Vibration Analysis Systems & Complete Solutions

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“The 600 Series has become an integral part of my advanced testing services.”
– Nelson Baxter P.E. ABM Technical Services
Certified Vibration Analyst Category IV

IOtech’s 640 and 650 four- and five-channel dynamic signal analyzer models provide cost-effective solutions targeted for NVH (Noise, Vibration, Harshness). Both are ideal for portable applications in rotating machinery and maintenance programs, and are available with either Ethernet or USB interfaces.

IOtech’s 652u and 655u USB dynamic signal analyzers provide ten high-speed analog inputs with simultaneous 24-bit resolution. In addition, the 655u provides five channels of temperature measurement. Both are ideal solutions for NVH (Noise, Vibration, Harshness) using IOtech’s popular eZ-Analyst software. When coupled with IOtech’s eZ-TOMAS and eZ-TOMAS Remote software, both are ideal for distributed machine monitoring applications.

For complete ZonicBook/618E information and specifications, visit iotech.com/zonicbook

For complete 600 Series information and specifications, visit iotech.com/600series
Thank you for reviewing our publication on Vibration Analysis Systems & Complete Solutions containing product overviews, and a compilation of actual customer applications which include: compressor and turbine vibration testing, bridge crane testing, steam turbine rotor testing, hydroelectric generator maintenance, and more. IOtech vibration measurement solutions are used in a multitude of different applications, and you can find more customer success stories online at www.iotech.com/appnotes.

IOtech’s Out-of-the-Box vibration monitoring and analysis solutions allow you to start taking data in minutes. Fast measurement, portability, built-in signal conditioning, and ease of use are the foundations for IOtech products.

The 600 Series dynamic signal analyzers set a new standard for real-time vibration and acoustic monitoring and analysis. Ethernet or USB versions offer 24-bit A/D's per channel, and direct accelerometer inputs. Four-, five-, or ten-channel units meet a wide variety of applications. The 655u is the first DSA in the 600 Series to offer direct temperature measurements — a critical part of many vibration analysis and monitoring applications. The Ethernet-based ZonicBook/618E is ideal for higher channel count applications and is expandable from 8 to 56 channels. In addition, the ZonicBook offers built-in signal conditioning for accelerometer or tachometer signals.

Our eZ-Series software is tailored to a variety of specific, vibration-based analysis applications: eZ-TOMAS and eZ-TOMAS Remote for rotating machine analysis, eZ-Analyst for real-time vibration and acoustic analysis, eZ-Balance for machine balancing, and eZ-NDT for non-destructive testing. Each package is easy to use and requires no programming, allowing the user to spend minimal time configuring a system. Visit iotech.com/software to download a 30-day evaluation copy of any eZ-Series package.

Contact IOtech or your local IOtech sales office to discuss the solution that best fits your application. We look forward to helping you. Contact our Inside Sales Department by phone at (888) 714-3272 (U.S. only) or (440) 439-4091, fax at (440) 439-4093, or email sales@iotech.com.

Software Solutions

**eZ-Analyst**
Real-Time Vibration & Acoustic Analysis Software
- Real-time FFT analysis
- Easy-to-use graphical user interface provides fast setup
- 3D Color Waterfall Spectrum Display
- Order Normalization and Order Tracked Plots
- Multiple Plot Overlays
- Wide selection of real-time analysis features, including integration/ differentiation, synchronous averaging, and much more

**eZ-TOMAS & eZ-TOMAS Remote**
Rotating Machine Monitoring & Analysis Software
- Rotating Machinery Analysis: Time Waveform, Orbit, Spectrum, Waterfall, Polar, Bode, Shaft Center Line, and Trend displays
- Transient and Steady State rotating machinery analysis
- Easy-to-use graphical user interface and multiple project configurations provide fast setup
- Spectral limit checking, with output relays and alarm event logging
- Machine and Bearing Fault analysis and limit checking

**eZ-Balance**
Machine Balancing Software
- Multiplane trial and trim balancing
- Polar, time, and spectral displays
- Computes and stores influence coefficients for future trim balancing
- Vibration data can be collected by the 600 Series or ZonicBook/618E, or entered manually
- Balancing toolkit

**eZ-NDT**
Resonant Inspection Software
- Provides inspection of metal, ceramic, and hard plastic parts
- Requires no parts preparation, making the test fast and inexpensive
- Tests parts in less than 1 second
- Quantifies and documents the first natural frequency for end-user comparison to final assembly resonant frequencies
- Removes the ambiguity that is common in other inspection systems

Hardware Solutions

**600 Series**
High-Performance, Portable Dynamic Signal Analyzer
- Dedicated 24-bit, 105.4 kS/s delta-sigma ADC per analog input
- Spurious-free dynamic range of 108 dB (typical)
- AC/DC coupling, software selectable per channel
- 4, 5, or 10 analog inputs, ±10V input range (±60V max without damage)

**ZonicBook/618E**
High-Channel Vibration Analysis & Monitoring System
- Eight dynamic input channels, expandable up to 56 channels
- Four tachometer channels for rotational measurements
- High-speed Ethernet connection to the PC for continuous recording
600 Series
Dynamic Signal Analyzer (DSA)

Features
- Dedicated 24-bit, 105.4 kS/s delta-sigma ADC per analog input
- Spurious-free dynamic range of 108 dB (typical)
- AC/DC coupling, software selectable per channel
- TEDS support for accelerometers
- Pseudo-differential input
- Total harmonic distortion of -100 dB (typical)
- Channel-to-channel phase matching of <0.12 degrees at 1 kHz
- 8-bit digital IO port
- Supported Operating Systems: Windows 2000®, Windows Vista® x86 (32-bit), and Windows XP®

NEW 652u Model
- USB interface
- 10 analog inputs, ±40V input range (±60V max without damage)
- 4 mA IEPE current source per channels 1-10 (22V compliance)
- 0.1 Hz high-pass filter

NEW 655u Model
- USB interface
- 10 analog inputs, ±40V input range (±60V max without damage)
- 4 mA IEPE current source per channels 1-10 (22V compliance)
- 0.1 Hz high-pass filter
- 5 temperature channels
- Analog output signal-to-noise ratio: 100 dB (typical)
- AC/DC coupling, software selectable per channel
- Channel-to-channel phase matching at 1 kHz.
- Supported Operating Systems: Windows 2000®, Windows Vista® x86 (32-bit), and Windows XP®

640 Models
- USB or Ethernet interface
- 4 analog inputs, ±10V input range (±60V max without damage)
- 2.1 mA IEPE current source per channel (22V compliance)
- 1.0 Hz high-pass filter
- 24-bit delta-sigma DAC analog output
- Analog outputs: sine, swept sine, random, burst, arbitrary
- Analog output signal-to-noise ratio: 98 dB (typical)
- Analog output signal-to-noise ratio: 100 dB (typical)
- AC/DC coupling, software selectable per channel
- Channel-to-channel phase matching at 1 kHz.
- Supported Operating Systems: Windows 2000®, Windows Vista® x86 (32-bit), and Windows XP®

650 Models
- USB or Ethernet interface
- 5 analog inputs, ±40V input range (±60V max without damage)
- 2.1 mA IEPE current source per channels 1-4 (22V compliance)
- 0.1 Hz high-pass filter

Vibration data acquisition, analysis, and monitoring has never been easier than with the IOtech 600 Series of dynamic signal analyzers and ez-Series software. The 600 Series are 24-bit dynamic signal analyzers with USB or Ethernet interfaces to transfer acquired data to the PC in real time. This means that every data sample can reside on a PC’s hard drive, which makes effective waveform re-creation and post acquisition analysis possible.

The spurious-free dynamic range of the 600 Series analog input is 108 dB. The 24-bit delta sigma ADC provides high resolution and excellent AC and DC accuracy. All channels are sampled synchronously and provide better than 0.12° of channel-to-channel phase matching at 1 kHz. The extremely low noise floor and extremely low distortion provide the user with high quality test data.

The IOtech 600 Series support a variety of analog input types, including Accelerometer, Velometer, Proximity, Microphone, Tachometer, or other voltage input. The 640 model accepts up to ±10V inputs, while the 650, 652, and 655 models can accept up to ±40V inputs. All are rated to withstand up to ±60V maximum without damaging the input. These signals may be either AC or DC coupled.

The 600 Series supports software selectable AC or DC coupling, and automatically connects the 2.1 mA (640, 650), or 4 mA (652u, 655u) current source with AC coupling for integrated electronic piezoelectric (IEPE) sensors. All models also supply the current source with a 22V compliance voltage at the input terminals for biasing the IEPE sensors.

All models can be programmed to select IEPE sensors and read sensor calibration information using Transducer Electronic Data Sheets (TEDS). The software can automatically connect to the sensors’ EEPROM memory, and retrieve their data sheet. Additional advantages include detecting over-voltage and open or shorted inputs for IEPE sensors.

The 640 model contains one programmable analog output channel that generates continuous or swept sine-wave signals, as well as random, burst, and arbitrary signals. A programmable 24-bit, delta sigma DAC and an internal amplifier stage drives these output signals at 93 kS/s. In addition, it can operate while receiving analog input data. The software synchronizes the signals between the ADC and the DAC within the unit. The analog output signal can drive audio or shaker table amplifiers and can be used for noise, vibration, and harshness (NVH) testing with a typical signal-to-noise ratio of 100 dB.
The 640u and 650u models draw power from either the USB source (PC or USB hub) or an external power source. The 640e, 650e, 652u, and 655u must use external power, either user supplied, or with the included universal AC/DC power adapter. All models may also be powered from a regulated external 5W supply ranging from 6 to 16 VDC.

The 600 Series DSA comes in two interface versions: one connects to the PC through a 10/100BaseT Ethernet interface, and the other uses a USB 2.0 port.

The 600 Series Ethernet version, the 640e or 650e models, also may be attached to a sufficient wide-band network. The data bandwidth is a function of the analysis rate, number of spectral lines, Nyquist factor, and the number of signals being measured. When measuring continuous signals over multiple channels, however, it is recommended to use a dedicated Ethernet or USB connection between the 600 Series DSA and the PC to ensure the data transfer is not interrupted.
Specifications

### Analog Specifications

#### Analog Measurements

ADC Converter Resolution: 24 bits
ADC Converter Type: Delta-Sigma per channel
Sample Rates: Up to 105,468 samples per second
Sample Rate Accuracy: ±50 ppm
Channels:
- **640**: 4 input channels
- **650**: 5 input channels
- **652u, 655u**: 10 input channels

#### Input Impedance

<table>
<thead>
<tr>
<th>Input Impedance</th>
<th>640</th>
<th>650/652u/655u</th>
</tr>
</thead>
<tbody>
<tr>
<td>High to ground</td>
<td>200k Ohm</td>
<td>130 pf</td>
</tr>
<tr>
<td>Low to ground</td>
<td>1k Ohm</td>
<td>1k Ohm</td>
</tr>
<tr>
<td>Low to low</td>
<td>20k Ohm</td>
<td>80k Ohm</td>
</tr>
</tbody>
</table>

Input Coupling: DC, AC, or AC + IEPE; software programmable per channel basis

#### High-Pass Filter (Cutoff)

- **640**: 1.0 Hz
- **650, 652u, 655u**: 0.1 Hz

#### RTD Measurement Uncertainty (1 sigma, Ambient 23°C, ±15°C, exclusive of RTD wire error)

<table>
<thead>
<tr>
<th>TC Type</th>
<th>Measured Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>-200  -100  0  100  200  300  400  600  800  1000  1200  1400  1600</td>
</tr>
<tr>
<td>E</td>
<td>0.21  0.18  0.18  0.18  0.18  0.18  0.18  0.18  0.18  0.20  0.20  0.22  0.22</td>
</tr>
<tr>
<td>J</td>
<td>0.22  0.19  0.18  0.18  0.18  0.19  0.19  0.19  0.19  0.20  0.20  0.22  0.24</td>
</tr>
<tr>
<td>K</td>
<td>0.25  0.19  0.18  0.18  0.18  0.19  0.19  0.19  0.19  0.20  0.21  0.22  0.24</td>
</tr>
<tr>
<td>N</td>
<td>0.32  0.21  0.19  0.19  0.19  0.19  0.19  0.19  0.19  0.20  0.21  0.22  0.23</td>
</tr>
<tr>
<td>R</td>
<td>-      -     0.48  0.34  0.35  0.33  0.31  0.29  0.31  0.31  0.31  0.33  0.35</td>
</tr>
<tr>
<td>S</td>
<td>-      -     0.48  0.42  0.34  0.33  0.31  0.33  0.32  0.32  0.34  0.36  0.37</td>
</tr>
<tr>
<td>T</td>
<td>0.25   0.20  0.18  0.18  0.18  0.19  0.19  0.19  0.19  -      -     -     -     -</td>
</tr>
</tbody>
</table>

### Power Supply

- **640**: 6.5 to 16 VDC
- **640u, 650u, 652u, 655u**: 6.0 to 16 VDC
- **Power Jack**: Barrel type; 5.5 mm O.D., 2.5 mm I.D.

