Solutions guide for commercial buildings, carports, and decentralised power plants using Conext TL small three-phase PV inverters
Schneider Electric,

a bankable partner you can trust
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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.
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 MPPTs 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 6mm² 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

### Electrical

<table>
<thead>
<tr>
<th></th>
<th>DC01(R)</th>
<th>DC02(R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imax</td>
<td>2 x 30 A DC</td>
<td>2 x 30 A DC</td>
</tr>
<tr>
<td>Umax</td>
<td>1000 V DC</td>
<td>1000 V DC</td>
</tr>
</tbody>
</table>

### 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
- Thalassa PLS modular 24, Ref: NSYPLS2727DLS24
  - 2 lines, 12 modules / line (18 mm)
  - 270 x 270 x 180

### Terminals

- to PV string connections
- to DC inverter inputs
- 4 x pairs of PV connectors
- 2 x pairs of spring terminals, 6 mm², 3 points
  - Ref: AB1RRN635U3
- 9mm - Ref: 27062
- 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
  - 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 mm²
    (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 20 kW inverters
- Possibility to increase cross-section cables to reduce AC losses
  - Output cables terminals up to 35 mm²
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

### Electrical

<table>
<thead>
<tr>
<th>Pn</th>
<th>kW</th>
<th>kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>In (Imax)</td>
<td>A</td>
<td>20</td>
</tr>
<tr>
<td>Un</td>
<td>V</td>
<td>29 (32)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Protections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output switch</td>
</tr>
<tr>
<td>Surge protective device</td>
</tr>
</tbody>
</table>

### Enclosure

<table>
<thead>
<tr>
<th>IP</th>
<th>IP 65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosure type</td>
<td>Thalassa PLS modular 12, Ref: NSYPLS1827PLS12</td>
</tr>
<tr>
<td>Modular distribution</td>
<td>1 line, 12 modules (18 mm)</td>
</tr>
<tr>
<td>H x L x P mm</td>
<td>180 x 270 x 180</td>
</tr>
<tr>
<td>Enclosure type</td>
<td>Thalassa PLS modular 24, Ref: NSYPLS2727DLS24</td>
</tr>
<tr>
<td>Modular distribution</td>
<td>2 lines, 24 modules (18 mm)</td>
</tr>
<tr>
<td>H x L x P mm</td>
<td>270 x 270 x 180</td>
</tr>
</tbody>
</table>

### 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 20 kW)
• 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

### Electrical

<table>
<thead>
<tr>
<th>Pn</th>
<th>Un (Imax)</th>
<th>AC60</th>
<th>AC100</th>
<th>AC160</th>
<th>AC250</th>
</tr>
</thead>
<tbody>
<tr>
<td>kVA</td>
<td>A</td>
<td>60</td>
<td>100</td>
<td>160</td>
<td>250</td>
</tr>
<tr>
<td>In</td>
<td>87 (100)</td>
<td>144 (160)</td>
<td>231 (250)</td>
<td>361 (400)</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>400 V, 3P+N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Protections

**Output switch**
- INS100, 4p
  - Ref: 28909
- INS160, 4p
  - Ref: 28913
- INS250, 4p
  - Ref: 31107
- INS400, 4p
  - Ref: 31111

**Input breakers**
- iC60: C curve, 32 A (for TL 8, 10, 15kW) or 40 A (for TL 20kW)
- iQuick PRD40r
  - Ref: A9L16294

### Enclosure

- IP 65
- **Enclosure type**
  - Thalassa PLM
    - Ref: NSYPLM54
    - H x L x P mm: 530 x 430 x 200
    - Modular distribution: 4 lines, 16 modules per line
    - Ref: NSYDLA48
- Thalassa PLM
  - Ref: NSYPLM75
  - H x L x P mm: 747 x 536 x 300
  - Modular distribution: 4 lines, 21 modules per line
  - Ref: NSYDLA88
- Thalassa PLM
  - Ref: NSYPLM86
  - H x L x P mm: 847 x 636 x 300
  - Modular distribution: 4 lines, 28 modules per line
  - Ref: NSYDLA112
- Thalassa PLM
  - Ref: NSYPLM108
  - H x L x P mm: 1056 x 852 x 350
  - Modular distribution: 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**
  - 35 mm², max, cable 3P+N
- **Output cable cross-section**
  - 120 mm², 3P+N
  - 185 mm², 3P+N
  - 240 mm², 3P+N
  - 2x240 mm², 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

