

Functional Testing of High Voltage X-Ray Tanks

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The Challenge: Developing an automated test system to perform functional testing, of a high-voltage source tank for X-ray generators used in medical applications, involving high voltages.

The Solution: Creating a compact and cost effective PXI based system using NI DMM, NI oscilloscope and data acquisition card, running a LabVIEW application.

Introduction

GE BEL, an Indian subsidiary of GE Medical Systems, wanted an automated system for testing the functionality of high voltage tanks, which is a critical component of X-Ray machines. Testing was conducted manually using individual instruments for measurement of electrical parameters. Nine individual tests were conducted and an operator would make the connections every time a particular test was performed. The manual testing was time consuming and required the intervention of the operator throughout the tests. The tests involve high voltages of 2500 V and frequent human intervention to change connections provided room for errors and safety concerns. Further, the measurements were noted manually and later transferred to a computer for report generation.

GE needed a test station that would perform all nine tests with minimal human intervention. ATE also needed to be able to communicate with the existing instruments that had computer connectivity through GPIB or RS 232 interface. We decided to build the ATE on a PXI platform to provide a compact yet cost effective replacement for the large manual test bay. The system was designed to restrict human intervention only to give the connections initially after which the system takes over and switches between the various instruments for the nine different tests. Further, the consolidated reports for GE's Six-Sigma quality analysis were also generated from the ATE thereby significantly saving time for GE.

System Description

The automated system acquires data directly using the scope card, the digital multimeter, and the data acquisition card. Data is also acquired from the external instruments using GPIB interface and RS 232 interfaces.

The ATE was compactly designed using an eight slot PXI chassis with an embedded controller. A PXI switch switches between the different external instruments. PXI 6508 digital I/O module in combination with an electromechanical relay module was used to control switching that was needed for the various tests. The switching arrangement eliminated the need to change connections after every test. High voltage supplies were controlled by the relays through contactors.

We used a PXI scope card to capture the waveforms. We used a PXI DMM to measure the high voltage by dropping it across a resistor and to measure resistances. A leakage tester that tests the system for leakage was controlled through the RS 232 interface. Through a GPIB interface, a high precision LCR meter from Wayne Kerr was used to measure HV capacitance, impedance, inductance and resonant frequencies. A programmable pulse generator was controlled through a GPIB interface for providing waveforms for different tests. The DAQ card measures the resultant voltages at different points and the results are compared with preset limits.

Safety was of primary concern in the system due to the presence of high voltages up to 3,000V. We analyzed all failure conditions and provided additional safety features to take care of situations that might arise out of contactor failures, or power failures.

Test sequencing was user selectable and the ATE would generate customized reports at the end of the test. The reports were required in Microsoft Excel format and using the Active X features of LabVIEW, the reports were directly created in the desired format in Excel.

System benefits

A comparison between the manual and the automated system for a better understanding of the system's benefits is included in Table 1.

Parameter	Manual System	Automated System
Cost effectiveness and Usability	Expensive and stand-alone instruments were used independently for the various tests	A single test platform that integrated some of the existing instruments with cost effective products from National Instruments to provide a easy to use system
Safety and Quality	Connections were given manually after each test. There were chances for errors in connections which might lead to unsafe conditions	Connections were given initially during the start of the test. This eliminates human intervention during the testing and minimizes risk
Productivity in Testing	The manual system takes 20 minutes for the nine tests, with continuous human intervention for data logging and switching connections	The automated system takes 6 minutes for the entire testing with no human intervention after the start of the test
Productivity in Report Generation	Six sigma consolidated score card generation by feeding in manual data to Excel and analysis took 32 manhours every month	The system generates the required reports in the desired formats at the click of a button in <i>less than a minute</i> .

Table 1. Comparison of manual and the automated systems

Conclusion

The virtual instrumentation-based system was more cost effective, compact, and easier to use than the earlier system. Our system improved testing productivity by three times and saved even more time and effort during report generation.