

## KPM – BMS Battery Monitoring System

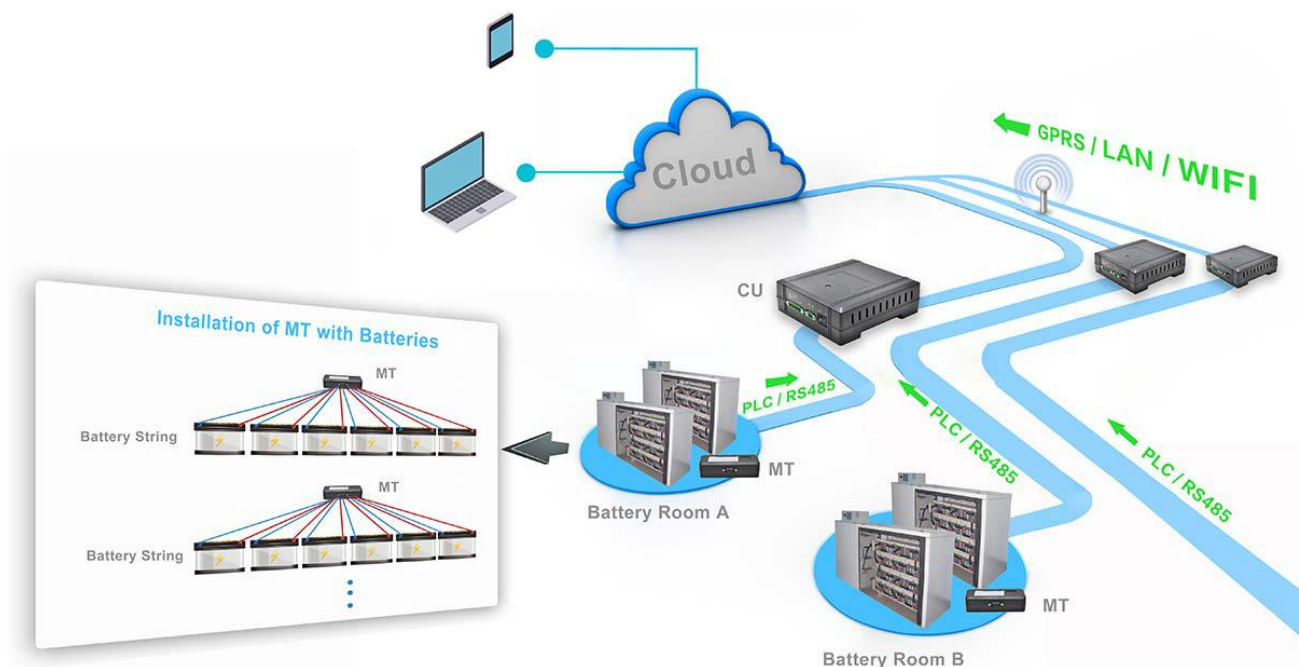
Real time knowledge about the battery condition is very significant to ensure the performance of critical power system. However, existing methods of manual measurement or online battery monitoring system will require very complicated wire connection, long time installation/commission, professional technicians and also very high cost. Therefore, the investment is pretty huge. What's more, they do not have complete measurement data to precisely predict battery capacity.

### More than Measurement Data!

**KPM – BMS** series battery monitoring system is an innovative solution to solve these problems. We apply new methods to measure battery condition with communication way of power line carrier (PLC). With multi-frequency measurement, users can analyze battery in all aspects including internal resistance, voltage, current, capacitance, temperature and so on. Based on KPM's years experience for battery management, we build very mature mathematical model that will precisely predict battery capacity. This will in another hand reduce the time that we spend on capacity measurement using a battery load bank.

With APP or Web page access based on Cloud server, you could easily manage your batteries simply with a smart phone remotely. Periodically you will receive very detailed diagnostic report from KPM indicating comprehensive data of your battery with suggestions and solutions in case of weak batteries.

