PV Box 1.360kVA
Concrete BEK300_560

Version	Etat *State*	Date	Rédigé par *Written by*	Vérifié par *Checked by*	Approuvé par *Approved by*
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Document Information

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01 – 20/05/2015		

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Summary

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1 Introduction

1.1 Purpose

This document provides all main information in order to describe the standard PV Box features with all electrical equipment inside for the photovoltaic power plants.

This PV Box has been optimized to meet all IEC standards constraints, the climatic conditions, the photovoltaic power & grid voltage requirements, the road transportation constraints and the monitoring remote options. It is then compatible with most of the PV plant projects around the world.

The solution described below can be adapted to several environmental and electrical conditions and consequently, shall be configured according to project location.

1.2 Advantages of Schneider Electric PV Box solution

1.2.1 Flexible

- Configurable to be optimized for specific project needs (climate, grid, power, transport)
- Adaptable to withstand severe weather conditions: continental, tropical, close to sea
- Adaptable to most of the MV grid voltages and codes
- Full grid-interactive functions available with configurable inverters
- Numerous building codes and requirements already integrated in the design

1.2.2 Easy to install

- Compact (to minimize civil work costs and unloading)
- Delivered pre-assembled, configured, and tested to reduce on-site labor and project duration
- Mono-block integrated basement so that installation on site shall not require any other work than soil preparation based on soil geotechnical characteristics

1.2.3 Easy to service

- Factory tested solution in order to minimize commissioning time
- Convenient and safe enclosure design for maintenance purposes by any weather conditions
- Integrate a variety of local health & safety requirements
- Separate MV and LV rooms for safe maintenance
- Local Schneider Electric service available in 100+ countries

1.2.4 Designed for reliability

- Tested and qualified in harsh environmental conditions
- Type-tested solution according to IEC-62271-202
- Industrialized solution according to Schneider Electric proven industrial processes
- Equipment made in Schneider Electric factories
- Robust design through rigorous Custom Reliability
- Components designed for lifespan of 20+ years in tough conditions

- Configurable to withstand severe weather conditions: continental, tropical and close to sea

1.2.5 Higher return on investment

- Optimized CAPEX: Feature level matching exactly customer requirements, reduced transportation and installation costs, no on-site wiring or cabling
- Reduced OPEX: Qualified and reliable design minimizing the risk of failure and the cost of site interventions
- Maximum production: High efficiency components (inverters, transformers)
- Increased lifespan: Components are kept in optimum ambient conditions whatever external conditions

1.2.6 True bankability

- Warranty from a trusted partner with over 177 years of experience
- World leader in industrial power drives, UPS and electrical distribution
- Strong service infrastructure worldwide to support your global needs

2 PV Box in concrete

2.1 Mechanical structure

The PV Box is made of 2 main parts ensuring the associated functions:

1. Concrete basement.
   - Supports the whole system
   - Allows cables connecting and path
   - Supports equipments
   - Retains transformer's oil in case of leakage
   - Offers a precasted foundation
2. Concrete walls and roof
   - Isolates whole system
     i. Waterproof
     ii. Thermal insulation
   - Protects from outer aggression

2.2 Electrical structure

There are 3 electrical compartments:

1. Low Voltage (LV) compartment containing:
   - 2 inverters
   - 1 DC Box
   - 1 LV Box
   - 1 mounting space for external monitoring cabinet

2. Transformer compartment, containing:
   - 1 Power Transformer
   - 1 Auxiliary Transformer

3. Medium Voltage (MV) compartment containing:
   - 1 Ring Main Unit with protection relay

2.3 Reference standards

PV Box is designed according to IEC 62271-202 (High-voltage/low-voltage prefabricated substation) applicable requirements.

PV Box components refer to following standards:

Reference standards	
Substation	IEC 62271-202 High-voltage/low-voltage prefabricated substation
	IEC 60529 Degrees of protection provided by enclosures (IP code)
	IEC 60721 Classification of environmental conditions
Transformer	IEC 60076-1 to 10 Power transformers
	EN50464-1 Three-phase oil-immersed distribution transformers 50 Hz, from 50 kVA to 2 500 kVA with highest voltage for equipment not exceeding 36 kV

MV Switchgear	IEC 60255-1 Measuring relays and protection equipment Part 1 : Common requirements
	IEC 60265-1 High-voltage switches Part 1: Switches for rated voltages above 1 kV and less than 52 kV
	IEC 62271-1 High-voltage switchgear and controlgear Part 1: Common specifications
	IEC 62271-100 High-voltage switchgear and controlgear Part 100 : Alternating-current circuit breakers
	IEC 62271-102 High-voltage switchgear and controlgear Part 102 : Alternating current disconnectors and earthing switches
	IEC 62271-103 High voltage switches for rated voltage above 1 kV and less than 52 kV
	IEC 62271-105 High-voltage switchgear and controlgear Part 105 : Alternating current switch-fuse combinations
	IEC 62271-200 High-voltage switchgear and controlgear Part 200 : AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
Inverter	EN 50178 Electronic equipment for use power installations
	EN 61000-6-2 Electromagnetic compatibility (EMC) Part 6-2 Generic standards-Immunity for industrial environments
	EN 61000-6-4 Electromagnetic compatibility (EMC) Part 6-4 Generic standards-Emission standard for industrial environments
DC box LV box Monitoring cabinet	IEC 61439-1 & 2 Low-voltage switchgear and controlgear assemblies

