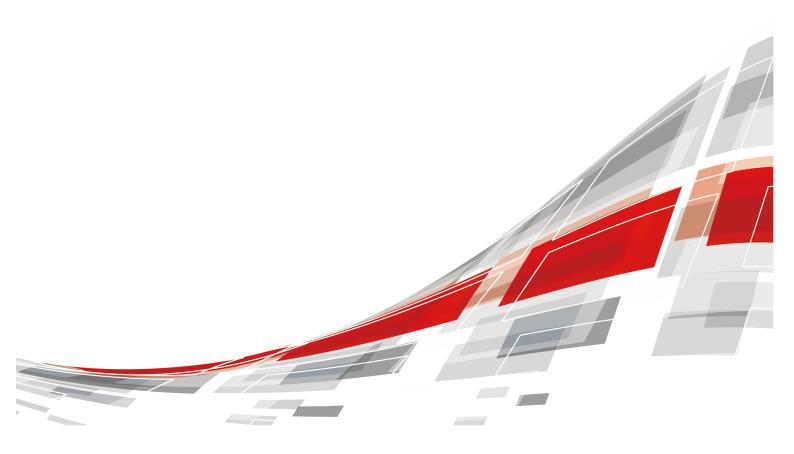
# FusionPoD for Al Rack-Scale Liquid-Cooled Server

# **Technology White Paper**

Issue 03

**Date** 2024-11-27



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# **About This Document**

## **Overview**

This document describes the appearance, functions, and structure of the FusionPoD for AI liquid-cooled rack-scale server.

## **Intended Audience**

This document is intended for pre-sales engineers.

# **Symbol Conventions**

The symbols that may be found in this document are defined as follows:

Symbol	Description
▲ DANGER	Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
<u></u> <b>⚠ WARNING</b>	Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
<b>⚠</b> CAUTION	Indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance deterioration, or unanticipated results.  NOTICE is used to address practices not related to personal injury.
□ NOTE	Supplements the important information in the main text.  NOTE is used to address information not related to personal injury, equipment damage, and environment deterioration.

# **Revision History**

Version	Release Date	Description
03	2024-11-27	Updated 3.5.3 PDU.
02	2024-07-19	Updated 2.4 Management System, 7.1 Security and A Appendix.
01	2024-01-05	This issue is the first official release.

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# Product Introduction

- 1.1 Overview
- 1.2 Features

## 1.1 Overview

FusionPoD for AI is a computing cluster server cabinet that features high density, high performance, high energy efficiency, high reliability, simple O & M, low TCO, and easy deployment. This product is suitable for large-scale and super-large-scale model training in AI scenarios.

Front and rear views (with cabinet door)

Front view (without cabinet door)

Rear view (without cabinet door)

Figure 1-1 Overall view of the liquid-cooled cabinet

#### 1.2 Features

#### **High Density**

A single cabinet supports eight HGX 8-GPU liquid-cooled servers.

#### **NOTE**

- The number of server nodes that can be configured depends on the actual power consumption of a single node. A cabinet supports only server nodes of the same model.
- For details about the supported server nodes, see 3.4 Server Node.
- The cabinet is equipped with guide rails. Server nodes are installed on the guide rails.
- The maximum power of a single cabinet is 105 kW.

#### **High Performance**

 Supports the fourth-generation Intel <sup>®</sup> Xeon <sup>®</sup> Scalable Processor (Sapphire Rapids).

- Supports NVIDIA HGX 8-GPU NVLink modules, Ampere Generation and Hopper HGX NVLink modules.
- Supports liquid-cooling environments. Server nodes can run at higher frequencies and provide super computing capabilities.

#### **High Energy Efficiency**

- Mains direct supply.
- 48 V centralized power supply, up to 97% high power efficiency.
- Liquid cooling for server nodes, supporting up to 45°C (113°F) water.
- Value of partial power usage effectiveness (pPUE) as low as 1.2 without the rear door heat exchanger (RDHx).
- Value of pPUE as low as 1.06 with the RDHx.
- Supports liquid-cooled doors to centrally dissipate heat from the entire cabinet, improving energy efficiency.

#### **High Reliability**

- 2N power distribution.
- The PSUs support two inputs.
- The PSUs are configured in a maximum of 35+1 redundancy mode (N+1 redundancy mode) and provide a maximum of 105 kW power.
- Server nodes support N+1 fan configurations. When a single fan and a single rotor fail, the maximum operating temperature is reduced by 5°C (41°F).
- Refrigeration medium is deionized working medium water.

#### □ NOTE

See A.2 Water Quality Standard for Secondary Water Supply for working fluid water standards.

- Server nodes and cabinets are designed to prevent liquid leakage, monitor liquid leakage at the node and cabinet levels, and shut down liquid leakage at the node to realize self-isolation.
- Cabinet-level components shall have a service life of at least 10 years.

#### **Extremely Simple Operation**

- Server nodes support electrical and hydraulic blind insertion.
- Redfish interface and third-party NMS integration.
- Supports intelligent management features such as FusionDirector.

# 2 System Architecture

- 2.1 Hardware Architecture
- 2.2 Heat Dissipation System
- 2.3 Power Supply System
- 2.4 Management System

### 2.1 Hardware Architecture

### 2.1.1 Two-Bus Architecture

FusionPoD for AI server nodes support two buses in blind insertion. The two buses in the cabinet are described as follows.

- Liquid cooling bus: Manifold supply and return pipes are connected to the secondary pipelines and server nodes in the equipment room to realize liquid cooling circulation.
- Power bus: Busbar provides 48 V DC power for server nodes.

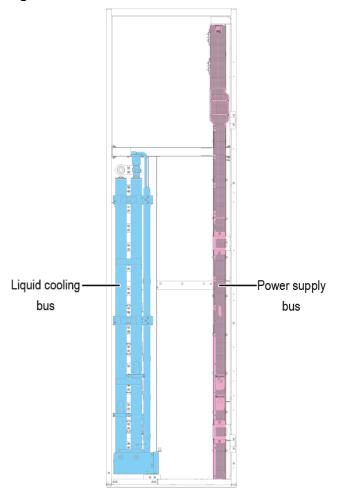


Figure 2-1 Two buses of the cabinet

## 2.2 Heat Dissipation System

## 2.2.1 Equipment Room Heat Dissipation

The FusionPoD for AI is applicable to equipment rooms in various scenarios and liquid cooling equipment rooms, and supports optional rear door heat exchanger (RDHx). The FusionPoD for AI rack-scale server liquid cooling solutions of the data center is shown in **Figure 2-2** and **Figure 2-3**. The coolant distribution unit (CDU) provides circulating power. Warm water output from the secondary loop of the CDU directly exchanges heat with the liquid-cooling board of the server node. The liquid-cooling heat sink directly dissipates heat of high-power components such as the CPU, memory modules and GPU out of the cabinet through liquid cooling, and the rest heat is dissipated by in-row air conditioners in the equipment room (by the RDHx in the full-liquid-cooling scenario).

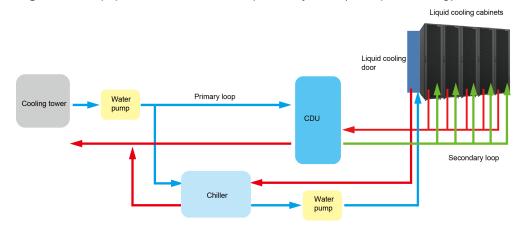
Cooling tower Primary loop

CDU

Secondary loop

Figure 2-2 Equipment room heat dissipation system (board-level liquid cooling)

Figure 2-3 Equipment room heat dissipation system (full liquid cooling)



The heat dissipation system of the equipment room consists of the primary loop and the secondary loop.

- The primary loop consists of the cooling tower, water pump, chiller, primary loop, and RDHx
- The secondary side comprises: CDU, secondary pipeline, liquid-cooled cabinet, and server nodes.

Table 2-1 Components in the heat dissipation system

Item	Descriptions
Cooling tower	<ul> <li>Dissipates the heat from the liquid loops to the exterior. Generally, it is placed outdoors. The water outlet temperature varies depending on the local temperature. The water outlet temperature ranges from 5°C to 35°C (41°F to 95°F).</li> <li>A closed cooling tower is recommended.</li> </ul>
Water pump	Drives the liquid circulation or increases the liquid pressure.

