SOFAR

USER MANUAL

PowerMaster Smart String Energy Storage System



Shenzhen SOFARSOLAR Co., Ltd.

2 Products

2.1 Product Description

PowerMaster is mainly used in large and medium-sized energy storage power stations, adopting standard 20-foot high container design, featuring air-liquid mixing intelligent cooling, modular design, '3+2' safety system, and container design to reduce the footprint, etc. It achieves the temperature balance of the battery cell, high efficiency and long service life, and facilitates installation, operation, and maintenance, etc. And on the AC side, PowerMaster can connect smart string 3.44MW energy storage converter with a 3.44MW medium-voltage transformer to form an integrated solution with low cost of electricity, high efficiency and flexibility, ultimate safety, intelligence and stability.

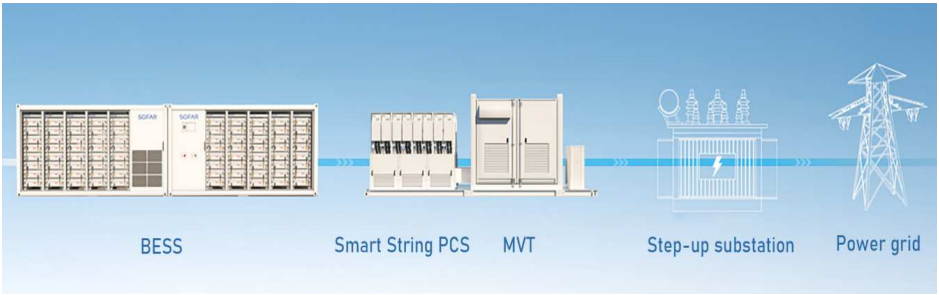


Figure 1: PowerMaster Solution

2.2 Functions and featuresGeneral Configuration

- **Intelligent cooling with air-liquid mixing**

PowerMaster's air-liquid hybrid intelligent temperature control cooling system can effectively solve the problems of bad temperature uniformity between system batteries, short lifespan, low efficiency, and easy condensation in the liquid-cooled battery compartment, etc. The main philosophy of the air-liquid hybrid intelligent cooling system is the homogeneous flow liquid-cooled piping system, which is designed to achieve the same cooling effect between the battery cells, resulting in a better cooling effect and a smaller temperature difference. On top of this main body, we carry out a dual fan disc design in the battery compartment and electrical compartment to provide intelligent air-

cooled redundant heat dissipation. Under the work of the air disc, it drives the whole compartment to circulate the gases, which not only provides a better cooling effect of the compartment, but also plays a role in preventing condensation in the compartment.

Through the wind disc anti-condensation design, it can effectively reduce the dew point temperature, making it more difficult to form condensation, which solves the problem of easy condensation in the container with liquid cooling technology. Meanwhile, the operation of homogeneous liquid cooling and intelligent air cooling, superimposed homogeneous flow design of the cold plate inside the PACK bring better battery temperature uniformity. Good humidity control and better battery temperature uniformity control improve the performance of the battery compartment.

