

## Millennium 1MWh Level Energy Storage System



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# 1 Scope of Specification

The scope of specification is limited to Energy Storage System-1MWh designed and produced by Millenniu Energy Storage Solution CO., LTD, with cell supplied from Tianjin Lishen Battery Joint-stock CO., LTD.

## 2 Standards and Specifications

ISO2875: 2000, Packaging-Complete, filled transport packages and unit loads-Water spray test, IEC 60255-21-2: 1988 Shock and bump tests on measuring relays and protection equipment

ISO 780: 1997 Packaging - Pictorial marking for handling of goods

IEC 60068-2-1: 2007 Environmental testing - Part 2: Test methods - Tests A: Cold

IEC 60068-2-2: 2007 Environmental testing - Part 2: Test methods - Tests B: Dry heat

IEC 60068-2-78: 2001 Environmental testing for electric and electronic products - Part 2: Testing method test Cab: Damp heat, Steady state

IEC 60068-2-32: 1990 Environmental testing for electric and electronic products - Part 2: Test methods - Test Ed: Free fall

IEC 60068-2-6: 1995 Environmental testing for electric and electronic products - Part 2: Tests methods - Test Fc: Vibration (sinusoidal)

IEC 60947-1: 2001 Low-voltage switchgear and control gear—Part 1: General rules

GB/T 15945-2008 Power quality - Frequency deviation for power system

GB/T 12325-2008 Power quality - Deviation of supply voltage

GB/T 15543-2008 Power quality - Three-phase voltage unbalance

IEC 61000-3-7 Power quality - Voltage fluctuation and flicker

GB/T 14549-1993 Quality of electric energy supply - Harmonics in public supply network

IEC 62053-22: 2003 Electricity metering equipment (a.c.) - Particular requirements - Part 22: Static meters for active energy (classes 0, 2 S and 0, 5 S)

IEC 1038: 1990 Multifunction electricity metering equipment

IEC 1107 Multi-function watt-hour meter communication protocol

IEC 62493: 2009 Assessment of lighting equipment related to human exposure to electromagnetic fields

DL/T 5429-2009 Technical code of design for the electric power system

DL/T 5136-2001 Technical code for designing of electrical secondary wiring in fossil fuel power plants and substations

DL/T 620-1997 Overvoltage protection and insulation coordination for AC electrical installations

DL/T 621-1997 Grounding for AC electrical installations

GB 50217-2007 Code for design of cables of electric engineering

IEC 60050 (482): 2003 Electrotechnical terminology - Primary and secondary cells and batteries

IEC 61427-2005 Secondary cells and batteries for photovoltaic energy systems (PVES) - General requirements and methods of test

### 3 Name and Specification

#### 1. System Name

Industrial MWh level Energy Storage System-1MWh

#### 2. System Specification

LP44147272-228S12P

### 4 System

#### 4.1 System Grouping

Table1 System Grouping

	Cell	Battery Module	Battery Cluster	1094KWh System Unit
Type	LP44147272	12S2P	228S2P	228S12P
Composition	-	12S2P	19 Module	6 Clusters
Specification	3.2V/125Ah	38.4V/250Ah	730V/250Ah	730V/1500Ah
Energy	400Wh	9.6KWh	182KWh	1094KWh
Number/1MWh	2736	114	6	1

