Billion Watts Technologies

Professional Solar Farm Management System

BILLION Watts

Billion Company Facts

- Founded in 1973
- IPO since 2000 (TAIEX: 3027)
- Headquarter: Taipei, Taiwan

  Billion USA: BEC Technology, Texas, USA
- Number of employees: > 900
- Business focus: Networking Communication, Power, and Energy Management Products and Solutions

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Our Capacities

Headquarter
Taipei, Taiwan

R&D Team
HsinChu, Taiwan

R&D Team
Nanjin, China

EG-Billion
Dongguan, China

BEC Technology
Texas, USA

Various Product Selections
Networking Communication Routers/Modems
LED Drivers/SPD/Power Supplies
Smart Indoor Lighting/Street Lighting Solution
Enterprise/ Commercial Energy Management Solution
Solar Power Plants Investment
Solar Power Monitoring System

100% Owned Plant
Billion HQ , Taipei

1 x SMT
1 x DIP
1 x Assembly

100% Owned Plant
EG-Billion China

4 x SMT
5 x DIP
7 x Assembly

Pb-Free Manufacturing Processes

Total Product Capacity:

400,000 Units

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Billion Global Customers

1. Over 43 years of proven track record in the development of Power and ICT technologies.
2. Comprehensive IoT (Internet of Things) management solutions in Lighting, Smart Grid, and Industrial and Commercial Energy Management.
3. Distribution network penetrates in over 35 countries. Now focus heavily on collaborating with regional partners across the globe to drive Smart Energy and Smart Lighting system deployments.

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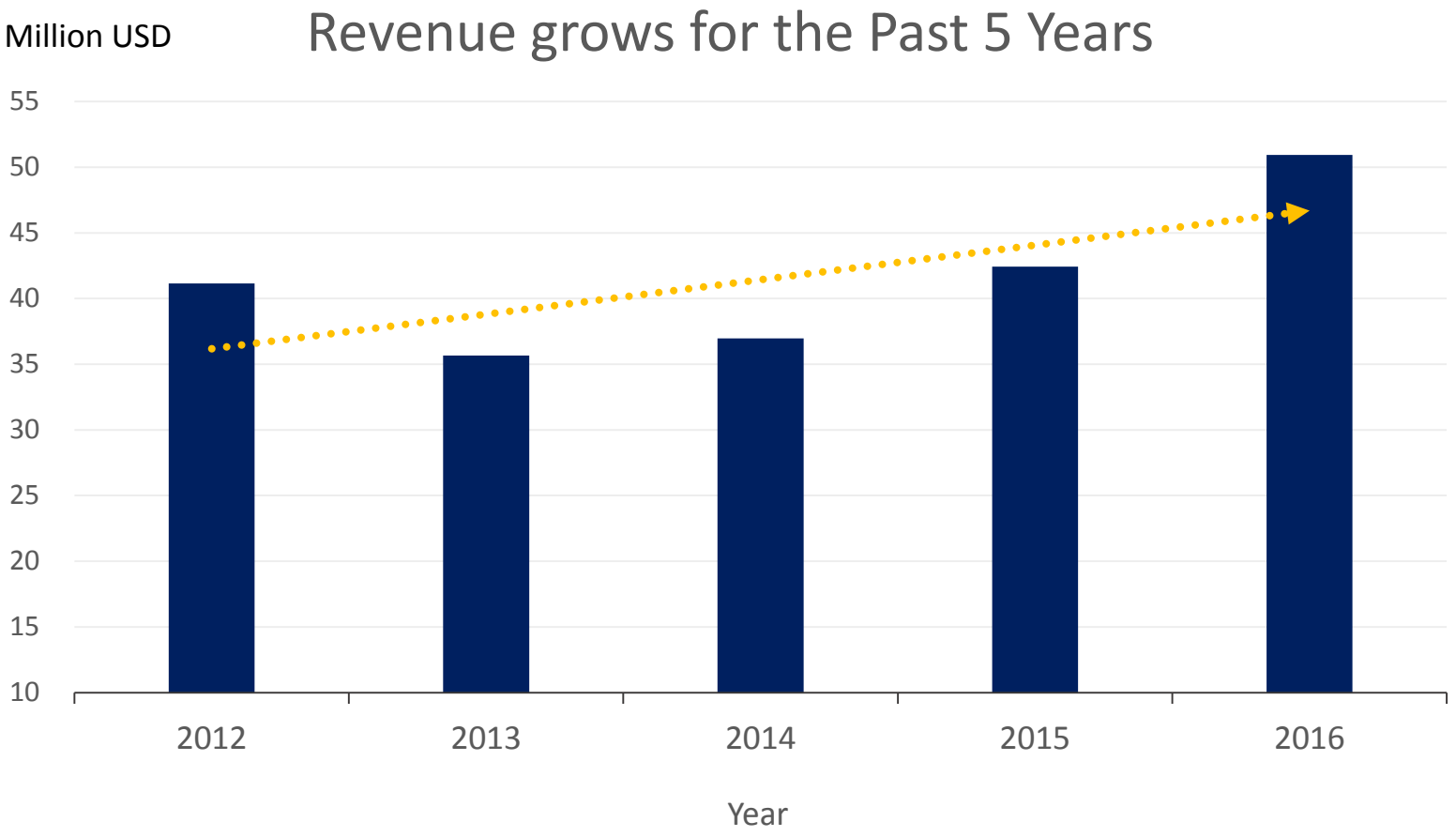
Revenue



Year	Revenue (USD in Million)
2012	41.15
2013	35.67
2014	36.97
2015	42.44
2016	50.93

Growth Rate :

20%

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- Complete Solar Farm Monitoring System
- Monitor detailed PV data generation down to the String level
- Compatible with all brands of inverters and solar modules
- Cost efficient PV monitoring system and significant reduction of O&M cost

To compensate the congenital deficiency on PV power generation

Chapter 1
The Importance of PV Serial & Parallel Monitoring

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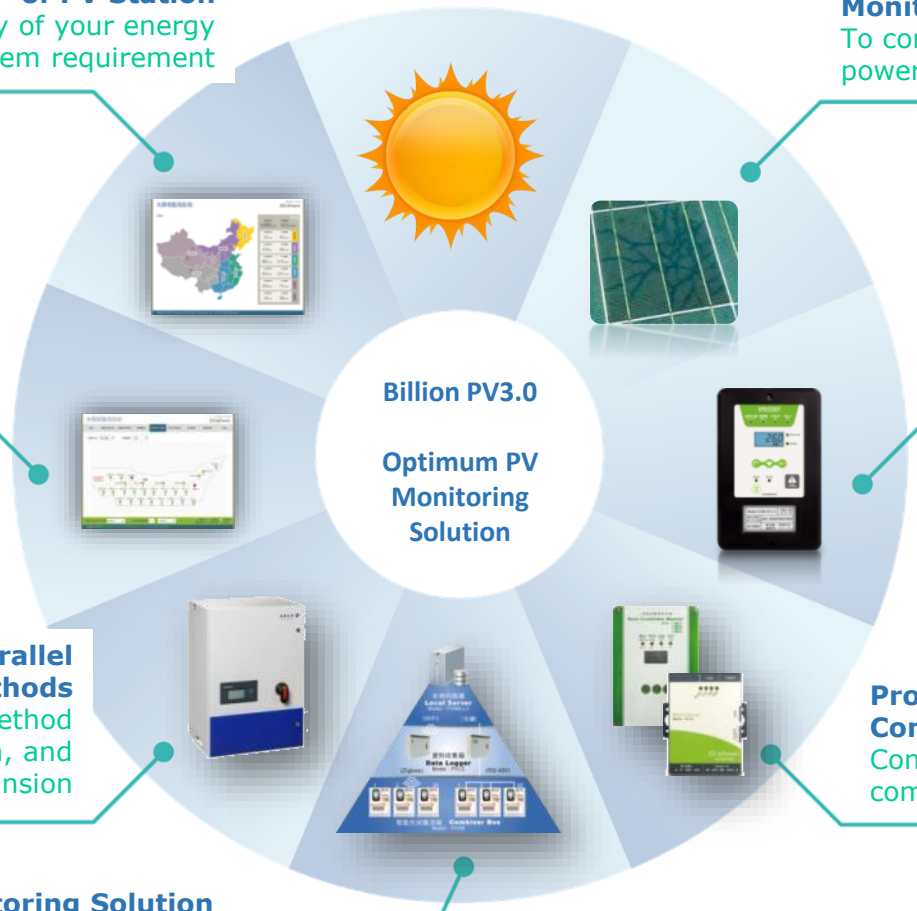
Billion PV3.0 - Optimum PV Monitoring Solution

Comprehensive Features Maximize the Yield of PV Station
One system meets every of your energy management system requirement

The Important of PV Serial & Parallel Monitoring
To compensate the congenital deficiency of PV power generation

The Essence of PV Monitoring System
Unique advanced function management
User-defined intelligent operation and maintenance filter



PV Serial & Parallel Monitoring Key Technology
Precise wide temperature PV serial monitoring

High Economical PV Serial & Parallel Methods
Standardize, consistent installation method
Beneficial for PV construction, operation, and future expansion

Providing One-stop Service and Business Continuity
Comprehensive hardware and software and communication measurement

Flexible, Scalable PV Monitoring Solution
Comprehensive, economic hardware & software design.

