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Technical Specification

Metrobit MPESL233 All-in-one Cabinet

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Contents

1. Abbreviations

Table 1-1 Abbreviations

No.	Abbreviations	Full Name
1	AC	Alternating Current
2	BAT	Battery
3	BESS	Battery Energy Storage System
4	BOS	Balance of System
5	BMS	Battery Management System
6	BMU	Battery Management Unit
7	BCU	Battery Cluster Management Unit
8	BAMS	Battery Administration Management System
9	BAU	Battery Administration Management Unit
10	BOP	Balance of Plant
11	BOL	Beginning of Life
12	DC	Direct Current
13	EMS	Energy Management System
14	EOL	End of Life
15	FSS	Fire Suppression System
16	HMI	Human Machine Interface
17	HV	High Voltage
18	HVAC	Heating & Ventilation and Air Conditioning
19	LFP	Lithium iron phosphate
20	MV	Middle Voltage
21	PCS	Power Conversion System
22	POC	Point of Connection
23	SOC	State of Charge
24	SOH	State of Health
25	UPS	Uninterruptable Power Supply

2. System Design

This system adopts the all-in-one outdoor cabinet with BESS and inverter system, which contains LFP battery: intelligent battery management system, the group technology and integrated PCS. Metrobit can supply safe, reliable, stable power supply solutions, to provide comprehensive highly quality energy.

2.1 Scope of Supply

Metrobit will offer solutions for the requirements as below:

1) Storage batteries;
2) BMS;
3) Liquid cooling unit;
4) Fire suppression system;
5) Integrated PCS;
6) AC Panel;
7) All-in-one cabinet.

Table 2-1 List of Supply Scope

Equipment	Specification and Models	Unit	Qty.	Remark
Battery Module Type		pcs	5	
Battery Strings	832V 280Ah system	set	1	With racks and BMS
All-in-one Cabinet	Outdoor cabinet	set	1	
Liquid Unit	3kW cooling capacity	unit	1	
FSS	Aerosol	set	1	
Integrated PCS	Metis 125 (M125-UL) / Metis 100 Series (M-100-E-IEC)	set	1	Two types of PCS: UL and CE certificate
AC Panel	Auxiliary power distribution	unit	1	

2.2 All-in-one Cabinet Specification

Table 2-2 MPESL233 All-in-one Cabinet Specification

Items			Unit	Parameters	
BESS		Cell Configuration	-	1P260S	
		Rack Qty.	pcs	1	
		Rated Voltage	V	832	
		Work Voltage Range	V	728 ~ 936	
		Rated Energy	kWh	232.9	
		Allowed C-rate	-	0.5C	
		Cooling Type	-	Liquid	
		Dimension (W × D × H)	mm	1000 × 1350 × 2400	
		Weight	kg	~2700	
		Temp. Difference	℃	≤5	
		AC RTE	%	≥88%	
		Lifespan	years	20	
		IP Grade	-	IP55 (Battery Room)	
		FSS Type	-	Aerosol	
		COM Port/Protocol	-	Modbus TCP/IP	
		Recommended Storage Temp. Range	℃	15 ~ 30	
		Operation Ambient Temp. Range	℃	-30 ~ 55	
		Relative Humidity	%	0 ~ 95%	
		Certificates	-	IEC62619, UL9540A, UL9540, UN3536	
PCS	General	System Operation Mode	-	On/Off-grid mode (manual switch)	
		PCS Model No.	-	Metis 125 (M125-UL)	Metis 100 Series (M-100-E-IEC)
		Compliance	-	UL	CE
		Rated Input / Output Power	kW	125	100
		Max. Operating Current	A	184	158
		Certificates	-	IEC62477-1, UK: G99/19/10, Italy: CEI0-21, Low Voltage Directive 2014/35/EU, IEC61000-6-2, IEC61000-6-4	

Items			Unit	Parameters	
PCS	AC Grid-connected	Rated. Output Power	kVA	125	100
		Max. AC Current	A	160	
		Rated Grid Voltage	-	277/480Vac, 3W+N+PE or 3W+PE	230/400Vac, 3W+N+PE or 3W+PE
		Frequency	Hz	60	50 / 60
		Power Factor Range	-	-1…+1	
	AC Off-grid	Output Voltage	-	277/480Vac, 3W+N+PE or 3W+PE	230/400Vac, 3W+N+PE
		Rated. Output Power	kVA	125	100
		Max. AC Current	A	150 (linear load) / 100 (nonlinear load)	
		Frequency	Hz	60	50 / 60
		Max. Allowable Crest Factor	-	2.5	

2.3 BESS Topologic

The BESS topological drawing shows the design of BESS and how the AC, DC, and control sections are interconnected. In this all-in-one cabinet, one battery bank is made up with one battery rack and one PCS. Several combinations of PCS and battery system establish the whole BESS, the maximum number of parallel all-in-one cabinets on grid is 5.

