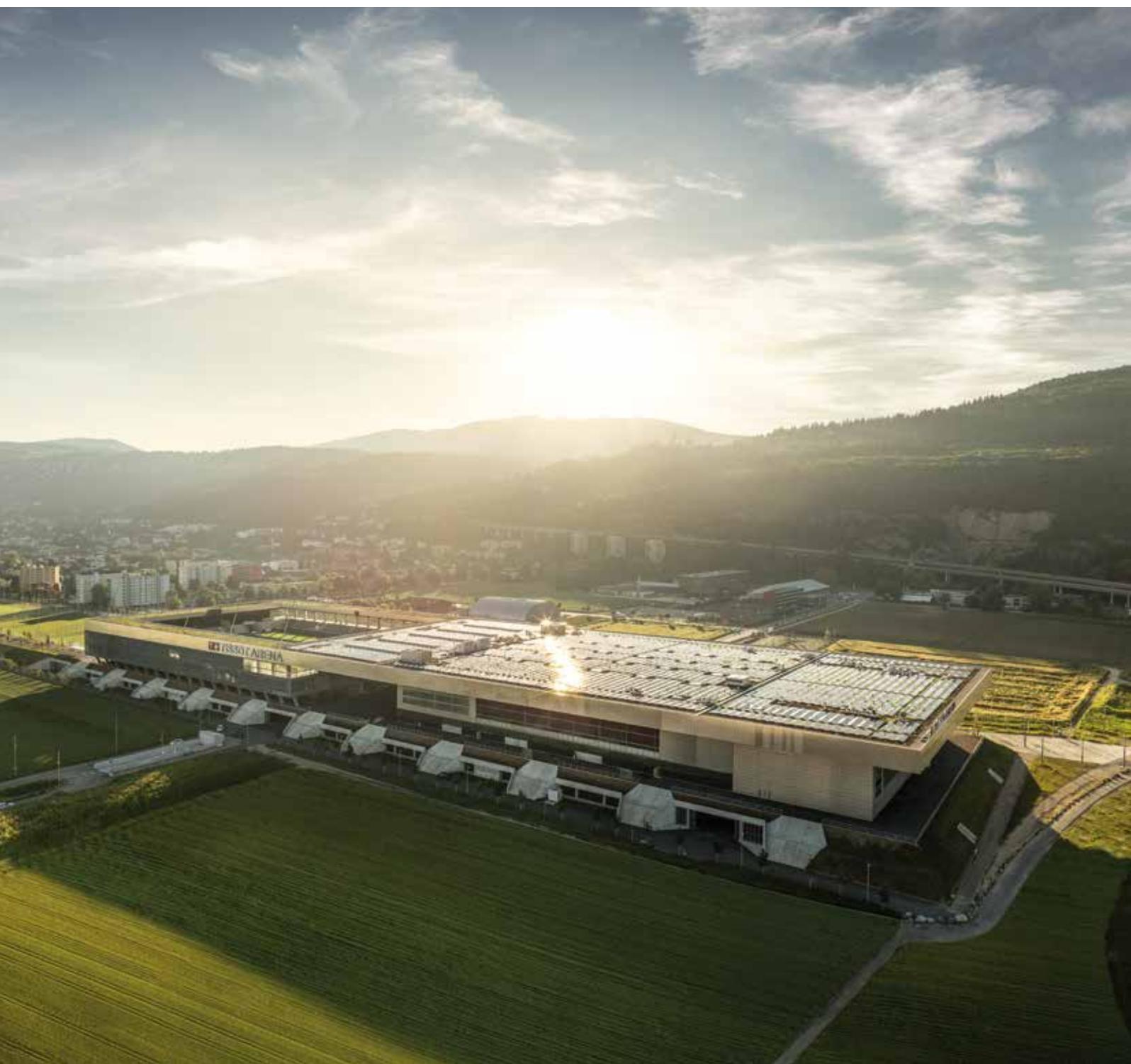

CATALOG

Solutions for solar energy

Low- and medium-voltage
components and systems



Summary

04–05	Unlimited clean energy with zero emissions
06–07	The photovoltaic system - Components
08–17	Examples of photovoltaic applications
18 –49	Products for DC side
50 –69	Products for AC side
70 –77	Other products
78 –94	Medium-voltage
95	Technical literature

Unlimited clean energy with zero emissions

ABB and solar energy

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 ABB 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 a reliable power source, 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 complete power and automation solutions for CSP plants to 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 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, able to operate as an efficient energy market.

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.

The photovoltaic system

Components

The efficiency and quality of a system can be measured by the efficiency and quality of each single component: a fundamental factor for a photovoltaic system's positive outcome is therefore the proper choice of components.

For the system to be considered a good investment, it must be able to last "in good condition" for at least 20 years, while being subjected to bad weather and intense sun exposure.

There is no doubt that what is generally referred to with the abbreviation BOS (Balance of System), or the "rest of the system" (electromechanical equipment for protection, switching, insulation and wiring) plays a specific role in ensuring adequate protection for the people and property connected to the system, as well as in the optimization of production over the course of time. From an economic point of view, even more so in respect to a normal electrical system, each single component in a photovoltaic system must be chosen above all based on its warranty date and its manufacturer.

Each component must maintain its functional characteristics unchanged for the entire lifespan of the system and of the correlated investment.

Just like any other electrical system, the installation of a photovoltaic system must be designed and implemented while taking into consideration the technological solutions and regulatory standards that can guarantee maximum operational safety and protection for those who must work on its structure. A relevant function is carried out by the breaking and protection devices, in the direct current system as well as in the downstream alternating current system.

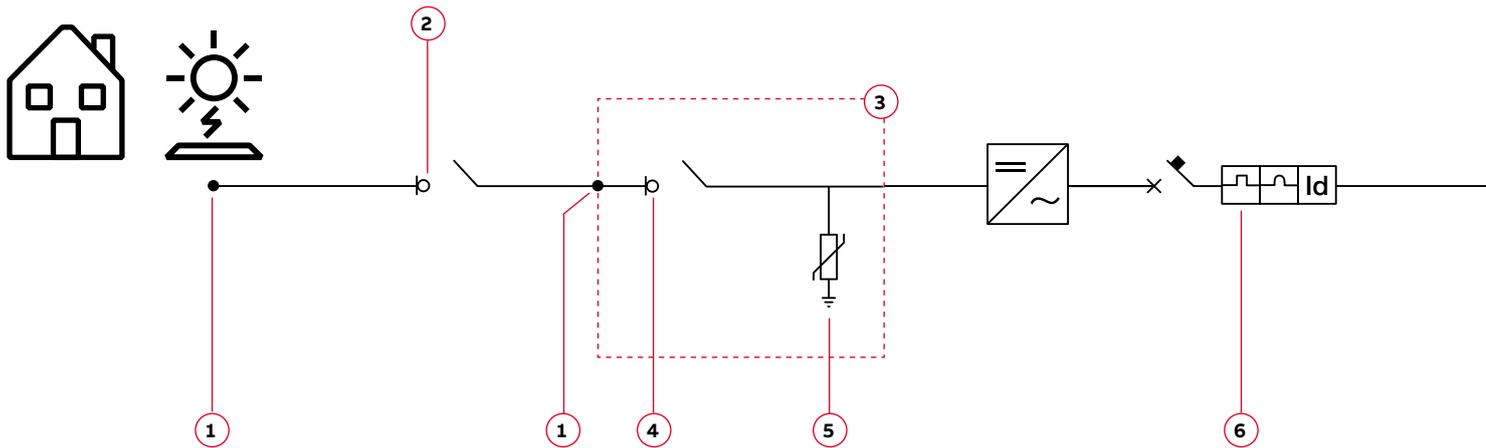
The variety of photovoltaic systems in terms of power, inverter type and type of hook-up to the public mains network (single-phase, three-phase, in low- and medium-voltage) requires careful selection of components by the designers and installers.





Examples of photovoltaic applications

Residential system ≤ 20 kW LV



Low-voltage products:

1. Connectors: MC4-EVO2 PV
2. PV Vault rapid shutdown
3. String boxes
 - Switchboards: Gemini
 - Consumer units: Europa
 - Circuit breakers: S200 M UC Z, S800 PV-SP
 - Fuse disconnectors: E 90 PV
 - Fuses: E 9F PV
 - Spring and screw terminal blocks: SNK PI
4. Switch-disconnectors: OTDC, S800 PV-SD
5. Surge protection devices: OVR PV QS
6. Residual current devices: F202B, F204B
7. Energy meters: EQmeters and current transformers
8. Contactors: AF Series
- Grid-feeding monitoring relays: CM-UFD.Mxx
- Power supplies: CP-x
9. Fuse disconnectors: E 90
10. Surge protective devices: OVR T1 / T1-T2 / T2 QS
11. Residual current circuit breakers: DS202C



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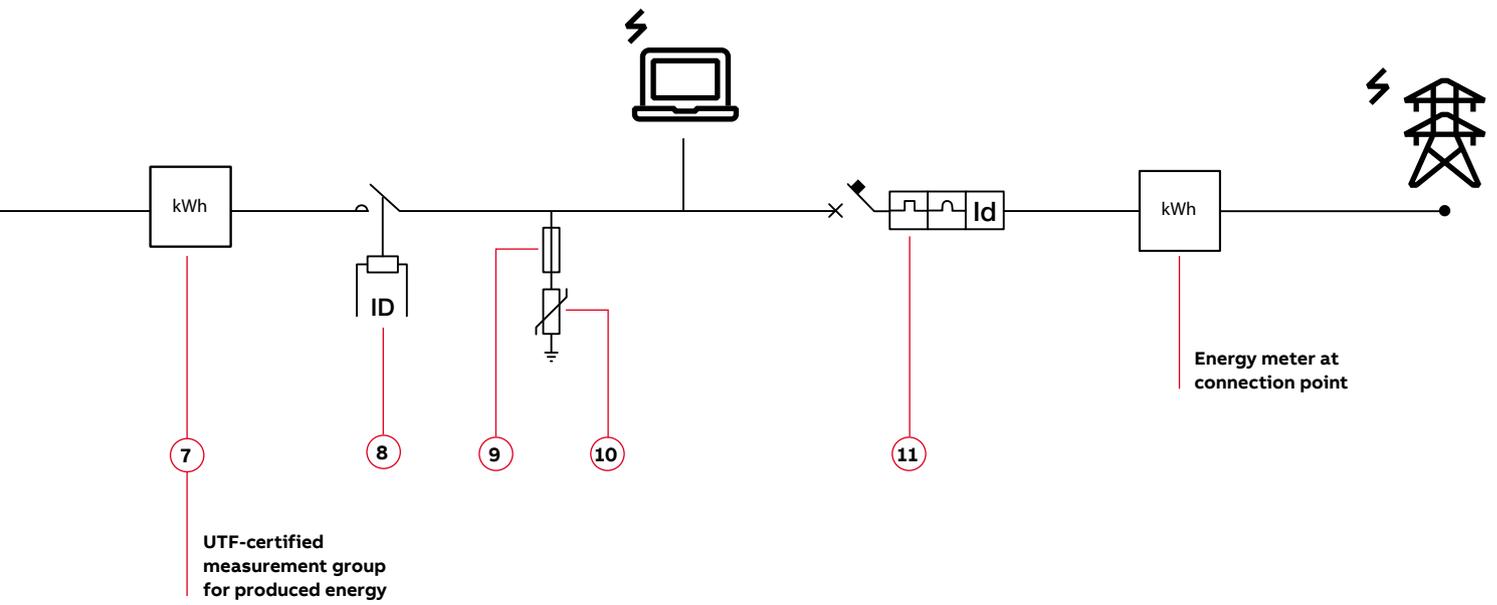
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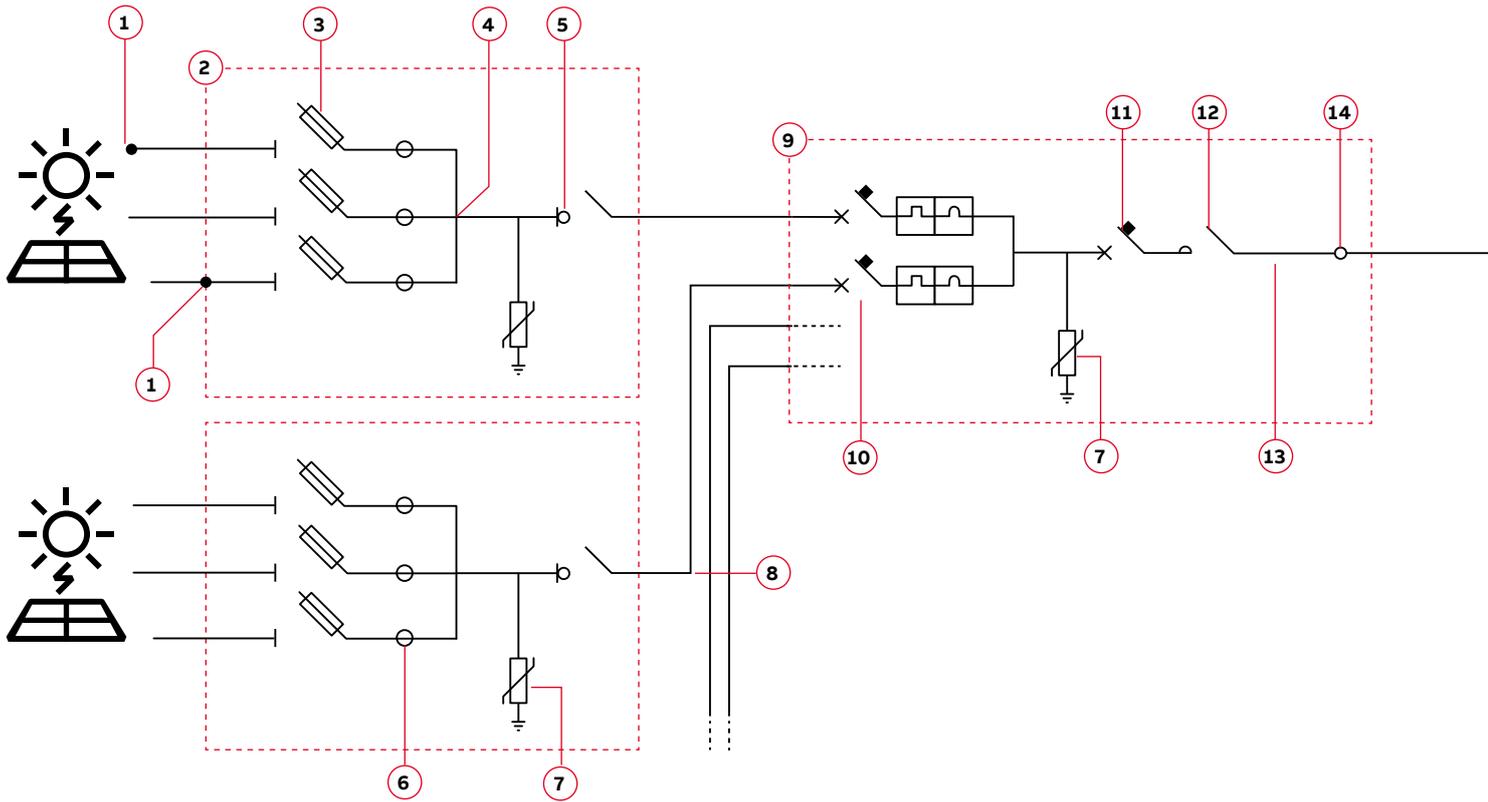
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Examples of photovoltaic applications

