3500/40M Proximitor* Monitor

Bently Nevada* Asset Condition Monitoring

Description

The 3500/40M Proximitor Monitor is a 4-channel monitor that accepts input from Bently Nevada proximity 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 3500/40M with the 3500 Rack Configuration Software to perform any of the following functions:

- Radial Vibration
- Thrust Position
- Differential Expansion
- Eccentricity
- REBAM®

Note:	The monitor channels are programmed in pairs and can perform up to two of these functions at a time. Channels 1 and 2 can perform one function, while channels 3 and 4 perform another (or the same) function.

The primary purpose of the 3500/40M monitor is to provide:

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

Each channel, depending on configuration, typically conditions its input signal into 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 transducer signals.

Input Impedance

Standard I/O

10 kΩ

TMR I/O

The effective impedance of three Bussed TMR I/O channels wired in parallel to one transducer is 50 kΩ.

Power Consumption

7 watts 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).

Eccentricity

3.94 mV/µm (100 mV/mil) or

7.87 mV/µm (200 mV/mil).

Differential Expansion

0.394 mV/µm (10 mV/mil) or

0.787 mV/µm (20 mV/mil).

REBAM

40 mV/µm (1000 mV/mil) or

80 mV/µm (2000 mV/mil).

Outputs

Front Panel LEDs

OK LED

Indicates when the 3500/40M is operating properly.

TX/RX LED

Indicates when the 3500/40M is communicating with other modules in the 3500 rack.

Bypass LED

Indicates when the 3500/40M is in Bypass Mode.

Buffered Transducer Outputs

The front of each monitor has one coaxial connector for each channel. Each connector is short-circuit protected.

Output Impedance

550 Ω

Transducer Power Supply

-24 Vdc

Signal Conditioning

Note: Specified at +25 ºC (+77 ºF) unless otherwise noted

Radial Vibration

Frequency Response

Direct filter

User programmable, 4 Hz to 4000 Hz or 1 Hz to 600 Hz.

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 stopband of -34.9 dB. (See Note that follows)

Smax

0.125 to 15.8 times running speed. (See Note that follows)

1X and 2X Vector filter

Constant Q Filter. Minimum rejection in stopband 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. Machines ramping up from a stop must reach 72 cpm before reaching an OK state.

Accuracy

Direct and Gap

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 and Differential Expansion

Frequency Response

Direct filter

-3 dB at 1.2 Hz.

Gap filter

-3 dB at 0.41 Hz.

Accuracy

Within ±0.33% of full-scale typical, ±1% maximum.

Eccentricity

Frequency response

Direct filter

-3 dB at 15.6 Hz.

Gap filter

-3 dB at 0.41 Hz.

Accuracy

Within ±0.33% of full-scale typical, ±1% maximum.

REBAM

Frequency response

Spike

User programmable from 0.152 to 8678 Hz.

Element

User programmable for BPFO ranging from 0.139 to 3836 Hz. High-pass corner is 0.8x BPFO. Low-pass corner is 2.2x BPFO.

Rotor

User programmable from 0.108 to 2221 Hz.

Direct

Programmable from 3.906 to 14.2 Hz. Selection is determined by Spike and Rotor filters.

Gap

Programmable from 0.002 to 1.0 Hz. Selection is determined by the Rotor filter.

1X Vector filter

The range of shaft speeds for which the value is valid is dependent upon the nominal Shaft Speed for which the channel is configured. The following table summarizes the relationship:

Nominal Shaft Speed (Hz)	Valid Speed Range (Hz)
10 to <126	0.071 to 160
126 to <252	0.133 to 330
252 to <504	0.25 to 660
504 to <584	0.50 to 750

Note: If a multi-event gear or speed wheel generates the speed input, the resultant

input signal has an upper limitation of approximately 20 KHz.

Filter quality

Spike high-pass

6-pole Elliptic (155 dB per decade, minimum). Corner frequency is -0.1 dB.

Element bandpass

8-pole Butterworth (155 dB per decade minimum). Corner frequency is -3 dB.

Rotor low-pass

6-pole Elliptic (155 dB per decade, minimum). Corner frequency is -0.1 dB.

Rotor, Direct high-pass

1-pole Butterworth (18 dB per decade, minimum). Corner frequency is -3 dB.

Spike, Direct low-pass

Corner is -0.3 dB maximum.

Gap low-pass

1-pole Butterworth (18 dB per decade, minimum). Corner frequency is -3 dB.