### System Architecture



### System Composition

The whole KPM – BMS system is composed of two basic hardware components and one software component. Hardware will include **Monitoring Terminal (MT) & Control Unit (CU)**.

With Power Line Carrier (PLC) data transmission, measurement data will be collected by MT simply via battery straps and send to CU. It is no need to have extra time and money consuming communication cable or any other

wireless data transmission. This enables the system to be installed in almost all battery systems with very simple wire connection and it is interference-free to battery system.

### Monitoring Terminal (MT)

Communication with CU: PLC (optional: RS485)

Cells connected per MT: One MT can be connected with 1, 4 or 6 depending on customers' requirement and different battery wiring structure onsite.

Function: Test battery voltage, internal resistance, capacitance & temperature and send to CU via simply via power line carrier (PLC). It has battery equalization function.

Model selection: 1-channel, 4-channel & 6-channel



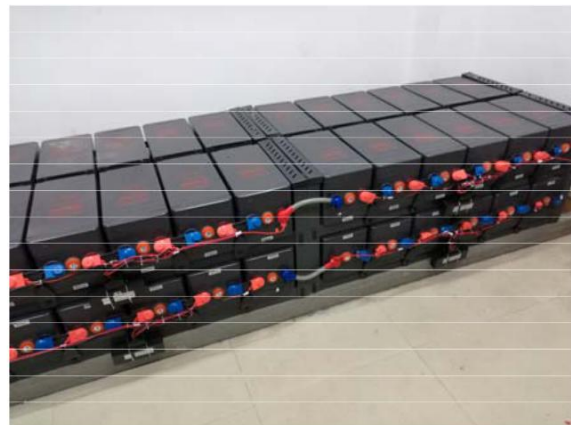
### Control Unit (CU)

Communication with server: WiFi or GPRS

Communication with MT: PLC (optional: RS485)

Function: Test string voltage, current and collect measurement data from MT simply via power line carrier (PLC). And it will send all data to cloud server via its built-in WiFi /GPRS module.

Onsite installation of battery monitoring system



## Our Advantages

### 1. Very simple wire connection, easy-going installation and commission onsite

KPM – BMS adopts the technology of Power Line Carrier (PLC) for data transmission. It takes advantage of communication circuit of battery string itself. Data of each cell will be transferred to CU simply via battery straps and power line, no need to connect extra wires or cables for data transmission. This saves you hours or even days of onsite installation and commission.

We use cloud computing platform for data management. Users do not need to purchase server or install server software by themselves. Just one login account and password from KPM will enable user to view everything about their battery condition simply with a smart phone.

### 2. KPM uses advanced mathematical model, consistent and precise

Customized solutions to meet different users in various applications. We have different types of monitoring terminals (MT). They can be connected to 1 cell, 4 cells or 6 cells each. Different terminals could be used for the same battery string. This makes it very convenient and flexible for connection with different types and wiring structure of batteries.

**3. Cloud server + mobile communication**

All you need is a smart phone to view battery status and all detailed information.  
Timely SMS warning info keeps you alert for lag-out or weak batteries.

**4. Smart and convenient methods for battery management**

Complete monitoring and recording for voltage, internal resistance, temperature and periodical monitoring for charge/discharge current. It helps you find out lag-out batteries beforehand.  
In case of power grid outage or manual switch-off of power grid for maintenance, system will automatically switch to discharge monitor. And it will record discharged Ah and voltage/temperature changes during discharge. This will further help judge the lag-out batteries.  
In case of battery malfunction, system will automatically send warning message to technician for immediate action.  
Map orientation of battery sites will help technicians reach site conveniently.

**5. Online battery equalization**

Battery equalization controls battery charge and discharge, effectively extend battery life.

**6. Unique technology for system resting**

Each MT gets very low power from batteries, no harmful to batteries that are monitored.

**7. More than measurement data, you get solutions**

Every month, you will get a very detailed analyzing report from KPM . This report will analyze all battery conditions completely. In case of battery failures, we will provide solutions in the report. This will enhance the reliability of your system. You do not also need to go the site for manual inspection and measurement. It saves your time and manpower.