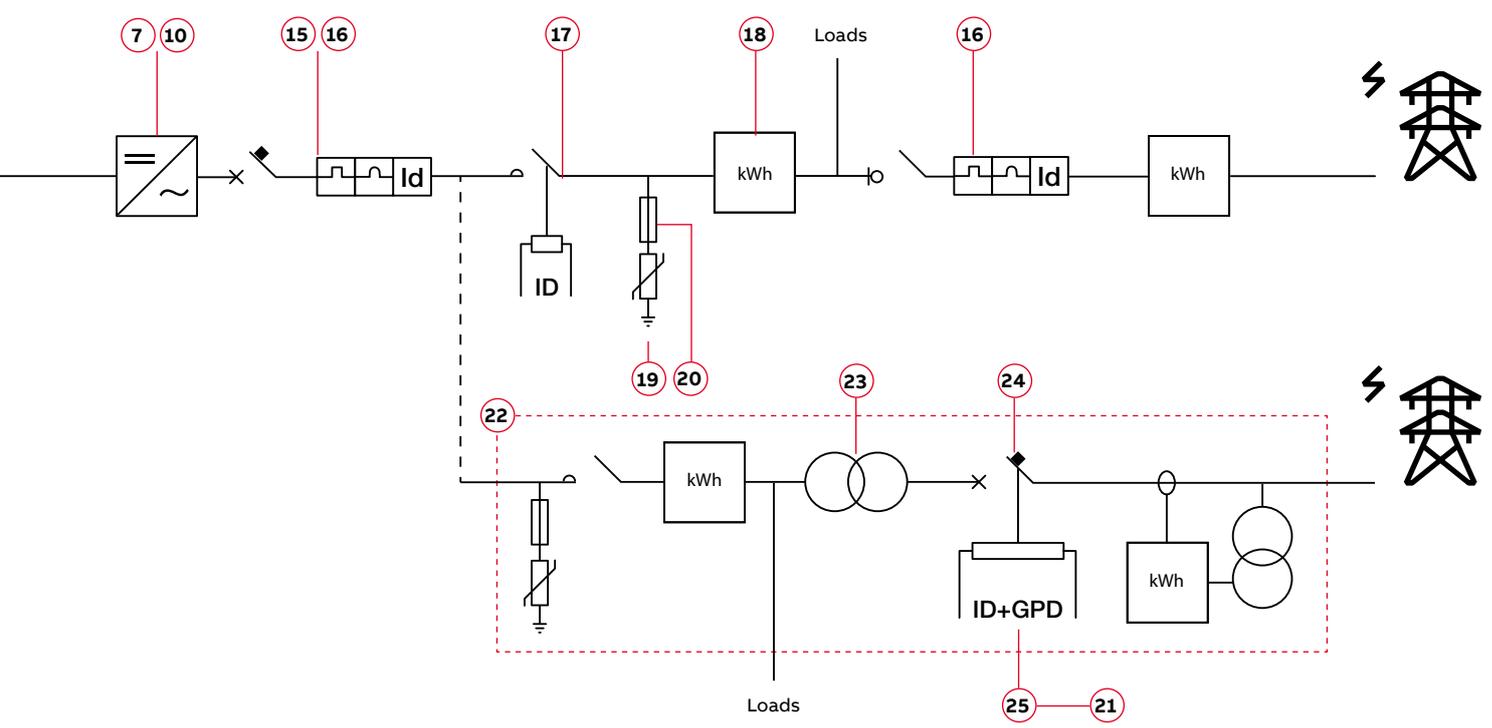
Commercial system 20 - 1000 kW LV/MV



Low-voltage products:

- 1. Connectors: MC4-EVO2 PV
 - 2. **String combiners 1000 VDC**
Switchboards: Gemini; Consumer units: Europa, Gemini
 - 3. Fuse disconnectors: E 90 PV; Fuses: E 9F PV
 - 4. Distribution blocks: DBL
 - 5. Switch-disconnectors: OTDC; S800 PV-SD
 - 6. Current measurement system: CMS; Power supplies: CP-x
 - 7. Surge protection devices: OVR PV QS
 - 8. String monitoring controller
 - 9. Recombiner
 - 10. Miniature circuit breakers: S200 M UC Z, S800 PV-SP
 - 11. Switch-disconnectors: Tmax PV, OTDC series
 - 12. Contactors: GAF Series + IOR Series rail contactor
 - 13. Insulation monitoring devices: CM-IWx
 - 14. GFDI Application: S804U-PV55
 - 15. Residual current devices: F202B, F204B
 - 16. Residual current blocks: DDA 200 B
- Residual current circuit breakers: F200 type B
Miniature circuit breakers: S 200
Moulded case circuit breakers: Tmax XT, Tmax T



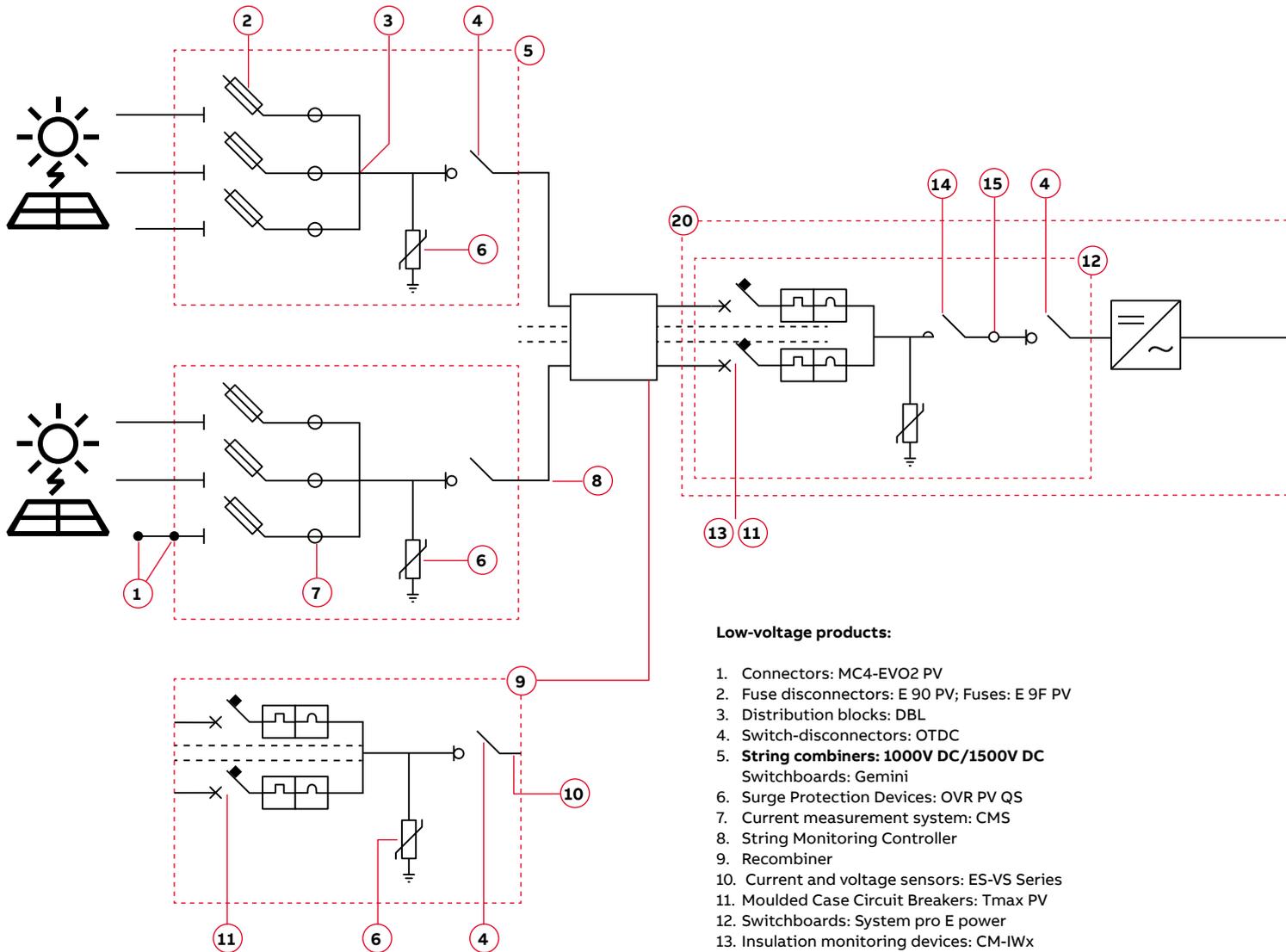


- Medium-voltage products:**
- 17. Contactors: AF Contactor Series
Grid-feeding monitoring relays: CM-UFD.Mxx
Power supplies: CP-x
 - 18. Energy meters: EQ meters and current transformers
 - 19. Surge protective devices: OVR T1 / T1-T2 / T2 QS
 - 20. Fuse disconnecter: E 90
 - 21. GSM telephone actuator: ATT
 - 22. Modular Systems: Compact Secondary Substation, Secondary Skid Unit, Secondary Enclosed Unit
 - 23. Transformers: Dry-type transformers, oil-immersed transformers
 - 24. Gas-insulated secondary switchgear: SafeRing / Safeplus
Air-insulated secondary switchgear: UniSec
Air-insulated switch-disconnector: NALF
Recloser: Gridshield®
Circuit breaker: VD4
 - 25. Interface protection system: ABB Relion® Family



Examples of photovoltaic applications

Utility scale systems > 1000 kW MV/HV



Low-voltage products:

1. Connectors: MC4-EVO2 PV
2. Fuse disconnectors: E 90 PV; Fuses: E 9F PV
3. Distribution blocks: DBL
4. Switch-disconnectors: OTDC
5. **String combiners: 1000V DC/1500V DC**
Switchboards: Gemini
6. Surge Protection Devices: OVR PV QS
7. Current measurement system: CMS
8. String Monitoring Controller
9. Recombiner
10. Current and voltage sensors: ES-VS Series
11. Moulded Case Circuit Breakers: Tmax PV
12. Switchboards: System pro E power
13. Insulation monitoring devices: CM-IWx
14. Contactors: GAF Series, IOR Series rail contactors
15. GFDI Application: S804U-PV55
16. Fuse disconnectors: E 90
17. Surge protection devices: OVR T1 / T1-T2 / T2 QS



1

2

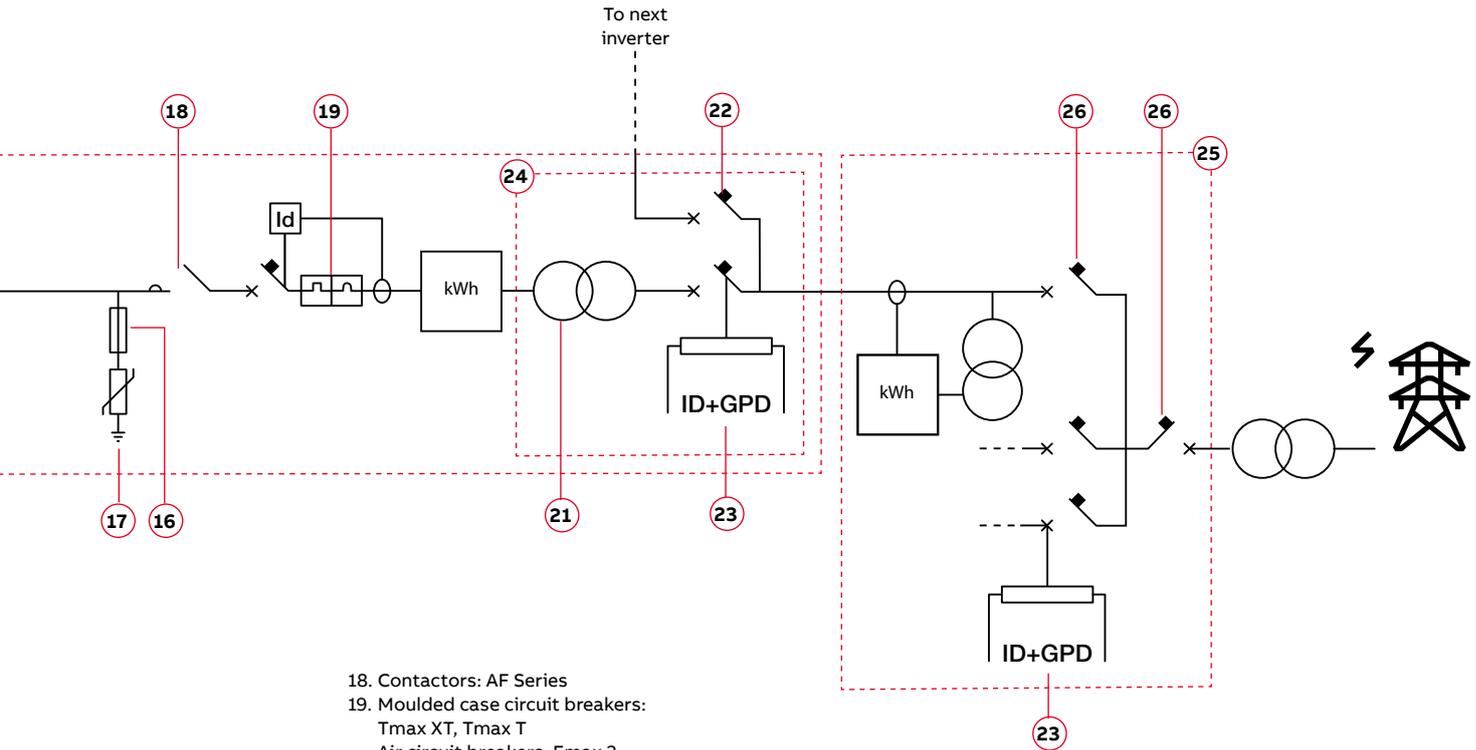
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- 18. Contactors: AF Series
- 19. Moulded case circuit breakers:
Tmax XT, Tmax T
Air circuit breakers: Emax 2

Medium-voltage products:

- 20. Megawatt station
- 21. Transformers: Dry-type transformers, oil-immersed transformers
- 22. Gas-insulated secondary switchgear: SafeRing / Safeplus
Air-insulated secondary switchgear: UniSec
Air-insulated switch-disconnector: NALF
Recloser: Gridshield
Circuit breaker: VD4
- 23. Interface protection system: ABB Relion® Family, REG615
- 24. Modular Systems: Compact Secondary Substation, Secondary Skid Unit, Secondary Enclosed Unit
- 25. eHouse, skid-mounted substation
- 26. Gas-insulated switchgear: ZX product family
Air-insulated primary switchgear: UniGear product family, UniGear Digital
Air-insulated secondary switchgear: UniSec
Outdoor breakers: R-MAG® (dead tank), OVB-VBF (life tank)
Recloser: Gridshield



