Elecnova

All-in-one Liquid-cooled

ESS Cabinet ECO- E233LS User Manual

Shanghai Elecnova Energy Storage Co., Ltd.

The release date identified in the change history for this Manual is correct. Elecnova reserves the right of modification at any time.

The images provided in this Manual are for demonstration purposes only. Details vary slightly based on product version and market region. Elecnova has the final right of interpretation for all designs of products.

The information and advice are given in good faith and are believed to be accurate as of the date of editing. Elecnova does not express or imply any warranty regarding the information

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Revision History

Version	Description	Editor	Date	Remarks
A/1	New Release	Jin Qinglin	July 23, 2024	

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1. About this Manual

1.1 Preface

Dear user, much appreciation for using the All-in-one Liquid-cooled ESS Cabinet ECO-E233LS product (hereafter referred as ECO-E233LS, or the ESS Cabinet, or the Product) developed and produced by Shanghai Elecnova Energy Storage Co., Ltd. We sincerely hope that this product meets your needs, and we also hope that you are satisfied with its performance and provide us with your valuable comments and suggestions. We will continue to evolve and improve product quality

1.2 Applicable Product

This Manual is applicable to product model: ECO-E233LS, the ESS Cabinet

1.3 Brief Introduction

The manual includes the following contents:

- **Safety Instructions**

Introduced the safety operation precautions for the Product.

- **Product Description**

Introduced the overview of the Product and the technical parameters related to the system.

- **Product operation**

Introduced the operation of the Product and HMI screen.

- **Other**

Introduced the faults handling methods for the Product, as well as our company's contact information.

1.4 Safety Statement

In this Manual, the “DANGER”, “WARNING” and “CAUTION” tags in the following instructions are used to deliver information about hazards related to specific tasks and procedures. These safety precautions do not represent all hazards when performing a given task. Installers and operators should adhere to premium industrial safety practices, site specific ambience, health/safety plans, local safety requirements and regulations.

Only properly trained and qualified personnel are allowed to perform the installation procedures identified in this Manual.

	" DANGER ” indicates a hazardous situation which, if not avoided, will result in death or serious injury. "DANGER" is only limited to the most extreme cases. "DANGER" indicator is not used for property damage hazards unless there is also a risk of personal injury corresponding to these levels.
	"WARNING" indicates a hazardous situation which, if not avoided, could result in death or serious injury. "WARNING" indicator is not used for property damage hazards unless there is also a risk of personal injury appropriate to those levels.
	"CAUTION" indicates a hazardous situation which, if not avoided, may result in minor or moderate injury. “CAUTION” indicator can be used to warn of unsafe operations that could result in property damage.

1.5 Safety Instructions

◆ **Safety Usage Instructions**

This section introduces the general safety rules that need to be followed during operation of ESS Cabinet. Read these safety instructions before operation.

For specific safety matters, refer to the corresponding chapters.

	Touching the terminals, contacts, etc. connected to the power grid or ESS Cabinet may result in death from electric shock! Lethal high voltage exists in the Cabinet. Pay attention to and follow the warning labels on the product! Damaged internal component may cause electric shock or fire!

◆ **User Manual**

Read this Manual before operation, and keep the manual properly for review.

Operate the ESS Cabinet in strict accordance with descriptions in this Manual; otherwise, serious accidents such as product damage, property damage, and even personal injury/death may occur.

◆ **Personnel Requirements**

	Staff who performs electrical work on this product must undergo professional training and hold relevant licenses!

◆ **Safety warning signs**

For safe maintenance and inspection, please comply with the following requirements:

- ✓ To avoid mis-operation, put up warning signs on the front and rear side of the Cabinet. Also stick warning signs nearby a switch.
- ✓ Put up warning signs or warning tapes around the installation area.

◆ **Battery protection signs**

	This sign indicates a high voltage hazard which may cause electrical hazards if touched.
	This sign indicates that this is the protective earthing (PE) terminal, which needs to be firmly grounded to ensure the safety of personnel.

◆ **Environment Requirements**

- ✓ It is strictly prohibited to stack flammable, explosive and other dangerous items around the ESS Cabinet.
- ✓ The installation location of the ESS Cabinet shall comply with moisture-proofing requirements and others
- ✓ The intrusion of moisture may damage the battery system. To ensure the normal and safe running of the system, pay attention to the ambient humidity when performing routine maintenance and inspection.

◆ **product end-of-life**

When the battery system reaches end-of-life, it shall not be disposed of as regular waste. Contact the relevant authorized recycling agency for proper disposal

2. ESS Cabinet Introductions

2.1 System Overview

ECO-E233LS is a C&I ESS Cabinet product solely developed and produced by Elecnova. This product adopts the All-In-One integrated design and integrates LFP batteries, BMS, PCS, FSS, BCQ (Local EMS Controller), liquid-cooling unit and other components into a single ESS Cabinet. This ESS Cabinet has the characteristics of energy saving, small size, high energy density, high environmental flexibility, fast on-site installation, friendly-grid-access and easy capacity expansion etc.

ECO-E233LS Cabinet appearance and internal view are shown below as Figure-1 and Figure 2-2.

Figure 2-1 ECO-E233LS Physical Image

Figure 2-2 ECO-E233LS Internal View

Product Advantages:

- Ingress Protection level IP55: Supports outdoor and indoor multi-scenario installation.
- Fire early-warning + Aerosol FSS
- Dual power design. Supports black start.
- High efficiency for charging/discharging: Deliver more power with excellent profitability
- Flexible installation for critical site conditions.
- On-site easy grid connection and commissioning.
- Easy multi-unit parallelization for easy capacity expansion.
- Support remote access, operation, maintenance management, unattended operation via local cloud platform

2.2 Technical Parameters

Item	Specifications	Remarks
DC Side Parameters		
Cell type	LFP 280Ah	
Configuration	1P260S	
Rated Cabinet Capacity	232.96KWh	100%DOD,（25±2）℃, 0.5P
Rated Cell Capacity	280Ah	
Rated Voltage	832V	
Recommended voltage range	DC 728-936V	Cell voltage range: 2.8V~3.6V

AC Side Parameters		
Rated Output Power	100kW	
Max Power	110kW (continuous 1 minute)	
Nominal Voltage	400Vac/3P+N+PE	
Nominal Frequency	50HZ/60HZ	
THDi	＜3%	
DC component	＜0.5%Ipn	
Power factor	-0.98 to 0.98	
System Parameter		
System Efficiency	≥89%	Auxiliary power excluded
Charge/discharge Rate	0.5P	Constant power
Depth of Discharge	95%DOD	
Cycle Life	≥8000 times (25±2℃)	Conditions: 25±2℃, 0.5P, 95%DOD
Ingress Protection	IP55	
Cooling Method	Liquid cooling	
Operating Temperature	-25 to 55℃	
Relative Humidity	0-95%RH, no condensing	
Working Altitude	≤2000m	Derated above 2,000m, maximum application altitude ≤ 4000m
Dimensions (W*D*H)	1050*1350*2400mm	
Weight	Appr 2570kg	
Fire Suppression System	PACK-level aerosol + Cabinet-level aerosol	
Communication interface	Ethernet/RS485	
Standards complied with	GB/T36276, GB/T 34120, GB/T34131, UN38.3, IEC62619, UL1973, UL9540, CE-EMC	

