GE Measurement & Control

bopONLINE* - Balance of Plant Online Condition Monitoring System

Bently Nevada* Asset Condition Monitoring

Description

The bopONLINE Machinery Protection and Condition Monitoring system is a continuous online monitoring system for Balance of Plant (BoP) machinery in the Power Generation industry. The bopONLINE design meets the specific needs of BoP online machinery monitoring and protection:

- Optimized design for balance of plant equipment in the power generation industry provides economical machinery vibration protection and condition monitoring for these assets.
- Reliability and functionality
- Applicable to a broad range of BoP machinery
- Flexible configuration
- Reduced physical size and simple cabinet mounting
- Integration with Plant DCS using Modbus TCP/IP or serial
- Relay outputs suitable for machinery protection
- 4-20 mA outputs
- Dynamic and transient data collection and System1* connectivity to support predictive maintenance.

The bopONLINE System is our most capable and flexible online Balance of Plant monitoring system. In addition, bopONLINE shares common configuration software with the Bently Nevada 3500 and 3500 Encore systems. The bopONLINE System modular design consists of:

- bopONLINE System Rack (required)
- bopONLINE Power Supply (required)
- bopONLINE Data Interface Module (DI) with Keyphasor® inputs (required)
- 3500 Rack Configuration Software (required), 3500 Rack Configuration Software configures multiple Bently Nevada online monitoring systems including bopONLINE
- One to four bopONLINE 4-Channel Vibration Monitor Modules (required)
- bopONLINE monitoring cabinets or panels (optional)

CE

System Components

Instrumentation Chassis

The bopONLINE rack is available currently in panel-cutout-mount version. This is a five slot rack with a backplane and backplane mounted I/O. The first rack slot is reserved for the bopONLINE/DI module. The DI (Data Interface) module supports four Keyphasor® inputs and can be configured to collect waveform data. The remaining four slots are for 4 –channel vibration monitors. All monitor modules are hot replaceable.

All monitors plug into the backplane and connect to associated I/O through the backplane.

The rack depth is 287 mm (11.29 inches), height is 267mm (10.5 inches) and width is 279 mm (11 inches).

Note:
The bopONLINE System does not support internal or external intrinsic safety barriers.

Power Supply

bopONLINE instrument racks are powered using the externally mounted bopONLINE Power Supply. The power supply operates from an input range of 115VAC to 230VAC and 47- 63 Hz covering AC voltage sources worldwide. Single or Dual Redundant power supply configurations are supported and a single bopONLINE power supply can power up to three bopONLINE systems. The redundant power supply option provides increased system availability for conditions where a single power line or supply fault cannot be allowed to take the system off-line. The supplies reside outside the bopONLINE rack and are simple to maintain or replace if a failure occurs. Each Power Supply can individually provide power to up to three fully loaded racks. When redundant supplies are used, one supply acts as primary power for the rack while the other acts as a backup, ready to instantly and automatically operate as the primary rack supply without interrupting rack functions.

The bopONLINE/PS Power Supply module has self-diagnostic functions that allow it to determine if all of its output voltages are within specifications. The module annunciates this via a green “Supply OK” LED on the Power Supply’s front panel.

Data Interface module - bopONLINE/DI

The Data Interface (DI) is the bopONLINE Rack’s interface to the Rack Configuration Software, Plant DCS, and System1. Each rack requires one DI, which resides in the first slot. The DI supports proprietary protocols used by the 3500 Configuration Software to configure the rack and by System1* Optimization and Diagnostic Software to configure and acquire machinery management data. The DI provides a direct interface with GE’s Bently Nevada’s System1* software.

The System OK relay on the backplane is connected to the DI. It is driven by NOT OK conditions within the DI itself and within other modules in the rack.

The DI performs “self-diagnostic” functions for its self and for the rack, in addition to those provided by the individual monitor. While the DI provides certain functions common to the entire rack, it is not part of the critical monitoring path and has no effect on normal operation of the overall machinery protection functions.

4 Front Panel /DI LEDs	
Rack OK	Indicates that bopONLINE rack is operating correctly.
CONFIG OK	Indicates configuration faults: • A module in the rack is not configured or has a configuration error • The DI stored configuration does not match the physical configuration of the rack. • A security option condition is not met.
DI OK	Indicates that the Data Interface (DI) Module and its I/O are operating correctly.
TM	Indicates when the rack is in the Trip Multiply mode.

