

MAY 2018

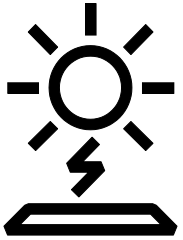
Improving CAPEX and OPEX of PV power plants with high power string inverters

Marco Trova, Product Management Manager

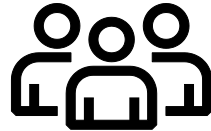


Business Unit Solar

Supporting you with experience, expert knowledge and strong global footprint



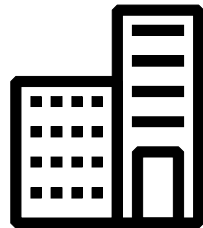
- **40** years experience in power conversion
- **30+ GW** installed solar inverters base



- **~200** ABB solar inverter service experts
- Optimised levelised costs of electricity and plant productivity



- Operate in **+100** countries with dedicated solar specialists in **30+** countries

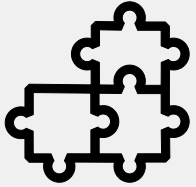


- **4** manufacturing sites
- **6** new products and platforms in 2017
- **~2 million** inverters worldwide shipped

ABB has the complete sun-to-socket offering from a single source

Our portfolio

Broadest inverter range in the industry



- For all power ranges, and all on- and off-grid applications and business models



- One-stop-shop with ABB's sun to socket portfolio



- Backed by a comprehensive package of communication, monitoring and control solutions and service across the complete plant lifetime



Trends in large industrial and ground-mounted applications

Utilising high power, state-of-the-art string inverters to optimise both CAPEX and OPEX

Advanced solutions for new market trends

- Using intelligent inverter technology to optimise the total system efficiency and LCOE of the solar plant
- Market requirement for string inverters with higher power classes and voltage levels
- Higher voltage levels optimise efficiency of power generation
- Advanced communication interfaces and intelligent remote monitoring and control for grid support and max. plant productivity



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Introduction of PVS-120

New high-power string inverter solution reduces CAPEX and OPEX

For large commercial/ industrial rooftops and for ground mounted PV installations

PVS-100/120 three-phase string inverter

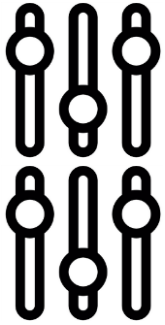


- **High power density** – 50% fewer inverters required and 50% less logistic/ installation costs
- **Easy to install** – Fast installation and easy configuration, thanks to ABB Ability™ platform
- **Maximised design flexibility** – 6 MPPT and wide input voltage range
- **Combiner-free design** – All-in-one integrated string combiner
- **Smart communication** – Proactive control and management of the solar plant through ABB Ability™. Commission and troubleshoot all units with standard mobile devices
- **High reliability** – Via extensive testing and advanced cooling methods



PVS-100/ PVS-120 – Technical Parameters

Inverter parameters



6 Independent MPP channels/ 24 strings

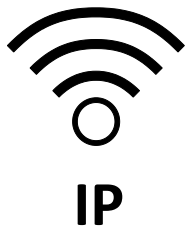
PVS-100

- 100kW, 400Vac, 50/60Hz
- VMPPT = 480 – 850 Vdc

PVS-120

- 120kW, 480Vac, 50/60Hz
 - VMPPT = 570 – 850 Vdc
- Max Efficiency 98.9%, EU 98.6% (PVS-120)

Communication



2x Ethernet;
Wi-Fi Channel

IP communication

1 x RS485;

Modbus RTU/ TCP (Sunspec compliant)

Integrated data logger and direct connection to Aurora Vision remote portal

User Interface



Standard LEDs

Integrated Web User Interface for managing inverter

IOS and Android installation app for multiple inverter commissioning

Standard level access to Aurora Vision remote monitoring service

Constructions, kg, vol



Two box construction, IP66

Forced air cooling

Mounting vertically/ horizontally



High Power density ~1000W/kg

Two box construction

Dimensions

High power density almost 1000W/kg

Two box structure (Inverter box ~70 kg, wiring box ~55kg)

Robust enclosure IP66 protection – monitored, replaceable fans IP54

Benefits

- **Two person can manage** the mounting of boxes
- **Cost savings on logistics**
- Wiring box/ inverter box can be stocked separately
- Future local variants of wiring box possible



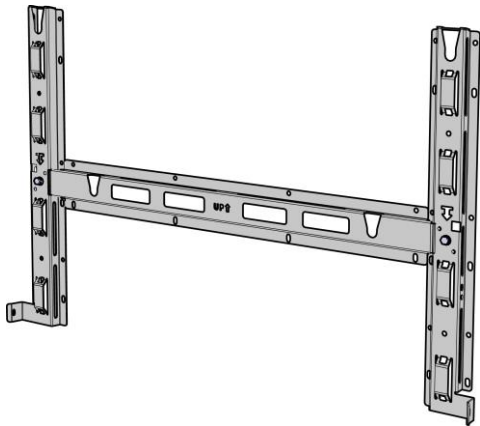
Horizontal and vertical mounting

Mounting bracket

Same bracket can be used in **vertical and horizontal** positions

Wiring box is installed at first and then power module

Power module can be easily **swap and replace** without removing the wiring box



Vertical



Horizontal



Reduced height for vertical mounting

Lateral DC/AC cable access

DC: 24 string inputs on left side

AC output on right side

Comm wiring 2xEth & RS485 on right side

Benefits

- Fits to plants where **reduced distance from PV panel to ground**
- Maintenance and installer friendly: **easy visual inspection, no need to go on knees** when installing cables
- Enough **space inside for AC cabling**
- **Large diameter cabling** support to lower AC side losses