2.3 System Diagram

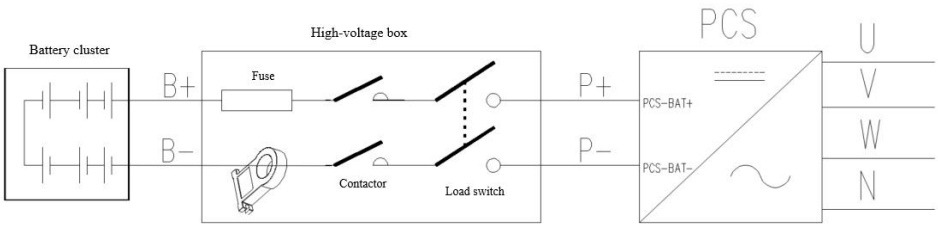

Figure 2-3 ECO-E233LS Main Circuit

Operation Modes

◆ Grid-tied Operation Mode

The AC side of ECO-E233LS is connected to the grid, and its DC side is internally connected to the lithium battery. It is applicable for scenarios such as power expansion, PV plus EV charging, peak shaving, demand management, power quality management. Based on grid-tied P/Q operating mode, ECO-E233LS can be charged/discharged with constant power, constant current and constant voltage on lithium batteries.

◆ Off-grid Operation Mode

The DC side of ECO-E233LS is connected to the lithium battery. When the system is running off-grid or as black start power, ECO-E233LS operates with VF mode: It delivers fixed-frequency and effective three-phase AC and voltage, supplying continuous AC power to load on AC side. ECO-E233LS is applicable in scenarios such as microgrid in islands and remote areas, as well as a power sources for important loads.

2.4 Communication Control

ECO-E233LS adopts a three-level communication system. Level-I is the BMU slave control device of the

BMS, which is responsible for acquisition of PACK voltage, NTC temperature and other signals as well as the battery equalization management. Level-II is the BCU, main control device of the BMS, responsible for the summary and processing of the signals acquired by BMU, the realization of charging/discharging control, threshold protection, and the formulation and execution of thermal management strategies. Level-III is the BCQ, Local EMS Controller, the brain of ESS: Level-III realizes the info-acquisition, monitoring, processing and control of the BMS, PCS, HVAC, FSS status and other signals of the ESS Cabinet.

