

Testing Starter Motor Durability Using National Instruments LabVIEW and Compact DAQ



Figure 1. Starter Durability Test System User interface.

"National Instruments LabVIEW and Compact DAQ enabled Radius Technologies, LLC to develop the custom user interface, data acquisition, data analysis and data presentation application needed to deliver a reliable and easy-to-use control and measurement application."

- Mark Ridgley, [Radius Technologies, LLC](http://www.radius-tek.com)

Industry:

Automotive.

Application:

Starter motor durability testing.



CASE STUDY

The Challenge:

Develop a LabVIEW control application for a system used to perform durability testing on up to four automotive starter motors in parallel while satisfying the following requirements:

- Test up to 4 starter motors in parallel controlled by a single computer system
- Allow a different part number starter motor to be tested on each test station in parallel
- Start or stop any test station at any time independent of the others
- Maintain input and output data segregation and integrity between all four test stations
- Share key system resources across all four test stations to reduce equipment cost

The Solution:

Radius Technologies, LLC utilized National Instruments LabVIEW and Compact DAQ to develop the user interface, data acquisition, data analysis and data presentation software needed to deliver a robust, scalable and modular control application that met all requirements of the starter durability test system.

Author(s):

Mark Ridgley – [Radius Technologies, LLC - Alliance Partner](#)

Understanding Starter Durability Test Systems

An automotive starter motor must provide many years of trouble-free operation. Manufacturers of automotive starter motors need a means to verify that their products are capable of meeting this requirement. Testing every unit produced would be time consuming and expensive, so manufacturers typically only test a small sample of the parts produced in a production run to verify product durability.

An automotive starter motor typically operates for 5 seconds or less, under high loading. Manufacturers of automotive starters require a test system that can simulate these operational conditions while simultaneously capturing, analyzing and logging key unit under test (UUT) and system data in addition to monitoring test system components for fault conditions,

A single UUT will be subjected to thousands of test cycles to verify its durability. A single test cycle consists of 5 seconds of run time followed by a 55 second cool down period. Because the testing of each UUT is a lengthy process, a starter durability test system must be robust, reliable and easy to use. The test system must fully, reliably and completely accomplish the following tasks within the 5 second run time window:

- Apply voltage to the appropriate test station
- Engage the starter motor solenoid on the appropriate test station
- Command the motor drive to apply a counter-torque to the starter motor on the appropriate test station
- Capture and log all measurement data acquired from the appropriate test station
- Repeat the process for the user-selected number of test cycles

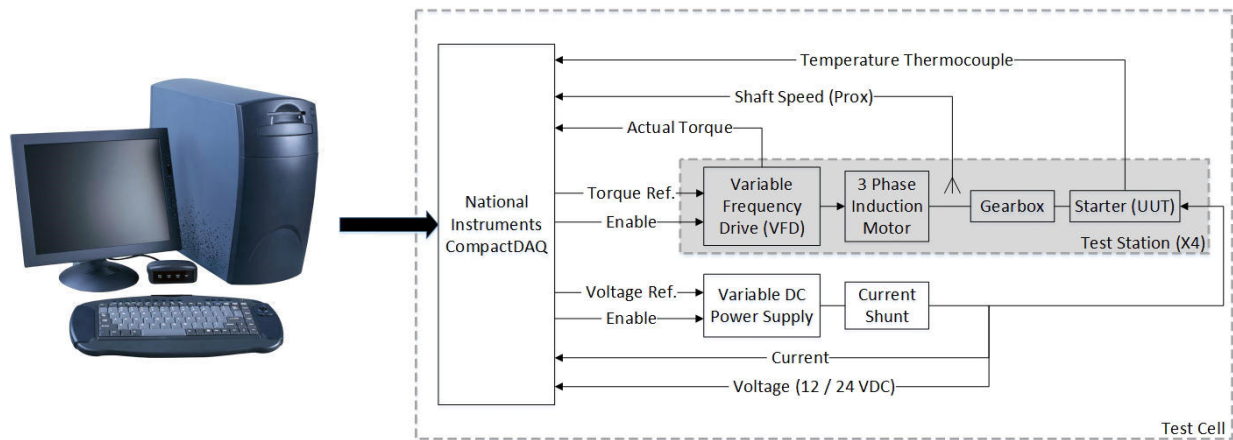


Figure 2 Starter Durability Test System Block Diagram.

