SOLAR STRING MONITORING

String monitoring with CMS - Circuit monitoring system

Increased productivity and improved maintenance of PV systems

Solar plant operators are constantly facing challenges to provide energy to the grid. Several obstacles can keep solar PV plants from producing energy.

Solar string monitoring devices can easily detect unusual system status from remote and enable a quick restoration of energy production.

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Solar PV application

String monitoring
Within large utility-scale solar power plants, several obstacles can keep solar panels from producing energy: clouds, birds, dirt on the panels, nighttime, or faults on the lines. While some of them are part of nature, others can be easily taken care of. Faults on the solar PV plant might lead to a stop of energy production: in the end, this would mean losing revenues.

Identifying those faults at an early stage will enable a selective maintenance, increasing the availability and safety of the plant. Solar string monitoring systems, installed inside of combiner boxes, can help detect such issues without great effort by providing up-to-date information about the system.

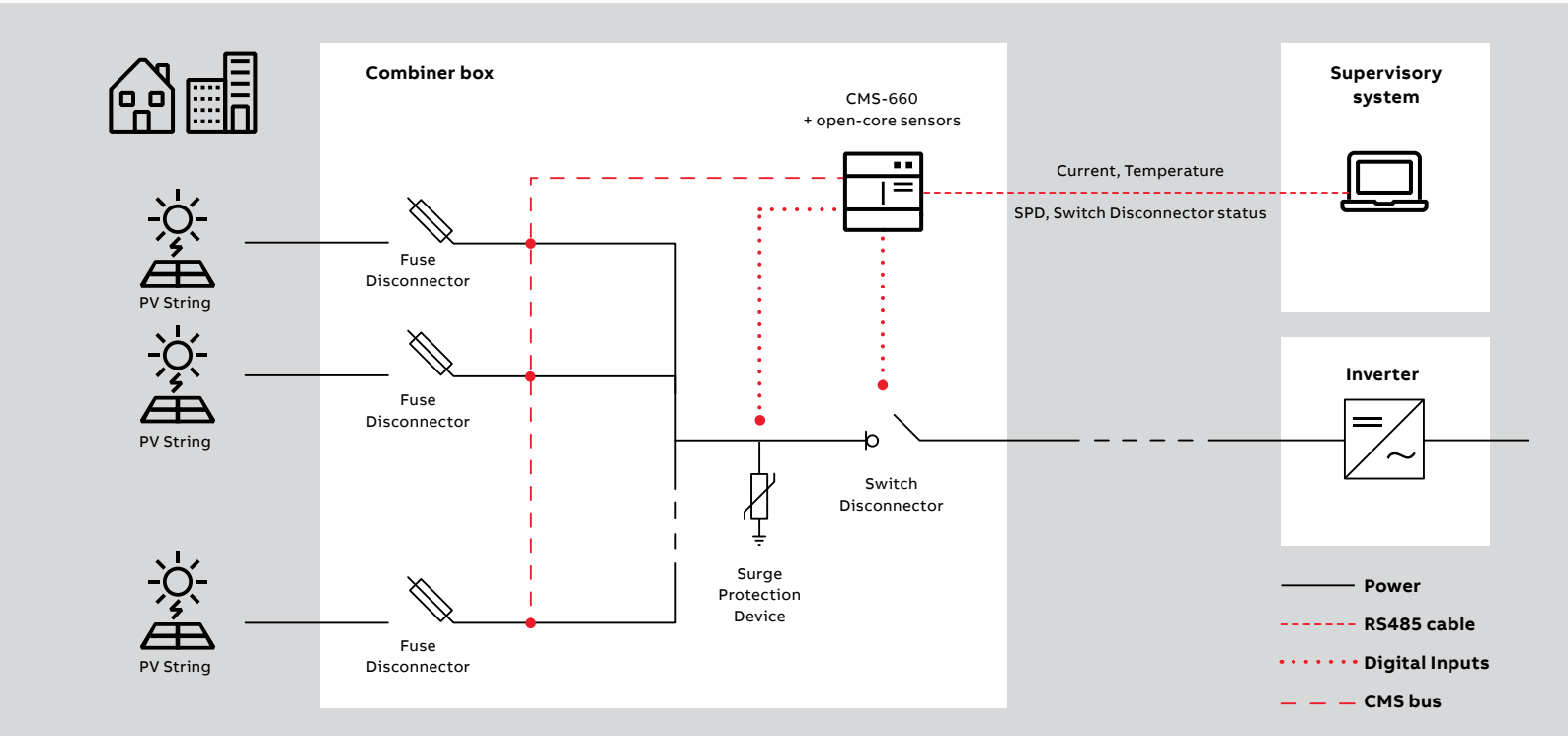
The measurement of the DC current produced by each string allows determining its efficiency, analyzing the performance with respect to the previous ones, as well as comparing it with the performance of other strings. In case of an unusual system status, the string monitoring system will notify about the end of life of a surge protective device (SPD), the tripping of a fuse disconnector or the status of a switch disconnector. This detailed up-to-date information allows to quickly carry out the appropriate maintenance to restore the production.

