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3500/44M Aeroderivative Monitor

Bently Nevada* Asset Condition Monitoring



Description

The 3500/44M Aeroderivative GT Vibration Monitor is a four-channel monitor designed for Aeroderivative Gas Turbine applications. The Aero GT and TMR Aero GT I/Os interface to velocity transducers through Bently Nevada™ interface modules 86517 and 86497. The monitor uses the Prox/Velom I/O to interface to our Velomitor® sensors and accelerometers. The user can configure the 3500/44M, using the 3500 Rack configuration Software, for any of the following filter options:

- Signal Integration
- 1X vibration tracking
- Band-pass vibration

The 3500/44M accepts input from two separate Keyphasor® signals, allowing each channel pair to use a different tracking filter.

The 3500/44M is designed to meet the recommended requirements of the following Aeroderivative Gas Turbine Manufacturers:

1. Rolls Royce: RB211, Avon.
2. General Electric: LM1600, LM2500, LM5000, LM6000.
3. United Technologies: Turbo Power GG 3, G44, FT 4, FT 8.

The primary purpose of the 3500/44M monitor is to provide:

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

For Triple Modular Redundant (TMR) applications, the user must install Aeroderivative Monitors adjacent to each other in groups of three. In this configuration the system uses voting to ensure accurate operation and to avoid single-point failures.

The user can configure multimode channels to have up to eight sets of alarm parameters (Alert and Danger setpoints and alarm time delays). The configuration of each set can be for a specific machine mode, and the monitor can switch to a specific set as the machine changes modes. This is done via contacts on multimode I/O modules or by software commands through a communications gateway.

Specifications

Inputs

Signal

Accepts 1 to 4 signals from our interface modules (86517 and 86497), Velomitors and Accelerometers.

Input Impedance

Aero GT I/O

Greater than 95 kΩ

Prox/Velom I/O and Multimode Prox/Velom I/O

10 kΩ for Prox/Accel.

3.5 MΩ for Velomitor.

Power Consumption

7.7 watts typical

Sensitivity

Aeroderivative

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

5.71 mV/(mm/s) (145mV/(in/s))

Aeroderivative2 and Multimode Aeroderivative

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

5.71 mV/(mm/s) (145mV/(in/s)) or

10.19 mV/(m/s^2) (100 mV/g) or

2.55 mV/(m/s^2) (25 mV/g) or

1.02 mV/(m/s^2) (10 mV/g)

Outputs

Front Panel LEDs

OK LED

Indicates when the 3500/44M is operating properly.

TX/RX LED

Indicates when the 3500/44M is communicating with other modules in the 3500 rack.

Bypass LED

Indicates when the 3500/44M 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

-23 Vdc nominal at 43 mA max.

Recorder

+4 to +20 mA. Output is proportional to monitor full-scale. One output is provided for each channel. Monitor operation is unaffected by short circuits on recorder outputs.

Voltage Compliance (current output)

0 to +12 Vdc range across load. Load resistance is 0 to 600 Ω.

Resolution

0.3662 µA per bit

±0.25% error at room temperature ±0.7% error over temperature.

Update rate 100 ms or less.

Signal Conditioning

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

Aeroderivative

Frequency Response

Direct signal

4 Hz to 30 kHz, -3 dB

Bandpass filter

Low-pass corner

200 Hz (-3 dB)

Low-pass rolloff

10-pole (200 dB per decade, 60 dB per octave)

High-pass corner

25, 75, or 100 Hz (-3 dB)

High-pass rolloff

10-pole (200 dB per decade, 60 dB per octave)

Tracking filter

Tracking filter is valid for machine speeds of 60 to 240,000 cpm.

Constant Q

User-configurable by selecting one of 22 normal operating speeds from 2,400 to 18,000 RPM and by bandwidth of 3 or 5Hz.

Rolloff

6-pole (120 dB per decade, 36 dB per octave).

Accuracy

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

Signal Conditioning

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

Aeroderivative2 and Multimode Aeroderivative

Frequency response

Direct Signal

Non-integrated velocity

4 Hz to 5500 Hz (-3 dB)

Integrated Velocity

18 Hz to 5500 Hz (-3 dB)

Non-integrated acceleration

4 Hz to 30,000 Hz (-3 dB)

Integrated Acceleration

18 Hz to 14,500 Hz (-3 dB)

Bias low-pass filter

0.01 Hz (-3 dB)

Bandpass filter

Low-pass cutoff frequency

Configurable between 100 Hz and 5500 Hz (-3 db)

Low-pass rolloff

8-pole (160 dB per decade, 48 dB per octave).

High-pass cutoff frequency

Configurable between 10 Hz and 1000 Hz (-3 dB)

High-pass rolloff

8-pole (160 dB per decade, 48 dB per octave).

Tracking filter

Tracking filter is valid for machine speeds of 60 to 300,000 cpm.