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3 PV Box design

3.1 Data Sheet

Type of PV Box concrete	PV Box 1.360kVA BEK300_560 (concrete)
	Input ratings (DC)
Nominal PV Box power at PF =1	2×680kW
Max DC voltage, open circuit	1 000 V
Maximum DC current	2×1280 A
Max short circuit DC Current in STC conditions	2x1600 A
Max short circuit DC current	2×2000 A
Number of protected DC inputs	2x2x8
	Output ratings (AC)
Nominal AC power	1360 kVA
Nominal MV voltage	Up to 36 kV
Frequency	50 Hz
Power factor range (cosφ)	0,80 leading to 0,80 lagging
	Inverter
Type	2×XC680
Nominal output voltage	380 V
	Auxiliary power connection
Voltage	230 Vac single phases + neutral (Neutral grounded)
Frequency	50 Hz
Auxiliary power Transformer (Optional)	3 kVA
	Cooling
PV Box inverter room	Ventilation ensured by inverter fans (2x4000m^3/h)
PV Box transformer room	ONAN Transformer
	Dimensions and weight
Nominal dimensions LV building BEK300_560 (L/W/H)	5,60 / 2,50m / 3,61m (including basement)
Weight BEK300_560	36,0 Tons (including concrete basement)
	Degree of protection
Internal arc classification (acc. to IEC 62271-202)	IAC A 16kA 1s
Degree of protection	IP54 (Inverter compartment)
	IP23 (Transformer compartment)
	IP54 (RMU compartment)

3.2 Basement design

The PV Box basement is made of precasted concrete allowing the handling of the whole box using a crane.
Holes, allowing external cables connection are distributed along each sides of the PVBOX, except around the transformer compartment, that is completely sealed to be able to contain 100% of the transformer's oil volume in case of leakage.
The external side of the concrete basement is coated to be waterproof. The transformer's retention tank is also coated with a special epoxy painting in order to improve fire resistance and oil retention.

3.3 External connections to PV Box

The typical links to PV box are:

- DC cables:

Qty: 2x300mm^2 x 2 polarities x n arrays box x n inverters
The maximum considered is 8 Array Box /inverter

- MV cables:

Qty: 3x1x240mm^2 x 2 connections

- LV auxiliary + Communication to Array Box:

Qty: 4x3G6mm^2 + RS485

- Communication between PV Box:

Optical fiber and RS485

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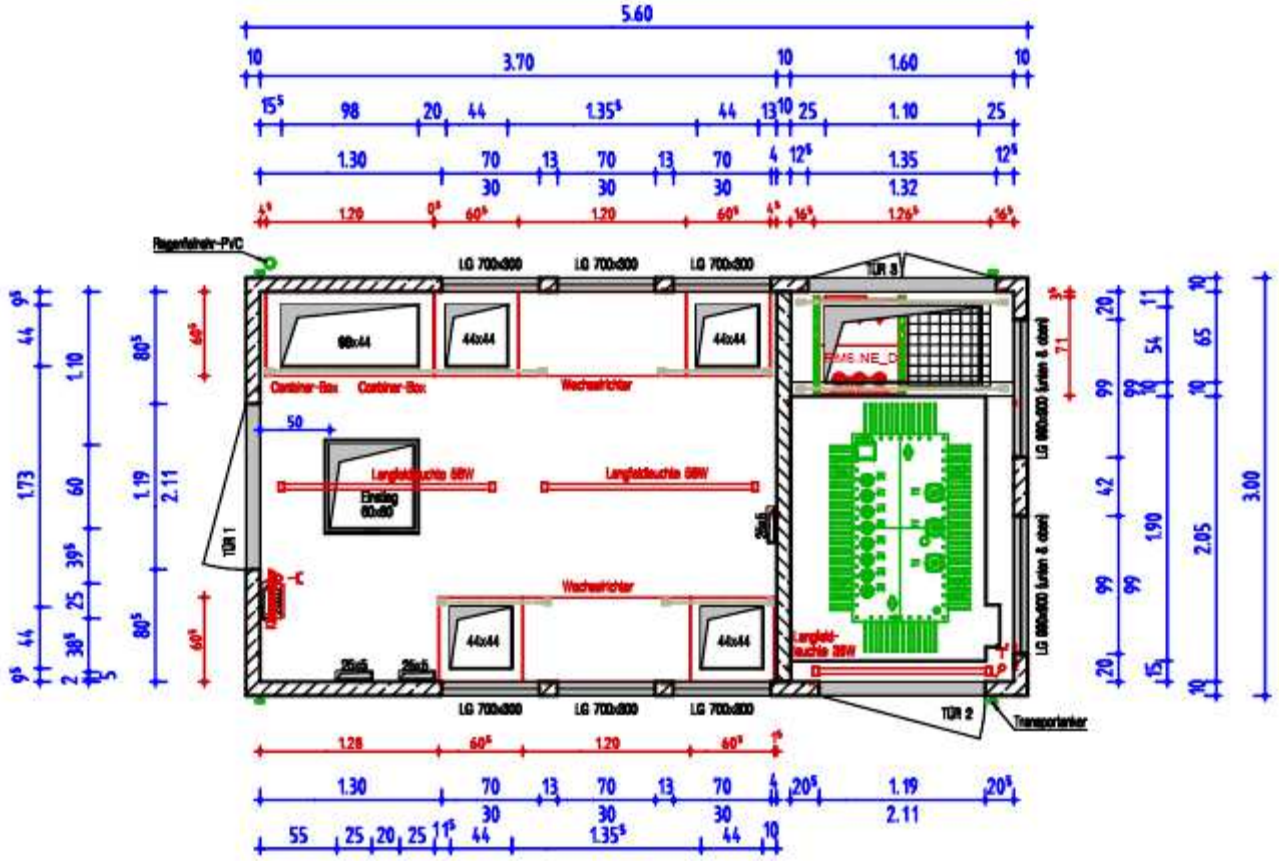
3.4 PV-Box design

Here below views of the PV Box arrangement for the configurations with four inverters.

