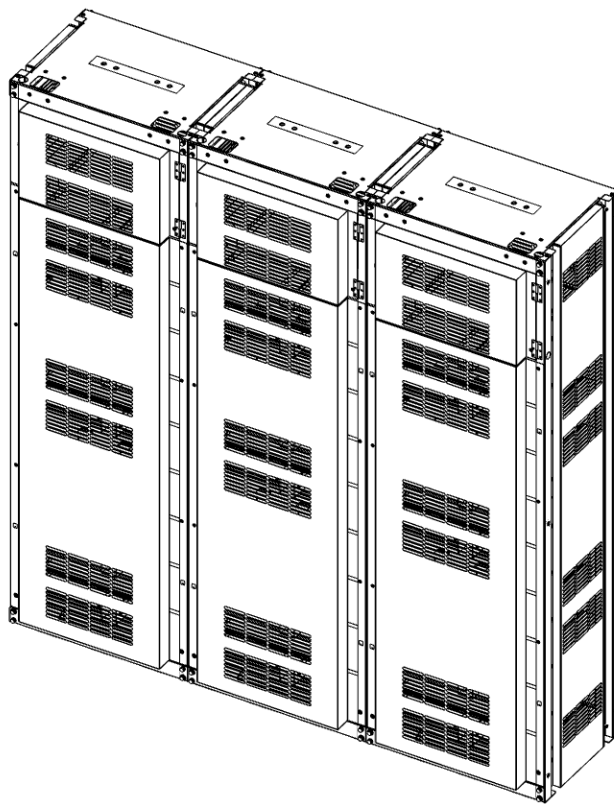


LIB System for UPS – U6A4

Operation and Maintenance Manual



Read this manual carefully before starting to install the battery system. Keep these instructions for future reference.

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Important Safety Instructions

Read and follow these instructions!

The following precautions are intended to ensure your safety and prevent property damage. Before installing this product, be sure to read all safety instructions in this document.

	DANGER Failure to comply with the instructions with this symbol may result in a serious accident, causing death or severe injury.
	WARNING Failure to comply with the instructions with this symbol may result in a serious accident, causing severe injury.
	CAUTION Failure to comply with the instructions with this symbol may result in minor or moderate injury.
	NOTICE Provides information considered important but not hazard-related. The information relates to property damage.
	Important Indicates valuable tips for optimal installation and operation of the product.

General Instructions

Be aware that a battery presents a risk of electric shock including high short-circuit current. Follow all safety precautions while operating the batteries.


- Remove watches, rings, and other metallic items.
- Use tools with insulated handles to avoid inadvertent short circuits.
- Wear rubber gloves and safety boots.
- Do not put tools or any metal parts on the top of the batteries.
- Disconnect the charging source and load before connecting or disconnecting terminals.
- Use proper lifting means when moving batteries and wear all appropriate safety clothing and equipment.
- Batteries must be handled, transported and recycled or discarded in accordance with federal, state and local regulations. Do not dispose of the batteries in a fire because they can explode.
- Do not open or mutilate the batteries.
- Only authorized, properly trained and qualified technicians should perform maintenance.
- Only qualified personnel who are familiar with the batteries and safety precautions should install or maintain the battery system.
- Do not allow unauthorized personnel to contact the batteries.

Safety Precautions

The following precautions are general safety guidelines that should be followed when working with or near the Energy Storage System (ESS). The user should develop complete, site-specific safety parameters and procedures.

- Review and refer to all safety warnings and cautions in this manual before installation.
- Build a clear, permanent, restricted access area around the system.
- Only authorized, properly trained electrical operators should be able to access the system.

The interior of this equipment must be considered a “no-go area except for qualified personnel who are familiar with the batteries and safety precautions.” Consult local codes and applicable rules and regulations to determine permit requirements. If required, mark enclosures appropriately before beginning work.

	NOTICE
	<p>This product shall be installed in a restricted access area where only the qualified personnel who are trained and have the knowledge of the product and the related safety precautions of the installation manual.</p>

“Restricted access area” is area accessible only to the electrically skilled persons and electrically instructed persons with the proper authorization.

Personnel and Equipment Warnings

Personnel in contact with the battery system should be aware of the following hazards:



WARNING—SHOCK HAZARD

Do not contact system connectors or terminals. Do not open the enclosure doors unless proper lock out and tag out procedures and related trainings are followed in accordance with local codes and regulations.



WARNING—ARC FLASH HAZARD

All electrical equipment presents an arc flash hazard. There is a serious risk of arc flash relating to any equipment modification, such as opening doors. Serious injuries can occur in arc flash incidents. Appropriate training is required in accordance with local codes and regulations.



WARNING—FIRE HAZARD

Certain faults may cause a fire.

In case of fire involving electrical equipment, use only carbon dioxide fire extinguishers or those approved for use in fighting electrical fires



CAUTION—PINCH POINTS

Multiple pinch-points are present in most system components. Be aware that there is a serious risk of injury while working around and in equipment enclosures.



CAUTION—STATIC SENSITIVE

Electronic devices can be damaged by electrostatic discharge. Proper handling procedures are required. Be sure to wear a grounded anti-static wrist strap and to discharge static electricity by touching a grounded surface near the equipment before touching any system components.

Dangerous Voltages



DANGER

The Energy Storage System (ESS) is powered by multiple power sources. Hazardous voltages may be present in the equipment even when it does not appear operational. Make sure that you completely understand the cautions and warnings in this manual. Failure to do so may result in serious injury or death. Follow all manufacturer-published safety procedures.

Electrical equipment can present a risk of electrical shock and can cause arc flash. The following precautions must be observed when working on or around electrical equipment:

- Remove watches, jewelry, rings, and other metallic objects.
- Use tools with insulated handles.
- Safety clothing and shoes must comply with local codes and regulations.

Lock Out/Tag Out Guidelines



DANGER

Failure to follow all the applicable lock out/tag out (LOTO) procedures at all times may result in serious injury or death.

With power applied to the ESS, hazardous voltages are present on some components. To prevent death or injury, do not touch any components within the enclosure unless specifically directed to do so. To reduce the risk of electrical shock, make sure that all equipment is properly grounded. For more information, refer to the installation manual.



WARNING

Enclosure doors must remain closed except when access to the enclosure interior is required. Personnel should keep a safe distance from enclosures whenever the equipment is energized. Always comply with local, state, and national lock out/tag out guidelines when working with or near the ESS. The LOTO procedures must meet or exceed the requirements of all guidelines presented in SAMSUNG SDI safety documentation. Follow these steps before entering potentially hazardous areas or beginning work on the ESS:

- Wear protective clothing and shoes-
- Identify and isolate all power and stored energy sources.
- Apply appropriate LOTO devices. When applying LOTO to the ESS, do not touch anything within the enclosure except as specifically directed in the work procedures.
- Complete the site-specific LOTO procedure and safety checklist before beginning work.

General Warnings



DANGER

When energized, this equipment presents a hazard of electric shock, death, and injury. Only authorized, properly trained personnel who are thoroughly familiar with the equipment and should install, operate, or maintain this equipment.



DANGER

To avoid death, injury, and property damage, follow all safety procedures promulgated by Environmental Health and Safety (EHS) guidelines.



DANGER

To minimize the hazards of electrical shock, death, and injury, approved grounding practices and procedures must be strictly followed.



WARNING

To avoid injury and equipment damage, personnel must adhere to the site protocol concerning working at heights.



WARNING

To avoid personal injury or equipment damage caused by equipment malfunction, only properly and qualified trained personnel should modify any programmable machine.



WARNING

Always ensure that applicable standards and regulations are followed and only properly certified equipment is used as a critical component of a safety system. Never assume that a safety-critical control loop is functioning correctly.

