¿Conquistarán los mercados latinoamericanos los inversores string de alta potencia para proyectos a gran escala?

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Con:
• Gianluca Pieralli, Gerente Regional de Venta de ABB
• Marco Trova, Gerente Global de Productos de ABB
• Moderador: Emiliano Bellini, pv magazine

Contenido:
• Tendencias de desglose de costos en el mercado en América Latina.
• Evolución del inversor: Inversor + estación transformadora.
• La construcción modular con caja de cableado desmontable.
• La electrónica ahorros de costos a nivel del sistema fuera de la caja del inversor.
• 1500 VDC y 800Vac combinados para permitir una mayor densidad de potencia y capacidad de clúster.
• Ventajas de la tecnología multi-MPPT.

Si desea más información, vaya a www.pv-magazine.com/webinars
There’s a new power in Solar

1500V ultra-high power string inverters for utility-scale PV applications

Andrea Genovesi, Gianluca Marri, Marco Trova, Gianluca Pieralli
Utility-scale PV market trends
Technology is fast moving to 1500Vdc

WW Utility scale market by DC voltage

Utility scale projects are moving to 1500Vdc!
Utility-scale PV market trends
Outlook on CAPEX and OPEX evolution in the next years

CAPEX repartition trend

Cost trend over next coming years
- PV Module: -32% in 2025
- Inverter: -25% in 2025
- Other: -50% in 2025

MAJOR COST SAVINGS WILL COME FROM "OTHER COSTS" (SOFT COSTS, INSTALLATION, HARDWARE)

CAPEX reduction will increase the share of the OPEX in the LCOE

Estimated OPEX and CAPEX share in the LCOE

In 2025 the Opex can reach 33% of the Total LCOE!

Inverter design targeting Total System Cost reduction is required!

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Source: IRENA analysis and Photon consulting, 2016
ABB – PVS-175-TL
Setting a new trend in the solar inverter technology

System cost breakdown evolving towards an higher share of BoS and O&M
Identifying other areas for cost optimization while preserving the yield

How inverters can support the solar industry to tackle these challenges?

- Evolving from component to a complete «all-in-one» solution
- Modular construction with detachable wiring box
- Power electronics enabling further system-level cost savings
  1500Vdc/ 800Vac = highest power density and cluster capacity
- Multi-MPPT Technology, offering maximum energy yield
  Fuse & DC combiner free design, minimizing EBoS and O&M

LCOE = CAPEX + OPEX

YIELD = YIELD

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Evolving from component to a complete «all-in-one» solution

Virtual Central Inverter

String Inverter

“All-In-One” String Inverter
ABB – PVS-175-TL

Evolving from component to a complete «all-in-one» solution

ABB’s PVS-175 the «all in one solution» – BoS benefit

**Virtual Central inverter**

-1,4€/ Wac

Cost saving > 63%

<table>
<thead>
<tr>
<th>ABB’s PVS-175</th>
<th>Virtual Central</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC cables feeder</td>
<td>DC Recombiner</td>
</tr>
<tr>
<td>DC Installation</td>
<td>DC cables string</td>
</tr>
</tbody>
</table>

**String inverter**

-0,5€/ Wac

Cost saving >45%

<table>
<thead>
<tr>
<th>ABB’s PVS-175</th>
<th>String Inverter</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Recombiner</td>
<td>AC Installation</td>
</tr>
<tr>
<td>AC cables</td>
<td></td>
</tr>
</tbody>
</table>

**PVS-175 additional cost savings**

- **Logistic:** Up to 65% less component to store onsite

- **MW Station:** Enabling bigger cluster size

- **Civil works:** Reduced basements and mechanical structures with respect to Virtual central solution
**ABB – PVS-175-TL**

Evolving from component to a complete «all-in-one» solution

**ABB’s PVS-175 the «all in one solution» – O&M benefit**

Modular construction with detachable wiring box reducing installation and maintenance effort.

- Two box structure (power module ~76kg, wiring box ~77kg)

**Benefits:**
- **Two person can manage** the mounting of boxes
- **Power module can be easily replaced** without removing the wiring box.

