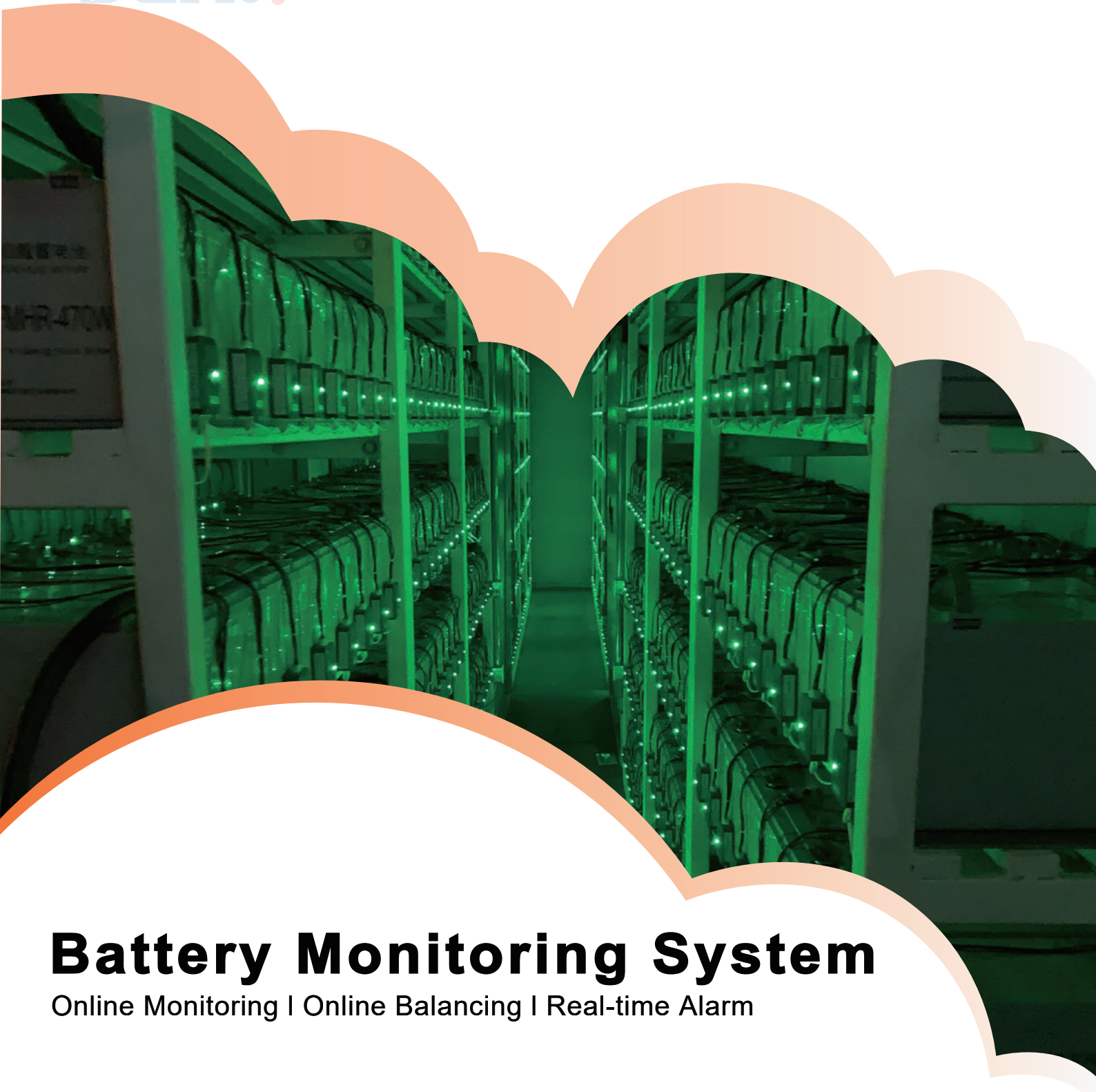


# Battery Monitoring System

Online Monitoring I Online Balancing I Real-time Alarm

DFUN (ZHUHAI) CO. , LTD.



DFUN (ZHUHAI) CO., LTD was established in April 2013, located in Zhuhai. Regional office distributed in Beijing, Jiangxi, Nanjing, Guangzhou & Shenzhen. DFUN Technology inherits the concept of quality oriented & serviceprioritized, we provide comprehensive hardware & software solutions for Battery Monitoring System, UPS Monitoring to our esteemed customers all over the world.

## OUR WORKSHOP








# DFUN TECH

With an international professional sales network, DFUN products have been widely used in international markets, such as Germany, Turkey, Russia, Thailand, Malaysia, Vietnam, India, Indonesia, Israel, Saudi Arabia, Mexico, Canada, Chile, Peru, Colombia, Brazil, Morocco, Africa…

To ensure the quality of products, services and environmental protection requirements, DFUN Technology implements the criteria of ISO9001, ISO14001, ISO45001 etc.

DFUN Technology will keep following with the new solutions & offer the best solutions for our customers. We listen carefully to our partners and strive to offer a diverse, comprehensive and effective BMS solution.


ISO9001


ISO14001


ISO45001


CE


ROSH


TTL

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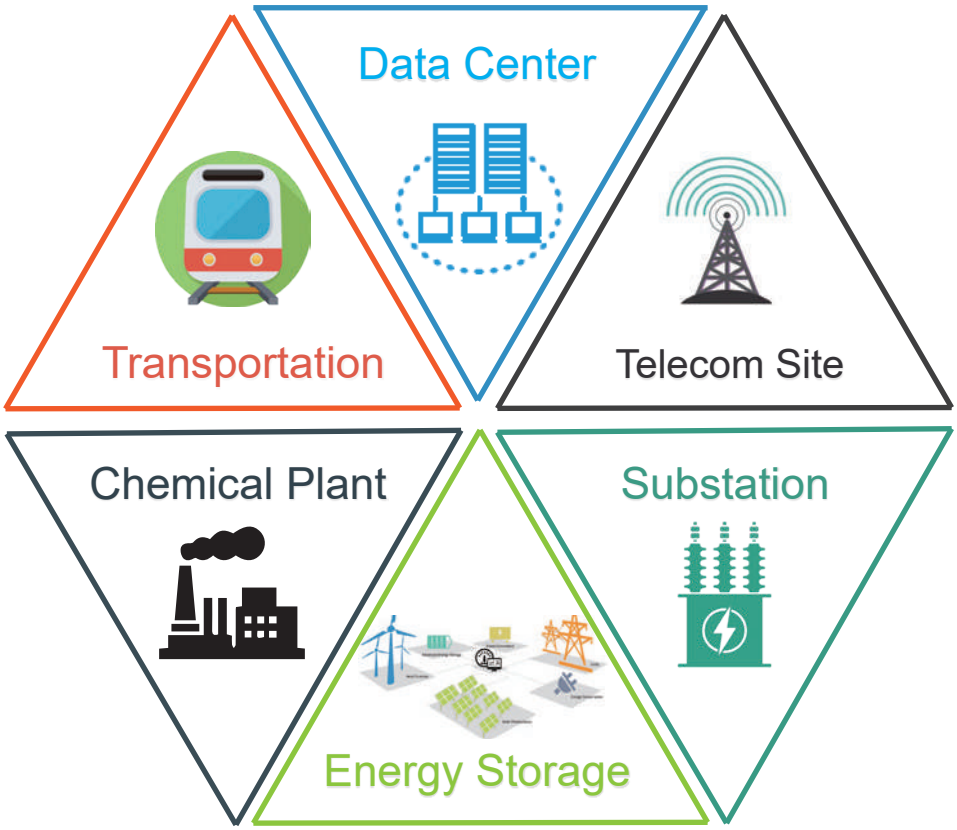
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# Application




# Application



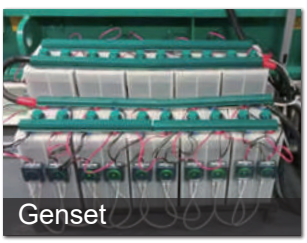








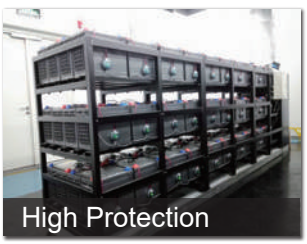










# Our Feature




### Online monitoring

24/7 on-line monitoring battery voltage, charge and discharge current, impedance and internal temperature, SOC, SOH etc. Accurate data report and real-time alarm, allowing to respond quickly to potential battery accidents. Reduce cost on human maintenance.



### Data inquiry

Provides historical data storage, data access and data management for large number of batteries and multiple sites project, support to export .CSV format data reports.



### Online balancing

Real-time on-line balancing for battery. The system will analyse the uploaded data and auto-judge. When the battery voltage is unbalancing, system will send command to balance the battery voltage.



### SOC

Support to calculate individual battery SOC and battery string SOC. The SOC is mainly calculated based on the characteristic parameters of the battery.



### Online alarm

Customer can set the alarm threshold for different project. When the battery real-time data is abnormal, the system will send out real-time alarm to maintanance through SMS or Email. What's more, we also provide mobile APP for customer to better maintain the battery at site.




### Breathing LED

With unique LED breathing light design of the hardware, the system indicates battery health by different color. When the battery is running normal, the LED light will keep on green. When the battery is in abnormal status, the LED light turn to red.



### Data analysis

Built-in storage function. Automatically store the real-time data of batteries. Helping users to know the battery status and health condition at any time.



### Auto-searching S/N

Support auto-searching for battery sensor's ID address. It can read the individual battery address at one time. Customer don't need to set one-by-one manually, which helps to save a lot of time for site engineering and labor costs.



# System Management Layer

Chapter 1

DFCS4100 Battery Monitoring System

# DFCS4100 Battery Monitoring System




Mobile APP
SMS / Email Alarm

**ONE IS ALL**

## Application

- Data center
- UPS cabinets
- Telecommunications
- Energy storage system
- Substation & power utility
- Oil, gas & fuel, generator
- Railway station & metro
- Financial institutions, like bank
- Hospital
- Government back up power supply

...

**24/7 hours online monitoring / balancing**
**Real-time alarm for VRLA / Ni-Cd battery**

- Online monitoring: voltage, internal temperature, ambient temperature & humidity, impedance, charge & discharge current, ripple current & voltage, SOC, SOH
- Battery leakage & liquid level

**All-in-one real-time monitoring**
**Batteries + Mobile APP + SMS & Email Alerts**

- System with mobile APP to remote manage the system
- Multiple contact by SMS / Email alerts

**Centralized monitoring**

- Multi-site and large quantity battery centralized management
- Monitor Max. 50,000 batteries

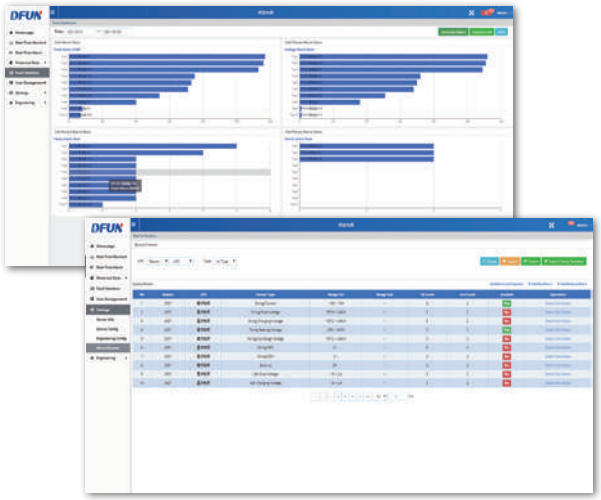
**B/S structure**
**Easy set-up, easy operation**