System configuration is secured by means of a key lock switch on the front of the DI and two levels of software password protection, preventing unauthorized changes to or tampering with the configuration. bopONLINE configuration is via the Ethernet ports on the front of the DI. The DI provides permanent system connectivity to Plant DCS or System1* software via Ethernet ports.

The DI provides a system reset switch on the front panel, allowing the user to clear any latched alarms in the system as well as latched NOT OK conditions. IO connections associated with DI are on the backplane and provide a set of rear-panel connections for remote activation of the reset switch, trip multiply, and alarm inhibit.

The bopONLINE DI supports four Keyphasor inputs. Keyphasor signals from the DI can be routed to appropriate monitor modules via the bopONLINE backplane for use in speed, phase, tracking filter, and other measurements.

Note:
Dozens of possible event conditions within the rack can drive the NOT OK relay. For this reason, it is not intended for use as part of a machinery auto-shutdown circuit and should be used for general annunciation purposes only.

Four Channel Vibration Input Monitor - bopONLINE/VI

The 4 Channel Vibration Monitors install in any of the remaining four slots of the rack. Each monitor occupies a single slot. The 4 Channel vibration monitor supports the following channel types.

- Channel types:
  - Radial Vibration
  - Thrust Position
  - Acceleration
  - Velocity
- 4 buffered outputs for vibration channels
- 4 analog 4-20 mA outputs
- 4 relay outputs

The monitor is microprocessor-based and offer digitally adjustable Alert and Danger set points for each channel. Users can configure alarms for latching or non-latching operation. Status indications for each channel is provided with bright, front panel LEDs, allowing observation without operator interaction for easy and convenient operation. The monitor provides independent 4 to 20 mA proportional outputs for each channel for connection to recording and indication devices. OK detection routines within

the monitor continuously check the integrity of each transducer and the associated field wiring.

Transducer input signals are buffered and sent to front-panel coaxial connectors.

Relays

One System OK Relay is located on the backplane and is actuated based on fault conditions within the rack. The OK Relay is Normally Energized and users can choose either an open or a closed contact. Each bopONLINE/VI 4-Channel Monitor has four dedicated Single-Pole Double Throw (SPDT) relays located on the backplane. These relays are arranged in two sets of two so that each channel pair in the monitor has an Alert and a Danger relay.

Each relay can be independently configured to actuate based on alarm status of the configured measurements for the channels of the pair. Users can program relays for either normally energized or normally de-energized operation.

bopONLINE Monitoring Cabinets

GE can provide custom bopONLINE monitoring cabinets designed to meet your specific project requirements. Factory Acceptance Test and other services can be provided. bopONLINE monitoring cabinets offer customers a turnkey solution thereby reducing overall customer site design and commissioning efforts.

Note:
In addition to the direct measurement made by the monitor, many channel types provide an enhanced data set consisting of a variety of measurement values that will depend on the monitor type and its configuration. For example, for a radial vibration channel this includes the basic overall (direct) vibration amplitude as well as gap voltage, 1X filtered amplitude, 1X filtered phase, 2X filtered amplitude, 2X filtered phase, NOT 1X amplitude, and Smax. These additional measurement values are provided for each channel, and ALERT alarm set points can be established on each proportional value, as desired. DANGER alarm setpoints can be established on any two proportional values returned from each channel.

Note:
Channel type is programmed by channel pair so each monitor can be configured for one or two channel types. For example, channels 1 and 2 can be Radial Vibration, while channels 3 and 4 can be Radial Vibration or a different channel type.

Note:
Channels configured for Velocity or Acceleration can provide, Direct, 1X amplitude/phase and 2X amplitude/phase.

Displays

Operator displays can be developed in Plant DCS Human Machine Interfaces (HMIs) using data served from the bopONLINE Modbus connection.

System1* software can also be used for basic display purposes as well as providing more sophisticated diagnostic plots and visualization formats using dynamic or transient data.

Applications

The bopONLINE system is intended for continuous online machinery protection and condition monitoring for Balance of Plant (BoP) machinery in the Power Generation industry. bopONLINE is designed to provide sophisticated online condition monitoring but at an optimized and economical system cost as required for BoP

equipment. Machine types addressed by the bopONLINE System include but are not limited to:

- Boiler Feed Pumps
- Blowers
- ID/FD fans
- Electric motors
- Compressors (air, radial/axial, centrifugal/positive displacement)
- Pumps (centrifugal and positive displacement)
- Pulverizers
- Gear boxes

In addition, GE's Bently Nevada Custom Products engineering, can often address special requirements for custom configuration of an existing monitor type or modifications to a standard monitor type. Contact your local sales professional for further information.