Table of Contents

Important Safety Instructions	i
General Instructions.....	ii
Safety Precautions.....	ii
Personnel and Equipment Warnings	iii
Dangerous Voltages	iii
Lock Out/Tag Out Guidelines	iv
General Warnings.....	iv
Table of Contents.....	i
Tables.....	iii
Figures	iv
1. About this Manual	1
1.1 Purpose.....	1
1.2 Target Audience.....	1
1.3 Organization	1
1.4 Revision History.....	2
1.5 Acronyms and Abbreviations.....	3
2. Product Description.....	4
2.1 Major Components	4
2.1.1 Battery Module (Type A / Type B).....	5
2.1.2 BCU (Battery Control Unit)	7
2.1.3 SMPS Assembly (Type A / Type B).....	8
2.1.4 Rack Frame.....	10
2.2 Product Specification.....	11
2.3 Product Labels.....	16
2.3.1 Battery Module.....	16
2.3.2 BCU	17
2.3.3 Battery System.....	17
2.4 Block Diagram	18
3. Battery System Operation	19
3.1 Indicator LED.....	19
3.2 Dry Contact Signals.....	21

3.3	Operation Status	22
3.3.1	Normal Status	28
3.3.2	Minor Protection Status (Alarm).....	28
3.3.3	Major Protection Status (Fault)	28
4.	Maintenance Checks.....	29
4.1	Daily Checks.....	29
4.2	Monthly Checks.....	29
4.3	Annual Check.....	29
4.4	Maintenance Checklist	30
5.	Troubleshooting, Repair and Replacement.....	31
6.	Appendix.....	32
6.1	Disposal and Recycling	32

Tables

Table 2-3: Cable and lug terminal requirements	7
Table 2-7: AC Terminal and Cable Description (3 phase)	9
Table 2-8: AC Terminal and Cable Description (1 phase)	9
Table 2-10: Battery System General Specification	11
Table 2-11: 136S Battery System Specification	12
Table 2-12: 128S Battery System Specification	12
Table 2-13: 112S Battery System General Specification.....	13
Table 2-14: 104S Battery System General Specification.....	13
Table 2-15: 96S Battery System General Specification.....	14
Table 2-16: 80S Battery System General Specification.....	14
Table 2-17: Configurations.....	15
Table 3-1: Indicator LED Status.....	19
Table 3-2: Indicated Codes	20
Table 3-10: Range of Operation (136S Configuration)	22
Table 3-11: Range of Operation (128S Configuration)	23
Table 3-12: Range of Operation (112S Configuration)	24
Table 3-13: Range of Operation (104S Configuration)	25
Table 3-14: Range of Operation (96S Configuration).....	26
Table 3-15: Range of Operation (80S Configuration).....	27
Table 4-1: Maintenance Checklist Template	30

Figures

Figure 2-1: Battery Module Type A 5

Figure 2-2: Battery Module Type B 6

Figure 2-3: BCU 7

Figure 2-7: SMPS Assembly..... 8

Figure 2-12: Rack Frame10

Figure 2-13: Battery Module Type A Label16

Figure 2-14: Battery Module Type B Label16

Figure 2-15: Battery Module Safety Label16

Figure 2-16: BCU Label17

Figure 2-17: 136S Battery System Label17

Figure 2-18: System Block Diagram.....18

1. About this Manual

This section briefly describes the purpose, audience, organization, revision history, and acronyms and abbreviations used in this document.

1.1 Purpose

The purpose of this manual is to provide information for the safe and successful operation and maintenance of the product.

1.2 Target Audience

This manual is intended for system administrators and operators who install, operate, maintenance and configure the product.

1.3 Organization

This manual is composed of the following chapters:

- Chapter 1, "About this Manual" introduces preliminary description about this document.
- Chapter 2, "Product Description" describes the major components of the product.
- Chapter 3, "Battery System Operation" explains the operation modes of the battery system.
- Chapter 4, "Maintenance Check" lists items to inspect daily, monthly, and annually.
- Chapter 5, "Troubleshooting" guides the reader through clearing protection modes and replacing components.

1.4 Revision History

Rev.	Description	Author	Date
0.0	First Draft (tentative release)		2019.08.20
0.1	Product specification, labels, block diagram added. Added replacement rack fuse information (Table 5-2) Terminal and cable information added. (P+, P-, AC inputs)		2019.11.07
0.2	Dimensions corrected		2019.11.14
0.3	Updated rack frame part number		2020.04.10
0.4	Product model number updated (Product Description) Updated 2.2 Product Specification and 3.3 Operation Status ("Storage Humidity" changed to "Humidity") Updated Table 4-1: Maintenance Checklist Template (Added contact resistance readings) Updated Table 5-1: Recommended Tools and Instruments for Repair and Replacement		2020.08.28
0.41	Version for end customer Removed confidential letterhead		2020.08.28

Approved By:		
Name	Signature	Date

Trusted Reviewers		
Name	Signature	Date

1.5 Acronyms and Abbreviations

The following acronyms and abbreviations are used in this manual.

Abbreviations	Full Name
AED	Automated External Defibrillator
BMS	Battery Management System
Comm.	Communication
EHS	Environmental Health and Safety
ESS	Energy Storage System
LOTO	LOCK OUT/TAG OUT
OT	Overtemperature
OVP	Overvoltage Protection
SMPS	Switched Mode Power Supply
BCU	Battery Control Unit
SOC	State Of Charge
SOH	State Of Health
UT	Undertemperature
UVP	Undervoltage Protection
UPS	Uninterruptible Power Supply

2. Product Description

Before operating the battery system, users must be familiar with its components.

2.1 Major Components

Samsung SDI's Lithium Ion Battery System has the following components:

- Battery Module (Type A / Type B)
- BCU
- Rack BMS (Embedded in BCU)
- Rack Frame
- SMPS Assembly (Type A / Type B)
- System BMS (Embedded in SMPS Assembly Type A)

Refer to the "Product Specification" document for detailed specifications of the components.

2.1.1 Battery Module (Type A / Type B)

Battery Module is the most basic component of the Battery System and it contains the energy storing battery cells. There is a Module BMS inside each Battery Module. Module BMS checks the status of a Battery Module by measuring its voltage and temperature. It also communicates with the BCU to send all measured voltage and temperature data, and to receive commands to control cell balancing.

There are two types of 8S1P Battery Module depending on the position of terminal's polarity. Type A's plus(+) terminal is on the right side. Type B is on the left.