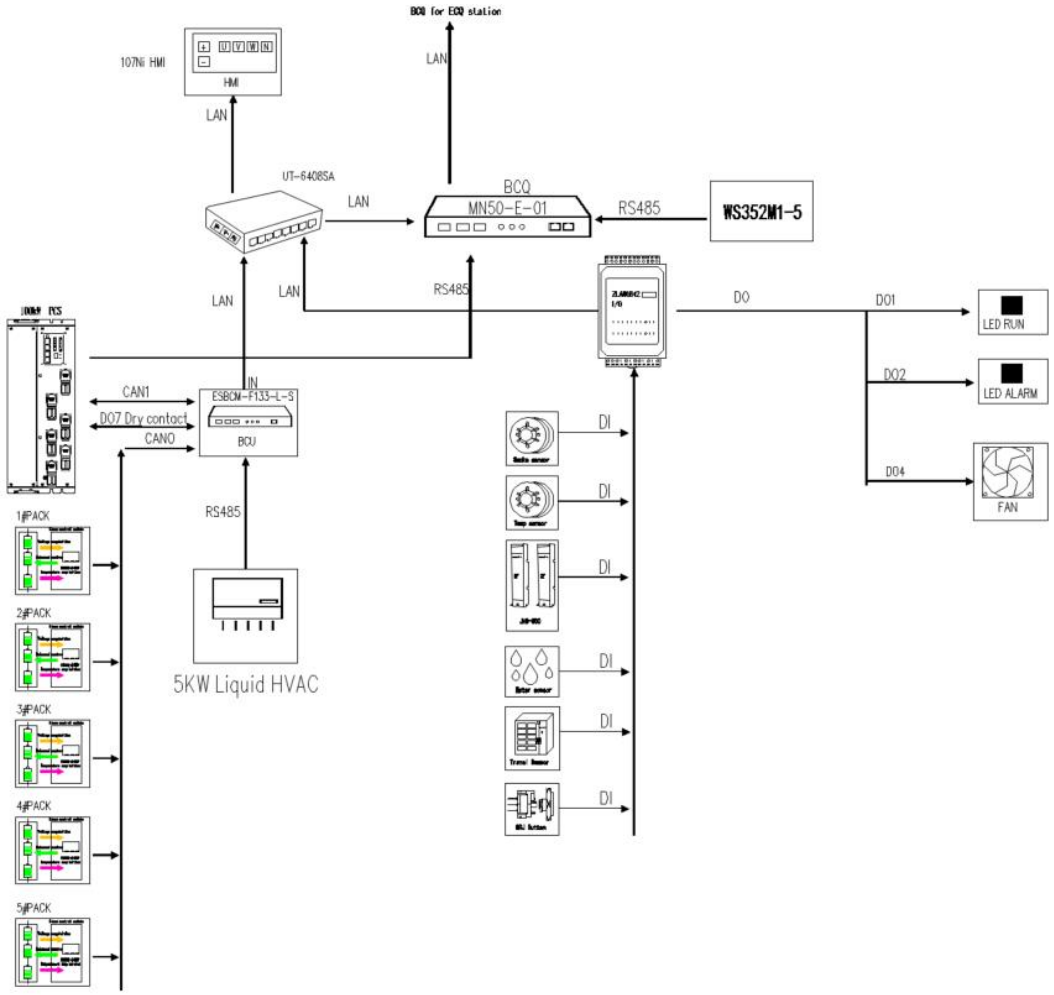

Figure 2-4 ECO-E233LS Communication Diagram

2.5 Ports

◆ 2.5.1 PACK Ports

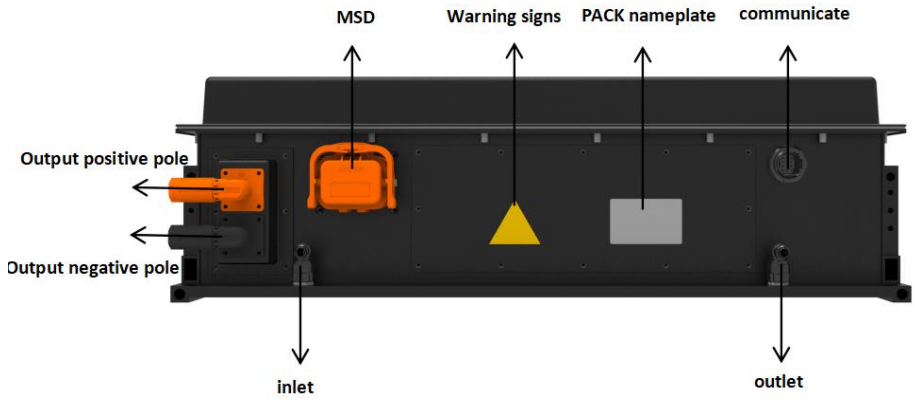

Figure 2-5 PACK Panel

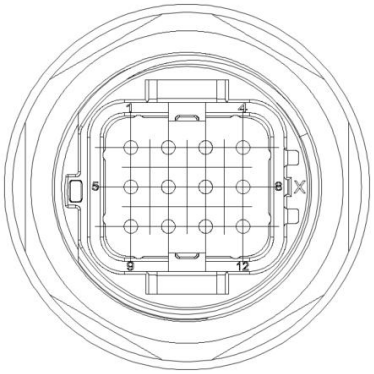

Figure 2-6 BMS Communication Socket

Port	Pin No.	Pin Descriptions	Pin Definitions
BMS communication	1	24V+	BMS 24V power supply +
	2	24V-	BMS 24V power supply -
	3	I01	Automatic allocation of BMS address
	4	CAN0H	BMS internal communication CAN0H
	5	CAN0L	BMS internal communication CAN0L
	6	24V+	BMS 24V power supply +
	7	24V-	BMS 24V power supply -
	8	I02	Automatic allocation of BMS address
	9	CAN0H	BMS internal communication CAN0H
	10	CAN0L	BMS internal communication CAN0L

◆ 2.5.2 High-voltage Box Ports

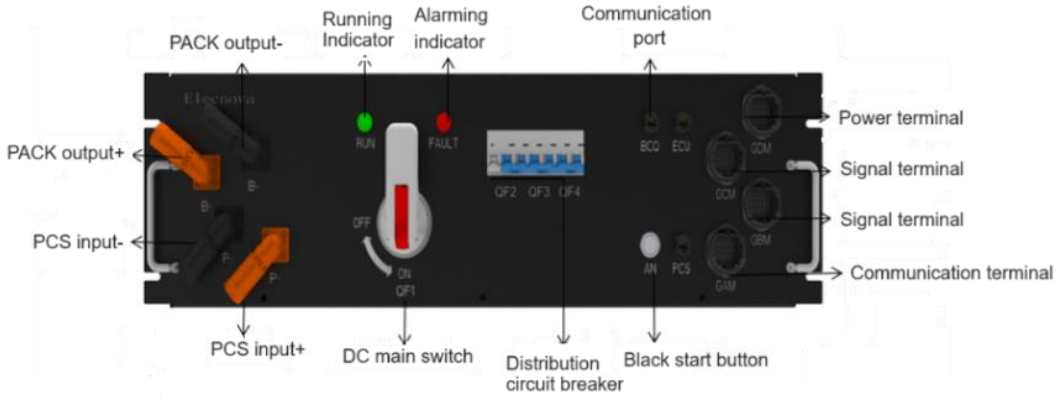

Figure 2-7 High-voltage Box Panel

Port Symbol	Device Name	Function Description	Remarks
B+	Battery positive connector	Positive pole connection between PACK and high-voltage box	
B-	Battery negative connector	Negative pole connection between PACK and high-voltage box	
P+	PCS positive connector	Positive pole connection between PCS and high-voltage control box	
P-	PCS negative connector	Negative pole connection between PCS and high-voltage control box	
RUN	High voltage control box operation indicator light	Indicate the normal operating status of the high-voltage control box	
FAULT	High voltage control box fault indicator light	Indicate the shutdown status of the high-voltage control box due to malfunction	
QF1	DC main circuit breaker	Connection control between battery system and PCS	
QF2	Auxiliary power circuit breaker	Auxiliary power control inside the cabinet	
QF3	Power circuit breaker for chiller unit	Power supply control of chiller unit	
QF4	Control power circuit breaker	Integrated cabinet control system power supply control	
BCQ	Local HMI Ethernet interface	Used for local control system network cable connection	
ECU	EMS Ethernet interface	Network cable connection with the higher-level EMS system	
PCS	PCS Ethernet interface	Network connection between local controller and PCS	
AN	Black start button switch	Control system black start power control switch	
GAM	BMS and PCS communication interface	BMS communication power supply and PCS communication interface	
GBM	IO node signal communication terminal	IO module node signal interface inside the high-voltage box	
GCM	Signal communication terminals for components inside the cabinet	Cabinet indication control and equipment communication interface	
GDM	High voltage control box	Power supply interface for electrical	

	interface power terminal	components inside the cabinet	

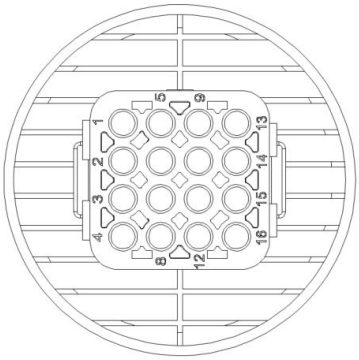

Figure 2-8 GAM, GBM and GCM Sockets

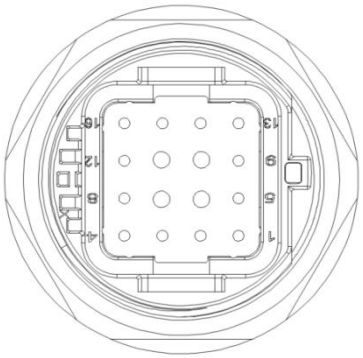

Figure 2-9 GDM Socket

Ports	Pin No.	Pin Descriptions	Port Definitions
GAM	1	2V+	Power supply for slave control
	2	2V-	Power supply for slave control
	3	A-5	Address allocation of slave control
	4	A-12	Internal communication of slave control
	5	A-24	Internal communication of slave control
	6	NA	/
	7	C-2	PCS CAN1H
	8	C-12	PCS CAN1L
	9	B-7	PCS DO7+
	10	B-25	PCS DO7-
	11	485A1	PCS 485A1
	12	485B1	PCS 485B1
	13	NA	/
	14	NA	/
	15	C-5	Debugging CAN2H
	16	C-15	Debugging CAN2L
GBM	1	DI1	Temperature detection feedback
	2	DI2	Smoke detection feedback
	3	DI3	Fire sprinkler feedback
	4	DI4	Immersion sensor feedback
	5	DI5	Door/access control feedback
	6	DI6	Emergency stop Feedback
	7	DI7	POC cabinet QF1 feedback
	8	DI8	POC cabinet QF feedback
	9	GND	GND common point
	10	NA	/
	11	KA2:A2	EPO shunt release QF2+
	12	ID:18	EPO shunt release QF2-
	13	KA2:A2	FSS shunt release QF2+
	14	ID:18	FSS shunt release QF2-
	15	B-31	FSS feedback BCU+
	16	B-5	FSS feedback BCU-
GCM	1	HW	Power indicator light
	2	HG	Running indicator light
	3	HR	Fault indicator light
	4	COM	Common point of indicator light
	5	B-18	Liquid-cooled unit 485A

