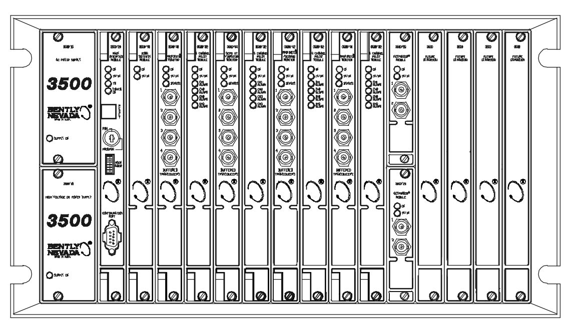
Part number 143489-01
Revision E, April 2004

3500/42M Proximitor/Seismic Monitor Module

Operation and Maintenance Manual

Bently Nevada



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Additional Information

Notice:
This manual does not contain all the information required to operate and maintain the 3500/42M Proximitor/Seismic Monitor Module module. Refer to the Following manuals for other require information.

3500 Monitoring System Rack Installation and Maintenance Manual (129766-01)
- general description of a standard system
- general description of a Triple Modular redundant (TMR) system
- instructions for installing the removing the module from a 3500 rack
- drawings for all cables used in the 3500 Monitoring System

3500 Monitoring System Rack Configuration and Utilities Guide (129777-01)
- guidelines for using the 3500 Rack Configuration software for setting the operating parameters of the module
- Guidelines for using the 3500 test utilities to verify that the input and output terminals on the module are operating properly

3500 Monitoring system Computer Hardware and Software Manual (128158-01)
- instructions for connecting the rack to 3500 host computer
- procedures for verifying communication
- procedures for installing software
- guidelines for using Data Acquisition / DDE Server and Operator Display Software
- procedures and diagrams for setting up network and remote communications

3500 Field Wiring Diagram Package (130432-01)
- diagrams that show how to hook up a particular transducer
- lists of recommended wiring

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1. Receiving and Handling Instructions

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1.1 Receiving Inspection

Visually inspect the module for obvious shipping damage. If shipping damage is apparent, file a claim with the carrier and submit a copy to Bently Nevada.

1.2 Handling and Storing Considerations

Circuit boards contain devices that are susceptible to damage when exposed to electrostatic charges. Damage caused by obvious mishandling of the board will void the warranty. To avoid damage, observe the following precautions in the order given:

Application Alert
Machinery protection will be lost when this module is removed from the rack.

- Do not discharge static electricity onto the circuit board. Avoid tools or procedures that would subject the circuit board to static damage. Some possible causes include ungrounded soldering irons, nonconductive plastics, and similar materials.
- Personnel must be grounded with a suitable grounding strap (such as 3M Velostat No. 2060) before handling or maintaining a printed circuit board.
- Transport and store circuit boards in electrically conductive bags or foil.
- Use extra caution during dry weather. Relative humidity less than 30 % tends to multiply the accumulation of static charges on any surface.

1.3 Disposal Statement

Customers and third parties that are in control of product at the end of its life or at the end of its use are solely responsible for proper disposal of product. No person, firm, corporation, association or agency that is in control of product shall dispose of it in a manner that is in violation of United States state laws, United States federal laws, or any applicable international law. Bently Nevada is not responsible for disposal of product at the end of its life or at the end of its use.

2. General Information

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2.1 Introduction

The 3500/42M Proximitor/Seismic Monitor is a 4-channel monitor that accepts input from proximity and seismic transducers, conditions the signal to make various vibration and position measurements, and compares the conditioned signals with user-programmable alarms. Each channel of the 3500/42M can be programmed using the 3500 Rack Configuration Software to perform any of the following functions:

- Radial Vibration
- Thrust Position
- Eccentricity
- Differential Expansion
- Acceleration
- Velocity
- Shaft Absolute
- 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.

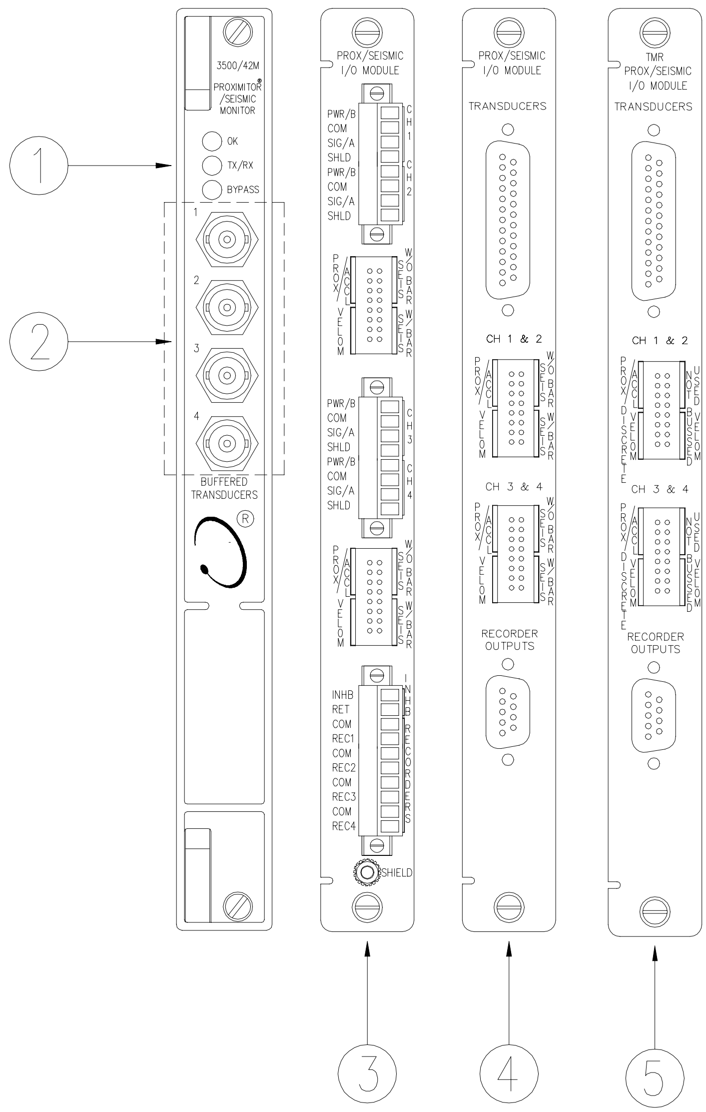
The primary purpose of the 3500/42M monitor is to provide:

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 into various parameters called "proportional values". Alert setpoints can be configured for each active proportional value and Danger setpoints can be configured for any two of the active proportional values.

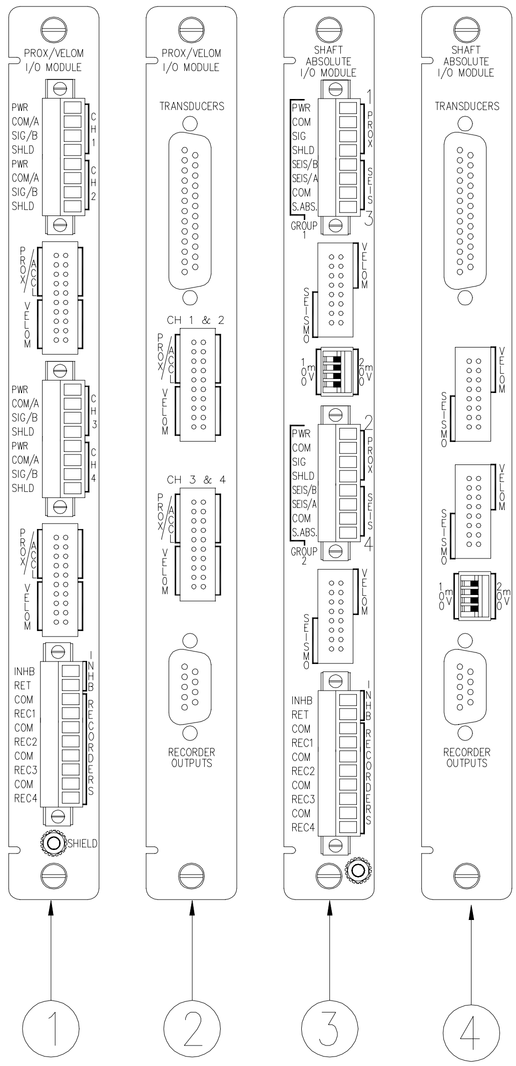
The 3500/42M is shipped from the factory unconfigured. When needed, the 3500/42M can be installed into a 3500 rack and configured to perform the required monitoring function. This lets you stock a single monitor for use as a spare for many different applications.

2.2 Views of the Front Panel and I/O Modules



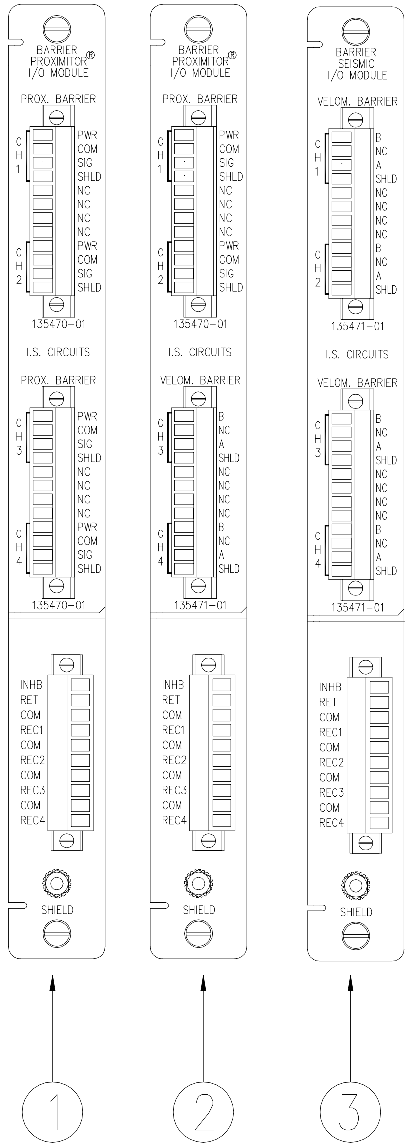
Front and rear view of the Proximitor®/Seismic Monitor

(1) Status LEDs
(2) Buffered Transducer Outputs
(3) I/O Module with Internal Terminators
(4) I/O Module with External Terminators
(5) TMR I/O Module with External Terminators



Additional I/O Modules of the Proximitor®/Seismic Monitor

(1) Prox/Velom I/O Module, Internal Terminations
(2) Prox/Velom I/O Module, External Terminations
(3) Shaft Absolute I/O Module, Internal Terminations
(4) Saft Absolute I/O Module, External Terminations



Barrier I/O Modules for the Proximitor®/Seismic Monitor

(1) Barrier I/O module for connecting two Proximitor® sensors.
(2) Barrier I/O module for connecting one Proximitor® sensor and one Velomitor® sensor.
(3) Barrier I/O module for connecting two Velomitor® sensors.

2.3 Triple Modular Redundant (TMR) Description

When used in a TMR configuration, 3500/42M monitors and I/O modules must be installed adjacent to each other in groups of three. When used in this configuration, two types of voting are employed to ensure accurate operation and to avoid single point failures.

The first level of voting occurs on the TMR Relay Module. With this voting, the selected alarm outputs for the three monitors are compared in a 2 out of 3 method. Two monitors must agree before the relay is driven. Refer to the 3500/32 & 34 Relay Module Operation and Maintenance Manual for more information on this voting.

The second type of voting is referred to as "Comparison" voting. With this type of voting, the proportional value outputs of each monitor in the group are compared with each other. If the output of one monitor differs from the output of the other monitors in the group by a specified amount, that monitor will add an entry to the System Event list. Configure comparison voting by setting Comparison and % Comparison in the Rack Configuration Software.

Comparison: The enabled proportional value of the TMR monitor group that is used to determine how far apart the values of the three monitors can be to each other before an entry is added to the System Event List.

% Comparison: The highest allowed percent difference between the middle value of the three monitors in a TMR group and the individual values of each monitor.

For TMR applications, two types of input configurations are available: bussed or discrete. Bussed configuration uses the signal from a single nonredundant transducer and provides that signal to all modules in the TMR group through a single 3500 Bussed External Termination Block.

Discrete configuration requires three redundant transducers at each measurement location on the machine. The input from each transducer is connected to separate 3500 External Termination Blocks or directly to the I/O module with internal terminations.

2.4 Available Data

The Proximitor/Seismic Monitor returns specific proportional values dependent upon the type of channel configured. This monitor also returns both monitor and channel statuses which are common to all types of channels.

2.4.1 Statuses

The following statuses are provided by the monitor. This section describes the available statuses and where they can be found.

2.4.1.1 Monitor Status

OK: This indicates if the monitor is functioning correctly. A not OK status is returned under any of the following conditions:

- Module Hardware Failure

- Node Voltage Failure
- Configuration Failure
- Transducer Failure
- Slot ID Failure
- Channel not OK

If the Monitor OK status goes not OK, then the system OK Relay on the Rack Interface I/O Module will be driven not OK.

Alert/Alarm 1: This indicates whether the monitor has entered Alert/Alarm 1. A monitor will enter the Alert/Alarm 1 state when any proportional value provided by the monitor exceeds its configured Alert/Alarm 1 setpoint.

Danger/Alarm 2: This indicates whether the monitor has entered Danger/Alarm 2. A monitor will enter the Danger/Alarm 2 state when any proportional value provided by the monitor exceeds its configured Danger/Alarm 2 setpoint.

Bypass: This indicates when the monitor has bypassed alarming for one or more proportional values at a channel. When a channel bypass status is set, this monitor bypass status will also be set.

Configuration Fault: This indicates if the monitor configuration is valid.

Special Alarm Inhibit: This indicates whether all the nonprimary Alert/Alarm 1 alarms in the associated monitor channel are inhibited. The Channel Special Alarm Inhibit function is active when:

- The Alarm Inhibit contact (INHB/RET) on the I/O Module is closed (active).
- A Channel Special Alarm Inhibit software switch is enabled.

2.4.1.2 Channel Status

OK: This indicates that no fault has been detected by the associated monitor channel. There are two types of channel OK checking:

- Transducer Input Voltage
- Transducer Supply Voltage.

A channel OK status will be deactivated if any of the two OK types goes not OK.

Alert/Alarm 1: This indicates whether the associated monitor channel has entered Alert/Alarm 1. A channel will enter the Alert/Alarm 1 state when any proportional value provided by the channel exceeds its configured Alert/Alarm 1 setpoint.

Danger/Alarm 2: This indicates whether the associated monitor channel has entered Danger/Alarm 2. A channel will enter the Danger/Alarm 2 state when any proportional value provided by the channel exceeds its configured Danger/Alarm 2 setpoint.

Bypass: This indicates that the channel has bypassed alarming for one or more of its proportional values. A channel bypass status may result from the following conditions:

- A transducer is not OK, and the channel is configured for Timed OK Channel Defeat.
- The Keyphasor associated with the channel has gone invalid causing all proportional values related to the Keyphasor signal (for example 1X Amplitude, 1X Phase, Not 1X, ...) to be defeated and their associated alarms bypassed.
- The monitor has detected a serious internal fault.
- A software switch is bypassing any channel alarming function.
- The Special Alarm Inhibit is active and causing enabled alarms not to be processed.

Special Alarm Inhibit: This indicates whether all the nonprimary Alert/Alarm 1 alarms in the associated monitor channel are inhibited. The Channel Special Alarm Inhibit function is active when:

- The Alarm Inhibit contact (INHB/RET) on the I/O Module is closed (active).
- A Channel Special Alarm Inhibit software switch is enabled.

Off: This indicates whether the channel has been turned off. The monitor channels may be turned off (inactivated) using the Rack Configuration Software.

Channel not monitoring: This indicates that alarming has been disabled for this channel due to a configuration error, I/O error, or hardware problem. Check the system events list for more information.

Channel Signal Path Not OK: This indicates the monitor cannot receive a valid signal for this channel due to a transducer not o.k. or a hardware problem. Check the system events list for more information.

The following table shows where the statuses can be found:

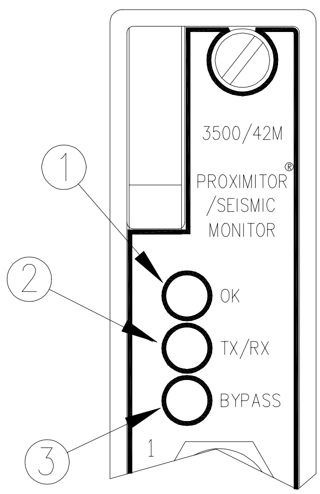
Statuses	Communication Gateway Module	Rack Configuration Software	Operator Display Software
Monitor OK	X	X	
Monitor Alert/Alarm 1	X	X	
Monitor Danger/Alarm 2	X	X	
Monitor Bypass		X	
Monitor Configuration Fault		X	
Monitor Special Alarm Inhibit		X	
Channel OK	X	X	X
Channel Alert/Alarm 1	X	X	X
Channel Danger/Alarm 2	X	X	X
Channel Bypass	X	X	X
Channel Special Alarm Inhibit	X	X	X
Channel Off	X	X	
Channel Not Monitoring	X		
Channel Signal Path Not OK	X		

2.4.2 Proportional Values

Proportional values are vibration measurements used to monitor the machine. The number and type of proportional values varies by channel type. Refer to the section on the applicable channel type for information about the proportional values for each channel type.

2.5 LED Descriptions

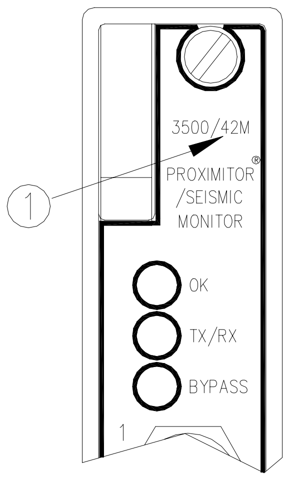
The LED's on the front panel of the Proximitor/Seismic Monitor indicate the operating status of the module as shown in the following figure. Refer to the channel type configuration sections in this manual for all of the available LED conditions.



(1) **OK:** Indicates that the Proximitor/Seismic Monitor and the I/O Module are operating correctly.
(2) **TX/RX:** Flashes at the rate that messages are received and transmitted.
(3) **Bypass:** Indicates that some of the monitor functions are temporarily suppressed.

2.6 Monitor Versions

The 3500/42M monitor is an enhanced replacement of the original 3500/42 monitor. It can be distinguished from the original by the model designation of 3500/42M on the front panel. The 3500/42M can be used in the same applications and as a direct replacement for the 3500/42. The M refers to the enhanced machine management capabilities. The monitor supports current and future Bently Nevada machine management systems.



(1) Model Number

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3. Monitor Configuration

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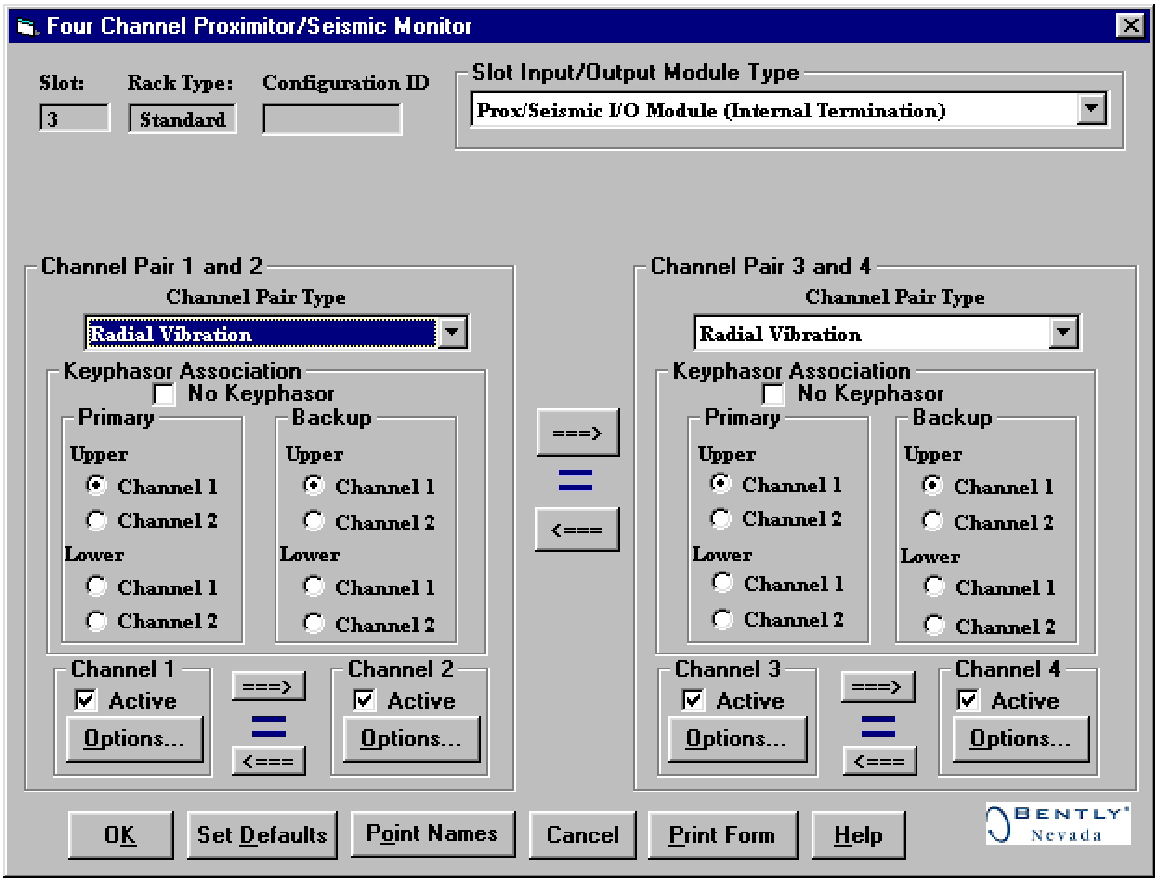
3.1 Introduction

This section describes how the 3500/42M Proximitor®/Seismic Monitor is configured using the Rack Configuration Software. It also describes any configuration restrictions associated with this module. Refer to the 3500 Monitoring System Rack Configuration and Utilities Guide and the Rack Configuration Software for the details on how to operate the software.

3.2 Configuration Options



3.2.1 Reference Information

These fields contain information that indicates which module you are configuring.

Slot: The location of the monitor in the 3500 rack (2 through 15).

Rack Type: The type of Rack Interface Module installed in the rack (Standard or TMR).

Configuration ID: A unique six-character identifier. The identifier can be entered when downloading a configuration to the 3500 rack.

3.2.2 Slot Input/Output Module Type

The I/O field lets you identify the type of I/O Module that is attached to the monitor (The option selected must agree with the I/O module installed).

Discrete I/O: Used when each monitor channel is connected to its own transducer. This applies to both standard and TMR installations.

Prox/Seismic I/O Module (Internal Termination): The transducer field wiring is connected directly to the I/O module.

Prox/Seismic I/O Module (External Termination): The transducer field wiring is connected to an External Termination Block and then routed from the External Termination Block to the I/O module through a 25-pin cable. The recorder field wiring is connected to an External Termination Block and then routed from the External Termination Block to the I/O module through a 9-pin cable.

Prox/Velom I/O (Internal Termination): The transducer field wiring is connected directly to the I/O module. Note that selecting the Prox/Velom Internal I/O option will disable certain transducer type options.

Prox/Velom I/O (External Termination): The transducer field wiring is connected to an External Termination Block and then routed from the External Termination Block to the I/O module through a 25-pin cable. The recorder field wiring is connected to an External Termination Block and then routed from the External Termination Block to the I/O module through a 9-pin cable. Note that selecting the Prox/Velom External I/O option will disable certain transducer type options.

Barrier Proximitor I/O (4 Prox/Accel): The transducer field wiring is connected directly to the Proximitor/Seismic Monitor Internal Barrier I/O Module. Note that selecting the Prox/Accel Internal Barrier I/O option will disable certain transducer type options.

Barrier Prox/Seismic I/O (2 Prox/Accel, 2 Velom): The transducer field wiring is connected directly to the Proximitor/Seismic Monitor Internal Barrier I/O Module. Note that selecting the Prox/Velom Internal Barrier I/O option will disable certain transducer type options.

Barrier Seismic I/O (4 Velom): The transducer field wiring is connected directly to the Proximitor/Seismic Monitor Internal Barrier I/O Module. Note that selecting the Velom Internal Barrier I/O option will disable certain transducer type options.

Bussed I/O: Used when one transducer input signal is bussed to three identical adjacent monitors and three TMR I/O Modules. This option is used when redundant transducers and field wiring are not required.

TMR I/O Prox/Seismic I/O: A single set of four transducers are sent to three identical adjacent monitors. Each transducer is connected to a Bussed External Termination Block and then the Bussed External Termination Block is connected to the Proximitor/Seismic TMR I/O Modules using three 25-pin cables. The recorder field wiring is connected to an External Termination Block and then routed from the External Termination Block to the Proximitor/Seismic TMR I/O Module through a 9-pin cable.

3.2.3 Channel Pair 1 and 2 and Channel Pair 3 and 4

The fields within these boxes pertain to both channels of the channel pair.

Channel Pair Type: The type of monitoring which is to be performed by the channel pair. The following Channel Pair types are available in the monitor:

- Radial Vibration
- Thrust Position
- Differential Expansion
- Eccentricity
- REBAM
- Acceleration
- Velocity
- Acceleration II
- Velocity II
- Shaft Absolute Radial Vibration
- Shaft Absolute Velocity
- Circular Acceptance Region

3.2.4 Keyphasor® Association

No Keyphasor: Can be used when a Keyphasor is not available. If this is marked then the only data that will be available is Direct and Gap. This field will automatically be marked for channel pairs which do not require a Keyphasor transducer (for example Thrust Position and Differential Expansion).

Primary: The Keyphasor channel selected that is normally used for measurement. When this Keyphasor transducer is marked invalid, the backup Keyphasor transducer will provide the shaft reference information.

Backup: The Keyphasor channel selected that will be used if the primary Keyphasor fails. If you do not have a backup Keyphasor, select the same Keyphasor channel as the primary Keyphasor.

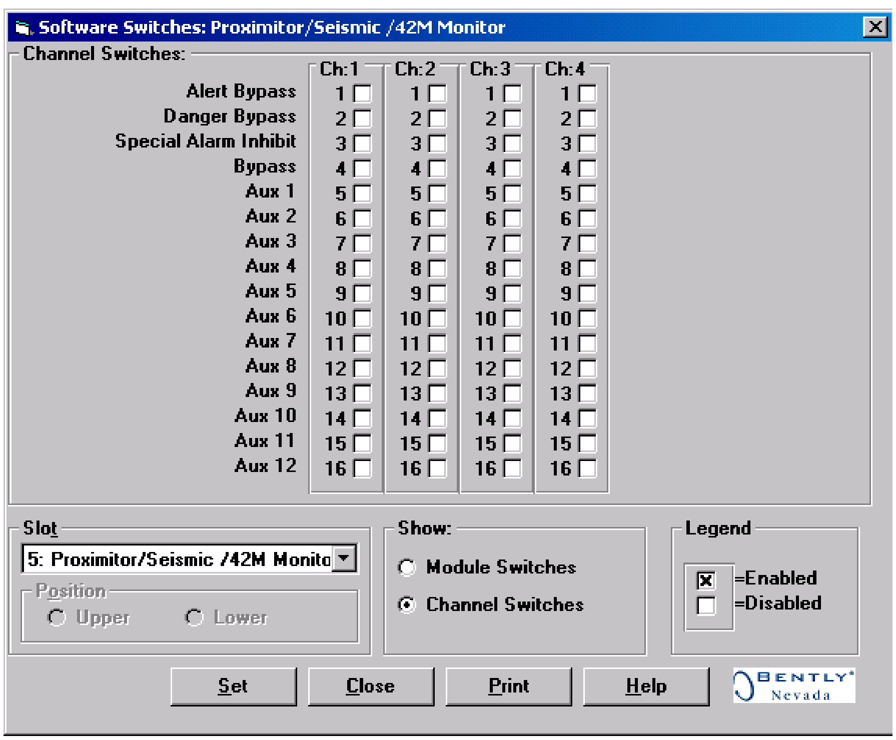
Note
For TMR applications, set Channel Pair 1 and 2 as primary Keyphasor and Channel Pair 3 and 4 as backup Keyphasor.

Active: Select whether the functions of the channel will be turned on (☑) or off (☐).

Options: A button to display the configuration options for the selected channel type.

3.3 Software Switches

The Proximitor/Seismic Monitor supports two module software switches and four channel software switches. These switches let you temporarily bypass or inhibit monitor and channel functions. Set these switches on the **Software Switches** screen under the **Utilities** Option on the main screen of the Rack Configuration Software.



No changes will take effect until the **Set** button is pressed.

3.3.1 Module Switches

Configuration Mode: A switch that allows the monitor to be configured. To configure the monitor, enable (☒) this switch and set the key switch on the front of the Rack Interface Module in the PROGRAM position. When downloading a configuration from the Rack Configuration Software, this switch will automatically be enabled and disabled by the Rack Configuration Software. If the connection to the rack is lost during the configuration process, use this switch to remove the module from Configuration Mode.

Monitor Alarm Bypass: When enabled, the monitor does not perform alarming functions. All proportional values are still provided. The monitor switch number is used in the Communication Gateway and Display Interface Modules.

Monitor Switch Number	Switch Name
1	Configuration Mode
3	Monitor Alarm Bypass

3.3.2 Channel Switches

Alert Bypass: When enabled, the channel does not perform Alert alarming functions.

Danger Bypass: When enabled, the channel does not perform Danger alarming functions.

Special Alarm Inhibit: When enabled, all nonprimary Alert alarms are inhibited.

Bypass: When enabled, the channel provides no alarming functions and supplies no proportional values.

The channel switch number is used in the Communication Gateway and Display Interface Modules.

Channel Switch Number	Switch Name
1	Alert Bypass
2	Danger Bypass
3	Special Alarm Inhibit
4	Bypass

4. I/O Module Descriptions

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4.1 Introduction

I/O Modules receive signals from the transducers and route the signals to the Proximitor/Seismic Monitor. The I/O module supplies power to the transducers and provides a 4 to 20 mA recorder output for each transducer input channels. Only one I/O module can be installed at any one time and must be installed behind the monitor (in a rack mount or panel mount rack) or above the monitor (in a Bulkhead rack).

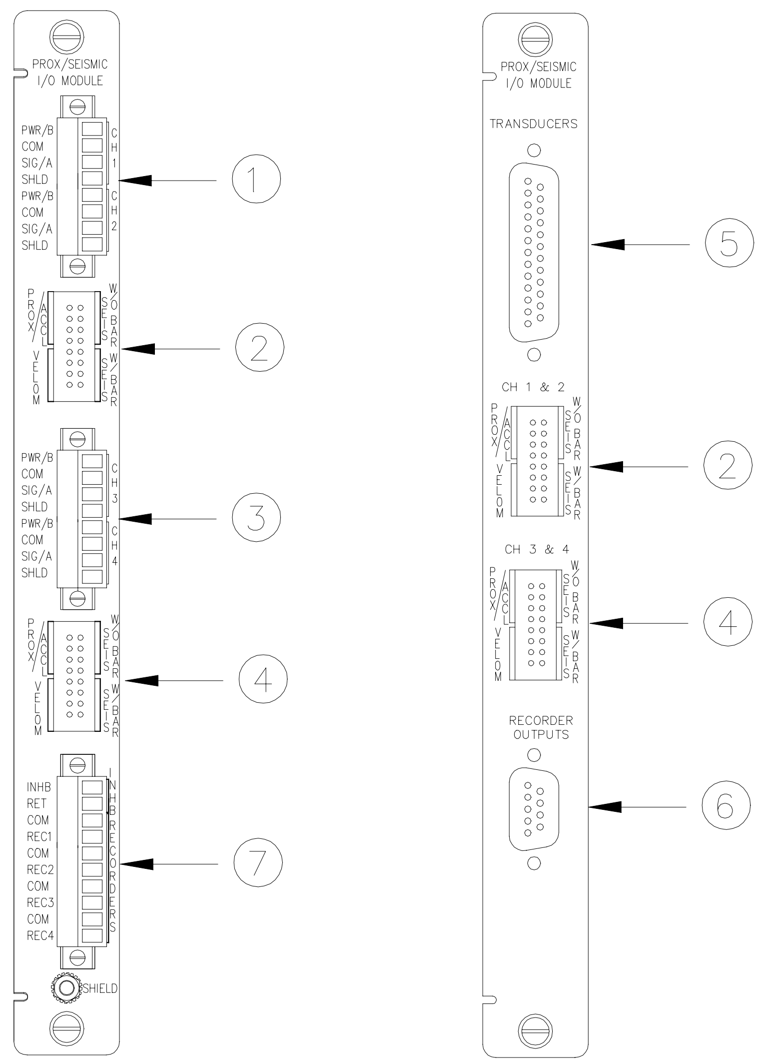
I/O modules can have either internal or external terminations. Internal termination requires that you wire each transducer and recorder directly to the I/O module. External termination lets you simplify the wiring to the I/O modules in a 3500 rack by using a 25-pin cable to route the signals from the four transducers and a 9-pin cable to route the signals from the recorders to the I/O module. With external termination I/O modules you can position the transducer wiring in any convenient location by using External Termination blocks.

