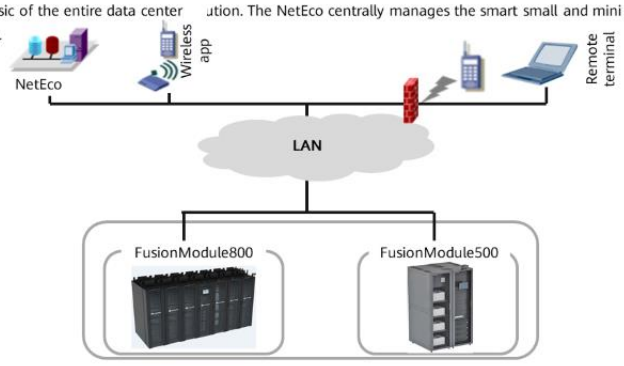


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- Independent application in outdoor scenarios: has no local monitoring center or distributed monitoring nodes; the management server is deployed inside the container.
- Cluster application in outdoor scenarios: Distributed monitoring nodes are deployed inside the container, and the central management platform is deployed in the monitoring center.
- In this scenario, the NetEco is required to have the following functions:
  - Monitors the matched electromechanical equipment and environment parameters.
  - Supports fast deployment.
  - Manages the reliability and health status of devices.

NetEco Application Scenarios - Smart Small and Mini Data Centers

- A smart small and mini data center is generally defined as a node or endpoint whose area is less than 200 square meters and which manages less than 10,000 monitoring points. Huawei provides two types of smart small and mini data centers: FusionModule500 and FusionModule800.
- The smart module is located at the edge of a network and integrates computing, storage, and network service functions. The smart small and mini data center is the basic of the entire data center ution. The NetEco centrally manages the smart small and mini data center and flattens the networking structure.



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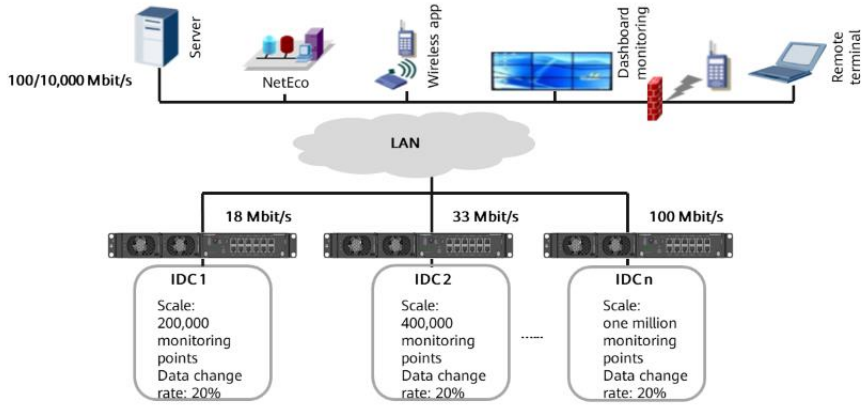
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Performance Counter - Bandwidth Requirement (1)

- For the central management of large data centers, you can deploy clusters of collectors in data centers and use a flattened management network. Real-time data collection of IDCs through the comprehensive management platform has high requirements for bandwidth. The following figure shows the long connection bandwidth requirements for different scales.



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Performance Counter - Bandwidth Requirement (2)

- Egress bandwidth requirements for the NetEco and network devices

Number of Devices	500	1000	2000	5000
Required Bandwidth (kbit/s)	2048	3072	6144	15,360

- Egress bandwidth requirements for the NetEco and northbound system

Number of Devices	500	1000	2000	5000
Required Bandwidth (kbit/s)	2048	4096	8192	20,480

- The egress bandwidth of the NetEco and the browser is affected by the number of devices and the number of video channels. It is recommended that the bandwidth between the client and the NetEco server be greater than or equal to 10 Mbit/s if videos are not included. Egress bandwidth requirements with videos and without videos.

Number of Devices (Without Videos)	500	1000	2000	5000
Required Bandwidth (kbit/s)	4096	6144	12,288	30,720

Video Channel	1	4	9	16
Required Bandwidth (Mbit/s)	25	100	225	400

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Quiz

1.(True or False) Huawei DCIM management system NetEco can customize report tasks based on actual O&M requirements and send the reports to specified recipients by email.（ ）

A. True

B. False

2.(True or False) Huawei DCIM management system NetEco provides monitoring management, O&M management, and energy efficiency management functions in standard configuration based on actual data center O&M scenarios.（ ）

A. True

B. False

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- Answer:
  - A.
  - B. O&M management and energy efficiency management are optional features.

Summary

- This chapter describes the following aspects:
  - Positioning and software and hardware components of the NetEco.
  - Detailed information about the basic and optional features of the NetEco.
  - Application scenarios and architecture topology of the NetEco.

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Thank you.

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