3500/70M Recip Impulse/Velocity Monitor

Bently Nevada™ Asset Condition Monitoring

Description

The 3500/70M Recip Impulse Velocity / Monitor is a 4-channel monitor that can be used as part of the reciprocating compressor solutions package for monitoring compressor crankcase and crosshead vibration. The monitor accepts input from seismic transducers, conditions the signal to derive various vibration measurements, and compares the conditioned signals with user-programmable alarms. Each channel of the 3500/70M can be programmed using the 3500 Rack Configuration Software to perform one of the following functions:

- Impulse Acceleration
- Recip Acceleration
- Recip Velocity

Note: The monitor channels are programmed in pairs and 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 purposes of the 3500/70M monitor are to provide:

1. machinery protection by continuously comparing monitored parameters against configured alarm set points to drive alarms, and
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”. Users can configure Alert setpoints for each active static value and Danger set points for any two of the active static values.

Specifications

Specified at 25 °C (77 °F), voltages referenced to monitor common unless specified otherwise.

Inputs

Signal

Accepts from 1 to 4 velocity or acceleration transducer signals.

Input Impedance

10 k Ω (Acceleration Input),

>1 MΩ (Velocity Input).

Sensor Compatibility

330500 Velomitor® Piezo-Velocity Sensor

330525 Velomitor XA Piezo-Velocity Sensor

190501 Velomitor CT Velocity Transducer

330400 Accelerometer Acceleration Transducer

330425 Accelerometer Acceleration Transducer

Special Inhibit

Contact closure, 5 Vdc @ 390µA typical.

Power Consumption

7.7 watts, typical

Sensitivity

Impulse Acceleration

10 mV/(m/s^2) (100 mV/g), or

user-selected 0.51 – 11.72 mV/(m/s^2) (5 – 115 mV/g).

Recip Acceleration

10 mV/(m/s^2) (100 mV/g), or

user-selected 0.51 – 11.72 mV/(m/s^2) (5 – 115 mV/g).

Recip Velocity

3.94 mV/(mm/s) (100 mV/(in/s)), or

user-selected 3.54 – 22.64 mV/(mm/s) (90 – 575 mV/(in/s).

Outputs

Front Panel LEDs

OK LED

Indicates the 3500/70M is operating properly.

TX/RX LED

Indicates the 3500/70M is communicating with other modules in the 3500 rack.

Bypass LED

Indicates the 3500/70M is in Bypass Mode.

Transducer Power Supply

Voltage

-22 Vdc minimum

Current

40 mA maximum; (15 mA maximum on startup to guarantee no fold back)

Output Impedance

20 Ω typical operating; 1000 Ω typical under fold back conditions.

Protection

Foldback current 15.4 to 24.9 mA

Buffered Transducer Outputs:

The front of each monitor has one coaxial connector for each channel.

Output Impedance

550 Ω typical.

Protection

Each connector is short-circuit protected.

Recorder:

+4 to +20 mA proportional to monitor full-scale. The user selects one static data value from each channel to be used for that channel's recorder value.

Voltage Compliance

+12 Vdc maximum.

Load Resistance

600 Ω maximum

Resolution

0.3662 µA maximum

Update rate

<100 msec.

Accuracy

Within ±0.05 mA,

±0.14 mA over temperature range.

Signal Conditioning

Impulse Acceleration

Accuracy

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

Band start

0 to 359°, 1° resolution.

Band duration

1 to 360°, 1° resolution.

Frequency Response

Bias Filter

-3 dB at 0.01 Hz, 1-pole, Low-Pass

Not OK Filter

-3 dB at 2400 Hz, 1-pole, Low-Pass

Static values

Smoothing filter, 8-revolution average value.

Filter Quality

High-Pass

4-pole (80 dB per decade, 24 dB per octave).

Low-Pass

4-pole (80 dB per decade, 24 dB per octave).

Corner selection:	Peak 3 db corner	RMS 3 dB corner
High-Pass	3-3000 Hz	10-3000 Hz
Low-Pass	30-30000 Hz	40-30000 Hz

Recip Acceleration

Accuracy

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

Frequency Response

Bias Filter

-3 dB at 0.01 Hz, 1-pole, Low-Pass

Not OK Filter

-3 dB at 2400 Hz, 1-pole, Low-Pass

Peak static values

-3 dB at 0.3 Hz, 1-pole, Low-Pass

RMS static values

-3 dB at 0.1 Hz, 1-pole, Low-Pass

Filter Quality

High-Pass

4-pole (80 dB per decade, 24 dB per octave).