1X amplitude

Constant Q of 16.67. Stopband frequencies are 0.91 and 1.09 times the running speed. Stopband attenuation is -51 dB minimum.

Accuracy

Amplitude

Within ± 0.33% of full scale typical, ± 1% maximum when input signal is at the center frequency of the proportional value's passband.

Phase

3 degrees error, maximum.

Channels enabled

Certain configurations allow the user to enable only one channel of a channel pair. See discussion and graphs in the final pages of this datasheet.

Filter tracking/ stepping (requires a valid speed signal)

Initial condition

Nominal filter set used.

Switch from nominal to lower filter set

Current shaft speed ≤ 0.9 x (Nominal Shaft Speed).

Switch from lower to nominal filter set

Current shaft speed ≥ 0.95 x (Nominal Shaft Speed).

Switch from nominal to higher filter set

Current shaft speed ≥ 1.1 x (Nominal Shaft Speed).

Switch from higher to nominal filter set

Current shaft speed ≤ 1.05 x (Nominal Shaft Speed).

Shaft speed error condition

Nominal filter set used.

Alarms

Alarm setpoints

The user can set Alert levels for each value measured by the monitor and Danger setpoints for any two of the values measured by the monitor. All alarm setpoints are set using software

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

Alarm time delays

Radial vibration, thrust, differential expansion, eccentricity

The user can program Alarm delays using software, and set them 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.

REBAM

The user can program Alarm delays using software, and set them as follows:

Alert

From (calculated minimum value) to 400 seconds in 1 second intervals.

Danger

From (calculated minimum value) to 400 seconds in 0.5 second intervals.

Static Values

Static values are measurements used to monitor the machine. The Proximitor 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.

Differential Expansion

Direct, Gap.

Eccentricity

Peak-to-peak, Gap, Direct Min, Direct Max.

REBAM

Spike, Element, Rotor, Direct, Gap, 1X Amplitude, 1X Phase Lag

Barrier Parameters

Circuit Parameters

Vmax (PWR) = 26.80 V

(SIG) = 14.05 V

Imax (PWR) = 112.8 mA

(SIG) = 2.82 mA

Rmin (PWR) = 237.6 Ω

(SIG) = 4985 Ω

Channel Parameters (entity)

Vmax = 28.0 V

Imax = 115.62 mA

Rmin (PWR) = 237.6 Ω

(SIG) = 4985 Ω

Environmental Limits

Operating Temperature

When used with Internal/External Termination I/O Module:

-30 °C to +65 °C (-22 °F to +150 °F)

When used with Internal Barrier I/O Module (Internal Termination):

0 °C to +65 °C (+32 °F to +150 °F)

Storage Temperature

-40 °C to +85 °C (-40 °F to +185 °F).

Humidity

95%, noncondensing.

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

Hazardous Area Approvals

North American

Approval Option (01)

When used with I/O module ordering options with internal barriers:

Ex nC [ia] IIC: Class I, Div 1

AEx nC [ia] IIC: Class 1, Zone 2/0

Groups A, B, C, D

T4 @ Ta = -20 °C to +65 °C

(-4 °F to +150 °F)

per drawing 138547

When used with I/O module ordering options without internal barriers:

Ex nC [L] IIC: Class I, Div 2

AEx nC IIC: Class 1, Div 2

Groups A, B, C, D

T4 @ Ta = -20 °C to +65 °C

(-4 °F to +150 °F)

per drawing 149243

ATEX:

Approval Option (02)

For Selected Ordering Options with ATEX/CSA agency approvals:

For ATEX agency approval ordering options with internal barriers:

 II 3/(1) G

Ex nC[ia Ga] IIC T4 Gc

T4 @ Ta = -20°C to +65°C

(-4°F to +150°F)

For ATEX agency approval ordering options without internal barriers:

 II 3/(3) G

Ex nC[nL Gc] IIC T4 Gc

T4 @ Ta = -20°C to +65°C

(-4°F to +150°F)

Brazil

Approval Option (02)

For Selected Ordering Options with ATEX/North American agency approvals:

BR-Ex nC [nL] IIC T4

T4 @ Ta = -20 °C to +65 °C

(-4 °F to +150 °F)

South Africa

Approval Option (02)

For Selected Ordering Options with ATEX/North American agency approvals:

Ex nCAL [ia] IIC T4

Ex nCAL [L] IIC T4

T4 @ Ta = -20 °C to +65 °C

(-4 °F to +150 °F)

Note: When used with Internal Barrier I/O Module, refer to specification sheet 141495-01 for approvals information.

