

Oil and Gas Well Drill Monitoring

using the DaqBook®

Energy

Application Note #28

Drilling for oil and gas has evolved into a sophisticated practice that often involves explosives, which penetrate dense geological formations deep within the earth. Accurately monitoring underground blasts with PC-based data acquisition equipment is a vital part of protecting drilling teams and maximizing detonation effectiveness.

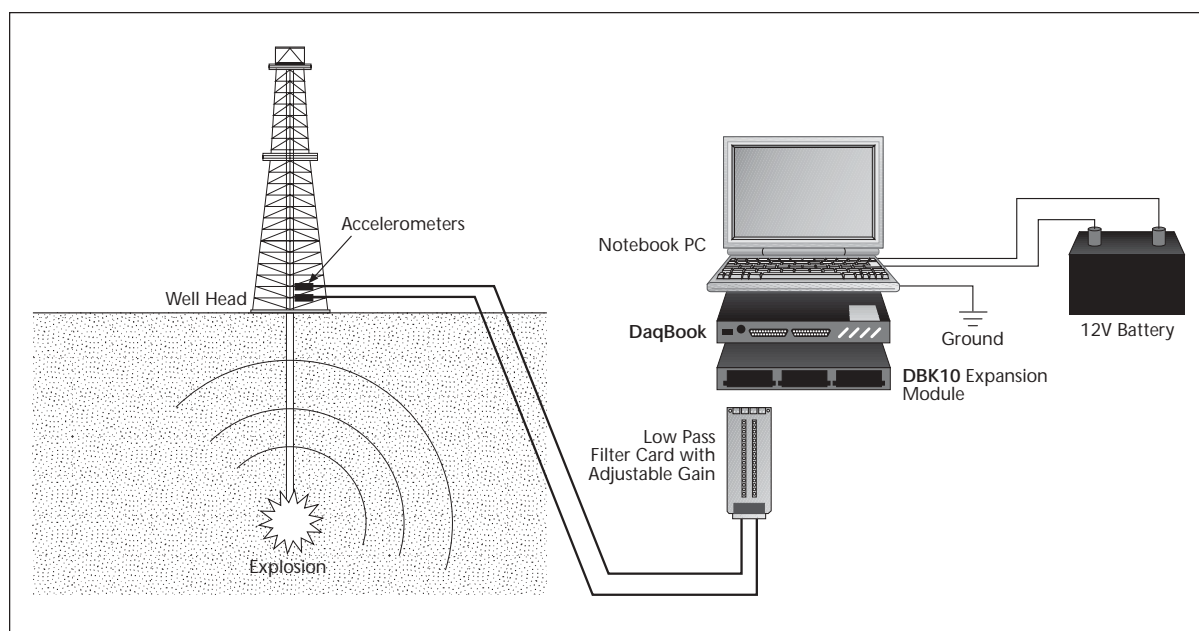
Application Summary

Strategically placed explosives enable oil companies to access valuable reserves that were once thought unobtainable. However, like any process involving volatile material, using explosives can create dangerous situations for those involved. To access reserves, a company drills a hole in the ground and carefully lowers explosives into the well casing at depths where geological formations are believed to hold oil or gas. A metal bar is then dropped down the well opening to detonate the explosives. The resulting explosion penetrates the casing wall allowing oil and gas to come to the earth's surface — if everything goes as planned.

Unfortunately, the explosive force does not always pierce the casing wall and trigger production. When an attempt fails, serious questions arise: How much explosive material was detonated, and where should the next charge be placed? Bringing the live explosives

to the surface is an extremely dangerous way of answering these questions — an option oil production companies would rather avoid. A much safer option is to use a PC-based data acquisition system to monitor, record, and analyze underground explosion activity. To be effective, the system has to be mobile, easily powered, and rugged enough to withstand the harsh environments often associated with remote drilling locations. An energy service firm that helps oil companies bring wells into production is utilizing such a system.

The system measures vibrations caused by the blasts via two accelerometers installed on the wellhead and connected to data acquisition equipment. A low-pass filter and gain-range card conditions the accelerometer signals before they are processed by an analog-to-digital (A/D) converter. The low-pass circuit prevents aliasing errors that can occur due to high-frequency accelerometer signals. Each accelerometer is a piezoelectric type that produces a buffered output signal with a millivolt magnitude. Signal level is boosted by the gain circuit of the signal conditioning card. The digitized accelerometer data is stored on the PC's hard disk for later analysis, allowing the user to examine fast fourier transforms (FFT) waveforms. The system includes an option for adaptive filtering so the user can isolate and inspect a specific portion of the frequency domain.



The oil well test set-up

The firm is extremely impressed with the data acquisition system's capability to distinguish between the vibrations unique to offshore and land operations. More importantly, the firm is impressed with its ability to give them "a clear picture of what is happening down below."

IOtech's Solution

The energy service firm selected IOtech's DaqBook®, a PC-based data acquisition system, because it is intrinsically safe and can be used on gas wells and offshore oil rigs. Easy to use, the DaqBook attaches directly to a notebook PC.

Creating a convenient, lightweight package, DaqBook is the same size as a notebook PC and can be attached to a PC with Velcro tabs supplied by IOtech. In most cases, both the DaqBook and the PC are powered by an automotive battery. However, the DaqBook also can be powered from an optional 14.4 V NiCad battery module available from IOtech, or from just about any other DC source with voltage in the range of 9 to 20 VDC. DaqBook products are supplied with DaqView™ *Out-of-the-Box*™ graphical display and data acquisition software. This software allows users to quickly set up and change configurations, and save data directly to disk.

Conclusion

Mobile and easy to use, DaqBook products are ideal for portable and benchtop applications. The DaqBooks'® high performance A/D and programmable channel/gain sequencer make them useful for applications with high-channel count and speed requirements. Their extensive I/O and signal conditioning capabilities and low cost per channel make them an effective alternative to more expensive stand-alone data loggers, strip-chart recorders, and dedicated handheld devices.

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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