

A Resistance Profile Characterization System for Electronic Spring Probes

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Category: Electrical/Electronics

NI Products Used (See Figure 1 for System)

LabVIEW 7.1 w/ FlexMotion Package

NI-PCI-6143 Simultaneous Sampling Multifunction DAQ

NI-PCI-5412 14-Bit Arbitrary Waveform Generator

NI-PCI-7342 2-Axis Stepper/Servo Controller

NI-RTSI Bus Cable

NI-UMI-7764 Universal Motion Interface

NI-SCXI-1000 Chassis with SCXI-1349 Connector

NI-SCXI-1142 8-Channel Low Pass Bessel Filter

NI-SCXI-1304 Terminal Block

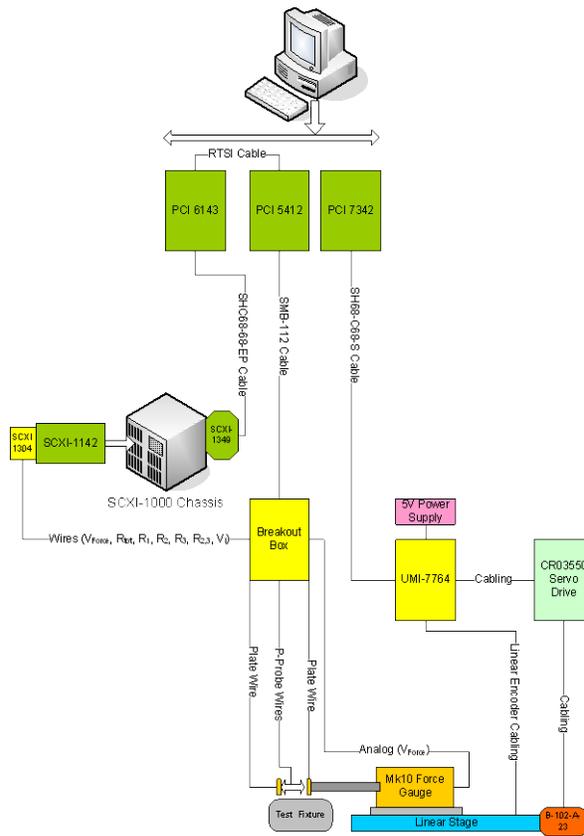


Figure 1. Probe Test System Schematic

The Challenge

The challenge was to develop a resistance characterization tester for contact spring probes that would provide R&D engineers the ability to characterize the resistance of the spring loaded electrical probe along its full linear motion and also be able to be used for production testing.

The Solution

The overall program design utilizes the powerful architecture of the producer/consumer loop in conjunction with the Event Structure. Multiple client applications can be working at the same time while the main application maintains supervisory control, allowing the operator to abort any test in case of problems. The use of the producer/consumer architecture is a scalable application and can easily accommodate future enhancements

Abstract

Automated test systems require multi-cycle connectivity to allow Units Under Test (UUTs), fixtures and receivers to be connected and disconnected reliably. This generally involves spring probes in the fixtures. At different positions along their lengths, the resistance of spring probes may vary. The consistency with which they vary directly impacts the consistency of the signal measurements being made. A system was developed in order to accurately characterize the resistance variation of the spring probes in order to provide more consistent measurements in the automated test equipment.

Introduction

The application had to incorporate the capability of two prior generation test units that performed static testing, or only provided resistance measurements at two discrete probe linear positions. This characterization information is critical for Quality Control and researching client issues – as the application of the spring probes in precise ATE whose resistances match at different linear positions. Due to the small voltage measurement that would need to

be taken over the spring probes it was desired to use an Offset Compensation method to remove the zero voltage offset. This technique is described at zone.ni.com. Characterization data would include Resistance vs. Position, Resistance vs. Force, and Force data vs. Position. Data Science Automation had to integrate the motion, force, and voltage reading systems to provide the desired data.