The 3500/42M Proximitor®/Seismic Monitor can operate with the following types of I/O modules:

Internal Termination	External Termination	External Termination Block
Proximitor®/Siesmic I/O module Proximitor®/Velomitor® I/O module Proximitor®/Siesmic Internal Barrier I/O module Shaft Absolute I/O module	Proximitor®/Siesmic I/O module Proximitor®/Velomitor® I/O module Proximitor®/Siesmic TMR I/O module Shaft Absolute I/O module	Terminal strip connectors Euro Style connectors

This section describes the connectors, jumpers, and switches for each type of I/O module, lists what cables should be used, and shows the pin outs of the cables. The 3500 Field Wiring Diagram Package (part number 130432-01) shows how to connect transducers and recorders to the I/O module or the External Termination Block.

4.2 Prox/Siesmic I/O Modules

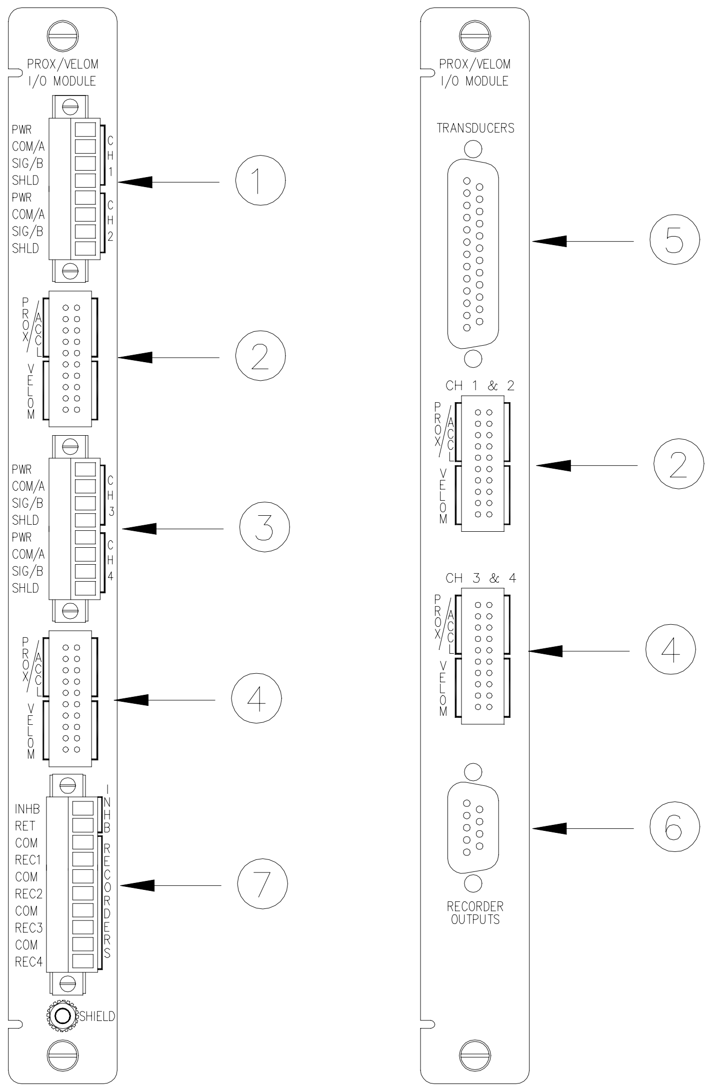


Prox/Seismic I/O Module
Internal Termination (left) and External Termination (right)

(1) Connection to transducers associated with channel 1 and 2
(2) Jumper for selecting the type of transducer connected to channel 1 and 2
(3) Connection to transducers associated with channel 3 and 4
(4) Jumper for selecting the type of transducer connect to channel 3 and 4
(5) Connect the I/O module to an External Termination block, use cable 129525-XXX-XX
(6) Connect the I/O module to the Recorder External Termination Block, use cable 129529-XXXX-XX

(7) Connect to switches and recorders: INHB/RET is used to inhibit all non-primary Alert/Alarm 1 functions for all four channels. COM/REC is used to connect each channel to a recorder.

4.3 Prox/Velomitor® I/O Module

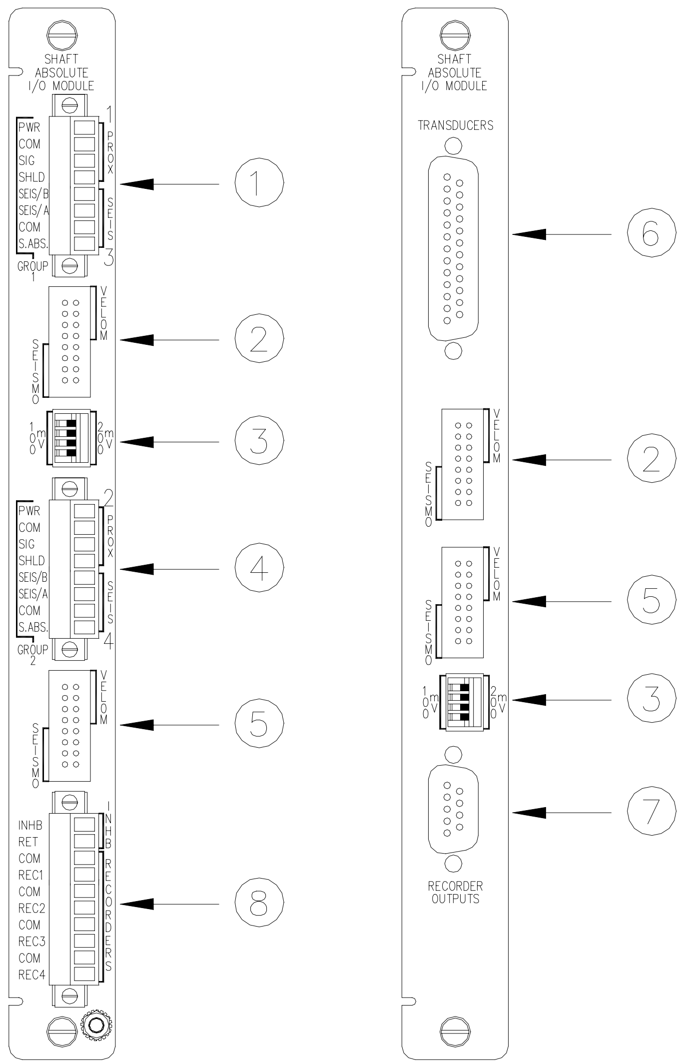


Prox/Velomitor® I/O Module
Internal Termination (left) and External Termination (right)

(1) Connection to transducers associated with channel 1 and 2
(2) Jumper for selecting the type of transducer connected to channel 1 and 2
(3) Connection to transducers associated with channel 3 and 4
(4) Jumper for selecting the type of transducer connect to channel 3 and 4

(5) Connect the I/O module to an External Termination block, use cable 129525-XXX-XX
(6) Connect the I/O module to the Recorder External Termination Block, use cable 129529-XXXX-XX
(7) Connect to switches and recorders: INHB/RET is used to inhibit all non-primary Alert/Alarm 1 functions for all four channels. COM/REC is used to connect each channel to a recorder.

4.4 Shaft Absolute I/O Modules



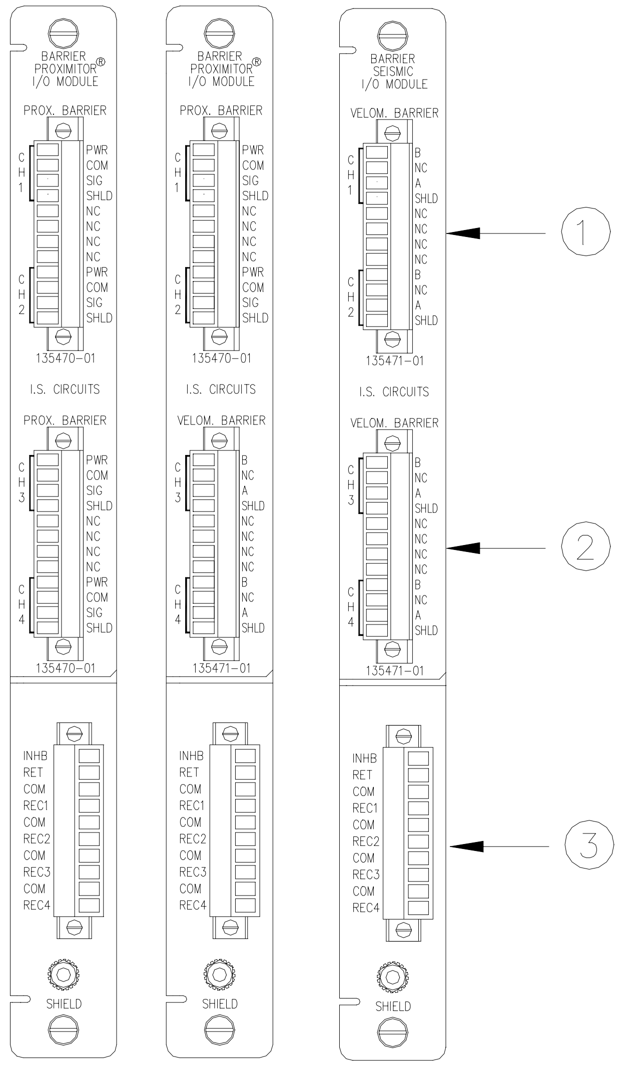
Shaft Absolute I/O Module
Internal Termination (left) and External Termination (right)

(1) Connection to transducers associated with channel 1 and 3. Buffered Shaft Absolute Output is also available.
(2) Jumper for selecting the type of transducer connected to channel 1 and 2

(3) Switch for selecting the scale factor to match the transducers connected to channel 1 and 2
(4) Connection to transducers associated with channel 2 and 4. Buffered Shaft Absolute Output is also available.
(5) Jumper for selecting the type of transducer connect to channel 3 and 4
(6) Connect the I/O module to an External Termination block, use cable 129525-XXX-XX
(7) Connect the I/O module to the Recorder External Termination Block, use cable 129529-XXXX-XX
(8) Connect to switches and recorders: INHB/RET is used to inhibit all non-primary Alert/Alarm 1 functions for all four channels. COM/REC is used to connect each channel to a recorder.

4.5 Internal Barrier I/O Modules

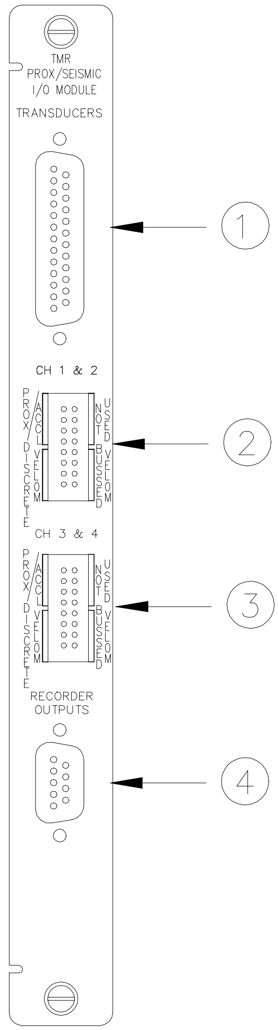
The Internal Barrier I/O modules require that each transducer be connected to the Barrier I/O module individually. This module provides four channels of intrinsically safe signal conditioning for Proximitor and/or Seismic transducers and has two internally mounted zener barrier modules, one for each pair of transducer channels. A 3500 Earthing Module is required for systems that use Internal Barrier I/O Modules to provide an intrinsically safe earth connection for intrinsically safe applications. Refer to the Rack Installation and Maintenance Manual for system requirements when using Internal Barrier I/O Modules



Internal Barrier I/O Modules

(1) Connection to transducers associated with channel 1 and 2
(2) Connection to transducers associated with channel 3 and 4
(3) Connect to switches and recorders: INHB/RET is used to inhibit all non-primary Alert/Alarm 1 functions for all four channels. COM/REC is used to connect each channel to a recorder.

4.6 TMR I/O Module



TMR I/O Module

(1) Connect the I/O module to the External Termination Block using cable 129525-XXXX-XX
(2) Jumper for selecting the type of transducer connected to channel 1 and 2
(3) Jumper for selecting the type of transducer connected to channel 3 and 4
(4) Connect the I/O module to the Recorder External Termination Blocks using cable 129529-XXXX-XX

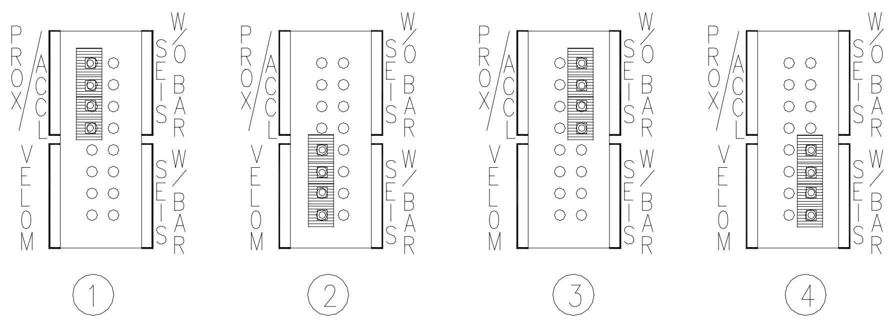
The Proximitor/Seismic TMR I/O Module is used in a TMR rack. Four transducers are bussed to three monitors so that each transducer is shared by three channels, one channel from each monitor. Four External Termination Blocks are required: one is a Bussed Proximitor/Seismic External Termination

Block used to wire the transducers; the other three are Recorder External Termination Blocks used to wire the recorders.

4.7 Setting the I/O Jumper

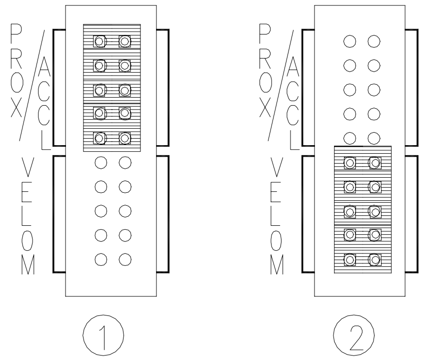
The I/O jumper on the I/O module is used to identify the type of transducer connected to the I/O module.

Note
The connector shunt must be installed vertically on the top or bottom group of terminal posts to select the corresponding transducer type. **WARNING -** Do not place shunt over NOT USED terminal posts. The connector shunt must be placed over the terminal posts for which the channel pair is configured, even when the channel pair is inactivated.



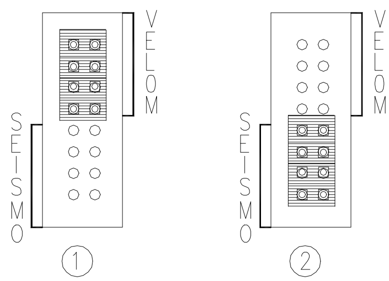
Jumper configurations for the Prox/Seismic I/O module

(1) Proximitor® transducer/ Accelerometer
(2) Velomitor® sensor
(3) Seismoprobe without barrier
(4) Seismoprobe with barrier



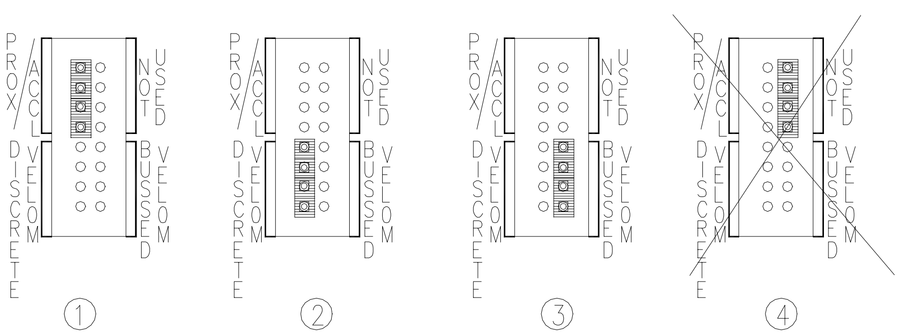
Jumper configurations for the Shaft Absolute I/O module

(1) Proximitor® transducer/ Accelerometer
(2) Velomitor® sensor



Jumper configurations for the Shaft Absolute I/O module

(1) Velomitor® sensor
(2) Seismoprobe



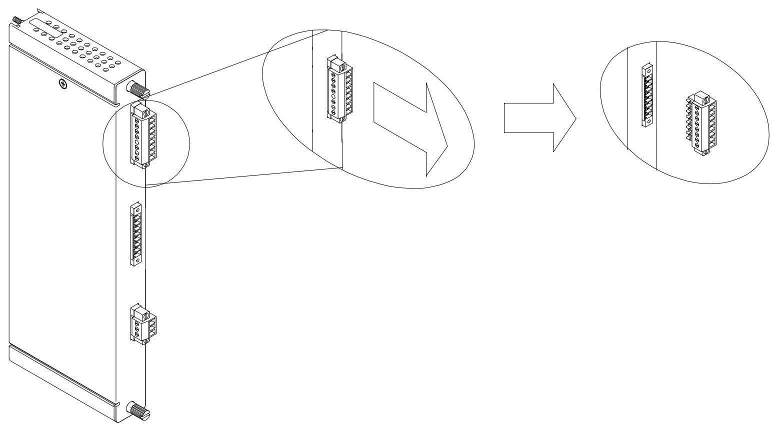
Jumper configurations for the TMR I/O module

(1) Proximitor® transducer/ Accelerometer
(2) Discrete Velomitor® sensor

(3) Bussed Velomitor® sensor
(4) Not used – never place a jumper over these terminal posts

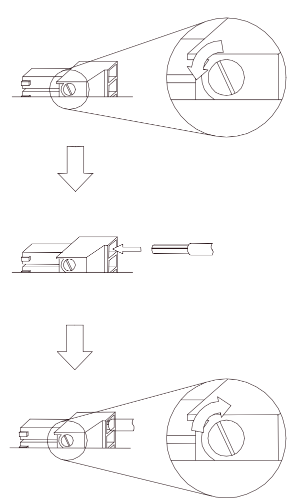
4.8 Wiring Euro Style Connectors

To remove a terminal block from its base, loosen the screws attaching the terminal block to the base, grip the block firmly and pull. Do not pull the block out by its wires because this could loosen or damage the wires or connector.



Typical I/O Module

Refer to the 3500 Field Wiring Diagram Package for the recommended wiring. Do not remove more than 6 mm (0.25 in) of insulation from the wires.



4.9 External Termination Blocks

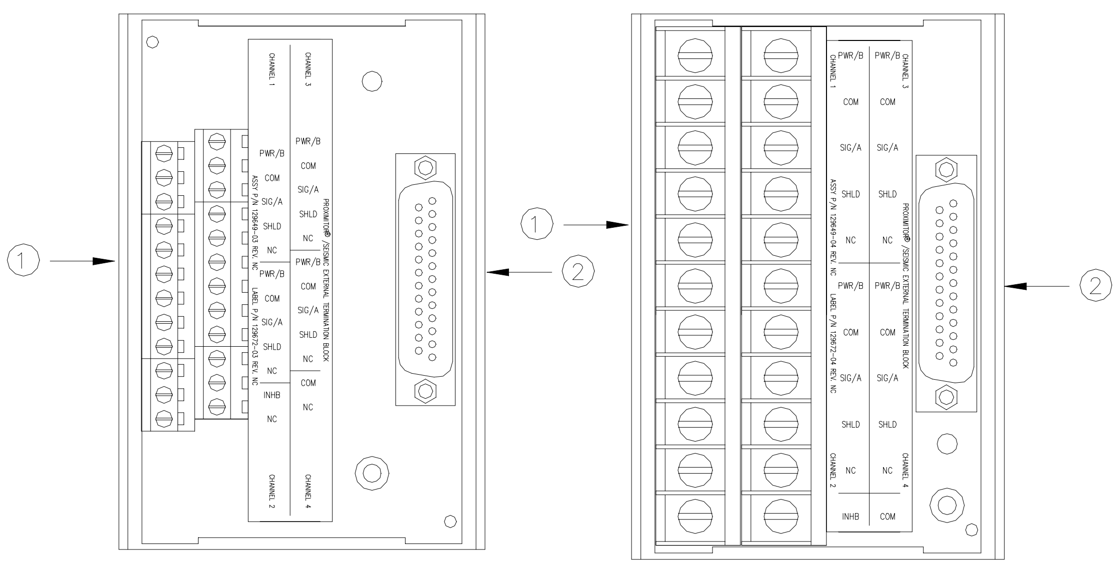
External termination blocks let you position the connectors for transducer wiring at a convenient location and then use multi-pin cables to route the signals to the 3500/42M I/O modules. The different types of termination blocks have different labels and part numbers. Refer to “Spares” in section "Ordering Information" for a complete list of the part numbers for all available termination blocks for the 3500/42M.

External Termination Blocks for the Prox/ Seismic I/O Module	External Termination Blocks for the Prox/ Velomitor I/O Module
Proximitor/ Seismic External Termination Block Bussed Proximitor/ Seismic External Termination Block Recorder External Termination Block	Proximitor/ Velomitor External Termination Block Recorder External Termination Block

Each type of External Termination Block comes with either Terminal Strip or Euro Style connectors. The field wiring diagram package (Bently Nevada part number 130432-01) shows how to connect the transducer wiring to all of these blocks.

4.9.1 External Termination Blocks for Standard Applications

The following figures show what these termination blocks look like.

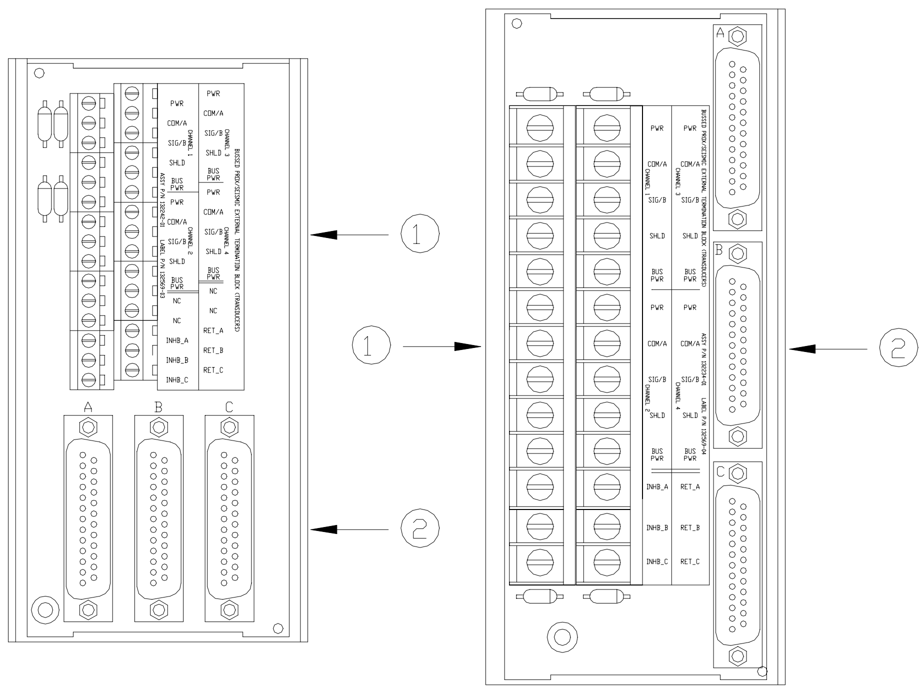


(1) Terminals for the transducer field wiring
(2) Connector for the cable to an external termination I/O module

4.9.2 External Termination Blocks for TMR Applications

The Proximitor/Seismic External Termination Blocks are used for TMR applications with discrete transducers. One termination block is connected to each 3500/42M monitor in the TMR group. See the above section for standard installations.

Bussed External Termination Blocks are used for TMR applications that do not use redundant transducers. These blocks let you route the signal from a single transducer to three redundant 3500/42M monitors. The following figures show the Bussed External Termination Blocks.

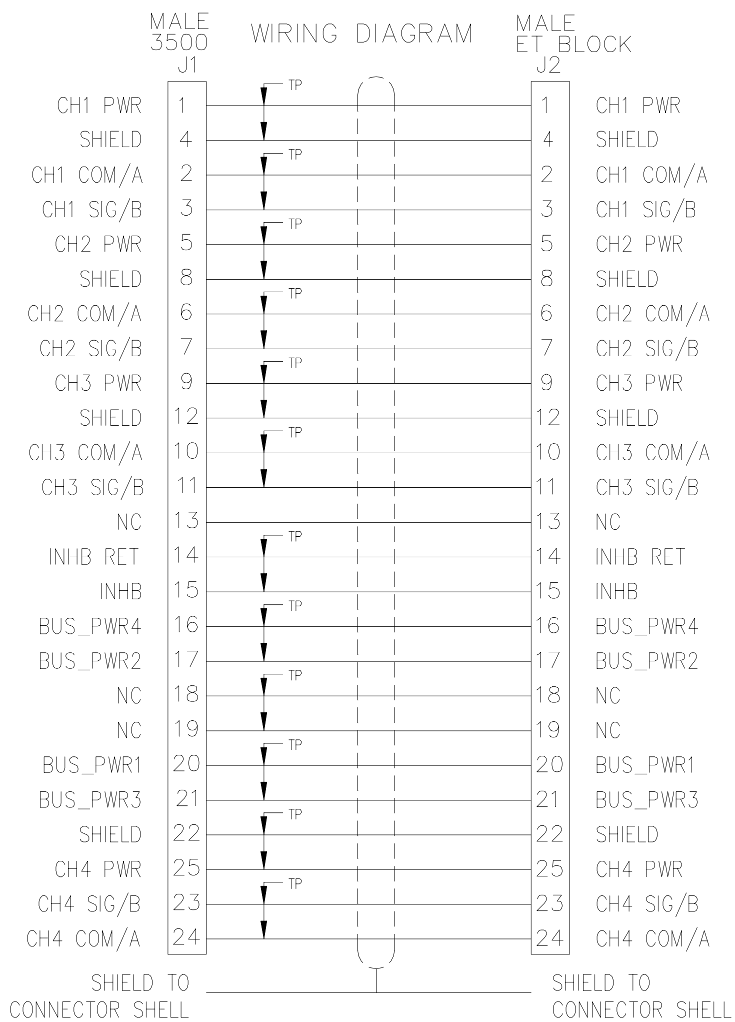


(1) Terminals for connecting signals from a single transducer
(2) Connectors for sending the signal from the same transducer to three redundant Prox/Siesmic monitors

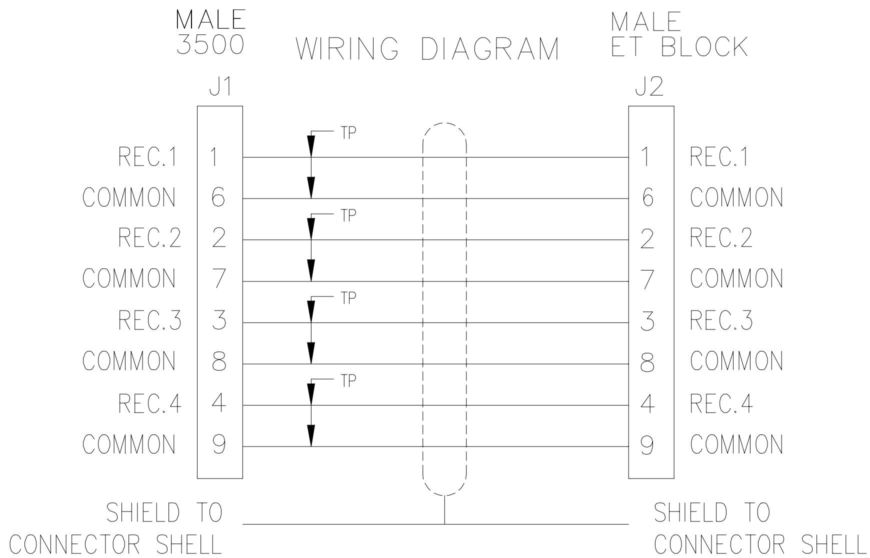
4.10 Cable Pin Outs

The following diagrams show how to wire the connectors to the end of cables that must be routed through conduit.

Note
Signal labels shown will vary. The following figure shows labels for Proximitor/Velomitor ET blocks.



Transducer Signal to External Termination Block
Cable part number 129525-XXXX-XX



3500 Recorder Output to External Termination Block
Cable part number 129529-XXXX-XX

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5. Monitor Verification

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5.1 Introduction

The boards and components inside of 3500 modules cannot be repaired in the field. Maintaining a 3500 rack consists of testing module channels to verify that they are operating correctly. Modules that are not operating correctly should be replaced with a spare.

When performed properly, this module may be installed into or removed from the rack while power is applied to the rack. Refer to the Rack Installation and Maintenance Manual (part number 129766-01) for the proper procedure.

Refer to the section of a particular channel type for information on verifying the operation of that channel type.

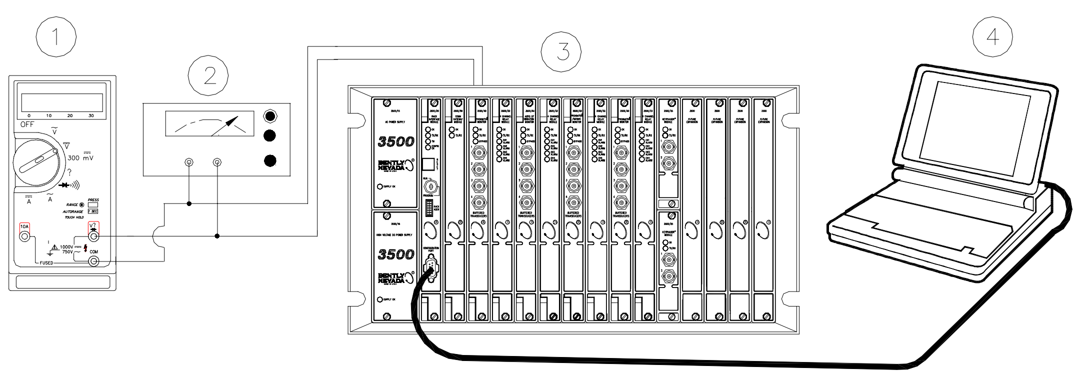
5.2 Choosing a Maintenance Interval

Use the following approach to choose a maintenance interval:

1. Start with an interval of one year and then shorten the interval if any of the following conditions apply:
   - the monitored machine is classified as critical.
   - the 3500 rack is operating in a harsh environment such as in extreme temperature, high humidity, or in a corrosive atmosphere.
2. At each interval, use the results of the previous verifications and ISO Procedure 10012-1 to adjust the interval.

5.3 Typical Verification Test Setup

The following figure shows the typical test setup for verifying a Proximitor®/Seismic Monitor. The test equipment is used to simulate the transducer signal and the laptop computer is used to observe the output from the rack.