	6	B-36	Liquid-cooled unit 485B
	7	485A2	Power meter 485A
	8	485B2	Power meter 485B
	9	NA	/
	10	NA	/
	11	DO4+	POC cabinet QF1+
	12	DO4-	POC cabinet QF1-
	13	NA	/
	14	NA	/
	15	DO5+	POC cabinet QF+
	16	DO5-	POC cabinet QF-
GDM	1	3V+	Power supply inside the cabinet+
	2	3V-	Power supply inside the cabinet-
	3	4V+	Fan power supply+
	4	4V-	Fan power supply-
	5	NA	/
	6	AC-L	PCS-U
	7	AC-N	PCS-N
	8	PE	PCS-PE
	9	NA	/
	10	KL	Water cooling unit L
	11	KN	Water cooling unit N
	12	KPE	Grounding of chiller unit
	13	NA	/
	14	UPSL	UPS power supply L
	15	UPSN	UPS power supply N
	16	UPSPE	UPS power supply

◆ **2.5.3 External Interface Diagram**

POC cabinet	ESS Cabinet
PCS incoming circuit breaker	PCS AC terminal
QF grid-tied circuit breaker	High-voltage box IO connected to BCQ
Load power meter	High-voltage box connected to EMS
POC cabinet switch	High-voltage box connected to EMS

Figure 2-10 External Interface Diagram
(See Installation Manual for Details. Actual wiring may vary for a specific project)

2.6 PCS

◆ **2.6.1 PCS Introduction**

PCS, also known as bidirectional converter, is a device that realizes bidirectional conversion of electrical energy. It converts DC into AC feeding to power grid or directly to AC loads; it also rectifies the AC into DC to charge the batteries.

◆ 2.6.2 PCS System Diagram

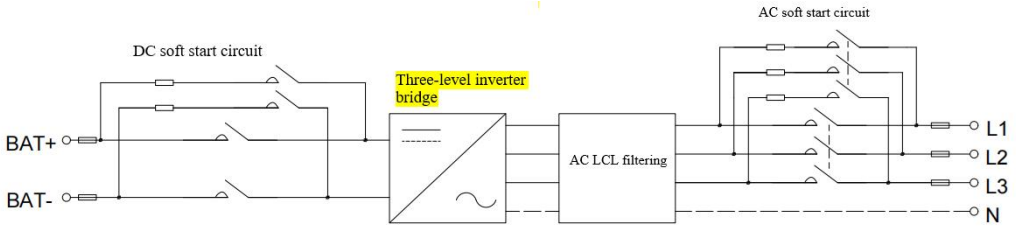

Figure 2-11 PCS System Diagram

◆ 2.6.3 PCS Parameters

Item	Technical Parameters	Note
DC-side Parameters		
Rated DC power (kW)	100	
Number of routes	1	
Maximum input current (A)	170	
Voltage range (V)	672-950Vdc	
Voltage stabilization accuracy	≤±2%	
Current stabilization accuracy	≤±5%	
Voltage limiting	Support	
Current limiting	Support	
AC-side Parameters		
Rated output power (kW)	100	
Rated output current (A)	145	
AC wiring	Three-phase four-wire (3L+N+PE)	
Isolation	Non-Transformer	
Power factor	-0.99 to +0.99	
Rated voltage (Vac)	AC400V/220V	
Voltage range (Vac)	400V (-20% to +15%)	
Rated grid frequency (Hz)	50	
Frequency range	45Hz-55Hz	
Charge/discharge switch time	<100 mS	
Protection Functions		
DC-side protection	Isolating switch or fuse bank	
DC-side control	DC contactor	
AC-side protection	Circuit breaker or fuse	
AC-side control	AC relay	
Short circuit protection	Support	
AC phase sequence protection	Support	
Comm fault protection	Support	
Anti islanding protection	< 2s	
DC overvoltage protection	Support	
AC overvoltage protection	Support	
Reverse Polarity protection	Support	
Overheating protection	Support	
LVRT	Fault-ride-through	Compliant with GB/T 36558
Other Parameters		
Dimensions(mm)	W544*D670*H270	
Structure and Ventilation	Front maintenance; Front air-in, rear air-out	
Weight (kg)	50	
Cooling method	Air cooling	
Overload capacity	110%	Long term

		@ ambient temp ≤ 35℃
	120%	60 seconds
Standby loss	<0.2% of rated power	
No load loss	< 0.5% of rated power	
Max efficiency	≥98%	
Communication protocol	RS485 and MODBUS-RTU for BCQ; CAN for BMS.	
Environment		
Installation location	Inside Cabinet	
Ingress Protection	IP20	
Oper environment temperature	-20℃ to +55℃	
Relative humidity	0%-95% RH	No condensing
Altitude	2000m	Derating above 2,000m

