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APPLICATION NOTE

# Grid Feeding System for Distributed Energy Sources

IEC Commercial & Industrial scale

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**05** Key Standards and Related Documents



# Overview

# 01

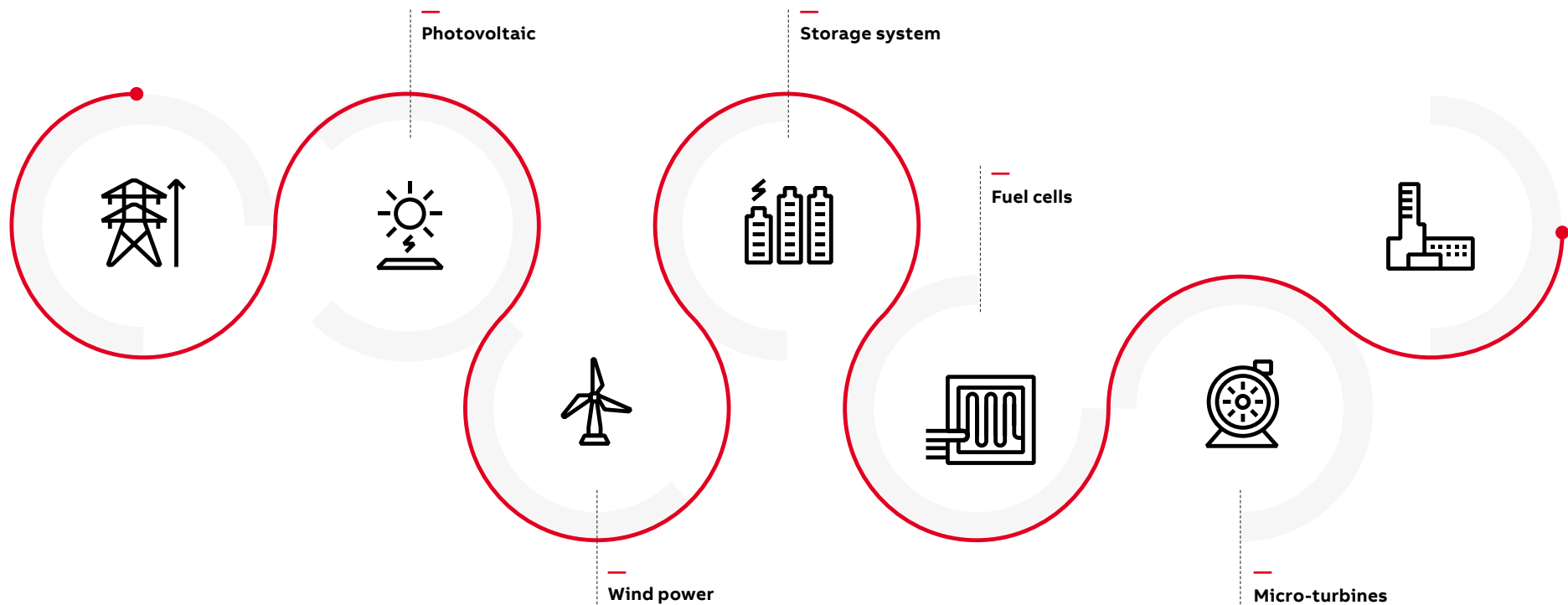




## The management of energy sources

Distributed Energy Resources (DERs) are decentralized energy technologies that generate electricity locally and feed it into the grid or off-grid plant. Examples include solar panels, wind turbines, battery storage systems, fuel cells, and micro-turbines.

Country-specific standards or regulations define the requirements for their grid connection mainly according to power plant size and determine the framework of the grid feeding systems.





## What is Grid Feeding System?

Grid Feeding System is a protection system that separates Distributed Energy Resources (DERs) whenever the voltage and frequency values of the utility grid are outside the ranges prescribed by regulations.





## Why it is needed

With the growth of DERs over the years, energy systems have become more decentralized and dynamic, allowing energy users to play a more active role in the energy market.

However, DERs also bring some technical complications.

The utility grid may have independent faults that affect the system voltage and frequency levels. Utility grid operators do not have control over DERs installed at user sites, which can be up to 1 MW in installation size. Therefore, DERs should be disconnected automatically to avoid feeding and magnifying the problem.

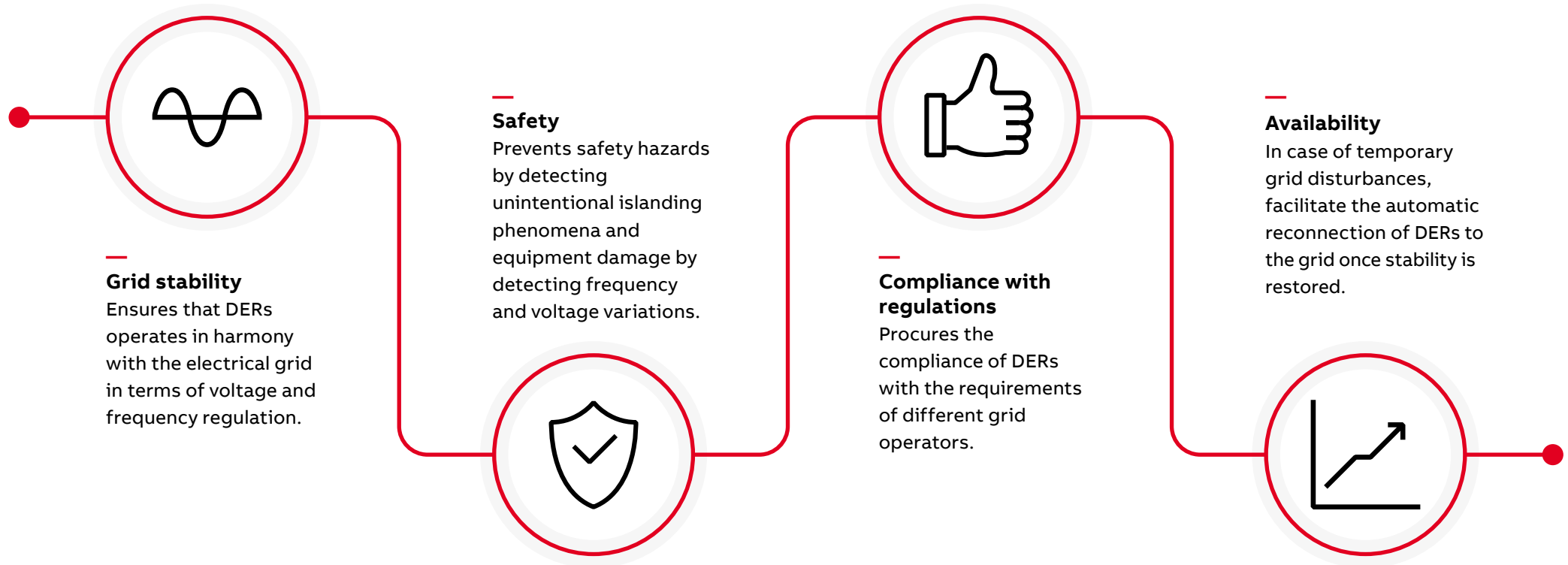
Also, power production can be inconsistent based on environmental conditions. When producing too much power, it can result in overvoltages, which can damage equipment and pose safety risks. During times of high demand or low DER output, voltage can drop below safe levels, resulting in flickers and inefficiencies. Additionally, DERs can cause over-frequency by injecting excess power into the grid, potentially damaging devices. Under-frequency occurs when there's not enough power to meet demand, leading to outages and grid failures.