#### PC Communication

- **640e, 650e**: 10/100BaseT Ethernet
- **640u, 650u, 652u, 655u**: USB 2.0

#### Dimensions

- **640, 650**: 142.2 mm W x 180.3 mm D x 38.1 mm H (5.6” x 7.1” x 1.5”)
- **652u, 655u**: 276.9 mm W x 169.8 mm D x 30.3 mm H (10.9” x 6.7” x 1.2”)

#### Weight

- **640, 650**: 0.7 kg (1.5 lbs)
- **652u, 655u**: 1.2 kg (2.7 lbs)

#### Warm-Up

- 10 minutes to rated specifications

#### Over-Range Indication: Software

Input Ranges
- **640**: ±10V peak
- **650, 652a, 655a**: ±40V peak

Input Protection
- **BNC Shell to BNC Center**: ±60V max without damage
- **BNC Shell to Earth Ground**: ±5V max without damage

#### Low-Pass Filter: Software programmable per channel

#### Type

- Anti-aliasing hardware 3-pole 360 kHz, software selectable FIR filter. Any unwanted signals above 27 MHz are lost in the noise floor of 64k FFT.

### Amplitude Accuracy

- **640**: ±0.07 dB typ ±0.12 dB max
- **650/652u/655u**: ±0.1 dB typ ±0.15 dB max

#### DC

- ±(0.05% of reading + 2 mV)
- ±(0.2% of reading + 15 mV)

#### Amplitude-3 dB: 0.49 x sample rate

#### Amplitude Flatness: ±0.05 dB typ ±0.10 dB max DC to 20 kHz

#### Total Harmonic Distortion: -100 dB typ 1 kHz, -97 dB typ 10 kHz

#### S/N Including Harmonics: 108 dB typ DC to 50 kHz

#### SFDR Including Harmonics: 128 dB typ DC to 50 kHz

#### Channel-to-Channel Crosstalk: <100 dB at 1 kHz

#### Channel-to-Channel Phase Matching

- **640, 640u**: <0.04°/kHz + 0.08°
- **650u, 652u, 655u**: <0.06°/kHz + 0.1°

#### Common Mode Rejection Ratio

- **640, 640u**: -70 dB typ -55 dB max at 1 kHz
- **650u, 652u, 655u**: -56 dB typ -41 dB max at 1 kHz

#### Wideband Noise

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Typical Noise (µV rms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (Hz)</td>
<td><strong>640</strong>, <strong>640u</strong></td>
</tr>
<tr>
<td>Channel</td>
<td><strong>650u</strong>, <strong>652u</strong>, <strong>655u</strong></td>
</tr>
<tr>
<td>AC at 1 kHz</td>
<td>20</td>
</tr>
<tr>
<td><strong>640</strong></td>
<td>2.4</td>
</tr>
<tr>
<td><strong>650u</strong></td>
<td>11</td>
</tr>
<tr>
<td><strong>652u</strong></td>
<td>20</td>
</tr>
<tr>
<td><strong>655u</strong></td>
<td>40</td>
</tr>
<tr>
<td><strong>640u</strong></td>
<td>15</td>
</tr>
<tr>
<td><strong>650u</strong></td>
<td>17</td>
</tr>
<tr>
<td><strong>652u</strong></td>
<td>20</td>
</tr>
<tr>
<td><strong>655u</strong></td>
<td>25</td>
</tr>
</tbody>
</table>

1. **640, 640u**: maximum noise @ 0°C = 1.4x; @ >50°C = 1.6x (where x is the typical value given in the above table)
2. **650u, 652u, 655u**: maximum noise @ 50°C = 1.4x; @ >50°C = 2.1x (where x is the typical value given in the above table)

### IEPE Bias Source

- **640, 650** (Channels 1 to 4)
  - Current: 2.1 mA, 22V compliance (on/off software programmable per channel)
  - Impedance: >25kΩ Ohm
- **652u, 655u** (Channels 1 to 10)
  - Current: 4.0 mA, 22V compliance (on/off software programmable per channel)
  - Impedance: >25kΩ Ohm

### IEPE Fault Detection Thresholds

- <1V (short), >20V (open)

### IEPE Fault Indication

- Software indicator, per channel
### Specifications & Ordering Information

#### Analog Temperature Measurements (655u only)
| ADC Converter Resolution | 24 bits |
| ADC Converter Type       | Delta-Sigma |
| Sample Rate              | 200 msec per conversion |
| Channels                 | 5 |
| Input Range              | ±100 mV |
| Offset Voltage           | ±5 µV |
| Offset Drift             | Zero |
| Gain Uncertainty         | ±0.05% |
| Gain Drift               | 0.005%/°C |
| Input Impedance          | Each input to analog ground, 100M Ohm |
| Open Sensor Detection Current | 50 nA |
| Common Mode Range        | ±10V |
| Common Mode Rejection Ratio | 150 dB typ |
| Maximum Voltage (without damage between inputs) | ±5V DC or 5V peak-to-peak AC |
| Maximum Voltage (without damage from earth ground to input) | ±17V DC or 34V peak-to-peak AC |
| Maximum Voltage (without damage from RTD excitation high to earth ground or high to RTD excitation low) | ±3V DC or rms AC |

#### Cold Junction Sensor Accuracy
| Ambient Temperature Range (°C) | Max Error (°C) |
| -40 to -20         | ±1.0 |
| -20 to 0          | ±0.8 |
| 0 to 10           | ±0.4 |
| 10 to 45          | ±0.2 |
| 45 to 60          | ±0.8 |

#### RTD
| Type Supported | PT100, alpha = 0.00385 |
| Excitation      | 100 mV through 100 Ohm |
| Accuracy        | ±0.2°C; exclusive of RTD error, assumes 4-wire connection |
| Connections     | 2, 3, and 4 wire |

#### Analog Output (640 only)
| Channels | 1 |
| Signal Connection | BNC |
| Frequency Range | DC to 45 kHz (-3.0 dB) |
| Frequency Accuracy | ±50 ppm |
| DAC Resolution | 24 bit |
| DAC Update Rate | 93.75 kS/s |
| DAC Type | delta sigma |
| Total Harmonic Distortion | 1 kHz; -96 dB typ |
| Total Harmonic Distortion + Noise | 1 kHz; -87 dB typ |
| Amplitude Settings | 0 to 7V p-p |
| Amplitude Accuracy at 1 kHz | ±0.05 dB typ ±0.12 dB max |
| Amplitude Flatness (DC to 20 kHz) | ±0.02 dB typ ±0.1 dB max |
| SNR (DC to 20 kHz) | 100 dB typ 90 dB max |
| Maximum Load | 1k Ohm (50 Ohm with external power) |
| Waveform Modes | Sine, swept sine, random, burst, arbitrary |
| Output Impedance | 50 Ohm |

### Tachometer Inputs
Any analog input channel may be used as a tachometer input.

### Digital I/O Lines
| Channels | 8 digital I/O, programmable as inputs or outputs on a line by line basis |
| Ports | 1 x 8-bit; each bit is programmable as input or output |
| Power-Up Mode | Inputs pulled low |
| Connector | DB9 female |
| Input Modes | 2 programmable input modes: asynchronous, under program control at any time relative to analog scanning; synchronous with analog scanning |

#### Input Protection
- Low: 0 to +0.8V
- High: +2.0V to +5.0V

#### Input Levels
- Output Voltage Range: 0 to +3.3V, may be pulled up to +5V
- Output Resistance: 100 Ohm
- Output Levels Low: <0.8V
- High: >3.0V with no load

#### Output Timing
Outputs are always written asynchronously.

### Ordering Information

#### Description
- Ethernet-based dynamic signal analyzer
- Ethernet-based dynamic signal analyzer for rotating machinery and maintenance
- USB-based dynamic signal analyzer
- USB-based dynamic signal analyzer for rotating machinery and maintenance
- 10-channel, USB-based dynamic signal analyzer
- 10-channel, USB-based dynamic signal analyzer, with 5 temperature channels

#### Accessories & Cables
- Handle for 652u or 655u
- HA-210-5-BK
- High-speed USB cable, 1 m.
- CA-179-1
- External power supply, 90 to 264 VAC; requires additional cable
- TR-2U
- USA version
- CA-1
- European version
- CA-216

#### Software
- Real-time vibration and acoustic analysis software: eZ-Analyst
- Rotating machine monitoring and analysis software: eZ-TOMAS
- Remote access and control client for eZ-TOMAS: eZ-TOMAS Remote
- Machine balancing software: eZ-Balance
- Resonant inspection software: eZ-NDT
- Lite version, includes all drivers; comes without analysis, limited module count, and one Layout Window
- Basic version, includes all drivers; comes with all standard modules (except Signal Analysis and Actions), and one Layout Window
- Full version, includes all drivers; comes with all standard modules, 200 Layout Windows, and Control Sequencer
- DASYLab LITE
- DASYLab BASIC
- DASYLab FULL
- DASYLab PRO
- Run-time license for DASYLab: DASYLab RUNTIME

### To schedule a demo or discuss your application, call or email IOtech at sales@iotech.com
ZonicBook/618E
High-Channel Vibration Analysis & Monitoring System

Features
- Eight dynamic input channels, expandable up to 56 channels
- Four tachometer channels for rotational measurements
- High-speed Ethernet connection to the PC for continuous recording
- eZ-Series software packages address a wide variety of vibration monitoring and analysis applications
- TEDS support for accelerometers
- Supported Operating Systems: Windows 2000®, Windows Vista® x86 (32-bit), and Windows XP®

Vibration analysis and monitoring has never been easier than with the ZonicBook/618E and eZ-Series analysis and monitoring software. The ZonicBook leverages more than 30 years of experience providing vibration measurement solutions. The ZonicBook hardware is the signal conditioning and acquisition engine, while the eZ-Series software in the PC defines the specific analysis and monitoring features of the system.

eZ-Series software packages for the ZonicBook are each tailored to a particular vibration measurement and analysis application. Choose the package that suits your application now, and upgrade to additional packages as your requirements evolve. Refer to the following pages for detailed information on each of the software packages.

The heart of the ZonicBook is a high-speed Ethernet engine powered by a PowerPC processor, enabling all acquired data to be transferred to the PC in real time at 2+ Mbytes per second. This means that every acquired data point can reside on your PC's hard drive, making recreation and post-acquisition analysis of acquired data as precise as possible. Other analyzers simply store frequency-domain information, which makes play-back less precise than the original real-time measurement. Instead, ZonicBook transmits all time-domain measurements, which means there’s no data loss when analyzing acquired waveforms. Since the data is already on your PC’s hard drive, there’s no time lost transferring data, as with other analyzers.

Another advantage of the ZonicBook’s architecture is it has virtually no limit to the length of time it can acquire continuous data. Other systems do not offer continuous time-domain transfer to the PC, and as a result the waveform length is limited by the amount of built-in data storage. With the ZonicBook, the only limitation is the amount of hard disk memory that can be added to your PC, or that can be accessed by your PC on a network.

Finally, the ZonicBook’s architecture makes expansion beyond the eight built-in channels less expensive than other suppliers. You can expand the ZonicBook in 8-channel increments up to 56 channels, and each additional 8 channels are approximately one third the cost of the first 8 channels. All channels in a ZonicBook system are measured synchronously, providing 1 degree phase matching between channels.