Increased lifetime with advanced cooling

Advanced cooling concept

Forced cooling

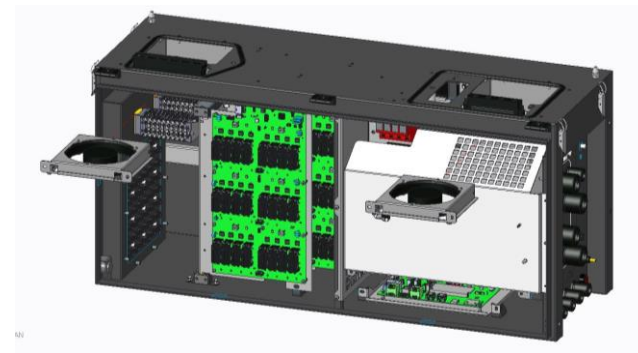
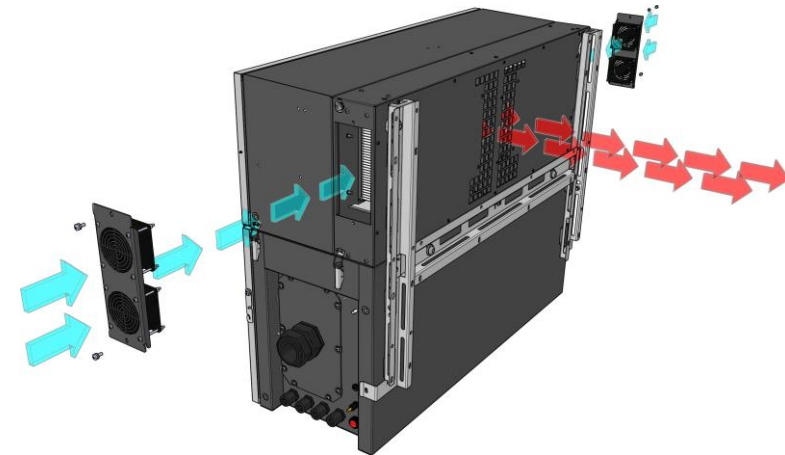
- Cold air from the sides of the unit
- Hot air exhaust from the rear

Internal air circulation with help of fans inside both boxes that are IP66 protected

Monitored and replaceable IP54 fans on both sides of the unit, internal fans circulating air inside boxes (2x2 external, 3 internal fans)

Benefits

- **Increased lifetime** as temperature of components kept under control
- Enables **vertical and horizontal** mounting
- Wiring box temperature controlled (minimize stress on fuses/ contactors)

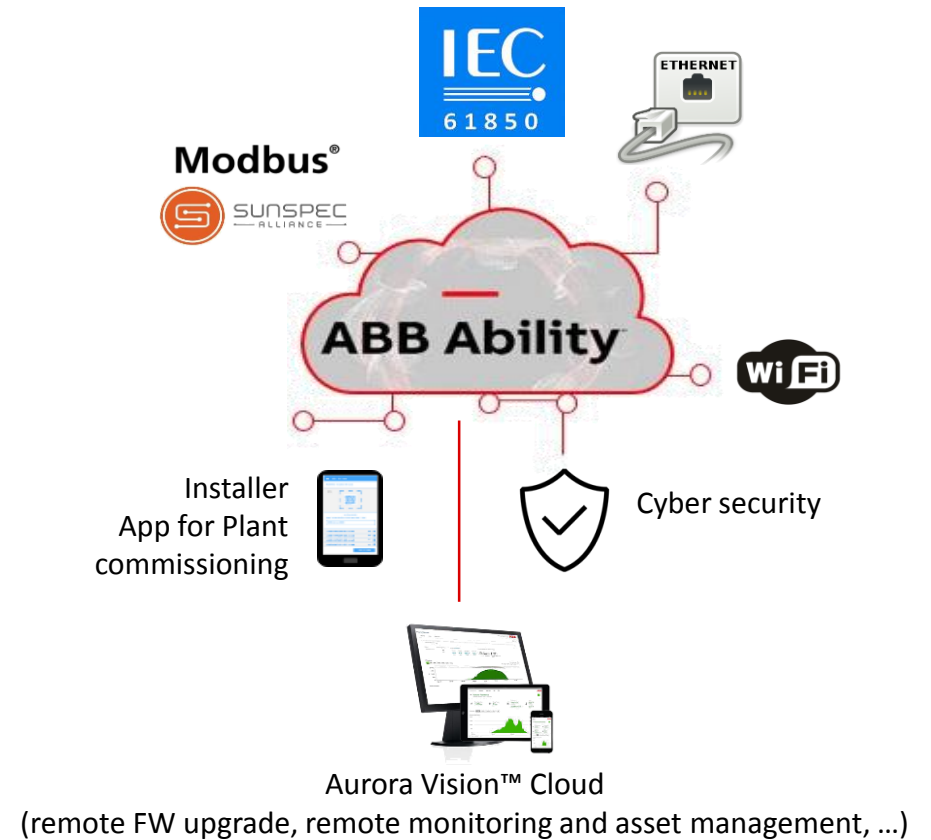


New smart ABB Ability™ communication capabilities

For PVS-100/120 three-phase string inverter, but also other latest additions to inverter portfolio

Benefits to customer

- **Improved user experience** in using ABB string solar inverters (Installer App for plant commissioning, installation wizard,...)
- **Reduced plant complexity and increased plant reliability** by integrating into the inverter advanced logging and controlling capabilities
- **Proven standard technology** for better protecting customer's investment (TCP/IP, Modbus Sunspec certified, IEC 61850 information model,...)
- **Compliant** with current/ future regulatory norms (like Rule 21- Step 2, EC61850, ...)
- Scalable closed loop control solution enabling **effective zero injection** as well as advanced utility's controlling strategy
- **Cyber Security managed:** Crypt transferring of data to the cloud, centralized managing of accounts
- **Minimized customer costs** by minimizing devices to install, simplifying commissioning procedure and providing lifetime standard level access to Aurora Vision monitoring portal



