Bently Nevada 60M100 Monitor
Bently Nevada* Asset Condition Monitoring

Description
The 60M100 Condition Monitoring System provides continuous on-line monitoring of Wind Turbine machine trains using sophisticated signal processing algorithms and machine operating states. The 60M100 Monitoring System, as a part of Condition Based Maintenance, lets wind turbine owners know, months in advance, that a turbine defect exists before failure of turbine assets occur. Bently Nevada’s Condition Monitoring Solution can save turbine owners hundreds of thousands to millions of dollars per year in lost revenue, depending on the size of the wind farm. Turbine owners can expect to see cost savings from several sources including reduced crane costs, as well as early detection and damage minimization. Moreover, turbine owners will experience a reduction in unnecessary turbine outage and production loss.

The 60M100 Monitor is a capable and flexible system that can be used as an independent standalone condition monitoring system, a networked distributed collection of inter-operating systems, or as an integrated part of a machine OEM’s control & instrumentation package. The 60M100 monitor includes features and advantages not provided in other systems. The monitor systems have all functionality required for condition monitoring of Wind Turbine machine trains including signal conditioning, alarming, configuration, speed inputs, and control system communication. The system components are:

- 60M100 monitor
- Adapt.wind software
- Transducers and cables

Sophisticated signal processing algorithms extract dozens of measurements and health indices from each accelerometer point and can be custom tuned to specific bearing and gear box characteristics.
60M100 Overview

The 60M100 Condition Monitoring System is specifically designed for continuous permanent monitoring of wind turbine generator machine trains. It is designed for monitoring applications that require extremely high reliability and availability. Applications that will be addressed by the 60M100 System include but are not limited to:

Tower Sway
Main Bearing
Main Rotor
Gear Boxes
- All Internal Bearings
- All Gear Meshes
- Debris Monitoring
Generator Bearings
Generator Grounding

Special configuration or modifications to a standard monitor can be addressed through Bently Nevada’s Custom Products Engineering. Contact your local Bently Nevada sales professional for further information.

60M100 Digital Communications

The 60M100 System includes digital communication capabilities for connection to ADAPT software using proprietary protocols via Ethernet connections. Moreover, the system provides extensive communication capabilities of all monitored values and statuses for integration with process control and other automation systems using Ethernet TCP/IP communications capabilities. It permits Ethernet communications with other 60M100 systems and System Software. Supported protocols include:

Modbus/TCP
Industry standard Modbus protocol over TCP. The 60M100 supports both server and client mode.

60M100 System Description

The 60M100 is a powerful and versatile Condition Monitoring system that provides basic monitoring functions and advanced signal processing and rules in a compact, robust unit. The module conditions the input signals to make various measurements and compares the conditioned signals with user-programmable alarms.

Capable of taking input from different sensor types, the 60M100 System can support up to 12 dynamic channel inputs, two Keyphasor signals, and digital communications. Channel 1 through channel 10 interface with 2-wire ICP type accelerometers. Channels 11 and 12 can be configured to interface with either 2-wire ICP type transducers or 3-wire proximity probes. Each dynamic channel can be independently configured with flexible signal processing options. The Keyphasor channels interface to either 3-wire proximity probes or other speed sensors which are powered externally.

The module provides enhanced capability for monitoring rolling element bearing machinery and gearing through its 24 bit Analog/Digital conversion and 40 kHz bandwidth design.