**Cost saving on logistics:**
- Wiring box/ inverter box can be stocked separately
- **Future local variants** of wiring box possible
ABB – PVS-175-TL
Evolving from component to a complete «all-in-one» solution

ABB’s PVS-175 the «all in one solution»

Reducing time spent on site: Commissioning, FW Upgrade, parameter’s setting and troubleshooting may be performed either remotely via cloud or locally through a mobile App.

- **Minimum costs (both OPEX and CAPEX)**
  - Multi-inverter plant commissioning via Installer App
  - Intelligent, remote monitoring and control

- **Protecting customer’s investment**
  - TCP/IP as proven standard technology
  - Cyber Security managed data transfer

- **Reduced plant complexity, improved reliability**
  - Integrated digitalization capabilities with ABB Ability™
  - Direct transferring of telemetry data to cloud
ABB – PVS-175-TL

Enabling further cost savings with the world’s highest power inverter in the string category

1500VDC allows high AC voltage!

High AC voltage is enabled with DC/DC boosters and 1500Vdc input voltage

Single stage inverter reasonable max AC voltage ~ 600VAC, Dual stage inverter AC voltage can be increased to 800VAC

800VAC to reduce Balance of System cost (i.e. AC side cabling) and enabling higher power units with same current (less units per power block)

More power from the same enclosure
AC power vs AC voltage

Less units and resources are needed

Bigger PV clusters may be designed

AC-BOS cost savings (LV distribution)

400VAC

800VAC

400V

600V

800V

600Vac

(140kVA/130kVA)

(185kVA/175kVA)

+31%

800Vac

+35%

Cluster size

3.7MVA

5MVA

75% less Cu/Al

-63% components

+31%
Enabling further cost savings with the world’s highest power inverter in the string category

1500VDC allows high AC voltage!

High AC voltage is enabled with DC/DC boosters and 1500Vdc input voltage

Main benefits
– Bigger PV clusters can be designed, reducing MV & AUX system costs, as well as installation costs!

<table>
<thead>
<tr>
<th>100MWac project</th>
<th>Virtual Central (600Vac)</th>
<th>ABB’s PVS-175 (800Vac)</th>
<th>Cost saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nº of Cluster</td>
<td>27</td>
<td>20</td>
<td>Installation and Civil works → 26%</td>
</tr>
<tr>
<td>Nº of MV/LV transformer</td>
<td>27 x (3.7MVA)</td>
<td>20 x (5MVA)</td>
<td>Equipment → 6%</td>
</tr>
<tr>
<td>Nº of MV switchgear</td>
<td>27</td>
<td>20</td>
<td>Equipment → 26%</td>
</tr>
<tr>
<td>Nº of LV switchgear</td>
<td>27</td>
<td>20</td>
<td>Equipment → 19%</td>
</tr>
</tbody>
</table>

Total cost saving for equipments: ~ 0.3 €c/W
ABB – PVS-175-TL
The ideal solution for decentralized utility-scale application

Integrated Solution overview

**Fits within a 20ft container**

- Dedicated protected feeder for each inverter
- All auxiliaries included
- Oil Transformer
- Up to 6.7MVA
- Most cost efficient

**Containerized 20ft solution**

- Dedicated protected feeder for each inverter
- All auxiliaries included
- Dry Transformer
- Up to 6.7MVA
- Self-transportable solution

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ABB – PVS-175-TL
The ideal solution for decentralized utility-scale application