The delivered test system consists of four separate test stations, controlled by a single computer system. The capabilities listed below were implemented to meet customer requirements:

- System operation is driven by a spreadsheet file containing starter motor specification data enabling the flexibility to test new part numbers as needed simply by updating the spreadsheet file with the specifications for new part numbers to be tested on the system. No modification to system software is required to test new products on the system.
- The software controlling each test station is designed such that each station runs as a separate instance, controlled by the top-level application. Each instance utilizes a distinct memory location to store its associated data— ensuring data segregation and integrity for all test stations.
- Because the system is required to run up to four test stations in parallel, several key system resources must be shared and the software is designed to prevent resource conflicts. When any test station is using a shared resource, all other test stations must wait until that resource is released.

Equipment Used

Equipment	Description	Function
NI cDAQ-9178	8-Slot USB Chassis	DAQ Measurement System Chassis
NI 9205	32-Ch ± 200 mV to ± 10 V, 16-Bit, 250 kS/s Analog Input Module	UUT Current Measurement
NI 9221	8-Channel, ± 60 V, 800 kS/s, 12-Bit Analog Input Module	System Current Measurement
NI 9263 (2)	4-Channel, 100 kS/s, 16-bit, ± 10 V, Analog Output Module	Drive Reference Voltage
NI 9422	8 Ch, 24 V to 60 V, 250 μ s, Sinking/Sourcing Digital Input	E-Stops, Drive Status, Jog Switches
NI 9472 (2)	8-Channel 24 V Logic, 100 μ s, Sourcing Digital Output Module	UUT Solenoid Relays, Drive Enable
NI 9211 (2)	4-Channel, 14 S/s, 24-Bit, ± 80 mV Thermocouple Input Module	UUT Temperature Measurement
Emerson Unidrive SP (4)	AC Motor Speed Controller	UUT Torque Loading
Emerson Commander SK	AC Motor Speed Controller	UUT DC Power Generation

Table 1 Starter Durability Test System Key Components



CASE STUDY

Radius Tehnologies, LLC

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

Why did Radius Tehnologies, LLC Select National Instruments LabVIEW and Compact DAQ?

Radius Tehnologies, LLC has more than 16 years experience developing applications based on National Instruments LabVIEW. As a National Instruments Alliance Partner we are strong advocates of the LabVIEW software development environment.

The LabVIEW software development environment is a graphical programming environment that enabled Radius Tehnologies, LLC to produce the intuitive graphical user interfaces (GUIs) that this customer required. We were able to quickly prototype and refine the necessary GUIs that would allow system Operators to execute tests quickly, with minimal user interaction and a reduced probability for errors.

NI CompactDAQ is a portable, rugged data acquisition platform that integrates connectivity and signal conditioning into modular I/O for directly interfacing to any sensor or signal. Utilizing NI CompactDAQ with LabVIEW enables developers to customize how measurement data is acquired, analyzed, presented, and managed to meet customer requirements.

National Instruments LabVIEW and Compact DAQ provide a complete system development platform that allows for maximum reuse and unifies design, validation, and automated test. In addition, the ability to replicate real-world environments for individual vehicle components, coupled with a wide range of I/O and control options, and flexible software, uniquely positioned NI LabVIEW and Compact DAQ as the best choice for this application.

Conclusion

National Instruments LabVIEW and Compact DAQ enabled Radius Tehnologies, LLC to develop the custom user interface, data acquisition, data analysis and data presentation application needed to deliver a reliable and easy-to-use control and measurement software application which met all customer requirements. The tight integration of NI hardware and software enabled Radius Tehnologies, LLC to meet all of the software design challenges presented by this demanding application.

The customer required minimum training in how to use the delivered software application and was able to quickly put the system into service without any significant software issues or downtime.

National Instruments LabVIEW and Compact DAQ were undoubtedly the best choices to meet this customer's rigorous requirements.

Author Information:

Mark Ridgley
[Radius Tehnologies, LLC - Alliance Partner](#)

Next Steps

[Have the Partner Contact Me](#)