Item	Descriptions
CDU	<ul> <li>Implements flow distribution, pressure control, physical isolation, and condensation prevention for the secondary loop. The CDU handles the heat dissipation of the liquid cooling part inside the liquid cooling cabinet. (The heat generated by the CPU and other components with large power consumption is taken away by the cold plate.)</li> <li>The CDU needs to be matched with the secondary side pipeline.</li> </ul>
Liquid- cooling cabinet	Provides liquid cooling for the devices in the cabinet. Heat is removed from the cabinet by water.
RDHx	The liquid-cooled door uses the warm water from the primary side of the equipment room to exchange heat with the hot air discharged from the server. The heat from the indirect liquid-cooled part of the liquid-cooled cabinet (usually low-power components) is carried out of the equipment room.
Chiller	Cools the water from the cooling tower. This is an optional device.
Primary Loop	Blue arrows indicate the inlet water, and red arrows indicate the outlet water. The primary loop performs the following two actions:  Circulating water between the cooling tower and the CDU.  The cooling tower passes through the chiller to the cooling circulating water system of the liquid cooling door.  NOTE  In special scenarios, the device configuration and environment specifications must be restricted. For details, contact technical support.
Seconda ry Loop	Circulates water between the CDU and the liquid cooling cabinet. Green arrows indicate the inlet water of the secondary loop, and red arrows indicate the outlet water of the secondary loop.

## 2.2.2 Cabinet Heat Dissipation

FusionPoD for AI supports multiple cooling modes and flexible configuration of liquid cooling doors. The high-power components, such as processors and DIMMs, are dissipated by the liquid-cooled modules. In the mixed liquid cooling scenario, the rest heat is dissipated through the in-row air conditioner in the equipment room. In the full liquid cooling scenario, the rest heat is dissipated through the liquid cooling door.

Heat Dissipation Mode of cold plate type liquid cooling cabinet

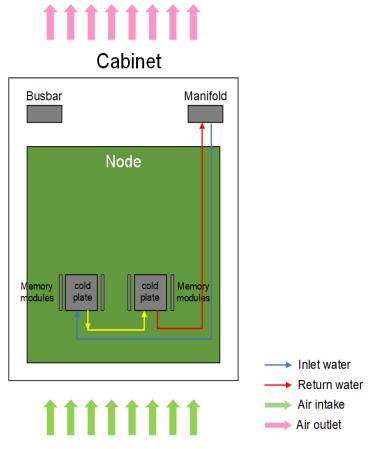


Figure 2-4 Heat Dissipation Mode of cold plate type liquid cooling

Heat Dissipation Mode of Liquid-Cooled Cabinets

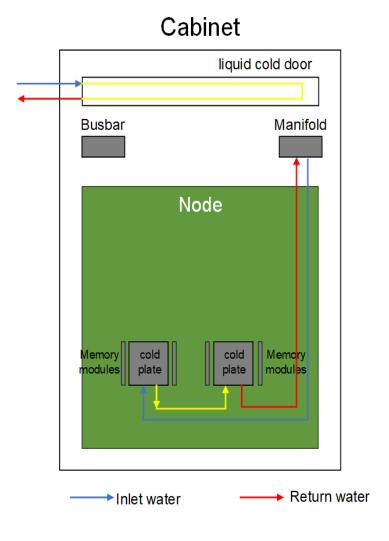


Figure 2-5 Heat dissipation mode of full liquid cooling

# 2.3 Power Supply System

## 2.3.1 Power Supply System of Equipment Room

FusionPoD for AI cabinet servers support 2N power supply.

Take the utility power input of the equipment room as an example. An 2N power supply system is a redundant system consisting of two or more power supply systems. Each data center equipment room power supply system consists of N power supply systems (called N masters), and its total capacity is the basic capacity of the equipment room power supply system. the entire path of the power supply system (from power supply input through power supply system to dual power supply input load) All links and devices in are configured in redundancy mode (called N standby) and are two isolated power supply lines. In normal operation, each power supply system bears only part of the total load. The 2N power supply system is shown in Figure 2-6.

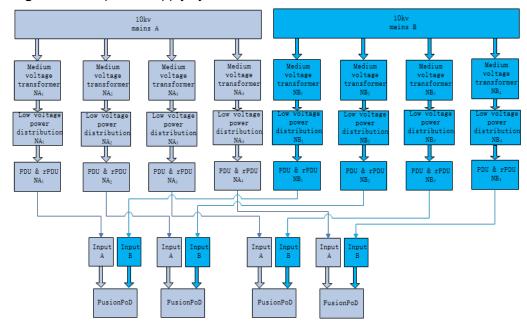


Figure 2-6 2N power supply system

## 2.3.2 Cabinet Power Supply

FusionPoD for AI cabinet servers support 2N power supply.

The FusionPoD 720 rack-scale servers provide joint power supply to the whole cabinet through the active circuit (N active), backup circuit (N backup) of the equipment room in active switching of power supply scenario (such as maintenance and repair) and passive switching of power supply scenario (such as abnormal power supply at the front level of the equipment room). The switching mode of power supply is shown in Table 2-2 and Table 2-3. The load ratio of N active and N standby is 100%, indicating the power supply source of the current cabinet. When the load ratio of active and standby N is 0%, all loads in the cabinet are powered off. When both the primary (active) and standby (standby) circuits are powered off, all devices in the cabinet are powered off.

Table 2-2 Active power supply switching

Input status	Main circuit (N main) load rate	Load ratio of standby circuit (N standby)
The main circuit (N active) and standby circuit (N standby) are normal	100%	0%
The main circuit (N active) is powered off and the standby circuit (N standby) is normal	0%	100%

Input status	Main circuit (N main) load rate	Load ratio of standby circuit (N standby)
The main circuit (N active) recovers power supply, and the standby circuit (N standby) is normal	100%	0%
The main circuit (N active) is normal. The standby circuit (N standby) is powered off or restored	100%	0%
The main circuit (N active) and standby circuit (N standby) are powered off	0%	0%
Resuming power supply for standby circuit only (N standby)	0%	100%
The main circuit (N main circuit) is powered back and the standby circuit is normal	100%	0%

**Table 2-3** Passive power supply switching

Input status	Main circuit (N main) load rate	Load ratio of standby circuit (N standby)
The main circuit (N active) and standby circuit (N standby) are normal	100%	0%
The main circuit (N active) is normal. The standby circuit (N standby) is powered off or restored	100%	0%
The main circuit (N active) is powered off and the standby circuit (N standby) is normal	0%	100%

FusionPoD for AI supports a maximum of two power subracks. The power subracks are 3 U and are located at the top of the cabinet. Each power subrack has 18 power slots. A maximum of 18 power modules can be installed. If two power subracks are configured, the power module can be configured in 35 + 1 mode. The management module is located in the main power subrack. The power subrack supports dual AC inputs and outputs 48 V DC. The power subrack supplies power to server nodes and management modules through the Busbar bus.

A cabinet can be configured with one PDU to supply power to the AC switch. The PDU is located under two power subracks. The PDU supports 1 + 1 380 V AC inputs,

1 + 1 380 V AC outputs to the power subrack, and 5 + 5 220 V AC outputs to the switch.

When the mains power supply is normal, 48 V DC supplies power to server nodes through Busbar. When the mains power is off, all devices in the cabinet are powered off.

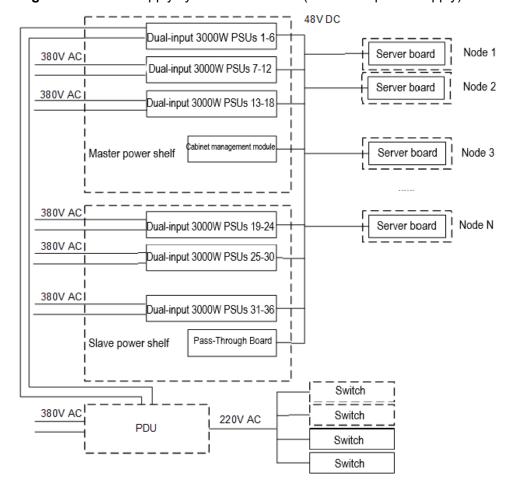


Figure 2-7 Power supply system architecture (switch DC power supply)

# 2.4 Management System

The FusionPoD for AI management system includes the iBMC management system and cabinet management system.

### Server Node BMC Management System

The server node backplane provides one iBMC GE port, which connects to the out-of-band management plane of the data center through the uplink port of the out-of-band management switch.

## **Cabinet Management System**

The RM230 is used to manage cabinet power supplies and cabinet sensors and connect to the data center management plane through switches.

# Interconnection with upper-layer cluster management software (FusionDirector)

Server nodes, iBMC, and iRM provide standard interfaces to allow upper-layer cluster management software (FusionDirector) to interconnect to manage devices.