Features

Digital and Analog Communications

The bopONLINE System features separate, concurrent digital communication over Ethernet for connection to:

- System1* machinery management software using Bently Nevada proprietary protocols via Ethernet connections
- Digital Control Systems and other plant automation systems using Modbus TCP via the bopONLINE Data Interface module
- 3500 Configuration Software

One Analog 4-20 mA output is available per channel and can be configured for any of the channel's measurement values.

Note:
Relays are recommended for machinery protection. The 4 - 20 mA and Modbus* connections are intended for operator annunciation and trending purposes.

Software Configurable

A single bopONLINE 4-Channel Monitor can be software configured for all the available channel types and most channel options. Some examples of software configurable options are:

- Transducer scale factor
- Alarm delays
- Transducer OK limits
- Full scale value
- Engineering Units
- Alarm Set points
- Latching/non-latching alarms
- Normal thrust direction toward or away from probe
- Trip Multiply factor
- Filter corner frequency
- Integration (velocity to displacement, acceleration to velocity)
- Recorder output clamping value
- Timed OK/Channel Defeat enabled/disabled
- Measurement value assigned to recorder output

Channel Density and Rack Size

The bopONLINE system increases channel density and decreases system size over conventional condition monitoring systems by eliminating separate I/O modules, relay controller cards, speed input cards, communication gateways, and reducing the number of power supplies. This results in lower installation costs by saving valuable cabinet space and spreading common components across more channels for lower per-channel costs.

Wiring Terminations

The terminations are provided in an innovative way on the backplane to provide ease of wiring and separation of inputs and outputs on each side of the rack. This helps separate power, Input

and output terminations, avoiding complex wiring in cabinet.

Remote Accessibility

WAN or LAN connections allow the user to remotely configure a bopONLINE system and even assess the system when an instrument problem arises. Users can implement simple changes, such as to an alarm set point or a filter corner, without traveling to site. This is ideal for locations where on-site access to the instrumentation is inconvenient or impractical.

Security

The bopONLINE System's two levels of password protection combined with a keylock for configuration changes ensures the system can't be adjusted, changed, or configured except by those authorized to do so. Users can document and control management of change much more easily, and the bopONLINE rack records any configuration changes in the system's event list. Additional security configuration settings can be made using the 3500 Rack Configuration Software.

Alarm/Event Lists

The bopONLINE System maintains extensive alarm and event lists that retain 8192 most recent alarm and 2048 most recent system events (configuration changes, errors, etc.). The syste m's DI retains the lists, which provide a description of each alarm or event and a corresponding date/time stamp. These lists are available by uploading to the 3500 Rack Configuration Software or, System 1, or events can be read by process control, historian, or other plant systems using Modbus commands.

Time Synchronization

The system's real-time clock can be synchronized with external clocks, via connected Bently Nevada software. The bopONLINE's alarm and event lists then provide time/date stamps that are synchronized with alarms and events in other process and automation equipment. This reduces or eliminates the need for elaborate, hardwired "Sequence of Event" recorders.

Removal and Insertion under Power

All bopONLINE monitors can be removed or installed with rack power on. Power Supplies (when redundant supplies are used) can be replaced when the rack is under power. This facilitates easier maintenance and system expansion without interruption of machinery protection functions or system operation.

Enhanced /Data

The bopONLINE System is able to provide more measurements from each transducer channel. For example, in addition to direct (unfiltered) vibration amplitude for a radial vibration proximity probe channel, the bopONLINE monitor can return gap voltage, 1X amplitude and phase, 2X amplitude and phase, NOT 1X amplitude, and Smax amplitude (when XY transducers are present). Thus, a single radial vibration channel can

actually return 8 conditioned parameters (termed proportional values) for a total of 32 in a single 4-channel monitor module. This is particularly valuable when machinery protection strategies require alarms on these proportional values. Activation or use of these proportional values has no impact on rack density, and does not consume additional channels in the monitor.

Note:
ALERT alarm setpoints can be established on each proportional value, as desired. DANGER alarm setpoints can be established on any two proportional values returned from each channel.

