Testing Implantable Neurostimulators Using LabVIEW and TestStand
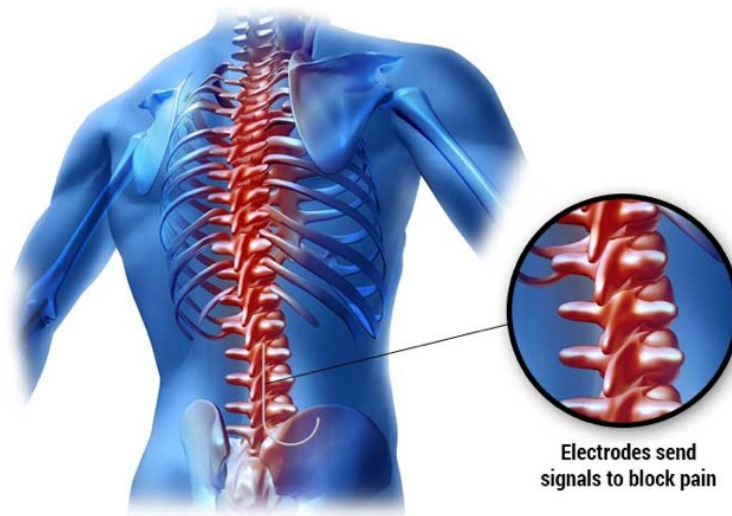

Figure 1. *Spinal cord stimulation (neurostimulation therapy) is delivered with a small spinal cord stimulator—similar to a pacemaker—that is implanted under the skin. The neurostimulator delivers mild electrical pulses to your spine, providing pain relief.*

"Radius Teknologies, LLC used the advanced capabilities of LabVIEW and TestStand to develop and deploy several key components of an automated test system used to test implantable neurostimulators in a highly regulated environment."—Mark Ridgley, Radius Teknologies, LLC

Industry:
Medical Devices

Application:
Implantable Neurostimulation

The Challenge:
Developing device-level tests, test sequences, user interfaces, and development tools to test implantable neurostimulators in development and production environments.

The Solution:
Using LabVIEW system design software to create customer-specified device-level tests, development tools, and user interface elements. We also used TestStand to develop the test sequences, custom report-generation capability, and customized process model to meet the customer's unique needs.

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Understanding Automated Test Systems
An automated test system must implement several key tasks to complete the testing process. Some of these tasks are specific to the device under test (DUT), and others are repeated for every device tested. Modular test system architecture clearly separates system-level tasks common to every device (test management software) and the DUT-level tasks that are different for each device tested (test code). An automated test system must perform all of these tasks reliably and efficiently to be effective.

Tasks common to each device include the following:

1. Operator Interfaces
2. User Management
3. DUT Tracking
4. Test-Flow Control
5. Results Storage
6. Test Reports

Tasks that are different for each device include the following:
1. Instrument Configuration
2. Measurements
3. Data Acquisition
4. Results Analysis
5. Calibration
6. Test Modules

In addition to performing the common and unique tasks required to test each device, a well-designed automated test system must be scalable, reliable, and efficient, so that the level of effort required to add new features, troubleshoot, or operate the system is reduced and the total cost of system ownership does not rise over time.

Company Background
Radius Teknologies, LLC was established as an NI Alliance Partner and independent LabVIEW consulting company in 2013. We are dedicated to helping companies be successful using NI hardware and software to design, develop, and implement creative, versatile, and sustainable solutions for complex technical challenges in measurement, automation, and control. We have experience designing, developing, and implementing test systems based on NI hardware and software for the academic, consumer, medical, automotive, industrial, and aerospace/military markets.

Project Background
For this project, we actually became part of the customer's automated test system development team. We were responsible for:

- **Temperature Setpoint Control**—We used LabVIEW to develop a method for accurately setting the test system to a specified temperature during the device temperature response test.
- **Device Event Log Data Parsing**—We used LabVIEW to develop tools for parsing device event log data to aid in troubleshooting device functionality.
- **Development Tool Creation**—We used LabVIEW to develop a utility for manually sending commands to a DUT and a utility for verifying the ability of the device to clear data from device memory.
- **Product-Level Test Development**—We used LabVIEW to develop and integrate several product-level tests as prioritized by the customer.
- **Production User Interface Development**—We used LabVIEW to develop and implement the production user interface per customer specifications. The production user interface consisted of several custom dialogs for operator data entry and instruction display, as well as process control and sequencing. We optimized all user interface elements for use with a touch screen.
- **Automated Test Selection**—We used LabVIEW and TestStand to develop and implement a method for automatically selecting which test sequence to execute based on data scanned from the DUT.
- **Input Data Validation**—We used LabVIEW and TestStand to develop and implement a data validation method to detect and report data entry errors.
- **Self-Test Interval and Interlock**—We used TestStand to develop and implement self-test interval control and system interlock to ensure the system self-test executed at regular intervals and that the test system could not be used for production testing if the self-test did not pass.
- **Report Generation**—We worked with customer team members to develop and implement custom report generation code and a process model plugin sequence to integrate the custom report generation code into the TestStand development environment.
- **Custom TestStand Process Model**—We used TestStand to develop and implement a method to integrate the custom system components into the TestStand process model.

Achieving Success with LabVIEW and TestStand
Radius Teknologies, LLC has more than 16 years experience developing applications based on LabVIEW and TestStand. As an Alliance Partner, we are strong advocates of the LabVIEW and TestStand software development environments. LabVIEW system design software is a graphical programming environment with which we produced the intuitive GUIs that this customer required. We were able to quickly prototype and refine the necessary GUIs so that production line operators could execute device tests quickly, with minimal required user interaction and reduced error probability.

TestStand, an industry standard for automated test, is used in a wide variety of applications, ranging from aerospace and defense, to medical and life sciences, to everyday consumer electronics. TestStand offers advanced functionality out of the box, along with complete customizability, making it an excellent choice for companies that need a scalable, reliable, and efficient solution for test automation.

Conclusion
Using LabVIEW and TestStand, we designed, developed, and deployed versatile, intuitive, and easy-to-use automated test system components that met customer requirements in the shortest time possible. We could not have done this, had the customer decided to develop the test code and system management software using other

development platforms. The customer deployed and used multiple systems successfully without experiencing any major problems or unacceptable downtime.

We used the advanced capabilities of LabVIEW and TestStand to develop and deploy several key components of an automated test system used to test implantable neurostimulators in a highly regulated environment. It is clear that LabVIEW and TestStand were the best choices to meet this customer's unique requirements.

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