10



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19

Key OEM supplier for top central inverter manufacturers

DC Side Components

Switch Disconnecter: OT and OTDC
Switch Disconnecter and MCCB: Tmax PV
Contactor: GAF and IOR Series
Surge Protection Device: OVR PV T2 QS
GFDI: S804PVS-5
Power Supplies: CP Series
Insulation Monitoring relay: CM-IWx

AC Side Components

Air Circuit Breaker: Emax 2
Moulded Case Circuit Breaker: Tmax XT, Tmax T
Miniature Circuit breaker: S200, S800
Contactor: A and AF Series
Surge Protection Device: OVR T1 / T1-T2 / T2 QS / TC
Energy Meters: EQ Range
Residual Current Devices: F200 B Type
Current and Voltage Sensors: ES and VS ranges
Grid Connection Relay: CM-UFD
Terminal Blocks: SNK Series
Switchboard: System Pro E Power



Key OEM supplier for top string inverter manufacturers

DC Side Components

Fuse Disconnect: E90PV
Switch Disconnect: OTDC
Miniature Circuit breaker: S200 MU C, S800 PV
Surge Protection Device: OVR PV T2 QS

AC Side Components

Switch Disconnect: OT
Miniature Circuit breaker: S 200, S800
Surge Protection Device: OVR T2 QS
Contactors: A and AF Series
Energy Meter: EQ Series
Terminal Blocks: SNK Series



DC string boxes

Switch-disconnectors: Tmax PV
Switch-disconnectors: OTDC series
Miniature circuit-breakers: S800 PV-S
Fuse disconnectors: E 90 PV
Surge protective devices: OVR PV QS
Current Measurement System: CMS
Outdoor Enclosure: Gemini, Europa
SNK terminal blocks
Wiring ducts



Medium-voltage (MV) solutions

Power Collection

Modular Systems: Compact Secondary Substation, Secondary Skid Unit, Secondary Enclosed Unit
Gas-insulated secondary switchgear: SafeRing / Safeplus
Air-insulated secondary switchgear: UniSec
Recloser: Gridshield
Switch-disconnector: NALF
Relays: Relion family
Fuses
Service

Grid Connection

Modular Systems: eHouses, skid-mounted substations
Gas-insulated primary switchgear: ZX product family
Air-insulated primary switchgear: UniGear product family, UniGear Digital
Air-insulated secondary switchgear: UniSec
Medium-voltage circuit breakers: VD4, ADVAC, AMVAC
Outdoor circuit breakers: R-MAG (dead-tank), OVB-VBF (life-tank)
Recloser: GridShield
Relays: ABB Relion, REG615
Service



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 V DC 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	30
Tightening torque	Nm	PZ2 2-2.5
Protection Class		IP20
Lockable (open position)		Yes
Sealable (closed position)		Yes
Approvals		UL, CCC, EAC, GOST UKR, BV

Cylindrical Fuses

E 9F PV



The E 9F PV range of cylindrical fuses has been designed to protect DC circuits up to 1000 V DC 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 I _n From 8 A up to 30 A = 2.0 x I _n
Dimensions	mm	10.3 x 38
Weight	g	7

Fuse disconnectors

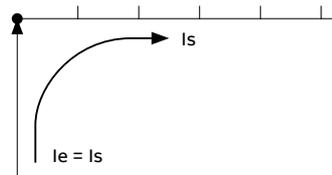
Busbars for E90 PV



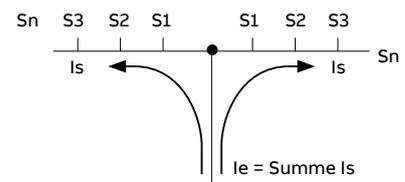
Main technical specifications		DC-Busbar 30mm ²	
Type	1 Phase	2 Phase	
Material	Copper	Copper	
Surface	Plain	Plain	
Insulation	ABS Grey RAL 7035		
End Cap	ABS Grey RAL 7035		
Technical data			
Heat deflection Temp. Long Term	90°C UL 94V0		
Heat deflection Temp. Short term	113°C UL94V0		
Comparative Tracking Index	600V		
Standards	EN60947-1:2007/IEC 60947-1:2007		
Insulation Coordination	Overvoltage Category III/ Degree of Pollution 2		
Electrical Data			
Max. electrical load	690V AC/1000V DC	690V AC/1000V DC	
Protection Class:	IP20		
Short Circuit Rating	IPK=25kA/0.1s (Surge Energy Capacity IPK) ICC 100kA-NH3 355A gC500V JM		
Impulse Voltage Strength	≥8.5KV		
Dielectric Strength	>32 kV/mm		
Capacity at 35°C ambient temperature depending on the feeding point			
Cross Section	30 mm ²		
Busbar Length	max. 1000mm	max. 300mm	
Feeding at beginning/ending			
Max Current Is/Phase	120A	200A	
Other Feeding Max current Is/Phase	160A	250A	

Feeding

Feeding at beginning or end of busbar



Other Feedings



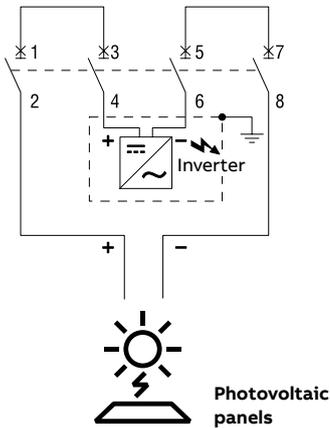
In case of center-feeding, please note that the sum of junction currents S1..Sn per rail branch may not be bigger than the above named max. busbar current Is/Phase.

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 440 V DC acc. to IEC 60947-2 with $I_{cu} = 10$ 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
Reference Standards		IEC/EN 60898-2, IEC/EN 60947-2, UL1077, CSA 22.2 No. 335
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-SP



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

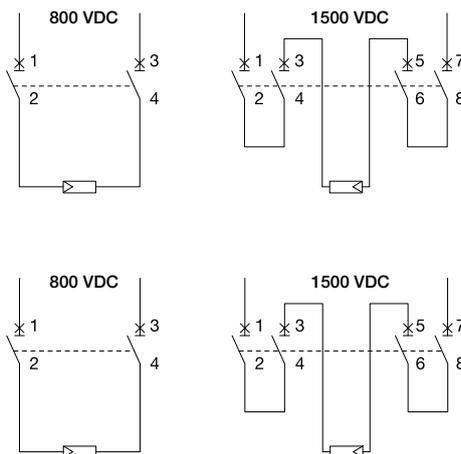
The main features of the S800 PV-SP circuit breakers include:

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

Main technical specifications		S800 PV-SP
Reference Standards		IEC EN 60947-2 and Annex P
Rated current	A	5...125, 125
Number of poles		2, 4
Rated voltage Ue		
(DC) 2 poles*	V	800
(DC) 4 poles*	V	1500
Ultimate rated short-circuit breaking capacity Icu		
5...16A acc. IEC 60947-2 Annex P	kA	5
20...125A acc. IEC 60947-2	kA	5
20...125A acc. IEC 60947-2 Annex P	kA	3
Thermomagnetic release characteristic		$4 I_n \leq I_m \leq 7 I_n$
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

Panel network in earth-insulated systems



Switch-disconnectors

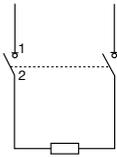
S800 PV-SD, S802 PV-M-H



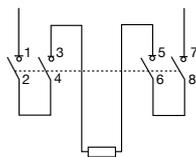
Panel network
in earth-insulated systems

S800 PV-M

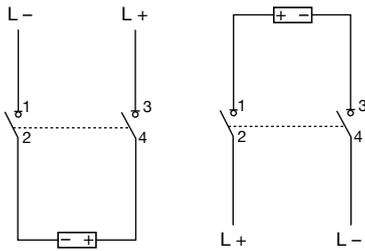
32...125 A
800 VDC



32...125 A
1500 VDC



S802 PV-M-H



Comply with polarity
and supply direction in wiring.

The S800 PV-SD modular switch-disconnectors can be used in networks up to 1500 V DC (4-poles execution). The S800 PV-SD 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-SD switch-disconnectors include:

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

Main technical specifications		S800 PV-SD
Reference Standards		IEC EN 60947-3 and Annex D
Rated current I_n	A	32, 63, 125
Number of poles		2, 4
Rated voltage U_e		
(DC) 2 poles*	V	800
(DC) 4 poles*	V	1500
Rated short-time withstand current I_{cw}		
(DC) 2 poles* 800 V	kA	1.5
(DC) 4 poles* 1500 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 V DC. 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		
(DC) 2 poles*	V	1000
Rated short-time withstand current I_{cw}		
(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

Switch-disconnectors

S804U-PVS5



Function: string protection.

The S804U-PVS5 is for string protection in photovoltaic systems.

In case of reverse currents, the breaker will trip. Thus the PV generator will not be damaged. The breaker is tested acc. to UL489B for 1000 V DC.

Main technical specifications		S804U-PVS5
Reference Standards		UL489B (Photovoltaic)
Poles		4
Tripping characteristics		PVS
Rated current I _e	A	5
Rated frequency f	Hz	-
Rated insulation voltage U _i acc. to IEC/EN 60664-1	V	DC 1500
Rated impulse withstand voltage U _{imp} . (1.2/50μs)	kV	8
Overvoltage category		IV
Pollution degree		3
Suitability for isolation		yes
Data acc. to UL / CSA		
Rated voltage	V	DC 1000
Rated interrupting capacity acc. to UL 1077	kA	
Short-circuit current rating acc. to UL 489	kA	
Short-circuit current rating acc. to UL 489B	kA	1.5kA
Application		GFDI in PV-applicatoin
Reference temperature for tripping characteristics	°C	50°C
Electrical and Mechanical endurance	ops.	acc. to UL489B 1000 with current; 1000 without current
Mechanical Data		
Housing		Material group I, RAL 7035
Toggle		black, lockable
Ambient temperature	°C	-25... + 60
Storage temperature	°C	-40 ... +70

Pole connector

S802-LINK125



The 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

Advantages of the pole connector:

- Avoid hazardous situation due to high temperatures in demanding applications
- Avoid early tripping of the MCB
- Reduce heat dissipation of the MCBs in the box with significant temperature reduction
- Rated current range of 50A and 125A used in 2 pole and 4 pole breakers
- Avoid isolation damage by excessive bent of the cable (not following cable manufacturer limits)

S800PV-SP

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	39	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-SD

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.

Distribution blocks

DBL



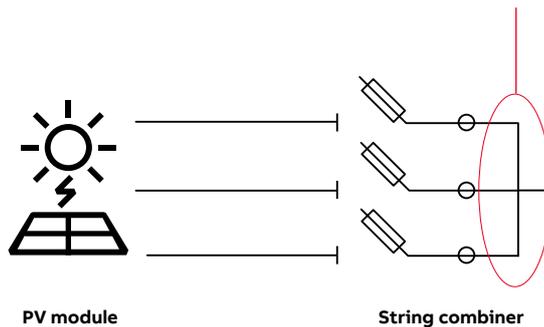
The DBL distribution blocks are adapted to the most recent solar inverters requirements with a voltage rating going up to 1500V DC IEC (1000V DC UL). They provide the benefit of 3 configurations in 1 single product: grouping several inputs into one output for DC applications, or single and multipole splitting for AC power applications.

The reversible cover facilitates identification and wiring tasks, and the modular and touch proof design eliminates the need for bus bars, isolators, fasteners or protection screens.

Finally it saves up to 50% rail space compared to conventional distribution bars.



Main technical specifications							DBL
Section	Number of inputs			Rated voltage			
16 mm ²	4 AWG	80A	7	1500 V DC (IEC)	1000 V DC (UL)	DBL80	
35 mm ²	2 AWG	125A	8			DBL125	
50 mm ²	2/0 AWG	160A	8			DBL160	
		175A	12			DBL175	
95 mm ²	250 Kcmil	250A	12			DBL250	
150 mm ²	400 Kcmil	400A	12			DBL400	



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 (UHT+ - UHT- > 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

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

String monitoring

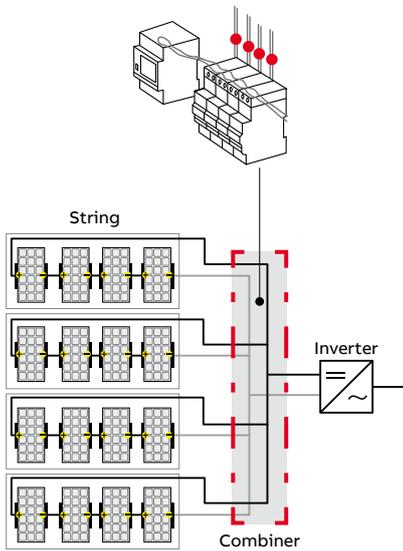
Current Measurement System (CMS)



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.

Main benefits:

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



Main technical specification		CMS
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 V DC
DC Accuracy (TA = +25 °C)	%	0,7 – 1,7
Operating temperature	°C	-25 .. +70
Communication	-	Modbus RTU (RS485 2 wire)

Mounting	System pro M	DIN rail	Cable Ties
AC accuracy ≤±1.0%	For all MCBs with dual terminals	universal use	universal use
The Laying Method Influences the accuracy			
18mm			
CMS-120xx (80 A)	CMS-120PS	CMS-120DR	CMS-120CA
CMS-121xx (40 A)	CMS-121PS	CMS-121DR	CMS-121CA
CMS-122xx (20 A)	CMS-122PS	CMS-122DR	CMS-122CA

Main technical specification		CMS-120xx	CMS-121xx	CMS-122xx
Measurement range	A	80	40	20
Measuring method		TRMS, AC 50/60 Hz, DC		
Peak factor, distorted waveform		≤ 1.5	≤ 3	≤ 6
AC accuracy (TA = + 25 °C)			≤ ± 1 %	
AC temperature coefficient			≤ ± 0,04 %	
DC accuracy (TA = + 25 °C)		≤ ± 1.2 %	≤ ± 1.4 %	≤ ± 1.8 %
DC temperature coefficient		≤ ± 1.4 %	≤ ± 0.24 %	≤ ± 0.44 %
Resolution	A		0.01	
Sampling rate, internal	Hz		5000	
Response time (±1 %)	sec		typ. 0.34	
Conductor penetration	mm		9,6	
Insulation strength	V		690 V AC/1500 V DC	
Dimensions				
CMS-120PS Serie	mm	17.4x41.0x26.5		17.4x41.0x30.9
CMS-120CA Serie	mm	17.4x41.0x29.0		
CMS-120DR Serie	mm	17.4x51.5x43.2		

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

Main technical specifications		ISL-A 600	ISL-C 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	V DC	-	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

Switch-disconnectors

OTDC16...32



OTDC16...32F

OTDC16...32U



OTDCP16...32F

OTDC16...32 disconnect switches are available up to 32 amperes and 1000V. The modular structure offers a simple and cost effective solution for disconnecting up to 1, 2, or 3 PV circuits within the same footprint area.

The main features of the OTDC16...32 disconnect switches include

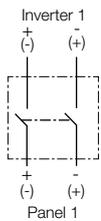
- Patented design of DC main contacts offer:
 - Low temperature rise for minimal contribution to overall heat-rise within any enclosure.
 - High operational performance, 32A up to 1000V, in high ambient temperatures.
 - Increased energy efficiency
- Compactness and modularity: allow for consistent and optimized mounting in switchboard equipment, therefore reducing implementation costs and increased space savings.
- DINrail, base, or door-mounted versions for simple installation in a variety of enclosure designs.
- Compliant with many global standards, including UL 508i.
- OTDC16...32US versions are factory pre-connected for single-wire breaking applications.
- Enclosed OTDCP16...32 versions are suitable for outdoor use in harsh environments.