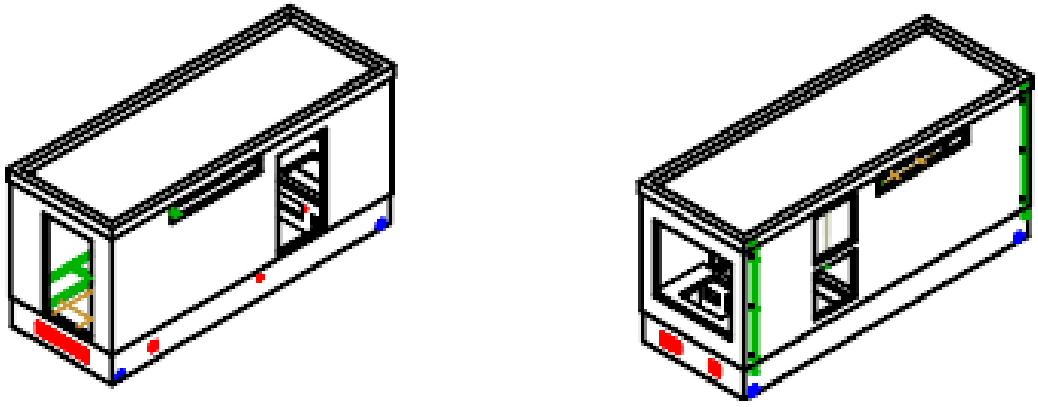
Top view:

Example of 20 kV / 2 inverters PV Box



PV Box 3D view:

Example of 20 kV / 2 inverters PV Box



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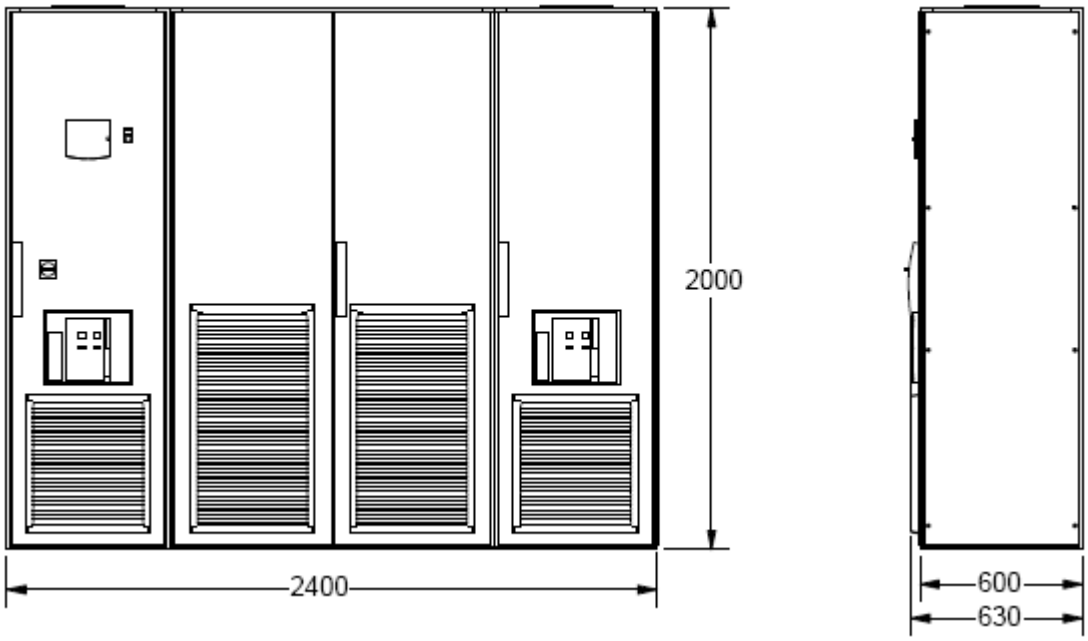
4 Main electrical equipment features

4.1 Inverter

The power conversion system of the PVBOX is the XC series inverter. According to the PV Box type Conext Core XC680.

