Solutions guide for commercial buildings, carports, and decentralised power plants

using Conext TL small three-phase PV inverters

Schneider Electric

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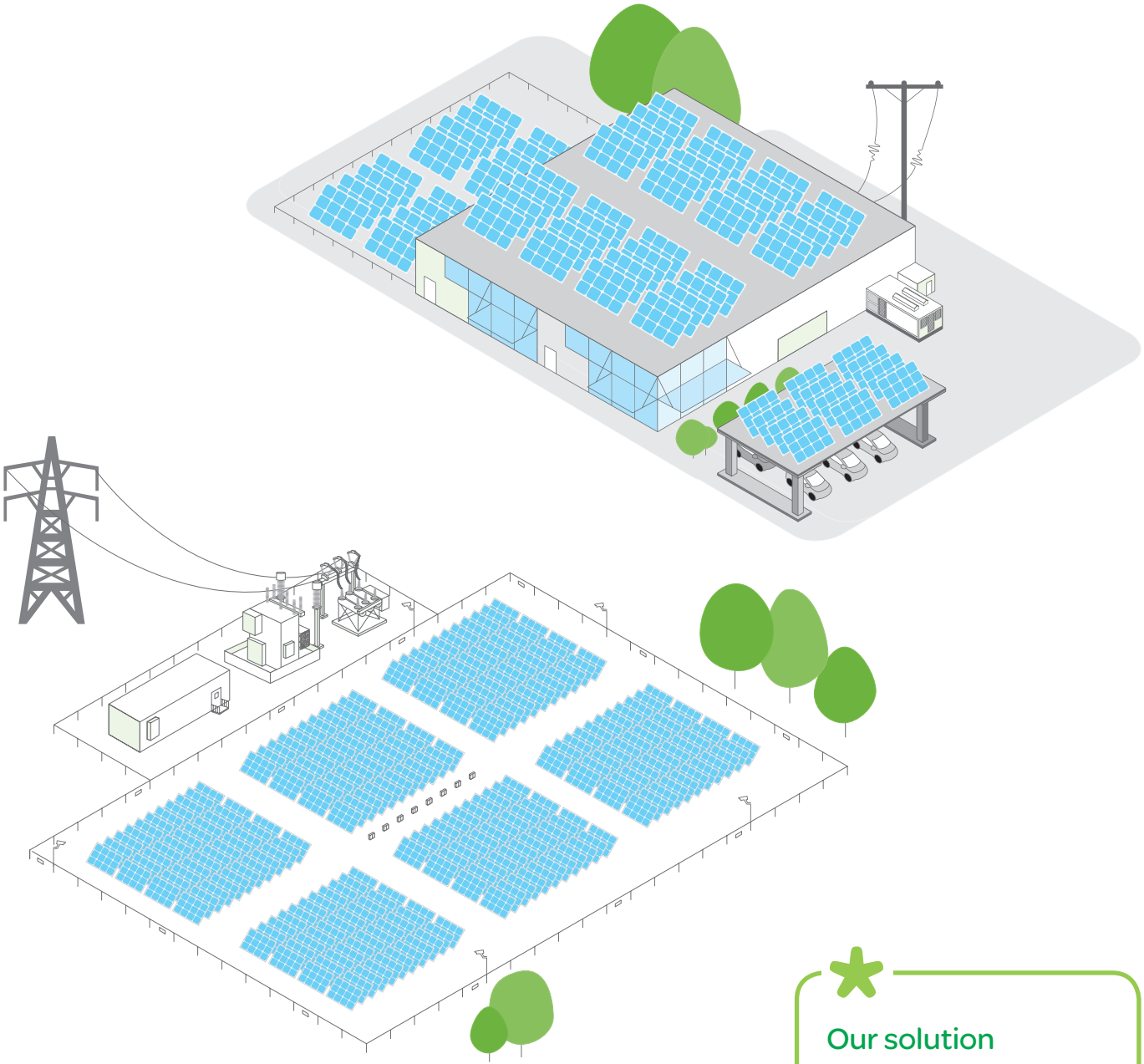
Innovative photovoltaic solutions for commercial buildings, carports, and decentralised power plants



Our solution

- Array box / DC box
- Conext TL inverters
- AC combiner box
- Grid connection box

Introduction

Introduction

> Purpose of this guide

- This guide is intended to facilitate the use of small three-phase (S3P) inverters, based on a decentralised architecture. It describes the interfaces required to implement this architecture and gives rules to build the solution.
- The complete layout of the photovoltaic (PV) field is a prerequisite to use this guide.

> Use of a decentralised PV architecture

- Small power inverters are decentralised on the PV area and located near the PV modules to allow for connection of the strings as simply as possible.
- Advantages of a decentralised PV architecture include:
  - Easy adaptation of the solution to roof or plant specificities
  - Easy installation of the inverters on roof or plant
  - Easy electrical protection
  - Easy connection to the grid
  - Easy monitoring
  - Easy system maintenance
  - Greater energy production

> Use of Conext TL small three-phase solar inverters

- The new Conext TL 8, 10, 15 kW and TL 20 kW grid-tie solar inverters are suited for outdoor use and are the ideal solution for commercial buildings, carports and decentralised power plants in multiple MW ranges. With their modular design and two wide input range MPPTs, these inverters are very flexible and therefore easy to install.

> Warnings

- Conext TL 8, 10, 15 kW and TL 20 kW are transformerless inverters, suited for use with PV modules not requiring the grounding of a DC polarity.
- In case of a “net metering” grid connection type, connection has to be adapted to the local rules specified by the utilities.t

Drivers for a decentralised PV architecture

> Lower cost of installation and easy to install

- Smaller units are lighter weight and easier to handle
- Inverters can be mounted directly on/underneath the PV mounting structures
- Product is easy and inexpensive to ship and can be installed by two persons versus central inverters which are typically very heavy and expensive to transport/install (crane often required)
- No concrete mounting pad required, unit mounted directly to wall, pole or PV frame racking
- Cost effective: No need to use a PV Box on roof or on ground for inverters

> Easy to service and increased energy harvest

- If there is a failed inverter, only part of the field is affected versus a large portion of the field when a large inverter is used = greater ROI
- Multiple MPPT's to allow greater installation flexibility and greater harvest

> Easy electrical protection

- DC circuit remains limited to the roof, without penetrating into the building
- DC cabling remaining "alive" is restricted
- AC circuit is enlarged, requiring additional AC equipments which are typically less expensive and more readily available
- Fire situation management is simplified and firemen safety is improved

> Easy adaptation to roof specificities

- Ability to support different roof pans orientations
- Heterogeneous layout of the strings is facilitated (unbalanced arrays)
- Obstacles on roofs and shadowing/shading have less production impact

> Easy connection to the grid

- Small 3-Phase inverters can be parallelized directly to the grid

> Easy monitoring

- Monitoring at much granular level about production areas
- Performance ratio calculations and fault detection can be reached at a reduced cost