FusionDirector supports multiple device access modes, such as batch import, manual addition, and automatic discovery, to meet various service requirements. As long as the management network is connected and meets network requirements (delay  $\leq$  100 ms, packet loss rate  $\leq$  0.1%, bandwidth  $\geq$  50 Mbit/s, and no IP address conflict occurring on the device), you can manage devices across regions.

You can view the information of managed devices, such as the device health status, configuration parameters, and alarms to learn the running status of devices in real time and handle exceptions in a timely manner, improving the management efficiency.

For details about importing cabinets, servers, switches, and CDUs into the upperlayer cluster management, see the System WebUI section in the FusionDirector Operation Guide.

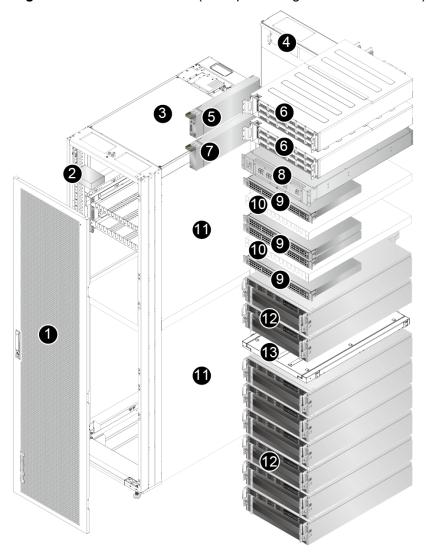
# 3 Hardware Description

- 3.1 Racks
- 3.2 RDHx (Optional)
- 3.3 Management module
- 3.4 Server Node
- 3.5 Power Supply Unit (PSU)
- 3.6 Leakage Detection Module

## 3.1 Racks

#### **External Structure**

Figure 3-1 External structure (example: configured with the RDHx)

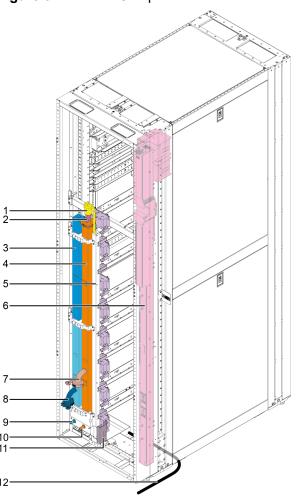


1	Cabinet door	2	Temperature and humidity sensor (optional)
3	Liquid-cooling cabinet	4	RDHx (Optional)
5	RM230 management module	6	Power shelf
7	Pass-through board	8	PDU
9	Switch	10	Cable tray

11	Cabinet side panel	12	Server node
13	Strengthen the tray	-	-

## **Internal Components**

Figure 3-2 Internal Components



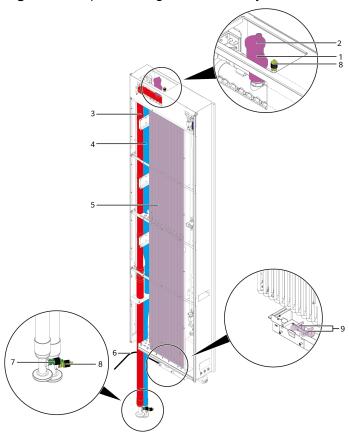
1	Mainfold exhaust valve	2	Manifold ball valve
3	Manifold water supply pipe	4	Manifold water return pipe
5	Diversion groove	6	Busbar
7	Manifold water return pipe port	8	Manifold water supply pipe port
9	Manifold cooling commissioning connector of the water supply pipe	10	Manifold cooling commissioning connector of the water return pipe

11	Photoelectric leakage	12	Catch-up drain pipe
	sensor		

# 3.2 RDHx (Optional)

# **Liquid Cooling Door Assembly**

Figure 3-3 Liquid Cooling Door Assembly



1	Liquid cooling door return pipe exhaust valve	2	Liquid cooling door water supply pipe exhaust valve
3	Liquid cooling door return pipe	4	liquid cooling door water supply pipe
5	Heat exchange core	6	Liquid cooling door drain pipe
7	Liquid cooling valve return pipe needle valve	8	Liquid cooling door water supply pipe needle valve
9	Float type liquid leakage sensor	-	-

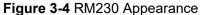
## 3.3 Management module

#### 3.3.1 RM230

RM230 is the management module of FusionPoD 820. It provides cabinet management functions, including management of asset, power supply module, temperature and humidity monitoring, power consumption, liquid leakage detection, and liquid leakage detection on the secondary loop.

The RM230 is installed in the power supply chassis of the FusionPoD for Al and shares the power supply chassis with the PSU.

For details, see the RM230 Management Module User Guide.



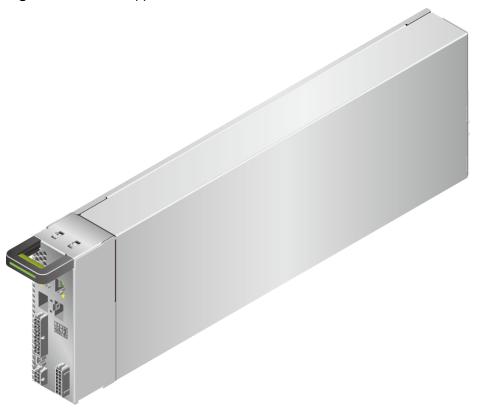
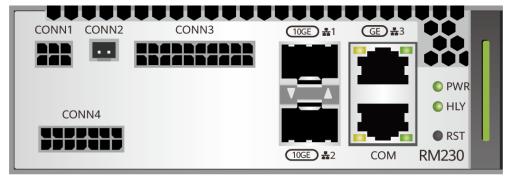


Figure 3-5 RM230 front panel appearance



#### 3.4 Server Node

#### 3.4.1 GN560E V7

The GN560E V7 server node (GN560E V7 for short) is a high-performance 4U 8GPU liquid-cooled server designed to meet the requirements of telecom, Internet, finance, Internet data center (IDC), and government and enterprise applications.

The GN560E V7 supports two fourth-generation <sup>®</sup> Xeon <sup>®</sup> scalable processors (Sapphire Rapids), 32 DDR5 DIMMs, NVIDIA HGX 8-GPU NVLink module, and eight 2.5-inch NVMe hard disks. Two 2.5-inch SAS/SATA disks, providing a maximum of 13 PCIe slots. Different types of standard PCIe cards can be flexibly configured.

The GN560E V7 panel provides one iBMC management GE port, one VGA port and two USB ports.

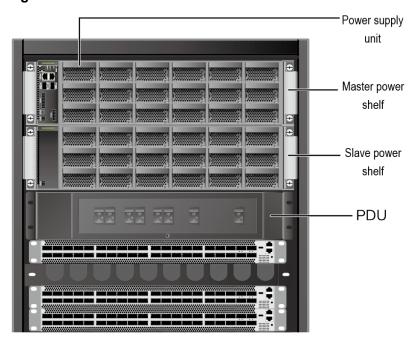
The GN560E V7 node supports CPU, VRD, 8-GPU liquid cooling, and memory liquid cooling (optional). You do not need to remove the cold board during DIMM insertion and removal.

Figure 3-6 GN560E V7 Appearance



# 3.5 Power Supply Unit (PSU)

Figure 3-7 Power distribution



#### 3.5.1 Power Shelves

The power shelf consists of the power chassis, power supply units (PSUs), and management module. The power shelf converts the AC power into stable DC power for the cabinet through the AC/DC module.

The power shelf supports a maximum of four three-phase 32 A inputs. See **Figure 3-8**.

