



Low Voltage Products Solutions for solar energy

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Unlimited clean energy with zero emissions

Environment friendly energy

Energy is one of the biggest global challenges we face today and major companies are at the heart of this issue. This is because the world expects them to come up with new technologies and systems to produce energy with reduced pollution and greenhouse gas emissions, widely recognised as one of the main causes of global warming.

Clean energy from the sun

Renewable energy plays a fundamental role in future energy policy in the light of the mounting interest in safeguarding the environment and the search for more efficient uses of energy resources, with the recognition that traditional fossil fuels will not last forever.

Against this background, the sun is unquestionably an energy source of huge potential, one that can be exploited without harming the environment. At any time, the hemisphere of the earth exposed to the sun receives over 50,000 TW of power, nearly 10,000 times the quantity of energy consumed all over the world.

ABB for solar energy

ABB has been a leading player in the solar power industry since the early 1990s when we developed an automation platform for the world's first test facility for concentrating solar power technologies at the Plataforma Solar de Almería (PSA) in Spain. Since then, we have been involved at a pioneering stage in just about every type of photovoltaic (PV) and concentrating solar power (CSP) technology developed, be it in Europe, North America, Australia, North Africa or the Middle East. This has given us a unique expertise in how best to harness, control and store solar energy and efficiently convert it into reliable electricity, ready for transfer into the local grid. ABB's portfolio of products, systems and solutions for the solar power industry is extensive. It ranges from turnkey photovoltaic power plants to complete power and automation solutions for CSP plants and for commercial, industrial and residential rooftop PV installations. On the manufacturing side, ABB supplies robots and robot-based systems for solar panel factories, and electrical, control and instrumentation solutions

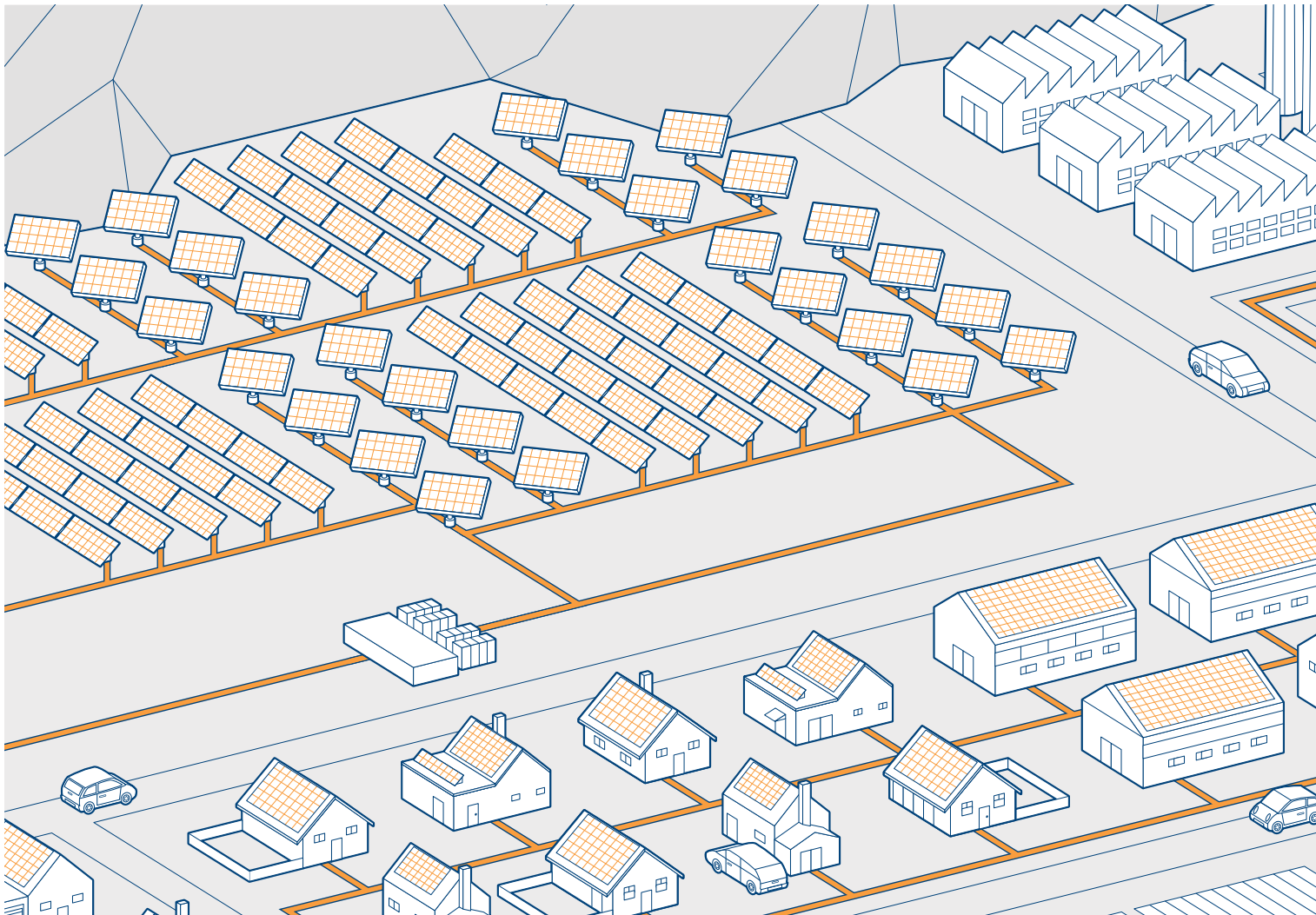


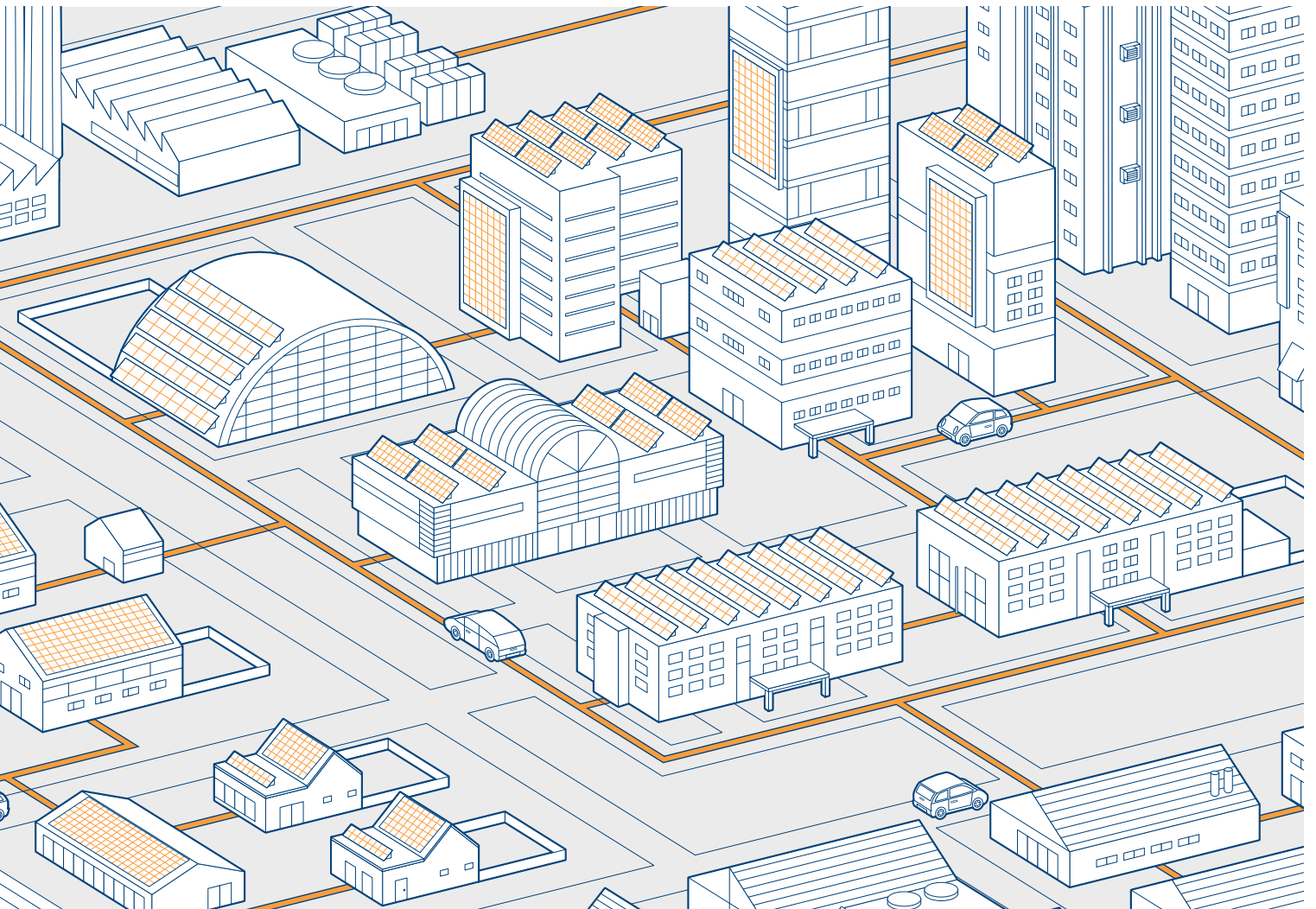
ABB and solar energy

for silicon processing factories, the material that is used to make solar cells. And in smart grids, ABB is at the forefront in developing the technologies and solutions that will make possible the electrical transmission and distribution systems of the future. These systems will integrate traditional types of large-scale, centralized power generation with small-scale, localized types of renewable energy like solar and wind, creating a single optimized network with multi-directional power flows and realtime grid monitoring and market mechanisms.

Quality and sustainability, our key factors

For every activity and every product family, ABB is highly focused on environmental sustainability and safety. The environmental management systems, certified to ISO 14001, cover most of ABB operations and its products comply with the main International European and North-American standards. The development of eco-compatible products, not containing any substances that can endanger or harm the environment, is

imperative in all the R&D activities of ABB. The reliability and efficiency of a plant depend on many factors, related both to the entire plant and to the functional details of the single subsystems and items of equipment. The quality and safety of each product are essential to guarantee the maximum performance of the plants. The more complex a plant, the more profitable it is to turn to an experienced partner, capable of providing global solutions to respond substantially and effectively to all the needs of each single application, from design to maintenance. ABB, a global leader in the automation and energy industry for years, can support its clients in building large-sized plants, financed on the basis of the reliability and soundness of the supplier companies.



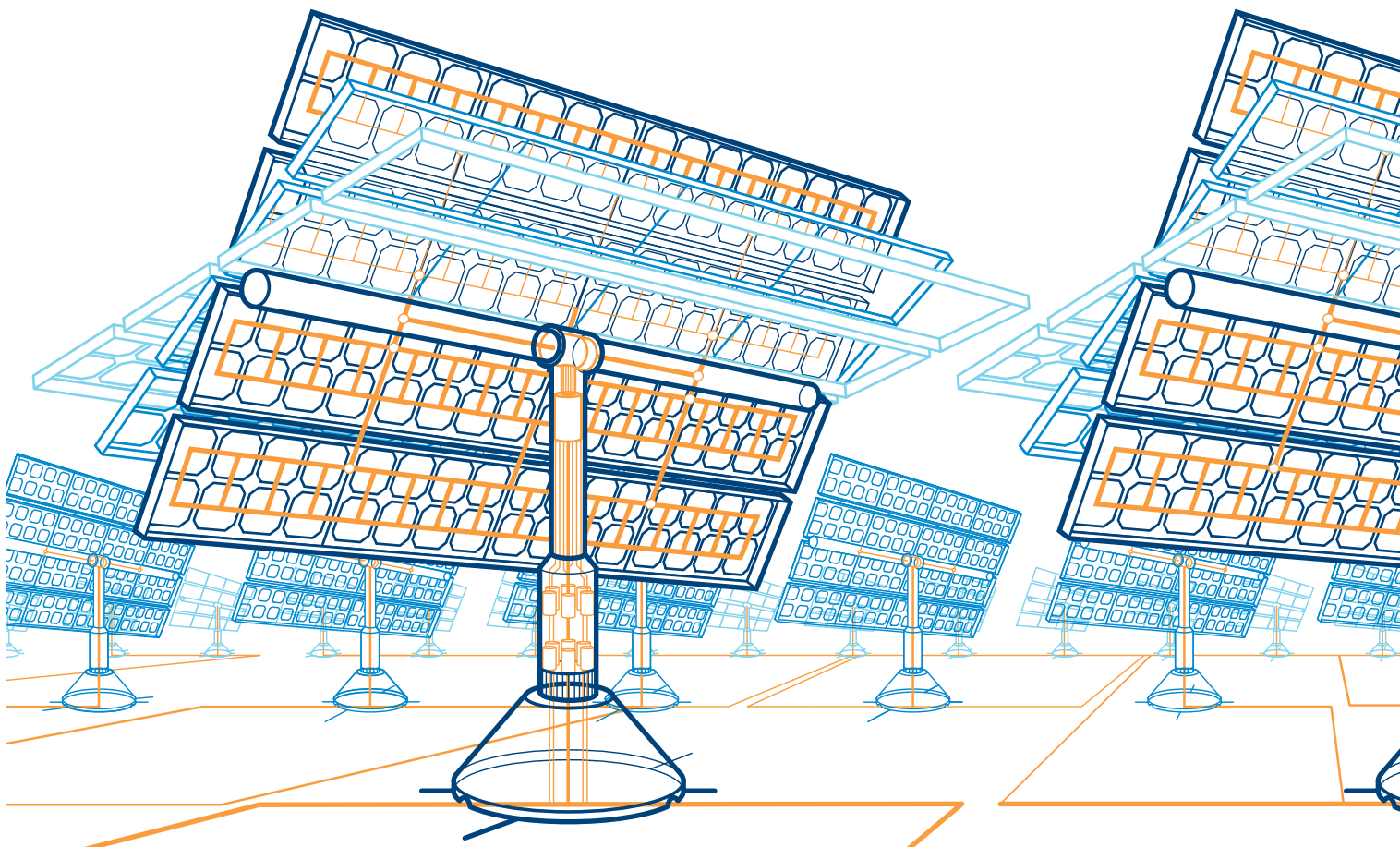
Photovoltaic energy

Efficiency and quality of a system are measured through efficiency and quality of each individual component

An accurate choice of components, especially modules and inverters, is of fundamental importance if a photovoltaic system has to be a success. Before it can be considered a good investment, a photovoltaic system must be able to function efficiently for at least 20 years in all weather conditions and under blazing sun.

What is commonly called the “BOS” (Balance of System), i.e. the “rest of the system” (electromechanical equipment for protection, control and isolation purposes, cables), undoubtedly plays an important role in ensuring that people and buildings connected to the system are properly protected and that there is an adequate production of energy over the years. From an economic viewpoint, it is even more important for each individual component of a photovoltaic system to be chosen on the basis of the warranties provided by the product and by its manufacturer than it is for a normal electric system. This is because the operating specifications of each device must remain unchanged throughout the entire life cycle of the system and related investment.

Always ready to meet any new demand from the market, ABB has developed a whole range of reliable products dedicated to photovoltaic applications and able to meet all installation requirements, from the strings on the direct current side through to the alternate current grid connection point. ABB product range includes circuit breakers, switch-disconnectors, fuse disconnectors and fuses, residual current-operated circuit-breakers, grid connection relays, metering devices, surge arresters, consumer units and enclosures suitable for outdoor installation, all specially designed for these applications. ABB can also provide a series of “plug & play” solutions, i.e. finished, wired and certified string boxes able to suit the requirements of a vast range of installations: from individual strings for residential applications to large photovoltaic plants.



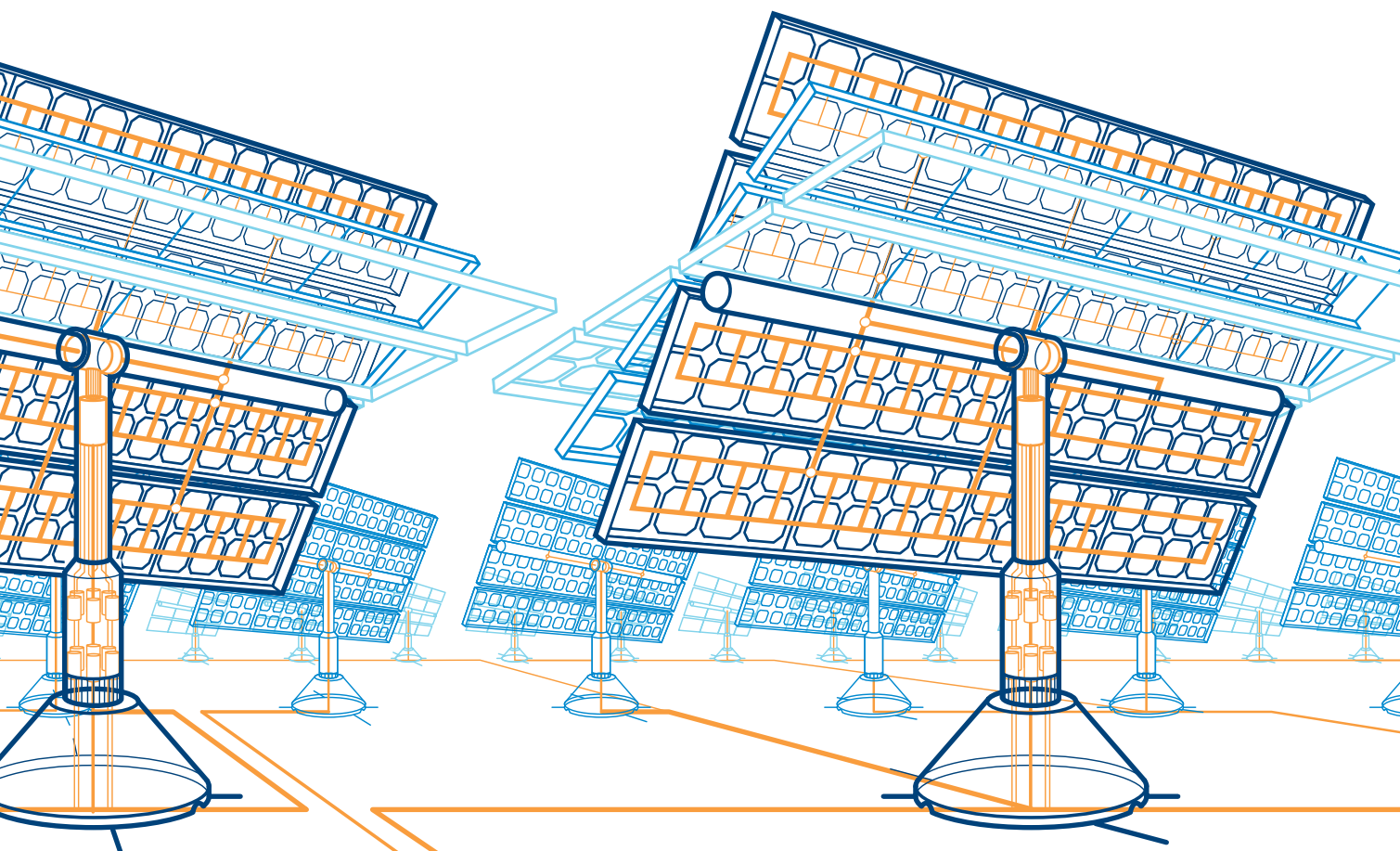
Photovoltaic systems

Protection and isolation in the DC side of PV systems

Similarly to any other electric system, a photovoltaic installation must be designed and built in accordance with all the technological solutions and standards able to guarantee the safest possible operation and the utmost protection for the people who must work on the structure.

An important role is played by isolating and protection equipments in both circuits on direct current side and those in alternate current section on the load side of the inverter.

There is a great variety of photovoltaic systems in reference to power, type of inverter (with a power-frequency transformer, high frequency transformer or without a transformer) and type of connection to the public grid (single-phase, three-phase, low or medium voltage), thus design engineers and installers need to carefully assess the components they choose.



Photovoltaic systems

Protections on the DC side

The direct current section of a typical photovoltaic system consists of a generator formed by parallel strings of solar panels connected in series.

Along with the specific characteristic of solar modules and strings (inability to shut off the voltage other than by obscuring the solar panels or generation of short-circuit currents with values very near to those produced in normal conditions), the presence of voltage in the range of 300-600 VDC and beyond requires a very careful assessment of the protection and isolating devices, which must be able to suppress direct fault currents under high voltages.

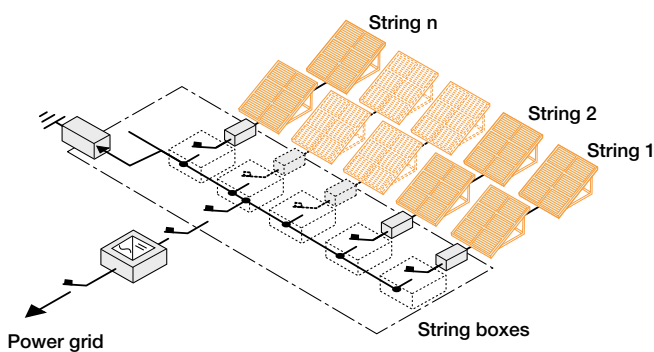
In accordance with the provisions established by Standard IEC 60364 (article 712), protection against overcurrents must be provided when cable carrying capacity is less than 1.25 times the calculated fault current in any point.

This means that in the majority of small systems or when several inverters have been installed, it is sufficient to install a switch-disconnector which should be of the DC21 class at least.

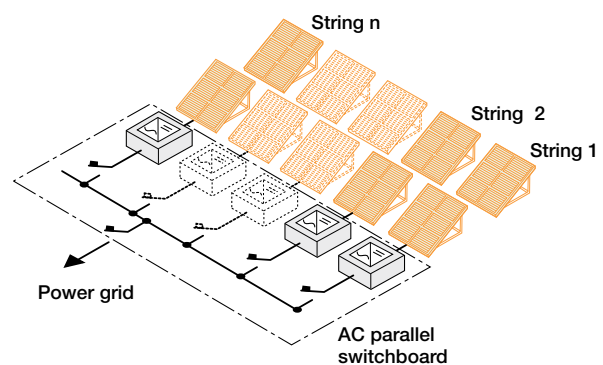
It is advisable to install an isolating device on each string to allow this latter to be inspected or serviced without having to shut down other parts of the system.

The exposed conductive parts of all the equipment must be earthed through the protection conductor with the aim to protect persons from indirect contacts. The PV generator can only be earthed if it is separated from the low voltage distribution network by a transformer.

Various different methods can be used to connect the strings in parallel in a photovoltaic system connected to the power grid.



Centralized conversion



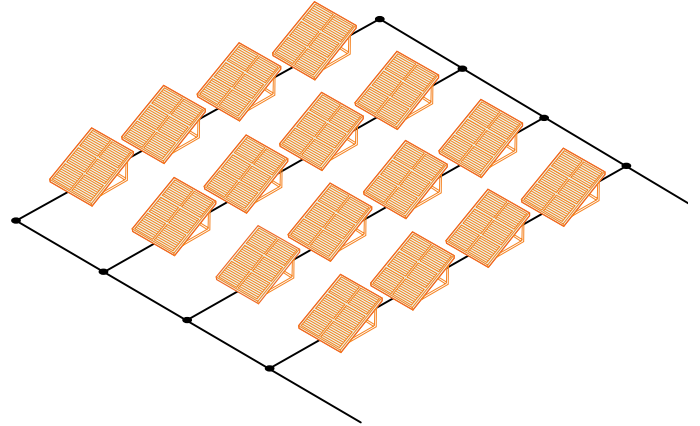
Distributed conversion

Photovoltaic systems

String protection against reverse currents

When the installation layout includes centralized conversion using a single inverter, strings must be protected against reverse current. This could circulate after faults or temporary unbalances in the system due, for example, to certain of the solar modules being partially in the shade or covered by snow, leaves and sand etc.