Main technical specifications ¹⁾		OTDC16...32	
		_F Type	_U Type
Mounting Versions	Base and Din Mount	OTDC_F_	OTDC_U_, OTDC_US_
	Door Mount	OTDC_FT_	OTDC_UT_, OTDC_UST_
Reference Standards		IEC 60947-3	
Rated Insulation Voltage (Ui) Pollution degree 3	V	1000	
Rated Impulse Voltage (Uimp)	kV	8	
Nominal Current In (Amps)		16, 25, 32	16, 25, 32
Rated Thermal Current Ith (Amps)	in open air	25...45	40...63
	in enclosure 40°C	25...45	32...50
	in enclosure 60°C	25...32	25...40
Utilization Category		DC-21B	
Number of Poles		2...4	2...6
Rated Operational Current Ie (Amps) at 660 V DC	1 circuit	16...32	16...32
	2 circuits	16...32	16...32
	3 circuits		16...32
Rated Operational Current Ie (Amps) at 1000 V DC ²⁾	1 circuit	10...32	10...20
	2 circuits	10...32	10...20
	3 circuits		10...20
Wire Size Range	mm ²	2.5...16	
Reference Standards		UL508i	
Number of Poles		-	2...6
Rated Current (Amps) at 600 V DC	1 circuit	-	10...25
	2 circuits	-	16...32
	3 circuits	-	16
Ambient temperature	°C	-	-20...+60
Short Circuit Rating	kA, 600V	-	5
	Protection Type	-	RK5 Fuse
	A, Max Fuse Size	-	70
Wire Size Range	AWG	-	12-6 AWG

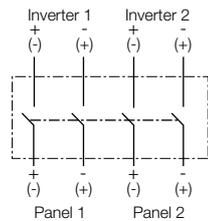
1) For additional technical details, refer to OTDC Main Catalog
 2) 1000 V DC not applicable to OTDC_US, UST versions.

Examples

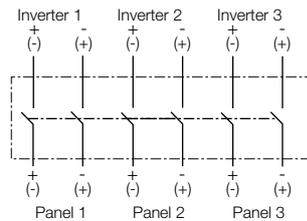
**One PV Circuit
 2 Pole**
 OTDC_F2, FT2
 OTDC_U2, UT2



**Two PV Circuit
 4 Pole**
 OTDC_F4, FT4
 OTDC_U4, UT4



**Three PV Circuit
 6 Pole**
 OTDC_F6, FT6
 OTDC_U6, UT6



Switch-disconnectors

1000 V DC and up to 1600A: OTDC100...1600



The OTDC series of switch-disconnectors is available with nominal currents from 100 to 1600 A.

OTDC 100...800: Two poles in series provides compact performance up to 1000 V DC. Up to three 1000 V circuits can be operated with a single device. It is also possible to use the switch as a combiner, with separate inputs and a combined output of up to 1500A.

OTDC1000...1600: Four poles in series provides compact performance up to 1000 V DC for use in high power applications.

The main features of the OTDC100...1600 switch-disconnectors include:

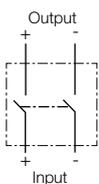
- Compactness: thanks to the patented DMB (Dual Magnetic Breaking) technology, the switches reach 1000 V DC with two poles in series for most sizes.
- Easy to install: connections are simple and independent from polarity, for providing greater wiring flexibility. The operating mechanism can be located between the poles or on the left side of the switch.
- Factory-installed or jumper kits available.
- Safety: Visible contacts allow a clear indication of position.



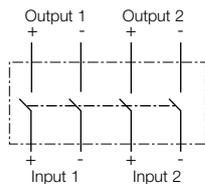
Main technical specifications ¹⁾		OTDC100...250		OTDC250...800		OTDC1000...1600	
		OTDC100... 250E_	OTDC100... 200U_	OTDC315... 800E_	OTDC250... 600U_	OTDC1000... 1600E_	OTDC800... 1000U_
Wiring configuration		Two-wire breaking		E types	U types	E types	U types
		Single-wire breaking		US types		US types	
Reference Standard		IEC 60947-3				IEC 60947-3	
Nominal Current In (Amps)		100, 160, 200, 250	160, 200, 250	315, 400, 500, 630, 800	250, 320, 400, 600	1000, 1250, 1600	800, 1000
Rated Insulation Voltage (Ui)		1000				1500	
Pollution degree 3		V				12	
Rated Impulse Voltage (Uimp)		kV				12	
Number of Poles		2...6		2...6		4	
Rated Thermal Current Ith (A)		in open air		100...250		315...800	
		in enclosure 40°C		100...250		315...800	
		in enclosure 60°C		100...200		315...680	
Utilization Category		DC-21B				DC-21B	
Rated Operational Current Ie (A) at 1000 V DC		1 circuit		100...250		315...800	
		2 circuits		100...250		315...500	
		3 circuits		100...200		315...500	
Rated Operational Current Ie of combined output (A) at 1000 V DC		2 input circuits, 1 output		-		315...500, 630...1000	
		3 input circuits, 1 output		-		315...500, 945...1500	
Reference Standard		UL 98B				UL 98B	
Number of Poles		-		2...4		-	
Rated Current (A) at 1000 V DC		1 circuit		-		100...200	
		2 circuits		-		100...200	
Rated Current (A) at 1000 V DC		3 circuits - 100...200		-		250...400, 500...800	
Ambient temperature		°C		-20...+50		-20...+50	
Short Circuit Rating		kA per input, 1000V		-		10	
		Protection Type		-		Circuit breaker	
Wire Size Range		MCM		#4-300		#2-600	
						4x #4-300	

Examples

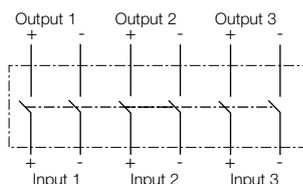
Single PV Circuit
1000 V DC IEC: 100-500A
1000 V DC UL: 100-400A



Double PV Circuit
1000 V DC IEC: 100-500A
1000 V DC UL: 100-400A



Triple PV Circuit
1000 V DC IEC: 315-500A



Switch-disconnectors

1500 V DC and up to 500A: OTDC250...500



The OTDC series of switch-disconnectors is also available for operating voltages up to 1500 V DC from 100A to 500A. OTDC250..500 switch-disconnectors can operate up to two separate 1500 V DC circuits with a single device.

The main features of the OTDC100...500 switch-disconnectors include:

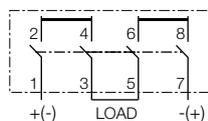
- Compactness: thanks to the patented DMB (Dual Magnetic Breaking) technology, the switches reach 1500 V DC with a small footprint and with 3 poles in a most of sizes.
- Easy to install: connections are simple and independent from polarity, for providing greater wiring flexibility.
- Factory-installed or jumper kits available.
- Safety: Visible contacts allow a clear indication of position.

Main technical specifications		OTDC100...200	
1500 V DC basic versions		OTDC100...200E_	OTDC100...200U_
Wiring configuration	Two-wire breaking	E types	U types
	Single-wire breaking		US types
Reference Standard		IEC 60947-3	
Nominal Current In (Amps)		100, 200	
Rated Insulation Voltage (Ui)		1500	
Pollution degree 3			
Rated Impulse Voltage (Uimp) kV		12	
Rated Thermal Current Ith (Amps) in open air		100...200	
in enclosure 40°C		100...200	
in enclosure 60°C		100...200	
Number of Poles		4	-
Utilization Category		DC-21B	
Rated Operational Current Ie (Amps) at 1500 V DC One circuit		100...200	
Reference Standard		UL 98B	
Number of Poles		4	
Rated Current (Amps) at 1500 V DC One circuit		-	100...200
Ambient temperature °C		-	-20+50
Short Circuit Rating kA, 1500V		-	10
Protection Type		-	Circuit breaker
Wire Size Range MCM -		-	#250-500

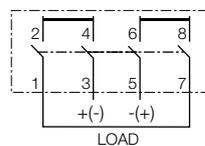
Examples

Single PV Circuit

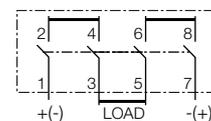
1500VDC IEC: 100-200A
 1500VDC UL: 100-200A
 Ungrounded and Grounded System



Single circuit
E and U types



Single circuit
E types



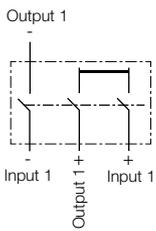
Single circuit
US types

Main technical specifications		OTDC250...500	
1500 V DC basic versions		OTDC315...500E_	OTDC250...400U_
Wiring configuration	Two-wire breaking	E types	U types
	Single-wire breaking		US types
Reference Standard		IEC 60947-3	
Nominal Current In (Amps)		315, 400, 500	250, 320, 400
Rated Insulation Voltage (Ui)			
Pollution degree 3	V	1500	
Rated Impulse Voltage (Uimp)	kV	12	
	in open air	315...630	
	in enclosure 40°C	315...550	
Rated Thermal Current Ith (Amps)	in enclosure 60°C	315...440	
Number of Poles		3...6	
Utilization Category		DC-21B	
Rated Operational Current Ie (Amps) at 1500 V DC	One circuit	315...500	
	Two circuits	315...500	
Reference Standard		UL 98B	
Number of Poles		-	3
Rated Current (Amps) at 1500 V DC	One circuit	-	250...400
Ambient temperature	°C	-	-20...+50
Short Circuit Rating	kA, 1500V	-	10
	Protection Type	-	Circuit breaker
Wire Size Range	MCM	-	#2-600

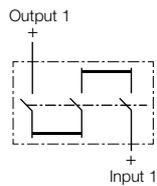
Examples

Single PV Circuit

1500 V DC IEC: 315-500A
 1500 V DC UL: 250-400A
 Ungrounded System

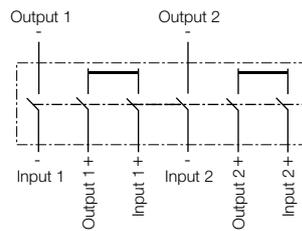


1500 V DC IEC: 315-500A
 1500 V DC UL: 250-400A
 Grounded System



Double PV Circuit

1500 V DC IEC: 315-500A
 Ungrounded System



Switch-disconnectors

Tmax PV



In accordance with IEC 60947-3, Tmax PV IEC range offers switch-disconnectors to meet standard 1100V DC applications. In addition, it offers the versatility of extended capacities up to 1500V DC. Connection jumpers are an available option for the Tmax PV IEC switch-disconnectors to increase safety and ease of installation. Tmax PV IEC automatic circuit-breakers up to 1000V DC are available as a special version of the standard Tmax T line. Moreover, new Tmax PV IEC automatic circuit-breakers have been developed in accordance to IEC 60947-2 in order to protect the plant up to 1500V DC. In accordance with UL 489B, Tmax PV UL range 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. 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. In addition, Tmax PV UL offers the versatility of extended capacities of switch-disconnectors up to 1500V DC.

The main features of the Tmax PV line include:

- up to 1500V DC rated voltage
- complete offer for a large range of current and voltage
- compliant with the most important standard, IEC 60947-3 and UL489B
- availability of the three and four poles in fixed versions
- suitable for use in extreme condition thanks to operating temperature from -25°C up to 70 °C.

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

Tmax PV switch-disconnectors in compliance with the IEC60947-3							
Electrical characteristics		T1D/PV	T3D/PV	T4D/PV	T5D/PV	T6D/PV	T7D/PV ¹⁾
Rated service current in category DC22 B, Ie	(A)	160	200	250	500	800	1250-1600
Number of poles	(No.)	4	4	4	4	4	4
Rated service voltage, Ue		1100V DC	1100V DC	1100V DC	1100V DC	1100V DC	1100V DC
Rated impulse withstand voltage, Uimp	(kV)	8	8	8	8	8	8
Rated insulation voltage, Ui	(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, Icm	(kA)	1.92	2.4	3	6	9.6	19.2
Rated short-time withstand current for 1s, Icw	(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	(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

* openings with SOR or UVR

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

Tmax PV switch-disconnectors in compliance with the IEC60947-3				
Electrical characteristics		T4D/PV-E	T5D/PV-E	T7D/PV-E 1)
Rated service current in category DC22 A, Ie	(A)	250	500	1250-1600
Number of poles	(No.)	4	4	4
Rated service voltage, Ue		1500V DC	1500V DC	1500V DC
Rated impulse withstand voltage, Uimp	(kV)	8	8	8
Rated insulation voltage, Ui	(V)	1500V DC	1500V DC	1500V DC
Test voltage at industrial frequency for 1 minute	(V)	3500	3500	3500
Rated short-circuit making capacity, switch-disconnector only, Icm	(kA)	3	6	19.2
Rated short-time withstand current for 1s, Icw	(kA)	3	6	19.2
Versions		F	F	F
Standard terminals		F	F	F
Mechanical life	(No. Operations)	7500	7500	20000
Electrical life (operations @ 1500V DC)	(No. Operations)	1000*	1000*	500*
Basic dimensions	W (mm/in)	140/5.52	186/7.33	280/11.02
	D (mm/in)	103.5/4.07	103.5/4.07	178/7.01
	H (mm/in)	205/8.07	205/8.07	268/10.55
Weight (with standard terminals only)	(kg/lbs)	3.05/6.72	3.15/9.15	14/30.86

1) installation in vertical position only

* openings with SOR or UVR

—
Molded case circuit-breakers up to 1500V DC in compliance with IEC 60947-2

Whenever a consistent short-circuit current can be found, 1000V and 1500V DC automatic circuitbreakers are available in the Tmax PV range. Below is the IEC60947-2 automatic circuit-breaker offering at 1500V.