◆ **2.6.4 PCS Panel Layout**

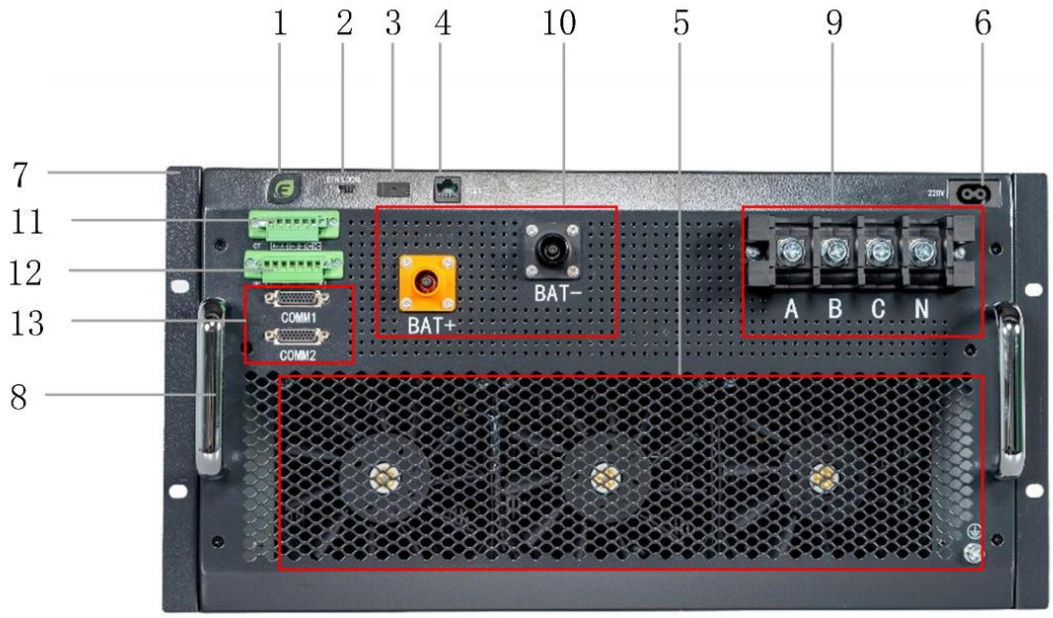

Figure 2-12 PCS Panel Layout

No.	Name	Descriptions
1	Indicator light	Steady-on in green when power is on; Fast flash in green at 0.5s intervals when standby; Slow flash at 1s intervals when power is off with no fault. Continuous in red when a fault occurs.
2	ETH/LOCAL	Ethernet/local debugging switch; Right turn for local debugging; Left turn for Ethernet (reserved)
3	(IO) 6-digit DIP switch	Digit 1, 2 for CAN communication matching resistor connection; Digit 3~6 for module address setting (binary) - the 6th digit is the lowest (from right to left)
4	TEST debugging network port	Debugging communication port for internal use only
5	Vents	Air duct vents, front air-in and rear air-out
6	220V/230V power	220Vac input (internal use only)
7	Fixing bracket	The fixing brackets are installed on the left and right sides of the module for fixing to Cabinet
8	Handle	Drawer module handle, not to bear heavy load
9	AC interface	AC terminal wiring
10	DC interface	DC terminal wiring

11	Grid current sampling interface	A/B/C three-phase current feed-in and feed-out interface (reserved for 105kW equipment)
12	Grid voltage sampling interface	A/B/C/N grid voltage sampling input interface (reserved for 105kW equipment)
13	External communication port	COM (26pin signal terminal) signal port

◆ **2.6.5 External Communication Terminal definition**

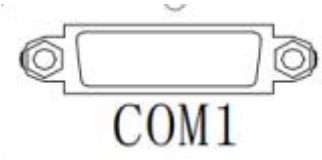

Figure 2-13 PCS External Communication Terminal

No.	Pin No.	Pin Descriptions	Pin Definitions
1	10	BCQ_485A	BCQ communication
2	19	BCQ_485	
3	1	HMI_485A	HMI communication
4	11	HMI_485B	
5	20	ETH_485A	Reserved communication
6	2	ETH_485B	
7	12	CAN_1L	CAN parallel connection
8	21	CAN_1H	
9	3	CAN_2L	BMS communication
10	13	CAN_2H	
11	18	OP	24V+/GND type selection signal
12	5	DC24V+ output power supply 1	DC24V output power
13	15	DC24V+ output power supply 2	DC24V output power
14	14	GND-ISO1	Signal common terminal 1
15	23	GND-ISO2	Signal common terminal 2
16	26	EPO_ISO	Emergency stop input
17	25	FIRE_ALARM	Fire alarm input signal
18	24	LED_RUN	LED running signal
19	6	LED_FLT	LED fault signal
20	16	SPD_ALARM	Lightning protection input signal
21	8	DO_ISO	DO1 digital output (reserved)
22	7	DI1_ISO	DI1 digital input signal (BMS to PCS fault shutdown alarm)
23	17	DI2_ISO	DI2 digital input signal (reserved)
24	4	INV_SYNC	Internal power frequency synchronization signal
25	22	CARRIER SYNC	Internal carrier synchronization signal
26	9	GND-ISO4	DO digital output (STS backup)

2.7 FSS

◆ 2.7.1 Working principals of FSS (**F**ire **S**uppression **S**ystem)

FSS consists of PACK-level FSS and Cluster-level FSS:

PACK-level applies early detection and fast fire extinguishing for internal combustion sources.

Cluster-level applies key control, expansion prevention and growth suppression for the external combustion sources.

PACK-level FSS

Each PACK is assembled with 1 set of module-level FSS devices, which detects fire and automatically extinguish fire without power supply. It provides PACK-level safety protection according to requirements of GB/T42288.

Once fire or heat reaching 185℃ is detected, FSS immediately start fire extinguishing.

Cluster-level Fire Protection System

Cluster-level FSS is an aerosol-based fire protection system. When smoke, or high temperature, or fire is detected, the audible and visual alarm is triggered immediately to inform personnels to take actions; At the meantime, it starts fire extinguishing device. The FSS Synchronously sends the Fire message to all related agents and personnels.

- 2.7.2 FSS components
  - ✓ Aerosol FSS devices

    JAD300-U01 fast aerosol-based fire extinguishing device is suitable for relatively closed spaces such as power cabinet etc.

    In case of fire, the aerosol generator in the fire extinguishing device is activated by the electric trigger after the fire extinguishing device receives the electric starting signal. The aerosol generator generates fire extinguishing agent through the combustion reaction. The heat from the reaction process decomposes the chemical coolant so that the fire extinguishing agent and the coolant work together to extinguish the fire.

  - ✓ **Audible and Visual Alarm**

    The audible and visual alarm is a device that emits audible and visual alarm signals. When the alarm device receives a signal, it emits a strong audible and visual signal to alert on-site personnel.

  - ✓ **Temperature and Smoke Detectors**

    The temperature/smoke detectors are anti-explosive, mounted on the ceiling of the Cabinet. They are used to detect the fire in Cabinet.

3. ESS Cabinet Operations

3.1 Hazards

- Electric Shock Hazard

	Personnel will be exposed to voltages up to 864 VDC from battery pack, and there is also the possibility of low- and medium-voltage AC exposure. Arc flash and electric shock hazards are common at ESS Cabinet sites. Elecnova encourages full compliance with the practices and procedures specified in NFPA 70E, including the use of personal protective equipment (PPE), to adequately mitigate hazards of arc flash. Emergency personnel should rely on standard operating procedures (SOPs) to respond to incidents at power generation facilities.

- Fire and Explosion Hazards

	The system contains flammable material and ignition sources. With enough oxygen, fire can spread. If not properly mitigated, the fire and other sources of extreme heat can cause thermal runaway of batteries and the release of combustible gases. If the combustible gases exist in sufficient density, there is a risk of explosion. If a fire alarm or other indication of thermal runaway occurs at ESS Cabinet site, first responders are advised to maintain a safety distance till BESS site is verified to be safe in accordance with the site-specific Emergency

	Response Plan (ERP) and SOP.

◆ Chemical Exposure Hazards

	The system contains hazardous chemicals named LFP battery electrolyte. These chemicals can be harmful to both human health and the environment.

3.2 Operation Precautions

	The battery cannot be powered off. The shutdown sequence described below only isolates the battery and associated hazardous voltages. Personnel must be extremely cautious and wear appropriate PPE at all times.