Type A: EM2031AE003A

Type B: EM2031AE004A

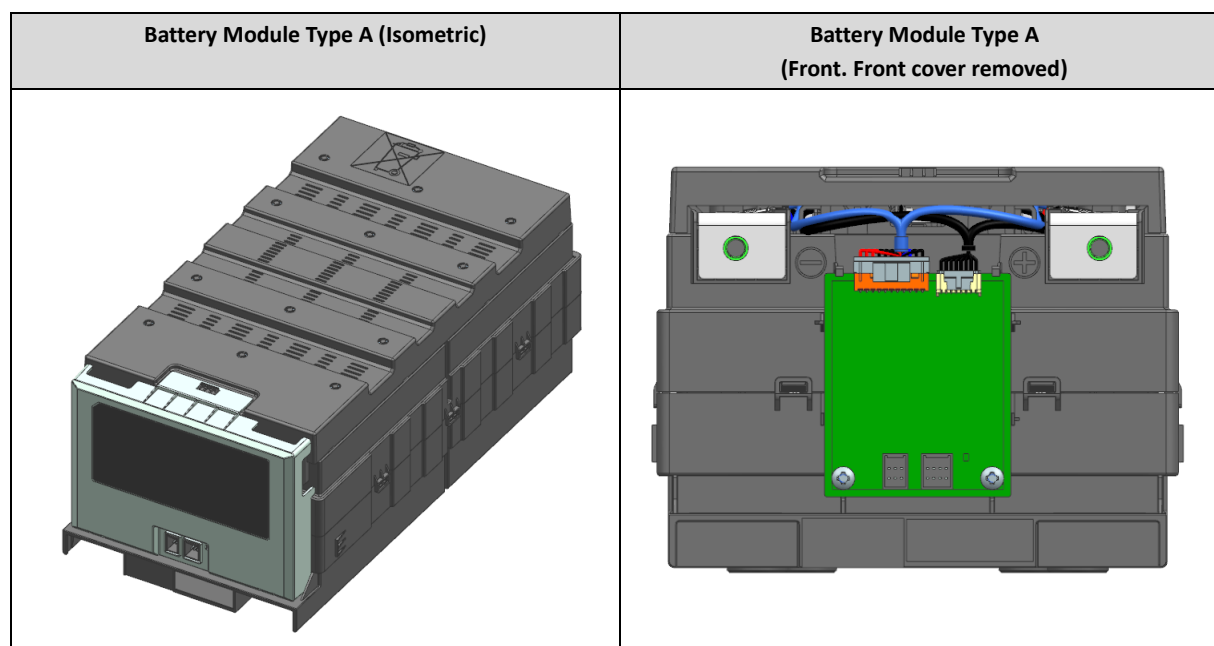


Figure 2-1: Battery Module Type A

2. Product Description

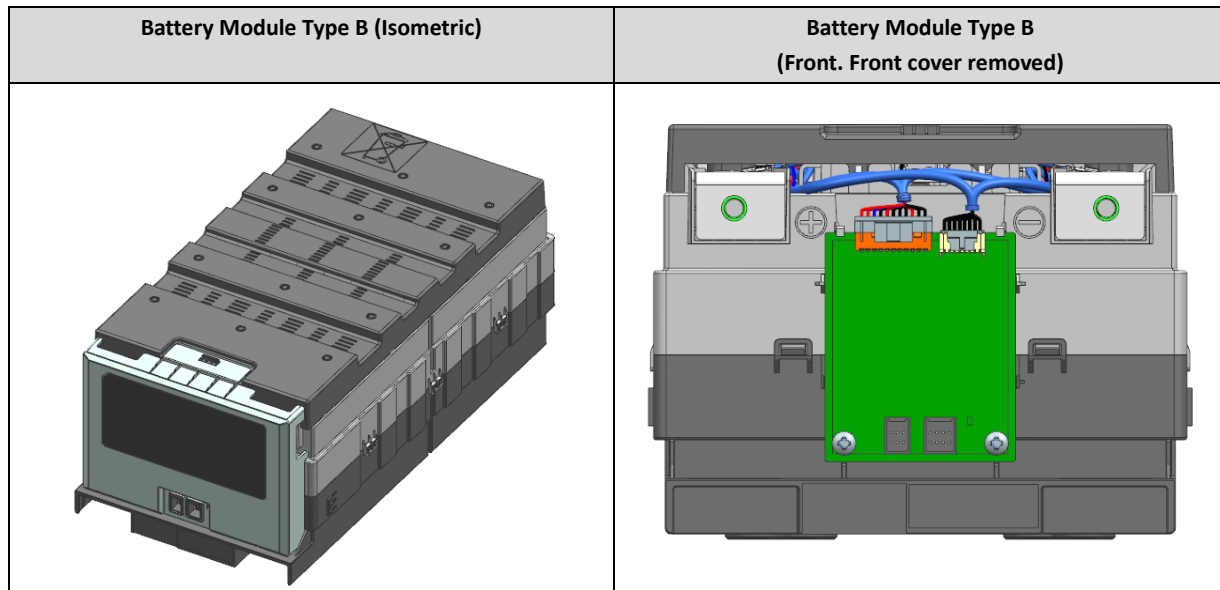


Figure 2-2: Battery Module Type B

2.1.2 BCU (Battery Control Unit)

BCU collects all information about the battery system and controls the battery system by switching the main power line and controls each Battery Module by cell balancing. BCU calculates the state-of-charge (SOC) and state-of-health (SOH) of the battery system. Key components in the BCU are Rack BMS, MCCB, and shunt resistor. Rack BMS is the main controller that takes all data from the Module BMS, measures the string voltage and current, determines the state of the battery and controls the MCCB accordingly.

V049-0012AA

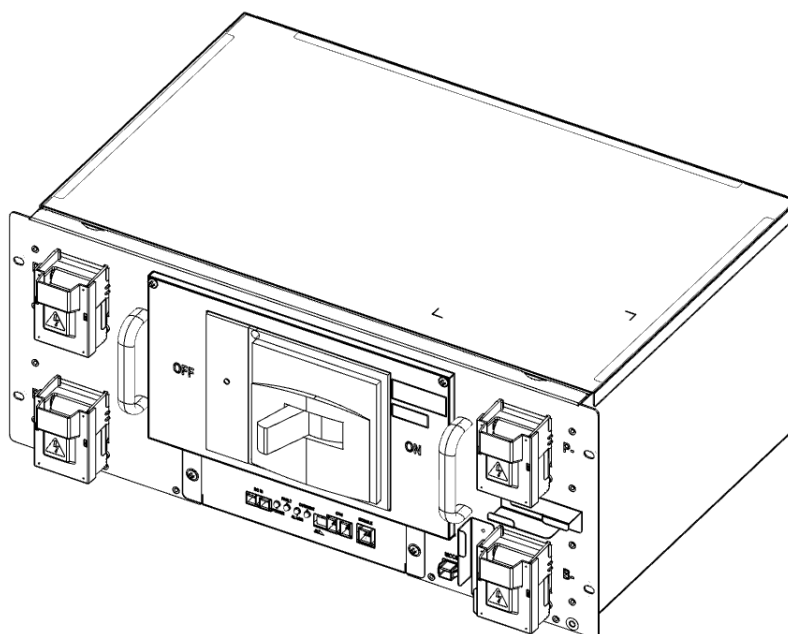


Figure 2-3: BCU

Table 2-1: Cable and lug terminal requirements

Terminal Name	Wire No.	Terminal Type	Description
P+	300 sq mm or thicker	M12 Single Hole Lug Terminal	Connects to DC link positive
P-	300 sq mm or thicker	M12 Single Hole Lug Terminal	Connects to DC link negative

2. Product Description

2.1.3 SMPS Assembly (Type A / Type B)

3-Phase Type A (with System BMS): V044-0006AA

3-Phase Type B (without System BMS): SJ94-00238B

1-Phase Type A (with System BMS): V044-0004AA

1-Phase Type B (without System BMS): V044-0005AA

SMPS Assembly houses the System BMS and SMPS, which provides power to the System BMS and BCU. Two options are available for the SMPS depending on the AC input range and cabling: 3 phase and 1 phase. The System BMS assembly provides data to the external systems (i.e. building management system, UPS, etc.) while controlling and monitoring all connected Rack BMS.

There are two types of SMPS Assembly: Type A is with System BMS and Type B is without System BMS.

