

For more information about Bently Nevada Asset Condition Monitoring solutions, contact your local GE sales professional or visit us online at: <http://www.ge-energy.com/bently>

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GE Energy
Measurement & Control Solutions



3500 ENCORE* Series Machinery Protection System

Bently Nevada* Asset Condition Monitoring

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Protection from Catastrophic Failures

Whether generating power, compressing and pumping fluids, or driving process equipment, industry relies on critical machinery every hour of every day. In these settings, machinery failure isn't just inconvenient, it can be catastrophic. While repair costs alone can be staggering, the partial or even total loss of production resulting from critical machinery failure—sometimes worth millions per day—can mean the difference between profit and loss for the entire year. With so much at stake, mechanical condition monitoring is more than just a good idea, it's a necessity.

Continuously monitoring critical asset parameters such as vibration, temperature, speed, and numerous other condition indicators is a proven method for anticipating and preventing mechanical failures—proven in tens of thousands of industrial facilities around the world by delivering tangible benefits such as:

- Improved protection from catastrophic failures
- Better machinery reliability/availability
- Fewer process interruptions
- Enhanced maintenance/outage planning
- Lower maintenance and repair costs
- Longer intervals between outages
- Reduced insurance premiums

And when it comes to protecting and monitoring critical machinery, one name has proven itself above all others: Bently Nevada* from GE Energy.

Service and Expertise ... Delivered

GE Energy's Bently Nevada machinery protection and monitoring systems span more than a dozen different models deployed during the last 40 years. Combined, they comprise the largest installed base of permanently installed transducers and monitoring channels in the world. It's a position of trust that has been earned over more than four decades of learning, refining, and improving our solutions to meet industry's most demanding applications. Applications that require the highest integrity. Applications where false trips or missed trips simply cannot be tolerated.

And it's not just our products, it's our people. Our reputation for the highest quality, best value in the industry is born of a culture that "takes excellent care of our customers." When you choose our condition monitoring solutions, you get it all: the best people, the best products, the best service, the best solutions, and the best value.

For nearly half a century, Bently Nevada products have been world-renowned as the standard by which all others are measured. Because after all—with so much riding on your machinery, why trust anyone else?

Experience

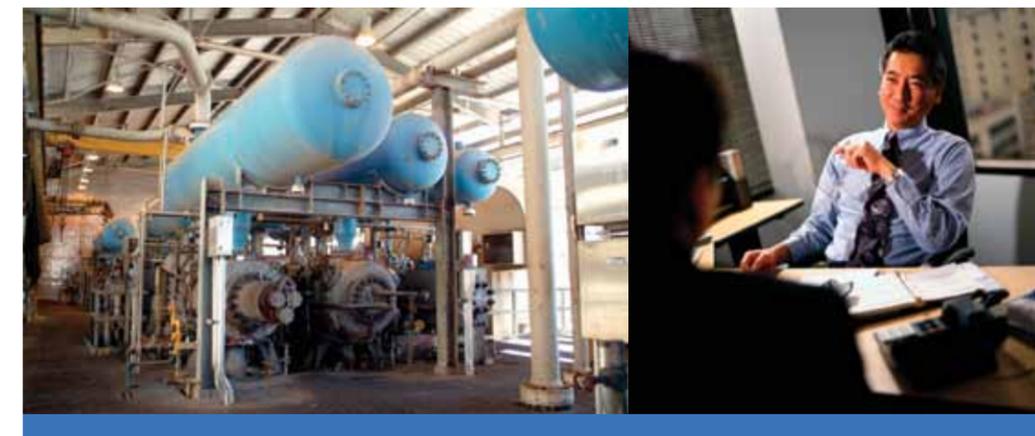
With more than two million transducers and monitoring channels installed worldwide, and more than 10,000 software solutions employed across the globe, more end users trust their machinery to Bently Nevada continuous monitoring systems than anyone else. We are also the supplier of choice to nearly every major machinery manufacturer in the world.

Technology

Today, although our products number in the thousands, we never rest. Each year, tens of millions of dollars are invested in expanding and improving our technology with the singular purpose of better serving our customers. Better technology that creates better value is our passion.

Technical Support

Behind everything we deliver, you'll find our unwavering commitment to provide the best technical support to our customers. No matter where in the world you are, or what time of the day, a knowledgeable professional with technical experience is standing by 24/7 to assist you with answers to your technical questions. We also have the ability to supply many emergency parts and services after traditional working hours. Additionally, our state-of-the-art knowledge database tracks every support call, every question, and every answer, allowing our global team to deliver faster, more complete support than ever before.



