

Keysight Technologies

Power Device Analyzer Contributes to Reliable Electric Equipment Development and Production



Case Study

Reliability Engineers in Technology Development Department at JUKI Corporation

A Major Sewing Machine Company Customer Success Story

Power device characterization is not only important to power device manufacturers; it is also critical for a variety of companies manufacturing products that use power devices in their end products.

This case study shows an example where the B1505A Power Device Analyzer/ Curve Tracer has been used to achieve reliable product development and production.

Technical Challenges at JUKI Corporation

JUKI Corporation sells more industrial sewing machines than any other company in the world. Customers in about 170 countries use JUKI sewing machines on a regular basis.

The reliability technology group in JUKI Corporation's Technology Development Department has the important mission to maintain and improve JUKI sewing machines' high quality so that customers around the world can use them safely and comfortably.

To continue to provide highly reliable sewing machines that can work stably in any environment in any part of the world, the reliability technology group has to overcome the following technical challenges:

- To provide the circuit development group with detailed circuit component characteristics in order to maintain high product reliability. This requires the characterization of devices such as MOSFETs, diodes and 3 terminal regulators, which are used in the motor drive circuitry to provide precise sewing machine motor control.
- To prevent the use of unreliable or out-of-spec devices that could cause product failure. This requires the periodic checking of incoming devices.

Overcoming the first challenge is critical to maintaining and improving the value of the JUKI sewing machine, since threshold voltage variations or large leakage currents can lead to product failure. For JUKI's products, both static characteristics and dynamic characteristics are important. For instance, MOSFET Crss (Reverse Transfer Capacitance) has to be small enough to avoid coupling with the surrounding circuit and causing oscillations. Many device parameters need to be within a certain specification for optimum sewing machine performance.

Recently, the second challenge has taken on much greater importance. One reason for this is the increased prevalence of counterfeit electronic components, which is a growing issue in the power device market. A counterfeit component was even recently discovered at a U.S. military facility, which assumedly has some of the strictest security measures in the world. Another issue is out-of-spec device performance.

The following are comments by Mr. Kamosaka – senior engineer in the reliability technology group at JUKI Corporation

“Introduction of B1505A to our company is a great success. It is now an essential instrument for us to provide reliable sewing machines for our world-wide customers by easily and surely evaluating power devices which are the critical parts from reliability perspective.

Although it is called curve tracer, my perception is far beyond that because you can measure all necessary parameters and IV/CV curves easily and automatically. I'm also satisfied with the Keysight Technologies, Inc. support.”

This issue has become more prevalent as power device manufacturing has moved to lower cost countries with less manufacturing experience. Therefore, verifying device parameters such as maximum voltage/current, on resistance or input/output capacitances against the datasheet parameters is the most effective means to detect bad or counterfeit devices.

Obviously, equipment capable of meeting these challenges needs to have sufficient voltage and current ranges as well as enough measurement accuracy to be able to verify proper device performance. In addition, the followings are also critical requirements:

- Measurement repeatability independent of the person performing the measurement.
- Minimal test measurement times.
- Ease of use. Users need to be able to detect device issues quickly not only through numerically measured parameters, but also graphically by viewing IV or CV curves. In addition, tests need to be repeated each time using exactly the same instrument settings to correctly isolate device performance issues.

A solution that meets JUKI Corporation's measurement challenges

The Keysight B1505A can meet all of these measurement challenges. We will examine each of the key challenges separately.

- *Optimizing test conditions quickly*
The B1505A's curve tracer mode allows you to quickly determine the optimal voltage and current test conditions, since it allows you to monitor device characteristics in real time as test conditions are changed interactively.
- *Testing devices and extracting parameters easily*
The B1505A's EasyEXPERT software has a standard library of over 300 application tests that allow the user to select the appropriate test and then fill in the appropriate measurement conditions quickly and effortlessly. These furnished application tests make it easy to perform measurements and extract parameters without having to write any test routines or create any program code.
- *Performing multiple tests automatically*
The B1505A's EasyEXPERT software allows multiple application tests created using the above procedure to be performed in-sequence with the press of a button. In addition, an integrated selector that automatically routes the correct measurement resource (high voltage or high current) during testing allows tests to be execute automatically without the need to manually change any connections. This feature eliminates human error, resulting in highly repeatable measurement results regardless of who performs the tests. Moreover, since the testing is fully automated the total test time is greatly reduced versus having a technician manually select and execute each test.
- *Automating data saving and simplifying test repeatability*
Regardless of whether a measurement is manual or automated, a variety of information is saved each time a test is performed. Saved information includes: measurement curves and extracted parameters, test setup conditions, measurement execution date/time and user specified comments. This makes it easy to recall and duplicate the same test at a later date, thereby greatly simplifying the process of isolating the performance issues on a suspect device.



Summary

The B1505A is an ideal test instrument, not only for power device manufacturers, but also for equipment manufacturers such as JUKI Corporation. It is now an indispensable tool for JUKI Corporation, which places a high value on product reliability and customer satisfaction for the users of its sewing machines.

B1505A Features

- All in one solution for power device characterization up to 1500 A/10 kV
- $\mu\Omega$ resistance measurement capability
- Accurate Sub-pA level current measurement at high voltage bias
- Capacitance measurement at up to 3000 V of DC bias
- High power pulsed measurement down to 10 μ s
- Temperature measurement capability
- Switch between high-voltage and high-current measurement without the need to re-cable
- Oscilloscope view allows verification of applied voltage and current waveform
- MS Windows-based EasyEXPERT software facilitates data management and simplifies data analysis
- Upgradable and scalable hardware architecture

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