Low-Pass

4-pole (80 dB per decade, 24 dB per octave).

Corner selection

Peak 3 db corner
Integrate and/or RMS 3 dB corner

High-Pass

3-3000 Hz

10-3000 Hz

Low-Pass

30-30000 Hz

40-30000 Hz

Recip Velocity

Accuracy

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

Velomitor

Additional accuracy degradation occurs when full scale signal levels are low:

Full Scale 0-0.5: ±3% Typical

Full Scale 0-1.0: ±2% Typical

Full Scale 0-2.0: ±1% Typical

Frequency Response

Bias filter

-3dB at 0.09 Hz, 1-pole, Low Pass

Not OK filter

-3 dB at 2400 Hz, 1-pole, Low Pass

Integration filter

-3 db at 0.34 Hz, 1-pole, Low-Pass

RMS static values

-3 dB at 0.1 Hz, 1-pole, Low-Pass

Peak static values

-3 dB at 0.3 Hz, 1-pole, Low-Pass

1X & 2X Vector Filter

Constant Q filter with bandwidth = ± 3% running speed (Q=16.7).

Filter QualityHigh-Pass

4-pole (80 dB per decade, 24 dB per octave).

Low-Pass:

2-pole (40 dB per decade, 12 dB per octave).

Corner selection:	Non-RMS 3 dB corner	RMS 3 dB corner
High-Pass	3-400 Hz 1-400 Hz (CT)	10-400 Hz
Low-Pass	40-5500 Hz	60-5500 Hz

Alarms

Alarm Set points:

Users can set Alert levels for each value measured by the monitor. In addition, users can set Danger set points for any two of the values measured by the monitor. All alarm set points are set using the 3500 Rack Configuration Software. Alarms are adjustable and can normally be set 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 software will limite the setpoint to the range of the transducer. Accuracy of alarms is within 0.13% of the desired value.

Alarm Time Delays:

Alarm delays can be programmed using software, and can be set as follows for all channel types:

Alert

From 1 to 60 seconds in 1 second intervals.

Danger

From 1 to 60 seconds in 0.5 second intervals or 0.1 seconds.

Static Values

Static values are measurements used to monitor the machine. The Recip Impulse / Velocity Monitor returns static values from one of the following channel types:

Impulse Acceleration

Direct, Bias Voltage, six (6) user-adjustable crank angle bands with peak or RMS acceleration in the band.

Recip Acceleration

Direct, 1X Amplitude, 2X Amplitude (defined as: RMS or peak acceleration or velocity) and 1X Phase, 2X Phase and Bias Voltage.

Recip Velocity

Direct, 1X Amplitude, 2X Amplitude (defined as: RMS or peak velocity or peak-to-peak displacement),and 1X Phase, 2X Phase and Bias Voltage

Note: Bias Voltage contains no information about the condition of the machinery being monitored but is provided only for monitor system diagnostics.

Barrier Parameters

The following parameters apply for both CSA-NRTL/C and CENELEC approvals.

Proximitor® Barrier

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

Seismic Barrier

Circuit Parameters

Vmax (PWR) = 27.25 V

Imax (PWR) = 91.8 mA

Rmin (PWR) = 297 Ω

Channel Parameters (Entity)

Vmax = 27.25 V

Imax = 91.8 mA

Rmin (PWR) = 297 Ω

Environmental Limits

Operating Temperature

With Internal/External Termination I/O Module

-30 °C to +65 °C (-22 °F to +150 °F)

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%, non-condensing.

CE Mark Directives

EMC Directives:

Certificate of Conformity:

136669

EN50081-2

Radiated Emissions

EN 55011, Class A

Conducted Emissions

EN 55011, Class A

EN50082-2

Electrostatic Discharge

EN 61000-4-2, Criteria B

Radiated Susceptibility

ENV 50140, Criteria A

Conducted Susceptibility

ENV 50141, Criteria A

Electrical Fast Transient

EN 61000-4-4, Criteria B

Surge Capability

EN 61000-4-5, Criteria B

Magnetic Field

EN 61000-4-8, Criteria A

Power Supply Dip

EN 61000-4-11, Criteria B

Radio Telephone

ENV 50204, Criteria B

CE Mark Low Voltage Directives:

Certificate of Conformity:

134036

EN 61010-1:

Safety Requirements

Hazardous Area Approvals

CSA/NRTL/C

Approval Option (01)

Class I, Div 2

Groups A, B, C, D

T4 @ Ta = -30 °C to +65 °C

(-22 °F to +150 °F)

Certification Number

CSA 150268-1002151 (LR 26744)

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

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 Module:

1 full-height front slot.