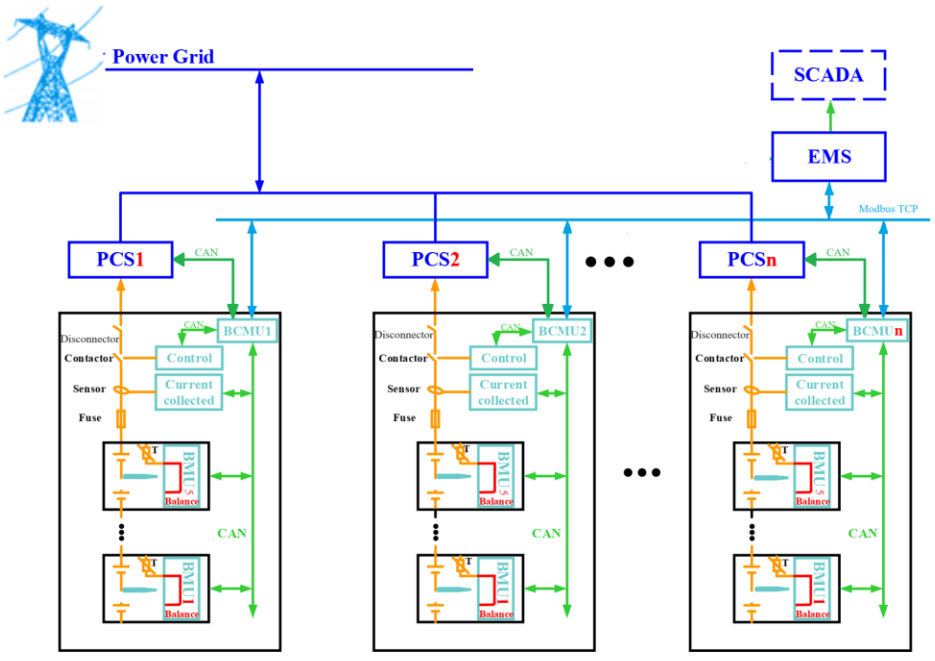

Figure 2-1 BESS Topological Drawing (For reference)

3. Battery System

3.1 Battery Cell

Battery cell, the basic unit of lithium iron phosphate battery, consists of positive, negative electrodes and electrolyte, with rated voltage of 3.2V and rated capacity of 280Ah. Adopts advanced LFP chemistry batteries, enjoying low cost, high efficiency and reliability as well as industry-leading safety technology. The battery cell is sealed in aluminum enclosure as shows in the following picture.

Table 3-1 Specification of Battery Cell

Item	Unit	Specification	Rendering
Battery Chemistry	-	LFP	 (For reference)
Nominal Capacity	Ah	280Ah	
Nominal Energy	Wh	896	
Nominal Voltage	V	3.2	
Operating Voltage	V	2.50 ~ 3.65	
Dimension (W×D×H)	mm	174 × 72 × 207	
Weight	kg	~5.5	
Recommended C-Rate	-	0.5C	
Certificate	-	UL9540A, IEC62619, UN38.3	

3.2 Battery Module

A battery module consists of a number of cells in a manner of 1P52S, with rated voltage of 166.4V and rated capacity of 280Ah. The battery module and BMS adopt unified standard modular design to ensure the universality of the system. Flexible configuration, multiple battery modules can be in serial for expanding voltage and capacity.

