



DC-DC Converter Testing

Manufacturer of automotive DC-DC converters slashes test time by 95 percent

Organization

- OEM of DC-to-DC converters

Challenges

- Testing and verification were taking too long for each new model
- Test accuracy was inconsistent from device to device
- Manual data logging and reporting were error-prone and time-consuming

Solutions

- Measured multiple parameters using a solution based on the Keysight B2985A electrometer/high-resistance meter
- Generated high power levels using the Keysight N8900 autoranging system DC power supply
- Simplified signal routing with the Keysight 34980A multifunction switch/measure unit

Results

- Reduced test time by 95 percent
- Increased throughput by 4x compared to one-at-a-time testing
- Implemented automated and continuous testing of multiple parameters for each DC-DC converter
- Improved overall test efficiency

The electrification of passenger cars and commercial vehicles has triggered a shift from traditional 12-volt platforms to high-voltage, high-power DC systems. Across a growing number of e-mobility applications, devices called DC-to-DC power converters are a crucial system component.

In the powertrain of an electric vehicle (EV) or hybrid electric vehicle (HEV), these converters operate at power levels that range from 60 to 180 kW or higher.

Elsewhere inside a vehicle, a growing number of “boost” (step-up) and “buck” (step-down) converters are also being used to power the latest advanced driver-assistance systems (ADAS) and a variety of safety, comfort, convenience, body, and chassis features.

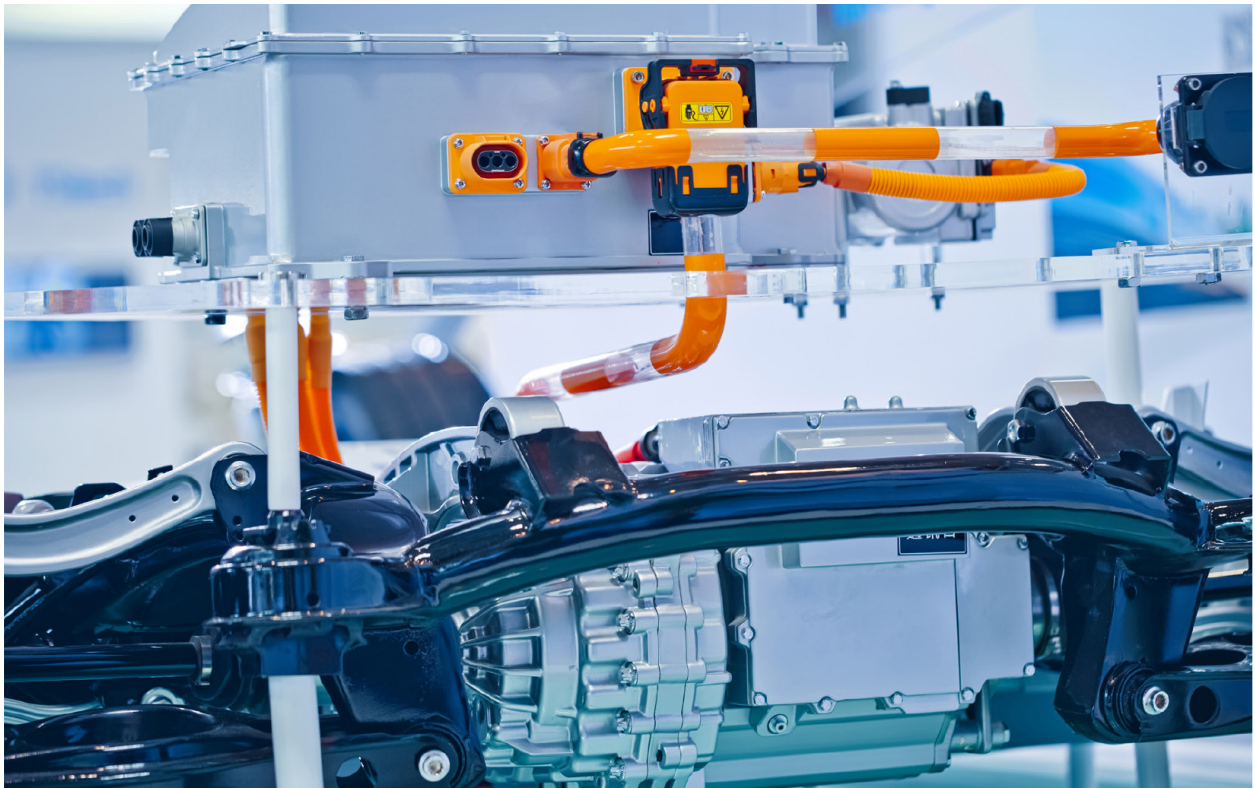
One of the world’s leading original equipment manufacturers (OEM) of DC-DC converters for EVs and HEVs faced a rapid increase in orders for its higher-power models. These included buck converters that step down high voltages (e.g., 200-300 V) to 48 V for EV and HEV powertrains. Because reliability is an important differentiator for all EV/HEV components, the company decided to replace a mostly manual testing process with a more automated solution that would save time and enhance product quality.