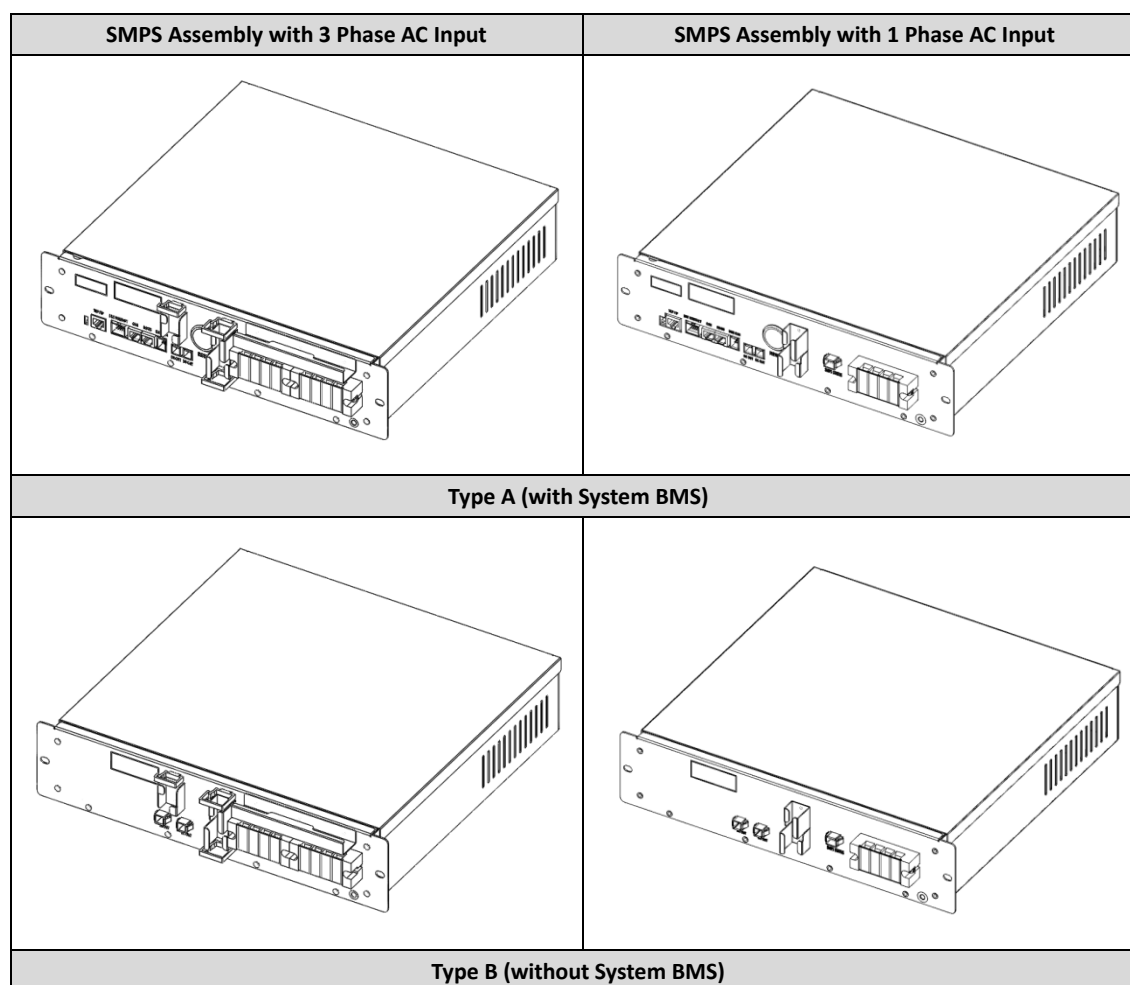


Figure 2-4: SMPS Assembly

Table 2-2: AC Terminal and Cable Description (3 phase)

Item	Part Name		Description	
Terminal Block	SL3T-4P		Seoil Electronics	
Terminals	Ring terminal		320 ~ 575VAC, 6A	
Pin No.	Pin Name	Function	Wire No.	Terminal Type
1	L1	3 phase AC, L1	AWG #12 (THHN Copper) or equivalent	M4 single hole ring terminal
2	L2	3 phase AC, L2	AWG #12 (THHN Copper) or equivalent	M4 single hole ring terminal
3	L3	3 phase AC, L3	AWG #12 (THHN Copper) or equivalent	M4 single hole ring terminal
4	PE	-	AWG #12 (THHN Copper) or equivalent	M4 single hole ring terminal

Table 2-3: AC Terminal and Cable Description (1 phase)

Item	Part Name		Description	
Terminal Block	SL3T-4P		Seoil Electronics	
Terminals	Ring terminal		100 ~ 240VAC, 6A	
Pin No.	Pin Name	Function	Wire No.	Terminal Type
1	L1	SMPS #1 1 phase AC, L	AWG #12 (THHN Copper) or equivalent	M4 single hole ring terminal
2	N1	SMPS #1 1 phase AC, N	AWG #12 (THHN Copper) or equivalent	M4 single hole ring terminal
3	L2	SMPS #2 1 phase AC, L	AWG #12 (THHN Copper) or equivalent	M4 single hole ring terminal
4	N2	SMPS #2 1 phase AC, N	AWG #12 (THHN Copper) or equivalent	M4 single hole ring terminal

SMPS Assembly with 1 phase AC input has auxiliary connectors for the status of the SMPS.

2. Product Description

2.1.4 Rack Frame

V808-0101BA: Black. 136S. For general customer

V808-0101CA: Black. 128S. For general customer

V808-0101DA: Black. 112S. For general customer

V808-0101EA: Black. 104S. For general customer

V808-0101FA: Black. 96S. For general customer

V808-0101GA: Black. 80S. For general customer

The Rack Frame is used to mount the modules, BCU and SMPS assembly and provides ground connections for BCU and SMPS Assembly.

(Grounding cable/busbar for the rack frame is necessary for the BCU and SMPS Assembly as they are grounded to the rack frame when installed. An equipment grounding conductor is required to ground the rack frames together and to the UPS module).

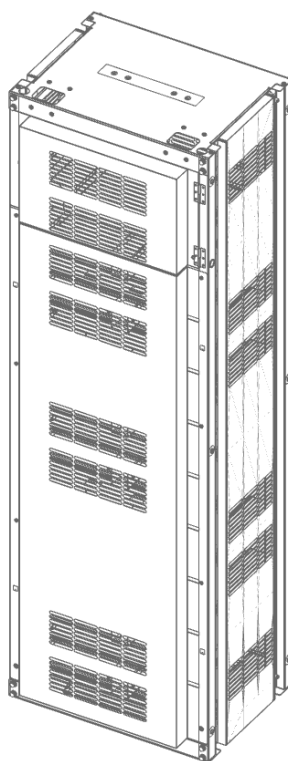


Figure 2-5: Rack Frame

2.2 Product Specification

Table 2-4: Battery System General Specification

No.	Item		Specification	Remarks
1	Dimension [mm, (inch)]	BCU	583 x 359.6 x 235.6, (22.95 x 14.16 x 9.28)	
		Battery Module	403.5 x 214 x 163, (15.89 x 8.43 x 6.42)	Type A and Type B
		SMPS Assembly 3 phase	397.4 x 355.6 x 85.5, (15.64 x 14 x 3.37)	Type A and Type B
		SMPS Assembly 1 phase	397.4 x 355.6 x 85.5, (15.64 x 14 x 3.37)	Type A and Type B
		Rack Frame	650 x 530 x 2055 (25.59 x 20.87 x 80.91)	
2	Weight [kg, (lb)]	BCU	About 18, (40)	
		Battery Module	About 16.5, (36)	Type A and Type B
		SMPS Assembly	About 5, (11)	Type A and Type B
		Rack Frame	About 163.4, (360)	
		136S Battery System	About 510, (1124)	
		128S Battery System	About 493, (1087)	
		112S Battery System	About 459, (1012)	
		104S Battery System	About 442, (974)	
		96S Battery System	About 425, (937)	
		80S Battery System	About 391, (862)	
3	Minimum Capacity		67Ah	1/3C (22.3A) charge and discharge @25°C
4	Recommended Operation Temperature		23±5°C	
5	Storage Temperature		0 ~ 40°C	Module storage temperature 0 ~ 30°C
6	Humidity		Less than 90 % RH	Noncondensing
7	Recommended Humidity		Less than 60 % RH	Noncondensing
8	Storage Period ¹		Less than 6 months	
9	Communication (Internal)		Differential UART, 2 Mbps	BCU – Battery Module
10	Communication (External)1		RS485	UPS – SMPS Assembly
	Communication (External)2		TCP/IP	UPS – SMPS Assembly
	Communication (External)3		Dry contact	UPS – SMPS Assembly
11	IP rating		IP20	
12	Protective Class		I	

¹ The Capacity degradation will occur depending on storage time.

- To minimize capacity degradation, storage temperature of less than 10°C and 3.630V per cell is recommended.

2. Product Description

Table 2-5: 136S Battery System Specification

No.	Item	Specification	Remarks
1	Number of Module	17	8 Type A 9 Type B
2	Nominal Capacity	34.6kWh	1/3C @25°C
3	Nominal Voltage ¹	516.8V DC	3.8V/cell
4	Maximum Voltage ¹	571.2V DC	4.2V/cell
5	Discharging Method	Constant Power	
	End of Discharge Voltage ¹	408V DC	3.0V/cell
	Recommended End of Discharge Voltage ¹	435.2V DC	3.2V/cell
	Standard Discharging Current ¹	22.3A	1/3C @25°C
	Maximum Continuous Discharge Power ¹	183.6kW	Peak 450A @ EODV
6	Charging Method	CC-CV, Floating	
	Floating Charging Voltage ¹	571.2V DC	4.2V/cell
	Standard Charging Current ¹	22.3A	1/3C
	Maximum Peak Charging Current ¹	250A	2 second pulse
	Maximum Continuous Charging Current ¹	67A	1C

¹ Specified voltage and current must be satisfied in all load and charging conditions.



