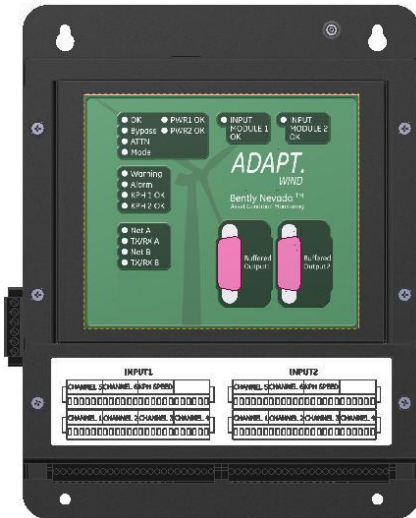


3701/60A Wind Turbine Monitor

Bently Nevada* Asset Condition Monitoring

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 module components are:

3701/60A Wind Condition Monitor

3701 System Configuration Software

Channel measurement types include Acceleration and Speed.

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.

Specifications

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 @ fs = 102.4 ksps

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

Net B: 10/100 BaseT

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.

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

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/s^2 (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

\pm 8.2 mV typical
 \pm 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

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, 2001

Global EMC

Standards

IEC 61000-6-4

IEC 61000-6-2

Ordering Information

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
- *New kits can be supported on request*

BB: Networking Type

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

CC: KPH Type

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

DD: Enclosure Type

- 00 - None
- 01 - Enclosure, 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