Data Interface module - bopONLINE/DI

Description

The bopONLINE Data Interface (DI) is the interface between the bopONLINE Monitoring System, bopONLINE Rack Configuration Software and GE's System1* Optimization and Diagnostic Software.

The DI installs in the left-most slot of a bopONLINE Monitor System and, in conjunction with the vibration monitors (bopONLINE Vibration Monitor) can be configured to continuously collect steady state and transient waveform data and pass this data through an Ethernet link to System1* . Static data capture is standard with the bopONLINE/DI, however with addition of System1* channel licenses, the DI will capture dynamic or transient data for service to System1.

The DI module provides extensive communication capabilities for all rack monitored values and statuses for integration with process control and other automation systems using serial (RS485) or Ethernet TCP/IP Modbus.

Every bopONLINE rack requires one DI, which always occupies the left-most slot in the rack.

Specifications

Inputs

Power Consumption	8 Watts
Ethernet (front panel)	2 Ports: 10Base-T or 100Base-TX Ethernet, auto-sensing
Ethernet (rear panel)	1 Port: 10Base-T or 100Base-TX Ethernet, auto-sensing
Serial Communication (rear I/O)	115.2 kbaud maximum RS485 serial communications 1200 baud minimum rate supported

Outputs - Front Panel LEDs and Relays

LEDS	
Rack OK	Indicates when the bopONLINE System is operating properly
CONFIG OK	Indicates that the bopONLINE system has a valid configuration
TDI OK	Indicates when the bopONLINE/D operating properly
Trip Multiply	Indicates when the bopONLINE System is in Trip Multiply mode
RELAYS	
bopONLINE System OK	Relay to indicate when the bopONLINE System is operating normally or when a fault has been detected within the rack. User can select either an "OPEN" or "CLOSED" contact to annunciate a NOT OK condition. This relay always operates as "Normally Energized".
OK	Rated 1A @ 24VDC, 24 Watts Switched Power.

Controls

Rack reset button	Clears latched alarms and Timed OK Channel Defeat in the rack. Performs the same function as "Rack Reset" contact on the rear of the bopONLINE system.
Configuration Keylock:	Used to place bopONLINE System in either "RUN" mode or "PROGRAM" mode. **RUN** mode allows for normal operation of the rack and locks out configuration changes. Locking the switch in the RUN position allows you to restrict unauthorized rack reconfiguration. **PROGRAM** mode allows for normal operation of the rack and also allows for local or remote rack configuration. Locking the switch in PROGRAM position allows remote reconfiguration of a rack at any time. The key can be removed from the rack in either position, allowing the switch to remain in either the RUN or PROGRAM position.

System Inputs

Trip Multiply	
Description	Used to place bopONLINE rack in Trip Multiply
Maximum Current	<1 mAdc, Dry Contact to Common
Alarm Inhibit	
Description	Used to inhibit all alarms in the bopONLINE rack.
Maximum Current	<1 mAdc, Dry Contact to Common
Rack Reset	
Description	Used to clear latched alarms and Timed OK Channel Defeat.
Maximum Current	<1 mAdc, Dry Contact to Common

Data Collection

Keyphasor* Inputs	• Supports the four bopONLINE system Keyphasor signals. • Supports multiple events per rev • Speed inputs up to 20 kHz.
Startup/Coast Down Data	• Data collected from speed and time intervals. • Increasing and decreasing speed interval independently programmable. • Initiation of transient data collection based on detecting the machine speed within one of two programmable windows. • The number of transient events that can be collected is only limited by the available memory in the module.
Alarm Data Collection	• Pre- and post-alarm data. • 1 second of static values collected for 10 minutes before the event and 1 minute after the event. • 100 ms static values collected for 20 seconds before the event and 10 seconds after the event. • 2.5 minutes of waveform data at 10-second intervals before the alarm and 1 minute collected at 10-second intervals after the alarm.
Static Values Data	• DI will collect the static values including the values measured by the monitors. • DI provides four nX static values for each point. Amplitude and phase are returned for each of the values.
Waveform Sampling	• Collection of waveforms for 16 channels. • DC-coupled waveforms. • Simultaneous Synchronous and Asynchronous data sampled during all operational modes • User-configurable Synchronous waveform sampling rates: ◦ 1 024 samples/rev for 2 revolutions, ◦ 512 samples/rev for 4 revolutions, ◦ 256 samples/rev for 8 revolutions, ◦ 128 samples/rev for 16 revolutions, 64 samples/rev for 32 revolutions, ◦ 32 samples/rev for 64 revolutions, and ◦ 16 samples/rev for 128 revolutions. • Asynchronous data sampled to

