ABB OEM Days 2014
Transformers
ABB OEM days
Transformers - index

- ABB – your global partner for “transformation”

- Application portfolio for OEMs

- Energy Efficiency and new EU rule N° 548

- Guidelines, features, characteristics and impact to transformers market
ABB’s transformer heritage and nowadays
From a long pioneering history to one-stop shop supplier

700 years of combined experience in transformers:
- Asea
- Ansaldo/ItalTrafo/IEL/OEL/OTE
- BBC
- GE
- National Industri
- Strömberg
- Westinghouse
- Kuhlman
- Trasfor

Facts & Figures:
- Global presence in more than 100 countries
- Complete range of Power and Distribution Transformers, Components and Services
- Service organization for Global Customer support
- Voltage range up to
  - 1000 kV AC and +/-
  - 1200 kV DC
A global footprint
55 transformer locations and 30 service centers

Global Supply market coverage through 55 Focused Factories

They follow Market Allocations based on:

- Best Logistics
- Best Customer
- Market knowledge
- Culture
- Standards

30 Service Centers with around 1000 experts
Specialized units and plants for Transformers Service:
- Preventive Maintenance
- Re-manufacturing – Repair – Upgrade
- Fleet Condition and Risk Assessment
- TrafoSite Repair and TrafoSite Testing
Transformers
Technology offering

4 common global design standards with technology platforms

<table>
<thead>
<tr>
<th>Rated Voltage</th>
<th>Small power transformers</th>
</tr>
</thead>
<tbody>
<tr>
<td>171 kV</td>
<td></td>
</tr>
<tr>
<td>72.5 kV</td>
<td>Dry type</td>
</tr>
<tr>
<td>36 kV</td>
<td>Liquid-filled Distribution</td>
</tr>
<tr>
<td>1 kV</td>
<td>Low voltage dry type</td>
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<table>
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<tr>
<th>10 MVA</th>
<th>40 MVA</th>
<th>63 MVA</th>
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The application portfolio
Wherever you are, transformers are nearby

Applications
- Power generation
- Wind & Solar
- Transmission and distribution
- Industrial
- Commercial and residential usage
- Railway application
- Oil & Gas application
- Underwater applications
The application portfolio
Typical liquid-filled and dry-type transformers for substations

- Rated power range: 50 kVA-2500 kVA
- Rated voltage max.: 36 kV
- Tap-changer: off-circuit
- Windings materials: aluminum/copper
- Insulating fluid: mineral oil
- Technologies: conservator/hermetic

- Rated power range: 100 kVA-3150 kVA
- Rated voltage max.: 36 kV
- Tap-changer: off-circuit
- Winding materials: aluminum/copper
- Enclosures: IP23
- Environmental classes: C2/E2/F1

3 Technologies covering all typical applications!
The application portfolio
Variable speed drives and rectifiers

- Multi-pulse, multi-winding configurations
- VPI, VCC and Resibloc windings for dry-type
- Can be supplied integrated with ABB’s ACS drives
The application portfolio
Renewables - windmills

- Both on-shore and off-shore application
- Customized design
- Dry-type transformers
- Oil-filled transformers
- Water-cooled inductors
- Eco-dry transformers for highest efficiency
The application portfolio
Renewables - PV farms

- Dry-type output transformers up to 2 MVA – 36 KV
- Oil-filled output transformers up to 3 MVA – 36 KV
- Output inductors and DC choppers
- Can be supplied integrated with ABB inverters
- Eco-dry transformers for highest efficiency
Transforming the distribution network
Changing networks

The power flow in modern networks is changing to become more complex

- Centralized power generation
- One-directional power flow
- Generation follows load
- Operation based on historical experience

- Centralized and distributed power generation
- Multi-directional power flow
- Intermittent renewable power generation
- Consumption integrated in system operation
Voltage regulation
Technical solution

Standard Distribution Transformer

Smart-R-Trafo

Voltage regulation problems

Max Infeed/No Load

No Infeed/Max load

Voltage is automatically regulated by Smart-R-Trafo

Max Infeed/No Load

No Infeed/Max load
Voltage regulation
Smart-R-trafo

Main features

- Power rating - 250 kVA to 800 kVA
- Voltage - up to 24 kV
- Tap changer - configurable for 5, 7 & 9 position (e.g. ± 4 x 2.5%)
- Vector Group - all Delta and Star configurations suitable
- Automatic voltage regulation on-load
- No changes in transformer footprint
- No service required as switching contacts are maintenance free
- Communication with external SCADA system
  - Automatic, remote and manual modes
  - Ethernet and RS232 interfaces
  - Control system protocols IEC 608705101, 608705104, 61850