Table 3-2 Specification of Battery Module

Item	Unit	Specification	Rendering
Type No.	-		
Module Configuration	-	1P52S	
Module Capacity	Ah	280	
Energy	kWh	46.59	
Nominal Voltage	V	166.4	

Item	Unit	Specification	Rendering
Operating Voltage	V	145.6 ~ 187.2	(For reference)
Dimension (W×D×H)	mm	760 × 1150 × 237	
Weight	kg	~340	
Recommended C-Rate	-	0.5C	
Certificate	-	UL9540A, IEC62619, UN38.3	

3.3 All-in-one Cabinet

A number of modules and integrated PCS are connected in series through electrical connectors, delivers high voltage up to 832V in rated voltage and 280Ah in rated capacity. Each battery rack contains 5 modules, 1 liquid cooling unit, 1 set of AC panel and 1 set of FSS and 1 integrated PCS.

Table 3-3 Specification of Battery Cabinet

Item	Unit	Specification	Rendering
Configuration	-	1P260S	 (For reference)
Capacity	Ah	280	
Energy	kWh	232.9	
Nominal Voltage	V	832	
Operating Voltage	V	728 ~ 936	
Dimension (W × D × H)	mm	1000 × 1350 × 2400	
Weight	kg	~2700	
Enclosure Rating	-	IP55 (Battery Room)	
Operating Temperature Range	℃	-30 ~ 55	
Recommended C-Rate	-	0.5C	
Noise Level	-	≤75dB @1m	
Anti-corrosion Grade	-	C4	
FSS	-	Smoke & temperature sensor; sound & light alarm; aerosol; deflagration panel; water inlet	

3.4 Battery Management System

3.4.1 Overview

BMS collects, processes and stores the important information during the operation of the battery module in real time, and exchanges the information with the external equipment to give real-time alarm and protection during the operation of the battery module. BMS generally adopts multi-level distributed architecture design. For two-level architecture, BMS system is composed of module level BMU, rack level BCMU. Then BCMU directly communicate with PCS with CAN protocol. The overall control and communication diagram is shown as below:

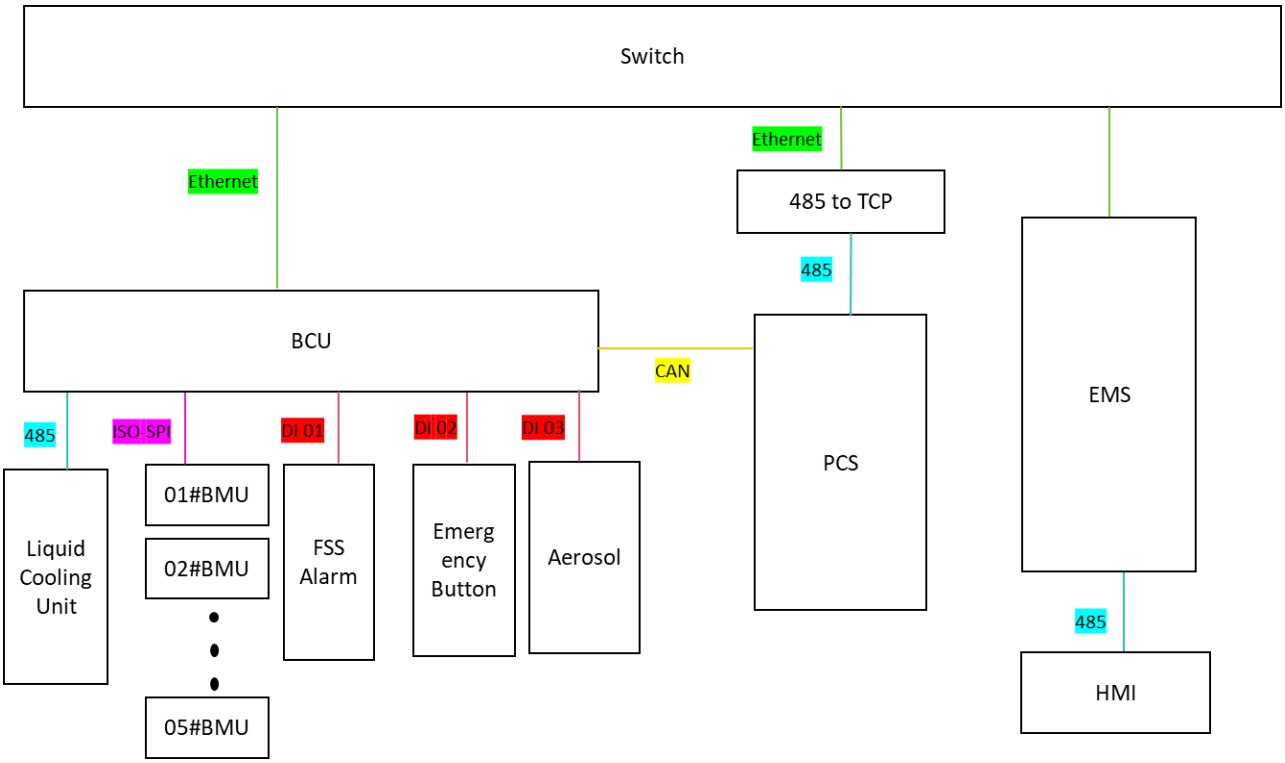

Figure 3-1 BMS Communication Diagram (For reference)

3.4.2 Multi-level BMS Function

Table 3-4 Multi-level BMS Function (For reference)

BMS Level	Main Function	Description
BMU	Basic hardware configuration	Cell voltage sampling
		Temperature sampling
	Battery cell management	Active equalization
	Information management	Communication with BCMU
	Failure diagnosis	Leakage detection
		MSD switch detection
		Fire suppression detection
BCMU	Battery status sampling	Total rack voltage sampling
		Insulation resistance sampling
	Thermal management	Temperature alarm signals
	Estimation of battery status	Estimation of SOC
		Estimation of SOH
	Failure diagnosis	Battery failure diagnosis alarm
		BMS system self-check and fault diagnosis alarm
	Information management	Software upgrade
		Communication with BMU
		Communicate with PCS, EMS and other equipment
	Data storage	Data storage, transmission and processing

4. Auxiliary Equipment

4.1 AC Panel

AC panel works as an important device for auxiliary power supply.

a) Power source of Liquid cooling unit, FSS, BMS, etc.;

b) With UPS minimum 15 minutes time as backup power supply;

c) Protection function with main circuit breaker and E-stop circuit systems.

4.2 Integrated PCS

The DC port of the energy storage inverter is connected to the energy storage battery, and the AC port is connected to the three-phase AC power grid or load. When the battery is discharged, the energy storage inverter converts the DC current of the energy storage battery into three-phase AC power supply for the load or into the power grid. When the battery is charged, the energy storage inverter rectifies the AC current of the

three-phase power grid into DC to charge the energy storage battery. The structure diagram of the energy storage converter is shown as follows:

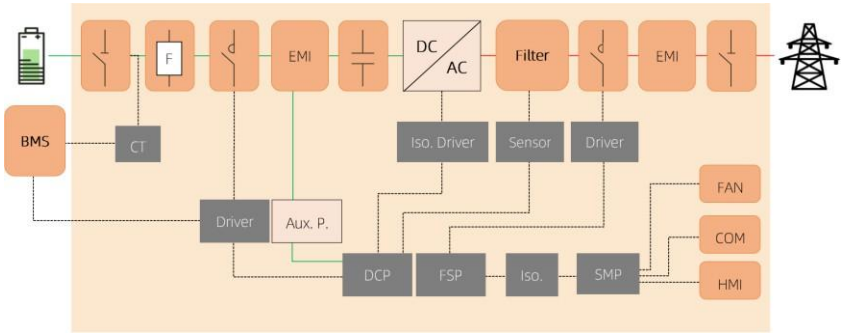

Figure 4-1 System Connection Schematic Diagram

The specification of PCS interface is shown in the table below.