	support an 800-line spectrum at the following frequency spans: ◦ 5Hz , 10 Hz, 20 Hz, 50 Hz, ◦ 100 Hz, 200 Hz, 500 Hz, ◦ 1000 Hz, 2000 Hz, 5000 Hz, ◦ 10 kHz, 20 kHz, and 30 kHz. • Asynchronous data is anti-alias filtered. • Channel Pairs for providing Orbit or synchronous full spectrum presentations can be split among multiple monitors. For asynchronous full spectrums the channels must be within a monitor channel pair (30 kHz frequency span data will not be phase correlated between channel pairs).

Communications

Protocols	
BN Host Protocol	Communication with bopONLINE Configuration Software
BN TDI Protocol	Communication with GE's System1* Optimization and Diagnostic Software
Modbus®	Based on AEG Modicon PI-MBUS-300 Reference Manual. Uses Remote Terminal Unit (RTU) transmission mode. Modbus is a registered trademark of Modicon, Inc.
Ethernet Communications	
Ethernet, 10Base-T and 100Base TX	Conforms to IEEE802.3.bopONLINE rack
Connection	2 ports: RJ-45 (telephone jack style) for 10Base-T/100Base-TX Ethernet cabling
Cable Length:	100 metres (328 feet) maximum
Serial 485 Communications	
Modbus Host	RS-485
Communications	RS485
Baud Rate	1200 minimum to 115.2K maximum
Connection	9-pin DSUB
Cable Length Host Computer to Rack	30 metres (100 feet) maximum
Cable Length Rack to Next Rack	1220 metres (4000 feet) maximum

Compliance and Certifications

EMC/EMI

The following harmonized standards have been employed as essential requirements of the 2004/108/EC directive:

- EN 61326-1:2013
- EN 61000-6-2:2005

LVD

The following harmonized standards have been employed as essential requirements of the 2006/95/EC directive:

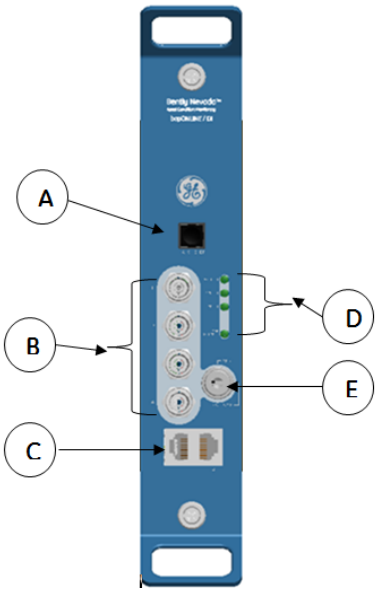
- EN 61010-1:2010

Battery Life

Powered DI	38 years @ 50°C (122 °F)
Un-powered DI	12 years @ 50°C (122 °F)

Physical

Dimensions	Height: 228mm (8.97 in) Width: 50mm (1.98 in) Depth: 289mm (11.39 in)
Weight	1.45kg (3.2 lb)
Storage Temperature	-40 °C to +85 °C (-40 °F to +185 °F)
Humidity	95%, non-condensing



A: Reset Switch
B: Buffered KPH Transducer Outputs
C: Ethernet Ports
D: Status LEDs
E: Keylock (Program / Run)

Figure 1: Front view of bopONLINE DI

Vibration Input Monitor - bopONLINE/VI

Description

The bopONLINE/VI Vibration Monitor is a 4-channel monitor designed for continuous on-line condition monitoring and protection for Balance of Plant (BoP) machinery in the Power Generation Industry. The bopONLINE/VI Vibration Monitor is used in a bopONLINE Monitoring System. Input/output (IO) terminations and relay contacts are located on the bopONLINE backplane on rear side of the bopONLINE system.

The monitor accepts input from proximity and seismic transducers, conditions the signal to provide various vibration and position measurements, and compares the conditioned signals with user-programmable alarms. The user can program each channel of the bopONLINE/VI using the bopONLINE Rack Configuration Software to perform any of the following functions:

- Radial Vibration
- Thrust Position
- Acceleration
- Velocity

The primary purpose of the bopONLINE/VI monitor is to provide:

1. Machinery protection by continuously comparing monitored parameters against configured alarm setpoints to drive alarms.
2. Essential machine information for both operations and maintenance personnel.

