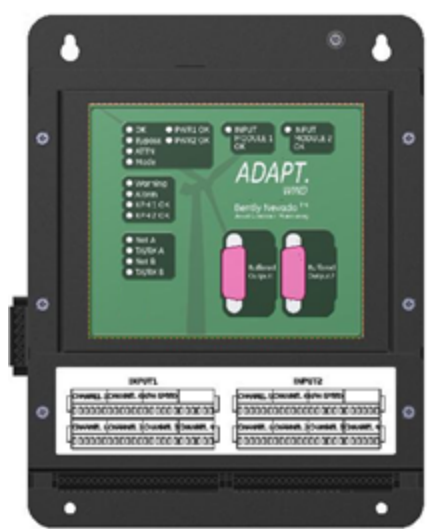


3701/60A Wind Turbine Monitor

Datasheet

Bently Nevada Machinery Condition Monitoring

286297 Rev. K



Description

The 3701/60A Wind Turbine Condition Monitoring System provides continuous on-line monitoring of Wind Turbine machine trains using sophisticated signal processing algorithms and machine operating states. The 3701 Wind Condition Monitoring (CM) 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 CM 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 3701/60A Wind Turbine Monitor is a capable and flexible system that can be used as an independent standalone protection system, a networked distributed collection of inter-operating systems, or as an integrated part of a machine OEM's control & instrumentation package. Our CM includes features and advantages not provided in other systems. The monitor modules 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:

- 3701/60A Wind Condition 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.



3701 Overview

The 3701/60A Wind Turbine Monitor Protection & 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 3701/60A 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.

3701 Digital Communications

The 3701/60A 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 3701/60A systems modules and 3701 System Software. Supported protocols include:

Modbus/TCP

Industry standard Modbus protocol over TCP. The 3701 supports both server and client mode.

3701/60A System Description

The 3701/60A is a powerful and versatile CM 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 3701/60A System can support up to 12 dynamic channel inputs, two Keyphasor signals, and digital communications. Channels are independently configurable with flexible signal processing options. Each channel can be configured independently to interface with 2-wire and 3-wire accelerometers, velometers, and proximity probes.

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 3701/60A Wind Turbine CM 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.

3701/60A System Electrical Specifications

Input Power

Min: 18 Vdc

Max: 36 Vdc

Current

Max: 1.7 A

Inrush Current

Max: 2.7 A, less than 5 ms

3701/60A Processor Module Specifications

Inputs

Max: 12 dynamic signals and 2 Keyphasor signals

Dynamic Range

110 dB @ $f_s = 102.4$ ksp/s

Signal/Noise Ratio

110 dB @ fs = 102.4 ksps

A/D Conversion

Sigma-Delta - 24 bits nominal

Bandwidth

0 to 40 kHz

Outputs

Two Independent Ethernet ports

Net A: 10/100 BaseT
Network DHCP Port

Net B: 10/100 BaseT
Local Static IP Port

Buffered Signal Outputs)

15 pin DSUB connector
550 ohm output impedance

LEDs

OK LED

Indicates when the module is functioning properly.

Bypass LED

Indicates that the monitor is in Bypass mode.

ATTN LED

Indicates that the monitor has added an event in the event list that may require action.

Mode LED

Indicates when the monitor is not using the default setpoint configuration.

Alarm LED

Indicates an Alarm condition.

Warning LED

Indicates an Warning condition.

Kph 1 OK LED

Indicates that Keyphasor signal 1 is triggering.

Kph 2 OK LED

Indicates that Keyphasor signal 2 is triggering.

Net A

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.

Accuracy

Direct pk or rms

Within $\pm 0.5\%$ of full-scale typical, $\pm 1.1\%$ Worst Case

Bias

+0.4 V / -0.8 V typical,
+0.8 V / -1.34 V Worst Case.