Decentralised architecture

A global overview

> Electrical line

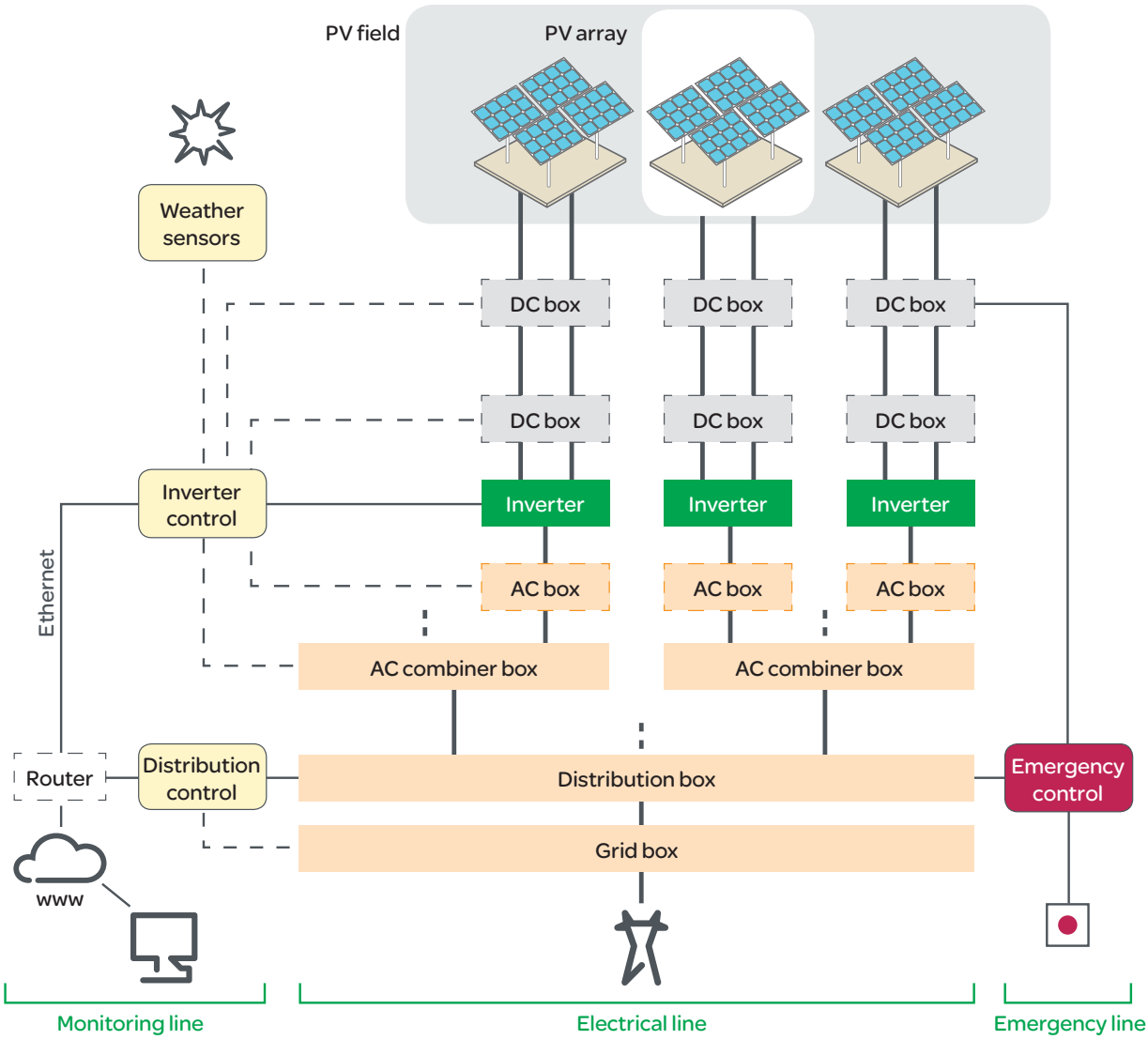
- Inverters are located close to the PV modules

> Monitoring line

- Monitoring is done at inverter level, possibly completed with weather sensor measurements and auxiliaries information
- Monitoring may be enriched at distribution level and/or utility control interface.
- Easy to connect to 3rd party monitoring solutions (open source)

> Emergency line

- Emergency shutdown to isolate AC and DC sources if required by building or fire regulation



The electrical line

> DC box

- **Optional** interface, required if:
  - The DC switch disconnector in the inverter is not in compliance with local rules or in case of risk of lightning
  - Two DC boxes are required for lightning protection or emergency purposes
- Functions include:
  - Isolation devices for each MPPT input of the inverter from DC lines
  - Protection of the inverter against surge voltages coming from DC lines

> AC box

- **Optional** interface, required if:
  - AC switch disconnector is too far from the inverter or there is difficulty safely accessing the inverter
  - AC surge protection is too far from the inverter to ensure protection.
- Functions include:
  - Isolation device for the inverter from AC lines
  - Protection of the inverter against voltage surges coming from AC lines, such as lightning

> AC combiner box

- First combiner stage:
  - Collecting AC currents coming from several inverters
  - Transferring AC current to the grid through the AC distribution box
- Functions include:
  - Protection of lines to the inverters against overcurrents
- If not done at AC box level:
  - Isolation devices for the inverters from AC lines
  - Protection of the inverters against voltage surges coming from AC lines, such as lightning

> Distribution box

- Second combiner stage:
  - Collecting AC currents coming from several AC combiner boxes
  - Transferring AC current to the grid box in LV
- Functions include:
  - Isolation device from the grid
  - Protection of the lines to the combiner boxes against overcurrents
  - Protection against surge voltages coming from AC lines in case of risk of lightning

> Grid box

- Final stage:
  - Connecting installation to a public LV and MV network according to the utility requirements
- Functions include:
  - A utility access area for service needs (metering, power quality management, etc)
  - A user access area for safety needs (isolation, protection, etc)

Monitoring line

> Weather sensors

- Possible sensors
  - Irradiance, temperature, wind speed
  - 4-20 mA or 0-1 0V signal types
- Sensors are connected to the selected gateway

> Inverter control

- First stage of monitoring
  - According to the selected gateway
    - Collecting data from inverters
    - Maximum number of inverters according to the gateway

> Distribution control

- First stage of monitoring
  - According to the selected gateway
    - Collecting data from grid energy meters and auxiliary contacts

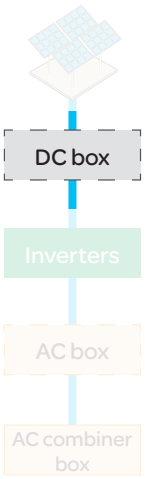
The emergency line

> Emergency control

- Pressing the emergency stop, leads to:
  - Isolation from the AC source at the combiner box level
  - Isolation from the DC source at the DC box level (at the location farther upstream if both)
- Pressing the emergency stop shall be taken into account even if the grid voltage is absent
- At least for the DC source, a feedback LED information indicates whether or not the shut-down action took place

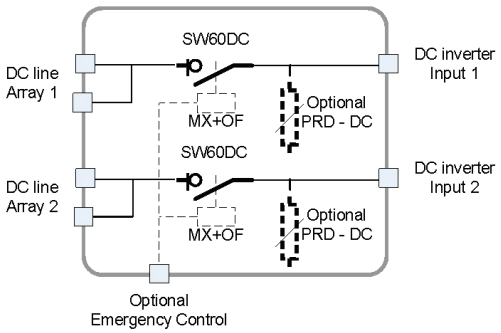
Electrical equipment

Connecting inverters:
The DC box



> Function

- Disconnects each MPPT input of the inverter from the DC line
  - SW60DC switch-disconnector
- Protects the inverter against voltage surges coming from DC lines
  - PRD-DC
- Controls the release of the switches remotely for emergency purpose
  - MX+OF releases / MN releases

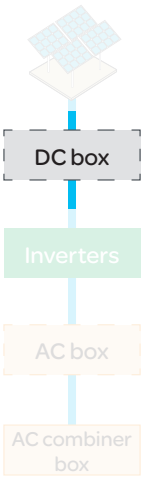


> Typical use

- The DC box is an optional offer, but is necessary when:
  - Local regulations require the use of external DC switch disconnectors (i.e. France)
  - Local regulations require the disconnection of DC lines remotely (generally as close as possible to the PV modules) in case of emergency
  - The lightning risk assessment concludes that protection by SPD is required
- The PV array of each MPPT input is preferably disconnected separately
  - One switch disconnector per DC input
- DC box is located close the inverter
  - Needing generally an outdoor enclosure
- An additional DC box is installed close the PV modules when:
  - Protection by SPD is required and the distance between PV modules and the inverter is higher than 10 m
  - Emergency control of the DC lines is required and the inverter is located far from the PV modules or inside the building
- Wiring between DC box and inverter must use 6mm^2 cross-section PV conductors

