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3500/40M Proximitor Monitor

Datasheet

Bently Nevada Machinery Condition Monitoring

141535 Rev. K



Description

The 3500/40M Proximitor Monitor is a four-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
- Eccentricity
- Differential expansion
- REBAM

The primary purpose of the 3500/40M Proximitor Monitor is to provide the following:

- Machinery protection by continuously comparing monitored parameters against configured alarm setpoints to drive alarms
- 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**. You can configure **alert setpoints** for each active static value and **danger setpoints** for any two of the active static values.



You program the monitor channels in pairs. The monitor channels can perform up to 2 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.



Specifications

Inputs

| Signal | Accepts from 1 to 4 proximity transducer signals |
|-------------------|---|
| Power consumption | 7.7 watts, typical |
| Input Impedance | |
| Standard I/O | 10 k Ω (Proximitor and acceleration inputs) |
| TMR I/O | The effective impedance of three bussed TMR I/O channels wired in parallel to one transducer is 50 k Ω |

Sensitivity

| | |
|------------------------|---|
| Radial Vibration | 3.94 mV/ μ m (100 mV/mil) or 7.87 mV/ μ m (200 mV/mil) |
| Thrust | 3.94 mV/ μ m (100 mV/mil) or 7.87 mV/ μ m (200 mV/mil) |
| Eccentricity | 3.94 mV/ μ m (100 mV/mil) or 7.87 mV/ μ m (200 mV/mil) |
| Differential Expansion | 0.394 mV/ μ m (10 mV/mil) or 0.787 mV/ μ m (20 mV/mil) |
| REBAM | 40 mV/ μ m (1000 mV/mil) or 80 mV/ μ m (2000 mV/mil) |

Outputs

| Front Panel LEDs | |
|-----------------------------|---|
| OK LED | Indicates when the 3500/40M SIL Proximitor is operating properly. |
| TX/RX LED | Indicates when the 3500/40M SIL Proximitor is communicating with other modules in the 3500 rack. |
| Bypass LED | Indicates when the 3500/40M SIL Proximitor 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



Specified at +25 °C (+77 °F) unless otherwise noted.

Radial Vibration

| Frequency Response | |
|-------------------------|--|
| Direct filter | User-programmable Single-pole 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 |
| Smax | 0.125 to 15.8 times running speed |
| 1X and 2X vector filter | Constant Q Filter Minimum rejection in stopband of -57.7 dB |



1X and 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 $\pm 0.33\%$ of full-scale typical $\pm 1\%$ maximum |
| 1X and 2X | Within $\pm 0.33\%$ of full-scale typical $\pm 1\%$ maximum |
| Smax | Within $\pm 5\%$ maximum |
| Not 1X | $\pm 3\%$ for machine speeds less than 30,000 cpm $\pm 8.5\%$ for machine speeds greater than 30,000 cpm |

Thrust and Differential Expansion

| | |
|---------------------------|--|
| Accuracy | Within $\pm 0.33\%$ of full-scale typical $\pm 1\%$ maximum |
| Frequency Response | |
| Direct filter | -3 dB at 1.2 Hz |
| Gap filter | -3 dB at 0.41 Hz |

Eccentricity


| | |
|---------------------------|--|
| Accuracy | Within $\pm 0.33\%$ of full-scale typical $\pm 1\%$ maximum |
| Frequency Response | |
| Direct filter | -3 dB at 15.6 Hz |
| Gap filter | -3 dB at 0.41 Hz |

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 depends on the nominal shaft speed for which the channel is configured. |