Reverse currents can reach extremely high values, especially when there is a large number of strings. Modules are unable to withstand this sort of currents and, in the absence of protection devices, they develop faults within a very short time. There are different methods for connecting the strings of solar modules in parallel in safe conditions: if there are only a few strings (1 or 2), obviously formed by the same number of modules, the parallel connection can be made without danger, otherwise protection devices must be installed in series with each string.



Protection for the parallel connection of the strings of photovoltaic modules. Simple parallel.

Advantages: simple to make

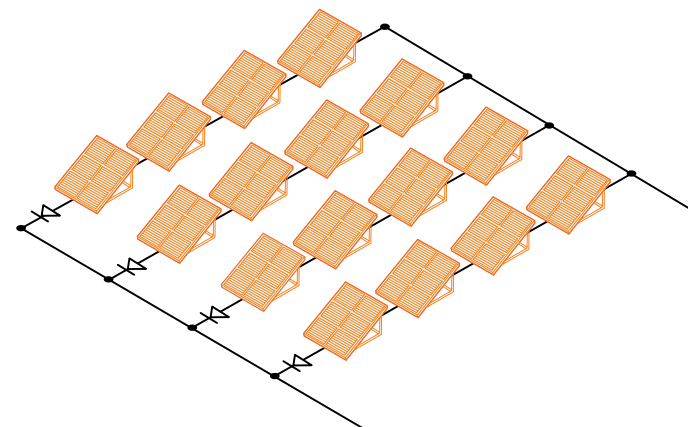
Disadvantages: the strings are liable to power reversals; can only be used for a very small number of strings

Reverse cut-off diode

This solution is unadvisable since not everyone considers it suitable for protecting the strings. It is not a substitute for overcurrent protections (IEC TS 62257-7-1) as the blocking diode may not function correctly and could be short-circuited. Moreover, diodes lead to a power loss owing to the effect of the voltage drop on junction, a loss that can be reduced by using Schottky diodes with a 0.4 V drop instead of the 0.7 V drop created by conventional diodes.

If reverse cut-off diodes are chosen, their maximum reverse voltage (according to IEC 60364-7-712 standards) must be at least twice the open circuit U_{OC} string voltage in STC conditions.

The direct overcurrent must be higher than the short-circuit current I_{SC} of the individual modules, with 1.25 I_{SC} minimum value.



Protection for the parallel connection of the strings of photovoltaic modules. Reverse cut-off diodes.

Advantages: Prevent power reversal

Disadvantages: They are not considered to be protection devices
They lead to a power loss in the circuit

Photovoltaic systems

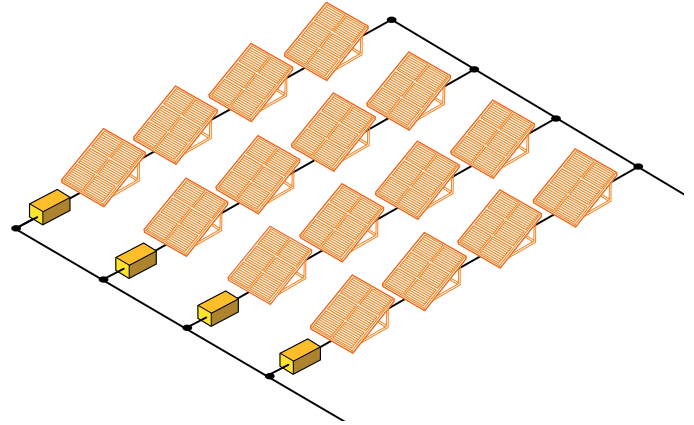
String protection against reverse currents

Fuses

Fuses are the string protection most widely used by designers since, unlike diodes, they interrupt the circuit if faults occur. However, although fuses are simple to use, the utmost care must be taken when they are sized and chosen as certain fundamental requirements must be considered:

- they must possess gPV trip characteristic suitable for protecting photovoltaic circuits according to IEC 60269-6;
- they must be sized for current values of no less than $1.25 I_S$ and no more than the value indicated by the manufacturer for module protection. In the absence of specific indications, consider a value must be $2.0 I_S$ or less;
- they must be installed in dedicated fuse-disconnectors able to dissipate the power that develops in the worst operating conditions.

With its small size and competitive cost, this solution does not completely prevent reverse current from circulating in the modules, which must consequently be able to withstand values of at least twice or three times the I_{SC} (such values are normally supported by the majority of the modules available on the market).



Protection for the parallel connection of the strings of photovoltaic modules. Fuses.

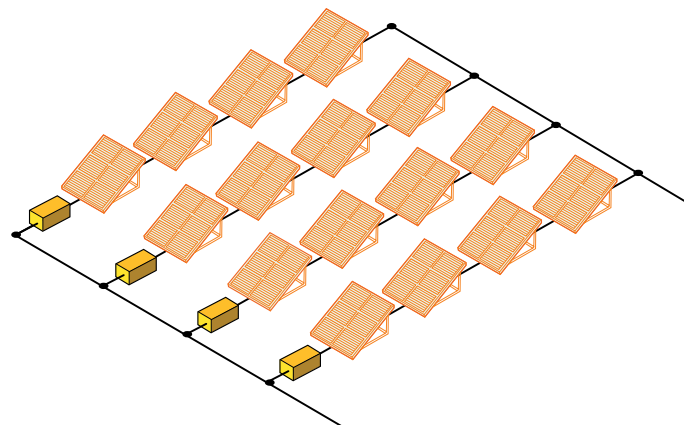
Advantages: simple to install; low cost; circuit disconnected if faults occur

Disadvantages: They must be replaced after a fault

Miniature circuit-breakers

Use of thermo-magnetic circuit-breakers is technically the best solution for protecting photovoltaic strings. Thus, manufacturers have created specific products comprising technological solutions able to function at high direct current voltage values that are usual in these applications.

ABB has created specific PV miniature circuit-breaker suitable for PV applications and able to safely extinguish dangerous DC arcs even in case of double faults. They provide high system availability, safe disconnection of all poles and easy and safe reset. In addition protection and isolating functions are provided by a single device which can be equipped with a wide variety of accessories (auxiliary and signal contacts, shunt, undervoltage releases and remote switching unit).



Protection for the parallel connection of the strings of photovoltaic modules. Automatic circuit-breakers.

Advantages: a single device provides both protection and isolating functions. High system availability through fast resetting after fault

Photovoltaic systems

String protection against overvoltage

Surge protective devices

Solar arrays, which are generally situated in exposed locations and, for the higher power versions, over wide areas, are subject to atmospheric activity and may be damaged by overvoltages generated by lightning.

To avoid problems, it is advisable to install Surge Protective Devices (SPD) on each polarity towards earth in the string boxes once the risks have been correctly assessed in accordance with EN 62305-2 standards.

The impedance of these devices varies depending on the voltage applied: when on hold, their impedance is extremely high and is reduced in case of overvoltage by discharging the associated current towards earth.

It is advisable to choose the right sort of SPD with tripping thresholds that suit the operating voltage values of the circuit.

The state of efficiency of the equipment must be constantly displayed locally and in remote mode if necessary, using products equipped with remote signalling contacts.

SPD with varistors or combined SPD should be used in the protection for the direct current side. Inverters usually are equipped with internal protection against overvoltage, but the addition of SPD to the terminals of the inverter improves the protection provided for this latter and stops inverter internal protections from operating if they trip, an event that would halt the production of energy and require the intervention of specialized personnel.

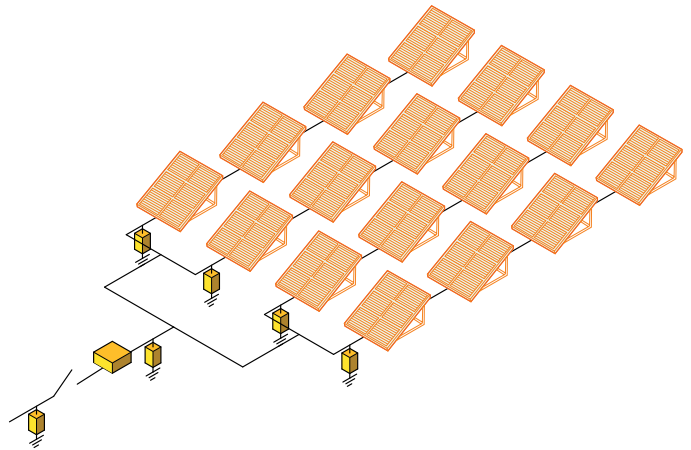
SPDs for solar installations must be specific to PV-DC networks.

Thus, according to UTE C 61740-51 and prEN 50539-11,

PV-DC SPDs shall have the following indications:

- PV symbol on the product
- U_{cpv} maximum continuous operating voltage
- I_n nominal discharge current
- I_{imp} or I_{max} depending on if it is a Type 1 or Type 2 SPD
- Up protection level
- I_{scwpv} short circuit DC PV current withstand

A specific back-up protection (fuses or MCBs) is also generally recommended. However, on PV-DC networks due to low current and high DC voltages, it is much more difficult to disconnect the MOV of the SPD in case of end of life in short circuit. Thus, for safety reasons a PV-SPD with a specific integrated thermal disconnection must be chosen. The SPD must be installed on the supply side (direction of the PV generator energy) of the inverter isolating device so that it also protects the modules when the isolating device is open.



Photovoltaic Systems

Monitoring on the DC side

String monitoring

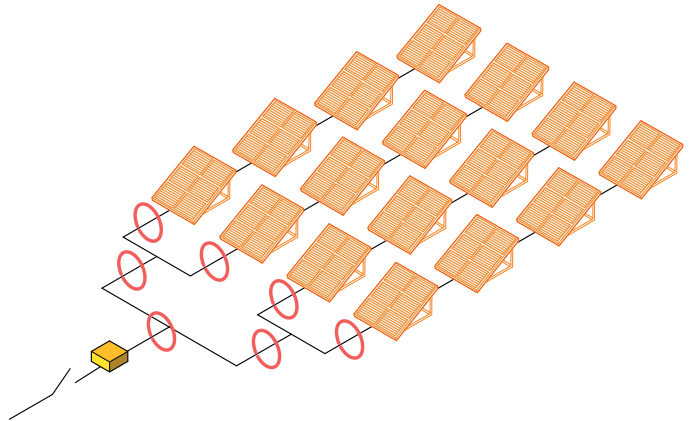
Photovoltaic systems must operate efficiently to get the maximum "feed-in-tariff". The system performance can be seriously influenced by:

- shadings effects like: snow, leaves, contamination, ...
- Damages
- theft
- overheated, aged panels

By the use of string monitoring the complete efficiency of the photovoltaic system is impacted due to consistency in fault detection and intimation to the control system.

Isolation monitoring

In some cases PV networks can be assimilated to an IT electrical distribution network. The high insulation impedance prevents earth faults from generating currents that would dangerously elevate the potential of exposed conductive parts. Therefore, in case of earth leakage, in an floating PV network it is not necessary to interrupt the supply, but it is still essential to monitor the insulation level in order to detect faults and restore optimal functioning of the system.



Example for photovoltaic plant 850kW (115 strings):

Average stringpower: 5.4 kW (900V/6A)

Average hours of sun per year: 1600h

feed-in-tariff: 0.22\$/kWh

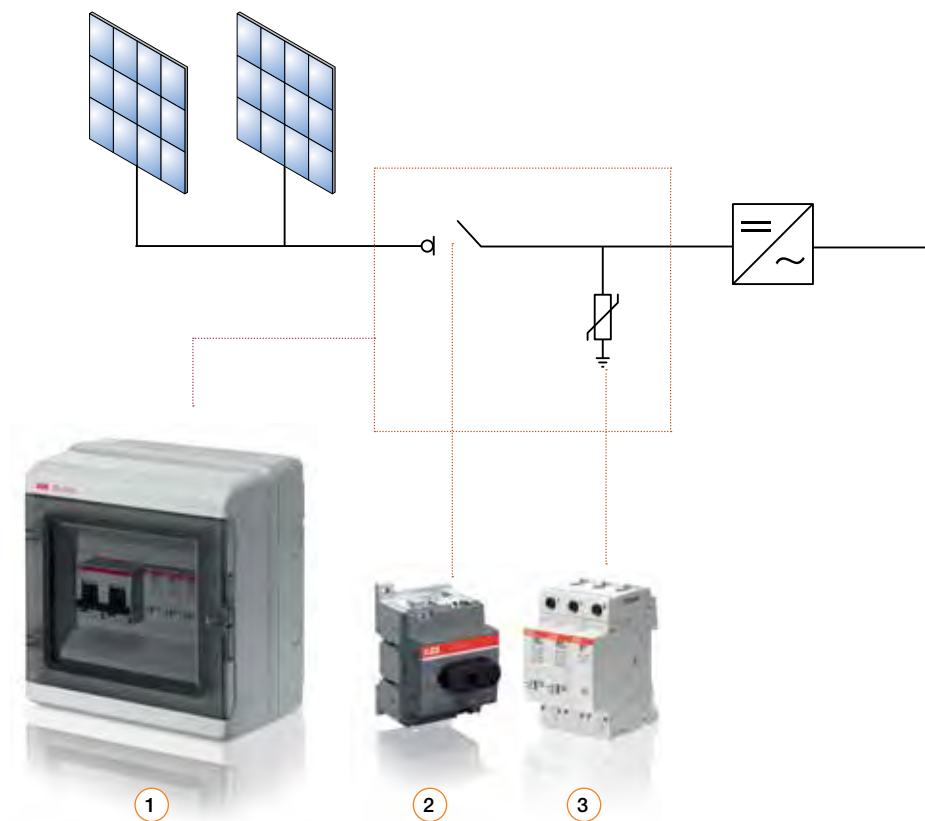
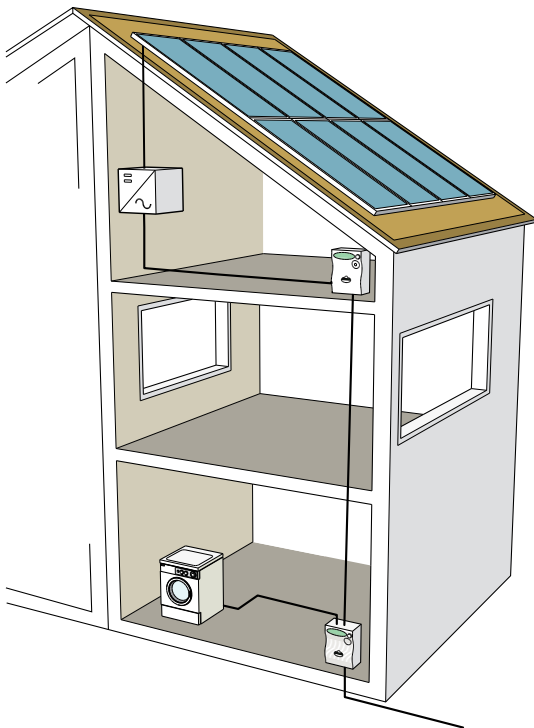
5 defect strings: $5 \times 5.4 \text{ kW} \times 1600\text{h} \times 0.22 \text{ \$/kWh}$ --- 9403 \$/year (783 \$/month)

9 shaded strings: $9 \times 5.4 \text{ kW} \times 1600\text{h} \times 0.22 \text{ \$/kWh} \times 0.3$ --- 5077 \$/year (423 \$/month)

Total losses: 14480 \$/year (1206 \$/month)

Example of photovoltaic applications

Application: residential $\leq 20\text{kW}$



Low voltage products:

1 - String boxes

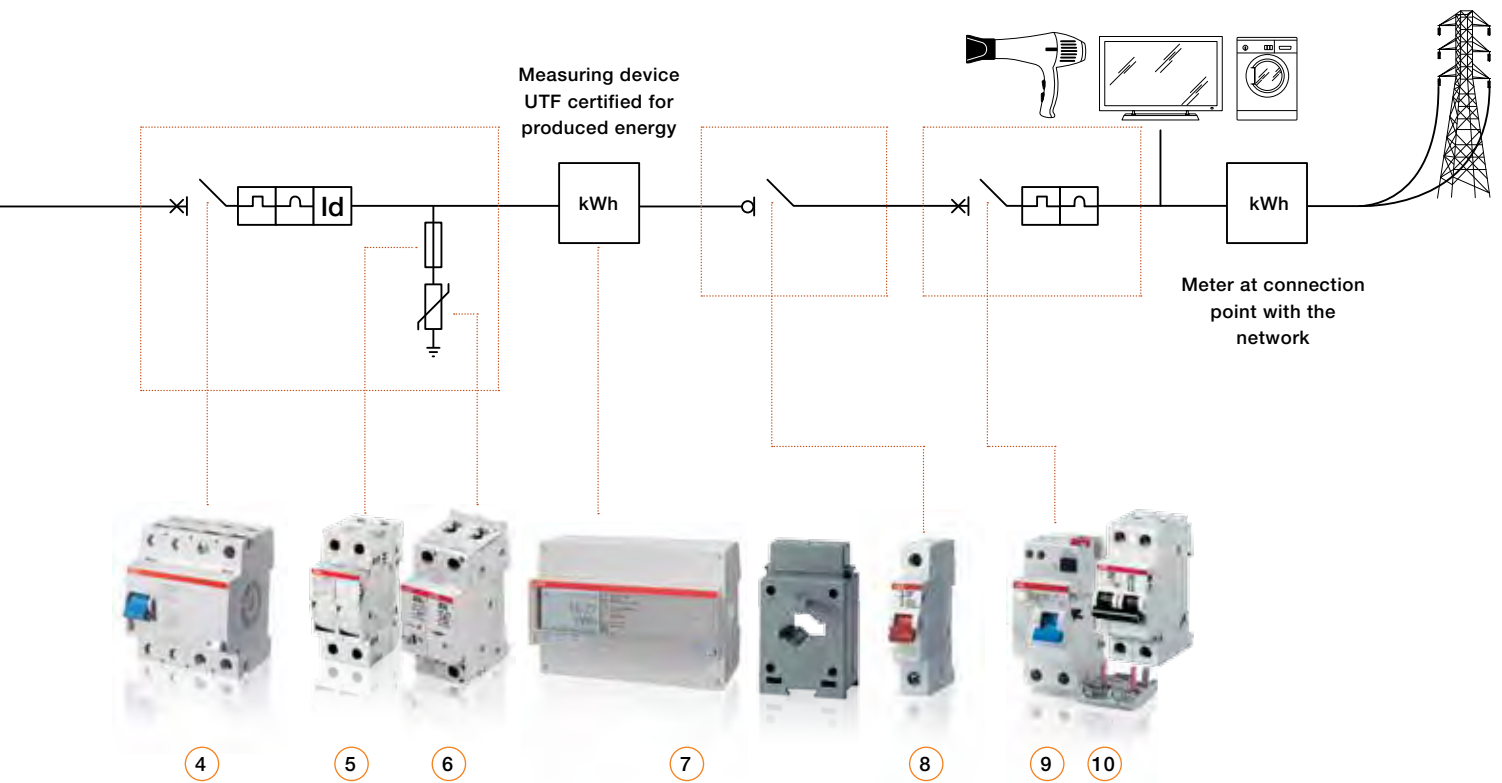
Switchboards: Gemini series; Consumer units: Europa series;
Miniature circuit-breakers: S200 M UC Z; Miniature circuit-breakers:
S800 PV-S; Fuse disconnectors: E 90 PV; Fuses: E 9F PV

2 - Switch-disconnectors: OTDC series

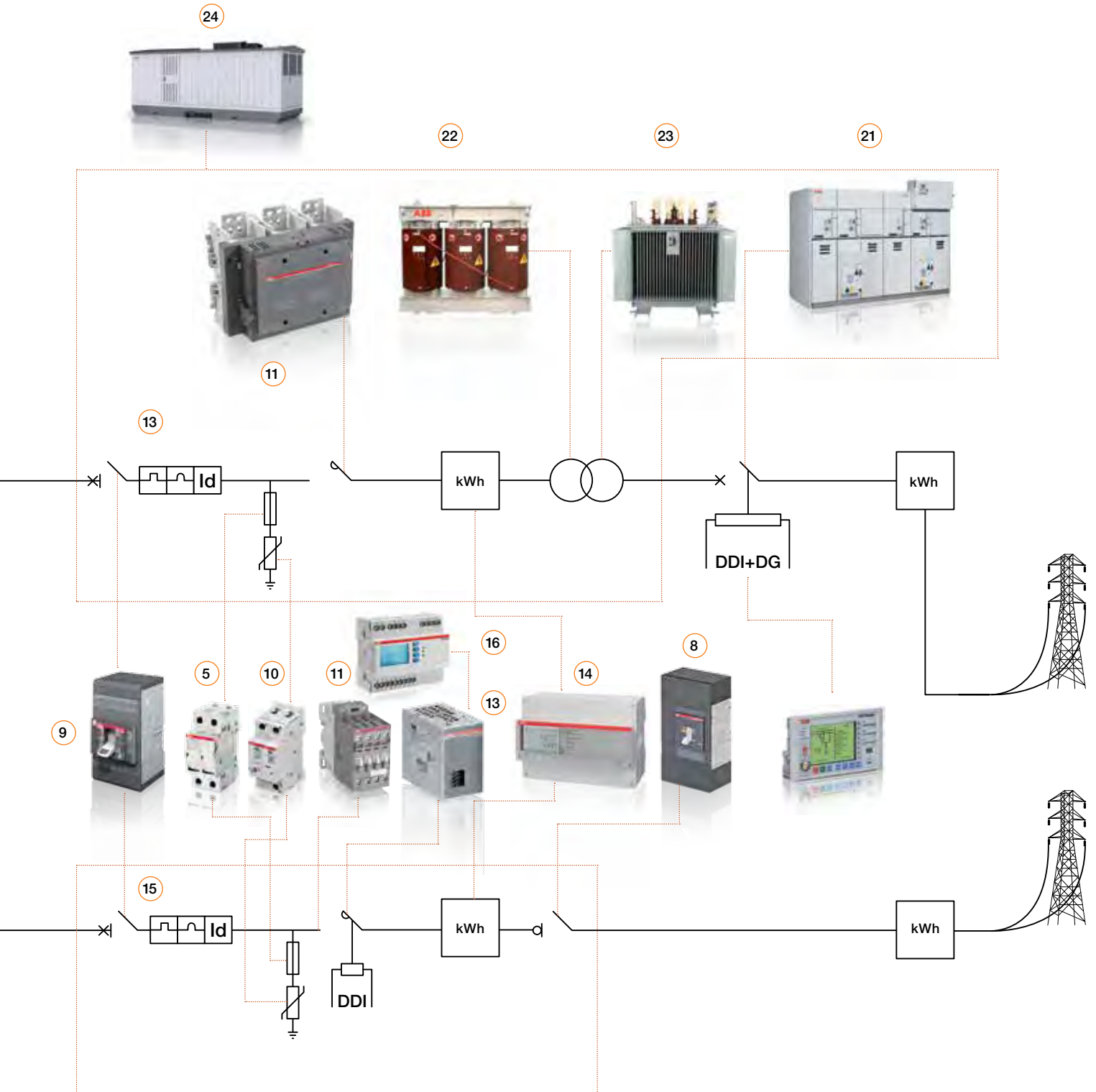
Switch disconnectors: S800 PV-M

3 - Surge protective devices: OVR PV

4 - Residual current devices: F202 PV B; F204 B



- 5 - Fuse disconnectors: E 90
- 6 - Surge protective devices: OVR T1 / T2
- 7 - Energy Meters: EQmeters and current transformers
- 8 - Switch-disconnector: E200
- 9 - Residual current devices-block: DDA 200 B
- 10 - Miniature circuit-breakers: S 200