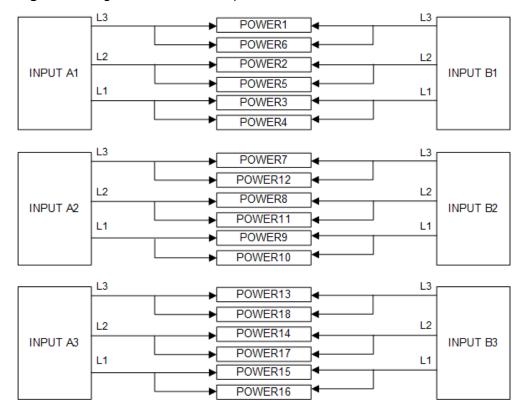
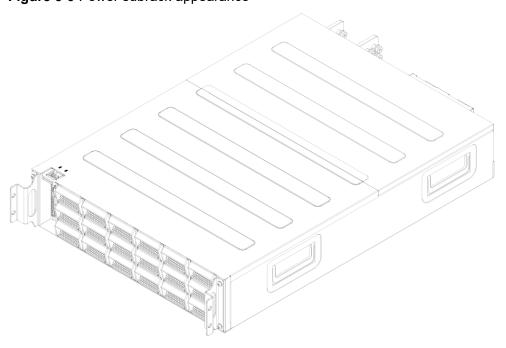


Figure 3-8 Logical structure of the power subrack

#### **Appearance**

Figure 3-9 Power subrack appearance



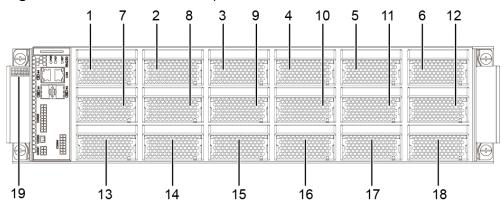


Figure 3-10 Power subrack front panel

1	Power module 1	2	Power module 2
3	Power module 3	4	Power module 4
5	Power module 5	6	Power module 6
7	Power module 7	8	Power module 8
9	Power module 9	10	Power module 10
11	Power module 11	12	Power supply module 12
13	Power module 13	14	Power module 14
15	Power module 15	16	Power module 16
17	Power supply module 17	18	Power module 18
19	PSU slot ID	-	-

#### **◯** NOTE

The cabinet is configured with two power subracks. The upper power subrack is the master power subrack, and the lower power subrack is the slave power subrack. Each PSU is configured with 18 PSUs. Power modules 1, 6, 7, 12, 13, and 18 work in L3 phase, power modules 2, 5, 8, 11, 14, and 17 work in L2 phase, and power modules 3, 4, 9, 10, 15, and 16 work in L1 phase. To balance the work between phases, the same number of power modules must be configured for each phase.

Figure 3-11 Rear panel of power subrack

1	Input interface A1 (INPUT A1)	2	Input interface B1 (INPUT B1)
3	Input interface A2 (INPUT A2)	4	Input interface B2 (INPUT B2)
5	Input interface A3 (INPUT A3)	6	Input interface B3 (INPUT B3)

## **Technical specifications**

Table 3-1 Technical Specifications of the Power Shelf

Items	Description
Number of PSUs	18 in full configuration
Input voltage system	3L+N+PE
Number of input ports	Six: INPUT A1/INPUT A2/INPUT A3 is the primary input power supply, and INPUT B1/INPUT B2/INPUT B3 are the secondary input power supply
Input voltage	346 V AC to 415 V AC (three-phase):
Input current	32A per phase
Output voltage	48V DC
Output current	Power shelf: max. 660 A; 55 A/PSU
Output Power	Total power of a power shelf:  Up to 54 kW (no redundancy)  Up to 51 kW (N+1 redundancy)
Dimensions (H x W x D)	133mm × 536mm × 750mm

## 3.5.2 Power Supply Module

The PSUs are connected to the power subrack through the AC/DC INPUT port. Their outputs are collected to the copper bars of the power subrack.

#### **Appearance**

Figure 3-12 PSU Appearance

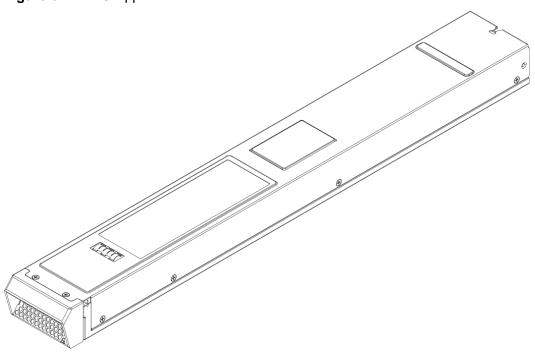


Figure 3-13 PSU front panel

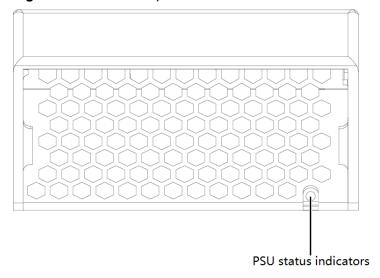


Table 3-2 Indicator status description

Indicator status	Status description	
Steady green light	The input is normal. The 48 V output of the main circuit is normal.	
Blinking green at 1 Hz	<ul> <li>Input is normal, power supply shuts down 48V output due to INSTALLED.</li> </ul>	
	The input is normal. The power supply enters power- off mode due to PSON # high.	
	Input Overvoltage.	
	Standby machine under cold backup.	
	The power supply enters Deep sleep mode.	
Blinking green at 4 Hz	The online upgrade is in progress.	
Orange light is always on	The input is normal. No output is generated due to power over-temperature protection, power output over-current or short circuit, output over-voltage, short circuit protection, and component failure (excluding all component failures).	
The indicator light out	No AC input.	

#### **Technical Parameters**

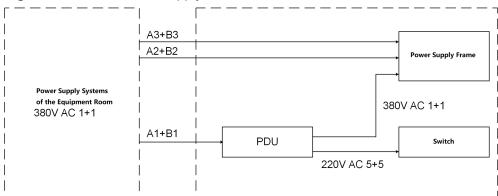
**Table 3-3** Technical Parameters

Project	Describe	
Dimensions (H × W × D)	40.7mm×68mm×538.5mm	
Weight	3.5kg	
Input rated voltage	110V AC/230V AC/240V AC/240V HVDC/380V HVDC	
Output rated voltage	48V DC	
Input Voltage Range	90V AC~264V AC 180V DC~400V DC	
Maximum Input Current	16A	
Maximum output power	<ul> <li>3000W@200V AC~264V AC/200V DC~400V DC</li> <li>2500W@180V AC~200V AC/180V DC~200V DC</li> <li>1500W@100V AC~180V AC</li> <li>1000W@90V AC~100V AC</li> </ul>	

#### 3.5.3 PDU

The FusionPoD for AI cabinet is configured with PDUs to supply power to the AC switches, meeting the requirements of common switches. A PDU is installed under the power shelf. It provides 380 V AC (1+1) power for the power shelf, and 220 V AC (5+5) power for the switching nodes to meet the power supply demand of the five switching nodes in the cabinet.

Figure 3-14 PDU Power Supply Architecture



#### **Appearance**

Figure 3-15 PDU appearance

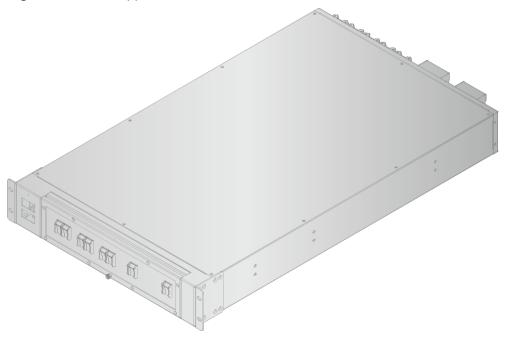


Figure 3-16 PDU front panel



Figure 3-17 PDU rear panel

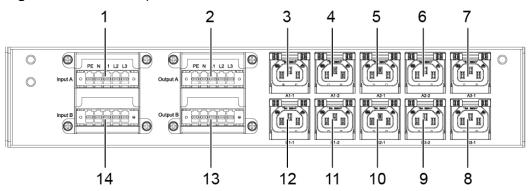


Table 3-4 Rear Panel Ports

Number	Interface description
1	Input A, connected to the barrel power cable
2	Output interface Output A, connected to the A-channel input of the power subrack and controlled by the QF-A switch
3	Output interface A1-1, connected to channel A input of the switch, supporting 5 A, controlled by QF-A1 switch
4	Output interface A1-2, connected to the A-channel input of the switch, supporting 5 A and controlled by the QF-A1 switch
5	Output interface A2-1, connected to the A channel input of the switch, supporting 5 A and controlled by the QF-A2 switch
6	Output interface A2-2, connected to the A channel input of the switch, supporting 5 A and controlled by the QF-A2 switch
7	Output interface A3-1, connected to channel A input of the switch, supporting 10 A, controlled by QF-A3 switch
8	Output interface B3-1, connected to the B-channel input of the switch, supporting 10 A, controlled by QF-B3 switch
9	Output interface B2-2, connected to the B-channel input of the switch, supporting 5 A and controlled by the QF-B2 switch
10	Output interface B2-1, connected to the B-channel input of the switch, supporting 5 A, controlled by QF-B2 switch
11	Output interface B1-2, connected to the B-channel input of the switch, supporting 5 A and controlled by the QF-B1 switch

Number	Interface description
12	Output interface B1-1, connected to the B-channel input of the switch, supporting 5 A, controlled by the QF-B1 switch
13	Output B interface, connected to the B input of the power subrack, controlled by the QF-B switch
14	Input B, connected to the barrel power cable

#### **NOTE**

- A3-1 and B3-1 can be preferentially connected to switches with power greater than 500 W, followed by A1-1 and B1-1, A2-1 and B2-1.
- Depending on the total number of PSUs in a cabinet and the power of different switches, the input and output connection methods of PDUs vary.
- When the current of a single channel of the switch is less than or equal to 5 A, the two PDU interfaces controlled by the same QF switch can be connected simultaneously. When the current of a single channel of the switch is greater than 5 A, only one interface can be connected to the two PDU power interfaces controlled by the same QF switch.

