The ABB Ability Power Transformer sets new industry standards

With its standard digital capabilities, the ABB Ability Power Transformer provides a future-proof platform that delivers health data and actionable intelligence. Users gain access to ABB’s digital ecosystem and can thus optimize reliability, availability and productivity while improving capital efficiency.

The power landscape is predicted to change more in the next 10 years than it has in the last 100 [1] →1. This is mostly due to the change in generation mix, where the integration of renewables and distributed energy resources is having the double impact of adding volatile supply sources while causing a decline in traditional high-inertia generation such as coal. This volatility will increase further, on the demand side, as e-mobility plays a greater role in the near future. At the same time, many utilities and industrial companies are under pressure to increase their efficiency and productivity in order to remain competitive in their respective fields.

Power transformers are critical elements in the electrical grid infrastructure that are impacted by these changes in the grid. While nobody can predict the exact effects on the typical power transformer over its lifetime of 30 to 50 years, it is certain that changing demand patterns will result in a more dynamic loading of the transformer, which can be detrimental to its remaining life →2.

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01 The ABB Ability Power Transformer delivers health data and actionable intelligence so users can optimize reliability, availability and productivity while improving capital efficiency.
To address this situation, users need actionable information and insights to enable better decision making and asset management as well as a future-proof technology concept. Therefore, the time has come for transformers to become digital by design. This is why ABB has developed the ABB Ability Power Transformer (AAPT) as a new standard for power transformers. The AAPT is an integrated solution with electronic temperature monitoring and on-board intelligence on load and aging conditions. Additionally, the AAPT offers a wide range of options, leveraging ABB’s broad portfolio of devices, software and services.

Digital power transformer platform and ecosystem

The technical development of the AAPT was based on a future-proof modular solution. The platform concept covers everything from the standard package with electronic temperature monitoring and indicators, up to a full monitoring package with plug-and-play connectivity including the whole family of ABB eDevices (digitally enabled instrumentation and protection devices), ABB’s dissolved gas analyzers (DGA) CoreSense and CoreSense M10, and the option to integrate third-party sensors and instrumentation.

Upstream connectivity options range from local devices such as laptops or tablets, control or SCADA (supervisory control and data acquisition) systems, to ABB’s own ABB Ability Ellipse asset performance management (APM) software.

Even just the standard AAPT configuration brings the benefit that multiple data points can be trended and stored for future reference or used to compare the relative performance of parallel units and aid in future planning. The AAPT also includes a self-check or watchdog function.

The AAPT platform has been conceived to be independent of the type and size of the transformer, as the accessories defined for the standard package are typically used in every oil-immersed power transformer.
The design models, drawings, installation and operating instructions, plus functional and installation tests are compatible with any power transformer and have been defined with this global requirement in mind. Last, but not least, the AAPT is fully compliant with industry standards applicable to both power transformers and low-voltage controls for any region of the world.

Connectivity

Many customers now demand actionable information, intelligent asset optimization and the ability to use real-time data to mitigate “nasty surprises.” The potential to network the AAPT is, therefore, a driver for many customers. The transformer can easily be connected to the station control via a built-in Ethernet cable and fiber-optic interfaces or via wireless. All connectivity solutions are supported by state-of-the-art cyber security and options include connection to ABB Ability cloud-based services.

Today, not everybody wants their most critical assets connected to the outside world. So, independent of the onboard cyber security, transformer monitoring can operate in on-premise or in standalone mode. Customers may send ABB raw data for interpretation and translation into useable information. Alternatively, customers can utilize ABB’s expertise on site.

Winding temperature

The beating heart of a power transformer is its windings, but traditional methods for controlling transformer cooling are based on monitoring the oil temperature rather than what is actually happening at the transformer’s hotspot. The aging of the insulation at the hottest point in the winding typically determines the life span of a power transformer; an oil temperature just 8°C above nominal could reduce the insulation life by up to 50 percent [3 →6].

The AAPT’s modern Electronic Temperature Monitoring solution can accurately calculate the transformer’s hotspot based on design data and factory type-test results, together with dynamic variables such as the loading and oil temperature. This can then be used to regulate the transformer’s hotspot temperature.

CoreTec™ 4

The brain of the AAPT is the CoreTec 4 module. CoreTec 4 is a digital hub, responsible for collecting and analyzing readings from the different sensors, and processing them to provide an assessment of transformer operation (including cooling equipment governance, if needed) and life expectancy.