The ZonicBook/618E with eZ-Series software and your PC makes a real-time, portable vibration analysis monitoring system.
Specifications & Ordering Information

Specifications

Environment
- Operating: 0° to 50°C, 0° to 95% RH, non-condensing
- Storage: -20° to 70°C

Power Consumption: 34.5W max @ 15 VDC

Input Voltage Range: 10 to 30 VDC

Vibration: MIL STD 810E, categories I and 10

PC Communication: 10/100BaseT Ethernet

Dimensions: 285 mm W x 220 mm D x 70 mm H (11" x 8.5" x 2.70")

Weight: 2.38 kg (5.25 lbs)

Throughput Rate: >2 Mbytes/s

Internal Data Buffer: 1 Msample built-in, 64 Msamples optional (factory installed)

Analog Inputs

Channels: 8 single-ended input channels, expandable up to 56 channels with six WBK18 modules

Input Connector: 1 BNC per channel

Input Impedance: 200k Ohm (single-ended)

Input Coupling: AC, DC (software programmable per channel)

High-Pass Filter: 0.1 Hz or 1 Hz software programmable

Input Ranges: ±25V (DC coupled only), ±3V, ±2.5V, ±1V, ±500 mV, ±250 mV, ±100 mV, ±50 mV, ±25 mV, ±5 mV (software programmable per channel)

Overrange Indication: Front panel, one LED per channel, software status

Low-Pass Filter
- Type: 8-pole Butterworth with simultaneous sample-and-hold (SSH)
- Cutoff Frequency (Fp): 10 Hz to 200 kHz in 1-2-5 progression
- Alias Rejection: 75 dB min

Channel-to-Channel Phase Matching: 1° typ, 2° max

Unit-to-Unit Phase Matching*: 1° typ, 2° max

Channel-to-Channel Phase Matching: 75 dB min

Input Ranges: ±25V (DC coupled only), ±3V, ±2.5V, ±1V, ±500 mV, ±250 mV, ±100 mV, ±50 mV, ±25 mV, ±5 mV (software programmable per channel)

Unit-to-Unit Phase Matching: 1° typ, 2° max

Accuracy**: ±0.1 dB (Fp ≤ Fc/2)

Total Harmonic Distortion: -70 dB typ

IEPE Bias Source: 4 mA, 24V compliance (on/off software programmable per channel)

IEPE Fault Detection Thresholds: <1V (short), >25V (open)

IEPE Fault Indication: Front panel LED per channel, software status

Coupling: AC, AC with IEPE or DC, programmable on a per-channel basis

Trigger Input (TTL Compatible)

Connector: BNC

Input Signal Range: 0 to 5V, TTL compatible

Input Characteristics: TTL compatible with 10k Ohm pull-up resistor

Input Protection: Zener clamped, 0.7V to ±5V

Latency: 300 ns max

Conditioned Analog Outputs

Each analog input signal is provided as a conditioned analog output on the rear panel

Channels: 8

Signal Connection: Female DB9

Amplitude: 0 to 2.5V max

Output Impedance: 50 Ohm

Protection: 26V transient voltage suppressor

Source Output (Excitation Source)

Channels: 8

Signal Connection: BNC

Frequency Range: 1 Hz to 5 kHz

Frequency Resolution: 0.01 Hz

Amplitude Settings (p-p): 5V, 2V, 1V, 500 mV, 200 mV, 100 mV, 0 mV

Waveform Modes: Continuous sine, Sweep sine

Output Impedance: 50 Ohm

Accuracy: ±0.1 dB

Analog Triggering

Hysteresis Level: 1/600 of the comparator range

Maximum Trigger Latency
- Pre-Trigger: 300 ns + T; where T equals the pre-trigger scan period
- Post-Trigger: 300 ns

Trigger Jitter
- Pre-Trigger: 50 ns + T; where T equals the pre-trigger scan period
- Post-Trigger: 50 ns

Tachometer Inputs

Channels: 4 differential

Connector: BNC

Input Impedance: 20k Ohm SE, 40k Ohm DE

Input Voltage Ranges: ±50V to +50V specified, -75V to +75V max

Resolution (V/bit): 0.002307

DC Accuracy: 0.25% of reading + 200 mV offset

Noise: 5 mVrms (typical); 10 mVrms (max)

Common Mode Rejection: -70 dB typical (0 to 60 Hz); -40 dB guaranteed (0 to 60 Hz)

Coupling: AC or DC, programmable per channel

Analog Sampling Bandwidth: DC to 1 MHz

Input Threshold: -12.5V to +12.5V referred to input, programmable in 100 mV steps

Threshold Accuracy: 2% of setting +125 mV offset

Input Hysteresis: 50 mV min, 100 mV max

Input Frequency: DC to 5 MHz

Sensitivity: 500 mVpp DC to 1 MHz; 5 Vpp 1 MHz to 5 MHz

Time Base Accuracy: 10 ppm (0° to 50°C)

Digital I/O lines

Channels: 8 programmable as all inputs or all outputs

Power-Up Mode: Inputs pulled high

Connector: Removable screw-terminal block

Output Type: Open-drain DMOSFET

Output Pull-Up Resistor: 27k Ohm to +5V

Output Sink Current: 150 mA/output continuous, 500 mA output peak (<100 μs)

150 mA total continuous (per bank of 8 outputs)

Output Voltage Range: 0 to +5V, no external pullup required; 0 to +30V, with external pullup resistor

Output Resistance: 10 Ohms max

Input Characteristics: TTL-compatible; can be scanned along with any other channel

Note: Digital I/O cannot be updated during measurement, and may not be suitable for digital I/O applications. See NDTRelay2.

Ordering Information

Description
- 8-channel vibration measurement system with one eZ-Series software package:
  - Includes eZ-Analyst
  - Includes eZ-Balance
  - Includes eZ-TOMAS
  - Includes eZ-NDT

- 8-channel vibration measurement system with eZ-Analyst and eZ-TOMAS
- 8-channel expansion option for the ZonicBook/618E

Part No.
- ZonicBook/618EZA
- ZonicBook/618EZB
- ZonicBook/618EZT
- ZonicBook/618EZNDT
- ZonicBook/618EZAT
- WBK18

Accessories & Cables

Additional handle (one is included) HA-210-5-BK

Tough, rugged, and lightweight carrying case HA-212

Ethernet patch cable, 7 ft. CA-242-7

CE Compliant Cable Kits (O-rings included)

1 male BNC to male BNC CA-150-1

8 male BNC to male BNC CA-150-8

Software

Real-time vibration analysis and recording software eZ-Analyst

Rotating machine monitoring and analysis software eZ-TOMAS

Remote access and control client for eZ-TOMAS eZ-TOMAS Remote

Machine balancing software eZ-Balance

Resonant inspection software for ZonicBook/618E, 640 & 650 models eZ-NDT

To schedule a demo or discuss your application, call or email IOtech at sales@iotech.com

tel: 440-439-4091 fax: 440-439-4093

7 sales@iotech.com iotech.com
Features

- Real-time FFT analysis
- Easy-to-use graphical user interface provides fast setup
- Field expandable from 8 to 56 channels
- Supports four separate tachometer channels
- 3D Color Waterfall Spectrum Display
- Order Normalization and Order Tracked Plots
- Multiple Plot Overlays
- View all functions simultaneously in eight display windows with up to 16 data overlays in each window
- Export your data to Excel, ME Scope, SMS Star, UFF type 58 ASCII or Binary, and RPC III
- Wide selection of real-time analysis features, including integration/differentiation, synchronous averaging, and much more
- Supported Operating Systems: Windows 2000®, Windows Vista® x86 (32-bit), and Windows XP®

eZ-Analyst software from IOtech adds real-time continuous and transient data acquisition in the Time, Frequency, or Order domain to 600 Series and ZonicBook/618E systems. Today's eZ-Analyst is the compilation of over 10 years of continuous software development and customer inputs that results in the most versatile vibration analyzer available.

eZ-Analyst is operated through a series of easy setup windows that display only the information important to your test. Acquisition configuration involves selection of the desired acquisition parameters from easy-to-use menus.

Configuration

eZ-Analyst features a familiar Windows*-style graphical user interface, making it easy to configure the hardware with simple fill-in-the-blank configuration screens. Selectable hardware parameters include channel selection, channel type (either response or reference), range, auto-ranging, triggering, and more. Configurations can be saved and recalled for future use, making it simple to change from one test to another.

Windowing. eZ-Analyst includes Hanning, Blackman Harris, Flat Top, Exponential with variable decay, and no window for response channels. Additionally, Rectangular and Cosine Taper Windows are provided for reference channels.

Averaging. Linear, Exponential, Peak Hold, and Time Synchronous

Resolution. eZ-Analyst offers resolution from 64 to 25,600 Spectral lines

Frequency Range. From DC up to 100 kHz*

Sample Rate. User selectable from 2.56, 5.12, or 10.24** times the frequency range selected to help in acquiring that elusive transient

Channels. Minimum of 8 to a maximum of 56 in increments of 8

Triggering. Any active channel may be used as an acquisition trigger, which is adjustable on level, slope, and pre or post delay as a percentage of the time window

Tachometer. Four independent inputs for RPM measurements

MIMO. Any number of active channels can be set as reference channels making MIMO (Multi Input Multi Output) testing easy and convenient

Display

eZ-Analyst allows the user to establish any combination of displays up to a maximum of 8 separate display windows and 16 data traces within each window for unparalleled versatility. Each display set up can be saved for instant recall providing the user with unlimited display flexibility.

3D Color Waterfall Spectrum Display

eZ-Analyst now includes a powerful 3D Color Waterfall Display to augment its already powerful spectrum display capabilities. Each Spectrum window added to the eZ-Analyst display screen can have its own 3D Waterfall with unique configuration settings. The eZ-Analyst Waterfall displays include the following capabilities:

- Latitude and Longitude display rotations
- 3D Plot cursor to display the value at a specific X, Y, and Z plot coordinate
- Configurable number of Spectrum records
- Automatic tracking of scale and axis changes made to the Spectrum display
- Spectrum record decimation
- Averaged Spectrum record tracking
- 3D display of Spectrum Single, Dual, Harmonic, Sideband and Free Form cursors
- Highlighted spectrum of current record in playback mode
- Six custom definable 3D plot rotation context menu presets for customized waterfall views
- Individual control of 3D surface plot and cursor trace transparency
- Auto and Log scaling capability
- Choice of three color modes for 3D surface plot

* Maximum bandwidth determined by number of active channels and sample rate
** Sample rates apply to only the ZonicBook
Order Normalized & Tracked Plots

View both Frequency and Order domain information at the same time. The user can specify any combination of orders, up to a maximum of 20 orders per display window while also viewing the order normalized and/or frequency domain plots. This feature may be selected while viewing real-time or post-processed data without the restriction of defining your display prior to running your test.

Multiple Plot Overlays

This new feature allows you to quickly compare current test measurements to previously acquired data and expected results. eZ-Analyst can directly import and overlay Microsoft® Excel® data while acquiring current test data in real time. This feature allows setting up test criteria by importing previously acquired or user-generated data into the real-time display plots. Up to 15 separate plot overlays can be imported, allowing you to analyze real-time data against multiple test criteria. You can compare test results and quickly determine whether the test measurement meets acceptance criteria.

In addition to the 3D Waterfall display, a new 2D Frequency/Order Slice display has been added to eZ-Analyst’s analysis toolbox. The cursors that appear in the main Spectrum can also be seen in a 2D Frequency/Order Slice Strip Chart that plots the values under the cursors over time. With eZ-Analyst’s flexible display configuration capability, you can view the Spectrum, 3D Waterfall, 2D Frequency Slice or order track displays individually, or you can vertically tile any two of these displays into the same window.

Display Windows. Up to 8 with 16 data traces per window in either real-time or post analysis.

Functions. Available display functions include Time, Spectrum, Order Spectrum, Order Track, Auto Spectrum, Waterfall, PSD, FRF (Magnitude, Phase, Real, Imaginary, Nyquist), Cross Spectrum, Coherence, Octave, Third Octave, Transfer Function (Inertia, Mobility, Compliance, Apparent Mass, Impedance, Dynamic Stiffness), and Averaged Time

Cursors

All cursors are selectable as independent of display window or locked for automatic tracking of frequency.

Single. Cursor displays Time or Frequency with amplitude and overall amplitude

Dual. Cursors display Time or Frequency with band overall

Harmonic. Displays fundamental and harmonics with the number of harmonics user selectable; harmonic markers have fine tuning

Side Band. Displays center frequency with ± delta frequency

Peak. Displays peak amplitudes with user-selectable number of cursors; user-selectable threshold level sorted by amplitude or frequency

Free Form. User-selectable number of cursors that can be placed at any location on the data display

Export Data

- Universal file format 58 ASCII or Binary
- ME Scope Modal. Vibration Technologies ME Scope native format
- STAR Modal. Spectral Dynamics STAR native format
- EXCEL. Microsoft® Excel®
- RPC III. For road simulation

Record/Playback Data

eZ-Analyst allows the user to record real-time data to the computer hard drive while viewing the data. The data is saved on the computer hard drive as a contiguous time data file and can then be played back and analyzed. The acquisition hardware does not have to be connected to the computer to perform this function. Data can be recorded at maximum bandwidth, and the file size is only limited by the available space on the hard drive. During playback, all display functions are available to the user. Additionally, the user may select any percentage (0% to 99%) of overlap processing during playback.

Waveform Output (640 Models Only)

Allows several different types of waveforms including random, burst random, sine, swept sine, square waves, as well as arbitrary waveforms from file. You can change the type of waveform, its signal level, DC offset, and for square waves, the duty cycle. Changes to these controls can be made while the waveform output is running. Burst on/off times are also selectable as well as sweep times for swept sine wave types. You can configure your waveform to output continuously, in a burst or to repeat. In addition, ramp up on start and ramp down on stop can be programmed to allow smooth transition of test equipment such as shakers. The waveform output feature also enables data capture on output start events so that analyzer data frames can be captured at the start of every waveform output sequence.