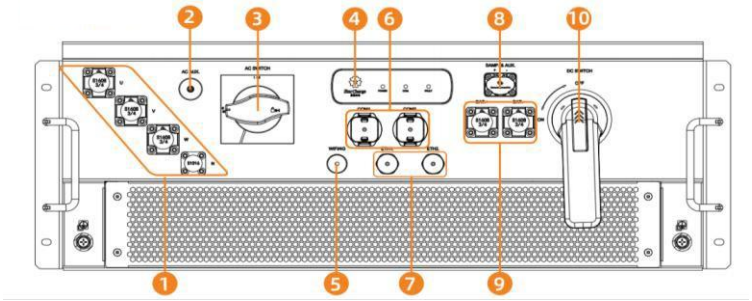

Figure 4-2 PCS Interface

Table 4-1 PCS Interface Specification

No.	Printing	Name	Note
1	AC（U/V/W/N）	Connector of grid	AC input wiring
2	AC AUX.	AUX. Mains interface	Output wiring for AC loads in energy storage cabinets power supply
3	AC SWITCH	Ac plastic case switch	Connection switch to the grid
4	/	Display panel	Display machine status
5	WIFI/4G	WIFI/4G interface	External communication and dry contact
6	COM1.COM2.	Communication and dry contact interface	Ethernet Communication cables (not supported)
7	ETH1.ETH2.	Ethernet interface (not supported)	For battery string voltage sampling and DC load power supply
8	SAMP&AUX.	Battery voltage sampling and DC auxiliary supply interface	For battery string voltage sampling and DC load power supply
9	BAT+, BAT-.	Battery interface	DC input wiring
10	DC SWITCH	Dc disconnecting switch	Connection switch to the battery

4.3 Thermal Management System

The system uses a liquid cooling system for heat dissipation. Liquid cooling is a technology that uses a liquid as a coolant to remove heat from the heated parts. It has good temperature homogeneity. The liquid cooling system mainly consists of pipes, pumps, heat exchangers and compressors. The main coolant of the system is ethylene glycol and water.

4.3.1 Equipment Cooling Design

Inside the cabinet, there are module-level cooling branch pipelines, which supports thermal management with inlet and outlet ports correspondingly. The coolant is sent to modules by the pumper from the rack pipe. After absorbing the heat generated by the battery, it returns to the cooling unit. Meanwhile, when the system reaches thermal balance, the cabinet maximum temperature difference can be controlled within 5 ℃. The temperature simulation results are shown as follows.

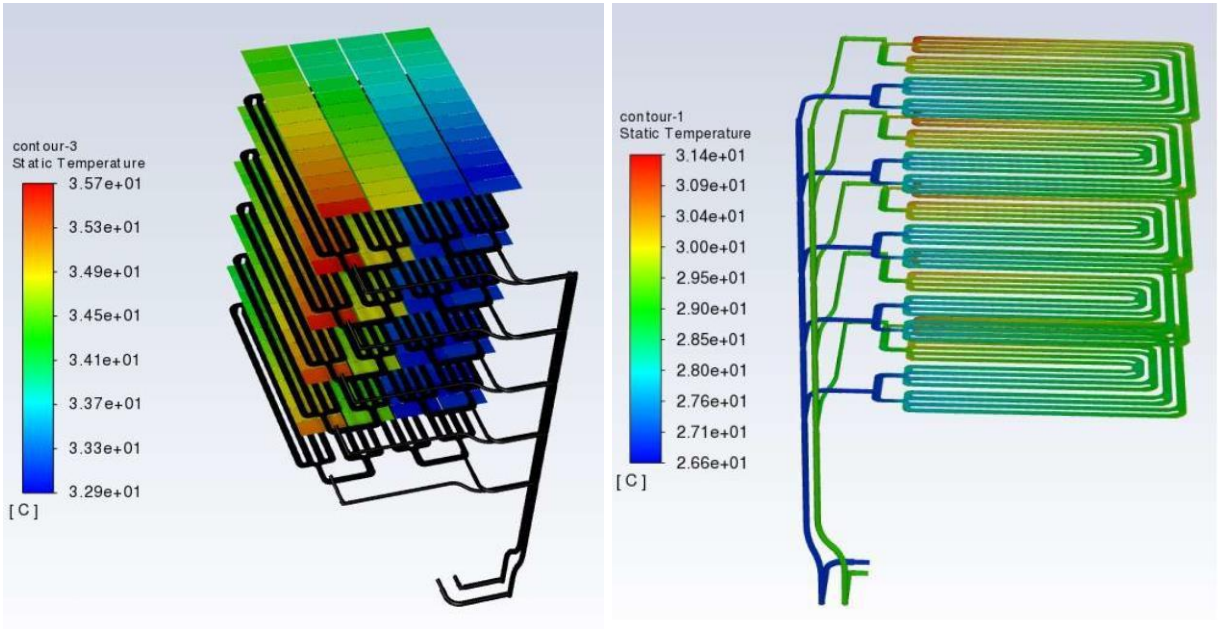

Figure 4-3 Cell Temperature Distribution Cloud Map (For reference)

4.4 Fire Suppression and Alarm System Design

4.4.1 Description

The fire suppression system of energy storage cabinet is composed of automatic fire alarm system, aerosol extinguishing system, deflagration panel and water inlet. Automatic fire alarm and aerosol extinguishing system consists of temperature sensor, smoke sensor, sound and light alarm, aerosol extinguishing system. The deflagration panel is installed on the top of the cabinet and the sprinkler inlet is equipped on the back of the cabinet.

