

Quartz™ Monitoring for Improved Industrial Process Operations

Vold Solutions Automation's **Quartz™** line of automated monitoring systems provides real-time continuous readout and automated documentation of vibration and other dynamic conditions of critical machinery and end-of-line Quality Control component assembly tests. The **Quartz™** product family has been applied to numerous applications including materials test rigs, roll grinder vibration, roll mill chatter monitoring and automotive engine assembly.

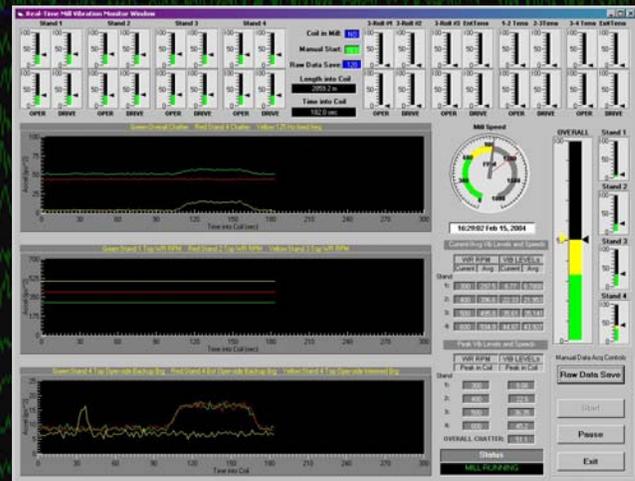
QuartzGrind™ is a system specifically designed for use on roll grinders. The system is typically used as an SPC tool to eliminate the production of rolls with grinder-induced chatter. **QuartzGrind™** also allows interactive adjustments of speeds and in-feeds by the grinder operator to be easily made and improved vibration settings to be identified.

QuartzMill™ is a system designed specifically for use on high speed cold, hot and temper mills. The system is typically used to reduce or eliminate the production of vibration-induced chatter defect in rolled product. **QuartzMill™** assists engineers in identifying the sources of vibration that are the root cause of mill chatter. In addition it can be used to assist with finding speeds, tensions and reductions settings that result in lower vibration levels.

QuartzLevel™ is a system designed specifically for use on multi-roll tension levelers. The system is used to reduce or eliminate the production of chatter defect that can be induced by high tension leveling on finishing lines. **QuartzLevel™** also assists engineers in identifying sources of vibration that cause undesirable leveler vibration, such as clogged sprays, chattered rolls, resonance speed zones and bearing defects. In addition it can also be used to assist with finding optimum speed and tension settings that lower vibration levels.

The **Quartz™** family brings a much-needed commonality in measurement methodology, sensors, data acquisition hardware, software, user-interface, vendor support, and data compatibility. Often, multiple operations reside in different departments employing different and incompatible technology from multiple vendors. This typically results in more "finger-pointing" than it does in problem solving, hence reducing plant efficiency and increasing scrap production costs. With the introduction of **Quartz™** systems, Vold Solutions Automation is the first vendor to offer a comprehensive, yet affordable, solution to this common problem.

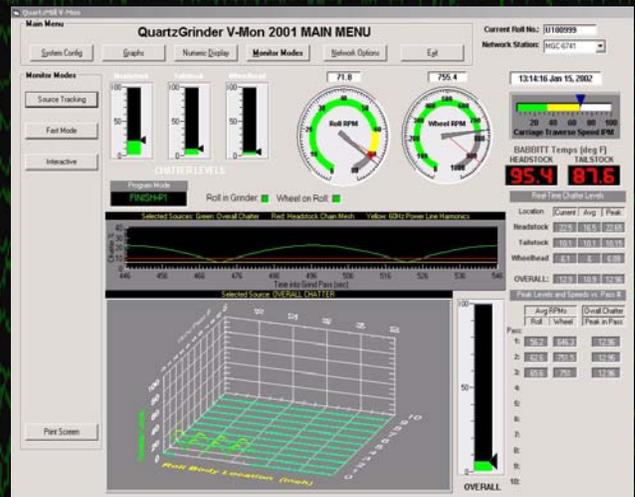
Quartz™ systems are used as failure alert and SPC tools to reduce and eventually eliminate the production of product with vibration or noise-induced quality problems. Fully processed data from the systems are automatically