- 9 - Moulded-case circuit-breakers: Tmax
Switch-disconnector: E200
- 10 - Surge protective devices: OVR T1 / T2
- 11 - Contactors: A and AF series
- 12 - Insulation monitoring devices: CM-IWN
- 13 - Power supplies
- 14 - Energy meters: EQ meters
- 15 - Residual current devices-blocks: DDA 200 B
Residual current devices: F202 PV B and F204 B
Miniature circuit-breakers: S 200
- 16 - CM-UFD.M22
- 17 - ArTu switchboards

Solar inverters:

- 18 - Central inverters: PVS 800
Remote monitoring portal

String monitoring:

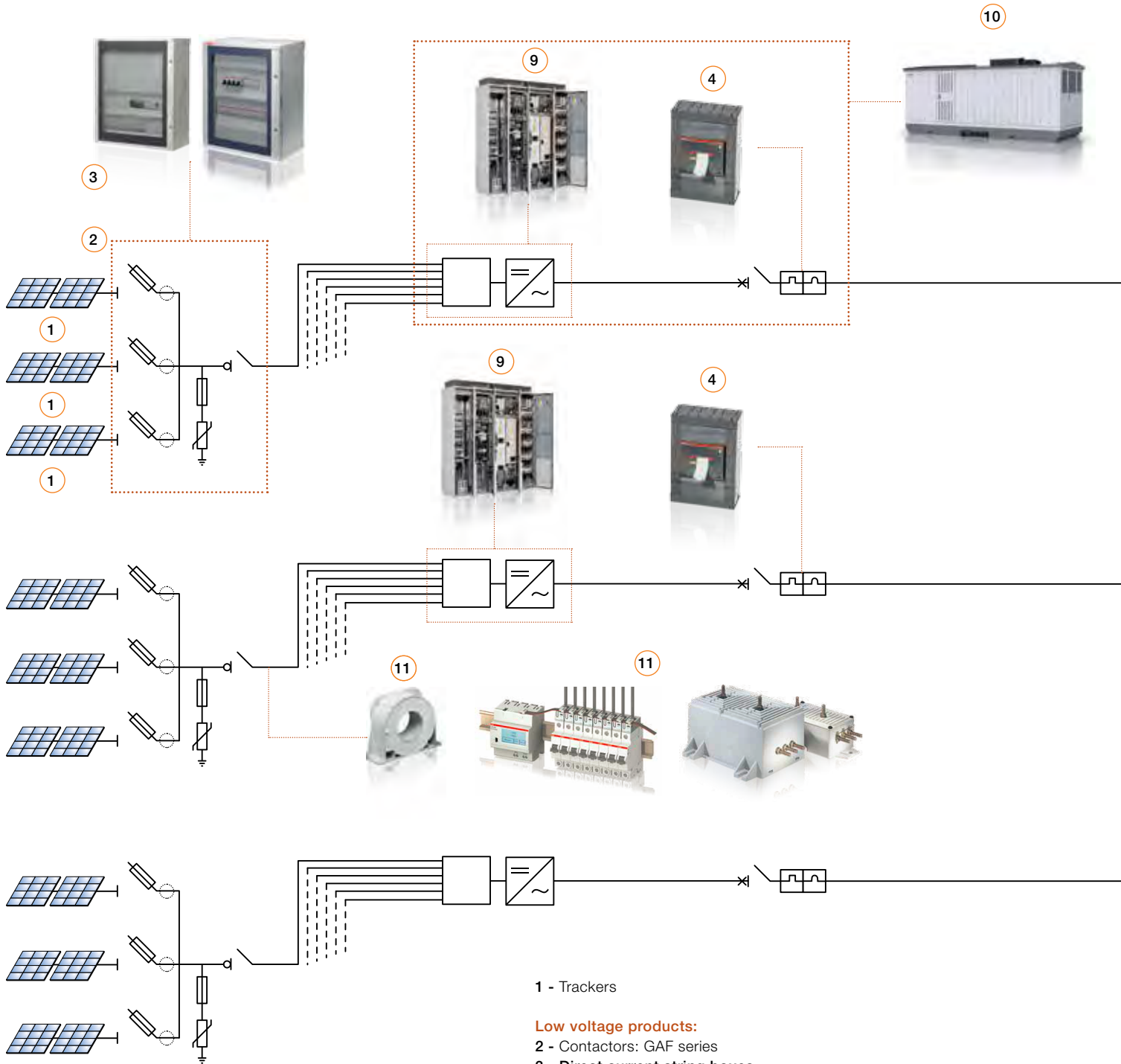
- 19 - PLC AC500
- 20 - Current Measurement System (CMS)

Medium voltage products:

- 21 - Secondary switchgears
- 22 - Dry type transformers
- 23 - Liquid type (oil filled) transformers
- 24 - Compact secondary substations

Example of photovoltaic applications

Application: Utility >1000 kW



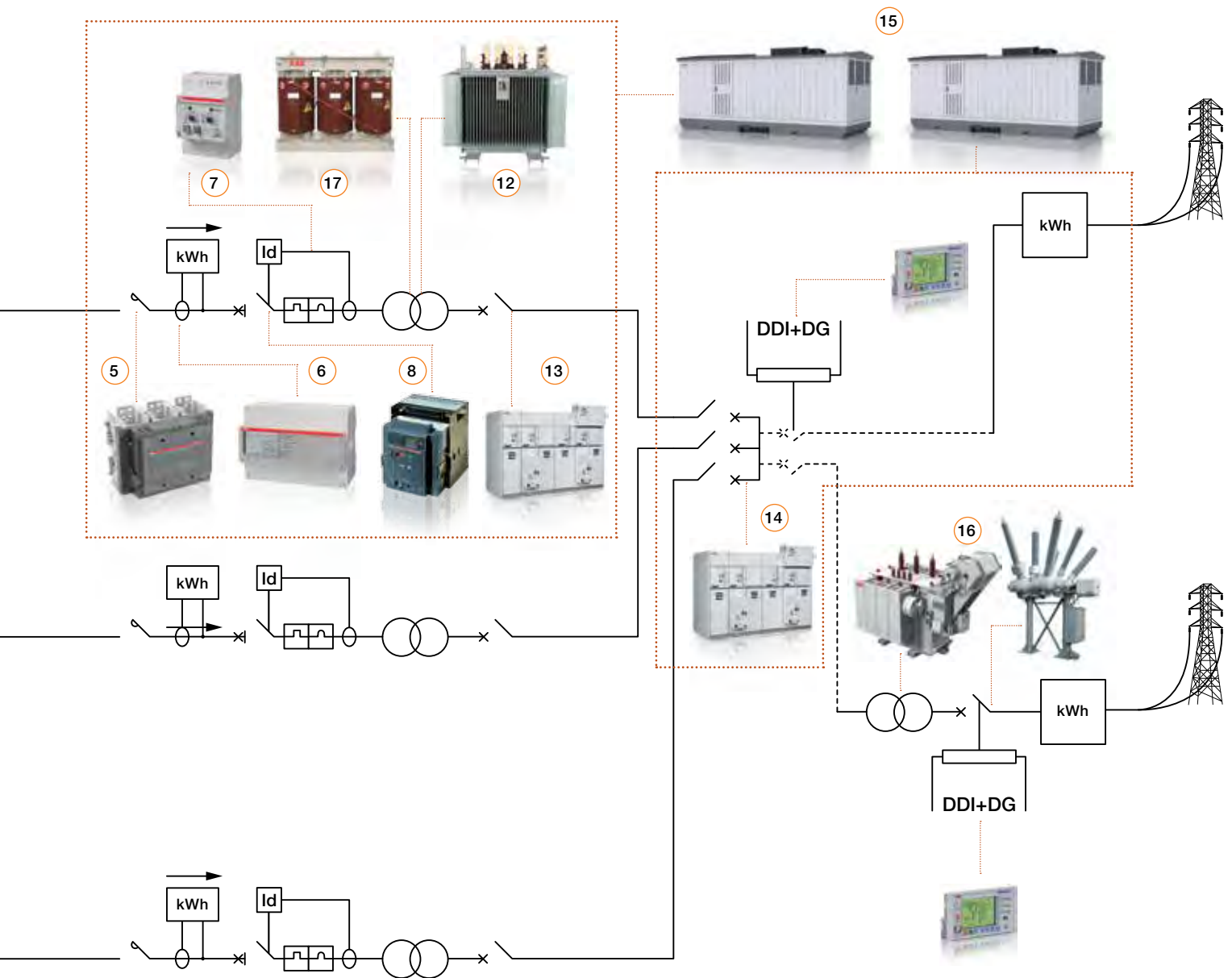
1 - Trackers

Low voltage products:

2 - Contactors: GAF series

3 - Direct current string boxes

- Switchboards: Gemini series,
- Consumer units: Europa series,
- Fuse disconnectors: E90 PV,
- Fuses: E 9F PV,
- Surge protective devices: OVR PV,
- Miniature circuit-breakers: S200 M UC Z,
- Miniature circuit-breakers: S800 PV-S
- Switch-disconnectors: OTDC series
- Switch-disconnectors: S800 PV-M
- Switch-disconnectors: Tmax PV
- PLC AC500
- Current Measurement System (CMS)



- 4 - Moulded-case circuit-breakers: Tmax
- 5 - Contactors: A and AF series
- 6 - Energy meters: EQ meters
- 7 - Residual current devices: RD3
- 8 - Air circuit-breakers: Emax

Solar inverters:

- 9 - Central inverters: PVS 800
Remote monitoring portal
- 10 - Megawatt station

String monitoring:

- 11 - ES Current Sensors,
VS Voltage Sensor

Medium voltage products:

- 12 - Liquid type (oil filled) transformers
- 13 - Secondary switchgears
- 14 - Primary switchgear
- 15 - Compact secondary substations
- 16 - Substations
- 17 - Dry type transformers

Example of photovoltaic applications

Key OEM supplier to top inverter manufacturers



Terminal blocks: SNK series
Current transformers
Surge protective devices: OVR PV, OVR T1, OVR T2, OVR TC
Miniature circuit-breakers: S800 PV-S
Switch-disconnectors: Tmax PV
Switches: OTDC series
Contactors: GAF series
Contactors: Bar contactor, IOR series
Contactors: A and AF series
Grid connection relay: CM-UFD
Pilot devices

Miniature circuit-breakers: S 200
Fuse disconnectors: E 90 PV
Residual current devices: F202 PV B and F204 B
Moulded-case circuit-breakers: Tmax
Insulation monitoring devices: CM-IWN
Power supplies: CP- series
Current and voltage sensors
PLC AC500
Current Measurement System (CMS)
Wiring ducts

Example of photovoltaic applications

DC string boxes



Switch-disconnectors: S800 PV-M
Switch-disconnectors: Tmax PV
Switches: OTDC series
Miniature circuit-breakers: S800 PV-S
Fuse disconnectors: E 90 PV
Surge protective devices: OVR PV
Current Measurement System (CMS)
Switchboards: Gemini series
Consumer units: Europa series
PLC AC500
Terminal blocks
Wiring ducts

Solar thermal energy

Controlling the plant

Solar thermal energy (STE) is a system that indirectly produces electricity using different technologies to collect and concentrate sun radiation.

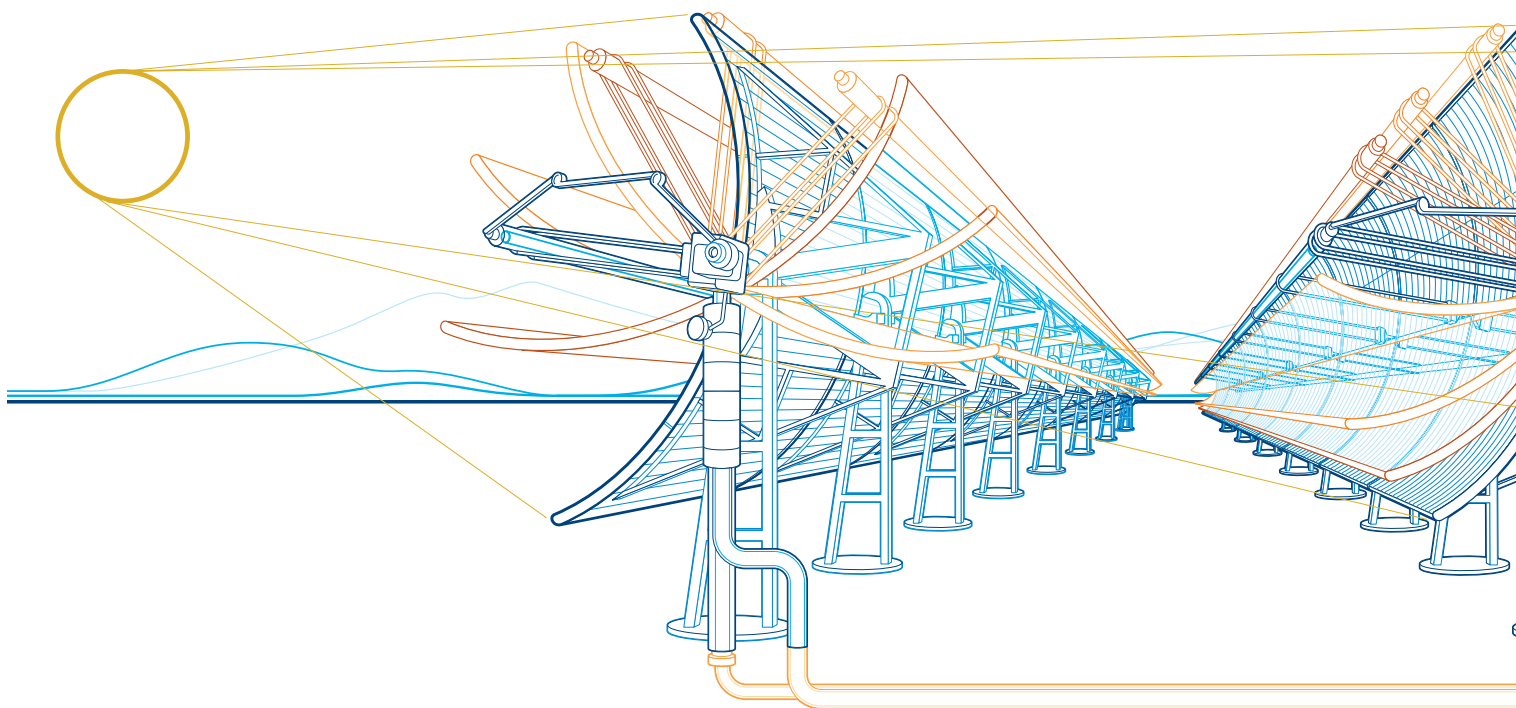
Two systems are used to generate power for the grid:

- parabolic trough systems
- power tower systems

In both cases, the system must track the sun movement precisely along one or two moving axes. ABB answer to this problem is AC500 PLC. It incorporates a special astronomical algorithm that ensures high precision control of horizontal rotation and vertical tilt, ensuring the correct incidence of the sun rays on the mirrors thereby optimizing system productivity.

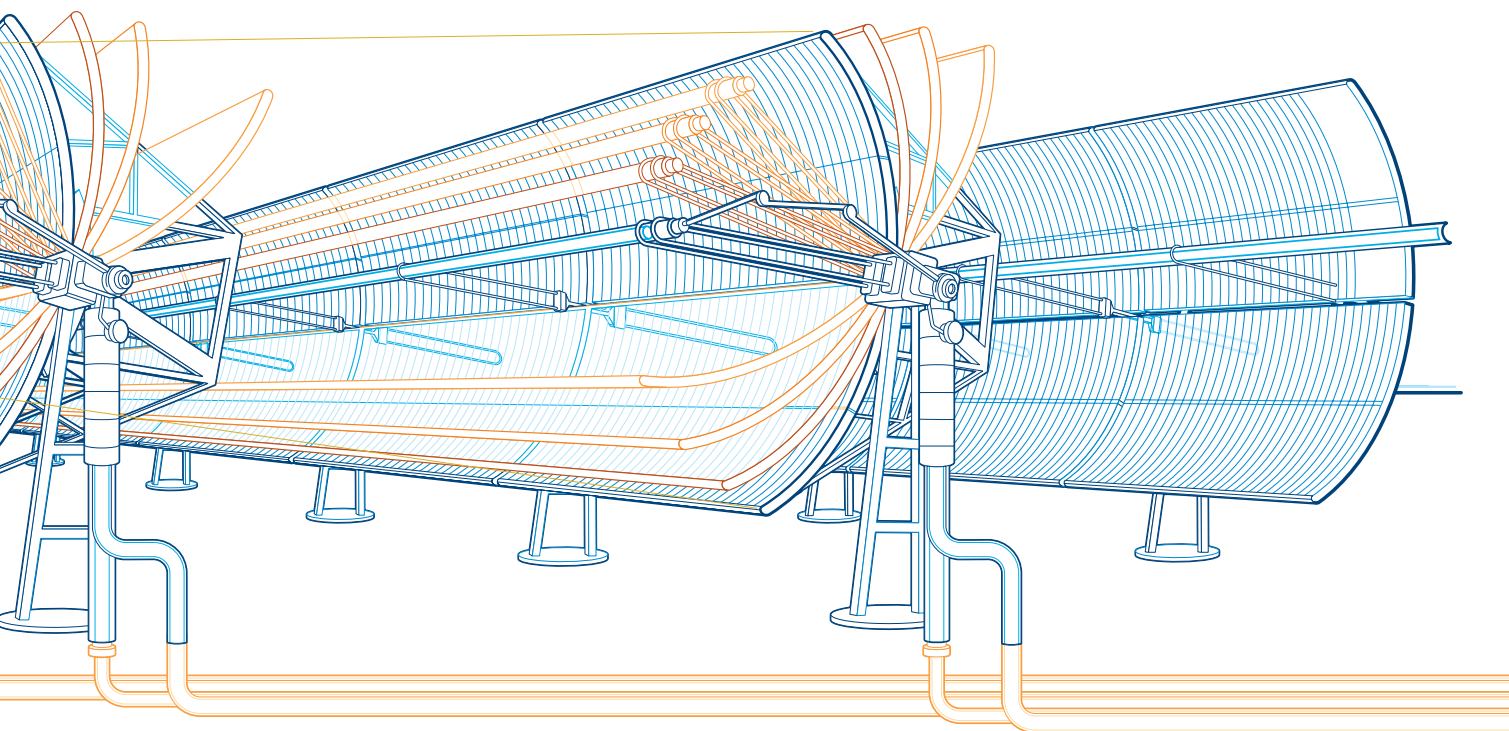
A high degree of accuracy is achieved thanks to the PLC real time clock together with azimuth and elevation calculations based on the date, solar time and mirror orientation.

Astronomic positioning is achieved using a trigonometric function which maintains optimal orientation with respect to the sun with a margin of error of less than a thousandth of a degree. In the event of wind, snow, hail or other emergency situations, the mirror is turned to the position of greatest safety.



Based on AC500 modular platform technology, a multitasking PLC can control several mirrors simultaneously. The PLC has incremental or absolute encoder fast counter inputs, analogue inputs (anemometers, rain gauges, etc), analogue outputs (controlling the frequency converters), a real time clock and dialogues with other PLCs or SCADA systems via Modbus RTU, Modbus TCP, DDE or OPC. It communicates with other PLCs or DCS systems using various protocols including Profibus DP, DeviceNet, CAN open, PROFINET and EtherCAT and has specific software libraries and engineering support. Maintenance is facilitated by a frontal display and an easy-to-remove standard SD card for security backups, firmware updates or source code downloads / uploads.

In addition, a typical ABB mirror control cabinet provides frequency converters (for axis movement), differential and thermo-magnetic protection with mini-contactors (for remote control of the electrical coupling of the axis systems and to shut off the power in case of emergency). All components must be able to tolerate high working temperatures, typical in this type of installation. On the power block, the switchboards for turbine/alternator group circuits must guarantee maximum safety for operating personnel. They must also allow for simple inspection and maintenance, easy installation and wiring and be compact in size.

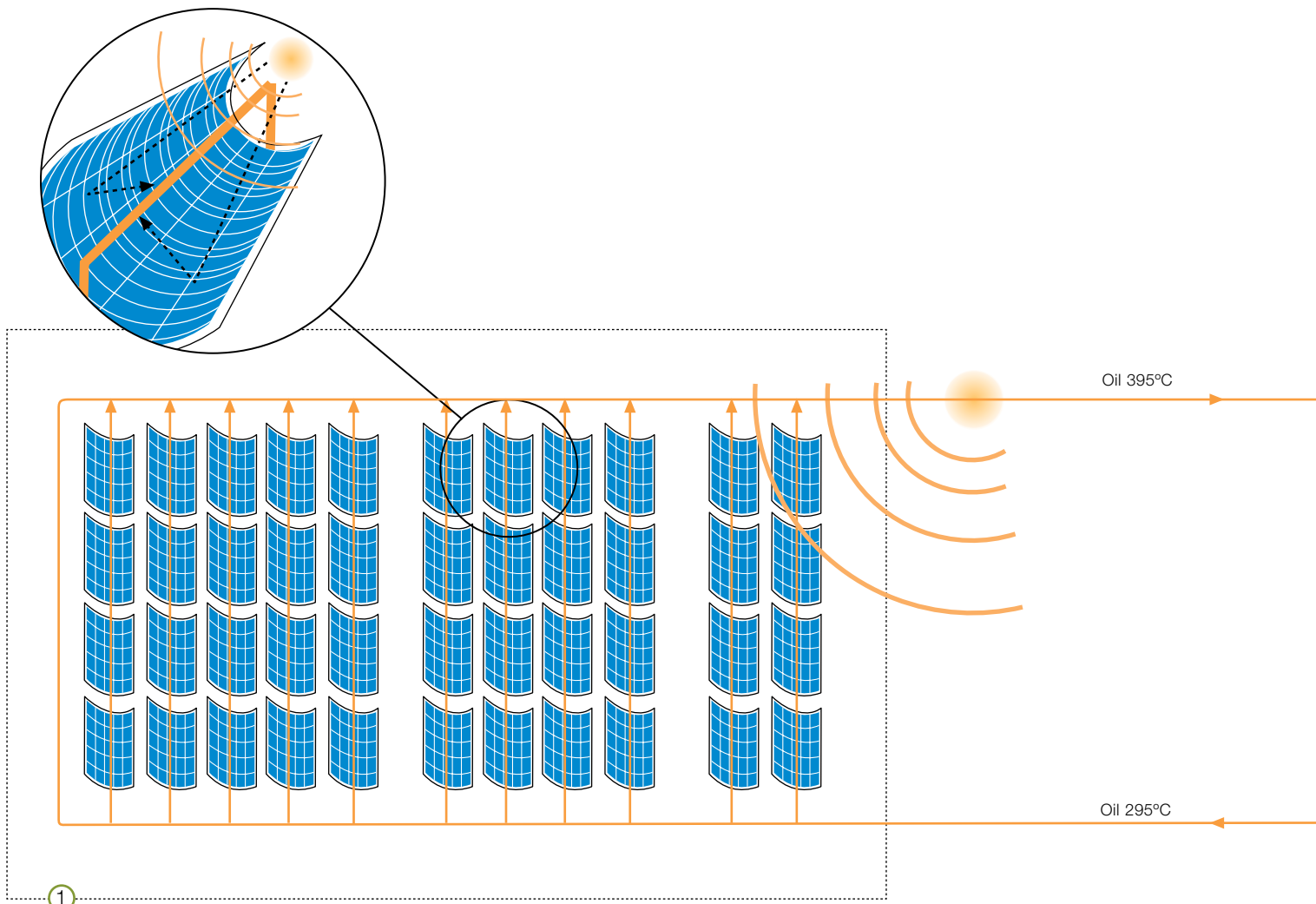


Solar thermal energy

Parabolic trough systems

In parabolic trough systems, solar field has a modular structure consisting of parabolic mirrors connected in series and arranged in parallel rows hundreds of meters long.