(Note: The sum of the currents of the two PDU power interfaces controlled by the same QF switch must be less than or equal to 10 A and cannot exceed the current load.))

#### **Technical Parameters**

Table 3-5 Technical specifications

Items	Describe	
Input voltage system	3L+N+PE	
Number of input ports	Phoenix terminal	
Input voltage	380 V AC, two three-phase, and five-wire	
Input current	A maximum of 32 A/phase	
Output voltage	380 V AC (1+1) and 220 V AC (5+5)	
Output current	Single phase output: The maximum value of two channels is 10 A, and the maximum value of other channels is 5 A	
	Three-phase output: a maximum of 27 A for each power output	
Dimensions (H × W × D)	86.1mm×442mm×750mm	

## 3.6 Leakage Detection Module

## 3.6.1 Photoelectric Leakage Sensor

The photoelectric leakage sensor is used to detect whether the Manifold has liquid leakage and report a liquid leakage alarm through the cabinet management module.

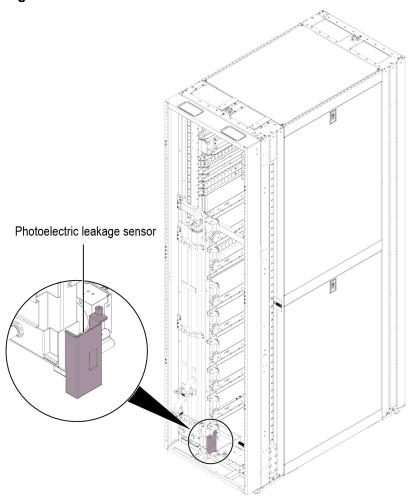


Figure 3-18 Photoelectric Leak Sensor Position

## 3.6.2 Float-Type Leakage Sensor

The float-type leakage sensor is used to detect whether liquid leakage exists in the liquid cooling door. The cabinet management module reports liquid leakage detection alarms.

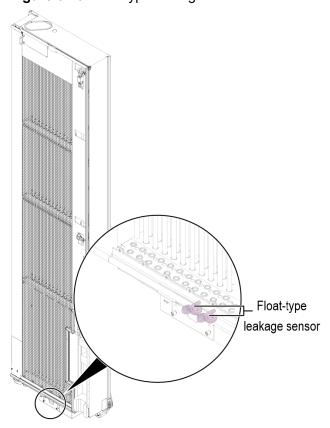


Figure 3-19 Float-type leakage Sensor Position

# 4 Product Specifications

- 4.1 Technical Specifications
- 4.2 Environmental Specifications
- 4.3 Physical Specifications

# 4.1 Technical Specifications

Table 4-1 Technical specifications

Indicator item	Descriptions	
Available Space	The node zone supports eight 4 U liquid-cooled server nodes.	
	The switch area supports a maximum of five 1 U universal switches.	
	The power supply area consists of two 3 U power subracks and one AC 2 U PDU.	
Heat dissipation mode	Full liquid cooling/cold plate type liquid cooling.	
Whole cabinet power consumption	Supports a maximum of 105 kW.	
Cabinet management module	Two 10GE ports, one GE port, and one RS485 serial port.	

Indicator item	Descriptions
Server node	Supports a maximum of eight 4 U liquid-cooled server nodes.  NOTE  The number of server nodes that can be configured depends on the actual power consumption of a single node. A cabinet supports only server nodes of the same model.  For details about the supported server nodes, see 3.4 Server Node.  The cabinet is equipped with guide rails. Server nodes are installed on the guide rails.  The GN560E V7 supports:  Support for two fourth-generation Intel ® Xeon ® Scalable Processors (Sapphire Rapids).  Supports a maximum of 32 DDR5 DIMMs.  Supports NVIDIA HGX 8-GPU NVLink modules and Ampere and Hopper HGX NVLink modules.  Supports flexible network configuration.  Supports liquid cooling of CPUs, GPUs, and DIMMs (optional).
Switching slots	<ul><li>Supports five switch slots.</li><li>Each slot supports one 1 U standard switch.</li></ul>
Cabinet door	<ul> <li>Supports front and rear mesh doors.</li> <li>When you configure the liquid-cooled door, you do not need to configure the rear door of the cabinet.</li> <li>When liquid-cooled doors are not configured, you can configure the cabinet rear door.</li> </ul>
Power supply	<ul> <li>Supports 2N power supply system.</li> <li>The cabinet supports a maximum of 36 PSUs, with a single PSU of 3 kW.</li> <li>PSUs support N + M hot-swappable redundant power supply. You can use N + 1 or N + 2 redundancy based on power requirements.</li> <li>Each AC power subrack supports 3 + 3 three-phase AC power inputs. The voltage range is as follows: 346 V AC to 415 V AC, 32 A per phase current.</li> <li>Each AC power subrack supports six IEC 60309 male AC plug connectors.</li> </ul>

# 4.2 Environmental Specifications

Table 4-2 Environmental Specifications

Indicator item	Descriptions	
Temperature	Operating temperature: 5°C to 40°C (41°F to 104°F)     (ASHRAE Classes A1 to A3 compliant)	
	Storage temperature (within three months): -30°C to +60°C (-22°F to +140°F)	
	Storage temperature (within six months): –15°C to +45°C (5°F to 113°F)	
	<ul> <li>Storage temperature (within one year): -10°C to +35°C (14°F to 95°F)</li> </ul>	
	Maximum temperature change rate: 20°C (36°F) per hour, 5°C (9°F) per 15 minutes	
Relative Humidity (RH, non-condensing)	<ul> <li>Operating humidity: 8% to 90% NOTICE All liquid cooling components are not allowed to condense. </li> <li>Storage humidity (within 3 months): 8% to 85%</li> <li>Storage humidity (less than 6 months): 8% to 80%</li> <li>Storage humidity (less than one year): 20% to 75%</li> <li>Maximum humidity change rate: 20% /hour</li> </ul>	
Working altitude	<ul> <li>≤3050m</li> <li>When the configuration meets the ASHRAE Class A1 and A2, the altitude exceeds 900 m, and the operating temperature is reduced by 1 °C for every 300 m.</li> <li>When the configuration meets ASHRAE Class A3, the altitude exceeds 900 m, and the operating temperature is reduced by 1 °C per 175 m.</li> </ul>	
The inlet temperature	5°C (41 ° F) to 45 °C (113 ° F), the actual inlet temperature should be greater than + 3 °C dew point in the equipment room	
Influent water flow	Single GN560E V7 : ≥10.8L/min, ≥95L/min for the whole cabinet	
Corrosive gaseous pollutants	Maximum rate of corrosion product thickness growth:  Copper Test Strip: 300 Å/month (Gas corrosion class G1 as defined by ANSI/ISA-71.04-2013)  Silver Test Strip: 200 Å/month	

Indicator item	Descriptions	
Particle pollutants	Data center cleaning compliance ISO14664-1 Class8	
	The equipment room has no explosive, conductive, magnetic, or corrosive dust	
	NOTE  It is recommended to hire a professional organization to monitor particulate pollutants in the equipment room.	
Noise	At operating temperature of 25 °C, declared according to ISO7779 (ECMA74) test and ISO9296 (ECMA109). A weighted sound power LWAd (declared A-Weighted sound power levels) and A weighted sound pressure LpAm (declared average bystander position A-Weighted sound pressure levels) are as follows:	
	Runtime:	
	<ul><li>LWAd: 8.3 Bels</li></ul>	
	NOTE  Actual operating noise varies depending on configurations, loads, and ambient temperature.	