**Typical Application**

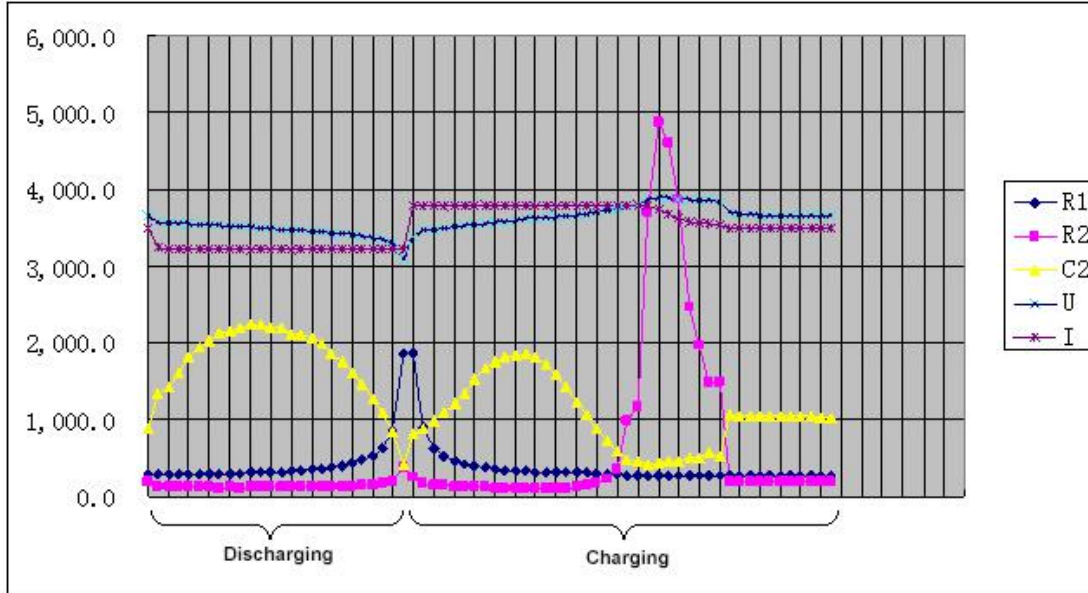
It could be used widely in many areas for battery online monitor like:

- Power substation
- Telecom machine room
- Data center
- Locomotive/Metro Steamship
- Forklift/truck
- Offshore platform
- Energy storage



## Our Unique Battery Measurement Technology

In our battery model, we use the method of AC discharge under different frequencies. We will measure different parameters and their changing tendency in battery charge and discharge. This tendency could be described as the diagram below:



The change of R1, R2, C2, U, I during battery charging and discharging

In this diagram, it is a process of firstly battery discharge and then charge. Electrical double-layer capacitance (C2) is very sensitive to battery capacity. And battery electrochemical resistance (R2) is very sensitive to chemical reaction during battery charging. It could be adopted to indicate if battery is full charged or not, which will avoid over charge that will decrease battery life due to hydrolysis reaction. Meanwhile, considering that battery aging will also decrease its voltage after full-charge, we will take voltage, ohmic resistance, electrochemical resistance and electrical double-layer capacitance as variable, and thus build the functional relation as the formula below:

$$Soh=f(V, R1, R2, C2)$$

We build the mathematical model based the parameters of V, R1, R2 and C2. Based on the experimental statistic and method of system identification, we will identify the parameter in this mathematical model. We will measure and gain values for parameter of V, R1, R2 and C2 under battery full charge or float charge. After substitution these values in the formula above, we will gain the value for SOH which is very close to capacity measurement that is done by a regular battery discharge.

## Other Parts



### Current Clamp (CT)

Function: Customized DC current clamp for measuring battery string discharge and charge current. Customized as 50A, 100A, 200A, 300A or the alike.

Power supply: No external power supply, it is powered by CU BUS.