Configuration

From the eZ-Analyst menu or toolbar, you bring up the waveform output dialog and make your selection of the type of waveform you want to generate. You can choose from several types of static waveforms and swept waveforms. Or you can import data from a text file or eZ-Analyst Time History file to create an arbitrary waveform.

Predefined static waveform types include: Sine, Square, Triangle and Random; and provide settings for Offset, Amplitude, Frequency, and for Square waves Duty Cycle.

For Swept waves you can choose from: Sine, Square, Triangle and Chirp; and utilize settings for Offset, Amplitude, Start Frequency, End Frequency, Log/Lin sweep, and Sweep direction. You can also add an optional Amplitude ramp up at the start of your waveform, or an Amplitude ramp down at the end of your waveform.

Ordering Information

<table>
<thead>
<tr>
<th>Description</th>
<th>Part No.</th>
<th>tel: 440-439-4091</th>
<th>fax: 440-439-4093</th>
<th><a href="mailto:sales@iotech.com">sales@iotech.com</a></th>
<th>iotech.com</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real-time vibration analysis and recording software for the 600 Series and ZonicBook/618E operating under all 32-bit versions of Windows®</td>
<td>eZ-Analyst</td>
<td></td>
<td></td>
<td></td>
<td>Note: eZ-Analyst is included with the ZonicBook/618EZA package.</td>
</tr>
</tbody>
</table>
eZ-TOMAS Features

- Rotating Machinery Analysis: Time Waveform, Orbit, Spectrum, Waterfall, Polar, Bode, Shaft Center Line, and Trend displays
- Transient and Steady State rotating machinery analysis
- Easy-to-use graphical user interface and multiple project configurations provide fast setup
- Up to 20 kHz Analysis Frequency, with up to 25,600 lines of resolution
- Supports up to 56 channels
- Overall, spectral amplitude, and phase gauges with peak hold indicators
- Spectral limit checking, with output relays and alarm event logging
- Limit sets for specific RPM ranges
- Event data storage based on user defined triggers, with automatic backup
- Machine and Bearing Fault analysis and limit checking
- Save/Recall display setups with up to 8 display windows, and multiple overlays
- Integration and differentiation for acceleration, velocity, and displacement inputs
- Harmonic, Sideband, and Peak cursors for time waveform and spectrum displays
- Statistical analysis report with automatic limit generation
- Generate production test cell reports
- Export data to Excel®, UFF Type 58 Binary, or ASCII format
- Supported Operating Systems: Windows 2000®, Windows Vista® x86 (32-bit), and Windows XP®

eZ-TOMAS is a highly sophisticated, yet easy-to-use tool for the monitoring and analysis of single or multiple machines, which allows the user to assess the reliability and operation of his process, and the critical machines pertaining to his process. Notification of faults are displayed locally, but can also be sent via text message or email, allowing the user to be notified of any problem regardless of his location.

eZ-TOMAS has built in an extensive set of data displays, allowing the user to view data in a variety of formats, and virtually eliminate any potential for errors in the diagnoses of potential problems.

Continuous Monitoring. eZ-TOMAS automatically stores data based on time or change in machine condition such as speed, vibration level, and alarm condition. A circular FIFO file, with automatic backup, records the data. If an alarm condition occurs, eZ-TOMAS can automatically notify you.

Analysis Tool for Rotating Machine. You can display and analyze historical data while eZ-TOMAS continues to collect, monitor, and store data. Displays include Waterfall, Spectrum, Bode, Orbit, Time Waveform, Shaft Center Line, and Trend displays.

Portability. The ZonicBook or 600 Series, and notebook PC running eZ-TOMAS, can be easily moved from machine to machine with very short setup times. Use it to reduce downtime, improve data collection, and troubleshoot problems, while maximizing inventory utilization by intelligently projecting down time for parts replacement. With minimal training, you can set up eZ-TOMAS, start monitoring, perform data reduction, and prepare reports all in the same day.

Acquisition
- Hardware: 600 Series or ZonicBook/618E
- Analysis Range: From DC up to 50 kHz
- Up to 25,600 spectral lines for high resolution
- Channel Coupling: AC, AC with IEPE, or DC
- Channel Input Range: From 25 mV to 25V
- Windowing: Hanning, Flat Top, Blackman Harris
- Multiple Tachs: Up to eight dedicated tach channels for phase reference
- Input Channel Types: Displacement, Velocity, Acceleration, Pressure, Tachometer, and other sensors
- Input channels can be order normalized to any tachometer input
- Averaging: Peak Hold, Linear, or None

Storage
- Event driven FIFO circular files change in Time, RPM, Vibration levels, or Alarm Condition
- User Defined FIFO Size: Up to 225,000 time waveform records per input channel
- View or Export historical data while monitoring is active
- Automatic backup of FIFO file
General Information, Specifications, & Ordering Information

Limit Checking
• Two High and two Low alarm Set Points can be defined for multiple RPM ranges
• Set Points can be entered manually, or generated automatically based on historical operating conditions
• Spectral Set Points can be specified for Machine and Bearing Fault frequencies
• Alarm Event Recognition can be delayed to reduce false alarms
• Alarm Events are logged with Date/Time stamps
• Email and Text Messaging can be sent on Alarm Event
• Output relays can be triggered on Alarm Events

Rotating Machine Displays & Reports
• Gauge displays with status indication and peak hold indicators
• Vertical gauges for overall and spectral amplitude
• Circular gauges for spectral phase
• Up to 8 plot windows, with up to 8 overlays per window
• Display Formats: Spectrum, Waterfall, Time, Orbit, Polar, Bode, Trend, and Shaft Center Line (SCL)
• Order normalization and order tracking
• Harmonic, Sideband, and Peak Cursors on Time Waveform and Spectrum displays
• Statistical reports with minimum, average, maximum, and deviation calculations
• Runout compensation for Polar and Bode displays
• Integration and Differentiation of acceleration, velocity, or displacement inputs
• Baseline and Limit overlays
• Bearing clearance circle overlay for Orbit and SCL displays
• Save and Recall your preferred data displays
• Production test cell reporting using Microsoft® Excel®

eZ-TOMAS Specifications

Acquisition Features
• Data collected from displacement, velocity, accelerometers, tachometers, and process probes
• Vibration data is referenced to up to eight tachs
• AC or DC coupled
• User-defined spectral bands (peak, overall, or phase values in a user-defined spectral band recorded over time)

Processing Characteristics
Analysis Frequency: From DC up 50 kHz, all input channels synchronously sampled at the analysis rate times the Nyquist factor
Spectral Resolution: From 200 to 25,600
FFT Windows: None, Hanning, Flat Top, 3 Term Blackman Harris
Integration: Single and double integration
Averaging: Linear, peak hold indicators, or none

Storage Features
• FIFO Design: User specified size to 225,000 records per channel
• Storage triggered on change in RPM, time, overall vibration, or alarm
• Storage enabled within an RPM range
• Continuous data storage can be user or alarm triggered
• Automatic backup FIFO file

Limit Checking Features
• Two (2) High and two (2) limit set points per spectral band
• Limit set points can be specific to multiple RPM ranges
• Alarm log records alarm events
• Output relays allow user control when event occurs
• Color status indication is shown on the gauge panels

Display & Report Features
• Gauge displays provide indication of current spectral band information and status
• Display Formats: Time, Spectrum, Waterfall, Orbit, Bode, Polar, Trend, and Shaft Center Line
• Integration and differentiation of acceleration, velocity, and displacement inputs
• Up to 8 display windows, each window supports up to 8 traces
• Statistical reports provide minimum, maximum, average, and deviation values
• Plot setups can be saved and recalled
• Baseline and limit set points can be overlaid

eZ-TOMAS Remote Features
• Provides remote monitoring, analysis, and control of multiple eZ-TOMAS systems
• Remote Real Time and Historical Spectral Analysis and Displays
• Configurable real-time Gauge Displays
• Multiple eZ-TOMAS Remote users can simultaneously monitor an eZ-TOMAS system

eZ-TOMAS Remote Overview
eZ-TOMAS Remote software allows you to remotely monitor and/or control eZ-TOMAS applications through client/server architecture. The server, an eZ-TOMAS application, interacts with the hardware, and is typically at a remote location, relative to one or more clients (eZ-TOMAS Remote).
eZ-TOMAS Remote, frequently referred to as the client, communicates with eZ-TOMAS via TCP/IP. Several clients can run simultaneously to monitor an eZ-TOMAS application. In addition to monitoring and controlling eZ-TOMAS applications, you can create unique plot setups that are local to eZ-TOMAS Remote. In other words, you can create custom setups that exist only at the client.
A single eZ-TOMAS Remote client can control multiple eZ-TOMAS servers. When connected to a server, eZ-TOMAS Remote has two modes of operation:
• Monitor mode
• Controller mode

Monitor Mode
Monitor mode allows you to view data from an eZ-TOMAS application. You can view gauges and plots; and the data viewed can be live or historical.

Controller Mode
A client may be enabled as a controller for a server if eZ-TOMAS is configured to permit such control. Control is restricted to a single controller at a time. The controller mode allows you to control every aspect of the acquisition state for an eZ-TOMAS application. While in the controller mode you can:
• Configure an acquisition
• Set Limits
• Configure Digital I/O
• Start and stop acquisitions
• View gauges and plots
• and more...

Ordering Information

Description | Part No.
--- | ---
Rotating machine monitoring and analysis software for 600 Series and ZonicBook/618EZ | eZ-TOMAS
Remote access and control client for eZ-TOMAS Automation module with 8 relay outputs | eZ-TOMAS Remote NDTRelay2

Note: eZ-TOMAS is included with the ZonicBook/618EZAT and ZonicBook/618EZAT packages.
eZ-Balance
Machine Balancing Software

Features
- Multiplane trial and trim balancing
- Polar, time, and spectral displays
- Computes and stores influence coefficients for future trim balancing
- Vibration data can be collected by the 600 Series or ZonicBook/618E, or entered manually
- Balancing toolkit
  - Trial weight calculations
  - Weight splitting
  - Centrifugal force
  - Stock weights
  - Weight removed
- Unbalance tolerance
- Balance solution can be based on multiple response points
- Supported Operating Systems: Windows 2000®, Windows Vista® x86 (32-bit), and Windows XP®

Balance rotating machinery with eZ-Balance and the 600 Series or ZonicBook/618E. The combination of the 600 Series or ZonicBook with eZ-Balance provides a powerful system for multi-plane (up to 7 planes) balancing applications. eZ-Balance computes the optimal balance weights and their locations, based on vibration data collected from the 600 Series or ZonicBook. The data is displayed in a convenient Polar plot that indicates the magnitude and phase of the unbalance as well as time and spectrum data.

eZ-Balance determines a balance solution by calculating the change in vibration condition based on adding trial weights. The balance process is a series of well defined steps. The initial trial run is used to measure the as-found vibration condition. The machine is shutdown and a trial weight is added. The balance run measures the effect of the trial weight and a trial solution is calculated. A trim run is then performed to confirm the results of the trial solution. Accelerometers, velocity probes, or displacement probes may be used to measure the vibration level at each balance plane. A tachometer measures the rotation speed and provides a phase reference.

Specifications
Input Bandwidth: DC to 20 kHz for 8-channel ZonicBook/618E; DC to 40 kHz for 4-channel 600 Series
Spectral Lines: 200 to 25,600
FFT Windows: None, Hamming, Flat Top, 3 Term Blackman Harris
Integration: Single and double integration, selectable low-frequency cutoff
Averaging: Linear

Ordering Information
Description Part No.
Machine balancing software for the 600 Series and ZonicBook/618E eZ-Balance
eZ-NDT
Resonant Inspection Software

Features
- Provides inspection of metal, ceramic, and hard plastic parts
- Removes the ambiguity that is common in other inspection systems
- Requires no parts preparation, making the test fast and inexpensive
- Tests parts in less than 1 second
- Quantifies and documents the first natural frequency for end-user comparison to final assembly resonant frequencies
- Compatible with ZonicBook/618E, 640 and 650 models
- Supported Operating Systems: Windows 2000®, Windows Vista® x86 (32-bit), and Windows XP®

IOtech’s eZ-NDT (non-destructive test) systems provide a fast and inexpensive method of 100% inspection of production parts, such as powder metal, ceramics, and composites. eZ-NDT uses acoustic analysis to identify part variations that are caused by process inconsistencies and defects. eZ-NDT systems apply acoustic energy to your part, monitor its acoustic response, and analyze its resonant frequencies. It then compares the results to the acoustic signature of a known-good part stored in its library. The test takes less than two seconds and requires no special tooling, dyes, chemicals, cleaning, magnetization, or expensive time-consuming visual inspection equipment.

eZ-NDT can detect deviations in dimensions, material properties, and defects including cracks, residual stress, inclusions, and variations in hardness, tempering, porosity, mass, holes, bonding and/or welding failures. Resonant inspection performs a whole body measurement, not just a spot check for visual indications. It also quantifies the first natural frequency, which many end users require for comparison to final assembly resonant frequencies. By keeping component first natural frequencies different from final assembly resonant frequencies, the end user avoids the potential for noise, vibration, or product damage. Because it’s fast, you can test all of your parts, not just a sampling.