# 4.3 Physical Specifications

Table 4-3 Physical Specifications

Indicator item	Descriptions
Cabinet dimensions	Without liquid-cooled door:
(height x width x depth)	<ul> <li>Size of optical cable: 2250mm × 600mm × 1200mm</li> </ul>
	<ul> <li>Cable size: 2250mm × 600mm × 1300mm</li> </ul>
	With liquid cooling door:
	<ul> <li>Size of optical cable: 2250mm × 600mm × 1325mm</li> </ul>
	<ul> <li>Cable size: 2250mm × 600mm × 1425mm</li> </ul>
Installation Dimension	Floor height ≥ 600 mm
Requirements	The front and rear doors reserve more than 1.2 m of maintenance space
Cabinet projection	Without liquid-cooled door:
area	<ul> <li>Size of optical cable: 600 mm × 1200 mm</li> </ul>
	<ul><li>Cable size: 600 mm × 1300 mm</li></ul>
	With liquid cooling door:
	<ul> <li>Size of optical cable: 600 mm × 1325 mm</li> </ul>
	<ul><li>Cable size: 600 mm × 1425 mm</li></ul>

Indicator item	Descriptions
Full weight	Total weight of the cabinet (excluding switches and reinforced trays) when eight nodes are fully configured: 1041 kg
Energy consumption	The energy consumption parameters vary according to different configurations (including those in the ErP standard).

# 5 System Reliability Design

5.1 Failure Prevention and Maintenance Design

5.2 Fault Tolerant Function Design

5.3 Liquid Cooling Reliability Design

## 5.1 Failure Prevention and Maintenance Design

#### **Fault Prevention**

FusionPoD for Al adopts derating design, fault warning, and sub-health detection to ensure fault prevention of the system.

- Derating design ensures that the stress of the components in the equipment is lower than the rated value, delaying performance degradation, prolonging working life and reducing failure rate. All components of the FusionPoD 720 adopt strict derating design for electrical and thermal stress, effectively improving product reliability.
- Fault pre-warning design: FDM can pre-warn the upcoming faults, which helps
  users to spare parts in advance, thus reducing maintenance time and improving
  system availability. Server nodes can provide fault warning for key components,
  such as hard disks, fans, and DIMMs.
- Subhealth is a state between health and faults. Improper handling of subhealth
  will directly affect services. FusionPoD for AI can detect subhealth of key
  components, such as memory and network ports, and set alarm thresholds.
  When a component status parameter reaches or exceeds the threshold, the
  system reports an alarm to prompt you to rectify the subhealth status of the
  component as soon as possible.
- Isolation circuit design: An isolation circuit is added at the output side of each PSU to prevent the busbar power supply stability from being affected due to a single PSU exception. The node-side PSU module has an overcurrent fast power-off circuit to prevent the single-node power supply from affecting Busbar.
- End-to-end physical protection for the busbar. When the busbar is installed at
  the output end of the power subrack, server access end, or cabinet, physical
  protection is added for all links to ensure that the busbar does not have physical
  faults.

#### **Easy Maintenance Design**

- The panels of server nodes, hard disks, and PSUs are configured with multiple indicators to clearly indicate whether the components are faulty.
- Server nodes and hard disks are hot swappable, facilitating onsite replacement and maintenance.

# 5.2 Fault Tolerant Function Design

Whether a device fault affects services reflects the fault tolerance capability of the system. FusionPoD for Al adopts the component-level redundancy design to ensure that single points of failure do not affect services. In addition, the compute node provides fault tolerance capability to allow a single processor or DIMM to fail.

#### **Redundant Design**

#### **NOTE**

FusionPoD for AI provides redundancy for switch slots, node fan modules, and cabinet PSUs.

- The fan automatically adjusts the fan speed at different ambient temperatures. In this way, the device components always work within the appropriate temperature range, ensuring the long-term reliability of the component.
- The cabinets provide centralized power supply, and PSUs are redundant. When
  the number of nodes is different, the system supports a maximum of N + N
  backup. If the PSUs are faulty, the system power supply is not affected.

#### **Internal Fault Tolerance Design of Server Nodes**

- If a single DIMM is faulty, services are not interrupted and performance may deteriorate.
- Memory alignment, which means that the server node can read memory when the processor is idle to find and fix errors.
- The DIMM supports the error checking and correcting (ECC) technology to automatically locate and correct errors. This improves the reliability of data storage and the security and stability of memory usage.

### 5.3 Liquid Cooling Reliability Design

#### **leakage Protection Design**

- The liquid-cooled server node supports self-isolation of the leakage. When a single node is faulty, it would not affect normal operation of other nodes in the cabinet.
- The liquid-cooled connector between the liquid-cooled server node and the liquid separator in the cabinet adopts the blind-plug quick-plug connector. The interface is self-sealed and no drip leakage occurs.
- The cabinet Manifold and liquid cooling door are designed with flow guide pipe and bottom water receiving tray. When the water level reaches a certain height, it can be discharged through the water outlet.

#### **Leakage Detection Design**

- The cabinet supports liquid leakage detection. The liquid leakage sensor connects to the RM230 through signal cables to report alarms.
- The liquid-cooled server node supports liquid leakage monitoring and shutdown, reports the node to the iBMC management software, and reports the secondlevel shutdown to the customer network management system.

# 6 Software and Hardware Compatibility

For more information on operating systems and hardware, please consult your local sales representative.

#### NOTICE

- If incompatible components are used, the device may be abnormal. Such a fault is beyond the scope of technical support and warranty.
- The performance of servers is closely related to application software, basic middleware software, and hardware. The slight differences of the application software, middleware basic software, and hardware may cause performance inconsistency between the application layer and test software layer.
  - If the customer has requirements on the performance of specific application software, contact technical support to apply for proof of concept (POC) tests in the pre-sales phase to determine detailed software and hardware configurations.
  - If the customer has requirements on hardware performance consistency, specify the specific configuration requirements (for example, specific drive models, RAID controller cards, or firmware versions) in the presales phase.

# **7** Control of Information

7.1 Security

7.2 Maintenance and Warranty

## 7.1 Security

#### **General Statement**

- Comply with local laws and regulations when installing equipment. These safety instructions are only a supplement.
- The "DANGER", "WARNING", and "CAUTION" information in this document does not represent all the safety instructions, but supplements to the safety instructions.
- Observe all safety instructions provided on device labels.
- Operators of special types of work (such as electricians, operators of electric forklifts, and so on.) must be certified or authorized by the local government or authority.



In a household scenario, operation of this device may cause radio interference.

#### **Grounding Requirements**

The following requirements are only applicable to the equipment that needs to be grounded.

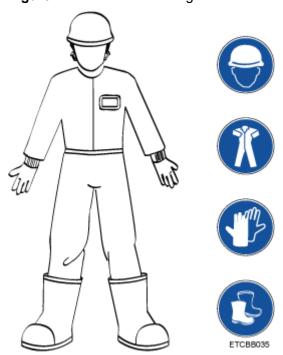
- To install the equipment, connect the PGND cables first. To uninstall the equipment, remove the PGND cables last.
- Do not damage grounding conductors.
- Do not perform operations on the equipment before grounding conductors are installed.

• The equipment must be grounded permanently. Before performing operations on the equipment, check the electrical connection of the equipment to make sure that the equipment is grounded reliably.

#### **Human Safety**

- This equipment is not suitable for use in places where children may be present.
- Only qualified personnel are allowed to perform special tasks, such as performing high-voltage operations and driving a forklift.
- Discontinue any dangerous operations and take protective measures. Report anything that could cause personal injury or equipment damage to a project supervisor.
- Do not move devices or install cabinets and power cables in hazardous weather conditions.
- For lifting or carrying hardware, ensure load limits and manpower provisions conform to legal specifications. Check the maximum equipment weight and arrange required personnel.
- Wear clean protective gloves, ESD clothing, a protective hat, and protective shoes, as shown in Figure 7-1.

Figure 7-1 Protective clothing



 Before touching a device, wear ESD clothing and gloves (or wrist strap), and remove any conductive objects (such as watches and jewelry). Figure 7-2 shows conductive objects that must be removed before you touch a device.

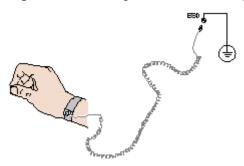
Figure 7-2 Removing conductive objects



Figure 7-3 shows how to wear an ESD wrist strap.

- a. Secure the ESD wrist strap around your wrist.
- b. Fasten the strap buckle and ensure that the ESD wrist strap is in contact with your skin.
- c. Insert the ground terminal attached to the ESD wrist strap into the jack on the grounded cabinet or chassis.

Figure 7-3 Wearing an ESD wrist strap



- Exercise caution when using tools.
- Use a stacker when lifting hardware above shoulder height.
- Avoid any contact with high-voltage cables.
- Properly ground a device before powering it on.
- Do not use the ladder unsupervised. Have someone else hold the ladder steady to prevent accidents.
- Do not look into optical ports without eye protection.