**1-channel Measurement Cable**

Connection: Each cable is connected with one cell.

Feature: There is built-in temperature sensor on the clip. Cable length and clip size are customized for different battery posts.



**4-channel Measurement Cable**

Connection: Each cable is connected with 4 cells.

Feature: There is built-in temperature sensor on the clips. Cable length and clip size are customized for different battery posts.



**6-channel Measurement Cable**

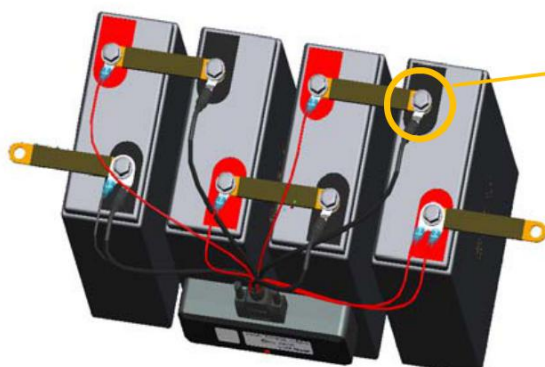
Connection: Each cable is connected with 6 cells.

Feature: There is built-in temperature sensor on the clips. Cable length and clip size are customized for different battery posts.

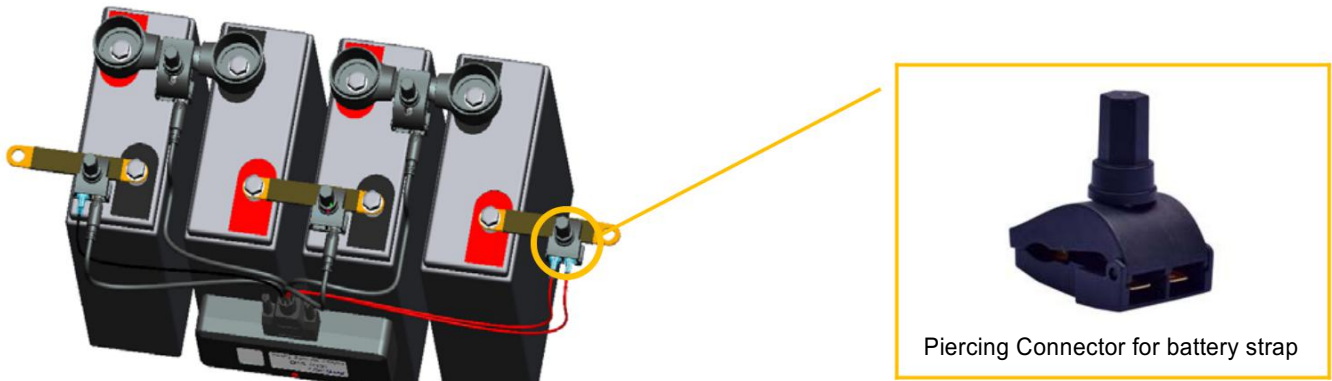
**Onsite installation of measurement cables**

For different styles of battery inter-connection onsite, KPM offers various options of connectors for fast connection of MT with battery posts or battery straps. You could either install the monitoring system when batteries are online or offline. This greatly simplifies onsite installation. Temperature sensor is built-in the measurement cables to record temperature of each cell.

**Ring Connector:**



**Piercing Connector:**



**Product Series**

Model Name	Communication between MT & CU	Cell type	MT channels
BMS-4/A	PLC	12V	4-channel
BMS-4/B	RS485		
BMSB	PLC		
BMS-6/A	PLC	2V	6-channel
BMS-6/B	RS485		
BMS-1/A	PLC	2V & 12V	1-channel
BMS-1/B	RS485		

