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# 3500/45E Position Monitor

Bently Nevada\* Asset Condition Monitoring



## Description

The 3500/45E Position Monitor is a 4-channel monitor that accepts input from proximity transducers, Rotary Position Transducers (RPTs), DC Linear Variable Differential Transducers (DC LVDTs), AC Linear Variable Differential Transducers (AC LVDTs) (Supported only in a 3300 rack upgrade (Encore 1.0)) and rotary potentiometers, 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 3500/45E using the 3500 Rack Configuration Software to perform any of the following functions:

- Axial (thrust) Position
- Differential Expansion
- Standard Single Ramp Differential Expansion
- Non-standard Single Ramp Differential Expansion
- Dual Ramp Differential Expansion
- Complementary Differential Expansion
- Case Expansion
- Valve Position

The 3500 ENCORE series is available in two configurations:

**3500 ENCORE Rack Upgrade:** In this configuration the 3500/45E is installed as part of a 3500 ENCORE upgrade of a 3300 Monitor System where the 3300 chassis and IO remain in place. When used in a rack upgrade the position monitors use the pre-existing 3300 series IO Module and the relays located on the 3300 series IO.

**3500 ENCORE System:** In this configuration there will be a 3500 ENCORE System Rack with 3500 ENCORE position IO modules. Monitors in 3500 ENCORE Systems use a logic programmable Relay Module to drive alarm relays.

The primary purpose of the 3500/45E 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.

Each channel, depending on configuration, typically conditions its input signal to generate 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 and Ordering Information  
Part Number 289792-01  
Rev. D (09/15)

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## Specifications

### Inputs

#### Signal

Accepts from 1 to 4 proximity, LVDT or Rotary Position Transducer (RPT) signals.

#### Input Impedance

1 M $\Omega$  (DC LVDT Inputs),  
10 k $\Omega$  (Proximity Inputs),  
137 K $\Omega$  (AC LVDT Inputs),  
200 k $\Omega$  (Rotary Potentiometer Inputs).

#### Power Consumption

6.8 W, typical.

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## Sensitivity

#### Thrust

3.937 mV/ $\mu$ m (100 mV/mil), or  
7.874 mV/ $\mu$ m (200 mV/mil).

#### Differential Expansion

0.394 mV/ $\mu$ m (10 mV/mil), or  
0.787 mV/ $\mu$ m (20 mV/mil).

#### Ramp Differential Expansion

0.394 mV/ $\mu$ m (10 mV/mil), or  
0.787 mV/ $\mu$ m (20 mV/mil).

#### Complimentary Input Differential Expansion

0.394 mV/ $\mu$ m (10 mV/mil), or  
0.787 mV/ $\mu$ m (20 mV/mil), or  
3.937 mV/ $\mu$ m (100 mV/mil).

#### DC LVDT Case Expansion

0.05 V/mm (1.25 V/in), or  
0.08 V/mm (1.90 V/in), or  
0.10 V/mm (2.50 V/in), or  
0.18 V/mm (4.50 V/in), or  
0.20 V/mm (5.00 V/in), or  
0.22 V/mm (5.70 V/in).

#### AC LVDT Case Expansion (3300 upgrade rack only)

28.74 mV/V/mm (0.73 mV/V/mil), or  
15.35 mV/V/mm (0.39 mV/V/mil), or  
9.45 mV/V/mm (0.24 mV/V/mil).  
Nonstandard Values: 1.14 to 19.34  
mV/V/mm (0.03 to 0.49 mV/V/mil).

#### AC LVDT Valve Position (3300 upgrade rack only)

28.74 mV/V/mm (0.73 mV/V/mil), or  
15.35 mV/V/mm (0.39 mV/V/mil), or  
9.45 mV/V/mm (0.24 mV/V/mil), or  
9.84 mV/V/mm (0.25 mV/V/mil), or  
7.48 mV/V/mm (0.19 mV/V/mil), or  
5.51 mV/V/mm (0.14 mV/V/mil), or  
3.54 mV/V/mm (0.09 mV/V/mil), or  
2.76 mV/V/mm (0.07 mV/V/mil).  
Nonstandard Values: 2.20 to 37.41  
mV/V/mm (0.06 to 0.95 mV/V/mil).

#### Rotary Potentiometer Valve Position

41 mV/degree rotation.

#### Rotary Position Transducer (RPT) Valve Position

140 mV/degree rotation. or  
70 mV/degree rotation, or  
50 mV/degree rotation.