#### **Equipment Safety**

- Use the recommended power cables at all times.
- Power cables are used only for dedicated devices.
- Wear ESD clothing and gloves before touching any devices.
- When moving a device, hold the bottom of the device. Do not hold the handles of the installed modules, such as the PSUs, fan modules, drives, and the mainboard. Handle devices with care. Handle the equipment with care.
- Exercise caution when using tools.
- Ground devices before powering it on.

#### **Chemical Safety**

- Hazard of liquid working medium: Swallows of or repeated exposure to the working medium may cause personal injury. If discomfort occurs, seek medical attention immediately.
- Precaution for handling liquid working medium: Do not eat, drink, or smoke during work. Wash skin thoroughly after work.
- Personal protection:
  - Eye and face surface protection: Use safety glasses with side protection.
  - Skin protection: Use chemical protective gloves suitable for this substance during long-term or frequent repeated exposure. Use chemical protective clothing to resist this substance when exposure is prolonged or repeated.
  - Respiratory system protection: Wear a respiratory protection device when exposure time is likely to exceed the specified limit value.
- First aid measures:
  - Inhalation: Move the person to a place with fresh air and keep him/her breathing comfortably. You are advised to consult a doctor.
  - Skin contact: Immediately rinse the skin with water and remove contaminated clothing and shoes. You are advised to consult a doctor.
  - Eye contact: Rinse eyes thoroughly with water for a few minutes. You are advised to consult a doctor.
  - Ingestion: Do not induce vomiting. Seek medical treatment immediately.
- Waste disposal:
  - Send the contents or containers to an approved waste treatment plant for disposal.

#### **Transportation Precautions**

Please comply with the on-site construction civilized management regulations. The following measures are for reference only.

- 1. During the transportation and installation, personnel must use special protective equipment, such as gloves, helmets, safety clothes, reflective vests, and safety shoes, and remove easy conductors such as jewelry and watches.
- 2. Heavy object handling requirements:
  - a. Hire certified logistics companies to transport devices complying with international standards for transporting electronics. Ensure that the devices being transported is always kept upright. Take necessary precautions against collisions, corrosion, moisture, package damage, and contamination.
  - b. Transport each device in its original packaging.
  - c. If the original packaging is unavailable, package heavy, bulky parts (such as chassis and blades) and fragile parts (such as optical modules and PCIe cards: GPU or SSD) separately.
  - d. Power off all devices before transportation.
  - e. The weight of the equipment is about 500 kg (excluding the node). The load capacity of the equipment room must be ≥ 6 kN/m² in the transport path. During the transport of the equipment, ensure that the inclination angle is ≤ 15 ° to prevent the equipment from falling over and causing personal injury.

f. When transporting with casters provided by the unit, ensure that the diameter of the transport wheel is flat and no dent or bulge ≥ 20mm. Otherwise, use steel plates or wooden boards on the floor of the transportation path. Arrange for more than four people to push and assist the unit to pass slowly. Push the unit from the rear door instead of pushing it from the side door.

#### **Maximum Weight Carried by a Person**



Comply with local regulations for the maximum load per person.

**Table 7-1** lists the maximum weight one person is permitted to carry as stipulated by a number of organizations.

**Table 7-1** Maximum weight carried per person

Organization	Weight (kg/lb)
CEN (European Committee for Standardization)	25/55.13
ISO (International Organization for Standardization)	25/55.13
NIOSH (National Institute for Occupational Safety and Health)	23/50.72
HSE (Health and Safety Executive)	25/55.13
General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ)	<ul><li>Male: 15/33.08</li><li>Female: 10/22.05</li></ul>

For more information about safety instructions, see the Server Safety Information.

# 7.2 Maintenance and Warranty

For details about maintenance, see Service Exceptions and Limitations.

For details about warranty, see Warranty.

# 8 The Certificate

Country / Region	Certification	Standard
China	RoHS	GB/T 26572-2011
		SJ/T 11364-2014
Europe	WEEE	2012/19/EU
Europe	REACH	EC NO.1907/2006
Europe	CE	Safety:
		EN 62368-1:2014+A11:2017
		EMC:
		EN 55032
		EN 55035
		EN 61000-3-12
		EN IEC 61000-3-11
		ETSI EN 300 386
		RoHS:
		EN IEC 63000:2018

# 9 Waste Product Recycling

If product users need product recycling service provided by xFusion after products are scrapped, contact technical support for services.



# A.1 Alarm Query Guide

Table A-1 Alarm Query Guide

Name	Ma na ge me nt sof twa re / de vic es	Management Software Interface Protocol	Alarm Type Overview	For alarm handling, see manual
<ul> <li>Fu sio nP oD for AI ca bin et</li> <li>R M2 30 Ma na ge me nt Mo dul e</li> <li>Po we r su ppl y mo dul e</li> </ul>	iR M	As the core software of the intelligent cabinet management system, the iRM is integrated into the asset management box. It provides Web, CLI, SNMP, IPMI, and Redfish management interfaces to facilitate user operations and third-party management applications.  For details, see the iBMC User Guide.	<ul> <li>Fault alarm</li> <li>Voltage alarm</li> <li>Power supply alarm</li> <li>Fan alarm</li> <li>Temperat ure alarm</li> <li>Cabinet alarm</li> <li>Other alarms</li> <li>Event type alarm</li> </ul>	For details about alarm handling, see "Alarm Handling" in the iRM User Guide.

Name	Ma na ge me nt sof twa re / de vic es	Management Software Interface Protocol	Alarm Type Overview	For alarm handling, see manual
GN56 0E V7 Liquid Coolin g Serve r	iB MC	The iBMC provides the following standard interfaces to meet system integration requirements in various modes:.  DCMI 1.5 interface IPMI 1.5/IPMI 2.0 interface Command line interface Redfish interface Hypertext Transfer Protocol Secure (HTTPS) Simple Network Management Protocol (SNMP) For details, see the iBMC User Guide.	<ul> <li>Fault alarm</li> <li>Temperat ure alarm</li> <li>Power supply alarm</li> <li>Watchdo g alarm</li> <li>Managem ent Subsyste m Alarms</li> <li>Storage alarm</li> <li>Fan alarm</li> <li>Memory alarm</li> <li>Other alarms</li> <li>Event type alarm</li> </ul>	For details about alarm handling, see the corresponding sections in the iBMC User Guide.

	Ma na ge me nt sof twa re / de vic es	Management Software Interface Protocol	Alarm Type Overview	For alarm handling, see manual
Coolin g Mana geme nt	Th e dis pla y scr een	The communication protocols supported by the group are: The northbound communication protocols FE SNMP V3 and Modbus RTU. For details, see the CDU User Guide.	<ul> <li>Temperature fault</li> <li>Sensor failure</li> <li>Inlet/Outlet Pressure Failure</li> <li>Filter plug failure</li> <li>Fluid supply failure</li> <li>Leakage fault</li> <li>Communicat ion failure</li> <li>Voltage fault</li> <li>Other faults</li> </ul>	For details of troubleshooting, please refer to the chapter of Unit Maintenance> Easy Troubleshooting from CDU Maintenance and Service Guide

# A.2 Water Quality Standard for Secondary Water Supply

Table A-2 Water Quality Standard for Secondary Water Supply

Project	Standard
Ethylene glycol concentration	25 ± 5% (by volume)  NOTE  The material brand and supply channel must be confirmed by the equipment manufacturer.
Appearance (initial water quality)	Transparent, no visible impurities
pH value (20°C or 68°F)	≥6.5
Bacterial	≤10 <sup>5</sup> CFU/mL

# A.3 Water Quality Standard for Primary Water Supply

Table A-3 Water Quality Standard for Primary Water Supply

Project	Standard
pH value (25 °C)	7.5~10
Turbidity	≤10 NTU
Suspended Matter	≤ 10 mg/L, granularity not more than 500 um
Electrical conductivity (25 °C)	≤2000 uS/cm
C1 ion	≤250 mg/L
Total iron ion	≤1.0 mg/L
Calcium (in CaCO <sub>3</sub> )	≤300mg/L
Total alkalinity (in CaCO <sub>3</sub> )	≤500mg/L
Dissolved oxygen	≤0.1 mg/L
Organophosphorus (as P)	≤0.5 mg/L

### A.4 Flow Resistance Curve of the RDHx

The relationship curve between flow resistance and inlet flow of the RDHx is shown in **Figure A-1**.