Notice: After a full discharge at maximum continuous discharge power, cool the battery for at least 12 hours before another discharge in order to avoid over-temperature protection. Immediate recharging is allowed with standard charging current. For optimal performance, wait until the battery temperature returns to at least $\pm 3^{\circ}\text{C}$ within the room temperature.

Table 2-6: 128S Battery System Specification

No.	Item	Specification	Remarks
1	Number of Module	16	8 Type A 8 Type B
2	Nominal Capacity	32.6kWh	1/3C@R.T
3	Nominal Voltage ¹	486.4V DC	3.8V/cell
4	Maximum Voltage ¹	537.6V DC	4.2V/cell
5	Discharging Method	Constant Power	
	End of Discharge Voltage ¹	384V DC	3.0V/cell
	Recommended End of Discharge Voltage ¹	409.6V DC	3.2V/cell
	Standard Discharging Current ¹	22.3A	1/3C@R.T
	Maximum Continuous Discharge Power ¹	173kW	Peak 450A @ EODV
6	Charging Method	CC-CV, Floating	
	Floating Charging Voltage ¹	537.6V DC	4.2V/cell
	Standard Charging Current ¹	22.3A	1/3C
	Maximum Peak Charging Current ¹	250A	2 second pulse
	Maximum Continuous Charging Current ¹	67A	1C

¹ Specified voltage and current must be satisfied in all load and charging conditions.



Notice: After a full discharge at maximum continuous discharge power, cool the battery for at least 12 hours before another discharge in order to avoid over-temperature protection. Immediate recharging is allowed with standard charging current. For optimal performance, wait until the battery temperature returns to at least $\pm 3^{\circ}\text{C}$ within the room temperature.

Table 2-7: 112S Battery System General Specification

No.	Item	Specification	Remarks
1	Number of Module	14	6 Type A 8 Type B
2	Nominal Capacity	28.5kWh	1/3C@R.T
3	Nominal Voltage ¹	425.6V DC	3.8V/cell
4	Maximum Voltage ¹	470.4V DC	4.2V/cell
5	Discharging Method	Constant Power	
	End of Discharge Voltage ¹	336V DC	3.0V/cell
	Recommended End of Discharge Voltage ¹	358.4V DC	3.2V/cell
	Standard Discharging Current ¹	22.3A	1/3C@R.T
	Maximum Continuous Discharge Power ¹	151kW	Peak 450A @ EODV
6	Charging Method	CC-CV, Floating	
	Floating Charging Voltage ¹	470.4V DC	4.2V/cell
	Standard Charging Current ¹	22.3A	1/3C
	Maximum Peak Charging Current ¹	250A	2 second pulse
	Maximum Continuous Charging Current ¹	67A	1C

¹ Specified voltage and current must be satisfied in all load and charging conditions.



Notice: After a full discharge at maximum continuous discharge power, cool the battery for at least 12 hours before another discharge in order to avoid over-temperature protection. Immediate recharging is allowed with standard charging current. For optimal performance, wait until the battery temperature returns to at least $\pm 3^{\circ}\text{C}$ within the room temperature.

Table 2-8: 104S Battery System General Specification

No.	Item	Specification	Remarks
1	Number of Module	13	6 Type A 7 Type B
2	Nominal Capacity	26.5kWh	1/3C@R.T
3	Nominal Voltage ¹	395.2V DC	3.8V/cell
4	Maximum Voltage ¹	436.8V DC	4.2V/cell
5	Discharging Method	Constant Power	
	End of Discharge Voltage ¹	312V DC	3.0V/cell
	Recommended End of Discharge Voltage ¹	332.8V DC	3.2V/cell
	Standard Discharging Current ¹	22.3A	1/3C@R.T
	Maximum Continuous Discharge Power ¹	140kW	Peak 450A @ EODV
6	Charging Method	CC-CV, Floating	
	Floating Charging Voltage ¹	436.8V DC	4.2V/cell
	Standard Charging Current ¹	22.3A	1/3C
	Maximum Peak Charging Current ¹	250A	2 second pulse
	Maximum Continuous Charging Current ¹	67A	1C

¹ Specified voltage and current must be satisfied in all load and charging conditions.



Notice: After a full discharge at maximum continuous discharge power, cool the battery for at least 12 hours before another discharge in order to avoid over-temperature protection. Immediate recharging is allowed with standard charging current. For optimal performance, wait until the battery temperature returns to at least $\pm 3^{\circ}\text{C}$ within the room temperature.

2. Product Description

Table 2-9: 96S Battery System General Specification

No.	Item	Specification	Remarks
1	Number of Module	12	6 Type A 6 Type B
2	Nominal Capacity	24.4kWh	1/3C@R.T
3	Nominal Voltage ¹	364.8V DC	3.8V/cell
4	Maximum Voltage ¹	403.2V DC	4.2V/cell
5	Discharging Method	Constant Power	
	End of Discharge Voltage ¹	288V DC	3.0V/cell
	Recommended End of Discharge Voltage ¹	307.2V DC	3.2V/cell
	Standard Discharging Current ¹	22.3A	1/3C@R.T
	Maximum Continuous Discharge Power ¹	130kW	Peak 450A @ EODV
6	Charging Method	CC-CV, Floating	
	Floating Charging Voltage ¹	336V DC	4.2V/cell
	Standard Charging Current ¹	22.3A	1/3C
	Maximum Peak Charging Current ¹	250A	2 second pulse
	Maximum Continuous Charging Current ¹	67A	1C

¹ Specified voltage and current must be satisfied in all load and charging conditions.



Notice: After a full discharge at maximum continuous discharge power, cool the battery for at least 12 hours before another discharge in order to avoid over-temperature protection. Immediate recharging is allowed with standard charging current. For optimal performance, wait until the battery temperature returns to at least $\pm 3^{\circ}\text{C}$ within the room temperature.

Table 2-10: 80S Battery System General Specification

No.	Item	Specification	Remarks
1	Number of Module	10	4 Type A 6 Type B
2	Nominal Capacity	20.4kWh	1/3C@R.T
3	Nominal Voltage ¹	304V DC	3.8V/cell
4	Maximum Voltage ¹	336V DC	4.2V/cell
5	Discharging Method	Constant Power	
	End of Discharge Voltage ¹	240V DC	3.0V/cell
	Recommended End of Discharge Voltage ¹	256V DC	3.2V/cell
	Standard Discharging Current ¹	22.3A	1/3C@R.T
	Maximum Continuous Discharge Power ¹	108kW	Peak 450A @ EODV
6	Charging Method	CC-CV, Floating	
	Floating Charging Voltage ¹	336V DC	4.2V/cell
	Standard Charging Current ¹	22.3A	1/3C
	Maximum Peak Charging Current ¹	250A	2 second pulse
	Maximum Continuous Charging Current ¹	67A	1C

¹ Specified voltage and current must be satisfied in all load and charging conditions.



Notice: After a full discharge at maximum continuous discharge power, cool the battery for at least 12 hours before another discharge in order to avoid over-temperature protection. Immediate recharging is allowed with standard charging current. For optimal performance, wait until the battery temperature returns to at least $\pm 3^{\circ}\text{C}$ within the room temperature.