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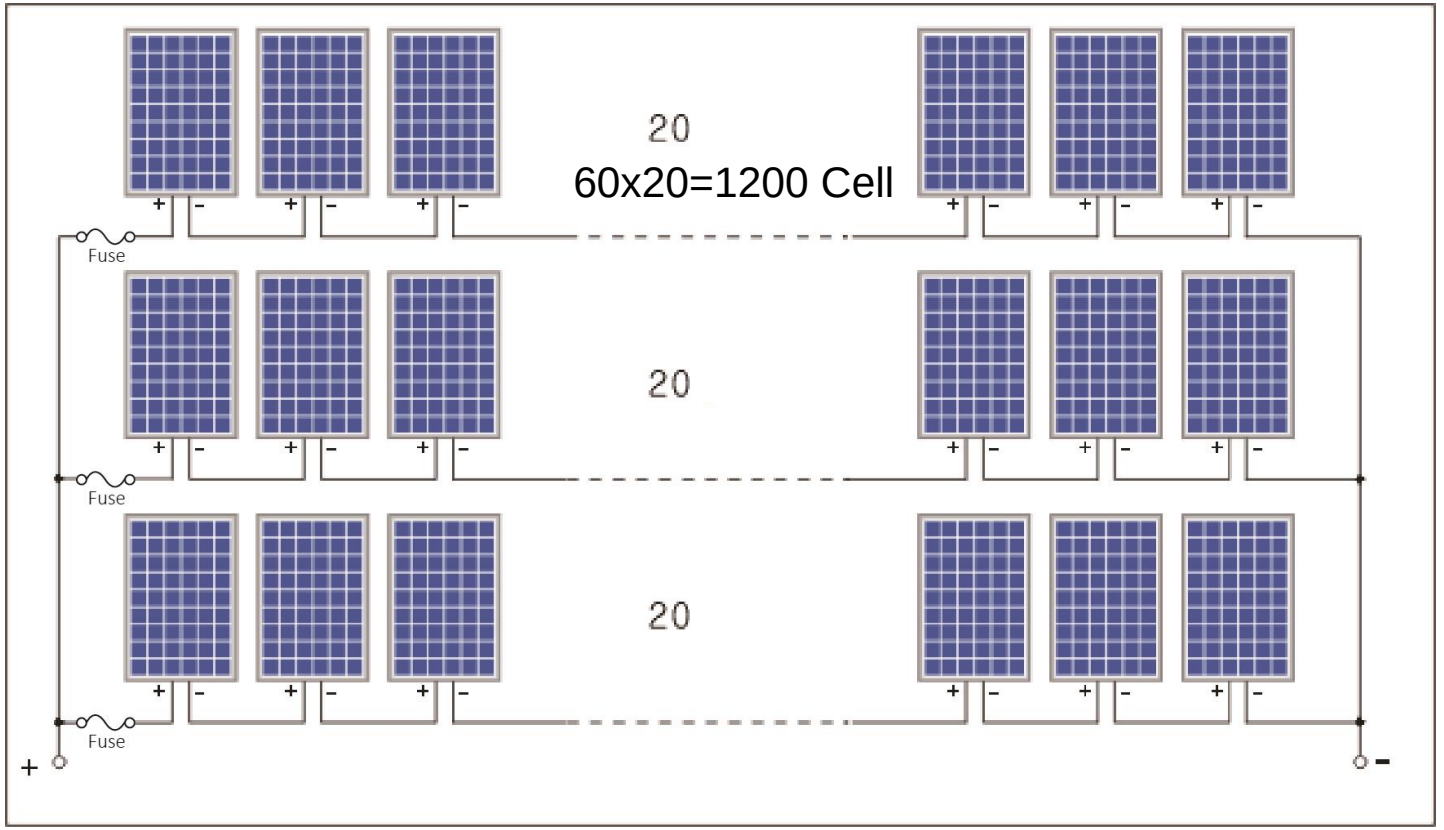
PV Array Composition Diagram

20 strings and 3 arrays (how to ensure that each cell work?)



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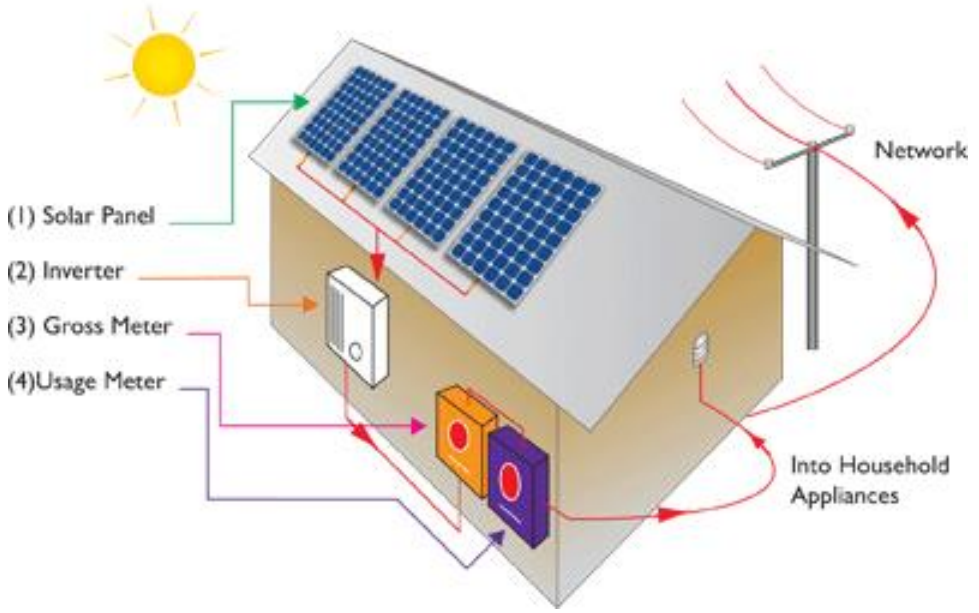
PV Module Combination Losses

- Any series will encounter current loss due to current component differences.
- Any parallel connection will meet voltage loss due to the module voltage difference.
- The combined loss sometimes can reach up to more than 8%; however, the general provisions should be less than 10%
- PV modules are made of PV cells connected in series, to reduce the loss of a combination, components must be consistently selected and placed in series.
- PV power arrays must be carefully selected with PV modules featuring consistent current in series and constant voltage in parallel to reduce the combined losses.