QuartzMill Main Operator Display

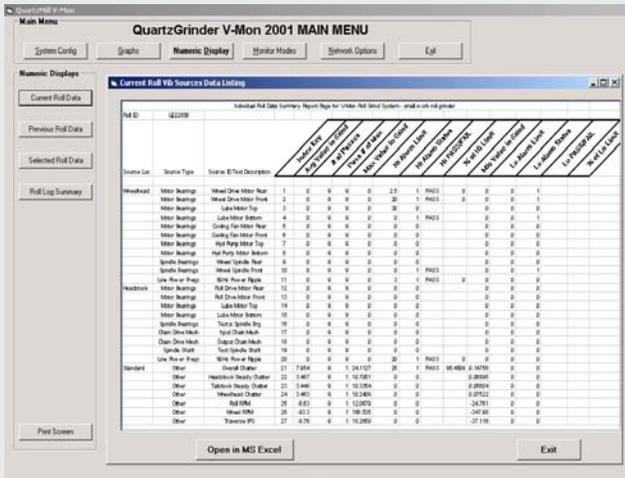
saved to Microsoft Excel® files and are identified by part number, date and time stamps. This simple automated documentation process allows the conditions for all production to be available for immediate callback and examination, should any questions about its quality arise. By directly saving data into pre-formatted Excel® spreadsheets, plant personnel can all share and compare data with a common, simple and familiar software tool.

Each **Quartz™** system is based on software powered by **V-FAST** technology. This means a machine-specific application that is developed using Visual Studio.NET®, incorporating the use of a sophisticated Vold Solutions VSI **Rotate©** signal processing library, combined with additional graphics and processing functions contained in the National Instruments Measurements Studio™.

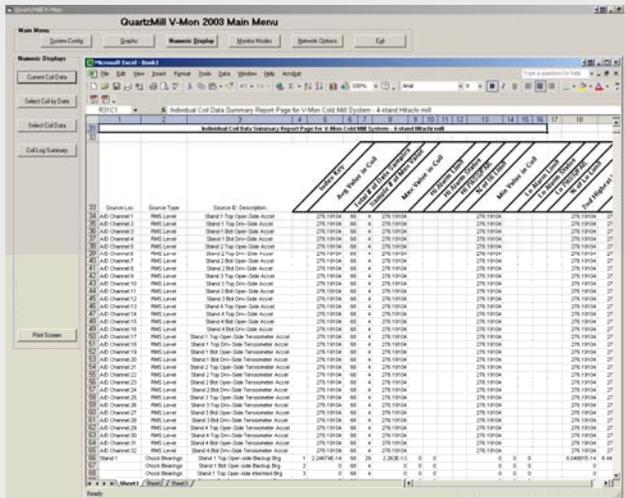


QuartzGrind Main Operator Display





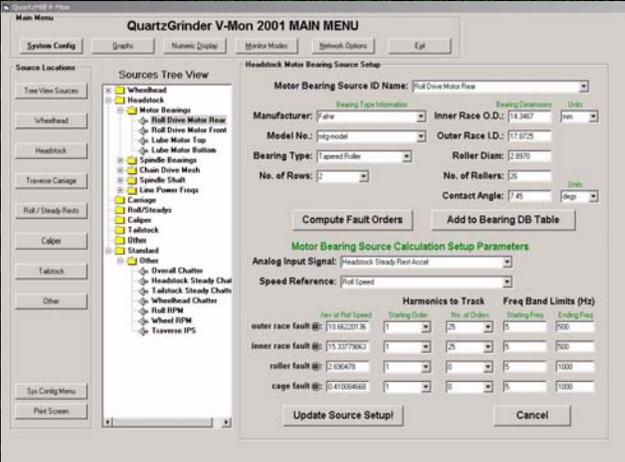
Data is auto-saved to pre-formatted Excel Sheets



More information about *V-FAST* and its application can be found at www.voldautomation.com.