Tmax PV circuit-breaker in compliance with IEC 60947-2				
Electrical characteristics		T4N-PV/E		
Frame size	(A)	250		
Rated service current	(A)	100-250		
Number of poles	(No.)	4		
Rated service voltage, Ue	(V)	1500		
Rated impulse withstand voltage, Uimp	(kV)	8		
Rated insulation voltage, Ui	(V)	1500		
Rated ultimate short-circuit breaking capacity @ 1500VDC, Icu	(kA)	25 according to IEC 60947-2 Annex P (time constant = 1 ms)		
	(kA)	10 (time constant = 5 ms)		
Rated service short-circuit breaking capacity @ 1500VDC, Ics	(kA)	20 according to IEC 60947-2 Annex P (time constant = 1 ms)		
	(kA)	5 (time constant = 5 ms) - To be confirmed		
Trip Unit		TMF		
Versions		F		
Terminals		F - FCCu - FCCuAl		
Connections*		Jumpers		
Mechanical life with Motor	(No. Operations)	7500		
Electrical life (operations @ 1000V DC)	(No. Operations)	1000**		
Basic dimensions	W (mm/in)	140/5.52		
	D (mm/in)	103.5/4.07		
	H (mm/in)	205/8.07		
Weight (with standard terminals only)	(kg/lbs)	3.05/6.72		

* Selection of one of the jumper connection options is mandatory

** openings with SOR or UVR

Switch-disconnectors

Tmax PV

Molded case switch-disconnectors up to 1500V DC in compliance with UL 489B

Main technical specifications		Tmax PV					
Tmax PV UL switch-disconnectors		T1N-D/PV	T4N-D/PV	T5N-D/PV	T6N-D/PV	T7N-D/PV ¹⁾	T7N-D/PV-E ¹⁾
Rated service current	(A)	100	200	400	600-800	1000	1000-1200
Number of poles	(No.)	4	3	3	4	4	4
Rated service voltage	(V)	1000V DC	1000V DC	1000V DC	1000V DC	1000V DC	1500V DC
Short-circuit current withstand	(kA)	1.2	3	5	10	18	18
Magnetic override	(kA)	-	3	5	10	-	-
Versions		F	F	F	F	F	F
Connections*		Jumpers	Jumpers	Jumpers	Jumpers	Jumpers	Jumpers
Terminals provided with Jumper kit		FCCu	FCCuAl	FCCu-ES	FCCuAl-EF	FCCuAl-F	1000A: F / FCCuAl 1200A: EF
Mechanical life	(No. Operations)	15000	7500	7500	7500	20000	20000
Electrical life (operations @ 1000V DC)	(No. Operations)	1000	1000**	500**	500**	500**	400**
Basic dimensions	W (mm/in)	102/4.02	105/4.13	140/5.52	280/11.02	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	178/7.01
	H (mm/in)	130/5.12	205/8.07	205/8.07	268/10.55	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	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

Automatic Molded Case Circuit Breakers

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 PV range. Below is the UL489B automatic circuitbreaker offering.

Tmax PV circuit-breaker in compliance with UL 489B

Electrical characteristics		T4N/PV	T5N/PV	T6N/PV
Frame size	(A)	200	400	600-800
Rated service current	(A)	40-200	225-400	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)	7.5	5	10
Trip Unit		TMD/TMA	TMF/TMA	TMA
Versions		F	F	F
Standard terminals		F	F	F
Connections*		Jumpers	Jumpers	Jumpers
Terminals provided with Jumper kit		FCCuAl	FCCuAl-FCCu-ES	FCCuAl-EF
Mechanical life	(No. Operations)	7500	7500	7500
Electrical life (operations @ 1000 V DC)	(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

Automatic Air Circuit Breakers

Emax DC



Emax DC is the only air circuit breaker on the market able to protect a DC plant up to 5000A at 1000V DC with integrated electronic trip units.

The main features of Emax DC include:

- Complying with IEC60947-2 Standard.
- Thanks to the exclusive technology applied to the SACE PR123/DC and PR122/DC trip units, Emax DC meets any installation requirement with protection up to 1000V DC for IEC. Also available in a switch-disconnector version.
- The compact sheet metal structure features a robust and durable construction which is directly attributed to its long life expectancies. Available in fixed-mounted and withdrawable versions.
- Configurable for use in grounded or ungrounded PV systems.
- Can be operated locally or remotely, via shunt trip and motor accessories.
- Can be fitted with the same terminal kits and most accessories common to the standard Emax range, reducing the need of stock for extra parts.
- With plant voltages higher than or equal to 100V, the electronic trip unit guarantees protection without the need of an auxiliary power supply.
- Protection is guaranteed even when the electronic trip unit is not powered thanks to the PR120/DC module which always equips both the PR122/DC and the PR123/DC.
- PR123/DC not only offers protection but also measurement of current and voltage of both polarities (+ and -), thus being suitable for any type of network.

Main technical specifications		Emax DC			
		E2	E3	E4	E6
Rated operational voltage, Ue	[V DC]	750 (3 Poles), 1000 (4 Poles)			
Rated impulse withstand voltage, Uimp	[kV]	12	12	12	12
Rated insulation voltage, Ui	[V]	1000	1000	1000	1000
Rated uninterrupted current, Iu	[A]	800-1600	800-2500	1600-3200	3200-5000
Operating Temperature	[°C]	-25...+70			
Utilization category (IEC 60947-2)		B			
Version		Fixed and Withdrawable			

— Contactors (for DC switching)

AF, GAF & IOR bar contactors



For DC switching, 2 solutions are available:

- GAF contactors which is dedicated for this application. Based on the A range, GAF are reliable and modern contactors.
- R bar contactors with its specific DC range. With a robust construction, R contactors are reliable with high performances.

Main technical specifications	GAF	R Bar Contactors
Rated operational voltage	1000 V DC	up to 1500 V DC
Current ratings, DC-1	275 – 2050 A	85 5000A
Control voltage	Electronically controlled AC/DC	AC or DC
Number of poles	3 (connect in series)	1 to 3 (depending on voltage and rating)
Reference standards	IEC60947-1, -4-1	IEC60947-1, 4-1 & UL508*

*only for some products, please refer to the 1SBC104119C0202 catalog

The 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

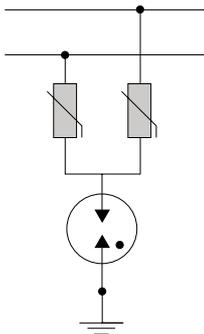
OVR PV



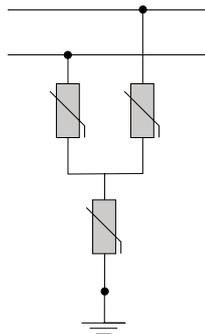
ABB offers a wide range of surge protection devices specifically designed for photovoltaic systems. The main features of the OVR PV SPDs include:

- OVR PV T1 and T2 version
- Auto-protected from end-of-life short circuits up to 10 kA 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
- bottom wiring to improve safety when there is humidity issues in enclosure
- QS Quick Safe® Technology- Fast disconnection in case of end of life of the SPD avooiding thermal runaway.

OVR PV xx 600



OVR PV xx 1000



Main technical specifications	OVR PV T1	OVR PV T2 40 QS	
Reference standards	IEC 61643-11 / UTE C 61740-51 prEN 50539-11 UL 1449 4th edition*		
Configuration	Y	Y	
SPDs Type / Test Class	T1 / I	T2 / II	
Max. cont. Operating voltage U _{cpv}	V	670 / 1000	600 / 1000 / 1500
Nominal discharge current I _n (8/20 μs)	kA	6.25	20
Impulse current I _{imp} (10/350 μs)	kA	6.25	-
Maximum discharge current I _{max} (8/20 μs)	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	10000
Back-up protection:			
- if I _{scwpv} ≤ 100A	- not required	- not require	- not require
- if I _{scwpv} > 100A	- 10A gPV fuse	- autoprotected	- up to 10 kA
Response time	ns	≤25	≤25
Specific integrated PV thermal disconnecter	Yes		QuickSafe Technology
Pluggable	Yes		QuickSafe Technology
Auxiliary contact	TS		TS

*UL version only for OVR PV 40

Surge protective devices

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

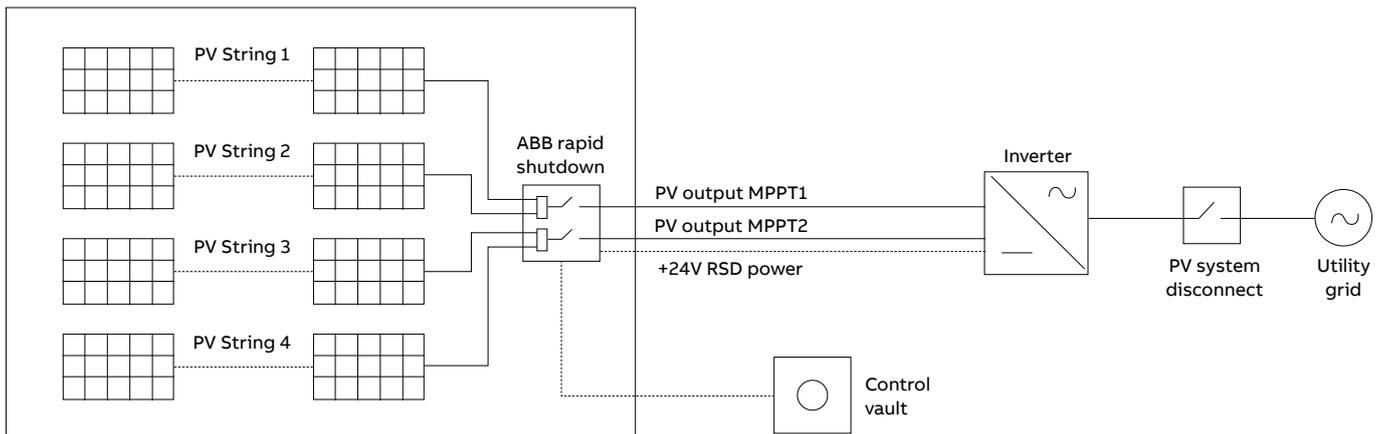
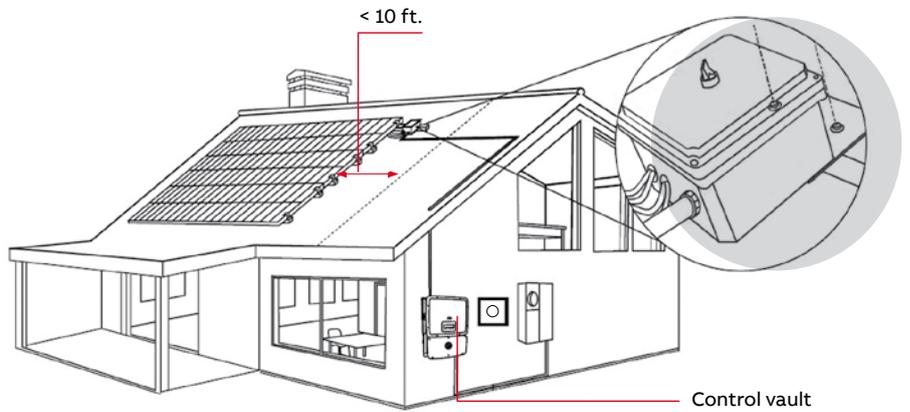
Rapid shutdown

PV Vault



Rapid Shutdown PV Vault

- Application: Residential & Small Commercial Rooftop
- Meets NEC 690.12-2014, UL 1741 and CSA C22 requirements
- 600V DC/20amps or less
- Connects 2 to 4 strings/arrays
- Dual MPPT outputs maintain the benefits of inverter channels
- NEMA 4X enclosure permits 0-90 degree
- Discharges PV array within 10 seconds
- Local On/Off selector switch
- Quick installation with two connections



DC Combiner Boxes



In a photovoltaic system, the modules are arranged in strings and fields depending on the type of inverter used, the total power and the technical characteristics of the modules. The connection of modules in series is made on the modules themselves, while the parallel connection of the strings is realized in the so-called “string boxes” that accommodate, along with the interconnection systems, also the overcurrent protection devices, disconnectors and surge protection devices. In medium and large sized systems, the string boxes form subsystems that can be standardized according to the number of strings, voltage and rated current.

ABB offers four different product ranges, each dedicated to specific installation conditions with typical configurations.

String boxes

The installation of a photovoltaic system often occurs in complex logistic situations, critical from the environmental and time perspective. The availability of tested and certified pre-assembled components allows the installer to avoid unnecessary on site assembly, wiring and certification activities for the string boxes. String boxes enclose functions such as string protection, protection against overvoltage and disconnect, with components suitable for the string’s various voltage levels and the number of connected strings.

Multi-output string boxes

The development and the increasingly frequent adoption of multi-string inverters has made it necessary to reduce the costs and the space occupied by the string boxes, to bring together in a single switchboard the protective devices and disconnectors of multiple strings intended to be connected to a specific inverter input. Multi-string inverters resolve in an easy and cost-effective manner system conditions characterized by modules installed in different leaning and exposure positions or minimize the problems related to systematic shading of parts of the system.

String boxes for monitoring

The string monitoring is an important function in running medium and large size installations, since it allows to improve the manufacturability and maintenance of the system. ABB offers a series of pre-wired string boxes for all installation conditions: they are equipped both with devices necessary for string protection, surge protection and disconnection, and with useful devices for string monitoring.

Highlights:

- 1000V DC and 1500V DC String combiner boxes
- 1 Strings - 32 Strings without monitoring
- 12 Strings - 32 Strings with monitoring (Current monitoring as standard)
- Enclosure: Gemini Thermoplastic, IP66, UV resistant, IK10
- Fuse holders 30A and cylindrical fuses 10.3x38mm
- Integrated disconnect switch
- Protection for both positive and negative
- Surge Protection Devices: OVR PV QS

Optional Features

- Monitoring for voltage, temperature and status of the disconnecter
- Positive protected versions for grounded systems
- Grounded or ungrounded negative
- Pole mounting kit
- Base mounting kit

DC Combiner Boxes



Main technical specifications	DC Combiner Boxes
Maximum DC Voltages	1000V DC versions 1500V DC Versions
Number of Strings	1 String to 32 Strings Configurations
Monitoring Solution	Versions available with and without monitoring functions
Maximum DC Short Circuit Current per String	15A
Rated String Current	10A
Switch Disconnecter	OTDC type
Switch Handle Type	Direct Handle (inside the enclosure)
Earthing DC	Floating Positive and Negative
Surge Protection on DC Side	OVR Type 2 PV, With Aux contact
Inputs	
Number of DC input (+&- being one input)	Based on the number of Strings
Input (+) cables to be connected to	E 92/32 PV Fuse holder
Input (-) cables to be connected to	E 92/32 PV Fuse holder
Input DC cables entrance through	M16 CG IP67, cable outer 5-10mm
Fuses	positive & negative
Fuse form factor	10,3x30mm
Location of fuse	positive and negative inputs
Fuse-link rated current (In)	15 A PV
Fuse-link time-current characteristic	gPV
Earth cable to be connected to	Terminal ZS35-PE
Earth cable entrance through	M20 CG IP67, cable outer 6-12 mm
Auxiliary AC cable to be connected to	Terminal ZS6 in & out
Auxiliary AC cable entrance through	M20 CG IP67, cable outer 6-12 mm
Auxiliary AC disconnecter	MCB switch
Enclosure	
Enclosure Type	Gemini/ Europa Thermoplastic co-injection
Cabinet with Hinged Door Type	Opaque as standard (Optional with transparent door)
Protection Rating	IP65/ IP66 Outdoor
Installation Type	Wall Mount
Ventilation	Passive, Maintain IP Code
Outputs	
Number of DC output	(Positive & Negative being one output) 1
DC Output Cable to be connected to	OTDC Switch Disconnecter Terminals
DC output cable exit through	IP67 cable gland
Monitoring	
Communication protocol	Modbus RS485
Sensor type	Hall effect
sensor accuracy	2% full scale (-20...+70°C)
Input Current	15A - 30A
Input voltage	Optional
Box temperature monitor	Optional
Monitoring type	Measure individual inputs
Power supply	230 V AC - 24 V DC
Other	
Standard and regulations	EN 61439-2, class II
Ambient temperature range	-20...+50°C