Inverter Drawing:



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Electrical data (XC540, XC630 and XC680):

Device short name	XC540	XC630	XC680
Electrical specifications			
Input (DC)			
Input voltage range, MPPT	440 - 800 V (at PF=1)	510 - 800 V (at PF=1)	550 - 800 V (at PF=1)
Static MPPT accuracy	>99.9% 5% to 100% of nominal power Entire MPP (maximum power point) range; PV generator Fill Factor from 60-80%	>99.9% 5% to 100% of nominal power Entire MPP (maximum power point) range; PV generator Fill Factor from 60-80%	>99.9% 5% to 100% of nominal power Entire MPP (maximum power point) range; PV generator Fill Factor from 60-80%
Input voltage range, operating	440 - 885 V	510 - 885 V	550 - 885 V
Max. input voltage, open circuit	1000 V	1000 V	1000 V
Max. input current	1280 A	1280 A	1280 A
Max. input short circuit current	2000 A	2000 A	2000 A
Output (AC)			
Nominal output power	540 kVA	630 kVA	680 kVA
Real power	540 kW (at PF=1)	630 kW (at PF=1)	680 kW (at PF=1)
Reactive power range	+ / - 540 kVAr	+ / - 630 kVAr	+ / - 680 kVAr
Output voltage	300 V	350 V	380 V
Frequency	50 / 60 Hz	50 / 60 Hz	50 / 60 Hz
Nominal output current	1040 A	1040 A	1040 A
Power factor settable range (Ppf dispatch)	0.8 to 1.0 leading and lagging	0.8 to 1.0 leading and lagging	0.8 to 1.0 leading and lagging
Power factor range (PQ dispatch)	0 to 1 leading and lagging	0 to 1 leading and lagging	0 to 1 leading and lagging
Harmonic distortion	< 3% at rated power	< 3% at rated power	< 3% at rated power
Efficiency (to IEC61683)			
Maximum (@ 50Hz)	98.5%	98.7%	98.9%
European (@ 50Hz)	98.3%	98.4%	98.6%
CEC (@ 60Hz)	98.5%	98.5%	98.7%
General specifications			
Power consumption, night time	< 100 W	< 100 W	< 100 W
IP degree of protection	IP20	IP20	IP20
Enclosure material	Steel	Steel	Steel
Seismic	IEEE-693-2005 High performance level*, ICC-ES AC156-2012**		
Product weight	1590.0 kg (3505.0 lb)	1590.0 kg (3505.0 lb)	1590.0 kg (3505.0 lb)
Product dimensions (H x W x D)	209.5 x 240.0 x 66.0 cm (82.0 x 94.5 x 26.0 in)	209.5 x 240.0 x 66.0 cm (82.0 x 94.5 x 26.0 in)	209.5 x 240.0 x 66.0 cm (82.0 x 94.5 x 26.0 in)
Ambient air temperature for operation	-10°C to 45°C (14°F to 113°F) full power. Power derating to 50°C		
Operating altitude	1000 m, derating for higher altitudes		
Relative humidity	0 to 95% non-condensing		
Features and options			
Type of cooling	Temperature-dependent forced convection cooling		
Display type	LCD multifunction removable display standard		
Communication interface	RS485/Modbus standard		
AC/DC disconnect	Load break rated DC disconnect and AC circuit breaker standard		
Ground fault detection/interruption	Optional isolation monitoring relay or GFDI with circuit breaker		
Sub-array combiner	Optional external combiners with various quantities and trip ratings		
Regulatory approvals			
Conext Core XC Series are CE marked for the EMC Directive (EN61000-6-2 and EN61000-6-4) and Low Voltage Directive (EN50178)			
Conext Core XC Series complies	French order of April 23, 2008, IEC 61727, PO 12.3 (Spain), US-MV (FERC 661/661A, FRCC, WECC, NERC PRC-024-1), BDEW (Germany), RD1663/200 (Spain), RD661/2007 (Spain), CEI-016 (Italy), ANRE Order 30/2013 (Romania), PEA (Thailand)		

Specifications are subject to change without notice. Other input voltage windows and power outputs available.
*ZPA=1.0 g 2% damping, **Seismic demand spectrum (SDS) of 1.78g and z/h of 0 Ip =1.5 (ground mounted equipment)

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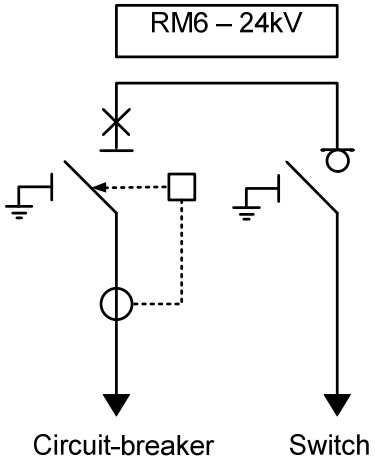
4.2 MV switchgear

MV switchgear references:

- RM6 NE-DI (Radial topology) up to 24 kV

In any case, transformer is protected by a Circuit Breaker cubicle with VIP 30/35/45 protection relay. Switch cubicles are used to connect upstream and downstream MV cables coming from other PV Boxes or Grid Main Substation.

Single Line Diagram:



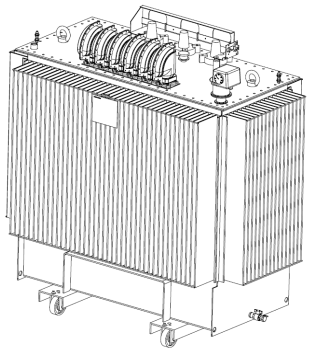
Electrical features:

Description	Unit	Value
		RM6
Rated voltage	kV	24
Frequency	Hz	50
Short-circuit current (1 sec.)	kA	16
Power frequency withstand voltage: 50Hz/1 min	kV rms	50
Lightning impulse withstand voltage : 1.2/50µs	kV peak	125
Auxiliary motors (for motorized version)	Vdc	48
Auxiliary supply voltage	Vac	230
Number of mechanical opening operations		2000

4.3 MV / LV transformer

The transformer is used to increase inverter output voltage to MV level, and to realize a galvanic insulation between LV and MV.