Each channel, depending on configuration, typically conditions its input signal to generate various parameters called “static values”. The user can configure Alert setpoints for each active static value and Danger setpoints for any two of the active static values.

Specifications

Inputs

Signal	Accepts from 1 to 4 proximity, velocity, or acceleration transducer signals
Input Impedance	10 kΩ (Proximitor and -24 Volt Acceleration Sensor Inputs)
Power Consumption	6.8W Typical

Sensitivity

Radial Vibration	3.94 mV/µm (100 mV/mil), or 7.87 mV/µm (200 mV/mil)
Thrust	3.94 mV/µm (100 mV/mil), or 7.87 mV/µm (200 mV/mil)
Acceleration	10 mV/(m/s2) (100 mV/g)
Velocity	20 mV/ (mm/s) pk (500 mV/(in/s) pk), or 5.8 mV/ (mm/s) pk (145 mV/(in/s) pk), or 4 mV/ (mm/s) pk (100 mV/(in/s) pk).

LEDs

OK	Indicates when the bopONLINE/VI is operating properly
ALERT	Indicates the bopONLINE/VI has detected an Alert condition and is driving the alert relay
DANGER	Indicates the bopONLINE/VI has detected a danger condition and is driving the danger relay
BYPASS	Indicates when the bopONLINE/VI is in Bypass Mode

Outputs

Buffered Transducer Outputs	The front of each bopONLINE/VI monitor has one coaxial connector for each channel. Each connector is short-circuit protected, with an output impedance of 499 Ω.
Relay Contacts	The bopONLINE/VI will drive the relays on the backplane of the bopONLINE Rack. There are two relays for each pair of channels, one for alert and the other for danger. Rated 1A @ 24VDC, 24 Watts Switched Power.
Transducer Power Supply	-24V, 12mA for prox/Accel -24V, 2.5mA constant current for Velom 24V, 2.5mA constant current for Positive Voltage bias constant current Acceleration sensors
Recorder	+4 to +20 mA. Values are proportional to monitor full-scale. The monitor provides individual recorder values for each channel. Monitor operation is unaffected by short circuits on recorder outputs.
Voltage Compliance (current output)	0 to +12 Vdc range across load. Load resistance is 0 to 600Φ.
Resolution	0.3662 µA per bit ±0.25% error at room temperature ±0.7% error over temperature range. Update rate 100 ms or less.

Signal Conditioning

Note: All measurements specified at +25 ºC (+77 ºF), unless otherwise noted.

Radial Vibration

Frequency Response	
Direct filter	User-programmable, single-pole, -3db at 4 Hz to 4000 Hz or 1 Hz to 600 Hz, ± 1% accuracy
Gap filter	-3 dB at 0.09 Hz.
Not 1X filter	60 cpm to 15.8 times running speed. Constant Q notch filter. Minimum rejection in stop band of -34.9 dB.
Smax	0.125 to 15.8 times running speed
1X and 2X Vector filter	Constant Q Filter. Minimum rejection in stop band of -57.7 dB **Note:** 1X & 2X Vector, Not 1X, and Smax parameters are valid for machine speeds of 60 cpm to 60,000 cpm.
Accuracy	
Direct and Gap	Exclusive of filtering, within ±0.33% of full-scale typical, ±1% maximum.
1X and 2X	Within ±0.33% of full-scale typical, ±1% maximum
Smax	Within ±5% maximum
Not 1X	±3% for machine speeds less than 30,000 cpm ±8.5% for machine speeds greater than 30,000 cpm

Thrust

Frequency Response	
Direct Filter	-3 dB at 1.2 Hz
Gap filter	-3 dB at 0.09 Hz
Smax	0.125 to 15.8 times running speed
Accuracy	
Direct and Gap	Exclusive of filtering, within ±0.33% of full-scale typical, ±1% maximum

Acceleration II

Frequency Response	
Bias filter	-3 dB at 0.01 Hz
Not OK filter	-3 dB at 2400 Hz
1X and 2X Vector filter	Valid for machine speeds of 60 cpm to 100,000 cpm
Filter Quality	
rms	Without Filter, Low or High-Pass Filter: 10 to 30,000 Hz With Integration: 10 to 20,000 Hz
Peak	Without Filter, Low or High-Pass Filter: 3 to 30,000 Hz With Integration: 10 to 20,000 Hz
Filter Quality	
High-Pass	4-pole (80 dB per decade, 24 dB per octave)
Low-Pass	4-pole (80 dB per decade, 24 dB per octave)
Accuracy	
	Within ± 0.33% of full scale typical, ± 1% maximum, exclusive of filters