Lastly, unintentional islanding may also occur when a part of the grid remains powered during maintenance, posing risks to workers and the public.





## Main benefits





## How does it work?

Power plant size up to 1MW, which are the subject of this document, are generally connected to the grid at low voltage level but sometimes at medium voltage.

### Industrial and commercial scale

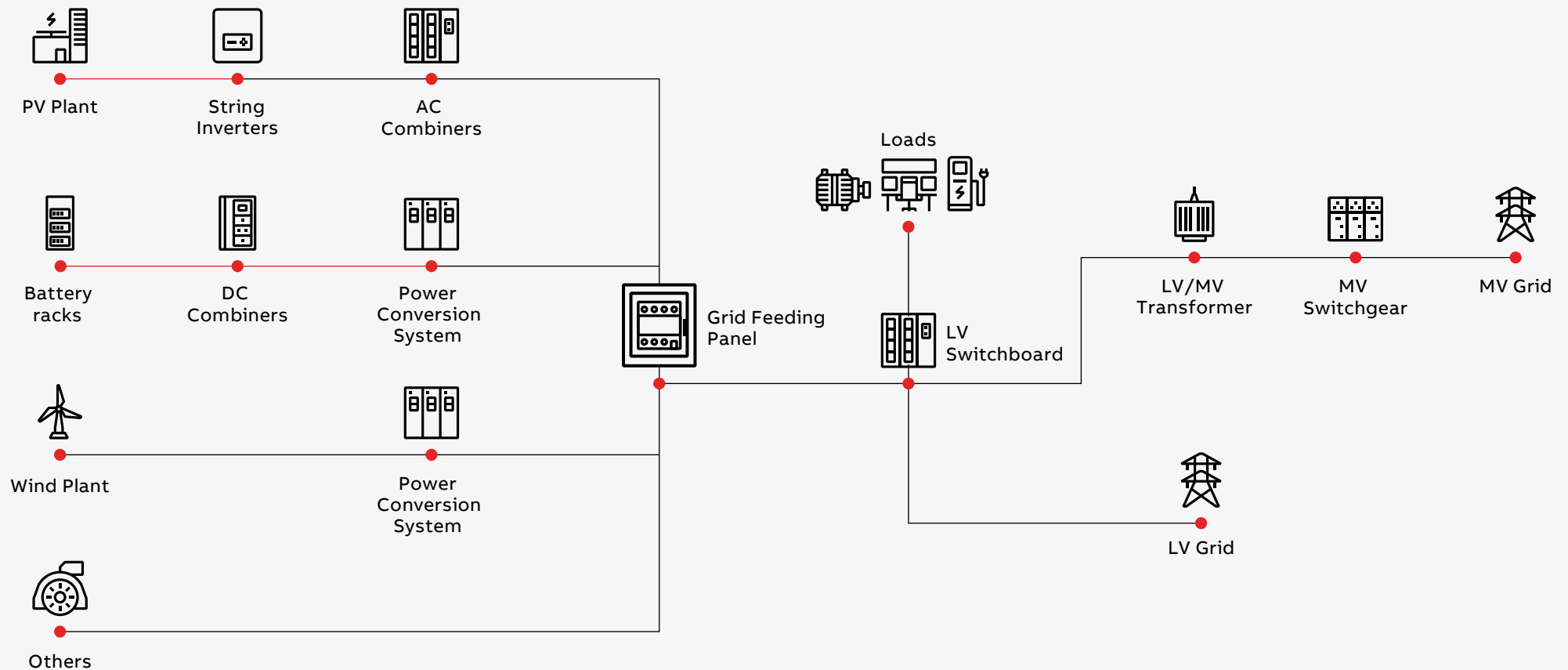


Figure 1: Typical diagram from to DERs to the Grid



## How does it work

According to EN 50549-1 European Standard\*, a typical diagram for a generating plant connected to a distribution network and main definitions is given in Figure 2.

### Distribution network

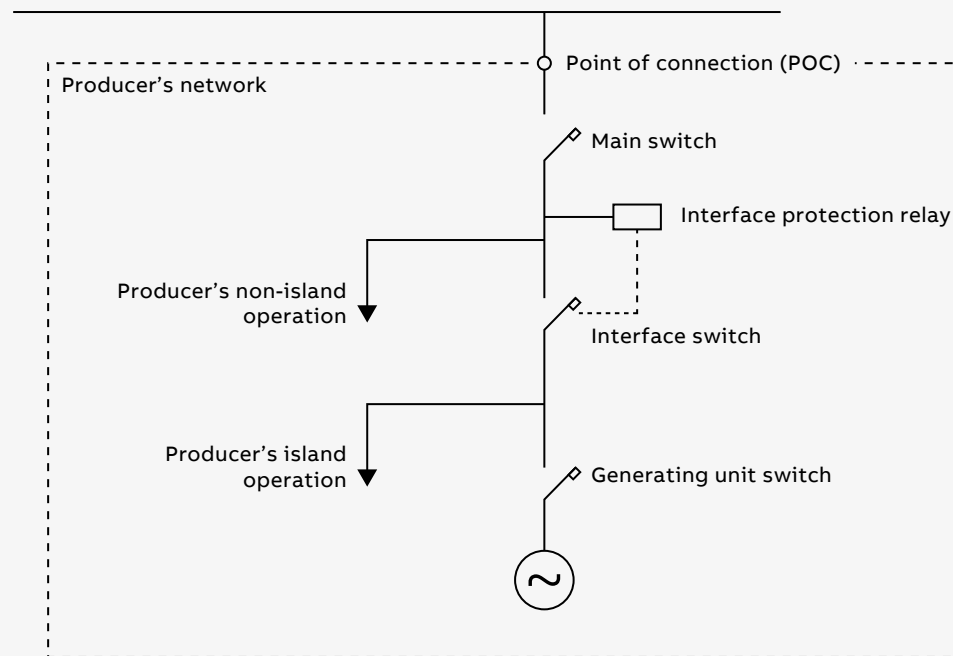


Figure 2: Example of a generating plant connected to a distribution network.

