Increased Equipment Utilization through Optical Switching Using PXI and LabVIEW

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The Challenge: **Decreasing the overall cost of testing by reducing test time, minimizing space requirements, and increasing utilization of expensive optical test equipment.**

The Solution: **Developing a PXI chassis equipped with a LabVIEW-controlled Pickering optical switch for fast test development and sharing of optical test equipment without splicing or manually reconnecting fiber. This solution reduced labor hours and saved thousands of dollars per station in capital expenses.**

Introduction

Mink Hollow Systems, Inc., a National Instruments Systems Integrator and Alliance Member, serves the optical networking industry by providing custom-automated test and measurement solutions to the greater Baltimore-Washington area. We have successfully integrated numerous optical test stations using National Instruments hardware, GPIB instrumentation, LabVIEW graphical development environment, and NI TestStand test executive.

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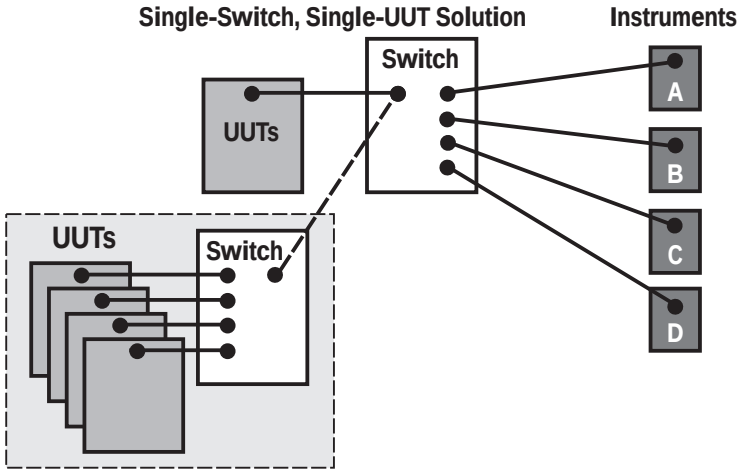
Cost-Effective Optical Testing

Optical testing from component level to system level is a time-consuming process using expensive test equipment that frequently costs $50,000 to $100,000 or more per unit. Commonly, a test requires multiple optical connections to various equipment, and this creates downtime. As downtime increases, equipment utilization decreases, resulting in millions of dollars of equipment being idle as optical fibers are manually connected to test equipment. In addition to being time consuming and tedious, splicing and manual connection tasks are prone to error. An incorrect optical fiber connection can cost time in retest and may result in damaged equipment. However, as test automation increases, manual connections and operator involvement decreases, which results in fewer errors, higher repeatability rates, and more efficient use of instrumentation.



With optical switching, we can connect a UUT to four optical test instruments that can run their specific tests.

Connecting to Multiple Instruments

With integrated software-controlled optical switching, we could dynamically connect a single fiber to multiple instruments, increasing the level of automation capable in a test station. For example, with a 1 x 4 switch, we can connect a unit under test (UUT) to four optical test instruments that can run their specific tests without requiring a manual reconnection. Therefore, we can develop the test software to run the four tests serially by switching the optical path between individual tests. Now, an operator makes one connection and runs one test to replace four connections and four tests. For some tests, this simple 1 x 4 switch integration can increase utilization by 50 percent or more. As we increase production and rescale testing, we can add additional switches to connect multiple UUTs to multiple instruments. As the operator connects a new UUT to switch position one, we can test a UUT on another switch position, which increases equipment utilization to near 100 percent.

Using PXI as a Compact Solution

A Pickering PXI optical switch integrated in a National Instruments PXI chassis with an embedded PXI controller is the foundation of this optical test station. We can easily add additional switches, GPIB instrumentation, and PXI data acquisition modules for custom test development.

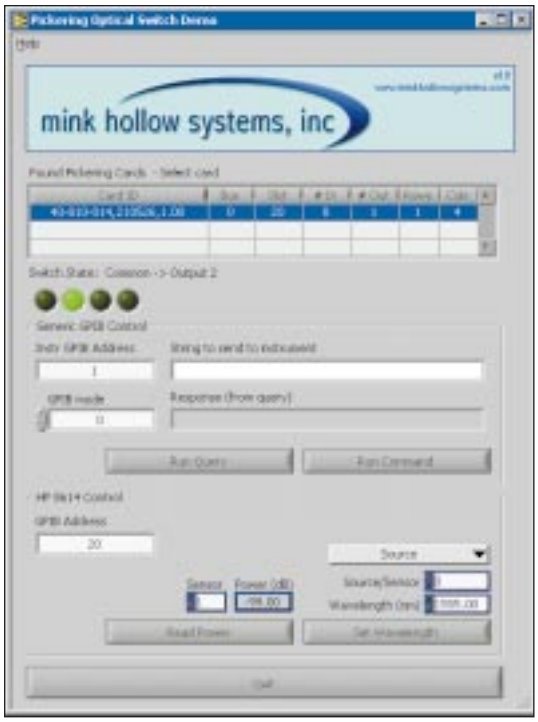
GPIB-controlled optical switches are a viable solution for optical test automation but do not give the compact solution inherent in PXI. Additionally, as we need multiple switches in a single test station, we can add PXI switches directly to the chassis. We can also link multiple chassis together for further growth. This scalability with minimal sprawl becomes a large cost savings by reducing complexity, size, and number of stand-alone instruments. Similarly, test station replication becomes easier with a PXI solution, and integrating measurement hardware is quick and requires no additional space. Other PXI measurement hardware modules include DMMs, function generators, high-speed digitizers, signal sources, DIO, multifunction I/O, counters, and timers.

Controlling Optical Switches with LabVIEW

We used LabVIEW to control a Pickering PXI optical switch module. Using the optical switch drivers, we obtained switch automation in less than half an hour. Additionally, we incorporated the PXI optical switch with GPIB instrumentation which enabled LabVIEW to fully automate the optical test.

The software first identifies if there are any Pickering optical switches in the PXI chassis and displays their specifications. By selecting a specific switch, a control becomes visible, automatically resizing to show the number of available connections. Clicking on a specific switch location toggles the connection. Therefore, if the optical path connects the common to output one and the user clicks on output one, the switch goes to an open state (no connections). If the same optical path exists and the user clicks on output four, the new optical path connects the common to output four and output one is closed. We do not need to open a connection before closing a new connection; we can simply close the new connection and all the others open.

A devie-independent generic control and an HP8164 Lightwave Measurement System control configure the GPIB instrumentation. The generic control requires an instrument address, found in Measurement & Automation Explorer. The GPIB command termination mode was explained in the software help. A query reads a response after sending the command, whereas running a command sends the command but does not read anything back. You can use this control for any connected GPIB instrument. To read a power level from the HP8164 Lightwave Measurement System, you need to specify the GPIB instrument, select the slot of the sensor, and press the “Read Power" button. Finally, to configure the source, you select the slot and wavelength before pressing “Set Wavelength." With the LabVIEW-controlled PXI optical switch demonstration software, you can quickly connect GPIB optical equipment to the switch, configure it, and select the optical path.



We used LabVIEW to control a Pickering PXI Optical Switch Module.

Conclusion

An automated optical test station can increase the utilization of optical test instrumentation, which increases productivity and reduces cost. A National Instruments PXI chassis and controller with a Pickering optical switch is a cost-effective, compact solution that is easy to customize and reproduce. Using LabVIEW to write an automated test gave us quick development time and increased equipment utilization to reduce costs.■

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