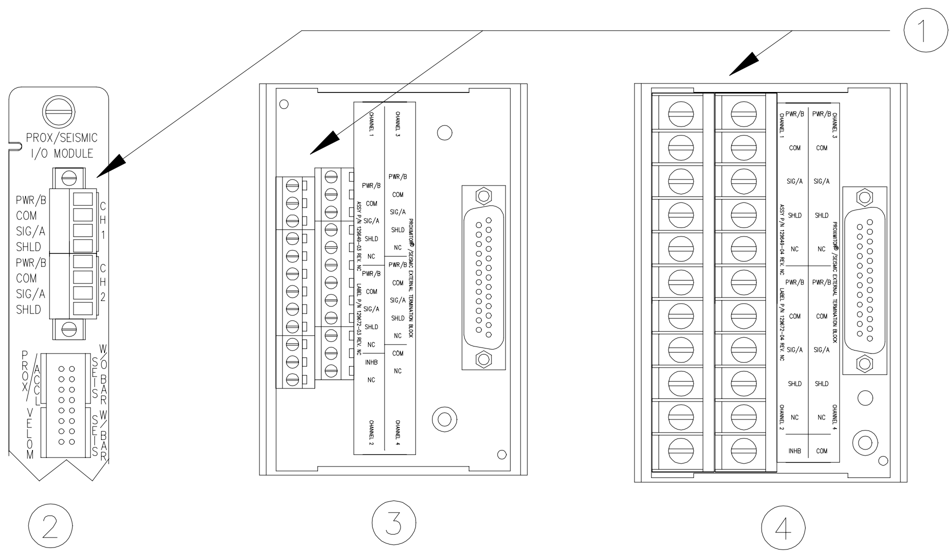


General Layout for Maintenance

(1) Voltmeter
(2) Power supply

(3) 3500 rack
(4) Laptop computer running 3500 Rack Configuration Software

Transducers can be connected to a 3500 rack in a variety of ways. Depending on the wiring option for the I/O module of your monitor, connect the test equipment to the monitor using one of the following methods:



(1) Connect test equipment here.
(2) Proximitor®/Seismic I/O Module
(3) External Termination Block with Euro Style connectors
(4) External Termination Block with Terminal Strip connectors

5.4 Using the Rack Configuration Software

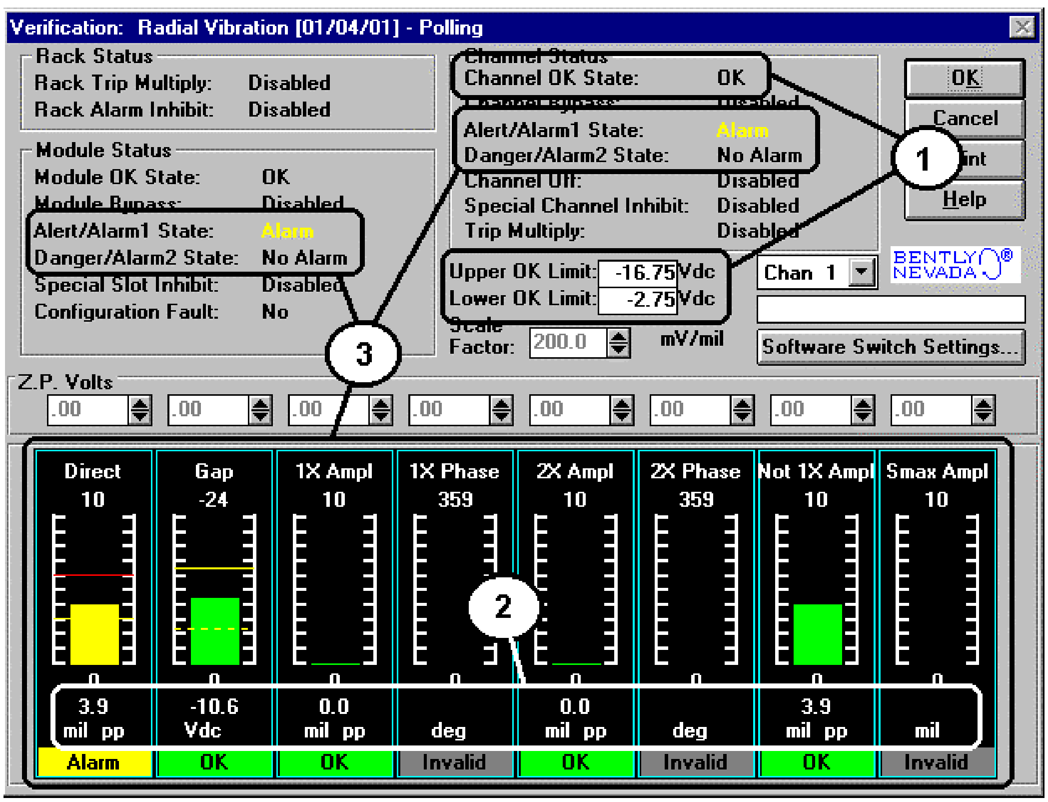
The laptop computer that is part of the test setup uses the Rack Configuration Software to display output from the rack and to reset certain operating parameters in the rack. To perform the test procedures in this section you must be familiar with the following features of the Rack Configuration Software.

- upload, download, and save configuration files
- enable and disable channels and alarms
- bypass channels and alarms
- display the Verification screen

The Rack Configuration and Test Utilities Guide (part number 129777-01) explains how to perform these operations.

Note
It is important to save the original rack configuration before doing any Maintenance and/or Troubleshooting Procedures. It may be necessary during these procedures to change setpoints, etc. which must be restored to their original values at the conclusion of the procedures. At that time the original configuration should be downloaded to the rack.

The following figures show how the Verification screen displays output from a 3500 rack:



(1) **OK Limit Verification Fields:** These fields display output for verifying OK limits.

(2) **Current Value Verification Fields:** The current proportional value is displayed in this box. These fields display output for verifying channel output.

(3) **Alarm Verification Fields:** These fields display output for verifying channel alarms. Alert/Alarm 1 alarms are displayed in yellow in the bar graph and with the word "Alarm" under the current value box. Danger/Alarm 2 alarms are displayed in red in the bar graph and with the word "Alarm" under the current value box.

Any channel bar graph value that enters Alert/Alarm 1 or Danger/Alarm 2 will cause the alarm lines in the Channel Status box to indicate an alarm. Any channel that enters alarm will cause the alarm lines in the Module Status box to indicate an alarm.

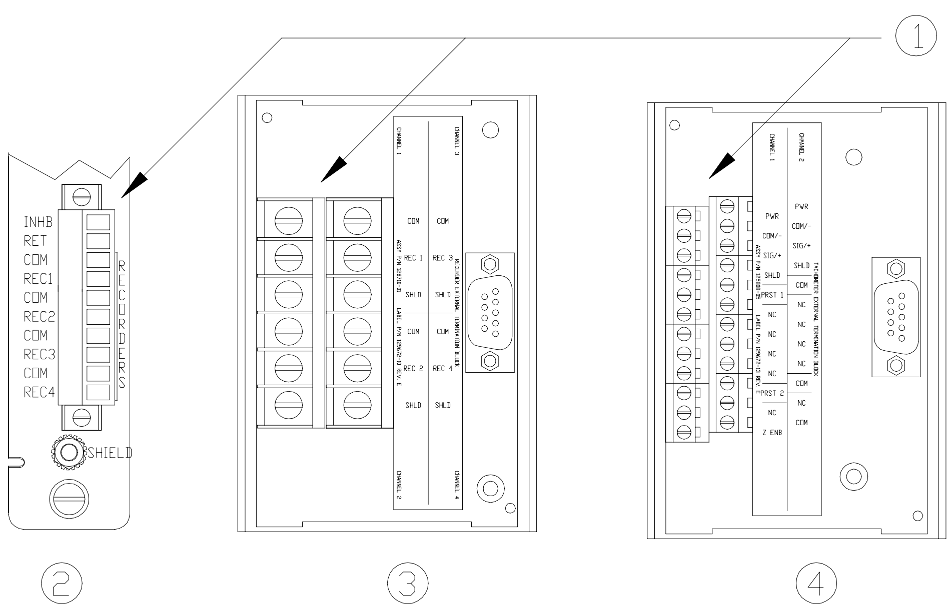
Setpoints are indicated by lines on the bargraph display:

- Danger/Alarm 2 Over = Solid Red Line
- Alert/Alarm 1 Over = Solid Yellow Line
- Alert/Alarm 1 Under = Dashed Yellow Line
- Danger/Alarm 2 Under = Dashed Red Line

Zero Position Voltage: The Zero Position Voltage is the voltage input that will cause the reading on the bar graph display and current value box to be zero. The Zero Position volts value is displayed in the Z.P. Volts box above each channel value bar graph

5.5 Verify Recorder Outputs

The following test equipment and procedure should be used in the verification of the recorder outputs. Recorder outputs for the 3500/42M Proximitor/Seismic Monitor Module are 4 to 20 mA.



(1) Connect test equipment here.
(2) Proximitor®/Seismic I/O Module
(3) External Termination Block with Euro Style connectors
(4) External Termination Block with Terminal Strip connectors

1. Disconnect the COM and REC field wiring from the channel terminals on the I/O module.
2. Connect a multimeter to the COM and REC outputs of the I/O module. The multimeter should have the capability to measure 4 to 20 mA.
3. **If the proportional value is not Gap:** Set the proportional value that the recorder is configured for to full-scale. (Refer to the proportional value of the channel type you are testing) Verify that the recorder output is reading 20 mA ±1 %. Go to step 4.
4. **If the proportional value is Gap:** Set the Gap proportional value to -18.00 Vdc (Refer to the proportional value of the channel type you are testing). Verify that the recorder output is reading 16 mA ±1 %.
5. Set the proportional value that the recorder is configured for to mid-scale. Verify that the recorder output is reading 12 mA ±1 %.
6. Set the proportional value that the recorder is configured for to bottom-scale. Verify that the recorder output is reading 4 mA ±1 %.
7. Disconnect transducer input and verify that the recorder output matches the set monitor clamp value ±1 %.
8. If you can not verify the recorder output, the recorder configuration and connections should be checked. If the monitor recorder output still does not verify properly, go to "If a channel fails a Verification Test" in this section.
9. Disconnect the multimeter and reconnect the COM and REC field wiring to the channel terminals on the I/O module.
10. Repeat steps 1 through 8 for all configured recorder channels.

5.6 Adjusting the Scale Factor and Zero Position

This section shows how to adjust the transducer scale factor and the transducer position, or "zero". The Scale Factor Adjustment can be used to accommodate any deviations in transducer scale factor as measured on the installed transducers. Do not use the procedure to compensate for any errors within the monitor and the I/O module. If a monitor does not meet specifications, exchange it with a spare and return the faulty module to Bently Nevada for repair. The newly installed spare module should be properly configured and tested.

Adjusting the scale factor affects the readings of all configured parameters associated with the channel. If you change the scale factor, be sure to use the new value when calculating inputs for verification of channel values.

The Zero Position Adjustment is used for Thrust, Eccentricity, and Differential Expansion measurements as well as for Gap measurements when Gap is configured to read in displacement units (not volts). Adjust the zero position after the probe is gapped and its target is in the proper position.

Both adjustment procedures consist of using the Rack Configuration Software to upload the configuration from the rack, change the setting for scale factor or zero position, and then downloading the new configuration back to the rack. You can adjust these settings using the following two methods:

1. enter a new value in the scale factor box on the transducer screen or the zero position box on the Channel Options screen.
2. use **Adjust** to get immediate feedback from the channel on the Adjust screen.

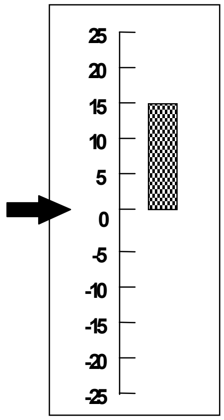
The advantage of using the Adjust screen is that you can use the bar graphs to see the effect of your adjustments on the output signals of the channel. The following procedures show how to use the methods.

5.6.1 Adjusting the Scale Factor

1. Connect the configuring computer to the rack using one of the methods listed in the 3500 Monitoring System Rack Configuration and Utilities Guide (part number 129777-01).
2. Run the Rack Configuration Software.
3. Initiate communication with the rack by clicking on the **Connect** option in the File menu and then selecting the connection method that you used in step 1.
4. Upload the configuration from the rack by clicking on the **Upload** option in the File menu.
5. Click on the **Options** button on the 3500 System Configuration screen.
6. Select the monitor you want to adjust. The Monitor screen will appear.
7. Select the **Options** button under the appropriate Channel. The configured Channel Options screen will appear.
8. Select the **Customize** button in the Transducer Selection box. A Transducer screen will appear.
9. Enter a value for scale factor in the Scale Factor box. If you go to the Adjust screen by selecting **Adjust**, be sure to adjust the input to the channel away from the Zero Position so you can adjust the scale factor and see the results.
10. Return to the 3500 System Configuration screen by clicking on the **OK** buttons of the successive screens. The new scale factor is now added to the configuration for this channel.
11. Download the new configuration to the appropriate monitor by selecting **Download** from the File menu. The new setting for scale factor will take effect when the "Download successful" prompt appears.

5.6.2 Zero Position Adjustment Description

When adjusting the Zero Position voltage, you are defining the transducer voltage corresponding to the position of the zero indication on a bar graph display (refer to the following figure).

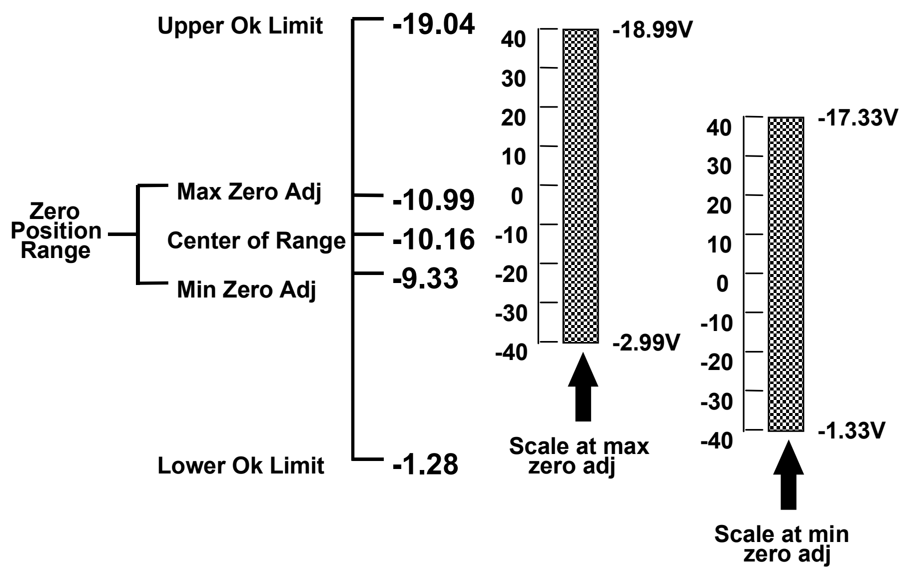


Thrust Position
Bargraph

For maximum amount of zero adjustment, gap the transducer as close as possible to the ideal zero position voltage based on the full-scale range and transducer scale factor. For a mid-scale zero, as in the example, the ideal gap is the center of the range. Refer to the transducer information of the applicable channel type for the appropriate center voltage

When increasing or decreasing the zero position voltage, you are actually mapping the monitor full scale range to a portion of the transducer linear range. The zero position voltage adjustment range is dependent upon the full-scale range of the proportional value being adjusted, the transducer scale factor, and the transducer Ok limits. The following example shows how these parameters are related to the zero position voltage range.

Parameter name	Setting
Channel pair type	Thrust Position
Direct Full-scale range	-40-0-40 mils
Transducer Type	3300 8mm
Scale Factor	200 mV/mil
OK limits	-19.04 (upper) -1.28 (lower)



5.6.3 Adjusting the Zero Position

1. Connect the configuring computer to the rack using one of the methods listed in the 3500 Monitoring System Rack Configuration and Utilities Guide (part number 129777-01).
2. Run the Rack Configuration Software.
3. Initiate communication with the rack by clicking on the **Connect** option in the File menu and then selecting the connection method that you used in step 1.
4. Upload the configuration from the rack by clicking on the **Upload** option in the File menu.
5. Select the **Options** button on the 3500 System Configuration screen.
6. Select the monitor you want to adjust. The Monitor screen will appear.
7. Select the **Options** button under the appropriate Channel. The Channel Options screen will appear.
8. Enter the voltage in the Zero Position or the Gap Position box. Changes are limited to the values listed adjacent to the box. If you go to the Adjust screen by selecting **Adjust**, you can adjust the Zero Position and see the results.
9. Return to the 3500 System Configuration screen by clicking on **OK** buttons in the successive screens. The new Zero Position or Gap Position is now added to the configuration for this channel.
10. Download the new configuration to the appropriate monitor by selecting the **Download** option in the File menu and then selecting the appropriate monitor. The new setting for Zero Position will take effect when the "Download successful" prompt appears.

5.7 If a Channel Fails a Verification Test

When handling or replacing circuit boards, always be sure to adequately protect against damage from Electrostatic Discharge (ESD). Always wear a proper wrist strap and work on a grounded conductive work surface.

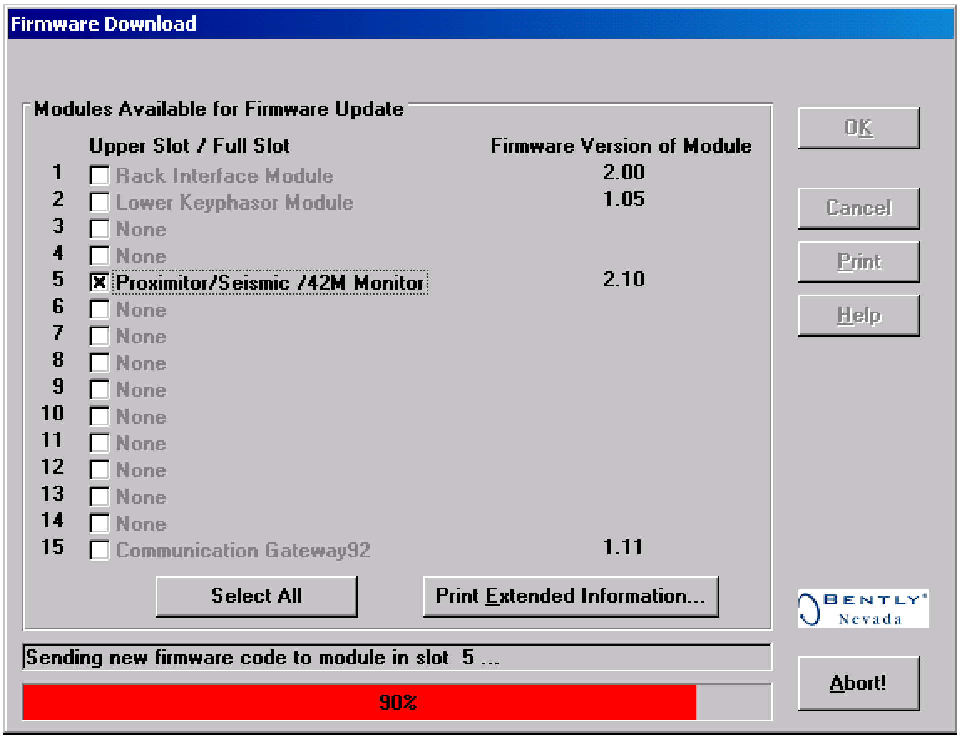
1. Save the configuration for the module using the Rack Configuration Software.
2. Replace the module with a spare. Refer to the installation section in the 3500 Monitoring System Rack Installation and Maintenance Manual (part number 129766-01).
3. Return the faulty board to Bently Nevada for repair.
4. Download the configuration for the spare module using the Rack Configuration Software.
5. Verify the operation of the spare.

5.8 Performing Firmware Upgrades

Occasionally it may be necessary to upgrade the original firmware that is shipped with the 3500/42M Proximitor Monitor. The following instructions describe how to upgrade the existing firmware using the 3500 Configuration software. The monitor will need to be reconfigured using the 3500 Rack Configuration software after having its firmware upgraded.

CAUTION!
During the following procedure power to the rack cannot be interrupted and the monitor that is being upgraded cannot be removed from the rack. If either of these occurs the monitor may become inoperable.

1. Start the 3500 Configuration software and connect to the rack.
2. Upload and save the current configuration of the monitor, the upgrade process will erase any configuration in the monitor.
3. Under the **Utilities** menu option select **Update Firmware.**



4. Select the module to be updated and click on the **OK** button.
5. The software will request the file to be downloaded. Select the file and click on the **Open** button.
6. The software will now download the file.
7. After the download is completed reload the configuration to the monitor. If the process fails the monitor will revert to its old code. Under no circumstances should the monitor be removed until it has finished the process.

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6. Troubleshooting

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6.6 Gateway Status Bits 6-18

6.1 Introduction

This section describes how to troubleshoot a problem with the Monitor by using the information provided by the self-test, the LED's, the System Event List, and the Alarm Event List.

6.2 Self-Test

To perform the monitor self-test:

1. Connect a computer running the Rack Configuration Software to the 3500 rack (if needed).
2. Select **Utilities** from the main screen of the Rack Configuration Software.
3. Select **System Events/Module Self-test** from the Utilities menu.
4. Press the **Module Self-test** button on the System Events screen.

Application Alert
Machinery protection will be lost while the self-test is being performed.

5. Select the slot that contains the monitor and press the **OK** button. The monitor will perform a full self-test and the System Events screen will be displayed. The list will not contain the results of the self-test.
6. Wait 30 seconds for the module to run a full self-test.
7. Press the **Latest Events** button. The System Events screen will be updated to include the results of the monitor self-test.
8. Verify if the monitor passed the self-test. If the monitor failed the self-test, refer to System Event List Messages.

6.3 LED Fault Conditions

The following table shows how to use the LED's to diagnose and correct problems.

OK LED	TX/RX	BYPASS	Condition	Solution
1 Hz	1 Hz	XXX	Monitor is not configured, is in Configuration Mode, or in Calibration Mode.	Reconfigure the Monitor, or exit Configuration, or Calibration Mode.
5 Hz	XXX	XXX	Monitor error	Check the System Event List for severity.
ON	Flashing	XXX	Module is operating correctly	No action required.
OFF	XXX	XXX	Monitor is not operating correctly or the transducer has faulted and has stopped providing a valid signal.	Check the System Event List and the Alarm Event List.
2 Hz	XXX	XXX	Monitor is configured for Timed OK Channel Defeat and has been not OK since the last time the RESET button was pressed.	Press the Reset button on the Rack Interface Module. Check the System Event List.
	Not flashing	XXX	Monitor is not operating correctly.	Monitor is not executing alarming functions. Replace immediately.
	XXX	OFF	Alarm Enabled	No action required.
	XXX	ON	Some or all Alarming Disabled	No action required.
XXX = Behavior of the LED is not related to the condition.				

6.4 System Event List Messages

This section describes the System Event List Messages that are entered by the monitor and gives an example of one.

6.4.1 Example of a System Event List Message

Sequence Number	Event Information	Event Number	Class	Event Date DDMMYY	Event Time	Event Specific	Slot
0000000123	Device Not Com-municating	32	1	02/01/90	12:24:31:99		5L

Sequence Number: The number of the event in the System Event List (for example 123).

Event Information: The name of the event (for example Device Not Communicating).

Event Number: Identifies a specific event.

Class: Used to display the severity of the event. The following classes are available:

Class Value	Classification
0	Severe/Fatal Event
1	Potential Problem Event
2	Typical logged Event
3	Reserved

Event Date: The date the event occurred.

Event Time: The time the event occurred.

Event Specific: It provides additional information for the events that use this field.

Slot: Identifies the module that the event is associated with. If a half-height module is installed in the upper slot or a full-height module is installed, the field will be 0 to 15. If a half-height module is installed in the lower slot, then the field will be 0L to 15L. For example, a module installed in the lower position in slot 5 would be 5L.

6.4.2 List of messages

The following System Event List Messages may be placed in the list by the monitor and are listed in numerical order. If an event marked with a star (*) occurs the monitor will stop alarming. If you are unable to solve any problems contact your nearest Bently Nevada office.

Flash Memory Failure

Event Number: 11
Event Classification: Severe / Fatal Event
Action: Replace the Monitor Module as soon as possible.

EEPROM Memory Failure

Event Number: 13
Event Classification: Potential Problem or Severe / Fatal Event
Action: Replace the Monitor Module as soon as possible.

Device Not Communicating

Event Number: 32
Event Classification: Potential Problem
Action: Check to see if one of the following components is faulty:

- the Monitor Module
- the rack backplane

Device Is Communicating

Event Number: 33
Event Classification: Potential Problem
Action: Check to see if one of the following components is faulty:

- the Monitor Module
- the rack backplane
-

*** Neuron Failure**

Event Number: 34
Event Classification: Severe / Fatal Event
Action:Replace the Monitor Module immediately. Monitor Module will stop alarming.

*** I/O Module Mismatch**

Event Number: 62
Event Classification: Severe / Fatal Event
Action: Verify that the type of I/O module installed matches what was selected in the software. If the correct I/O module is installed, there may be a fault with the Monitor Module or the Monitor I/O module. Monitor Module will stop alarming.

I/O Module Compatible

Event Number: 63
Event Classification: Severe / Fatal Event
Action: Verify that the type of I/O module installed matches what was selected in the software. If the correct I/O module is installed, there may be a fault with the Monitor Module or the Monitor I/O module.

*** Fail I/O Jumper Check**

Event Number: 64
Event Classification: Severe / Fatal Event
Action: Verify that the type of I/O module installed matches what was selected in the software. If the correct I/O module is installed, there may be a fault with the Monitor Module or the Monitor I/O module. Monitor Module will stop alarming.

Pass I/O Jumper Check

Event Number: 65
Event Classification: Severe / Fatal Event
Action: Verify that the type of I/O module installed matches what was selected in the software. If the correct I/O module is installed, there may be a fault with the Monitor Module or the Monitor I/O module.

Fail Main Board +5V-A (Fail Main Board +5V - upper Power Supply)

Event Number: 100
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot

Pass Main Board +5V-A (Pass Main Board +5V - upper Power Supply)

Event Number: 101
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot

Fail Main Board +5V-B (Fail Main Board +5V - lower Power Supply)

Event Number: 102
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the lower slot

Pass Main Board +5V-B (Pass Main Board +5V - lower Power Supply)

Event Number: 103
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the lower slot

* **Fail Main Board +5V-AB** (Fail Main Board +5V - upper and lower Power Supplies)

Event Number: 104
Event Classification: Severe/Fatal Event
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot
- the Power Supply installed in the lower slot
- Monitor Module will stop alarming.

Pass Main Board +5V-AB (Pass Main Board +5V - upper and lower Power Supplies)

Event Number: 105
Event Classification: Severe/Fatal Event
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot
- the Power Supply installed in the lower slot

Fail Main Board +15V-A (Fail Main Board +15V - upper Power Supply)

Event Number: 106
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot

Pass Main Board +15V-A (Pass Main Board +15V - upper Power Supply)

Event Number: 107
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot

Fail Main Board +15V-B (Fail Main Board +15V - lower Power Supply)

Event Number: 108
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the lower slot

Pass Main Board +15V-B (Pass Main Board +15V - lower Power Supply)

Event Number: 109
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the lower slot

* **Fail Main Board +15V-AB** (Fail Main Board +15V - upper and lower Power Supplies)

Event Number: 110
Event Classification: Severe/Fatal Event
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot
- the Power Supply installed in the lower slot
- Monitor Module will stop alarming.

Pass Main Board +15V-AB (Pass Main Board +15V - upper and lower Power Supplies)

Event Number: 111
Event Classification: Severe/Fatal Event
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot
- the Power Supply installed in the lower slot

Fail Main Board -24V-A (Fail Main Board -24V - upper Power Supply)

Event Number: 112
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot

Pass Main Board -24V-A (Pass Main Board -24V - upper Power Supply)

Event Number: 113
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot

Fail Main Board -24V-B (Fail Main Board -24V - lower Power Supply)

Event Number: 114
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the lower slot

Pass Main Board -24V-B (Pass Main Board -24V - lower Power Supply)

Event Number: 115
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the lower slot

*** Fail Main Board -24V-AB** (Fail Main Board -24V - upper and lower Power Supplies)

Event Number: 116
Event Classification: Severe/Fatal Event
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot
- the Power Supply installed in the lower slot

Monitor Module will stop alarming.

Pass Main Board -24V-AB (Pass Main Board -24V - upper and lower Power Supplies)

Event Number: 117
Event Classification: Severe/Fatal Event
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot
- the Power Supply installed in the lower slot

Fail Main Board -24V-A or B (Fail Main Board -24V Pre-Regulation)*

Event Number: 158
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot
- the Power Supply installed in the lower slot

*This event will only be return by the 3500/40M and only if the rack is configured for two power supplies.

Pass Main Board -24V-A or B (Pass Main Board -24V Pre-Regulation)*

Event Number: 159
Event Classification: Potential Problem
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot
- the Power Supply installed in the lower slot

* This event will only be return by the 3500/40M and only if the rack is configured for two power supplies.

*** Fail Main Board +3.3V-AB** (Fail Main Board +3.3V)

Event Number: 162
Event Classification: Severe/Fatal Event
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot
- the Power Supply installed in the lower slot

Monitor Module will stop alarming.

Pass Main Board +3.3V-AB (Pass Main Board +3.3V)

Event Number: 163
Event Classification: Severe/Fatal Event
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot
- the Power Supply installed in the lower slot

*** Fail Main Board +2.5V-AB** (Fail Main Board +2.5V)

Event Number: 164
Event Classification: Severe/Fatal Event
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot
- the Power Supply installed in the lower slot

Monitor Module will stop alarming.

Pass Main Board +2.5V-AB (Pass Main Board +2.5V)

Event Number: 165
Event Classification: Severe/Fatal Event
Action: Verify that noise from the power source is not causing the problem. If the problem is not caused by noise, check to see if one of the following components is faulty:

- the Monitor Module
- the Power Supply installed in the upper slot
- the Power Supply installed in the lower slot

Device Configured

Event Number: 300
Event Classification: Typical Logged Event

- Action: No action required.

*** Configuration Failure**

Event Number: 301
Event Classification: Severe/Fatal Event
Action: Download a new configuration to the Monitor Module. If the problem still exists replace the Monitor Module immediately.
Monitor Module will stop alarming.

Configuration Failure

Event Number: 301
Event Classification: Potential Problem
Action: Download a new configuration to the Monitor Module. If the problem still exists replace the Monitor Module as soon as possible.

*** Module Entered Cfg Mode** (Module Entered Configuration Mode)

Event Number: 302
Event Classification: Typical Logged Event
Action: No action required.
Monitor Module will stop alarming.

Software Switches Reset

Event Number: 305
Event Classification: Potential Problem
Action: Download the software switches to the Monitor Module. If the software switches are not correct, replace the Monitor Module as soon as possible.

Internal Cal Reset (Internal Calibration Reset)

Event Number: 307
Event Classification: Severe/Fatal Event
Event Specific: Ch pair x
Action: Replace Monitor Module immediately.

Monitor TMR PPL Failed (Monitor TMR Proportional value Failed)

Event Number: 310
Event Classification: Potential Problem
Action: Replace the Monitor Module.

Monitor TMR PPL Passed (Monitor TMR Proportional value Passed)

Event Number: 311
Event Classification: Potential Problem
Action: Replace the Monitor Module.

Module Reboot

Event Number: 320
Event Classification: Typical Logged Event
Action: No action required.

*** Module Removed from Rack**

Event Number: 325
Event Classification: Typical Logged Event
Action: No action required. Monitor Module will stop alarming.

Module Inserted in Rack

Event Number: 326
Event Classification: Typical Logged Event
Action: No action required.

Device Events Lost

Event Number: 355
Event Classification: Typical Logged Event
Action: No action required. This may be due to the removal of the Rack Interface Module for an extended period of time.

Module Alarms Lost

Event Number: 356
Event Classification: Typical Logged Event
Action: No action required. This may be due to the removal of the Rack Interface Module for an extended period of time.

*** Module Entered Calibr**. (Module Entered Calibration Mode)

Event Number: 365
Event Classification: Typical Logged Event
Action: No action required. Monitor Module will stop alarming.

Module Exited Calibr. (Module Exited Calibration Mode)

Event Number: 366
Event Classification: Typical Logged Event
Action: No action required.

Pass Module Self-test

Event Number: 410
Event Classification: Typical Logged Event
Action: No action required.

*** Enabled Ch Bypass** (Enabled Channel Bypass)

Event Number: 416
Event Classification: Typical logged event
Event Specific: Ch x
Action: No action required. Alarming has been inhibited by this action.

Disabled Ch Bypass (Disabled Channel Bypass)

Event Number: 417
Event Classification: Typical logged event
Event Specific: Ch x
Action: No action required.

* **Enabled Alert Bypass**

Event Number: 420
Event Classification: Typical logged event
Event Specific: Ch x
Action: No action required. Alarming has been inhibited by this action.

Disabled Alert Bypass

Event Number: 421
Event Classification: Typical logged event
Event Specific: Ch x
Action: No action required.

* **Enabled Danger Bypass**

Event Number: 422
Event Classification: Typical logged event
Event Specific: Ch x
Action: No action required. Alarming has been inhibited by this action.

Disabled Danger Bypass

Event Number: 423
Event Classification: Typical logged event
Event Specific: Ch x
Action: No action required.

* **Enabled Special Inh** (Enabled Special Inhibit)

Event Number: 424
Event Classification: Typical logged event
Event Specific: Ch x
Action: No action required. Alarming has been inhibited by this action.

Disabled Special Inh (Disabled Special Inhibit)

Event Number: 425
Event Classification: Typical logged event
Event Specific: Ch x
Action: No action required.

* **Enabled Mon Alarm Byp** (Enabled Monitor Alarm Bypass)

Event Number: 426
Event Classification: Typical logged event
Action: No action required. Monitor Module will stop alarming.

Disabled Mon Alarm Byp (Disabled Monitor Alarm Bypass)

Event Number: 427
Event Classification: Typical logged event
Action: No action required.

*** Fail Slot Id Test**

Event Number: 461
Event Classification: Severe/Fatal Event
Action: Verify that the Monitor Module is fully inserted in the rack. If the Monitor Module is installed correctly, check to see if one of the following components is faulty:

- the Monitor Module
- the rack backplane

Monitor Module will stop alarming.

Pass Slot Id Test

Event Number: 462
Event Classification: Severe/Fatal Event
Action: Verify that the Monitor Module is fully inserted in the rack. If the Monitor Module is installed correctly, check to see if one of the following components is faulty:

- the Monitor Module
- the rack backplane

*** Enabled Test Signal**

Event Number: 481
Event Classification: Typical logged event
Action: No action required.
Monitor Module will stop alarming.

Disabled Test Signal

Event Number: 482
Event Classification: Typical logged event
Action: No action required.