- B/S structure, no more messy set-up
- Friendly user interface design

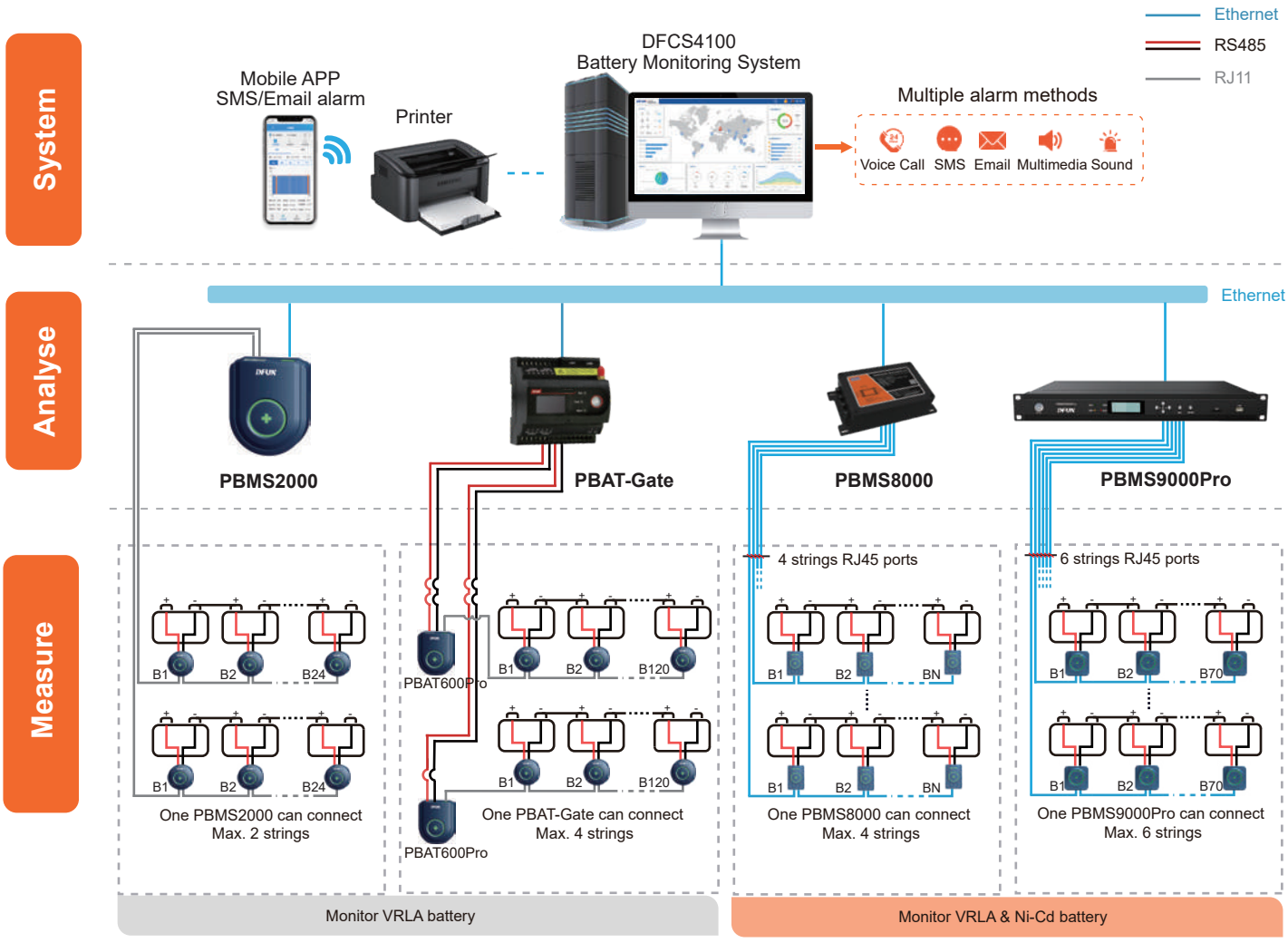
# DFCS4100 Battery Monitoring System

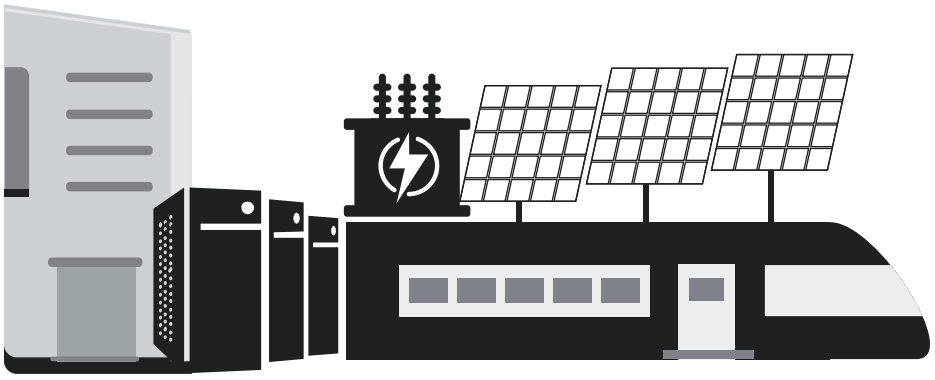
## System Feature

- 24/7/365 real-time monitoring ≤50,000pcs batteries
- B/S structure with simple and UI set-up
- Realize all data display at one location, suitable for project by large number of batteries or batteries locate in different site
- Sent out timely alarm notifications for abnormal battery via SMS & Email alerts (support multiple contact)
- Setpoint multi-level alarm
- Graphical and visual display of battery trends and faults
- Provides centralized data storage, data access and data management, export .csv format reports for data analysis
- Monitor ambient temperature & humidity
- Support monitoring thermal runaway
- Support to connect with 3rd party system (EMS, EPC, SCADA, DCIM...)



## System Structure





# BMS for Different Applications

Chapter 2

PBAT-Gate for Small-scale Data Center

PBMS2000 for Telecom Site

PBMS8000 for High Protection (Ni-Cd/VRLA Battery)

PBMS9000 for Large-scale Data Center

PBMS9000Pro for Substation (Ni-Cd/VRLA Battery)

System

Build-in Web Server
with Visual Display



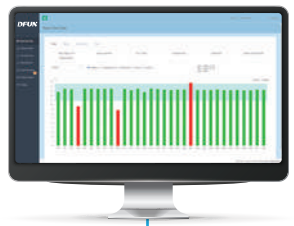
DFCS4100 BMS
Battery Monitoring System



Mobile APP
SMS/Email Alarm



Build-in Web Server
with Visual Display



Ethernet

Analyse

**Solution 1**



PBAT-GATE



PBAT600 PRO

**Solution 2**



PBMS2000

**Solution 3**



PBMS8000

**Solution 4**



PBMS9000



PBMS-CM PBMS-VM

**Solution 5**



PBMS9000Pro



PBMS-CM PBMS-VM

Application



Small-scale Data Center
PBAT61 for Lead-acid battery



-48V Power Supply Station
PBAT61 for Lead-Acid battery



Chemical Plant
PBAT81 for for both
Ni-Cd & Lead-Acid battery



Large-scale Data Center
PBAT61 for Lead-Acid battery



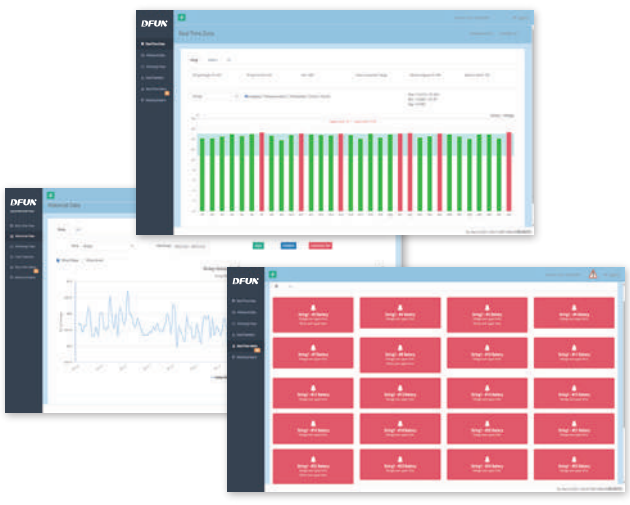
Substation
PBAT71 for both
Ni-Cd & Lead-Acid battery

# PBAT-Gate
## Battery Monitoring Solution



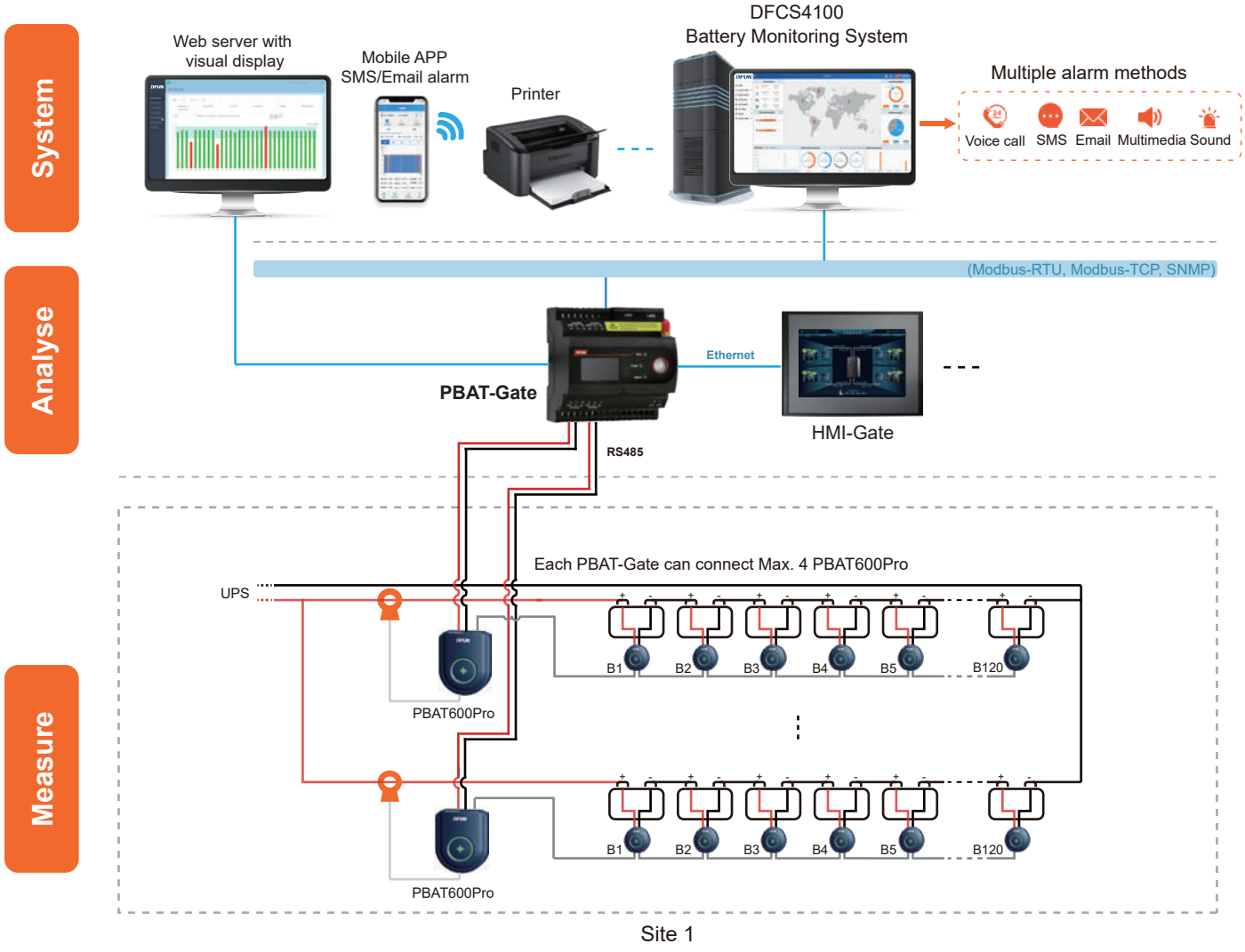

## Feature

- Apply to UPS and data center
- 24/7 hours on-line monitoring & remote alarms notification
- Monitor Max. 4 string, in total of 480 batteries
- Measure Lead-Acid battery
- Anti-interference design, support to connect with high-frequency UPS
- Auto-sensing for the battery sensor's ID address
- Multi-communication protocol (MODBUS-TCP, SNMP)
- Support 4G sending SMS alarm or wireless upload to cloud
- Comply with IEEE 1188-2005



# PBAT-Gate Battery Monitoring Solution

## System Structure




Site 1

## Management Layer

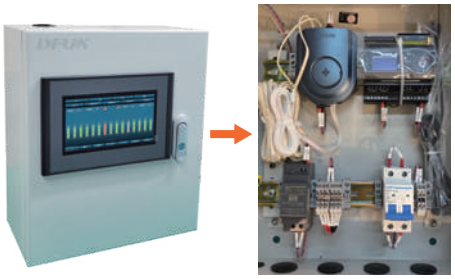
### PBAT-Gate Battery Monitoring System Main Controller

- Real-time monitoring 1 set UPS with Max. 480 batteries
- Data logging for all measuring data for 12 months
- Build-in web server with bar chart and trend curve analysis for voltage, charge and discharge current, internal temperature, impedance
- Report for battery string voltage & current, individual battery voltage, temperature, impedance, support export PDF, CSV etc. document
- Setpoint alarm for cell voltage, internal temperature, impedance, SOC, SOH (upper limit / lower limit) and string voltage, current, SOC (upper limit / lower limit)
- Optional sensor for 2 AI ports for ambient temperature & humidity sensor, 1 DO port for sound and light alarm, 4DI ports for digital input connecting
- Support SNMP, Modbus TCP protocol
- Support HTTP protocol (RESTful API, JSON, XML format)
- Support SMS/Email alarm
- Support 4G data upload to the 3rd party