3500 ENCORE – Simply The Best

Beginning with the 5000 series in the 1960s, we have introduced seven successive generations of highly successful monitoring platforms. Today, that experience is embodied in the most advanced, powerful, and reliable system we have ever offered: The Bently Nevada 3500 ENCORE Series Machinery Protection System.

Certified

3500 ENCORE is designed to fully comply with the American Petroleum Institute's Standard API 670, the world's most widely used specification for machinery protection systems. In addition, the 3500 ENCORE is approved to meet relevant Canadian Standards Association (CSA) and CE requirements.

Reliable

We understand that our systems are routinely used not just for indication, but to provide auto-shutdown protection. That's why – even in simplex mode—3500 ENCORE Series is the most reliable monitoring system we have ever offered with extensive self-checking and fault tolerant design features.

Connected

Connecting to condition monitoring and diagnostic software has never been easier. With 3500 ENCORE Series there are no bulky external modules, no additional wiring, and no extra rack slots required. Simply use the Ethernet port in the 3500/23E Rack Interface Module and a single network cable to communicate with our System 1* software. Connecting to plant control and automation systems is straightforward as well. Simply add a communication gateway module. You can even add multiple gateways when communication redundancy is required, or when multiple systems must be supported with differing protocols.

Flexible

The 3500 ENCORE Series features the industry's most extensive selection of machinery measurement parameters combined with software configuration for virtually all monitor options. Local full color displays on the face of the monitor show set points and alarms while remotely mounted displays provide added options. The result is unparalleled flexibility to address almost any application.

Field-Proven

The 3500 Series System has proven its value and dependability with customers everywhere, year after year. More than 50,000 racks are installed globally.

	Monitor Modules				
	3500/25E	3500/42E	3500/45E	3500/50E	3500 /61E, /67E
3500 ENCORE Series Measurement Capabilities					
Phase reference	•				
Radial vibration (proximity probes)		•			
Radial position (proximity probes)		•			
Axial position (proximity probes)		•	•		
Eccentricity (proximity probes)		•			
Seismic vibration (velocity transducers/ accelerometers)		•			
Shaft absolute (proximity and seismic)		•			
Aeroderivative gas turbine casing vibration					
Differential expansion		•	•		
Ramp differential expansion			•		
Complementary differential expansion			•		
Case expansion			•		
Valve position			•		
Hydro turbine/generator vibration					
Hydro generator air gap					
Machine operating state (discrete input)					
Rotor speed				•	
Rotor speed rate-of-change (acceleration)				•	
Rotor zero speed (turning gear engagement)				•	
Overspeed					
Temperature (direct)					•
Process variable signals (4-20 mA, 1-5 vdc, etc.)					
Hazardous gas detection					
Gas turbine combustor instabilities					
Reciprocating compressor impulse/velocity					
Reciprocating compressor rod position					
Reciprocating compressor cylinder pressure					



3500/15E Power Supply – AC supply accepts worldwide AC voltages and frequencies. Can also be ordered for high and low voltage DC applications.

Digital Communications – The 3500/23E System Monitor supports Modbus® protocols via serial (RS232/422/485) for digital communications with PLCs, DCSs, and other instrument and automation platforms. Both the 3300 and 3500 register maps are supported to allow the system to interface to existing implementation, or to take advantage of the additional measurements available from the monitors.

Analog Communications – All monitor module channels are available with analog 4-20 mA proportional outputs for compatibility with strip chart recorders, process control systems, and other instrumentation.

Local Monitor Displays – Each monitor features a high visibility color display. The displays shows current values, setpoint levels, and alarm status with a single view. Additional measurements from the monitor can be viewed by toggling through the display.

Keyphasors – The system monitor accepts single and multi-event per turn signals from proximity probes and magnetic pickups. A rack can accommodate up to four Keyphasor signals.

Keylock Security – All monitor modules are software configurable via the 3500 ENCORE's Rack Interface Module – key lockable to prevent unauthorized tampering.

System Monitor – Transient Data Interface provides configuration interface as well as single cable connection to System 1* software via conventional wired or wireless Ethernet networks. The 3500E's design enables simultaneous data acquisition for all channels in the rack.

Buffered Outputs – Every dynamic input signal is conveniently available at the front panel via buffered output connectors for easy connection to portable and test instrumentation.