Rotor, Mesh and Fault Frequencies

$\pm 6.7\%$ typical, $\pm 9.7\%$ Worst Case

Bearing Frequencies

$\pm 6.7\%$ typical, $\pm 9.7\%$ Worst Case

Tower Sway

$\pm 0.16 \text{ m/s}^2$ (0.016 g) typical
 $\pm 0.23 \text{ m/s}^2$ (0.023 g) Worst Case

Kurtosis

$\pm 1\%$ 50 Hz to 10,000 Hz
 $\pm 3\%$ 1 Hz to 49.9 Hz

Generator Electrical Noise

$\pm 1\%$ 50 Hz to 10,000 Hz
 $\pm 3\%$ 1 Hz to 49.9 Hz

Crest Factor

Within $\pm 0.5\%$ of full-scale typical, $\pm 1.1\%$ Worst Case

Minimum Amplitude for Crest Factor, Skewness, and Kurtosis measurements

0.6 m/s² (0.06 g)

Alarming

Modes

5 modes + default mode

Modes are determined from Generator Power

Mode 1: 25% to 40% power

Mode 2: > 40% to 55% power

Mode 3: > 55% to 70% power

Mode 4: > 70% to 85% power

Mode 5: > 85% power

Setpoints

2 Levels: Warning and Alarm

Time Delay

300 seconds (fixed) for all measurements

Latching

All alarm statuses are latching

Dynamic Data

Asynchronous Waveform

8192 samples, 320 ms

Synchronous Waveform

8192 samples

4 revolutions, 2048 samples/rev

8 revolutions, 1024 samples/rev

16 revolutions, 512 samples/rev

32 revolutions, 256 samples/rev

64 revolutions, 128 samples/rev

Spectrums

Main Bearing

8 revolutions, 1024 samples/rev

3200 lines Sync Enveloped

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 $\pm$ - 0.1 rpm

100 to 2000 rpm $\pm$ 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 Proximity Probes

Oil Particle Sensors

GasTOPs
Macom

Proximity Channel (for Shaft Crack Detection)

Bently Prox Probe 3300 XL 11mm

3701/60A 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

Vibration

5g @ 57-500 Hz. IEC68-2-6

Shock

15g, 11ms

Pollution Degree

Pollution Degree 2 (Working voltage < 30 Vrms
or 60 Vdc)

Physical

Dimensions

26.7 x 21.6 x 17.8 cm (10.5 x 8.51 x 7.01 in)

Weight

4.3 kg (9.4 lbs)

Mounting

Bulkhead Mounting

EMC Compliance

CE

2004/108/EC EMC Directive

Standards

EN 61000-6-4

EN 61000-6-2

2006/95/EC Low Voltage

Standards

EN 61010-1

Global EMC

Standards

IEC 61000-6-4

IEC 61000-6-2

Ordering Information

For a detailed listing of country and product specific approvals, refer to the Approvals Quick Reference Guide (document 108M1756) located at the following website: Bently.com.

3701/60A Wind Turbine Condition Monitoring System

Product Number with Options 3701/60A-AAA-BB-CC-DD-EE-FF

AAA: Kit Type

- 000 - None (Just the monitor, no kit)
- 001 - GE 1.x MW
- 002 - GE 2.x MW
- 003 - GE 4.x MW
- 004 - GE 750 kW
- 020 - Vestas V82
- 021 - Vestas V100
- 040 - Suzlon S88
- 061 - Gamesa G87
- 080 - Clipper Liberty 2.5
- 100 - Sinovel SL1500
- 120 - DEC 1.5 MW
- 121 - Guohua DEC 1.5 MW
- 122 - DEC FD82 2.0 MW
- 123 - DEC 2.5 MW
- 124 - DEC 3.0 MW
- 125 - DEC FD87A 2.0 MW
- 140 - SEC 2.0 MW
- 150 - Xuji 2.0 MW
- 160 - CNR 3.0 MW
- 240 - Mingyang 1.5 MW
- 250 - Samsung 7 MW Offshore

BB: Networking Type

- 00 - None
- 01 - Optical Down Tower Kit
- 02 - CAT5e Ethernet Cable

CC: KPH Type

- 00 - None
- 01 - KPH Kit for non BH Turbine

DD: Enclosure Type

- 00 - None
- 01 - Enclosure, Panel, etc.
- 02 - Enclosure, w/seals Panel, etc.
- 03 - Enclosure, Compact, w/seals Panel, etc.