Before purchasing an eZ-NDT system from IOtech, we recommend that you engage in our Feasibility Study, where we verify that your parts respond appropriately to our inspection process.

Software
The eZ-NDT software is extremely easy to use, with step-by-step instructions and an intuitive graphical user interface. Three password-controlled security levels are provided: Manager (full access), Technician (limited access), and Inspector (test only). Only the manager can access the setup screens that set the pass/fail criteria and the known-good resonant signature. Operators are provided with simple, straightforward screens showing the performance of each part against the predetermined resonant signature and the pass/fail results.

The eZ-NDT software stores several test parameters during normal testing. Users with Manager and Technician privilege levels can access part-specific information and summary reports, including statistical analysis.

Feasibility Study Service
IOtech offers a service that determines the feasibility of resonant inspection for your parts, minimizing the risk of problems during deployment of the final test system. As part of the Feasibility Study, IOtech tests a sample lot of both good and bad parts. The Feasibility Study isolates the resonant disparities between the two lots and states whether the part-under-test is a good candidate for resonant inspection. When the system is purchased, IOtech will include the pass/fail criterion developed during the Feasibility Study, and credit the cost of the Feasibility Study to the purchase of a system.

Ordering Information

<table>
<thead>
<tr>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>eZ-NDT resonant inspection software for manual and automated systems</td>
<td>eZ-NDT</td>
</tr>
<tr>
<td>eZ-NDT resonant inspection system for manual and automated systems with the ZonicBook/618E</td>
<td>Zonic/618EZNDT</td>
</tr>
<tr>
<td>600 Series Feasibility study performed by IOtech to characterize</td>
<td></td>
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<tr>
<td>one part type</td>
<td></td>
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<tr>
<td>Manual hand-held hammer</td>
<td>NDTHammer1</td>
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<tr>
<td>Automated electric hammer</td>
<td>NDTHammer2</td>
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<tr>
<td>Impact hammer tip assembly, steel</td>
<td>NDTHamtip2</td>
</tr>
<tr>
<td>High accuracy, directional microphone</td>
<td>NDTMic1</td>
</tr>
<tr>
<td>Two day on-site training and system integration</td>
<td>NDTTrain*</td>
</tr>
<tr>
<td>Automation module with 8 relay outputs</td>
<td>NDTRelay2</td>
</tr>
<tr>
<td>6 ft. BNC to BNC signal connection cable; 2 are needed to connect hammer and microphone to ZonicBook</td>
<td>CA-148</td>
</tr>
</tbody>
</table>

* Contact factory for availability
When used in conjunction with IoTech’s eZ-NDT software, the NDTHammer2 strikes the part under test with controlled impulse energy, eliminating the variation caused by striking the part manually with a hand-held hammer. NDTHammer2 is especially well suited for automated NDT systems where the striking of the part under test and the collection of the resultant resonant information are totally under control of the eZ-NDT software.

The NDTHammer2 system consists of two separately packaged items; the hammer unit and the control unit. Unlike other electric impact hammers, NDTHammer2 isolates the electronic control circuitry from the mechanical striking components, eliminating failures due to hammer heat, shock, and vibration.

The control unit is housed in a NEMA12 enclosure and contains user controls to adjust the strike force of the hammer. The control unit also contains a resettable counter and display showing the number of hits since it last was reset. This is a trigger signal in the form of a TTL pulse or a switch closure from a PLC or like device.

**Specifications**

- **Hammer Shaft Displacement:** 18 mm nominal (0.7”)
- **Hammer Unit Weight:** 1.6 kg (3.6 lbs)
- **Control Unit Weight:** 2.2 kg (4.8 lbs)
- **Hammer Unit Dimensions:** 254 mm W x 127 mm D x 77 mm H (10” x 5” x 3”)
- **Control Unit Dimensions:** 178 mm W x 254 mm D x 127 mm H (7” x 10” x 5”)
- **Control Unit NEMA Rating:** NEMA12
- **Storage Temperature:** -20˚ to +70˚C
- **Operating Temperature:** 0˚ to 50˚C, 0-95% RH non-condensing

**Ordering Information**

- **Description:** Hammer unit, control unit, interconnect cable, 10 ft. remote signal input cable, and 2 tips
- **Part No.:** NDTHammer2
- **eZ-NDT resonant inspection system for manual and automated systems:** Zonic/618EZNDT

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**NDTRelay2**

RS-232 Relay Interface for eZ-NDT & eZ-TOMAS

**Features**

- 8 normally open contact outputs
- 4 digital inputs
- 16-bit counter
- eZ-NDT & eZ-TOMAS software support

When added to an IoTech Non-Destructive Test system (eZ-NDT), or to an IoTech Online Monitoring and Analysis system (eZ-TOMAS), the NDTRelay2 module allows the system to read external discrete signals, and control the output state of relay contacts. eZ-NDT and eZ-TOMAS software asynchronously control all functions of the NDTRelay2 module. No user programming is required.

The output relay contacts can be used to communicate the current alarm status to external devices. eZ-NDT and eZ-TOMAS systems can automatically trigger a state change of any output relay contact based on an Alarm Event. When an Alarm Event occurs, the output relay will change from Normally Open to Closed.

**Specifications**

- **Contact Outputs**
  - **Quantity:** 8
  - **Type:** SPST, normally open
  - **AC Rating:** 0.5 Amp @ 120 VAC max
  - **DC Rating:** 1.0 Amp @ 30 VDC max
  - **Approvals:** UL, CSA
  - **Electrical Life:** 100,000 operations, min
- **Digital Inputs**
  - **Quantity:** 4
  - **Type:** TTL or contact (weak pull-up)
  - **Input Voltage High:** 4.00V, min
  - **Input Voltage Low:** 0.8V, max
- **Event Counter**
  - **Quantity:** 1
  - **Type:** TTL or contact
  - **Resolution:** 16 bits
- **Communication Interface**
  - **RS232:** Standard DB9S (female)
  - **Configuration:** 9600 baud, 8-bit words, no parity, 1 start bit

**Power**

- **Line Voltage, Input:** 85 to 265 VAC, 47 to 440 Hz
- **DC Power Out:** +12 VDC @ 3.5A max, via DIN 5 power connector

**Operating Environment**

- **Temperature:** 0˚ to 50˚C
- **Humidity:** 0 to 95% RH, non-condensing

**Ordering Information**

- **Description:** Automation module with 8 relay outputs
- **Part No.:** NDTRelay2

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NDTHammer2’s two-part design is well suited for even the toughest manufacturing environments.
Application Summary
Serious compressor problems often appear during startup and shutdown. During this time, dynamic stresses from acceleration and deceleration inertia typically run higher on certain components than when the compressors operate at constant speed, and the stresses may aggravate a defect. Also, some anomalies may be more observable. This is not to say that problems do not arise during steady-state operating conditions; they do, but they may be less obvious during the onset of a failure.

Centrifugal compressors that separate liquid air belong to the dynamic compressor family and operate at extremely high speeds. They contain a large bull gear that drives high-speed pinions, which develop the pressure. A prime mover, such as an electric motor, connects its drive shaft to the compressor unit through a coupling to spin the bull gear.

During the start up or shut down, events take place very quickly and it requires a system with real-time recording capability to detect and identify problems that may arise.

For example, Nelson Baxter, a consultant with AZIMA Corp., Woburn, Mass., was recently requested to measure the startup operation of a four-stage, 5.0-khp liquid-air separation compressor. The purpose of the test was to evaluate the unit’s condition and detect any root problems that might have caused an excessive vibration transient in the first stage that resulted in a subsequent trip event. Baxter initially recorded some sub-synchronous instability, but for five succeeding days, no unusual vibration transients appeared.

IOtech’s Solution
The data recorded during the test came from IOtech’s 650u Dynamic Signal Analyzer (DSA). The client’s original data acquisition system is acceptable for recording overall data, but it has no time or spectral data collection capabilities. In contrast, the 650u DSA collects data from each probe continuously, and then streams it to a computer’s hard drive for post-processing analysis. The DSA was set to collect 5120 samples/sec during the startup phase. It recorded each revolution of all four stages from startup through the first seven minutes of operation.

Following the startup it was then reconfigured to obtain waveform and spectra data every minute or during a level increase thereafter. Although the system continued to operate without an automatic shutdown from excessive vibration transients, Baxter closely analyzed the recorded data. During the first ten seconds of startup, he found that all four stages of the compressor experienced periods of extremely high vibration. The bull gear generated tangential forces that substantially shifted the centerlines of the pinion shafts. He also found an unexpected amount of high-amplitude, dynamic sinusoidal motion during two separate periods; the first immediately upon switch closure, and the second near the synchronous point.

These events explain why the compressor shows such high levels of motion during startup. (See Figure 1.) Data analysis indicates that, most likely, the two peaks in the dynamic amplitude come from the bull gear’s torsional response. The torque pulse generates the first peak during initial motor startup. The second peak appears to come from the synchronization pulse rate, around 80% of full speed, which indicates a suspected natural, torsional frequency. This is not particularly surprising, since synchronous motors are commonly known to generate torsional vibration during startup. After the motor reaches synchronous speed, the amplitudes level off and remain relatively constant.

After the unit stabilizes, stage 3 generates the highest vibration level. These time-based wave shapes were taken from stage 3 when operating at a relatively low speed. They show 1.5-mil amplitude notches every revolution. Notches such as these that appear at low speeds usually indicate a scratched shaft, the most probable reason that the stage 3 proximity probe shows abnormally high values.

Conclusion
The compressor unit did not indicate noticeable rubbing during startup. However, it did go through some extremely high vibration levels as shown in the continuously collected time-data graph. These vibrations probably arose before, as well, but instrumentation like the IOtech 650u Digital Signal Analyzer that could capture the vibrations, previously had never been available at the site. The high levels of motion do show the need to have enough clearance in the seals. The second item that the advanced instrumentation made clear was that a flawed surface finish of the shaft being monitored by the probe was the most likely cause of the vibration on the third stage. Scratches probably generated the sharp pulses that were seen at low speeds. Observing the time-based wave that appears when the shaft rotates at low speed reinforces this assumption; it looks the same here as it does when running at full speed or 215 Hz.

The steady-state data were sampled each minute with the provision that any increase in vibration would also trigger the data-capture feature. The trigger did initiate a few data sets, but none appeared to be high enough to trigger a trip. Unfortunately, the source of the original trip remains unknown. A random event might have caused the sub-synchronous vibration to spike, which is always present at some level on the first stage, or the original instrumentation had an intrinsic transient problem.

Figure 1. The plot shows the motion on all four stages during the first ten seconds of startup. All stages experience periods of abnormally high vibration. The torsional pulse rate is 7200 CPM at zero rpm, and as the speed increases, the torsional pulse rate decreases to zero. Therefore, during the startup phase, a time comes when the pulse rate may equal a natural, torsional frequency — the most likely cause of the second peak. After the motor reaches synchronous speed, the amplitudes level off and then remain relatively constant.

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Nuclear Pump Bearing Testing

Application Summary
Nuclear power plants depend on electric motor-driven pumps to circulate coolant through a closed system of pipes to help dissipate excess heat. These machines, called reactor coolant pumps, RCPs, must be monitored continuously to ensure dependable operation. RTDs located on the pump's bearings measure temperature and send the signal to an automatic alarm and control system that quickly alerts operators of any change in status. RCP bearings are likely suspects for failures, which could delay power production and cause the plant to lose significant revenues. One failure mode is a bearing seal that leaks lubricant and can become a fire hazard. Because of their importance, RCP bearings are a high priority component to watch, and usually, multiple sensors serve each bearing to provide a certain amount of redundancy.

Because issues with bearing seals have been a reoccurring problem in numerous nuclear power plants, the Nuclear Regulatory Commission (NRC) has issued a multilevel procedure for reoccurring problem in numerous nuclear power plants.