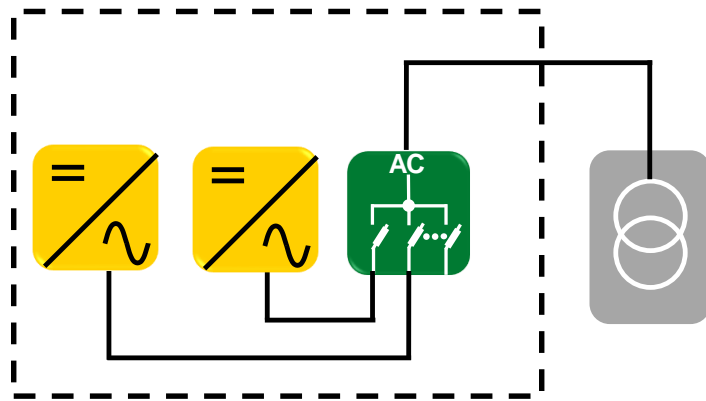
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Cost effects in plant design and installation

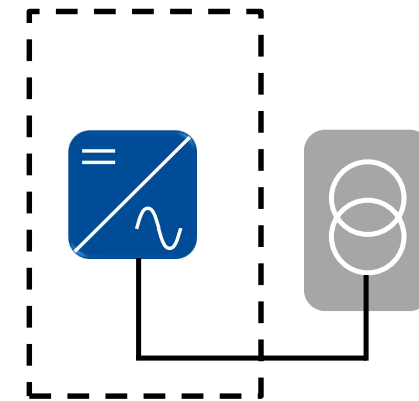
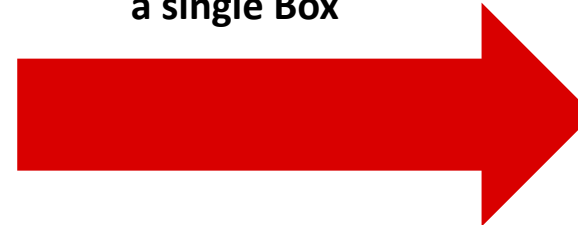
Effects of power density on block design and costs

ABB PVS-100 / PVS-120

- The largest power rating on the market for a 1000Vdc string inverter!
- Less inverters are required to complete the optimal power block
- Reduced logistic and installation costs



From 3 Boxes
to
a single Box



Effects of power density on block design and costs

2,4 MW Power Block Layout

– N° 20 x PVS-120: 24 strings for each inverter

or

– N° 40 x 60kVA Inverter: 12 strings for each inverter
(ref. TRIO-60.0-TM)

COMMON DATA	
Installed DC Power [kWp]	2976
PV module Type	Poly
	72cells
	310Wp
Panels in series	20
Total number of strings	480