The 60M100 System is not a substitute for hard wired safety systems, nor does it replace the standard systems for the acquisition of operational data of the wind turbine.
### Specifications

#### 60M100 System Electrical Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Power</strong></td>
<td>Min: 18 Vdc</td>
<td>Max: 36 Vdc</td>
</tr>
<tr>
<td><strong>Current</strong></td>
<td>Max: 1.7 A</td>
<td></td>
</tr>
<tr>
<td><strong>Inrush Current</strong></td>
<td>Max: 2.7 A, less than 5 ms</td>
<td></td>
</tr>
</tbody>
</table>

#### 60M100 Processor Module Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inputs</strong></td>
<td>Max: 12 dynamic signals and 2 Keyphasor signals</td>
</tr>
<tr>
<td><strong>Dynamic Range</strong></td>
<td>110 dB @ fs = 102.4 ksps</td>
</tr>
<tr>
<td><strong>Signal/Noise Ratio</strong></td>
<td>110 dB @ fs = 102.4 ksps</td>
</tr>
<tr>
<td><strong>A/D Conversion</strong></td>
<td>Sigma-Delta 24 bits nominal</td>
</tr>
<tr>
<td><strong>Bandwidth</strong></td>
<td>0 to 40 kHz</td>
</tr>
<tr>
<td><strong>Outputs</strong></td>
<td>Two Independent Ethernet ports</td>
</tr>
<tr>
<td></td>
<td>Net A: 10/100 BaseT Network DHCP Port</td>
</tr>
<tr>
<td></td>
<td>Net B: 10/100 BaseT Local Static IP Port</td>
</tr>
</tbody>
</table>

#### Buffered Signal Outputs

- Two 15 pin DSUB connector
- 550 ohm output impedance

#### LEDs

- **POWER LED**
  - Indicates when a proper power input is present.
- **OK LED**
  - Indicates when the system is functioning properly.
- **Danger LED**
  - Indicates an Danger Alarm condition
- **Alert LED**
  - Indicates an Alert condition
- **Kph 1 OK LED**
  - Indicates that Keyphasor signal 1 is triggering.
- **Kph 2 OK LED**
  - Indicates that Keyphasor signal 2 is triggering.
- **NetA**
  - Indicates that Network A has a valid link
- **TX/RX A**
  - Indicates that network traffic is flowing on Network A
- **Net B**
  - Indicates that Network B has a valid link
- **TX/RX B**
  - Indicates that network traffic is flowing on Network B
<table>
<thead>
<tr>
<th>Specifications</th>
<th>Alarming Modes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accuracy</strong></td>
<td>5 modes + default mode</td>
</tr>
<tr>
<td><strong>Direct pk or rms</strong></td>
<td>Modes are determined from Generator Power</td>
</tr>
<tr>
<td>Within ± 0.5% of full-scale typical, ± 1.1% Worst Case</td>
<td>Mode 1: 25% to 40% power</td>
</tr>
<tr>
<td><strong>Bias</strong></td>
<td>Mode 2: &gt; 40% to 55% power</td>
</tr>
<tr>
<td>+0.4 V / -0.8 V typical, +0.8 V / -1.34 V Worst Case.</td>
<td>Mode 3: &gt; 55% to 70% power</td>
</tr>
<tr>
<td><strong>Rotor, Mesh and Fault Frequencies</strong></td>
<td>Mode 4: &gt; 70% to 85% power</td>
</tr>
<tr>
<td>± 6.7% typical, ± 9.7% Worst Case</td>
<td>Mode 5: &gt; 85% power</td>
</tr>
<tr>
<td><strong>Bearing Frequencies</strong></td>
<td><strong>Setpoints</strong></td>
</tr>
<tr>
<td>± 6.7% typical, ± 9.7% Worst Case</td>
<td>2 Levels: Warning and Alarm</td>
</tr>
<tr>
<td><strong>Tower Sway</strong></td>
<td><strong>Time Delay</strong></td>
</tr>
<tr>
<td>± 0.16 m/s² (0.016 g) typical</td>
<td>300 seconds (fixed) for all measurements</td>
</tr>
<tr>
<td>± 0.23 m/s² (0.023 g) Worst Case</td>
<td><strong>Latching</strong></td>
</tr>
<tr>
<td><strong>Kurtosis</strong></td>
<td>All alarm statuses are latching</td>
</tr>
<tr>
<td>± 1% 50 Hz to 10,000 Hz</td>
<td><strong>Dynamic Data</strong></td>
</tr>
<tr>
<td>± 3% 1 Hz to 49.9 Hz</td>
<td><strong>Asynchronous Waveform</strong></td>
</tr>
<tr>
<td><strong>Generator Electrical Noise</strong></td>
<td>8192 samples, 320 ms</td>
</tr>
<tr>
<td>± 1% 50 Hz to 10,000 Hz</td>
<td><strong>Synchronous Waveform</strong></td>
</tr>
<tr>
<td>± 3% 1 Hz to 49.9 Hz</td>
<td>8192 samples</td>
</tr>
<tr>
<td><strong>Crest Factor</strong></td>
<td>4 revolutions, 2048 samples/rev</td>
</tr>
<tr>
<td>Within ± 0.5% of full-scale typical, ± 1.1% Worst Case</td>
<td>8 revolutions, 1024 samples/rev</td>
</tr>
<tr>
<td><strong>Minimum Amplitude for Crest Factor, Skewness, and Kurtosis measurements</strong></td>
<td>16 revolutions, 512 samples/rev</td>
</tr>
<tr>
<td>0.6 m/s² (0.06 g)</td>
<td>32 revolutions, 256 samples/rev</td>
</tr>
<tr>
<td><strong>Spectrums</strong></td>
<td>64 revolutions, 128 samples/rev</td>
</tr>
<tr>
<td><strong>Main Bearing</strong></td>
<td><strong>Spectrums</strong></td>
</tr>
<tr>
<td>8 revolutions, 1024 samples/rev</td>
<td><strong>Main Bearing</strong></td>
</tr>
<tr>
<td>3200 lines Sync Enveloped</td>
<td></td>
</tr>
</tbody>
</table>
### Gearbox Stages