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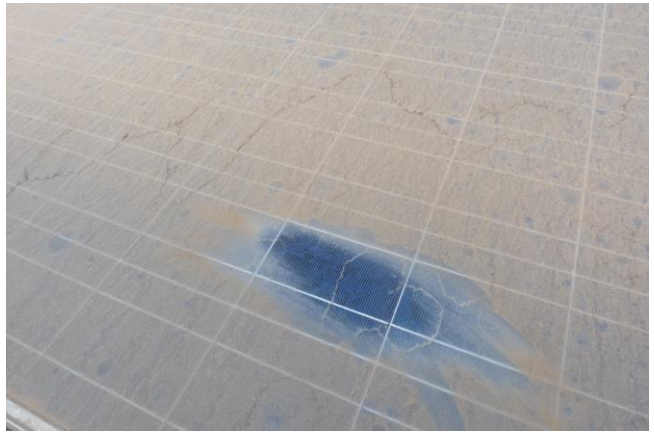
PV Power Generation Greatest Weakness: Shading Effect

- General PV power generation system is combined with various solar modules in series to achieve sufficient voltage, and then connect the series in parallel. The inverter converts the power to the load, but if any of the solar PV modules in series is partially shielded, the output characteristics will change, and the power generation efficiency will be reduced, that is called “the shading effect”.
- Any shade, such as dust, bird droppings, adjacent building shadows, etc., will result in a substantial decline in solar photovoltaic power generation system. When the shade is severe, the same group of solar modules will have almost zero power output.

Bird Droppings

Dust



Adjacent Building Shadows

Five Major Factors Determine the PV Power Generation

1. PV module quality	● The hot spot effect ● The snail veins ● PID attenuation (hydrolysis of EVA resin resulting in power attenuation)
2. Shading effect loss	● Dirt accumulation ● Bird excreta ● Other shades
3. Component combination loss (junction box)	● The status of each PV confluence loop ● Electrical current in each loop is the same ● Comparison of the generation of each loop to another
4. Inverter switching losses	● The status of each inverter ● The tracking and efficiency of MPPT · load shedding as a result of overheating ● The status of each inverter compared with one another
5. Line loss	● The status of each series & parallel of DC circuit ● Status of the fuse ● The line loss of DC and AC after confluence? Infirmly assembled?

PV Station Maintenance Common Problems

1. When a PV station is completed, how do we assess its standard and data?
2. What is its RA ratio? If it's too little how to fix it?
3. For daily maintenance，how to make sure that each panel is operating normally? The working rate and electricity generation data of each loop?
4. How to make sure that each inverter and its surrounding s are working regularly? Conversion rate data?
5. Is the temperature too high?
6. When in malfunction, can we know in real time when and where?
7. The PV module accumulates excessive dust? When do we clean it?
8. Relative electricity generation data?
9. How do we maintain the PV station working at a high efficient rate while using a minimum amount of human resources possible? Comparison with other PV station?

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Precise Wide Temperature PV Serial Monitoring

Chapter 2
PV Serial & Parallel Monitoring Key Technology

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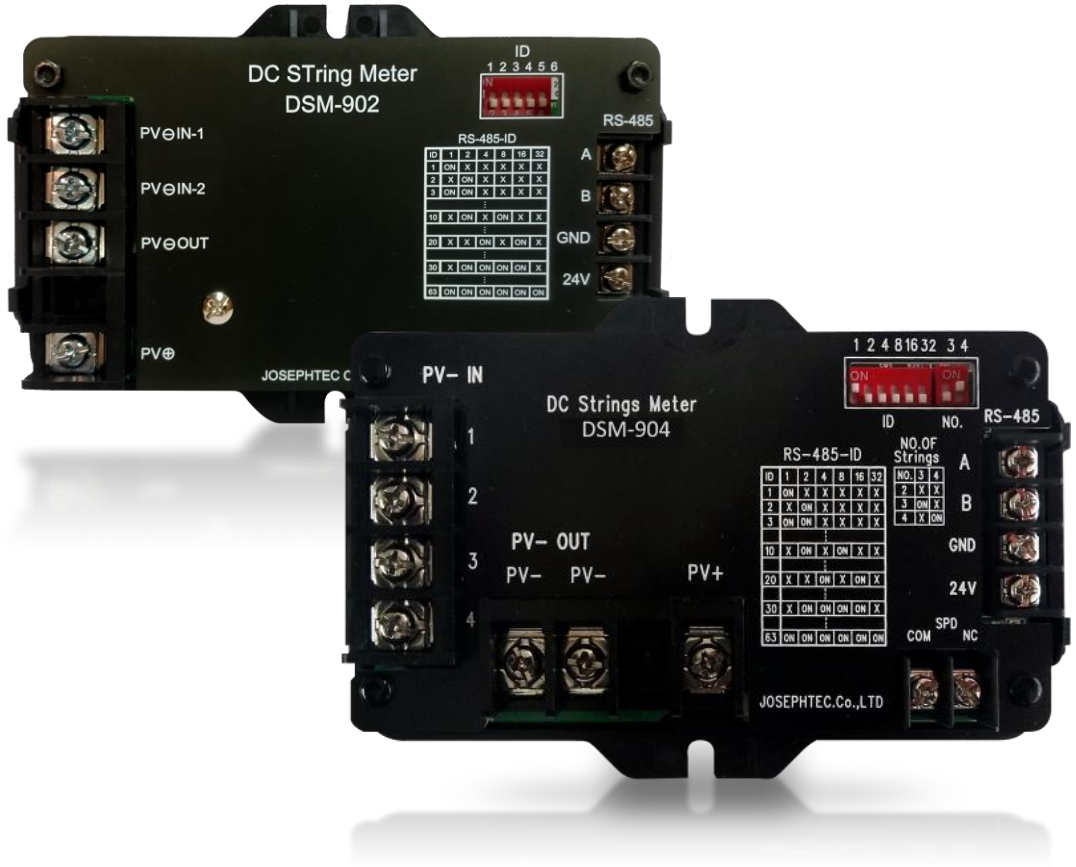
2/4 String DC Tandem Meters – SG3202S, SG3204S

- The 2 and 4 DC Strings Meters are suitable to be installed on small & medium sized DC combiner box and can measure the total power generation and the total accumulated power of the four groups (SG3204S) or 2 groups (SG3202S) PV power generation circuit.
- SG3202S and SG3204S can also measure the power of each branch of the individual power, and the current voltage, current, ambient temperature and arrestor action detection and so on.
- Data can be collected by SG6300NX(Z)L through the RS-485 interface. Featuring computer control or network remote monitoring, we ensure that individual pieces of PV panel and strings are generating optimal electricity.



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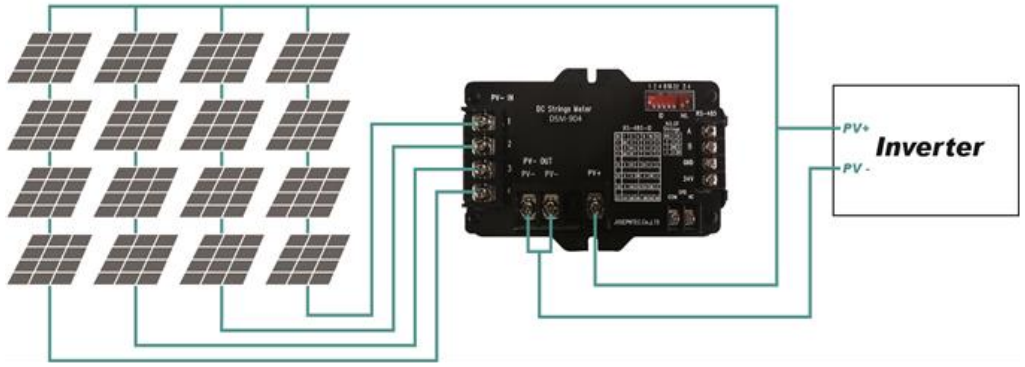
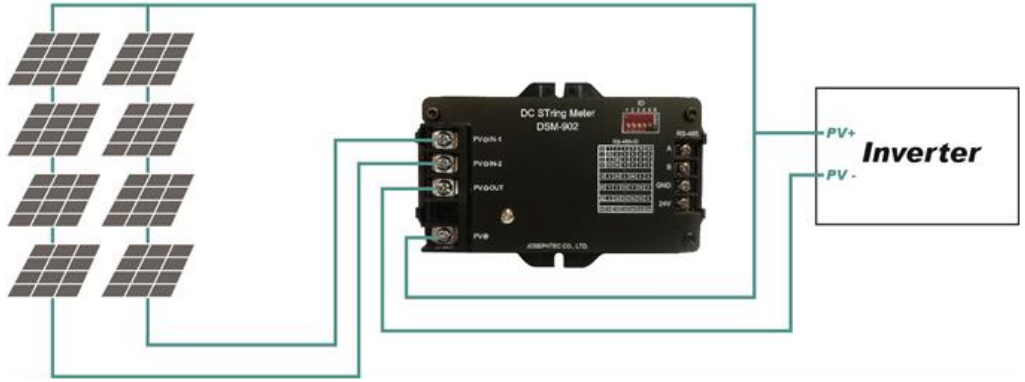
Overview & Features

