ABB Solar
Central Inverters (PMGD)
ABB Solar
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- 1. Market Scenario
- 2. PMGD Solutions
  - 2.1. ULTRA Inverters
  - 2.2. ULTRA-MVC-Skid
- 3. Service
ABB Solar
Market Scenario
## ABB Solar

### Market Scenario – Residential / Commercial

<table>
<thead>
<tr>
<th>EU – APAC – LATAM Market</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Single Phase</strong></td>
</tr>
<tr>
<td>0kW 2kW 3kW 4kW 5kW 6kW</td>
</tr>
<tr>
<td><strong>Three Phase</strong></td>
</tr>
<tr>
<td>7kW 8kW 9kW 10kW 12kW 20kW 27.6kW 33kW</td>
</tr>
</tbody>
</table>

### LEDG 20.571: Net Metering

<100kW
ABB Solar
Market Scenario – Utilities
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Market Scenario - PMGD

<3MW

- No Environmental studies required
- Easy to develop
- Savings in connection and electrical studies
- Developed by local companies
- Easy to get local investment and equity.
- Distributed generation.
- High value in generating and integrated solution for Inverters + Cells + MV Transformer.
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Market Scenario - PMGD

2015

>50kW

>Vdc

>2MW

Future
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Market Scenario - PMGD
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ULTRA-700.0-TL
ULTRA-1050.0-TL
ULTRA-1400.0-TL

Transformerless Inverter
Outdoor IP65
Liquid Cooled
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Introduction of the ULTRA Inverter

Outdoor Inverter for Utility-Grade System

- Thermally Insulated IP65 Enclosure
- **Thermal management solution optimized for Utility-Grade applications:** Passive liquid cooling, unaffected by rougher ambient conditions at the installation site.

Easy Installation

- **Compact Lightweight Single Cabinet:** 60% volume reduction respect to traditional cabinet of the same power.
- **Installation by Pier or Pad mounting:** no needs additional infrastructures.

Reduced Cabling Costs

- Low Voltage (LV) Distribution Cost Reduction
- Lower cost AC switches with reduced breaking capacity
Modularity Structure

- 1 Independent MPPT for each Module
- Nominal Module Power 350kW: in case of cosφ=1 the maximum module power is 390kW
- Three available versions: 700kW, 1050kW and 1400kW

High Efficiency with Low Common-Mode Noise

- Peak Efficiency: 98,7%, Euro Efficiency: 98,2%. Innovative Multi-Level Topology; Efficiency increase with the input operating voltage range.
- Extended MPPT Voltage Range: Max Input Voltage: 1000Vdc. Possibility of use longer strings with lower DC input current.
- Low Common-Mode Noise: AC parallel connection between more inverters is possible, in addition, is possible to use traditional transformer with NOT Common-Mode Noise Immunity

Easy Maintenance

- Frontal Access to all Critical part of the inverter

Certifications, Safety and Grid Standard

- CE
- EN 50178, EN61000-6-2, EN61000-6-4, EN61000-3-11, EN61000-3-12, EN62109-1
- CEI 0-16, BDEW, FERC 661
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ULTRA Inverter: Available Models

ULTRA-700.0-TL
Maximum Power: 780kVA
2 Independent Modules
Transformerless
Outdoor IP65
Vout: 690Vac

ULTRA-1050.0-TL
Maximum Power: 1160kVA
3 Independent Modules
Transformerless
Outdoor IP65
Vout: 690Vac

ULTRA-1400.0-TL
Maximum Power 1560kVA
4 Independent Modules
Transformerless
Outdoor IP65
Vout: 690Vac
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ULTRA: Architecture and Assembly

DC Combiner Compartment
6-8 or 5 fused inputs for each 350KW module

Power Compartments (2 to 4)
350kW nominal power modular clusters from DC disconnect to output line filter

AC Output Compartment
AC switch and fuses
Controller, touch-screen display

Passive liquid cooling
Sealed liquid cooled plates for IGBT
Air/Water exchanger for passive components
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ULTRA: Available kit and versions

**BASIC**

**STANDARD**
Including Louver

**FULL**
Including Awning and Louver

6DC input or 8 DC input (for each 350kW module)
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ULTRA – 5DC input: New DC Compartment

5DC input (for each 350kW module)

Possibility to choose different size of fuses:
- 200A;
- 250A;
- 315A;
- 400A.