Table 2-11: Configurations

Configurations	1P136S	1P128S	1P112S	1P104S	1P96S	1P80S
Model Name	PHR3462-001A	PHR3262-001A	PHR2852-001A	PHR2652-001A	PHR2442-001A	PHR2042-001A
Nominal Energy (kWh)	34.6	32.6	28.5	26.5	24.4	20.4
Nominal Voltage (Vdc)	516.8	486.4	425.6	395.2	364.8	304
Nominal Capacity (Ah)	67	67	67	67	67	67
Recommended CC (A)	22.3	22.3	22.3	22.3	22.3	22.3
Recommended CV (Vdc)	571.2	537.6	470.4	436.8	403.2	336.0
End Charge Current (A)	1.34	1.34	1.34	1.34	1.34	1.34
Voltage Range (Vdc)	408.0 - 571.2	384.0 - 537.6	336.0 - 470.4	312 - 436.8	288 - 403.2	240 - 336
Number of Modules	17	16	14	13	12	10
	Type A: 8	Type A: 8	Type A: 6	Type A: 6	Type A: 6	Type A: 4
	Type B: 9	Type B: 8	Type B: 8	Type B: 7	Type B: 6	Type B: 6
Weight (kg)	510	493	459	442	425	391

2. Product Description

2.3 Product Labels

2.3.1 Battery Module

Type A

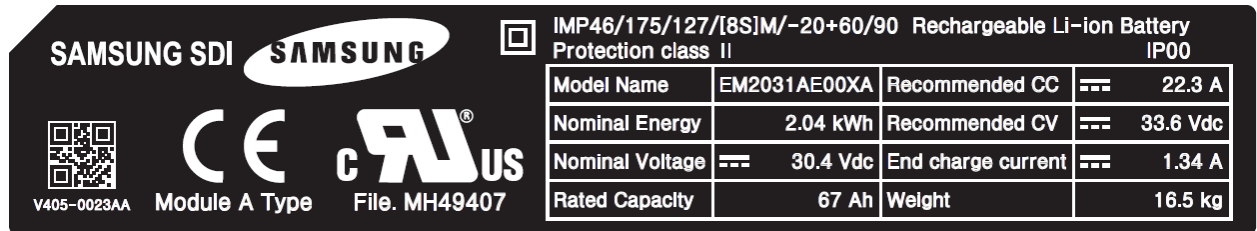


Figure 2-6: Battery Module Type A Label

Type B

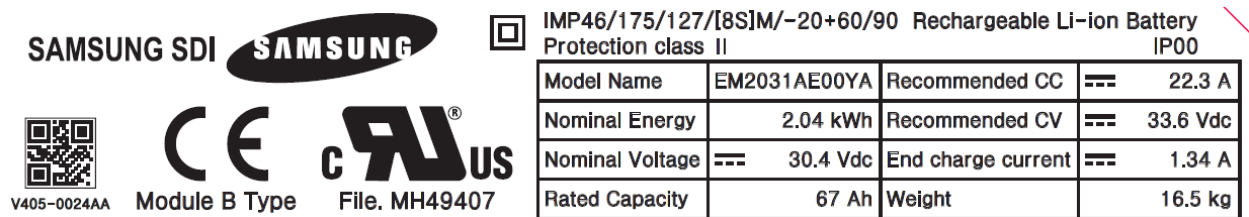


Figure 2-7: Battery Module Type B Label

Safety Label



Figure 2-8: Battery Module Safety Label

2.3.2 BCU


SAMSUNG SDI SAMSUNG

IMP46/175/127/[136S]M/-20+60/90
Rechargeable Li-ion Battery

Protective class I IP00

LIB Battery for UPS - U6A4



Model Name	V049-0012XA
Product Name	Switch Gear
Input rated Voltage	== 24 Vdc
Rated Input Current/Power	250 mA/6 W
Nominal Capacity	67 Ah
Maximum Voltage	== 571.2 Vdc
Weight	18 kg


CE  V405-0036AA

⚠ DANGER ⚠ HIGH VOLTAGE

ENERGY STORAGE DEVICE
Read the instruction manual before starting work or operating

- To reduce risk of burn or electrical hazard
 - Follow proper precautions before handling
 - Serious injury can occur if proper precautions are not followed
 - Off power before servicing
 - Service must be done by trained personnel only
- Electric shock hazard
 - Do not disassemble product
 - Wear personal protective equipment such as safety gloves
- Electrolyte hazard
 - Do not contact on eyes, skin and clothing
 - When exposed, flush with clean water and seek medical attention
- Flammable Electrolyte
 - Do not expose to fire, incineration, puncture, or impact
 - Do not dispose in trash
 - Follow local regulations and manufacturer's instruction



Li-ion

Figure 2-9: BCU Label

2.3.3 Battery System

SAMSUNG SDI SAMSUNG

IMP46/175/127/[136S]M/-20+60/90
Rechargeable Li-ion Battery


Protective class I IP20


LIB Battery for UPS - U6A4

Model Name	PHR3462-001A	Recommended CC	== 22.3 A
Nominal Energy	34.6 kWh	Recommended CV	== 571.2 Vdc
Nominal Voltage	== 516.8 Vdc	End charge Current	== 1.34 A
Nominal Capacity	67 Ah	Weight	510 kg
Voltage Range	== 408-571.2 Vdc	No. of Modules	17 EA

SMPS AC Input

Port Name	L1, L2, L3, PE	Lx, Nx
AC Input	3 Phase AC	1 Phase AC
AC Input Voltage	400-500 Vac	100-240 Vac
Frequency	50-60 Hz	50-60 Hz
Nominal Current Consumption per SMPS	0.65 A	1.4 A



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⚠ DANGER ⚠ HIGH VOLTAGE

ENERGY STORAGE DEVICE
Read the instruction manual before starting work or operating

- To reduce risk of burn or electrical hazard
 - Follow proper precautions before handling
 - Serious injury can occur if proper precautions are not followed
 - Off power before servicing
 - Service must be done by trained personnel only
- Electric shock hazard
 - Do not disassemble product
 - Wear personal protective equipment such as safety gloves
- Electrolyte hazard
 - Do not contact on eyes, skin and clothing
 - When exposed, flush with clean water and seek medical attention
- Flammable Electrolyte
 - Do not expose to fire, incineration, puncture, or impact
 - Do not dispose in trash
 - Follow local regulations and manufacturer's instruction



Li-ion

Samsung SDI Europe GmbH, Reichenbachstr 2 Jarmenig Germany 85737
Samsung SDI America GmbH, 3655 North First Street San Jose CA 95134

Figure 2-10: 136S Battery System Label

2.4 Block Diagram

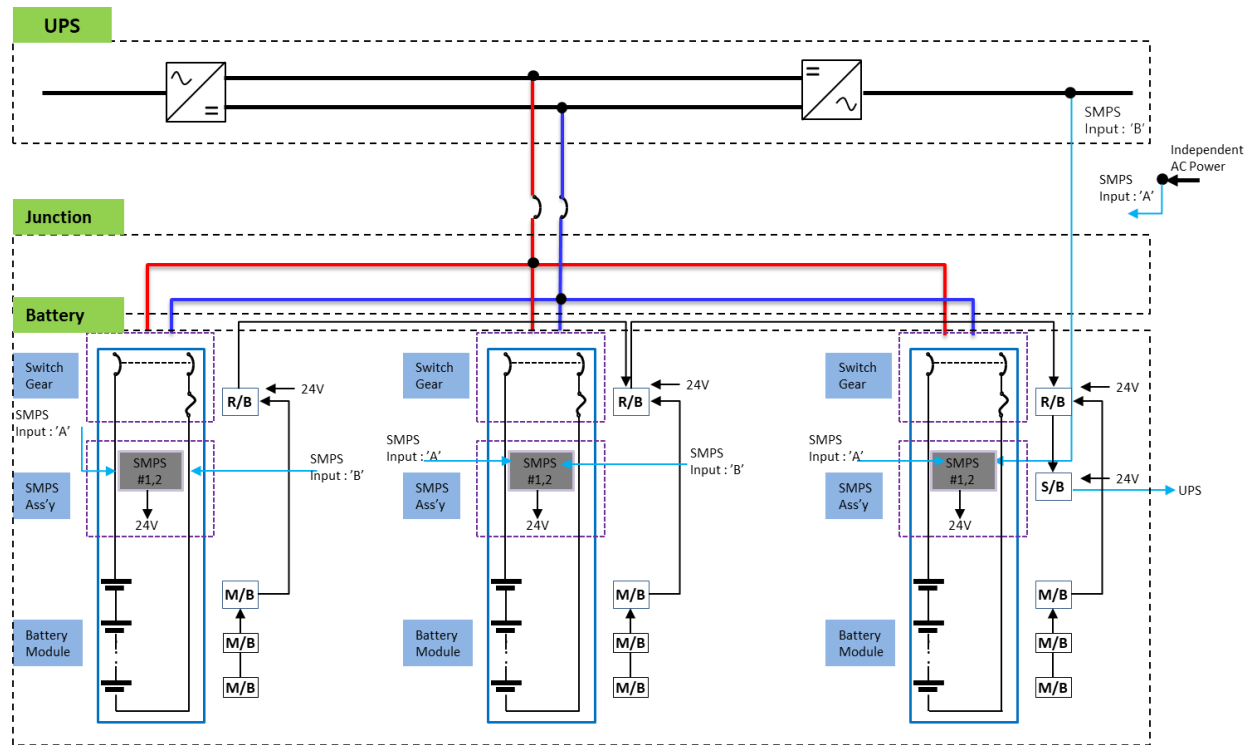


Figure 2-11: System Block Diagram

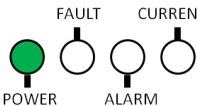
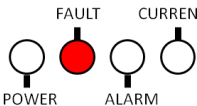
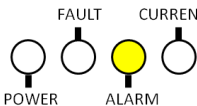
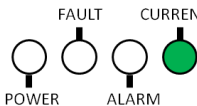
3. Battery System Operation

The battery system for a UPS is designed to be always on. The UPS and the critical load must be set up so that the battery system's maximum allowable voltage and current are not exceeded.