- **Wide Range Usage Temperature**：40V~800Vdc
- **Low power consumption**：< 0.5W (including voltage measurement & circuit consumption)
- **Wide Range Operation Temperature** ： -40°C~75°C
- **High Precision** ：
  kWh, W, Vdc, A measurement accuracy：
  - ±1%+0.5%FS (@ TA 0~40°C)
  - ±2%+ 1 %FS (@ TA 40~70°C)
- **Wide Range Measurement**：
  - Voltage measurement range: 40Vdc~1000Vdc，resolution 0.1Vdc
  - Each string electrical current: 0.1A~15A， resolution 0.01A
  - Each string electrical power range: 0.01kW~12kW，resolution 0.001kW
  - Total energy metering range: 0.1kWh~99999 kWh
- **Power Source:**
  - External 24~48Vdc power source。





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12 Strings DC Tandem Meters - SG3212 (S)

- This DC String Meter is suitable for medium large PV stations, it should be installed in DC confluence box and it can detect the total amount of working rate and accumulated electricity generation of 12 sets of PV loops. It can also measure each loop's working rate, power voltage, electrical current, ambient temperature, and lighting condition.

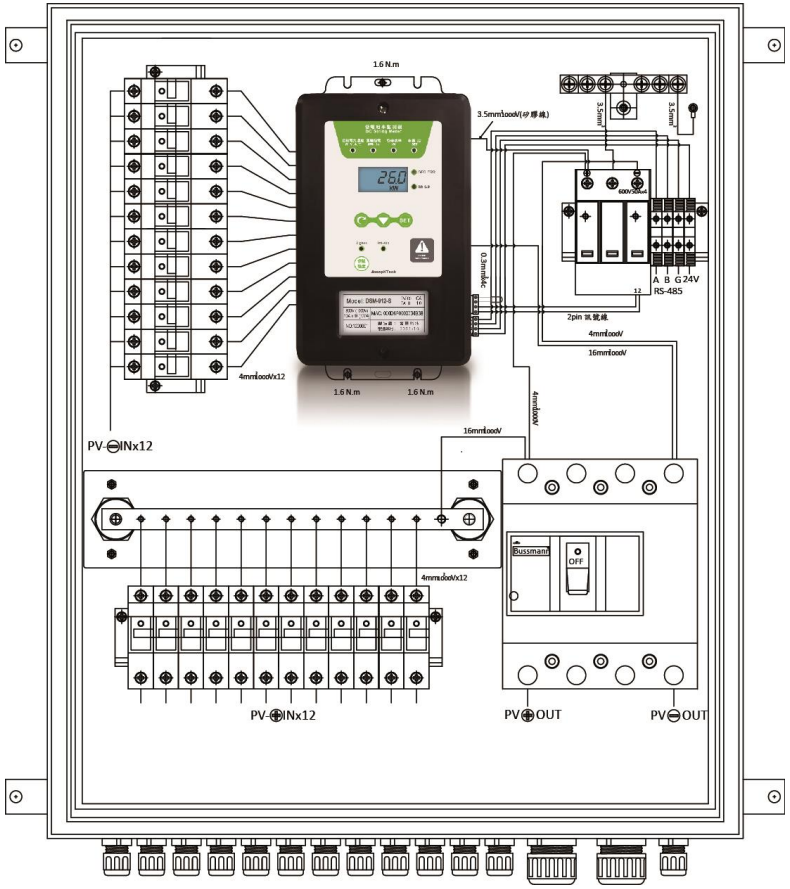
- Data can be displayed via the built-in LCD screen, and can be collected by the RS-485 or wireless Zigbee interface. Featuring computer control and network remote monitoring, SG3212 (S) ensures that every piece of PV board, each circuit is normal power generation.

- The SG3212 (S) features a wide measurement & operating temperature range with excellent accuracy and stability, suitable for outdoor harsh environments.

BILLION Watts

Overview & Features

- Wide Range Usage Temperature : 150Vdc~1000Vdc
- Low power consumption : < 3W (including voltage measurement & circuit consumption)
- Wide Range Operation Temperature : -40℃~75℃
- High Precision :
  - kWh, W, Vdc, A measurement accuracy :
  - 0.5%+ ±0.5%FS (@TA 0~40℃)
  - 1%+ ±0.5%FS (@TA -40~70℃)
- Wide Range Measurement :
  - Voltage measurement range : 150Vdc~1000Vdc，resolution 0.1Vdc ;
  - Each string electrical current: 0.1A~15A， resolution 0.01A ;
  - Each string electrical power range: 0.01kW~15kW， resolution 0.001kW ;
  - Total energy metering range : 0.1 kWh ~99999 kWh
- Certification : CE EMC、Taiwan Electric Power Research and Testing Center、National Solar PV Product Quality Supervision and Inspection Center
- Power Source: PV Power Source。



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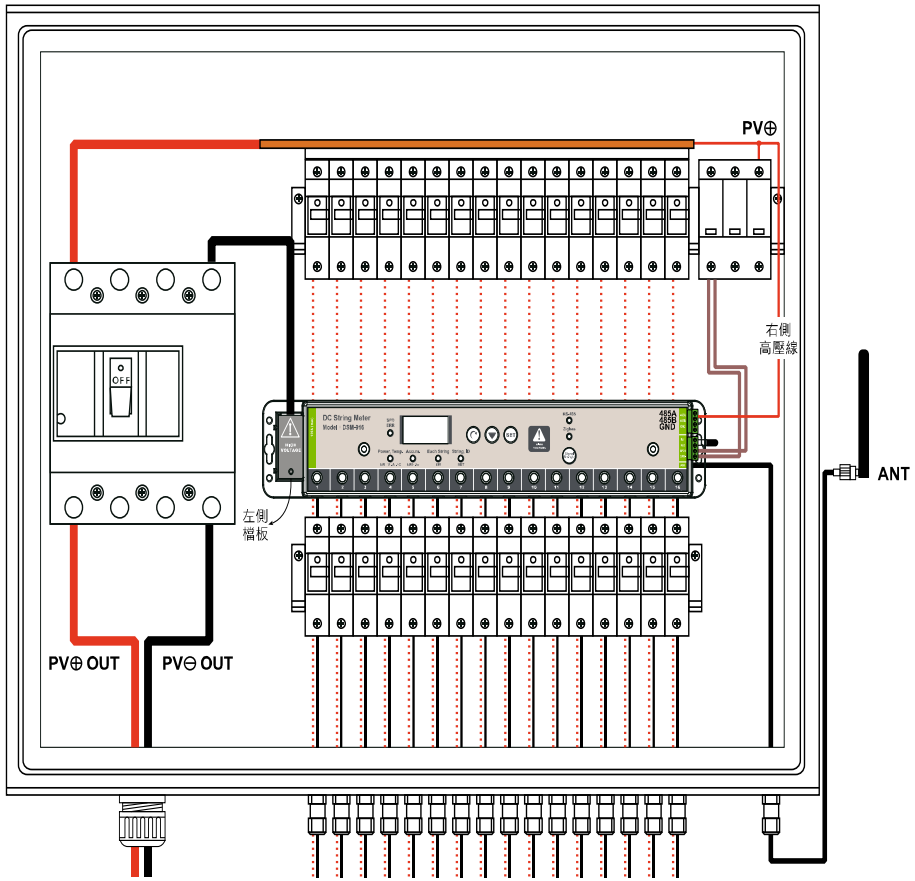
16 String DC Series Monitor- SG3216 (S)

- Overview
  - SG3216 (S) is suitable for generation monitoring at large PV stations. It is installed in DC confluence box and can detect the total amount of PV electricity and the accumulated electricity generated from16 PV strings. SG3216 (S) can also measure each string’s electrical rate, power voltage, electrical current, ambient temperature, and lighting condition. ◦
  - Data can be displayed on the built-in LCD panel and can be collected by SG6300N(Z)XL via the RS-485 or wireless Zigbee interface. With computer control and network remote monitoring, SG3216 (S) can ensure that every piece of PV module and string are generating the optimal electricity.
  - The SG3212 (S) features a wide measurement & operating temperature range with excellent accuracy and stability, suitable for outdoor harsh environments.