Each of Vold Solutions Automation's *Quartz™* automated monitoring systems provides real-time continuous readout and automated documentation of vibration and other dynamic conditions during on-line operation. The systems allow interactive adjustments of speeds and other operator-controlled parameters to be easily made and improved vibration settings to be identified. All *Quartz™* systems use a similar easy-to-learn and easy-to-use user interface along with a common hardware and software platform. Each also has features that are unique to the specific machinery or product being monitored. For example, the *QuartzGrind™* system incorporates unique non-contact infrared sensors that continuously monitor the temperature of the steady-rest babbitt bearings. Worn or poorly lubricated babbitts are a potential vibration-inducing source that is unique to grinders, and constant monitoring of babbitt temperatures helps to prevent this condition.

Less advanced systems simply measure and display an overall frequency band-limited level. *Quartz™* systems, of course, offer this capability, but go far beyond simplistic RMS level-monitoring and offer discrimination of individual mechanical sources. Potential vibration-inducers such as bearing faults, couplings, line-power harmonics, chain and gear teeth, unbalance and other mechanical components can be easily setup and defined within the software as data "sources". Once these sources are setup, they are stored in an interactive MS Access® database and the computed level associated with each



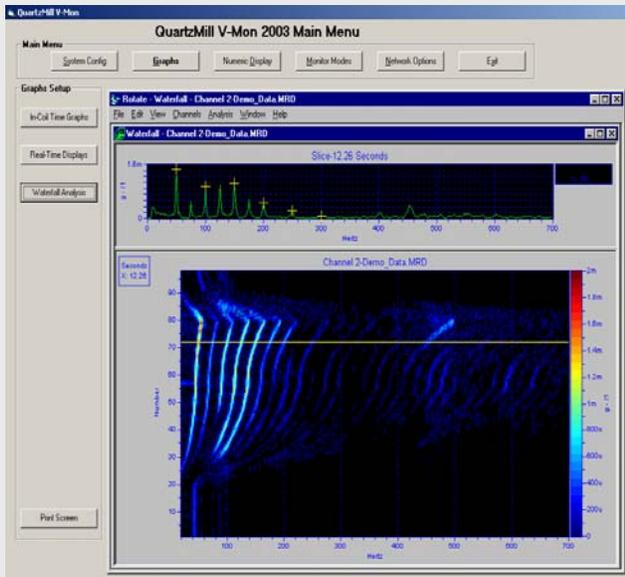
Sources Tree View sets up Bearing as a Source

defined source is continuously calculated and stored along with overall signal levels. A unique *Sources Tree-View™* display is available that allows quick and intuitive viewing of all the potential sources that have been defined and are currently being monitored by the system. The *Sources Tree-View™* can also be used interactively to make setup adjustments to graph data traces, add additional data sources, adjust alarm level settings and change calculation parameter setups.

All of the user-adjustable setups of the software are saved into MS Access® database files, and multiple setups can be saved for later recall at any time. In addition, any mechanical components that are defined to the system are also saved in the Access database, allowing users of the system to build up libraries and easily save a library of components that are specific to each mill, grinder or leveler.

Real-time selectable oscilloscope-like displays of raw sensor signals and Power Spectra are also available to assist with signal diagnosis and detailed analysis of signals from the system's sensors. During on-line operations, the main monitor display contains bar graphs indicating individual signal levels detected by all installed sensors, as well as customized **Overall Vibration Condition Levels**.