> Advantages of the offer

- Two models of DC box: with or without surge protection
  - Each model is suitable for both 8, 10, 15 kW and 20 kW inverters
- One DC box per inverter, for both MPPT inputs
  - This allows for separate disconnection of the PV arrays
- Easiness of the DC connections
  - Using PV connectors mounted on the DC box, or close to the DC box



Connecting inverters: The DC box

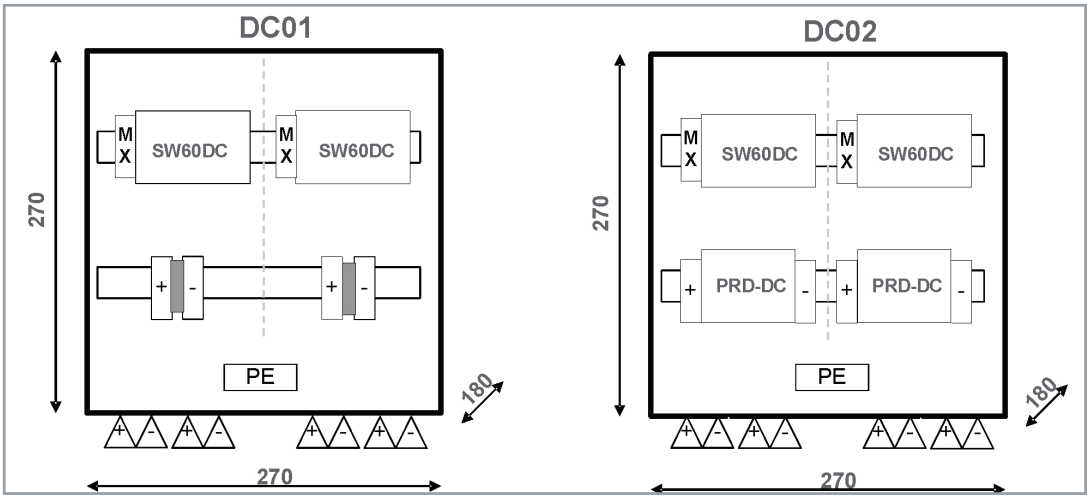
> Range

- Two models: DC01(R), DC02(R)
  - DC01 with switch-disconnectors only – DC01R includes release for emergency control
  - DC02 with switch-disconnectors and surge voltage protection – DC02R includes release for emergency control
- One single rating for 8, 10, 15 kW and 20 kW Conext inverters

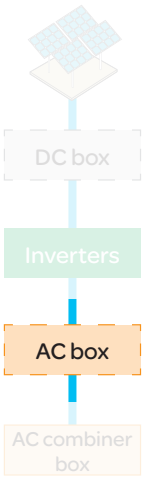
		DC01(R)	DC02(R)
Electrical			
Imax	*A*	2 x 30 A DC	
Umax	*V*	1000 V DC	
Protections			
Switch-disconnector		SW60 DC, 1000 V, 50A, pre-wired poles Ref: A9N61699	
Optional release		MX+OF 48-130 VDC, Ref: 26947 or 12-24 VDC, Ref: A9N26948	
Surge protective device		No	iPRD 40r - 1000DC Ref : A9L16436
Enclosure			
IP		IP 65	
Enclosure type		Thalassa PLS modular 24, Ref: NSYPLS2727DLS24	
Modular distribution		2 lines, 12 modules / line (18 mm)	
H x L x P	*mm*	270 x 270 x 180	
Terminals			
to PV string connections		4 x pairs of PV connectors	
to DC inverter inputs		2 x pairs of spring terminals, 6 mm², 3 points Ref: AB1RRN635U3	
Spacers		9mm - Ref: 27062	
PE connection		Internal PE terminal	

> Recommended implementation

- Use Thalassa™ PLS polyester enclosures, with modular distribution

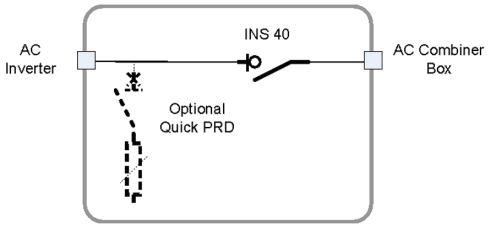


Connecting inverters:
The AC box



> Function

- Disconnects inverter from the AC line
  - INS 40 switch-disconnector
- Protects the inverter against voltage surges coming from AC lines
  - Quick PRD



> Typical use

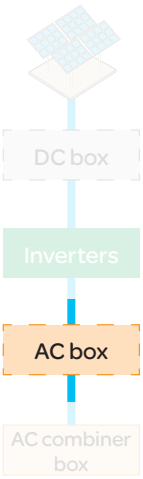
- The AC box is an optional offer, but is necessary when:
  - The distance or an obstacle between inverter and AC combiner box prevents the safe disconnection of the inverters at the AC combiner box level

and/or

  - The distance between inverter and AC combiner box is more than 10 m and may prevent the safe surge voltage protection of the inverter at the AC combiner box level
- AC box is located near the inverter
  - Generally needs an outdoor enclosure
- Possible long distance between AC box and AC combiner box
  - Requires cross-section terminals for output cabling higher than 6 mm^2 (maximum cross-section of the cables at the AC plug)

> Advantages of the offer

- Two models of the AC box: with or without surge protection
  - Each model is suitable for both 8, 10, 15 kW and 2 0kW inverters
- Possibility to increase cross-section cables to reduce AC losses
  - Output cables terminals up to 35 mm^2



Connecting inverters: The AC box

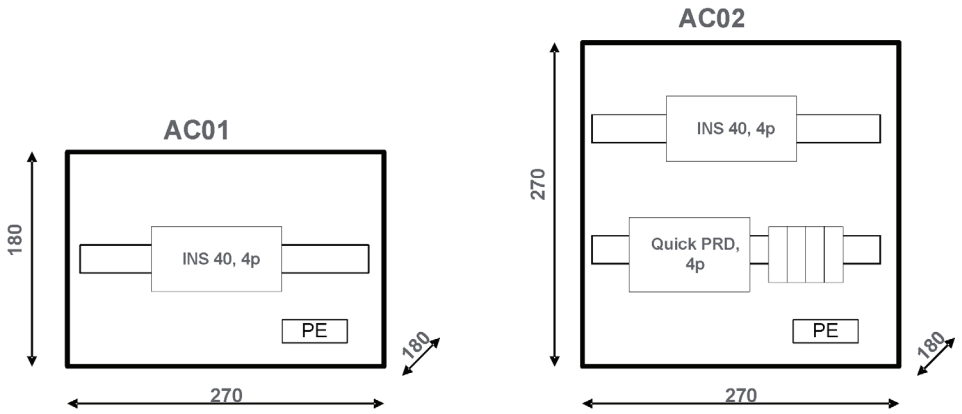
> Range

- Two models AC01, AC02
  - AC01 with switch-disconnector only
  - AC02 with switch-disconnector and surge voltage protection
- One single rating for 8, 10, 15 kW and 20 kW Conext inverters

		AC01	AC02
Electrical			
Pn	*kVA*	20	
In (Imax)	*A*	29 (32)	
Un	*V*	400V, 3P+N	
Protections			
Output switch		INS40, 4p Ref: 28901	
Surge protective device		No	iQuick PRD40r Ref : A9L16294
Enclosure			
IP		IP 65	
Enclosure type		Thalassa PLS modular 12 Ref: NSYPLS1827PLS12	Thalassa PLS modular 24 Ref: NSYPLS2727DLS24
Modular distribution		1 line, 12 modules (18 mm)	2 lines, 24 modules (18 mm)
H x L x P	*mm*	180 x 270 x 180	270 x 270 x 180
Terminals			
to AC grid connection		upstream INS switch terminals, max 35 mm²	
to AC inverter connection		downstream INS terminals	4 x spring terminals, 6 mm², 3 points Ref: AB1RRN635U3
PE connection		Internal PE terminal	