**Producer:** Natural or legal person who already has connected or is planning to connect an electricity generating plant to a distribution network.

**Producer's network:** AC electrical installations downstream from the point of connection operated by the producer for internal distribution of electricity.

**Generating plant:** Sum of generating units connected at one point of connection, including auxiliaries and all connection equipment.

**Islanding:** When a section of the distribution network with generating plants becomes physically disconnected and one or more generating units continue supplying electrical energy to the isolated section.

**Point of connection:** Reference point on the electric power system where the user's electrical facility is connected.

**Main switch,** switch installed as close as possible to the point of connection, for protection against internal faults and disconnection of the whole plant from the distribution network.

\* Requirements for generating plants to be connected in parallel with distribution networks – Part 1: Connection to a LV distribution network – Generating plants up to and including Type B.



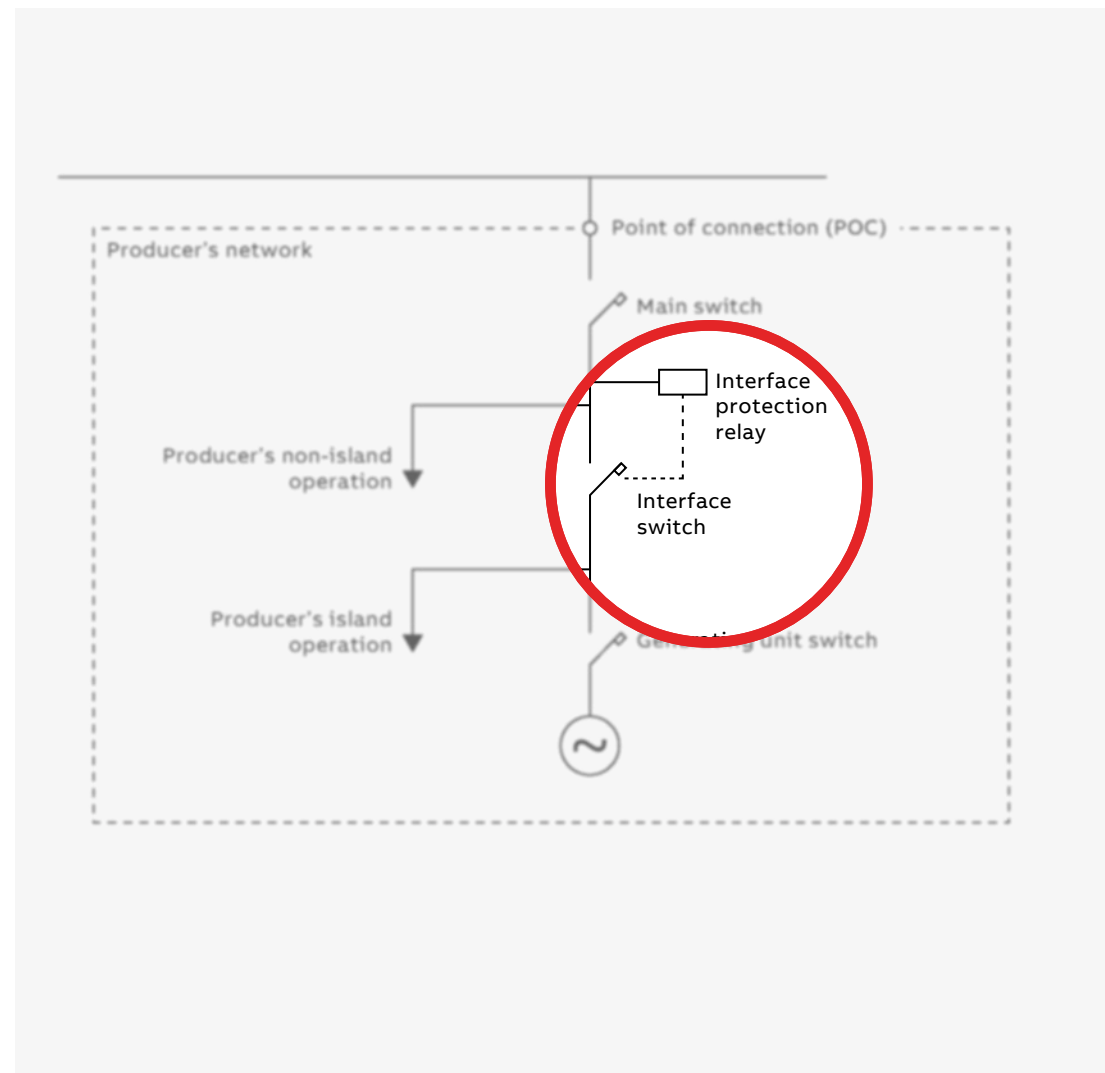
## How does it work

A Grid Feeding System is the protection system which comprises of different components and installed in the producer's network. This system ensures to separate the part(s) of the producer's network containing at least one generating unit from the distribution network.

When the Producer has grid-connected generating plants, the Grid Feeding System should have below devices which their purpose of usages is explained here.

- Interface protection relay, combination of different protection relay functions which opens the interface switch of a generating unit and prevents its closure, whichever is appropriate in case of: a fault on the distribution network, an islanding situation, the presence of voltage and frequency values outside the corresponding regulation values. Once, the distribution network restabilizes and all conditions are okay, this relay reconnects the generating unit(s) to the grid.
- Interface switch, switching device (circuit breaker, switch-disconnector, or contactor) installed in the producer's network, for separating the part(s) of the producer's network containing at least one generating unit from the distribution network.
- Generating unit switch, switch installed electrically close to the terminals of each generating unit, for protection and disconnection of that generating unit.

The Grid feeding system can be built as a separated panel or combined with the specific DER panels, such as solar AC combiner panels, depending on the conditions of producer's site and power plant.



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# Reference architectures

# Q2





## Reference architectures

Reference architectures can vary a lot according to country regulations, user habits, whether it is a new or existing project, distances between main distribution board (MDB) and power plant etc.