Table 1: Relationship Between Nominal Shaft Speed and the Valid Speed Range

| 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 |

 If a multi-event gear or speed wheel generates the speed input, the upper limitation of the resultant input signal is 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 $\pm 0.33\%$ of full scale typical $\pm 1\%$ maximum when input signal is at the center frequency of the measured value's passband |
| Phase | 3 degrees error, maximum |
| Channels enabled | Certain configurations allow the user to enable only one channel of a channel pair. |

| Filter Tracking / Stepping (Requires a valid speed signal) | |
|--|--|
| Initial condition | Nominal filter set used |
| Switch from nominal to lower filter set | Current shaft speed $\leq 0.9 \times$ (nominal shaft speed) |
| Switch from lower to nominal filter set | Current shaft speed $\geq 0.95 \times$ (nominal shaft speed) |
| Switch from nominal to higher filter set | Current shaft speed $\geq 1.1 \times$ (nominal shaft speed) |
| Switch from higher to nominal filter set | Current shaft speed $\leq 1.05 \times$ (Nominal Shaft Speed) |
| Shaft speed error condition | Nominal filter set used |

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 Modules (non-barrier) | |
| Dimensions (Height x Width x Depth) | 241.3 mm x 24.4 mm x 99.1 mm (9.50 in x 0.96 in x 3.90 in) |
| Weight | 0.20 kg (0.44 lb) |
| I/O Modules (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 | 1 full-height front slot |
| I/O Modules | 1 full-height rear slot |

Barrier Parameters


The following parameters apply to CSA-NRTL/C and ATEX / IECEx approvals.

| Proximito Barrier | |
|-----------------------------|---|
| Circuit Parameters | $V_{max} (PWR) = 26.25V$ $(SIG) = 13.65 V$ |
| | $I_{max} (PWR) = 110.48 mA$ $(SIG) = 2.74mA$ |
| | $R_{min} (PWR) = 237.6 \Omega$ $(SIG) = 4985 \Omega$ |
| Channel Parameters (entity) | $V_{max} = 27.45 V$ $I_{max} = 113.24 mA$ $R_{min} (PWR) = 237.6 \Omega$ $(SIG) = 4985 \Omega$ |

Alarms

| | |
|-----------------------------|--|
| Alarm Setpoints | Use Rack Configuration Software to set alert levels for each value measured by the monitor and Danger setpoints for any two of the values measured by the monitor. Alarms are adjustable from 0 to 100% of full-scale for each measured value. However, when the full-scale range exceeds the range of the transducer, the range of the transducer will limit the setpoint. |
| Accuracy of alarm setpoints | Within 0.13% of the desired value |

Alarm Time Delays



You can program alarm delays using **Rack Configuration Software.**

| Radial vibration, thrust, differential expansion and eccentricity | |
|---|-------------------------------|
| Alert | From one to 60 seconds in one |

| | |
|--------------|--|
| | second intervals |
| Danger | 0.1 seconds or from one to 60 seconds in 0.5 second intervals |
| REBAM | |
| Alert | From the calculated minimum value to 400 seconds in one second intervals |
| Danger | From the calculated minimum value to 400 seconds in 0.5 second intervals |

Static Values

Static values are measurements used to monitor the machine. The 3500/40M Proximitor Monitor returns the following static values:

| | |
|------------------------|--|
| Radial Vibration | Direct, Gap, 1X Amplitude, 1X Phase Lag, 2X Amplitude, 2X Phase Lag, Not 1X Amplitude and Smax Amplitude |
| Thrust Position | Direct, Gap |
| Differential Expansion | Direct, Gap |
| Eccentricity | Peak-to-peak, Gap, Direct Minimum, Direct Maximum |
| REBAM | Spike, Element, Rotor, Direct, Gap, 1X Amplitude, 1X Phase Lag |

Compliance and Certifications

FCC

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

EMC

European Community Directive:

EMC Directive 2014/30/EU

Standards:

EN 61000-6-2 Immunity for Industrial Environments

EN 61000-6-4 Emissions for Industrial Environments

Electrical Safety

European Community Directive:

LV Directive 2014/35/EU

Standards:

EN 61010-1

RoHS

European Community Directive:

RoHS Directive 2011/65/EU

Maritime

ABS - Marine and Offshore Applications

DNV GL Rules for Classification – Ships, Offshore Units, and High Speed and Light Craft

Hazardous Area Approvals





For the detailed listing of country and product specific approvals, refer to the *Approvals Quick Reference Guide* (108M1756) available from Bently.com.