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## Outputs

#### Front Panel LEDs

##### OK LED

Indicates when the 3500/45E is operating properly.

##### DANGER LED

Indicates the 3500/45E has detected a danger condition and is driving the danger relay.

### ALERT LED

Indicates the 3500/45E has detected an Alert condition and is driving the alert relay.

### Bypass LED

Indicates when the 3500/45E 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. When using AC LVDT's, all channels are a DC representation of the AC signals returned by the LVDT.

### Output Impedance

499 Ω.

### Relay Contacts (3300 upgrade rack only)

The 3500/45E will drive the relays for the various 3300 SIRM options.

### Proximitors or RPT

-24 Vdc.

### DC LVDT

+15 Vdc.

### AC LVDT

2.3 Vrms 3400 Hz sine wave.

### Rotary Potentiometer

-14.68 Vdc.

### Recorder

+4 to +20 mA. Values are proportional to monitor full-scale. The monitor provides individual recorder values 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 range.

Update rate 100 ms or less.

### Signal Conditioning

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

### 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.

### Ramp Differential Expansion

#### Frequency Response

Direct filter

-3 dB at 1.2 Hz.

Gap filter

-3 dB at 0.41 Hz.

### Accuracy

	Channel Pair Type and Configuration Parameters		
Maximum Tolerance in percent of full-scale	Standard Single Ramp Differential Expansion	Non-standard Signal Ramp Differential Expansion	Dual Ramp Differential Expansion
±1.0	<ul style="list-style-type: none"> <li>Ramp angles 4 - 45 degrees.</li> <li>Greater than 3 Vdc full-scale span.</li> <li>Same model transducers on each channel.</li> </ul>	<ul style="list-style-type: none"> <li>Ramp angles 4 - 70 degrees.</li> <li>Greater than 3 Vdc full-scale span.</li> </ul>	<ul style="list-style-type: none"> <li>Ramp angles 4 - 70 degrees.</li> <li>Greater than 3 Vdc full-scale span.</li> </ul>

	Channel Pair Type and Configuration Parameters		
Maximum Tolerance in percent of full-scale	Standard Single Ramp Differential Expansion	Non-standard Signal Ramp Differential Expansion	Dual Ramp Differential Expansion
±1.25	<ul style="list-style-type: none"> <li>• Ramp angles 4 - 70 degrees.</li> <li>• Greater than 3 Vdc full-scale span.</li> <li>• Same model transducer on both channels.</li> </ul>	Not Applicable	Not Applicable
±1.5	<ul style="list-style-type: none"> <li>• Ramp angles 4 - 70 degrees.</li> <li>• Greater than 3 Vdc full-scale span.</li> <li>• Different model transducer on each channel.</li> </ul>	Not Applicable	Not Applicable
±2.0	<ul style="list-style-type: none"> <li>• Ramp angles 4 - 70 degrees.</li> <li>• Less than 3 Vdc full-scale span.</li> <li>• Same or Different model transducer on each channel.</li> </ul>	<ul style="list-style-type: none"> <li>• Ramp angles 4 - 70 Degrees.</li> <li>• Less than 3 Vdc fullscale span.</li> </ul>	<ul style="list-style-type: none"> <li>• Ramp angles 4 - 70 degrees.</li> <li>• Less than 3 Vdc fullscale span.</li> </ul>

### Complimentary Input Differential Expansion (CIDE)

#### 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.

#### Case Expansion

#### Frequency Response

*Direct filter*

-3 dB at 1.2 Hz.

*Position filter*

-3 dB at 0.41 Hz.

*Accuracy*

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

### Valve Position

#### Frequency Response

*Direct Filter*

-3dB at 1.2 Hz.

*Position filter*

-3 dB at 0.41 Hz.

*Accuracy*

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

## Alarms

### Alarm setpoints

The user can use software configuration to set Alert levels for each value measured by the monitor and Danger set points for any two of the values measured by the monitor. Alarms are adjustable and can normally be set from 0 to 100% of full-scale for each measured value. However, some set point limits are based on transducer type. In some cases the combination of full-scale range and zero position voltage can cause the full-scale or bottom scale voltage to exceed the setpoint limit. In this case the setpoint range is restricted and does not include the entire measurement range. Accuracy of alarms is within 0.13% of the desired value.

### Alarm Time Delays

**Note:** Applies to Radial Vibration, Thrust, Differential Expansion, Eccentricity, Acceleration, Velocity, Acceleration2, Velocity2

The user can program alarm delays using software 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.