	The complete ESS shutdown sequence varies based on project-specific design. Always consult site-specific schematics and manuals to ensure proper isolation of electrical equipment.

	All personnel operating the ESS Cabinet should be properly trained and qualified. Personnel are expected to read and understand all manuals and project documents and comply with their requirements and instructions.

	Turning off thermal management and communication systems for extended periods of time can result in equipment damage and failure to detect fault conditions.

	Disconnecting the BMS contactor under load may damage the BMS, and direct power failure may cause the main positive and negative contactors to stick. Only use the Emergency Stop in emergency situations.

	Do not start the ESS Cabinet until commissioning and inspection are completed by Elecnova on-site technicians. Do not restart ESS Cabinet before scheduled maintenance are completed.

	Do not modify or alter this manual without Elecnova's written permission.

3.3 Cabinet Panel

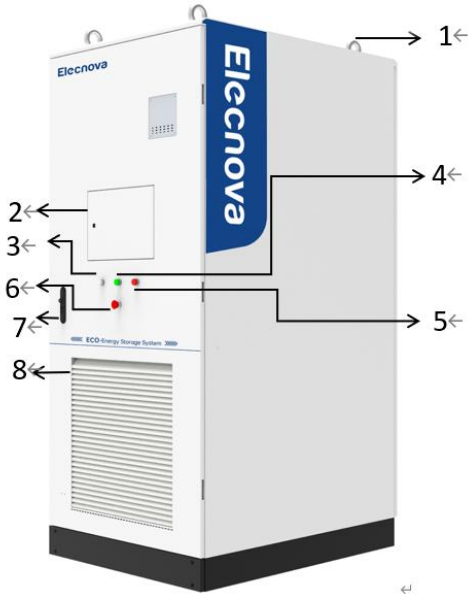

Figure 3-1 ECO-E233LS Front View

No.	Item	Q'ty	Remarks
1	Hanging ring	4	For lifting the Cabinet
2	Human machine interface (HMI)	1	Onsite parameter monitoring
3	Indicator light (white)	1	Power indication
4	Indicator light (green)	1	Running indication
5	Indicator light (red)	1	Fault indication
6	Emergency stop button	1	For emergency shut down
7	Cabinet door lock	1	
8	Ventilation grille	1	For ventilation

Indicator status

Indicator	Status	Operation Conditions	Remarks
POWER indicator white light	Off	1. AC220V/230V main power is on; 24V power is on. QF2 is switched on 2. Power supply for liquid cooling unit is on; QF3 is switched on 3. DC/DC power is on. 24V power is on. QF4 is switched on	
	On	Both AC220V/230V and DC/DC power are switched on, which means QF2 and QF4 are both switched on.	
	Off	Both AC220V/230V and DC/DC are power off, which means QF2 and QF4 are both switched off	
RUN indicator green light	On	1. ESS Cabinet in charging status, charging power ≥5kW. 2. ESS Cabinet in discharging status, discharging power ≥3kW.	
	Off	The ESS Cabinet in standby mode, neither charging nor discharging.	

FAULT indicator Red light	On	1. Temperature detector is activated (alarm signal transmitted) 2. Smoke detector is activated (alarm signal transmitted) 3. Aerosol device is activated (alarm signal transmitted) 4. Immersion detector is activated (alarm signal transmitted) 5. Charge/discharge power ≥5kW. Cabinet door is open 6. BMS charge/discharge 3rd level alarm (SOC alarm excluded).	General Faults
	On	PCS fault list 1. Grid peak value overvoltage fault; 2. Grid effective value overvoltage fault 3. Grid effective value undervoltage fault 4. Branch-I peak value overvoltage fault 5. Branch-II peak value overvoltage fault 6. Branch-I effective value overvoltage fault 7. Branch-II effective value overvoltage fault 8. DC fuse failure; 9. Emergency stop failure; 10. DC overvoltage fault; 11. DC undervoltage fault; 12. Ove deviation fault between positive and negative busbars; 13. DC overcurrent fault; 14. Battery short circuit fault; 15. Grid high frequency fault; 16. Grid low frequency fault; 17. Grid phase sequence fault; 18. Grid Phase missing fault; 19. Battery polarity reversal fault, reserved (for parallel use); 20. Module external CAN comm fault; 21. EEPROM read and write failure; 22. IGBT module over temperature fault; 23. Hardware overcurrent fault; 24. Zero sequence over circulating current; 25. Grid instantaneous overcurrent fault; 26. AC pre-charge failure; 27. DC pre-charge failure; 28. High-voltage close failure; 29. Contactor status fault, communication fault with BMS and/or with BCQ (RUN light on, and PCS working)	PCS fault
	On	BMS fault list 1. PACK discharge over-current 2nd-level alarm; 2. PACK charge over-current 2nd-level alarm; 3. PACK insolation 2nd-level alarm 4. Cell charge over-heat 2nd-level alarm 5. Cell charge under-heat 2nd-level alarm 6. Cell voltage difference abnormal 2nd-level alarm; 7. Cell temp difference abnormal 2nd-level alarm; 8. DI1, DI2, DI3, DI4, DI5, DI6, DI7 and DI8 faults; 9. Internal comm lost; 10. Cell voltage sampling abnormal; 11. Cell temperature sampling abnormal; 12. Battery limit fault; 13. Software version parameters inconsistent; 14. PCS communication fault; 15. PC forced control debugging mode; 16. CAN Hall sensor failure; 17. CAN Hall sensor comm failure; 18. Hardware self-test abnormal; 19. Balance fault;	BMS fault

		20. BCQ communication fault 21. Cell discharge over heat 2nd-level alarm; 22. Cell discharge under heat 2nd-level alarm 23. Cell temperature rise abnormal 2nd-level alarm 24. AC communication fault	
	On	BCQ Fault: 1. IO module Fault; 2. 4G router Fault; 3. Industrial computer body fault; 4. Industrial switch fault; 5. IO module Communication fault; 6. 4G router Communication fault; 7. Industrial exchange Comm fault; 8. Comm fault with BMS (Indicator on, PCS running); 9. Comm fault with PCS (indicator on. PCS running); 10. Comm fault with meter (indicator, PCS running);	BCQ fault
	Off	The battery is either fully charged or fully discharged, the 3rd-level alarm not triggered.	Fully charged or discharged
	Off	BMS 1st-level or 2nd-level alarm	MBS Mild fault
	Off	ECO-E233LS no-fault status.	No-fault

3.4 Connection and Power-on

◆ 3.4.1 Cable Connection

Please refer to Installation Manual.

◆ 3.4.2 Power-on Operation

After POC cabinet is connected to Grid and Grid power is connected to the ESS Cabinet, the PCS indicator light flashes green and the cooling fan starts. If there is a red light in PCS, check whether the power supply phase sequence and voltage of the POC cabinet are normal.