The Offset Ohms Compensation method is the key to the ability of this system to measure low level voltages across the spring probes. These low level voltages could be hidden in the noise caused by thermoelectric voltage stimulus across a limiting 50 Ohms resistor and also control the data acquisition timing of the NI-PCI-6143 Simultaneous Sampling DAQ. (See Figure 2)

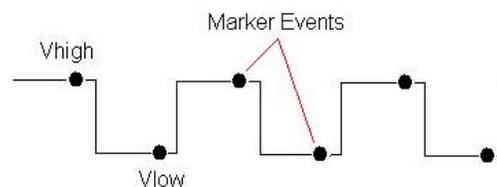


Figure 2 – Offset Ohm Compensation

The NI-RTSI Bus Cable was used to connect the NI-PCI-5412 Arb to the NI-PCI-6143 Simultaneous Sample DAQ. Through the use of DAQmx task timing, and DAQmx signal routing, the marker signals from the Function Generator were used to drive the sample clock of the NI-PCI-6143. This allowed simultaneous sampling of the analog channels used to measure the signal from the force gauge and 6 channels of voltage measurements in the test circuit.

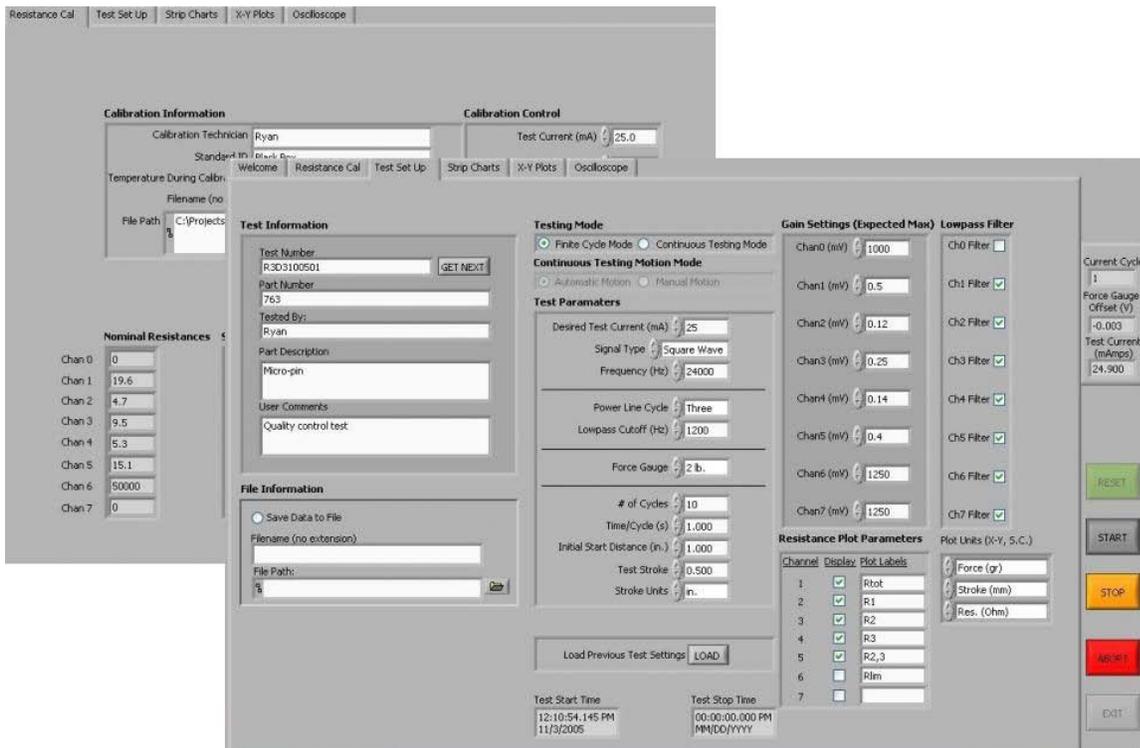


Figure 3. Calibration (Background, Test Set up (Foreground))

The Calibration tab Figure 3 Background allows the operator to check the system against known resistance standards (Figure 3). The resistance standards nominal values are read from an external configuration file that may be easily edited to handle the use of different standards. Measurement offsets for each channel are read from a configuration file and will allow the operator to run an “As Received” test to verify the system measurements fall within an operator specified tolerance range. If the tolerance for the resistance measurements has been exceeded the operator can run a calibration procedure to update the stored offsets for each channel based on the average deviation test of the readings from the stored nominal values. Every “As Received” test and Calibration event is logged in a text file for audit traceability.