CSA/NRTL/C

| | |
|---|---|
| <p>When used with I/O module ordering options without internal barriers</p> | <p>Class I, Zone 2: AEx/Ex nA nC ic IIC T4 Gc; Class I, Zone 2: AEx/Ex ec nC ic IIC T4 Gc; Class I, Division 2, Groups A, B, C, and D; T4 @ Ta= -20°C to +65°C (-4°F to +149°F) When installed per drawing 149243 or 149244.</p> |
| <p>When used with I/O module ordering options with internal barriers</p> | <p>Class I, Zone 2: AEx/Ex nA nC ic [ia Ga] IIC T4 Gc; Class I, Zone 2: AEx/Ex ec nC ic [ia Ga] IIC T4 Gc; Class I, Division 2, Groups A, B, C, and D (W/ IS Output for Division 1) T4 @ Ta= -20°C to +65°C (-4°F to +149°F) When installed per drawing 138547.</p> |

ATEX/IECEX

| | |
|---|--|
| <p>When used with I/O module ordering options without internal barriers</p> | <p> II 3 G Ex nA nC ic IIC T4 Gc; Ex ec nC ic IIC T4 Gc; T4 @ Ta= -20°C to +65°C (-4°F to +149°F) When installed per drawing 149243 or 149244.</p> |
| <p>When used with I/O module ordering options with internal barriers</p> | <p> II 3(1) G Ex nA nC ic [ia Ga] IIC T4 Gc; Ex ec nC ic [ia Ga] IIC T4 Gc; T4 @ Ta= -20°C to +65°C (-4°F to +149°F) When installed per drawing 138547.</p> |

Ordering Considerations

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 (Document 141495) 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 Proximitior Monitor.

Ordering Information



For the detailed listing of country and product specific approvals, refer to the *Approvals Quick Reference Guide* (108M1756) available from Bently.com.

Proximitor Monitor 3500/40M - AA-BB

| A: I/O Module Type | |
|-----------------------------------|--|
| 01 | Proximitor I/O Module with Internal Termination |
| 02 | Proximitor I/O Module with External Terminations |
| 03 | Proximitor I/O Module with Internal Barriers and Internal Terminations |
| B: Hazardous Area Approval Option | |
| 00 | None |
| 01 | CSA / NRTL / C (Class 1, Division 2) |
| 02 | ATEX / IECEx / CSA (Class 1, Zone 2) |



Agency Approval Option B-02 is only available with Ordering Option A-03

External Termination Blocks

| | |
|-----------|---|
| 125808-01 | Proximitor ET Block Euro Style Connectors |
| 128015-01 | Proximitor ET Block Terminal Strip Connectors |
| 132242-01 | Proximitor/ Seismic TMR ET Block Euro Style Connectors |
| 132234-01 | Proximitor/Seismic TMR ET Block Terminal Strip Connectors |