Power generation
When it comes to the power generation in a PV plant, it becomes increasingly important to reach high levels of granularity of measurement. Monitoring the solar production of every single string helps increasing the overall productivity of the plant.

Together with solar inverters, solar string monitoring systems provide all the information needed for transparent monitoring of the generated power. The current level of each string is collected by the string monitoring system, which is installed inside of combiner boxes. Those combiner boxes are first connected in parallel with each other, and then connected to a central inverter, meaning that the voltage at inverter level is the same for all the DC switchboards. For this reason, voltage reference can be directly taken at the inverter inputs, avoiding investments on additional voltage monitors inside of individual combiner boxes.

Data coming from the combiner boxes and inverters are usually transferred via a communication protocol (Modbus RTU) and collected through plant or inverter monitoring systems, enabling remote monitoring from a central location.

Scenario 1: string monitoring of residential / commercial installations



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01 Application example of a commercial solar PV installation
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02 CMS-660

In scenario 1, a combiner box takes care of string protection, protection against over-voltages, disconnection and string monitoring.

Inside of this combiner box, the CMS system, composed by CMS-660 control unit and one open-core sensors per string, collects the data of surge protective devices (SPD) and switch disconnectors via digital inputs. The data measured by the each sensor allow the CMS to analyze the performance and compare it with previous data.

The up-to-date information about system status is then transmitted to the supervisory system via Modbus RTU protocol. This allows quick maintenance in case of over-currents, over-voltages or disconnections.

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Circuit monitoring system CMS-660

The CMS string monitoring increases the efficiency of photovoltaic systems by detecting failures on PV strings. CMS-660 continuously checks the DC current produced by each string, allowing the comparison not only with its previous performance, but also with the performance of the other strings.

Easy to integrate, CMS-660 helps improve reactivity to unusual system statuses, such as defective strings, over-voltages, breaker trips or high temperatures.

Thanks to the intelligent, intuitive configuration, the CMS system can be configured and put into operation in a few minutes.