Solar panels installation products



TnB Ty-Rap Cable Edge Solar Clips

- Application: Residential & Commercial Rooftop
- Solar Panel wire management
- U-Style cable management parallel to frame
- W-Style for extra cable capacity Hold-Down Clamps and Grounding Washers
- Holds up to four #10 AWG solar cables
- Corrosion resistant materials
- Temperature rated. -85 to +194 degree F
- Heat stabilized Nylon 6.6 option rated -85 to +220 degree F
- Quick and easy installations. No tools required
- 90° installation available

TnB Kindorf Solar Panel Hold Down Clamps, Fittings, Grounding

- Application: Residential & Commercial Rooftop
- Hold-Down Clamps and Grounding Washers
- Corrosion resistant materials
- Ease of installation. Slotted design
- Works with all brands of solar panels

Solar Panel Hold-Down Clamps

Rugged, Corrosion-Resistant Materials

- Body and channel nut made from high-strength extruded aluminum alloy 6061-T6 with clear anodized finish.
- $\frac{1}{4}$ -20 x 3" bolt, lock washer and flat washer made from Type 304 stainless steel

Time-Saving Features

- Hardware is pre-assembled on clamp to save installer time and labor
- Self-oriented channel nut is staked to bolt to ensure fast, easy installation

Versatile Design

- Can be used with both 1 $\frac{1}{2}$ " Kindorf channel and 1 $\frac{5}{8}$ " strut systems

Solar Panel Grounding Washer

- Slotted for quicker installation. No need to disassembly clamp assembly
- Bent tab ensures washer stays in place during installation.
- Can be used with both 1($\frac{1}{2}$)" Kindorf channel and 1($\frac{5}{8}$)" strut systems
- Made from tin-plated, case-hardened steel
- Can be used on carbon steel or aluminum strut channel
- Complies with UL 467 (UL Listed E9809)
- Designed for use with $\frac{1}{4}$ " bolt installed with minimum torque value of 100 lb-in

Photovoltaic systems

Products for AC side



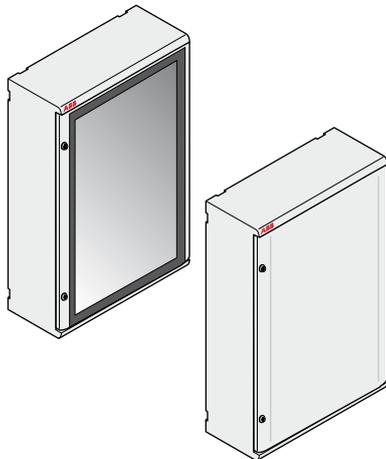


Switchboards

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 V DC
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

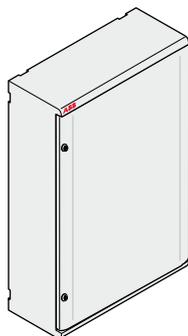
Size	External WxHxD (mm)	Internal WxHxD (mm)	Max num. DIN mod.
1	335x400x210	250x300x180	24 (12x2)
2	460x550x260	375x450x230	54 (18x3)
3	460x700x260	375x600x230	72 (18x4)
4	590x700x260	500x600x230	96 (24x4)
5	590x855x360	500x750x330	120 (24x5)
6	840x1005x360	750x900x330	216 (36x6)

Switchboards

Gemini UL IP 66



Main technical specifications	Gemini UL IP 66
Protection	
Protection class	UL IP 66 (CEI EN 60529)
Insulation	class II
Strength	
Material	joint-injection moulded thermo-plastic
Heat and fire resistance	up to 960 °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	-4°F up to 158°F (-20°C up to 70°C)...+100 °C
Performance	
Nominal insulation voltage	1000 V AC – 1500 V DC
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 NEMA Types: 1, 3R, 4, 4X UL Listed: UL508A, UL50, UL50E CSA Listed: C22.2 Nr14
Standards, quality, environment	



Boxes and doors

- RAL 7035 grey color
- only opaque door available

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

EUROPA65 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 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 V DC
- shock resistance: 20 joules (IK 10)
- 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
- consumer units in compliance with IEC 23-48, IEC 23-49 and IEC 60670 standards

Description Type	Dimensions (mm)
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

EUROPA65 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 V DC
- shock resistance: 20 joules (IK 10 degrees)
- junction boxes in compliance with IEC 23-48 and IEC 60670 standards
- IMQ approved

Description Type	Dimensions (mm)
Box IP65 PC	140x220x140
Box IP65 PC	205x220x140
Box IP65 PC	275x220x140
Box IP65 PC	275x370x140
Box IP65 PC	275x570x140
Box IP65 PC	380x570x140

Miniature Circuit Breakers

S 200, S800



Miniature circuit breakers are necessary also on the AC side of the PV installation for protection of electric lines and equipment 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 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 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	6 ... 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 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 DC 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	0 V
<ul style="list-style-type: none"> to detect currents of type A / AC to detect currents of type B 	30 V AC
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)	V AC 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 a 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



Moulded-case circuit-breakers can be used in low-voltage civil and industrial installations with 10 A to 3200 A operating current.

The Tmax family includes 9 circuit-breaker sizes in three- or four-pole versions:

- XT1, XT2, XT3 and XT4 up to 250A;
- T4, T5 and T6 up to 1000A;
- T7 and T8 up to 3200A.

Main characteristics of the Tmax family are:

- High breaking capacity in compact dimensions: the ultimate short-circuit breaking capacity (I_{cu}) at 415V ranges from 18kA to 200kA, or up to 80kA for 690V
- Ease of use and installation flexibility: a complete range of mechanical and electrical cabled accessories and a solution for electronic trip units to adapt Tmax to each application scenario
- Increased safety for operators: wide range of keylocks and padlocking options, plug in and withdrawable versions to speed up maintenance operations and improved diagnostic to have ready to use information about breakers' status
- Information availability: Modbus communication modules for integration in a supervision system and for remote control

Air Circuit Breakers

Emax 2



Emax 2 air circuit breakers can be used in several electrical installations with 100 A up to 6300 A. The Emax 2 family includes 4 circuit breaker sizes in three or four poles and fixed or withdrawable versions:

- - E1.2 up to 1600 A
- - E2.2 up to 2500 A
- - E4.2 up to 4000 A
- - E6.2 up to 6300 A

The main feature and advantage of the Emax 2 family include:

- High breaking capacity in compact dimension, from 42 kA up to 200 kA, to match the needs of today's installations.
- Increased safety for operators with a wide range of locking accessories.
- No need for costly and difficult external conversion modules for fieldbus connection thanks to 7 different protocols integrated communication modules.
- Emax 2 is designed with highly efficient contacts and smart thermal performance which offers proven material and space savings.
- Up to 25% savings in enclosure material costs versus leading competitors.
- Up to 18% savings in copper material for bus-bars versus leading competitors .
- Up to 20% floor space savings in final equipment installation versus leading competitors.
- Provides increased flexibility for implementation in customer equipment with connection terminals that can be configured for vertical or horizontal bus-bar connections without any additional parts.
- Fast and flexible upgrades with interchangeable trip units.

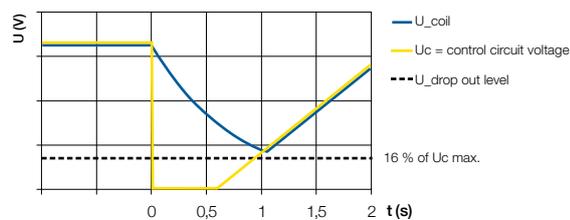
— Contactors (for grid compliance)

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-disconnectors

SD 200



SD 200 switches disconnectors 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)	V AC	253/440
Operation Temperature	C	-25...+55 °C

Switch-disconnectors

OT, OTM



OT16...125M

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 performance, reliability and a number of safety features.

The main features include:

- Full range to cover any application up to 4000 A
- User-independent quick-make and quick-break operation of the main contacts
- Door, base or DIN-rail mounting, flexible installation in any direction
- Wide selection of accessories, including aux contacts and handle options
- Small frames save money as less space is needed
- Remote control available with motorized versions (OTM) up to 2500A
- OT16...125M versions, with light gray color, are available for up to 415 V applications for a DIN-type EN 60715 solution, which are compatible with standard 45 mm enclosure openings.

Main technical specifications	OT
Reference standard	IEC 60947-3, UL 508 & UL 98
Nominal voltage, Ue	up to 1000 V AC
Nominal current, In	16 - 4000 A (IEC), 20 - 2000 A (UL)
Number of poles	1 ... 8
Mounting	Base, DIN rail and door mounting

Surge protective devices

OVR T1, OVR T2



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)
- Certified to the last IEC 61643-11:2012 standard with the QuickSafe technology3.

Main technical specifications		OVR T1	OVR T1-T2 QS	OVR T2 QS
Reference Standards		IEC EN 61643-11 / UL 1449 3rd edition*	IEC EN 61643-11	IEC EN 61643-11 / UL 1449 3rd edition*
IEC Type		T1 / I	T1-T2 / I-II	T2 / II
Max. cont. Operating Voltage Uc	V	255	275	275
Nominal discharge current In (8/20 μs)	kA	25	30	5, 20 and 30
Impulse current Iimp (10/350 μs)	kA	25	12.5	/
Maximum discharge current I _{max} (8/20 μs)	kA	/	80	20, 40 and 70
Response time	ns	< 100	< 25	< 25
Safety reserve		/	yes	"S" Version
Pluggable		/	"P" Version	"P" Version
Remote indicator		"TS" Version	"TS" Version	"TS" Version

* UL Version only for OVR T2 U

Grid feeding monitoring relays

CM-UFD.Mxx



The CM-UFD.Mxx is a multifunctional grid feeding monitoring relay. It trips the section switch which is connected between the distributed generation and the public grid in order to disconnect the distributed generation in case of problems (e.g. unstable grid), faults or maintenance on the grid. 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
- Type tested in accordance to several local Standards
- Over- and undervoltage, 10 minutes average value as well as over- and underfrequency monitoring
- Vector shift detection configurable
- 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 relative values
- Default setting according to several local Standards
- 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

EPR in solar

Grid Feeding Monitoring Relays CM-UFD.Mxx range

Device		Characteristics
CM-UFD.M31		Product complies with the German standard VDE-AR-N 4105 (LV) and BDEW (MV)
CM-UFD.M22		Product complies with the Italian standard CEI 0-21
CM-UFD.M33		Product complies with the UK standard G59/3 & G83/2 UL 508 & CAN/CSA C22.2 No.14 Approved for international use
CM-UFD.M34		Product complies with the United Arab Emirates standard DRRG from DEWA

Primary switch mode power supplies

CP-E and CP-C.1 range



CP-C.1 range

The CP-C.1 power supplies are ABB's higher performance and most advanced range. With excellent efficiency, high reliability and innovative functionality it is prepared for the most demanding industrial applications. These power supplies have a 50 % integrated power reserve and operate at an efficiency of up to 94 %. They are equipped with overheat protection and active power factor correction. Combined with a broad AC and DC input range and extensive worldwide approvals the CP-C.1 power supplies are the preferred choice for professional DC applications. Giving the power to control.

Key features

- Rated output voltage 24 V DC
- Power reserve design delivers up to 150 % at $T_a \leq 40\text{ °C}$
- Output voltage adjustable via front-face rotary potentiometer "OUTPUT Adjust", 22.5-28.5 V
- Input voltage range 100-240 V AC, 90-300 V DC
- High efficiency
- Low power dissipation and low heating
- Free convection cooling (no forced cooling)
- Ambient temperature range during operation $-25\text{...}+70\text{ °C}$
- Open-circuit, overload and short-circuit stable
- Integrated input fuse
- DC OK - signaling output "13-14" (Relay),
- Power reserve signaling output "I > IR (Transistor)
- Redundancy unit CP-A RU offering true redundancy, available as accessory



CP-E range for 24 V DC applications

The CP-E range offers enhanced functionality while the number of different types has been considerably reduced. Now all power supply units can be operated at an ambient temperature of up to $+70\text{ °C}$.

Key features

- Output voltage 24 V DC
- Adjustable output voltages
- Output currents 0.75 A / 1.25 A / 2.5 A / 5 A / 10 A / 20 A
- Power range 15 W, 30 W, 60 W, 120 W, 240 W, 480 W
- High efficiency of up to 90 %
- Low power dissipation and low heating
- Free convection cooling (no forced cooling with ventilators)
- Ambient temperature range during operation $-40\text{...}+70\text{ °C}$
- Open-circuit, overload and short-circuit stable
- Integrated input fuse
- U/I characteristic curve on devices $> 18\text{ W}$
(fold-forward behaviour at overload – no switch-off)
- Redundancy units offering true redundancy
- LED(s) for status indication
 - Signalling output/contact for output voltage OK
 - Transistor on 24 V devices $> 18\text{ W}$ and $< 120\text{ W}$
 - Solid-state on 24 V devices $\geq 120\text{ W}$
- Approvals / Marks
(depending on device, partly pending):
- 

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, Ethernet TCP/IP, KNX.

Insulation monitoring devices

CM-IWx



The CM-IWx series offers an innovative insulation monitoring device. In combination with a new measurement principle, networks up to 1000 V DC or 690 V AC (15-400 Hz monitor range) can be measured.

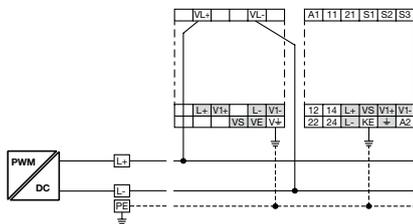
Measurement principle

Using CM-IWx, 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.

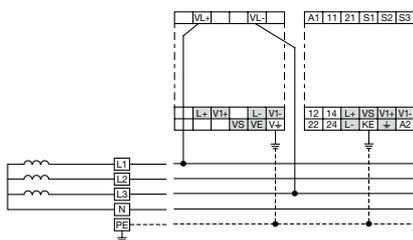
When the estimated insulation resistance corresponds to the insulation resistance calculated in the next measurement cycle and is below the pre-set value, the output relays are either activated or deactivated depending on the configuration of the device. This measurement principle is also useful to detect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

Main Characteristics

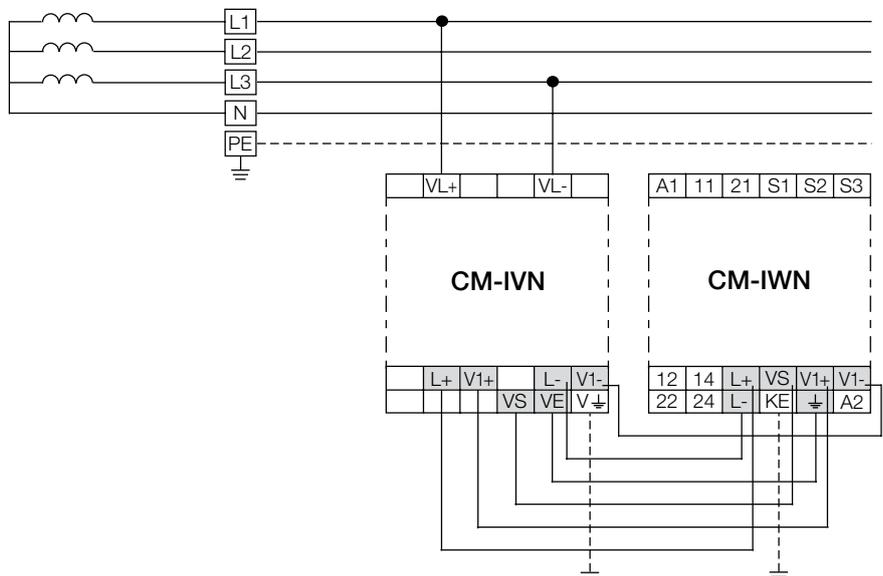
- Compliance with IEC/EN 61557-8 or IEC/EN 60255-1 reference Standards
- Direct connection to systems up to 690 V AC and 1000 V DC with coupling module CM-IVN
- Nominal frequency 15-400 Hz
- Wire interruption monitoring
- Faulty setting monitoring
- High reliability with built-in system start-up test
- Possibility to reset and test at product front or via remote control
- New predictive measurement principle
- Maximum capacity of earth leakage up to 2000 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 ATT
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 V DC, 2 mA input voltage 0...10 V input impedance < 10 KOhm / 100 nF sampling rate 90 ksps	
	Analog		
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





Connection devices

PV connectors



With a voltage rating up to 1500 V DC IEC and 1500V DC UL, ABB's MC4-EVO2 PV connectors can be installed in any environment including commercial, industrial and residential rooftop PV installations.

