

## Lexmark – When Speed and Accuracy Matter

by Ed Coleman, Test Engineer, Lexmark International Inc.

**The Challenge:** Testing printer ink cartridges more accurately while maintaining production volume.

**The Solution:** Upgrading existing PC-based test instrumentation to use the highly accurate NI 5911 digitizer.

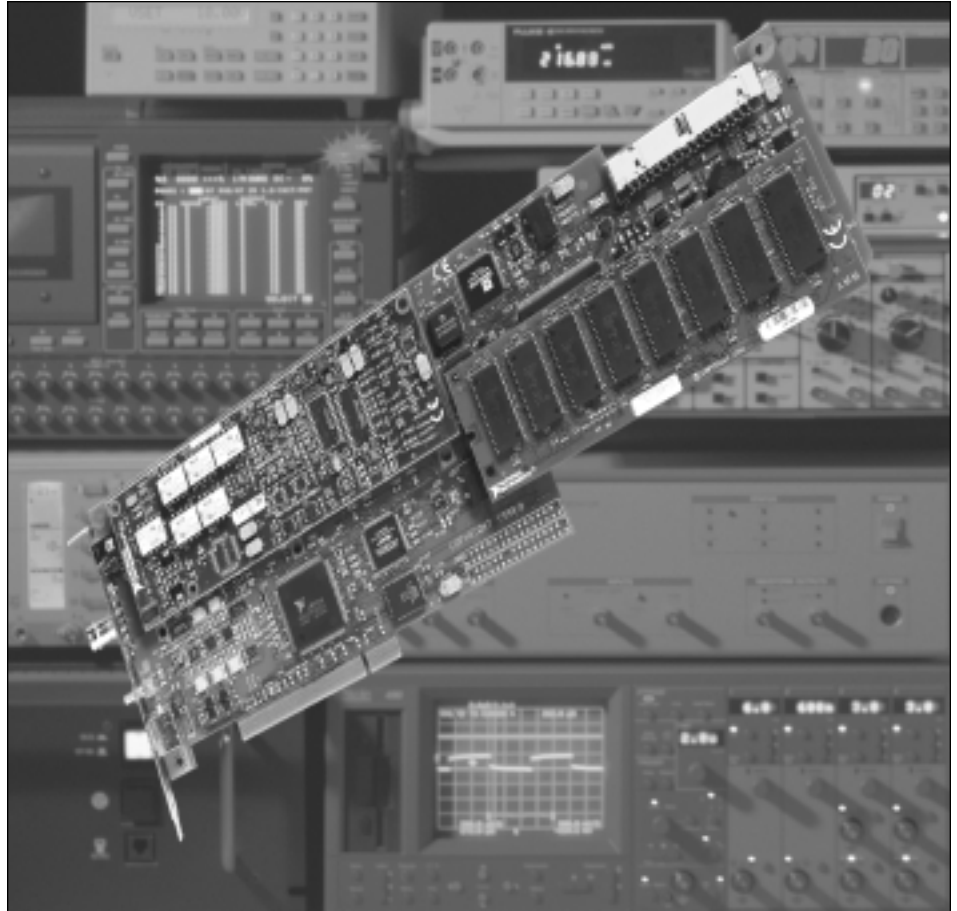
### Introduction

Lexmark is a global developer, manufacturer, and supplier of printing solutions, including laser, inkjet, and dot matrix printers and associated consumable supplies for the office and home markets.

The companies in the highly competitive printer market rely on high volume production and short time-to-market cycles with a critical focus on managing costs to maintain margins. In this environment, test engineers must quickly develop low-cost test systems that keep pace with production. In particular, the total system cost is a concern for Lexmark because the company must deploy the test system for the inkjet product line in manufacturing plants in Scotland and Mexico and duplicate it several times. For this reason, Lexmark chose a PC-based test solution to test ink cartridges used with the inkjet family of printers including the Lexmark Z11, 3200, Z31, 5700, Z51, and the 5770 models.