**PBAT-Gate**

**All-in-one**



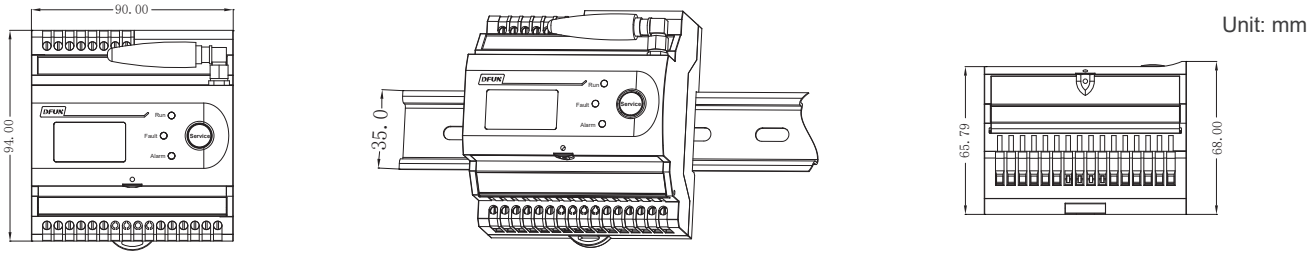
**Pre-install & pre-wiring for PBAT-Gate, PBAT600Pro and HMI-Gate (optional)**

# PBAT-Gate Battery Monitoring Solution

## Technical Specification

| | | | | |
|---|---|---|---|---|
| CPU | ARM cortex-A8 800MHz | Dimension | 90mm x 94mm x 68mm | |
| Memory | 512MB flash, 8G TF memory card | Operating system | Embedded linux | |
| Flash | Nand flash 512MB | Communication | 4CL | 4 RS485 serial ports, 2 Ethernet ports |
| MTBF | ≥ 50,000 hours | | 2ZL | 2 RS485 serial ports, 2 Ethernet ports |
| Display | OLED | Power consumption | < 5W | |
| Weight | 650g | Optional function | 4 DI, 2 AI, 1 DO ( only for PBAT-GATE-2ZL ) | |
| Baudrate | 1200 ~ 115200bps | Operation temperature | -15°C ~ 55°C | |
| Power supply | 18 ~ 36VDC | Operation humidity | 10% ~ 95% Non-condensing | |

## Dimension and Installation




# Battery String Sensor

## PBAT600Pro Battery String Sensor

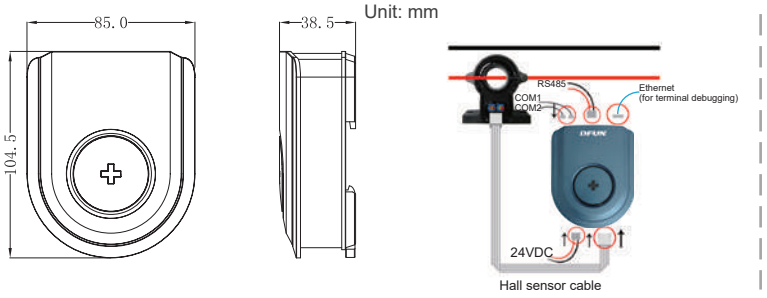
- Monitor battery string voltage, charge and discharge current
- Calculate battery status of charge (SOC)
- Auto-balancing
- Data acquisition
- Auto-sensing for whole battery string sensor's ID address
- Accessories:
  1) Hall sensor and cable: range from 0 ~ ±1000A with 2m cable
  2) Communication cable : 5m with RJ11 port




Running status | Alarm status | Hall sensor

| Item | Measuring range | | External power supply | Power consumption |
|---|---|---|---|---|
| | Voltage | String current | | |
| PBAT600Pro | 0 ~ 800VDC ( ±0.5% ) | -1000 ~ 1000A by hall sensor ( ±2.0% ) | 12 ~ 36VDC | 1W |

### ➢ Dimension and Installation






# PBAT-Gate Battery Monitoring Solution

## Battery Cell Sensor

### PBAT61-02/PBAT61-06/PBAT61-12 Battery Cell Sensor

- PBAT61-02 for 2V battery, PBAT61-06 for 6V battery, PBAT61-12 for 12V battery
- Monitor individual battery voltage, internal temperature (negative pole), Impedance(ohmic value)
- Auto-balancing



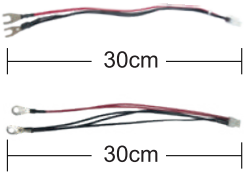
Running status



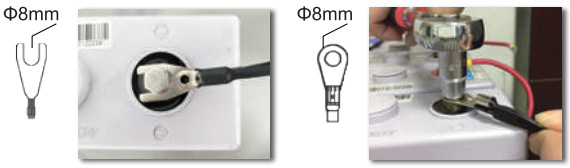
Abnormal status

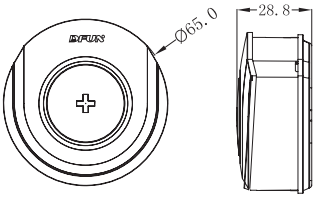
| Item | Rated input voltage | Measuring range | | | |
|---|---|---|---|---|---|
| | | Voltage | Internal temperature | Impedance | Power consumption |
| **PBAT61-02** | 02V | 1.6 ~ 2.6V (±0.2%) | -20°C ~ 85°C (±0.5%) | Range: 0.1mΩ~50mΩ<br>Repeatability error: 1.0%±25μΩ<br>Conformity error: 1.5%±25μΩ | Running: <110mW<br>Sleeping: <12mW |
| **PBAT61-06** | 06V | 4.8 ~ 10V (±0.2%) | | | Running: <90mW<br>Sleeping: <10mW |
| **PBAT61-12** | 12V | 7.5 ~ 15.6V (±0.2%) | | | Running: <90mW<br>Sleeping: <10mW |

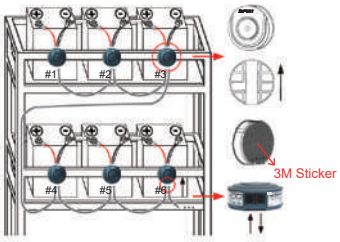
### ➢ Dimension and Installation




| Battery measuring cable | Item | Description |
|---|---|---|
| | Length | 30cm |
| | Terminal & Size | U type, hole diameter: 8mm |
| | | O type, hole diameter: 8mm |





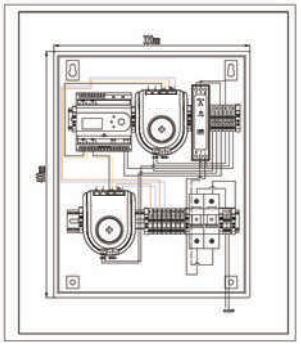


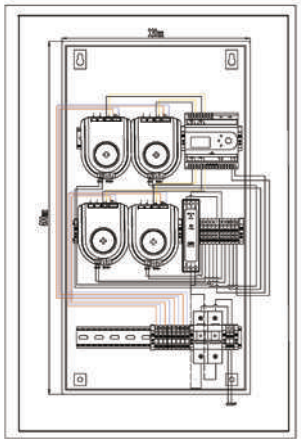

## Cabinet for Pre-wiring in Factory

### PBAT-BOX

- Pre-install & pre-wiring for PBAT-Gate, PBAT600Pro and power supply converter inside
- Pre-mount HMI-Gate if selected
- Provide wiring drawing

| Hardware | | |
|---|---|---|
| **Dimension** | For 1 ~ 2 battery strings | **PBAT-BOX-400:** 400*320*138.5mm (H*W*D) |
| | For 3 ~ 4 battery strings | **PBAT-BOX-600:** 600*320*138.5mm (H*W*D) |
| **Installation** | Wall-mount, hang on the battery rack | |
| **Material** | Steel plate, with rock | |


**PBAT-BOX-400**


**PBAT-BOX-600**

## Order Information

| System structure | | Model | Description | Remark |
|---|---|---|---|---|
| Management layer | | PBAT-GATE-4CL | Battery monitoring system main controller with 4 RS485 ports, SMS/Email alarm, 4G data upload | One per UPS<br>Max. 4 strings × 120 batteries = 480 batteries |
| | | PBAT-GATE-2ZL | Battery monitoring system main controlle with 2 RS485 ports, 4DI, 2AI, 1DO, SMS/Email alarm, 4G data upload | One per UPS<br>Max. 2 strings × 120 batteries = 240 batteries |
| Battery string sensor | | PBAT600Pro | Battery string sensor | One per string<br>1 RS485 port, one PBAT600Pro can connect Max. 120pcs PBAT61 series battery sensor, Max. 2 Hall sensor and cable: range from 0 ~ ±1000A with 2m cable.<br>Communication cable: 5m with RJ11 port |
| Battery cell sensor | | PBAT61-02 | 02V battery cell sensor | One per battery cell |
| | | PBAT61-06 | 06V battery cell sensor | One per battery cell |
| | | PBAT61-12 | 12V battery cell sensor | One per battery cell |
| Accessory | Cell sensor communication cable | PBAT-COM-40 | Cable terminal: RJ11 port, length: 40cm (standard) | |
| | | PBAT-COM-70 | Cable terminal: RJ11 port, length: 70cm | |
| | Battery measuring cable | PBAT-C1-U-M8-30 | Cable terminal: U type  , hole diameter, 8mm, length: 30cm (standard) | |
| | | PBAT-C1-O-M8-30 | Cable terminal: O type  , hole diameter, 8mm, length: 30cm | |
| | Hall sensor for PBAT600Pro | CS050EK1T5 | Rated input: 50A | Measure range: 0 ~ ± 100A, Φ20mm |
| | | CS100EK2T5 | Rated input: 100A | Measure range: 0 ~ ± 200A, Φ40mm |
| | | CS200EK2T5 | Rated input: 200A | Measure range: 0 ~ ± 400A, Φ40mm |
| | | CS400EK2T5 | Rated input: 400A | Measure range: 0 ~ ± 800A, Φ40mm |
| | | CS500EK2T5 | Rated input: 500A | Measure range: 0 ~ ± 1000A, Φ40mm |
| | Power supply | HDR-30-24 | 24VDC power source, 220VAC to 24VDC | |
| Optional module | HMI for local display & operation | HMI-Gate | 7-inch touch-screen HMI for local display & operation | One per PBAT-Gate<br>communication with PBAT-Gate via Ethernet |
| | Cabinet for pre-wiring in factory | PBAT-BOX-400 | Dimension: 400*320*138.5mm (H*W*D) | Pre-install & pre-wiring for PBAT-Gate, PBAT600Pro and power supply converter, pre-mount HMI-Gate if customer selected |
| | | PBAT-BOX-600 | Dimension: 600*320*138.5mm (H*W*D) | |

# PBMS2000

## Battery Monitoring Solution

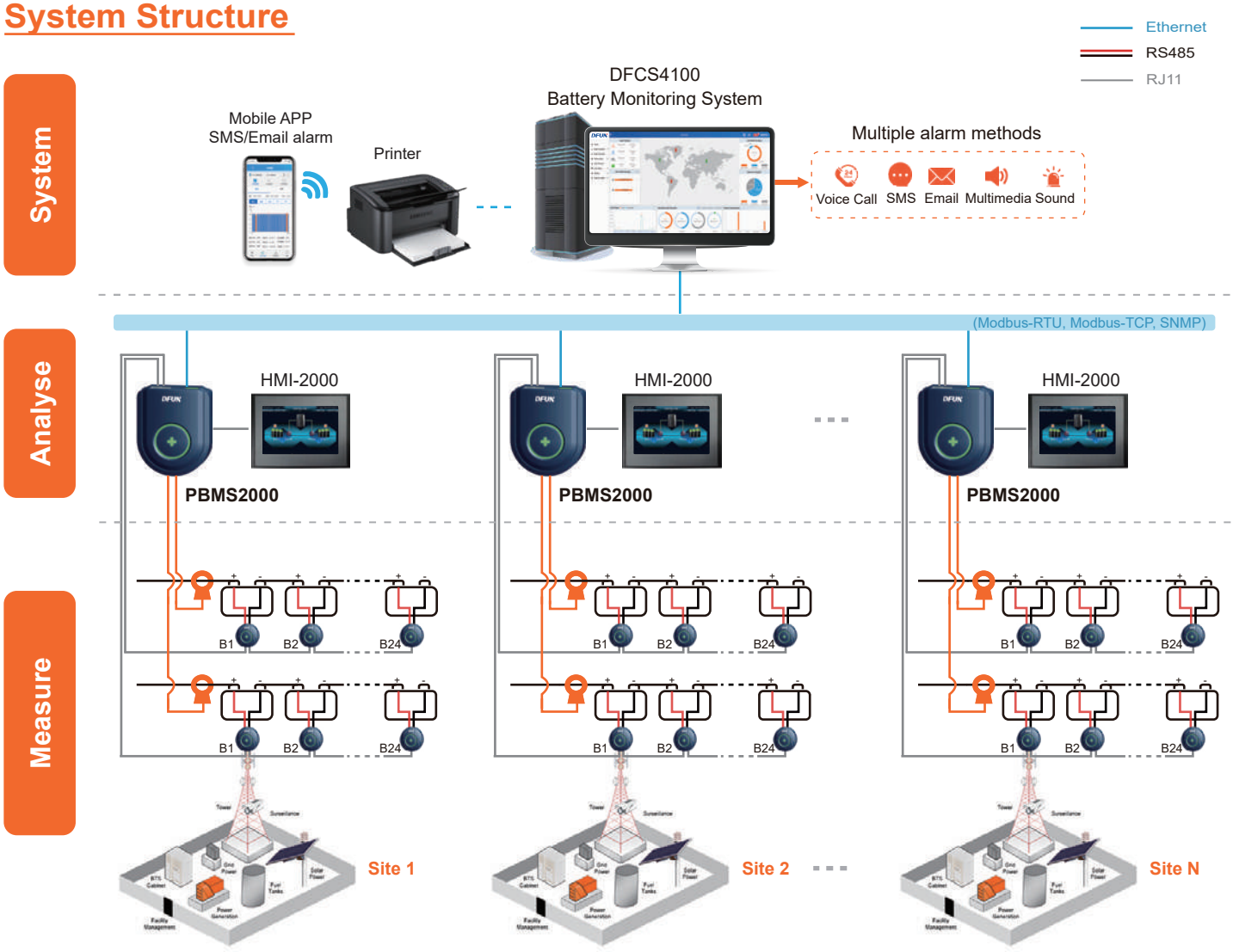



## Feature

- Dedicated design for telecommunication 24V or -48V system
- 24/7 hours on-line monitoring & remote alarm
- Cost competitive solution, support Max. 1 string, total 120pcs batteries, or Max. 2 strings, Max. 60pcs batteries each string
- Measure Lead-Acid battery
- Multi communication protocol (Modbus-RTU, MODBUS-TCP, SNMP)
- Comply with IEEE 1188-2005