Effects of power density on block design and costs

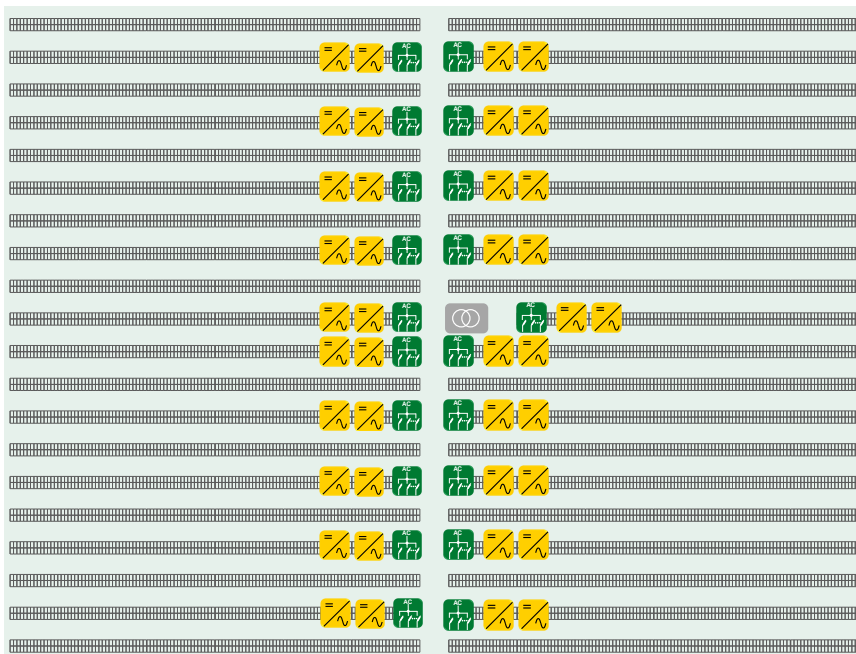
2,4 MW Power Block Layout



60kW Inverter solution

40 inverters / 120 MPPT are required

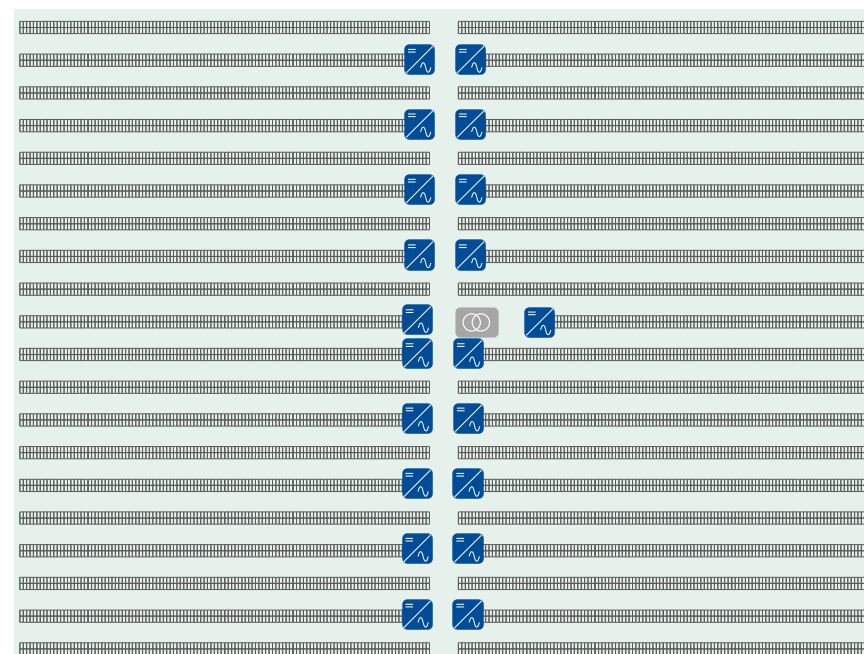
20 AC recombining boxes are required



PVS-120 inverter solution

20 inverters / 120 MPPT are enough

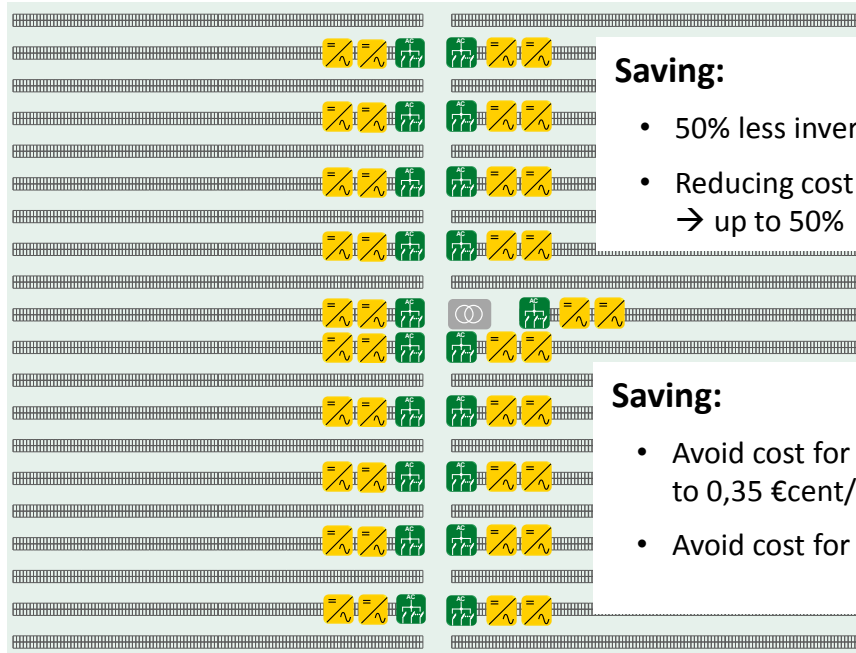
No recombining boxes needed



Effects of power density on block design and costs

2,4 MW Power Block Layout

60kW Inverter solution



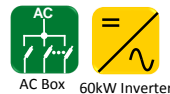
Saving:

- 50% less inverters
- Reducing cost for logistics and installation
→ up to 50%

Saving:

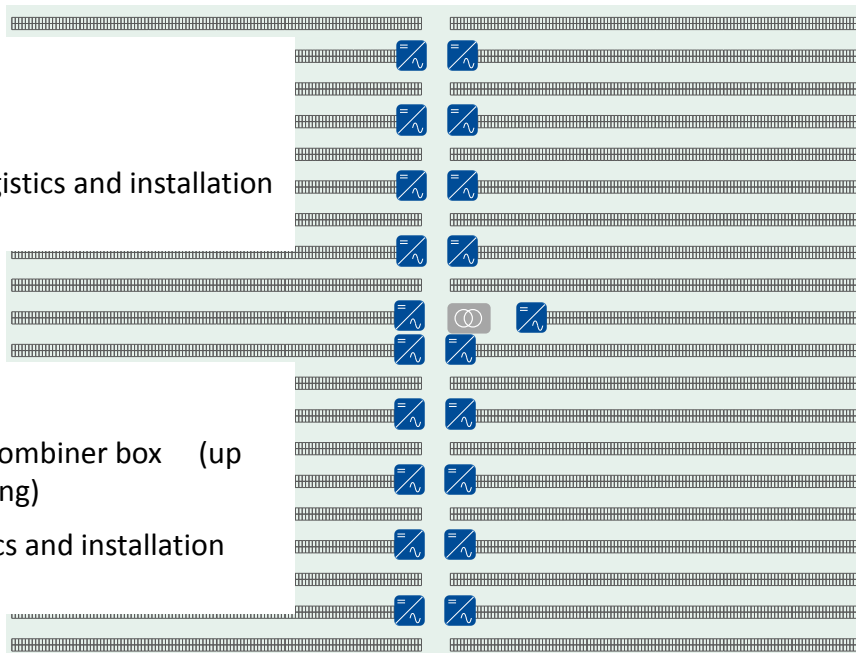
- Avoid cost for AC recombined box (up to 0,35 €/cent/W saving)
- Avoid cost for logistics and installation

- N° 40 inverter / 120MPPT
- N° 20 AC recombined box



- N° 20 inverter / 120MPPT

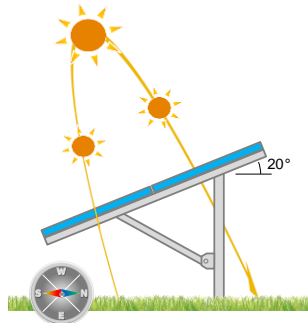
PVS-120 inverter solution



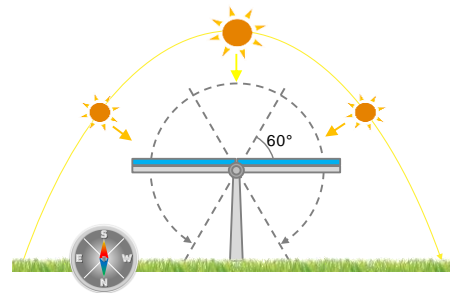
Versatile inverter allowing design flexibility

ABB PVS-100 / PVS-120

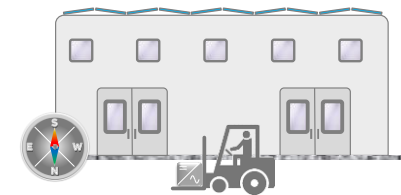
- Multi-MPPT (6), wide input voltage range platform
- Larger capacity comes without compromising the inherent flexibility and versatility which is typical of smaller string inverters
- Design-friendly inverter, can be easily adapted for any application in commercial rooftop and free field ground mount installations