Additional side door for easy maintenance and fuses replacement
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ULTRA: Architecture and Assembly

PVI-ULTRA-1400
Exploded view
Main Components
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ULTRA: Architecture and Assembly

Main Components

- DC combiner
- 350kW replaceable module (4x)
- DC-link capacitor module (4x)
- 350kW liquid-cooled IGBT module
- Top Mounted Chiller units (Water/Glycol)
- Backside mount Air/Water heat exchangers
- AC distribution cabinet
- 350kW Inverter cabinets (4x)

PVI-ULTRA-1400
Exploded view
Main Components

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ULTRA: DC Combiner Compartment

- 12 or 16 Fuses 160A/1000Vdc for each module (both polarity)
- Input controlled protection fuses for each polarity (160A/1000V)
- 6 or 8 DC Input in parallel for each 350kW module
- DC cable entry via Roxtec sealing blocks (IP65)

ULTRA-1400.0-TL-OUTD

Cable Terminal Blocks
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ULTRA: Power Compartment

350kW Inverter compartment

ULTRA-1400.0-TL-OUTD

Liquid-Cooled 350 kW Module
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ULTRA: AC Compartment

ULTRA-1400.0-TL-OUTD

Touch Screen Graphic Display

AC Output On-Load Disconnector

AC LV Cable-Out with Roxtec (IP65)
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ULTRA: Liquid-Cooled 350kW Module

350kW single cold-plate IGBT Power Module:
- Optimum trade-off between weight, dimensions and lowest specific cost at maximum efficiency
- **Very compact, high power density** and environmentally protected construction thanks to the liquid-cooled cold plate technology
- **Weight below 55kg** (IGBT module), to ensure easy maintenance and installation
- **Self-contained solution.** All critical functional blocks integrated on the same chassis

Fully modular construction:
- IGBT Module, DC-Link Film Capacitor, Power Supply, Controller (CPU) and Bus-Bars
- Commonality of the replacement parts for all inverters belonging to this family (700kW/1050kW and 1400kW)
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Liquid-Cooling System: Features and Benefits

Heat exchange characteristic
- Passive liquid/glycole cooling (no gas inside)
- Stand alone system
- Low power consumption
- Easy maintenace
- Fan redundancy
- Extended temperature -40 to 50°C
  (-40°F to 122°F)
- Night mode energy save
- Mod Bus communication status and
dry contact alarm (Pump, pressure, flow....)
- 30kW Cooling Capacity
- Standard power supply voltage 400Vac/50Hz
  460Vac/60Hz three phase
- Monoethylene or monopropylene glycol available
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Liquid-Cooling System: Features and Benefits

Thermal management Solution optimized for Utility-Grade Applications

Features:
- Direct cooling of power electronics via cold-plates
- Combined Air/Water Heat Exchangers for cooling passive components and extract the heat generated by solar radiation
- Self contained roof-top assembly, including fluid pump, expansion tank, control logic
- Cooling via 2 temperature-controlled fans

Benefits:
- Air/Water heater exchanger ensure an IP65 protection in order to prevents any interaction of active parts with ambient
- Keep the enclosure cool under harsh conditions
- For use with high ambient temperatures and/or aggressive air (marine or desert locations)
- Maintenance–free
### ULTRA-1400.0-TL-OUTD: Technical Data

<table>
<thead>
<tr>
<th>Technical Data</th>
<th>ULTRA-1400-TL-OUTD</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPP Input Voltage Range</td>
<td>470-900 Vdc</td>
</tr>
<tr>
<td>Rated Power MPP Input Range</td>
<td>585-850 Vdc</td>
</tr>
<tr>
<td>Maximum Power MPP Input Range</td>
<td>645-850 Vdc</td>
</tr>
<tr>
<td>Max. Input Voltage</td>
<td>1000 Vdc</td>
</tr>
<tr>
<td>Number of Independent MPPT</td>
<td>Up to 4</td>
</tr>
<tr>
<td>Independent functional module</td>
<td>350 kW</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>690 Vac</td>
</tr>
<tr>
<td>Rated Power (P&lt;sub&gt;ac,i&lt;/sub&gt;)</td>
<td>1.400 kW</td>
</tr>
<tr>
<td>Maximum Power (P&lt;sub&gt;ac,i&lt;/sub&gt; @ cosφ = 1)</td>
<td>1.560 kW</td>
</tr>
<tr>
<td>Max. Eff. (η&lt;sub&gt;max&lt;/sub&gt;) / Euro Eff. (η&lt;sub&gt;EU&lt;/sub&gt;) / CEC Eff. (η&lt;sub&gt;CEC&lt;/sub&gt;)</td>
<td>98.7%/98.2%/98.0%</td>
</tr>
<tr>
<td>Power factor (cosφ)</td>
<td>Adjustable +/-0.9</td>
</tr>
<tr>
<td>User Interface</td>
<td>Touch Screen Graphical Display</td>
</tr>
<tr>
<td>Communication</td>
<td>RS 485 (optional Ethernet, Modbus)</td>
</tr>
<tr>
<td>Ambient Temperature Range</td>
<td>-20/60°C (with derating above 50°C)</td>
</tr>
<tr>
<td>Environmental Protection Rating</td>
<td>IP 65 / NEMA 4X</td>
</tr>
<tr>
<td>Cooling</td>
<td>Liquid with on board heat exchanger</td>
</tr>
<tr>
<td>Size (WxHxD in mm)</td>
<td>4420 mm x 2920 mm x 1520 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>4600 kg</td>
</tr>
<tr>
<td>ON board transformer</td>
<td>No</td>
</tr>
<tr>
<td>Certification</td>
<td>CE</td>
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<tr>
<td>Safety Standards</td>
<td>EN50178, EN61000-6-2, EN61000-6-4, EN61000-3-11, EN61000-3-12</td>
</tr>
<tr>
<td>Grid Standard</td>
<td>CEI 0-16; P.O..12.3; BDEW, FERC661</td>
</tr>
</tbody>
</table>