Once the operator has verified the calibration of the system they proceed to the Test Set-Up tab (Figure 3 Foreground) where they enter information needed to perform the spring probe characterization testing. The operator can control the amount of gain applied to the individual channels through the NI-SCXI-1142 Amplifier/Filter Module, and also control whether the low pass filter will be used on that channel. The operator can select whether any of the resistance channel measurements will be plotted, and what the units are on the graph axis – this tailors the data presentation to the operator’s needs. The operator may run the system in one of two modes: dynamic motion mode or manual motion mode. In dynamic motion mode the spring probes are cyclically compressed and relaxed over the operator specified stroke length by the motion of the linear stage pressing the force gauge probe on the end of the spring probe. In manual motion mode no programmatic motion occurs after the linear stage has moved to the home position. The motor is then disabled to allow the operator to manually turn the stage leadscrew by adjusting the knob on the stage.

The operator is able to graphically view the test results as data is acquired, on two sets of tabs. The first set of tabs (Figure 4. Foreground) shows the data in the time domain. Separate tabs in this group present Position vs. Time, Force vs. Time, and Resistance vs. Time individually or all of these plots together on one tab. The second set of tabs (Figure 4. Middleground) shows the data on X-Y plots. Separate tabs in this group present Force vs. .Position, Resistance vs. Force, and Resistance vs. Position individually or all these XY plots on one tab. If the operator has

selected the option to save the data, it is written to a tab delimited text file (Figure 4. Background) for archival purposes.

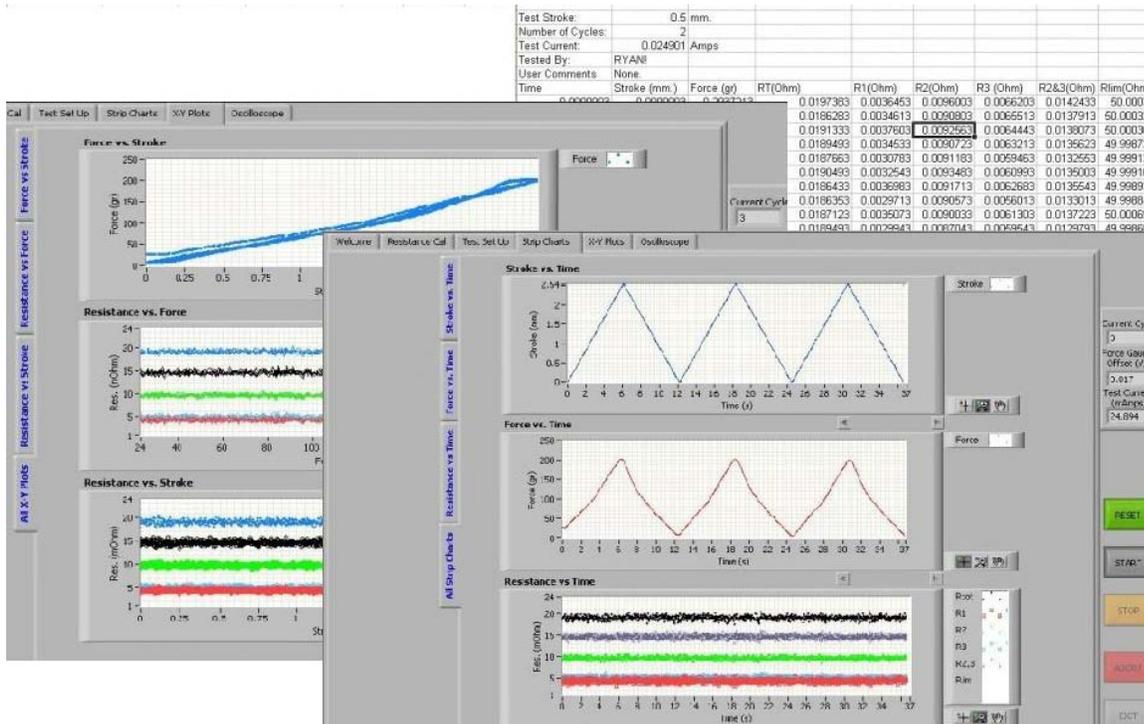


Figure 4. Data File Example, XY Plots, and Waveform Graphs

Summary

This application combines and enhances the functionality and ease of use of two separate testing applications previously in use. The operator is now able to fully characterize the resistance and force profiles of a spring probe along its entire length of motion. The use of National Instruments hardware allowed an elegant integration of the voltage signal generation and data acquisition tasks. The use of producer-consumer loop architecture with the use of the event structure assures scalability.