I/O Modules:

1 full-height rear slot.

Ordering Considerations

General

External Termination Blocks cannot be used with Internal Termination I/O Modules.
When ordering I/O Modules with External Terminations, the External Termination Blocks and Cables must be ordered separately.
The 3500 Internal Barrier specification sheet (part number 141495-01) should be consulted if the Internal Barrier Option is selected.

Software / Firmware Compatibility

The 3500/70M Module requires the following (or later) firmware and software revisions:
Software:

3500/01 Configuration Software

Version 3.70

3500/02 Data Acquisition Software

Version 2.50

3500/03 Operator Display Software

Version 1.50

System 1™ Software

Version 5.10

Firmware:

3500/70M Firmware

Version 2.30

3500/22M TDI Firmware

Version 1.30

Ordering Information

Recip Impulse/Velocity Monitor

3500/70-AXX-BXX

A: I/O Option

0 1	Prox/Velom I/O Module with Internal Terminations
0 2	Prox/Velom I/O Module with External Terminations
0 3	Internal Barrier, 4 accelerometers
0 4	Internal Barrier, 2 accelerometers, 2 Velomitors
0 5	Internal Barrier, 4 Velomitors

B: Agency Approval Option

00	None
01	CSA/NRTL/C

External Termination Blocks

128702-01

Recorder External Termination Block (Euro Style connectors).

128710-01

Recorder External Termination Block (Terminal Strip connectors).

125808-08

Proximitor/Velomitor External Termination Block (Euro Style connectors).

128015-08

Proximitor/Velomitor External Termination Block (Terminal Strip connectors).

Cables

3500 Transducer (XDCR) Signal to External Termination (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 metres)
0 0 2 5	25 feet (7.5 metres)
0 0 5 0	50 feet (15 metres)
0 1 0 0	100 feet (30.5 metres)

B: Assembly Instructions

0 1	Not Assembled
0 2	Assembled

3500 Recorder Output to External Termination (ET) Block Cable

129529-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 metres)
0 0 2 5	25 feet (7.5 metres)
0 0 5 0	50 feet (15 metres)
0 1 0 0	100 feet (30.5 metres)

B: Assembly Instructions

0 1	Not Assembled
0 2	Assembled

Spares

176449-09

3500/70M Impulse/Velocity Monitor.

166226-01

3500/70M Recip Impulse/Velocity Monitor Manual.

135489-01

I/O Module with Internal Barriers (Internal Terminations)

(4 x Prox/Accel).

135489-02

I/O Module with Internal Barriers (Internal Terminations)

(2 x Prox/Accel + 2 x Velomitor).

135489-03

I/O Module with Internal Barriers (Internal Terminations)

(4 x Velomitor).

140471-01

Prox/Velom I/O Module with Internal Terminations.

140482-01

Prox/Velom I/O Module with External Terminations.

00561941

3500/70M Prox/Velom I/O Module ten-pin connector shunt.

00580434

Internal I/O Module connector header, Euro Style, 8 pin. Used on I/O modules 128229-01 and 138708-01.