EE: DC Power Supply Type

- 00 - None
- 01 - Traco 2A 24 Vdc

FF: Shaft Crack Detection

- 00 - None
- 01 - Shaft Crack Detection

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

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

Sensors and Cables

323394

Turningpoint TP100 Accelerometer
100 mV/g, 0.5 - 14,000 Hz

200355

Low Frequency Accelerometer
100 mV/g, 0.2 - 10,000 Hz

287844

Accelerometer Mounting Stud
1/4 -28 to M8x1.25 SST

284613-050

Accelerometer Cable, 15.2 m (50ft) with straight
connector

284613-030

Accelerometer Cable, 9.1 m (30ft) with straight
connector

284622-050

Accelerometer Cable, 15.2 m (50ft) with right
angle connector

284622-030

Accelerometer Cable, 9.1 m (30ft) with right
angle connector

138131

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.

323314-01

Buffered output cable, 15-pin DSUB to 7 SMA
connectors

323314-02

Buffered output cable, 15-pin DSUB to 7 BNC
connectors

Accessories

283624

Surge Protector

284005

Surge Protector Cover

Miscellaneous

04425545

Grounding Wrist Strap (Single use only)

Graphs and Figures

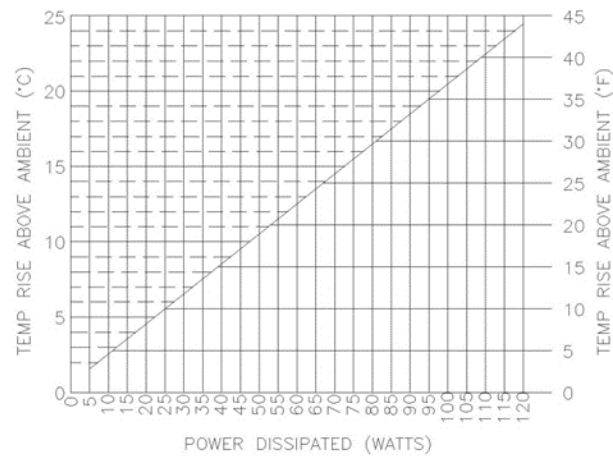
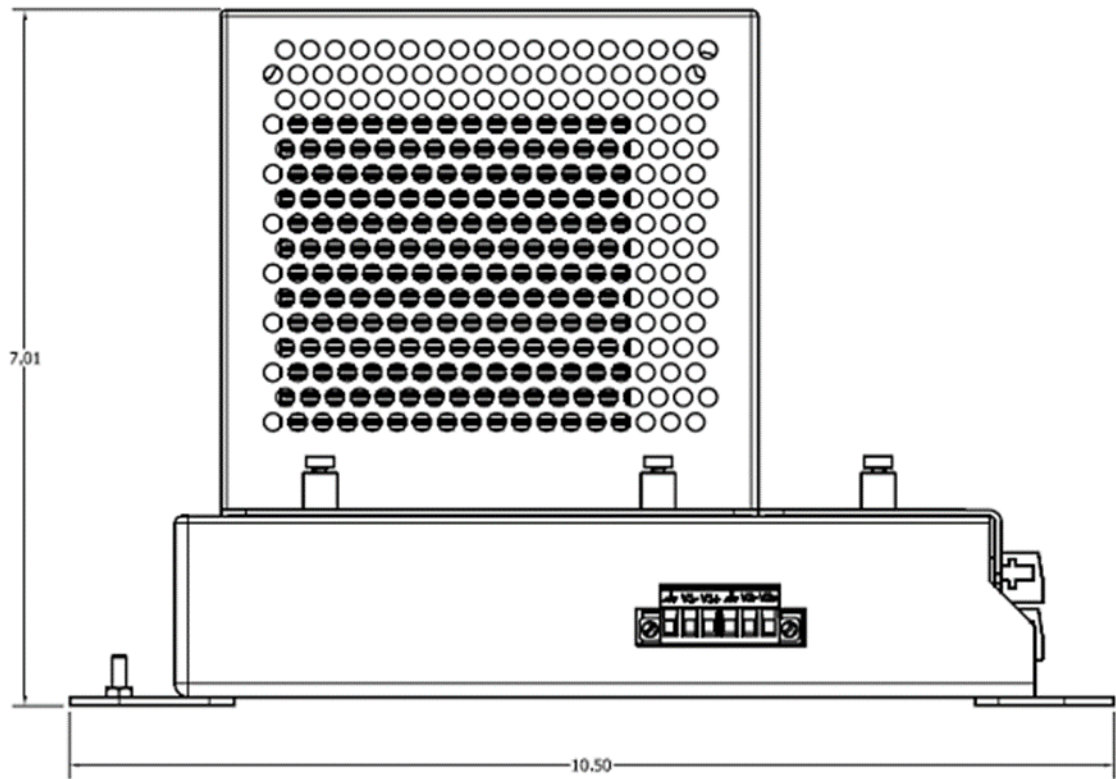
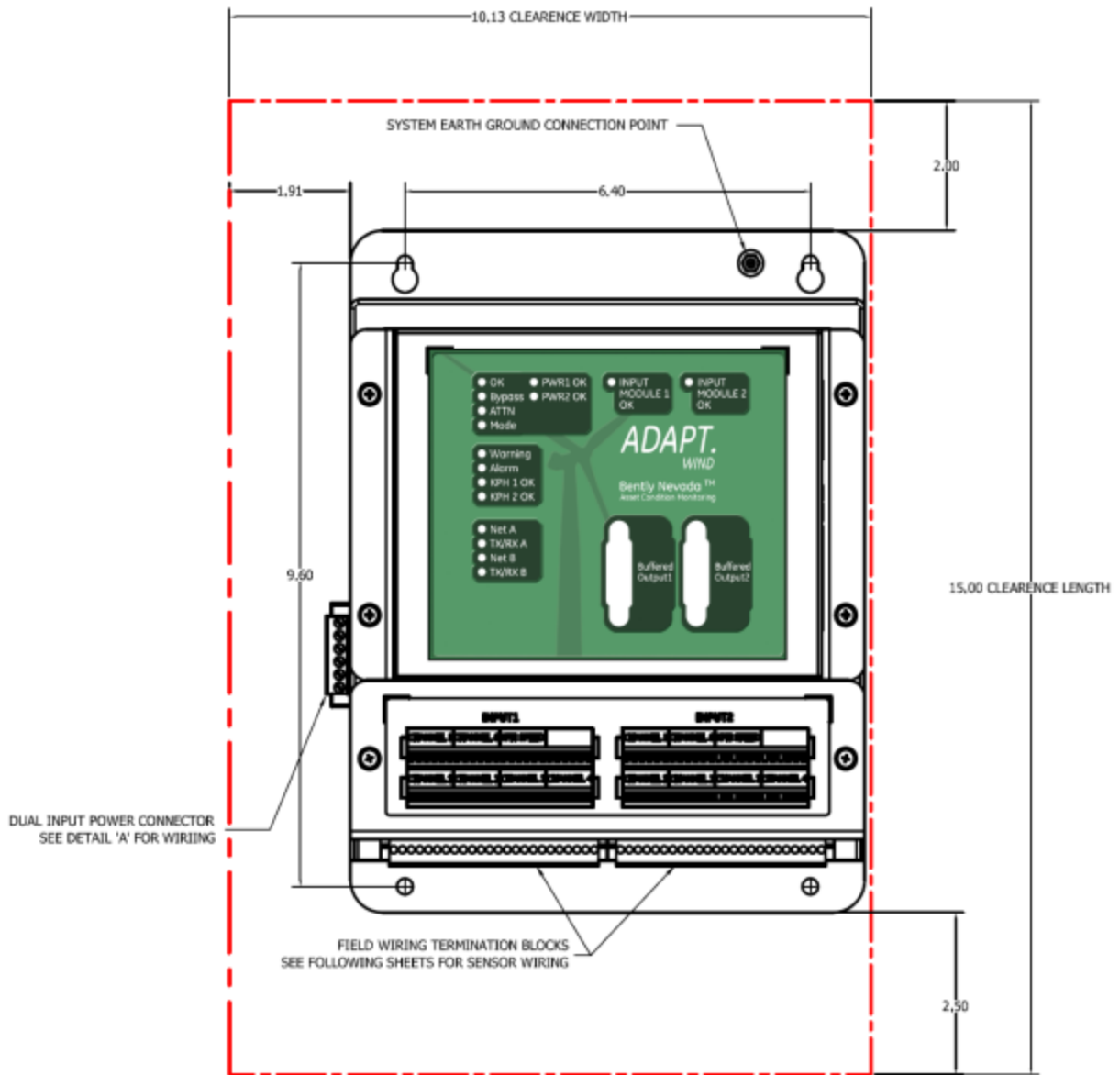
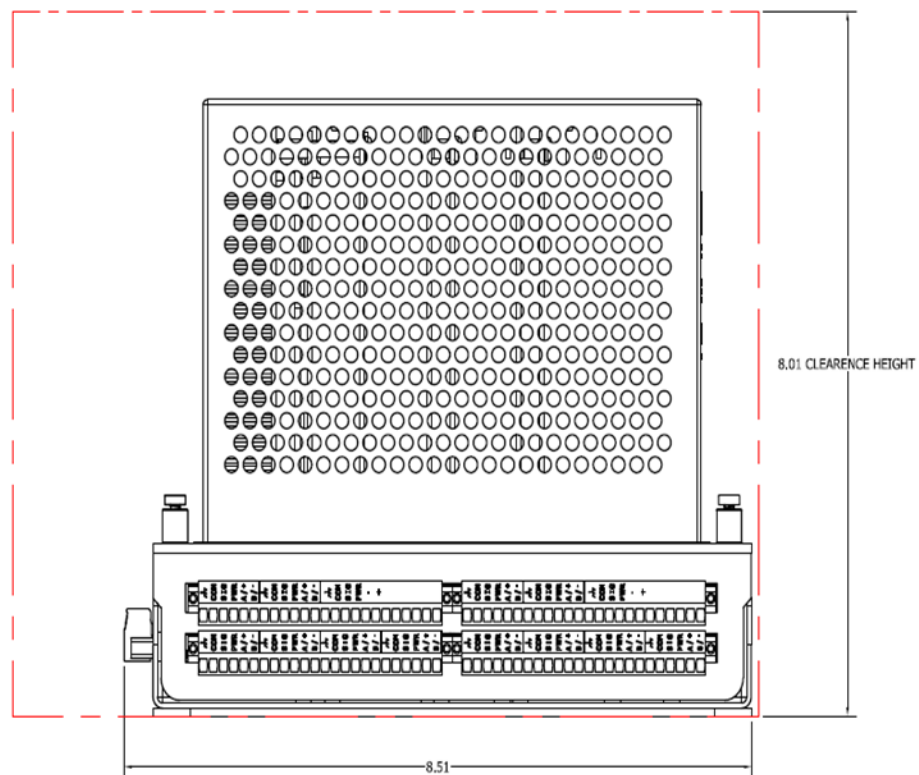


CHART 1: TEMPERATURE DERATING







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