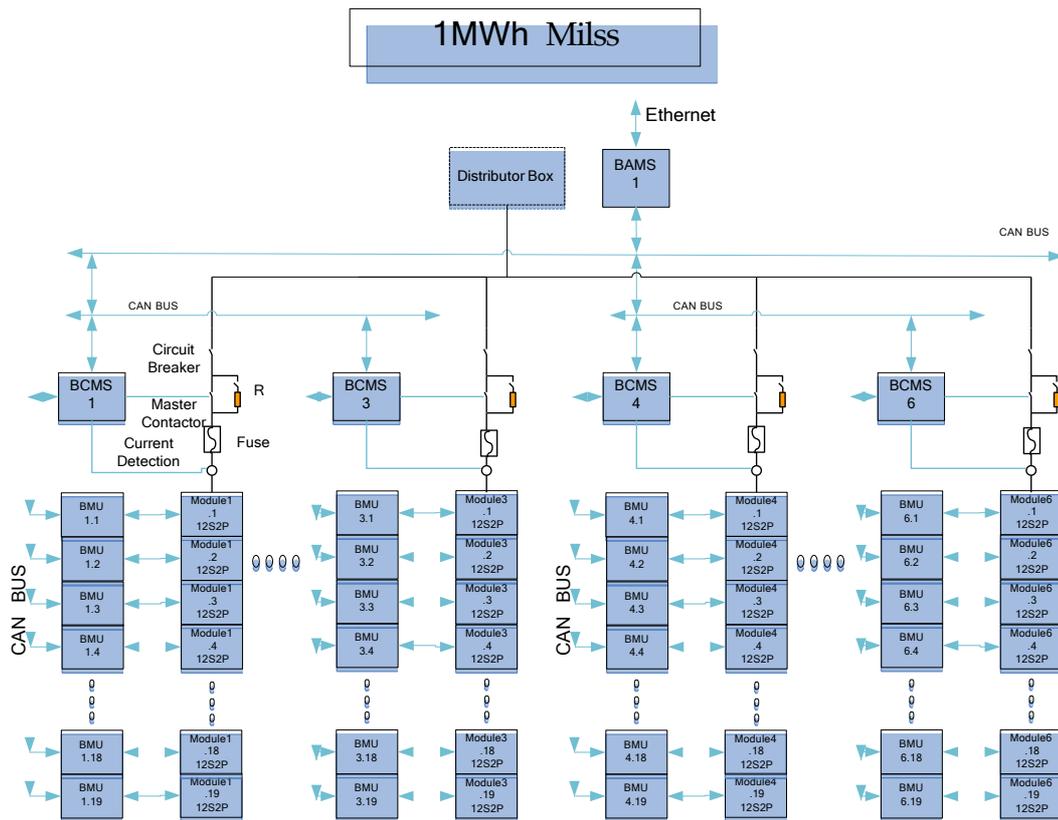


Figure1 System Grouping

## 4.2 System Configuration

Table2 System Configuration

No.	Item	Specifications	unit	No.	Remarks
1	Battery System	1MWh	Set	1	Including batteries、 battery modules
2	BMS	1MWh	Set	1	Including a complete set of BMS and wire harness
3	HVC		Set	6	Including high voltage control box and some devices
4	High Voltage Device		Set	1	Including high voltage device cabinet and some devices

	Cabinet				
5	Connected System		Set	1	Including internal cables and so on
6	Container	40 Feet	Set	1	Including thermal management system、 fire extinguishing system、 lighting system and so on

## 4.3 Performance

### 4.3.1 System Performance

Table3 System Performance

No.	Item	Specifications
1	Cell Type	LFP
2	Cell	LP44147272 / 3.2V / 125Ah
3	System Series and Parallel	228S12P
4	System Nominal Voltage	730V
5	System Nominal Capacity	1MWh
6	System Working Voltage Range	570~832.2
7	Charge cut-off Voltage	Cell 3.65V
8	Discharge cut-off Voltage	Cell 2.5V
9	System Discharge Current	0.5C
10	System Maximum Discharge Current	2C (30S)
11	System Charge current	0.5C

12	System Charge Current	2C (30S)
13	Maximum Working Temperature Range	0°C ~ 45°C
	Charge	5°C ~ 45°C
	Discharge	0°C ~ 45°C
14	The Best Working Temperature Range	15°C ~ 35°C
15	System Storage Temperature	35%SOC or 3.275V ~ 3.305V
	In 1 month	-40°C ~ 45°C
	In 6 months	-20°C ~ 35° C
16	System Environmental Humidity Requirement	≤90%RH
17	Cycle life	≥4000 Times @80%DOD@80% initial Capacity Left
18	Charge and Discharge Efficiency	93%
19	System Weight	7t*4
20	Dimensions(W D H)	6785*850*2400(W D H)
21	Level of Protection	IP40
22	Cooling Type	Air cooling
23	Communication Type	RS485、 Ethernet