# PBMS2000 Battery Monitoring Solution

## System Structure



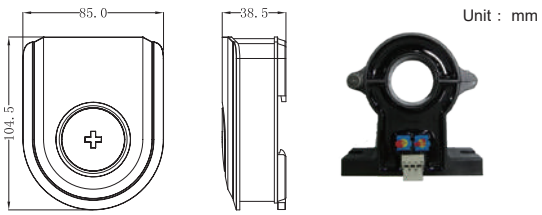

## Management Layer

PBMS2000 Battery Monitoring System Main Controller

- Monitor battery string voltage, charge and discharge current
- Calculate battery string SOC
- Auto-balancing
- Auto-sensing for the battery sensor's ID address
- Setpoint alarm (upper limit / lower limit)
- Data collecting
- Data uploading function via build-in RS485 (Modbus-RTU) & Ethernet (Modbus-TCP or SNMP)
- Support 3rd party system
- Local display via HMI
- Accessories:
  1) Hall sensor and cable: range from 0 ~ ±1000A with 2m cable
  2) Communication cable : 5m with RJ11 port




Running status  Alarm status

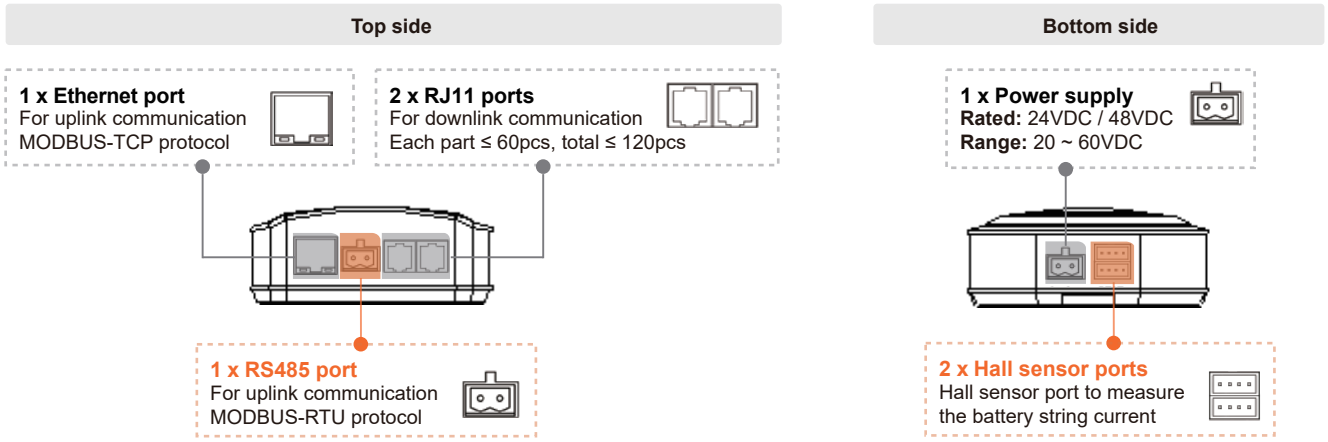


# PBMS2000 Battery Monitoring Solution

## Technical Specification

| | | |
|---|---|---|
| **Application** | | **DC power system (telecom site)** |
| **Rated input voltage** | | 24VDC or 48VDC range: 20 ~ 60VDC |
| **Measuring** | **voltage** | 0 ~ 800V ( accuracy: ±0.5% ) |
| | **current** | -1000 ~ 1000A (by hall sensor, accuracy: ±2.0%) |
| **Power comsumption** | | < 2W |
| **Up-link communication** | | 1 Etherent port ( 10/100M ), Modbus-TCP / SNMP protocol |
| | | 1 RS485 port， Modbus-RTU protocol, baudrate: 9600bps, 19200bps, 38400bps (optional) |
| **Down-link communication** | | 2 RJ11 ports, each port connect Max. 60pcs batteries, total Max. 120pcs batteries |

## Terminal Introduction




## Order Information

| System structure | | Model | Description | Remark |
|---|---|---|---|---|
| **Management layer** | | **PBMS2000** | Battery monitoring system main controller | One PBMS2000 can monitor Max. 1 string, total 120pcs batteries or Max. 2 strings, each string Max. 60pcs batteries. Hall sensor and cable: range from 0 ~ ±1000A with 2m cable. Communication cable: 5m with RJ11 port |
| **Battery cell sensor** | | **PBAT 61-02** | 02V battery cell sensor | One per battery cell |
| | | **PBAT 61-12** | 12V battery cell sensor | One per battery cell |
| **Accessory** | **Cell sensor communication cable** | **PBAT-COM-40** | Cable terminal: RJ11 port, length: 40cm (standard) | |
| | | **PBAT-COM-70** | Cable terminal: RJ11 port, length: 70cm | |
| | **Battery measuring cable** | **PBAT-C1-U-M8-30** | Cable terminal: U type , hole diameter: 8mm, length: 30cm (standard) | |
| | | **PBAT-C1-O-M8-30** | Cable terminal: O type , hole diameter: 8mm, length: 30cm | |
| | **Hall sensor for PBMS2000** | **CS050EK1T5** | Rated input: 50A | Measure range: 0 ~ ±100A, Φ20mm |
| | | **CS100EK2T5** | Rated input: 100A | Measure range: 0 ~ ±200A, Φ40mm |
| | | **CS200EK2T5** | Rated input: 200A | Measure range: 0 ~ ±400A, Φ40mm |
| | | **CS400EK2T5** | Rated input: 400A | Measure range: 0 ~ ±800A, Φ40mm |
| | | **CS500EK2T5** | Rated input: 500A | Measure range: 0 ~ ±1000A, Φ40mm |
| **Optional module** | **Local display & operation** | **HMI-2000** | 7-inch touch-screen HMI for local display & operation | One per PBMS2000 Communication with PBMS2000 via RS485 |

# PBMS8000

## Battery Monitoring Solution

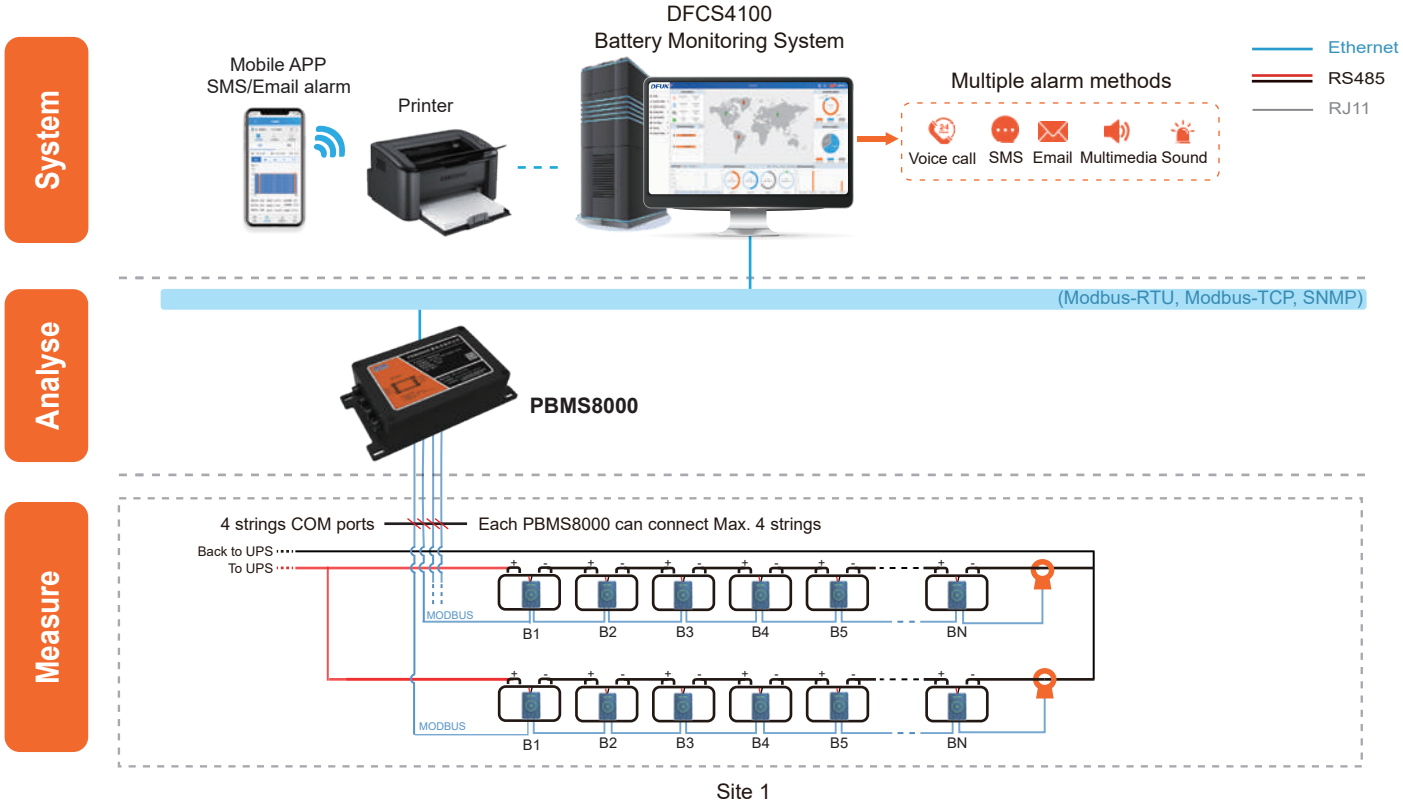



## Feature

- Apply to high protection applications like chemical plant, train etc
- Monitor Max. 4 strings battery, in total of 60 batteries
- Measure Lead-Acid, Ni-Cd battery
- IP65 protection degree
- UL94-HB-V0 fire rating
- Aviation connector
- Powered by communication bus, no draw any power from the batteries
- Auto-sensing for the battery sensor's ID address
- Monitor string leakage current (optional sensor)
- Monitor battery voltage, current, impedance, internal temperature, leakage current, SOC, SOH, etc.
- Comply with IEEE 1188-2005

# PBMS8000 Battery Monitoring Solution

## System Structure




Site 1

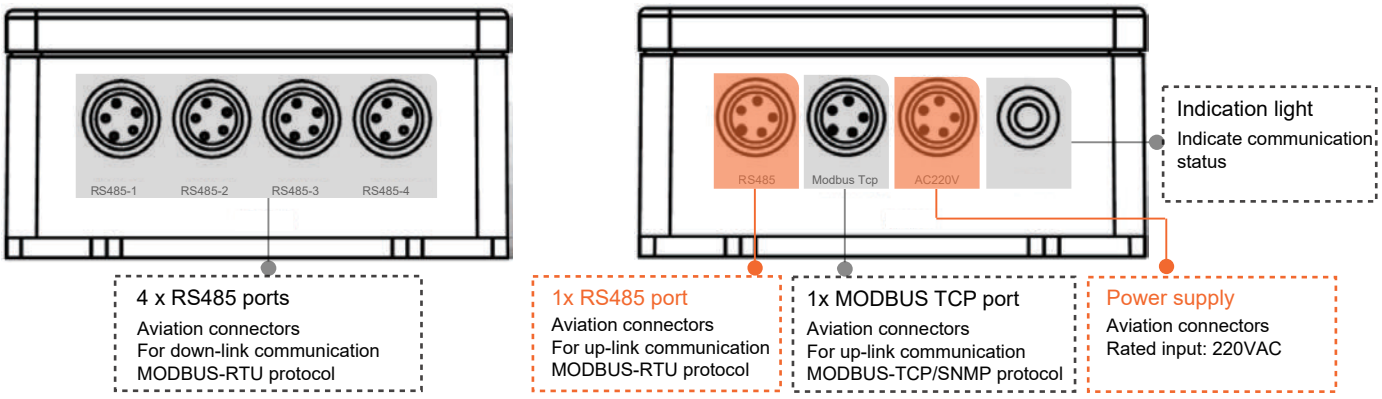
## Management Layer

### PBMS8000 Battery Monitoring System Main Controller

- Monitor battery string voltage, charge and discharge current
- Calculate battery string SOC & SOH
- Auto-balancing
- IP65 protection degree
- Auto-sensing for the battery sensor's ID address
- Data uploading function via RS485 (Modbus-RTU) & Ethernet (Modbus-TCP or SNMP)
- Accessories: Hall sensor and cable: range from 0 ~ ±1100A with 20cm aviation connector (male & female)