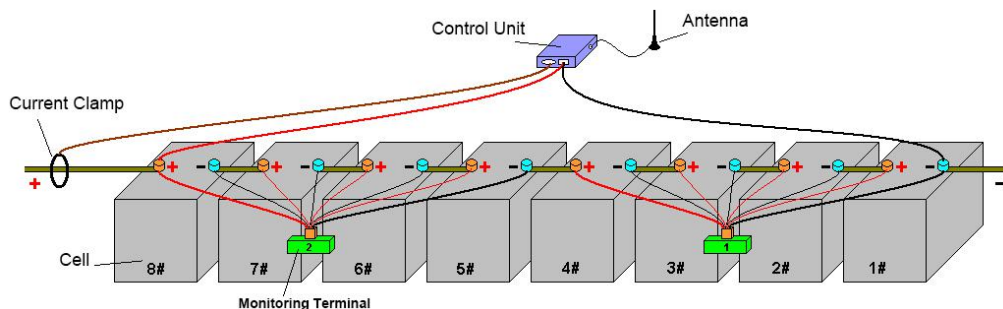
**NOTE:**

- There are two optional ways of communication between MT and CU: PLC and RS485. When it is using PLC (Power Line Carrier), you will not need extra cables between each MT and U for data transmission. The data recorded by MT will be transferred via the battery power line to CU directly. This simplifies the wire connection and makes it very easy going for onsite system installation. RS485 is optional for communication. It is for connection between each MT and CU.
- There are 3 models of MT: 1-channel, 4-channel and 6-channel for connection of 1 cell, 4 cells and 6 cells respectively. They are for different battery type and based on different wiring structure onsite.
- For BMS -1/A, the MT could be alternatively installed outside or inside the battery. When it is installed inside, it will need remolding of batteries.

**BMS-4/A**

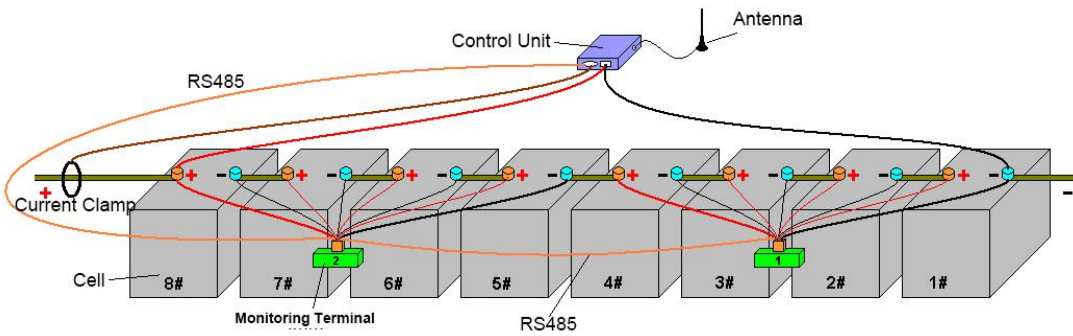
MT communication: PLC, no need extra communication cables.

Cells connected per MT: 4



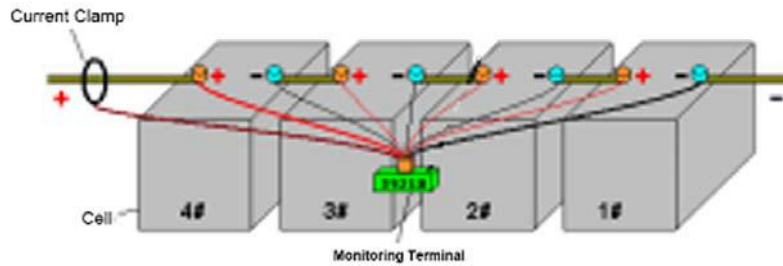
**BMS- 4/B**

MT communication: RS485, need extra communication cables.  
 Cells connected per MT: 4