Potential Solution
Stress analysis engineers at a Pittsburgh, PA based consulting firm, were assigned the project to design and develop the test stand and appropriate instrumentation. The consultants had several dual-channel data acquisition systems from which to choose, but the design eventually called for more than 50 channels of simultaneous data collection. Clearly, they had to find a compact data acquisition system capable of handling that many channels and flexible enough to accommodate a wide variety of sensor types.

Potential Solution
Stress analysis engineers at a Pittsburgh, PA based consulting firm, were assigned the project to design and develop the test stand and appropriate instrumentation. The consultants had several dual-channel data acquisition systems from which to choose, but the design eventually called for more than 50 channels of simultaneous data collection. Clearly, they had to find a compact data acquisition system capable of handling that many channels and flexible enough to accommodate a wide variety of sensor types.

Iotech's Solution
After investigating several possible systems, the consulting team selected the Iotech ZonicBook for the application. Although it was the first Iotech system they had experience with, their Mechanical Engineer learned how to use it in less than a day. The data acquisition system let him connect 56 channels with a mix of sensors that included RTDs, flow sensors, pressure sensors, tachometers, and proximity probes.

The Mechanical Engineer worked with a thrust bearing assembly that weighs about 12,500 lb, and measures three feet high by five feet in diameter. The test stand also contains a 500-hp motor coupled to a 600-hp electrical drive and a thrust bearing assembly. The system contains hydraulic cylinders that apply vertical and horizontal thrust to the bearings to simulate loads. The vertical thrust loads are 100,000 to 177,000 lb, and the side loads range from zero to about 700 lb. The thrust load is controlled over a range of 170,000 to 102,000 lbf as the shaft runs up to operating speed. The shaft ramps up from zero to 1190 rpm in 16 seconds and down in five minutes to simulate actual field-spin times. The bearing reservoir contains view ports in the top cover and sidewalls and features that accommodate thermocouple pressure sensors, three borescopes, and five cameras.

“The original design called for about 20 sensor channels,” says the Mechanical Engineer, “but it expanded to 56 channels as the project developed.” Six WBK18, 8-channel dynamic signal conditioning modules were added to the ZonicBook to expand the channel count, as well as two DBK84 thermocouple modules to handle multiple temperature channels. “The ZonicBook and expansion modules worked out extremely well for us because they are flexible enough to handle the wide variety of variables in our customers specification,” says the Mechanical Engineer. “We could monitor the data in real time and track changes as they appeared.”

The parameters measured included pressure from 0 to 60 psig, temperature from 80˚ to 350˚F, and shaft speed from zero to 1190 rpm.

In addition to the original specification, proximity sensors were added to measure vibration and the axial position of the shaft and sensors to measure the oil level. Hydraulic cylinders were installed on mounting collars to apply side loads to the bearings and thrust runner reaction bearings to apply vertical loads. Load cells were installed on these actuators to measure the amount of force applied to the bearings.

“The simulator stand had to be compact,” says the Mechanical Engineer. “We built a single control panel to contain the ZonicBook, signal conditioning modules, computer, TV monitor, and digital video recorder.” The consulting firm also used the Iotech DBK48 signal conditioning module containing NDT relay outputs to shut down the motor in the event of an over-temperature or over-speed condition, excessive vibration, low oil level, or excessive vertical or horizontal thrust.

“The ez-TOMAS software supplied with the ZonicBook was easy to use and let me construct Bode plots of the vibration,” says the Mechanical Engineer. “We were able to commission the system and turn it over to the customer within three months, and we taught its engineers how to use both the software and hardware in less than a week.”

Conclusion
ZonicBooks are used to monitor the bearings in reactor coolant pump simulators. Thermocouples measure the bearing temperature, proximity sensors measure vibrations, and the software generates Bode plots, which give the vibration specialist a means to detect and analyze bearing failures easily and repair them quickly.
Compressor Testing

Sometimes a product test that invalidates a suspected cause of failure can be just as valuable as a test that confirms a failure mode. Such was the case for a hydrogen reciprocating compressor test intended to discover a failure called “wiped” wrist-pin bearings, a condition where the bearing surface shows excessive, premature wear from the wiping action of the journal. The new compressor appeared to behave normally during short, startup test runs and gave no obvious outward sign that the bearings were in the process of being damaged. The maintenance personnel found the wiped wrist-pin condition when the machine was disassembled after the test runs. If the condition was not discovered at that time, the machine could have suffered more severe damage such as a broken connecting rod.

Watching a Prime Suspect

Engineers decided to instrument the compressor to collect data that would help them identify the root cause of the wrist-pin bearing failures. They used strain gages and pressure sensors. The compressor manufacturer was looking for crankcase twisting or other possible deflection problems. Concurrently, Ken Singleton, manager of KCS Consulting, Bristol, VA, was hired to measure compressor vibration and analyze operating deflection. He connected an IOtech ZonicBook and three expansion modules with 32 channels to measure data from accelerometers located around the compressor and a once-per-revolution phase reference signal from the crankshaft.

The number of data channels eventually totaled about 100, which included the OEM’s and plant site analyst’s sensors. Singleton used IOtech’s eZ-Analyst for data acquisition and ME’scopeVES software to calculate the operating deflection shapes (ODS). The software includes a drawing module that lets him develop 3D models in which the data, either modal or ODS, can be mapped and animated. First, data were collected during no-load and then full-load conditions. After the compressor was thermally stable, data were measured to develop the ODS model. This procedure let Singleton inspect the vibration modes of the crankcase and cylinders at different frequencies between 0.50 Hz and 1000 Hz with about 0.25 Hz resolution. Other forms of data were also calculated which included coherence and phase.

Reducing the Data

After the data are imported to ME’scopeVES, they must be “curve-fit.” Several methods are used to fit the curve, including “peak fitting.” This approach uses two cursors to enclose a narrow band of data in the frequency domain. The peak fit finds the highest amplitude frequency and its associated phase. These data are then used to animate the 3D model.

The ODS is depicted by a mesh model labeled with the accelerometer and DOF sites. The cross-channel data are measured at each DOF, imported to the ME’scopeVES software, and then curve-fit. The curve-fit data then animate the 3D model.

Transmissibility data for developing the operating deflection model or ODS comes from cross-channel, accelerometer measurements with units of g/g. The data represent the relative amplitude and phase between an accelerometer that remains fixed throughout the test, and one or more roving sensors that are moved to different locations on the structure under test. The fixed sensor establishes a reference point, and all other vibration frequencies are measured with respect to this reference. The roving sensors measure vibration at other various points on the machine. These points are called degrees of freedom or DOF. The DOF are laid out in a mesh pattern on the machine or structure and match the 3D model. The cross-channel data are measured at each DOF, imported to the ME’scopeVES software, and then curve-fit. The curve-fit data are used to animate the 3D model. The motion of the 3D model can then be analyzed to understand how the machine or structure is moving or vibrating at a specific frequency. Also, the structure can be animated in the time domain to view the complex motion.

The Illuminating Results

Singleton’s test results showed that the compressor housing deflections were within specifications and not the most likely cause of the wrist-pin bearing failures. The ODS model in ME’scopeVES showed the expected vibration motion of the compressor cylinders and frame under no load. At full load, the ODS showed the approximate shapes of the natural frequencies of the compressor that were being excited. Engineers then investigated other possibilities, which included insufficient bearing lubrication and overloading. The engineers concluded that the root cause of the problem was insufficient oil film development in the bearings. They modified the machine to solve the problem, and subsequent operation and inspection showed that the bearings were no longer being damaged. Fortunately, costly downtime and maintenance charges were minimized by eliminating frame flexure and misalignment as possible causes for the failure early in the investigation.

Conclusion

A new, large hydrogen compressor was found to have wiped wrist-pin bearings, a premature failure mode, during startup testing. The compressor was instrumented with accelerometers to record suspected excessive vibrations that could be used with ME’scopeVES software to simulate and animate any housing deflections in 3D. The vibrations were found to be within tolerance, and subsequent investigations uncovered a lubrication problem that was solved and verified in succeeding test runs. Early elimination of suspected vibration problems substantially reduced the cost of an otherwise long-term investigation and analysis.
Steel Mill Monitoring & Vibration Testing

Application Summary
Continuous casting process lines used for manufacturing steel, all around the world, contain components that undergo extremely high pressures and temperatures, and they often run for weeks without stopping. When the molten steel is ready to leave the furnace, it goes into a water-cooled mold and forms a slab. The slab comprises a solid outside layer that surrounds a molten core. The metal then cools further as it passes through several water spray stations.

Typically, several pairs of rolls arranged in segments on a 65-foot radius contain the slab while it solidifies. During this time, each pair of rolls must maintain a gap tolerance of 0.040 inches. As this takes place, a dedicated data acquisition system continuously monitors the processing equipment for certain variables such as temperature, cast speed, and mold behavior. After the slab completely solidifies, it is cut into lengths according to the customer's order. The next step takes it to a hot strip mill. Here, the slab passes through a furnace where it is reheated to a uniform temperature before it runs through a processing line composed of a series of rolling stands. The hot slab is descaled and run through a roughing mill to further reduce its thickness. The slab gradually reforms into a long bar, runs through a series of finishing stands, becomes a sheet of steel, and finally reaches a thickness specified by the customer, typically less than 1/8-inch. The steel sheet is then coiled at a high rate of speed and either shipped to the customer or sent to a cold-rolling mill for further processing.

Potential Solution
Most mills employ one or more of a variety of permanent, distributed data acquisition systems that continuously monitor temperature, vibration, force, displacement, and speed. In addition to the permanent data system, a portable system is used to process vibration and speed information from accelerometers and tachometers located. They measure roll speed and vibrations at each reducing stage that might be caused by faulty rollers and roller bearings. The data acquisition system measures and analyzes these vibrations along the process line to help pinpoint the source of the problem. Resident software then defines the source of any abnormality in the process line, such as worn rolls, faulty bearings, and interstand tensiometer problems.

Iotech's Solution
An independent consultant from Ohio, who visits numerous steel and tin mills every year, measures anomalies that can eventually cause serious quality and maintenance problems. Although he occasionally uses the onsite data equipment, usually he finds it limited and prefers to use his own IOtech ZonicBook for measuring vibration and speed from his customer's accelerometers and tachometers. He finds the ZonicBook convenient to carry on trips to different facilities and easy to set up with his laptop computer anywhere in the plant.

“Vibrations at one stage on the line can upset the roller calibration not only at that stage, but also at another stage downstream from it,” says the consultant. “I place capacitive type accelerometers next to the screws located on top of the mill that can measure very low frequencies.” Vibration and tachometer measurements are synchronized and correlated using an FFT algorithm with a waterfall presentation. “This maps out a graph of events that defines the rolling coil of steel. I record this high-speed information for two to three minutes, then I use special software to process the data and highlight the critical frequency information for the bearings and the meshing frequency of the gear teeth,” he continues. The ZonicBook also takes information from the thickness gages at the end of the mill. The system tracks the tachometer and thickness perturbation data from each rolling stand in a specific order. After the consultant analyzes the accelerometer signals he can identify the rolling element on the stand that produced the thickness variations.

“Some of the data we gather with the ZonicBook are quite revealing,” he says. “For example, we had a problem with one line in a tin mill that repeatedly yielded substandard surfaces. We discovered that the spindle gears were generating a 161 Hz forcing function that produced 5th octave chatter.” The geared couplings contain as much as 0.020 in. of slop. The consultant had the geared spindles replaced with universal joints at that location and eliminated the chatter and increased the tin mill's quality. By comparison, the universal joint slop is typically only 0.002 in., a 10 times improvement.

“The ez-Analyst software from Iotech is easy to use and presents the data in a number of formats that is convenient and useful,” says the consultant. “In addition, I use third-party software to insert the cursors and calculate critical frequencies. I examine the waterfall presentation and use a color format to highlight the vibration intensity.”

Conclusion
An independent consultant, uses the Iotech ZonicBook to measure vibrations and analyze problems on cold and hot-strip rolling mills as well as continuous casters. He finds the ZonicBook fast and easy to set up and use. The software also provides him with a variety of data presentations that help him pinpoint the source of the problem. The FFT algorithm and waterfall presentation combined with ez-Analyst software are extremely helpful to him in diagnosing faults.
Compressor & Turbine Vibration Testing

Application Summary

Many companies in the petrochemical industry operate refineries that supply fuel, base oils, and ingredients for a variety of consumer products used globally, from plastic bottles to automotive tires. They also produce chemical intermediates for manufacturing polyester resins and automotive tires. They also produce chemical intermediates used globally, from plastic bottles to automotive ingredients for a variety of consumer products.