Switch To Primary Kph

Event Number: 491
Event Classification: Potential Problem
Event Specific: Ch pair x
Action: Check to see if one of the following is faulty:

- the secondary Keyphasor® transducer on the machine
- the Monitor Module

Switch To Backup Kph

Event Number: 492
Event Classification: Potential Problem
Event Specific: Ch pair x
Action: Check to see if one of the following is faulty:

- the primary Keyphasor transducer on the machine
- the Monitor Module

*** Kph Lost**

Event Number: 493
Event Classification: Potential Problem
Event Specific: Ch pair x
Action: Check to see if one of the following is faulty:

- both Keyphasor transducers on the machine
- the Monitor Module
- the Keyphasor Module

For vector and Keyphasor based, alarms the Monitor Module will stop alarming.

DSP Reset Attempted

Event Number: 501
Event Classification: Severe / Fatal Event
Event Specific: Ch pair x
Action: If the message is seen repeatedly in the System Event List, then replace the Monitor Module immediately.

*** DSP Self-test Failure**

Event Number: 502
Event Classification: Severe / Fatal Event
Event Specific: Ch pair x
Action: Replace the Monitor Module immediately. Monitor Module will stop alarming.

*** DSP Self-test Failure**

Event Number: 503
Event Classification: Severe / Fatal Event
Event Specific: Ch pair x
Action: Replace the Monitor Module immediately. Monitor Module will stop alarming.

6.5 Alarm Event List Messages

The following Alarm Event List Messages are returned by the monitor.

Alarm Even List Message	When the Message will occur
Entered Alert/ Alarm 1	A proportional value in the channel has entered Alert / Alarm 1 and changed the channel Alert / Alarm 1 status
Left Alert/ Alarm 1	A proportional value in the channel has left Alert / Alarm 1 and changed the channel Alert / Alarm 1 status
Entered Danger/ Alarm 2	A proportional value in the channel has entered Danger / Alarm 2 and changed the channel Danger / Alarm 2 status
Left Danger/ Alarm 2	A proportional value in the channel has entered Danger / Alarm 2 and changed the channel Danger / Alarm 2 status
Entered not OK	Module went not OK
Left not OK	Module returned to the OK state

6.6 Gateway Status Bits

The following status bits are reported to other monitors and are visible in places such as Modbus registers in the communication Gateway. Whenever one of these status registers is unexpectedly set, the system events list should be consulted for more information.

Gateway Status Bit	When the Message will occur
Channel not OK	Module went not OK
Channel Alert/Alarm1	A proportional value in the channel has entered Alert / Alarm 1 and changed the channel Alert / Alarm 1 status
Channel Danger/ Alarm 2	A proportional value in the channel has entered Danger / Alarm 2 and changed the channel Danger / Alarm 2 status
Channel in Bypass	Channel Bypass switch for this channel has been set
Channel Off	Channel is inactive
Channel Trip Multiply Mode	Channel has been placed in Trip Multiply
Special Alarm Inhibit	The alarm inhibit switch has been set for this channel
Channel Not Monitoring	Alarming has been disabled for this channel
KPH Not OK	Keyphasors associated with this channel are invalid
Signal Path Not OK	Monitor is not receiving a transducer signal

7. Radial Vibration General Information

Radial vibration is the dynamic motion of a shaft or casing in a direction perpendicular to the shaft axis. 3500 Radial Vibration channels measure this motion by using signals from proximity probes.

In a 3500 Monitoring System, Radial Vibration channels are programmed in pairs. These channels, depending on configuration, typically condition the input signals into various parameters called “proportional values”. These values, along with a Keyphasor® signal provide phase measurements. When 2 proximity probes are positioned in XY or orthogonal orientation the dynamic data can be used to create plots such as orbit, full spectrum and shaft centerline for enhanced machinery management.

The channels also provide setpoints that can be used for alarming. Alert setpoints can be configured for each active proportional value and Danger setpoints can be configured for any two of the active proportional values.

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8. Radial Vibration Configuration

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8.1 Introduction

This section discusses the Configuration Considerations and the Rack Configuration Software screens associated with the Radial Vibration Channel.

8.2 Configuration Considerations

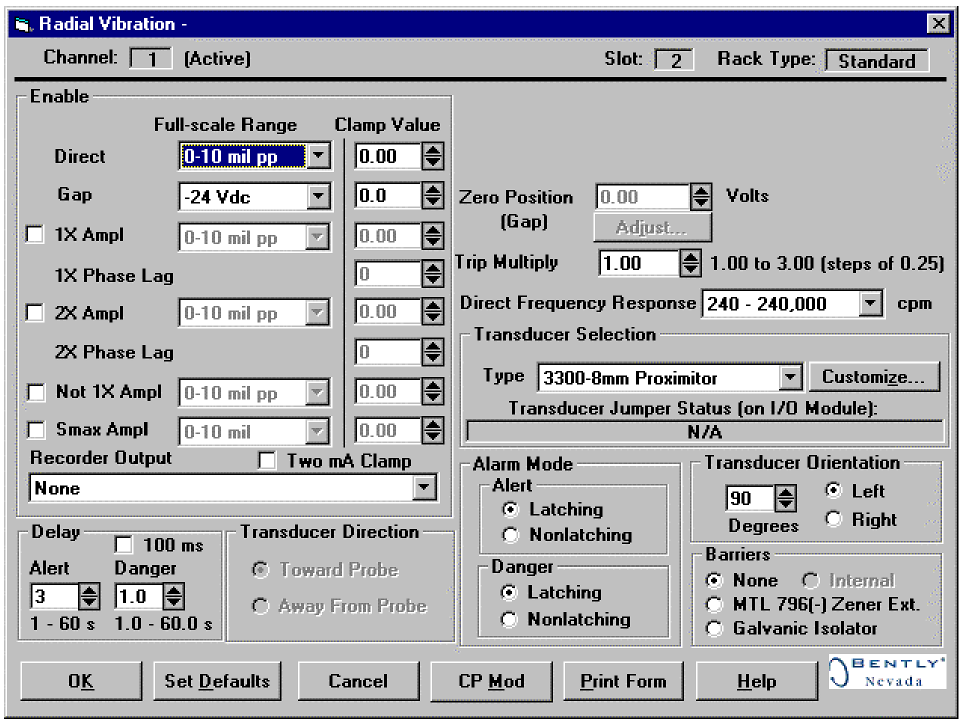
Consider the following items before configuring a Radial Vibration Channel:

- Internal Barrier I/O Modules and External barriers are not currently supported with 7200 11 mm or 14 mm, or 3000 Proximitors, or the 3300 16 mm HTPS.
- When "No Keyphasor" is selected, the 1X Amplitude (Ampl) and Phase Lag, 2X Amplitude (Ampl) and Phase Lag, Not 1X Amplitude (Ampl), and S_{max} Amplitude (Ampl) can not be selected.
- If a Keyphasor channel is selected, a Keyphasor Module must be installed in the rack.
- The 1X and 2X Phase values can be enabled only if the selected Keyphasor channel is configured for an events per revolution equal to 1 will.
- The full scale options allowed for each proportional value is dependent upon the transducer type.
- If a Non-Standard transducer is selected, the setpoint OK limits are set to ±1 volt from the Upper and Lower OK limits that are selected.
- There are two selections for 3000 Series transducers:
    - **3000(-24V) Proximitor** Select this option when connecting a 3000 Series proximitor directly to a 3500 monitor. A default scale factor of 285 mV/mil will be selected. This may be adjusted ±15 %. Note that the buffered transducers on the front of the monitors and to the Data Manager are not compensated and should be interpreted at 285 mV/mil.
    - **3000(-18V) Proximitor** Select this option when connecting a 3000 Series proximitor directly to a 3500 monitor, but supplying proximitor power from an external 18 volt source. A default scale factor of 200 mV/mil will be selected. This may be adjusted ±15 %. Note that the buffered transducers on the front of the monitors and to the Data Manager are not compensated and should be interpreted at 200 mV/mil.
- Setpoints may only be set on proportional values which are enabled.
- Monitors must be configured in channel pairs (for example, Channels 1 and 2 may be configured as Radial Vibration and Channels 3 and 4 may be configured as Thrust Position).
- When a full-scale range is modified, the setpoints associated with this proportional value should be readjusted.
- It is best to set the Scale Factor value and the Trip Multiply value before the Zero Position value.

- 3000 (-18V), 3000 (-24V), and 3300 RAM Proximitors have limited linear ranges. Therefore, you should use caution when selecting the Full-scale range of the Direct, 1X Amplitude (Ampl), 2X Amplitude (Ampl), Not 1X Amplitude (Ampl) and S_{max} Amplitude (Ampl) PPLs. Full-scale value x Trip Multiply should not exceed the linear range of the transducer.

8.3 Configuration Options

This section describes the options available on the Radial Vibration Channel configuration screen.



8.3.1 General Parameters and Buttons

Timed OK Channel Defeat: This prevents a channel from returning to an OK status until that channel's transducer has remained in an OK state for 30 seconds. This feature is always enabled in the Radial Vibration Channels. The option protects against false trips caused by intermittent transducers.

CP Mod: Selecting the CP Mod button Channel Options Dialog Box, allows a Custom channel configuration to be downloaded to the monitor. Custom configuration data is stored in a Custom Products Modification File. Custom Products Modification files follow the naming convention <modification #.mod>. These files must be located in the \3500\Rackcfg\Mods\ directory. When a CP Mod file is selected, a window is displayed which describes the function of the modification. CP Mod files are available through Bently Nevada's Custom Products Division. Contact your local Bently Nevada Sales Representative for details.

Zero Position (Gap): Represents the zero position (in volts) when the gap scale is to read the engineering units of displacement. To ensure maximum amount of zero adjustment, the probe should be gapped as close as possible to the center gap voltage specified in the OK Limit table. This field is not available for Voltage Gap Scale.

Adjust Button: Adjust the Zero Position voltage. When this button is clicked, a utility starts that helps you set the gap zero position voltage. Since this utility provides active feedback from the 3500 rack, a connection with the rack is required. Refer to "Adjusting the Scale Factor and Zero Position" in the "Monitor Verification" section of the manual.

Trip Multiply: The value selected to temporarily increase the alarm (Alert and Danger) setpoint values. This value is normally applied by manual (operator) action during startup to allow a machine to pass through high vibration speed ranges without monitor alarm indications. Such high vibration speed ranges may include system resonances and other normal transient vibrations.

Direct Frequency Response: The upper and lower corners for the band-pass filter used with direct vibration measurements. The available ranges are 240 to 240,000 cpm and 60 to 36,000 cpm.

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. Refer to "Setting the I/O Jumper" in the "I/O Module Descriptions" section of the manual, if applicable.

8.3.2 Reference Information

These fields contain information that indicates which module you are configuring.

Channel: The number of the channel being configured (1 through 4).

Slot: The location of the monitor in the 3500 rack (2 through 15).

Rack Type: Identifies the type of Rack Interface Module installed in the rack (Standard or TMR).

8.3.3 Enable

An enabled proportional value specifies that the value will be provided by the channel (☑ enabled, ☐ disabled).

Direct: Data which represents the overall peak to peak vibration. All frequencies within the selected Direct Frequency Response are included in this proportional value.

Gap: The physical distance between the face of a proximity probe tip and the observed surface. The distance can be expressed in terms of displacement (mils, micrometres) or in terms of voltage. Standard polarity convention dictates that a decreasing gap results in an increasing (less negative) output signal.

1X Ampl: In a complex vibration signal, notation for the amplitude component that occurs at the rotative speed frequency.

1X Phase Lag: In a complex vibration signal, notation for the phase lag component that occurs at the rotative speed frequency.

2X Ampl: In a complex vibration signal, notation for the amplitude component having a frequency equal to two times the shaft rotative speed.

2X Phase Lag: In a complex vibration signal, notation for the phase lag component having a frequency equal to two times the shaft rotative speed. 2X phase lag is the angular measurement from the leading or trailing edge of the Keyphasor pulse to the following positive peak of the 2X vibration signal.

Not 1X Ampl: In a complex vibration signal, notation for the amplitude component that occurs at frequencies other than rotative speed.

S_{max} Ampl: Single peak measurement of unfiltered XY (orthogonal) probes, in the measurement planes, against a calculated "quasi zero" point. Only one S_{max} Ampl value is returned per channel pair (channel 1 or channel 3).

Full Scale Range: Each selectable proportional value provides the ability to set a full scale value. If the desired full scale value is not in the pull down list, then the custom selection can be chosen.

The values in the following table are the same for all transducer types.

Direct **1X Ampl** **2X Ampl** **Not 1X Ampl** **S_{max} Ampl**
0-3 mil pp 0-5 mil pp 0-10 mil pp 0-15 mil pp 0-20 mil pp 0-100 µm pp 0-150 µm pp 0-200 µm pp 0-400 µm pp 0-500 µm pp Custom

Gap Full-scale Ranges by Transducer Type

3300–5 mm Proximitor **3300 XL 8 mm Proximitor** **3300–8 mm Proximitor** **7200–5 mm Proximitor** **7200–8 mm Proximitor**	**3300 XL 11 mm Proximitor** **7200–11 mm Proximitor** **7200–14 mm Proximitor** **3300–16 mm HTPS** **Nonstandard**	**3000 (-18V) Proximitor** **3000 (-24V) Proximitor** **3300 RAM Proximitor**
-24 Vdc 15-0-15 mil 25-0-25 mil 300-0-300 μm 600-0-600 μm Custom	-24 Vdc 15-0-15 mil 25-0-25 mil 50-0-50 mil 300-0-300 μm 600-0-600 μm 1000-0-1000 μm Custom	-24 Vdc 15-0-15 mil 300-0-300 μm

Clamp Value: The value that a proportional value goes to when that channel or proportional value is bypassed or defeated (For example when a problem occurs with the transducer). The selected value can be between the minimum and maximum full-scale range values. (1X and 2X Phase Lag have available values of 0 to 359 degrees.) Only the values available from the Recorder Outputs, Communication Gateway and Display Interface Module are clamped to the specified value when the proportional value is invalid.

Recorder Output: The proportional value of a channel that is sent to the 4 to 20 mA recorder. The recorder output is proportional to the measured value over the channel full scale range. An increase in the proportional value that would be indicated as upscale on a bar graph display results in an increase in the current at the recorder output.

If 1X Phase Lag or 2X Phase Lag are selected then the two options available are with and without Hysteresis. If the channel is Bypassed, the output will be clamped to the selected clamp value or to 2 mA (if the 2 mA clamp is selected).

The Hysteresis option helps prevent the Recorder Output from jumping from Full to Bottom Scale when the phase measurement is near 0 or 359 degrees. When the Hysteresis option is checked, the recorder signal operates as follows:

- The recorder output is scaled such that 4 mA corresponds to 0 degrees and 20 mA corresponds to 380 degrees (360 plus 20 degrees).
- The transition of a phase measurement that is increasing does not occur until the measurement has gone 20 degrees past 360 degrees. At this point, the recorder signal switches from 20 mA to a signal that corresponds to 20 degrees or 4.842 mA.
- The transition of a phase measurement that is decreasing occurs at 0 degrees (4 mA). At this point, the recorder signal switches from 4 mA to a signal that corresponds to 360 degrees or 19.158 mA.

8.3.4 Delay

The time which a proportional value must remain at or above an over alarm level or below an under alarm level before an alarm is declared as active.

Alert: First level alarm that occurs when the transducer signal level exceeds the selected Alert/Alarm 1 setpoint. This setpoint can be set on the Setpoint screen. The Alert time delay is always set at one second intervals (from 1 to 60) for all available proportional values.

Danger: Second level alarm that occurs when the transducer signal level exceeds the selected Danger/Alarm 2 setpoint. This setpoint can be set on the Setpoint screen.

100 ms option: The 100 ms (typical) option applies to the Danger time delay only and has the following results:

If the 100 ms option is off (☐):

- The Danger time delay can be set at one second intervals (from 1 to 60).
- The Danger time delay can be set for up to two available proportional values.

If the 100 ms option is on (☑):

- The Danger time delay is set to 100 ms.
- The Danger time delay can only be set for the primary proportional value.

8.3.5 Transducer Selection

Type: The following transducer types are available for the Radial Vibration Channel (non-barrier I/O module):

3300 Transducers

- 3300 XL 8 mm Proximitor
- 3300 XL 11 mm Proximitor
- 3300 – 5 mm Proximitor
- 3300 – 8 mm Proximitor
- 3300 RAM Proximitor
- 3300 – 16 mm HTPS

7200 Transducers

- 7200 – 5 mm Proximitor
- 7200 – 8 mm Proximitor
- 7200 – 11 mm Proximitor
- 7200 – 14 mm Proximitor

3000 Transducers

- 3000 (-18 V) Proximitor
- 3000 (-24 V) Proximitor
- Nonstandard

The following transducer types are available for the Radial Vibration Channel (barrier I/O module):

3300 Transducers

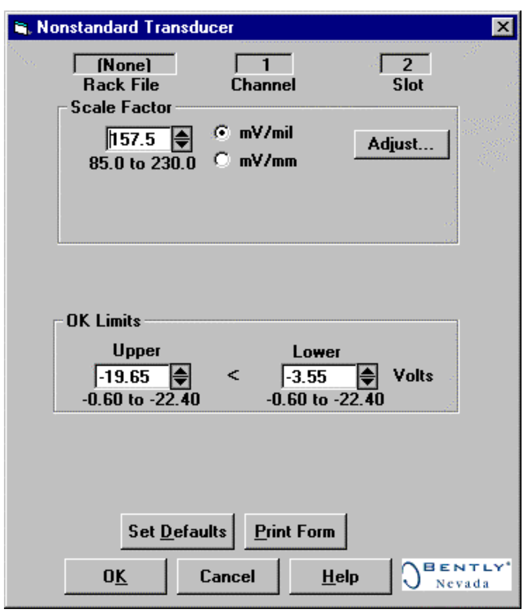
- 3300 XL 8 mm Proximitor
- 3300 XL 11 mm Proximitor
- 3300 – 5 mm Proximitor
- 3300 – 8 mm Proximitor
- 3300 RAM Proximitor

7200 Transducers

- 7200 – 5 mm Proximitor
- 7200 – 8 mm Proximitor
- Nonstandard

Customize button: Used to adjust the Scale Factor for transducers. Refer to "Adjusting the Scale Factor and Zero Position" in the "Monitor Verification" section of the manual. Also, note that:

- If Non-standard is selected as the transducer type, the OK Limits can also be adjusted.
- The Non-standard transducer's scale factor must be between 85 and 230 mV/mil.
- There must be at least 2 volts between the Upper and Lower OK Limits.



Scale Factor by Transducer Type

Transducer	Scale Factor				
	Without Barriers	With Bently Nevada Internal Barriers	Standard I/O With Barriers	Discrete TMR I/O With Barriers	Bussed TMR I/O With Barriers
3300 XL 8 mm 3300 5 and 8 mm 7200 5 and 8 mm	200 mV/mil	200 mV/mil	192 mV/mil	200 mV/mil	199 mV/mil
3300 XL 11 mm	100 mV/mil	100 mV/mil	96 mV/mil	100 mV/mil	100 mV/mil
7200 11 mm	*100 mV/mil	*	*	*	*
7200 14 mm	*100 mV/mil	*	*	*	*
3000 (-18 V)	*200 mV/mil	*	*	*	*
3000 (-24 V)	*285 mV/mil	*	*	*	*
3300 RAM	200 mV/mil	200 mV/mil	192 mV/mil	200 mV/mil	199 mV/mil
3300 16 mm HTPS	100 mV/mil	*	*	*	*
Note: ±15 % scale factor adjustment allowed * Barriers are not supported with this transducer option.					

OK Limits by Transducer Type

Transducer	Upper		Lower		Center Gap Voltage	
	Without Barriers (V)	With Barriers (V)	Without Barriers (V)	With Barriers (V)	Without Barriers (V)	With Barriers (V)
3300 XL 8 mm 3300 XL 11 mm 3300 5 mm 3300 8 mm 7200 5 mm 7200 8 mm	-16.75	-16.75	-2.75	-2.75	-9.75	-9.75
7200 11 mm	-19.65	*	-3.55	*	-11.6	*
7200 14 mm	-16.75	*	-2.75	*	-9.75	*
3000 (-18 V)	-12.05	*	-2.45	*	-7.25	*
3000 (-24 V)	-15.75	*	-3.25	*	-9.5	*
3300 RAM	-12.55	-12.15	-2.45	-2.45	-7.5	-7.3
3300 16 mm HTPS	-16.75	*	-2.75	*	-9.75	*

* Barriers are not supported with this transducer option.

Note: With Barriers includes BN Internal Barrier I/O Modules.

8.3.6 Alarm Mode

Latching: Once an alarm is active it will remain active even after the proportional value drops below the configured setpoint level. The channel will remain in alarm until it is reset using one of the following methods:

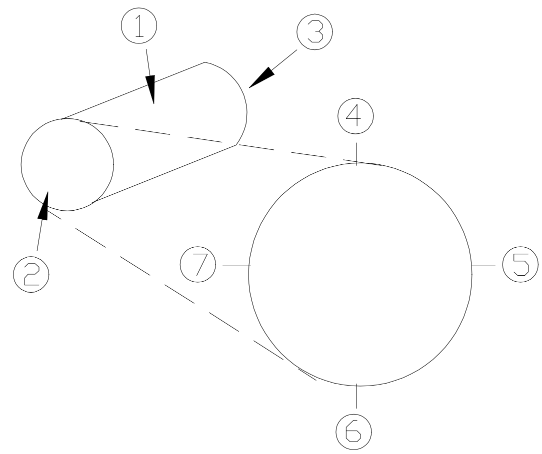
- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: When an alarm is active it will go inactive as soon as the proportional value drops below the configured setpoint level.

Alert should be the first level alarm that occurs when the transducer signal level exceeds the selected value. Danger should be the second level alarm that occurs when the transducer signal level exceeds the selected value. The Alert and Danger values are set on the Setpoint screen.

8.3.7 Transducer Orientation

Degrees: The location of the transducer on the machine. The range for orientation angle is 0 to 180 degrees left or right as observed from the driver to the driven end of the machine train. Refer to the following figure:



This drawing is for horizontal shafts

(1) Shaft
(2) Driver end
(3) Driven end
(4) 0°
(5) 90° right
(6) 180°
(7) 90° left

8.3.8 Barriers

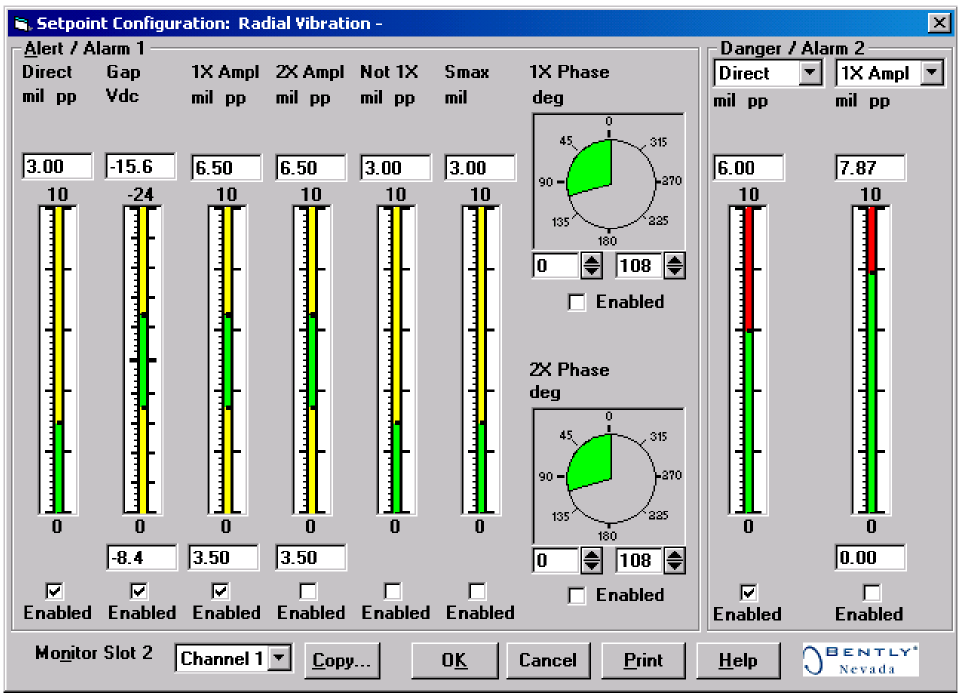
Select the MTL 796(-) Zener External option, or Galvanic Isolators if external safety barriers are connected between the monitor and the transducer. If using an Internal Barrier I/O Module, select the internal option. These devices are used to restrict the amount of energy that can flow into a hazardous area.

8.4 Alarm Setpoints

This section lists the available setpoints for the Radial Vibration channel. A setpoint is the level within the full-scale range that determines when an alarm occurs. The 3500 Monitoring System allows Alert/Alarm 1 setpoints to be set for every proportional value on each channel. The channel will drive an Alert/Alarm 1 indication if one or more of the channel proportional values exceeds its setpoints. The 3500 Monitoring System also allows up to four Danger/Alarm 2 setpoints (two over setpoints and two under setpoints) to be set for up to two of the proportional values. You may select any two of the available proportional values for the channel.

Note
The setpoint over and under limits can only be placed within the OK limits of the specified transducer.

Use the following screen in the Rack Configuration Software to adjust Alert/Alarm 1 and Danger/Alarm 2 setpoints for Radial Vibration channels.



8.4.1 Available Setpoints

The following tables list the Alert/Alarm 1 and Danger/Alarm 2 setpoints available for each Radial Vibration channel pair. The setpoint number is used in the Communication Gateway and Display Interface Modules.

Setpoint Number	Radial Vibration
1	Over Direct
2	Over Gap
3	Under Gap
4	Over 1X Ampl
5	Under 1X Ampl
6	Over 1X Phase Lag
7	Under 1X Phase Lag
8	Over 2X Ampl
9	Under 2X Ampl
10	Over 2X Phase Lag
11	Under 2X Phase Lag
12	Over Not 1X Ampl
13	Over S_{max} Ampl
14	Danger (configurable)
15	Danger (configurable)
16	Danger (configurable)
17	Danger (configurable)

8.4.2 Alarm Hysteresis

The alarming hysteresis for all channel configurations is 1/64 of Full Scale. When a channel exceeds an alarm setpoint, it must fall back below the setpoint less the hysteresis before it can go out of alarm.

For example, for a channel configuration with a 0–10 mils full scale and an alarm setpoint at 6 mils. The hysteresis = 10 mils/64 = 0.16 mils. The channel input, therefore, must fall below 6 mils - 0.16 mils (5.84 mils) before the channel is out of alarm.

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9. Radial Vibration Verification

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9.1 Introduction

The following sections describe how to test alarms, verify channels, and test OK limits for channels configured as Radial Vibration. The output values and alarm setpoints are verified by varying the input vibration signal level (both peak to peak amplitude and DC voltage bias) and observing that the correct results are reported in the Verification screen on the test computer.

Radial Vibration channels can be configured for the following channel values and alarms:

Channel Values	Alarms	
	Over	Under
Direct	X	
Gap	X	X
1X Amplitude and Phase	X	X
2X Amplitude and Phase	X	X
Not 1X Amplitude	X	
S_{max} Amplitude	X	

9.2 Test Equipment and Software Setup

The following test equipment and software setup can be used as the initial set up needed for all the Radial Vibration channel verification procedures (Test Alarms, Verify Channels, and Test OK Limits).

WARNING!
High voltage present. Contact could cause shock, burns, or death. Do not touch exposed wires or terminals.

Application Alert
Tests will exceed alarm setpoint levels causing alarms to activate. This could result in a relay contact state change.

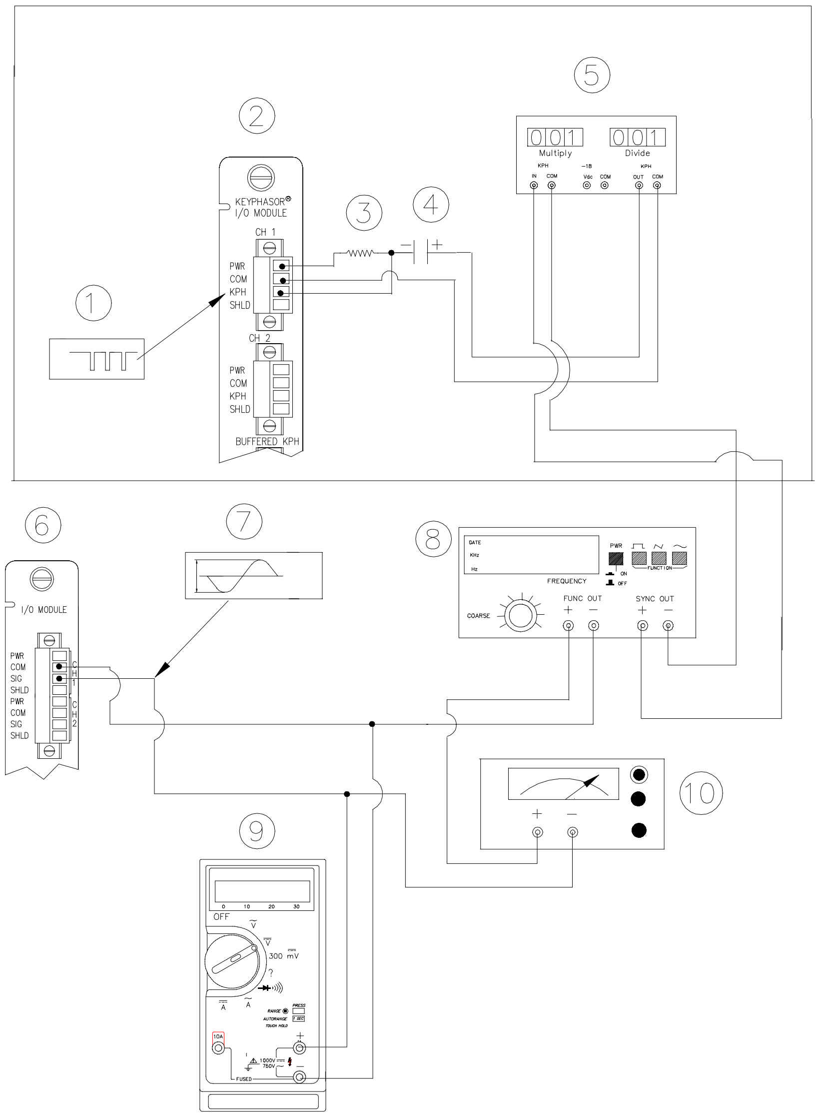
Application Alert
Disconnecting the field wiring will cause a not OK condition.

9.2.1 Test Equipment Setup

Simulate the transducer signal by connecting the power supply, function generator, and multimeter to COM and SIG of channel 1 with polarity as shown in the figure below. Set the test equipment as follows:

Power Supply	Function Generator	Keyphasor Multiplier/Divider
-7.00 Vdc	Waveform: sinewave DC Volts: 0 Vdc Frequency: 100 Hz Amplitude level: Minimum (above zero)	Multiply Switch: 001 Divide Switch: 001

The equipment shown in the dashed box is required for 1X Amplitude and Phase, 2X Amplitude and Phase, Not 1X Amplitude, and S_{max} Amplitude.



Test equipment for Radial Vibration

(1) Keyphasor® Signal
(2) Keyphasor® I/O Module
(3) 40 kΩ
(4) 100 μF
(5) Keyphasor® Mulitplier/Divider
(6) Typical I/O module
(7) Simulated input signal
(8) Function generator
(9) Mulitmeter
(10) Power supply

9.2.2 Verification Screen Setup

Run the Rack Configuration Software on the test computer. Choose **Verification** from the Utilities menu and choose the proper Slot number and Channel number then click on the **Verify** button.

Note
Timed OK Channel Defeat is enabled for Radial Vibration channels. It will take 30 seconds for a channel to return to the **OK** status from a **not OK** condition.

9.3 Test Alarms

The general approach for testing alarm setpoints is to simulate the vibration and Keyphasor® signal with a function generator. The alarm levels are tested by varying the vibration signal (both peak to peak amplitude and DC voltage bias) and observing that the correct results are reported in the Verification screen on the test computer. It is only necessary to test those alarm parameters that are configured and being used. The general test procedure to verify current alarm operation will include simulating a transducer input signal and varying this signal:

- to exceed over Alert/Alarm 1 and Danger/Alarm 2 Setpoints, and
- to drop below any under Alert/Alarm 1 and Danger/Alarm 2 Setpoints and
- to produce a nonalarm condition.

When varying the signal from an alarm condition to a nonalarm condition, alarm hysteresis must be considered. Adjust the signal well below the alarm setpoint for the alarm to clear.

9.3.1 Direct

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the function generator amplitude to produce a reading that is below the Direct setpoint levels on the Direct bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Direct is green, and the Current Value field contains no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the Direct Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct

changes color from green to yellow and that the Current Value Field indicates an Alarm.

6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the Direct Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Direct changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. If you can't verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
11. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
12. Repeat steps 1 through 11 for all configured channels.