### 4.3.2 Module Performance

**Table4 Module performance**

No.	Item	Spec
1	Nominal Voltage	38.4V

2	Nominal Capacity	250Ah
3	Energy	9.6KWMh
4	Voltage range	30~43.8V
5	Standard Charge Method	CC/CV
6	Current	125A
7	Max Operating Temperature Range	0~45°C
8	Storage Temperature	-20~35°C
9	Weight	113±5Kg

### 4.3.3 Cell Performance

**Table5 Cell performance**

No.	Item	Spec
1	Nominal Capacity	125Ah
2	Nominal Voltage	3.2V
3	Voltage range	2.5-3.65V
4	Size	147×44×272mm
5	Weight	3.5±0.1 KG
6	Volume/Energy	0.4/1759.3kWh/L
7	Wdight/Energy	0.114 (0.4/3.5) kWh/kg

### 4.3.4 Features of the BMS

- Intelligent management and protection for a longer battery life and run time
- Modular design for extending easily, up to 360 Li-ion batteries in series
- Accurate cell voltage monitor ( $\pm 1\text{mV}$  each cell), reliably protecting against overcharge/overdischarge
- Full time active balance, max balance current is more than 5A, average balance current is more than 2A. Protects cells from disbalancing to maxmize battery capacity and battery life
- Internal system uses CAN2.0 high-speed bus to transmit data efficiently
- High accurace current monitor prevents battery from charging/discharging overcurrent
- Each cell adopts SOC distribution estimation so that cell power can be controlled individually

to prolong the battery life.

- Multi-point temperature monitor

### 4.3.5 BMS Performance

**Table6 BMS performance**

No.	Item	Spec
1	Accuracy of Voltage Sample	±1mV
2	Period of Voltage Sample	≤100ms
3	Temperature Detection Accuracy	±1°C
4	Period of Temperature Sample	≤100ms
5	Accuracy of Current Sample	≤±1%
6	Period of Current Sample	≤100ms
7	Single unit Consumption	≤2.5W
8	Average Balancing Current	2A
9	Accuracy of SOC	≤5%
10	Communication with PCS	RS485
11	Communication with background monitoring system	Ethernet
12	Event log database	≥10000event records
13	Constants database	≥30 days