> Recommended implementation

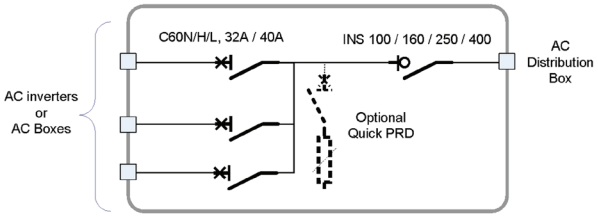
- Use Thalassa PLS polyester enclosures, with modular distribution



Connecting inverters:
The AC combiner box

> Function

- Combines AC currents coming from several inverters
- Isolates the combiner box from AC line
  - Output switch-disconnector, INS type
- Protects AC lines to inverters against overcurrents
  - Circuit breaker C60 N/H/L (according prospective current), four poles, C curve, 32 A (for TL 8, 10, 15 kW) / 40 A (for TL 20kW)
- Protects inverters against voltage surges from AC line
  - Quick PRD, 4p
  - If not done at the AC box level

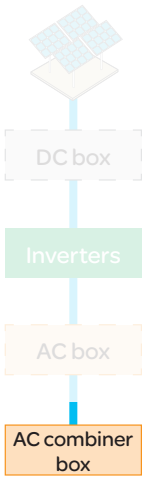


> Typical use

- AC combiner box is located near the inverters
- Long distance between AC combiner box and AC distribution box
  - Requires high cross-section terminals for output cabling

> Advantages of the offer

- Modular offer
  - Range of four rated powers: 60, 100, 160, 250 kW
  - The number of inputs can be adapted to the PV application
- Disconnection of the inverters at AC combiner box level
- Single surge arrester for all inverters connected to the combiner box



Connecting inverters: The AC combiner box

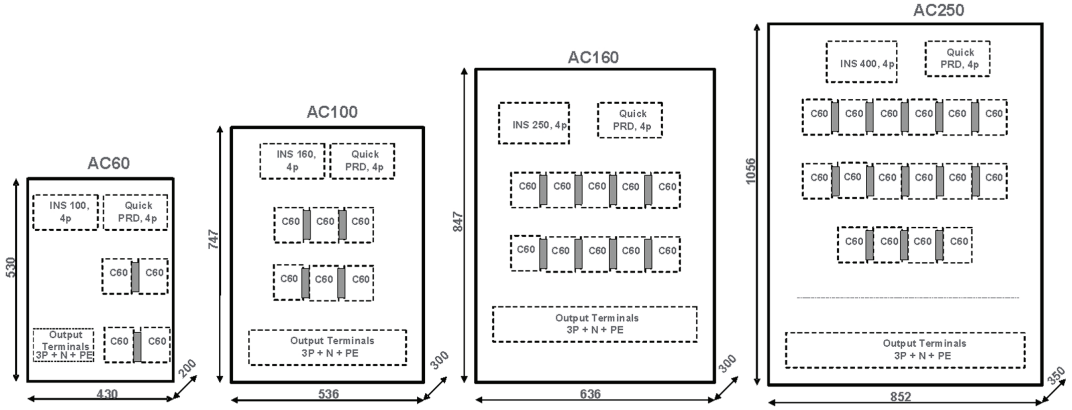
> Range

- 4 models: AC60, AC100, AC160, AC250
  - Four rated powers: 60kVA, 100kVA, 160kVA, 250kVA
  - Number of inputs is configurable
  - SPD optional

		AC60	AC100	AC160	AC250
Electrical					
Pn	*kVA*	60	100	160	250
In (Imax)	*A*	87 (100)	144 (160)	231 (250)	361 (400)
Un	*V*	400 V, 3P+N			
Protections					
Output switch		INS100, 4p Ref: 28909	INS160, 4p Ref: 28913	INS250, 4p, mounting plate Ref: 31107	INS400, 4p, mounting plate Ref: 31111
Input brakers		iC60. C curve, 32 A (for TL 8, 10, 15kW) or 40 A (for TL 20kW)			
Surge protective device		iQuick PRD40r Ref: A9L16294			
Enclosure					
IP		IP 65			
Enclosure type		Thalassa PLM Ref: NSYPLM54	Thalassa PLM Ref: NSYPLM75	Thalassa PLM Ref: NSYPLM86	Thalassa PLM Ref: NSYPLM108
H x L x P	*mm*	530 x 430 x 200	747 x 536 x 300	847 x 636 x 300	1056 x 852 x 350
Modular distribution		4 lines, 16 modules per line Ref: NSYDLA48	4 lines, 21 modules per line Ref: NSYDLA88	4 lines, 28 modules per line Ref: NSYDLA112	6 lines, 39 modules per line Ref: NSYDLA234
Terminals					
Number of inputs		2 - 4	3 - 6	4 - 10	6 - 16
Spacers between CBs		9 mm width, Ref: 27062			
Input cable cross-section	mm^2	35 mm^2 max, cable 3P+N			
Output cable cross-section	mm^2	120 mm^2, 3P+N	185 mm^2, 3P+N	240 mm^2, 3P+N	2x240 mm^2, 3P+N

> Recommended implementation (for the full arrangement)

- Use Thalassa PLM polyester enclosures
- Use with spacers between circuit breakers (CBs)



Connecting to a public LV network

> Rules for connecting a PV installation to an LV network

- In regards to connecting to a public LV network, power limits vary by country
  - 250 kVA in France, 100 kVA in Spain and Italy, 30 to 100 kVA in Germany
- Some local grid codes allow the connection of a PV installation to the grid without use of an additional protective relay when:
  - Inverters are VDE 0126 certified: in France up to 250 kVA, in Germany up to 3 0kVA
- When a protective relay is required, it must be installed in the distribution box or in the distribution control box
  - Functions and adjustments of the protection relay vary by country (Min-Max U, Min-Max F)

> Grid box

- The connection to an LV network is made through a grid box provided by the utility
  - Interface is at the terminals of the metering unit or at those of the main circuit breaker
  - Grid box can be located indoors or outdoors
- The grid box is divided into two parts:
  - Service connection area accessible only by the utility for service needs (metering, disconnecting)
  - User connection area accessible by the customer for safety needs (isolation, protection…)
- User connection area is generally equipped with a main circuit breaker
  - The main circuit breaker can be provided by the customer. If the main circuit breaker is not included in the grid box, it must be integrated in the distribution box
- Three types of grid boxes (GB1, GB2, GB3) are available to account for varying types of grid connections

> Distribution box

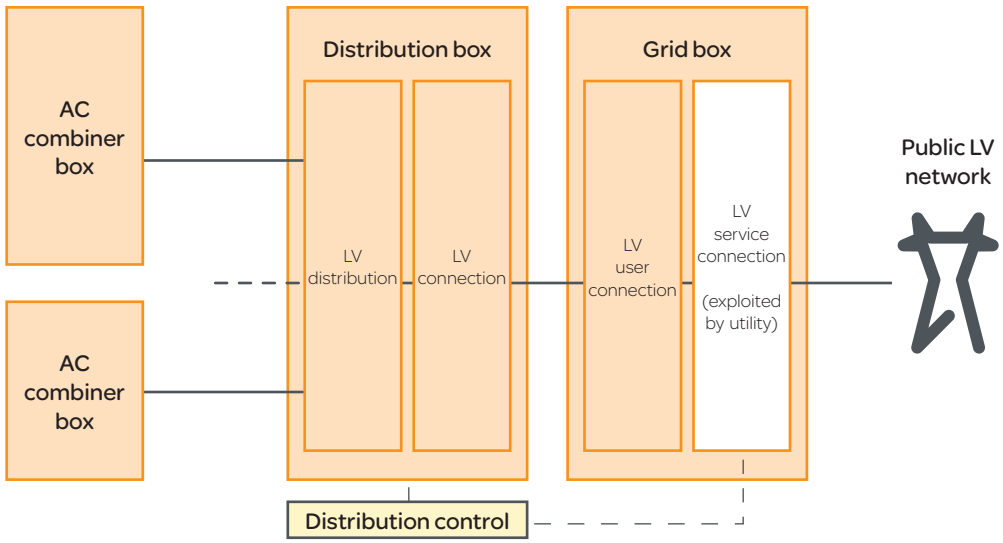
- The distribution box is adapted according to the type of grid box and the requirements of the utility
- The distribution box is divided into two parts :
  - LV distribution to connect to all AC combiner boxes while protecting the cabling and possibly measuring currents
  - LV connection to connect to the grid box while ensuring compatibility with grid box and utility requirements