MVS main characteristics

<table>
<thead>
<tr>
<th>Data-sheet</th>
<th>String-MVS 5180</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output (AC)</td>
<td>PVS-175</td>
</tr>
<tr>
<td>Compatible String Inverter type</td>
<td>PVS-175</td>
</tr>
<tr>
<td>Maximum AC output power (U_{peak} @30C)</td>
<td>5180 kVA</td>
</tr>
<tr>
<td>Maximum Inverters Inputs</td>
<td>28</td>
</tr>
<tr>
<td>Medium voltage range (U_{MAX})</td>
<td>12 kV to 36 kV</td>
</tr>
<tr>
<td>Output frequency</td>
<td>50/60 Hz</td>
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<tr>
<td>Power factor compensation (cosφ)</td>
<td>Yes</td>
</tr>
<tr>
<td>Transformer type</td>
<td>ABB Vacuum cast coil dry type</td>
</tr>
<tr>
<td>Medium voltage switchgear type</td>
<td>ABB Safetria, SF6 insulated (CV, CCV)</td>
</tr>
<tr>
<td>Power consumption</td>
<td>Maximum 5900 W 3800 W</td>
</tr>
<tr>
<td>Auxiliary voltage for customer use</td>
<td>3 – 400 V/50 Hz, up to 40kVA</td>
</tr>
<tr>
<td>Dimensions and weight</td>
<td>Width/Height/Depth 2438 mm/6058 mm/2438 mm (20’ HC container dimensions)</td>
</tr>
<tr>
<td>Weight approx.</td>
<td>&lt; 20 t</td>
</tr>
<tr>
<td>Environmental limits</td>
<td>IP54</td>
</tr>
<tr>
<td>Ambient temperature range (nominal ratings)</td>
<td>-20° C to +50° C</td>
</tr>
<tr>
<td>Maximum altitude (above sea level)</td>
<td>1000 m</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>9% to 90%</td>
</tr>
<tr>
<td>Civil Code/standard</td>
<td>Eurocode: Roof/wind/seismic 200kg/47ms/0.3g.</td>
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</table>

<table>
<thead>
<tr>
<th>Item.</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>MV Switchgear</td>
</tr>
<tr>
<td>2</td>
<td>MV Transformer</td>
</tr>
<tr>
<td>3</td>
<td>AC cabinet</td>
</tr>
<tr>
<td>4</td>
<td>Inverter outputs</td>
</tr>
<tr>
<td>5</td>
<td>Auxiliary transformer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>AC cabinet heating</td>
</tr>
<tr>
<td>7</td>
<td>Transformers external fan 1</td>
</tr>
<tr>
<td>8</td>
<td>Transformers external fan 2</td>
</tr>
<tr>
<td>9</td>
<td>External power socket</td>
</tr>
<tr>
<td>10</td>
<td>Lighting</td>
</tr>
<tr>
<td>11</td>
<td>Communication cabinet</td>
</tr>
<tr>
<td>12</td>
<td>MVS control equipment</td>
</tr>
<tr>
<td>13</td>
<td>AC cabinet control system</td>
</tr>
<tr>
<td>14</td>
<td>Spare</td>
</tr>
<tr>
<td>15</td>
<td>Spare</td>
</tr>
</tbody>
</table>
The ideal solution for decentralized utility-scale application

MVS lay-out

Customizable aux booth
Communication board
UPS
MW switchgear

Extra compartment
Fans
MV switchgear compartment
Aux transformer
MV transformer compartment
MV transformer
Exhaust air hood
AC panel compartment
Preserving maximum energy yield while reducing CAPEX and OPEX of the system

Fully exploit the benefits of string inverters with Multi-MPPT and fuseless technology

String level Inverter

High YIELD and CAPEX
Preserving maximum energy yield while reducing CAPEX and OPEX of the system

Fully exploit the benefits of string inverters with Multi-MPPT and fuseless technology

CAPEX reduction penalizing YIELD
ABB – PVS-175-TL
Preserving maximum energy yield while reducing CAPEX and OPEX of the system

Fully exploit the benefits of string inverters with Multi-MPPT and fuseless technology

String level Inverter

Virtual Central Inverter (Single MPPT)

Multi MPPT String Inverter (2 Strings x MPPT)

Maximizing YIELD while reducing OPEX
Preserving maximum energy yield while reducing CAPEX and OPEX of the system

Fully exploit the benefits of string inverters with Multi-MPPT and fuseless technology

<table>
<thead>
<tr>
<th>String level Inverter</th>
<th>Virtual Central Inverter (Single MPPT)</th>
<th>Multi MPPT String Inverter (2 Strings x MPPT)</th>
<th>ABB’s PVS-175 (12 MPPT/ fuseless/ detachable WB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPEX</td>
<td>CAPEX</td>
<td>CAPEX</td>
<td>CAPEX</td>
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<td>OPEX</td>
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<td>LCOE</td>
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<td>YIELD</td>
<td>YIELD</td>
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Preserving maximum energy yield while reducing CAPEX and OPEX of the system