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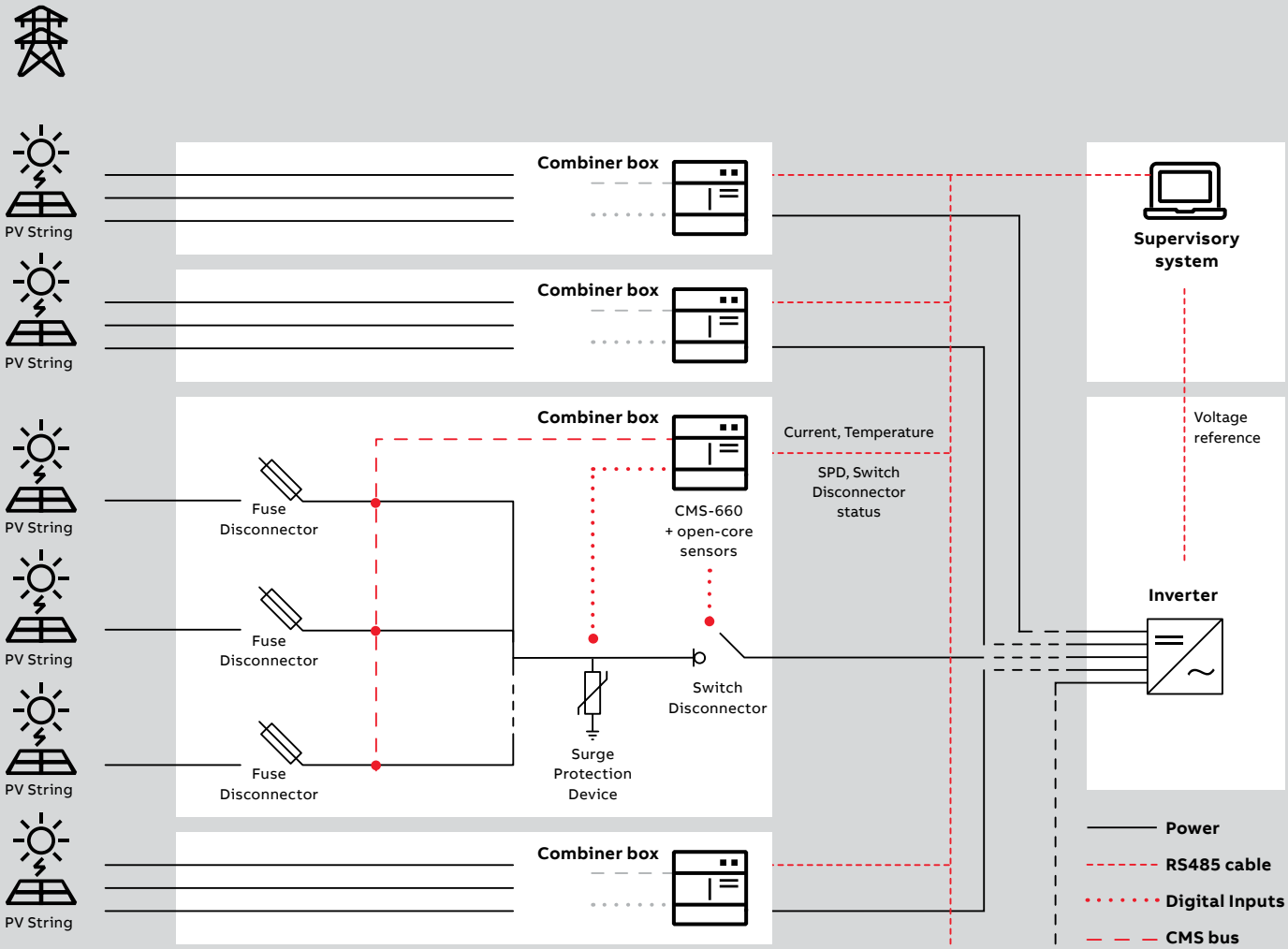
Scenario 2: utility-scale solar PV installation (individual string monitoring)