Note that, this fire system design is just for reference, and should be redesigned or modified at system design stage.

4.4.2 Main Equipment List of FSS

Table 4-2: Main Equipment List of FSS (For reference)

No	Components	Qty.	Location	Note
1	Smoke Sensor	1	Inside the cabinet	Detect the smoke concentration in the cabinet and send the alarm to the alarm controller when there is an alarm value
2	Temperature Sensor	1	Inside the cabinet	Detect the ambient temperature in the cabinet and sends an alarm to the alarm controller when there is an alarm value
3	Sound and Light Alarm	1	Outside the cabinet	Provide sound and light alarm when multiple alarms of smoke and temperature are given
4	Aerosol Extinguishing System	1	Inside the cabinet	Spray aerosol to protect the cabinet with full flood extinguishing
5	Deflagration Panel	1	Top of the cabinet	The deflagration panel will rupture when the pressure reaches a designed value, releasing the explosion pressure to the top of the cabinet.
6	Water Inlet	1	The back of the cabinet	Manually connect the DN65 water pipe connector to the back of cabinet water inlet

4.4.3 Fire Suppression System Work Flow

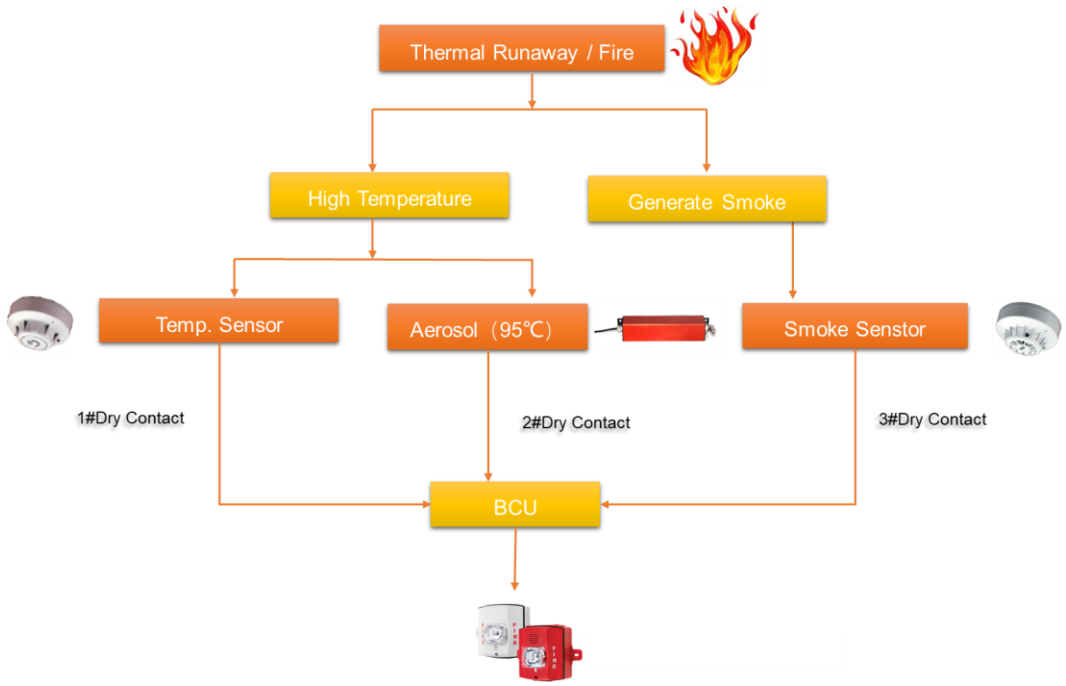

Figure 4-4 Fire Suppression System Work Flow (For reference)

4.4.4 Control logic

a) If smoke sensor is triggered, the Sound & Light Alarm will start.

b) If temperature sensor is triggered, the Sound & Light Alarm will start. And if the temperature reaches 95 ℃, the fixed aerosol fire extinguishing system will be activated.

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