Constant Q

User configurable by selecting one of 35 normal operating

speeds from 2,400 to 30,000 RPM and by bandwidth of 3 or 5 Hz.

Rolloff

6-pole (120 dB per decade, 36 dB per octave).

Accuracy

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

Alarms

Alarm Setpoints

The user can set Alert levels for various values measured by the monitor and Danger setpoints for up to two of the values measured by the monitor using configuration software.

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 will limit the setpoint. Accuracy of alarms are to within 0.13% of the desired value.

Aeroderivative

Direct, 1X Amplitude, Bandpass

Aeroderivative2

Direct, Bandpass, 1X Amplitude, 1X Phase Lag

Multimode Aeroderivative

Direct, Direct-B, Bandpass, Bandpass-B, 1X Ampl, 1X Ampl-B, 1X Phase Lag

Alarm Time Delays

For Aeroderivative channels, one alert and one danger delay can be set for each channel.

For Aeroderivative2 and Multimode Aeroderivative channels, delays can be set for each proportional value having alarm setpoints.

Alert

From 1 to 60 seconds in 1 second intervals.

Danger

0.1 seconds or from 1 to 60 seconds in 1 second intervals.

Proportional Values

Proportional values are measurements used to monitor the machine. The 3500/44M Monitor provides the following proportional values:

Aeroderivative

Direct, 1X Amplitude, Bandpass

Aeroderivative2

Direct, Bandpass, Bias, 1X Amplitude, 1X Phase Lag

Multimode Aeroderivative

Direct, Direct-B, Bandpass, Bandpass-B, 1X Ampl, 1X Ampl-B, 1X Phase Lag, Mode

Environmental Limits

Operating Temperature

-30 °C to +65 °C (-22 °F to +150 °F)

Storage Temperature

-40 °C to +85 °C (-40 °F to +185 °F)

Humidity

95%, noncondensing

CE Mark Directives

Declaration of Conformity

134036

EMC Directives

EN61000-6-4

Radiated Emissions

EN 55011, Class A

Conducted Emissions

EN 55011, Class A

EN61000-6-2

Electrostatic Discharge

EN 61000-4-2, Criteria B

Radiated Susceptibility

EN61000-4-3, Criteria A

Conducted Susceptibility

EN61000-4-6, Criteria A

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

Low Voltage Directives

IEN61010-1

Safety Requirements

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)

Monitor Module

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

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

0.45 kg (1.0 lb.).

Rack Space Requirements

Monitor Module

1 full-height front slot.

I/O Modules

1 full-height rear slot.

Ordering Considerations

The following (or newer) is required to use the Aeroderivative channel type:

3500 Rack Configuration Software – Version 2.50

The following (or newer) is required to use the Prox/Velom I/O:

3500 Rack Configuration Software – Version 3.0

The following (or newer) is required to use the Aeroderivative2 channel type:

3500 Rack Configuration Software – Version 3.3

The following (or newer) is required for Multimode Aeroderivative applications:

3500/44M Module Firmware – Version 2.41

3500/01 Software – Version 3.87

Multimode applications that will use hardware contacts to change monitor modes require:

3500/44M Module Hardware – Revision S or newer Multimode I/O modules.

Multimode applications that will use software commands to change monitor modes require:

3500/22 Module Firmware – Version 1.32 or newer

3500/92 Module Firmware – Version 1.16 or newer

Multimode applications incorporating the 3500/94 Display require:

3500/22 Module Firmware – Version 1.60 or newer

3500/94 Module Firmware – Version 2.30 or newer

Multimode applications will have the following restrictions:

System1® Software – Supported as Custom Monitors only.

3500 Data Acquisition – Historical trending not supported.

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

A multimode recorder ET block must be used with an external termination multimode I/O module, and a 129525 signal cable is used to connect these components. The ET block provides recorder outputs and mode inputs.

Ordering Information

Aeroderivative Monitor

3500/44-AXX-BXX

A: I/O Module Type

0 1	Aero GT I/O Module with Internal Terminations
0 2	Aero GT I/O Module with External Terminations
0 3	Bussed TMR I/O Module with External Terminations
0 5	Prox/Velom I/O Module with Internal Terminations
0 6	Prox/Velom I/O Module with External Terminations
0 7	Multimode Prox/Velom I/O Module with Internal Terminations

0 8 Multimode Prox/Velom I/O Module with External Terminations

B: Agency Approval Option

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

Note: Agency Approval Option B 02 is only available with Ordering Options A 01, A 05, A 07, and A 08.

External Termination (ET) Blocks

125808-03

Aeroderivative ET Block (Euro Style Connectors)

125808-08

Prox/Velom External Termination Block (Euro Style connectors).

125808-11

Multimode Prox/Velom External Termination Block (Euro Style connectors).

125808-13

Multimode Recorder Output and Mode Input External Termination Block (Euro Style connectors).

128702-01

Recorder External ET Module (Euro Style connectors).