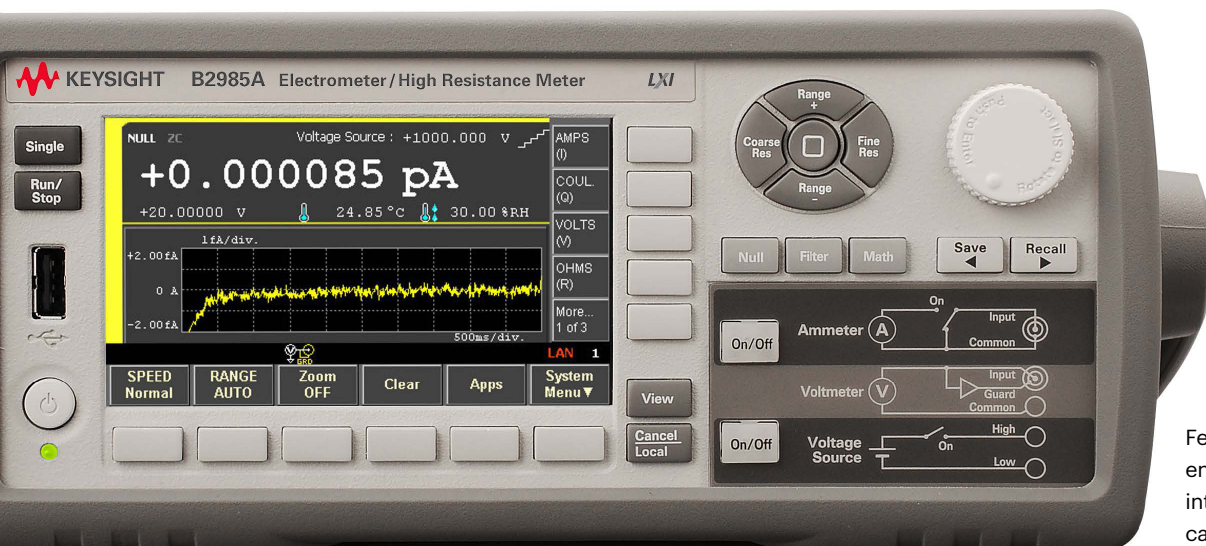
The Challenge: Overhauling an Outdated Test Process

Among the manufacturers that produce multiple lines of DC-DC converters— 48, 300 or 1,000 V—all face the challenge of testing a wider range of devices while meeting increasingly difficult goals for cost-of-test and time-to-market.

In this case, the challenges were especially difficult because the OEM's manufacturing-test team was relying on technicians to manually characterize converters on the production line. This process had two critical bottlenecks. First, their existing power analyzer was capable of testing only one converter at a time. Second, data logging was especially slow and tedious because reports were being entered manually, and this increased the likelihood of misleading results caused by human error.