9.3.2 Gap

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2.
3. Adjust the power supply to produce a voltage that is within the Gap setpoint levels on the Gap bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Gap is green and that the Current Value field has no alarm indication.
5. Adjust the power supply voltage such that the signal just exceeds the Gap Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Gap changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Gap remains yellow and that the Current Value Field still indicates an Alarm.

7. Adjust the power supply such that the signal just exceeds the Gap Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Gap changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Gap remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the power supply voltage such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Gap changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. Repeat steps 5 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the power supply to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

9.3.3 1X Amplitude (1X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the function generator amplitude to produce a reading that is within the 1X Ampl setpoint levels on the 1X Ampl bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 1X Ampl is green and that the Current Value field contains no alarm indication.

5. Adjust the function generator amplitude such that the signal just exceeds the 1X Ampl Over Alert/Alarm 1 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Ampl changes color from green to yellow and the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Ampl remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the 1X Ampl Over Danger/Alarm 2 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Ampl changes color from yellow to red and the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Ampl remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Ampl changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the function generator amplitude to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

9.3.4 1X Phase

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2.

Note
If you can not change the phase output, change the phase alarm setpoints to activate the over and under phase alarms. The setpoints must be downloaded to the monitor to take effect.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the phase to produce a reading that is within the 1X Phase setpoint levels on the 1X Phase bar graph display of the Verification screen.
4. The 1X Amplitude needs to be a minimum of 42.7 mV to get a valid 1X Phase reading.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 1X Phase is green, and the Current Value field contains no alarm indication.
6. Adjust the phase such that the reading just exceeds the 1X Phase Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Phase changes color from green to yellow and the Current Value Field indicates an Alarm.
7. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Phase remains yellow and that the Current Value Field still indicates an Alarm.
8. Adjust the phase such that the reading just exceeds the 1X Phase Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Phase changes color from yellow to red and that the Current Value Field indicates an Alarm.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Phase remains red and that the Current Value Field still indicates an Alarm.
10. Adjust the phase such that the reading is below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Phase changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
11. Repeat steps 3 through 10 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the phase to exceed the Under Alarm setpoint levels.
12. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
13. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED

comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.

14. Repeat steps 1 through 13 for all configured channels.

9.3.5 2X Amplitude (2X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two. Adjust the function generator amplitude to produce a reading that is within the 2X Ampl setpoint levels on the 2X Ampl bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 2X Ampl is green, and the Current Value field has no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the 2X Ampl Over Alert/Alarm 1 setpoint level. Wait 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 2X Ampl changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Ampl remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the 2X Ampl Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 2X Ampl changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Ampl remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 2X Ampl changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.

10. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the function generator amplitude to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

9.3.6 2X Phase

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2.

Note
If you can not change the phase output, change the phase alarm setpoints to activate the over and under phase alarms. The setpoints must be downloaded to the monitor to take effect.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two. Adjust the phase to produce a reading that is within the 2X Phase setpoint levels on the 2X Phase bar graph display of the Verification screen.
4. The 2X Amplitude needs to be a minimum of 42.7 mV to get a valid 2X Phase reading.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 2X Phase is green, and the Current Value field has no alarm indication.
6. Adjust the phase such that the reading just exceeds the 2X Phase Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay and verify that the bar graph indicator for 2X Phase changes color from green to yellow and that the Current Value Field indicates an Alarm.
7. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Phase remains yellow and that the Current Value Field still indicates an Alarm.
8. Adjust the phase such that the reading just exceeds the 2X Phase Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time

delay expires and verify that the bar graph indicator for 2X Phase changes color from yellow to red and that the Current Value Field indicates an Alarm.

9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Phase remains red and that the Current Value Field still indicates an Alarm.
10. Adjust the phase such that the reading is below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 2X Phase changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
11. Repeat steps 3 through 10 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the phase to exceed the Under Alarm setpoint levels.
12. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
13. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
14. Repeat steps 1 through 13 for all configured channels.

9.3.7 Not 1X Amplitude (Not 1X)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two. Adjust the function generator amplitude to produce a reading that is below the Not 1X setpoint levels on the Not 1X bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Not 1X is green, and the Current Value field has no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the Not 1X Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the

alarm time delay expires and verify that the bar graph indicator for Not 1X changes color from green to yellow and that the Current Value Field indicates an Alarm.

6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Not 1X remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the Not 1X Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Not 1X changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Not 1X remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Not 1X changes color to green and the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
11. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
12. Repeat steps 1 through 11 for all configured channels.

9.3.8 S_{max} Amplitude

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel pair terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2. **S_{max} requires input connections to both channel 1 and 2 or channel 3 and 4.**

3. Adjust the function generator amplitude to produce a reading that is below the S_{max} setpoint levels on the S_{max} bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for S_{max} is green, and the Current Value field has no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the S_{max} Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for S_{max} changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for S_{max} remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the S_{max} Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for S_{max} changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for S_{max} remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for S_{max} changes color to green and the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
11. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel pair terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
12. Repeat steps 1 through 11 for all configured channels.

9.4 Verify Channel Values

The general approach for testing channel values is to simulate the vibration and Keyphasor input signal with a function generator. The output values are verified by varying the input vibration signal level (both peak to peak amplitude and DC voltage bias) and observing that the correct results are reported in the Verification screen on the test computer.

Note
These parameters have an accuracy specification of ±1 % of full scale for amplitude and ±3 degrees for phase.

9.4.1 Direct

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2.
3. Calculate the full-scale voltage according to the equation and examples shown below. Adjust the amplitude of the function generator to the calculated voltage.

Application Alert
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Full Scale Voltage = Direct Meter Top Scale $\times$ Transducer Scale Factor

Example 1:
Direct Meter Top Scale = 10 mil
Transducer Scale Factor = 200 mV/mil

Full Scale = (10×0.200)
= 2.000 Vpp

For Vrms input:

Vrms = $(0.707/2) \times$ (Vpp), for a sinewave input
= $(0.707/2) \times (2)$
= 0.707 Vrms

Example 2:
Direct Meter Top Scale = 200 μm
Transducer Scale Factor = 7,874 mV/mm
= 7.874 mV/μm

Full Scale = (200×0.007874)
= 1.5748 Vpp

For Vrms input:

Vrms	=	(0.707/2) × (Vpp), for a sinewave input
	=	(0.707/2) × (1.574)
	=	0.5566 Vrms

4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Verify that the Direct bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

9.4.2 Gap

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2.
3. **If Gap is configured to read in volts**, adjust the power supply to produce a voltage equal to -18.00 Vdc on the Gap bar graph display. Verify that the Gap bar graph display and Current Value Box is reading ±1 % of -18.00 Vdc.
4. Adjust the power supply to produce a voltage equal to mid-scale on the Gap bar graph display. Verify that the Gap bar graph display and Current Value Box is reading ±1 % of the mid-scale value. Go to step 8.

If Gap is configured to read in displacement units, calculate the full-scale and bottom-scale voltage using the following equation:

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Gap Full-Scale = Gap Zero Position Volts + (Gap Meter Top Scale × Transducer Scale Factor)

Example 1:

Transducer Scale Factor	=	200 mV/mil
Gap	=	15-0-15 mil

Gap Top Scale	=	15 mil
Gap Zero Position Volts	=	-9.75 Vdc
Gap Full Scale input	=	-9.75 Vdc + (15 × 0.200)
	=	-6.75 Vdc

Example 2:

Transducer Scale Factor	=	7,874 mV/mm
	=	7.874 mV/µm
Gap	=	300-0-300 µm
Gap Top Scale	=	300 µm
Gap Zero Position Volts	=	-9.75 Vdc
Gap Full Scale input	=	-9.75 Vdc + (300 × 0.007874)
	=	-7.3878 Vdc

Gap Bottom-Scale = Gap Zero Position Volts - (Gap Meter Bottom Scale × Transducer Scale Factor)

Example 1:

Transducer Scale Factor	=	200 mV/mil
Gap	=	15-0-15 mil
Gap Bottom Scale	=	15 mil
Gap Zero Position Volts	=	-9.75 Vdc
Gap Bottom Scale input	=	-9.75 Vdc - (15 × 0.200)
	=	-12.75 Vdc

Example 2:

Transducer Scale Factor	=	7,874 mV/mm
	=	7.874 mV/µm
Gap	=	300-0-300 µm
Gap Bottom Scale	=	300 µm
Gap Zero Position Volts	=	-9.75 Vdc
Gap Bottom Scale input	=	-9.75 Vdc - (300 × 0.007874)
	=	-12.1122 Vdc

5. Adjust the power supply voltage to match the voltage displayed in the Gap Zero Position Volts Box. The Gap bar graph display and Current Value Box should read 0 mil (0 mm) ±1 %.
6. Adjust the power supply to produce a voltage equal to top scale (from step 3) on the Gap bar graph display. Verify that the Gap bar graph display and Current Value Box is reading ±1 % of top scale.
7. Adjust the power supply to produce a voltage equal to bottom scale (from step 3) on the Gap bar graph display. Verify that the Gap bar graph display and Current Value Box is reading ±1 % of bottom scale.
8. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.

9. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
10. Repeat steps 1 through 9 for all configured channels.

9.4.3 1X Amplitude (1X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2.
3. Calculate the full-scale voltage according to the equation and examples shown below. Adjust the function generator amplitude to the calculated voltage.

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Full Scale Voltage = 1X Ampl Meter Top Scale X Transducer Scale Factor

Example 1:
1X Ampl Meter Top Scale = 10 mil
Transducer Scale Factor = 200 mV/mil

Full Scale = (10×0.200)
= 2.000 Vpp

For V rms input:
V rms = $(0.707/2) \times$ (Vpp), for a sinewave input
= $(0.707/2) \times (2)$
= 0.707 Vrms

Example 2:

1X Ampl Meter Top Scale	=	200 μm
Transducer Scale Factor	=	7,874 mV/mm
	=	7.874 mV/μm

Full Scale	=	(200 × 0.007874)
	=	1.5748 Vpp

For V rms input:

V rms	=	(0.707/2) × (Vpp), for a sinewave input
	=	(0.707/2) × (1.574)
	=	0.5566 Vrms

4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Verify that the 1X Ampl bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

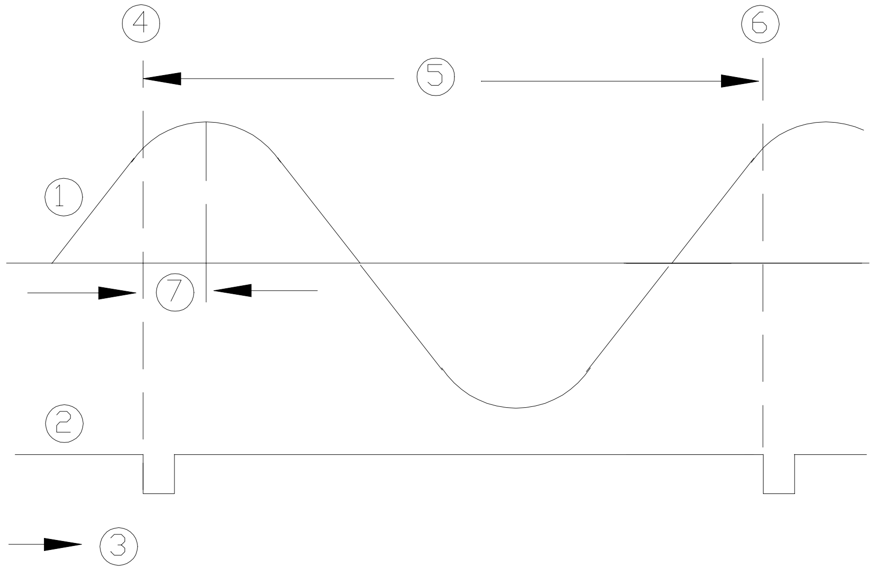
9.4.4 1X Phase

If the test equipment is not capable of changing the phase output to a known value, use the following procedure. If your test equipment can change the phase output to a known value, use the procedure "If the Test Equipment Can Change the Phase Output (1X Phase)" on page 9-20.

9.4.4.1 If the Test Equipment Cannot Change the Phase Ouput (1X Phase)

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
3. Attach one channel of a two channel oscilloscope to the vibration signal buffered output and attach the other channel to the associated Keyphasor® signal buffered output and observe the two signals simultaneously.
4. Measure the phase. 1X Phase will be measured from the leading edge of the Keyphasor® pulse to the first positive peak of the vibration signal. See the example below which illustrates a phase of 45°. Observe the 1X Phase bar graph display and Current Value Box; it should read approximately what was measured above.

Example:
1X = one cycle of vibration signal per shaft revolution



(1) 1X Vibration Signal
(2) Keyphasor Signal
(3) Time
(4) 0°
(5) One cycle
(6) 360°
(7) Phase lag = 45°

5. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
6. Repeat steps 1 through 5 for all configured channels.

9.4.4.2 If the Test Equipment Can Change the Phase Output (1X Phase)

If the test equipment has the capability to change the phase output to a known value, use the following procedures.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
3. Adjust the phase for mid-scale. Verify that the 1X Phase bar graph display and Current Value Box is reading ±1.5 % of mid-scale.

4. If the reading does not meet specifications double check the input signal to ensure it is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
5. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
6. Repeat steps 1 through 5 for all configured channels.

9.4.5 2X Amplitude (2X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2.
3. Calculate the full-scale voltage according to the equation and examples shown below. Adjust the function generator amplitude to the calculated voltage.

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Full Scale Voltage = 2X Ampl Meter Top Scale × Transducer Scale Factor

Example 1:
2X Ampl Meter Top Scale = 10 mil
Transducer Scale Factor = 200 mV/mil

Full Scale = (10 × 0.200)
= 2.000 Vpp

For V rms input:
V rms = (0.707/2) × (Vpp), for a sinewave input

= $(0.707/2) \times (2)$
= 0.707 Vrms

Example 2:
2X Ampl Meter Top Scale = 200 µm
Transducer Scale Factor = 7,874 mV/mm
= 7.874 mV/µm

Full Scale = (200×0.007874)
= 1.5748 Vpp

For V rms input:
V rms = $(0.707/2) \times$ (Vpp), for a sinewave input
= $(0.707/2) \times (1.574)$
= 0.5566 Vrms

4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two. Verify that the 2X Ampl bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

9.4.6 2X Phase

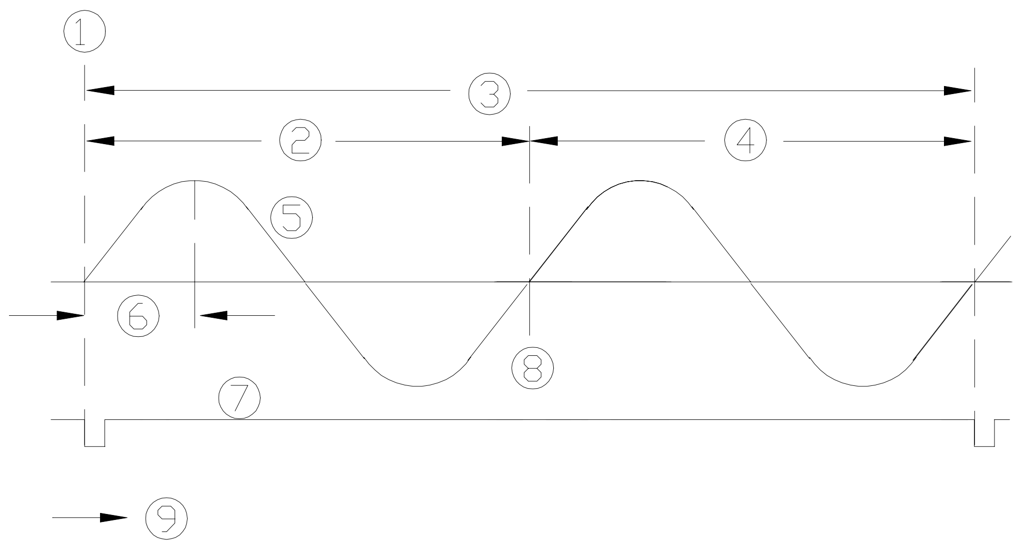
If the test equipment is not capable of changing the phase output to a known value, use the following procedure. If your test equipment can change the phase output to a known value, use the procedure "If the Test Equipment can Change the Phase Output (2X Phase) on page 9-23.

9.4.6.1 If the Test Equipment Cannot Change the Phase Output (2X Phase)

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup on page 9-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two.
3. Attach one channel of the two channel oscilloscope to the vibration signal buffered output and attach the other channel to the associated Keyphasor® signal buffered output and observe the two signals simultaneously.
4. Measure the phase. 2X Phase will be measured from the leading edge of the Keyphasor® pulse to the first positive peak of the vibration signal. See the example below which illustrates a phase of 90°. Observe the 2X Phase bar

graph display and Current Value Box; it should read approximately what was measured above.

Example:
2X = two cycles of vibration signal per shaft revolution



(1) 0°
(2) First Cycle
(3) One shaft revolution
(4) Second cycle
(5) 2X Vibration Signal
(6) Phase lag = 90°
(7) Keyphasor® signal
(8) 360°
(9) Time

5. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
6. Repeat steps 1 through 5 for all configured channels.

9.4.6.2 If the Test Equipment can Change the Phase Output (2X Phase)

If the test equipment has the capability to change the phase output to a known value, use the following procedure.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.

2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two.
3. Adjust the phase for mid-scale. Verify that the 2X Phase bar graph display and Current Value Box is reading ±1.5 % of mid-scale.
4. If the reading does not meet specifications, double check the input signal to ensure it is correct. If the monitor still does not meet specifications and/or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
5. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
6. Repeat steps 1 through 5 for all configured channels.

9.4.7 Not 1X Amplitude

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2.
3. Calculate the full-scale voltage according to the equation and example shown below. Adjust the function generator amplitude to the calculated voltage.

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Full-Scale Voltage =Not 1X Ampl Meter Top Scale × Transducer Scale Factor

Example 1:

Not 1X Ampl Meter Top Scale	=	10 mil
Transducer Scale Factor	=	200 mV/mil

Full Scale	=	(10×0.200)
	=	2.000 Vpp

For Vrms input:

Vrms	=	$(0.707/2) \times$ (Vpp), for a sinewave input
	=	$(0.707/2) \times (2)$
	=	0.707 Vrms

Example 2:

Not 1X Ampl Meter Top Scale	=	200 µm
Transducer Scale Factor	=	7,874 mV/mm
	=	7.874 mV/µm

Full Scale	=	(200×0.007874)
	=	1.5748 Vpp

For V rms input:

V rms	=	$(0.707/2) \times$ (Vpp), for a sinewave input
	=	$(0.707/2) \times (1.574)$
	=	0.5566 Vrms

4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two. Verify that the Not 1X bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

9.4.8 S_{max} Amplitude

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel pair terminals on the I/O module.

2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2. **S_{max} requires input connections to both channel 1 and 2 or channel 3 and 4.**
3. Calculate the full-scale voltage using the equation and example shown below.

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Full-Scale Voltage = (S_{max} Meter Top Scale × Transducer Scale Factor) × 1.414

Example 1:

S_{max} Meter Top Scale	=	10 mil
Transducer Scale Factor	=	200 mV/mil

Full Scale	=	(10 × 0.200) × 1.414
	=	2.828 Vpp

For Vrms input:

Vrms	=	(0.707/2) × (Vpp), for a sinewave input
	=	(0.707/2) × (2.828)
	=	0.999 Vrms

Example 2:

S_{max} Meter Top Scale	=	200 µm
Transducer Scale Factor	=	7,874 mV/mm
	=	7.874 mV/µm

Full Scale	=	(200 × .007874) × 1.414
	=	2.2267 Vpp

For Vrms input:

Vrms	=	(0.707/2) × (Vpp), for a sinewave input
	=	(0.707/2) × (2.2267)
	=	0.7871 Vrms

4. Set the Keyphasor multiplier/divider so that the multiply setting is set to one and the divide setting is set to one. Adjust the function generator amplitude for full scale. Verify that the S_{max} bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part

of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.

6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel pair terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

9.5 Test OK Limits

The general approach for testing OK limits is to input a DC voltage and adjust it above the Upper OK limit and below the Lower OK limit. This will cause a channel not OK condition and the OK Relay to change state (de-energize). The Upper and Lower OK limits are displayed in the Verification screen on the test computer.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 9-2.
3. Bypass all other configured channels.
4. Adjust the power supply voltage to -7.00 Vdc.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the monitor OK LED is on and that the Channel OK State line in the Channel Status box of the Verification screen reads **OK**.

Note
If the Danger Bypass has been activated, then the BYPASS LED will be on. All other channels in the rack must be OK or bypassed for the relay to be energized.

6. Verify that the OK relay on the Rack Interface I/O Module indicates OK (energized). See 3500/20 Rack Interface Module Operation and Maintenance Manual, part number 129768-01.
7. Increase the power supply voltage (more negative) until the OK LED just goes off (upper limit). Verify that the Channel OK State line in the Channel Status box reads **not OK** and that the OK Relay indicates not OK. Verify that the Upper OK limit voltage displayed on the Verification screen is equal to or more positive than the input voltage.
8. Decrease the power supply voltage (less negative) to -7.00 Vdc.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on and the OK relay energizes. Verify that the Channel OK State line in the Channel Status box reads **OK**.

10. Gradually decrease the power supply voltage (less negative) until the OK LED just goes off (lower limit). Verify that the Channel OK State line in the Channel Status box reads **not OK** and that the OK Relay indicates not OK. Verify that the Lower OK limit voltage displayed on the Verification screen is equal to or more negative than the input voltage.
11. Increase the power supply voltage (more negative) to -7.00 Vdc.
12. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on, the OK relay energizes and that the Channel OK State line in the Channel Status box reads **OK**.
13. If you can not verify any configured OK limit, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
14. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the Monitor I/O Module. Press the RESET switch on the Rack Interface Module (RIM) and verify that the OK LED comes on and the OK relay energizes.
15. Repeat steps 1 through 14 for all configured channels.
16. Return the bypass switch for all configured channels back to their original setting.

Radial Vibration Default OK Limits Table

Transducer	Lower OK Limit (volts)	Upper OK Limit (volts)
7200 5&8 mm w/ barriers	-2.7 to -2.8	-16.7 to –16.8
7200 5&8 mm w/o barriers	-2.7 to -2.8	-16.7 to -16.8
7200 11 mm w/o barriers	-3.5 to -3.6	-19.6 to -19.7
7200 14 mm w/o barriers	-2.7 to -2.8	-16.7 to -16.8
3300 5&8 mm w/ barriers	-2.7 to -2.8	-16.7 to -16.8
3300 XL 8 mm w/ barriers	-2.7 to -2.8	-16.7 to -16.8
3300 5&8 mm w/o barriers	-2.7 to -2.8	-16.7 to -16.8
3300 XL 8 mm w/o barriers	-2.7 to -2.8	-16.7 to -16.8
3000 (-18 V) w/o barriers	-2.4 to -2.5	-12.0 to -12.1
3000 (-24 V) w/o barriers	-3.2 to -3.3	-15.7 to -15.8
3300 RAM w/o barriers	-2.4 to -2.5	-12.5 to -12.6
3300 RAM w/ barriers	-2.4 to -2.5	-12.1 to -12.2
3300 16 mm HTPS w/o barriers	-2.7 to -2.8	-16.7 to -16.8
Note: Assume ±50 mV accuracy for check tolerance.		

10. Thrust Position General Information

Thrust position, a measure of the position or change in position of a rotor in axial direction with respect to the thrust bearing, lets you monitor the wear of the thrust collar of a rotor.

In a 3500 Monitoring System, Thrust Position channels are programmed in pairs. These channels, depending on configuration, typically condition the input signals into various parameters called “proportional values”. Alert setpoints can be configured for each active proportional value and Danger setpoints can be configured for any two of the active proportional values.

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11. Thrust Position Configuration

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11.1 Introduction

This section discusses the Configuration Considerations and the Rack Configuration Software screens associated with the Thrust Position Channel.

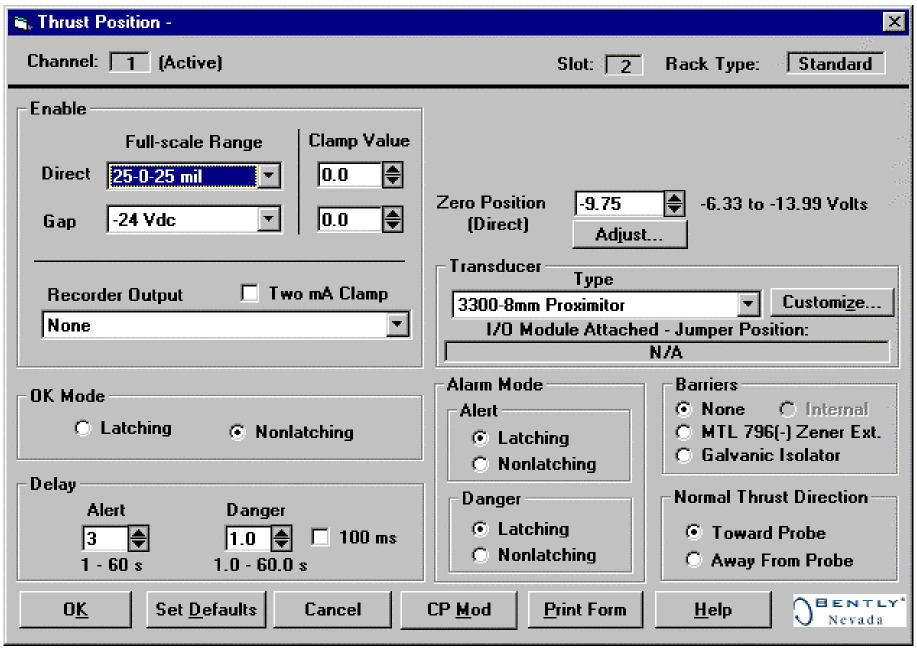
11.2 Configuration Considerations

Consider the following items before configuring a Thrust Position Channel:

- Internal Barrier I/O Modules are not currently supported with 7200 11 mm or 14 mm, or 3000 Proximitors, or the 3300 16 mm HTPS.
- Because an extreme Thrust Position movement can exceed the OK limits of the transducer, a transducer Not OK event on a Thrust Position channel will not inhibit alarming on that channel.
- The "No Keyphasor" option is automatically selected for this channel type. No Keyphasors are required.
- The Thrust Direct full-scale range is dependent upon the transducer type.
- The Zero Position voltage range is dependent upon the direct full-scale range and the upscale direction.
- Monitors must be configured in channel pairs (for example, Channels 1 and 2 may be configured as Thrust Position and Channels 3 and 4 may be configured as Radial Vibration).
- When a full-scale range is modified, the setpoints associated with this proportional value should be readjusted.
- If a Non-Standard transducer is selected, the setpoint OK limits are set to ±1 volt from the Upper and Lower OK limits that are selected.
- There are two selections for 3000 Series transducers:
    - **3000(-24V) Proximitor** Select this option when connecting a 3000 Series proximitor directly to a 3500 monitor. A default scale factor of 285 mV/mil will be selected. This may be adjusted ±15 %. Note that the buffered transducers on the front of the monitors and to the Data Manager are not compensated and should be interpreted at 285 mV/mil.
    - **3000(-18V) Proximitor** Select this option when connecting a 3000 Series proximitor directly to a 3500 monitor, but supplying proximitor power from an external 18 volt source. A default scale factor of 200 mV/mil will be selected. This may be adjusted ±15 %. Note that the buffered transducers on the front of the monitors and to the Data Manager are not compensated and should be interpreted at 200 mV/mil.

11.3 Configuration Options

This section describes the options available on the Thrust Position Channel configuration screen.



11.3.1 General Parameters and Buttons

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. For the function of this jumper, refer to “Setting the I/O Jumper” in the manual of the monitor that contains this channel.

CP Mod: Selecting the CP Mod button in the Channel Options Dialog Box, allows a Custom channel configuration to be downloaded to the monitor. Custom configuration data is stored in a Custom Products Modification File. Custom Products Modification files follow the naming convention <modification #.mod>. These files must be located in the \3500\Rackcfg\Mods\ directory. When a CP Mod file is selected, a window is displayed which describes the function of the modification. CP Mod files are available through Bently Nevada's Custom Products Division. Contact your local Bently Nevada Sales Representative for details.

Zero Position (Direct): Represents the transducer DC voltage corresponding to the zero indication on the channel's meter scale for the direct proportional value. The amount of adjustment allowed is dependent upon the Direct Full Scale Range and the transducer OK limits. For maximum amount of zero adjustment, gap the transducer as close as possible to the ideal zero position voltage based on the full-scale range, the transducer scale factor, and the Upscale Direction. For a mid-scale zero the ideal gap is the center of the range.

Adjust Button: Adjust the Zero Position voltage. When this button is clicked, a utility starts that helps you set the direct zero position voltage. Since this utility provides active feedback from the 3500 rack, a connection with the rack is required. Refer to “Adjusting the Scale Factor and Zero Position” in the "Monitor Verification" section of the manual.

Normal Thrust Direction: Towards the active thrust bearing (for example towards or away from the probe mounting). This field defines whether rotor movement toward or away from the thrust probe corresponds to a more positive thrust reading (for example upscale on a bar graph). If this field is set to "Toward Probe", then as the rotor moves toward the thrust probe the thrust position direct proportional value will increase and go upscale on a bar graph.

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. Refer to “Setting the I/O Jumper” in the "I/O Module Descriptions" section of the manual, if applicable.

11.3.2 Reference Information

These fields contain information that indicates which module you are configuring.

Channel: The number of the channel being configured (1 through 4).

Slot: The location of the monitor in the 3500 rack (2 through 15).

Rack Type: Identifies the type of Rack Interface Module installed in the rack (Standard or TMR).

11.3.3 Enable

Direct: Average position, or change in position, of a rotor in the axial direction with respect to some fixed reference. This value may be displayed in mils or µm. This proportional value supports both center zero and non-center zero Full Scale Ranges.

Gap: The physical distance between the face of a proximity probe tip and the observed surface. The distance is expressed in terms of voltage. Standard polarity convention dictates that a decreasing gap results in an increasing (less negative) output signal.

Direct Full-scale Ranges by Transducer Type

3300 XL 8 mm Proximitor **3300 - 5 and 8 mm Proximitor** **7200 - 5 and 8 mm Proximitor**	**3300 XL 11mm Proximitor** **7200 - 11 and 14 mm Proximitor** **3300 - 16 mm HTPS** **Nonstandard**	**3000 (-18V) Proximitor** **3000 (-24V) Proximitor** **3300 RAM Proximitor**
25-0-25 mil 30-0-30 mil 40-0-40 mil 0.5 - 0 – 0.5 mm 1.0 - 0 – 1.0 mm Custom	25-0-25 mil 30-0-30 mil 40-0-40 mil 50-0-50 mil 75-0-75 mil 0.5 - 0 - 0.5 mm 1.0 - 0 - 1.0 mm 2.0 - 0 - 2.0 mm Custom	25-0-25 mil 0.5 - 0 - 0.5 mm Custom

The Gap Full Scale Ranges are the same for all transducer types.

Gap
-24 Vdc Custom

Clamp Value: The value that a proportional value goes to when that channel or proportional value is Bypassed or defeated. The selected value can be between the minimum and maximum full-scale range values. Only the values available from the Recorder Outputs, Communication Gateway and Display Interface Module are clamped to the specified value when the proportional value is invalid.

Recorder Output: The proportional value of a channel that is sent to the 4 to 20 mA recorder. The recorder output is proportional to the measured value over the channel full scale range. An increase in the proportional value that would be indicated as upscale on a bar graph display results in an increase in the current at the recorder output. If the channel is bypassed, the output will be clamped to the selected clamp value or to 2 mA (if the 2 mA clamp is selected).

11.3.4 OK Mode

Latching: If a channel is configured for Latching OK, once the channel has gone not OK the status stays not OK until a reset is issued. Reset a latched not OK by using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: The OK status of that channel will track the defined OK status of the transducer.

11.3.5 Delay

The time which a proportional value must remain at or above an over alarm level or below an under alarm level before an alarm is declared as active.

Alert: First level alarm that occurs when the transducer signal level exceeds the selected Alert/Alarm 1 setpoint. This setpoint can be set on the Setpoint screen. The Alert time delay is always set at one second intervals (from 1 to 60) for all available proportional values.

Danger: Second level alarm that occurs when the transducer signal level exceeds the selected Danger/Alarm 2 setpoint. This setpoint can be set on the Setpoint screen.

100 ms option: The 100 ms (typical) option applies to the Danger time delay only and has the following results:

If the 100 ms option is off (☐):

- The Danger time delay can be set at one second intervals (from 1 through 60).
- The Danger time delay can be set for all available proportional values.

If the 100 ms option is on (☑):

- The Danger time delay is set to 100 ms.
- The Danger time delay can only be set for the primary proportional value.