They enable to connect the DC circuits from the inverter to the PV modules, in compliance with the standards IEC 62852:2014 and UL 6703.

Their housing is made in impact-resistant polyamide and can withstand UV radiation, salt spray and ammonia vapors. They are fully compatible with MC4-type PV connectors.



Plug connector

Ø insulation section	Section			Female	Male
4.7-6.1 mm	4-6 mm ²	12-10 AWG		PV-PLUG-F6/6.1	PV-PLUG-M6/6.1
6.1-7.6 mm	4-6 mm ²	12-10 AWG	1500V DC (IEC)	PV-PLUG-F6/7.6	PV-PLUG-M6/7.6
7.6-8.5 mm	4-6 mm ²	12-10 AWG		PV-PLUG-F6/8.5	PV-PLUG-M6/8.5
7.6-8.5 mm	10 mm ²	8 AWG	1500V DC (UL)	PV-PLUG-F10/8.5	PV-PLUG-M10/8.5

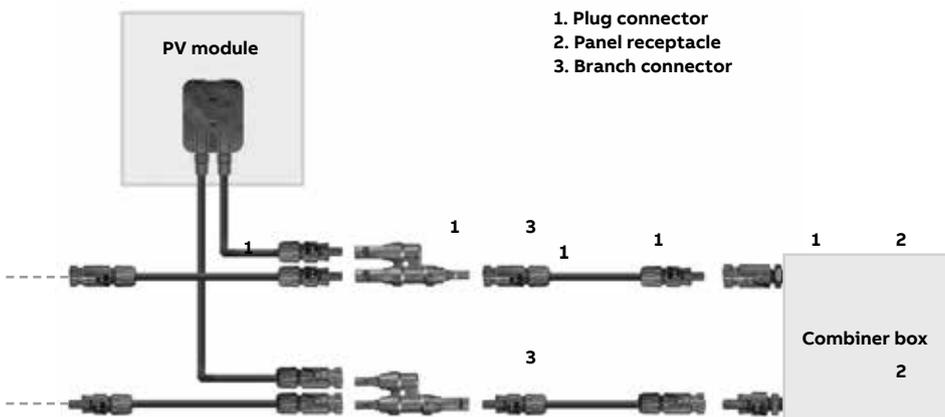
Panel receptacle

Section			Female	Male
4.6 mm ²	12-10 AWG		PV-RECEP-F6	PV-RECEP-M6
10 mm ²	12-10 AWG	1250V DC (IEC*)	PV-RECEP-F10	PV-RECEP-M10

*MC4-EVO2 version (1500V dc IEC and 1500V dc UL) available at the end of 2016

Branch connector

In / Out		Female	Male
2 females / 1 male		PV-BRANCH-F	-
2 males / 1 female	1000V DC (IEC)	-	PV-BRANCH-M



Connection devices

SNK terminal blocks



The SNK terminal blocks are suitable for AC power applications and DC photovoltaic systems with a voltage rating going up to 1250V DC IEC and 1000V DC UL.

2 technologies are available with common accessories:

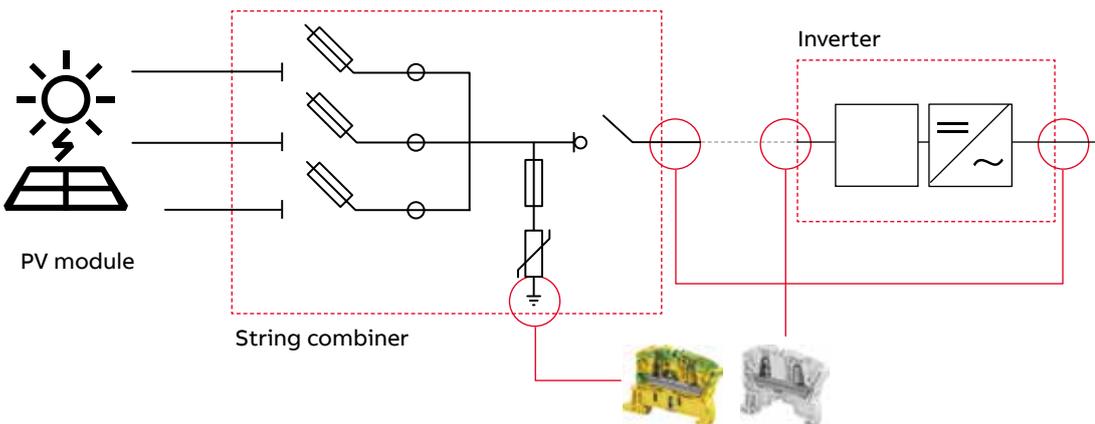
- The screw clamp technology is the most accepted technology providing the highest choice of functions and enabling to connect 2 wires in 1 clamp.
- The PI-Spring technology is a screwless technology that combines 2 connection modes: direct push-in for 50% time saving compared to screw, and connection using a screwdriver for improved comfort. It is particularly well adapted for high demanding environment with vibration and shock.



DC side	Main technical specifications							SNK
	Section (mm ²)	AWG	Current		N. of connections	Rated voltage		
			IEC (A)	UL (A)		IEC	UL	
Screw clamp	2.5 to 10	14 to 6	32 to 57	20 to 42	2	1030V DC	600V DC	ZS4...10
	16	4	76	67		1050V DC		ZS16
	25	3	101	100		1000V DC *		ZS25
	50 to 95	1/0 to 3/0	150 to 232	140 to 230		1250V DC	1000V DC	ZS50...95
PI-Spring	2.5 to 10	12 to 6	24 to 57	20 to 55	2/3	1000V DC	600V DC	ZK2.5...10 ZK2.5...10-3P
	2.5 and 4	12 and 10	24 and 32	20 to 30	4	1000V DC	600V DC	ZK2.5-4P ZK4-4P
	10 and 16	6 and 4	57 and 76	55 to 75	2	1000V DC	600V DC	ZK10 ZK16
								3

* With dedicated accessories

For AC side, all the SNK terminal blocks can be used.



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	Cable ties
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.

Comprehensive selection fittings:

- 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

Comprehensive selection conduits:

- 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

Comprehensive selection of accessories:

- Various support systems for all requirements
- Connection and branching parts available
- Compatible with all PMA products

All PMA products are rigorously tried and tested to meet the demands of industry worldwide:



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	Pilot devices
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 for any kind of use:

- 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
- New Rodcheck system as visual strike indicator.

Main technical specifications		OPR
Lightning current withstand (10/350 μ s)	kA	100
Gain in Sparkover Time	us	30 / 45 / 60
EMC Interferences measurements / Interferences immunity		EN 50 081.1 / EN 50 082.2 / NFC17102

Power collection and grid connection

Medium-voltage





Compact Secondary Substations

Compact substations used for energy transformation



These substations are typically installed in locations accessible to the public and ensure protection for all people according to specified service conditions.

Type-tested, arc-tested assembly comprising an enclosure containing medium-voltage switchgear, distribution transformers, low-voltage switchboards, connections and auxiliary equipment to supply LV energy from MV systems.

Compact Secondary Substations (CSS)

A CSS is made of concrete, glass reinforced polymer (GRP) or steel enclosure and manufactured per the latest standards: IEC 62271-202, GB 17467-2010 AS 62271-202. The preferred material is GRP, since it is light to transport, strong and very resistant to environmental conditions. Designs are available for DC Power Collection, consisting of a power inverter, transformer and MV protection or for AC Power Collection consisting of a step-up distribution transformer and medium-voltage switchgear. The CSS includes an internal arc-tested enclosure to provide the highest safety level for any service or public personnel close to the substation, which is recommended when installed in a public area. It also includes an oil collection pit to protect the environment from oil leakage.

Typical equipment:

- SF₆ or air-insulated switchgear up to 40.5 kV
- Oil transformer up to 3,500 kVA or Dry up to 2,500 kVA

Major options:

- Walk-in for simple maintenance vs non walk-in for compact size
- Multiple enclosure material options

Main features and benefits

- High level of reliability and safety for equipment and personnel (internal arc tested IAC-AB)
- Type tested according to IEC/AS/GB standards for prefabricated substations, IEC 62271-202 or applicable
- Fully enclosed solutions
- Most enclosure materials available in industry
- All doors are lockable to prevent unauthorized entry
- Concrete enclosure with increased corrosion resistance
- GRP housings to meet demanding environmental conditions
- Enclosures are compartmented and electrically segregated for safety
- CSS designs include an oil collection pit for environmental protection in case of oil leakage
- Walk-in option for ease of service
- Separate access entries to MV and transformer secondary skid

Secondary Skid Units

Most economical solution for solar Power Collection



A popular option in the SSU is to cover the transformer with steel mesh giving efficient cooling and increased safety (SSU-P).

A skid-mounted, compact solution that offers Power Collection and transforms AC low-voltage to medium-voltage.

Secondary Skid Units (SSU)

Skid-mounted substations provide an economical solution. They are easy to transport and install on most sites, making them ideal for remote locations. Pre-engineered designs are available consisting of all of the needed electrical elements for solar systems. Skid-mounted units are equipped with the step-up transformer and medium-voltage switchgear.

Typical equipment:

- SafeRing up to 40.5 kV for MV protection
- Oil transformer up to 3,500 kVA

Optional equipment:

- Automation for remote monitoring and control
- Switch with fuse to reduce costs in lower rated installations
- Dry type transformer to increase safety

Main features and benefits

- Easy access to equipment for visual inspection and service
- Open-air cooling for maximum efficiency
- Compact and easily transportable
- Economic solution
- MV compartment locking system prevents unauthorized entry

Secondary Enclosed Units

Offering completely assembled solutions with optimized footprint



Provides fully assembled solutions, including (optional) inverter, transformer and medium-voltage equipment, to decrease site works and site assembly time.

— This product is recommended when the inverter is required to be installed in the same enclosure or when it is preferred to protect the equipment from the environment.

Secondary Enclosed Units (SEU)

SEU is the portfolio range for solar Power Collection. Typically, SEU includes a step-up transformer and medium-voltage switchgear for protection. As an option, the SEU can accommodate an inverter. The design of the SEU range is robust and reliable and easy to transport with standard transportation equipment.

The enclosed design can include an oil collection pit and locking against unintentional entry.

Typical equipment:

- SF₆ or air-insulated switchgear up to 40.5 kV
- Oil transformer up to 3,500 kVA or dry type up to 2,500 kVA
- Inverter – optionally installed internally or separately

Main features and benefits

- Robust and reliable components from a single source
- Compact and easily transportable
- Optional oil collection pit for environmental protection
- Internal maintenance available
- Equipment protected from environment
- Economic solution
- All doors are lockable to prevent unauthorized entry
- Any inverter can be installed internally or connected externally, as required

eHouse

Steel buildings that house medium-voltage switchgear, control and communication panels



Protects operator from environmental conditions, as well as restricts close access to the equipment for non-authorized personnel without additional fencing.

The enclosure can also house auxiliary equipment, safety devices and communication equipment. A step-up transformer can be installed internally to reduce wear and simplify maintenance.

eHouse

The eHouse is manufactured per the latest applicable standards. Enclosures are walk-in to ease maintenance. Air conditioning and humidity control are options to meet environmental conditions. Safety equipment, such as eye wash, fire and smoke sensors, alarms, etc. can be included. Stations to connect a solar park to the grid usually contain primary medium-voltage switchgear fully equipped with all protection relays, measurement, monitoring and control systems. A step-up transformer and HV equipment are usually installed separately.

Typical equipment:

- MV switchgear
- Control and communication panels
- Oil or dry transformer (optional)

Main features and benefits

- High level of reliability and safety for equipment and personnel
- Simple and quick installation – pre-test units at the factory, drop in place and connect cables
- All ABB designs are green to support the environment
- Safety interlocking designs available
- SCADA ready packages available
- All equipment contained in the solar modules are type-tested according to their relevant standards
- Minimized engineering time
- Products designed specifically for the local utility applications and standards

Skid-mounted substations

Offering easily-accessible MV switchgear panels in outdoor enclosures mounted on a stiff, metal, skid base



Switching operations are performed externally to provide the most compact design.

The solution can also include a step-up transformer mounted on the same skid base.

Skid-mounted substations

Skid-mounted substations are an economical solution for Grid Connections, mounted on a heavy duty, welded skid.

The unit is easy to lift or drag into place on site, plus very quick to connect. Designs usually include primary medium-voltage switchgear fully equipped with all protection relays, measurements, monitoring and control systems. Optionally, transformers and HV equipment can be mounted on the same base.

Typical equipment:

- MV switchgear in outdoor enclosure
- Dry or oil transformer (optional)

Main features and benefits

- High level of reliability and safety for equipment and personnel
- Simple and quick installation – pre-test units at the factory, drop in place and connect cables
- All ABB designs are green to support the environment
- Safety interlocking designs available
- SCADA ready packages available
- All equipment contained in the solar modules are type-tested according to their relevant standards
- Minimized engineering time
- Products designed specifically for the local utility applications and standards

UniGear

Indoor medium-voltage air-insulated switchgear and motor control centers for primary distribution



The UniGear product family of IEC switchgear and motor control centers for primary distribution allow you to freely combine different types of panels (UniGear ZS1, UniGear 550, UniGear 500R and UniGear MCC) in the same switchgear, giving the highest flexibility while optimizing footprint.

Main features and benefits

- Proven air-insulated primary switchgear up to 40.5kV, 50kA
- Ensure highest flexibility while optimizing footprint
- Freely combine different types of panels in the same switchgear
- Easy to install, maintain and simple to extend
- High flexibility and high seismic vibration endurance

UniGear Digital

An innovative solution for medium-voltage air-insulated switchgear



UniGear Digital is an advanced switchgear solution to meet the requirements of the future. It is based on the well-proven UniGear product family of switchgears and provides unprecedented flexibility, increased process efficiency, lower cost of operation and maximized integration, reliability and safety.

UniGear Digital is accomplished by providing state-of-the-art, well-proven components such as current and voltage sensors, intelligent electronic devices for protection and control, and IEC 61850 digital communication.