## 4.4 Size and Appearance

### 4.4.1 Size and Appearance of Cell

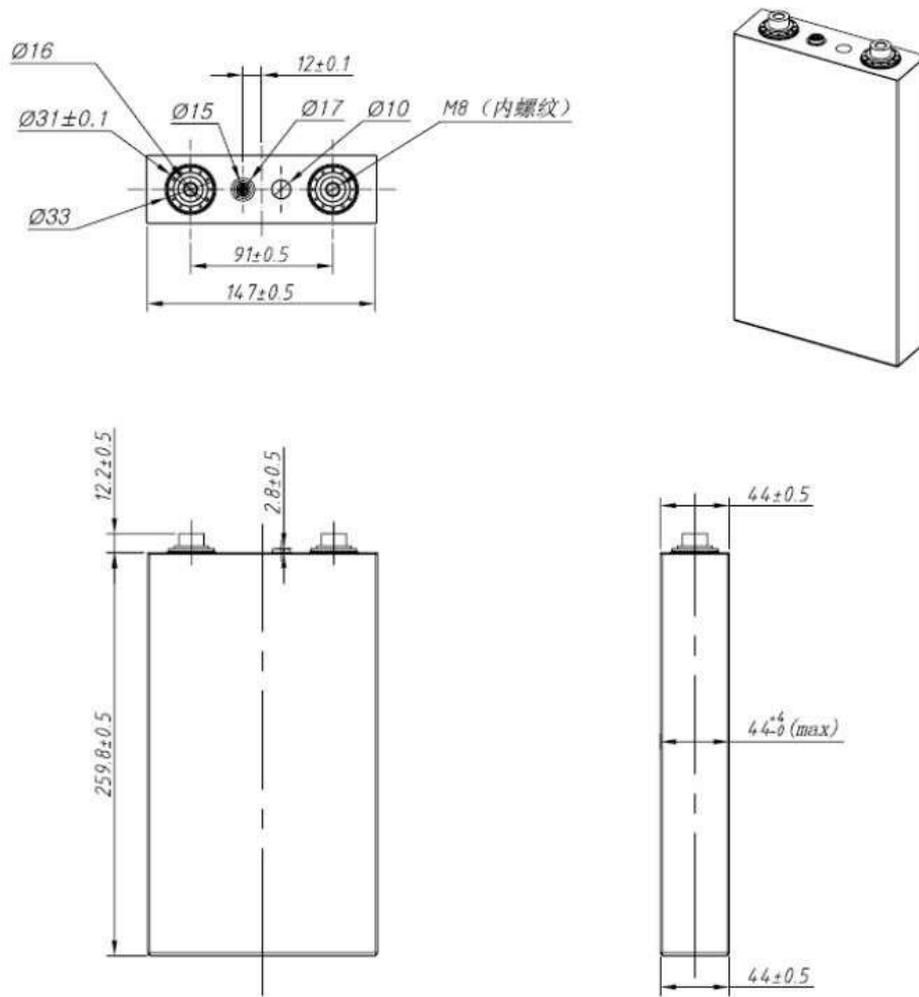


Figure2 Size and Appearance of Cell

### 4.4.2 Size and Appearance of Module

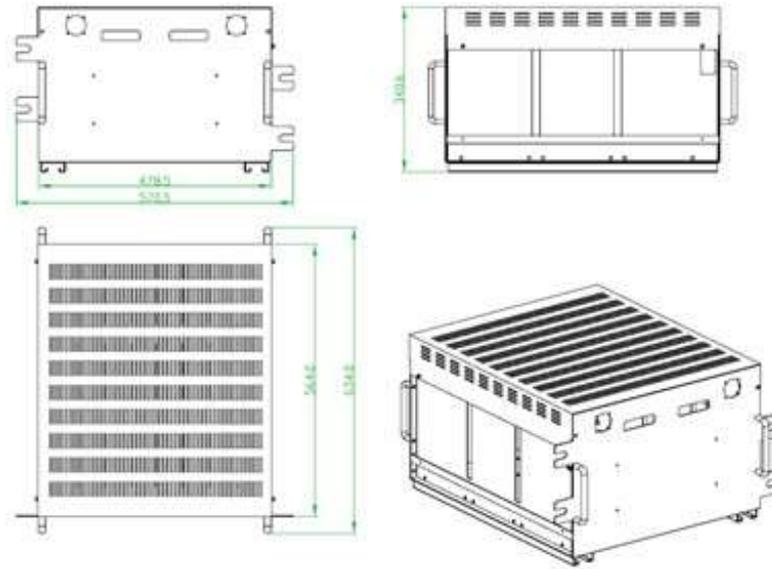


Figure3 Size and Appearance of Module

### 4.4.3 Container





Figure4 Container

#### 4.4.4 System layout

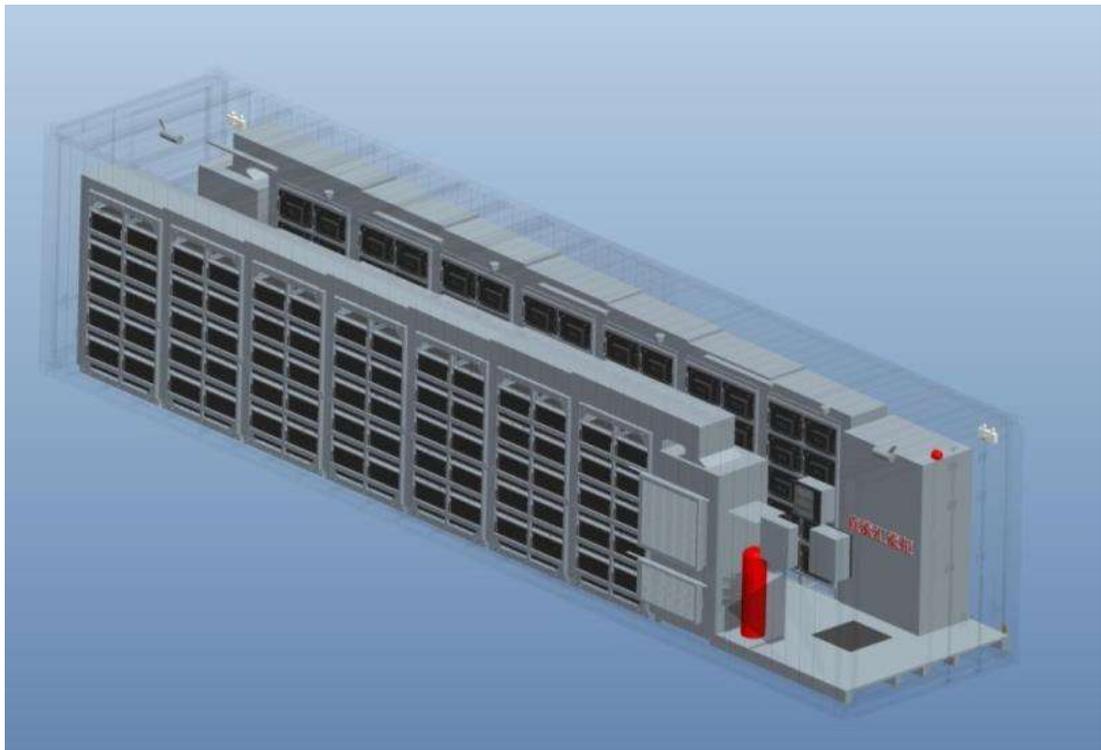