Distribution transformer with automatic voltage regulation already available in ABB product portfolio
Transformers
Energy Efficiency
Eco design directive
Focus on energy saving

More awareness on environmental sustainability

+  

Economical crisis and scarcity of resources

=  

Need of improved energy efficiency products

↓  

ECO-design directive No. 2009/125 for energy related products
Transformers Energy Efficiency
Energy Saving for Transformers

Timeline

2009

June 11th 2014

July 1st 2015

2017

July 1st 2021

- **Ecodesign Directive 125/2009** for Energy Related Products
- **EU 548/2014 Rule** for Transformers comes in force
- **Tier 1** Compliance on energy efficiency
- **Mid term assessment** By the EU
- **Tier 2** Compliance with higher levels of energy efficiency
Transformers energy efficiency

What changes

The EU Rule 548/2014 introduces following significant changes:

- The rule impacts on both dry and oil transformers (with some exemptions)
- No power ratings limitations
- Up to power ratings of 3150 kVA given allowable values of losses
- For power ratings > 3150 kVA introduction of “Peak Efficiency Index”
- Staged decrease of max allowable losses
- Zero tolerances on both load and no-load losses
Transformers energy efficiency

Exemption from the EU rule N°548

- Instrument transformers
- Testing transformers
- Transformers with LV windings for use with rectifiers to provide DC supply
- Transformers connected to furnaces
- Welding transformers
- Transformers for explosion proof and underground mining applications
- Transformers for off-shore and floating off-shore applications
- Transformers for emergency installations
- Earthing or grounding transformers
- Traction transformers mounted on rolling stock
- Transformers for railway feeding systems
- Motor starting transformers
- MV-MV interface transformers
- LPT where it isn’t technically feasible to meet the min. efficiency requirements
- LPT where a replacement would entail disproportionate costs
Transformers energy efficiency
Zero tolerances

Load Losses $P_k$
Current Tolerance: $+15\%$ (IEC60076-1)
New Tolerance: $0\%$

No-Load Losses $P_0$
Current Tolerance: $+15\%$ (IEC60076-1)
New Tolerance: $0\%$

Total Losses: $P_k + P_0$
Current Tolerance: $+10\%$ (IEC60076-1)
New Tolerance: $0\%$
Transformers energy efficiency
Oil transformers

Liquid-filled distribution transformers with one winding with $U_m \leq 24 \text{ kV}$ and the other one with $U_m \leq 1.1 \text{ kV}$

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<th>Step 2 (from 1st July 2021)</th>
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<td>Max. Load Losses Pk (W)</td>
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<td>$\Delta$ Pk</td>
<td>$\Delta$ P0</td>
</tr>
<tr>
<td>25 – 1000</td>
<td>Ck</td>
<td>-20%</td>
</tr>
<tr>
<td>1001 - 3150</td>
<td>Bk</td>
<td>-50%</td>
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Transformers energy efficiency
Dry transformers

Dry-type distribution transformers with one winding with $U_m \leq 24 \text{ kV}$ and the other one with $U_m \leq 1.1 \text{ KV}$

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Transformers energy efficiency

CE marking

- It will be the manufacturer’s responsibility to ensure that the transformer is compliant
- CE marking is a key indicator of a product compliance with EU legislation to be put on main rating plate as proof of compliance
- Customers must verify the presence of the CE marking on the rating plate
- The rating plate will have to bear also load-loss, no-load loss and cooling-loss and information on the weight of the main components
Transformers energy efficiency

Key elements

- Distribution Transformers are already very efficient (+98%) yet load and no-load losses can be further improved
- Energy saving possibility in new building applications
- The industry state-of-the-art already allows the construction of transformers with losses in compliance to the new rule
- A higher energy efficiency means increase of dimensions and product price to be paid back thanks to lower electricity fares
ABB is already capable of offering transformers with losses lower than those prescribed by the Regulation.
Transformers energy efficiency
Amorphous core for extremely low no-load losses

ABB is capable of constructing transformers with amorphous magnetic core with no-load losses lower than those prescribed by Step 2 (2021) of the standard.
Transformers energy efficiency
Benefits to ABB’s customers

- Proximity to your business
- Tailor-made solutions for OEMs’ applications
- Reliability and technical expertise
- Sustainability
- Solutions compliant to the EU rule
- Ultra-efficient product lines
Questions & Answers
Power and productivity for a better world™