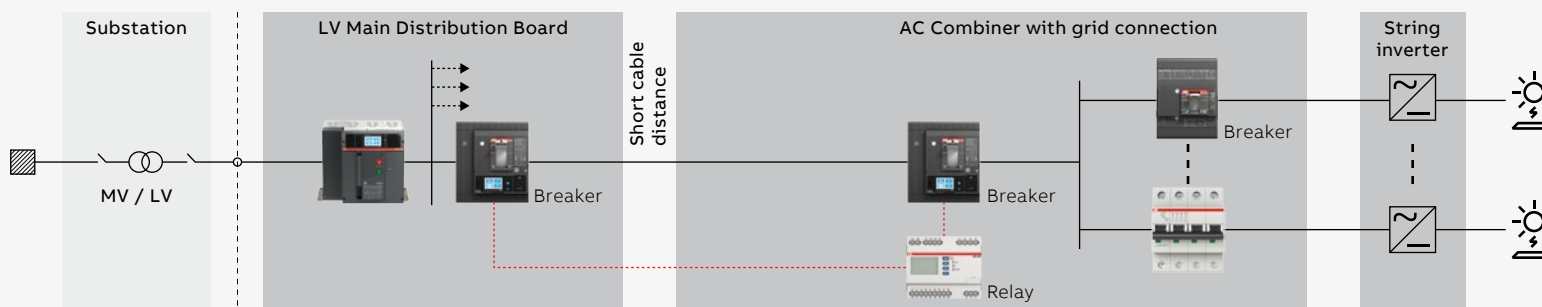
Here a few common versions are examined with important design criteria. In these examples a solar power plant is used as the DER being integrated.

Moreover, the priority architectures in the countries where the main standards are used are given in table 1.

**Table 1**

The most common architectures - Scheme X	CEI-021	VDE-AR-N	G99	DRRG
	5-2-1	6-7	6-2	1-2-3

### Scheme 1: New solar power plant in existing building

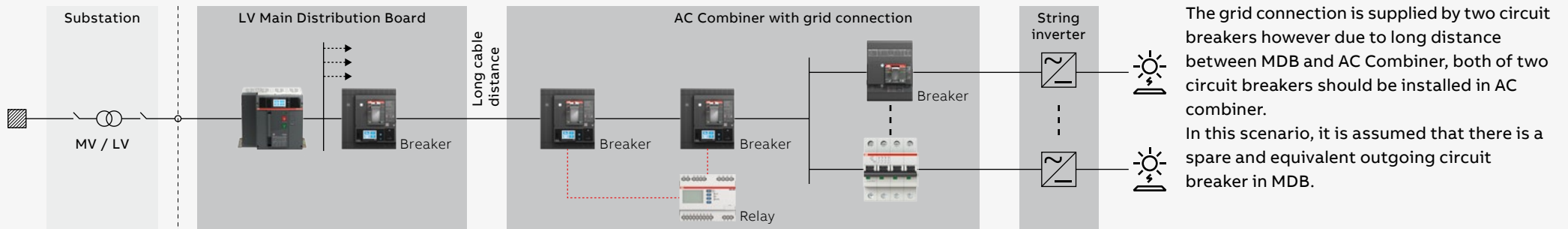


In some country regulations, grid connection have to be managed by two switching devices which are two circuit breakers here, one in the MDB and one in the AC combiner. In this scenario, it is assumed that there is a spare and equivalent outgoing circuit breaker in MDB and the cable length between them is short enough to ensure effective command transmission.

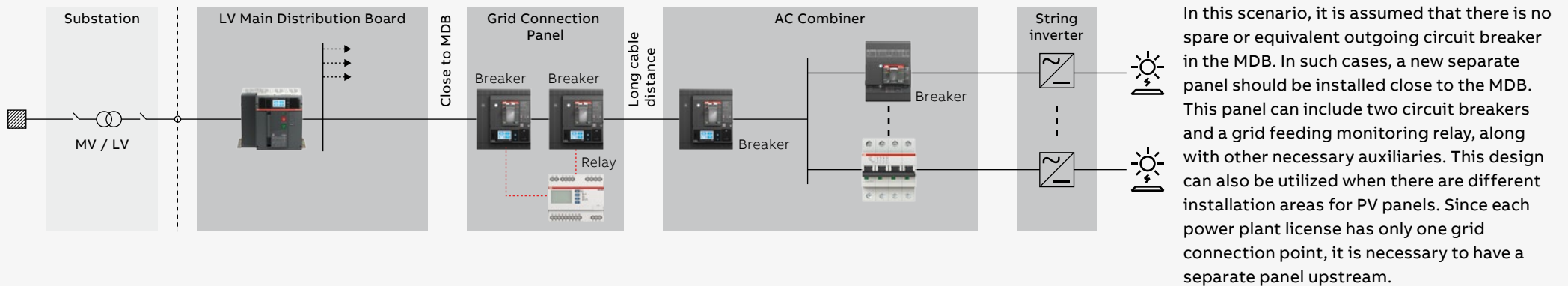


## Reference architectures

**Scheme 2: New solar power plant in existing building**



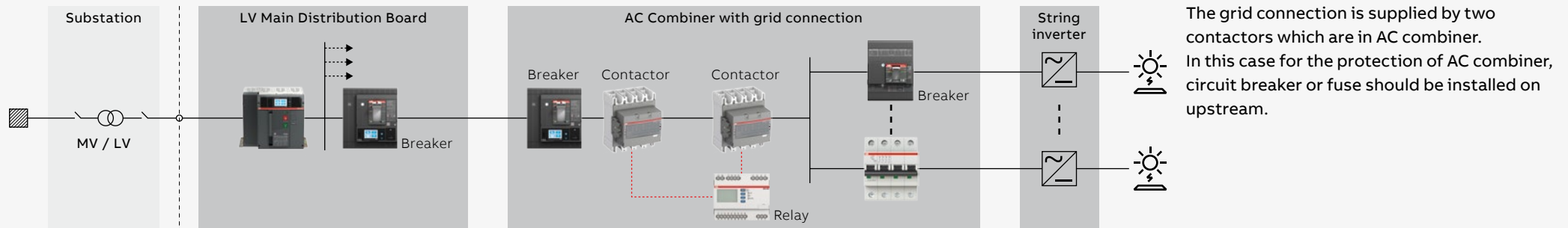
**Scheme 3: New solar power plant in existing building**