Description:



- Three-phases three windings mineral oil distribution transformer complying IEC
- Aluminum windings (or copper for some versions)
- Limited inrush current (< 10 In)
- Hermetically sealed or screwed, oil transformer
- RAL 7033 final color
- ONAN cooling type
- New mineral oil in according to the IEC 60296 – Specific to high temperatures
- Outdoor installation
- Compliance to IEC 60076-1 to 10 and EN 50588-1
- Electrostatic screen between primary and secondary windings

Following Standard Electrical Characteristics are proposed as a standard:
(Other characteristic can be proposed)

Ground mounted immers. transfo - Three phases- Type Indoor use - According to EN 50588-1

Dielectric liquid :	Mineral oil
Rated power (ONAN) :	1360 kVA
Operation :	Step-up
Rated frequency :	50 Hz
Vector group :	D y 11
Windings HV/LV :	According to manufacturer optimisation

Rated high voltage HV1 : .....20000 V (On-load)

Rated high voltage insulation level :	24 kV
Applied voltage to industrial frequency :	50kV
B.I.L. (1,2 / 50 µs) :	125kV
HV tapping (off-circuit) :	+/-3,5%/+/-7% (5 positions)
Power factor (customer installation) :	1

Rated low voltage LV1 : ..... 380 V (680kVA)

Rated low voltage insulation level :	1.1 kV
Applied voltage to industrial frequency :	3
B.I.L. (1.2 / 50 µs) :	N/A

Rated low voltage LV2 : ..... 380 V (680kVA)

Rated low voltage insulation level :	1.1 kV
Applied voltage to industrial frequency :	3
B.I.L. (1.2 / 50 µs) :	N/A

High voltage connections

Number of connections :	3
Connections location :	On the cover
Connections type :	Fixed plug-in bush. EN 50180
Connections characteristics :	250 A / 24 kV

Low voltage connections

Number of connections :	6
Connections location :	On the cover
Connections type :	Bus-bars
Connections characteristics:	1250 A / 1.1 kV
Cables box type :	Steel - Type 21-S - IP 21
Removable plate on cables boxes :	Aluminium

Electrical characteristics

No load losses :	1183 W
Load losses (ONAN) at 75°C :	13137 W
Impedance voltage (ONAN) at 75)C :	6 %
Tolerances :	Without overtaking of losses

Thermal characteristics

Thermal insulation class :	Class A
Windings temperature rise :	65 K
Dielectric temperature rise :	60 K

Dimensions & weights (transformer with accessories)

Length (+/-200 mm – non contractual) :	1750 mm
Width (+/-200 mm – non contractual) :	1080 mm
Height (+/-200 mm – non contractual) :	2185 mm
Weight (+/-20 % – non contractual) :	4100 Kg

Mechanical characteristics

Technology :	Hermetically sealed
Tank type :	With fins or with radiators
Cover:	Bolted
Frame type :	Standard
Corrosivity category :	C3 (medium corrosivity)
Durability (ISO 12944-6) :	Medium (5-15 years)
Bolts :	Stainless steel
Final colour :	RAL 7033 greenish-grey

Site conditions

Altitude :	≤ 1000 m
Maximum ambient temperature :	40 °C
Daily average temperature :	30 °C
Yearly average temperature :	20 °C
Minimum standby temperature :	-25 °C
Electrostatic screen :	Yes
Rectifier supply :	No

Basic equipments

Bi-directional rollers :	4
Lifting lugs :	2
Earthing connections (M12) :	1
Haulage holes on base :	4
Draining device :	1
Rating plate fixed on HV side (Aluminium - in French) :	1
Installation manual :	1

Additional requested equipments

DMCR
2 free thermometer pockets
Drain valve with sampling device

Routine tests according to IEC 60076 standard

Induced voltage dielectric test :	Yes
Applied voltage dielectric test :	Yes
Measurement of the no load losses and current :	Yes
Measurement of the HV and LV resistances :	Yes
Measurement of the load losses and Uk :	Yes
Measurement of the transformer ratio & vector group :	Yes
Test report (in French - English) :	1
Factory acceptance tests with customer :	No

(1): Contractual voltage at the connection point

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Accessories:

- DMCR protection relay
- 3 x plug-in bushing 250A up to 24kV
- 3 x LV bushings (1250A) by secondary
- 1 thermostat (for the desert/tropical version only)
- Valves for oil filling, draining and sampling
- 2 x earthing terminal on the tank
- 4 x bidirectional rollers under the tank
- 2 x lifting lugs
- IP2X protection on the LV bushings
- Rating and diagram aluminum plate