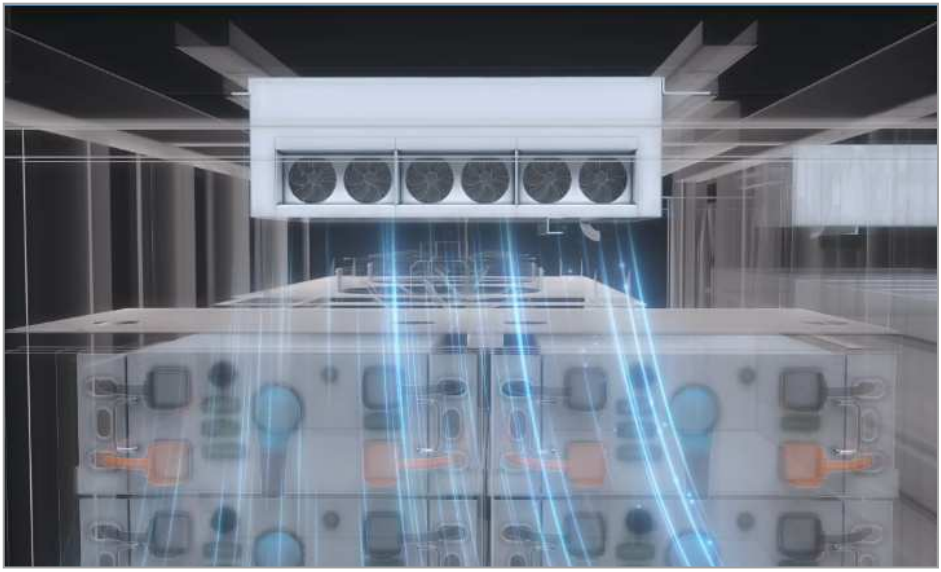


Figure 2: Fan disc in the wind-liquid mixing intelligent temperature control system

Modular design

PowerMaster has a modular design for the battery compartment. The purpose of modular design is to reduce the difficulty of operation and maintenance in the later stage and to improve the product delivery capability. Each module works independently, maximizing the power and capacity, and the O&M efficiency is greatly improved by directly replacing the modules on site. The battery compartment adopts a 20-foot container, with a maximum of 3.44MWh

in a single compartment, a single battery cluster of 344KWh, and 10 clusters in the compartment, so that the clusters can be increased or decreased according to demand.

In terms of cluster-level management design, BESS can support cluster-by-cluster management of batteries and single cluster connection of a single 215kW PCS in the battery compartment to realize a refined management, fully releasing the charging and discharging potentials of the battery cells and enhancing the system charging and discharging capacity.

'3+2' security system

PowerMaster's 3+2 security system for ultimate security.

3 means 3 levels of fire protection in the battery compartment. The first level of fire protection is the cell level perfluorohexanone gas fire protection. When battery cells thermal runaway, the first level of fire protection will be activated, the fire extinguishing gas spraying directly to cells. In order to cope with the problem of secondary re-ignition of electrochemical energy storage, we carry an automatic control valve to achieve automatic control of multiple spraying, which solves the problem of re-ignition of the battery cells. Secondary fire fighting refers to cabin-level perfluorohexanone gas fire fighting. When there is an electrical fire in the cabin, the secondary fire fighting will be activated to realize gas fire fighting in the whole cabin. Tertiary fire-fighting refers to water fire-fighting. The cabin's water nozzle connected with external water station, when the temperature, combustible gases and other detection exceeds the threshold value, it will active the whole cabin water spraying. With rapid cooling, the system prevent the fire out of the container and inhibit the fire spread.

2 refers to the explosion relief design and combustible gas discharge. Through the internal exhaust duct design and 10 explosion relief vents at top of each hatch, can achieve the cabin pressure balance and combustible gas rapid discharge, further reducing the safety risk.

Packaging design

In terms of reducing the footprint, PowerMaster uses 20-foot containers, but also carries out a design that combines boxes and connects them into 40-foot containers to further reduce the footprint.

2.3 External dimensions

DIMENSIONS:

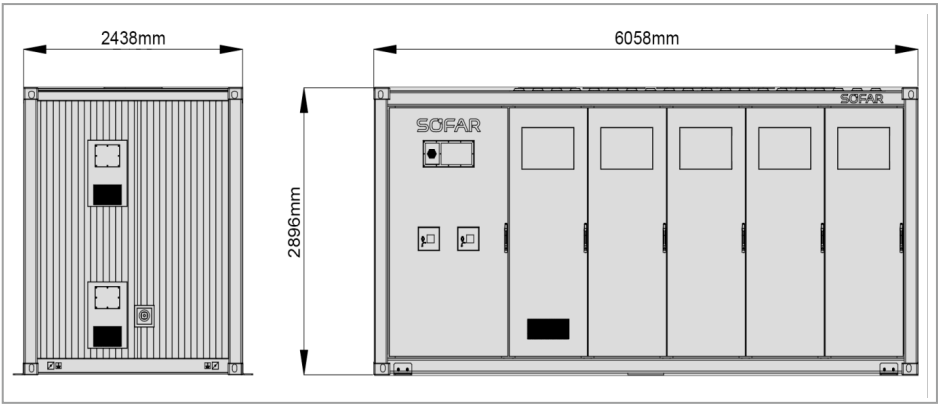


Figure 3: BESS External Dimensions

Maximum door opening size:

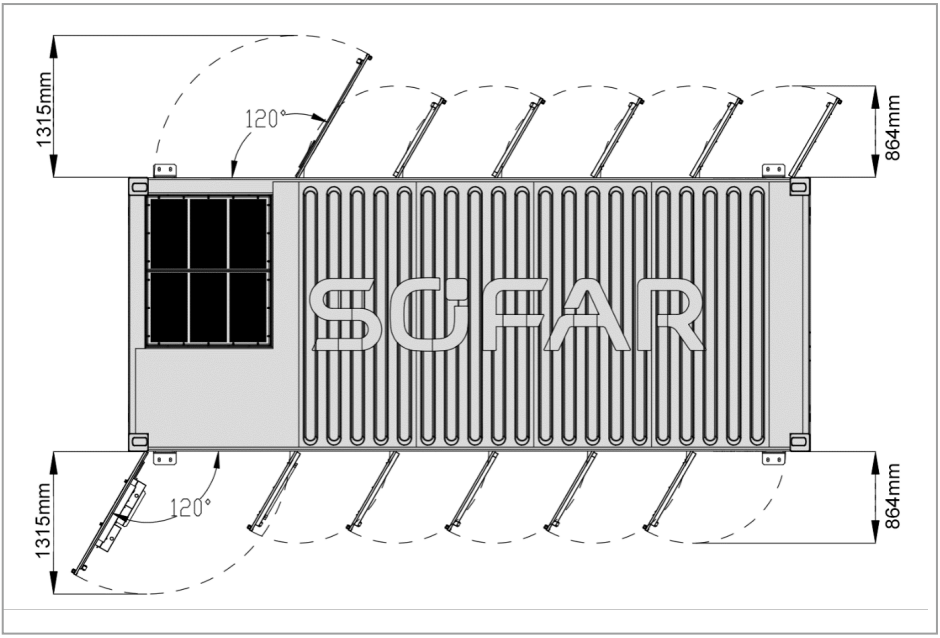


Figure 4: Maximum door opening size for BESS

2.4 Introduction to Components

2.4.1 Introduction of components (closing doors)

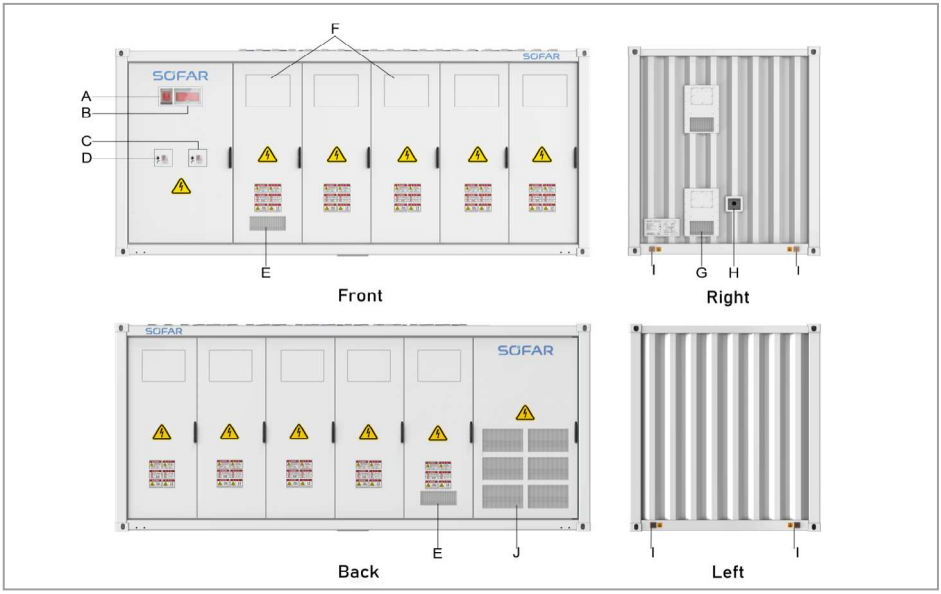


Figure 5: Presentation of BESS components (closed door)

The above pictures are for reference only, please refer to the actual object received!