PBMS8000 Hall Sensor



# PBMS8000 Battery Monitoring Solution

## Technical Specification

| | | | | |
|---|---|---|---|---|
| **CPU** | ARM cortex M4 180MHz | **Up-link communication** | 1 Ethernet port (10/100M), MODBUS-TCP, SNMP<br>1 RS485 serial port, MODBUS-RTU, baudrate: 9600bps, 19200bps, 38400bps (optional) | |
| **Flash** | 128Mbit flash | | | |
| **Power supply** | Rated 220VAC<br>Range: 85 ~ 264VAC, 100 ~ 370VDC | **Down-link communication** | 4 Aviation connectors, each port Max. 15pcs batteries, total Max.60pcs, MODBUS-RTU. | |
| **MTBF** | ≥100,000 hours | **Measure range** | String voltage | 1 ~ 4 strings, range: 20 ~ 1000VDC (±0.5%), resolution：0.01V |
| **Dimension** | 190mm×100mm×44mm | | String current | 1 ~ 4 strings, range: -1000 ~ 1000ADC (±1%Fs, under 15°C ~ 35°C), resolution: 0.01A |
| **Power consumption** | <11W (only main controller) | **Operation environment** | Working temperature: -20°C ~ 60°C<br>Storage temperature: -40°C ~ 70°C | |
| | | | Humidity: 5% ~ 95%, non-condensing | |

# Battery Cell Sensor

## PBAT81-02 / PBAT81-12 Battery Cell Sensor

- PBAT81-02 for 2V Lead-Acid battery or 1.2V Ni-Cd battery
  PBAT81-12 for 12V Lead-Acid battery
- Monitor individual battery voltage, internal temperature (negative pole), impedance(ohmic value)
- Auto-balancing
- IP65 protection degree
- UL94-HB-V0 fire rating
- Powered by communication bus, no draw any power from the batteries




PBAT81



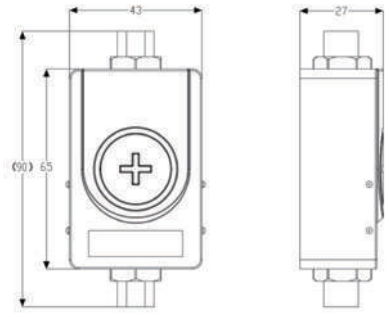
**Base (optional)**
Snap-in DIN-rail installation

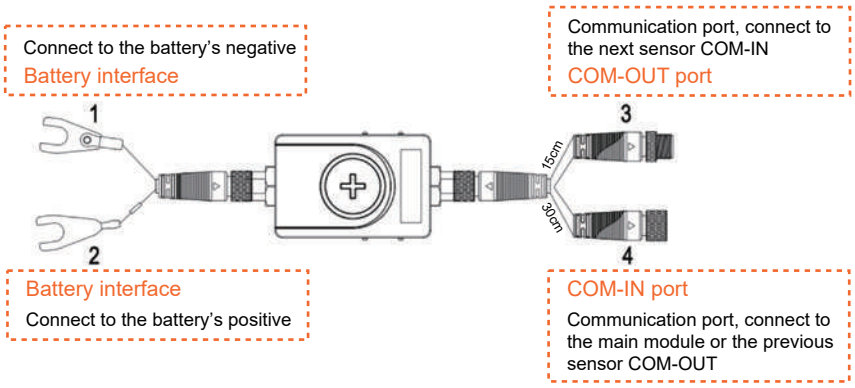



| Item | Power supply | Rated input voltage | Measuring range | | |
|---|---|---|---|---|---|
| | | | Voltage | Internal temperature | Impedance |
| **PBAT81-02** | 24VDC<br>Power consumption: <0.25W | 02V / 1.2V | 0.5 ~ 3VDC (±0.2%) | -20°C ~ 85°C (±0.5°C) | Range: 0.1mΩ ~ 50mΩ<br>Repeatability error: 1.0%±25μΩ<br>Conformity error: 1.5% ±25μΩ |
| **PBAT81-12** | | 12V | 5 ~ 18VDC (±0.2%) | | |

## Dimension

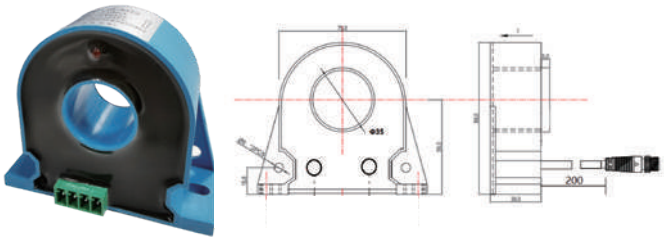
Unit : mm



## DC Leakage Current Sensor (Optional)

- Accuracy: ±1%FS
- Monitoring string leakage current to prevent fire caused
- 1 string can connect Max. 1 leakage current sensor



## Order Information

| System structure | | Model | Description | Remark |
|---|---|---|---|---|
| Management layer | | PBMS8000 | Battery monitoring system main controller | One per each UPS, one PBMS8000 can monitor Max. 4 strings, Max. 60 batteries. Hall sensor and cable: range from 0 ~ ±1100A with 20cm aviation connector (male & female) |
| Battery cell sensor | | PBAT81-02-A | 2V / 1.2V battery cell sensor | Terminal material: industrial plastic |
| | | PBAT81-12-A | 12V battery cell sensor | |
| | | PBAT81-02-B | 2V / 1.2V battery cell sensor | Terminal material: industrial metal |
| | | PBAT81-12-B | 12V battery cell sensor | |
| | | PBAT81-DZ | Base, snap-in DIN-rail installation | One per each cell sensor (optional) |
| Accessory | AP to RJ45 | PBAT-COM -AP12-RJ45 | Length: 10m | One per each string |
| | Cell sensor communication cable | PBAT-COM -AP12-30 | IP65 with aviation connectors, length: one side 30cm,other side 15cm. | If PBAT81 is meta terminal, the aviation connectors of cable also is metal |
| | Battery measuring cable | PBAT-C1/AP12 -U-M8 | Cable terminal: U type , hole diameter: 8mm, length: 30cm (standard) | |
| | Hall sensor for PBMS8000 | ST50K2S-M-DF | Rated input: ±50A | Measure range: 0 ~ ±55A, Φ40mm |
| | | ST100K2S-M-DF | Rated input: ±100A | Measure range: 0 ~ ±110A, Φ40mm |
| | | ST200K2S-M-DF | Rated input: ±200A | Measure range: 0 ~ ±220A, Φ40mm |
| | | ST400K2S-M-DF | Rated input: ±400A | Measure range: 0 ~ ±440A, Φ40mm |
| | | ST500K2S-M-DF | Rated input: ±500A | Measure range: 0 ~ ±550A, Φ40mm |
| | | ST1000K2S-M-DF | Rated input: ±1000A | Measure range: 0 ~ ±1100A, Φ40mm |
| | DC leakage current sensor (optional) | STL3S-MT2-DF -300mA/RS485 | Rated input: ±300mA | Measure range: 0 ~ ±350mA, Φ35mm |
| | | STL3S-MT2-DF -1A/RS485 | Rated input: ±1A | Measure range: 0 ~ ±1.2A, Φ35mm |
| | | STL5S-MT2-DF -10mA/RS485 | Rated input: ±10mA | Measure range: 0 ~ ±300mA, Φ55mm |
| | | STL8S-MT2-DF -10mA/RS485 | Rated input: ±10mA | Measure range: 0 ~ ±300mA, Φ72mm |

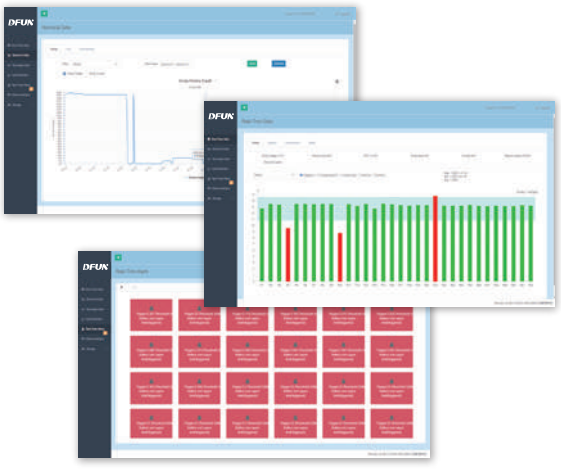
# PBMS9000

## Battery Monitoring Solution



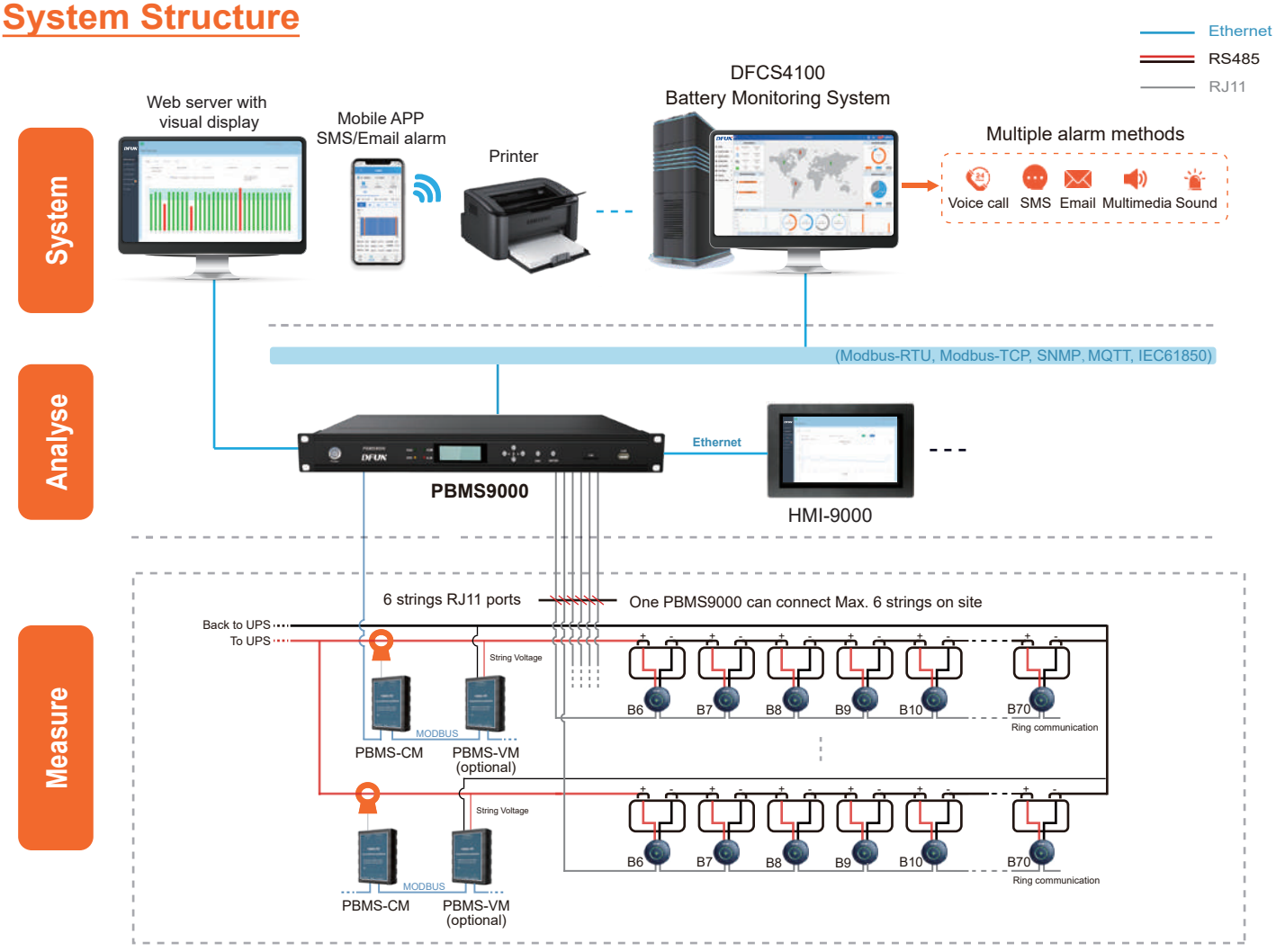

## Feature

- Apply to UPS and data center application
- Measure lead-acid or multi-pole battery
- Ring communication, any communication failure will not affect other sensors communication
- Monitor battery voltage, current, impedance, insulation resistance, ripple current & voltage, SOC, SOH, etc.
- Support Modbus, SNMP, MQTT and IEC61850 protocols
- Auto-sensing for the battery sensor's ID address
- Dual-source to avoid power shutdown
- Anti-interference design, support to connect with high-frequency UPS
- Comply with IEEE 1188-2005