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## Static Values

Static values are measurements used to monitor the machine. The Proximator/Seismic Monitor returns the following static values:

### Thrust Position

Direct, Gap.

### Differential Expansion

Direct, Gap.

### Ramp Differential Expansion

Composite, Direct, Gap.

### CIDE

Composite, Direct, Gap.

### Case Expansion

Composite, Direct, Position.

### Valve Position

Direct, Position.

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## Barriers

The 3500/45E supports the external and internal barriers when used in a 3300 system retro fit only.

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## Environmental Limits

### Operating Temperature

-20°C to +65°C (-4°F to +150°F).

### Storage Temperature

-40 °C to +85 °C (-40 °F to +185 °F).

### Humidity

95%, noncondensing.

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## Compliance and Certifications

### EMC

European Community Directives:  
EMC Directive 2004/108/EC

#### Standards:

EN 61326-1:2006  
Emissions and Immunity  
EN 61000-6-2 (2005) +C1  
EN 61000-3-2 (2006) +A1, +A2  
EN 61000-3-3 (2008)  
EN 61000-6-4 (2007) +A1

### Electrical Safety

#### Standards:

EN 61010-1: 2010

European Community Directive:  
2006/95/EC Low Voltage

For further certification and approvals information please visit the following website:

<http://www.GEmeasurement.com>

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## Hazardous Area Approvals

**For a detailed listing of country and product specific approvals, refer to the Approvals Quick Reference Guide (document 108M1756) located at the following website: [www.GEmeasurement.com](http://www.GEmeasurement.com).**

### North American:

Class I, Div 2.

Groups A, B, C, D.

T4 @ Ta = -20 °C to +65 °C.

(-4 °F to +150 °F).

**Note:** When installed as a retrofit monitor for a 3300 System, hazardous area approval is valid only if the existing 3300 System has the same type of approval.

For further certification and approvals information please visit the following website:

<http://www.GEmeasurement.com>

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## Physical

### Monitor Module (Main Board)

#### *Dimensions (Height x Width x Depth)*

228mm (8.97 in) x 50mm (1.98 in) x 289mm (11.39 in).

#### *Weight*

1.27kg (2.8 lb).

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## Rack Space Requirements

### Monitor Module

1 full-height front slot.

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## Ordering Information

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### General

The 3500/45E Module requires the following (or later) firmware, and software revisions:

3500/01 Software:

Version 4.4. - 3300 upgrade only.

Version 4.6 - 3500 Encore System.

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## Ordering Options

### Proximitor Seismic Monitor

#### 3500/45E-AXX-BXX

#### A: I/O Module Type

- 00 none, uses currently installed 3300 SIM or SIRM
- 01 3500/45E Position I/O

#### B: Agency Approval Option

- 00 None
- 01 CSA/NRTL/C (Class 1, Div 2)

**Note:** For installation as a retrofit monitor for a 3300 System, Agency Approval Option B01 should be ordered only if the existing 3300 System has the same type of approvals. Installation of a retrofit monitor in a system without approvals will invalidate the approvals of the monitor.