A typical medium to large-size refinery contains from 2000 to 5000 hefty pumps and compressors that move, store, and process the numerous chemical products. The plants also use waste flue gas to produce heat for steam boilers and chemical products. The plants also use waste flue gas to produce heat for steam boilers and chemical products. The plants also use waste flue gas to produce heat for steam boilers and chemical products. The plants also use waste flue gas to produce heat for steam boilers and chemical products.

Because these refineries handle thousands of barrels of crude petroleum each day, the pumps and compressors that move them must remain in first-rate operating condition. Removing these components from service before a scheduled maintenance date can be very expensive in terms of lost production. Common problems that could take them out of service include vibrations due to worn bearings and unbalanced rotors and couplings. Vibration experts routinely monitor these units to check for abnormal and accelerated wear before stopping them for scheduled maintenance.

Potential Solution

A vibration specialist at a U.S. refinery has the responsibility of regularly instrumenting what’s considered critical machines. “We have machines that are always monitored, but we also have critical machines that are part of a unit that is hard to justify the installation of a continuous monitoring system, so we move a portable data acquisition system between them,” says the specialist. These machines usually collect steady-state running data, but before she performs an overhaul or shuts them down, she collects startup and shutdown data as well.

“Usually, I’ll move the portable data acquisition system to a machine, leave it there for about a week, collect some critical data, shut it down, move it to another machine, and start the acquisition again,” she says.

The specialist had used some well-known, older data acquisition systems for a time, but the equipment had only 8 channels. She really needed 16 channels to measure machines with large gearboxes and multiple key-phasors, and a data acquisition system that could measure synchronous data — the bearing vibrations on both sides of the gearboxes simultaneously.

IOtech’s Solution

The vibration expert evaluated a few widely used data acquisition systems and settled on the 16-channel ZonicBook. “We could justify its purchase based on its portability and the ability to have a wide range of sensors,” she says. “I currently use the ZonicBook for 12 machines.” And when she has a machine that’s not equipped or instrumented with proximity or eddy-current sensors, she installs piezoelectric accelerometers. “One of the features that we really liked about the ZonicBook was that it came with integrated circuit power capability to supply the accelerometers and let us go from one type of transducer to another very easily,” she says.

“We also liked the ZonicBook’s number of lines of resolution and the playback features for handling the data,” she says. “We like to see the waveforms overlaid; open in multiple plots. And it is really good at viewing and analyzing a lot of data.” The specialist says it has the bandwidth, the speed, and all that she needs for steady-state work. It monitors the different states of the machine and can be left unattended to acquire the data she needs.

“I’m a software person,” says the vibration specialist, “so, I found the eZ-TOMAS and eZ-Balance software quite easy to learn.” She likes being able to adjust the alarms on the bar graph, and the 360 degree type plots, for setting up the phases. Also, she likes the plot functions and being able to adjust the scale.

Conclusion

Petrochemical companies in the U.S. are increasingly using IOtech’s ZonicBook to monitor and analyze vibrations in high-capacity process pumps and turbine generators. Vibration experts monitor some critical machines continuously while others share a portable data acquisition system among them. Before shutting down a machine for scheduled maintenance, they measure the vibration to make certain it is within expected tolerance. If it is not, then they look for additional problems that must be addressed beyond the normal maintenance activity such as a new, but defective coupling between the gear box and pump shaft. This procedure often extends valuable production time.
Turbine Generator Balance Testing

Application Summary
Leading universities, hospitals, and certain chemical manufacturers are increasingly installing their own boiler houses and power plants to generate steam for internal processes, to heat their facilities, and for turbines to generate electricity. The turbines typically develop from 5 to 50 MW and are used for back up as well as primary power sources. Such action breeds several benefits, not the least of which comes from selling electricity to the utility company's power grid. Other benefits include cleaner environments, more efficient use of energy, and local control, which in turn means less downtime from nationwide power-grid failures.

But there are some drawbacks as well, although on average, not particularly serious. For instance, continuously running machines suffer wear and require periodic maintenance by mechanical specialists. Also, turbines frequently suffer from imbalance and misalignment vibration through normal bearing wear. Unfortunately, serious, premature problems frequently crop up when service personnel cannot get turbines aligned properly. Poor alignment accelerates bearing wear and can cause components to rub.

Potential Solution
Diagnosis combines skills in acquiring critical data and analyzing them. But analysts only 10% of the job. Acquiring the right data consumes the remaining 90%. The instrumentation required for robust data acquisition and storage must meet certain basic guidelines, including high acquisition speed and accuracy, portability, and durability. Its memory must be large enough to store hours of continuous data gathered from sensors of different types, and it should support numerous channels. Many data acquisition manufacturers supply computer plug-in boards and dedicated equipment with appropriate software to measure, store, display, and analyze vibrations. But not every one has the ability to meet all these requirements simultaneously.

IOtech’s Solution
A vibration consultant with many years of measurement and analysis experience servicing rotating machines uses an IOtech ZonicBook. He likes the ability to have his entire measurement system in one small enclosure and be able to connect up to 8 channels simultaneously. In contrast, auxiliary equipment that he previously employed included digital tape recorders, integrating power supplies, racks, and a stash of auxiliary hardware — all too cumbersome and heavy to conveniently carry around among the different installations.

Moreover, the ZonicBook provides the accuracy, resolution, and frequency range needed for analysis. The IOtech system lets analysts identify critical frequencies and measure shaft eccentricity in terms of velocity to as little as one inch per second. Allowable displacements are less than 30% of the bearing clearance, which amounts to about 0.003 inches for a 0.010-inch bearing specification. Displacements exceeding 50% of the bearing clearance, however, can lead to turbine bearing failures.

Vibration analysts typically connect the ZonicBook to seismic sensors and proximity probes that are permanently mounted to clients’ machines. Because they are of various brands and operating specifications, the ZonicBook input can be adapted and calibrated to each sensor in the field under software control. Some older turbines do not have permanently installed proximity probes or seismic sensors, but have what's called “shaft riders,” spring-loaded devices that ride on the shaft. Under these conditions, the analyst installs his own accelerometers on the shaft riders and runs those signals into his ZonicBook.

The eZ-Analyst software that works with the ZonicBook has the capability of digital recording and playback, which lets the analyst manipulate the data resolution, frequency ranges, and other parameters to suit his specific needs after acquiring the data. Moreover, the equipment can be set up in the field to record data for two days at a time using eZ-TOMAS before the analyst attempts to balance a rotor. In 48 hours of collecting data, he may find that one particular file is the best.

In another example, an analyst recorded two vibration readings, one vibration measured on the bearing housing and the other, a seismic vibration, measured on the casing. The two vibrations were summed together, and the result is the absolute vibration, with a displacement close to 10 mils (pk-pk). Consider that the rotating element weighs 2500 pounds and runs at 1800 rpm. The force equals the mass of the rotating element multiplied by the eccentricity, or half the unbalance, and the square of the angular velocity. These parameters determine the force. Using the radius and the 5 mils (pk), (half the absolute vibration mentioned above), the force is calculated to be 10,000 lb. From this, the weight that had to be added was calculated, and it worked on the first try.

Conclusion
The bearings were inspected, and one packing bearing rub was evident in both the compressor and turbine. The most likely condition is oil whip, which caused the rub when the vibration amplitude increased dramatically. The turbine inboard bearing instability appears to have been caused by the compressor bearing damage. The instability occurred after the bearing failure and was apparently mitigated after the bearing repair. The two problems were corrected and the machine ran smoothly.

Vibration analysts often use an IOtech ZonicBook, a portable data acquisition system, connected to a combination of displacement sensors and accelerometers to diagnose vibration problems in large compressors, fans, turbines, and similar machinery. Sensors located in both horizontal and vertical planes around the bearings and case measure the maximum displacement of the rotor as well as vibrations that provide data for frequency and spectrum analyses, Fourier transforms, and determining balancing weights.

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Steam Turbine Rotor Testing

Application Summary
Steam turbines are often the drivers for large electric generators, pumps, and compressors in utilities and other process industries. The turbines can weigh several tons and generate power from just a few kW to many MW. It’s common for these machines to run for several years without repairs or bearing replacement as long as they are well monitored and maintained. However, it is essential that the rotors in these large machines retain good alignment, balance, lubrication, and a few other factors to avoid vibrations that can cause extensive damage. For this reason, built-in seismic or displacement vibration sensors continuously monitor the journal bearings to detect adverse vibration characteristics.

Many different kinds of problems can cause turbine rotor vibrations. Some common ones are called oil whirl, oil whip, and rub. Their symptoms are similar, and maintenance people often find difficulty distinguishing one from the other. Oil whip is a condition arising from a more basic problem called oil whirl, which in turn results from an uneven oil distribution (oil wedge) around the shaft in the journal bearing. Machine misalignment, improper oil viscosity, or an incorrectly designed bearing can cause this anomaly. It often generates a vibration at a frequency that is a subharmonic of the full rotor speed.

Rub is a condition where the turbine rotor contacts the stationary components including seal rings and the inside diameters of the bearings. Running the machine for a short time usually clears the problem, but in some cases, the wear continues to generate larger amplitudes that may become unstable and damage the machine in a short time.

Potential Solution
Engineers and technicians typically use data acquisition systems to measure, monitor, and record minute time vs. amplitude waveforms of the turbine-rotor shaft displacements within the journal bearings. The wave shape characteristics of the resulting plots help them determine which fault is the cause of the vibration condition.

Nelson Watson, president of Watson Engineering, Inc., Baton Rouge, LA, has been consulting in the utilities and process industries for many years. One of his clients was faced with exactly this situation recently, and Watson was called upon to diagnose and remedy the problem.

The test gear that resided at the site of a turbine compressor train was a type widely used by maintenance people and engineers in the process industry, but in this case, some of the permanently embedded sensors used to monitor vibration and generate orbit and phase plots were defective.

IOtech’s Solution
A 12,000-hp steam turbine driving a centrifugal compressor had been running without a problem for several years. Then, two years ago, the machine developed a vibration that damaged the bearings, which were subsequently replaced with a modified version.

The bearing malfunction came from a discharge check-valve failure that caused the compressor to rotate in reverse while the system was being switched to another unit. Soon after the incident, the turbine developed another high-amplitude vibration. The machine would shut down due to high vibration before reaching operating speed each time it was energized.

Watson set up his IOtech ZonicBook to record signals from radial proximity sensors located at both turbine and compressor bearings. A tachometer signal was connected to the governor speed sensor and calibrated to the turbine speed using a ratio function in the ZonicBook software. “Because the client’s embedded sensors were not operating,” says Watson, “I was unable to perform the typical orbit and phase analysis normally done under these conditions. In addition, the speed sensor stopped operating when the turbine vibration became excessive near the maximum running speed.”

So Watson connected the ZonicBook to the eight proximity sensors, two on each of the four bearings, and four tachometer signals, one at each of the four main bearings. He says, “The total recording time was about 10 minutes. The ZonicBook was able to record vibration signals that ranged from about 0.8 mils to 10 mils from a slow rotor speed to a maximum of 2400 rpm. The initial vibration amplitude during the slow roll was about 0.8 mils, then it went through a critical speed where the amplitude reached 3 mils, and finally, it backed down to less than 2 mils.” As the speed increased, the amplitude reached approximately 10 mils.

Watson used the ZonicBook’s software to print a waterfall plot of vibration frequencies and amplitudes that characterized the turbine’s behavior. The first critical speed appears to be about 2100 rpm, although the manufacturer claims the critical speed should be 2850 rpm. The constant speed lines start at 1569 rpm and show zeros above 3824 rpm. The zeros appeared after the speed sensor stopped functioning when the vibration amplitude suddenly increased. The diagonal row of peaks is recorded at running speed and was the only significant vibration until it passed 3824 rpm. Beyond that point, the speed approached 4200 rpm (70 Hz) and the sudden vibration appears at 2100 rpm (35 Hz).

The oil whirl condition usually precedes the oil whip condition. Spectral and orbit analysis can be used to identify either situation. When this occurs, usually a sub-synchronous frequency can be measured in a range less than half of rotor speed.

Conclusion
Nelson Watson, president of Watson Engineering, Inc., uses an IOtech ZonicBook to trouble-shoot large turbine and compressor problems that originate from a variety of sources, including unbalanced rotors and bearing problems due to oil whip, and rub. In a typical test, he connects eight proximity sensors to the bearings and records the vibration frequencies and amplitudes. The eZ-TOMAS software helps him analyze the data and pinpoint the problem’s source.
Remote Turbine Vibration Monitoring

Application Summary
Numerous electrical generators owned by a major U.S. utility company help supply energy needed for the power distribution grid spread across the North American continent. And the turbine-driven generators must continuously run smoothly without much vibration; otherwise they could sustain significant damage. Machine downtime costs could easily run in the thousands of dollars per hour. So, to keep the systems up and trouble free, their vibration signatures are recorded endlessly. The experts who watch over the equipment can frequently detect an imminent failure just by noticing changes in the shape of the waveform. The data acquisition equipment that monitors the health of these generators is permanently connected to vibration sensors including displacement transducers and proximity probes strategically placed around the generators, particularly to monitor shaft vibrations on the bearings. A critical requirement is that the equipment ties into the plant's DCS (distributed control system) and provides remote monitoring.