3.1 Indicator LED

Four indicator LED's on the front of the BCU in each rack displays the status of the battery system per string. Table 3-1 shows each LED's color and the battery status indicated.

Table 3-1: Indicator LED Status

Items	POWER(Green)	FAULT(Red)	ALARM(Yellow)	CURRENT(Green)
Location				
Status	On : MCCB Off Off : Power Off Blink : MCCB On	On : N/A Off : No Major Protection Blink : Major Protection	On : N/A Off : No Minor Protection Blink : Minor Protection	On : Discharge Off : Idle Blink : Charge

3. Battery System Operation

Depending on the battery system's operating conditions, each indicator LED may be on, blinking or off. Table 3-2 shows the LED indication for the battery status.

Table 3-2: Indicated Codes

LED Status	Battery Status	Remarks
<p>POWER FAULT ALARM CURRENT</p> <p>All LED's Off</p>	BMS Power Off	MCCB Off
<p>POWER FAULT ALARM CURRENT</p> <p>POWER LED Steady</p>	Normal	MCCB Off
<p>POWER FAULT ALARM CURRENT</p> <p>POWER LED Flashing</p>	Normal	MCCB On
<p>POWER FAULT ALARM CURRENT</p> <p>POWER LED Flashing CURRENT LED Steady</p>	Normal	Discharge
<p>POWER FAULT ALARM CURRENT</p> <p>POWER LED Flashing CURRENT LED Flashing</p>	Normal	Charge
<p>POWER FAULT ALARM CURRENT</p> <p>POWER LED Steady FAULT LED Flashing</p>	Major Protection MCCB Tripped	Overvoltage Protection Undervoltage Protection Overtemperature Protection Overcurrent Protection
<p>POWER FAULT ALARM CURRENT</p> <p>POWER LED Flashing ALARM LED Flashing</p>	Minor Protection MCCB On	Voltage Imbalance Error Voltage Sensing Error Undertemperature Protection Temperature Imbalance Error

3.2 Dry Contact Signals

This section has been removed from the customer facing copy of the operation and maintenance manual.

3.3 Operation Status

Refer to the table below for typical and maximum state of charge and discharge conditions to keep the battery system in normal operation.

Table 3-3: Range of Operation (136S Configuration)

No.	Item	Specification	Remarks
1	Nominal Capacity	34.6kWh	1/3C@R.T
2	Nominal Voltage ¹	516.8V DC	3.8V/cell
3	Maximum Voltage ¹	571.2V DC	4.2V/cell
4	Discharging Method	Constant Power	
	End of Discharge Voltage ¹	408V DC	3.0V/cell
	Recommended End of Discharge Voltage	435.2V DC	3.2V/cell
	Standard Discharging Current	22.3A	1/3C@R.T
	Maximum Continuous Discharge Power	183.6kW	Peak 450A @ EODV
5	Charging Method	CC-CV, Floating	
	Floating Charge Voltage	571.2V DC	4.2V/cell
	Standard Charge Current	22.3A	1/3C
	Maximum Peak Charge Current	250A	2 second pulse
	Maximum Continuous Charging Current	67A	1C
6	Recommended Operation Temperature	23±5°C	
7	Storage Temperature	0 ~ 40°C	
8	Humidity	Less than 90 % RH	Noncondensing
9	Recommended Humidity	Less than 60 % RH	Noncondensing
10	Storage Period ²	Less than 6 months	

¹ Specified voltage must be satisfied in all load and charging conditions.

² Capacity degradation will occur depending on storage time. To minimize capacity degradation, storage temperature of less than 10°C and 3.630V per cell is recommended.

Table 3-4: Range of Operation (128S Configuration)

No.	Item	Specification	Remarks
1	Nominal Capacity	32.6kWh	1/3C@R.T
2	Nominal Voltage ¹	486.4V DC	3.8V/cell
3	Maximum Voltage ¹	537.6V DC	4.2V/cell
4	Discharging Method	Constant Power	
	End of Discharge Voltage ¹	384V DC	3.0V/cell
	Recommended End of Discharge Voltage	409.6V DC	3.2V/cell
	Standard Discharging Current	22.3A	1/3C@R.T
	Maximum Continuous Discharge Power	173kW	Peak 450A @ EODV
5	Charging Method	CC-CV, Floating	
	Floating Charge Voltage	537.6V DC	4.2V/cell
	Standard Charge Current	22.3A	1/3C
	Maximum Peak Charge Current	250A	2 second pulse
	Maximum Continuous Charging Current	67A	1C
6	Recommended Operation Temperature	23±5°C	
7	Storage Temperature	0 ~ 40°C	
8	Humidity	Less than 90 % RH	Noncondensing
9	Recommended Humidity	Less than 60 % RH	Noncondensing
10	Storage Period ²	Less than 6 months	

¹ Specified voltage must be satisfied in all load and charging conditions.

² Capacity degradation will occur depending on storage time. To minimize capacity degradation, storage temperature of less than 10°C and 3.630V per cell is recommended.

3. Battery System Operation

Table 3-5: Range of Operation (112S Configuration)

No.	Item	Specification	Remarks
1	Nominal Capacity	28.5kWh	1/3C@R.T
2	Nominal Voltage ¹	425.6V DC	3.8V/cell
3	Maximum Voltage ¹	470.4V DC	4.2V/cell
4	Discharging Method	Constant Power	
	End of Discharge Voltage ¹	336V DC	3.0V/cell
	Recommended End of Discharge Voltage	358.4V DC	3.2V/cell
	Standard Discharging Current	22.3A	1/3C@R.T
	Maximum Continuous Discharge Power	151kW	Peak 450A @ EODV
5	Charging Method	CC-CV, Floating	
	Floating Charge Voltage	470.4V DC	4.2V/cell
	Standard Charge Current	22.3A	1/3C
	Maximum Peak Charge Current	250A	2 second pulse
	Maximum Continuous Charging Current	67A	1C
6	Recommended Operation Temperature	23±5°C	
7	Storage Temperature	0 ~ 40°C	
8	Humidity	Less than 90 % RH	Noncondensing
9	Recommended Humidity	Less than 60 % RH	Noncondensing
10	Storage Period ²	Less than 6 months	

¹ Specified voltage must be satisfied in all load and charging conditions.

² Capacity degradation will occur depending on storage time. To minimize capacity degradation, storage temperature of less than 10°C and 3.630V per cell is recommended.

Table 3-6: Range of Operation (104S Configuration)

No.	Item	Specification	Remarks
1	Nominal Capacity	26.5kWh	1/3C@R.T
2	Nominal Voltage ¹	395.2V DC	3.8V/cell
3	Maximum Voltage ¹	436.8V DC	4.2V/cell
4	Discharging Method	Constant Power	
	End of Discharge Voltage ¹	312V DC	3.0V/cell
	Recommended End of Discharge Voltage	332.8V DC	3.2V/cell
	Standard Discharging Current	22.3A	1/3C@R.T
	Maximum Continuous Discharge Power	140kW	Peak 450A @ EODV
5	Charging Method	CC-CV, Floating	
	Floating Charge Voltage	436.8V DC	4.2V/cell
	Standard Charge Current	22.3A	1/3C
	Maximum Peak Charge Current	250A	2 second pulse
	Maximum Continuous Charging Current	67A	1C
6	Recommended Operation Temperature	23±5°C	
7	Storage Temperature	0 ~ 40°C	
8	Humidity	Less than 90 % RH	Noncondensing
9	Recommended Humidity	Less than 60 % RH	Noncondensing
10	Storage Period ²	Less than 6 months	

¹ Specified voltage must be satisfied in all load and charging conditions.