For further certification and approvals information please visit the following website:
www.ge-mcs.com/bently

Physical

Monitor Module (Main Board)

Dimensions (Height x Width x Depth)

241.3 mm x 24.4 mm x 241.8 mm

(9.50 in x 0.96 in x 9.52 in).

Weight

0.91 kg (2.0 lb.)

I/O Module (non-barrier)

Dimensions (Height x Width x Depth)

241.3 mm x 24.4 mm x 91.1 mm

(9.50 in x 0.96 in x 3.90 in).

Weight

0.20 kg (0.44 lb.)

I/O Module (barrier)

Dimensions (Height x Width x Depth)

241.3 mm x 24.4 mm x 163.1 mm

(9.50 in x 0.96 in x 6.42 in)

Weight

0.46 kg (1.01 lb.)

Rack Space Requirements

Monitor Module

1 full-height front slot.

I/O Modules

1 full-height rear slot.

Ordering Information

General

The 3500/40M Module requires the following (or later) firmware, and software revisions:

3500/01 Software – Version 2.50

3500/02 Software – Version 2.20

3500/03 Software – Version 1.21

When ordering I/O Modules with External Terminations the External Termination Blocks and Cable must be ordered separately for each I/O Module.

External Termination Blocks cannot be used with Internal Termination I/O Modules.

Bussed External Termination Blocks are to be used with TMR I/O Modules only.

Internal Barrier I/O Modules

Consult the 3500 Internal Barrier specification sheet (part number 141495-01) if the Internal Barrier Option is selected.

REBAM

The REBAM channel type requires the following (or later) firmware, and software revisions:

3500/40M Module Firmware – Revision 2.1

3500/01 Software – Version 3.30

3500/02 Software – Version 2.40

3500/03 Software – Version 1.40

DM2000 Software - Version 3.40.

Requires the M version of the 3500 Proximitor Monitor.

Proximitor Monitor

3500/40 -AXX –BXX

A: I/O Module Type

0 1	Proximitor I/O Module with Internal Terminations
0 2	Proximitor I/O Module with External Terminations
0 3	Proximitor I/O Module with Internal Barriers and Internal Terminations
0 4	TMR Proximitor I/O Module with External Terminations

B: Agency Approval Option

0 0	None
0 1	CSA/NRTL/C (Class 1, Div 2)
0 2	ATEX/CSA (Class 1, Zone 2

Note: Agency Approval Option B 02 is only available with Ordering Option; A 03.

External Termination (ET) Blocks

125808-01

Proximitor ET Block (Euro Style Connectors)

128015-01

Proximitor ET Block (Terminal Strip Connectors)

132242-01

Prox/Seismic Bussed TMR ET Block (Euro Style connectors)

132234-01

Prox/Seismic Bussed TMR ET Block (Terminal Strip connectors)

Cables

3500 Transducer (XDCR) Signal to ET Block Cable

129525 -AXXXX-BXX

A: Cable Length

0 0 0 5	5 feet (1.5 metres)
0 0 0 7	7 feet (2.1 metres)
0 0 1 0	10 feet (3.0 metres)
0 0 2 5	25 feet (7.6 metres)
0 0 5 0	50 feet (15.2 metres)
0 1 0 0	100 feet (30.5 metres)

B: Assembly Instructions

0 1	Not assembled
0 2	Assembled

Spares

176449-01

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125680-01

Proximitor I/O Module with Internal Terminations

126615-01

Proximitor I/O Module with External Terminations

135489-04

Proximitor I/O Module with Internal Barriers and Internal Terminations.