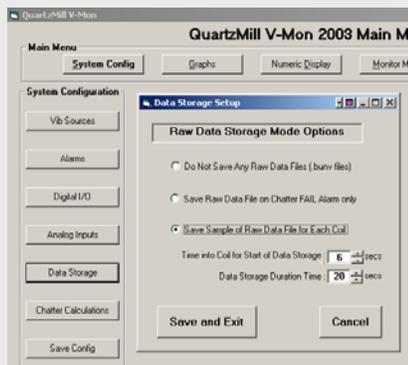




Data easily processed into Color Spectrograms

On-screen indicators display the level of calculated “condition” parameters that are adjusted to be sensitive to the data signatures most likely to indicate a problem or defect. Multiple machine speeds can also be displayed in real-time along with computed signal level graphs. **QuartzGrind’s** main monitor display even includes a 3-D graph showing vibration level vs. roll body length vs. grind pass that forms a pass-by-pass contour history of any selected vibration source or of the overall chatter level for the roll.

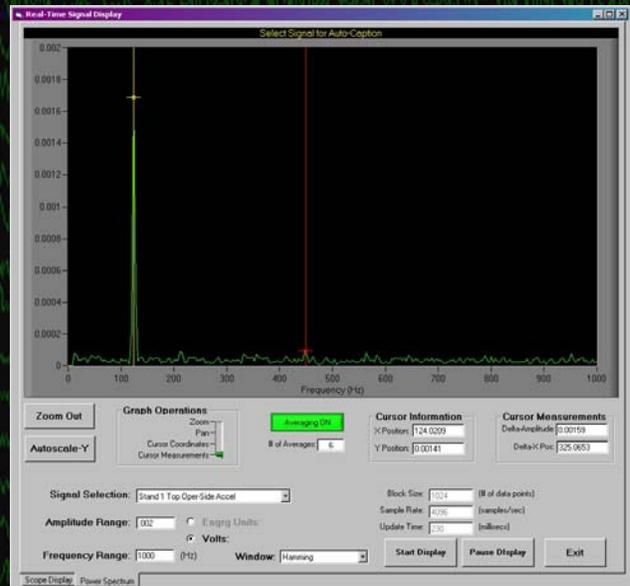
Trend plots of the measured and stored data can easily be made using built-in and VB script routine functions in MS Excel. Trending of the stored level data is useful for



User-Selectable Auto-Save

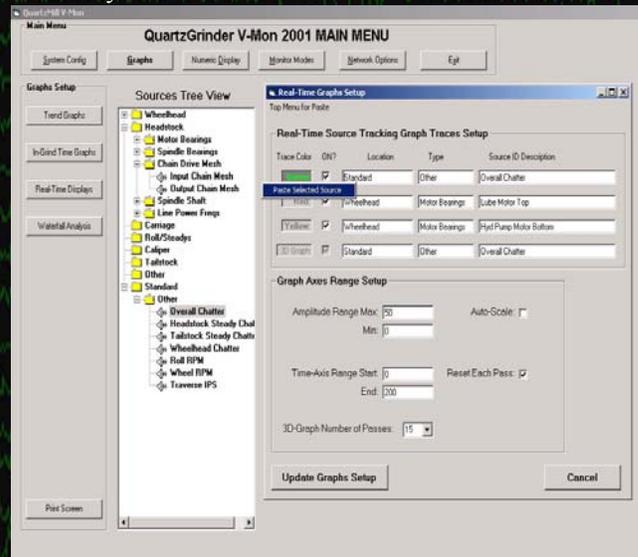
analyzing whether any significant changes have occurred in either machinery mechanical or operating conditions. Historical data trends for the same calculated quality-control parameters can be used to compare data acquired during each on-line test.

Raw signal time history data can also be captured automatically or at the push of a button. The system can be setup to automatically save raw data when alarm conditions occur, to save a user-defined length of raw data for each test or to only save data when manually triggered.