11.3.6 Transducer Selection

Type: The following transducer types are available for the Thrust Position Channel (non-barrier I/O module):

- 3300 - 5mm Proximitor
- 3300 XL 8mm Proximitor
- 3300 XL 11mm Proximitor
- 3300 - 8mm Proximitor
- 7200 - 5mm Proximitor
- 7200 - 8mm Proximitor
- 7200 - 11mm Proximitor

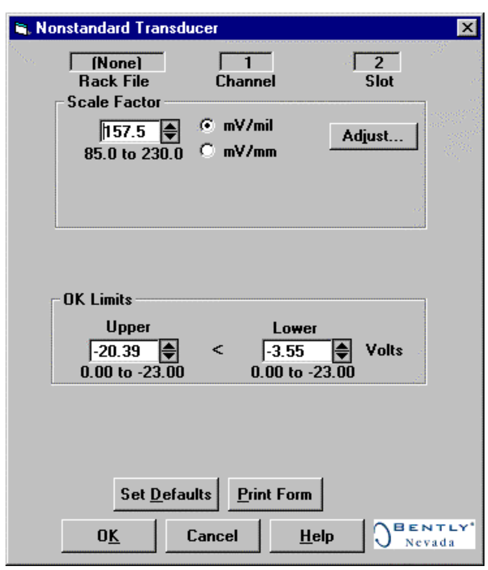
- 7200 - 14mm Proximitor
- 3000 (-18V) Proximitor
- 3000 (-24V) Proximitor
- 3300 RAM Proximitor
- 3300 - 16mm HTPS
- Nonstandard

The following transducer types are available for the Thrust Position Channel (barrier I/O module):

- 3300 - 5mm Proximitor
- 3300 XL 8mm Proximitor
- 3300 XL 11mm Proximitor
- 3300 - 8mm Proximitor
- 7200 - 5mm Proximitor
- 7200 - 8mm Proximitor
- 3300 RAM Proximitor
- Nonstandard

Customize button: Used to adjust the Scale Factor for transducers. Refer to "Adjusting the Scale Factor and Zero Position" in the "Monitor Verification" section of the manual. Also, note that:

- If Non-standard is selected as the transducer type, the OK Limits can also be adjusted.
- The Non-standard transducer's scale factor must be between 85 and 230 mV/mil.
- There must be at least 2 volts between the Upper and Lower OK Limits.



Scale Factor by Transducer Type

Transducer	Scale Factor				
	Without Barriers	With Bently Nevada Internal Barriers	Standard I/O with Barriers	Discrete TMR I/O with Barriers	Bussed TMR I/O with Barriers
3300 XL 8 mm	200 mV/mil	200 mV/mil	192 mV/mil	200 mV/mil	199 mV/mil
3300 5 and 8 mm					
7200 5 and 8 mm					
3300 XL 11 mm	100 mV/mil	100 mV/mil	96 mV/mil	100 mV/mil	96 mV/mil
7200 11 mm	100 mV/mil	*	*	*	*
7200 14 mm	100 mV/mil	*	*	*	*
3000 (-18 V)	200 mV/mil	*	*	*	*
3000 (-24 V)	285 mV/mil	*	*	*	*
3300 RAM	200 mV/mil	200 mV/mil	192 mV/mil	200 mV/mil	199 mV/mil
3300 16 mm HTPS	100 mV/mil	*	*	*	*

Note : ±15% scale factor adjustment allowed.

* Barriers are not supported with this transdcuer option.

OK Limits by Transducer Type

Transducer	Upper		Lower		Center Gap Voltage	
	Without Barriers (V)	With Barriers (V)	Without Barriers (V)	With Barriers (V)	Without Barriers (V)	With Barriers (V)
3300 XL 8 mm	-19.04	-18.20	-1.28	-1.10	-10.16	-9.65
3300 XL 11 mm				-1.28**		-9.74**
3300 8 mm						
3300 5 mm						
7200 5 mm						
7200 8 mm						
7200 11 mm	-20.39	*	-3.55	*	-11.97	*
7200 14 mm	-18.05	*	-1.65	*	-9.85	*
3000 (-18 V)	-13.14	*	-1.16	*	-7.15	*
3000 (-24 V)	-16.85	*	-2.25	*	-9.55	*
3300 RAM	-13.14	-12.35	-1.16	-1.05 -1.16**	-7.15	-6.7 -6.76**
3300 16 mm HTPS	-18.05	*	-1.65	*	-9.85	*

* Barriers are not suppoted with this transducer option.

** BN Internal Barrier I/O Modules.

11.3.7 Alarm Mode

Latching: Once an alarm is active it will remain active even after the proportional value drops below the configured setpoint level. The channel will remain in alarm until it is reset using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: When an alarm is active it will go inactive as soon as the proportional value drops below the configured setpoint level.

Alert should be the first level alarm that occurs when the transducer signal level exceeds the selected value. Danger should be the second level alarm that occurs when the transducer signal level exceeds the selected value. The Alert and Danger values are set on the Setpoint screen.

11.3.8 Barriers

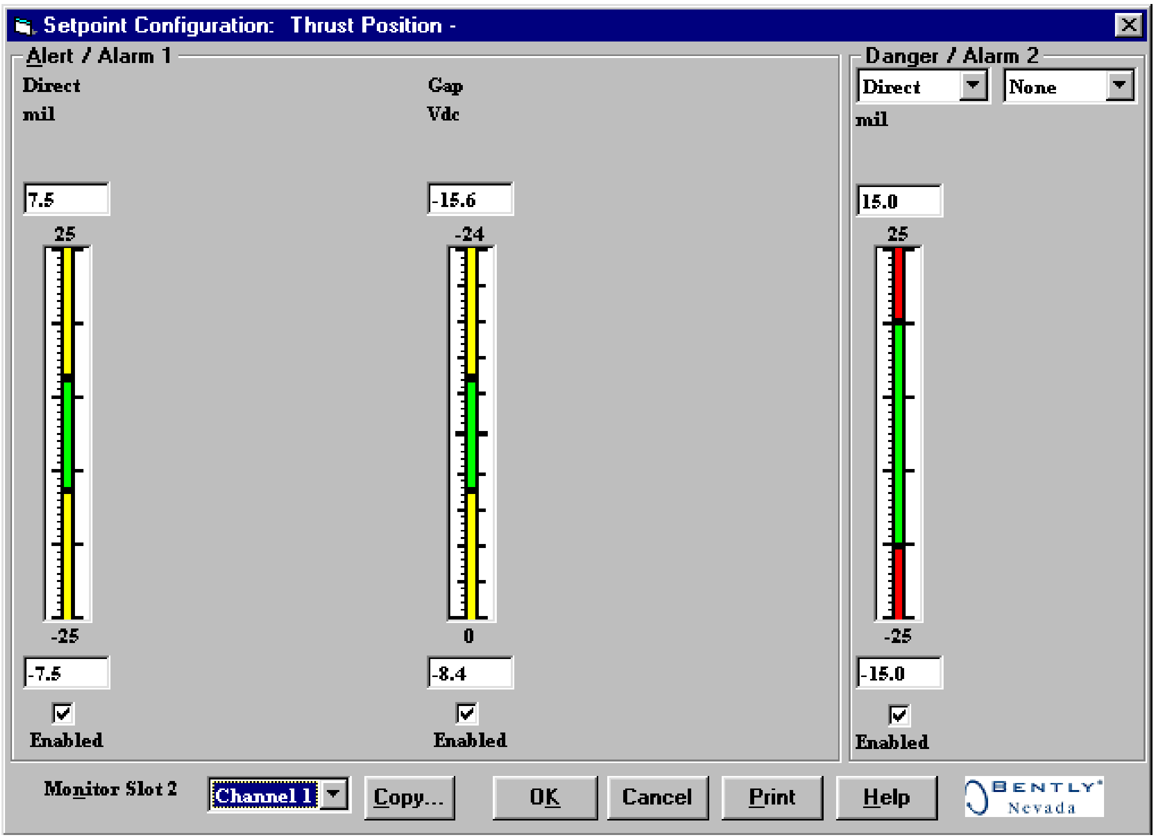
Select the MTL 796(-) Zener External option, or Galvanic Isolators if external safety barriers are connected between the monitor and the transducer. If using an Internal Barrier I/O Module, select the internal option. These devices are used to restrict the amount of energy that can flow into a hazardous area.

11.4 Alarm Setpoints

This section specifies the available setpoints for each type of channel. A setpoint is the level within the full-scale range that determines when an alarm occurs. The 3500 Monitoring System allows Alert/Alarm 1 setpoints to be set for every proportional value on each channel. The channel will drive an Alert/Alarm 1 indication if one or more of the channel proportional values exceeds its setpoints. The 3500 Monitoring System also allows up to four Danger/Alarm 2 setpoints (two over setpoints and two under setpoints) to be set for up to two of the proportional values. You may select any two of the available proportional values for the channel.

Note
The setpoint over and under limits can only be placed within the OK limits of the specified transducer.

Use the following screen in the Rack Configuration Software to adjust Alert/Alarm 1 and Danger/Alarm 2 setpoints. This screen will vary depending upon the type of channel.



11.4.1 Available Setpoints

The following table list the Alert/Alarm 1 and Danger/Alarm 2 setpoints available for the Thrust Position channel type. The setpoint number is used in the Communication Gateway and Display Interface Modules.

Setpoint Number	Thrust Position
1	Over Direct
2	Under Direct
3	Over Gap
4	Under Gap
5	Danger (configurable)
6	Danger (configurable)
7	Danger (configurable)
8	Danger (configurable)

All the Alert/Alarm 1 setpoints are provided first, followed by the configured danger setpoints.

Example 1:
Radial Vibration with the Danger/Alarm 2 Over 2X Ampl setpoint and the Danger/Alarm 2 Under 2X Ampl setpoint selected.

Alert/Alarm 1 setpoints:	setpoints 1 through 13
Danger/Alarm 2 setpoints:	setpoint 14 is Over 2X Ampl (Danger)
	setpoint 15 is Under 2X Ampl (Danger)

Example 2:
Thrust Position with the Danger/Alarm 2 Over Gap setpoint and the Danger/Alarm 2 Under Gap setpoint selected.

Alert/Alarm 1 setpoints:	setpoints 1 through 4
Danger/Alarm 2 setpoints:	setpoint 5 is Over Gap (Danger)
	setpoint 6 is Under Gap (Danger)

12. Differential Expansion General Information

Differential expansion, a measure of the axial position of the rotor with respect to the machine case, lets you monitor the thermal expansion or contraction of a rotor.

In a 3500 Monitoring System, Differential Expansion channels are programmed in pairs. These channels, depending on configuration, typically condition the input signals into various parameters called “proportional values”. Alert setpoints can be configured for each active proportional value and Danger setpoints can be configured for any two of the active proportional values.

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13. Differential Expansion Configuration

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13.1 Introduction

This section discusses the Configuration Considerations and the Rack Configuration Software screens associated with the Differential Expansion Channel.

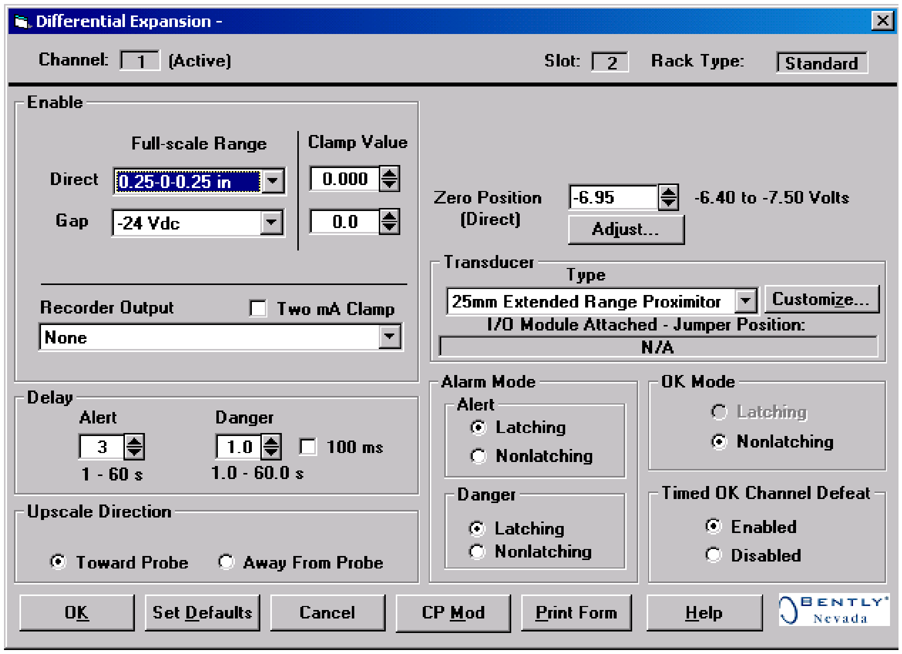
13.2 Configuration Considerations

Consider the following items before configuring a Differential Expansion Channel:

- None of the differential expansion channel transducers are able to support discrete Internal Barrier I/O modules.
- The "No Keyphasor" option is automatically selected for this channel type. No Keyphasors are required.
- The Differential Expansion Direct full-scale range is dependent upon the transducer type.
- The Zero Position voltage range is dependent upon the direct full-scale range.
- Monitors must be configured in channel pairs (for example, Channels 1 and 2 may be configured as Differential Expansion and Channels 3 and 4 may be configured as Thrust Position).
- When a full-scale range is modified, the setpoints associated with this proportional value should be readjusted.
- The Latching OK Mode and the Timed OK Channel Defeat options are not compatible.
- If a Non-Standard transducer is selected, the setpoint OK limits are set to ±1 volt from the Upper and Lower OK limits that are selected.

13.3 Configuration Options

This section describes the options available on the Differential Expansion Channel configuration screen.



13.3.1 General Parameters and Buttons

Zero Position (Direct): Represents the transducer DC voltage corresponding to the zero indication on the channel's meter scale for the direct proportional value. The amount of adjustment allowed is dependent upon the Direct Full Scale Range and the transducer OK limits. For maximum amount of zero adjustment, gap the transducer as close as possible to the ideal zero position voltage based on the full-scale range, the transducer scale factor, and the Upscale Direction. For a mid-scale zero the ideal gap is the center of the range.

Adjust Button: Adjust the Zero Position voltage. When this button is clicked a utility starts that helps you set the direct zero position voltage. Since this utility provides active feedback from the 3500 rack, a connection with the rack is required. Refer to "Adjusting the Scale Factor and Zero Position" in the "Monitor Verification" section of the manual.

CP Mod: Selecting the CP Mod button in the Channel Options Dialog Box, allows a Custom channel configuration to be downloaded to the monitor. Custom configuration data is stored in a Custom Products Modification File. Custom Products Modification files follow the naming convention <modification #.mod>. These files must be located in the \3500\Rackcfg\Mods\ directory. When a CP Mod file is selected, a window is displayed which describes the function of the modification. CP Mod files are available through Bently Nevada's Custom Products Division. Contact your local Bently Nevada Sales Representative for details.

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. Refer to "Setting the I/O Jumper" in the "I/O Module Descriptions" section of the manual, if applicable.

13.3.2 Reference Information

These fields contain information that indicates which module you are configuring.

Channel: The number of the channel being configured (1 through 4).

Slot: The location of the monitor in the 3500 rack (12 through 15).

Rack Type: Identifies the type of Rack Interface Module installed in the rack (Standard or TMR).

13.3.3 Enable

Direct: Change in position of the shaft due to the thermal growth relative to the machine casing. This value may be displayed in inches or mm. This proportional value supports both center zero and noncenter zero Full Scale Ranges.

Gap: The physical distance between the face of a proximity probe tip and the observed surface. The distance is expressed in terms of voltage. Standard polarity convention dictates that a decreasing gap results in an increasing (less negative) output signal.

Direct Full Scale Ranges by transducer type

25 mm Extended Range Proximitor 35 mm Extended Range Proximitor	50 mm Extended Range Proximitor Nonstandard
5-0-5 mm	5-0-5 mm
0-10 mm	0-10 mm
0.25 - 0 - 0.25 in	10-0-10 mm
0.0 - 0.5 in	0-20 mm
Custom	0-25 mm
	0.25 - 0 - 0.25 in
	0.0 - 0.5 in
	0.5 - 0 - 0.5 in
	0.0 - 1.0 in
	Custom

The Gap Full Scale Ranges are the same for all transducer types.

Gap
-24 Vdc
Custom

Clamp Value: The value that a proportional value goes to when that channel or proportional value is Bypassed or defeated (For example when a problem occurs with the transducer). The selected value can be between the minimum and maximum full-scale range values. Only the values available from the Recorder Outputs, Communication Gateway and Display Interface Module are clamped to the specified value when the proportional value is invalid.

Recorder Output: The proportional value of a channel that is sent to the 4 to 20 mA recorder. The recorder output is proportional to the measured value over the channel full-scale range. An increase in the proportional value that would be indicated as upscale on a bar graph display results in an increase in the current at the recorder output. If the channel is Bypassed, the output will be clamped to the selected clamp value or to 2 mA (if the 2 mA clamp is selected).

13.3.4 OK Mode

Latching: If a channel is configured for Latching OK, once the channel has gone not OK the status stays not OK until a reset is issued. Reset a latched not OK by using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: The OK status of the channel will track the defined OK status of the transducer.

13.3.5 Timed OK Channel Defeat

An option that prevents a channel from returning to an OK status until that channel's transducer has remained in an OK state for the specified period of time. If the option is enabled, the time is set to 10 seconds. The option protects against false trips caused by intermittent transducers.

13.3.6 Delay

The time which a proportional value must remain at or above an over alarm level or below an under alarm level before an alarm is declared as active.

Alert: First level alarm that occurs when the transducer signal level exceeds the selected Alert/Alarm 1 setpoint. This setpoint can be set on the Setpoint screen. The Alert time delay is always set at one second intervals (from 1 to 60) for all available proportional values.

Danger: Second level alarm that occurs when the transducer signal level exceeds the selected Danger/Alarm 2 setpoint. This setpoint can be set on the Setpoint screen.

100 ms option: The 100 ms (typical) option applies to the Danger time delay only and has the following results:

If the 100 ms option is off (☐):

- The Danger time delay can be set at one second intervals (from 1 to 60).
- The Danger time delay can be set for all available proportional values.

If the 100 ms option is on (☑):

- The Danger time delay is set to 100 ms.
- The Danger time delay can only be set for the primary proportional value.

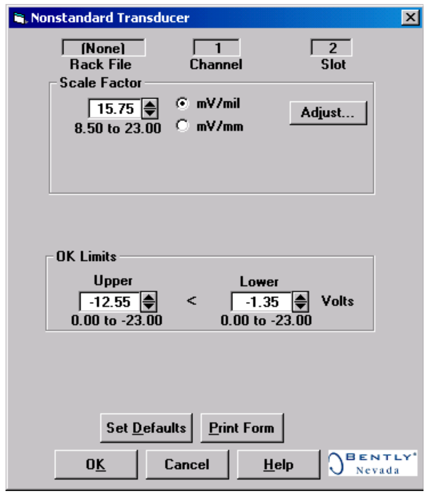
13.3.7 Transducer Selection

Type: The following transducer types are available for the Differential Expansion Channel:

- 25mm Extended Range Proximitor
- 35mm Extended Range Proximitor
- 50mm Extended Range Proximitor
- Nonstandard

Customize button: Used to adjust the Scale Factor for transducers. Refer to "Adjusting the Scale Factor and Zero Position" in the "Monitor Verification" section of the manual. Also, note that:

- If Non-standard is selected as the transducer type, the OK Limits can also be adjusted.
- The Non-standard transducer's scale factor must be between 8.5 and 23 mV/mil.
- There must be at least 2 volts between the Upper and Lower OK Limits.



Scale Factor by Transducer Type

Transducer	Without Barriers
25 mm	20 mV/mil
35 mm	20 mV/mil
50 mm	10 mV/mil
Note: ±15 % scale factor adjustment allowed.	

OK Limits by Transducer Type

Transducer	Upper (V)	Lower (V)	Center Gap Voltage (V)
25mm	-12.55	-1.35	-6.95
35mm	-12.55	-1.35	-6.95
50mm	-12.55	-1.35	-6.95

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. For the function of this jumper refer to “Setting the I/O Jumper” in the manual of the monitor that contains this channel.

13.3.8 Alarm Mode

Latching: Once an alarm is active, it will remain active even after the proportional value drops below the configured setpoint level. The channel will remain in alarm until it is reset using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module

- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: When an alarm is active, it will go inactive as soon as the proportional value drops below the configured setpoint level. Alert should be the first level alarm that occurs when the transducer signal level exceeds the selected value. Danger should be the second level alarm that occurs when the transducer signal level exceeds the selected value. The Alert and Danger values are set on the Setpoint screen.

13.3.9 Upscale Direction

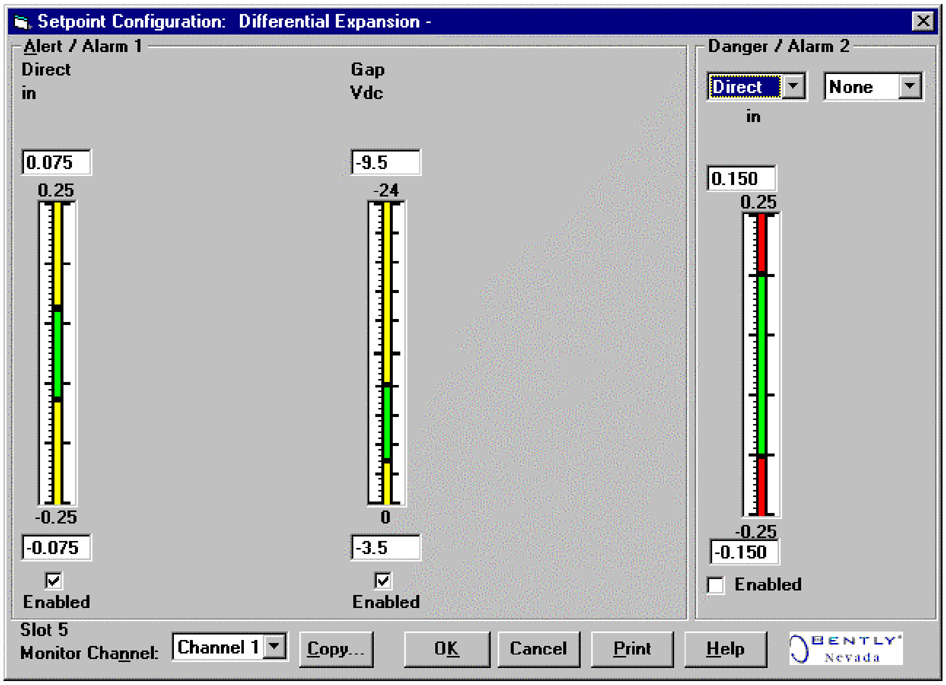
Towards or away from the probe mounting. This field defines whether rotor movement toward or away from the differential expansion corresponds to a more positive differential expansion (for example upscale on a bar graph). If this field is set to "Toward Probe", then as the rotor moves toward the differential expansion probe the differential expansion direct proportional value will increase and go upscale on a bar graph.

13.4 Alarm Setpoints

This section specifies the available setpoints for each type of channel. A setpoint is the level within the full-scale range that determines when an alarm occurs. The 3500 Monitoring System allows Alert/Alarm 1 setpoints to be set for every proportional value on each channel. The channel will drive an Alert/Alarm 1 indication if one or more of the channel proportional values exceeds its setpoints. The 3500 Monitoring System also allows up to four Danger/Alarm 2 setpoints (two over setpoints and two under setpoints) to be set for up to two of the proportional values. You may select any two of the available proportional values for the channel.

Note
The setpoint over and under limits can only be placed within the OK limits of the specified transducer.

Use the following screen in the Rack Configuration Software to adjust Alert/Alarm 1 and Danger/Alarm 2 setpoints.



13.4.1 Available Setpoints

The following tables list the Alert/Alarm 1 and Danger/Alarm 2 setpoints available for each channel pair type. The setpoint number is used in the Communication Gateway and Display Interface Modules.

Setpoint Number	Differential Expansion
1	Over Direct
2	Under Direct
3	Over Gap
4	Under Gap
5	Danger (configurable)
6	Danger (configurable)
7	Danger (configurable)
8	Danger (configurable)

13.4.2 Alarm Hysteresis

The alarming hysteresis for all channel configurations is 1/64 of Full Scale. When a channel exceeds an alarm setpoint, it must fall back the setpoint less the hysteresis before it can go out of alarm.

For example, for a channel configuration with a 0 to 10 mil full scale and an alarm setpoint of 6 mils, the hysteresis = 10 mils/64 = 0.16 mils. The channel input, therefore, must fall below 6 miles – 0.6 mils (5.84 mils) before the channel is out of alarm.

14. Thrust Position and Differential Expansion Verification

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14.1 Introduction

The following sections describe how to test alarms, verify channels, and test OK limits for channels configured as Thrust Position and Differential Expansion. The output values and alarm setpoints are verified by varying the input DC voltage from a power supply and observing that the correct results are reported in the Verification screen on the test computer.

Thrust Position and Differential Expansion channels can be configured for the following channel values and alarms:

Channel Values	**Alarms**	
	Over	**Under**
Direct	X	X
Gap	X	X

14.2 Test Equipment and Software Setup

The following test equipment and software setup can be used as the initial setup needed for all the Thrust Position and Differential Expansion channel verification procedures (Test Alarms, Verify Channels, and Test OK Limits).

14.2.1 Required Test Equipment

The verification procedures in this section require the following test equipment.

- Power Supply (single channel)
- Multimeter - 4½ digits

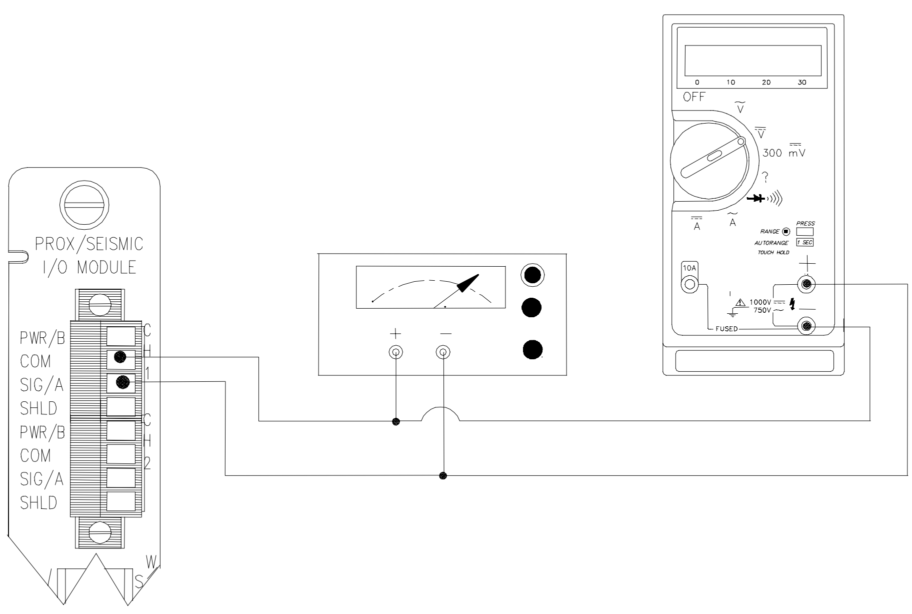
WARNING!
High voltage present. Contact could cause shock, burns, or death. **Do not touch exposed wires or terminals.**

Application Alert
Tests will exceed alarm setpoint levels causing alarms to activate. This could result in a relay contact state change.

Application Alert
Disconnecting field wiring will cause a not OK condition.

14.2.2 Test Equipment Setup

Simulate the transducer signal by connecting power supply (output terminals) and multimeter (input terminals) to COM and SIG of channel 1 with polarity as shown below.



The Test Equipment outputs should be floating relative to earth ground.

14.2.3 Verification Screen Setup

Run the Rack Configuration Software on the test computer. Choose **Verification** from the Utilities menu and choose the proper Slot number and Channel number then click on the **Verify** button.

14.3 Test Alarms

The general approach for testing alarm setpoints is to simulate the Thrust Position and Differential Expansion signal with a power supply. The alarm levels are tested by varying the DC voltage and observing that the correct results are reported in the Verification screen on the test computer. It is only necessary to test those alarm parameters that are configured and being used. The general test procedure to verify current alarm operation will include simulating a transducer input signal and varying this signal:

- to exceed over Alert/Alarm 1 and Danger/Alarm 2 Setpoints.
- to drop below any under Alert/Alarm 1 and Danger/Alarm 2 Setpoints.
- to produce a nonalarm condition.

14.3.1 Direct

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 14-2.
3. Adjust the power supply to produce a voltage that is within the Direct setpoint levels on the Direct bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Direct is green, and the Current Value field has no alarm indication.
5. Adjust the power supply voltage such that the signal just exceeds the Direct Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the power supply such that the signal just exceeds the Direct Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the power supply voltage such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that

the bar graph indicator for Direct changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.

10. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the power supply to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

14.3.2 Gap

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 14-2.
3. Adjust the power supply to produce a voltage that is within the Gap setpoint levels on the Gap bar graph display.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Gap is green, and the Current Value field has no alarm indication.
5. Adjust the power supply voltage such that the signal just exceeds the Gap Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds until the alarm time delay expires and verify that the bar graph indicator for Gap changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Gap remains yellow and that the Current Field still indicates an Alarm.
7. Adjust the power supply such that the signal just exceeds the Gap Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Gap changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Gap remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the power supply voltage such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Gap changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.

10. Repeat steps 5 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the power supply to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

14.4 Verify Channel Values

The general approach for testing these parameters is to simulate the Thrust Position and Differential Expansion signal with a power supply. The output values are verified by varying the input DC voltage and observing that the correct results are reported in the Verification screen on the test computer.

14.4.1 Direct

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 14-2.
3. Calculate the full-scale and bottom scale values. These values can be calculated in the following way:

   Full-scale Value, Bottom Scale Value = Zero Position Voltage ± (Transducer Scale Factor × Scale Range)

Note
The Zero Position Voltage is the voltage input that will cause the reading on the bar graph display and the Current Value Box to be zero. The Zero Position Volts value is displayed in the Z.P. Volts box above each channel value bar graph.

Note
If the bottom scale range is zero (for example 0 to 80 mil), use the Full-scale Value formula.

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

If Upscale direction (Normal for Thrust, Long for Differential Expansion) is toward the probe:

Full Scale = (Zero Position Voltage) + (Transducer Scale Factor × Top Meter Scale)

Bottom Scale = (Zero Position Voltage) - (Transducer Scale Factor × ABS (Bottom Meter Scale)

Example 1:

Transducer scale factor	=	200 mV/mil
Meter scale range	=	25-0-25 mil
Zero Position Voltage	=	-9.75 Vdc

Full Scale Value	=	(-9.75) + (0.200 × 25)
	=	-4.75 Vdc

Bottom Scale Value	=	(-9.75) - (0.200 × 25)
	=	-14.75 Vdc

Example 2:

Transducer scale factor	=	7,874 mV/mm
Meter scale range	=	1-0-1 mm
Zero Position Voltage	=	-10.16 Vdc

Full Scale Value	=	(-10.16) + (7.874 × 1)
	=	-2.286 Vdc

Bottom Scale Value	=	(-10.16) - (7.874 × 1)
	=	-18.03 Vdc

If Upscale direction (Normal for Thrust, Long for Differential Expansion) is away from the probe:

Full Scale = (Zero Position Voltage) - (Transducer Scale Factor × Top Meter Scale)

Bottom Scale = (Zero Position Voltage) + (Transducer Scale Factor × ABS(Bottom Meter Scale)

Example 1:

Transducer scale factor	=	200 mV/mil
Meter scale range	=	25-0-25 mil
Zero Position Voltage	=	-9.75 Vdc

Full Scale Value = (-9.75) - (0.200 × 25)
= -14.75 Vdc

Bottom Scale Value = (-9.75) + (0.200 × 25)
= -4.75 Vdc

Example 2:

Transducer scale factor	=	7,874 mV/mm
Meter scale range	=	1-0-1 mm
Zero Position Voltage	=	-10.16 Vdc

Full Scale Value = (-10.16) - (7.874 × 1)
= -18.03 Vdc

Bottom Scale Value = (-10.16) + (7.874 × 1)
= -2.286 Vdc

4. Adjust the power supply voltage to match the voltage displayed in the Z.P. Volts box. The Direct bar graph display and the Current Value Box should read 0 mil (0 mm) ±1 %.
5. Adjust the power supply voltage for the calculated full scale. Verify that the Direct bar graph display and the Current Value Box is reading ±1 % of full scale.
6. Adjust the power supply voltage for the calculated bottom scale. Verify that the Direct bar graph display and the Current Value Box is reading ±1 % of bottom scale.
7. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
8. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
9. Repeat steps 1 through 8 for all configured channels.