High performance utility grade inverter for large PV installations 98.7% efficiency

- 690Vac Output
- Designed for direct connection to MV transformer
- 1000Vdc input voltage
- Power Capacitors Electrolytic free technology
- Passive liquid cooling system.
- Modular architecture with functionally independent 350kW clusters
- Touch screen graphic display

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ULTRA: System cost savings – compared to a 320Vac conventional system

AC wiring
- Reduced cable size
- \( S_{690} = S_{320} \times (320/690)^2 = S_{320} \times 0.215 \)

AC breaker
- Lower ampacity (\( I_{out} \)) and Breaking capacity (\( I_k \))
- Es (1400kW): \( I_{out} = 1300A/2810A \); \( I_k = 21.7kA/47kA \)

MV transformer
- Standard 690Vac transformer
- Larger transformer size is feasible (reduced current)
- No transformer with dV/dT immunity
- Simple 2-winding standard transformer
System design optimization:
- Efficiency increase towards the upper end of the input operating voltage range.
- Design for maximum string length and minimum DC current can be pursued, thus reducing DC cable and distribution cost.

Performance optimization:
- Overall system PR is maintained or further improved.
- Ready for transition to higher system voltages.

<table>
<thead>
<tr>
<th>Vin</th>
<th>$\eta_{\text{MAX}}$</th>
<th>$\eta_{\text{Euro}}$</th>
<th>$\eta_{\text{CEC}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>98,1</td>
<td>97,8</td>
<td>97,8</td>
</tr>
<tr>
<td>760</td>
<td>98,6</td>
<td>98,2</td>
<td>98,2</td>
</tr>
<tr>
<td>800</td>
<td>98,7</td>
<td>98,4</td>
<td>98,3</td>
</tr>
</tbody>
</table>
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ULTRA Performance: Derating vs Altitude

Percentage of max power

Mt

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The area delimited by the arc of circle is the set of all work-point permitted by ULTRA. The *Active Power* \((P)\) is generated by photovoltaic system; the *Reactive Power* \((Q)\) is determined by grid requirements.

### Reactive Power Q can be set in three different ways:
- Directly by setting value of *Reactive Power*.
- Setting the *Reactive Current*.
- Setting the *Cosφ*.

Minimum \(\text{Cosφ}=0.1\)

<table>
<thead>
<tr>
<th></th>
<th>ULTRA 700</th>
<th>ULTRA 1050</th>
<th>ULTRA 1400</th>
</tr>
</thead>
<tbody>
<tr>
<td>(P_{\text{max}})</td>
<td>(\text{Cosφ}=0.9)</td>
<td>700 kW</td>
<td>1050 kW</td>
</tr>
<tr>
<td>(\text{Cosφ}=1)</td>
<td>780 kW</td>
<td>1160 kW</td>
<td>1560 kW</td>
</tr>
</tbody>
</table>
1. Market Scenario

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   - 2.2. ULTRA-MVC-Skid

3. Service
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ULTRA-MVC-Skid: New Cost Optimized Solution
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ULTRA-MVC-Skid: Main Features and Optional

ULTRA-STATION-1550.0

ULTRA-1400.0-TL (1.555 kW@cosphi=1)  
LV Connection 690Vac  
(cables not provided)  
ULTRA-MVC-1550.0-S  
MV Grid Connection

ULTRA-STATION-3110.0

2 x ULTRA-1400.0-TL (3.111 kW@cosphi=1)  
LV Connection 690Vac  
(cables not provided)  
ULTRA-MVC-3110.0-S  
MV Grid Connection
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ULTRA-MVC-Skid: Housing

- **LV Connection by bushings**
- **MV connection by ELASTIMOLD**

- **Thermally Insulated Enclosure**
  Double metal panel: external in aluminium alloy and internal in galvanized iron polyurethane foam inside

- **Door with safety look**
  The key is connected with the key of MV ground disconnector

- **Support for LV cables**

- **Oil Tank**
  110% of oil volume (stainless steel)