Multiple parameters from each channel – Radial vibration channels can provide eight individual parameters (overall, gap 1X amplitude/phase, 2X amplitude/phase, NOT 1X Smax), meaning a 4-channel monitor actually provides up to 32 channels of measurement. Alarms can be set on any or all 8 parameters from each channel.

Hot-Swappable Modules – For ease of maintenance and maximum uptime, modules can be removed and reinserted without removing rack power.

Integral Relays dedicated to a monitor – The original relays on the 3300 I/O modules are supported by the 3500 ENCORE monitors. No rewiring is required.

Built-In Intrinsic Safety (I.S.) Barriers – I/O modules can be ordered with or without internally mounted I.S. barriers to decrease wiring, increase accuracy, and reduce installation costs when hazardous environments require intrinsically safe installation practices.

Rack Sizes – Supports existing 3300 rack size of 8, 10, 12, and 14 positions.



System 1 Connectivity

Protecting your critical machinery with 3500 ENCORE Series is an important step. But there's more to effective asset management than just protection. The 3500 ENCORE Series System also serves as a fully functional gateway to GE's powerful System 1 software, allowing totally proactive condition monitoring and in-depth diagnostics.

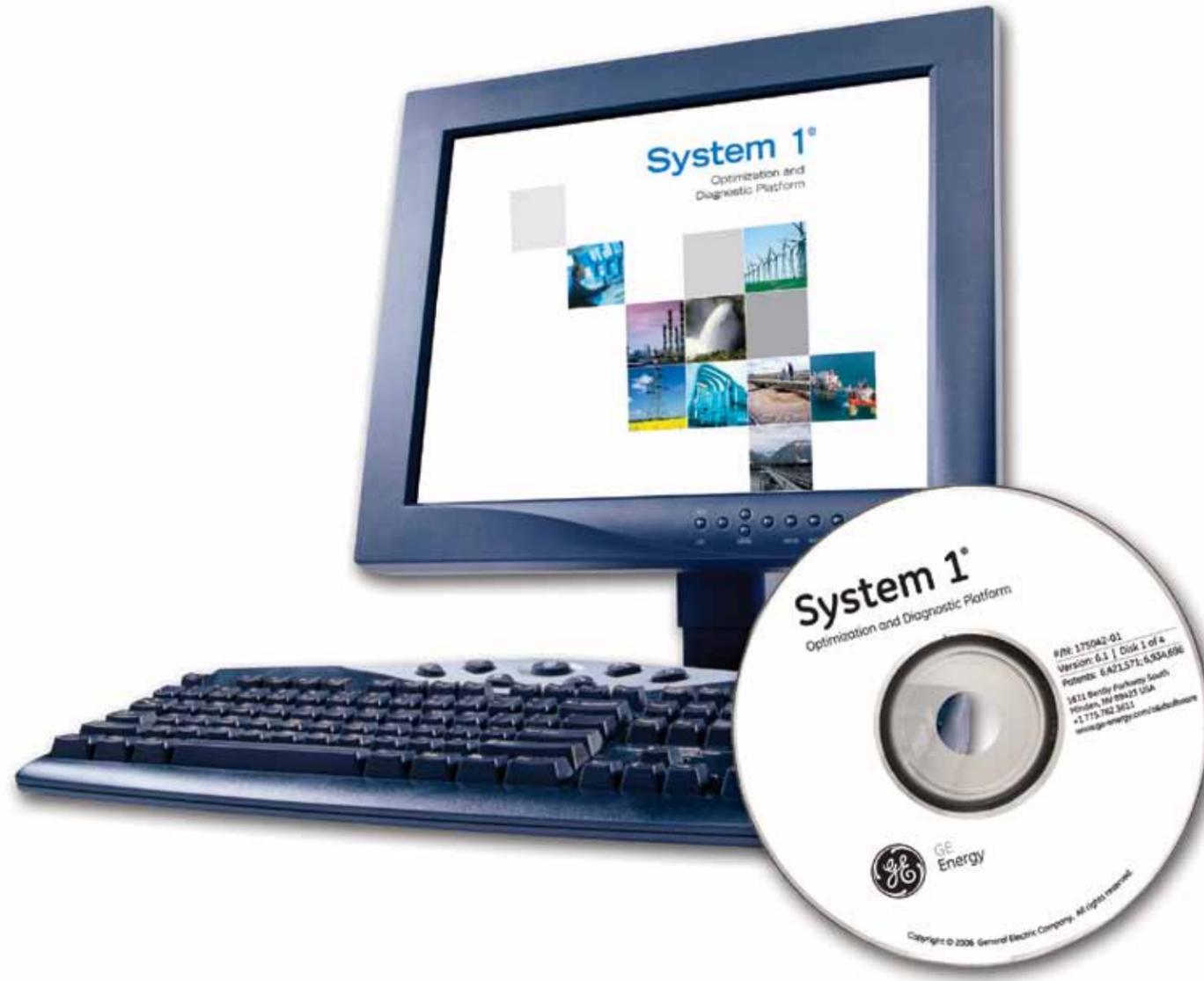
System 1 software links portable data collection instruments, permanent monitoring systems, manually input data, and data from process control and automation systems into an integrated condition monitoring environment.