² Capacity degradation will occur depending on storage time. To minimize capacity degradation, storage temperature of less than 10°C and 3.630V per cell is recommended.

3. Battery System Operation

Table 3-7: Range of Operation (96S Configuration)

No.	Item	Specification	Remarks
1	Nominal Capacity	24.4kWh	1/3C@R.T
2	Nominal Voltage ¹	364.8V DC	3.8V/cell
3	Maximum Voltage ¹	403.2V DC	4.2V/cell
4	Discharging Method	Constant Power	
	End of Discharge Voltage ¹	288V DC	3.0V/cell
	Recommended End of Discharge Voltage	307.2V DC	3.2V/cell
	Standard Discharging Current	22.3A	1/3C@R.T
	Maximum Continuous Discharge Power	130kW	Peak 450A @ EODV
5	Charging Method	CC-CV, Floating	
	Floating Charge Voltage	403.2V DC	4.2V/cell
	Standard Charge Current	22.3A	1/3C
	Maximum Peak Charge Current	250A	2 second pulse
	Maximum Continuous Charging Current	67A	1C
6	Recommended Operation Temperature	23±5°C	
7	Storage Temperature	0 ~ 40°C	
8	Humidity	Less than 90 % RH	Noncondensing
9	Recommended Humidity	Less than 60 % RH	Noncondensing
10	Storage Period ²	Less than 6 months	

¹ Specified voltage must be satisfied in all load and charging conditions.

² Capacity degradation will occur depending on storage time. To minimize capacity degradation, storage temperature of less than 10°C and 3.630V per cell is recommended.

Table 3-8: Range of Operation (80S Configuration)

No.	Item	Specification	Remarks
1	Nominal Capacity	20.4kWh	1/3C@R.T
2	Nominal Voltage ¹	304V DC	3.8V/cell
3	Maximum Voltage ¹	336V DC	4.2V/cell
4	Discharging Method	Constant Power	
	End of Discharge Voltage ¹	240V DC	3.0V/cell
	Recommended End of Discharge Voltage	256V DC	3.2V/cell
	Standard Discharging Current	22.3A	1/3C@R.T
	Maximum Continuous Discharge Power	108kW	Peak 450A @ EODV
5	Charging Method	CC-CV, Floating	
	Floating Charge Voltage	336V DC	4.2V/cell
	Standard Charge Current	22.3A	1/3C
	Maximum Peak Charge Current	250A	2 second pulse
	Maximum Continuous Charging Current	67A	1C
6	Recommended Operation Temperature	23±5°C	
7	Storage Temperature	0 ~ 40°C	
8	Humidity	Less than 90 % RH	Noncondensing
9	Recommended Humidity	Less than 60 % RH	Noncondensing
10	Storage Period ²	Less than 6 months	

¹ Specified voltage must be satisfied in all load and charging conditions.² Capacity degradation will occur depending on storage time. To minimize capacity degradation, storage temperature of less than 10°C and 3.630V per cell is recommended.

3.3.1 Normal Status

In normal status, the battery system is available for charge or discharge. The system operator must follow the guidelines below to ensure safe and optimal performance from the battery.

- The battery must be fully charged to power the critical load for the duration of the backup time.
- After a full discharge at maximum continuous power, cool the battery for at least 12 hours before another discharge in order to avoid over-temperature protection. For optimal performance, wait until the battery temperature returns to at least $\pm 3^{\circ}\text{C}$ within the room temperature.
- Immediate recharging after a full discharge at maximum continuous power may degrade the battery performance.

3.3.2 Minor Protection Status (Alarm)

When a minor protection (alarm status) occurs, the battery system will send a message to the UPS or other systems and request that all charge or discharge operation be stopped until the problem is corrected. Battery system will not be disconnected in minor protection status to maximize the battery's availability. Refer to Section 5 "Troubleshooting" for solutions to minor protection status.

3.3.3 Major Protection Status (Fault)

If the system detects a major protection (fault status), it will trip the MCCB to disconnect the battery system from the UPS to prevent damage to the battery. Measures must be taken to clear the major protection status and return the battery system to normal status. Personnel must be on-site to return the MCCB from "trip" to "on" position after returning the system status to normal. Refer to Section 5 "Troubleshooting" for details on solutions to major protection status.

4. Maintenance Checks

The battery system components are designed to be free of regular maintenance. Regular inspection of components and power connections are recommended to ensure proper performance. Scheduled checks of the battery system are recommended but not mandatory for optimal performance. Refer to 3.3 Operation Status for the battery system's operating conditions.

4.1 Daily Checks

Following is a list of items to be checked daily.

- Rack voltage should be in its floating charge voltage.
- Cell voltage range should be within 300mV.
- MCCB must be on for all racks.
- There must be no alarms or faults.
- Maintaining room temperature and humidity according to the range of operation..

4.2 Monthly Checks

Personnel should visually inspect the battery system monthly and review log data about the battery and its operating environment.

- Battery should have no visible damage (rust, bent structure, damaged or missing cables or busbars, etc.)
- Check the recorded data of the battery system for the voltage and current readings.
- Check the date and time of charge and discharge cycles.
- Check whether any alarms or faults have been triggered.

4.3 Annual Check

A trend analysis of the recorded data (battery and environment) is recommended.

4.4 Maintenance Checklist

Refer to the following checklist template for scheduled checks. Detailed recordings may be necessary depending on the level of maintenance required by the user. Use Table 3-3: Range of Operation to check the criteria for each item. Refer to the product specification and installation manual for more details.

Table 4-1: Maintenance Checklist Template


Items	Criteria	Location	Schedule	Result
Battery Status	1. Battery voltage a) Rack voltage check b) Cell voltage check (max/min difference) 2. Alarm or faults: No alarms or faults set 3. MCCB status: All on	Control room	Daily	
	1. Alarm or protection: No alarms or protections set Check the indicator LED's in each rack 2. MCCB status: All on Check the position of the MCCB handle	On-Site	Weekly	
	1. Visual Inspection: check for physical damages (rust, bent structure, damaged or missing cables, etc.)	On-Site	Monthly	
	1. Contact resistance of battery terminal and busbar	On-Site	Semi-annual	
Environment	Temperature (measured from facility's HVAC unit or other measurement devices)	Control Room or On-Site	Daily	
	Humidity (measured from facility's HVAC unit or other measurement device)		Daily	
Recorded Data	1. Recorded voltage and current 2. Date and time of charge and discharge cycles 3. Number of alarms and faults recorded	Control Room	Monthly	
	1. Recorded voltage and current 2. Date and time of charge and discharge cycles 3. Number of alarms and faults recorded 4. Record of temperature and humidity (measured from facility's HVAC unit or other measurement device)	Control Room	Annual	

5. Troubleshooting, Repair and Replacement

Users must operate the battery system within its specified range of operating conditions. Refer to the “Product Specification” for details.

If the battery system is not operated under the specified conditions, it may display protective modes depending on conditions. Users should familiarize themselves with the types of protective modes and the battery system’s behavior during these modes. Dry contact signals from the System BMS and indicator LED’s on the front of each BCU displays the status of the battery system. Users can quickly and easily determine the battery system’s status from a centralized monitoring location using the dry contact signals or perform an on-site examination using the indicator LED’s. Detailed status of the battery system can be examined by using additional monitoring software.

If repair or replacement is required, refer to the installation manual for safety guidelines and basic information on disassembly and reassembly of components.

	DANGER Repair of the battery system should only be attempted by factory trained service engineers.
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This section has been removed from the customer facing copy of the operation and maintenance manual.

6. Appendix

6.1 Disposal and Recycling

For recycling, contact the manufacturer.

Contaminated packaging must be disposed in accordance with local regulations.

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This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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