Main features and benefits

- Innovative solution based on the proven UniGear product family
- Full advantage of ABB's Relion® protection relays, IEC 61850 communication and sensor technology
- Safe and reliable with fewer live parts and insulating components
- Extended communication supervision functionality
- Simple and efficient with 30% faster delivery time
- Easier installation, commissioning and testing
- Ready for the future and smart grids with IEC 61850 communication protocol and easy switchboard extension and integration
- Lower environmental impact with reduced energy consumption and switchgear footprint

SafeRing / SafePlus / SafeRing AirPlus™

Compact medium-voltage gas-insulated ring main units and switchgear for secondary distribution



SafeRing is a ring main unit (RMU) for secondary distribution networks. It is available in 10 standard configurations suitable for most switching applications within the range from 6 to 40.5kV.

SafePlus is a metal enclosed compact switchgear system for distribution applications from 6 to 40.5kV. The switchgear offers unique flexibility thanks to its extendibility and the possible combination of fully modular and semi-modular configurations. Both SafeRing and SafePlus are from the same product family and have an identical user interface.

ABB also offers a climate-friendly alternative with AirPlus to end users with a green focus - keeping the same compact switchgear dimensions, safety and reliability. With AirPlus the global warming potential of the insulation gas is reduced to less than 1 - a reduction of more than 99.99% compared to SF₆. The new AirPlus insulation gas is available in proven, safe and reliable switchgear design: ZX2 AirPlus for primary distribution and SafeRing AirPlus for secondary distribution.

Main features and benefits

- ABB also offers a climate-friendly alternative with AirPlus
- SafeRing AirPlus: an eco-efficient gas-insulated switchgear, with 99.99% reduced global warming potential

UniSec

Indoor medium-voltage air-insulated switchgear for secondary distribution



UniSec is an indoor air-insulated switchgear for medium-voltage secondary distribution. It is suitable, according to maximum ratings and available technical solutions, for many of applications, ie substations, utilities, commercial and residential buildings, smart grids, grid with distributed generation, hospitals, renewable (solar, wind, small hydropower), marine and transportation.

Main features and benefits

- Air-insulated switchgear for secondary distribution up to 24 kV
- Highly flexible, modular concept that can be readily configured to meet specific application needs
- High number of mechanical operations to allow frequent operations

Compact generator and extensive interconnection protection for power generation



REG615 is equipped with a large graphical display which can show customizable single-line diagrams (SLD) with position indication for the circuit breaker, disconnectors and the earthing switch.

REG615 is a dedicated generator and interconnection protection relay for protection, control, measurement and supervision of power generators and interconnection points of distributed generation units in utility and industrial power distribution systems.

Application

REG615 has been designed to be the main protection for small synchronous generators, and offers full protection during start-up and normal run for both the generator and the prime mover. REG615 can also be used as backup protection for medium-sized generators in applications where an independent and redundant protection system is required. The main protection functionality includes generator differential protection, out-of-step protection and 100% stator earth-fault protection. REG615 is typically used in small and medium-sized diesel, gas, hydroelectric, combined heat and power (CHP), and steam power plants.

Main features and benefits

- Withdrawable plug-in unit design for swift installation and testing
- Extensive range of protection functionality for both synchronous generators and interconnection points of distributed generation units
- Ready-made standard configurations for fast and easy setup with tailoring capabilities
- Extensive generator protection with 100% stator earthfault, generator differential and out-of-step protection
- Advanced interconnection protection fulfilling the latest grid codes for higher grid stability and reliability
- IEC 61850 Edition 2 and Edition 1 support, including HSR and PRP, GOOSE messaging and IEC 61850-9-2 LE for less wiring and supervised communication
- IEEE 1588 V2 for high-accuracy time synchronization and maximum benefit of substation-level Ethernet communication
- Large graphical display for showing customizable SLDs, accessible either locally or through a web browser-based HMI

Outdoor vacuum reclosers

Increase protection and reliability of the solar plant



Three phase reclosers up to 38 kV, 16 kA and 1250 A for outdoor pole mount or substation installation.

Outdoor vacuum reclosers

ABB reclosers have over 15 years of proven field performance incorporating innovative technology and unique ABB expertise, including embedded sensors with the highest accuracy and least environmental sensitivity in the market. With multiple controller options, ABB reclosers are designed to continually meet and exceed expectations supporting the growing demands of solar connection to the medium-voltage grid.

Thanks to their functionalities and flexibility, ABB's Gridshield and OVR product lines are suitable for collection points and outdoor substations connecting solar farms to the medium-voltage grid.

Main features and benefits

- Reliability – unparalleled vacuum interrupters (VI) and magnetic actuators for full reliability and long-term performance.
- Safety – no maintainable electronics in the high voltage cabinet. Emergency trip handle.
- Functionality – protection, measurements of main electrical characteristics, synchro-check with network, connection to SCADA for remote monitoring and control.
- Unparalleled performance - HCEP (Hydrophobic Cycloaliphatic Epoxy) poles together with the highest creep distance on the market of reclosers provide the best insulation for outdoor use. Suitable for heavily polluted areas.
- Flexibility – site-ready units allowing fast installation. Easy integration with multiple controller options, including the ABB Relion family RER615 and RER620.
- Maintenance-free – state of the art VI and magnetic actuators ensure limited or no maintenance needs.

R-MAG outdoor vacuum circuit breaker

Combines vacuum interrupter technology with magnetic actuation for unparalleled reliability and operator safety



Three-phase dead tank R-MAG family has full 15, 27 and 38 kV versions with different ratings up to 3700 A and 40 kA.

R-MAG outdoor vacuum circuit breaker

ABB recognizes the industry's focus on safety and reliability, and helps meet these goals with the R-MAG circuit breaker. Based on magnetic actuation, the R-MAG has less moving parts and is mechanically simpler than breakers with traditional spring mechanisms. The durable R-MAG design and low maintenance requirements have been consistently tested over the past 10 years in over 10,000 installations.

By employing magnetic actuation and reducing the number of moving parts, R-MAG breakers reduce the potential for safety incidents by eliminating maintenance on mechanically charged components, coils, and motors which can result in injuries to field personnel.

Magnetic actuator

- No maintenance required
- Reduced operations and maintenance costs
- Few moving parts and consequent spare parts required

ABB vacuum interrupter

- Long electrical life with proven ABB vacuum interrupters that utilize the excellent arc quenching and insulating properties of ABB vacuum technology
- Maintenance-free for life

Maintenance

- 2,000 operations between servicing, four times ANSI requirements
- No maintenance required on operating mechanism
- No gas SF₆ or oil is required to guarantee the insulation

Main features and benefits

- Compatible with all forms for overcurrent, reclosing, and control functions
- Reduced maintenance with magnetic actuator and easy plug and play actuator circuitry
- Durable design exceeds ANSI C37.06 standard with a rating of 10,000 mechanical or load operations
- 15/27/38 kV rating classes and up to 3,700 A continuous current
- Up to 40 kA short circuit interrupting current

OVB-VBF outdoor vacuum circuit breaker

Medium-voltage circuit breaker with spring mechanism



Three-phase live tank circuit breakers up to 40.5 kV, 31.5 kA and 2,500 A for outdoor substation installation.

Live tank vacuum circuit breakers

In the live tank design the vacuum interrupters are housed in hollow porcelain insulators filled with Nitrogen gas to safeguard against condensation. A spring-operated mechanism is housed in a weather-proof cabinet and a sturdy extruded steel angle structure is used for mounting the breaker.

ABB OVB-VBF circuit breakers are used for solar applications, mainly in outdoor substations connecting the plant to the medium-voltage grid.

Main features and benefits

- Designed and type tested as per IEC 62271-100
- Porcelain-clad construction suitable for outdoor substation ensures protection from hazardous conditions
- Long electrical life with proven ABB vacuum interrupters that utilize the excellent arc quenching and insulating properties of ABB vacuum technology
- Suitable for auto-closure duty cycle of O-0.3 sec-CO-3 min-CO and CO-15 sec-CO
- Simple and reliable spring mechanism minimizes operating energy and ensures longer mechanical life
- Simple installation – structure mounted with option of extension for ie CTs
- The complete breaker can be shipped as one unit with minimal adjustments to be made on site. As an option, the breaker can be shipped in knocked-down kits which can be easily assembled at site.

MV indoor circuit breakers and switches

Safety and reliability – protection and switching full portfolio



Maximizing safety and energy flow uptime.

MV indoor circuit breakers and switches

When it comes to ensure an optimized power flow from the solar energy generation towards the grid, selecting the right system has a direct impact in ensuring maximized safety and energy flow uptime. ABB supports these challenges from the core of the system with the comprehensive portfolio for protection and switching, providing even the most demanding ratings required as well as meeting the applicable standards around the world: everything with the ABB recognized design quality, with developed eco-compatible products, to support continuous operation of your plant with an optimum interface to the user.

Product portfolio includes:

- VD4 circuit breaker
- ADVAC and AMVAC circuit breakers
- VD4-G generator circuit breaker
- VSC contactor
- DS1 capacitor switch

Main features and benefits

- Global availability - ABB's globally recognized families of VD4 circuit breakers, VSC contactors and switches fulfilling standards and ratings according to the required installation site.
- Safety and protection - safe management of assets through a streamlined portfolio, yet ensuring the right fit to the application required including safety interlocks.
- Continuous operation - select between withdrawable circuit breakers, spring or magnetic operating mechanism or specific purpose applications for your solar plant: ensuring core components are fulfilling your needs to make your plant dependable.

NALFWind/NAL/GSec

Indoors switches and switch-fuse combinations for secondary distribution



NALFWind is a 36 kV air-insulated switch-fuse combination for protection of distribution transformers in renewable installations. It is equipped with fast-acting ABB CEF-S current limiting fuses that provide protection on both MV and LV sides for transformers up to 3,000 kVA.

NAL/NALF are air-insulated switches for protection of transformers and for application as line switches in medium-voltage networks. Their flexible design supports creation of customer-friendly configurations.

GSec is modern gas-insulated load break switch for up to 24 kV installations. It is available with a fuse tripping system and offers easy adaptation with smart grid systems. This is a very compact product with an integrated earthing switch with making capacity.

All ABB indoor switches come with wide range of accessories for customized configurations. One of the largest advantages of this portfolio is the fact that ABB offers both switches and dedicated current limiting fuses that create reliable and full range protection against overload and short circuit currents. They are typically applicable in either compact substations or in air-insulated switchgear. All switches can be easily equipped with a remote operating kit, connectable to many control and protection systems like SCADA.

Main features and benefits

- Smart integration: Modular construction, compact size, easy installation, one switch - many applications
- High electrical and mechanical endurance
- Full range protection against overload and short circuits current
- Stringent testing of each unit, multi-standard worldwide use
- Smart grid ready

Smart Asset Management solutions for MV networks



ABB's solutions enable the maintenance team to supervise equipment health conditions and performance trends, minimize downtime, increase reliability and optimize maintenance activities. These solutions and services support the implementation of advanced maintenance strategies such as condition and predictive based servicing activities.

MyRemoteCare: analytics, reporting and remote support

MyRemoteCare offers a simple to use and powerful fleet dashboard, where it is possible to analyze asset performance trends, and therefore plan the required mitigation actions. It has been designed to support service personnel to implement condition and predictive based maintenance offering an analysis tool, a notification system by mail and reporting in a simple and straightforward way.

Main features and benefits

- Simple to use but powerful fleet dashboard for condition and predictive based maintenance
- Advanced predictive analytics estimates e.g. remaining useful life, health index, health sub scores
- ABB Service engineers offer remote proactive support exploiting the know-how and experience of our service engineers.

Smart Asset Management solutions for MV networks



MySiteCare: capturing data and diagnosis

This monitoring and diagnostic unit uses various sensors to capture circuit breaker, contactors and switchgear data and converts them into equipment health information in order to enable condition based maintenance. MySiteCare sensors guarantee a scalable and accurate early detection of the most important failure cases.

Local monitoring and communication

MySiteCare is installed in the auxiliary compartment and offers binary inputs and sensors used to monitor the equipment. It offers advanced algorithms to calculate and show diagnostic information (traffic light), monitored values, alerts log. The local communication can be achieved via Modbus protocol.

Circuit breaker diagnosis

Operations, timings, compartment temperature, auxiliary voltage, are all constantly monitored for a detailed mechanical analysis. The analysis of the flowing current in special components, like the spring charging gear motor, allows the detection of electro-mechanical wear-out. The primary current is measured in order to estimate contacts wear and remaining life.

Main features and benefits

- The monitoring and diagnostic unit uses various sensors to capture circuit breaker, contactors and switchgear data
- Converts the data into equipment health information in order to enable condition based maintenance
- Thermal monitoring of the switchgear to detect loose joints in advance

Technical literature

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

Document	Code
Technical application handbook N° 10	1SDC007109G0202
My System pro. Solutions for electrical distribution in buildings	2CSC000001D0202
S800/S500. The High Performance MCB	2CCC413003C0208
Distribution blocks. DBL range	1SNC166001B0202
Current sensors. Voltage sensors	1SBC140156C0201
CMS – Circuit Monitoring Systems	2CCC481002C0201
Switch-disconnectors OTDC and OTDCP. Switches for photovoltaic applications	1SCC301021C0202
SACE Tmax PV. Adaptability, versatility and complete freedom	1SDC210054D0204
SACE Emax DC	1SDC200012D0202
Motor protection and control. Manual motor starters, contactors and overload relays	1SBC100192C0205
R contactors. Control of AC and DC power circuits up to 5000 A	1SBC104119C0202
Surge and lightning protection solutions with QuickSafe technology	1TXH000375C0201
PV Vault. Yielding safety quickly	1SXU172055B0201
System pro E control Gemini. Low-voltage insulating switchboards	1SLC805001D0205
Electronic relays and controls	2CDC110004C0210
SACE Emax 2. New low-voltage air circuit-breakers	1SDC200023D0205
SACE Tmax. T generation	1SDC210015D0208
EQ meters made for interaction	2CMC481006B0201
MC4-Evo2 photovoltaic connectors	1SNC160040C0201
OPR lightning protection systems	1TXH000247C0202
Flexible cable protection systems	7TCA292000R6653
Insulating enclosures and installation materials	1SLC001001D0204
SNK series. Terminal blocks	1SNK160027C0204
Pilot devices, 22 mm	1SFC151005C0201
Modular Systems solar portfolio Power Collection and Grid Connection products	1VPD110001A0330
Compact Secondary Substation (CSS) Solar Power Collection application	1VPD110001A0332
Secondary Enclosed Unit (SEU) Solar Power Collection application	1VPD110001A0333
Secondary Skid Unit (SSU) Solar Power Collection application	1VPD110001A0331
UniSec	1VFM200003 EN rev. L
UniSec brochure for solar applications	1VCP000539 EN rev. A
SafeRing SafePlus 12/24kV	1VDD006104 EN rev. Feb 2016
SafeRing SafePlus 36kV	1VDD006114 EN rev. May 2015
UniGear Digital	1VLC000058 EN rev. F
UniGear ZS1	1VCP000138 EN rev. G
UniGear 550	1VCP000327 EN rev. B
UniGear 500R	1VCP000285 EN rev. B
UniGear MCC	1VCP000405 EN rev. F

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abb.com/solar