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4.4 DC Box

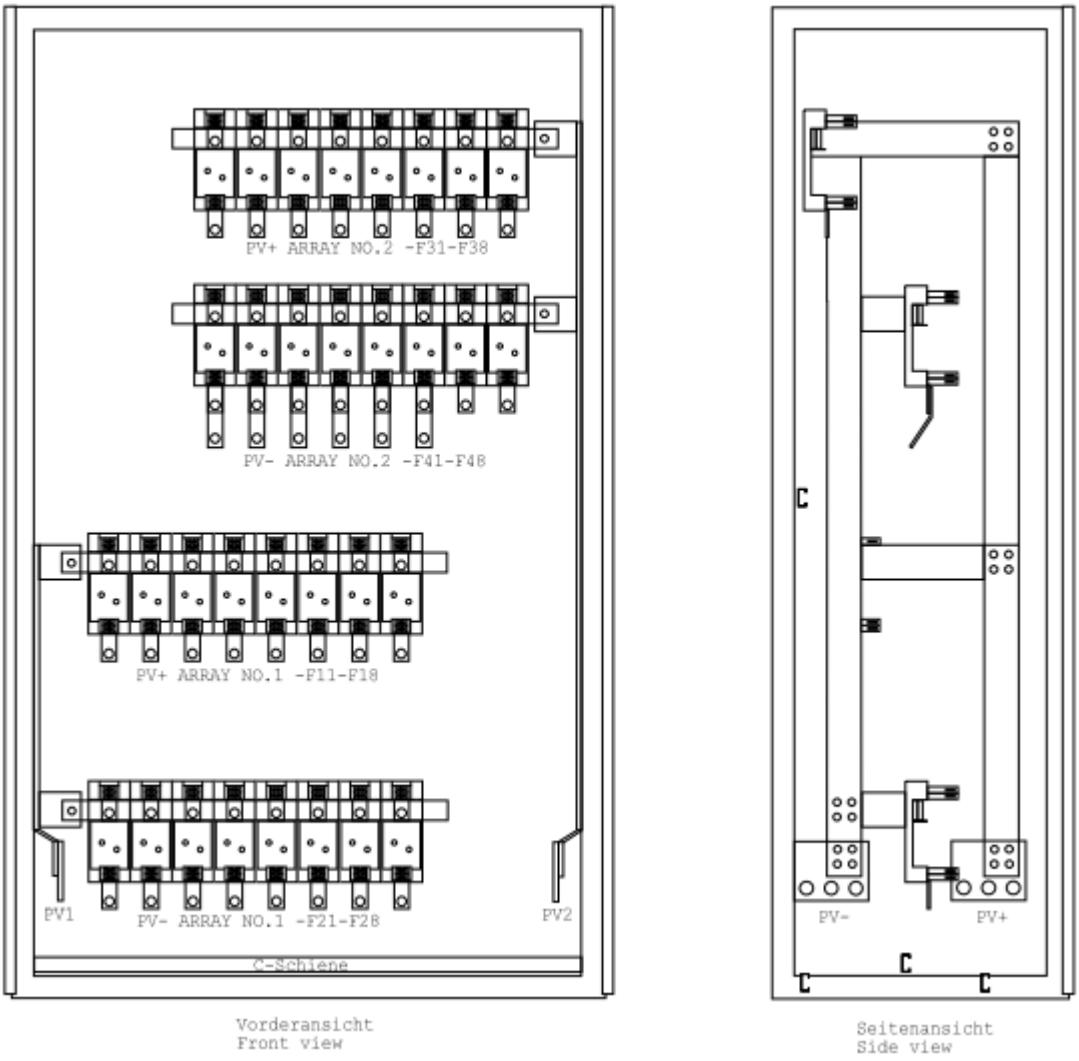
The DC Box makes the connection and protection of cables from Arrays Boxes to inverters. The DC Box is available in 8 feeders.

The protection is made on the two polarities with gPV fuses, up to 1000Vdc, with a large choice of rated current (160 A to 400A).

DC Box is supplied with fuse holders from Wöhner and fuses from Siba.

View diagram:

DC box 8 ways



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DC Box Electrical data:

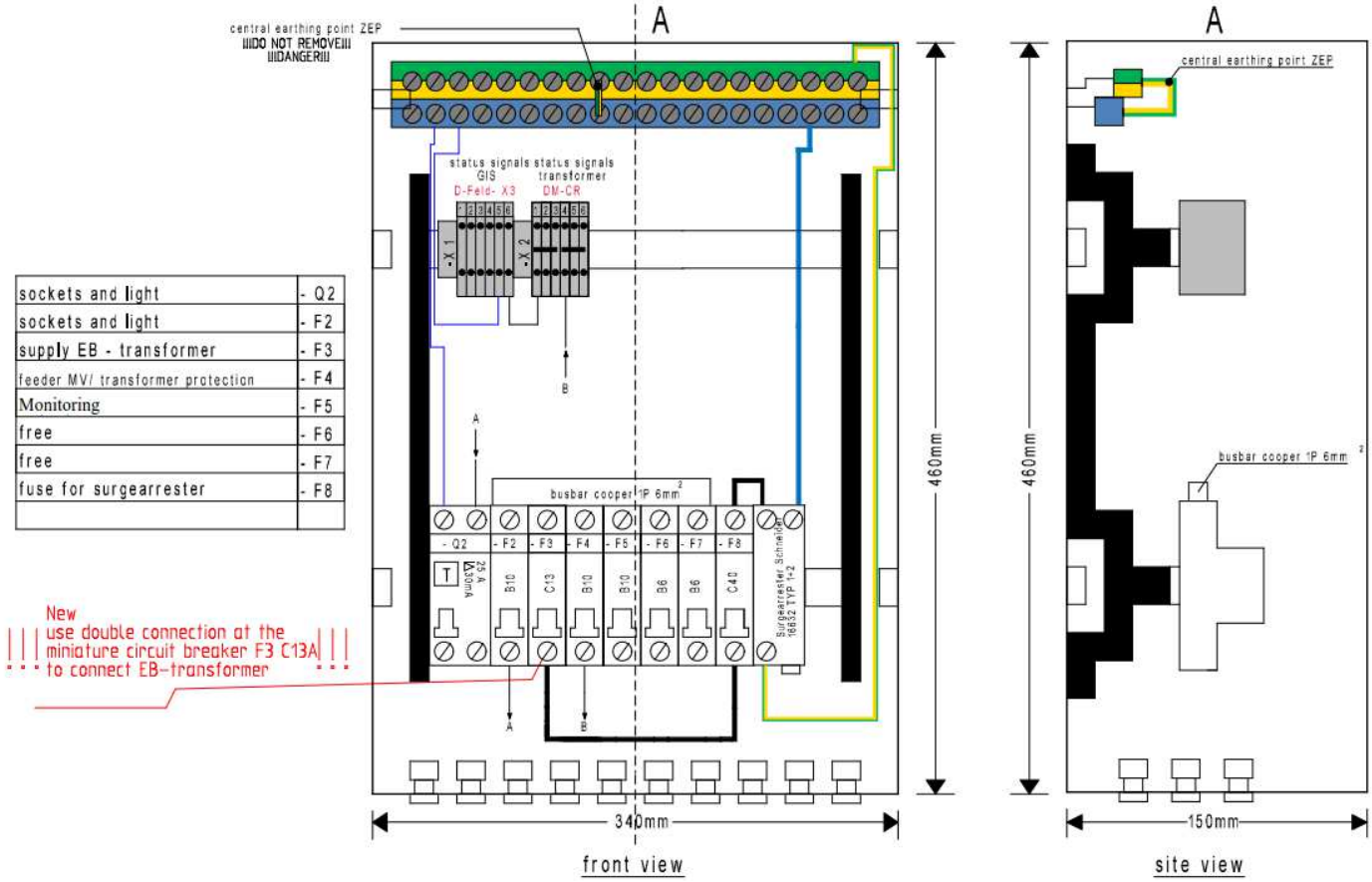
Norm	DIN EN 61439 / VDE 660 part 600
Order-No.	AU-1400517 / Combiner Box
Typ	Schneider Electric Spacial SF
Protection system	IP20
Protection class	I
Voltage	max. 1000V DC
Current	2 x 1280A DC
Control voltage	
Frequency	
Date	03.03.2015
Checked	Reschke
Device-No.	001