- 3200 lines Sync Enveloped
- 3200 lines Sync High Res

Number of revolutions and samples per revolution vary based on the selected asset.

### Generator Inboard / Outboard

- 64 revolutions, 128 samples/rev
- 3200 lines Sync Enveloped
- 3200 lines Sync High Res

### Tower Sway

- 15.625 Hz, 200 lines

### Anti- Alias

- -80 dB minimum

### Update Rate

- 30 seconds

### Historical Data Storage Rate

- 4 Hours

### Data Storage

- 2 Weeks (typical, no alarms)

### Keyphasor Signal Inputs

#### Speed Range

- 1 to 120,000 rpm
- Limited to 2,000 rpm for Wind Turbines

#### Speed Resolution

- 1 to 100 rpm ± 0.1 rpm
- 100 to 2000 rpm ± 1 rpm

#### Gap

- ±8.2 mV typical
- ±22.3 mV worst case

### Supported Transducers

#### Acceleration Channels

- TurningPoint TP100 Accelerometer

#### Keyphasor Channels

- Turck Ni8–M18T–AP6X7M, externally powered
- Bently Prox Probes

#### Oil Particle Sensors

- GasTOPs
- Macom

#### Proximity Channel (for Shaft Crack Detection)

- Bently Prox Probe 3300 XL 11mm

### 60M100 System Environmental Specifications

#### Operating Temperature Range

- -40 C to +70 C
- (-40 F to 158 F)

#### Storage Temperature Range

- -45 C to +85 C
- (-49 F to 185 F)

#### Relative Humidity

- 0% to 95% non-condensing

#### Operating and Storage Pollution Degree

- Pollution Degree 2 (Working voltage < 30 Vrms or 60 Vdc)
Specifications and Ordering Information
Part Number 104M0791-01
Rev. B (6/16)

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Physical Dimensions
8.88 X 5.89 X 2.17 inches [225 X 150 X 55 mm] (See Figure 1)

Weight
1.4 kg [3 lbs]

Mounting
Din Rail Mounting

Compliance and Certifications

EMC
Standards:
EN 61000-6-2 Immunity for Industrial Environments
EN 55011/CISPR 11 ISM Equipment
EN 61000-6-4 Emissions for Industrial Environments
European Community Directives:
EMC Directive 2004/108/EC