Fixed Tilt Mounting



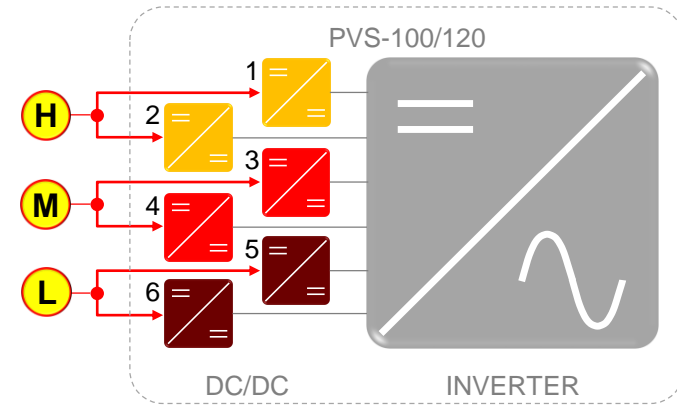
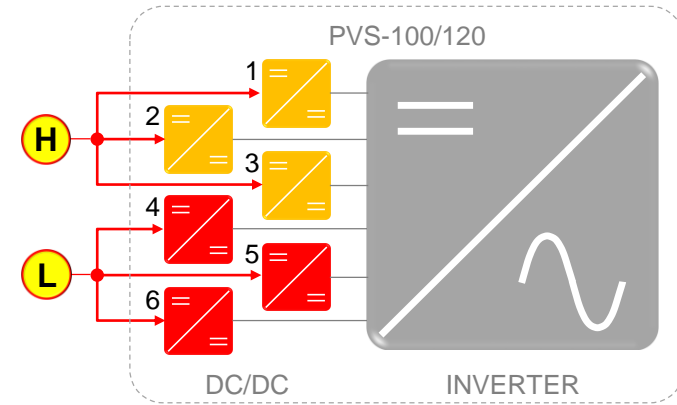
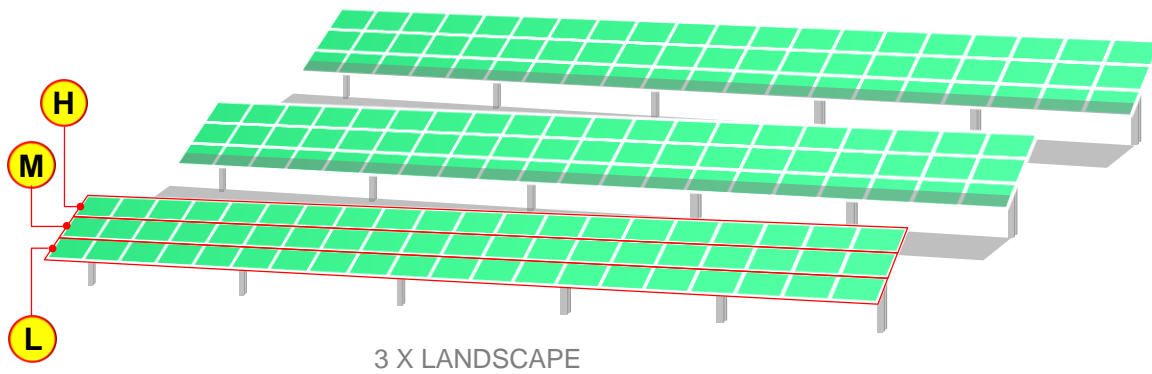
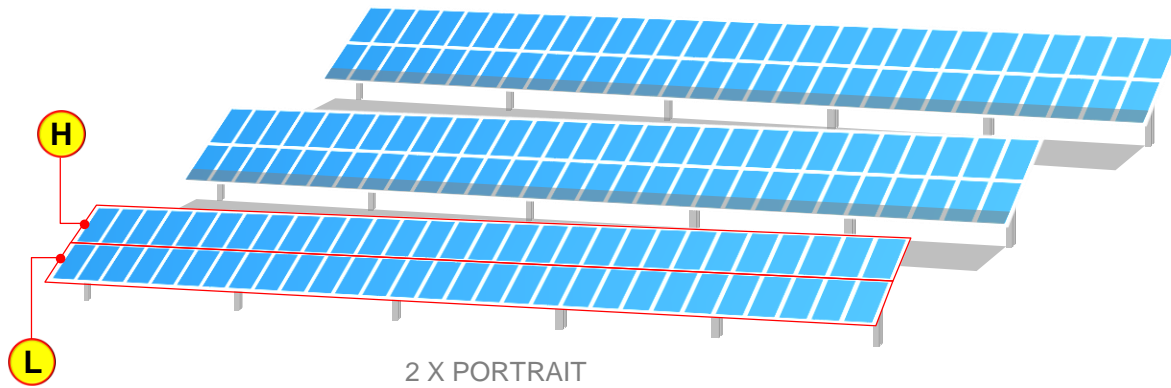
Single-Axis Tracking