Each collector consists of a parabolic reflector (a common glass mirror) which focuses the sun radiation onto an absorber tube (or receiver) positioned at the focal point of the mirror. The heat transfer fluid, normally mineral oil, is pumped through the receivers and fed to a power station at the centre of the solar field. The heat generated is converted to steam to drive a steam turbine electricity generator. Operating temperatures typically reach 400°C.



Heliostats field

- 1 - Heliostats Automation
- PLC AC500.
- Frequency converters.
- Motors.
- Miniature circuit breakers.
- Residual current devices.
- Mini contactors.
- Manual Motor Starter.
- Plug-in relays.

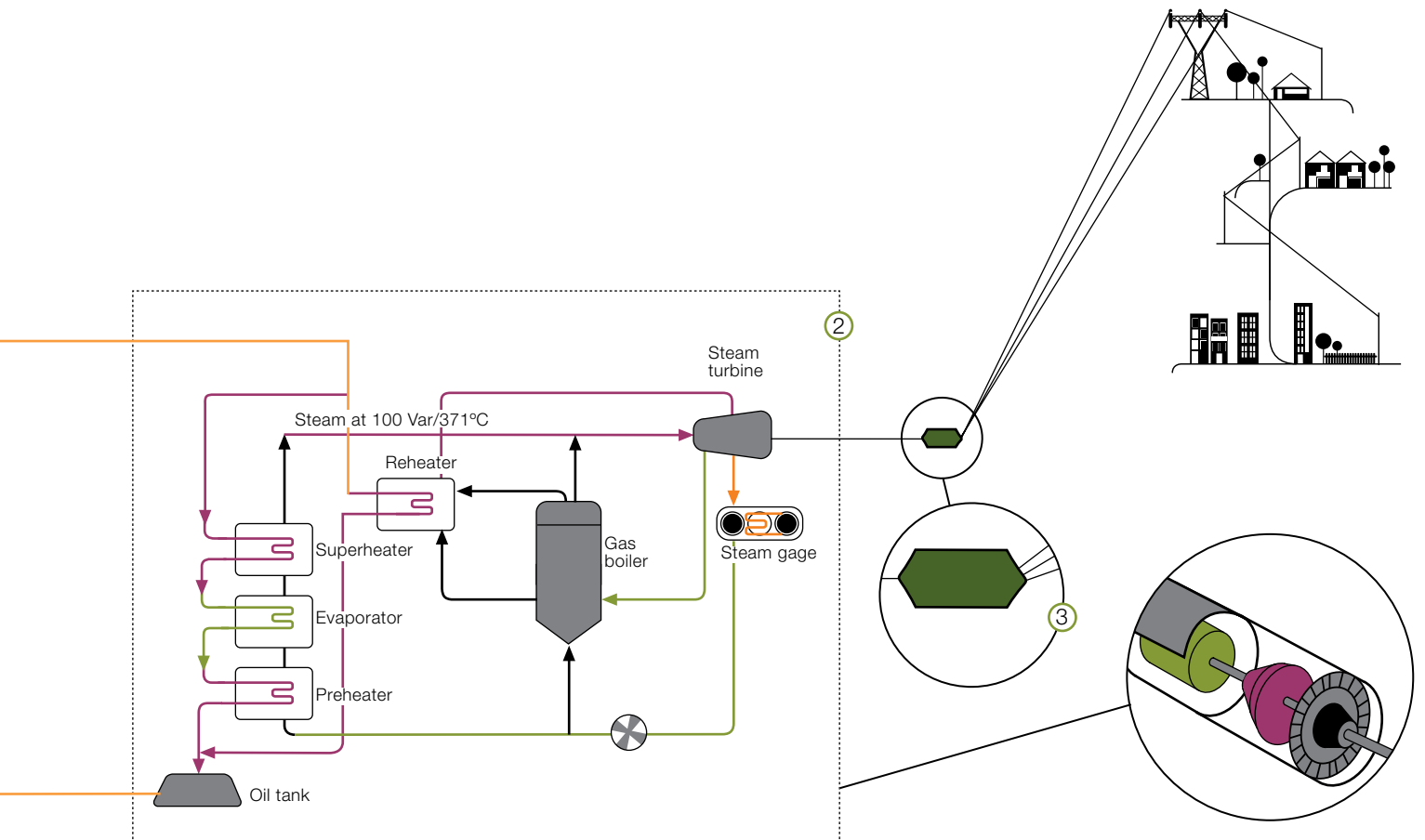
- Single phase power source.
- Emergency pushbuttons and momentary 2-position selectors.
- Surge Arresters.
- Surge Arresters for telecommunications.
- Temperature sensors.
- Terminal fuse holder.
- Connection terminal.
- Plastic enclosure.

Steam system

- 2 - Power block
- Switchboards.
- Motor control centers.
- Distributed control.
- Electrical switching for regulation of heat interchanging pumps:
- Frequency converters.
- Motors.

Transformation centre

- 3 - Transformation centre
- Dry transformer.
- Cabinets.

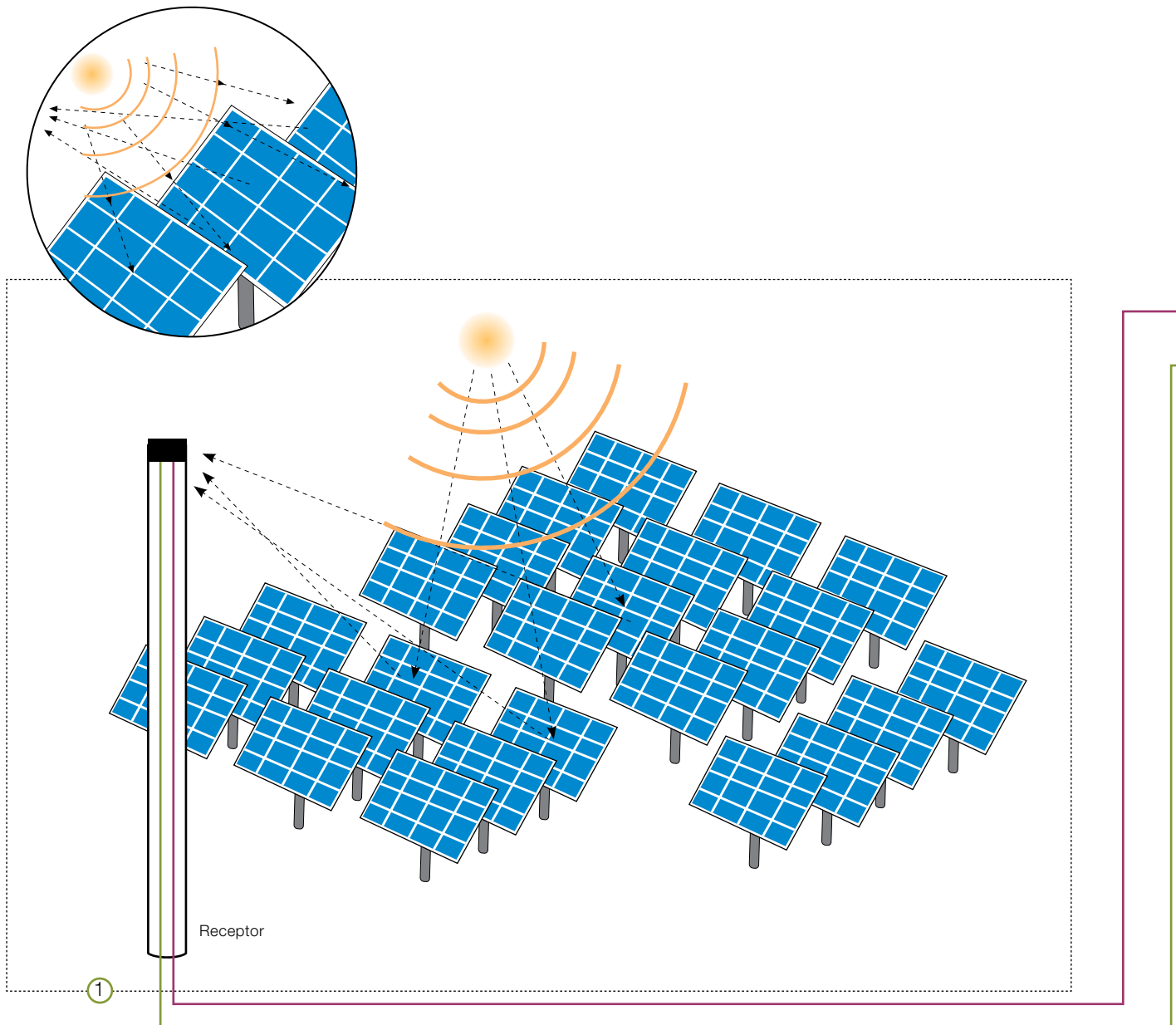


Solar thermal energy

Power tower systems

In tower plants thousands of flat mirrors (or heliostats) track sun movement and focus its rays on a receiver mounted on top of a tower at the centre of the plant.

The receiver contains a blend of molten salts which absorb the concentrated heat. Salts are stored in special tanks at temperatures of over 400° C and used to produce steam which drives a turbine generator.



Heliostats field

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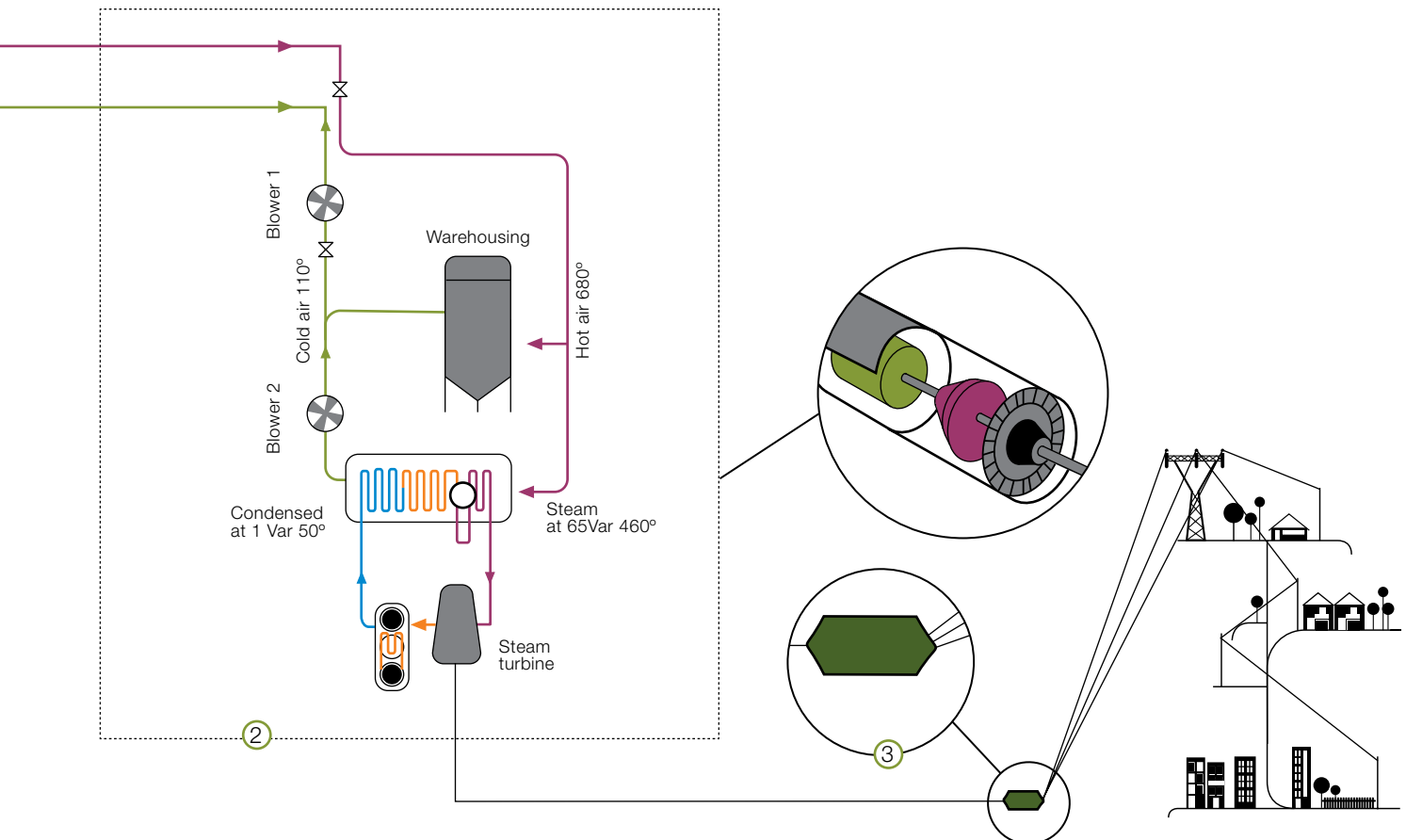
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Steam system

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- Frequency converters.
- Motors.

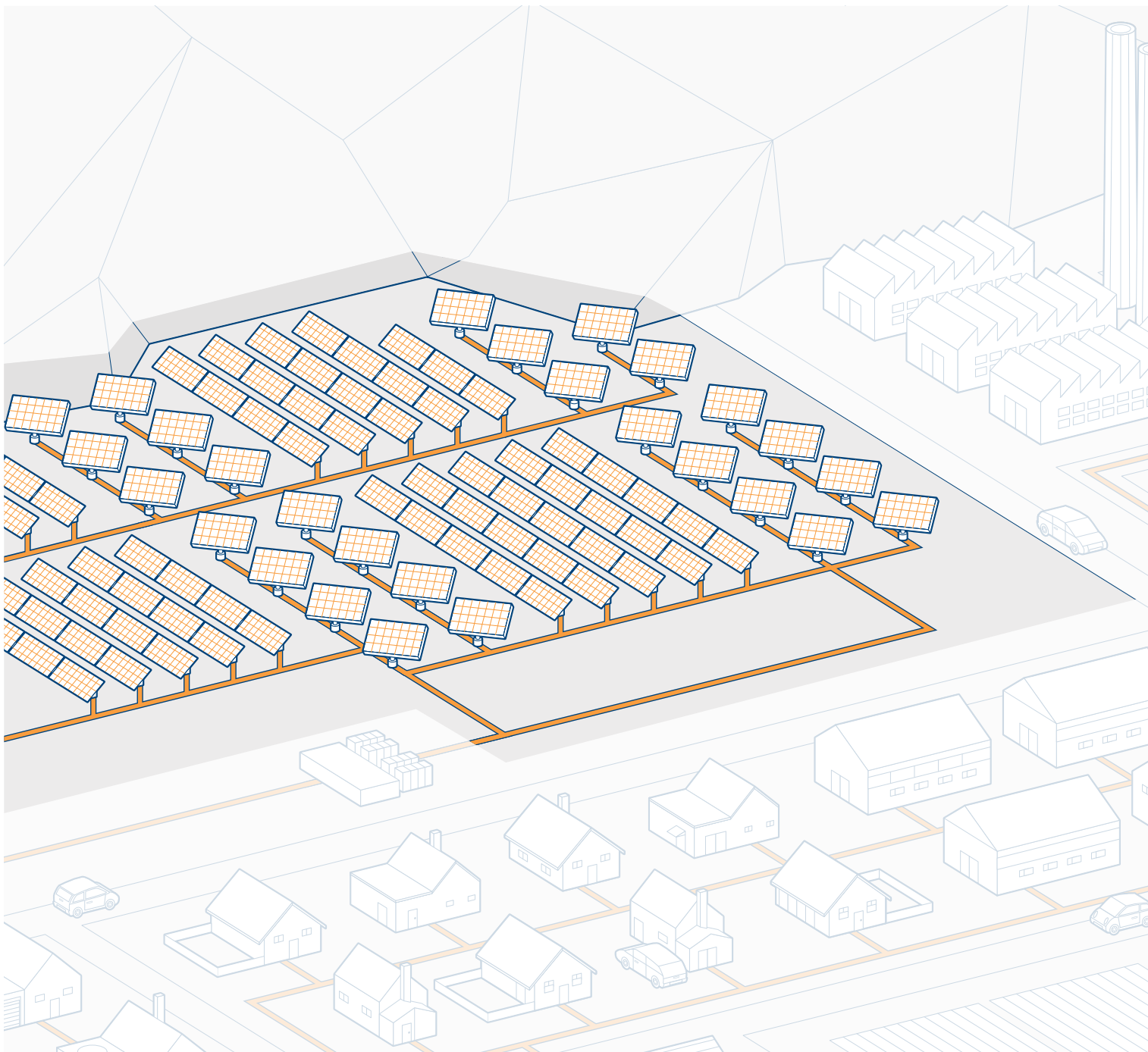
Transformation centre

- 3 - Transformation centre
- Dry transformer.
- Cabinets.



Photovoltaic systems

Products for DC side





Fuse disconnectors

E 90 PV



The E 90 PV series of fuse disconnectors has been designed for up to 1000 VDC applications in DC-20B category. The E 90 PV series is specifically focused on overcurrents protection of photovoltaic systems. It provides a reliable, compact and effective solution due to its 10.3 x 38 mm gPV cylindrical fuses.

The main features of E 90 PV fuse disconnectors include:

- 90° opening handle for an easy insertion of fuse even wearing gloves or using the thumb
- Only 17 mm difference in depth between open and closed position
- 25 mm² terminals with knurled cage for a better cable clamp
- Fully compatible with electrical screwdrivers
- Pozidriv screws for flat or cross screwdrivers
- Lockable in open position through standard padlocks, for a safer maintenance
- Sealable in closed position with lead seals to prevent unauthorized access
- Cooling chambers and ventilation slots improve heat dissipation
- Available with indicator LED lights to signal if the fuse is blown

Main technical specifications		E 90/32 PV
Reference Standards		IEC 60947-3, UL 4248-1, UL 4248-18
Rated Voltage	V DC	1000
Utilization category		DC-20B
Fuse	mm	10 x 38 gPV curve
Current		DC
Rated Current	A	32
Tightening torque	Nm	PZ2 2-2.5
Protection Class		IP20
Lockable (open position)		Yes
Sealable (closed position)		Yes

Cylindrical Fuses

E 9F PV



The new E 9F PV range of cylindrical fuses has been designed to protect DC circuits up to 1000 VDC according to gPV trip characteristic specific for PV systems. E 9F PV 10.3 x 38 mm fuses offer the best solution for protecting strings, inverters and surge arresters in photovoltaic systems with nominal currents up to 30 A.

Main technical specifications		E 9F PV
Reference Standards		IEC 60269-6, UL 4248-1, UL 4248-18
Rated voltage	V DC	1000
Rated current	A	1...30
Breaking capacity	kA	10
Minimum breaking capacity		From 1 A up to 7 A = 1.35 x In From 8 A up to 30 A = 2.0 x In
Dimensions	mm	10.3 x 38
Weight	g	7

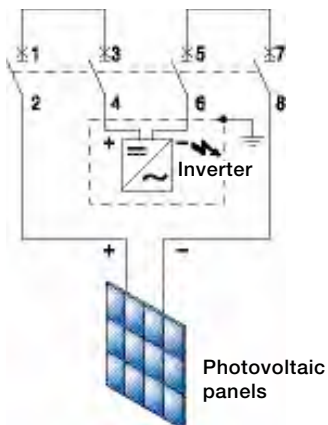
Miniature circuit-breakers S204 M UC Z



The S200 M UC Z range of miniature circuit-breakers features permanent magnets on the internal arcing chutes able to extinguish an electric arc of up to 500 V DC with $I_{cu} = 4.5$ kA. However, use of these components establishes circuit-breaker polarity, thus they must be powered in a certain direction. A diagram showing how the string and inverter must be connected is given alongside.

Main technical specifications		S204 M UC Z
Rated current I_n	A	$0,5 \leq I_n \leq 63$
Number of poles		4
Rated operational voltage U_e (DC)	V	440
Ultimate rated breaking capacity $I_{cu} - 4P$	kA	10
Electromagnetic release		$3 I_n \leq I_m \leq 4,5 I_n$
Operating temperature	°C	-25...+55
Mounting		on DIN rail EN 60715 (35 mm) by means of fast clip device

In IT systems an isolation monitoring device should not be installed.



Miniature circuit-breakers S800 PV-S

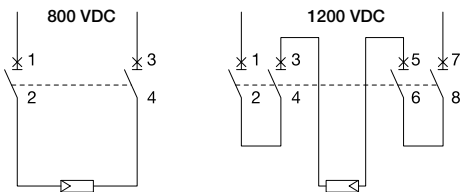


The S800 PV-S modular miniature circuit-breakers can be used in networks up to 1200 VDC (4-poles execution). The S800 PV-S circuit breakers and its range of accessories (auxiliary contacts, undervoltage releases, motorized commands) allow for a wide spectrum of configurations.

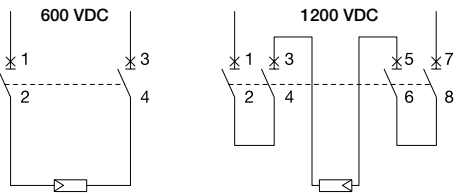
The main features of the S800 PV-S circuit breakers include:

- interchangeable terminals
- central trip safe disconnection of all poles
- contact status displayed for each pole
- polarity independent wiring

Panel network in
earth-insulated systems
≤ 80A



100, 125A



Main technical specifications		S800 PV-S	
Reference Standards		IEC EN 60947-2	
Rated current	A	10...80	100, 125
Number of poles		2, 4	
Rated voltage Ue			
(DC) 2 poles*	V	800	600
(DC) 4 poles*	V	1200	1200
Ultimate rated short-circuit breaking capacity Icu			
(DC) 2 poles* 800 V	kA	5	5
(DC) 4 poles* 1200 V	kA	5	5
Thermomagnetic release characteristic		4 I _n ≤ I _m ≤ 7 I _n	
Class of use		A	
Operating temperature	°C	-25...+60	
Mounting		DIN rail EN 60715 (35 mm) by means of fast clip device	

* Please refer to the wiring diagrams

Switch-disconnectors

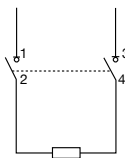
S800 PV-M, S802 PV-M-H



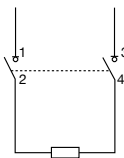
Panel network
in earth-insulated systems

S800 PV-M

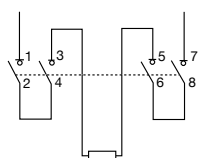
25 A
650 VDC



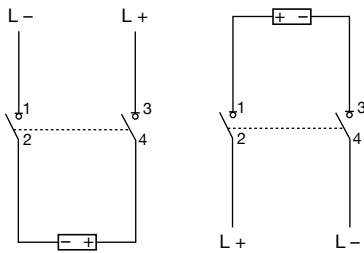
32...125 A
800 VDC



32...125 A
1200 VDC



S802 PV-M-H



Comply with polarity
and supply direction in wiring.

The S800 PV-M modular switch-disconnectors can be used in networks up to 1200 VDC (4-poles execution). The S800 PV-M switch-disconnectors and its range of accessories (auxiliary contacts, undervoltage releases, motorized commands) allow for a wide spectrum of configurations.

The main features of the S800 PV-M switch-disconnectors include:

- interchangeable terminals
- contact status displayed for each pole
- polarity independent wiring

Main technical specifications		S800 PV-M	
Reference Standards		IEC EN 60947-3	
Rated current I_n	A	25	32, 63, 125
Number of poles		2	2, 4
Rated voltage U_e	(DC) 2 poles*	V	650
	(DC) 4 poles*	V	800 1200
Rated short-time withstand current I_{cw}	(DC) 2 poles* 800 V	kA	1.5
	(DC) 4 poles* 1200 V	kA	1.5
Class of use		DC-21A	
Operating temperature	°C	-25...+60	
Mounting		on DIN rail EN 60715 (35 mm) by means of fast clip device	

* Please refer to the wiring diagrams

The S802 PV-M-H polarized switch-disconnectors are specially designed for networks up to 1000 VDC. They are equipped with permanent magnets which provide the switch polarity, therefore a correct supply voltage is required. S802 PV-M-H switch-disconnectors and its range of accessories (auxiliary contacts, undervoltage releases, motorized commands) allow for a wide spectrum of configurations.