BILLION Watts

Overview & Features

- Wide Range Usage Temperature : 150Vdc~1000Vdc
- Low power consumption : < 3W (including voltage measurement & circuit consumption)
- Wide Range Operation Temperature : -40℃~75℃
- High Precision :
  - kWh measurement accuracy : 0.5%+0.5%FS (@TA 0~40℃);
  - W, Vdc, A measurement accuracy : 1%+0.5%FS (@TA -40~70℃)
- Wide Range Measurement :
  - Voltage measurement range : 150Vdc~1000Vdc, resolution 0.1Vdc
  - Each string electrical current: 0.1A~15A, resolution 0.01A
  - Each string electrical power range: 0.01kW~15kW, resolution 0.001kW
  - Total energy metering range : 0.1 kWh ~99999 kWh
- Power Source : Use the power supply for the panel.
- Certification : Taiwan Electric Power Research and Testing Center、National Solar PV Product Quality Supervision and Inspection Center



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Comparison Table

	Other brands	DSM-912/916 billion
Precision	None	0.5%@-40~75℃ National certificate
Product design	Component wise : measurement, power, communication	Integration of many components
Reliability	1~2 years	5~6 years
Power consumption	10~20W	<3W
Current detection	Use hall components, prone to temperature fluctuation	Adapt negative resistance detection measurement technique, resistant to temperature fluctuation
Communication	RS-485	RS-485、Zigbee (RS-485/Zigbee mix)
Back end platform	Data inquiry	Customize
Price	Average	Competitive

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Providing One-stop Service and Business Continuity

Comprehensive hardware and software and communication measurement

- The solar radiation monitor can transfer the measured data via use RS-485 or Zigbee. The cumulative solar energy (kWh) can be used to analyze the solar panels for a long time power generation efficiency and attenuation. The temperature data can be detected on solar panels level.

Solar Radiation Monitor
SG70 Series

- Featuring (-40 ℃ -75 ℃) hardware design, SG6300NXL supports PLC, RS485 and Zigbee equipment, solar data can be sent to the back-end software for real-time analysis and monitoring through the Ethernet, Wireless, 3G, 4G / LTE.

Wide Range Temperature
Multi-Function Gateway
SG6300NXL

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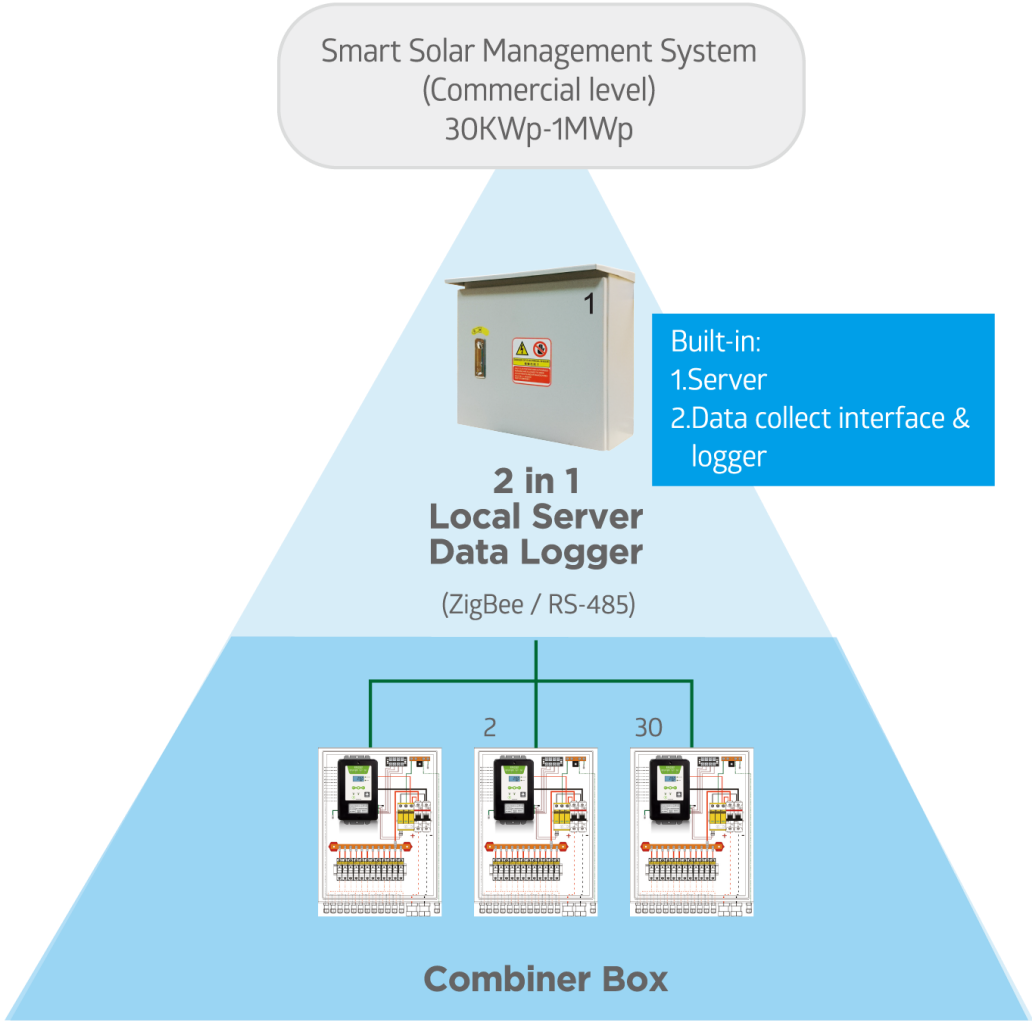
Intelligent PV Convergence Management System
PVMS-L2(30kWp~1000kWp)



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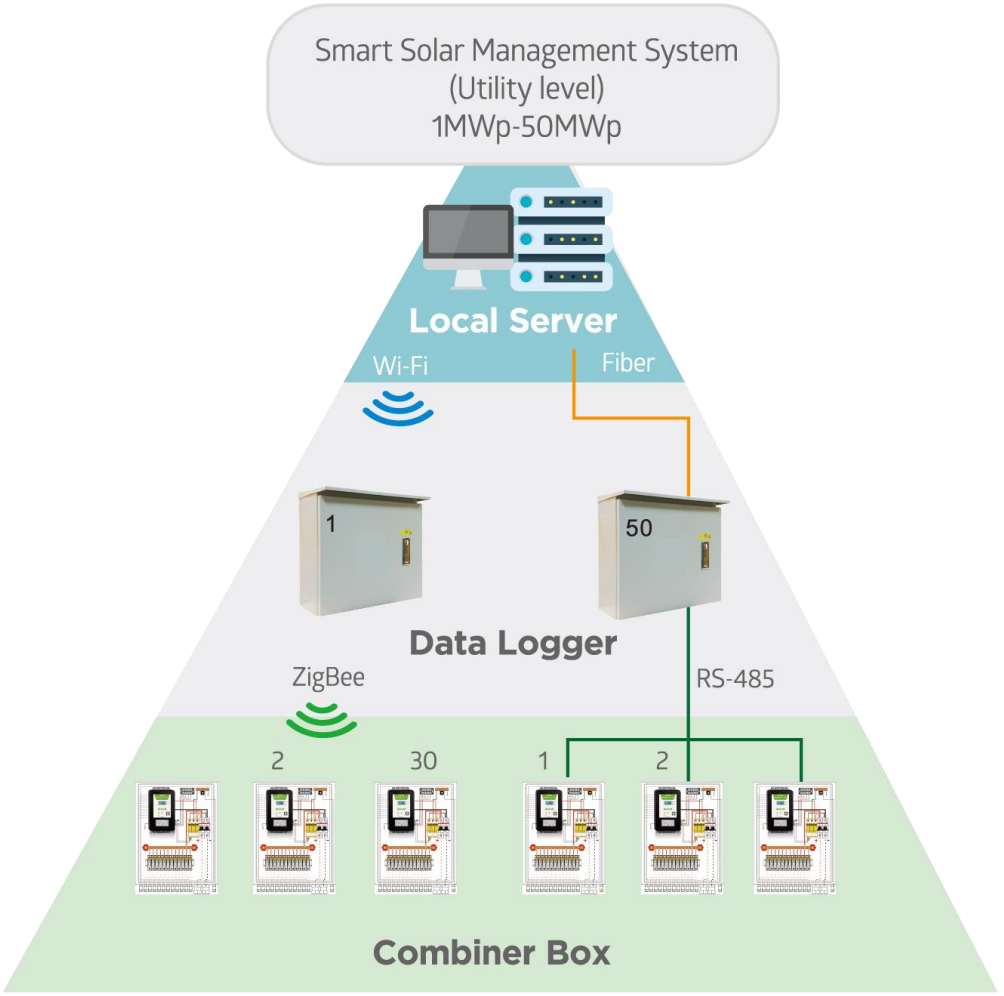
Intelligent PV Convergence Management System
PVMS-L3(1MWp~50MWp)