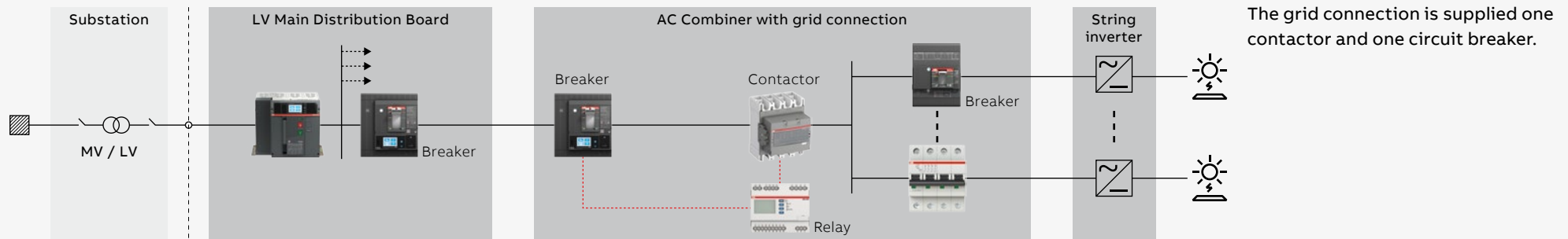


## Reference architectures

**Scheme 4: New solar power plant in new building**



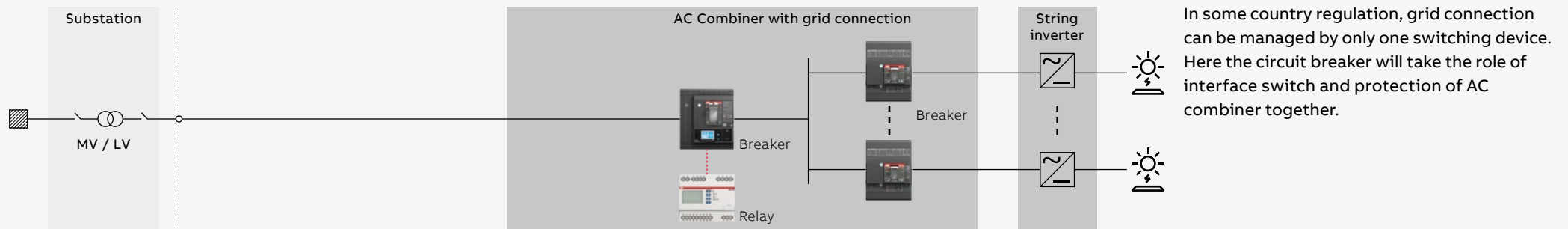
**Scheme 5: New solar power plant in new building**



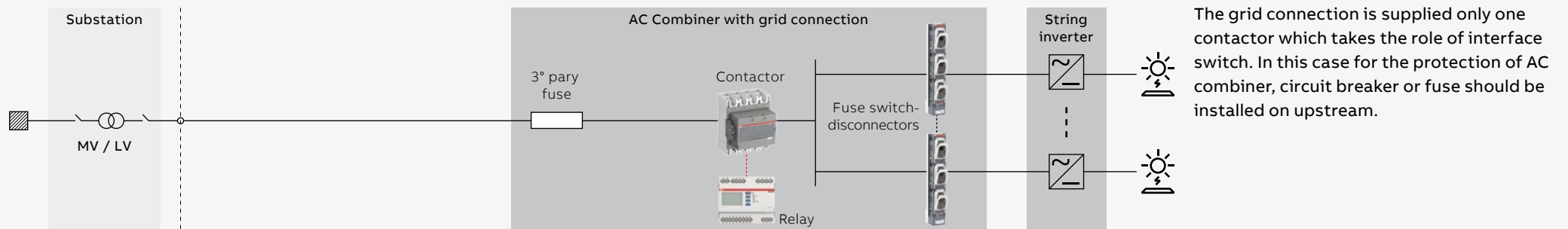


## Reference architectures

**Scheme 6: New solar power plant in existing building**



**Scheme 7: New solar power plant in existing building**



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# Applications

200kW AC combiner with grid feeding applications are shown as referring the different architectures.

For each one of them, electrical scheme, bill of material, and some design notes are given together.