After connecting to the mains power normally, close the high voltage box switches QF2, QF3, and QF1 in sequence to ensure that the external PCS is in a shutdown state after power on (confirm PCS status on HMI or WEB). Close the high voltage box QF4; Then BMS closes the main contactors. As a result, the ESS Cabinet RUN indicator lights up, indicating that the whole ESS Cabinet is successfully powered on.

- ✓ **QF2 switched on, the 220V/230V auxiliary power system is on;**
- ✓ **QF3 switched on, the chiller unit is powered on, and the chiller unit enters the self check start state;**
- ✓ **QF1 switched on, the main positive/negative contactors of PACKs are connected;**
- ✓ **QF4 switched on, the high-voltage box is powered on, and the cabinet power indicator light is on. After the high-voltage box is powered on, BMS will enter a self check state. After there are no faults, the high voltage box operation indicator light will light up, and the system will automatically close the high voltage contactor in the high voltage box. At this point, a DC high voltage is generated at both positive and negative polarities of the battery. Then BCQ starts checking PCS. If no fault is found, BCQ notifies PCS to connect its main contactors. If BCQ does not release any command, PCS remains standby. If BCQ issues power-on command, PCS starts self-checking for grid connection;**

Note: During commissioning or maintenance, if PCS is not in standby mode, it is strictly prohibited to perform power-on operation via BMS!!!

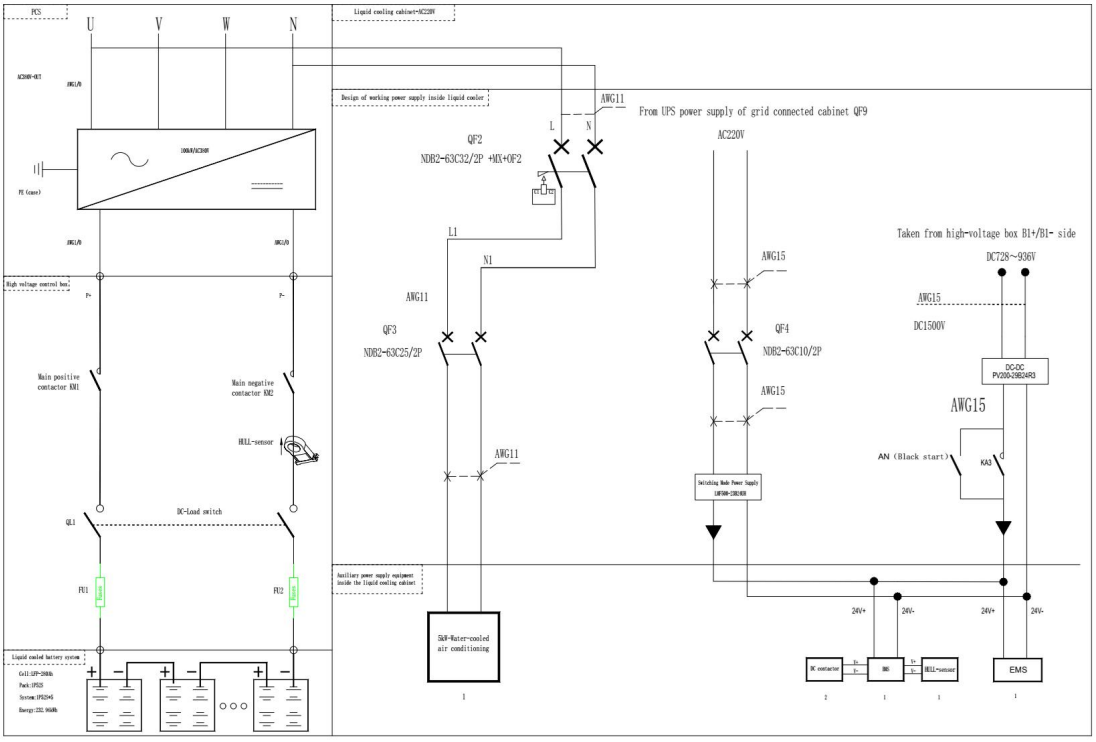

Figure 3-2 ESS Primary Circuit Wiring Diagram

3.5 Charging and Discharging

After ESS Cabinet is powered on, BCQ starts its programmed operation and issues charging/discharging commands to the charger. BMS detects the charging/discharging current. Built-in charger starts charging/discharging operations. During charge/discharge period, both green indicator and white indicator light up.

3.6 Power-off Operation

1) First step, disconnect QL1, DC load switch, on the high-voltage box. Second step, disconnect QF4, MCB, on the high-voltage box panel. As a result, the main circuit contactors in the high-voltage box are disconnected, the green and red LED indicators on the high-voltage box panel goes out, indicating that the high-voltage box is powered off.

2) After the high-voltage box is powered off, switch off QF3 to cut off the liquid-cooled unit; Thereafter, switch off QF2 to disconnect ESS Cabinet from AC220V/230V power supply. Then disconnect Power DB to disconnect ESS Cabinet from Power Grid.

3) The white LED indicator on the Cabinet panel goes out: it indicates that ECO-E233LS, the ESS Cabinet, is successfully powered off.

Note: Before powering off ECO-E233LS, please ensure that it has exited from the charge/discharge mode. Never cut off the power supply when the ESS Cabinet is in charge/discharge mode!!!

3.7 Operation Instructions for Upper Computer

◆ 3.7.1 Preparation before Debugging of Upper Computer

- ✓ According to the installation manual, locate and connect the corresponding debugging port: the debugging/testing section of the liquid cooled integrated cabinet battery system, and the debugging CAN interface led out by the 16P external connector of the CAN card connection;
- ✓ Before turning on low-voltage power supply, make sure that the voltage is within right range. The power supply of a 12V (24V) system is usually within the range of DC9-16V (DC22-32V);
- ✓ Before turning on the low-voltage power, connect CAN card and measure resistance between

CAN-H and CAN-L with a multimeter: Resistance value around 60Ω is acceptable, minding sequence of CAN-H and CAN-L

- ✓ Before turning on the low-voltage DC power, double check the sequence of Voltage ± wire
- ✓ Check installation software of the upper computer. Make sure that the script ControlCAN.dll is consistent with the model of CAN card;
- ✓ Check the system configuration table: Be sure that EvbmaServer.ini is consistent with the model of CAN card. Examine the baud rate;
- ✓ Check the parameter configuration table: Be sure that EVBCM_Para_new.ini is consistent with the design parameters of the battery system.
- ✓ Popular CAN cards, 6 types

- ✓ It is necessary to install CAN driver for computers that CAN software is not yet installed in.