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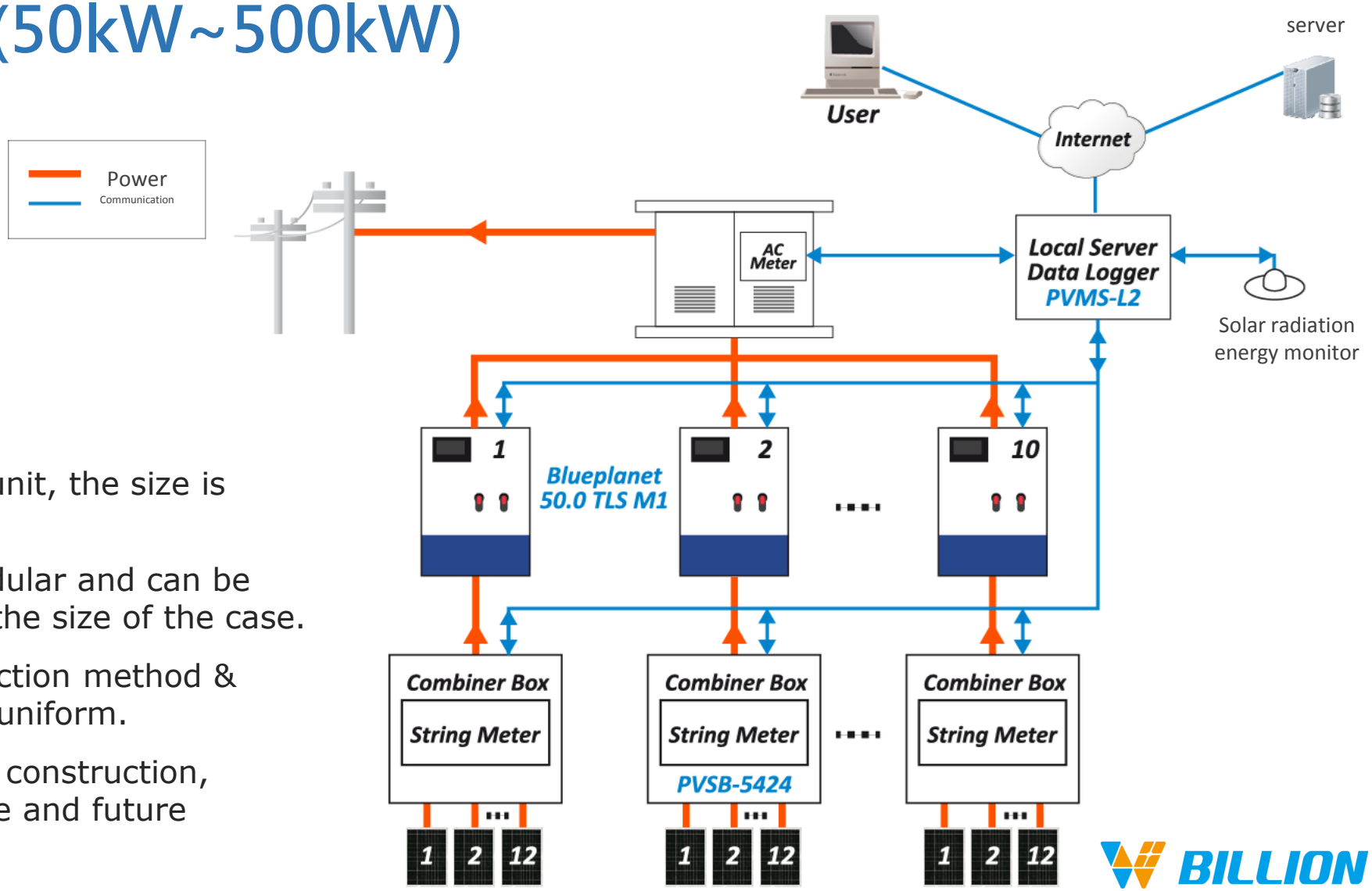
1. Optimized PV Station for Commercial & Industrial Distribution Level (50kW~500kW)



- 50kW as a unit, the size is moderate.
- Easy to modular and can be adapted to the size of the case.
- The construction method & standard is uniform.
- Scalable for construction, maintenance and future expansion.

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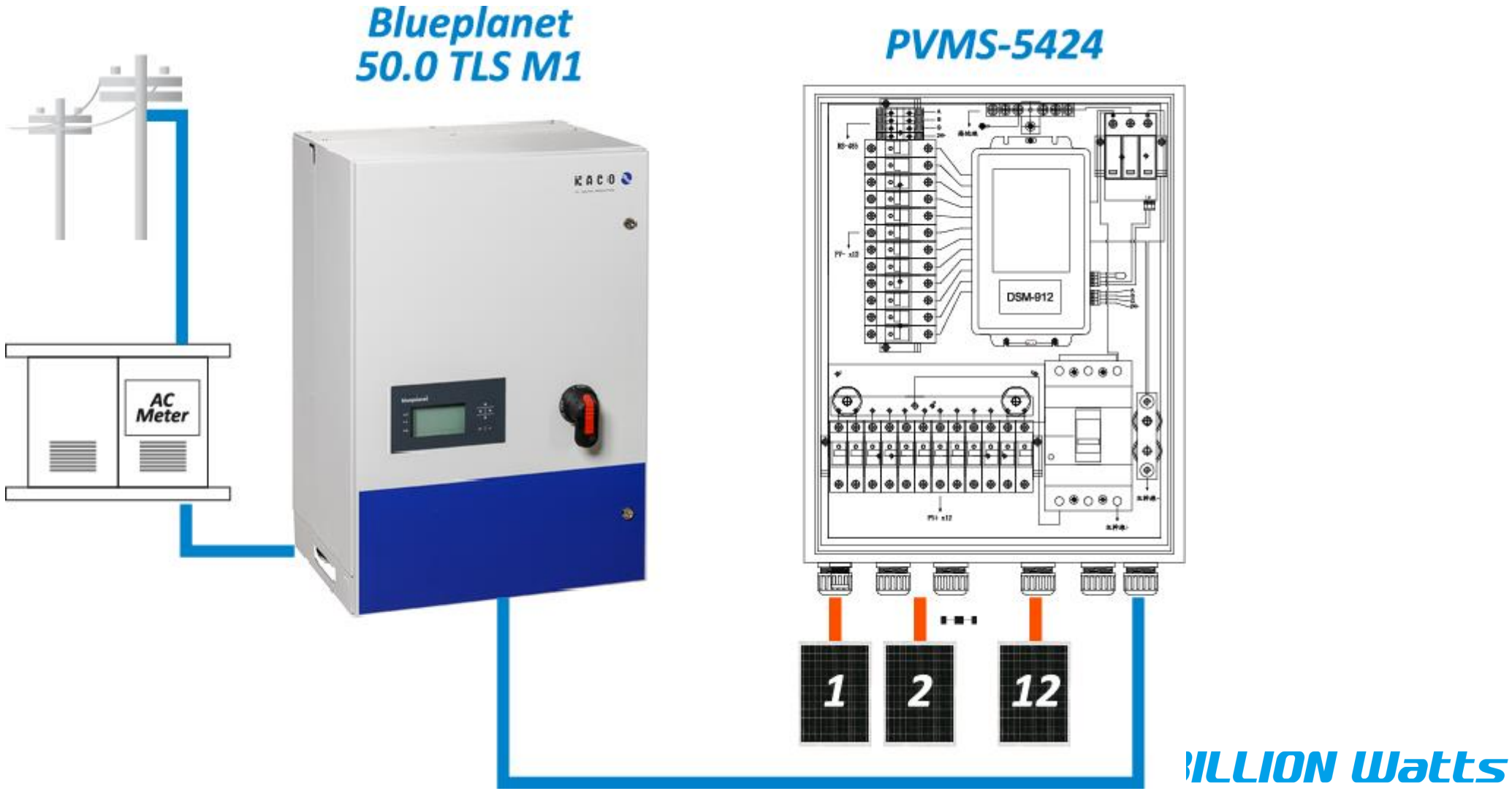
2.Wiring diagram