The main features of the S802 PV-M-H switch-disconnectors include:

- interchangeable terminals
- contact status displayed for each pole

Main technical specifications		S802 PV-M-H	
Reference Standards		IEC EN 60947-3	
Rated current I_n	A	32, 63, 100	
Number of poles		2	
Rated voltage U_e		V	
(DC) 2 poles*	V	1000	
Rated short-time withstand current I_{cw}		kA	
(DC) 2 poles* 1000 V	kA	1.5	
Class of use		DC-21A	
Operating temperature	°C	-25...+60	
Mounting		on DIN rail EN 60715 (35 mm) by means of fast clip device	

* Please refer to the wiring diagrams

Pole connector S802-LINK125



The new pole connector S802-LINK125 is for currents up to 125A
The black cooling elements help to avoid overheating

What has to be secured in PV-application?

- Simultaneity factor is 1 in photovoltaic
- Ambient temperature of devices must be observed
- Calculation of internal resistance of all devices in an enclosure → due to dimension of enclosure
- Pole connection must be observed
- Terminal temperature must be maintained in accordance with IEC 61439-1
- Dimensioning of enclosure (power losses of all devices / heating)
- Assembly area of enclosure (no directly sun radiation)
- Mounting distances between each device
- ABB recommend to perform temperature rise tests

S800PV-S

I _e [A]	10°C	15°C	20°C	25°C	30°C	35°C	40°C	45°C	50°C	55°C	60°C
10	11	11	11	10	10	10	9	9	9	8	8
13	15	14	14	13	13	12	12	12	11	11	10
16	18	18	17	17	16	15	15	14	14	13	13
20	22	22	21	21	20	19	19	18	17	17	16
25	28	28	27	26	25	24	23	23	22	21	20
32	36	35	34	33	32	31	30	29	28	27	26
40	45	44	43	42	40	38	37	36	35	33	32
50	56	55	54	52	50	48	47	45	45	43	40
63	71	69	67	66	63	61	59	57	57	54	50
80	90	88	86	83	80	77	74	72	72	68	64
100	112	110	107	104	100	96	93	90	90	85	80
125	140	137	134	130	125	120	100	94	88	81	75

S800PV-M

I _e [A]	10°C	15°C	20°C	25°C	30°C	35°C	40°C	45°C	50°C	55°C	60°C
32	32	32	32	32	32	32	32	32	32	32	32
63	63	63	63	63	63	63	63	63	63	63	63
125	125	125	125	125	125	125	100	100	100	100	100

These value apply in combination with pole connector S802-LINK50

The tables are based on measurements using cable as stated in IEC 60947-2. Any deviation from these cable diameters and lengths might lead to higher temperatures. Therefore ABB recommends to perform temperature measurements to verify the real maximum temperature in the application.

Current sensors

ES range



As components get smaller but more powerful, installing current sensors is becoming a real problem. But with ES range, the whole thing is child's play. By being the first in the field to offer these smaller current sensors that maintain your high-performance objectives, ABB met the challenge of giving you the space you always needed.

Once again ABB lead the field by giving installers a chance to choose between two ways of fastening sensors: horizontally or vertically. This flexibility means that ES sensors can be installed in any position.

This is a major breakthrough that greatly simplifies the task of systems integrators. The ES range is the ideal way of reducing the size of equipment.

The main features are:

- Plastic case and insulating resin are self-extinguishing.
- Fixing holes in the case moulding for two positions at right angles.
- Direction of the current: A primary current flowing in the direction of the arrow results in a positive secondary output current from terminal M.

Primary connection

- Hole for primary conductor.
- The temperature of the primary conductor in contact with the case must not exceed 100°C.

Secondary connection

- Molex type HE14 connector
- JST connector (ref.: B3P-VH)
- 3 x 200 mm cables (cross section 0.38 mm²)

Technical data

			ES100C	ES300C	ES500C	ES500-9672	ES1000C	ES1000-9678	ES2000C
	Molex type HE14 connector								
	JST connector		-	ES300S	ES500S	ES500-9673	ES1000S	ES1000-9679	ES2000S
	Cables		ES100F	ES300F	ES500F	ES500-9674	ES1000F	ES1000-9680	ES2000F
Nominal primary current		A r.m.s.	100	300	500	500	1000	1000	2000
Accuracy at I _{PN}	-5 ... +70°C	%	≤ ± 1	≤ ± 1	≤ ± 1	≤ ± 1	≤ ± 1	≤ ± 1	≤ ± 1

Voltage sensors

VS range



To push the performance barriers back ever further, VS sensors are made 100% electronic. Our sensors are the first ones on the market to incorporate this innovation. They prove themselves every day and give their users the edge in a broad range of applications. This guarantees you unbeatable dynamic performances that give optimal slaving of customer equipment while complying with the latest standards in force. VS sensors are perfect for use in sectors such as solar, railways, mining and control in hazardous environments.

The main features are:

- Coated electronic circuit.
- Plastic case and insulating resin are self-extinguishing.
- Direction of the current: A positive primary differential voltage ($U_{HT+} - U_{HT-} > 0$) results in a positive secondary output current from terminal M.
- Protections:
 - of the measuring circuit against short-circuits.
 - of the measuring circuit against opening.
 - of the power supply against polarity reversal.
- Burn-in test in accordance with FPTC 404304 cycle.
- Tightening torque for M5 terminal studs (N.m): 2 N.m.

Primary connection

- 2 M5 studs

Standard secondary connections

- 4 M5 studs and 3 Faston 6.35 x 0.8

Technical data

		VS750B	VS1000B	VS1500B
Nominal primary voltage	V r.m.s.	750	1000	1500
Accuracy at U_{PN}	-40 ... +85°C	% $\leq \pm 1.7$	$\leq \pm 1.7$	$\leq \pm 1.7$

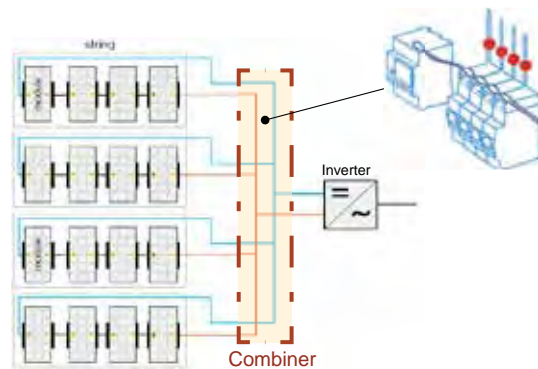
String monitoring Current Measurement System (CMS)



The CMS string monitoring increases the efficiency of your photovoltaic system. The easy-to-integrate system enables you to immediately detect either a defective string or a loss in performance, e.g., caused by contaminated or damaged panels and to quickly implement appropriate countermeasures. Main use is for string monitoring in combiner boxes to detect failures on PV strings.










Benefits:

- small sizes
- high accuracy
- quick installation start up time
- freely selectable amount of measurement points
-



Main technical specification

Measurement range CMS-100 Series (18mm Sensor)	A	80, 40, 20
Measurement range CMS-200 Series (25mm Sensor)	A	160, 80, 40
Insulation Voltage	V	1500 VDC
DC Accuracy (TA = +25 °C)	%	0,7 - 1,7
Operating temperature	°C	-25 .. +70
Communication	-	Modbus RTU (RS485 2 wire)

Mounting	S800	DIN rail	Cable Ties
	for all ABB S800 devices with cage terminals 	universal use 	universal use 
18mm	CMS-100S8 CMS-101S8 CMS-102S8 	CMS-100DR CMS-101DR CMS-102DR 	CMS-100CA CMS-101CA CMS-102CA 
25mm	CMS-200S8 CMS-201S8 CMS-202S8 CMS-203S8 	CMS-200DR CMS-201DR CMS-202DR CMS-203DR 	CMS-200CA CMS-201CA CMS-202CA CMS-203CA 

Switch-disconnectors OT_M



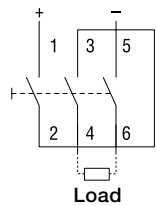
The rotary switch-disconnectors of OT_M series are specially designed for quick-disconnection of electrical lines according to IEC 60947-3 standard; they are used to control and insulate strings up to 750 VDC and offer an ideal complement for a safety maintenance of FV systems. The main features of the OT_M switch-disconnectors include:

- quick-make and quick-break operations with independent snap function
- available options include auxiliary contacts and knobs for remoted rotary command
- Integrated with the System pro M compact product line and compatible with OT series accessories
- Versions over 40 A with pad lockable door locking knob

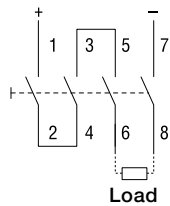
Main technical specifications		OT_M		
Reference Standards		IEC EN 60947-3		
Nominal current I _n	A	40, 80, 125		
Number of poles		3, 4		
Switch-disconnector		40M_	63ML_	125M_
Nominal Operating Current in DC-21A/ series poles				
500 VDC	A	16/4	16/4	20/4
750 VDC	A	-	-	-
Class of use		DC-21A		
Operating temperature	°C	-25...+50		
Mounting		on DIN rail EN 60715 (35 mm) by means of fast clip device		

* Refer to wiring diagrams

3 poles in series



4 poles in series



Switch-disconnectors

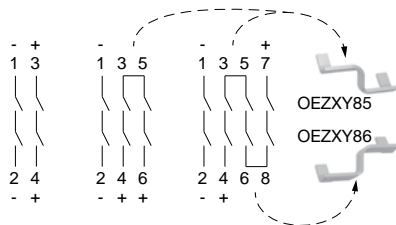
OTDC 16- 32



OTDC switch-disconnectors are available with nominal currents from 16A up to 32A in three different modular versions, with the same frontal footprint and one, two or three arc plates depending on operating DC voltage.

The main features of the OTDC switch-disconnectors include:

- Compactness and modularity: allow for switchboard dimension and costs reduction
- Thermal efficiency: low resistive losses for reduced heat dispersion, avoiding waste of energy
- High operating voltages: the in-depth development of arc plates allows to reach insulating voltages up to 1000V
- Rail mounting for easy installation
- DIN, tunnel terminals and jumpers for parallel wiring included: easy and quick assembly
- OTDC from 16 to 32 A is also available in a plastic enclosure (OTDCP), suitable for outdoor use.



Wiring diagram

Main technical specifications		OTDC		
Reference Standards		IEC EN 60947-3		
Nominal current In	A	16, 25, 32		
Nominal current Ie / Number of poles (Ue = 600 VDC)	A / -	16 / 2 16 / 2x2	25 / 2 25 / 2x2	32 / 2 32 / 2x2
Nominal current Ie / number of poles (Ue = 1000 VDC)	A / -	10 / 2 16 / 3 10 / 2x2	16 / 2 25 / 3 16 / 2x2	20 / 2 32 / 3 20 / 2x2
Class of use		DC-21B		
Maximum operating temperature in box without Ith*derating	°C	60		
Mounting		With screws on the bottom of the switchboard or on DIN rail EN 60715 (35 mm) by means of fast clip device		

*Minimum cable size of 4, 6 and 10 mm² respectively

Switch-disconnectors OTDC100...250



OTDC100...250 series of switch-disconnectors is available with nominal currents from 100A up to 250A in single footprint with two poles (1000 VDC version).

Four pole (1500 VDC) or double device versions (two devices operated simultaneously by a single handle) are available.

The main features of the OTDC100...250 switch-disconnectors include:

- Compactness: thanks to the patented DMB (Dual Magnetic Breaking) technology are the first switch-disconnectors in the market to reach 1000 VDC with only 2 poles (front footprint WxH 113x176)
- Easy to install: connections are independent from polarity, for a greater wiring flexibility. The command mechanism can be located between the poles or on the left side of the switch
- Safety: visible contacts allow a clear indication of switch status

Main technical specifications		OTDC 100 - 250
Reference Standards		IEC EN 60947-3 UL-98B
Nominal current I _n	A	100,160,200,250 (IEC EN 60947-3) 100, 180, 200 (UL98B)
Number of poles		2, 4
Nominal voltage U _e		
(DC) 2 poles	V	1000
(DC) 4 poles	V	1500
(DC) 4 poles (2X2)	V	1000
Class of use		DC-21B
Maximum operating temperature in box without I _{th} *derating	°C	40
Mounting		With screws on the bottom of the switchboard



Wiring diagram

Switch-disconnectors

OTDC250...500



The OTDC series of switch-disconnectors is available with nominal currents from 250 to 500 A, in single footprint with two poles (1000 VDC).

Three pole (1500 VDC) or double device versions (two devices operated simultaneously by a single handle) are available.

The main features of the OTDC250...500 switch-disconnectors include:

- Compactness: thanks to the patented DMB (Dual Magnetic Breaking) technology, the switches reach 1000 VDC with only 2 poles. The front footprint is WxH 197 X 227.
- Easy to install: connections are independent from polarity, for a greater wiring flexibility. The command mechanism can be located between the poles or on the left side of the switch
- Safety: visible contacts allow a clear indication of switch status.



Wiring diagram

Main technical specifications		OTDC 250 - 500
Reference Standards		IEC EN 60947-3 UL98B
Nominal current I _n	A	315, 400, 500 (IEC EN 60947-3) 250, 320, 400 (UL98B)
Number of poles		2, 3, 4
Nominal voltage U _e		
(DC) 2 poles	V	1000
(DC) 4 poles	V	1500
(DC) 4 poles (2X2)	V	1000
Class of use		DC-21B
Maximum operating temperature in box without I _{th} derating	°C	40
Mounting		With screws on the bottom of the switchboard

Switch-disconnectors Tmax PV



Using the Tmax PV line, the customer is able to select the most appropriate device for any Solar PV need.

Under IEC 60947-3, Tmax PV offers switch-disconnectors to meet standard 1100V DC applications. In addition, it offers the versatility of extended capacities to 1500V DC for the increasingly demanding solar applications of today's market.

Finally, connection jumpers are an available option for the IEC switch-disconnectors to increase safety and ease of installation.

Tmax Automatic Circuit-breakers according to IEC up to 1000V DC are available as a special version of the standard Tmax line. Information about that range can be found in the Tmax technical catalogue.

Under UL 489B, Tmax PV offers adaptability in the form of the availability of both switch-disconnectors and molded case circuit-breakers.

Multiple formats allows for the ability of a uniform end product and shared accessories. In addition, ABB offers connection jumpers as a mandatory accessory to Tmax PV UL. The jumpers provide simple, safe use and ensured compliance to new UL regulations.

Molded case switch-disconnectors up to 1100V DC in compliance with IEC 60947-3

Main technical Specification

Tmax PV IEC switch-disconnectors		T1D/PV	T3D/PV	T4D/PV	T5D/PV	T6D/PV	T7D/PV ¹⁾
Conventional thermal current, I _{th}	(A)	160	250	250	630	800	1250-1600
Rated service current in category DC22 B, I _e	(A)	160	200	250	500	800	1250-1600
Number of poles	(No.)	4	4	4	4	4	4
Rated service voltage, U _e		1100V DC	1100V DC	1100V DC	1100V DC	1100V DC	1100V DC
Rated impulse withstand voltage, U _{imp}	(kV)	8	8	8	8	8	8
Rated insulation voltage, U _i	(V)	1150V DC	1150V DC	1150V DC	1150V DC	1150V DC	1150V DC
Test voltage at industrial frequency for 1 minute	(V)	3500	3500	3500	3500	3500	3500
Rated short-circuit making capacity, switch-disconnector only, I _{cm}	(kA)	1.92	2.4	3	6	9.6	19.2
Rated short-time withstand current for 1s, I _{cw}	(kA)	1.92	2.4	3	6	9.6	19.2
Versions		F	F	F	F	F	F
Standard terminals		FC Cu	FC Cu	F	F	F	F
Mechanical life with motor	(No. Operations)	15000	15000	7500	7500	7500	20000*
Electrical life (operations @ 1100V DC)	(No. Operations)	500	500	500**	500**	500**	500**
Basic dimensions	W (mm/in)	102/4.02	140/5.52	140/5.52	186/7.33	280/11.02	280/11.02
	D (mm/in)	70/2.76	70/2.76	103.5/4.07	103.5/4.07	103.5/4.07	154/6.06 (manual) 178/7.01 (motorized)
	H (mm/in)	130/5.12	150/5.91	205/8.07	205/8.07	268/10.55	268/10.55
Weight (with standard terminals only)	(kg/lbs)	1.2/2.65	2/4.41	3.05/6.72	4.15/9.15	12/26.46	12.5/27.56 (manual) 14/30.86 (motorized)

¹⁾ installation in vertical position only

* ask ABB SACE for the availability of the improved 20000 mechanical operation version of T7D PV M

** openings with SOR or UVR

Switch-disconnectors

Tmax PV

Molded case switch-disconnectors up to 1500V DC in compliance with IEC 60947-3

Main technical Specification

Tmax PV IEC switch-disconnectors		T4D/PV-E	T7D/PV-E ¹⁾
Conventional thermal current, I _{th}	(A)	250	1250-1600
Rated service current in category DC22 A, I _e	(A)	250	1250-1600
Number of poles	(No.)	4	4
Rated service voltage, U _e		1500V DC	1500V DC
Rated impulse withstand voltage, U _{imp}	(kV)	8	8
Rated insulation voltage, U _i	(V)	1500V DC	1500V DC
Test voltage at industrial frequency for 1 minute	(V)	3500	3500
Rated short-circuit making capacity, switch-disconnector only, I _{cm}	(kA)	3	19.2
Rated short-time withstand current for 1s, I _{cw}	(kA)	3	19.2
Versions		F	F
Standard terminals		F	F
Mechanical life	(No. Operations)	7500	20000 **
Electrical life (operations @ 1500V DC)	(No. Operations)	1000*	500*
Basic dimensions	W (mm/in)	140/5.52	280/11.02
	D (mm/in)	103.5/4.07	178/7.01
	H (mm/in)	205/8.07	268/10.55
Weight (with standard terminals only)	(kg/lbs)	3.05/6.72	14/30.86

1) installation in vertical position only

* openings with SOR or UVR

** ask ABB SACE for the availability of the improved 20000 mechanical operation version of T7D PV M

Molded case switch-disconnectors up to 1000V DC in compliance with UL 489B

Main technical Specification

Tmax PV UL switch-disconnectors		T1N-D/PV	T4N-D/PV	T5N-D/PV	T6N-D/PV	T7N-D/PV ¹⁾
Frame size	(A)	100	200	400	600-800	1000
Rated service current	(A)	100	200	400	600-800	1000
Number of poles	(No.)	4	3	3	4	4
Rated service voltage	(V)	1000V DC	1000V DC	1000V DC	1000V DC	1000V DC
Short-circuit current withstand	(kA)	1	3	5	10	15
Magnetic override	(kA)	-	3	5	10	-
Versions		F	F	F	F	F
Connections*		Jumpers	Jumpers	Jumpers	Jumpers	Jumpers
Terminals provided with Jumper kit		FCCu	FCCuAl	FCCu-ES	FCCuAl-EF	FCCuAl-F
Mechanical life with Motor	(No. Operations)	15000	7500	7500	7500	20000***
Electrical life (operations @ 1000V DC)	(No. Operations)	1000	1000**	500**	500**	500**
Basic dimensions	W (mm/in)	102/4.02	105/4.13	140/5.52	280/11.02	280/11.02
	D (mm/in)	70/2.76	103.5/4.07	103.5/4.07	103.5/4.07	178/7.01
	H (mm/in)	130/5.12	205/8.07	205/8.07	268/10.55	268/10.55
Weight (with standard terminals only)	(kg/lbs)	1.2/2.65	2.35/5.18	3.25/7.17	12/26.46	14/30.86

1) installation in vertical position only

* Selection of one of the jumper connection options is mandatory for Tmax PV UL

** openings with SOR or UVR

*** ask ABB SACE for the availability of the improved 20000 mechanical operation version

Switch-disconnectors

Tmax PV

Whenever a consistent short-circuit current can be found (like in recombiner boxes), 1000V DC automatic circuit-breakers are available in the Tmax range. Below is the UL489B automatic circuit-breaker offering:

Molded case circuit-breakers up to 1000V DC in compliance with UL 489B

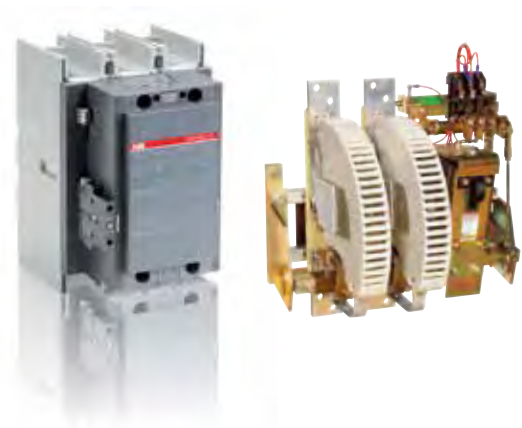
Main technical Specification

Tmax PV UL MCCBs		T4N/PV	T5N/PV	T6N/PV
Frame size	(A)	200	400	600-800
Rated service current	(A)	40-200	400	600-800
Number of poles	(No.)	3	3	4
Rated service voltage	(V)	1000V DC	1000V DC	1000V DC
Short-circuit interrupting rating @ 1000V DC	(kA)	3	5	10
Trip Unit		TMD/TMA	TMA	TMA
Versions		F	F	F
Standard terminals		F	F	F
Connections*		Jumpers	Jumpers	Jumpers
Terminals provided with Jumper kit		FCCuAl	FCCu-ES	FCCuAl-EF
Mechanical life with motor	(No. Operations)	7500	7500	7500
Electrical life (operations @ 1000 VDC)	(No. Operations)	1000**	500**	500**
Basic dimensions	W (mm/in)	105/4.13	140/5.52	280/11.02
	D (mm/in)	103.5/4.07	103.5/4.07	103.5/4.07
	H (mm/in)	205/8.07	205/8.07	268/10.55
Weight (with standard terminals only)	(kg/lbs)	2.35/5.18	3.25/7.17	12/26.46

* Selection of one of the jumper connection options is mandatory for Tmax PV UL

** openings with SOR or UVR

Contactors (for DC switching) GAF & IOR bar contactors



The GAF range is dedicated to DC switching. Based on the A range, these are reliable and modern contactors.*

When DC voltage and/or current ratings higher than below table, ABB offers bar contactors, designed by customer specification.

Main technical specifications	GAF
Rated operational voltage	1000 VDC
Current ratings, DC-1	275 – 2050 A
Control voltage	Electronically controlled AC/DC
Number of poles	3 (connect in series)
Reference standards	IEC60947-1, -4-1

*Available from end 2010

The IOR bar contactors Iquo totas ent vel imagnienim nobis moloria preium, sum dolorrovitio et labores ressimaiorro quassinctiae vel mostis quis dollectati non necusciis erem est essi beruptatus es exceptam id quaectur magnatint id ma voluptio officium quatur, id quam repudaerumet ulluptate dolorepedit aut aute aspellorecum voluptat estiassim ut maxime natatem que ma dicto blaborem dunt es im que omnim harum ut est, et, optat molupicatur, consequi blam eatin.

Main technical specifications		IOR...-CC, IORR...-CC contactors (a.c. operated)	IORE...-CC contactors (d.c. operated - with economy resistor)	IORC...-CC contactors (d.c. operated - without economy resistor)
Rated operational current $U_e \leq 1500$ V d.c.				
DC-1	A	85, 170, 275, 550, 800, 1500, 1800	85, 170, 275, 550, 800, 1500, 1800	85, 170, 275, 550, 800
DC-3/DC-5	A	68, 125, 205, 500, 720	68, 125, 205, 500, 720	68, 125, 205, 500, 720
Number of poles			3	

Standard A and AF range



The A and AF ranges are standard, general purpose block contactors for reliable remote switching of both AC and DC circuits.