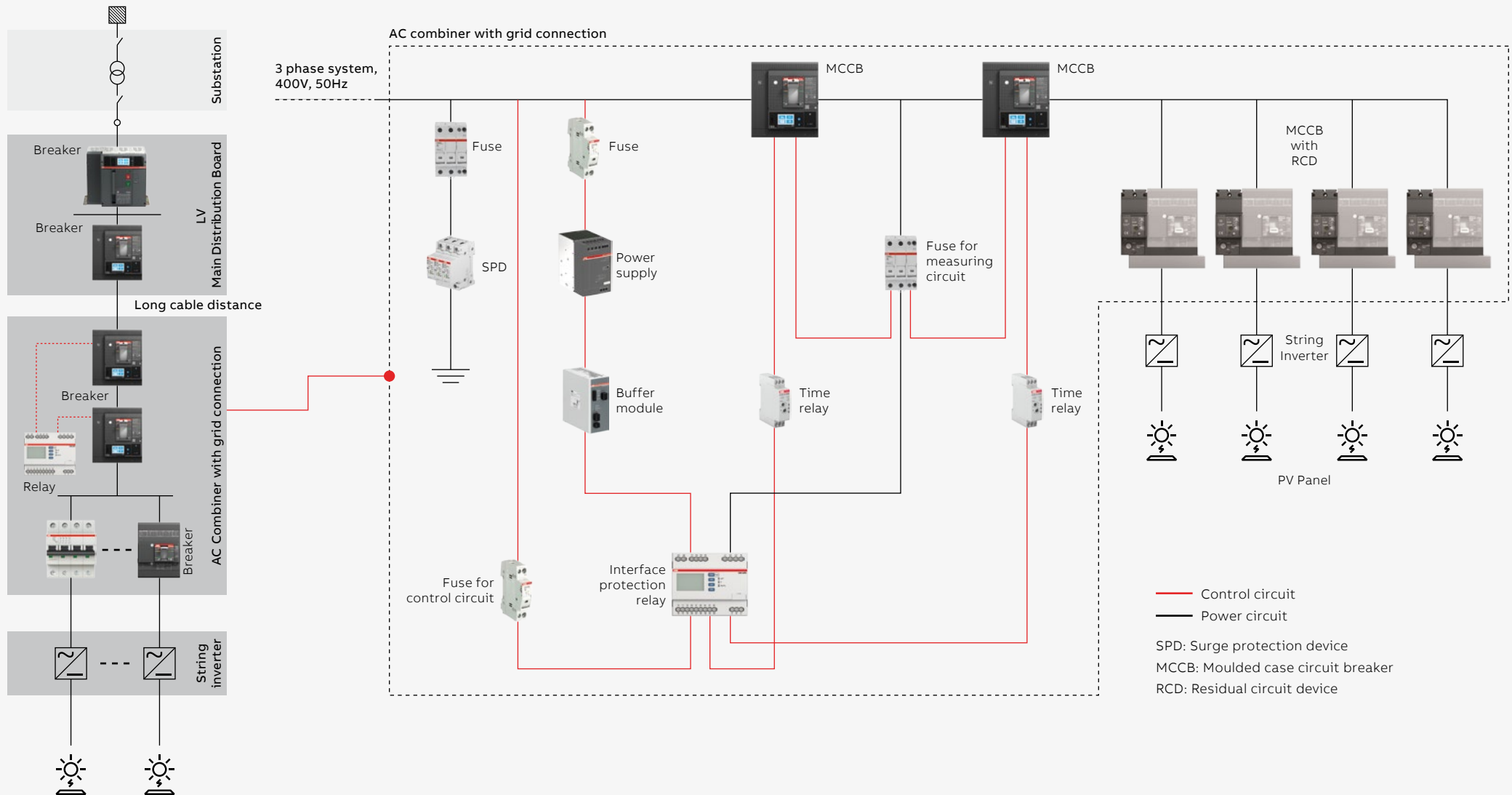
# 03





# Application Bundle 1#

## 200kW AC combiner with grid feeding in the architecture





# Application Bundle 1#

## 200kW AC combiner with grid feeding in the architecture

### Design notes

- Fuses are used for current protection of the measuring and control circuit of relay, and surge protective device.
- Surge protective device is used to protect the system from transient voltage spikes and surges in ac combiner.
- Power supply + Buffer module: can be used for providing uninterrupted power for relay and accessories of switching devices. Also, UPS can be an option instead of these two devices.
- Time relay is used when a time delay is needed to ensure the motor of the breaker is charged before sending the closure command to the breaker.
- Circuit breaker with residual current device is used to protect people against electric shock and current protection for each inverter.

### Bill of Material

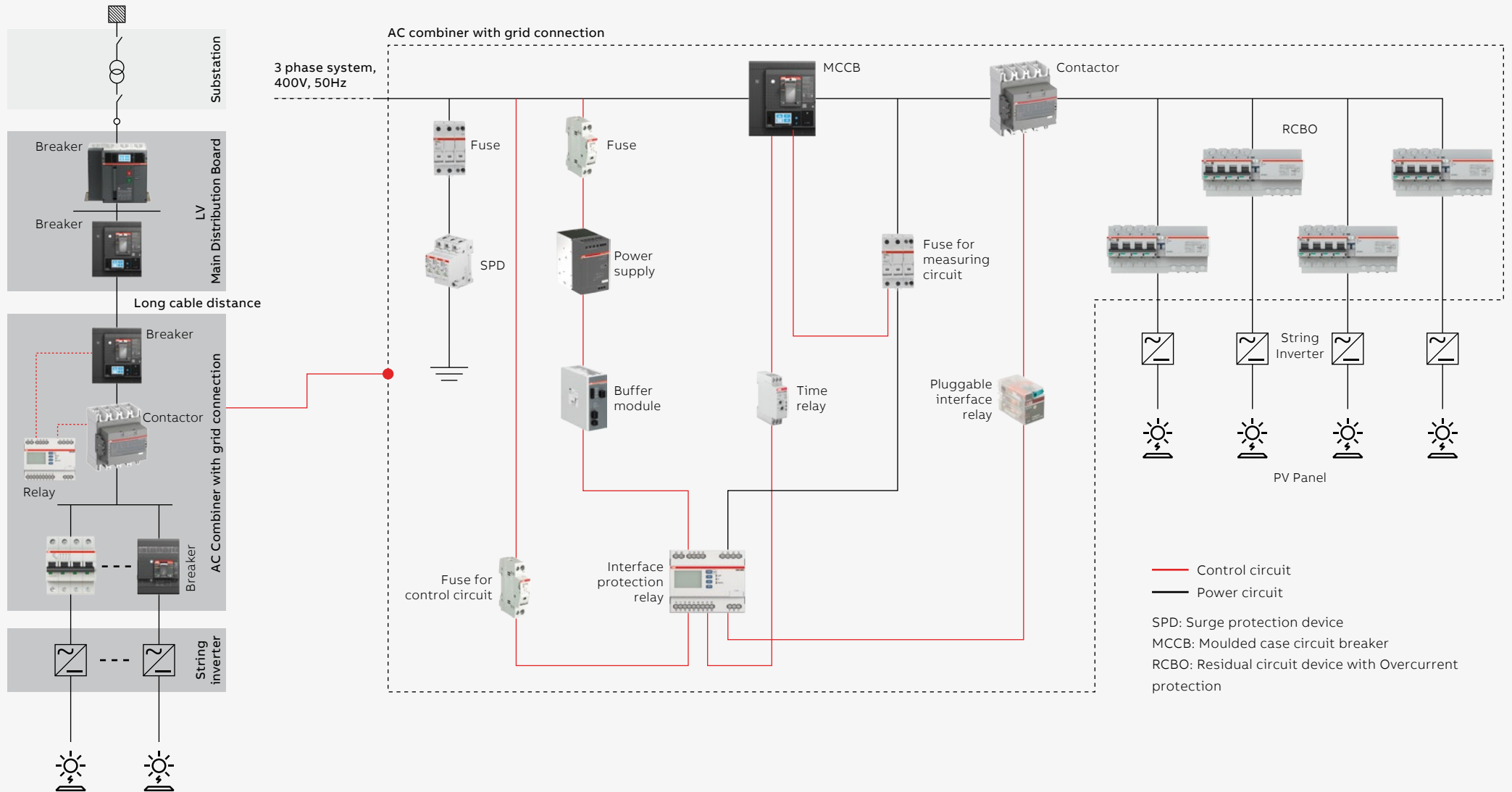
Input data	IEC
System rated power [kW]	200
Rated LVAC voltage [V]	400
Cosfi	0,9
Rated LVAC bus current [A]	321
Short circuit current LVAC bus [kA]	16
Inverter rated AC active power [kW]	50
Inverter max. output current @400V	80
N. inverters per AC recombiner	4