# PBMS9000 Battery Monitoring Solution

## System Structure




## Management Layer

### PBMS9000 Battery Monitoring System Main Controller

- Standard 1 U design for distribution cabinet
- Dual-source to avoid power shutdown
- Built-in web server with visual display
- Monitor Max. 6 strings battery, in a total of 420 batteries
- Measure battery string current & voltage, ripple voltage & current, charge & discharge current, internal temperature, impedance, insulation resistance, ambient temperature & humidity, SOC and SOH
- Alarm message by SMS or Email
- Support Modbus-TCP, Modbus-RTU, SNMP and IEC61850 protocols
- Support MQTT for JSON format to data upload
- 1 RS485 port, 2 Ethernet ports and 1 4G Antenna port to data upload
- 6 DI ports (digital Input connecting)
- 6 DO ports (sound and light alarm)



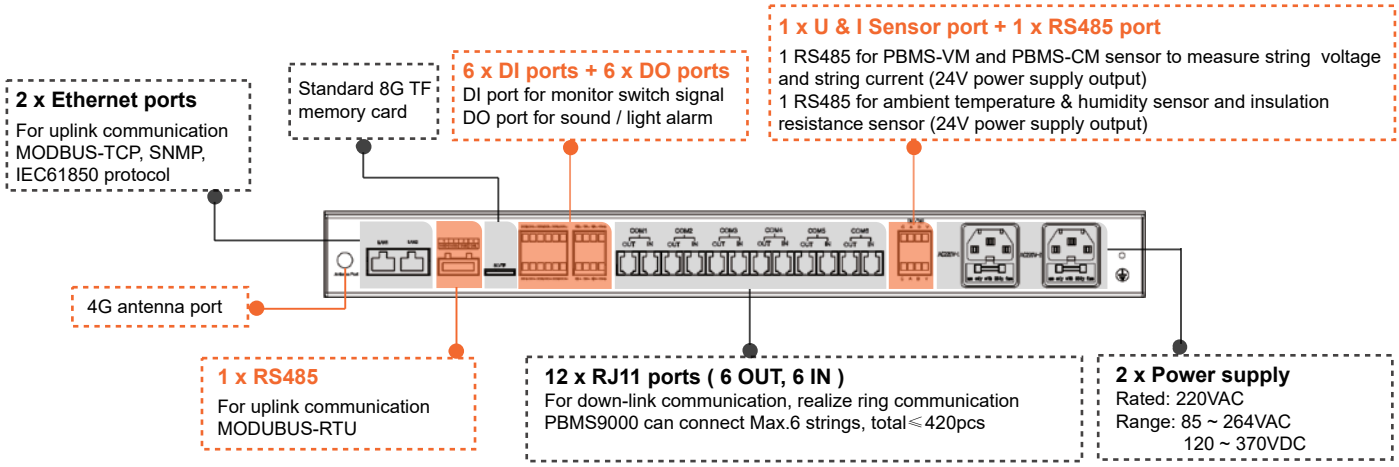
Unit : mm

**Pre-install & pre-wiring for PBMS9000 and HMI-9000 (optional)**



# PBMS9000 Battery Monitoring Solution

## Dimension and Installation




## Technical Specification

| | | | | |
|---|---|---|---|---|
| **CPU** | ARM cortex A7 528MHz | **Up-link communication** | 2 Ethernet ports (10/100M), MODBUS-TCP, SNMP, IEC61850<br>1 RS485 port, MODBUS-RTU, baudrate: 9600bps, 19200bps, 38400bps (optional) | |
| **Memory** | 512MB flash, 4G EMMC + 8G TF memory card | **Down-link communication** | 6 Channels RJ11 ports, each port Max. connect ≤ 70pcs batteries, total Max. 420pcs | |
| **Display** | 2-inch LCD with backlight | **Measure range** | Voltage | 1 ~ 6 strings, range: 8 ~ 1000VDC (±0.5%), resolution：0.01V |
| **MTBF** | ≥ 100,000 hours | | Ripple voltage | 1 ~ 6 strings, range: 2 ~ 100V (peak), resolution: 0.01V |
| **Power supply** | Rated: 220VAC<br>Range: 85 ~ 264VAC<br>120 ~ 370VDC | | Current | 1 ~ 6 strings, range: -2000 ~ 2000ADC (±2.0%, under 15°C ~ 35°C), resolution：0.01A |
| **Dimension** | Standard 19-inch 1 U device<br>483mm × 206mm × 44.5mm (W*D*H)<br>Open hole: 440mm×46mm ( L*H ) | | Ripple current | 1 ~ 6 strings, according to the rated current of the hall sensor, range: DC 0 ~ 0.4*I (peak), resolution：0.01A |
| **Power consumption** | < 15W (only main controller) | **Operation environment** | Working temperature: -15°C ~ 55°C<br>Storage temperature: -40°C ~ 70°C<br>Humidity: 5% ~ 95% non-condensing | |
| **Additional port** | 6 x DI dry contact<br>6 x DO relay output, 250VAC/5A or 30VDC/5A | **Extension sensor (optional)** | - RS485 for 1~6 strings string voltage & current measuring<br>- RS485 for Max. 6 strings ambient temperature & humidity measuring<br>- RS485 for 1~6 strings DC insulation resistance measuring | |

# String Measuring Sensor

## PBMS-CM String Current Measuring Sensor & Hall Sensor

- One string need 1 PBMS-CM, each PBMS-CM with 2 hall sensor ports
- Measure battery string charge and discharge current, ripple current
- Measure multi-pole battery's string charge and discharge current and ripple current with flexiable module and hall sensor
- Accessories:
  1） Hall sensor and cable: range from 0~±1000A with 2m cable
  2） Communication cable : 5m with RJ45 port




**PBMS-CM**



**Hall Sensor**

# PBMS9000 Battery Monitoring Solution

| Item | Power supply | Measuring range | | Environment |
|---|---|---|---|---|
| | | String current | Ripple current | |
| **PBMS-CM** | 24VDC (range: 9 ~ 32VDC)<br>Power consumption: ＜0.5W | 1 Hall sensor: -1000 ~ 1000A<br>2 Hall sensor: -2000 ~ 2000A<br>(±2.0%, 15°C ~ 35°C) | 20% of Hall sensor<br>Rated current (peak value)<br>Frequency: 50Hz ~ 1KHz | Working temperature: 0°C ~ 45°C<br>Working temperature limit: -15°C ~ 55°C<br>Humidity: 5% ~ 95%RH, non-condensing<br>Storage temperature: -40°C ~ 70°C |

## PBMS-VM String Voltage Measuring Sensor (Optional)

- One PBMS-VM can measure 1 string's voltage
- Measure battery string voltage and ripple voltage




**PBMS-VM**

| Item | Power supply | Measuring range | | Environment |
|---|---|---|---|---|
| | | String voltage | Ripple voltage | |
| PBMS-VM | 24VDC<br>(range: 9 ~ 32VDC)<br>Power consumption: ＜1W | 8 ~ 1000VDC<br>(±0.5%) | 2 ~ 100VDC<br>(peak value) | Working temperature: 0°C ~ +45°C<br>Working temp limit: -15°C ~ +55°C<br>Humidity: 5% ~ 95%RH, non-condensing<br>Storage temperature: -40°C ~ +70°C |

## Extension Sensor (Optional)



### Ambient temperature & humidity sensor

- Dual RJ45 interface, fast wiring, support cascade use
- Adsorption by magnet
- Temperature: -20°C ~ 60°C (±0.4°C), resolution: 0.1°C. Humidity: 0 ~ 100%RH (±3%RH), resolution: 0.1%RH



### DC insulation resistance sensor

- Measuring range: 1KΩ ~ 30MΩ
- Measurement accuracy: 10% (100KΩ ~ 50KΩ)

## Order Information

| System Structure | | Model | Description | Remark |
|---|---|---|---|---|
| Management layer | | PBMS9000-L | Battery monitoring system main controller with 4G antenna port (standard) | One per each UPS<br>One PBMS9000 can monitor Max. 6 strings, Max. 420pcs batteries |
| Management layer | | PBMS9000-L-CP | Battery monitoring system main controller with 4G antenna port, IEC61850 protocol | |
| String measuring sensor | | PBMS-CM | String current measuring sensor | One per each string, each has 2 hall sensor ports, can connect Max. 2 hall sensor. If use for multi-pole battery, then we can configure PBMS-CM according to the number of pole.<br>Hall sensor and cable: range from 0 ~ ±1000A with 2m cable.<br>Communication cable: 5m with RJ45 port |
| | | PBMS-VM | String voltage measuring sensor | One per each string (optional) |
| Battery cell sensor | | PBAT 61-02 | 02V battery cell sensor | One per battery cell |
| | | PBAT 61-06 | 06V battery cell sensor | One per battery cell |
| | | PBAT 61-12 | 12V battery cell sensor | One per battery cell |
| Accessory | Cell sensor communication cable | PBAT-COM-40 | Cable terminal: RJ11 port, length: 40cm (standard) | |
| | | PBAT-COM-70 | Cable terminal: RJ11 port, length: 70cm | |
| | Battery measuring cable | PBAT-C1-U-M8-30 | Cable terminal: U type  , hole diameter: 8mm, length: 30cm (standard) | |
| | | PBAT-C1-O-M8-30 | Cable terminal: O type  , hole diameter: 8mm, length: 30cm | |
| | Hall sensor for PBMS-CM | CS050EK1T5 | Rated input: 50A | Measure range: 0 ~ ±100A, Φ20mm |
| | | CS100EK2T5 | Rated input: 100A | Measure range: 0 ~ ±200A, Φ40mm |
| | | CS200EK2T5 | Rated input: 200A | Measure range: 0 ~ ±400A, Φ40mm |
| | | CS400EK2T5 | Rated input: 400A | Measure range: 0 ~ ±800A, Φ40mm |
| | | CS500EK2T5 | Rated input: 500A | Measure range: 0 ~ ±1000A, Φ40mm |
| Optional module | HMI for local display & operation | HMI-9000 | 10-inch touch-screen HMI for local display & operation | One per one PBMS9000<br>Communication with PBMS9000 via Ethernet |
| | Ambient temperature & humidity | H-THDRJ45 | Temperature: -20°C ~ 60°C (±0.4°C)<br>Humidity: 0 ~ 100%RH (±3%RH) | 1 PBMS9000 can conncet Max. 6pcs |
| | DC insulation resistance sensor | PBMS-IM | Measuring range: 1KΩ ~ 30MΩ | One per each string, 1 PBMS9000 can connect Max. 6pcs |
| | Cabinet for pre-wiring in factory | PBAT-BOX-260 | Dimension: 535*260*350mm (W*H*D) | Pre-install & pre-wiring for PBMS9000 and HMI-9000 |