Main technical specifications	A9-AF2050
Rated operational voltage	1000 V
Current ratings	9 – 2050A (AC) max 1900A DC at 600 V according to cULus
Control voltage, A range	Direct operation, AC or DC
Control voltage, AF range	Electronically controlled AC/DC
Number of poles	3
Reference standards	IEC60947-1, -4-1

Surge protective devices

OVR PV

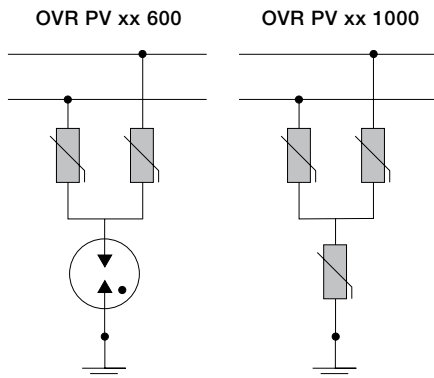


ABB offers a wide range of surge protection devices specifically designed for photovoltaic systems. The main features of the OVR PV SPDs include:

- OVR PV T1 and T2 version
- Auto-protected from end-of-life short circuits up to 100 A DC thanks to the integrated thermal protection with direct current breaking capacity
- pluggable cartridges for easy maintenance, no need to disconnect the line
- auxiliary contact for remote signaling of line status ("TS" version)
- absence of short circuit follow current
- absence of risk for reversed polarity
- "Y" configuration for a safer protection

Main technical specifications		OVR PV T1	OVR PV 40
Reference standards		IEC 61643-11 / UTE C 61740-51 prEN 50539-11 UL 1449 3rd edition*	
Configuration		Y	Y
SPDs Type / Test Class		T1 / I	T2 / II
Max. cont. Operating voltage U_{cPV}	V	670 / 1000	670 / 1000
Nominal discharge current I_n (8/20 μ s)	kA	6.25	20
Impulse current I_{imp} (10/350 μ s)	kA	6.25	-
Maximum discharge current I_{max} (8/20 μ s)	kA	-	40
Voltage protection level U_p	kV	1.9 / 2.5	2.8 / 3.8
Short circuit DC current withstand I_{scwPV}	A	100	100
Back-up protection:			
- if $I_{scwPV} \leq 100A$		- not required	- not required
- if $I_{scwPV} > 100A$		- 10A gPV fuse	- 10A gPV fuse or MCB
Response time	ns	≤ 25	≤ 25
Specific integrated PV thermal disconnecter		Yes	Yes
Pluggable		Yes	Yes
Auxiliary contact		TS	TS

*UL version only for OVR PV 40



OVR TC

With increasing request of monitoring systems, OVR TC data line SPDs are right choice to protect the monitoring lines of the PV plants from surges. They are installed in series with the network and have removable cartridges, making maintenance simple, without having to cut the power to the telecommunications line.

Main technical specifications		OVR TC
Reference Standard		IEC/EN 61643-21 - UL497B
IEC type		C2
Max. cont. operating voltage U_c	V	7 to 220V (AC/DC)
Nominal Discharge current I_n (8/20us)	kA	5
Max. discharge current I_{max} (8/20us)	kA	10
Response time	ns	1
Pluggable		Yes



Insulation monitoring devices

ISL-A 600, ISL-C 600



In IT electrical distribution networks with isolated neutral, and in PV networks particularly, the high insulation impedance prevents earth faults from generating currents that would dangerously elevate the potential of exposed conductive parts. Therefore, in case of earth leakage, in an IT network it is not necessary to interrupt the supply, but it is still essential to monitor the insulation level in order to detect faults and restore optimal functioning of the system.

The ISL-C 600 is a insulation monitoring device for IT distribution networks up to 760 VAC (1100 VAC in three phase networks with neutral). The ISL-A 600 version is an insulation monitoring device for DC IT networks up to 600 VDC.

Main technical Specification		ISL-A 600	
		For PV applications	For PV applications
Power consumption	VA	6	5
ALARM threshold	k Ω	30÷300	-
TRIP threshold	k Ω	30÷300	10÷100
Max measuring current	mA	1.5	0.240
Max measuring voltage	VDC	-	48
Internal Impedance	k Ω	880 k Ω L+/L- 450 k Ω L/Ground	200
TRIP relay output (NO-C-NC)		1	2
ALARM relay output (NO-C-NC)		2	-
Relay contact capacity		250 V 5 A	250 V 5 A
Operating temperature	°C	-10 ÷ 60	-10 ÷ 60
Storage temperature	°C	-20 ÷ 70	-20 ÷ 70
Relative humidity		≤ 95%	≤ 95%
Max terminal section	mm ²	2.5	2.5
IP class		IP40 front, IP20 case	
Modules		6	6
Weight	g	400	500
Reference standards		EN 61010-1, EN 61557-8, EN 61326-1	EN 61010-1, EN 61557-8, EN 61326-1

DC string boxes

ABB catalog of photovoltaic systems is complemented by a wide range of field switchboards, string switchboards and parallel switchboards ready to install. These products, based on insulation class II units, are equipped with all the necessary components to realize the functions of protection and isolation, according to the type of system.



1 string
Europa consumer units
IP65 8 modules
10 A, 800 V
Miniature circuit breaker
S802PV-S10
Surge arrester
OVR PV 40 1000 P TS

Europa consumer units
IP65 12 modules
16 A, 660 V
Switch-disconnector
OTDC 16 F2
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV

16 A, 1000 V
Switch-disconnector
OTDC 16 F3
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV



2 strings
Europa consumer units
IP65 12 modules
16 A, 800 V
Miniature circuit breaker
S802PV-S16
Surge arrester
OVR PV 40 1000 P TS

Europa consumer units
IP65 18 modules
25 A, 660 V
Switch-disconnector
OTDC 25 F2
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string

25 A, 1000 V
Switch-disconnector
OTDC 25 F3
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string



3 strings
Europa consumer units
IP65 18 modules
32 A, 660 V
Switch-disconnector
OTDC 32 F2
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string

32 A, 800 V
Miniature circuit breaker
S802PV-S32
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string

32 A, 1000 V
Switch-disconnector
OTDC 32 F3
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string



4 strings
Europa consumer units
IP65 36 modules
32 A, 660 V
Switch-disconnector
OTDC 32 F2
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string

32 A, 1000 V
Switch-disconnector
OTDC 32 F3
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string

40 A, 800 V
Miniature circuit breaker
S802PV-S40
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string

DC string boxes



5 strings
Gemini switchboard size 1 IP66
50 A, 800 V
Miniature circuit breaker
S802PV-S50
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string

50 A, 800 V
Switch-disconnector
T1D 160 PV
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string



6 strings
Gemini switchboard size 2 IP66
63 A, 800 V
Miniature circuit breaker
S802PV-S63
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string

63 A, 800 V
Switch-disconnector
T1D 160 PV
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string

8 strings
80 A, 1000 V
Miniature circuit breaker
S804PV-S80
Scaricatore di
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string

80 A, 1000 V
Switch-disconnector **T1D 160 PV**
Surge arrester
OVR PV 40 1000 P
Disconnecting fuses
E 92/32 PV for each string



10 strings
Gemini switchboard size 4 IP66
100 A, 1000 V
Switch-disconnector
T1D 160 PV
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string

12 strings
120 A, 1000 V
Switch-disconnector
T1D 160 PV
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string



14 strings
Gemini switchboard size 4 IP66
140 A, 1000 V
Switch-disconnector
T1D 160 PV
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string

16 strings
160 A, 1000 V
Switch-disconnector
T1D 160 PV
Surge arrester
OVR PV 40 1000 P TS
Disconnecting fuses
E 92/32 PV for each string

CPI DC string boxes

The CPI versions of ABB's DC string switchboards are based on M-series S800PV or Tmax PV load disconnectors, with undervoltage release. The connection with an emergency switchboard, to be installed in a visible and accessible site, allows disconnecting of the line between the DC switchboard and the inverter, thus ensuring a high standard of safety.



1 string
Europa consumer units
IP65 12 modules
10 A, 800 V

Switch-disconnectors
S802 PV-M32
Equipped with
Undervoltage release
Surge arrester
Fuse disconnectors
Screw terminals for voltages up to 1000 V
Quick connectors MC4
Package includes emergency switchboard (cod. 13180) and signs



2 strings
Europa consumer units
IP65 18 modules
20 A, 800 V

Switch-disconnectors
S802 PV-M32
Equipped with
Undervoltage release
Surge arrester
Fuse disconnectors
Screw terminals for voltages up to 1000 V
Quick connectors MC4
Package includes emergency switchboard (cod. 13180) and signs



3 strings
Europa consumer units
IP65 36 modules
30 A, 800 V

Switch-disconnectors
S802 PV-M32
Equipped with
Undervoltage release
Surge arrester
Fuse disconnectors
Screw terminals for voltages up to 1000 V
Quick connectors MC4
Package includes emergency switchboard (cod. 13180) and signs



4 strings
Europa consumer units
IP65 36 modules
40 A, 800 V
 Switch-disconnectors
S802 PV-M63
 Equipped with
 Undervoltage release
 Surge arrester
 Fuse disconnectors
 Screw terminals for voltages up to 1000 V
 Quick connectors MC4
 Package includes emergency switchboard
 (cod. 13180) and signs



5 strings
Gemini Switchboard Size 2
IP66 54 modules
50 A, 1000 V
 Switch-disconnector
Tmax T1D160 PV
 Equipped with
 Undervoltage release
 Surge arrester
 Fuse disconnectors
 Screw terminals for voltages up to 1000 V
 Quick connectors MC4
 Package includes signs



6 strings
Gemini Switchboard Size 2
IP66 54 modules
60 A, 1000 V
 Switch-disconnector
Tmax T1D160 PV
 Equipped with
 Undervoltage release
 Surge arrester
 Fuse disconnectors
 Screw terminals for voltages up to 1000 V
 Quick connectors MC4
 Package includes signs

8 strings
80 A, 1000 V
 Switch-disconnector
Tmax T1D160 PV
 Equipped with
 Undervoltage release
 Surge arrester
 Fuse disconnectors
 Screw terminals for voltages up to 1000 V
 Quick connectors MC4
 Package signs

S800 - FSS - Fire Service Switch

According to VDE-AR-E 2100-712



Designed for large systems, but also for residential applications. The Fire Service Switch will provide optimal protection for persons and objects. Depending on the number of inverter MPPT's, two version are available. All fault contingencies are covered with this protection system. Through an innovative remote switch after fault clearing or power outage the system will switch on automatically. Short voltage interruptions or voltage fluctuations will be detected and the system won't trip. Maximum protection in case of fire combined with highest reliability is given with the new Fire Service Switch.

Key Features

- Disconnection properties, switching under load
- String protection up to 63A
- Operation with a button or optional with smoke detector
- Contact status visualization
- Closed circuit current principle
- Remote switch, after fault clearing or power outage the system will switch on automatically
- Short voltage interruptions or voltage fluctuations will be bridged through an energy storage.
- Intuitive operation

Fields of application

- PV systems on roofs of industrial, public and farm buildings
- PV systems on roofs of residential buildings
- PV systems on front of buildings

Main Technical Specifications

S800 - FSS Typ	Channels	System Voltage	Max Current	Aux Contacts	Energy Storage	Dimensions	IP
S810 - FSS	1	1200V	63A	1 NC + 1 NO	4 sec.	335 x 400 x 210	IP 65
S820 - FSS	2	1000V	2 x 32A	1 NC + 1 NO	4 sec.	335 x 400 x 210	IP 65

Multi-output DC string boxes

The multi-output DC switchboard contains independent circuits in a single switchboard allowing the autonomous management of the individual strings from the inverter (multi MPPT) and ensuring the maximum performance of the system.



2 strings (2 inputs, 2 outputs)

Europa consumer units

IP65 36 modules

16 A, 660 V

Switch-disconnector

OTDC 16 F2

Surge arrester

Fuse disconnectors

Screw terminals for voltages up to 1000 V

10 A, 800 V

Miniature circuit breaker

S802 PV-S10

Surge arrester

Fuse disconnectors

Screw terminals for voltages up to 1000 V



3 strings (3 inputs, 3 outputs)

Gemini Switchboard size 2

IP66 54 modules

16 A, 1000 V

Switch-disconnector

OTDC 25 F3

Surge arrester

Fuse disconnectors

Screw terminals for voltages up to 1000 V

10 A, 1000 V

Miniature circuit breaker

S804 PV-S10

Surge arrester

Fuse disconnectors

Screw terminals for voltages up to 1000 V

Switchboards for string control and monitoring system for large networks

Designed for large systems, but also for commercial applications, the string control switchboards allow to maintain the control of each string and to report any loss in energy production. Depending on the number of strings to check, the switchboards are equipped with all the devices needed for the protection and the disconnection of the string, as well as with AC500 PLC series of components.



12 strings - 1000V

Gemini switchboard size 5 IP66

Dimensions: 590 x 855 x 360

16 strings - 1000V

Gemini switchboard size 6 IP66

Dimensions: 840 x 1005 x 360

24 strings - 1000V

Gemini switchboard size 6 IP54

Dimensions: 840 x 1005 x 360

Dimensions: b x h x p mm

* also available as concentrator switchboard for Gemini switchboard size 4

Using a RS485 serial line, they transmit to a substation PLC the current values, and the status of switches and surge arresters of the individual strings. This allows assessing the productivity of the plant via software.

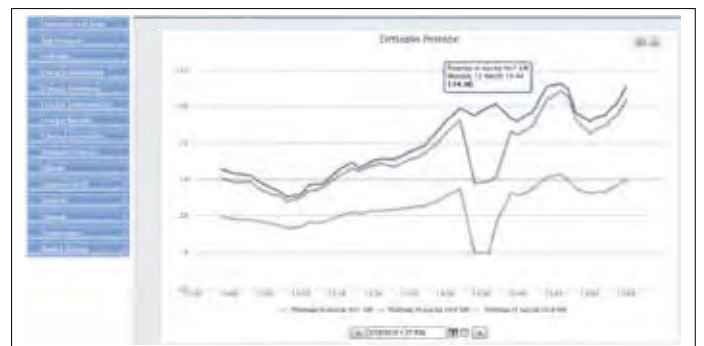
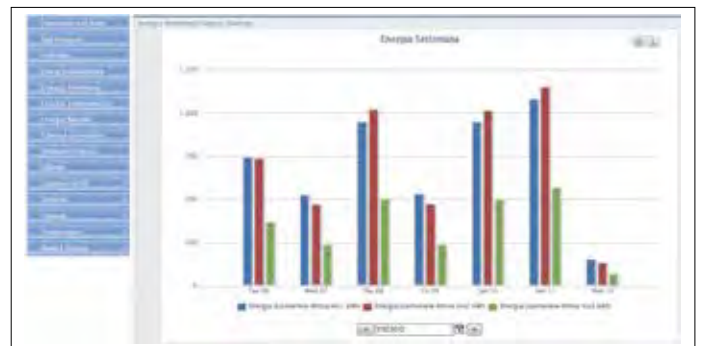


Substation PLC - AC500 series*

Dimensions: 590 x 700 x 260

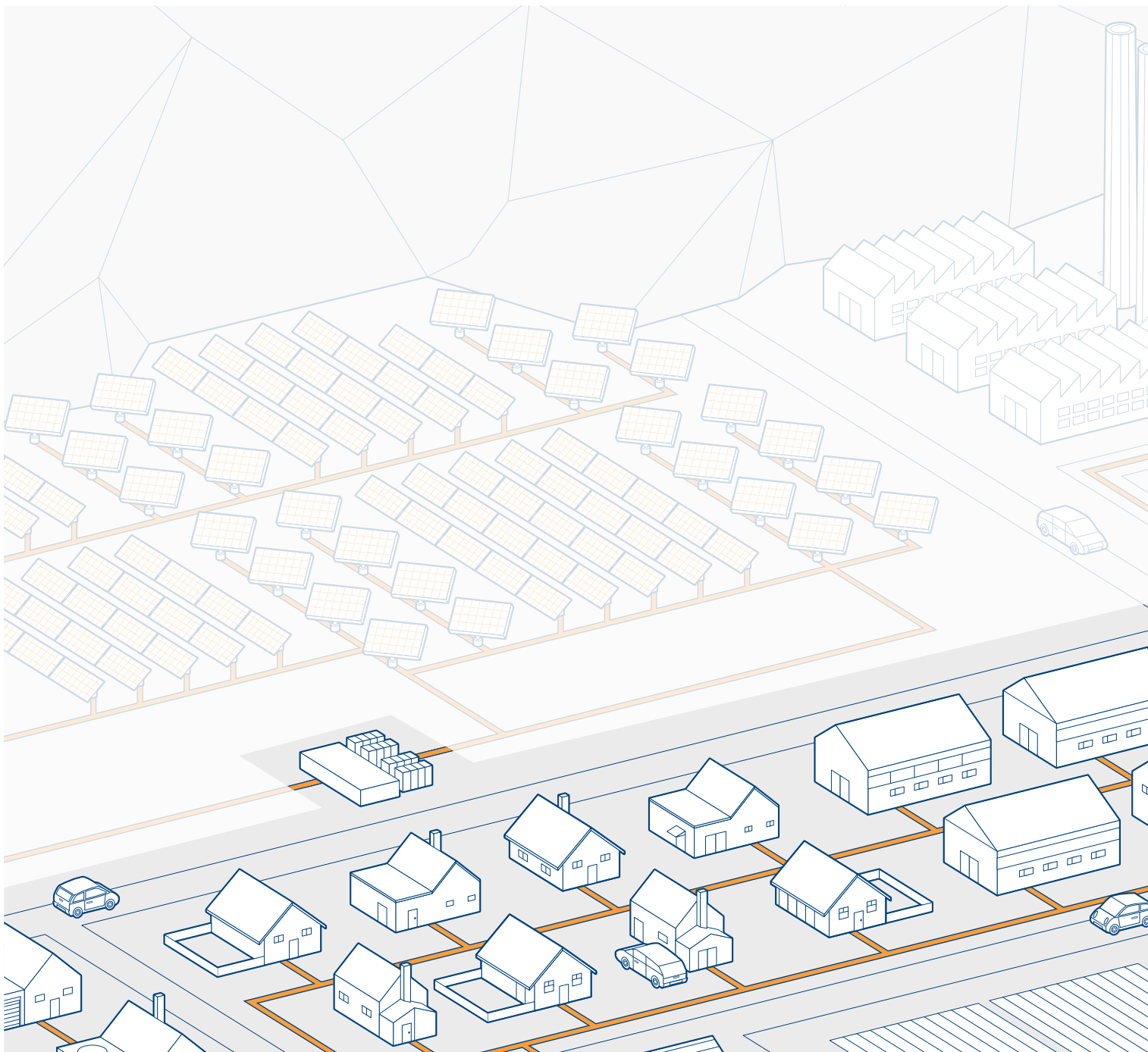
Datalogger

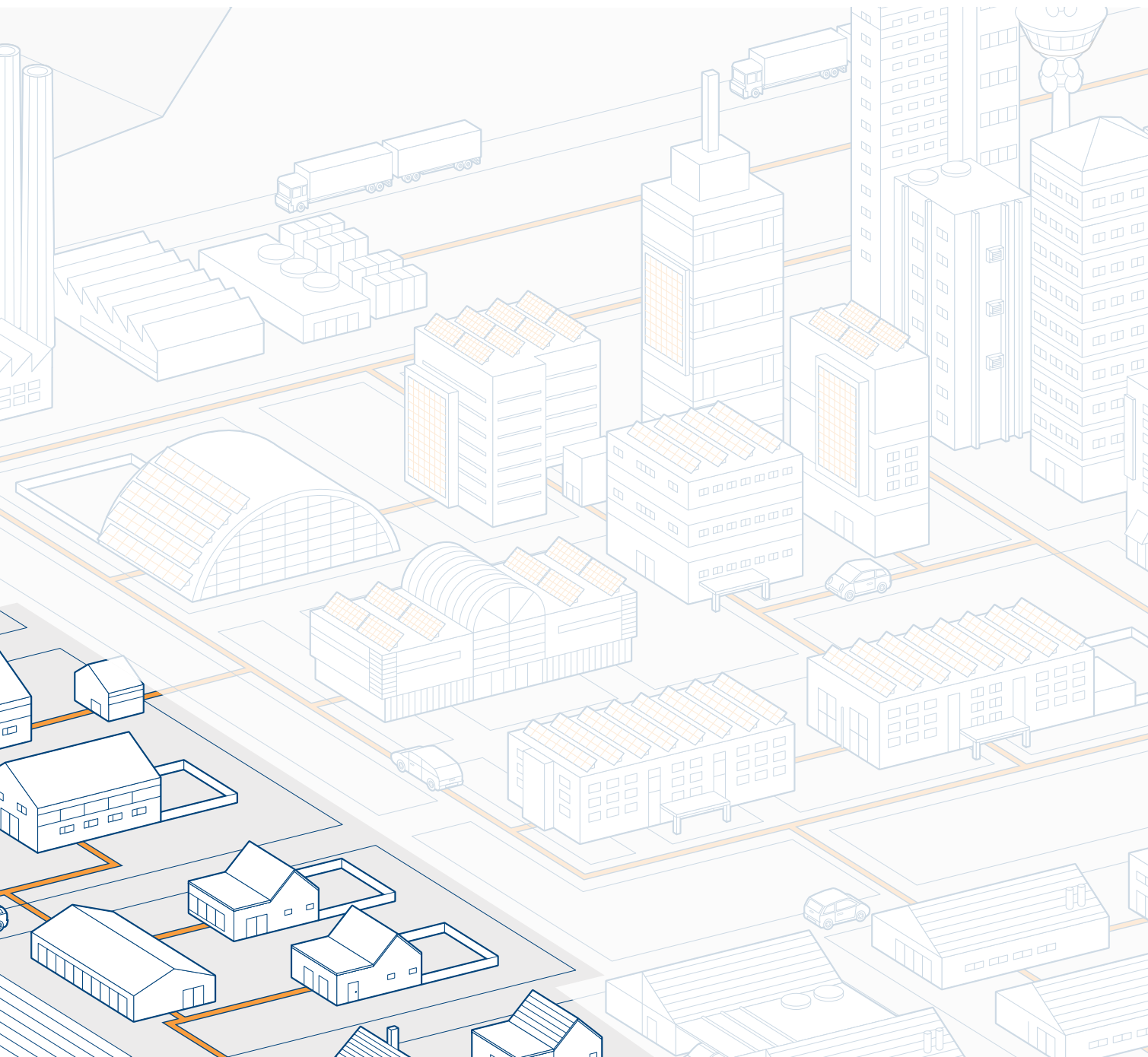
Solar Datalogger for substation concentrator switchboard



Photovoltaic systems

Products for AC side





Pre-wired interface switchboards

In addition to the interface protection relay, the CEI 0-21 Standard provides the requirements for other components needed to produce an interface switchboard. The main components provided by ABB for this kind of applications are:

- S 200 series main switches or E 90 fuse holders
- OS disconnectors with fuse holder
- interface protection relay CM-UFD.M22
- Class AC-3 omnipolar contactor (series AF or EK) coordinated with suitable protection for short circuit protection or Tmax series moulded-case circuit-breakers with undervoltage release and motor for reset
- energy storage system for CM-UFD.22 relay and for contactors or circuit breakers: CP-E 24 series and buffer modules CP-B series
- Gemini series switchboards
- SNK Series terminal blocks
- E 90 fuse holders

For power installations over 20 kW, an undervoltage or shunt trip device is required to manage a remote external switch.