Real-Time Power Spectrum Display

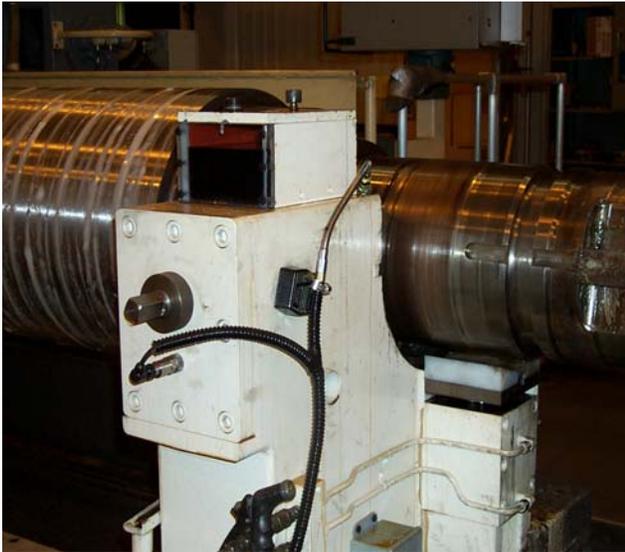
The saved raw data can be immediately processed into waterfall or color contour time vs. frequency vs. amplitude spectrograms using the advanced analysis capabilities of **VSI Rotate®** - the world’s premier rotating machinery data analysis software.



The System’s computer hardware consists of a high-speed, specially configured PC running the MS Windows7 or XP Professional® as its operating system. Special hardware from **National Instruments** is utilized to perform high-speed analog-to-digital data acquisition, and high speed encoder speed processing. Signal conditioning for temperature and vibration sensors, digital I/O interfacing to the line controlling computer or PLC, and anti-aliasing filters are placed in an auxiliary electrical enclosure. This



computer system can be located remotely from the sensors and signal conditioning. This is mandatory for mill and other industrial installations and is also useful for newer computer-controlled process stations that have their native computer controls located in an operator's pulpit rather than on the machine itself. The cost and inconvenience of requiring separate NEMA-rated cabinetry for the monitoring system hardware is also avoided in most installations.



Vibration and Temperature Sensors on a Grinder

The system includes capacity for hundreds of filtered, and gain-adjustable, fully conditioned analog-to-digital (A/D) input channels. Additional counter/timer or Analog input channels are used to accept either encoder pulse-type or analog speed signals that are connected to existing signals on the machinery motor drive units. An extended remote flat-screen display monitor is available as an option for displaying the monitor system screens in additional locations, in addition to a main display on or near the operators' location.

Commercially available industrial rugged vibration, speed, sound, temperature and other sensors are used and are mounted on either magnetic bases or permanent mounting plates that are ground isolated to reduce noise levels. Use of magnetic base mountings allows for quick and convenient removal of the sensors. The moveable mounts also allow the option of roaming the sensors around the machine to investigate vibration levels at other locations. Twisted and shielded wire is used for all sensor and signal lines to further reduce electrical noise levels.

The system is interfaced to the line control computer or PLC by means of both networking and digital I/O. Digital I/O signals are generated by the controller and are used to indicate events such as "Test Start" or "Constant Speed

Achieved" allowing automated control of monitor data acquisition. A simple network interface is used to share a file that is updated with new identification information each time a new test of a component is begun. Additional digital I/O lines are available to send level-exceeded alarms signals back to the control computer.

Use of Visual Studio.NET® as a development platform has the speed advantages inherent to a compiled language (as opposed to an inherently slow interpreted script language) combined with the flexibility of an object-oriented script-like language supported by thousands of 3rd party object developers. Quartz™ also takes advantage of Embedded Automation technology in order to make the data produced by the system immediately available in MS Excel®. Use of popular industry-standard software platforms and development tools insures the purchaser of the system that the software will be highly supportable. For further information please contact:

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Or visit our website at www.voldautomation.com.

- notes: 1. U.S. patents are pending on the software and system described in this paper
 2. A copy of Mr. Nieb's paper entitled *Automated Monitoring of Roll Grinders for Chatter-Inducing Vibration* can be obtained from the Proceedings of the 2002 AISE Annual Convention and Steel Expo, contact: AIST (412) 281-6323 www.aist.org



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