The problem became more severe as the OEM experienced rapid order growth and escalating demand for exceptional product reliability. This put the manufacturing team under tremendous pressure to test more parameters on more units in less time. Hoping to find a solution, they decided to explore new test strategies that would shorten test time and reduce the escalating cost of test.





Features in the B2985A ensure measurement integrity through external cables and fixtures

The Solution: Redefining Converter Testing

During its initial meeting with Keysight, the OEM outlined two essential needs. First and foremost, they wanted a robust and future-proof system that would help them test a variety of high-powered products quickly and cost-effectively. In addition, they wanted an architecture that would ensure the safety of their engineers and technicians when working with high voltages and power levels.

After assessing the overall situation and the crucial needs, Keysight's engineers proposed a new process that would save time and reduce costs by automating testing and data logging. The solution addressed five key areas: measuring insulation resistance, simulating high-power DC voltages, measuring input voltages, measuring multiple output voltages, and sinking current measurements.




The system included four primary elements:

- Keysight B2985A electrometer/high-resistance meter
- Keysight N8900 autoranging DC power supply
- Keysight 34980A multifunction switch/measure unit (SMU)
- Keysight N3300 Series DC electronic loads

The Results: Saving Time Throughout the Process

Elements of the new test solution contributed to a 4x increase in test throughput and collectively a 95 percent reduction in overall test time. For example, through the measurement capabilities built into the N3300 Series electronic loads, the test system can make simultaneous measurements of multiple outputs from a single converter or single outputs from multiple converters. This is a substantial advancement over the previous one-at-a-time process, and is a key contributor to the substantial improvements in test time and throughput.

Another major time saver is the 34980A multifunction SMU, which enables the customization of multiple tests to address a variety of converter models. Specifically, the SMU provides a flexible and reliable way to control switch relays inside a converter and measure the resulting output voltages.

| Product | Solution | Results |
|-----------------------------------|--|---|
| N3300 Series electronic load | Captures multiple outputs from single converter or single outputs from multiple converters | <div>4X increase in test throughput</div> <div>95% decrease in total test time</div> <div></div> |
| 34980A multifunction SMU | Customizable tests for varying converter models | |
| B2985A electrometer | Refined resolution down to 0.01 fA for insulation resistance measurement | |
| N8900 autoranging DC power supply | Supplies high-power, high-voltage outputs for the OEM's wide range of converters | |

The new test strategy shortened test time and reduced the escalating cost of test

Configuring the B2985A to check insulation resistance, the system can provide measurement resolution down to 0.01 fA. With the built-in ability to measure up to 1000 V_{dc}, the electrometer also enables the team to confidently measure earlier-generation DC-DC converters designed for EV applications.

To confirm proper operation of a DC-DC converter over its entire range of input voltages, the system also uses the B2985A as a programmable source to produce a variety of test scenarios. The meter has built-in data logging capabilities that can capture a series of test results, making it easier to analyze transients and, ultimately, contributing to improved product quality, reducing human error in previous manual processes.

With the N8900 autoranging DC power supply, the test system can produce the high-power, high-voltage outputs needed to test the OEM's full range of converters. In addition, the N8900 saves time and reduces cost by simulating the vehicle battery within the manufacturing test process.

Going Forward

After the successful implementation of the automated test process, the OEM's next steps were to standardize the associated test and measurement software. This occurred not only at the initial pilot site but across other business units in different countries. The OEM is now poised to meet the needs of existing and emerging DC-DC power conversion applications in e-mobility and beyond.

Related Information

- Data Sheet: *B2980A Series Femto/Picoammeter and Electrometer/High-Resistance Meter*, publication 5991-4878EN
- Data Sheet: *Keysight N8900 Series Autoranging System DC Power Supplies*, publication 5991-2818EN
- Data Sheet: *34980A Multifunction Switch/Measure Unit*, publication 5989-1437EN
- Data Sheet: *N3300 Series DC Electronic Loads*, publication 5980-0232E

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