East-West Mounting

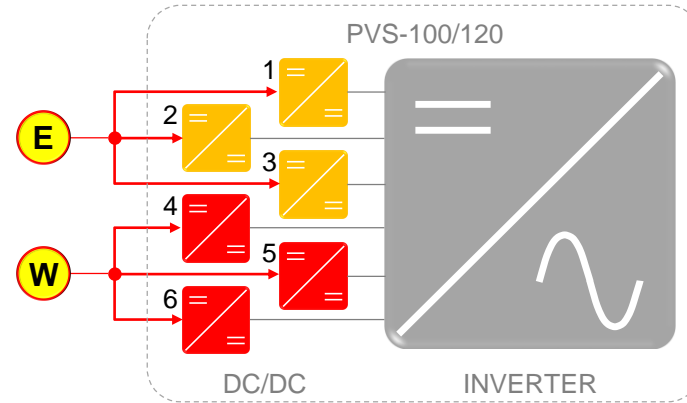
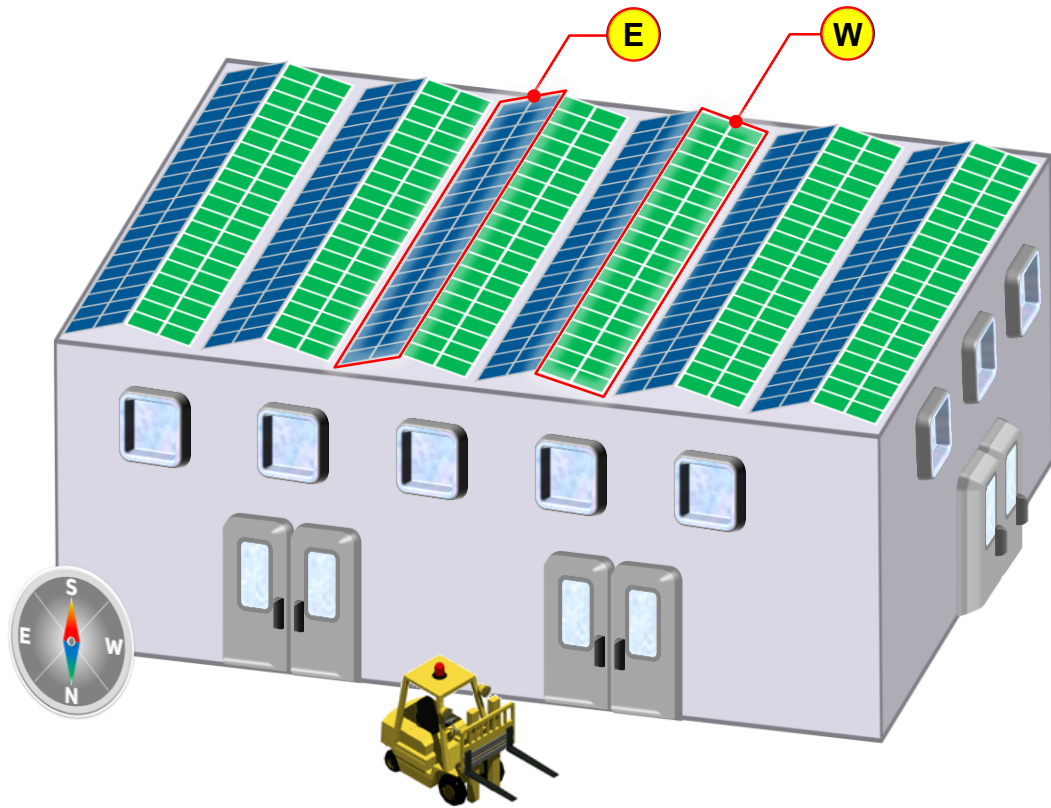
Free Field Ground Mount Installation

Versatile with ABB PVS-100 / PVS-120



Commercial Rooftop Installation

Versatile with ABB PVS-100 / PVS-120



24 strings (12 east, 12 west) / 4 each MPPT

20 modules in series, 350Wp

$P_{DC} = 168\text{kWp}$

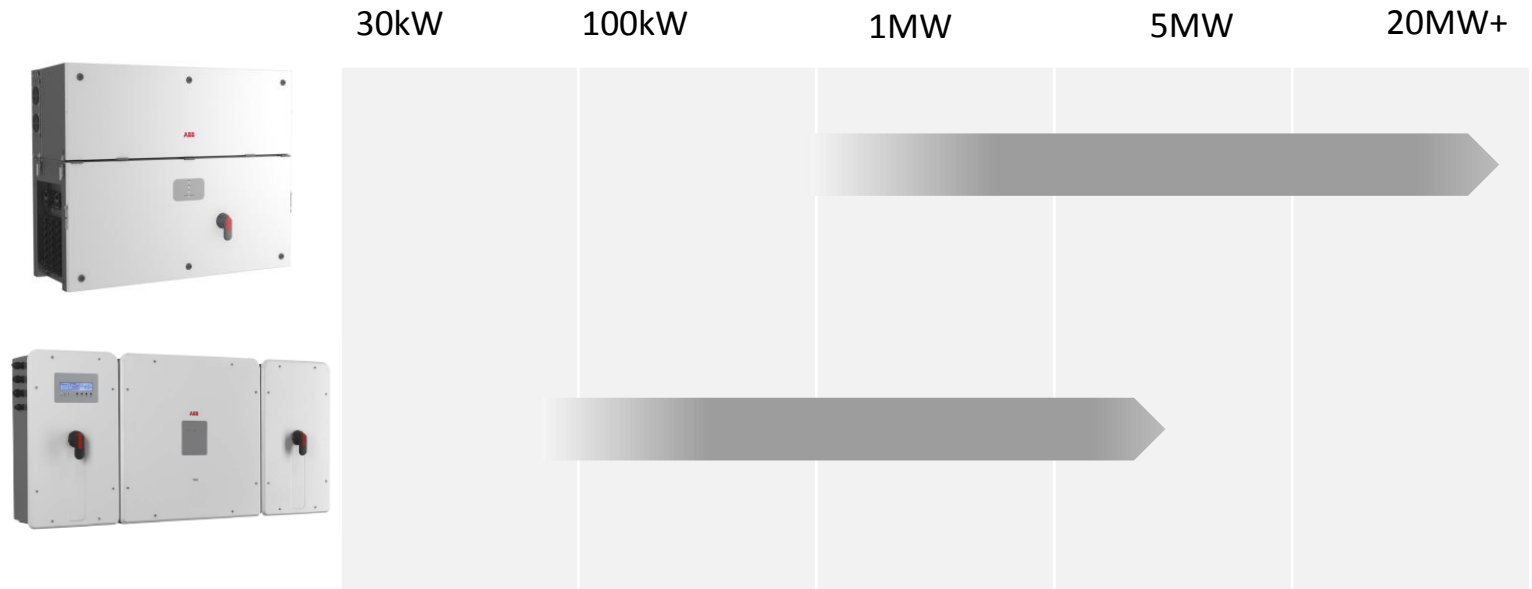
DC/AC Ratio = 140%

Utilizing different power classes to optimize design

Complete portfolio benefits:

With higher power inverters further cost effectiveness and savings in balance of system cost

Use smaller inverter to fill in the corners of the plant



All-In-One / Combiner-Free Design

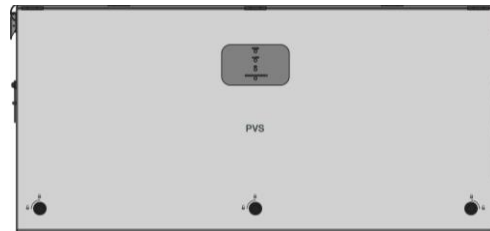
ABB PVS-100 / PVS-120

- Saving CAPEX and OPEX costs
- Integrated string combiner box with DC disconnect and the AC wiring compartment
- Wide space for wiring and ability to receive large Aluminum cable cross section
- Saving the cost of separate DC combiner box and AC 1st level combiners plus the associated installation costs!