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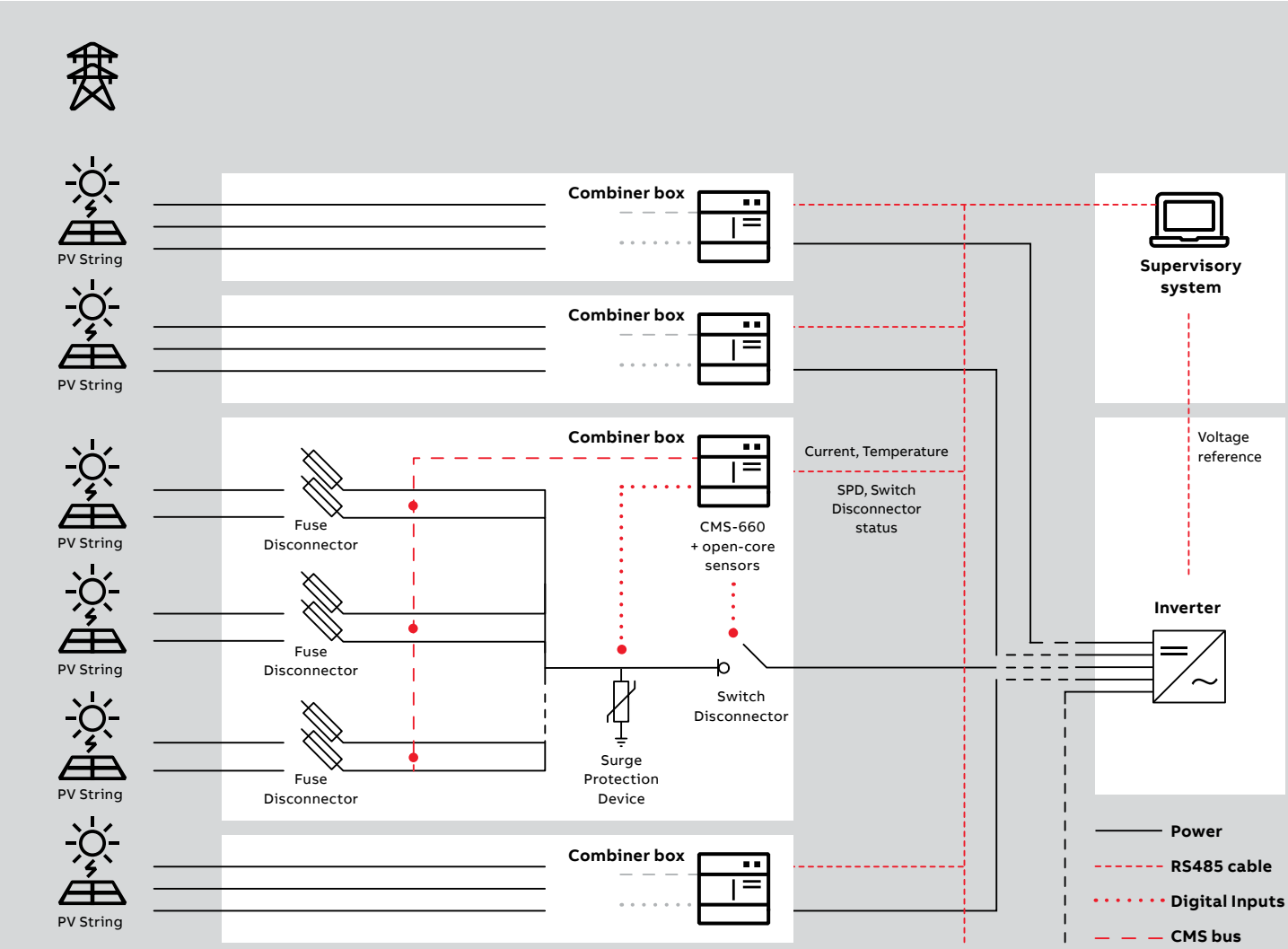
01 Application example of a utility-scale solar PV installation

Components per each combiner box in scenario 2

Product	Order code	Quantity
Control Unit CMS-660	2CCA880020R0001	1
CMS Sensor 20A CMS-122CA	2CCA880222R0001	24
Connector set CMS-820	2CCA880145R0001	1
Flat Cable 5m CMS-802	2CCA880331R0001	1

Scenario 3: utility-scale solar PV installation (combined monitoring of strings)



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01 Application example of a utility-scale solar PV installation

Components per each combiner box in scenario 3

Product	Order code	Quantity
Control Unit CMS-660	2CCA880020R0001	1
CMS Sensor 40A CMS-101CA	2CCA880108R0001	12
Connector set CMS-820	2CCA880145R0001	1
Flat Cable 5m CMS-802	2CCA880331R0001	1

String monitoring of utility-scale applications

01 CMS open-core sensor for ABB devices

02 CMS open-core sensor for DIN rail devices

03 CMS open-core sensor for cable ties

In scenario 2, 16 combiners are installed in the PV plant. Each combiner box is connected to an input of the central inverter. A supervisory system, running on Modbus RTU protocol, monitors the PV plant from remote. Each combiner box includes the control unit CMS-660 and 24 sensors, as well as protection devices (SPD, switch disconnector, fuse disconnectors).