14.4.2 Gap

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 14-2.
3. Adjust the power supply to produce a voltage equal to -18.00 Vdc on the Gap bar graph display. Verify that the Gap bar graph display and the Current Value Box is reading ±1 % of -18.00 Vdc.
4. Adjust the power supply to produce a voltage equal to mid-scale on the Gap bar graph display. Verify that the Gap bar graph and Current Value Box is reading ±1 % of the mid-scale value.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

14.5 Test OK Limits

The general approach for testing OK limits is to input a DC voltage and adjust it above the Upper OK limit and below the Lower OK limit. This will cause a channel not OK condition and the OK Relay to change state (de-energize). The Upper and Lower OK limits are displayed in the Verification screen on the test computer.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 14-2.
3. Bypass all other configured channels.
4. Adjust the power supply voltage to -7.00 Vdc.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the monitor OK LED is on and that the Channel OK State line in the Channel Status box of the Verification screen reads **OK**.

Note
If the Danger Bypass has been activated, then the BYPASS LED will be on. All other channels in the rack must be OK or bypassed for the OK relay to be energized.

6. Verify that the OK relay on the Rack Interface I/O Module indicates OK (energized). See 3500/20 Rack Interface Module Operation and Maintenance Manual, part number 129768-01.
7. Increase the power supply voltage (more negative) until the OK LED just goes off (upper limit). Verify that the Channel OK State line in the Channel Status box reads **not OK** and that the OK Relay indicates not OK. Verify that the Upper OK limit voltage displayed on the Verification screen is equal to or more positive than the input voltage.
8. Decrease the power supply voltage (less negative) to -7.00 Vdc.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on, the OK relay energizes, and the Channel OK State line in the Channel Status box reads **OK**.
10. Gradually decrease the power supply voltage (less negative) until the OK LED just goes off (lower limit). Verify that the Channel OK State line in the Channel Status box reads **not OK** and that the OK Relay indicates not OK. Verify that the Lower OK limit voltage displayed on the Verification screen is equal to or more negative than the input voltage.
11. Increase the power supply voltage (more negative) to -7.00 Vdc.
12. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on, the OK relay energizes, and the Channel OK State line in the Channel Status box reads **OK**.
13. If you can not verify any configured OK limit, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
14. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the Monitor I/O Module. Press the RESET switch on the Rack Interface Module (RIM) and verify that the OK LED comes on and the OK relay energizes.
15. Repeat steps 1 through 14 for all configured channels.
16. Return the bypass switch for all configured channels to their original setting.

Thrust Position Default OK Limits Table

Transducer	Lower OK Limit (volts)	Upper OK Limit (volts)
3300 XL 8mm, 3300 XL 11mm 3300 5 mm & 3300 8 mm w/o barriers	-1.23 to -1.33	-18.99 to -19.09
3300 XL 8mm, 3300 XL 11mm 3300 5 mm & 3300 8 mm w/ barriers	-1.05 to -1.15 -1.23 to -1.33 *	-18.15 to -18.25
7200 5 & 8 mm w/ barriers	-1.05 to -1.15 -1.23 to -1.33 *	-18.15 to -18.25
7200 5 & 8 mm w/o barriers	-1.23 to -1.33	-18.99 to -19.09
7200 11 mm w/o barriers	-3.50 to -3.60	-20.34 to -20.44
7200 14 mm w/o barriers	-1.6 to -1.7	-18.0 to -18.1
3000 (-18V) w/o barriers	-1.11 to -1.21	-13.09 to -13.19
3000 (-24V) w/o barriers	-2.2 to -2.3	-16.8 to -16.9
3300 RAM w/o barriers	-1.11 to -1.21	-13.09 to -13.19
3300 RAM w/ barriers	-1.0 to -1.1 -1.11 to -1.21 *	-12.3 to -12.4
3300 16mm HTPS w/o barriers	-1.6 to -1.7	-18.0 to -18.1
Note: Assume ±50 mV accuracy for check tolerance. * = BN Internal Barrier I/O Modules.		

Differential Expansion Default OK Limits Table

Transducer	Lower OK Limit (volts)	Upper OK Limit (volts)
25 mm w/o barriers	-1.30 to -1.40	-12.5 to -12.6
35 mm w/o barriers	-1.30 to -1.40	-12.5 to -12.6
50 mm w/o barriers	-1.30 to -1.40	-12.5 to -12.6
Note: Assume ±50 mV accuracy for check tolerance.		

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15. Eccentricity General Information

The Eccentricity channel type measures the amount of shaft bow. The shaft bow may be due to: (1) fixed mechanical bow, (2) temporary thermal bow, or (3) temporary bow due to any sort of sag or bow at rest, sometimes called gravity bow.

In a 3500 Monitoring System, Eccentricity channels are programmed in pairs. These channels, depending on configuration, typically condition the input signals into various parameters called “proportional values”. Alert setpoints can be configured for each active proportional value and Danger setpoints can be configured for any two of the active proportional values.

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16. Eccentricity Configuration

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16.1 Introduction

This section discusses the Configuration Considerations and the Rack Configuration Software screens associated with the Eccentricity Channel.

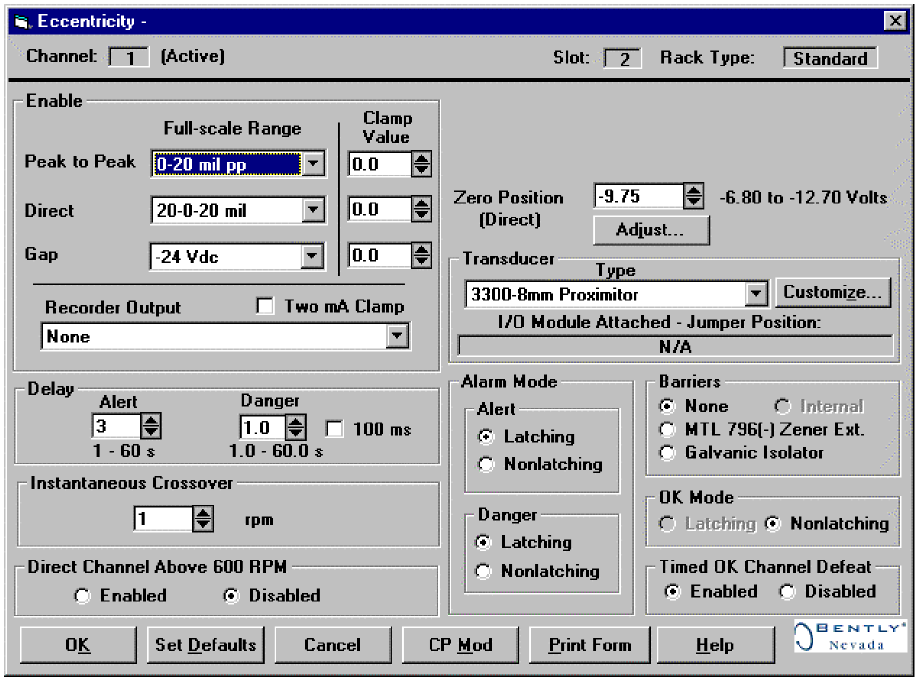
16.2 Configuration Considerations

Consider the following items before configuring an Eccentricity Channel:

- Internal Barrier I/O Modules are not currently supported with 7200 11 mm or 14 mm, 3000 Proximitors, 3300 16 mm HTPS, or 3300 RAM.
- If a Keyphasor channel is selected, a Keyphasor Module must be installed in the rack.
- The full-scale options allowed for each proportional value is dependent upon the transducer type.
- External barriers are not currently supported with 7200 11 mm, 14 mm, or 3300 16 mm HTPS.
- Monitors must be configured in channel pairs (for example Channels 1 and 2 may be configured as Eccentricity and Channels 3 and 4 may be configured as Thrust Position).
- When a full-scale range is modified, the setpoints associated with this proportional value should be readjusted.
- The Peak to Peak proportional value is disabled when "No Keyphasor" is selected on the Four Channel Monitor screen.
- The Latching OK Mode and the Timed OK Channel Defeat options are not compatible.
- If a Non-Standard transducer is selected, the setpoint OK limits are set to ±1 volt from the Upper and Lower OK limits that are selected.

16.3 Configuration Options

This section describes the options available on the Eccentricity Channel configuration screen.



16.3.1 General Parameters and Buttons

CP Mod: Selecting the CP Mod button in the Channel Options Dialog Box, allows a Custom channel configuration to be downloaded to the monitor. Custom configuration data is stored in a Custom Products Modification File. Custom Products Modification files follow the naming convention <modification #.mod>. These files must be located in the \3500\Rackcfg\Mods\ directory. When a CP Mod file is selected, a window is displayed which describes the function of the modification. CP Mod files are available through Bently Nevada's Custom Products Division. Contact your local Bently Nevada Sales Representative for details.

Zero Position (Direct): Represents the transducer DC voltage corresponding to the zero indication on the channel's meter scale for the direct proportional value. The amount of adjustment allowed is dependent upon the Direct Full Scale Range and the transducer OK limits. To ensure maximum amount of zero adjustment, gap the probe as close as possible to the center gap voltage specified in the OK Limit table.

Adjust Button: Adjust the Zero Position voltage. When this button is clicked a utility starts that helps you set the direct zero position voltage. Since this utility provides active feedback from the 3500 rack, a connection with the rack is required. Refer to “Adjusting the Scale Factor and Zero Position” in the "Monitor Verification" section of the manual.

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. Refer to “Setting the I/O Jumper” in the "I/O Module Descriptions" section of the manual, if applicable.

16.3.2 Reference Information

These fields contain information that indicates which module you are configuring.

Channel: The number of the channel being configured (1 through 4).

Slot: The location of the monitor in the 3500 rack (2 through 15).

Rack Type: Identifies the type of Rack Interface Module installed (Standard or TMR).

16.3.3 Enable

Peak to Peak: The difference between the positive and the negative extremes of the rotor bow. The proportional value is only available when a Keyphasor channel has been selected. This value may be displayed in mils or µm.

Direct: The instantaneous eccentricity value. The direct value can be displayed three ways:

- At shaft rotative speeds greater than 600 rpm, the direct value is the average distance between the probe tip and the shaft and is displayed in a way similar to a thrust measurement. This direct measurement is displayed only when Direct Channel Above 600 rpm is enabled.
- At shaft rotative speeds between 600 rpm and the rpm setting for Instantaneous Crossover, the direct measurement consists of two values: a maximum and minimum value relative to a zero reference. These two direct values are called Direct Max and Direct Min.
- At shaft rotative speeds less than the rpm setting for Instantaneous Crossover, Direct Max and Direct Min are equal and the direct measurement consists of an instantaneous measurement relative to a zero reference. This type of direct measurement is called instantaneous gap.

Gap: The physical distance between the face of a proximity probe tip and the observed surface. The distance is expressed in terms of voltage. Standard polarity convention dictates that a decreasing gap results in an increasing (less negative) output signal.

Peak to Peak Full Scale Ranges by transducer type

3300 XL 8 mm Proximitor **3300 - 5 and 8 mm Proximitor** **7200 - 5 and 8 mm Proximitor**	**3300 XL 11 mm Proximitor** **7200 - 11 and 14 mm Proximitor** **3300 – 16 mm HTPS** **Nonstandard**
0-5 mil pp 0-10 mil pp 0-20 mil pp 0-30 mil pp 0-100 µm pp 0-200 µm pp 0-500 µm pp Custom	0-5 mil pp 0-10 mil pp 0-20 mil pp 0-30 mil pp 0-50 mil pp 0-100 µm pp 0-200 µm pp 0-500 µm pp 0-1000 µm pp Custom

Direct Full Scale Ranges by transducer type

3300 XL 8 mm Proximitor **3300 - 5 and 8 mm Proximitor** **7200 - 5 and 8 mm Proximitor**	**3300 XL 11 mm Proximitor** **7200 - 11 and 14 mm Proximitor** **3300 – 16 mm HTPS** **Nonstandard**
5-0-5 mil 10-0-10 mil 20-0-20 mil 30-0-30 mil 100-0-100 µm 200-0-200 µm 500-0-500 µm Custom	5-0-5 mil 10-0-10 mil 20-0-20 mil 30-0-30 mil 50-0-50 mil 100-0-100 µm 200-0-200 µm 500-0-500 µm 1000-0-1000 µm Custom

The Gap values are the same for all transducer types.

Gap
-24 Vdc
Custom

Clamp Value: The value that a proportional value goes to when that channel or proportional value is bypassed or defeated (For example when a problem occurs with the transducer). The selected value can be between the minimum and maximum full-scale range values. Only the values available from the Recorder Outputs, Communication Gateway and Display Interface Module are clamped to the specified value when the proportional value is invalid.

Recorder Output: The proportional value of a channel that is sent to the 4 to 20 mA recorder. The recorder output is proportional to the measured value over the channel full-scale range. An increase in the proportional value that would be indicated as upscale on a bar graph display results in an increase in the current at the recorder output. If the channel is Bypassed, the output will be clamped to the selected clamp value or to 2 mA (if the 2 mA clamp is selected).

16.3.4 Delay

The time which a proportional value must remain at or above an over alarm level or below an under alarm level before an alarm is declared as active.

Alert: First level alarm that occurs when the transducer signal level exceeds the selected Alert/Alarm 1 setpoint. This setpoint can be set on the Setpoint screen. The Alert time delay is always set at one second intervals (from 1 to 60) for all available proportional values.

Danger: Second level alarm that occurs when the transducer signal level exceeds the selected Danger/Alarm 2 setpoint. This setpoint can be set on the Setpoint screen.

100 ms option: The 100 ms (typical) option applies to the Danger time delay only and has the following results:

If the 100 ms option is off (☐):

- the Danger time delay can be set at one second intervals (from 1 to 60).
- the Danger time delay can be set for any two available proportional values.

If the 100 ms option is on (☑):

- the Danger time delay is set to 100 ms.
- the Danger time delay can only be set for the primary proportional value.

16.3.5 Instantaneous Crossover

The value for shaft-rotative speed where the direct eccentricity measurement changes from Direct Max/ Direct Min to instantaneous gap. The value for Instantaneous Crossover must be between 1 and 10 rpm.

16.3.6 Direct Channel Above 600 RPM

Disabled: Display and alarming of the Direct proportional value will be disabled when the shaft rotative speed exceeds 600 rpm.

Enabled: Display and alarming of the Direct proportional value will remain active when shaft rotative speed exceeds 600 rpm.

16.3.7 Transducer Selection

Type: The following transducer types are available for the Eccentricity Channel (non-barrier I/O module):

- 3300 XL 8 mm Proximitor
- 3300 XL 11 mm Proximitor
- 3300 – 5 mm Proximitor
- 3300 – 8 mm Proximitor
- 3300 – 16 mm HTPS
- 7200 – 5 mm Proximitor
- 7200 – 8 mm Proximitor
- 7200 – 11 mm Proximitor
- 7200 – 14 mm Proximitor
- Nonstandard

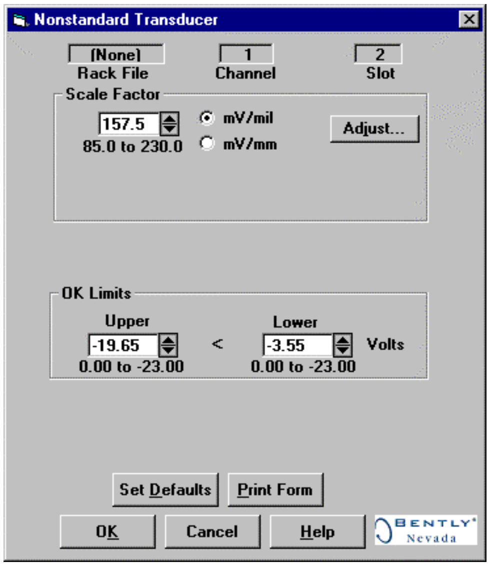
The following transducer types are available for the Eccentricity Channel (barrier I/O module):

- 3300 XL 8 mm Proximitor
- 3300 XL 11 mm Proximitor
- 3300 – 5 mm Proximitor
- 3300 – 8 mm Proximitor
- 7200 – 5 mm Proximitor
- 7200 – 8 mm Proximitor
- Nonstandard

Customize button: Used to adjust the Scale Factor for transducers. Refer to "Adjusting the Scale Factor and Zero Position" in the "Monitor Verification" section of the manual. Also, note that:

- If Non-standard is selected as the transducer type, the OK Limits can also be adjusted.

- The Non-standard transducer's scale factor must be between 85 and 230 mV/mil.
- There must be at least 2 volts between the Upper and Lower OK Limits.



Scale Factor by Transducer Type

Transducer	Scale Factor				
	Without Barriers	**With Bently Nevada Internal Barriers**	**Standard I/O with Barriers**	**Discrete TMR I/O with Barriers**	**Bussed TMR I/O with Barriers**
3300 XL 8 mm	200 mV/mil	200 mV/mil	192 mV/mil	200 mV/mil	199 mV/mil
3300 5 and 8 mm					
7200 5 and 8 mm					
3300 XL 11 mm	100 mV/mil	100 mV/mil	96 mV/mil	100 mV/mil	96 mV/mil
7200 11 mm	100 mV/mil	*	*	*	*
7200 14 mm	100 mV/mil				
3300 16 mm HTPS	100 mV/mil	*	*	*	*

Note : ±15% scale factor adjustment allowed.

* Barriers are not supported with this transdcuer option.

OK Limits by Transducer Type

Transducer	Upper		Lower		Center Gap Voltage	
	Without Barriers (V)	**With Barriers (V)**	**Without Barriers (V)**	**With Barriers (V)**	**Without Barriers (V)**	**With Barriers (V)**
3300 XL 8 mm	-16.75	-16.75	-2.75	-2.75	-9.75	-9.75
3300 XL 11 mm						
3300 8 mm						
3300 5 mm						
7200 5 mm						
7200 8 mm						
7200 11 mm	-19.65	*	-3.55	*	-11.60	*
7200 14 mm	-16.75	*	-2.75	*	-9.75	*
3300 16 mm HTPS	-16.75	*	-2.75	*	-9.75	*

Barriers are not suppoted with this transducer option.

Note: With Barriers includes BN Internal Barrier I./O Modules

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. For the function of this jumper, refer to "Setting the I/O Jumper" in the manual for the monitor that contains this channel.

16.3.8 Alarm Mode

Alert should be the first level alarm that occurs when the transducer signal level exceeds the selected value. Danger should be the second level alarm that occurs when the transducer signal level exceeds the selected value. The Alert and Danger values are set on the Setpoint screen.

Latching: Once an alarm is active, it will remain active even after the proportional value drops below the configured setpoint level. The channel will remain in alarm until it is reset using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module

- the reset command in the Rack Configuration Software

Nonlatching: When an alarm is active, it will go inactive as soon as the proportional value drops below the configured setpoint level.

16.3.9 Barriers

Select the MTL 796(-) Zener External option, or Galvanic Isolators if external safety barriers are connected between the monitor and the transducer. If using an Internal Barrier I/O Module, select the internal option. These devices are used to restrict the amount of energy that can flow into a hazardous area.

16.3.10 OK Mode

Latching: If a channel is configured for Latching OK, once the channel has gone not OK the status stays not OK until a reset is issued. Reset a latched not OK by using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: If a channel is configured for Nonlatching OK, the OK status of that channel will track the defined OK status of the transducer.

16.3.11 Timed OK Channel Defeat

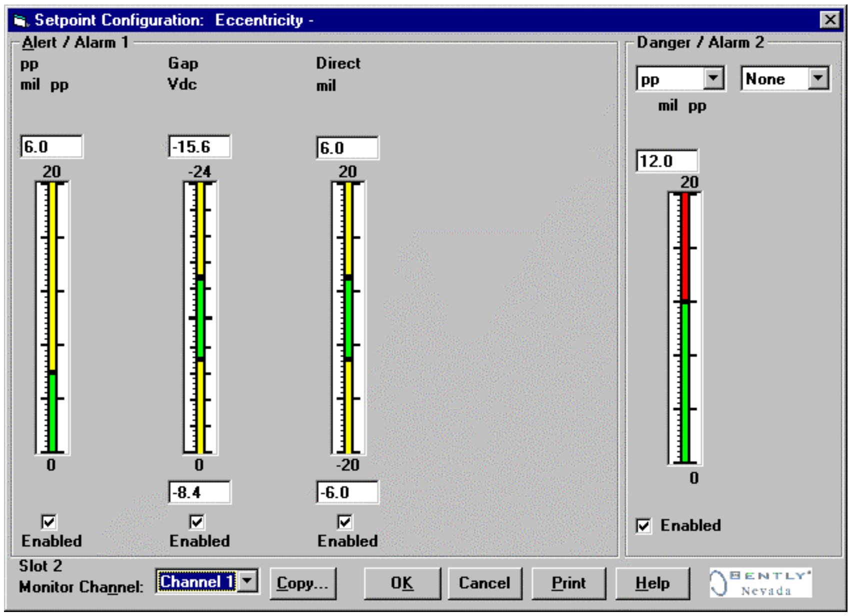
An option that prevents a channel from returning to an OK status until that channel's transducer has remained in an OK state for the specified period of time. If the option is enabled, the time is set to 60 seconds. The option protects against false trips caused by intermittent transducers.

16.4 Alarm Setpoints

This section specifies the available setpoints for each type of channel. A setpoint is the level within the full-scale range that determines when an alarm occurs. The 3500 Monitoring System allows Alert/Alarm 1 setpoints to be set for every proportional value on each channel. The channel will drive an Alert/Alarm 1 indication if one or more of the channel proportional values exceeds its setpoints. The 3500 Monitoring System also allows up to four Danger/Alarm 2 setpoints (two over setpoints and two under setpoints) to be set for up to two of the proportional values. You may select any two of the available proportional values for the channel.

Note
The setpoint over and under limits can only be placed within the OK limits of the specified transducer.

Use the following screen in the Rack Configuration Software to adjust Alert/Alarm 1 and Danger/Alarm 2 setpoints.



16.4.1 Available Setpoints

The following tables list the Alert/Alarm 1 and Danger/Alarm 2 setpoints available for each channel pair type. The setpoint number is used in the Communication Gateway and Display Interface Modules.

Setpoint Number	Eccentricity
1	Over Peak to Peak
2	Over Gap
3	Under Gap
4	Over Direct Max
5	Under Direct Max
6	Over Direct Min
7	Under Direct Min
8	Danger (configurable)
9	Danger (configurable)
10	Danger (configurable)
11	Danger (configurable)

16.4.2 Alarm Hysteresis

The alarming hysteresis for all channel configurations is 1/64 of Full Scale. When a channel exceeds an alarm setpoint, it must fall back the setpoint less the hysteresis before it can go out of alarm.

For example, for a channel configuration with a 0 to 10 mil full scale and an alarm setpoint of 6 mils, the hysteresis = 10 mils/64 = 0.16 mils. The channel input, therefore, must fall below 6 mils – 0.16 mils (5.84 mils) before the channel is out of alarm.

17. Eccentricity Verification

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17.1 Introduction

The following sections describe how to test alarms, verify channels, and test OK limits for channels configured as Eccentricity. The output values and alarm setpoints are verified by varying the input Eccentricity signal level (both peak to peak amplitude and DC voltage bias) and observing that the correct results are reported in the Verification screen on the test computer.

Eccentricity channels can be configured for the following channel values and alarms:

Channel Values	Alarms	
	Over	Under
Peak to Peak	X	
Gap	X	X
Direct	X	X

17.2 Test Equipment and Software Setup

The following test equipment and software setup can be used as the initial setup needed for all the Eccentricity channel verification procedures (Test Alarms, Verify Channels, and Test OK Limits).

WARNING!
High voltage present. Contact could cause shock, burns, or death. Do not touch exposed wires or terminals.

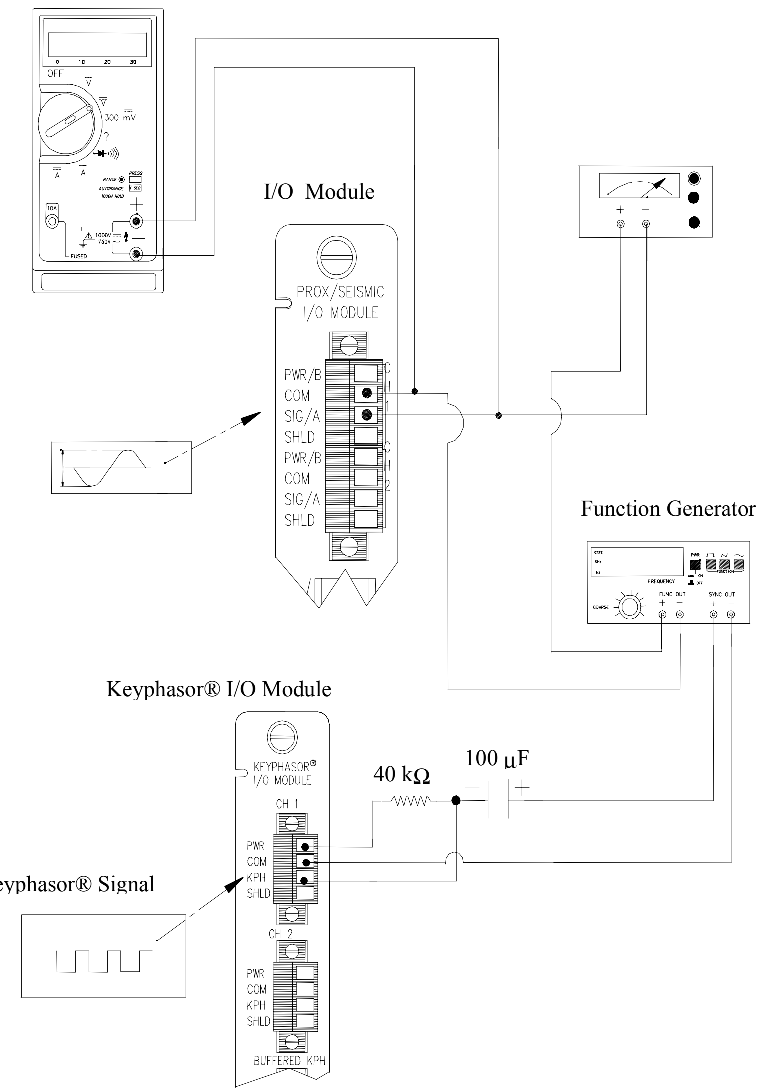
Application Alert
Tests will exceed alarm setpoint levels causing alarms to activate. This could result in a relay contact state change.

Application Alert
Disconnecting field wiring will cause a not OK condition.

17.2.1 Test Equipment Setup

Simulate the transducer signal by connecting the power supply, function generator and multimeter to COM and SIG of channel 1 with polarity as shown below. Set the test equipment as specified below:

Power Supply	Function Generator
-7.00 Vdc	Waveform: sinewave DC Volts: 0 Vdc Frequency: 5 Hz Amplitude level: Minimum (Above Zero)



Eccentricity Test Setup

The Test Equipment outputs should be floating relative to earth ground.

17.2.2 Verification Screen Setup

Run the Rack Configuration Software on the test computer. Choose **Verification** from the Utilities menu and choose the proper Slot number and Channel number then click on the **Verify** button.

Note
If the Timed OK Channel Defeat is enabled, the OK LED will not come on immediately after you connect the test equipment. It will take 60 seconds for a channel to return to the **OK** status from **not OK**. If OK mode is configured for latching, press the RESET button on the Rack Interface Module (RIM) to return to the **OK** status.

17.3 Test Alarms

The general approach for testing alarm setpoints is to simulate the eccentricity signal with a function generator and power supply. The alarm levels are tested by varying the output from the test equipment and observing that the correct results are reported in the Verification screen on the test computer. It is only necessary to test those alarm parameters that are configured and being used. The general test procedure to verify current alarm operation will include simulating a transducer input signal and varying this signal:

- to exceed over Alert/Alarm 1 and Danger/Alarm 2 Setpoints.
- to drop below any under Alert/Alarm 1 and Danger/Alarm 2 Setpoints.
- to produce a nonalarm condition.

17.3.1 Peak to Peak

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 17-2.
3. Adjust the function generator amplitude such that the signal level does not exceed any setpoint value for the pp mil bar graph.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for pp is green, and the Current Value field has no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the pp Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for pp changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for pp remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the pp Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for pp

changes color from yellow to red and that the Current Value Field indicates an Alarm.

8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for pp remains red and the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for pp changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
11. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
12. Repeat steps 1 through 11 for all configured channels.

17.3.2 Gap

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 17-2.
3. Adjust the power supply to produce a voltage that is within the Gap setpoint levels on the Gap bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Gap is green, and the Current Value still has no alarm indication.
5. Adjust the power supply voltage such that the signal just exceeds the Gap Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Gap changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Gap remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the power supply such that the signal just exceeds the Gap Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Gap changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Gap remains red and that the Current Value Field still indicates an Alarm.

9. Adjust the power supply voltage such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Gap changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the power supply to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

17.3.3 Direct

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 17-2.
3. Adjust the power supply to produce a reading that is within the Direct setpoint levels on the Direct bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Direct is green, and the Current Value field has no alarm indication.
5. Adjust the power supply voltage such that the signal just exceeds the Direct Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains yellow and that the Current Value Field still indicates an Alarm.

7. Adjust the power supply such that the signal just exceeds the Direct Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the power supply voltage such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Direct changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the power supply to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

17.4 Verify Channel Values

The general approach for testing these parameters is to simulate the eccentricity signal with a function generator and power supply. The output levels are verified by varying the output from the test equipment and observing that the correct results are reported in the Verification screen on the test computer.

17.4.1 Peak to Peak

Note
Most DMM's are not designed for measuring ac signals at low frequencies. An oscilloscope is recommended

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 17-2.

3. Calculate the full-scale voltage according to the following equation and examples.

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Verification Input Signal = Peak to Peak Meter Full-scale × Transducer Scale Factor

Example 1:
Peak to Peak Meter Top Scale = 10 mil
Transducer Scale Factor = 200 mV/mil

Full Scale = (10 × 0.200)
= 2.000 Vpp

For Vrms input:
Vrms = (0.707/2) × (Vpp), for a sinewave input
= (0.707/2) × (2)
= 0.707 Vrms

Example 2:
Peak to Peak Meter Top Scale = 200 µm
Transducer Scale Factor = 7,874 mV/mm
= 7.874 mV/µm

Full Scale = (200 × 0.007874)
= 1.5748 Vpp

For Vrms input:
Vrms = (0.707/2) × (Vpp), for a sinewave input
= (0.707/2) × (1.574)
= 0.5566 Vrms

4. Adjust the function generator amplitude for the calculated full scale. Verify that the pp bar graph display and the Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED

comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.

7. Repeat steps 1 through 6 for all configured channels.

17.4.2 Gap

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 17-2.
3. Adjust the power supply to produce a voltage equal to -18.00 Vdc on the Gap bar graph display. Verify that the Gap bar graph display and the Current Value Box is reading ±1 % of -18.00 Vdc.
4. Adjust the power supply to produce a voltage equal to the mid-scale on the Gap bar graph display. Verify that the Gap bar graph display and current value box is reading ±1 % of the mid-scale value.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

17.4.3 Direct

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 17-2.
3. Calculate the full-scale and bottom-scale values. These values can be calculated in the following way:

   Full / Bottom Scale Value = Zero Position Voltage ± (Transducer Scale Factor × Scale Range)

Note
The Zero Position Voltage is the voltage input that will cause the reading on the bar graph display and the Current Value Box to be zero. The Zero Position Volts value is displayed in the Z.P. Volts box above each channel value bar graph.

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Full Scale = (Zero Position Voltage) - (Transducer Scale Factor × Top Meter Scale)

Bottom Scale = (Zero Position Voltage) + (Transducer Scale Factor × ABS (Bottom Meter Scale))

Example 1:

Transducer scale factor	=	200 mV/millmeter
scale range	=	20-0-20 mil
Zero Position Voltage	=	-9.75 Vdc

Full-Scale Value	=	(-9.75) - (0.200 × 20)
	=	-13.75 Vdc
Bottom-Scale Value	=	(-9.75) + (0.200 × 20)
	=	-5.75 Vdc

Example 2:

Transducer scale factor	=	7,874 mV/mm
	=	7.874 mV/µm
Meter scale range	=	200-0-200 µm
Zero Position Voltage	=	-9.75 Vdc

Full-Scale Value	=	(-9.75) - (0.007874 × 200)
	=	-11.3248 Vdc
Bottom-Scale Value	=	(-9.75) + (0.007874 × 200)
	=	-8.1752 Vdc

4. Adjust the power supply voltage to match the voltage displayed in the Z.P. Volts Box. The Direct bar graph display and the Current Value Box should read 0 mil (0 mm) ±1 %.
5. Adjust the power supply voltage for full scale. Verify that the Max value in the Current Value Box (the value on the left of the divider bar) is reading ±1 % of full scale.
6. Adjust the power supply voltage for bottom scale. Verify that the Min value in the Current Value Box (the value on the right of the divider bar) is reading ±1% of bottom scale.
7. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
8. Disconnect the power supply and multimeter and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
9. Repeat steps 1 through 8 for all configured channels.

17.5 Test OK Limits

The general approach for testing OK limits is to input a DC voltage and adjust it above the Upper OK limit and below the Lower OK limit. This will cause a channel not OK condition and the OK Relay to change state (de-energize). The Upper and Lower OK limits are displayed in the Verification screen on the test computer.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 17-2.
3. Bypass all other configured channels.
4. Adjust the power supply voltage to -7.00 Vdc.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the monitor OK LED is on and that the Channel OK State line in the Channel Status box of the Verification screen reads **OK**.