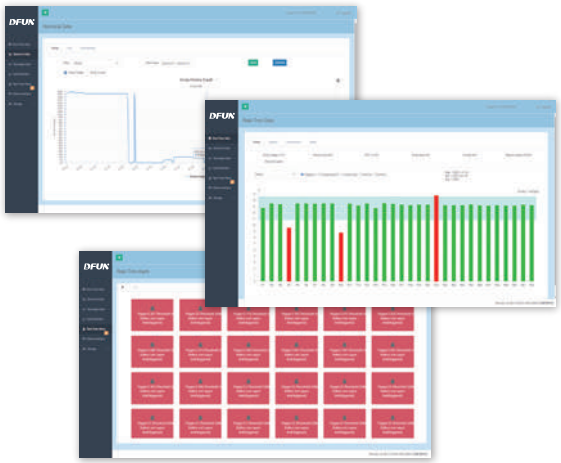
# PBMS9000Pro

## Battery Monitoring Solution



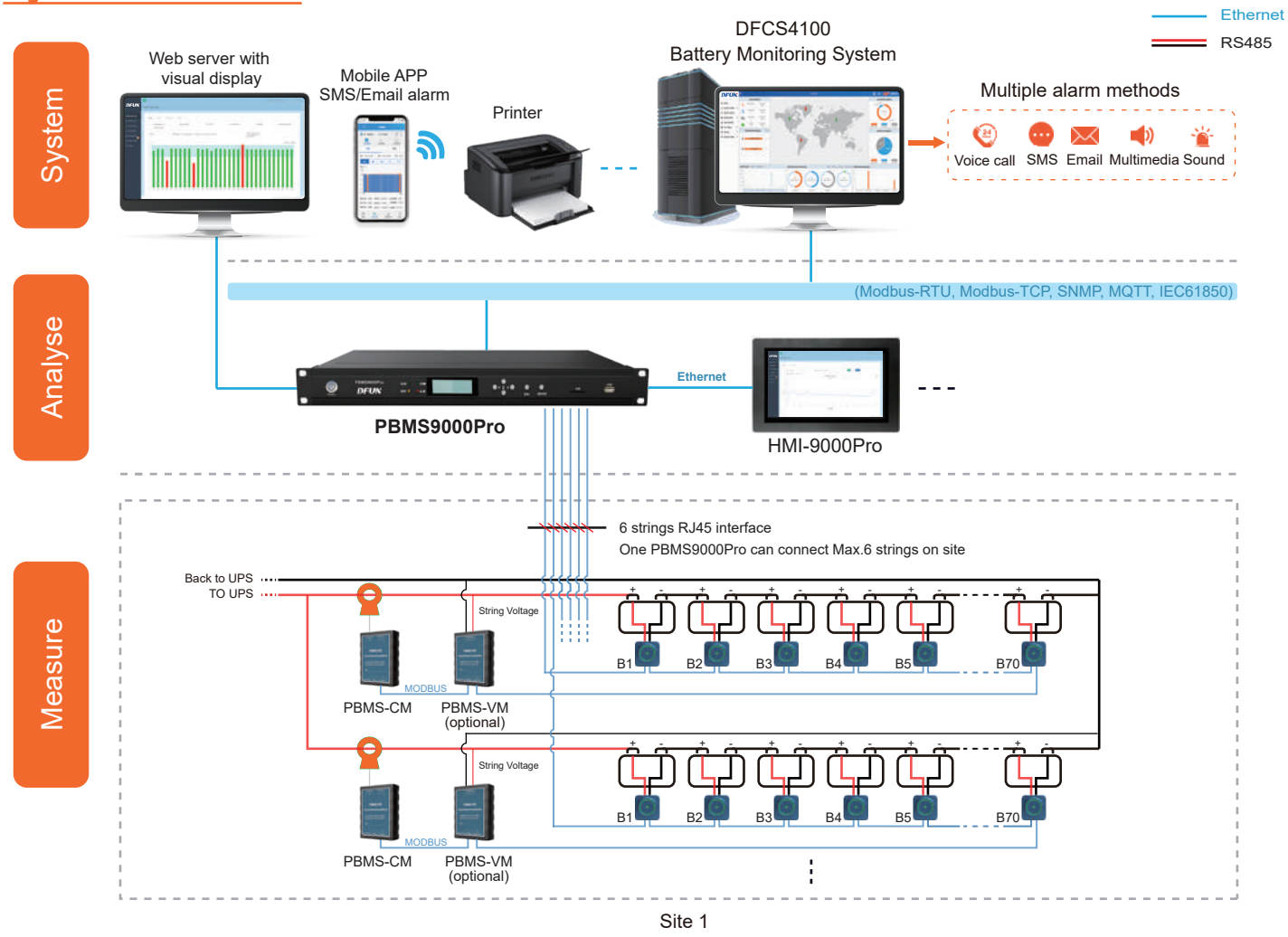

## Feature

- Apply to DC power systems like substation, power plants, etc
- 24/7 online monitoring & remote alarm notifications
- Monitor Max. 6 strings and 420pcs batteries in total
- Measure Ni-Cd, Lead-Acid, and muti-pole battery
- Powered by communication bus, no consuming battery power
- Anti-interference design, support to connect with high-frequency UPS
- Anti-reverse protection, no damaging the cell sensor and battery
- Auto-sensing for the battery sensor's ID address
- Support Modbus, SNMP, MQTT and IEC61850 protocols
- Support monitoring battery leakage and liquid level (optional)
- Support extension sensor for measuring ambient temperature & humidity, leakage current, insulation resistance (optional)
- Comply with IEEE 1188-2005



# PBMS9000Pro Battery Monitoring Solution

## System Structure




Site 1

## Management Layer

### PBMS9000Pro Battery Monitoring System Main Controller



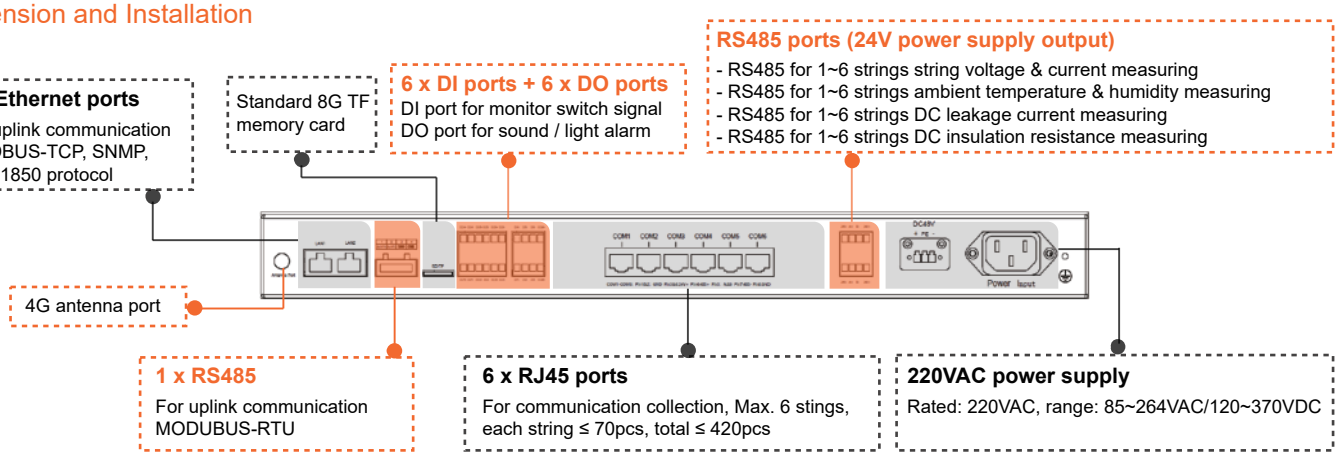

- Standard 1 U design for distribution cabinet
- Built-in web server with visual display
- Monitor Max. 6 strings battery, in a total of 420 batteries
- Measure battery string current & voltage, ripple voltage & current, charge & discharge current, internal temperature, impedance, insulation resistance, leakage current, ambient temperature & humidity, SOC and SOH
- Alarm message by SMS or Email
- Support Modbus-TCP, Modbus-RTU, SNMP and IEC61850 protocols
- Support MQTT for JSON format to data upload
- 1 RS485 port, 2 Ethernet ports and 1 4G Antenna port to data upload
- 6 DI ports (digital Input connecting)
- 6 DO ports (sound and light alarm)

**Pre-install & pre-wiring for PBMS9000Pro and HMI-9000Pro (optional)**



# PBMS9000Pro Battery Monitoring Solution

## Dimension and Installation




## Technical Specification

| | | | |
|---|---|---|---|
| **CPU** | ARM cortex A7 528MHz | **Up-link communication** | 2 Ethernet ports (10/100M), MODBUS-TCP, SNMP,<br>1 RS485 port, MODBUS-RTU, baudrate: 9600bps, 19200bps, 38400bps (optional) |
| **Memory** | 512MB DDR3, 4G EMMC + 8G TF memory card | **Down-link communication** | 6 channels RJ45 ports, each port Max. connect 70pcs batteries, |
| **MTBF** | ≥ 100,000 hours | **Measure range** | Voltage: 1 ~ 6 strings, range: 8 ~ 1000VDC (±0.5%), resolution：0.01V |
| **Display** | 2-inch LCD with backlight | | Ripple voltage: 1 ~ 6 strings, range: 2 ~ 100V (peak), resolution: 0.01V |
| **Power supply** | Rated: 220VAC, range:<br>85 ~ 264VAC / 120 ~ 370VDC | | Current: 1 ~ 6 strings, range: -2000 ~ 2000ADC (±2.0%, under 15°C ~ 35°C), resolution：0.01A |
| **Dimension** | Standard 19-inch 1 U device<br>483mm × 206mm × 44.5mm (W*D*H)<br>Open hole: 440mm×46mm ( L*H ) | | Ripple current: 1 ~ 6 strings, according to the rated current of the hall sensor, range: DC 0 ~ 0.4*I (peak), resolution：0.01A |
| **Power consumption** | < 15W (only main controller ) | **Operation environment** | Operating temperature: -15℃ ~ 55℃<br>Storage temperature: -40℃ ~ 70℃<br>Humidity: 10 ~ 95% RH, non-condensing |
| **Additional port** | 6 x DI dry contact<br>6 x DO relay output, 250VAC/5A or 30VDC/5A | **Extension sensor (optional)** | - RS485 for 1~6 strings string voltage & current measuring<br>- RS485 for Max. 6 strings ambient temperature & humidity measuring<br>- RS485 for 1~6 strings DC leakage current measuring<br>- RS485 for 1~6 strings DC insulation resistance measuring |

# String Measuring Sensor

## PBMS-CM String Current Measuring Sensor & Hall Sensor

- One string need 1 PBMS-CM, each PBMS-CM with 2 hall sensor ports
- Measure battery string charge and discharge current, ripple current
- Measure multi-pole battery's string charge and discharge current and ripple current with flexiable module and hall sensor
- Accessories:
  1） Hall sensor and cable: range from 0~±1000A with 2m cable
  2） Communication cable : 5m with RJ45 port




**PBMS-CM**



**Hall Sensor**

| Item | Power supply | Measuring range | | Environment |
|---|---|---|---|---|
| | | String current | Ripple current | |
| **PBMS-CM** | 24VDC (range: 9 ~ 32VDC)<br>Power consumption: ＜0.5W | 1 Hall sensor: -1000 ~ 1000A<br>2 Hall sensor: -2000 ~ 2000A<br>(±2.0%, 15°C ~ 35°C) | 20% of Hall sensor Rated current (peak value)<br>Frequency: 50Hz ~ 1KHz | Working temperature: 0°C ~ 45°C<br>Working temperature limit: -15°C ~ 55°C<br>Humidity: 5% ~ 95%RH, non-condensing<br>Storage temperature: -40°C ~ 70°C |

# PBMS9000Pro Battery Monitoring Solution

## PBMS-VM String Voltage Measuring Sensor (Optional)

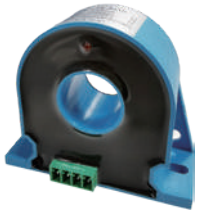
- One PBMS-VM can measure 1 string's voltage
- Measure battery string voltage and ripple voltage



**PBMS-VM**

| Item | Power supply | Measuring range | | Environment |
|---|---|---|---|---|
| | | String voltage | Ripple voltage | |
| PBMS-VM | 24VDC<br>(range: 9 ~ 32VDC)<br>Power consumption: ＜1W | 8 ~ 1000VDC<br>(±0.5%) | 2 ~ 100VDC<br>(peak value) | Working temperature: 0°C ~ +45°C<br>Working temp limit: -15°C ~ +55°C<br>Humidity: 5% ~ 95%RH, non-condensing<br>Storage temperature: -40°C ~ +70°C |

## Extension Sensor (Optional)



**DC leakage current sensor**

- Measurement accuracy: ±1%FS
- Monitoring string leakage current to prevent fire caused



**Ambient temperature & humidity sensor**

- Dual RJ45 interface, fast wiring, support cascade use
- Adsorption by magnet



**DC insulation resistance sensor**

- Measuring range: 1KΩ ~ 30MΩ
- Measurement accuracy: 10% (100KΩ ~ 50KΩ)

# Battery Cell Sensor

## PBAT71-02 / PBAT71-12 Battery Cell Sensor

- PBAT71-02 for 2V Lead-Acid battery or 1.2V Ni-Cd battery
  PBAT71-12 for 12V Lead-Acid battery
- Monitor individual battery voltage, internal temperature (negative pole), impedance(ohmic value)
- Calculate individual battery state of charge (SOC), state of health (SOH)
- Support battery leakage and liquid level monitoring (optional)
- Powered by communication bus, no consuming battery power
- Auto-balancing