◆ 3.7.2 Data Viewing on Upper Computer

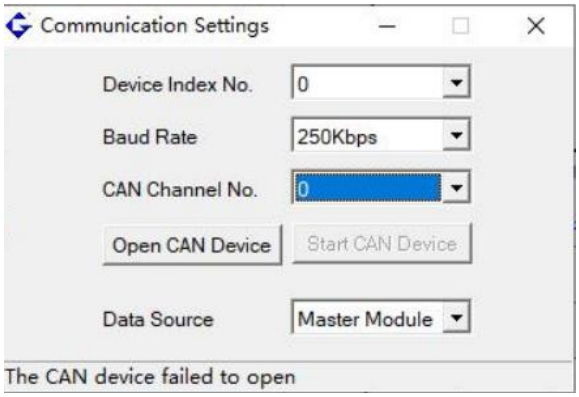

Figure 3-3 Communication Setting Interface of BMS Upper Computer

For other details, please check User Manual for BMS

WARNING	When manually simulating the closing of DO on the upper computer, check and confirm that the load end is in unloaded state, verifying the logical relationship. Unauthorized closing may lead to safety accident and system damage.
CAUTION	Before turning on the upper computer, check and confirm that other CAN software has been turned off; otherwise, software errors may occur.

3.8 Operation Instructions for HMI

Refer to User Manual for HMI configuration screen

3.9 Operation Instructions for Website Platform

Refer to User Manual for website platform

4. Maintenance

4.1 Interpretation of Terms

- Normal Operation: ESS Cabinet operates every day;
- Intermittent Operation: ESS Cabinet operation frequency is not fixed during a month. ESS Cabinet does not run on daily basis;
- Long-term Idle: ESS Cabinet is shut down for more than 3 consecutive months (the battery system shall be charged to minimum SOC 40% before it is laid idle).

4.2 Maintenance under Normal Operation

- Perform the battery system maintenance once every 12 months to prevent battery damage. Refer to Chapter 4.5 for specific maintenance methods;
- Inspect the system once every 12 months (Refer to Annex 1) and keep the inspection records properly.

4.3 Maintenance under Intermittent Operation

Same as those for Normal Operation system (see Chapter 4.2).

4.4 Maintenance under Long-term Idle

- Keep ESS Cabinet SOC in 30%~50% during storage; Avoid long-term storage when SOC is lower than 15%. In case ESS Cabinet is to lay idle for a long time, turn off the power-consuming equipment in a timely manner;
- Check ESS Cabinet every 3 months (Refer to Annex 1). Make and keep the inspection records properly.
- ESS Cabinet maintenance shall be done every 3 months to prevent battery damage. Refer to 4.5 for maintenance methods;
- Before using ESS Cabinet under Long-term Idle, fully charge the ESS Cabinet at least once to restore its performance to the optimal state.

4.5 Maintenance Methods

To ensure safety and reliability, read and comply with the following instructions:

- Option 1:
  - ✓ This option is recommended for ESS Cabinet with SOC at low level.
  - ✓ Discharge the battery to the cut-off condition (average cell voltage <3.1V or min voltage <2.8V), then keep still for 1 hour;
  - ✓ Charge the battery to SOC 100% (max cell voltage >3.65V), then keep still for 1 hour;
  - ✓ Discharge the battery to SOC 40%.
- Option 2:
  - ✓ This option is recommended for ESS Cabinet with SOC at high level.
  - ✓ Charge the battery to SOC 100% (max cell voltage >3.65V) then keep still for 1 hour;
  - ✓ Discharge the battery to cut-off condition (average cell voltage <3.1V or min voltage <2.8V), then keep still for 1 hour;
  - ✓ Recharge the battery to SOC 40%.

5. ESS Cabinet Fault Handling

5.1 Common Faults Classifications

The abnormal operations of ESS Cabinet are classified as "Warning", "Minor fault", and "Major fault". For "Warning", the ESS Cabinet does not take any action; For "Minor fault", there is a minor fault in the system; For "Major fault", there is a major abnormality in the system.

Users may view fault details through HMI, ESS Cabinet display interface.

Users may also view fault details through local Website (within the same LAN area)

Users may contact after-sale-service to report a fault as well.

5.2 Emergency Faults Handling Methods

- 5.2.1 Fire
  - ✓ Step 1: Evacuate on-site personnel to a safe place, delineate an isolation zone, and pass the warning message to relevant personnels to report.
  - ✓ Step 2: To the extent that safety is ensured, follow steps below:

    In case wiring harness is in fire, fight fire with a carbon dioxide or dry powder fire extinguisher

    In case ESS Cabinet catches fire, fight fire with a high-pressure water gun at distance.

    In case site smoke inhaled, evacuate and seek medical methods at nearest hospital as soon as possible.
- 5.2.2 Water Flooding
  - ✓ Step 1: Regardless of whether the system is powered on or not, evacuate personnels from site to a safe place and delineate a safe isolation zone.
  - ✓ Step 2: Notify ESS Cabinet supplier for maintenance after the water recedes.
  - ✓ Step 3: Do not start the ESS Cabinet until original supplier/manufacturer examines and determines so.

If a fire is caused by abnormal charging or discharging, cut off the power supply immediately. Then extinguish the fire!!!

6. Warranty Statement

Refer to Limited Warranty Letter for Elecnova ESS Products (Standard Edition).

The warranty conditions are also subject to terms and conditions of a contract.

7. After-sales Services

For any question about this product, please contact us with info below:

Name: Shanghai Elecnova Energy Storage Co., Ltd.

Address: 3F-T1, Hongqiaohui, Shanghai, China

T: +86 21 5439 6121, +86 199 0616 5606

Service Hotline: +86 21 5439 6121,

Email: sales@elecnova-ess.com,

Https://www.Elecnova-ess.com

To the extent permitted by laws, Elecnova has the final right of interpretation for this Manual. Elecnova reserves the right to modify this Manual without further notice.

Annex 1:

Inspection Item	Method	Yes –√ No -× N/A -O	Abnormal Record
Is the fire extinguishing system complete	Visual inspection		
Is the cooling system complete	Visual inspection		
Is the air duct of cooling system blocked	Visual inspection		
Are there any surfaces of the cabinet deformed	Visual inspection		
Are there any surfaces of the cabinet rusted or damaged	Visual inspection		
Is there any moisture inside the cabinet	Visual inspection		
Is the low-voltage wiring harness loose or damaged	Visual inspection		
Is the high-voltage wiring harness loose or damaged	Visual inspection		
Is there wiring harness interfering with structural components	Visual inspection		
Is the high voltage connection ablated	Visual inspection		
Are there any bolts loose or missing	Visual inspection		
Is there foul odor inside the cabinet	Smelling with nose		
Is there irritating odor inside the cabinet	Smelling with nose		
Is there burnt smell in the high voltage connection area	Smelling with nose		
Is the summary data complete	by upper computer		
Is the cell voltage data complete	by upper computer		
Is the cell temperature data complete	by upper computer		
Is there abnormal alarm in the alarm bar	by upper computer		
Note: In case that an abnormality is found, please provide feedback in time and contact relevant personnel for handling			

(END)