And connecting to System 1 software has never been easier, thanks to 3500 ENCORE Series design which completely integrates all data capture and communication functions into the rack. Simply provide an Ethernet network connection from your System 1 server computer to the 3500/23E Rack Interface Module and use our convenient software configuration capabilities to enable the appropriate channels in the rack. That's it. No external boxes or wiring to worry about, no separate signal conditioning or interface devices.

So move beyond simply protecting your machinery and start proactively managing it as well. With 3500 ENCORE Series, we've made it easier than ever.

M³* Technology

All 3500 ENCORE monitor modules can communicate with System 1 software to supply status and value data. The 3500/42E and 3500/45E modules are capable of supplying high-bandwidth dynamic waveform data as well. It is this dynamic data that allows you to more effectively diagnose and manage your machinery assets by providing a precise picture of mechanical condition with every shaft revolution.



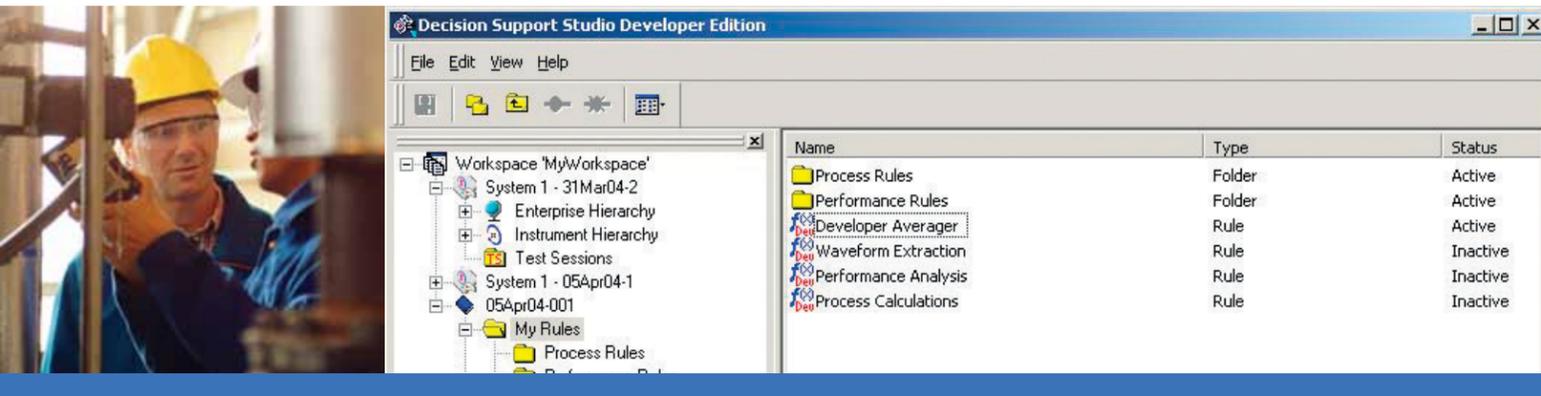
Results			Operands	
Average Tem...	Temp Standar...	High Average ...	Temperature	Temperature
60.00000	63.87488	Severity 4	138.0000 deg C	2.000000 deg
60.00000	63.87488	Severity 4	138.0000 deg C	2.000000 deg
60.00000	63.87488	Severity 4	138.0000 deg C	2.000000 deg
58.50000	64.58844	Severity 4	138.0000 deg C	2.000000 deg
58.50000	64.58844	Severity 4	138.0000 deg C	2.000000 deg
58.50000	64.58844	Severity 4	138.0000 deg C	2.000000 deg
59.00000	64.09368	Severity 4	138.0000 deg C	2.000000 deg
59.00000	64.09368	Severity 4	138.0000 deg C	2.000000 deg
59.00000	64.09368	Severity 4	138.0000 deg C	2.000000 deg
34.50000	36.23534	Severity 1	38.00000 deg C	2.000000 deg
34.50000	36.23534	Severity 1	38.00000 deg C	2.000000 deg
34.50000	36.23534	Severity 1	38.00000 deg C	2.000000 deg
35.00000	37.14835	Severity 1	38.00000 deg C	2.000000 deg
35.00000	37.14835	Severity 1	38.00000 deg C	2.000000 deg
35.00000	37.14835	Severity 1	38.00000 deg C	2.000000 deg
35.00000	35.87014	Severity 1	38.00000 deg C	2.000000 deg
35.00000	35.87014	Severity 1	38.00000 deg C	2.000000 deg
35.00000	35.87014	Severity 1	38.00000 deg C	2.000000 deg
35.00000	35.87014	Severity 1	38.00000 deg C	2.000000 deg
35.00000	35.87014	Severity 1	38.00000 deg C	2.000000 deg
60.00000	63.87488	Severity 4	138.0000 deg C	2.000000 deg
60.00000	63.87488	Severity 4	138.0000 deg C	2.000000 deg
60.00000	63.87488	Severity 4	138.0000 deg C	2.000000 deg
60.50000	64.15347	Severity 4	138.0000 deg C	2.000000 deg
60.50000	64.15347	Severity 4	138.0000 deg C	2.000000 deg
60.50000	64.15347	Severity 4	138.0000 deg C	2.000000 deg
36.00000	37.70057	Severity 1	38.00000 deg C	2.000000 deg