For the development of CoreTec 4, ABB was able to leverage existing expertise and experience in transformer monitoring systems, building on developments that go back to the 1980s with first fiber-optic temperature monitoring systems, the 2000s with Transformer Electronic Control (TEC) and the previous CoreTec generations.

Apart from functionality, additional design requirements such as compactness, expandability (by plug-ins), ease of installation and durability were considered in the development process.

To ensure system robustness, demanding mechanical, thermal and dielectric laboratory trials were carried out. Mechanical testing covered not only vibration but also thorough seismic and shock tests (over 10 G). Thermal validation was achieved in steady-state conditions and in contingency situations, such as when cabinet cooling is lost. All these validation tests had positive results – the readings were consistent during the tests with no interruption, no visual damage and successful operation after the tests.

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### Table: Product type and Description

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<tr>
<th>Product type</th>
<th>Description</th>
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<tbody>
<tr>
<td>eSDB</td>
<td>Self-dehydrating breather</td>
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<tr>
<td>eOTI</td>
<td>Liquid temperature indicator</td>
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<tr>
<td>eWTI</td>
<td>Winding temperature indicator</td>
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<tr>
<td>eOLI</td>
<td>Liquid level indicator</td>
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<tr>
<td>eVIEWER</td>
<td>Remote viewer for eOLI</td>
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<tr>
<td>eBR</td>
<td>Buchholz relay</td>
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<tr>
<td>ePRD</td>
<td>Pressure relief device</td>
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### Table: Dissolved gas analyzers

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<tr>
<td>CoreSense</td>
<td>Hydrogen and moisture monitor</td>
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<tr>
<td>CoreSense M10</td>
<td>Monitor for nine different gases and moisture</td>
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The AAPT has been validated as an integrated solution in several new and retrofit applications of different types. The validation included thousands of hours of real on-site conditions, at different locations and applications around the world. Data gathered during validation demonstrated reliable performance, with all functional parameters within expected ranges, confirming the benefits of the measurement analysis. Indeed, the owners of these pilot units have started to see the benefits of the AAPT technology by making use of the advanced analytics to translate the collected data into actionable information.

**Field experience**

Various use cases were identified and proven in the field. In a transmission network, the information provided on temperature and load enabled the operator to optimize the cooling control in such way that the top oil temperature fluctuation was reduced from over 15 °C to less than 5 °C, under varying ambient and load conditions. This results in stable conditions for the insulation and extends the transformer’s lifetime.

In an industrial installation, the operator noticed an increase of temperature and dissolved gases while the load was constant. An investigation found a that a mineral buildup had resulted in a faulty fan at a heat exchanger – a situation that could have proven costly in the long run.

In a smelter application, the customer wanted to increase their production capacity by 15 percent. Thanks to the digital capability it was possible to calculate the trade-off in terms of remaining transformer life, and to ensure the asset integrity while running the transformer in overload condition.
In the future, with more data becoming available from an expanded base of installations, and with the advancement of analytics technologies, additional use cases will emerge that further leverage the digital capabilities and the ecosystem that ABB can provide.

The future of power transformers is digital

In the past, transformers were an asset that kept running under stable conditions in a centralized grid. The exact condition of the transformer, especially that of its insulation and aging, were not known but due to stable load conditions many transformers had a long lifetime. Today, however, grid conditions have become more stressful due to the integration of volatile renewables and distributed energy resources, and, for example, the rise in the number of electric-vehicle charging stations.

Additionally, asset owners feel pressure to ensure competitiveness and effective allocation of capital and operational expenditures. Therefore, better insights are needed in order to ensure sound decisions on transformer maintenance, repair or new investment.

Further, those armed with the right data interpretation can benefit from dynamic optimization of the transformer loading and reduce the need for site visits. They can make informed decisions and trade-offs between overloading the transformer for immediate financial gains versus shortening transformer life.

ABB is enabling asset owners to meet all these challenges by digitalizing new transformers as a standard feature. The ABB Ability Power Transformer monitors health data and delivers actionable information to enhance grid reliability and the efficiency of load distribution, and increase service and maintenance productivity by enabling condition-based maintenance.

During the lifetime of the transformer, upgrades are easily possible thanks to a modular and scalable architecture. Therefore, the ABB Ability Power Transformer is a future-proof investment designed to open the world of digital possibilities to asset owners and enable them to gain a competitive edge in a changing environment →7.

The AAPT was introduced to the public at the Hannover Messe 2018 and garnered positive reactions and feedback. The market launch of this new product underlined how ABB has, throughout its long history, been able to solve important customer problems, deliver real benefits and spearhead innovation.

References