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## Spares

### 285692-01

3500/45E Position Monitor

### 287199

Connector Shunt

### 288619-01

3500/45E Monitor Manual

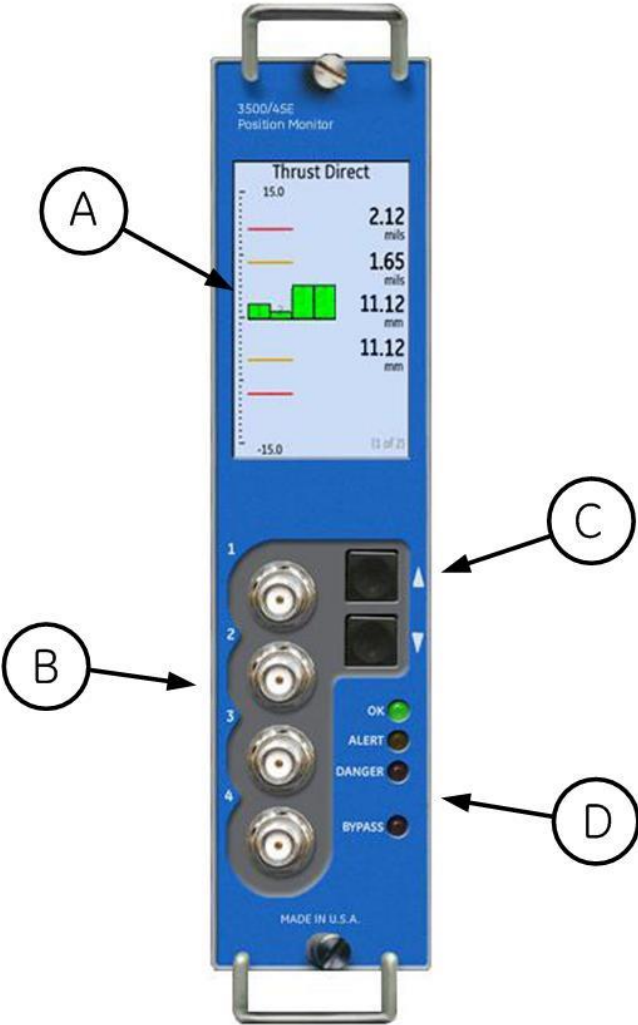
### 287199

Jumper, 18 Pin, 2 x 9

### 100M2145-01

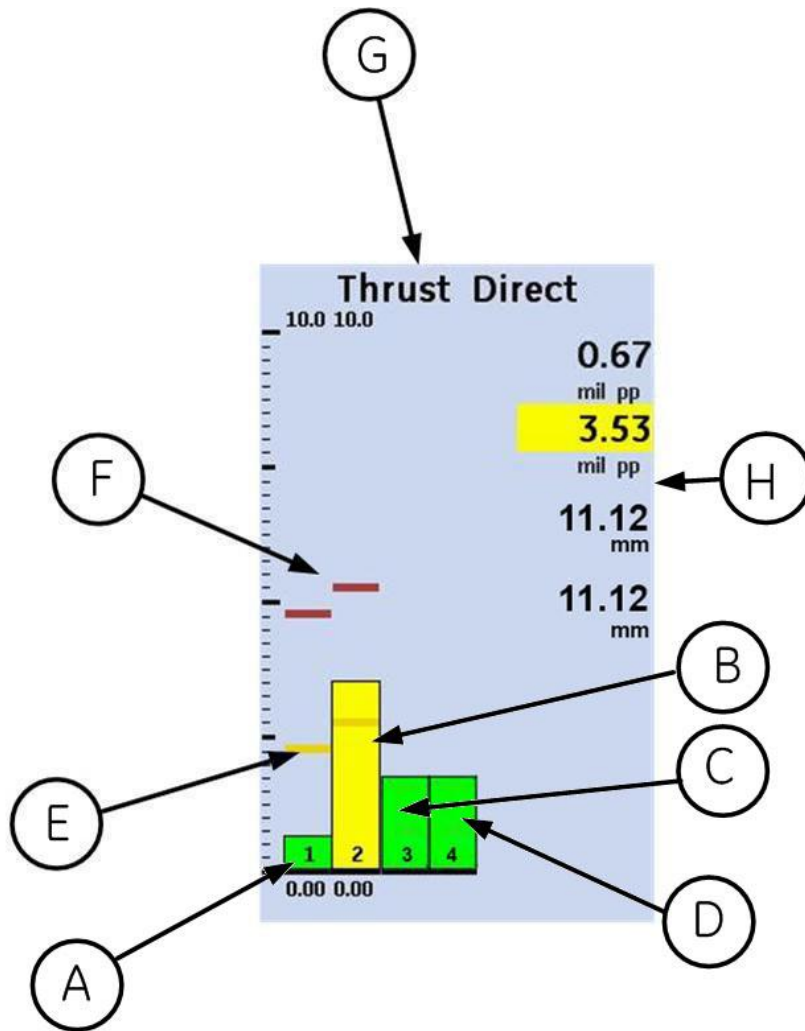
3500/45E Prox/DC LVDT/Rotary Position I/O

Graphs and Figures



- A. Color LCD Display
- B. Buffered Transducer Outputs
- C. Display Control Switches
- D. Status LEDs

Figure 1: Front view of the Position Monitor



- A. Channel A Bargraph - Shows Channel not in alarm
- B. Channel B Bargraph - Shows Channel in alert
- C. Channel C Bargraph - Shows Channel not in alarm
- D. Channel C Bargraph - Shows Channel not in alarm
- E. Alert Setpoint
- F. Danger Setpoint
- G. Channel Type
- H. Channel Values

**Figure 2: LCD Display for the Position Monitor**

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