Potential Solution
The data acquisition equipment that the utility company used initially is relatively expensive and has some serious operational shortcomings.

The system hardware is large, not easily transportable, does not have remote monitoring capability, shows only the RMS amplitude of the signals, and is unable to show an adequate level of waveform detail to help the engineers detect an impending failure. It does not provide signature analyses or FFTs.

IOtech's Solution
Because of these limitations, the utility company is now supplementing the old equipment with two 8-channel ZonicBooks and its companion eZ-TOMAS software. According to the Outage Services Manager, “We primarily bought the ZonicBooks to measure shaft vibrations before and after an outage. Our secondary use is to remotely measure vibration levels and signatures. We can tie into the plant's DCS via our server and see what the direct amplitudes are. But without the ZonicBook, we can’t remotely monitor phase angle, one, two, or three-times amplitudes, and more discrete parts of the vibration signal.” He also emphasizes that it’s easier to say there’s a problem when the vibration is increasing, but being able to see what part of the vibration signal or amplitude component is changing is the most important aspect for diagnostics. The engineers monitor the signals over a period of time, so they can see what's developing and how rapidly.

The ZonicBook's output connects to a laptop computer at the turbine site, which is used as a server on the network. The engineers can remotely access the server's output from another location via the network neighborhood to observe the systems vibration activity. The ZonicBook itself, like the original data acquisition system, connects to sensors at the turbine generator site. The engineers connect them to the existing monitor and control panels, access and record the data, and then examine the acquired data. Alternatively, they return to the office with the ZonicBook and computer, observe and analyze the data, and then decide what must be done. For example, the engineers use the information to calculate the weight and location for applying balance shot. Then they return to the site to install it or make other changes necessary to solve the problem. After installing the balance shot, or otherwise repairing the machine, they restart the machine and record another set of data. If the data are good, they solved the problem. When a balance problem has been pinpointed in a combustion or steam turbine, the one-time amplitude and phase angles have to be observed and analyzed. The eZ-TOMAS software isn’t used to calculate a shot directly, but it can break down the direct reading into various components, and then that information is used to calculate, or plot the location and size of the needed balance weight.

For the present time, all the IOtech equipment is on-site. The engineers are familiar enough with the ZonicBook to set it up and collect the discrete vibration component data needed to be analyzed, but they would like to program the system so the ZonicBook could be remotely located or controlled. “There is sure to be a learning curve because it involves networking and a little higher level IT information,” says the Outage Services Manager, “but with the very complete instructions that came with the manual, the engineers should be able to figure it out quite easily. They are in the process of doing that right now.”

Conclusion
The IOtech equipment is performing well at each site for the utility company. The major advantage is the ZonicBook's portability. In addition to the displacement transducers and proximity sensors, the company runs a few Aero-Derivative engines that use accelerometers, velocity pickups, or seismic probes, all of which can be analyzed by the ZonicBook, but most of the new generators are outfitted with proximity probes and built-in displacement transducers.

A major utility company uses IOtech's ZonicBook and eZ-TOMAS software to capture generator and exciter vibration signals on a gas-turbine-powered machine. The waveforms are typical displays of historical data that engineers need to monitor trends over time. Any subtle changes in the data as seen through the eyes of an expert can be enough information to alert the maintenance engineers of possible failures.

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Bridge Crane Testing

Application Summary
IVC Technologies is a high tech service company offering customers route-based monitoring, field troubleshooting, commissioning, and various forms of multi-channel data acquisition. Since October 2004, IVC has been performing vibration analysis for NUCOR, a producer of hot-rolled carbon steel products. NUCOR’s Steel Bar Mill Group in Jewett, Texas has three major production cranes in service, the charge, ladle, and billet bay cranes. These cranes are crucial for production. NUCOR had suffered a history of problems with wheel and shaft fits on these cranes. Inadequate tolerances between the wheel and shaft assemblies had led to premature wheel and keyway failures.

IVC Technologies was asked by NUCOR to determine if vibration analysis could aid them in determining which wheels were in jeopardy of failing unexpectedly, and to help them plan future wheel replacements based on their mechanical condition.

This issue was originally approached from a vibration analysis perspective. After thorough evaluation by Allen Bailey, IVC Technologies Regional Manager – Texas Gulf Coast, the issue was escalated to the IVC Advanced Engineering Group (AEG). Directed by Bob Miller, a cohesive program was successfully developed through the collaborative efforts of this highly regarded team at IVC Technologies.

Industrial machines that are “identical” commonly vibrate differently, and cranes are no exception. Statistical analysis showed that though these cranes were the same make and model, built to the same manufacturing specifications, and perform the same jobs while in service, they would typically vibrate differently (both in amplitude and frequency).

Previous data collected with standard condition monitoring equipment was used to determine exactly what type of testing would be required to properly diagnose, predict, and set defect severities for these wheel assembly problems. The data was statistically analyzed, all known fault frequencies were then added to the database, and the wheels that were operating above the statistical alarm levels were analyzed for specific defect characteristics.

Typically, vibration data taken on cranes can show what appear to be transient events in the waveforms. Though transient events are commonly found in these systems, one must be able to mathematically link any vibration signal change to process or mechanical anomalies before assuming that an event is transient. The incorporation of process and crane operation data may need to occur in order to properly catalogue all waveform events.

IOtech’s Solution

Once the initial test data was collected, it became clear that transient vibration data collection would be best suited for this application. This was determined because of the limits on time involved with the data collection process and the many transient events that were occurring in the vibration data as the crane was being operated. IVC Technologies began investigating which type of collection device and software would best fit this scenario, and eventually decided to use the IOtech ZonicBook. The ZonicBook offered eight direct accelerometer inputs (IEPE) along with four dedicated tachometer inputs. In addition to being lightweight and portable, the ZonicBook’s included eZ-Analyst software was easy to operate.

As with any vibration analysis based test, one should always take enough data at a high enough resolution to resolve any defect signature that might be in the system. On most cranes, many critical components have slow shaft speeds with limited run times. Because of this, a person limited to conventional vibration analysis methods (i.e. route-based data collectors) will have a difficult time collecting enough raw vibration data to perform adequate post processing analysis on the back end to offer definitive fault diagnosis. The high-speed ZonicBook let IVC capture high-speed, transient data on multiple inputs which allowed them to accurately predict wheel assembly failures.

Conclusion

Since the implementation of these tests (which have been performed quarterly since 2007), no wheel failures have occurred requiring NUCOR to slow or cease production. Multiple wheels have been changed during this time frame, and an engineering spec change was implemented to further lengthen the life span of these wheel assemblies.

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IOtech Product Application using the ZonicBook

Gearbox Testing

Application Summary
Chemical processing plants that produce olefin and polyolefin materials for the plastics industry employ mixers of gigantic proportions. It’s not uncommon to see 2000 hp electric motors driving speed-reducing gearboxes of similar size for mixing a batch of ethylene, propylene, or polyethylene—materials that are eventually converted to pellets for plastic injection and blow-molding machines. The heavy loads placed on the gearboxes under such conditions are reason enough to have teams of engineers and technicians forever vigilant of the sounds and vibrations these giants continually generate. Their mission is to prevent premature gearbox failures.

A reliability engineer for a large chemical company has the responsibility to monitor and analyze these gearboxes, and develop specifications for their repair and overhaul. He is a member of the machinery support group that analyzes gearbox vibrations, spent oil, and reciprocating compressors where he monitors pressures and volumes. Several large gearboxes on site occasionally need to be line-bored and completely stripped down for overhaul. But because of the high cost of the repair, it’s imperative that the gearbox not be overhauled either too soon or too late. This means that reliable and accurate data must be logged continuously regarding mechanical vibrations from the gear teeth and bearings to establish a signature for both acceptable and marginal components.

Potential Solution
The machinery support group currently uses walk-around data collectors for most of their vibration monitoring requirements. The equipment is capable of collecting long time records, but to do this, the high-frequency data must be filtered out. Unfortunately, the higher frequencies contain the information needed to completely analyze the most critical element, the gear teeth. The machinery group also has reel-to-reel tape recorders, FFT analyzers, and ordinary oscilloscopes. But the equipment is severely limited to measuring only two channels simultaneously, gathering hardly enough data to sufficiently characterize a gearbox noise or vibration issue. Also, virtually no post processing of the most critical data is possible.

IOtech’s Solution
Because the cost of missing an opportunity to prevent a gearbox failure far exceeds the cost of new equipment that could predict failures, the reliability engineer looked at other data acquisition systems. He needed a monitoring and analyzing system that could provide plots of vibration data recorded simultaneously on several gears and bearings. And as a result of his search, he purchased a ZonicBook vibration analyzer with eZ-Analyst software. The 8-channel IOtech instrument has a built-in RPM/frequency port, piezoelectric accelerometer input, and anti-aliasing filters that let the machinery group monitor and analyze the output of several accelerometers attached to the gearbox case and bearing hubs. They also monitor gear and shaft speeds with tachometer signals derived from reflective tape sensors.

The test setup monitors a tachometer speed signal from each bearing and vibration in two or three directions with accelerometers. Proximity probes are placed in the X and Y axes at each bearing location, along with a pair of thrust probes and a single key phasor that provides a once-per-revolution timing signal. The gearbox contains driver and driven elements, so four bearing and eight vibration probes are needed for radial vibration.

The biggest advantage, however, is the fact that with eZ-Analyst software, the reliability engineer can stack up the plots, one above the other synchronized in time, to see anomalies as they relate to each other.

As a result of numerous recordings with the ZonicBook, the machinery group now can gather enough information to go further than just recommending a replacement with the same kind of gearbox; they can provide design-improvement data. The reliability engineer is now working closely with the gear manufacturer, and between them, they recently pulled off three or four fantastic overhauls. They dropped the noise level substantially, and expect to get 30 years out of a gearbox before it needs an overhaul.

The reliability engineer said that he found the ZonicBook easy to configure, compared to the other analyzers he has that are much more confusing to set up. He claims that software-based analyzers, like the ZonicBook, are much easier to set up and use because he can just pick and choose options from a menu. The other analyzers were purchased in the early 1980s. They lacked the ability to use a mouse, a standard keyboard, and set up an efficient configuration.

Also, the reliability engineer finds the IOtech equipment very durable and portable. He even had it in areas that were extremely dusty and humid, and never experienced a failure or problem. The new IOtech tools are a big plus over those that he had on the shelf before.

Conclusion
A leading manufacturer and user of olefins and polyolefins, employs an IOtech ZonicBook with eZ-Analyst software for analyzing gearbox vibrations. The system lets engineers analyze the data collected, establish vibration signatures for the gearbox components, and develop a realistic repair schedule. The comprehensive maintenance program prevents surprise failures and considerably lowers repair costs by ensuring that the gearboxes are serviced at optimal times.
IOtech Product Application using the ZonicBook

Hydroelectric Generator Maintenance

It’s hard to beat Mother Nature when it comes to maximizing efficiency. She does a wonderful job in performing any task from forming soap bubbles to creating extraordinary plants that adapt to their environment and survive adverse conditions. The same idea of efficiency holds true for producing electricity the North American continent consumes in the quest to sustain its quality of life. In spite of the effort expended to deploy nuclear power plants over the past 50 years, the Pacific Northwest still produces 90% of its needs from nuclear power plants. In the last 50 years, the North American continent consumes in the quest to sustain its quality of life.

Application Summary

A large utility in the Pacific Northwest, such as the IOtech ZonicBook, has a Senior Maintenance Engineer, “We have several of the most widely used vibration monitoring panels available, but they strictly give us an overall vibration reading. They provide no spectrum, waveform, or anything else to analyze.”

IOtech’s Solution

The IOtech ZonicBook is helping a Senior Maintenance Engineer maintain 29 hydro generators, ranging from 10 to 75 MW, that supply power to the Pacific Northwest, including British Columbia, California, and Alberta. He sets up preventive maintenance programs and uses a ZonicBook to troubleshoot problems and measure turbine shaft vibrations. Occasionally the ZonicBook is installed at one site for an extended time to log vibration data on a suspected turbine shaft, but more often, the engineer takes it from one site to another during his regular travel schedule.

Conclusion

Many machines have permanent Eddy-current displacement probes installed to measure vibration. The displacement probes, with an output of 200 mV/mil, are used instead of accelerometers. The machines run around 300 rpm, speeds that are not very effective for accelerometers.