

Truck Turbocharger Testing using the DaqBook®

Automotive

Application Note #37

To meet quality standards and shorten design times, vehicle equipment manufacturers are evaluating new components with portable PC-based data acquisition systems. These PC-based systems provided more mobility, higher performance and often cost less than traditional test-and-measurement instruments. As a result, manufacturers are designing better components while saving time and money.

Application Summary

A leading truck engine manufacturer set out to test a new diesel-engine turbocharger. During testing, engineers needed to record high-frequency oscillations at the turbocharger's inlet as the truck operated in demanding environments, such as sweltering heat and metal-chilling cold.

To accurately gather the turbocharger's performance data, the engineers needed a multichannel test-and-measurement system that was capable of providing high resolution, signal conditioning, and noise isolation — all for a reasonable cost. This demanding test criteria eliminated the possibility of using traditional off-the-shelf equipment.

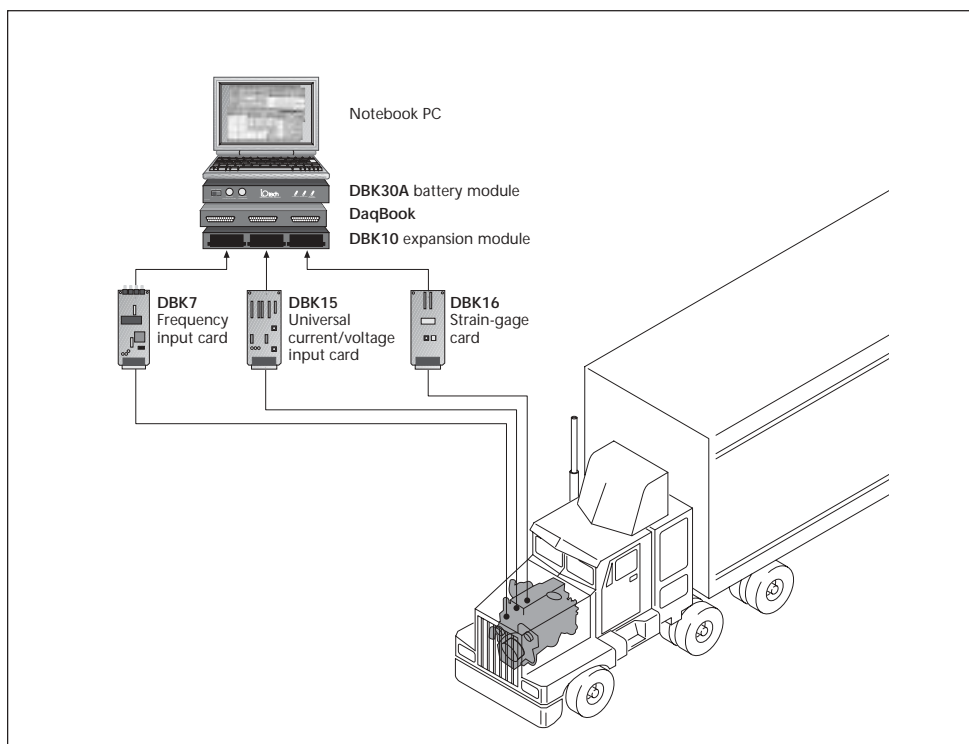
Potential Solution

Initially, the engineering team attempted to monitor the turbocharger manually by having an engineer listen to the oscillations by ear. This method was very inaccurate.

Searching for a new test method, the team reviewed proposals from system integrators. Unfortunately, the proposed systems consisted of several bulky instruments with limited performance capabilities and expensive price tags, ranging from \$25,000 to \$50,000. In need of a better solution, the engineers began researching portable PC-based data acquisition systems.

IOtech's Solution

Research led the team to IOtech's DaqBook®, a portable PC-based data acquisition system. The DaqBook was matched with signal conditioning cards housed in a DBK10 expansion module: a DBK7 frequency input card, a DBK15 universal current/voltage input card, and a DBK16 strain-gage card. The system was powered by a DBK30A battery module, adding to the system's mobility.