**BMS-B**

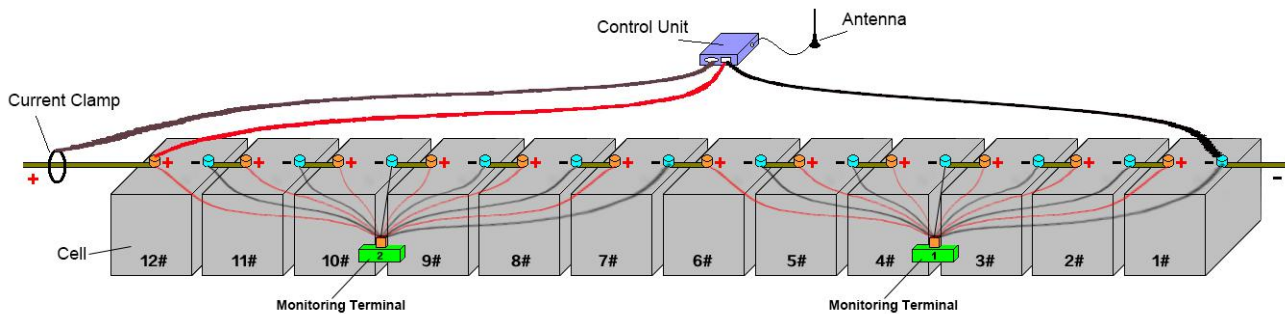
Cells connected per MT: 4  
 MT and CU is integrated as ONE



This application is typically used in telecom battery system where there are 4 cells of 12V. In this application, CU and MT will be integrated as ONE single unit which will measure each cell and transfer data to server directly via its build-in communication module.

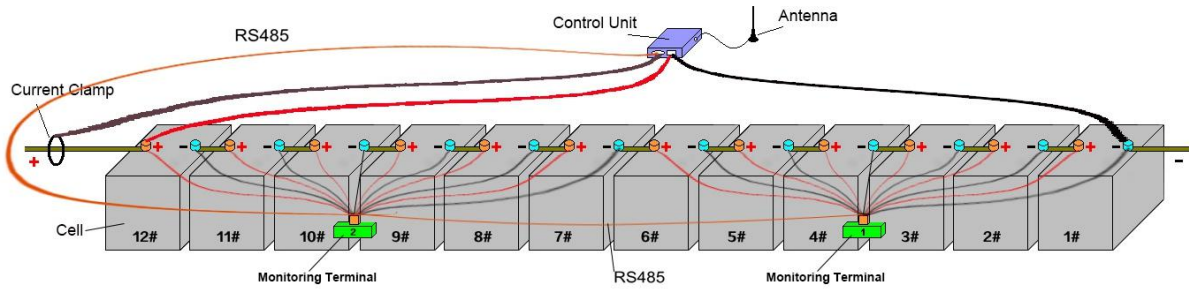
**BMS--6/A**

MT communication: PLC, no need extra communication cables.  
 Cells connected per MT: 6



**BMS-6/B**

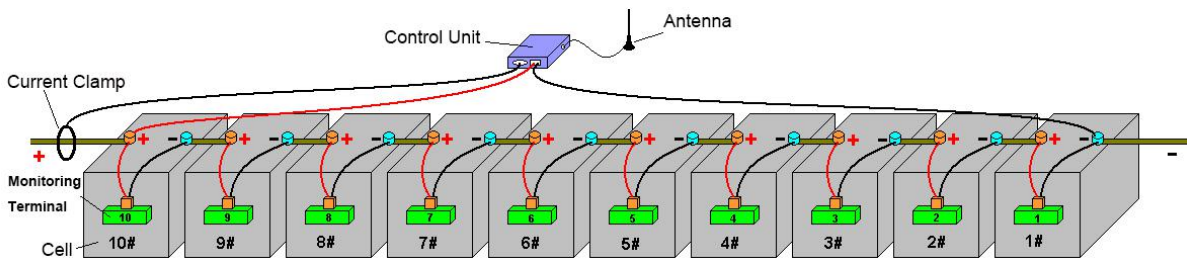
MT communication: RS485, need extra communication cables.  
 Cells connected per MT: 6