> Distribution control

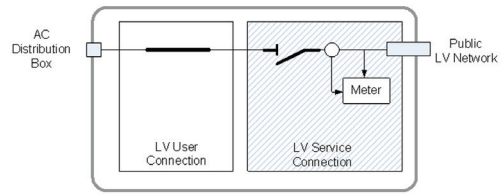
- Distribution control may be required for monitoring purposes
  - Can capture measurements from NSX µLogic devices or capture utility metering information
  - Can be located inside the distribution box if room is available or in a dedicated enclosure close to the distribution box

Connecting to a public LV network

> LV connection interfaces



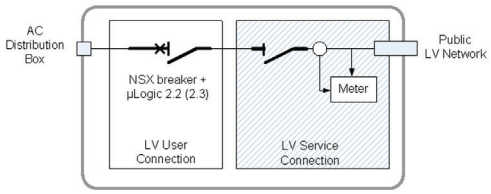
> Types of grid boxes



GB1

User connection area with no protective device

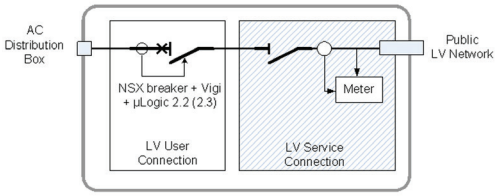
- A main circuit breaker has to be included in the distribution box, with or without Vigi™ according earthing system



GB2

User connection area with main circuit breaker

- Typically used with TNS systems
- If a Vigi protection is required, it has to be included in distribution box



GB3

User connection area with main circuit breaker + Vigi

- Typically used with TT systems

Connecting to a public LV network: The distribution box

> Function

- Combines AC currents coming from the AC combiner boxes
- Connects to the grid box while ensuring compatibility with the grid box and compliance with grid connection requirements
- Protects the AC lines connected to the AC combiner boxes
  - Using C120 circuitbreakers or Compact NSX according current, optionally with Vigi modules
- Protects against voltage surges coming from AC lines
  - Using type 1 or type 2 SPD, protected by circuit breaker
- Isolates the distribution box (and the whole PV installation) from the AC line
- Optionally, monitors currents and energies at each input
  - Use of µLogic™ 5.2E module for protection and monitoring purposes
- When a remote emergency shutdown is required, an optional release MN or MX is used at the LV connection stage

> Typical use

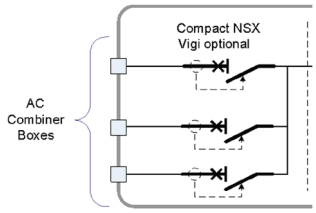
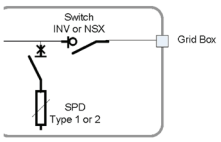
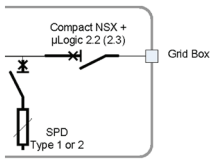
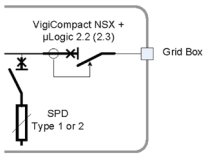
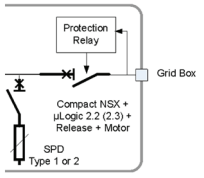
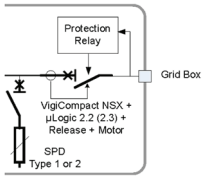
- Different types of distribution box are required according to the type of grid box and to the need for an external protective relay
  - Six types of distribution box are defined, with differences at the LV connection stage
- In the case of connecting only one AC combiner box, only the LV connection stage of the distribution box is required
- The distribution box can be located indoors or outdoors, normally close to the grid box
- Buildings protected with lightning rods require the use of type 1 SPDs at distribution box level

> Advantages of the offer

- Full adaptation to grid codes and limits of all European countries
  - Adaptation between the grid box and the distribution box
  - Rated power up to 250 kVA in LV
- Modular offer
  - Range of four rated powers (60, 100, 160, and 250 kW); same range as AC combiner boxes
  - The number of inputs has to be adapted to the application
- Easy monitoring of currents and energies
  - Possible use of µLogic 5.2E/5.3E units with NSX™ circuit breakers

Connecting to a public LV network: The distribution box

> Types of distribution box

LV distribution	LV connection	
 When connecting only one AC combiner box, only the **LV connection stage** of the distribution box is required		**DB1** • For connection to GB2 with TNS system • For connection to GB3 with TT system • External protective relay not required by utility
		**DB2** • For connection to GB1 with TNS systems • External protective relay is not required by utility
		**DB3** • For connection to GB1 with TT systems • External protective relay is not required by utility
		**DB4** • For connection to GB1 with TNS system • For connection to GB2 with TNS system • For connection to GB3 with TT system • External protective relay required by utility
		**DB5** • For connection to GB1 with TT systems • External protective relay required by utility

Grid box type	GB1	GB1	GB2	GB3	GB1	GB2	GB3	GB1
Earthing system	TNS	TT	TNS	TT	TNS	TNS	TT	TT
External protective relay required	N	N	N	N	Y	Y	Y	Y
Distribution box type	DB2	DB3	DB1		DB4			DB5

Connecting to a public LV network: The distribution box

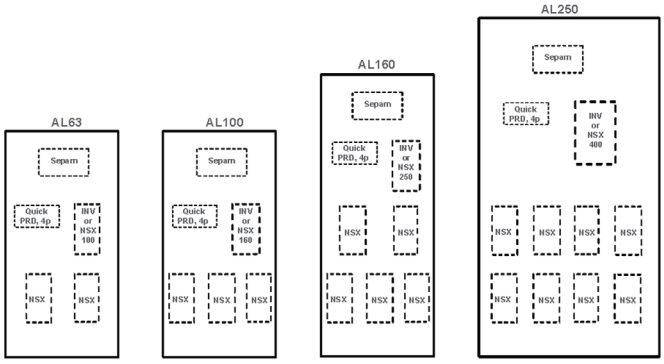
> Range

- 4 models: AL60, AL100, AL160, AL250
  - Four rated powers: 60 kVA, 100 kVA, 160 kVA, and 250 kVA
  - Each model can be implemented with one of the 5 types (DB1, DB2, DB3, DB4, DB5)