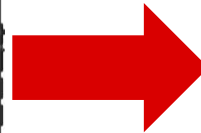


Two combiner models available:

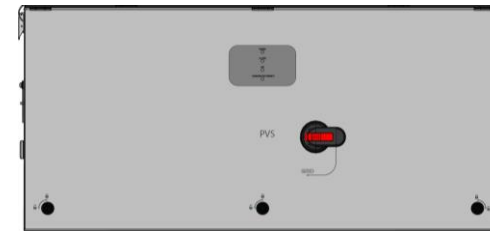
BASE solution
Save costs



WB-SX-PVS-100/120-TL



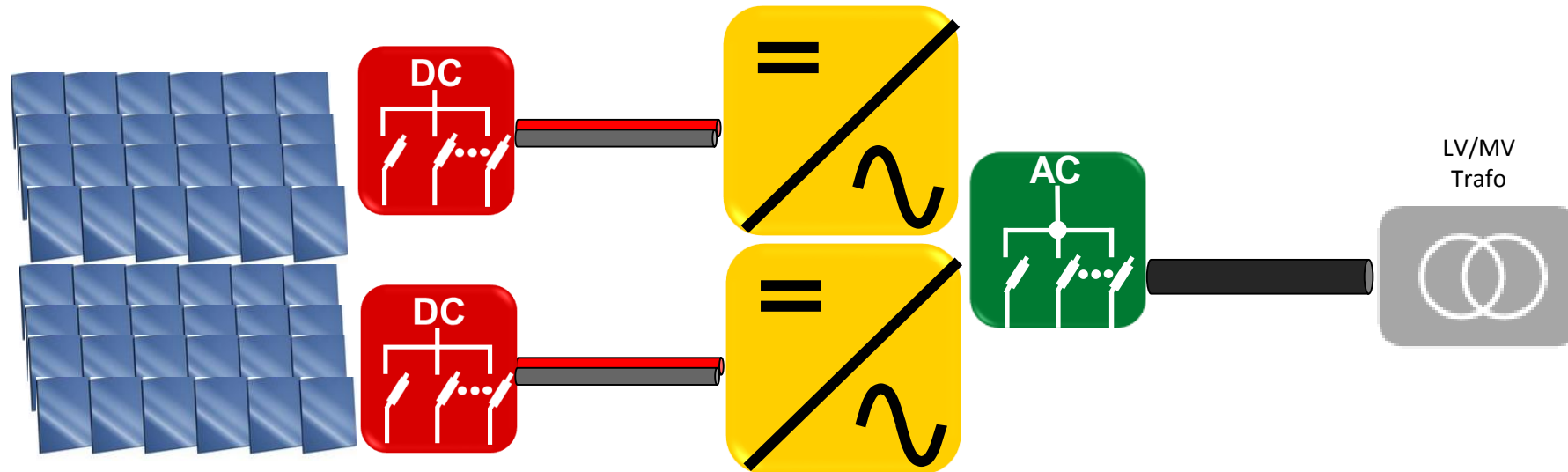
FULL optional
solution



WB-SX2-PVS-100/120-TL

All-In-One / Combiner-Free Design

Typical design with two 60kWp string inverters: What we can do with the NEW PVS-100/120 ?



- Integrated string combiner box with DC disconnect and the AC wiring compartment
- Saving the cost of separate DC combiner box and AC 1st level combiners plus the associated installation costs!

All-In-One / Combiner-Free Design

What do we mean with a real “ALL-IN-ONE” combiner?