Mounted in the truck's cabin, the DaqBook and its signal conditioning cards collect data from nearly 20 transducers connected to the turbocharger and other engine components

The system was compact and easy to install. The DaqBook and its modules each matched the typical form factor of a notebook PC and were stacked and secured on top of each other. The total system weighed less than 20 lbs., making it easy to mount inside the truck's cab, and its convenient installation eliminated the set-up problems associated with the larger integrated instruments.

Once installed, the system received signals from various strain gages, piezoelectric transducers and thermocouples, collecting nearly 20 channels of data from the turbocharger and other engine components. The DaqBook provided the accuracy needed to measure rapidly changing variables, and the system's digital output transferred the data to the PC through the PC's parallel port.

The measurements were viewed in real time on the PC's screen, giving the engineers a clear picture of how the turbocharger was performing during the field tests.

Running data acquisition software, the system gave the engineers the ability to specify A/D settings, such as the channel sequence, sample rate, and display frame length. The system also gave them the ability to create virtual instruments on the PC's screen. The system's digital-meter feature made it easy to read average real-time values, while the strip-chart recorder function was useful for trending.

For post-acquisition analysis, software enabled important data to be identified with the PC cursor and then bookmarked to annotate specific points. As engineers placed markers on specific waveforms, corresponding data values were automatically sent to a compatible spreadsheet program. This eliminated manual entries for customized reports and data plots.

The DaqBook proved to be extremely valuable to the engineering team. The system was able to gather numerous types of data from a variety of transducers in ways that no other test-and-measurement system was capable of doing. As a result of the testing, the engineers were able to quickly make adjustments to the turbocharger's design, improving its quality and shortening its time to market.

Because the DaqBook system was so effective during turbocharger testing, the manufacturer's engineering team continues to use the DaqBook system for several other component tests.

Conclusion

The DaqBook system provided the analog-to-digital (A/D) conversion, signal conditioning, performance flexibility, and portability required to thoroughly evaluate the turbocharger during field tests. The system's low cost, ease of setup, portability, and high performance continue to make it an ideal solution for an endless number of vehicle field tests.

DaqBook/2000 Series

The DaqBook/2000® series of portable data acquisition devices are available with either a built-in Ethernet interface (model /2000E), or a parallel-port interface (model /2000A or /2000X). The Ethernet-based DaqBook/2000E can attach directly to the Ethernet port of a PC, or to an installed Ethernet network. The DaqBook/2000E also contains three parallel expansion ports, which can attach to an additional three parallel DaqBooks, thereby quadrupling the channel capacity of a single Ethernet link to the PC.

Features

- Analog input, frequency input, timer output, digital I/O, and analog output; all in one compact and portable enclosure
- Available with either an Ethernet PC connection, or a parallel port which can link directly to a PC parallel port, or with an interface to PCI bus, PC-Card slot, or ISA slot
- 16-bit, 200-kHz A/D converter
- Synchronous analog, digital, and frequency measurements
- 8 differential or 16 single-ended analog inputs (software selectable per channel)
- Expandable up to 256 analog input channels, while maintaining 200-kHz (5 μ s per channel) scan rate
- Expandable up to 1024 analog inputs with DaqBook/2000E plus three slave parallel DaqBooks
- 512 location channel/gain FIFO, capable of scanning all channels, including expansion channels and digital/counter channels, at 5 μ s per channel
- Trigger modes include analog, digital, & software, with <5 μ s latency
- Virtually infinite pre-trigger buffer
- Optional four channel, 16-bit, 100-kHz analog output card installs internally
- 40 digital I/O lines scanned synchronously or asynchronously with analog inputs
- Digital I/O is expandable up to 272 lines, including isolation and relay closure options
- Four cascadable counter/pulse input channels scanned synchronously or asynchronously with analog inputs
- Two timer/pulse output channels
- Digital calibration — no potentiometers
- Multi-unit scan synchronization
- Vehicle network interface option



Signal Conditioning Options

- Signal conditioning and expansion options for thermocouples, strain gages, accelerometers, isolation, RTDs, etc.—over 40 DBK I/O expansion options in all



Software

- DaqView™ software with eZ-PostView™
- Included drivers for Visual Basic®, Delphi™ and C++ for Windows®, DASyLab®, TestPoint®, and LabVIEW®

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