		AC60	AC100	AC160	AC250
Electrical					
Pn	*kVA*	60	100	160	250
In	*A*	87	144	231	361
Imax	*A*	100	160	250	400
Un	*V*	400 V, 3P+N			
Output protection, according to distribution box type					
DB1 → Switch disconnector		INV100, Ref: 21161 or NSX100NA Ref: LV429639	INV100, Ref: 21165 or NSX160NA Ref: LV430639	INV100, Ref: 31167 or NSX250NA Ref: LV431639	INV100, Ref: 31171 or NSX400NA Ref: LV432757
DB2, DB4 → Circuit breaker for service connection		NSX100F + µLogic 2.2 Ref: LV429780	NSX160F + µLogic 2.2 Ref: LV430780	NSX160F + µLogic 2.2 Ref: LV431780	NSX160F + µLogic 2.3 Ref: LV432677
DB3, DB5 → Circuit breaker + Vigi for service connection		NSX100F + µLogic 2.2 + VigiMH, Ref: LV429980	NSX100F + µLogic 2.2 + VigiMH, Ref: LV430980	NSX100F + µLogic 2.2 + VigiMH, Ref: LV431980	NSX100F + µLogic 2.3 + VigiMH, Ref: LV432732
DB4, DB5 → Protection relay		Sepam 1000+ or Micom P992G			
DB4, DB5 → Auxiliaries for circuit breaker		Remote tipping units MN/MX, motor mechanism module			
Surge protective device		Quick PRD40r, 3P+N, Ref: A9L16294 or PRD1/PRF1 with associated breaker			
Input protection, according to AC combiner box model to connect					
Number of inputs		1 → 2	1 → 3	1 → 5	1 → 8
Input breakers AC60 models		NSX100B (2 max)	NSX100B (3 max)	NSX100B (5 max)	NSX100B (8 max)
AC100 models		-	NSX160B (1 max)	NSX160B (3 max)	NSX160B (5 max)
AC160 models		-	-	NSX250B (1 max)	NSX250B (3 max)
AC250 models		-	-	-	NSX400B (1 max)
Enclosure					
Indoor enclosure type		Spacial SF	Spacial SF	Spacial SF	Spacial SF
H x L x P	*mm*	1200 x 600 x 400	1200 x 600 x 400	1200 x 600 x 400	1200 x 600 x 400
Outdoor enclosure type		Thalassa PLAT	Thalassa PLAT	Thalassa PLAT	Thalassa PLAT
H x L x P	*mm*	1000 x 500 x 420	1000 x 500 x 420	1000 x 500 x 420	1000 x 500 x 420
Terminals					
Input cable cross-section	mm^2	120 mm^2, 3P+N	185 mm^2, 3P+N	240 mm^2, 3P+N	2x240 mm^2, 3P+N
Output cable cross-section	mm^2				

> Recommended implementation (for the full arrangement)

- Use Thalassa PLAT or Spacial SF enclosures



Monitoring

Monitoring of the installation

> For monitoring of solar installations of up to 20 kW, use the Schneider Electric Conext Monitor 20 communication device

The Conext Monitor 20 is a simple and compact remote monitoring and control solution for small PV plants of up to 2 0kW. The easy-to-configure Conext Monitor 20 allows PV plant owners to monitor the operating performance of the inverter online, regardless of location.

> 3rd-party monitoring solutions such as Meteocontrol™, Solar-Log™ and Enerwise™ are pre-tested and qualified for plug and play

For more information visit:
Meteocontrol: www.meteocontrol.com
Solar-Log: www.solar-log.com
Enerwise: www.enerwise.asia

Selection rules and application case

Selection rules

> Starting point

- Organisation of the PV field is done
  - Number of separated PV zones? . . . . . 1, 2, 3…
  - Peak power of the whole PV field? . . . . . kWp
- Sizing of each PV zone is validated
  - Peak power of each PV zone? . . . . . kWp
  - Number of S3P 8, 10, 15 kW / 20 kW inverters in each PV zone? 1, 2, 3…x TL 8, 10, 15 / TL 20
  - Number of strings per MPPT input? 1, 2

> Information to collect

- Topology of the installation
  - Where are the inverters located? . . . . . On roof, inside the building
  - How are the inverters installed? . . . . . Distributed, put together
  - Where is the grid connection point? . . . . . Indoor, Outdoor
- Electrical requirements
  - Which type of grid box? . . . . . GB1, GB2, GB3 (see page 25)
  - Which type of grid earthing system? . . . . . TT, TNS

  - Is an external protective relay required by local code? . . . . . Y/N
  - Are external DC switches required by local code? . . . . . Y/N
  - Is an emergency shutdown system required by local code? . . . . . Y/N

  - What is the lightning risk level evaluation? . . . . . Medium, high, maximum
  - Is the distance between the inverters and modules >10 m? . . . . . Y/N
  - Is the distance between the inverters and grid box >10 m? . . . . . Y/N
  - Is the distance between the inverters and AC combiner box >10 m? . . . . . Y/N

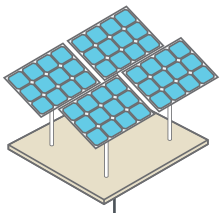
  - Is the area between the inverter and AC combiner box difficult to access? . . . . . Y/N
- Monitoring requirements
  - Which type of monitoring access is there? . . . . . Local, remote
  - What is the expected level of service? . . . . . Supervision, alarms

Association modularity
between 8, 10, 15 kW/20 kW inverters

> To have 5 kW modularity

TL20 kW / TL15 kW	0	1	2	3	4	5	6	7	8	9	10	11	12
0			40	60	80	100	120	140	160	180	200	220	240
1		35	55	75	95	115	135	155	175	195	215	235	
2	30	50	70	90	110	130	150	170	190	210	230	250	
3	45	65	85	105	125	145	165	185	205	225	245		
4	60	80	100	120	140	160	180	200	220	240			
5	75	95	115	135	155	175	195	215	235				
6	90	110	130	150	170	190	210	230	250				
7	105	125	145	165	185	205	225	245					
8	120	140	160	180	200	220	240						
9	135	155	175	195	215	235							
10	150	170	190	210	230	250							
11	165	185	205	225	245								
12	180	200	220	240									
13	195	215	235										
14	210	230	250										
15	225	245											
16	240												

Selection rules



DC box

Emergency shutdown required	Y	Y	Y	N	Y	N	N	Y	Y
Lightning risk high or maximal	Y	N	Y	Y	Y	N	Y	Y	N
Distance inverter / modules >10 m	N	?	Y	Y	Y	?	N	N	?
Inverters located inside the building	Y	Y	N	?	Y	?	?	N	N
DC box model	DC01 + release		DC02		DC03 + release	X			

DC box

Lightning risk high or maximum	N	Y	N
External DC switch required	Y	?	N
DC box model	DC02	D02	X

Inverter

AC box

Inverters distributed	N	N	Y	N
Difficult access between inverter and combiner box	Y	•	•	N
Distance inverter/combiner box >10 m	N	Y	•	N
DC box model	AC01	AC02		X

AC combiner box

Number of separated PV zones	→	Number of combiner boxes	
For each PV Zone			
Number of TL 15kW inverters in the PV zone	→	Number of input breakers for TL 15kW	
Number of TL 20kW inverters in the PV zone	→	Number of input breakers for TL 20kW	
Rated Power of combiner box	→	Pn ≥ ∑ inverters rated power of the zone	
Use of AC02 box for each inverter	N	→	SPD required

Distribution box

Grid box type	GB1	GB1	GB2	GB3	GB1	GB2	GB3	GB1
Earthing System	TNS	TT	TNS	TT	TNS	TNS	TT	TT
External protective relay required	N	N	N	N	Y	Y	Y	Y
Distribution box type	DB2	DB3	DB1		DB4			DB5
Rated power of distribution box		→	Pn ≥ 4 inverters rated power of the installation					
Emergency shutdown required		→	Switch release required					
Grid point connection indoor/outdoor	indoor	→	Spacial SF enclosure type					
	outdoor	→	Thalassa PLAT enclosure type					
Lightning risk	medium, high	→	SPD type 2					
	maximal	→	SPD type 1					

Grid box

Application case
Commercial Building – Hoor – NL

> Initial information

- PV field features:
  - PV modules: cSi type, 235Wp
  - Number of independant PV zones : 3
  - Array 1: 120 modules ➜ 28.2 kWp
  - Array 2: 132 modules ➜ 31.0 kWp
  - Array 3: 170 modules ➜ 40.0 kWp
  - Total peak power ➜ 99.2 kWp
  - Min PV site temp ➜ -15°C

Location:	Hoorn	
Climate Data Record:	Hoorn (1981-2000)	
PV Output:	99.41	kWp
Gross/Active PV Surface Area:	696.28 / 695.32	m2
PV Array Irradiation:	786,566	kWh
Energy Produced by PV Array (AC):	90,466	kWh
Grid Feed-in:	90,466	kWh
Yield Reduction Due to Shading:	8	%
System Efficiency:	11.5	%
Performance Ratio:	80.4	%
Specific Annual Yield:	909.8	kWh/kWp
CO2 Emissions Avoided:	80,127	kg/a