	Product type	Code	Description	Quantity
Main circuit	Circuit breaker	1SDA100396R1*	XT5N 400 Ekip Dip LS/I In=400 4p F F	2
	Interface protection relay for DEWA DRRG	1SVR560731R3703	CM-UFD.M34M	1
	Fuseholder	2CSM274343R1801	E 93hN/32S	2
	Fuse	2CSM257453R1801	E 9F10 GG10	6
	Surge protection device	2CTB815710R4700	OVR T1-T2 3L 12.5-440s P QS	1
	Circuit breaker	1SDA067406R1	XT1C 160 TMD 100-1000 4p F	4
Control Circuit	Circuit breaker - residual current device	1SDA067125R1	RC Sel HV 85...690Vac XT1 4p F	4
	Circuit breaker - undervoltage release	1SDA104955R1	YU-C XT5-XT6 F/P 24...30 Vac/dc	2
	Circuit breaker - auxiliary contact	1SDA066446R1	AUX-C 1Q+1SY 24Vdc XT1..XT6 F/P	2
	Circuit breaker - auxiliary contact	1SDA066429R1	AUX-SA-C 1S51 250Vac/dc XT2-XT4... XT6 F/P	2
	Circuit breaker - motor	1SDA104885R1	MOE XT5 220...250V AC/DC	2
	Timing relay	1SVR500100R0000	CT-ERD.12	2
	Fuseholder	2CSM206573R1801	E 91hN/32S	2
	Fuse	2CSM256363R1801	E 9F10 GG6	2
	Power supply module	1SVR360763R2001**	CP-C.1 24/20.0-C	1
	Buffer module	1SVR427060R2000**	CP-B 24/20.0	1
Alternatives		1SDA100552R1	XT5N 400 BREAKING PART 4p F F	2
	*For embedded communication and measurement function breaker can be chosen with Ekip Touch trip unit.	1SDA100681R1	Ekip Touch Measuring LSI In=400 XT5 4p	2
	** UPS is an option for power supply and buffer modules combination.	4NWP100163R0005	UPS PowerValue 11T G2 3 KVA	1



# Application Bundle 2#

## 200kW AC combiner with grid feeding in the architecture



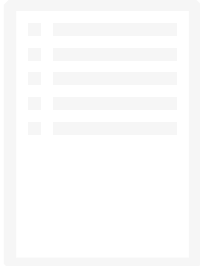


# Application Bundle 2#

## 200kW AC combiner with grid feeding in the architecture

### Design notes

- Miniature circuit breakers are used for current protection of the measuring and control circuit of relay, and surge protective device.
- Surge protective device is used to protect the system from transient voltage spikes and surges.
- Power supply + Buffer module: can be used for providing uninterrupted power for relay and accessories of switching devices. Also, UPS can be an option instead of these two devices.
- Time relay is used when a time delay is needed to ensure the motor of the breaker is charged before sending the closure command to the breaker.
- Pluggable interface relay is used for electrical isolation, amplification and signal matching between the coil of contactor and CM-UFD control outputs.
- Residual circuit device with overcurrent protection is used to protect people against electric shock and current protection for each inverter.



### Bill of Material

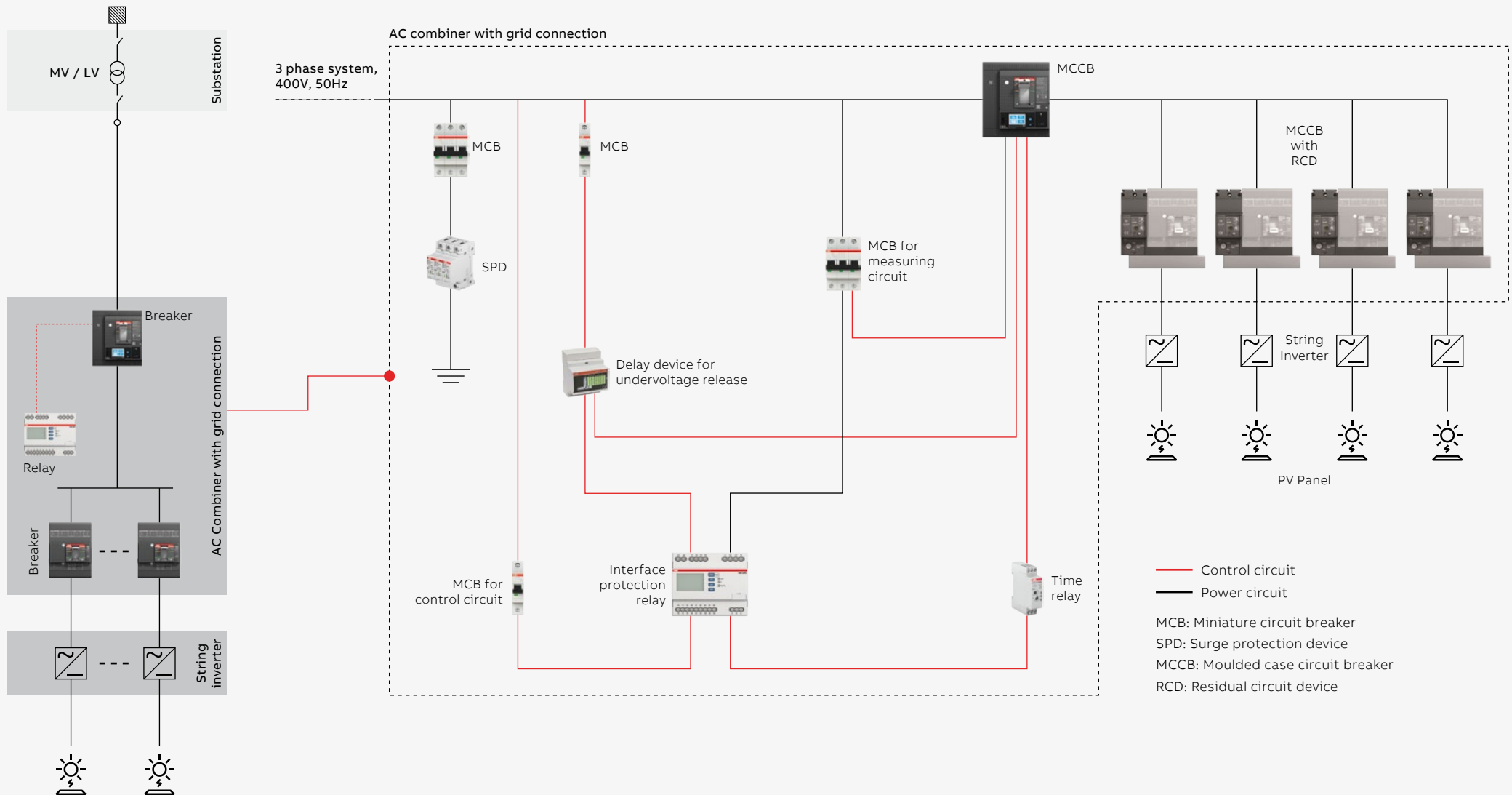
Input data	IEC
System rated power [kW]	200
Rated LVAC voltage [V]	400
Cosfi	0,9
Rated LVAC bus current [A]	321
Short circuit current LVAC bus [kA]	16
Inverter rated AC active power [kW]	50
Inverter max. output current @400V	80
N. inverters per AC recombiner	4