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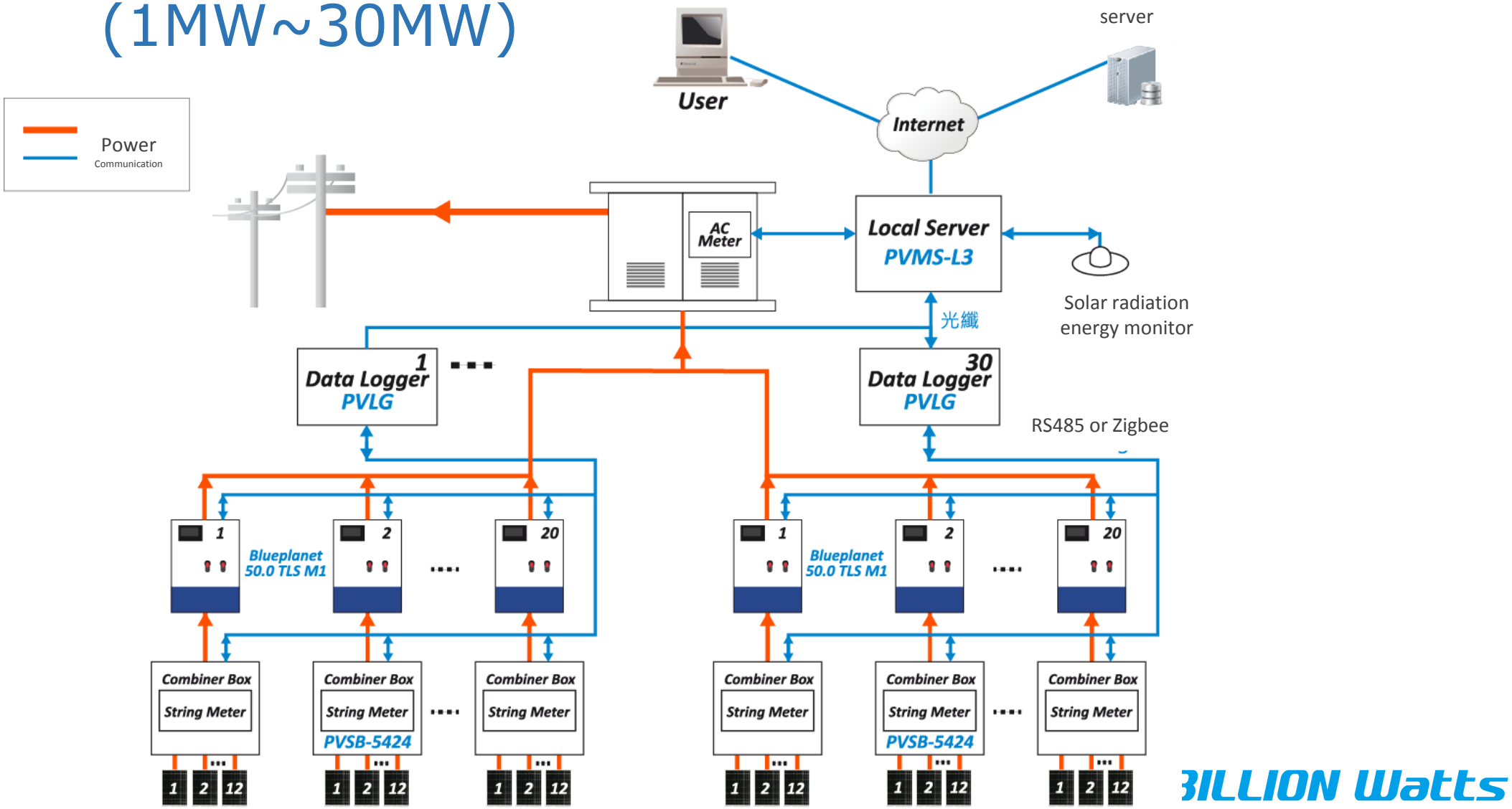
3. Optimized PV Station for Centralized Power Plant-Level

(1MW~30MW)



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Unique advanced function management User-defined intelligent operation and maintenance filter

Chapter 3
The Essence of PV Monitoring System

1. The Essence of PV Monitoring System

•PV monitoring, different from the general system of data recording and statistics, can further collect more detailed information on electricity with professional analysis and utilization, then convert into a simple, concrete action instructions.

•During PV power collection and convergence process, we can grasp an in-depth insight into each key PV convergence box and inverter and set our screening conditions to protect the power plant efficiency. With the online color management, Billion Watts can pinpoint the series or parallel location of different types of failures to make the power plant operation and maintenance extremely effortless, efficient.

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Comprehensive Features Maximize the Yield of PV Station

Chapter 4
One system meets every of your energy management system requirement

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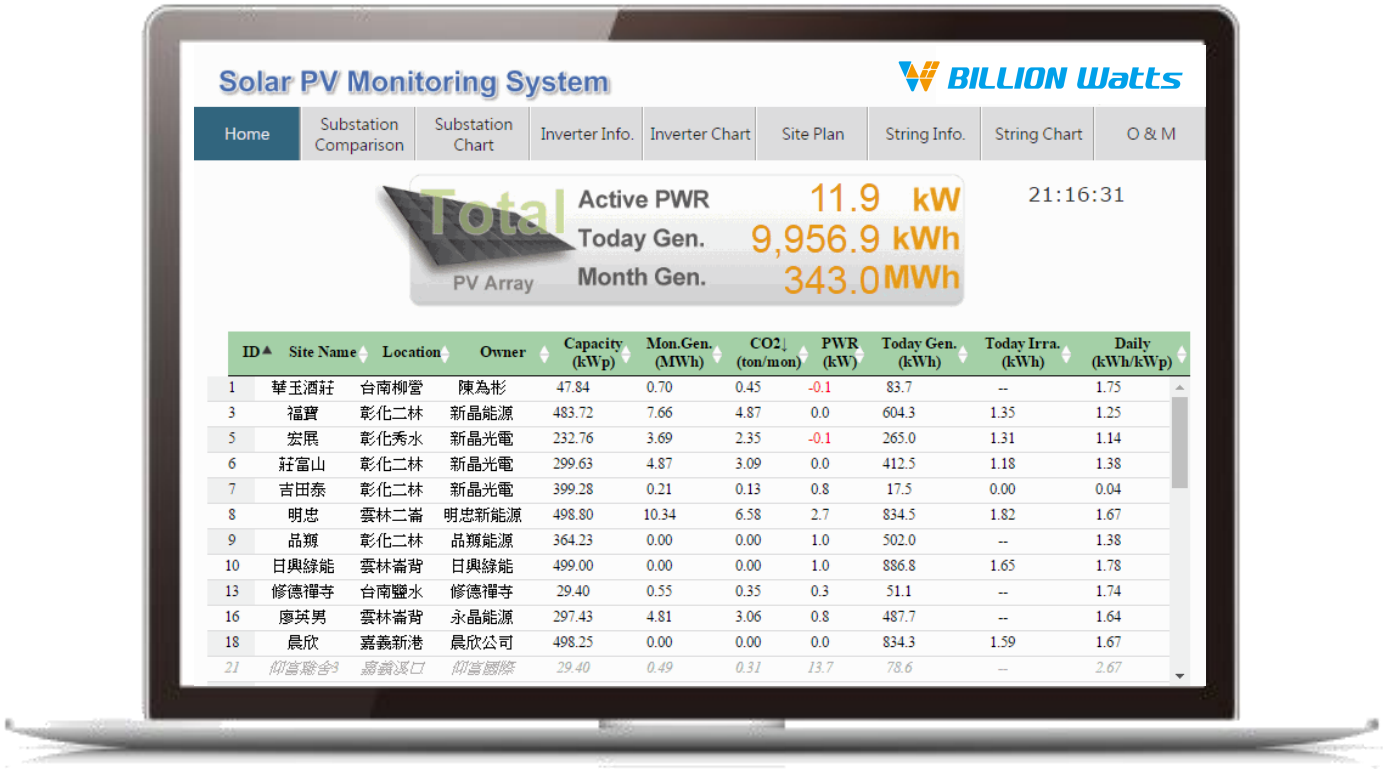
Dynamic Functional Configuration

Meet Your Every Management Need

Billion Watts can satisfy the need for local monitoring, remote monitoring, cross-regional and groups monitoring, as well as remote service support with trouble shooting functions. We provide one-stop solar power management solution for investors, owners, consultants, power plant management, operation and maintenance personnel, etc., who can leverage our technologies to create their unique values.