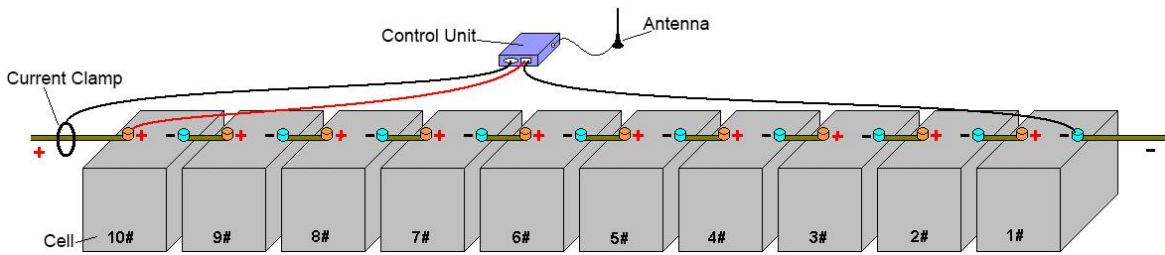
**BMS-1/A**

MT communication: PLC, no need extra communication cables.

Cell connected per MT: 1



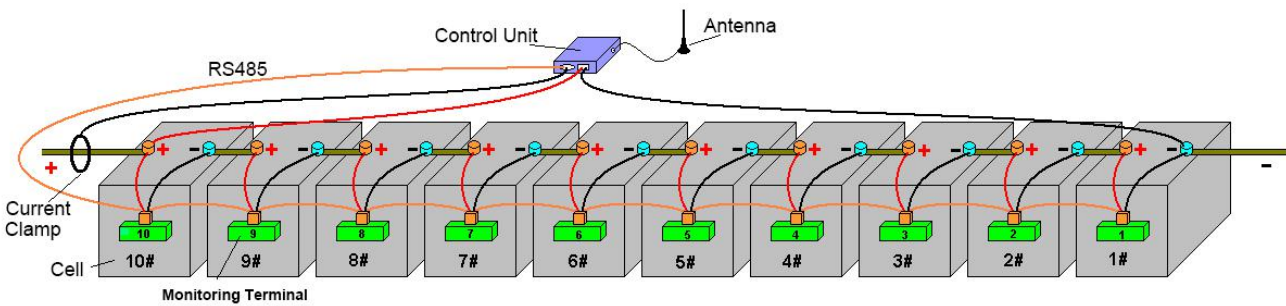
When the MT is installed inside each cell, wire connection will look like normal battery connection as below:



**BMS-1/B**

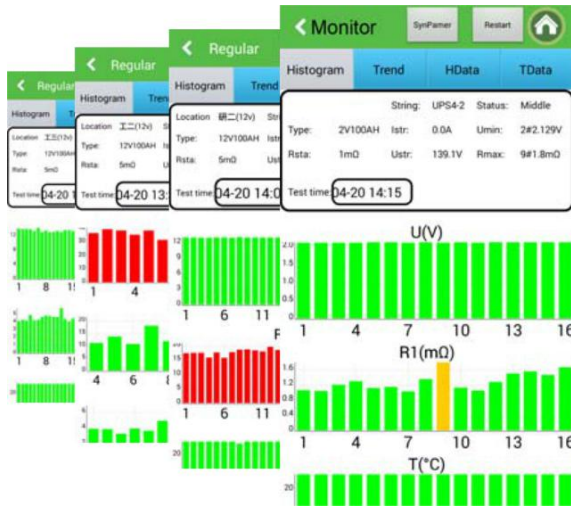
MT communication: RS485, need extra communication cables.

Cell connected per MT: 1





## Data Interface



With KPM's cloud servers in different countries of the world, users can easily access to KPM's data system simply with a smart phone or web page. All parameters could be viewed clearly in hand. Lagged out batteries will be listed with warning information sent to battery administrator timely beforehand.

What's more, you will get a very detailed analyzing report from KPM periodically. It will analyze all battery conditions in different aspects. In case of battery failures, we will provide solutions in the report.