CMS-660 measures the current of the individual strings and collects the information about SPD and switch disconnector status, as well as the temperature inside the combiner box. Voltage references are taken at the inverter input level from the combiner boxes.

All measured data from single combiner boxes, as well as the voltage reference, are transmitted to the central supervisory system via Modbus RTU. The easy integration of the measured data via open protocol map enables the calculation of the power generation at single combiner level from the supervisory system. However, the data that is necessary to identify faults on the system does not always require the level of detail of each single string.

In scenario 3, the CMS string monitoring system helps ensure safety of the PV system by reducing the number of measurement points by 50%. Two strings can be monitored with one sensor thanks to the high rated current levels of CMS sensors, reaching 40A or 80A if needed. In case 2 strings are monitored by one sensor, the solid core CMS sensors have to be installed. Therefore, in this scenario, inside each combiner box the detection of faults on 24 strings is achieved with only 12 solid-core sensors.

CMS sensors

CMS sensors can be placed anywhere in the solar PV system for measuring AC, DC or mixed currents up to 160 A (TRMS). Depending on the application, you can choose between two sets of sensors - one specifically designed for ABB installation devices, the other with a universal design to be installed on cables or DIN-rail. To retrofit existing installations, a range of open-core sensors is available.

The unique ID assigned to each one guarantees the easy initialization of the sensors via the CMS-660 Control Unit in a few simple steps. All measurement functions are available right after commissioning.

Increased productivity and improved maintenance of PV systems

Using the CMS (circuit monitoring system) string monitoring can increase the efficiency and safety of PV systems as it detects failures on PV strings and monitors string currents. The easy-to-integrate CMS-660 monitors the performance of the solar strings with the help of sensors connected to each string. In case it detects any unusual system status (e.g. defective strings, faults, breaker trips or high temperatures), it notifies the supervisory system immediately, so that appropriate counter-measures can be implemented quickly.

String monitoring with CMS

CMS-660 for string monitoring

Benefits	Technical features
Up-to-date system status	CMS-660 immediately detects unusual system status (e.g. solar shading, over-voltages, breaker trip, high temperature), facilitating maintenance of the system
Extreme flexibility	The number (up to 32) and positioning of the sensors is fully customizable, ensuring the highest flexibility in integration to different system conditions
Easy retrofitting and upgrades	As new sensors are added to the system over time, CMS-660 quickly includes these new monitoring points in the system. This ensures highest flexibility to adapt to changing system conditions
Simplified installation	Time-saving installation thanks to quick mounting of sensors in just a few steps. Up to 32 sensors can be mounted one-by-one over the fuses, as required by the application.
Smart commissioning	Thanks to the intelligent, intuitive configuration, the CMS system can be configured and put into operation in just a few minutes.
One sensor for all currents and strings	Direct, alternating or mixed - in a wide measuring range up to 80A, allowing the combination of two strings into one sensor.

The pre-assembled solution from ABB: string combiner boxes for solar PV applications

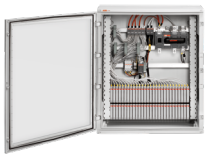

ABB offers a plug&play solution for photovoltaic solar installations with pre-assembled string combiner boxes from 1 -32 Strings in 1000 and 1500V DC catering to the requirements of residential, commercial and industrial solar installations.

- String boxes with and without monitoring: pre-wired solar string combiner boxes with individual string protection, surge protection and disconnection, with additional monitoring devices are available as option, e.g. CMS-660
- Multi-output string boxes: specially designed for residential, commercial installations. To be used in combination with String Inverters with Multiple MPPTs. Thanks to the multi-output string box, multiple inputs in the inverters can be connected with a single combiner box.

ABB Group
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Business Unit Building Products

abb.com/solar
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