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Dynamic Functional Configuration Meet Your Every Management Need

For investors, owners, banks, consultants:

- Through the “Substation Comparison" function, a quick understanding of the relevant performance of the power plant data can be set at any time when we want to compare the efficiency of various power plant groups.
- The categories include the density of sunshine, the amount of DC power generation, the amount of AC power generation, DC PR value, AC PR value, the efficiency per kilowatt power, and performance & efficiency ranking.

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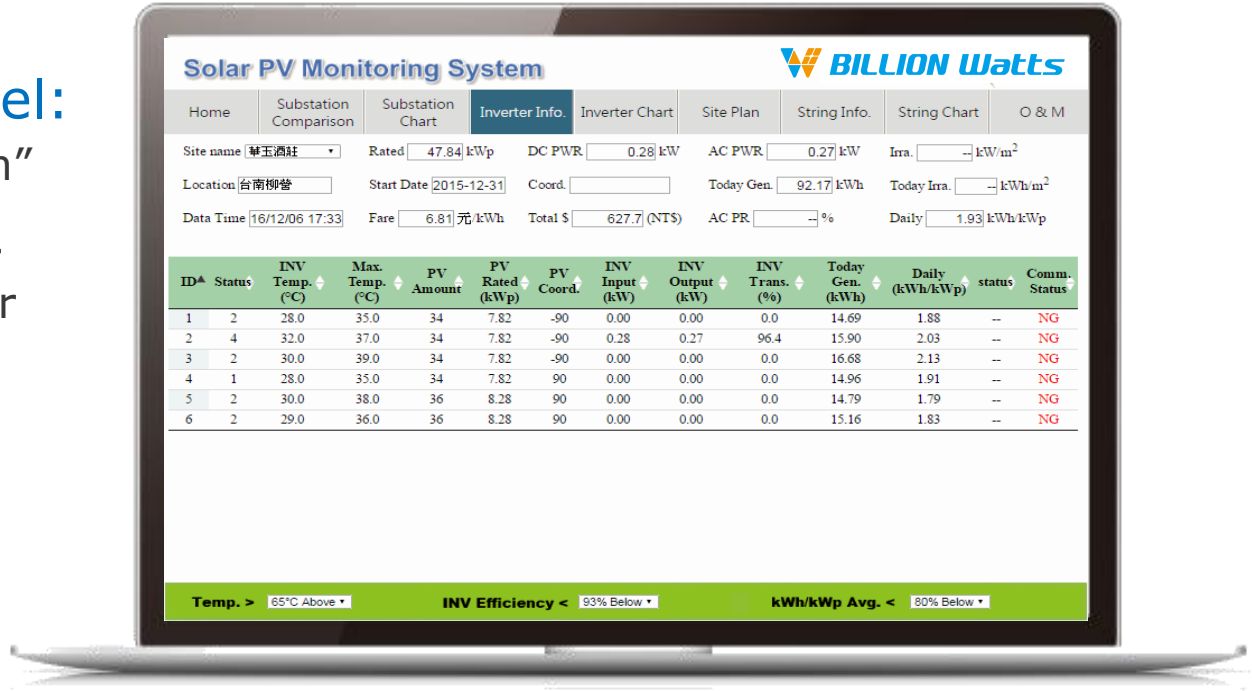
Dynamic Functional Configuration Meet Your Every Management Need

For Consultants, Management, Field Operation and Maintenance Personnel:

- By reviewing the “Inverter Information” and “Site Plan”, we can instantly understand the inverter-related power generation data. Users can set the filer conditions for automatic review and judgment, including online color management to signal different operations at a glance.



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Dynamic Functional Configuration Meet Your Every Management Need

For Site Managers, Technical Operation, and Maintenance Personnel:

- By reviewing the “Site Plan”, “Strings Information”, “Strings Chart”, and the most critical “Maintenance Operation” functions, we can quickly learn the power generation data gathered from the most front-end and the most basic power generation.
- We can set filter conditions in the “Site Plan” to automatically review data and make judgments. By utilizing the online color floor management platform, Billion Watts can enable an ever efficient power plants operation and maintenance for site managers.

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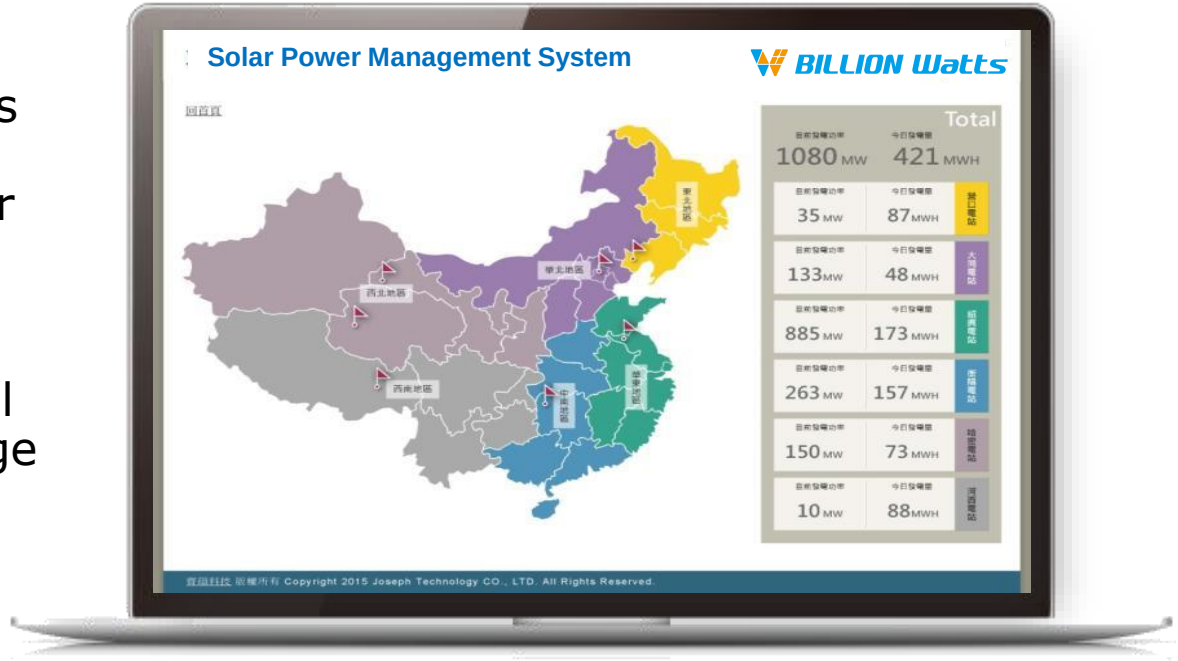
Complete WEB Service Architecture

To meet multi-national conditions and customer needs

•Cloud PV3.0 version provides a complete set of Web services architecture that allows system integrators or software developers to take full advantage of Billion Watts Solar Management System. Via the secondary system development of new sites & pages with an easy to use APP, we can cater our solutions in an alignment with international user requirements, including multi-language texts to meet all customer scenarios.



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