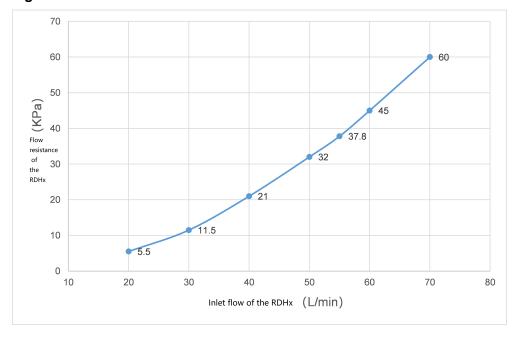


Figure A-1 Flow Resistance Curve of the RDHx



### **B.1 A-E**

В

baseboard management controller (BMC)	The BMC complies with the Intelligent Platform Management Interface (IPMI). It collects, processes, and stores sensor signals, and monitors the operating status of components. The BMC provides the hardware status and alarm information about the managed objects to the management system so that the management system can implement unified management of the devices.
Busbar	Busbar refers to the copper or aluminum bar connecting the main switch of the electric cabinet and the shunt circuit switch in the power supply system. Its surface is treated with insulation, and it is mainly used as a wire.

Ε

End of Row (EOR)	A way of distinguishing switches based on cabling. EOR switches are deployed in one or two cabinets at the end of a row. All servers in the cabinets in the row are connected to EOR switches using horizontal cabling.
ejector lever	A part on the panel of a device used to facilitate installation or removal of the device.

A baseband local area network (LAN) architecture developed by Xerox Corporation by partnering with Intel and DEC. Ethernet uses the Carrier Sense Multiple Access/Collision Detection (CSMA/CD) access method and allows data transfer over various cables at 10 Mbit/s. The Ethernet specification is the basis for the IEEE 802.3 standard.
---

# **B.2 F-J**

G

Gigabit Ethernet (GE)	An extension and enhancement of traditional shared media Ethernet standards. It is compatible with 10 Mbit/s and 100 Mbit/s Ethernet and complies with IEEE 802.3z
	standards.

Н

-	Replacing or adding components without stopping or shutting down the system.
	onatang down and dysterm

# **B.3 K-O**

K

KVM	Keyboard, video and mouse.
-----	----------------------------

## **B.4 P-T**

Ρ

panel	An external component (including but not limited to ejector levers, indicators, and ports) on the front or rear of the server. It seals the front and rear of the chassis to
	ensure optimal ventilation and electromagnetic compatibility (EMC).

Peripheral Component Interconnect Express (PCIe)	A computer bus PCI, which uses the existing PCI programming concepts and communication standards, but builds a faster serial communication system. Intel is the main sponsor for PCIe. PCIe is used only for internal interconnection. A PCI system can be transformed to a PCIe system by modifying the physical layer instead of software. PCIe delivers a faster speed and can replace almost all AGP and PCI buses.
Power Usage Effectiveness (PUE)	A comprehensive indicator that is widely accepted and used by data centers worldwide to measure the energy efficiency of data centers.

R

redundancy	A mechanism that allows a backup device to automatically take over services from a faulty device to ensure uninterrupted running of the system.
redundant array of independent disks (RAID)	A storage technology that combines multiple physical drives into a logical unit for the purposes of data redundancy and performance improvement.

S

server	A special computer that provides services for clients over a network.
system event log (SEL)	Event records stored in the system used for subsequent fault diagnosis and system recovery.
Serializer and Deserializer (SerDes)	An interface device used to implement medium- and long-distance high-speed communication. The SerDes interface is often selected as a physical layer implementation solution of communication protocols such as PCI Express, Gigabit Ethernet, and optical fiber communication. It is widely used for high-speed interconnection between chips, cards, and devices.

Т

A way of distinguishing switches based on cabling. To switches are deployed at the top of a cabinet. Servers the cabinet are connected to the switches using optical fibers or network cables, and the switches are connected to the upper-layer aggregation switches.
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# **B.5 U-Z**

U

U	A unit defined in International Electrotechnical Commission (IEC) 60297-1 to measure the height of a cabinet, chassis, or subrack. 1U = 44.45 mm.
UltraPath Interconnect (UPI)	A point-to-point processor interconnect developed by Intel.

# C Acronyms and Abbreviations

#### **C.1 A-E**

Α

AC	Alternating Current
AES	Advanced Encryption Standard New Instruction Set
ARP	Address Resolution Protocol
AVX	Advanced Vector Extensions

В

BBU	Backup Battery Unit
BIOS	Basic Input Output System
вмс	Baseboard Management Controller

C

ccc	China Compulsory Certification
CD	Calendar Day
CE	Conformite Europeenne
CIM	Common Information Model
CLI	Command-Line Interface

D

DC	Direct Current
DDR5	Double Data Rate 5
DDDC	Double Device Data Correction
DEMT	Dynamic Energy Management Technology
DIMM	Dual In-Line Memory Module
DRAM	Dynamic Rrandom-Access Memory
DVD	Digital Video Disc

Ε

ECC	Error Checking and Correcting
ECMA	European Computer Manufacturers Association
EDB	Execute Disable Bit
EN	European Efficiency
ERP	Enterprise Resource Planning
ETS	European Telecommunication Standards

# C.2 F-J

F

FB-DIMM	Fully Buffered DIMM
FC	Fiber Channel
FCC	Federal Communications Commission
FCoE	Fibre Channel over Ethernet
FTP	File Transfer Protocol

G

GE	Gigabit Ethernet
GPIO	General Purpose Input/Output

GPU graphics processing unit	GPU	graphics processing unit
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#### Н

НА	High Availability
HDD	Hard Disk Drive
HPC	High Performance Computing
НТТР	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure

I

iBMC	intelligent baseboard management controller
IC	Industry Canada
ICMP	Internet Control Message Protocol
IDC	Internet Data Center
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IGMP	Internet Group Message Protocol
IOPS	input/output operations per second
IP	Internet Protocol
IPC	intelligent power capability
ІРМВ	Intelligent Platform Management Bus
IPMI	Intelligent Platform Management Interface

# C.3 K-O

#### Κ

KVM keyboard, video, and mouse
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L

LC	Lucent Connector
LRDIMM	Load-reduced dual in-line memory module
LED	Light emitting diode
LOM	LAN on Motherboard

M

MAC	Media Access Control
ммс	Module management controller

Ν

NBD	Next Business Day
NC-SI	Network Controller Sideband Interface

0

ОСР	Open Compute Project
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# **C.4 P-T**

Ρ

PCle	Peripheral Component Interconnect Express
PDU	Power Distribution Unit
PHY	Physical Layer
PMBUS	power management bus
PMem	Persistent Memory
POK	Power OK
PWM	pulse-width modulation
PXE	Preboot Execution Environment
pPUE	partial Power Usage Effectiveness

#### R

RAID	redundant array of independent disks
RAS	Reliability, Availability and Serviceability
RDIMM	registered dual in-line memory module
REACH	Registration Evaluation and Authorization of Chemicals
RJ45	Registered Jack 45
RoHS	Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment

S

SAS	Serial Attached Small Computer System Interface
SATA	Serial Advanced Technology Attachment
SCM	Supply Chain Management
SDDC	Single device data correction
SERDES	Serializer/Deserializer
SGMII	Serial Gigabit Media Independent Interface
SMI	Serial Management Interface
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SOL	Serial over LAN
SONCAP	Standards Organization of Nigeria-Conformity Assessment Program
SSD	Solid-state drive
SSE	Streaming SIMD Extensions

T

TACH	Tachometer Signal
ТВТ	Turbo Boost Technology
TCG	Trusted Computing Group
TCM	Trusted Cryptography Module
TCO	Total cost of ownership

TDP	Thermal Design Power
TELNET	Telecommunication Network Protocol
TET	Trusted Execution Technology
TFM	Trans Flash Module
TFTP	Trivial File Transfer Protocol
TOE	TCP Offload Engine
ТРМ	Trusted Platform Module

## **C.5 U-Z**

U

UBC	Union Bus Connector
UBC DD	Union Bus Connector Double Density
UDIMM	Unbuffered Dual In-line Memory Module
UEFI	Unified Extensible Firmware Interface
UID	Unit identification light
UL	Underwriter Laboratories Inc.
UPI	UltraPath Interconnect
USB	Universal Serial Bus

V

VCCI	Voluntary Control Council for Interference by Information Technology Equipment
VGA	Video Graphics Array
VLAN	Virtual local area network
VRD	Voltage Regulator-Down
VROC	Virtual RAID on CPU

W

WEEE	waste electrical and electronic equipment
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WSMAN	Web Service Management
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