Decision Support

The combination of 3500 ENCORE Series, System 1 software, and Decision Support capabilities provides your critical machinery with today's most advanced technology to proactively detect and avoid problems.

Decision Support is System 1 software's unique ability to automatically audit its collected data against user-embedded rules and knowledge, detect mechanical or thermodynamic problems, and generate Actionable Information* advisories. Building your own rules is simple and requires no special programming skills—just drag and drop logical and mathematical operators into any sequence of conditions that correspond to a particular malfunction.

When a specific malfunction or condition is detected, System 1 software alerts plant personnel that there is a problem, how severe it is, and what to do about it—in real time. The Actionable Information messages used to notify plant personnel are fully configurable, reflecting your specific operating practices and procedures. Supported notification methods include cell phone, pager, PDA, email, computer and process control system pop-up windows, and even conventional analog annunciator panels.



Applications

The table on page 5 summarizes the enormous selection of measurement types available in 3500 ENCORE Series. This allows it to be applied to an extremely wide range of rotating and reciprocating machinery in many industries. Below are just a few of the more common applications that can be easily addressed by the 3500 ENCORE Series.

- Steam turbines
- Hydraulic turbines
- Industrial gas turbines
- Centrifugal compressors
- Axial compressors
- Screw compressors
- Gears
- Turbo-expanders
- Horizontal and vertical centrifugal pumps
- Electric motors
- Generators
- Fans
- Blowers
- Agitators
- Mixers
- Centrifuges
- Pulp refiners
- Ball mills
- Crushers/pulverizers
- Extruders
- Pelletizers
- Cooling tower/heat exchanger fans

If your specific machine doesn't appear on the list, just ask us. Chances are, our applications engineers have already developed a solution that is right for you. And, with our extensive custom applications capabilities, we can easily modify off-the-shelf 3500 ENCORE Series solutions to handle your nonstandard applications and signal processing requirements.



Service and Support

As the people who design and manufacture the 3500 ENCORE Series as well as the entire portfolio of Bently Nevada asset condition monitoring products, there's nobody better equipped than GE Energy to professionally install and support these products. We have successfully completed over 75,000 installation, repair, machinery diagnostic, balancing, alignment, and system commissioning projects worldwide. And, we are everywhere you are with hundreds of locally available, factory-trained sales and service professionals in convenient locations around the world—knowledgeable people that speak your language.

- Complete pre-wired, pre-tested cabinet packages for your 3500 ENCORE Series racks and associated instrumentation
- Transducer and monitor system installation
- System integration services for connection of Bently Nevada monitoring systems to third-party control and automation systems
- Complete project management scope
- Product verification and repair
- Training, including product operation, product maintenance, and machinery diagnostics

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