Figure5 System layout

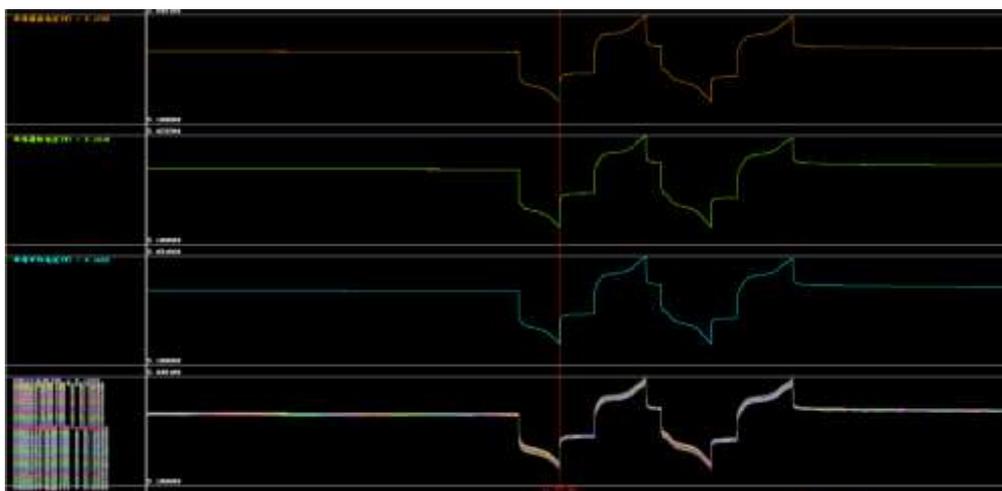
## 5 System Test Datas

### 5.1 Operating Condition

- Operating days 70 days
- Operating style Peak and valley filling
- Cycles 120 times
- Total charging capacity 70725KWh
- Total discharging capacity 65752KWh
- System efficiency 88% (96%\*96\*95)
- Self consumption 4905W (air conditioner are open)  
1905W (air conditioner are not open)