132242-02

Bussed Aero GT ET Module (Euro Style connectors).

128015-03

Prox/Velom ET Block

128015-08

Aeroderivative ET Block (Terminal Strip Connectors).

128015-11

Multimode Prox/Velom External Termination Block (Terminal Strip connectors).

128015-13

Multimode Recorder Output and Mode Input External Termination Block (Terminal Strip connectors).

128710-01

Recorder External ET Module (Terminal Strip connectors).

132234-02

Bussed Aero GT ET Module (Terminal Strip connectors).

External Termination Cables

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 (3.0 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

Recorder Output to External Termination (ET) Block Cable

129529-AXXX-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 (7.5 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
0 0 0 5 5 feet (1.5 metres)

Spares

176449-03

3500/44M Aeroderivative Monitor.

143490-01

3500/44M Aeroderivative Manual.

126599-01

Aero GT I/O Module Internal Terminations.

126623-01

Aero GT I/O Module External Terminations.

140471-01

Prox/Velom I/O Module with Internal Terminations

140482-01

Prox/Velom I/O Module with External Terminations.

169459-01

Multimode Prox/Velom I/O Module with Internal Terminations.

169459-02

Multimode Prox/Velom I/O Module with External Terminations.

126640-01

Bussed TMR I/O Module with External Terminations.

00580434

Euro Style connector header, 8 pin, green, for use on I/O modules with internal terminations.

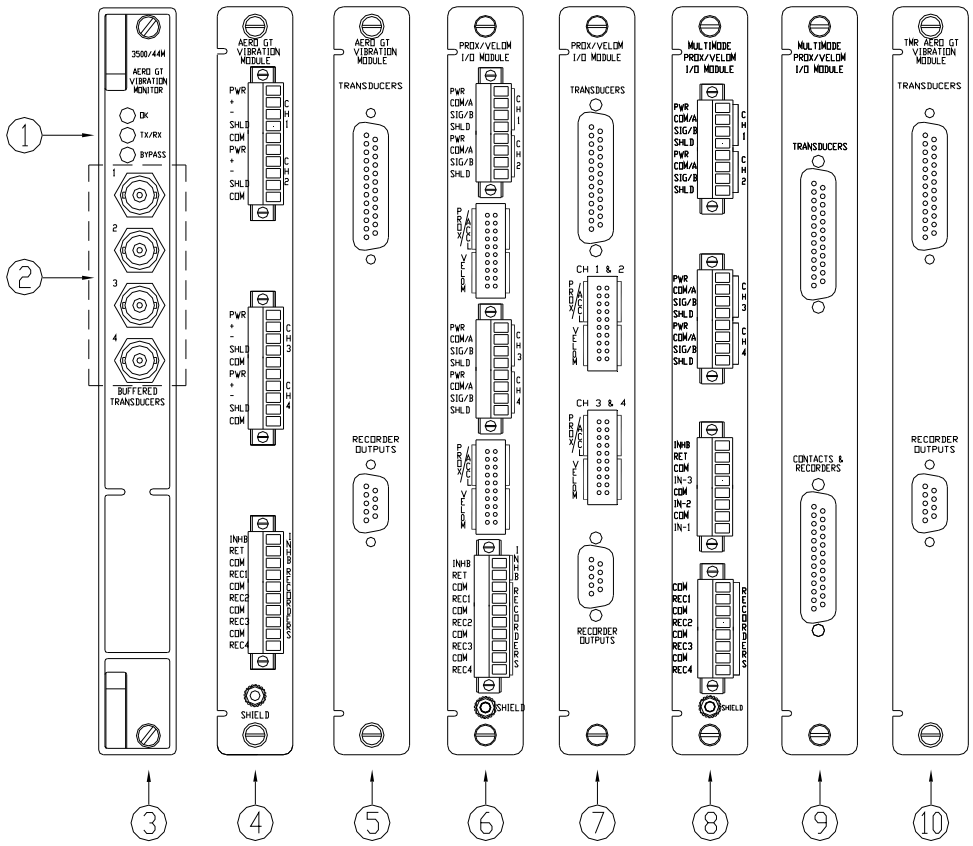
00580432

Euro Style connector header, 10 pin, green, for use on I/O modules with internal terminations.

00561941

Prox/Velom and Multimode Prox/Velom I/O Module ten-pin connector shunt.

Figures and Tables



1. Status LEDs
2. Buffered Transducer Outputs
3. 3500/44M Main Module
4. Aero GT I/O Module, Internal Terminations
5. Aero GT I/O Module, External Terminations
6. Prox/Velom I/O, Internal Terminations
7. Prox/Velom I/O, External Terminations
8. Multimode Prox/Velom I/O, Internal Terminations
9. Multimode Prox/Velom I/O, External Terminations
10. Bussed TMR I/O Module, External Terminations

Figure 1: Front and rear view of the Aero GT Monitor

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