<table>
<thead>
<tr>
<th>GB1</th>
<th>User connection area with no protective device</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• A main circuit breaker has to be included in the distribution box, with or without Vigil according earthing system</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GB2</th>
<th>User connection area with main circuit breaker</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Typically used with TNS systems</td>
</tr>
<tr>
<td></td>
<td>• If a Vigil protection is required, it has to be included in distribution box</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GB3</th>
<th>User connection area with main circuit breaker + Vigil</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Typically used with TT systems</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>LV distribution</th>
<th>LV connection</th>
<th>DB1</th>
<th>DB2</th>
<th>DB3</th>
<th>DB4</th>
<th>DB5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

When connecting only one AC combiner box, only the LV connection stage of the distribution box is required.
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)

<table>
<thead>
<tr>
<th>Electrical</th>
<th>AC60</th>
<th>AC100</th>
<th>AC160</th>
<th>AC250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pn kVA</td>
<td>60</td>
<td>100</td>
<td>160</td>
<td>250</td>
</tr>
<tr>
<td>Imax A</td>
<td>87</td>
<td>144</td>
<td>231</td>
<td>361</td>
</tr>
<tr>
<td>Un V</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
</tr>
</tbody>
</table>

Output protection, according to distribution box type
- **DB1** → Switch disconnector
- **DB2, DB4** → Circuit breaker for service connection
- **DB3, DB5** → Circuit breaker + Vigi for service connection
- **DB4, DB5** → Protection relay
- **DB4, DB5** → Auxiliaries for circuit breaker
- Surge protective device
  - Sepam 1000+ or Micom P992G
  - Quick PRD40r, 3P+N, Ref: A9L16294 or PRD1/PRF1 with associated breaker

Electrical equipment

Input protection, according to AC combiner box model to connect

<table>
<thead>
<tr>
<th>Number of inputs</th>
<th>AC60 models</th>
<th>AC100 models</th>
<th>AC160 models</th>
<th>AC250 models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input breakers</td>
<td>NSX100B (2 max)</td>
<td>NSX100B (3 max)</td>
<td>NSX100B (5 max)</td>
<td>NSX100B (8 max)</td>
</tr>
<tr>
<td>Output breakers</td>
<td>NSX100B (1 max)</td>
<td>NSX160B (1 max)</td>
<td>NSX160B (3 max)</td>
<td>NSX250B (1 max)</td>
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</table>

Enclosure

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<thead>
<tr>
<th>Indoor enclosure type</th>
<th>Spacial SF</th>
<th>Spacial SF</th>
<th>Spacial SF</th>
<th>Spacial SF</th>
</tr>
</thead>
<tbody>
<tr>
<td>H x L x P mm</td>
<td>1200 x 600 x 400</td>
<td>1200 x 600 x 400</td>
<td>1200 x 600 x 400</td>
<td>1200 x 600 x 400</td>
</tr>
<tr>
<td>Outdoor enclosure type</td>
<td>Thalassa PLAT</td>
<td>Thalassa PLAT</td>
<td>Thalassa PLAT</td>
<td>Thalassa PLAT</td>
</tr>
<tr>
<td>H x L x P mm</td>
<td>1000 x 500 x 420</td>
<td>1000 x 500 x 420</td>
<td>1000 x 500 x 420</td>
<td>1000 x 500 x 420</td>
</tr>
</tbody>
</table>

Terminals

| Input cable cross-section mm² | 120 mm², 3P+N | 185 mm², 3P+N | 240 mm², 3P+N | 2x240 mm², 3P+N |
| Output cable cross-section mm² |             |             |             |             |