*At various sampling rates, the accuracy of the NI 5911 digitizer surpasses other alternatives for a PC and virtually eliminates stand-alone instrument solutions.*

**Measuring Voltage with a Computer-Based Oscilloscope**  
Initially, Lexmark used the National Instruments NI 5102 oscilloscope installed in a PC, and developed the tests using LabVIEW. The NI 5102 is a PCI-based oscilloscope featuring 8-bit resolution and a 20 MS/s sampling rate (15 MHz input bandwidth). For testing the ink cartridge,



*With the NI 5911 oscilloscope, you can increase your measurement accuracy from 8 to 21 bits by varying sampling rates from 100 MHz to 10 kHz.*

the NI 5102 sequentially measured the resistance of more than 200 inkjet nozzles on the ink cartridge. The cartridge was stimulated using a custom designed driver card that simulates the voltage waveforms typically generated by the printer. The current was pulled through a single resistor connected to an operational amplifier (Op Amp). The NI 5102 measured the output of the Op Amp.

Another requirement for the test systems was that each nozzle could not be stimulated longer than 2  $\mu$ s. Otherwise, the nozzle becomes damaged. A PC-based solution, combined with a digitizer, is capable of acquiring an accurate signal in that 2  $\mu$ s window. This results in measurement time that takes less than one second because of the high-speed PCI interface from the digitizer to the PC.

### Improving Quality with the NI 5911

To improve the quality and increase the production yield, we needed more stringent test requirements. In particular, Lexmark increased the resistance measurement accuracy specification. To meet the new accuracy requirement, Lexmark sought a PC-based digitizer with at least 12 bits of vertical resolution at 12.5 MHz to replace the NI 5102. The 8-bit vertical resolution of the NI 5102 yields 2.5 percent accuracy. With the increase in the accuracy specification, we dramatically narrowed the number of available options.

Ultimately, Lexmark chose the NI 5911 flexible resolution digitizer. The NI 5911 possesses high accuracy at the required sampling rate, which surpasses other alternatives for a PC and virtually eliminates

stand-alone instrument solutions. For the required sampling rate of 12.5 MS/s in the inkjet test, the NI 5911 achieves over 12 bits of vertical resolution for yielding an overall accuracy of 0.006 percent of full-scale range, satisfying the new requirement. Because the NI 5911, like the NI 5102, is PCI-based, Lexmark maintained the overall test time of less than one second.

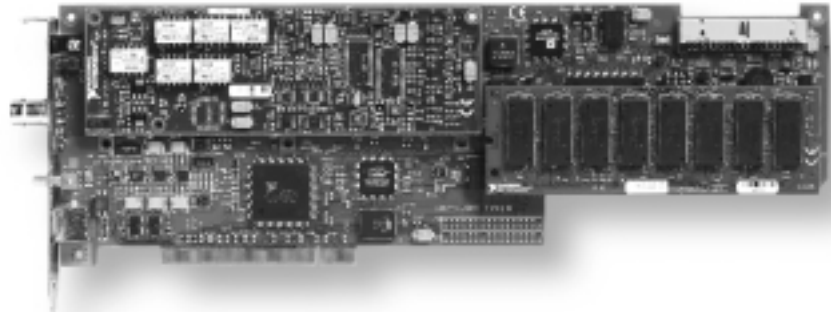
*Using the NI 5911 and LabVIEW, Lexmark increased the quality of their products and production yields and maintained their test performance with minimal development expense.*

**Transitioning Made Simple**  
Although they selected new instrumentation hardware for the test system, Lexmark did not incur significant development delays transitioning to the NI 5911. The LabVIEW test programs written for the NI 5102 did not require modification because both

products support a common application programming interface (API).

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*The NI 5911 digitizer.*

*Using the PCI-based NI 5911 digitizer, Lexmark maintained the overall test time of less than one second.*



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