Velocity II

Frequency Response**	
Bias	-3 dB at 0.01 Hz
Not OK filter	-3 dB at 40 Hz
rms	10 to 5,500 Hz, -3 dB
Peak or Peak-to-Peak	3 to 5,500 Hz, -3 dB 1X and 2X Vector filter Valid for machine speeds of 60 to 100,000 cpm. (Velocity II only)
Filter Quality	
High-Pass	2-pole (40 dB per decade, 12 dB per octave)
Low-Pass	4-pole (80 dB per decade, 24 dB per octave).
Accuracy	
	Within ± 0.33% of full scale typical, ± 1% maximum, exclusive of filters
Velomitor Sensor Accuracy	
Full Scale 0-0.5	±3% Typical
Full Scale 0-1.0	±2% Typical
Full Scale 0-2.0	±1% Typical

Alarms

Alarm Setpoints

The user can use software configuration to set Alert levels for each value measured by the monitor and Danger set points for any two of the values measured by the monitor.

Alarms are adjustable from 0 to 100% of full-scale for each measured value. The exception is when the full-scale range exceeds the range of the transducer. In this case, the range of the transducer will limit the set points.

Accuracy of alarms are to within 0.13% of the desired value.

Alarm Time Delays

Note: Applies to Radial Vibration, Thrust, Acceleration, Velocity,

The user can program alarm delays using software as follows:

Alert	From 1 to 60 seconds in 1 second intervals
Danger	0.1 seconds or from 1 to 60 seconds in 0.5 second intervals

Static Values

Static values are measurements used to monitor the machine. The bopONLINE Vibration Monitor returns the following static values:

Radial Vibration

- Direct
- Gap
- 1X Amplitude
- 1X Phase Lag
- 2X Amplitude
- 2X Phase Lag
- Not 1X Amplitude
- Smax Amplitude

Thrust Position

- Direct
- Gap

Acceleration

Direct can be configured as one of the following:

- RMS Acceleration
- Peak Acceleration
- RMS Velocity
- Peak Velocity
- Band-pass peak Acceleration
- Band-pass peak Velocity
- Bias Voltage

Additionally, 1X and 2X Amplitude can select 1X and 2X Phase and Bias Voltage.

Velocity

Direct can be configured as one of the following:

- RMS Velocity
- Peak Velocity,
- Peak-to-peak Displacement
- Band-pass peak Velocity
- Band-pass
- Bias Voltage

Additionally, 1X and 2X Amplitude can select 1X and 2X Phase and Bias Voltage.

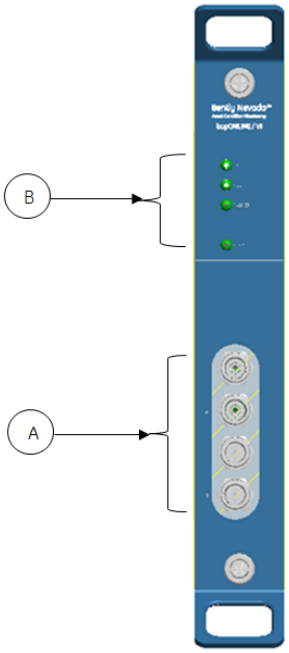
Physical

Monitor Module (Main Board)

Dimensions	Height: 205.2mm (8.08 in) Width: 38.1mm (1.5 in) Depth: 245.5mm (9.664 in)
Weight	1.27kg (2.8 lb)

Rack Space Requirements

Monitor Module: 1 full-height front slot



A. Buffered Transducer Outputs
B. Display LEDs

Figure 1: Front view of the bopONLINE Vibration Monitor

bopONLINE Physical Summary

Environmental Requirements

The bopONLINE power supplies are compliant to each item in this specification for the following environmental conditions.

The power supply is cooled by convection cooling. For operation above +55°C, the unit requires a minimum air flow of 300 ft/min moving across the rack.