4.5 LV Box

The LV Box includes all devices required to supply and to protect PV Box auxiliaries:

- MV switchgear
- PV Box auxiliaries
- PV Box Monitoring Cabinet (if applicable)
- Battery charger for Monitoring Cabinet (if applicable)

View diagram:



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4.6 Auxiliary transformer

The auxiliary transformer supply power to auxiliaries directly from the PV Box (connection at one inverter AC side).

Description

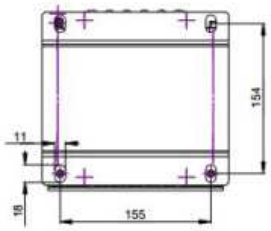
Power Supply for internal electrical consumer. Realization of the galvanic isolation

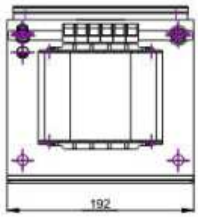
Features

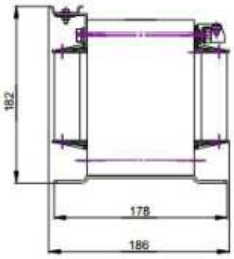
- Auxilary transformer 300-350-380V
- Single-phase isolation transformer IP00
- Prim.: 300-350-380 fuse protection Zyl. 20A
- Sek.: 230V no fuse protection
- Power: 3000VA, 50-60Hz

Specificationen and Dimensions/ Weights

Technisches Datenblatt(Technical datasheet)		
EB03KVA-MULTI-V2 **nach / acc to VDE 0570 Teil 2-2 (EN61558-2-2)**		
Leistung	3000 VA	Rated output power
Eingangsspannung	1 x 300/350/380V AC	Rated supply voltage
Absicherung Eingang	20A 10x38gG	Fuse Incomer
Frequenz	50-60Hz	Rated frequency voltage
Ausgangsspannung	1 x 230V AC	Rated output voltage
Ausgangsstrom	13A AC	Rated output current
Absicherung Ausgang	Automat C13A	Fuse output
Leerlaufverluste (typ)	60W	No-load losses typ.
Schaltgruppe	Ii0	Vector group
Schutzart	IP 00 / I	Protection class
Isolierstoffklasse	IEC 60085 : B	Insulation class
Kühlung	AN	Cooling
Betriebsart	DB / S1	Operation mode
Höchste Umgebungstemperatur	40°C	Rated max. ambient temperature
Anschluß Eingang Klemme bis	4mm²	Supply terminals for wires up to
Anschluß Ausgang Klemme bis	4mm²	Output terminals for wires up to
Abmessungen B x T x H	192 x 190 x 186mm	Dimensions WxDxH
Gewicht	27kg	Weight
Artikelnummer	169-0196	Item No.