	Description	Power	Gemini Size
	Pre wired interface switchboards Single phase Pmax 6 kW	6 kW	Size 1
	Pre wired interface switchboards Three phases 3P+N Pmax 13,5 kW	13,5 kW	Size 2
	Pre wired interface switchboards Three phases 3P+N Pmax 20 kW	20 kW	Size 2
	Pre wired interface switchboards Three phases 3P+N Pmax 31 kW	31 kW	Size 3
	Pre wired interface switchboards Three phases 3P+N 46,5 kW	46,5 kW	Size 5

Miniature Circuit Breaker

S 200, S800



Miniature circuit breakers are necessary also on the AC side of the PV installation for protection of electric lines and equipments from overload and short circuit. They provide protection of the cables that exit from inverter to the network as well as the different auxiliary circuits of the PV inverters.

S 200

S 200 is a new enhanced series of miniature circuit breakers.

The main features of the S 200 MCBs are:

- Available with all the tripping curve B, C, D, K and Z.
- Terminal for cable up to 35 mm² with protective flap to avoid accidental contact with the live parts.
- High temperature and shocks resistance thanks to a new type of thermoplastic materials
- Indelible laser screen-printing
- Multiple certification marks visible on the upper and lower face of the S200 circuit breakers.

Main technical specifications		S 200
Reference Standard		IEC 60898, IEC/EN 60947-2, UL 489, UL 1077
Nominal Current (In)	A	0,5 ... 63
Breaking capacity (Icu)	kA	6 (S200), 10 (S200M), 15 (S200P), 25 (S200P)
Nominal Voltage (Ue)	V AC	1P: 12 ... 230 / 2P ... 4P: 12 ... 400
Operation Temperature	C	-25 ... +55



S800

S800 is a high performance miniature circuit breaker.

The main features of the S800 HPMCBs are:

- Designed for high short-circuit protection up to 50 kA
- Available with tripping curves B, C, D and K.
- Switch with intermediate trip position (TRIP).
- Differentiate manual actuation from over-current trip.

Main technical specifications		S800
Reference Standard		IEC 60898, IEC/EN 60947-2
Nominal Current (In)	A	10 ... 125
Breaking capacity (Icu)	kA	16 (S800B), 25 (S800C), 36 (S800N), 50 (S800S)
Nominal Voltage (Ue)	V AC	1P: 12 ... 230 / 2P ... 4P: 12 ... 400
Operation Temperature	C	-25...+60

Residual Current Circuit-breakers (RCCBs)

F200, F204 B, F202 PV-B



Residual current circuit-breakers type B are also sensitive to fault currents with a low ripple level, similar to continuous fault currents. They however remain sensitive to sinusoidal alternating and pulsating continuous earth fault currents. When a photovoltaic plant includes an inverter without at least a simple DC/AC separation, it's necessary to install on DC side an RBCO of B class, according to IEC 60364-7 art. 712.413.1.1.1.2: "Where an electrical installation includes a PV power supply system without at least simple separation between the AC side and the DC side, an RCD installed to provide fault protection by automatic disconnection of supply should be type B. If the PV inverter by construction is not able to feed D.C. fault current into the electrical installation a B-type RCD is not mandatory".

Main technical specifications	F200 type B
Rated current I_n	25, 40, 63, 125 A
Rated sensitivity $I_{\Delta n}$	0.03 - 0.3 - 0.5 A
Operating frequency range	0 - 1000 Hz
Minimum supply voltage	
- to detect currents of type A / AC	0 V
- to detect currents of type B	30 VAC
Number of poles	2P, 4P
Conditional short-circuit current I_{nc}	10 kA
Conditional residual short-circuit current $I_{\Delta c}$	10 kA
IP Class	IP40 (when installed into a switchboard)
Operating temperature	-25°C...+40°C
Reference standards	IEC 62423 ed. 2

On the other hand, in case a DC/AC electrical separation exists, residual current circuit breaker type A can be used.



Main technical specifications		F200 A
Reference Standard		Standard IEC/EN 61008
Nominal Current (I_n)	A	16 ... 125
Nominal Voltage (U_e)	VAC	230...400
Sensitivity	mA	10 - 30 - 100 - 300 - 500
Number of poles		2P, 4P
Operation Temperature	C	-25...+55

Residual Current devices (RCDs)

DDA200 type B



DDA202 B, DDA203 B and DDA204 B RCD-blocks type B are also sensitive to fault currents with a low level ripple similar to continuous fault currents. If used in combination with S200 series MCBs, they assure the protection of people and installations against fire risks, short circuit and overcurrents. They however remain sensitive to sinusoidal alternating and pulsating continuous earth fault currents. When an electrical system includes a PV power system without at least a simple DC/AC separation, the residual device installed to provide protection against indirect contact by automatic supply disconnection must be of type B according to IEC 62423 ed.2 (IEC 60364-7 art. 712.413.1.1.1.2) standard.

Main technical specifications		DDA200 type B
Type		B (instantaneous) and B S (selective)
Rated current I_n	A	25, 40, 63
Rated sensitivity $I_{\Delta n}$	A	0.03 - 0.3 - 0.5
Operating frequency range	Hz	0 - 1000
Operating voltage	V	230...400
Number of poles		2P - 3P - 4P
Ambient temperature	°C	-25...+55
Reference standards		IEC 61009 Annex G, IEC 62423 ed.2

Moulded Case Circuit Breakers

Tmax



Tmax family is available as a complete range molded case circuit breakers up to 1600A. All the circuit-breakers, both three-pole and four-pole, are available in the fixed version, XT1,XT2, XT3, XT4 and T5 in the plug-in version and XT2, XT4, T5, T6 and T7 in the withdrawable one as well. Within the same frame size, the circuit-breakers in the Tmax family, are available with different breaking capacities and different rated uninterrupted currents.

Outstanding performance

The electric arc interruption system used on the Tmax circuit-breakers allows the short-circuit currents of very high value to be interrupted extremely rapidly. The considerable opening speed of the contacts notably limits the value of the specific let through energy I^2t and the current peak.

Remote Control and Supervision

Circuit breakers of the Tmax family can be remotely commanded in opening and closing, even by means of bus communication. All status, alarms and measurements performed by the breakers can be sent through local or system buses to supervising systems.

Installation

Tmax circuit-breakers are very flexible: they can be installed in the switchboards, mounted in any horizontal, vertical or lying down position, without undergoing any derating of their rated characteristics. Tmax circuit-breakers can be installed easily in all types of switchboards, above all thanks to the wide possibility of being supplied either by top or bottom terminals, without jeopardizing the apparatus functionality.

Air Circuit Breaker

Emax 2



Emax 2 family is available as a complete range air circuit breakers up to 6300A. All the circuit-breakers, both three-pole and four-pole, are available in the fixed and withdrawable versions. All Emax 2 circuit breakers share the same accessories and the same trip units along all the four physical frame sizes.

Outstanding performance

The SACE Emax 2 enables switchgear of compact dimensions and high ratings to be built with busbars of reduced length and cross-section. The rating levels are updated and uniform throughout the sizes to meet the demands and needs of today's installations, from 42kA to 200kA, and to standardize switchgear projects.

High short-time currents, together with the efficiency of the protection functions, guarantee complete selectivity in all situations.

Accurate design and choice of materials enables optimization of the overall dimensions of the circuit-breaker. In this way switchgear of compact dimensions can be built and outstanding savings at the same performance can be obtained.

Remote Control and Supervision

Emax 2 circuit-breakers can be equipped with communication units available for use with Modbus, Profibus, and DeviceNet protocols as well as the modern Modbus TCP, Profinet and EtherNet IP protocols. Furthermore, the integrated IEC61850 communication module enables connection to the Substation Automation world.

Installation

Double insulation between the front of the switchgear and the live parts is granted to ensure operation in complete safety. The circuit-breakers can be powered indifferently from above or below. All essential information is available in the central area of the front shield and enables immediate identification of the status of the circuit-breaker: open, closed, ready to close, charged and discharged springs. Maintenance is simply and safe: the main accessories can be frontally accessed without completely removing it. The withdrawable circuit-breaker is inserted and removed via dedicated guide rails that simplify movement. The correct movement from racked-in, test isolated, to racked-out position is guaranteed by a lock in each position. As a further guarantee of safety, the shutters of the fixed part can be locked from the front when the circuit-breaker is removed; the shutters of the upper terminals are independent of those of the lower terminals to facilitate checking and maintenance operations. The Ekip Touch protection trip units are equipped with a large colour touch-screen display which enables safe and intuitive operation.

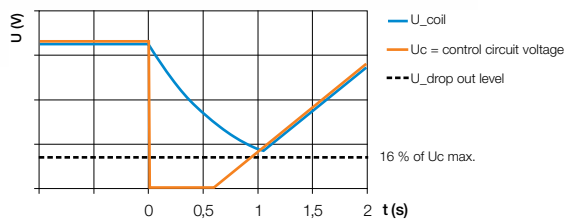
Contactors (for grid compliance)

AF..T range



The AF..T range is specially designed for renewable energy AC switching applications with “Low Voltage Ride Through” function. The AF..T contactor is able to withstand a voltage drop on the control voltage without opening. The built-in drop-out delay circuit provides enough energy for the coil voltage to remain above the drop-out level.

Main technical specifications	AF1350T – AF2050T
Reference standards	IEC60947-1, -4-1
Rated operational voltage	1000 V
Current ratings	1350 – 2050 A
Control voltage, AF range	Electronically controlled AC/DC
Number of poles	3



Switch Disconnecter SD 200



SD 200 switches disconnecters can be used as the main switch of the AC side of the inverters. The devices are mounted on a DIN rail or on the rear panel of a switchboard (depending on the rated current) and include a wide range of accessories, facilitating their use in various applications.

Main technical specifications		SD 200
Reference Standard		Standard IEC 60947-3
Rated Current (In)	A	16...63
Rated Voltage (Ue)	VAC	253/440
Operation Temperature	C	-25...+55 °C

Switch Disconnecter OT



The OT series of switch-disconnectors from ABB has been the industry standard in traditional AC applications for many years. They are a perfect solution for the AC side of solar applications.

OT switch-disconnectors are not only among the most compact in the market, but they also offer high technical ratings.

The main features include:

- Full range to cover any application up to 3800 A
- Door, base or DIN-rail mounting, flexible installation in any direction
- Wide selection of accessories
- Small frames save money as less space is needed
- Remote control with motorized versions (OTM_)

Main technical specifications	OT
Reference standard	IEC 60947-3 UL 508 & UL 98
Nominal voltage, Ue	up to 690 V
Nominal current, In	16 - 4000 A (IEC) 20 - 2000 A (UL)
Number of poles	2, 3, 4
Mounting	Base, DIN rail and door mounting

Surge protective devices

OVR T1 & T2, OVR TC



To provide efficient protection for a photovoltaic system the alternate current side must also be protected against overvoltage. OVR T1, Type-1 SPD, is installed in the main (AC side) switchboard at the system input and is able to conduct the direct lightning current to earth and to ensure safety in the case of a direct lightning strike. OVR T2, Type-2 SPDs, are installed on the load side of the inverter and in possible other sub-switchboard to protect against switching surges and the indirect effect of lightning.

The main features of the OVR range are:

- Network configuration in single pole, 3 poles, 1 Phase+N and 3 Phases+N
- Simplified maintenance with the pluggable cartridges (P option)
- Increased security with the safety reserve (S option)
- Remote indication with the auxiliary contact (TS option).



Main technical specifications		OVR T1	OVR T2
Reference Standards		IEC EN 61643-11 / UL 1449 3rd edition*	
IEC Type		T1 / I	T2 / II
Max. cont. Operating Voltage U _c	V	255	275
Nominal discharge current I _n (8/20 μs)	kA	15 and 25	5, 20 and 30
Impulse current I _{imp} (10/350 μs)	kA	15 and 25	/
Maximum discharge current I _{max} (8/20 μs)	kA	/	20, 40 and 70
Response time	ns	< 100	< 25
Safety reserve		/	"S" Version
Pluggable		/	"P" Version
Remote indicator		"TS" Version	"TS" Version

Grid feeding monitoring relays

CM-UFD.Mxx



The new protection relay (SPI) for three phase networks voltage and frequency monitoring provides the switch over of the Distributed Generation (DG) when electrical parameters exceed setup parameters. Totally configurable, it offers the flexibility needed for integrate medium and small networks into main systems.

Main features:

- Monitoring of voltage and frequency in single- and three phase mains 2-wire, 3-wire or 4-wire AC systems
- Over- and undervoltage, 10 minutes average value as well s over- and underfrequency monitoring
- Two-level threshold settings for over-/undervoltage and frequency
- ROCOF (rate of change of frequency) monitoring configurable
- Integrated management of redundancy function
- Measured values, thresholds and settings shown on the display
- All threshold values adjustable as absolute values
- True RMS measuring principle
- High measurement accuracy
- 3 control inputs for remote trip, feedback signal, and external signal
- Tripping delay for each threshold adjustable
- Interrupted neutral detection
- Error memory for up to 99 entries (incl. cause of error, measured value, relative timestamp)
- Autotest function
- Password setting protection
- 3 c/o (SPDT) contacts
- LEDs for the indication of operational states
- Multiline, backlit LCD display

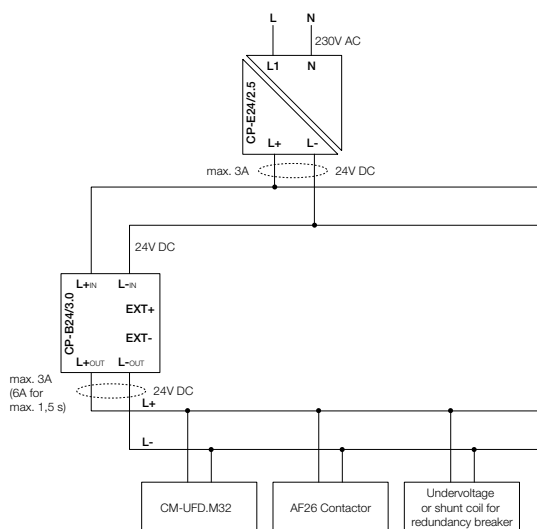
Product standard	
Product standard	IEC/EN 60255,
	IEC/EN 60255-1
Application standards	VDE-AR-N 4105,
	BDEW, CEI 0-21: 2012-06
	+ CEI 0-12; V1: 2012-12
	+ A70 Tema
Low Voltage Directive	2006/95/EC
EMC Directive	2004/108/EC
RoHS Directive	2002/95/EC ;2011/65/EC

Model	CM-UFD.M22
Supply Voltage	24-240 V CA/CC (-15, +10%)
5 seconds of buffering during auxiliary voltage faults	external (CP-B)
Power consumption	1.5 VA (1.5 W)
Over/Under-Voltage interval	(L-N) 0 -312 V CA
	(L-L) 0 - 540 V CA
Over/Under-Frequency interval	40-60 Hz
Voltage measurement accuracy	± 2 % of measured value
Frequency measurement accuracy	± 0,02 Hz
Output relay	250 VAC - 5 A
Inputs	Self supplied; maximum lenght unshield cables 10 m
Dimensions	108 x 90 x 67 mm
Operating temperature	-20...+60 °C
Reference standards	CEI 0-21 June 2012 edition

For technical data and other information refer to document 2CDC 112001D0200

Ultracapacitor power buffers

CP-B range



In most areas of automation, generation and energy management, power supply systems must be highly reliable. To overcome the temporary interruptions of electricity, in-storage systems are increasingly used. The CP-B buffer modules offer an ideal solution to ensure the continuity of interface protection devices (DDI) in compliance with CEI 0-21 standard, June 2012 edition.

It is in fact necessary to ensure the auxiliary supply for at least 5 seconds even in the absence of the network, avoiding undue separations at the occurrence of voltage faults (LVFRT-Low Voltage Fault Ride Through), thus increasing the overall efficiency of the system.

The common battery systems have a limited lifetime, are affected by environmental constraints and need regular maintenance, resulting in expenditure of labor and costs.

Using the latest ultracapacitor technology, ABB offers an innovative and completely maintenance-free solution for buffering the 24 VDC up to 20 A in the event of a mains supply interruption. Thanks to the CP-B series modules, in case of power fault, the energy stored in the capacitor ensures the load continuity up to several hundreds of seconds depending on absorbed current.

Key Features

- Output voltage 24.0 VDC, 23.0 V in buffer mode
- LED for status indication
- Relay contacts for status signaling
- Backup times higher (i.e. With CP-B 24/10.0 up to 6 minutes for a load current of 1 A)
- Quick charging times
- High efficiency, exceeding 90%
- Wide operating temperature range -20...+60 ° C
- DIN rail mounting, compact enclosures
- Advantages in comparison to battery buffer modules: maintenance-free, deep discharge immunity, resistance to high temperatures
- Approval (UL508, CSA 22.2 Ranked # 14) ¹⁾

¹⁾ In progress

Main technical Specifications		CP-B 24/3.0	CP-B 24/10.0	CP-B 24/20.0	CP-B EXT.2
Nominal Input Voltage DC		24 V	24 V	24 V	-
Nominal Current DC		3 A	10 A	20 A	-
Storable Energy (min.)		1000 Ws	10000 Ws	8000 Ws	2000 Ws
Typical charge time 100% with 0% load current		65 s	120 s	68 s	
		56 s	82 s	62 s	
Typical buffering time ¹⁾					
According to load current	100 %	14 s	40 s	15 s	
	50 %	28 s	80 s	30 s	
	25 %	74 s	140 s	60 s	
	10 %	148 s	380 s	150 s	
Dimensions					
Length		60 mm	127 mm	84 mm	60 mm
Height		92.5 mm	163 mm	192 mm	92.5 mm
Depth		116 mm	150 mm	198 mm	116 mm

¹⁾ Buffering Time $\sim \frac{\text{torable energy} * 0.9}{23 \text{ V}}$

Modular energy meters

EQ meters



Modular energy meters are ideal for metering and monitoring the energy produced by a photovoltaic system downstream of the inverter. ABB EQ meters are compliant and tested according to the European MID directive, which allows meters to be used whenever an energy consumption reading is requested for billing.

The EQ meters are available in three different product ranges, A, B and C series

A series:

- Single phase or three phase
- Direct connected up to 80 A or transformer current- and/or voltage transformers (CTVT)
- Active energy measurement Class B (Cl. 1) or Class C (Cl. 0,5 S) on CTVT connected meters
- Wide voltage range 100 - 500 V phase to phase 57,7 - 288 V phase to neutral
- Alarm function
- MID
- Reactive energy measurement
- Import/export measurement of energy
- Optional communication via M-Bus or RS-485
- 4 tariffs controlled by inputs, communication or built-in clock
- Previous values (by day, week or month)
- Demand measurement (max and min)
- Load profiles (8 channels)
- Harmonics measurement up to 16th harmonic and evaluation of THD

B series:

- Single phase or three phase
- Direct connected up to 65 A or CT connected (three phase versions)
- Active energy measurement Class B (Cl. 1) or Class C (Cl. 0,5 S)
- Alarm function
- MID
- Reactive energy measurement
- Import/export measurement of energy
- Optional communication via M-Bus or RS-485
- 4 tariffs controlled by input or communication

C series:

- Single phase or three phase
- Very compact, 1 & 3 modules.
- Direct connected up to 40 A
- Active energy measurement
- Instrument values
- Accuracy class 1 or class B (MID versions)
- Alarm function
- Optional MID

Modular energy meters

EQ meters



Standards

IEC 62052-11, IEC 62053-21 class 1 & 2, IEC 62053-22 class 0,5 S, IEC 62053-23 class 2, IEC 62054-21, EN 50470-1, EN 50470-3 category A, B & C

Communication

Built-in communication interfaces and separate communication devices enable serial data communication between energy meter and remote supervision system. Data on energy consumption and electrical parameters to be collected via serial protocols such as: Modbus RTU, M-Bus, Ethernet TCP/IP and KNX.

CT current transformers

Whenever indirect measurement is required, CT current transformers are the best solution to create a complete plant, ensuring long-term accuracy and precision of measurements.

Serial Communication Adapters

Communication adapters allow the serial data communication between energy meter and remote supervision system. The adapters allow data on energy consumption and electrical parameters to be collected via serial protocols such as: Modbus RTU, MeterBus, MeterBus, Ethernet TCP/IP, KNX.

Insulation monitoring device CM-IWN



The CM- IWx series offers an innovative insulation monitoring device. Thanks to increased performance the CM-IWN.5 is able to provide reliable measurements in installations with a capacity of earth leakage up to 1000 μ F. In combination with a new measurement principle, networks up to 1000 VDC or 690 V AC (15-400 Hz monitor range) can be measured.

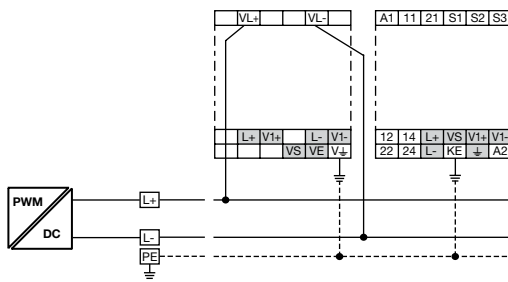
Measurement principle

Using CM-IW.x, a pulsating measurement signal is sent to the system to be monitored and the insulation resistance is calculated. This pulsating measurement signal changes depending on the insulation resistance and system dispersion capacity. The change in the insulation resistance can be forecast from this alteration.

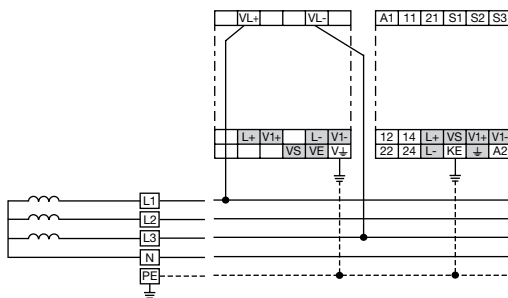
When the estimated insulation resistance corresponds to the insulation resistance calculated in the next measurement cycle and is below the pre-set value, the output relays are either activated or deactivated depending on the configuration of the device. This measurement principle is also useful to detect symmetrical insulation faults.