Fully exploit the benefits of string inverters with Multi-MPPT and fuseless technology

Preserving maximum energy Yield while reducing CAPEX and OPEX
Preserving maximum energy yield while reducing CAPEX and OPEX of the system

Fully exploit the benefits of string inverters with Multi-MPPT and fuseless technology

<table>
<thead>
<tr>
<th>Virtual Central Inverter (Single MPPT)</th>
<th>More power generation by</th>
<th>Multi-MPPT vs Virtual Central</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mismatch &amp; Shading Losses (12 MPPT)</td>
<td></td>
<td>+0.3% ÷ +0.7%</td>
</tr>
<tr>
<td>Higher system availability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(fuseless technology)</td>
<td></td>
<td>+0.1%</td>
</tr>
<tr>
<td>Overall Benefit using</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABB’s PVS-175</td>
<td></td>
<td>+0.4% ÷ +0.8%</td>
</tr>
</tbody>
</table>

Assumptions
- 2200 equivalent hours
- PPA @ 3€/kWh
- (100MWac/20y)

Up to €1,1 Million additional income over 20 years!
Preserving maximum energy yield while reducing CAPEX and OPEX of the system

**Fuseless technology benefit**

The PV panels must be protected by reverse current according to manufacturer **data-sheet**. Generally, if 3 or more strings are connected in parallel, a reverse current protection must be used.

Fuses are prone to nuisance tripping over the years and this increase:
- **O&M cost** → Site inspections are needed to check and replace fuses
- **Energy yield losses**

ABB’s PVS-175 with 12 MPPTs and only 2 strings into each MPPT no need fuses:
- **Simplify O&M** → Cost Saving
- **Avoid energy yield losses**
ABB – PVS-175-TL
Overview

PVS-175 1500Vdc/800Vac a unique, six-in-one product

- 185kVA @30°C/ 175kVA @40°C: The World’s Highest Power Inverter in the String Category
- Modular Construction: with detachable wiring box
- Remote Fw update & parameters setting
- Fuse-free design: Minimize EBoS and O&M
- 12 independent MPPTs for the highest yield and configurability in all ground conditions
- Installer App: 70% faster wireless plant commissioning
ABB – PVS-175-TL
Data-sheet

Inverter key parameters
- 185kW@30°C, 175kW@40°C
- Max Input Voltage 1500Vdc
- Vac = 800Vrms 3-ph/ 3 wire, 50/ 60Hz
- 12 Independent MPP/ 24 strings
- Fuseless DC combiner design
- VMPPT = 850 – 1350 Vdc, full power

Construction, weight, volume
- IP65
- Forced Air cooling
- Two box construction
- Overall weight ≈ 153kg (76kg + 77kg)

Efficiency
- Max. Efficiency: 98,7%
- EU Efficiency: 98,4%
- CEC Efficiency: 98,4%

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

Communication
- 2 x Ethernet;
- Wi-Fi Channel
- 1 x RS485;
- Modbus RTU/ TCP (Sunspec compliant);
- Integrated datalogger and direct connection to Aurora Vision remote portal

In/ Out protections
- Type 2 Surge arrester (both DC and AC)
- Insulation monitoring control per IEC 62109-2
- DC Series Arc Fault Circuit Interrupter (optional)
Evolving from component to a complete «all-in-one» solution

ABB’s PVS-175 the «all in one solution» – Benefit:

**Lower CapEx**
- > 63% saving on DC-BoS compared to Virtual Central
- > 45% saving on AC-BoS compared to conventional String Solution
- Up to 65% less components to install
- 20% to 40% saving on AC cables and components versus 600Vac string inverters

**Better OpEx**
- 28% to 43% less inverter to manage versus all other string proposals
- up to 65% less components to commission onsite
- Multi inverter commissioning thanks to installer app
- 30-50% less field interventions for fuses replacement

**Maximum Yield**
- 0,3-0,7% lower losses on the harvesting versus to Virtual Central solution
- 0,1% increase on availability thanks to fuse free design
<table>
<thead>
<tr>
<th>Próximos seminarios web</th>
<th>Próximos eventos</th>
</tr>
</thead>
</table>