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5 Your PV Box configuration in conclusion

PV Box RT Configuration			Equipment	Included (√)
Project	Power	1360kVA	2 XC680 + 1Tfo 1360kVA	√
	Grounding system	Floating	Ground fault relay	√
	Grid Voltage	0kV - 24kV	RM6 24kV 2 functions	√
DC side	DC input	2x2x8 channels	DC Box with fuse holder SS Size 2XL/3L (NH1-NH2) and fuse range of 160A – 400A	√
Monitor & Control	Without Monitoring		No wiring	√
Standard Equipment			LV Box: single phase	√
			Auxiliary transformer 3kVA, single phase	√
			Accessories**	√
Options	Automatic Progressive Reconnection		MV Switchgear CB motorization & RMU Box	
	Safety Kit		1 Powder fire-extinguisher 1 insulated rod (MV) 1 casing with insulated gloves 2 anti-panic bars on doors 1 insulating stool	
	Auxiliaries Power Supply		LV/LV transformer	√

****Accessories:**

- 2 fluorescent tube 58W in LV room
- 1 fluorescent tube 36W in MV room
- 3 combinations of switch and sockets

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Project specific comments and exclusions

The PV Box is designed to be plug-and-play. Once delivered on-site, following tasks have to be performed to plug it and to put it in operating conditions:

-Crane it down on a flat, civil work prepared ground in accordance with geotechnical survey
-Connect DC power cables
-Connect LV cables for Array Boxes supply
-Connect power MV cables from solar farm
-Fill with gravels the top of transformer's retention tank to obtain a fire trap
-Commissioning - Punch list of visual inspections and off load tests is deemed clear prior to Commissioning

The positioning of the cables connecting to the panels shall minimize their degree of curvature inside the ducts according to Schneider Electric instructions

Unless stated differently in Schneider Electric commercial proposal, these tasks aren't in the scope of Schneider Electric.

Upon request from the Client, Schneider Electric can propose a service contract including spare parts management, preventive and curative maintenance for an adapted duration (ex: 5 years, 10 years, 20 years)

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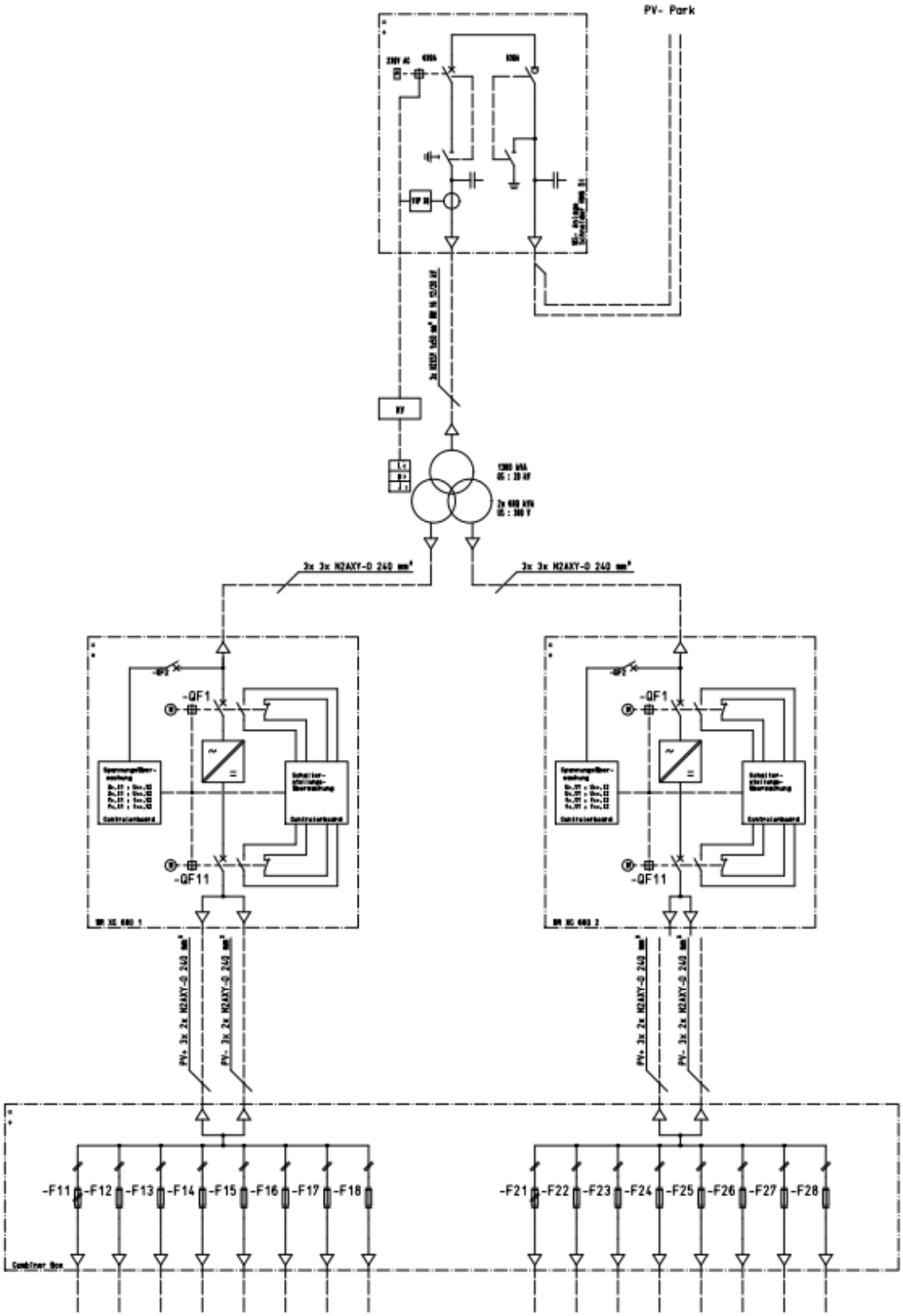
6 Single Line Diagram



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