### 5.2 Consistence Testing On Battery

( 10%-90%SOC , 120 cycles )

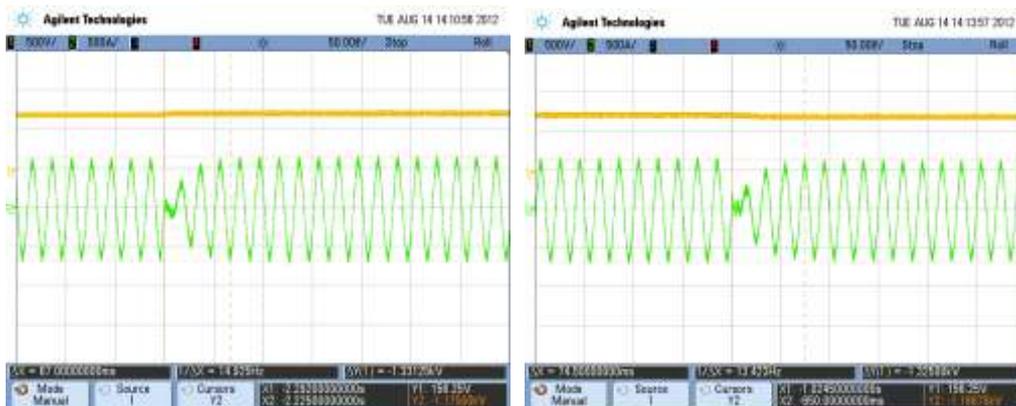


Voltage difference in discharge end: 21.5mV;

Voltage difference in charge end :24.2mV;

Voltage difference static: 7.2mV

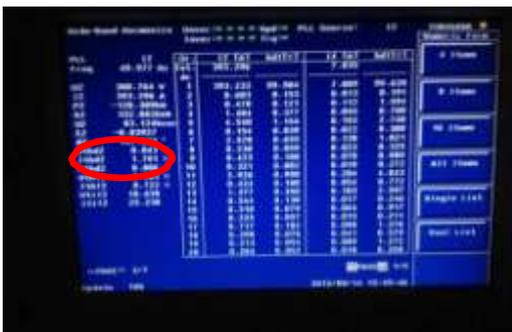
### 5.3 System test of response speed



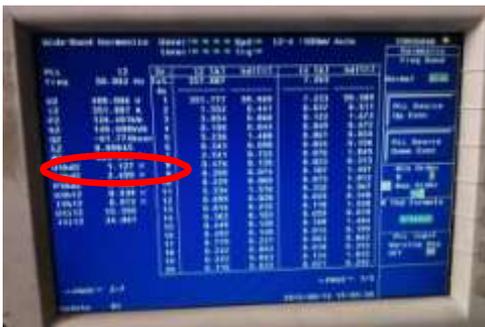
Time from charge full to discharge is 74.5ms.

Time from discharge empty to charge is 67ms.

### 5.4 Electricity Quality Test



Harmonic rate of 250KW Discharge with full power is 2.499%.



Harmonic rate of 250KW charge with full power is 1.791%.

## 5.5 Key Parameters Comparison

Item	Requirement of State grid	Target of state 863 project	The actual value of state grid phase 1 project	The actual value of AlphaESS
Voltage in consistence	80mV		36~90mV	20mV
Response speed of charge and discharge exchange	200mS	100mS		74mS
Current distortion rate	3%	3%		2.499%
System efficiency			86%	88%