DC Side connections & protections

AC Side connections & protections

Control & Monitoring

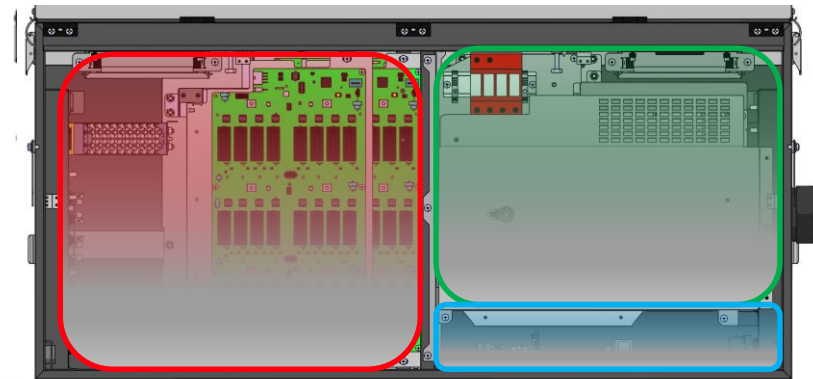


ABB three phase string inverter – PVS-100/ PVS-120

Installer and maintenance friendly mechanical design

Fast installation, service friendly

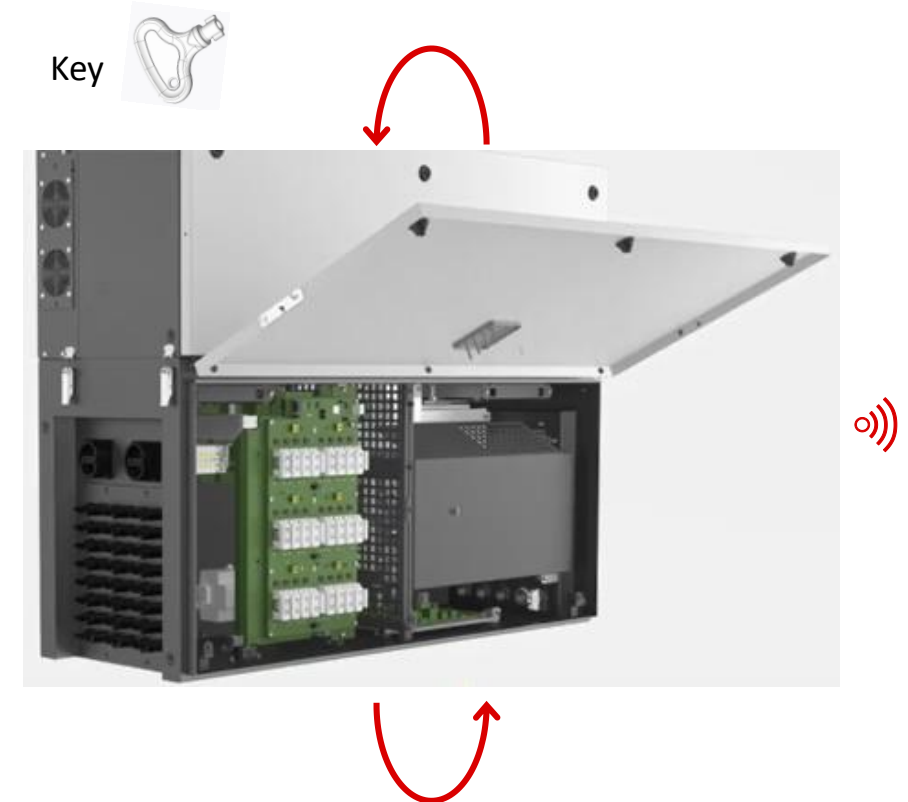
Fast opening of cover with key

PV quick connectors for fast installations

Wi-Fi for WebUI access

Benefits

- **Reduced time for cabling, fuse/ SPD check** (AC, Comm wiring)
- Configuration via Wi-Fi **without the need to open covers** reduces risk of water leak inside the inverter
- **Reduced time to repair** (i.e. consumables fuses, SPD)
- Repair on site concept – fast and cost effective repair at site or close to the site

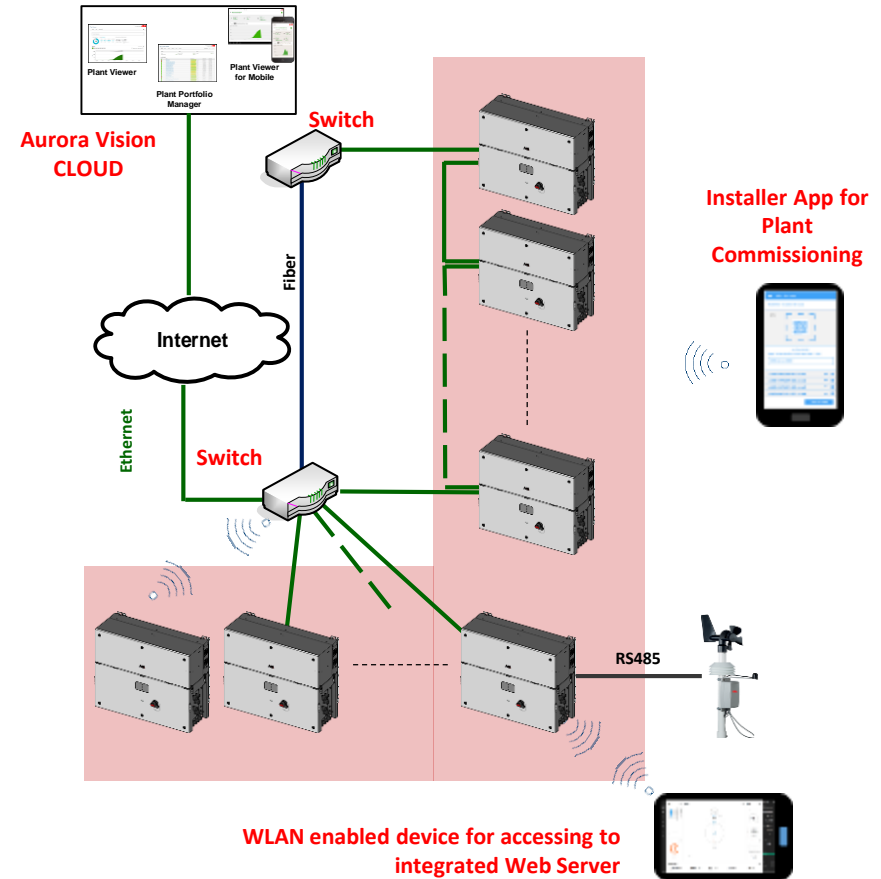


New smart ABB Ability™ communication capabilities

Minimizing devices to install, simplifying commissioning procedure and providing lifetime standard level access to Aurora Vision monitoring portal

Minimizing costs

- Accessories directly connected to the inverter: (VSN800 Weather Station, meter, ...)
- Multi inverter commissioning via Installer App
- Integrated Web Server and Wi-Fi channel: parameter's setting via any WLAN-enabled device
- Free of charge access to ABB cloud remote services including:
 - Remote access to inverter data
 - Remote FW update
 - Remote monitoring / troubleshooting
 - User and asset management
 - Reporting and alarming through mobile app and web portal



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Summary

Summary

Optimizing overall system performance

- 1 – Intelligent technology to optimize not just inverter performance but overall system efficiency and energy yield

Minimizing cost

- 2 – High power density, integrated all-in-one and fast-installation enabled brings down both CAPEX and OPEX

Allowing flexible design

- 3 – Increased PV plant design flexibility with Multi-MPPT and increased yield in complex installation like on rooftops or hilly ground

Enabling proactive plant management

- 4 – Direct connection to ABB cloud for monitoring and services to improve reliability and operational cost efficiencies

ABB