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

323461

TP100 Accelerometer

200355

Low Frequency Accelerometer

287844

Accelerometer Mounting Stud

284613-02

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

284622-02

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

138131-01

CAT5 Cable

Accessories

283624

Surge Protector

284005

Surge Protector Cover

Miscellaneous

04425545

Graphs and Figures

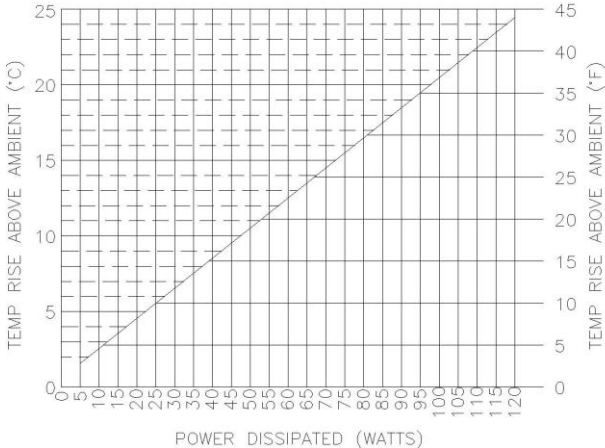
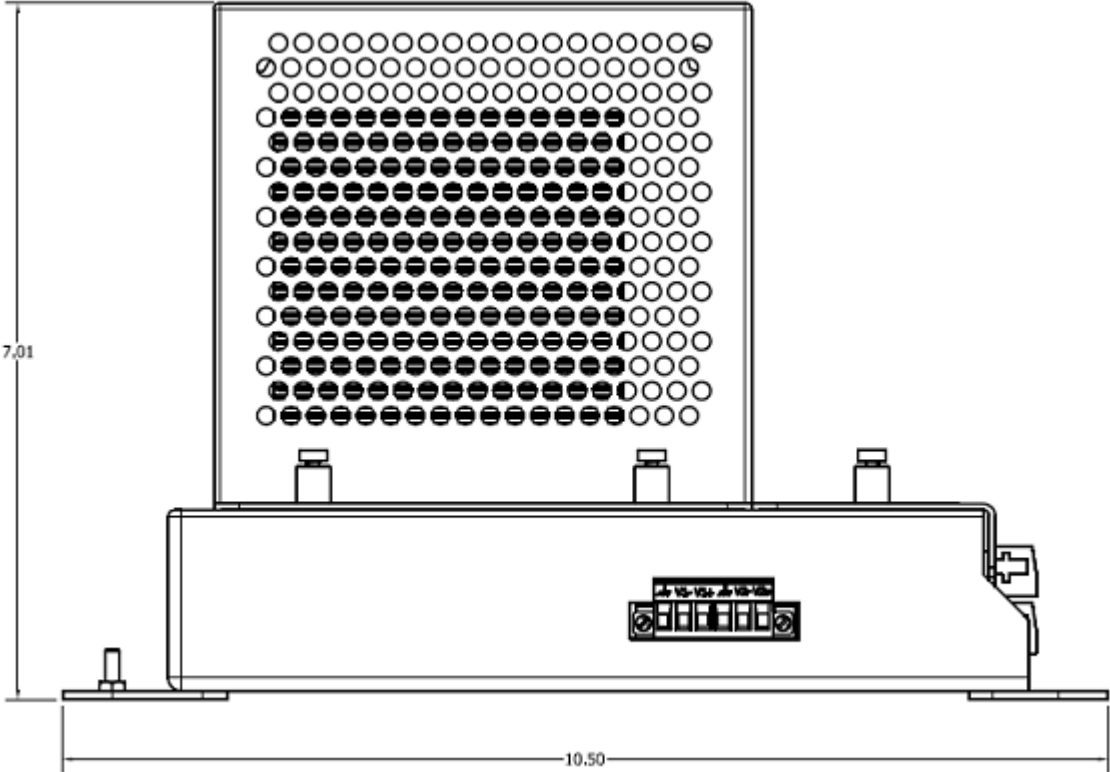
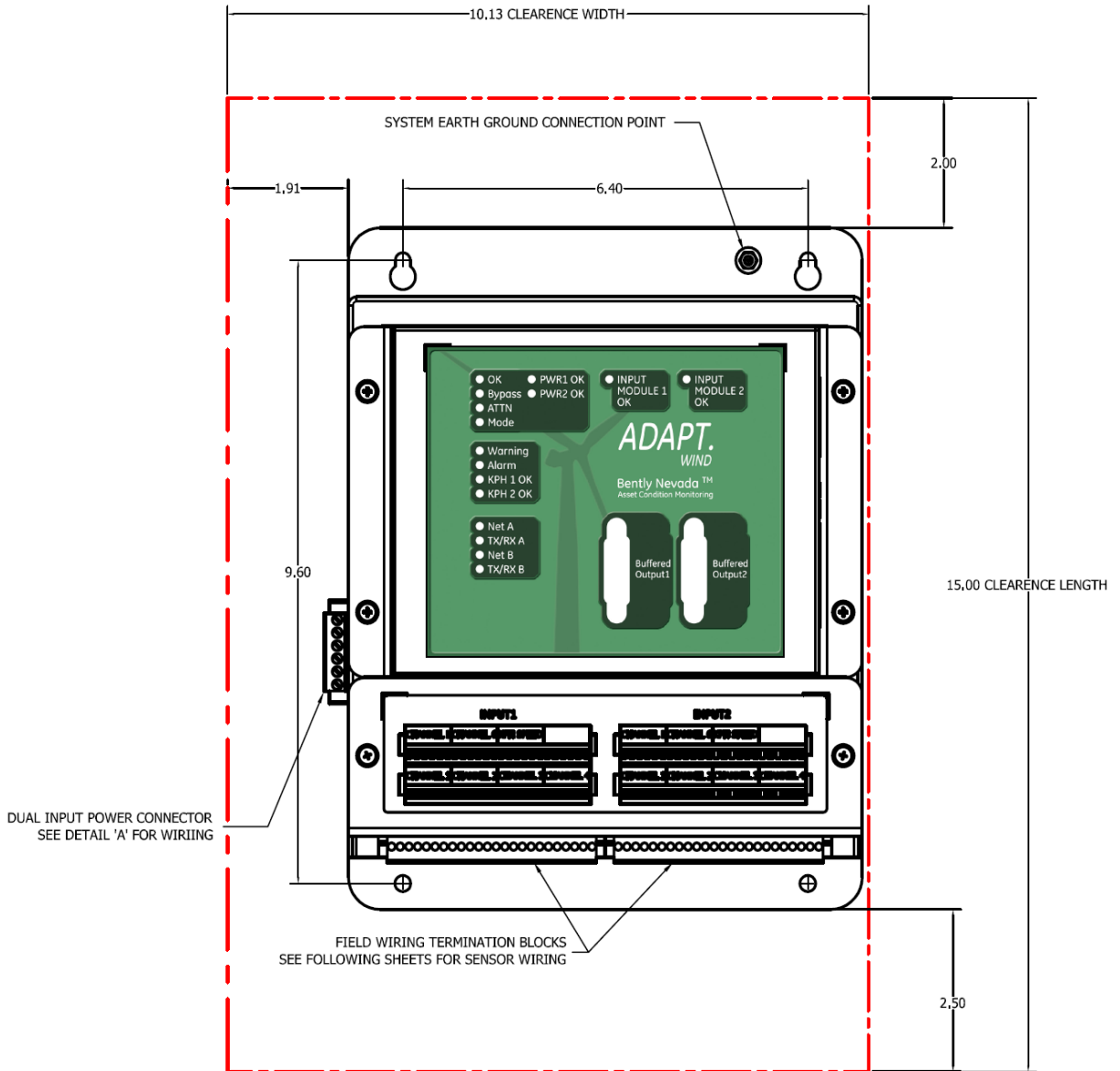
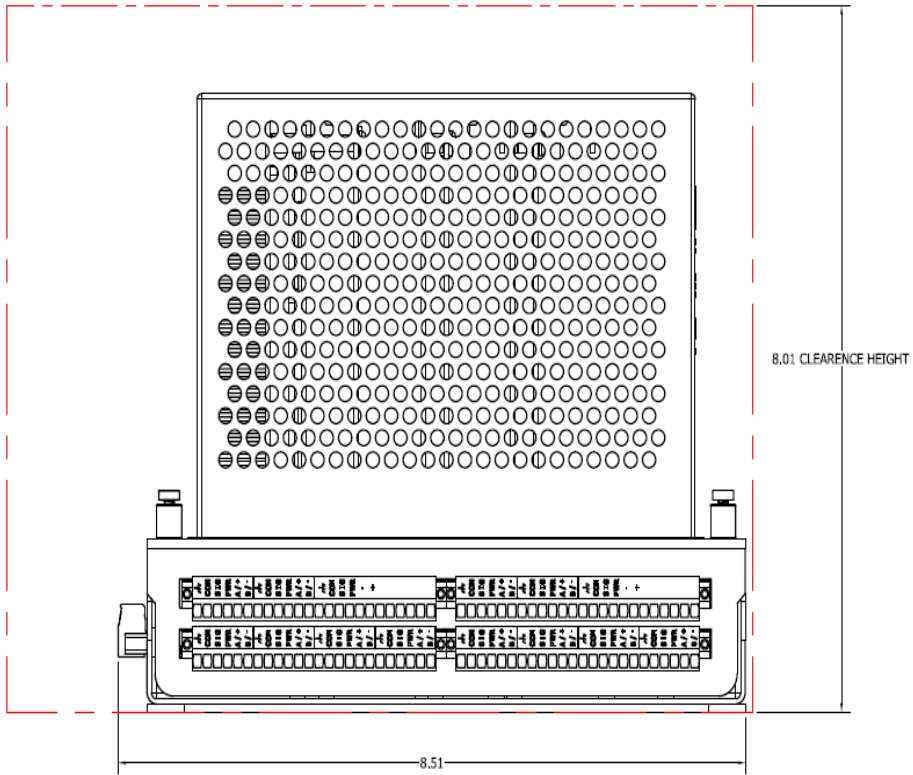


CHART 1: TEMPERATURE DERATING







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