- **Support for Lifting**
Tree phase Oil Insulated transformer:
Hermetically sealed (maintenance free) IP65
XXkV/690V with single secondary winding
Power size up to 3150kVA
Ambient Temperature 45°C
Overtemperature Oil/winding 55/60°C
Losses Class according new European Regulation «Eco Design»

All the features to which the transformer has to be compliant are defined in a proper document
URP.V0A01.0SP_AA_OIL TRX_Tech-Specification_Rev1.3
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ULTRA-MVC-Skid: MV Switch Gear

ABB UniSec
For application up to 24kV

ABB SafePLUS
For application up to 36kV
**ABB Solar**  
**ULTRA-MVC-Skid: Optional Components**

### Auxiliary dry transformer 15kVA

<table>
<thead>
<tr>
<th>MAIN DATA /dati di targa</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RATED POWER Potenza</td>
<td>kVA 15</td>
</tr>
<tr>
<td>PRIMARY VOLTAGE Tensione primaria</td>
<td>V 690 CONNECTION: PRIMARY/SECONDARY Collegamento: primaria/secondaria</td>
</tr>
<tr>
<td>SECONDARY VOLTAGE (at no load) Tensione secondaria (a vuoto)</td>
<td>V 400 GROUP Gruppo</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ELECTRIC DATA /dati elettrici</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NO LOAD LOSSES Perdite a vuoto</td>
<td>W 130 TEST VOLTAGE Tensione di prova</td>
</tr>
<tr>
<td>IMPEDANCE LOSSES (115°C) Perdite a carico (115°C) Test a incursio</td>
<td>W 460 INDUCED OVER VOLTAGE TEST Test incursio</td>
</tr>
<tr>
<td>IMPEDANCE VOLTAGE Tensione di corto circuito</td>
<td>% 3 OVER TEMPERATURE Sovratensione</td>
</tr>
<tr>
<td>MAX INRUSH CURRENT Massima corrente d’incursio</td>
<td>in ≤ 20 AMBIENT MAX TEMPERATURE Temperature ambiente max</td>
</tr>
<tr>
<td>ELECTROSTATIC SHIELD Schermo elettrostatico</td>
<td>/ YES WINDINGS MATERIAL (PRI/SEC) Materiali avvolgimenti</td>
</tr>
</tbody>
</table>

### Auxiliary dry transformer 25kVA

<table>
<thead>
<tr>
<th>MAIN DATA /dati di targa</th>
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</tr>
</thead>
<tbody>
<tr>
<td>RATED POWER Potenza</td>
<td>kVA 25</td>
</tr>
<tr>
<td>PRIMARY VOLTAGE Tensione primaria</td>
<td>V 690 CONNECTION: PRIMARY/SECONDARY Collegamento: primaria/secondaria</td>
</tr>
<tr>
<td>SECONDARY VOLTAGE (at no load) Tensione secondaria (a vuoto)</td>
<td>V 400 GROUP Gruppo</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ELECTRIC DATA /dati elettrici</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NO LOAD LOSSES Perdite a vuoto</td>
<td>W 200 TEST VOLTAGE Tensione di prova</td>
</tr>
<tr>
<td>IMPEDANCE LOSSES (115°C) Perdite a carico (115°C) Test a incursio</td>
<td>W 650 INDUCED OVER VOLTAGE TEST Test incursio</td>
</tr>
<tr>
<td>IMPEDANCE VOLTAGE Tensione di corto circuito</td>
<td>% 3 OVER TEMPERATURE Sovratensione</td>
</tr>
<tr>
<td>MAX INRUSH CURRENT Massima corrente d’incursio</td>
<td>in ≤ 20 AMBIENT MAX TEMPERATURE Temperature ambiente max</td>
</tr>
<tr>
<td>ELECTROSTATIC SHIELD Schermo elettrostatico</td>
<td>/ YES WINDINGS MATERIAL (PRI/SEC) Materiali avvolgimenti</td>
</tr>
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The inverter is the most technological component

50% of failures can be associated
Service Solutions for PV Plants
Pay the right attention

- Run PV plants at the highest levels of capacity, flexibility and reliability
- Increase operational security
- Extend the life cycle
- Increase overall productivity
- Improve energy efficiency
- Reduce operation costs
- Reduce maintenance costs
Service Solutions for PV Plants
The key points

- Uptime warranty
- Supplier Bankability
- Local technical support and training
- Local and structured Service presence
- Logistic Center (spare parts availability)
- Installation and commissioning
- Single point of contact + Single Service contract
- Competent after sales support
Conclusions

- Product reliability
- OpEx as the key point in the PV Plant’s operation especially in extreme conditions
- Scheduled Service and Maintenance activities
- Uptime Warranty
- Partners local presence and bankability
Power and productivity for a better world™