	Product type	Code	Description	Quantity
Main circuit	Circuit breaker	1SDA100396R1*	XT5N 400 Ekip Dip LS/I In=400 4p F F	1
	Contactor with auxiliary contact	1SFL587102R1311	AF305-40-11-13	1
	Interface protection relay for CEI-021	1SVR560730R3400	CM-UFD.M22	1
	Fuseholder	2CSM274343R1801	E 93hN/32S	2
	Fuse	2CSM257453R1801	E 9F10 GG10	6
	Surge protection device	2CTB815710R4700	OVR T1-T2 3L 12.5-440s P QS	1
	Residual current circuit breaker with Overcurrent protection	2CCG001319R0001	DS804P-C125/0.3A	4
Control Circuit	Circuit breaker - undervoltage release	1SDA104955R1	YU-C XT5-XT6 F/P 24...30 Vac/dc	1
	Circuit breaker - auxiliary contact	1SDA066446R1	AUX-C 1Q+1SY 24Vdc XT1..XT6 F/P	1
	Circuit breaker - auxiliary contact	1SDA066429R1	AUX-SA-C 1S51 250Vac/dc XT2-XT4... XT6 F/P	1
	Circuit breaker - motor	1SDA104885R1	MOE XT5 220...250V AC/DC	1
	Timing relay	1SVR500100R0000	CT-ERD.12	1
	Pluggable interface relay	1SVR405613R1100	CR-M024DC4L	1
	Fuseholder	2CSM206573R1801	E 91hN/32S	2
	Fuse	2CSM256363R1801	E 9F10 GG6	2
Alternatives	Power supply module	1SVR360763R2001**	CP-C.1 24/20.0-C	1
	Buffer module	1SVR427060R2000**	CP-B 24/20.0	1
	*For embedded communication and measurement function breaker can be chosen with Ekip Touch trip unit.	1SDA100552R1	XT5N 400 BREAKING PART 4p F F	1
		1SDA100681R1	Ekip Touch Measuring LSI In=400 XT5 4p	1
** UPS is an option for power supply and buffer modules combination.	4NWP100163R0005	UPS PowerValue 11T G2 3 KVA	1	



## Application Bundle 3#

### 200kW AC combiner with grid feeding in the architecture





# Application Bundle 3#

## 200kW AC combiner with grid feeding in the architecture

### Design notes

- Miniature circuit breakers are used for current protection of the measuring and control circuit of relay, and surge protective device.
- Surge protective device is used to protect the system from transient voltage spikes and surges in ac combiner.
- Electronic time-delay device for undervoltage release of breaker (UVD) ensure continuous power supply by acting as a load buffer in the event of a power failure. This ensures that the prescribed buffer time of at least 3 s is respected.
- Time relay is used when a time delay is needed to ensure the motor of the breaker is charged before sending the closure command to the breaker.
- Circuit breaker with residual current device is used to protect people against electric shock and current protection for each inverter.

### Bill of Material

Input data	IEC
System rated power [kW]	200
Rated LVAC voltage [V]	400
Cosfi	0,9
Rated LVAC bus current [A]	321
Short circuit current LVAC bus [kA]	16
Inverter rated AC active power [kW]	50
Inverter max. output current @400V	80
N. inverters per AC recombiner	4

	Product type	Code	Description	Quantity
Main circuit	Circuit breaker	1SDA100396R1*	XT5N 400 Ekip Dip LS/I In=400 4p F F	1
	Interface protection relay for VDE	1SVR560730R3401	CM-UFD.M31	1
	Miniature circuit breaker	2CDS383001R0105	S303P-B10	2
	Surge protection device	2CTB815710R4700	OVR T1-T2 3L 12.5-440s P QS	1
	Circuit breaker	1SDA067406R1	XT1C 160 TMD 100-1000 4p F	4
	Circuit breaker - residual current device	1SDA067125R1	RC Sel HV 85...690Vac XT1 4p F	4
Control Circuit	Circuit breaker - undervoltage release	1SDA104958R1	YU-C XT5-XT6 F/P 220..240Vac-220..250Vdc	1
	Circuit breaker - auxiliary contact	1SDA066431R1	AUX-C 1Q+1SY 250Vac/dc XT1...XT6 F/P	1
	Circuit breaker - auxiliary contact	1SDA066429R1	AUX-SA-C 1S51 250Vac/dc XT2-XT4...XT6 F/P	1
	Circuit breaker - motor	1SDA104885R1	MOE XT5 220...250V AC/DC	1
	Circuit breaker - delay device for undervoltage release	1SDA101982R1	UVD XT5-XT6 220..250Va.c./d.c.	1
	Timing relay	1SVR500100R0000	CT-ERD.12	1
Alternatives	Miniature circuit breaker	2CDS381001R0065	S301P-B6	2
		1SDA100552R1	XT5N 400 BREAKING PART 4p F F	1
	*For embedded communication and measurement function breaker can be chosen with Ekip Touch trip unit.	1SDA100681R1	Ekip Touch Measuring LSI In=400 XT5 4p	1

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# Products and solutions

# 04





# Products and solutions

**SACE Tmax XT**  
molded-case circuit breakers



Website

**AF contactors**



Website

**CM-UFD**  
Interface protection relays



Website

**OVR surge protective devices**



Ordering details



Technical details

**System pro E power main**  
distribution switchboards



Website

**ARIA**  
universal polyester enclosures



Website



Ordering details



Technical details

**Gemini multipurpose**  
enclosures



Website



Ordering details



Technical details

**PowerValue**  
single-phase ups



Website



Catalog



Brochure

**System pro M**  
modular products for DIN rail



Website

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# Key Standards and Related Documents

# 05





# Key Standards and Related Documents

## Interface monitoring relay type

CM-UFD.M22 • CM-UFD.M22M



Data Sheet

CM-UFD.M31 • CM-UFD.M31M



Data Sheet

CM-UFD.M33 • CM-UFD.M33M



Data Sheet

CM-UFD.M34M



Data Sheet

CM-UFD.M35M



Data Sheet

## Standard/Regulation and Country in use

**Italy**  
CEI 0-21



Componenti per quadri di interfaccia ABB

**Germany**  
VDE-AR-N 4105/ 4110/ 4120



Schaltungsempfehlungen  
NA-Schutz und  
Kuppelschalter

**Austria**  
TOR-Erzeuger TYP-A/ B/ C/ D/

**Switzerland**  
AES NA/ EEA-NE7



Netz- und  
Anlageschutz-  
Lösung von ABB



Solution d'ABB pour  
la protection  
du réseau et des  
installations



La soluzione di ABB  
per la protezione  
di rete e impianti

**Great Britain**  
G99

**Australia**  
IEC 60255-1, -26, -27, -127, -18

**Finland**  
EN50549-1

**UAE, Oman, Bahrain**  
DEWA DRRG

**France**  
VDE 0126-1-1



**ABB**