149716-01

TMR Proximitor I/O Module with External Terminations

143488-01

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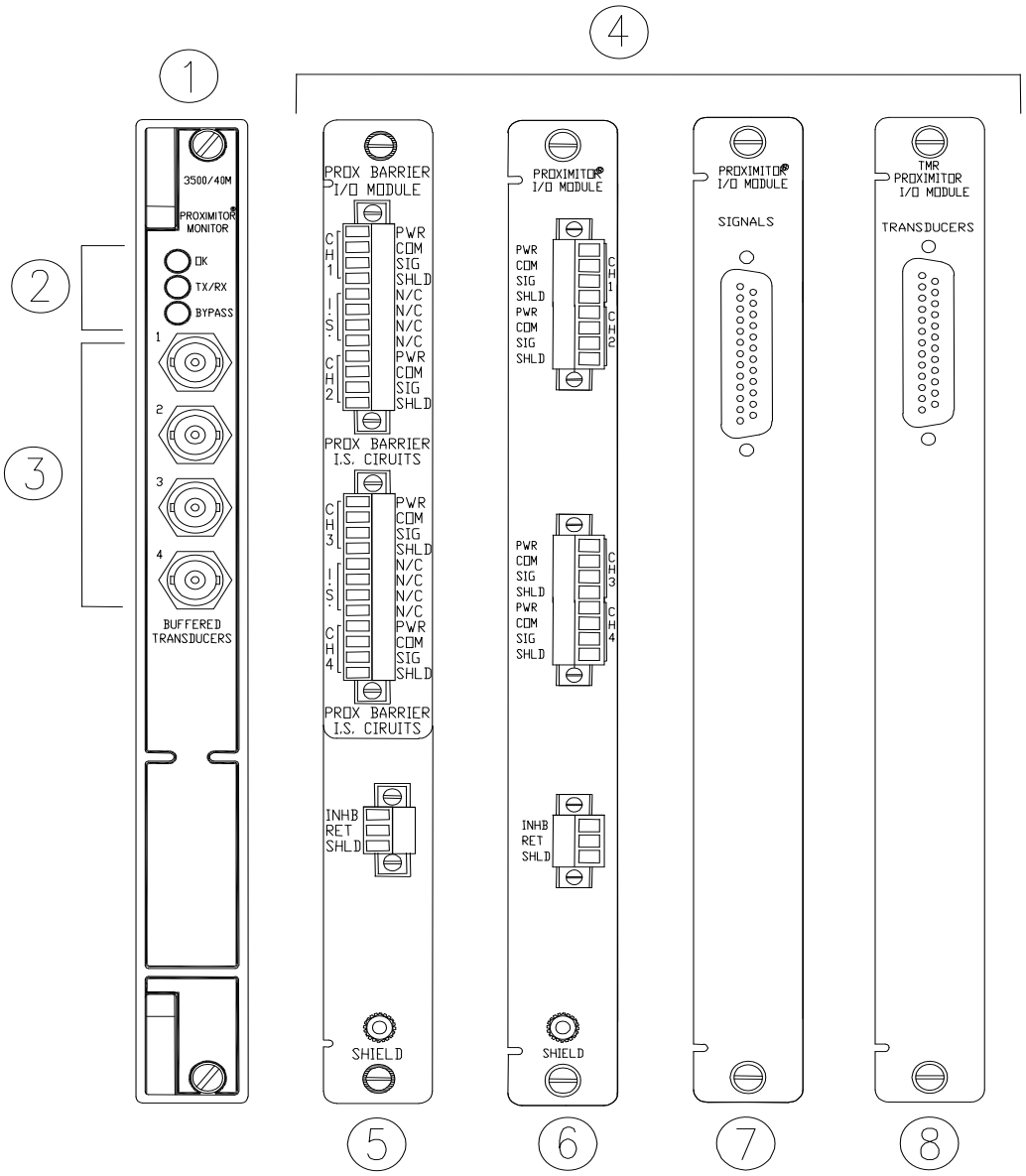
00580434

Connector Header, Internal Termination, 8-position, Green

00502133

Connector Header, Internal Termination, 12-position, Blue

Graphs and Figures



1. Main module front view.
2. Status LEDs.
3. Buffered Transducer Outputs.
4. I/O modules
5. Barrier I/O module, Internal Termination.
6. I/O Module, Internal Termination.
7. I/O Module, External Termination.
8. I/O Module, External Termination.

Figure 1

REBAM® Channels

The following graphs show the maximum machine speed allowed for a monitor channel pair configured for REBAM. The top graph assumes that both channels of the channel pair are enabled. The bottom graph assumes that only one channel of a channel pair is enabled. The maximum speed depends on the number of rolling elements in the bearing. The graph assumes that the rotor low-pass filter corner is set at 3.2X the shaft speed and the spike high-pass filter corner is set at 4X the element pass frequency for the outer race (BPFO).