Electrical Safety
Standards:
EN 61010-1

European Community Directives:
2006/95/EC Low Voltage

For further certification and approvals information please visit the following website:
http://www.GEmeasurement.com/

Ordering Information


60M100: Bently Nevada 60M100 Condition Monitor (Monitor Only)
AA: Approvals
00 – Standard

60M100_KIT: Bently Nevada 60M100 Condition Monitoring System Kit
AAA: Configuration
XX1 – GE 1.X MW
XX2 – GE 2.X MW
XX3 – GE 2.3-107
XX4 – GE 2.5 MW PMG
020 – Vestas V82
022 – Vestas V110/V110 After Market
026 – Vestas V110/V110 Factory Enclosure
028 – Vestas 3MW Onshore

BB: Approvals
00 – None

Spares
3701 Software Package with Options 3701/00-AA-BB-CC
AA: Order Type
01 – Initial Purchase
99 – SW Update DVD

BB: Licensing
00 – Update
01 – 200 Turbine Farm
02 – 33 Turbine Farm

CC: Software Version
01 – Latest†
†The 60M100 monitor is only compatible with software version 1.9 or later.

3701 Server and Monitor with Options 3701/11-AA-BB
AA: Server Computers
00 – None
01 – Hi Perf Tower
02 – Hi Perf Rack
03 – Compact Server
04 – Compact Server (O & M Building)

BB: Monitors
00 – None
01 – 19-Inch TFT Flat Panel
<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>323394</td>
<td>Turningpoint TP100 Accelerometer 100 mV/g, 0.5 - 14,000 Hz</td>
</tr>
<tr>
<td>200355</td>
<td>Low Frequency Accelerometer 100 mV/g, 0.2 - 10,000 Hz</td>
</tr>
<tr>
<td>287844</td>
<td>Accelerometer Mounting Stud 1/4 -28 to M8x1.25 SST</td>
</tr>
<tr>
<td>284613-050</td>
<td>Accelerometer Cable, 15.2 m (50ft) with straight connector</td>
</tr>
<tr>
<td>284613-030</td>
<td>Accelerometer Cable, 9.1 m (30ft) with straight connector</td>
</tr>
<tr>
<td>284622-050</td>
<td>Accelerometer Cable, 15.2 m (50ft) with right angle connector</td>
</tr>
<tr>
<td>284622-030</td>
<td>Accelerometer Cable, 9.1 m (30ft) with right angle connector</td>
</tr>
<tr>
<td>138131</td>
<td>CAT5 Cable. Minimum cable length is 3 feet. Maximum cable length is 320 feet. Cable lengths are 3, 6, 10, 25, 40, 50, 75, 85, 100, 120, 150, 200, 250, and 320 feet.</td>
</tr>
<tr>
<td>323314-01</td>
<td>Buffered output cable, 15-pin DSUB to 7 SMA connectors</td>
</tr>
<tr>
<td>323314-02</td>
<td>Buffered output cable, 15-pin DSUB to 7 BNC connectors</td>
</tr>
<tr>
<td>283624</td>
<td>Surge Protector</td>
</tr>
<tr>
<td>284005</td>
<td>Surge Protector Cover</td>
</tr>
</tbody>
</table>

**Miscellaneous**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>104M4408-01</td>
<td>3701/60A to 60M100 Retrofit Mounting Kit</td>
</tr>
<tr>
<td>04425545</td>
<td>Grounding Wrist Strap (Single use only)</td>
</tr>
</tbody>
</table>
Graphs and Figures

Figure 1: 60M100 Monitor Overall Dimensions

Figure 2: 60M100 Monitor Side View
Figure 3: 60M100 Monitor Top and Bottom Views
Figure 4: Recommended minimum clearance window for cable terminations and monitor cooling

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