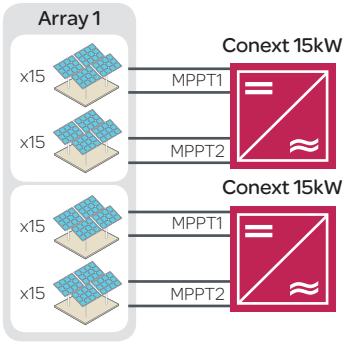
ELECTRICAL CHARACTERISTICS	200W$_p$	205W$_p$	210W$_p$	215W$_p$	220W$_p$	225W$_p$	230W$_p$	235W$_p$	240W$_p$	245W$_p$
Maximum Power, P_{max} (W)	200	205	210	215	220	225	230	235	240	245
Voltage at Pmax, V_{mp} (V)	28.02	28.29	28.58	28.79	28.03	29.27	28.50	28.83	30.16	30.67
Current at Pmax, I_{mp} (A)	7.14	7.25	7.35	7.47	7.58	7.69	7.80	7.88	7.96	7.99
Open Circuit Voltage, V_{oc} (V)	36.05	36.25	36.38	36.50	36.64	36.95	37.25	37.41	37.65	37.77
Short Circuit Current, I_{sc} (A)	7.95	7.99	8.04	8.07	8.14	8.23	8.34	8.44	8.49	8.55
Temperature coefficients of P_{max} (%/K)	-0.45									
Temperature coefficients of V_{oc} (%/K)	-0.35									
Temperature coefficients of I_{oc} (%/K)	0.05									
Powe Tolerance (%)	±3									
Maximum System Voltage (IEC/UL) (V DC)	1000/600									
Cells per By-pass Diode (Nos)	20									

- Sizing of the PV zones and inverter selection
  - The installation is designed as follows:

Zone 1

Configuration:

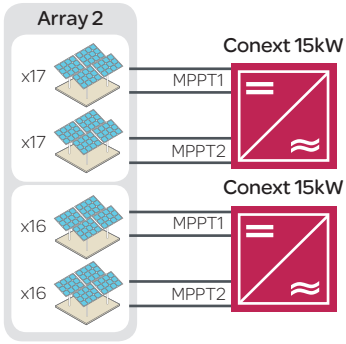
Pzone = 28.2 kWp
# of inverters: 2 x Conext 15kW
# of modules: 120
# of strings: 8
8 x strings with 15 modules / string



Zone 2

Configuration:

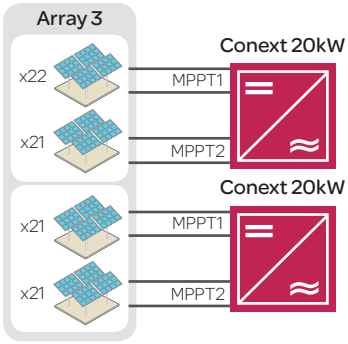
Pzone = 31 kWp
# of inverters: 2 x Conext 15kW
# of modules: 132
# of strings: 8
4 x strings with 16 modules / string
4 x strings with 17 modules / string



Zone 3

Configuration:

Pzone = 40 kWp
# of inverters: 2 x Conext 20kW
# of modules: 170
# of strings: 8
2 x strings with 22 modules / string
6 x strings with 21 modules / string

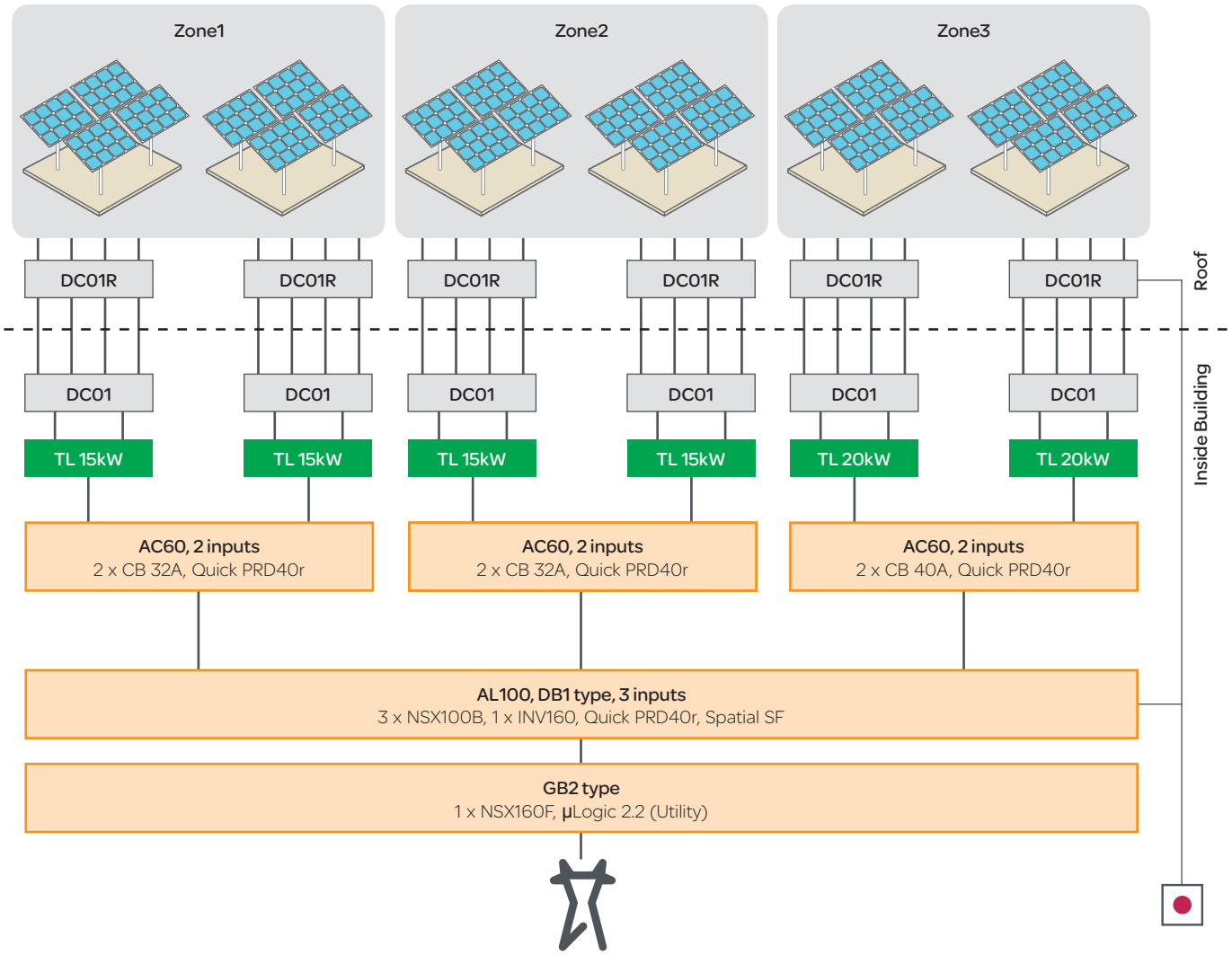


Application case
Commercial Building – Hoor – NL

> Information to collect

- Topology of the installation
  - Where are the inverters located? . . . . . Inside the building
  - How are the inverters installed? . . . . . Put together
  - Where is the grid connection point? . . . . . Indoors
- Electrical requirements
  - Which type of grid box? GB2
  - Which type of grid earthing system? . . . . . TN-S
  - Is an external protective relay required by local code? . . . . . No
  - Are external DC switches required by local code? . . . . . Yes
  - Is an emergency shutdown system required by local code? . . . . . Yes
  - What is the lightning risk level evaluation? . . . . . Medium
  - Is the distance between the inverters and modules >10 m? . . . . . Yes
  - Is the distance between inverters and grid box >10 m? . . . . . Yes
  - Is the distance between the inverters and AC combiner box >10 m? . . . . . No
  - Is the area between the inverter and the AC combiner box difficult to access? . . . . No