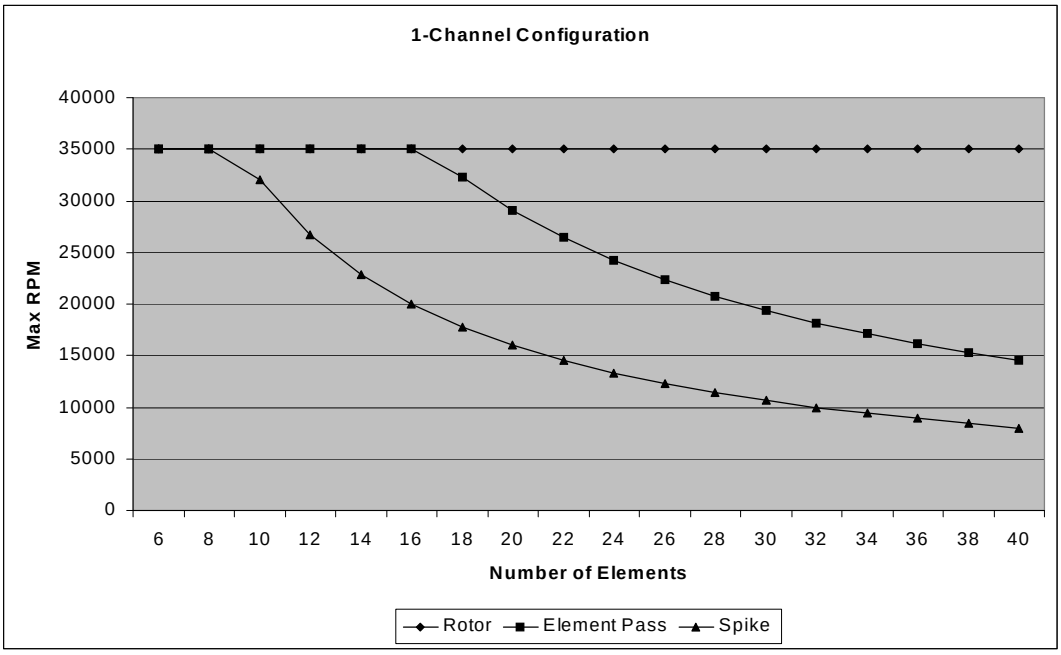


Figure 2

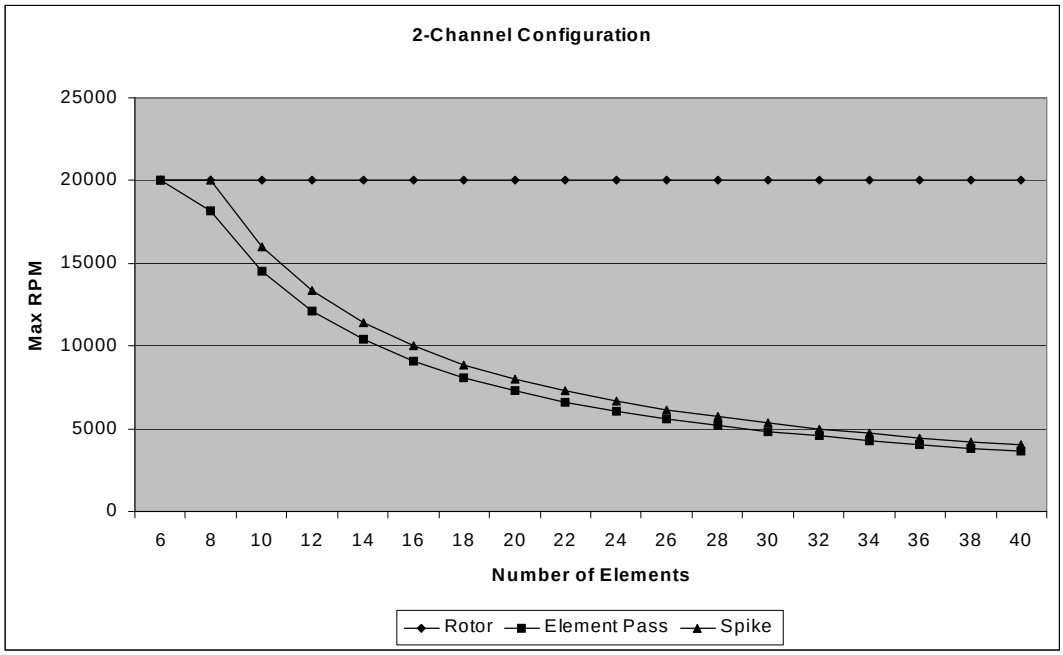


Figure 3

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