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 20 kW. 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
### Selection rules

<table>
<thead>
<tr>
<th>Emergency shutdown required</th>
<th>Y</th>
<th>Y</th>
<th>Y</th>
<th>N</th>
<th>Y</th>
<th>N</th>
<th>N</th>
<th>Y</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightning risk high or maximal</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Distance inverter / modules &gt;10 m</td>
<td>N</td>
<td>?</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>?</td>
<td>N</td>
<td>N</td>
<td>?</td>
</tr>
<tr>
<td>Inverters located inside the building</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>?</td>
<td>Y</td>
<td>?</td>
<td>?</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

DC box model

| DC box model | DC01 + release | DC02 | DC03 + release | X |

<table>
<thead>
<tr>
<th>Lightning risk high or maximal</th>
<th>N</th>
<th>Y</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>External DC switch required</td>
<td>Y</td>
<td>?</td>
<td>N</td>
</tr>
</tbody>
</table>

DC box model DC02 D02 X

<table>
<thead>
<tr>
<th>Inverters distributed</th>
<th>N</th>
<th>N</th>
<th>Y</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficult access between inverter and combiner box</td>
<td>Y</td>
<td>-</td>
<td>-</td>
<td>N</td>
</tr>
<tr>
<td>Distance inverter/combiner box &gt;10 m</td>
<td>N</td>
<td>Y</td>
<td>-</td>
<td>N</td>
</tr>
</tbody>
</table>

DC box model AC01 AC02 X

- 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 ≥ \( \sum \) inverters rated power of the zone
  - Use of AC02 box for each inverter → SPD required

<table>
<thead>
<tr>
<th>Grid box type</th>
<th>GB1</th>
<th>GB1</th>
<th>GB2</th>
<th>GB3</th>
<th>GB1</th>
<th>GB2</th>
<th>GB3</th>
<th>GB1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthing System</td>
<td>TNS</td>
<td>TT</td>
<td>TNS</td>
<td>TT</td>
<td>TNS</td>
<td>TNS</td>
<td>TT</td>
<td>TT</td>
</tr>
<tr>
<td>External protective relay required</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Distribution box type</td>
<td>DB2</td>
<td>DB3</td>
<td>DB1</td>
<td>DB4</td>
<td>DB5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated power of distribution box</td>
<td>Pn ≥ 4 inverters rated power of the installation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency shutdown required</td>
<td>Switch release required</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid point connection indoor/outdoor</td>
<td>indoor</td>
<td>Special SF enclosure type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lightning risk</td>
<td>medium, high</td>
<td>SPD type 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>maximal</td>
<td>SPD type 1</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Application case
Commercial Building – Hoor – NL

Initial information
- PV field features:
  - PV modules: cSi type, 235Wp
  - Number of independent 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

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

<table>
<thead>
<tr>
<th>Zone 1</th>
<th>Zone 2</th>
<th>Zone 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Configuration:</strong></td>
<td><strong>Pzone = 28.2 kWp</strong></td>
<td><strong>Pzone = 31 kWp</strong></td>
</tr>
<tr>
<td># of inverters: 2 x Conext 15kW</td>
<td># of inverters: 2 x Conext 15kW</td>
<td># of inverters: 2 x Conext 20kW</td>
</tr>
<tr>
<td># of modules: 120</td>
<td># of modules: 132</td>
<td># of modules: 170</td>
</tr>
<tr>
<td># of strings: 8</td>
<td># of strings: 8</td>
<td># of strings: 8</td>
</tr>
<tr>
<td>8 x strings with 15 modules / string</td>
<td>4 x strings with 16 modules / string</td>
<td>2 x strings with 22 modules / string</td>
</tr>
<tr>
<td></td>
<td>4 x strings with 17 modules / string</td>
<td>6 x strings with 21 modules / string</td>
</tr>
</tbody>
</table>

ELECTRICAL CHARACTERISTICS

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

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’