Main Characteristics

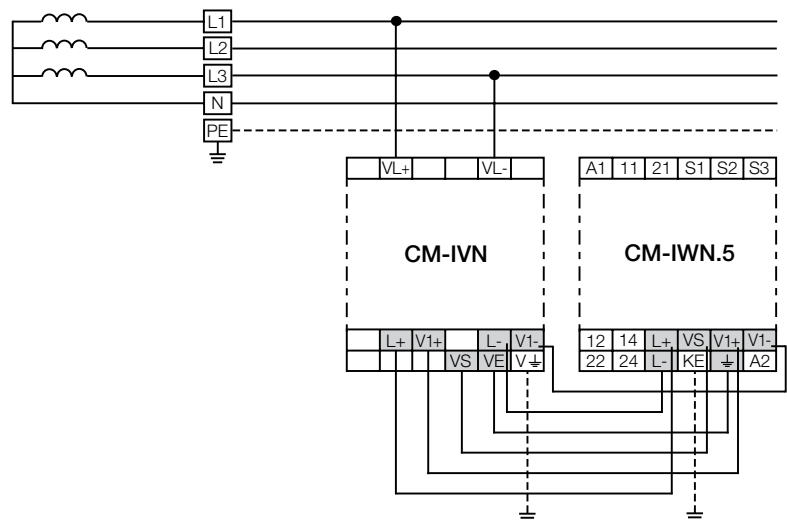
- Compliance with IEC/EN 61557-8 reference standards
- Direct connection to systems up to 690 V AC and 1000 VDC with coupling module CM-IVN
- Nominal frequency 15-400 Hz
- Wire interruption monitoring
- Faulty setting monitoring
- High reliability with built-in system start-up test
- Possibility to reset and test at product front or via remote control
- New predictive measurement principle
- Maximum capacity of earth leakage 1000 μ F



2 wires DC system



4 wires AC system



Remote command devices

GSM ATT

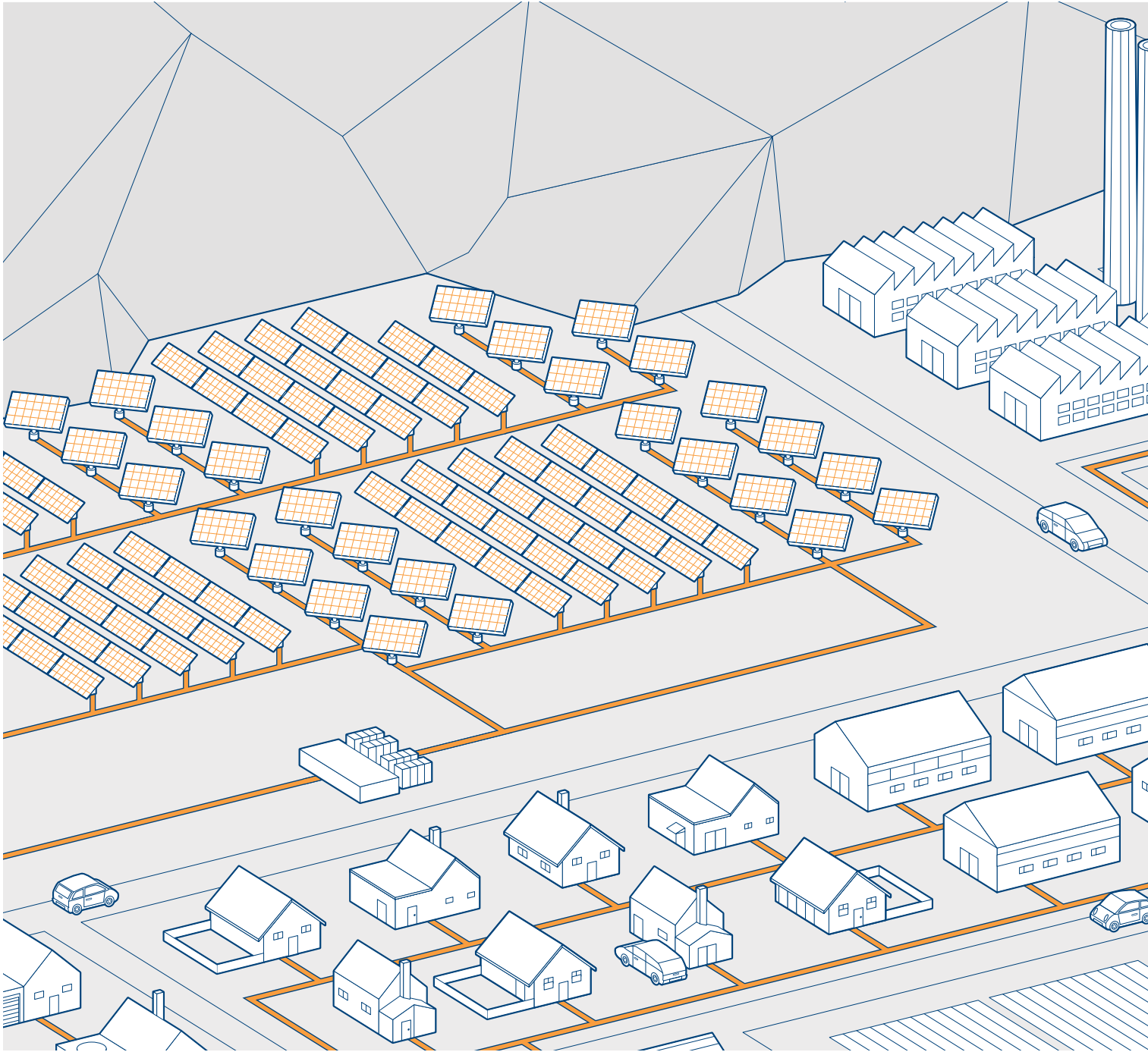


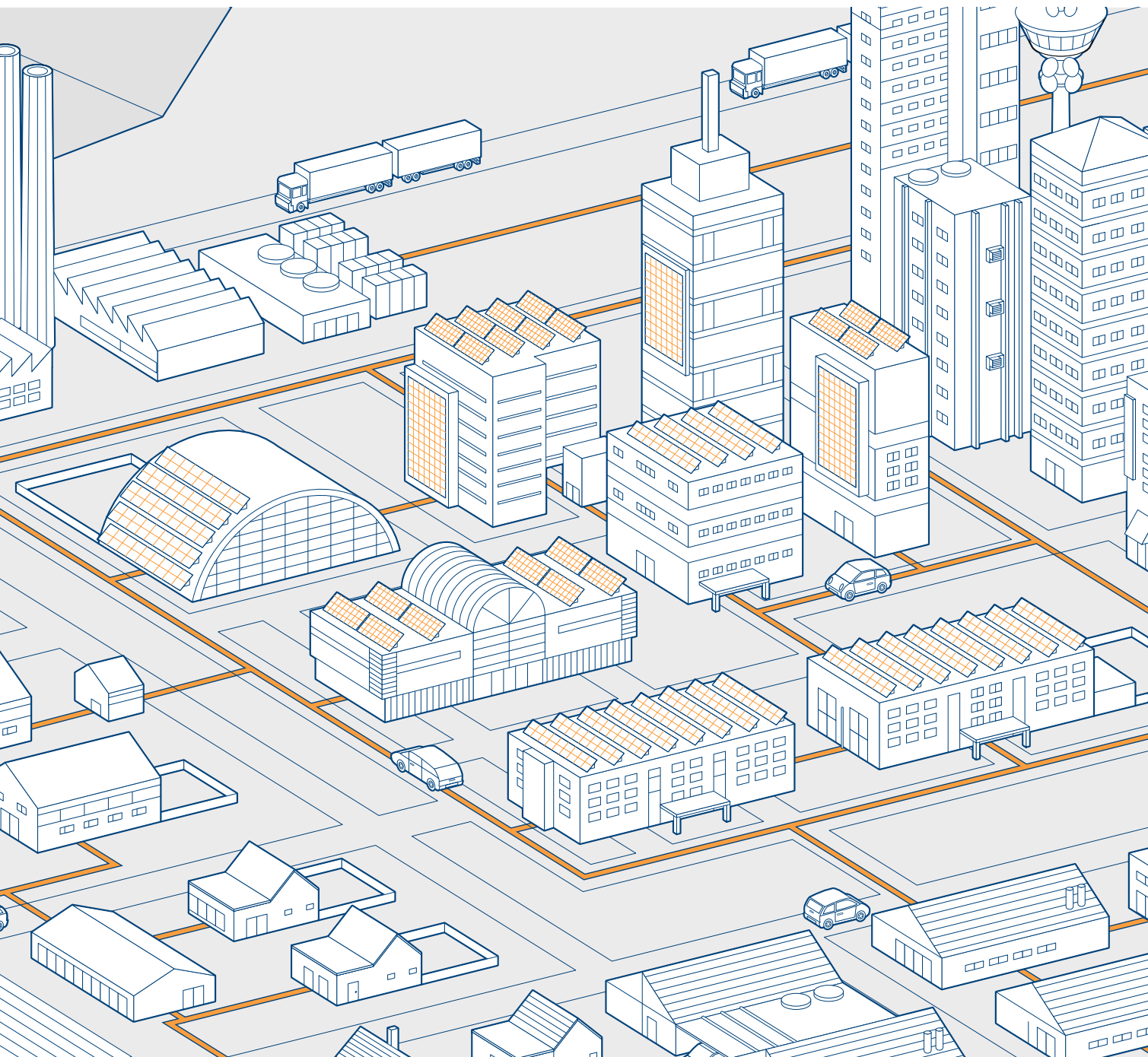
The ATT modules are GSM telephone actuators for electrical loads remote control over mobile phone network. In particular, the ATT-22 version consists of a control module with 2 outputs and 2 inputs for photovoltaic applications. Instructions and alarms can be sent via SMS message and free phone call rings. Configuration can be accomplished by SMS messages or using the ATT-Tool software. All the ATT modules are supplied with a backup battery, ATT-Tool programming software and PC connecting cable. In addition, the ATT-22E models are equipped with a pre-wired external antenna – essential if the module is installed in locations that do not assure adequate GSM coverage. The modules can be supplied with a modular transformer.

Main Technical Specifications

GSM module		Dual band EGSM900 and GSM1800 for data, sms, fax and voice applications. Full Type Approved conforming to ETSI GSM Phase 2+	
Output power		Class 4 (2 W@900 MHz) Class 1 (1 W@1800 MHz)	
Power consumption		5 VA	
Commands sent by		SMS, call rings, DTMF tones, GPRS connection	
Incoming alarms		SMS, call rings, e-mail, fax	
Inputs	Digital	self-powered max. 20 VDC, 2 mA	
	Analog	input voltage 0...10 V input impedance < 10 KOhm / 100 nF sampling rate 90 ksps	
Outputs	Relay	NO 4 A 250 V AC- max 2500 VA	
	Minimum load	100 mA, 12 V	
GSM indicator LED	OFF	Device not powered	
	STEADY	Device under power not connected to mobile network, SIM pin code missing or incorrect device	
	SLOW BLINK	Under power, connected to mobile network	
	FAST BLINK	Communication in progress	
Power supply		V	12 ±10% AC/DC
Power consumption	when transmitting	W	2.5
	in stand-by	W	0.4
Terminal section		mm ²	2.5
Temperature	ambient	°C	-20...55
	storage	°C	-30...85
Relative humidity	ambient	5...95% non condensing	
	storage	5...95% only external condensation	
Modules		4	
Protection		IP40	
Reference standards		R&TTE, Directive 1999/5/EG; Low Voltage, Directive 2006/95/CE; EMC, Directive 2004/108/CE	

Solar energy
Other products





Switchboards

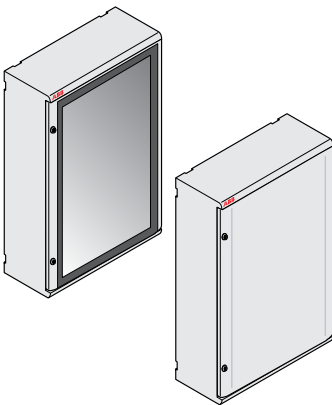
Gemini IP 66



Main technical specifications	Gemini IP 66
Protection	
Protection class	IP 66 (CEI EN 60529)
Insulation	class II
Strength	
Material	joint-injection moulded thermo-plastic
Heat and fire resistance	up to 750 °C (IEC EN 60695-2-11)
Shock resistance	IK10 (IEC EN 50102)
Protection against chemicals and weather conditions	water, saline solutions, acids, basics, mineral oils, UV rays
Operating temperature	-25 °C...+100 °C
Performance	
Nominal insulation voltage	1000 V AC – 1500 VDC
Flexibility WxHxD, external dimensions	6 sizes from 335 x 400 x 210 mm to 840 x 1005 x 360 mm DIN modules from 24 to 216
Installation	Snap-in assembly of all components
Standards, quality, environment	IEC EN 50298, IEC 23-48, IEC 23-49, IEC 60670, IEC EN 60439-1 IMQ Mark according to the IEC EN 50298 standard. Fully recyclable

Boxes and doors

– RAL 7035 grey color



Size	External WxHxD (mm)	Internal WxHxD (mm)	Max num. DIN mod.
1	335x400x210	250x300x180	24 (12x2)
2	460x550x260	375x450x230	54 (18x3)
3	460x700x260	375x600x230	72 (18x4)
4	590x700x260	500x600x230	96 (24x4)
5	590x855x360	500x750x330	120 (24x5)
6	840x1005x360	750x900x330	216 (36x6)

Wall mounting consumer units Europa Series



The Europa series wall-mounting units feature IP65 protection which makes them ideal for outdoor installation. This means that they can be used for making string boxes on the load side of photovoltaic strings.

The main features of the Europa series wall-mounted units include:

- class II insulation
- manufactured in self-extinguishing thermoplastic material able to withstand abnormal heat and fire up to 650 °C (glow wire test) in compliance with IEC 60695-2-11 standards
- installation temperature: -25 °C to +60 °C
- nominal insulation voltage: 1000 V AC; 1500 VDC
- shock resistance: 6 joules (IK 08 degrees)
- pull-out DIN rails holder frame for more convenient bench wiring. Can be disassembled (and re-assembled by means of a snap-fit mechanism) to make the individual wires easier to route
- 53, 68 and 75 mm depth switchgear can be installed
- models with 8 or more modules equipped with bi-metal and rigid flanges for easier insertion of pipes and cables
- consumer units in compliance with IEC 23-48, IEC 23-49 and IEC 60670 standards
- IMQ approved

Description Type	Dimensions
IP65 consumer unit P/smoke grey 4M	140x220x140
IP65 consumer unit P/smoke grey 8M	205x220x140
IP65 consumer unit P/smoke grey 12M	275x220x140
IP65 consumer unit P/smoke grey 18M 1 row	380x220x140
IP65 consumer unit P/smoke grey 24M 2 rows	275x370x140
IP65 consumer unit P/smoke grey 36M 2 rows	380x370x140

Junction boxes



ABB provides IP65 polycarbonate junction boxes that are perfect for use in outdoor installations.

The main features of the junction boxes include:

- class II insulation
- manufactured in self-extinguishing thermoplastic material able to withstand abnormal heat and fire up to 960 °C (glow wire test) in compliance with IEC 60695-2-11 standards
- installation temperature: -25 °C to +60 °C
- nominal insulation voltage: 1000 V AC; 1500 VDC
- shock resistance: 20 joules (IK 10 degrees)
- junction boxes in compliance with IEC 23-48 and IEC 60670 standards
- IMQ approved

Description Type	Dimensions
Box IP65 PC	140x220x140
Box IP65 PC	205x220x140
Box IP65 PC	275x220x140

Screw clamp terminal blocks



The screw clamp terminal blocks of the new SNK series are ideal for use in photovoltaic systems. The SNK series offers a modern, innovative and compact design, and a wide range of accessories for any requirement. The series come with the highest international certifications.

Main technical specifications

Electrical specifications		
Nominal voltage	V	1000
Nominal current	A	max 232
Nominal section	mm ²	max 95

Compliance with IEC 60947-7-1, IEC 60947-7-2 standards

Parallel interconnections are available

Self-extinguishing material UL94V0



The screw clamp terminal blocks are available in single pole, 3-pole and 4-pole versions.

Main technical specifications

Electrical specifications	
Nominal voltage	1000 V a.c. / 1500 V c.c.
Nominal current	max 400 A for single pole max 175 A for 3-pole 125 A for 4-pole

Cable glands and nuts with metric pitch



Main technical features of the cable glands and nuts with metric pitch:

- IP 68 protection class
- material: polyamide 6.6, self-extinguishing material in accordance with the UL94 V2 standard. Withstands abnormal heat and fire up to 750 °C (glow wire test) according to IEC 60695-2-11 standards
- utilization temperature: from -20 °C to +120 °C (brief period)
- neoprene seal
- tightening by means of a lamellar crown around the entire cable diameter
- possibility of reuse of the gland without compromising its effectiveness

Polyamide 6.6 and 12 cable ties - UV-resistant black



The main features of the cable ties include:

- UV-resistant version, especially recommended for outdoor applications
- Black version (2% carbon for military specifications)
- Also available in heat stabilised + UV-resistant version, for outdoor applications that also require a resistance to high temperature (+105 °C). See page 21 (TY...MX-A series)
- Several lengths and 6 typical widths with a tensile strength up to 780N, to cover the most demanding applications
- Packaging: OEM bulk quantities in recyclable polythene bags
- Also available in small bags with Euroslot and in workbench boxes

Main technical specifications

Material - Moulding	polyamide 6.6 and polyamide 12
Material - Locking barb	316 grade stainless steel
Temperature range	-40°C to +85°C
Colour	black
Flammability rating	UL 94 V-2
Other properties	UV-resistant, Halogen free, Silicone free



PMA Cable Protection System Solutions

PMA offers a broad product portfolio of cable protection products.

Our 30 years experience in the design and production of cable protection systems guarantees optimal solutions for use in power generation applications whether they are driven by water, wind, sunlight or gas.

- Protection degree: IP66 / IP68 and IP69K
- Metric, NPT and PG threads made of metal and plastic
- Available with strain relief elements
- Compatible with all leading component manufacturers
- EMC fittings in the standard range
- Junction pieces available from stock
- Continuous operating temperature: $-100\text{ }^{\circ}\text{C}$ to $+200\text{ }^{\circ}\text{C}$
- Both for internal and external use
- Excellent UV resistance
- Resistant to high dynamic loading
- Extremely high compression strength
- Electro-statically discharging materials
- Nominal diameters: 07 to 125
- Closed and divisible conduits types
- Free from halogens, REACH + ROHS compliant



Manual motorstarters MS116, MS132



ABB's new manual motor starters, MS116 and MS132 covers all needs, including overload and short circuit protection (with trip identification) for motors as well as disconnection/isolation by manual switching. Wide range of accessories is available.

Main technical specifications	MS116, MS132
Rated operational voltage	690 V AC
Current ratings	0,16 - 32 A
Trip class	10
Number of poles	3
Reference standards	IEC60947-1, -2, -4-1, -5-1

Pilot Devices Modular or Compact ranges



ABB has a complete range of pilot devices; emergency stops, pilot lights, push buttons and selector switches. Two ranges are available; The Modular range for flexibility and quick assembly and the Compact range for high quality at low cost by "all-in-one" design. Both ranges are with high ratings. Compact range offers high degree of protection with IP67/IP69K.

Main technical specifications	
Hole diameter	22 mm (30 mm adaptors available)
Contacts	690 V, 10 A, wiping action Low energy block (gold plated or micro switch) available
Colours	Red, Green, Yellow, Blue, White, Black, Clear
Customized marking available	Yes ("L-mark" system)
Enclosures	Plastic or metallic. Separate enclosures or complete assembled stations
Reference standards	IEC60947 (general) IEC60947-5-5 (emergency stops)

Electronic Products and Relays EPR

ABB could offer a wide and complete range of EPR products indicate for any kind of use like:

- electronic timers provide timing functions for all applications
- measuring and monitoring relays to measure voltage, current, temperature, isolation and more
- High efficient switch mode power supplies for single and 3 phase applications
- Signal converters for analog signal conversion and isolation and for serial data transmission
- Interface Relays and Optocouplers in pluggable and compact version for multi purpose usage in all kind of control applications



Direct lightning protection

OPR, simple rod & earthing system



To provide efficient protection for a Solar system, the solar plant must be protected against direct lightning strikes and have a proper grounding system in addition to protection against overvoltage on both side of the inverter. ABB offers:

- OPR, ESE lightning rod protect against direct lightning,
- Simple rod lightning protection against direct lightning,
- Earthing and interconnection system to safely dissipate the lightning current.

Main technical specifications		OPR
Lightning current withstand (10/350µs)	kA	100
Gain in Sparkover Time	us	30 / 60
EMC Interferences measurements / Interferences immunity		EN 50 081.1 / EN 50 082.2 / NFC17102

Intelligent Building Control

ABB i-bus® KNX

ABB i-bus® KNX is the first globally standardized system for the automation of residential and non-residential buildings in accordance to the following worldwide standards:

- international ISO/IEC 14543-3;
- european CENELEC EN 50090 and CEI EN 13321-1 and 13321-2;
- chinese (GB/Z 20965)
- USA (ANSI/ASHRAE 135)

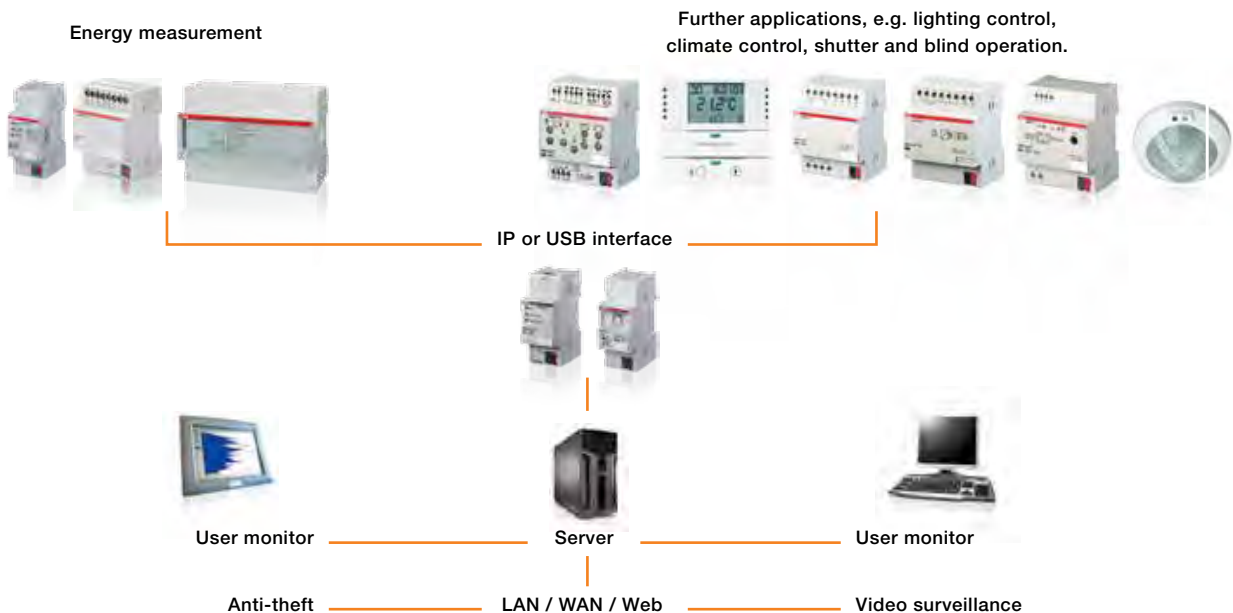
Thanks to the KNX platform, it's possible to interoperate solutions and systems provided by different producers, granting the best investment for the future because you just need a software to design, set up, manage and widen any KNX installation linked to a supervising system.

The complex requirements needed to manage a wide solar plant are fully met by a KNX installation linked to an Integrated Supervision System, that is able to provide simultaneous monitoring of any different subsystems installed in the plant. As an example, ABB i-bus® KNX components together with an Integrated Supervision System could efficiently work as anti-theft protection system for solar panels mounted at ground level and control all the panel strings over 24 hours. Sensors housed inside the panels and installed adjacent to each inverter, could immediately detect any removal of even one panel of each string.

Centralized control and command of the electric switches distributed throughout the plant, just like panels and strings energy metering, could be easily done through KNX bus devices, even for fiscal purposes.

Collected data could be automatically used as reference for the administrative tasks of billing and invoicing, while all production data (active and reactive power, current, power factor) could be collected by appropriate data loggers, transmitted to and stored in a Supervision System database. This system could read in real time all the values measured in the field and draw periodic comparisons and subsequent reports. Furthermore the user, via its own remote monitor, could control the whole system and obtain over 24 hours any energy production report.

ABB i-bus® KNX system



If you require further details about products, please refer to the following technical catalogues.

Document	Code
Sustainable solar power	9AKK105152A5494
Technical application handbook N° 10	1SDC007109G0203
System pro <i>M</i> compact®	2CSC400002D0211
Current sensors. Voltage sensors	1SBC140152C0205
Switches. Switch-disconnectors. OT, OETL, OTDC and OTM	1SCC301001C0201
SACE Tmax PV. Adaptability, versatility and complete freedom continue	1SDC210054D0201
Motor protection and control. Manual motor starters, contactors and overload relays	1SBC100173C0201
R ... series contactors	1SBC104112C0201
Electronic products and relays	2CDC110004C0209
SACE Emax 2. New low voltage air circuit-breakers	1SDC200023D0202
Tmax. T generation	1SDC210015D0207
Insulating enclosures and installation materials	1SLC001001D0204
SNK series. Terminal blocks	1SNK160027C0201
Pilot devices, 22 mm	1SFC151004C0201
ABB i-bus® KNX. Smart Home and Intelligent Building Control	2CDC500098C0201

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