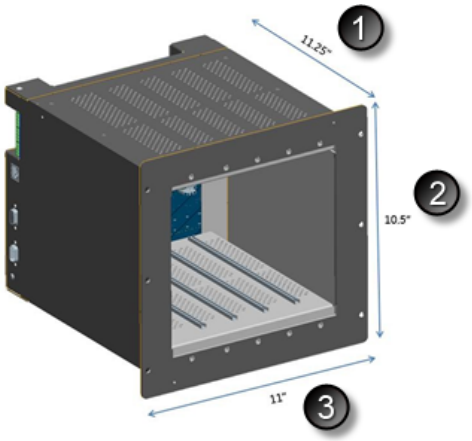
Note: Temperature is measured 1 inch below the power supply with a vertical mount installation.

Temperature Range	
Operating	-30°C to +65°C (-22°F to +149°F)
Storage	-40°C to +85°C (-40°F to +185°F)
Humidity Range	
Operating	0-95% RH. Non-condensing
Storage	0-95% RH. Non-condensing
Altitude	
Operating	15,000 ft
Storage	50,000 ft

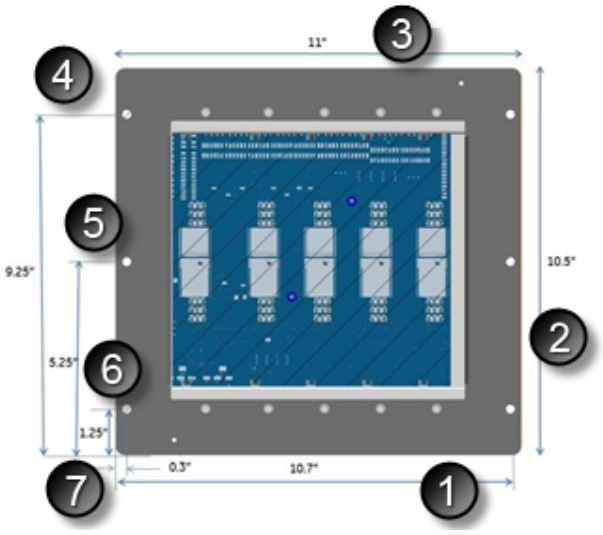
Hazardous Approvals

None

Physical Dimensions



bopONLINE Chassis Dimensions	
1	285.75 mm (11.25 in)
2	299.7 mm (10.5 in)
3	279.0 mm (11.0 in)



bopONLINE Rack Front Panel and Mounting Hole Dimensions		
1	mounting hole centerline to mounting hole centerline	271.8 mm (10.7 in)
2	height	266.7 mm (10.5 in)
3	width	279.4 mm (11.0 in)
4	top mounting hole offset from bottom edge	234.95 mm (9.25 in)
5	middle mounting hole offset from bottom edge	133.35 mm (5.25 in)
6	bottom or top mounting hole offset from bottom edge	31.75 mm (1.25 in)
7	mounting hole centerline offset from side edge	7.62 mm (0.3 in)

bopONLINE Ordering Information

For current firmware, refer to the Tech Support website at BNTechSupport.com.

bopONLINE System

The bopONLINE System includes the following items:

- bopONLINE System Rack
- bopONLINE Data Interface Module (always in the first slot)
- bopONLINE Vibration Input Module (options available in slots 2 - 5)

bopONLINE-AXX-BXX-CXX-DXX-EXX

A: Slot 1
- **01** bopONLINE /DI - Data Interface Module

B: Slot 2
- **00** none - blank cover
- **01** bopONLINE/VI - Vibration Input

C: Slot 3
- **00** none - blank cover
- **01** bopONLINE /VI - Vibration Input Monitor

D: Slot 4
- **00** none - blank cover
- **01** bopONLINE /VI - Vibration Input Monitor

E: Slot 5
- **00** none - blank cover
- **01** bopONLINE /VI - Vibration Input Monitor

bopONLINE Power Supply

The power supply should include the power supply and the power supply cable.

100M9448 (power supply)

102M0984-AXX (cable)

A: Power supply cable
- **01** for 3 meter cable
- **02** for 5 meter cable

Surge Protector Kit

109959-AXX (surge protection kit for serial communication interfaces)

A: Cable
- **04** for cable (47125)
- **09** for cable (89968)

107M5140 (surge protection for power supply)

Spares

The following part numbers listed in this section can be used to order spare parts for the bopONLINE system.

323307-01	Data Interface Module
323308-01	Vibration Input Monitor
100M9448	External bopONLINE Power Supply
323309-01	Blank monitor slot cover
323306-01	System Chassis/Backplane

Printed in USA. Uncontrolled when transmitted electronically.

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