Table 1: Description of BESS components (closed)

No.	Item	Quantity per containers	Instructions
A	Audible and visual alarm	1	For internal equipment temperature, smoke and other abnormal alarms.
B	Bleeder indicator	1	Indication of internal fire exhaust
C	Emergency stop button	1	For emergency shutdown of mains power

No.	Item	Quantity per containers	Instructions
D	Fire start/stop button	1	Fire suppression system emergency start and stop
E	Air inlet	2	Container air intake
F	Venting window	10	In case of internal ignition/explosion, directional venting is carried out.
G	Exhaust vent	2	Container exhaust
H	Hydrant connector	1	Water hydrant adapter
I	Access point	4	Integral grounding of containers
J	Liquid-cooled unit air inlet	1	Liquid-cooled unit air intake

2.4.2 Introduction of components (opening doors)

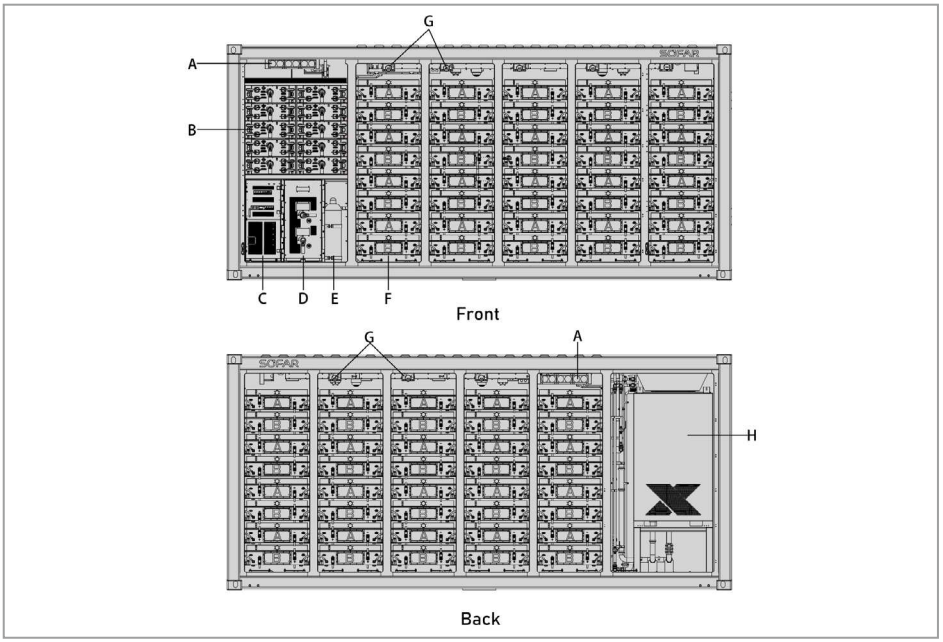


Figure 6: Introduction to BESS components (open door)

Table 2: Description of BESS components (open door)

No.	Item	Quantity per containers	Instructions
A	Wind disc	2	For temperature and humidity control of electrical and battery compartments.
B	High voltage box	10	Single Cluster Battery Control Management
C	Auxiliary power modules	1	Auxiliary circuit power supply
D	Converging module	1	5 clusters of cells converging 1 cluster (*2)
E	Firefighting bottles	2	Fire gas storage
F	PACK	80	Battery pack (with battery management unit)
G	MSD box	10	Single Cluster Battery Maintenance Switch
H	Liquid-cooled units	1	Liquid Cooling Systems