> Recommended solution



Product selection overview

Product selection overview

DC circuit breakers

C60 PV-DC

C60 NA-DC

SW60-DC

Range description

- C60PV-DC: circuit breaker for the protection of photovoltaic modules from fire in case of shortcircuits
- Insulation voltage Ui = 1000 V- Max. operating voltage Ue = 800 V DC- Ratings: from 1A to 25 A Non-polarised (Two-way)
- C60NA DC: modular switch electrically insulating a chain of modules in any enclosure managing more than 3 chains
- Insulation voltage Ui = 1000V- Max. operating voltage Ue = 1000V DC Max. current Ie = 20 A / 1000 V to 50 A / 700 V- Non-polarised (two-way)
- SW60 DC: modular switch electrically insulating the UPS from the upstream generators
- Insulation voltage Ui = 1000 V- Max. operating voltage Ue = 1000 V DCMax. current Ie = 50 A- Polarised (one-way)

Circuit breakers

Compact NSX

Compact NSX connected to FDM 121 display

Compact NSX 250 in plug-in version

Range description

- Compact NSX is the next generation of circuit breakers
- A power monitoring unit enhances their invariably impeccable protective functions. For the first time, users can monitor both energy and power, offering new performance in a remarkably compact device
  - Integrated monitoring
  - New breaking capacities
  - 100% service continuity
  - Simplicity of installation and use

Product selection overview

Surge protection devices

SPD Type 1 AC
iPRF1™ 12,5r

SPD Type 2 AC
iQuick™ PRD

SPD Type 2 AC
iQuick PF

SPD Type 2 DC
iPRD™ 40r PV-DC

Description

- Surge arrester/disconnector combinations certified for short-circuit current withstand, Isc, up to 25 kA (IEC 61643-11, version 2005)
- Suitable for any earthing system: TT, TN-S, TN-C and IT
- Contacts for the remote transfer of end-of-life information
- Single-pole products to be assembled or multiple-pole versions
- Fixed or withdrawable surge arresters

SPD Type 1 AC

- Impulse current discharge: 12.5, 25 kA (10/350)
- Up <1.5 kV
- Uc = 350 V

SPD Type 2 AC

- Maximum discharge current 8 to 40 kA (8/20)
- Up <2.5 kV
- Uc = 340,460 V

SPD Type 2 DC

- Maximum discharge current: 40 kA (8/20)
- Ucpv = 600 V, 1000 V versions

AC disconnects

Interpact™ INS/INV

INS250 4 poles

Description

- By adapting to a whole host of LV applications, the Interpact INS/INV switch-disconnectors offer all the safety that the user requires
- Designed for maximum performance and safety, this comprehensive and homogeneous range operates with a wide choice of accessories and auxiliaries

Product selection overview

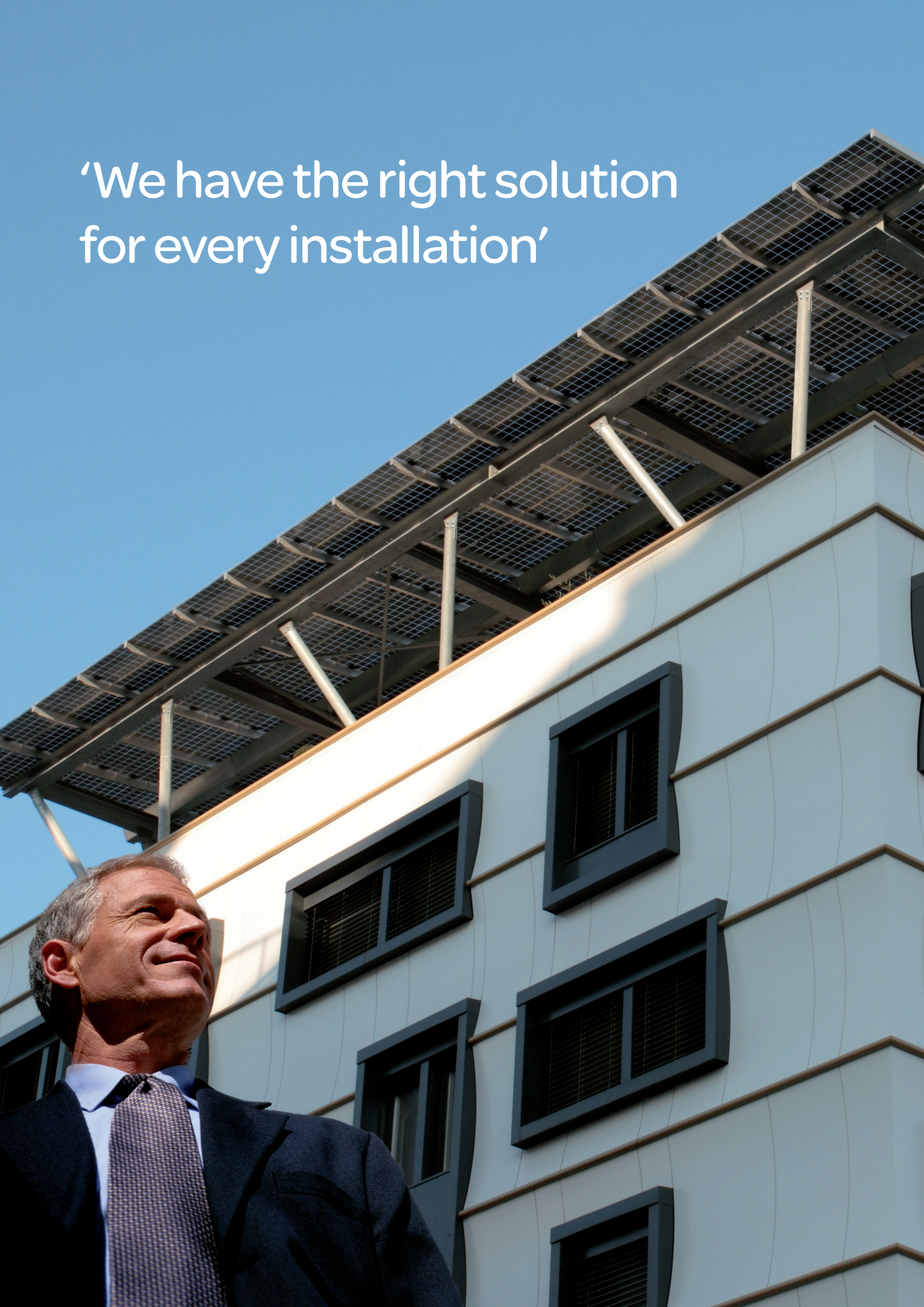
Miniature circuit breakers (MCB)

Acti 9 IC60
DIN rail MCB

iC60 DIN rail MCB
with add-on
Vigi module

Description

- With exclusive features, the Acti 9™ iC60 DIN rail MCB is geared towards optimised safety and improved continuity of service
- VisiSafe™: for safe operation and maintenance work on circuits.
- Class-2 insulation: continuous optimised safety for operators and unqualified personnel
- VisiTrip™: detects faulty miniature circuit-breaker outgoers quickly and reduces intervention time
- Add-on fully immune earth leakage protection devices: better continuity of service, especially in polluted environments and networks
- Nominal current: 1 to 63 A
- Large choice of breaking capacities up to 100 kA and tripping curves: B, C, D, compliance with standards IEC/EN 60898 or IEC/EN 60947-2
- Full coordination with Acti 9 range residual current devices (RCDs) and Compact NSX moulded case circuit breakers (MCCBs)
- Suitable for isolation in accordance with industrial standard IEC 60947
- Operating voltage: up to 440 V AC, insulation voltage: 500 V
- Optional add-on earth leakage modules: iC60 Vigi
- Optional auxiliaries: indication of state and tripping, shunt tripping, undervoltage tripping, overvoltage tripping


‘We have the right solution
for every installation’

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