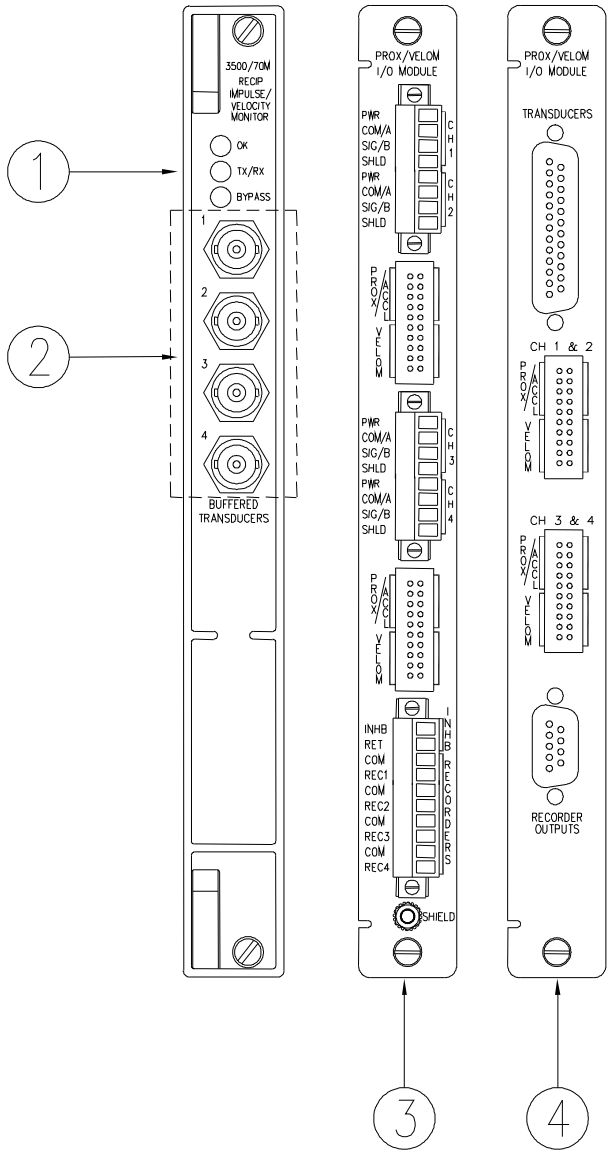
00580432

Internal I/O Module connector header, Euro Style, 10 pin. Used on I/O modules 128229-01, 138708-01.

00502133

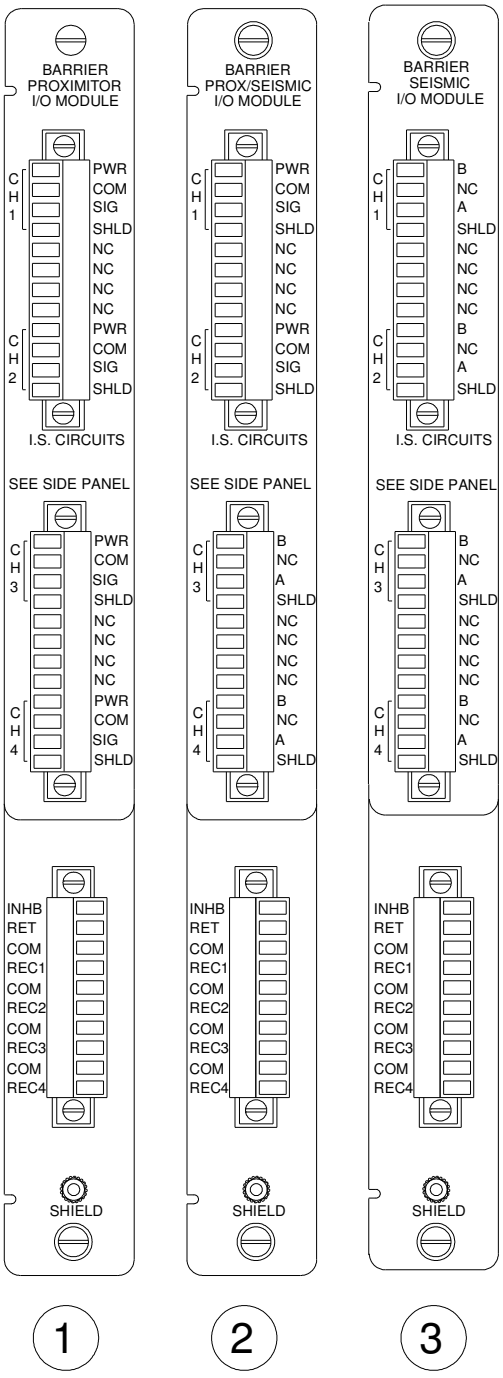
Internal I/O Module connector header, Euro Style, 12 pin

Graphs and Figures



1. Status LEDs
2. Buffered Transducer Outputs
3. Prox/Velom I/O Module, Internal Terminations, 140471-01
4. Prox/Velom I/O Module, External Terminations, 140482-01

Figure 1: **Front and rear view of the Recip Impulse / Velocity Monitor**



1. Barrier I/O module for connecting four Accelerometer sensors. 135489-01
2. Barrier I/O module for connecting two Accelerometer sensors and two Velomitor® sensors. 135489-02
3. Barrier I/O module for connecting four Velomitor® sensors. 135489-03

Figure 2: Barrier I/O Modules for the ImpulseRecip Impulse / Velocity Monitor

1631 Bently Parkway South, Minden, Nevada USA 89423
Phone: 775.782.3611 Fax: 775.215.2873
www.ge-energy.com/bently