Running status

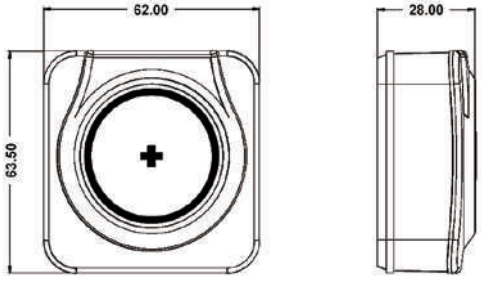


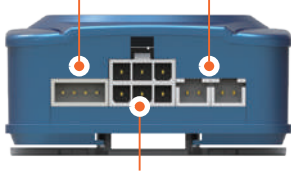
Alarm status

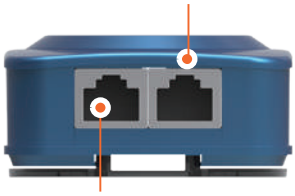
| Item | Power supply | Rated input voltage | Measuring range | | |
|---|---|---|---|---|---|
| | | | Voltage | Internal temperature | Impedance |
| **PBAT71-02** | 24VDC<br>Power consumption:<br>< 0.25W | 02V / 1.2V | 0.5 ~ 3VDC (±0.2%) | -20°C ~ 85°C<br>(±0.5°C) | Range: 0.1mΩ ~ 50mΩ<br>Repeatability error: 1.0%±25μΩ<br>Conformity error: 1.5% ±25μΩ |
| **PBAT71-12** | | 12V | 5 ~ 18VDC (±0.2%) | | |

## Dimension and Installation

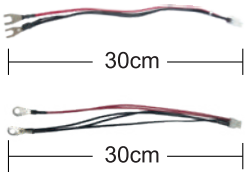
Unit : mm



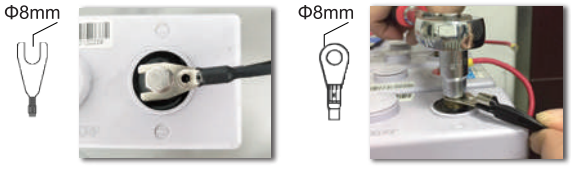



# PBMS9000Pro Battery Monitoring Solution




| Battery measuring cable | Item | Description |
|---|---|---|
| | Length | 30cm |
| | Terminal & size | U Type, hole diameter: 8mm |
| | | O Type, hole diameter: 8mm |




## Order Information

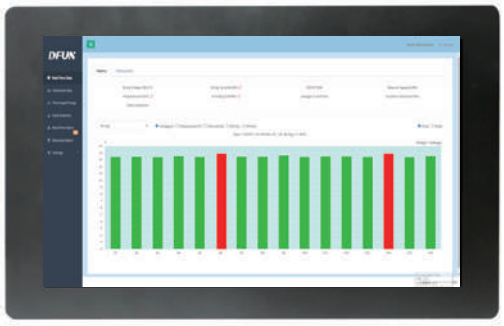
| System Structure | | Model | Description | Remark |
|---|---|---|---|---|
| Management layer | | PBMS9000Pro-L | Battery monitoring system main controller with 4G antenna port (standard) | One per each UPS<br>One PBMS9000Pro can monitor Max. 6 strings, Max. 420pcs batteries |
| | | PBMS9000Pro-L-CP | Battery monitoring system main controller with 4G antenna port, IEC61850 protocol | |
| String measuring sensor | | PBMS-CM | String current measuring sensor | One per each string, each has 2 hall sensor ports, can connect Max. 2 hall sensor. If use for multi-pole battery, then we can configure PBMS-CM according to the number of pole.<br>Hall sensor and cable: range from 0 ~ ±1000A with 2m cable.<br>Communication cable : 5m with RJ45 port. |
| | | PBMS-VM | String voltage measuring sensor | One per each string (optional) |
| Battery cell sensor | | PBAT 71-02 | 02V / 1.2V battery cell sensor | One per battery cell |
| | | PBAT 71-12 | 12V battery cell sensor | One per battery cell |
| Accessory | Cell sensor communication cable | PBAT-COM-RJ45-50 | Cable terminal: RJ45 port, length: 50cm (standard) | |
| | Battery measuring cable | PBAT-C1-U-M8-30 | Cable terminal: U type , hole diameter: 8mm, length: 30cm (standard) | |
| | | PBAT-C1-O-M8-30 | Cable terminal: O type , hole diameter: 8mm, length: 30cm | |
| | Hall sensor for PBMS-CM | CS050EK1T5 | Rated input: 50A | Measure range: 0 ~ ±100A, Φ20mm |
| | | CS100EK2T5 | Rated input: 100A | Measure range: 0 ~ ±200A, Φ40mm |
| | | CS200EK2T5 | Rated input: 200A | Measure range: 0 ~ ±400A, Φ40mm |
| | | CS400EK2T5 | Rated input: 400A | Measure range: 0 ~ ±800A, Φ40mm |
| | | CS500EK2T5 | Rated input: 500A | Measure range: 0 ~ ±1000A, Φ40mm |
| Optional module | HMI for local display & operation | HMI-9000Pro | 10-inch touch-screen HMI for local display & operation | One Per PBMS9000Pro<br>Communication with PBMS9000Pro via Ethernet |
| | DC leakage current sensor | STL3S-MT2-DF -300mA/RS485 | Rated input: ±300mA | Measure range: 0 ~ ±350mA, Φ35mm |
| | | STL3S-MT2-DF -1A/RS485 | Rated input: ±1A | Measure range: 0 ~ ±1.2A, Φ35mm |
| | | STL5S-MT2-DF -10mA/RS485 | Rated input: ±10mA | Measure range: 0 ~ ±300mA, Φ55mm |
| | | STL8S-MT2-DF -10mA/RS485 | Rated input: ±10mA | Measure range: 0 ~ ±300mA, Φ72mm |
| | Ambient temperature & humidity sensor | H-THDRJ45 | Temperature: -20°C ~ 60°C (±0.4°C)<br>Humidity: 0 ~ 100%RH (±3%RH) | 1 PBMS9000Pro can connect Max. 6pcs |
| | DC insulation resistance sensor | PBMS-IM | Measuring range: 1KΩ ~ 30MΩ | One per each string, 1 PBMS9000 can connect Max. 6pcs |
| | Liquid level sensor | PBMS-ELS | Monitor liquid level, for transparent battery | One per each battery, length: 30cm |
| | | PBMS-Y26 | Monitor liquid level, for non-transparent battery | One per each battery, length: 50cm |
| | Leakage sensor | PBMS-LS-O35 | Monitor leakage with two ports (connect to the battery +/- port) | One/Two per each battery, length: 30cm<br>Hole diameter: 35mm |
| | Cabinet for pre-wiring in factory | PBAT-BOX-260 | Dimension: 535*260*350mm (W*H*D) | Pre-install & pre-wiring for PBMS9000Pro and HMI-9000Pro |

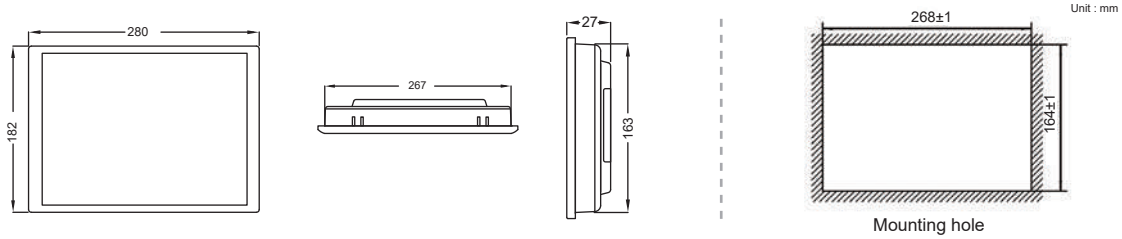
# HMI (Optional)

## Local Display & Operation for Different Main Controller

### HMI (Ethernet Connection)

- 10.1" inch touch-screen HMI for local display and operation
- OS: Android 10.0
- CPU: R818 (4-core A53 1.6GHz)
- Running memory: 1GB,
- EMMC: 8GB
- Support the reading and configuration of all parameters of the system





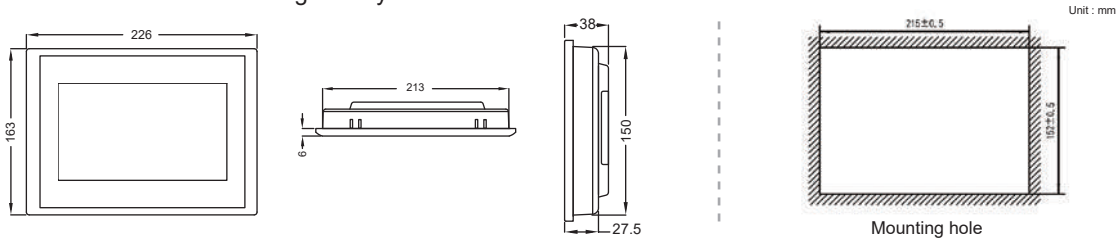

Order Information

| Model | Description | Remark |
|---|---|---|
| HMI-9000 | One per PBMS9000 main controller | One per PBMS9000, Communication with PBMS9000 via Ethernet |
| HMI-9000Pro | One per PBMS9000Pro main controller | One per PBMS9000Pro, Communication with PBMS9000Pro via Ethernet |

### HMI (Ethernet/RS485 Connection)

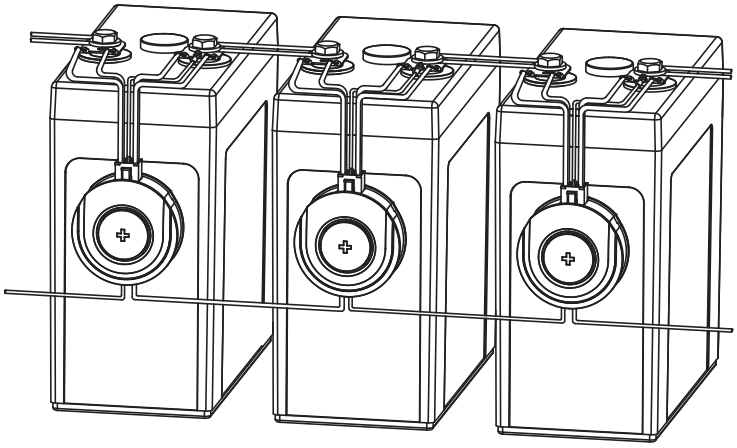
- 7-inch touch-screen HMI for display and operation
- **Real-time data inquiry:**
  1) Individual battery voltage, impedance, inner temperature, SOC, SOH
  2) String voltage, charge and discharge current, SOC, balance degree
- **Alarm data inquiry:**
  1) Real-time alarm status and related alarm information (faulty battery ID, date/time, alarm reason, communication status, etc.)
  2) 3000 alarm records for each string battery






Order Information

| Model | Description | Remark |
|---|---|---|
| HMI-Gate | One per PBAT-Gate main controller | One per PBAT-Gate, communication with PBAT-Gate via Ethernet |
| HMI-2000 | One per PBMS2000 main controller | One per PBMS2000, communication with PBMS2000 via RS485 |



# Case Study & Our Clients

Chapter 3

# Case Study

## Data Center

Thailand INET Data Center
Thailand True IDC Bangna Data Center
Thailand Suvarnabhumi Airport
Thailand KTP Bank
Malaysia Intel Data Center
Malaysia Ekova Data Center
Qatar OOREDOO Google Data Center
Qatar Lusail Towers Data Center
Dubai Gulf Data Hub Data Center
Chile Entel Data Center
Chile WalMart UPS IT Room
Chile Claro Telecommunication
Singapore ST Engineering IT Room
Singapore Changi Airport
Indonesia TELKOMSEL Server Room
Indonesia PLN Island Energy Storage
South Africa MTN Data Center
DATA POWER Perú S A C.
Turkey Turkcell Date Center
Vietnam VIETEL Data Center
ChinDATA - ChinaNorth H02 Data Center
Sangyuan Cloud Computer Industrial Base
Shanghai Cloud Data Center
Beijing TaiHeQiao Communication Power Supply
Beijing Guanghuan Net IDC
ZTE R&D Center IDC (ShenZhen Xili)
China Mobile IDC (GuangZhou)
Hubei University of Technology Micro-grid Experimental
Chengdu Wanda Online Cloud base (phase 1)
Shen Zhen Polytechnic
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## Transportation

Russia Moscow Metro Station
Australia Northconnex Traffic
Sydney North Connex Rail
XinJiang RailWay Station (Line 1)
HeFei RailWay Station (Line 2)
Chengdu Modern Tram (Line 2)
Changsha Metro Station (Line 4)
Harbin RailWay Station (Line 3)



## Bank & Substation

CHINA CITIC BANK (30 Branches)
Malaysia Bank of Negara
Thailand KTB BANK
Thailand GHB (Government Housing Bank)
Iran HREC Substation
Romania TRANSELECTRICA Substation
Romania Nama Raureni Substation
Singapore Panitan-Nanbas Substation Line 2
Greece IPTO Substation
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# Our Clients


vodafone
India


中国移动
China Mobile


Telkom
Indonesia


entel


viettel
Say it your way


TURKCELL


MTN
everywhere you go


KDDI
KDDI Thailand


trueIDC


Google


amazon


NTT


TM


G | D | H
Gulf Data Hub


CHINDATA
GROUP

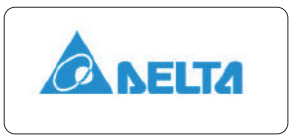

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EATON


KSTAR


HBL


HOPPECKE


LEOCH
Leoch Battery


EXIDE


JD.COM


Alibaba Cloud


Walmart


BASF
We create chemistry

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