2.4.3 Battery systems

Table 3: Battery system specification parameters

Battery System Specifications		
	Cell Type	LFP/280Ah
	Nominal power (BOL)	Max3.44MWh
	Operating voltage range	960 to 1401.6V
	Charge/discharge ratio	≤0.5P
	Working environment temperature	-30℃~55℃
	Relative humidity of working environment	0 to 100% (no condensation)
	Working altitude	≤4000m
	Cooling method	Wind-liquid mixing
	Fire Fighting Methods	Perfluorohexanone gas fire protection
	Communication interface	Ethernet/CAN/RS485
	Communication protocols	IEC61850, IEC104/CAN2.0/ Modbus
	Protection class	IP55
	Anti-corrosion grade	C4
	Dimensions (W*D*H)	6058*2438*2896mm
	Weights	~34T
	Standards & Certifications	GB36276/IEC62619/UL973/ UL9540A/UN3536

Table 4: Cell Specification Parameters

Specification of battery cell		
	Cell Type	LFP
	Nominal capacity/energy	280Ah/896Wh
	Rated voltage	3.2V
	Operating voltage range	2.5-3.65V Temperature T＞0℃ 2.0-3.65V Temperature T≤0℃
	Working environment temperature	-30℃~60℃
	Maximum continuous charging and discharging power	1P
	Cycle life	≥10000 times
	Dimensions (W*D*H)	174.70*71.65*207.11mm
	Weights	5.43±0.20kg

Table 5: PACK Specification Parameters

PACK Specifications		
	Cell Type	LFP
	Nominal capacity/energy	280Ah/43KWh
	Rated voltage	153.6V
	Operating voltage range*	120 to 175.2V
	Charge/discharge ratio	≤0.5P
	Working environment temperature	-30℃~55℃
	Relative humidity of working environment	0 to 95%
	Working altitude	≤4000m
	Cooling method	liquid cooling
	Fire Fighting Methods	PACK fire protection (perfluorohexanone)
	Communication interface	CAN
	Protection class	IP67
	Dimensions (W*D*H)	1050*765*245mm
	Weights	≤310Kg
	Standards & Certifications	gb36276/iec62619/ul1973/un38.3

Table 6: Battery Cluster Specifications

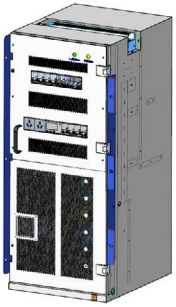
Battery Cluster Specifications		
	Series/parallel connection	1P384S
	Nominal energy	344kWh
	Rated voltage	1228.8V
	Operating voltage range	960 to 1401.6V
	Charge/discharge ratio	≤0.5P
	Working environment temperature	-30˚C~55˚C
	Relative humidity of working environment	0 to 100% (no condensation)
	Working altitude	≤4000m
	Cooling method	liquid cooling
	Fire Fighting Methods	Perfluorohexanone gas fire protection
	Communication interface	CAN, Dry Contact
	Dimensions (W*D*H)	1050*1105*2400mm
	Weights	≤3.2T
	Standards & Certifications	GB/T36276, IEC62619

2.4.4 Distribution systems

Table 7: High Pressure Box Specifications

High voltage box		
	Bus-side voltage range	960 to 1401.6V DC
	Operating current	≤160A
	Working environment temperature	-30℃~55℃
	Auxiliary voltage	24V DC
	Communication method	CAN
	Surge protection	Support
	Insulation testing	Support
	Battery side short circuit protection	Support
	Sizes	500*450*210mm
	weights	29.5kg
	Input and output terminals	OT terminal

Table 8: Auxiliary Power Module Specifications and Parameters

Auxiliary power modules		
	Inlet method	Three-phase four-wire (AC 380V)
	Operating voltage	/
	Auxiliary load power	Max 34kW
	Indicator light	2-way (powered indication, running indication)
	Working environment temperature	-30℃~55℃