

Knowles Increases Production with NI PC-Based DSA

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The Challenge: Reducing test times in the high-volume manufacturing of receivers and microphones for hearing aids, while maintaining measurement accuracy and integrity.

The Solution: Replacing a stand-alone dynamic signal analyzer (DSA) with a National Instruments PC-based DSA controlled with LabVIEW.

Reducing test times is a primary concern for high-volume manufacturers. This concern was the motivation for Knowles Electronics, a leading manufacturer of receivers and microphones used in hearing aids, to redesign their transducer test systems. The redesign involved replacing a stand-alone DSA with a National Instruments NI 4551 PC-based DSA. In doing so, we achieved a lower-cost solution, while maintaining the same measurement accuracy and integrity. The overall redesign resulted in a greater than expected five to one reduction in test time.

In testing the receivers and microphones, we test each transducer twice. Because our

control the equipment, provided us with a familiar, user-friendly environment for software modification. LabVIEW simplified the integration of the new analyzer into our existing program and preserved our software investment.

We modified the system program for quick and easy changes between the stand-alone DSA and the NI 4551, which greatly facilitated comparison of the two devices. We performed measurements on the stand-alone DSA and on the NI 4551 and compared them for accuracy and speed. Key measurements performed were power spectrum, frequency response, and distortion of the devices under test. In all cases, good correlation existed between the data from the stand-alone DSA and the data from the NI 4551.

As a result of the performance on individual tests made with the NI 4551, test times decreased greatly. When performing a FFT to obtain the power spectrum or frequency response, we used the extended resolution feature of the NI 4551 to obtain 950 lines of resolution.

The source of the NI 4551 was configured for a chirp signal with a frequency range of 0.0 to 9.5 kHz, providing 10.0 Hz frequency resolution – a significant improvement over the 32.0 Hz resolution provided by the stand-alone DSA. Consequently, only one sweep was required, which was a significant time saver compared to the 15 sweeps necessary on average previously. The time to acquire and display a frequency response for the stand-alone DSA was 1.80 s. For the NI 4551, the measurement time was only 0.12 s, a 15 to 1 improvement. Also, the increase in resolution improved low-frequency accuracy and interpolation.



Knowles Electronics realized a 5 to 1 reduction in test time.

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receiver test ran three to five times longer than our microphone test, we chose the receiver test systems for modification.

National Instruments NI 4551 was ideal for the application. Because it plugged directly into the PCI bus of the controlling PC, it provided speeds 40 to 100 times faster than communication on the GPIB bus. We also significantly reduced the redesign cost of the test system by using the computer-based DSA. The price of the NI 4551 was one-third the original cost of the stand-alone DSA.

National Instruments LabVIEW, already in use as the programming environment to

The greatest improvement in test time reduction came with the distortion measurements. We performed a total harmonic distortion (THD) measurement using the first five harmonics. A single distortion measurement took 1.00 s with the stand-alone DSA, but only 0.12 s with the NI 4551. Because a typical test sequence has at least three distortion tests, the 10 to 1 distortion test improvement resulted in the greatest reduction. The original estimate for test time reduction was 50 percent. However, a typical receiver test showed a five to one reduction. The total test time went from 5.24 to 1.03 s. Because of the magnitude of this unexpected improvement, microphone test systems formerly considered as marginal will now be considered for computer-based DSA replacement. Future system designs will also take full advantage of National Instruments products. ❧

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