Cables

3500 Transducer XDCR signal to External Termination (ET) Block Cable 129525 - AAAA-BB

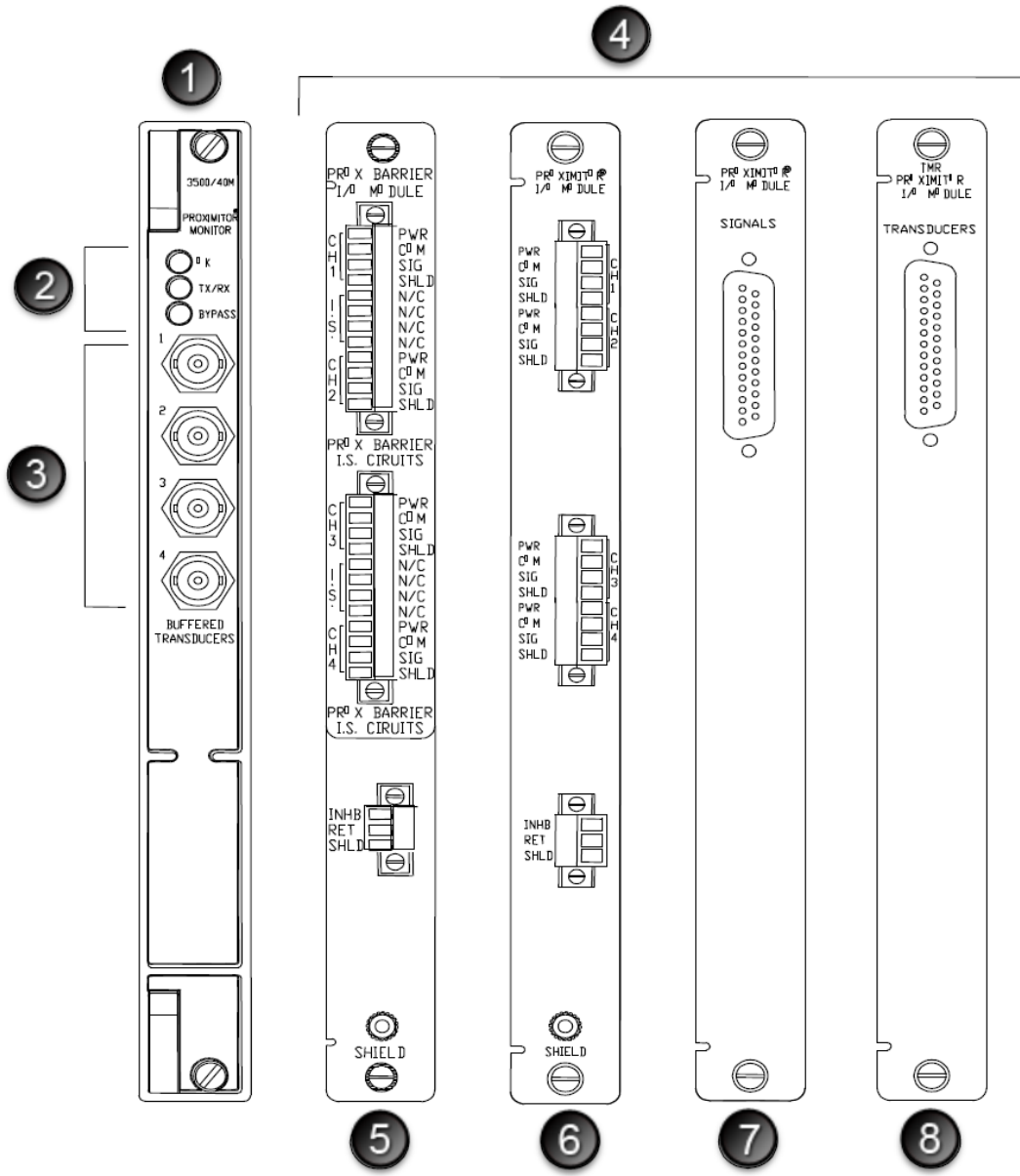
| A: I/O Cable Length | |
|---------------------|------------------------|
| 0005 | 5 feet (1.5 metres) |
| 0007 | 7 feet (2.1 metres) |
| 0010 | 10 feet (3.0 metres) |
| 0025 | 25 feet (7.6 metres) |
| 0050 | 50 feet (15.2 metres) |
| 0100 | 100 feet (30.5 metres) |

| B: Assembly Instructions | |
|--------------------------|---------------|
| 01 | Not assembled |
| 02 | Assembled |

Spares

| | |
|-----------|--|
| 176449-01 | 3500/40M Proximitor Monitor |
| 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 | 3500/40M Monitor User Guide |
| 00580434 | Internal I/O Module connector header, Euro style, 8-pin |
| 00502133 | Internal I/O Module connector header, Euro style, 12-pin |

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: Assorted 3500/40M Proximitor Monitor Views

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