Note
If the Danger Bypass has been activated, then the BYPASS LED will be on. All other channels in the rack must be OK or bypassed for the relay to be energized.

6. Verify that the OK relay on the Rack Interface I/O Module indicates OK (energized). See 3500/20 Rack Interface Module Operation and Maintenance Manual, part number 129768-01.
7. Increase the power supply voltage (more negative) until the OK LED just goes off (upper limit). Verify that the Channel OK State line in the Channel Status box reads **not OK** and that the OK Relay indicates not OK. Verify that the Upper OK limit voltage displayed on the Verification screen is equal to or more positive than the input voltage.
8. Decrease the power supply voltage (less negative) to -7.00 Vdc.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on and the OK relay energizes and that the Channel OK State line in the Channel Status box reads **OK**.
10. Gradually decrease the power supply voltage (less negative) until the OK LED just goes off (lower limit). Verify that the Channel OK State line in the Channel Status box reads **not OK** and that the OK Relay indicates not OK. Verify that the Lower OK limit voltage displayed on the Verification screen is equal to or more negative than the input voltage.
11. Increase the power supply voltage (more negative) to -7.00 Vdc.
12. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on, the OK relay energizes, and the Channel OK State line in the Channel Status box reads **OK**.
13. If you can not verify any configured OK limit, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
14. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel 1 terminals on the Monitor I/O Module. Press the RESET switch on the Rack Interface Module (RIM) and verify that the OK LED comes on and the OK relay energizes.
15. Repeat steps 1 through 14 for all configured channels.
16. Return the bypass switch for all configured channels back to their original setting.

Eccentricity Default OK Limits Table

Transducer	Lower OK Limit (volts)	Upper OK Limit (volts)
3300 XL 8mm, 3300 XL 11mm, 3300 5mm & 3300 8 mm w/ barriers	-2.70 to -2.80	-16.70 to -16.80
3300 XL 8mm, 3300 XL 11mm, 3300 5mm & 3300 8 mm w/o barriers	-2.70 to -2.80	-16.70 to -16.80
7200 5 & 8 mm w/ barriers	-2.70 to -2.80	-16.70 to -16.80
7200 5 & 8 mm w/o barriers	-2.70 to -2.80	-16.70 to -16.80
7200 11 mm w/o barriers	-3.50 to -3.60	-19.60 to -19.70
7200 14 mm w/o barriers	-2.70 to -2.80	-16.70 to -16.80
3300 16 mm HTPS w/o barriers	-2.70 to -2.80	-16.70 to -16.80
Note: Assume ±50 mV accuracy for check tolerance.		

18. REBAM General Information

REBAM stands for rolling element bearing activity monitor. Major features of this channel type are:

- Monitor of the bearing's condition through the use of high pass filter to implement a "spike" region.
- Monitor the loading of the bearing through the use of a band pass filter centered about the element pass frequency.
- Monitor rotor related issues such as balance and alignment through the use of a lowpass filter setting related to nominal machine speed and by providing 1X amplitude and phase information.
- Monitor variable-speed machines by adjusting the filter settings based on the current machine speed.

In a 3500 Monitoring System, REBAM channels are programmed in pairs. These channels, depending on configuration, typically condition the input signals into various parameters called “proportional values”. These values, along with a Keyphasor® signal provide phase measurements.

The channels also provide setpoints that can be used for alarming. Alert setpoints can be configured for each active proportional value and Danger setpoints can be configured for any two of the active proportional values.

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19. REBAM Configuration

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19.1 Introduction

This section discusses the Configuration Considerations and the Rack Configuration Software screens associated with the REBAM Channel.

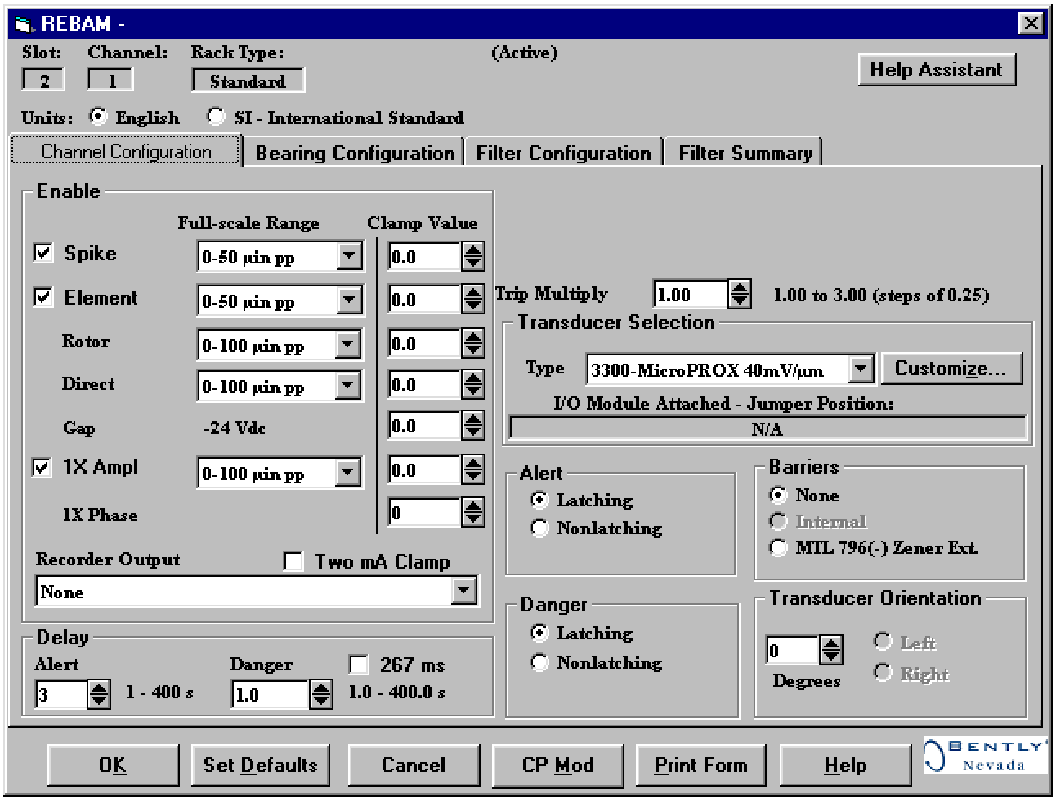
19.2 Configuration Considerations

Consider the following items before configuring a REBAM Channel:

- When "No Keyphasor" is selected, the 1X Amplitude (Ampl) and Phase Lag values cannot be enabled.
- When "No Keyphasor" is selected, the filter Stepping/Tracking feature cannot be enabled.
- If a Keyphasor channel is selected, a Keyphasor Module must be installed in the rack.
- The 1X Phase value can be enabled only if the selected Keyphasor channel is configured for an events per revolution equal to 1 will.
- If a Non-Standard transducer is selected, the setpoint OK limits are set to ±1 volt from the Upper and Lower OK limits that are selected.
- Setpoints may only be set on proportional values that are enabled.
- Monitors must be configured in channel pairs (for example, Channels 1 and 2 may be configured as REBAM and Channels 3 and 4 may be configured as Thrust Position).
- Some configurations, typically for the higher speed machines, will allow only one channel of a channel pair to be enabled. Refer to "Signal Conditioning" in the "Specifications" section of the manual.
- When a full-scale range is modified, the setpoints associated with this proportional value should be readjusted.
- TMR configurations are not supported by the REBAM channel type.

19.3 General Options

This section describes the general options available on the REBAM Channel Type configuration screens.



19.3.1 Reference Information

These fields contain information that indicates which module you are configuring.

Channel: The number of the channel being configured (1 through 4).

Slot: The location of the monitor in the 3500 rack (2 through 15).

Rack Type: Identifies the type of Rack Interface Module installed in the rack (Standard or TMR).

Help Assistant: Select this button to turn on the context-sensitive help system. Select the button again to turn the help system off.

19.3.2 General Parameters and Buttons

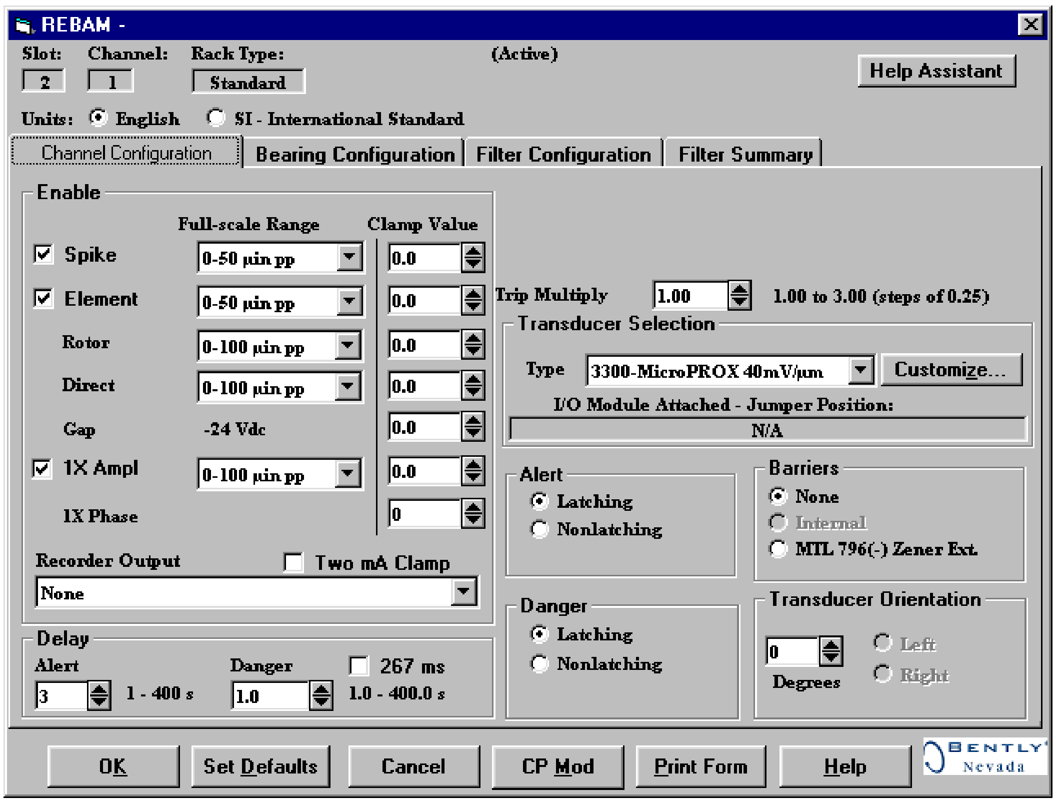
Units: Allows the user to view and configure the channel parameters using either English or Metric units of measure.

CP Mod: Selecting the CP Mod button Channel Options Dialog Box, allows a Custom channel configuration to be downloaded to the monitor. Custom configuration data is stored in a Custom Products Modification File. Custom Products Modification files follow the naming convention <modification #.mod>.

These files must be located in the \3500\Rackcfg\Mods\ directory. When a CP Mod file is selected, a window is displayed which describes the function of the modification. CP Mod files are available through Bently Nevada's Custom Products Division. Contact your local Bently Nevada Sales Representative for details.

19.4 Channel Configuration Tab

This section describes the options available on the Channel Configuration tab.



19.4.1 Trip Multiply

The value selected to temporarily increase the alarm (Alert and Danger) setpoint values. This value is normally applied by manual (operator) action during startup to allow a machine to pass through high vibration speed ranges without monitor alarm indications. Such high vibration speed ranges may include system resonances and other normal transient vibrations.

19.4.2 Transducer Jumper Status (on I/O Module)

Returns the position of the Transducer Jumper on the I/O Module. Refer to “Setting the I/O Jumper” in the "I/O Module Descriptions" section of the manual, if applicable.

19.4.3 Enable

An enabled proportional value specifies that the value will be provided by the channel (☑ enabled, ☐ disabled).

Spike: A high-pass filtered value that contains the high frequency content of the input signal. This is generally associated with the condition of the bearing.

Element: A band-passed filtered value that contains the signal content of the Element Pass Frequency (Outer Race). It is generally associated to the loading of the bearing.

Rotor: A low-pass filtered value that is generally used to monitor rotor related issues such as misalignment and unbalance.

Direct: Wide-band data that represents the overall peak to peak vibration.

Gap: The physical distance between the face of a proximity probe tip and the observed surface. The distance is expressed in terms of voltage. Standard polarity convention dictates that a decreasing gap results in an increasing (less negative) output signal.

1X Ampl: In a complex vibration signal, notation for the amplitude component that occurs at the rotor rotative speed frequency.

1X Phase Lag: In a complex vibration signal, notation for the phase lag component that occurs at the rotor rotative speed frequency.

Full Scale Range: All proportional values except Gap provide the ability to set a full scale value. If the desired full scale value is not in the pull down list, then the custom selection can be chosen. The full scale range for Gap is always 0 - (-24) Vdc The values in the following table are the same for all transducer types.

Full Scale Range (uin pp) (um pp)	Proportional Value				
	Spike	Element	Rotor	Direct	1X Ampl
0-50 0-1	X	X			
0-100 0-2	X	X	X	X	X
0-200 0-5	X	X	X	X	X
0-500 0-10	X	X	X	X	X
0-1000 0-20	X	X	X	X	X
0-2000 0-50		X	X	X	X
0-3000 0-75		X	X	X	X

Clamp Value: The value that a proportional value goes to when that channel or proportional value is bypassed or defeated (For example when a problem occurs with the transducer). The selected value can be between the minimum and maximum full-scale range values. (1X and 2X Phase Lag have available values of 0 to 359 degrees.) Only the values available from the Recorder Outputs, Communication Gateway and Display Interface Module are clamped to the specified value when the proportional value is invalid.

Recorder Output: The proportional value of a channel that is sent to the 4 to 20 mA recorder. The recorder output is proportional to the measured value over the channel full scale range. An increase in the proportional value that would be indicated as upscale on a bar graph display results in an increase in the current at the recorder output.

1X Phase Lag cannot be selected as a recorder output.

19.4.4 Delay

The time which a proportional value must remain at or above an over alarm level or below an under alarm level before an alarm is declared as active.

Alert: First level alarm that occurs when the transducer signal level exceeds the selected Alert/Alarm 1 setpoint. This setpoint can be set on the Setpoint screen. The time delay is adjustable in one-second increments. The minimum number allowed is based on the current configuration of the REBAM channel.

Danger: Second level alarm that occurs when the transducer signal level exceeds the selected Danger/Alarm 2 setpoint. This setpoint can be set on the Setpoint screen. The time delay is adjustable in 0.5 second increments. The minimum number allowed is based on the current configuration of the REBAM channel.

??? ms option: The ??? ms option applies to the Danger time delay only. The value of ??? is based on the current configuration of the REBAM channel and has the following results:

If the ??? ms option is off (☐):

- The Danger time delay can be set at 0.5 second intervals (up to 400).
- Danger setpoints can be set for up to two proportional values.

If the ??? ms option is on (☑):

- The Danger time delay is set to the time displayed.
- Danger setpoints can only be set for one proportional value.

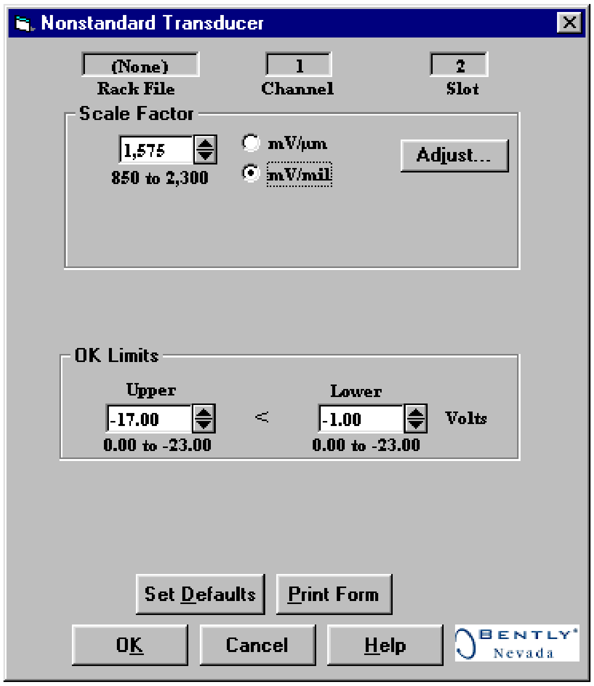
19.4.5 Transducer Selection

Type: The following transducer types are available for the REBAM Channel:

- 3300 MicroProx 40 mV/um
- 3300 MicroProx 80 mV/um
- 7200 MicroProx 80 mV/um
- Nonstandard

Customize button: Used to adjust the Scale Factor for transducers. Refer to "Adjusting the Scale Factor and Zero Position" in the "Monitor Verification" section of the manual. Also, note that:

- If Non-standard is selected as the transducer type, the OK Limits can also be adjusted.
- The Non-standard transducer's scale factor must be between 850 and 2300 mV/mil.
- There must be at least 2 volts between the Upper and Lower OK Limits.



Scale Factor by Transducer Type

Transducer	Scale Factor		
	Without Barriers (mV/mil)	**With Bently Nevada Internal Barriers (mV/mil)**	**Standard I/O With External Barriers (mV/mil)**
3300 MicroProx 40 mV/um	1000	1000	960
3300 MicroProx 80 mV/um	2000	2000	1919
7200 MicroProx 80 mV/um	2000	2000	1919
Note: ±15 % scale factor adjustment allowed			

OK Limits by Transducer Type

Transducer	Upper		Lower	
	Without Barriers (V)	With Barriers (V)	Without Barriers (V)	With Barriers (V)
3300 MicroProx 40 mV/um	-17.00	-17.00	-1.00	-1.00
3300 MicroProx 80 mV/um	-17.00	-17.00	-1.00	-1.00
7200 MicroProx 80 mV/um	-19.00	-19.00	-3.00	-3.00
* Barriers are not supported with this transducer option. Note: OK limits With Barriers includes the Bently Nevada Internal Barrier I/O Modules				

19.4.6 Alarm Mode

Latching: Once an alarm is active it will remain active even after the proportional value drops below the configured setpoint level. The channel will remain in alarm until it is reset using one of the following methods:

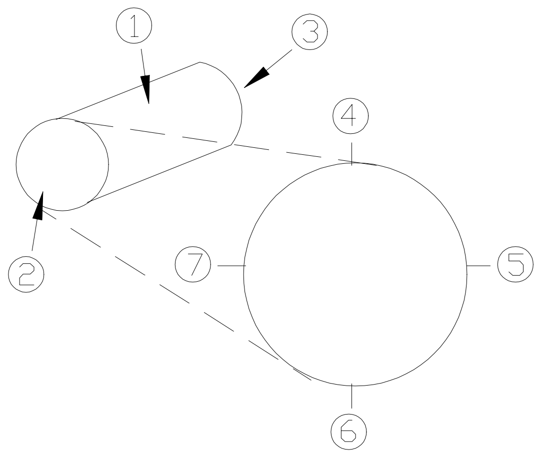
- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: When an alarm is active it will go inactive as soon as the proportional value drops below the configured setpoint level.

Alert should be the first level alarm that occurs when the transducer signal level exceeds the selected value. Danger should be the second level alarm that occurs when the transducer signal level exceeds the selected value. The Alert and Danger values are set on the Setpoint screen.

19.4.7 Transducer Orientation

Degrees: The location of the transducer on the machine. The range for orientation angle is 0 to 180 degrees left or right as observed from the driver to the driven end of the machine train. Refer to the following figure:



This drawing is for horizontal shafts

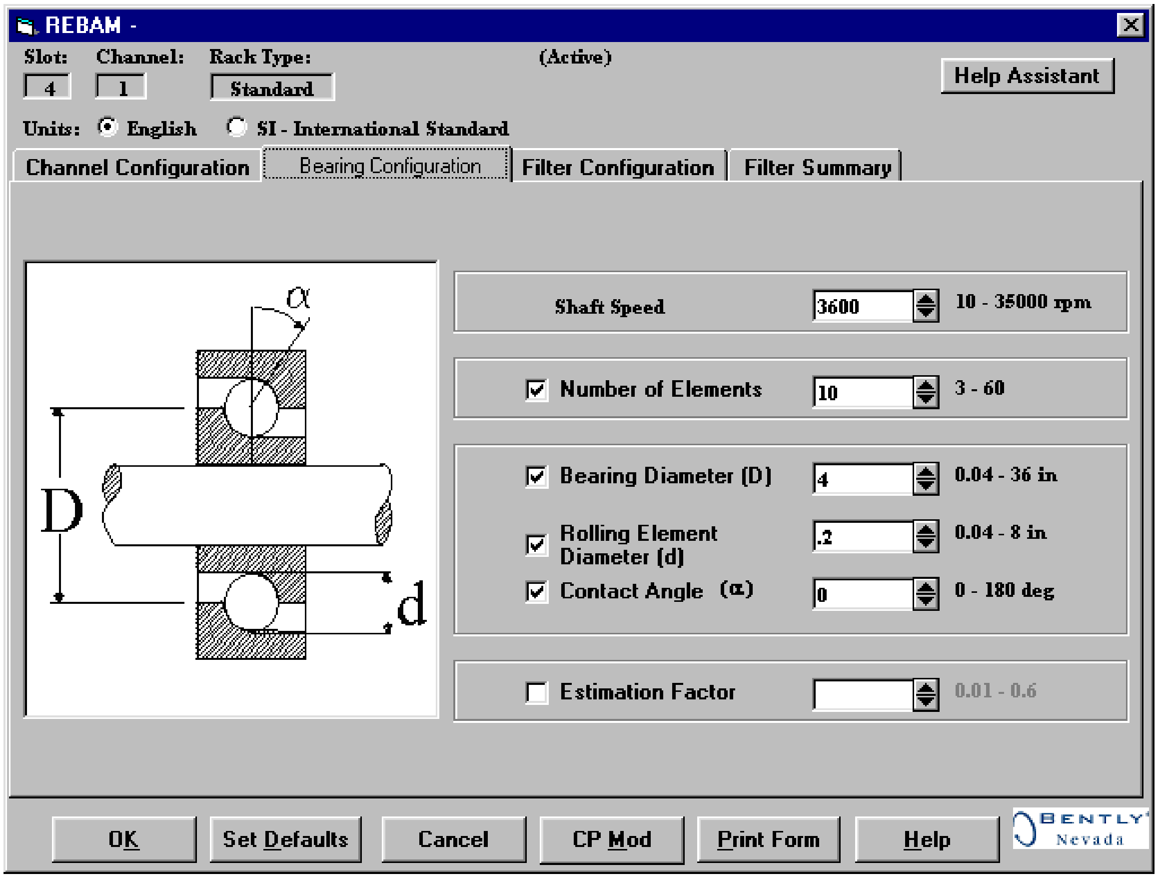
(1) Shaft
(2) Driver end
(3) Driven end
(4) 0°
(5) 90° right
(6) 180°
(7) 90° left

19.4.8 Barriers

Select the MTL 796(-) Zener External option if external safety barriers are connected between the monitor and the transducer. If using an Internal Barrier I/O Module, select the internal option. These devices are used to restrict the amount of energy that can flow into a hazardous area.

19.5 Bearing Configuration Tab

This section describes the options available on the Channel Configuration tab.



The following table summarizes the required entries for each of the three methods of entering the bearing configuration. If all the required information is provided for either Accurate or Estimated, the software will calculate various bearing frequencies and select appropriate filter settings.

Method	Parameters					
	Shaft Speed	Number of Elements	Bearing Diamter	Element Diameter	Contact Angle	Estimation Factor
Accurate	X	X	X	X	X	
Estimated	X	X				X
Unknown	X					

19.5.1 Shaft Speed

Enter the nominal speed (in rpm) of the shaft that the bearing is applied to. The nominal shaft speed applies to the normal operating speed of the shaft.

19.5.2 Number of Elements

If known, enable this field by checking the box on the left, then enter the number of rolling elements contained in the bearing.

19.5.3 Bearing Diameter (D)

If known, enable this field by checking the box on the left, then enter the pitch diameter of the bearing. Refer to the diagram for the definition of "pitch diameter".

19.5.4 Rolling Element Diameter (d)

If known, enable this field by checking the box on the left, then enter the diameter of the rolling element in the bearing.

19.5.5 Contact Angle (a)

If known, enable this field by checking the box on the left, then enter the contact angle of the bearing. Refer to the diagram for the definition of "contact angle".

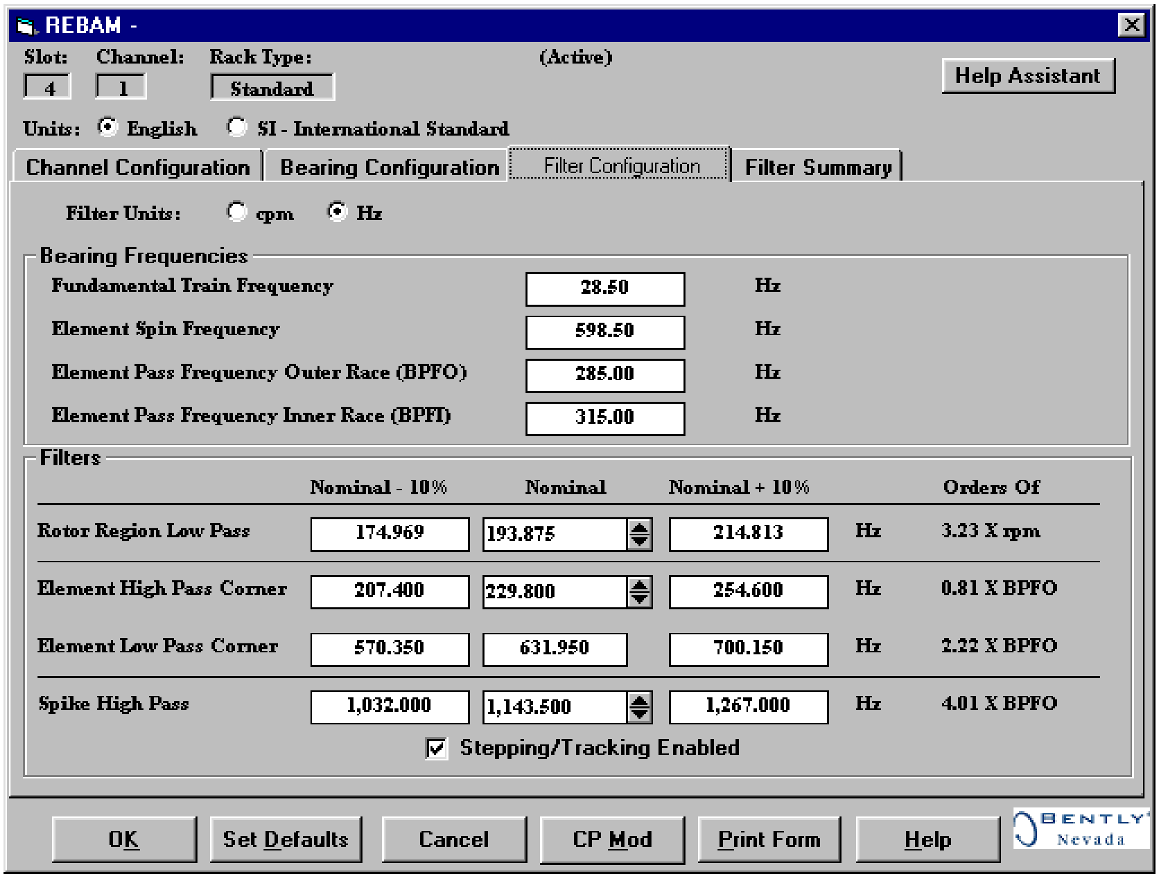
19.5.6 Estimation Factor

Use this field only if either of the diameters or contact angle are not accurately known. Shaft Speed and Number of Elements must be known and entered in their appropriate fields. The definition of Estimation Factor is (d/D) cos(a).

Note
If Estimation Factor is enabled, the software will ignore entries for Bearing Diameter, Rolling Element Diameter and Contact Angle.

19.6 Filter Configuration Tab

This section describes the options available on the Filter Configuration tab.



19.6.1 Filter Units

The user can view the bearing frequencies and filter settings in either cycles per minute (cpm) or Hertz (Hz)

19.6.2 Bearing Frequencies

If the appropriate fields were enabled on the Bearing Configuration tab, the software will calculate the following frequencies generated by the bearing while the shaft is running at its nominal operating speed:

- Fundamental Train Frequency: Also known as the cage frequency, this is the frequency at which the bearing cage and the rolling elements as a set make one revolution.
- Element Spin Frequency: The frequency at which a rolling element spins one revolution about its own spin axis.
- Element Pass Frequency, Outer Race (BPFO): The frequency at which a specific point on the bearing's outer race is passed by the rolling elements.

- Element Pass Frequency, Inner Race (BPFI): The frequency at which a specific point on the bearing's inner race is passed by the rolling elements.

19.6.3 Filters

This section displays the current filter selections for the rotor, element pass and spike regions. These values can be adjusted by changing the nominal values for each filter region. The "Orders Of" section displays the orders of magnitude relationship between a region's primary signal of interest and its "Nominal" filter corner frequency.

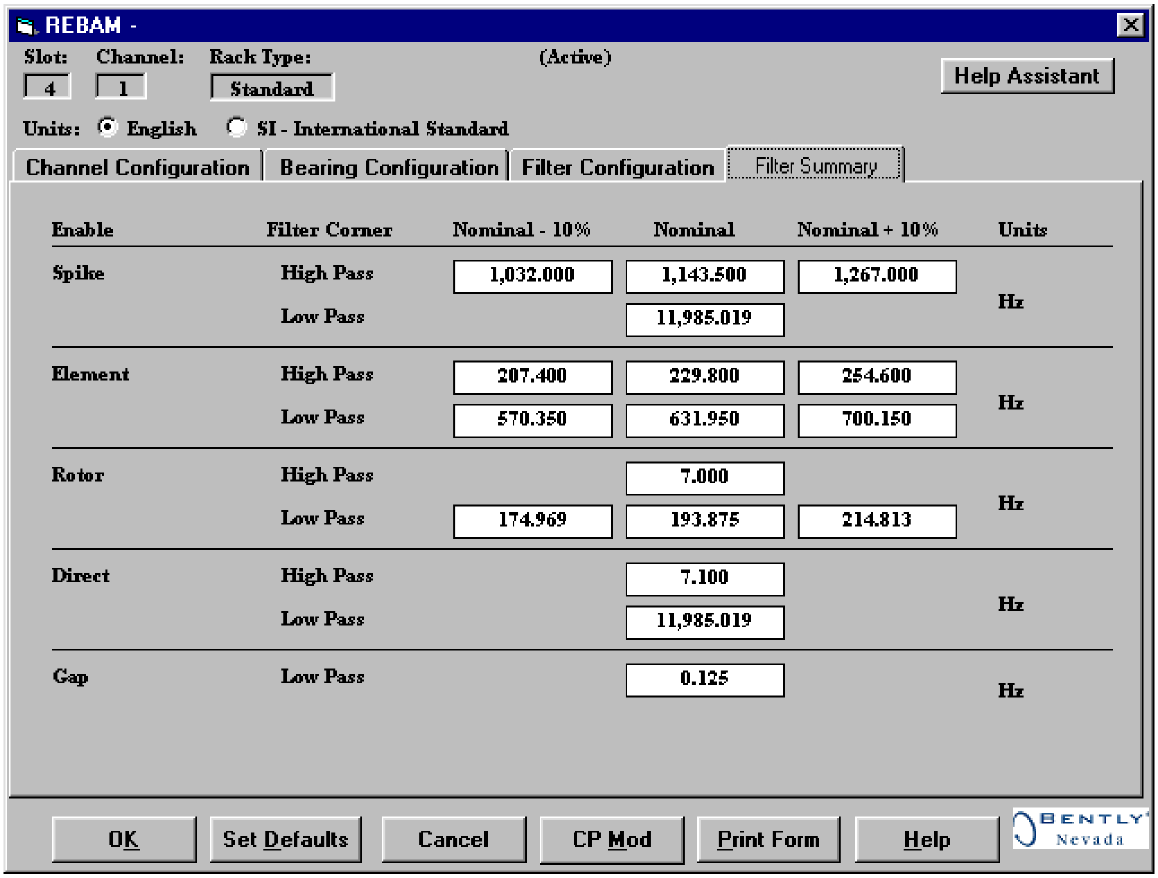
- Rotor Region Low Pass: The lowpass filter that will be applied to the input signal for calculating the Rotor proportional value.
- Element High Pass Corner and Element Low Pass Corner: The bandpass filter that will be applied to the input signal for calculating the Element proportional value.
- Spike High Pass: The highpass filter that will be applied to the input signal for calculating the Spike proportional value.

19.6.4 Stepping/Tracking Enabled

If this box is checked, the filter regions will switch between the Nominal and the +/- 10% filters as the shaft speed changes by the appropriate amount. A rotor speed signal is required for this feature.

19.7 Filter Summary Tab

This section describes the information available on the Filter Summary tab.



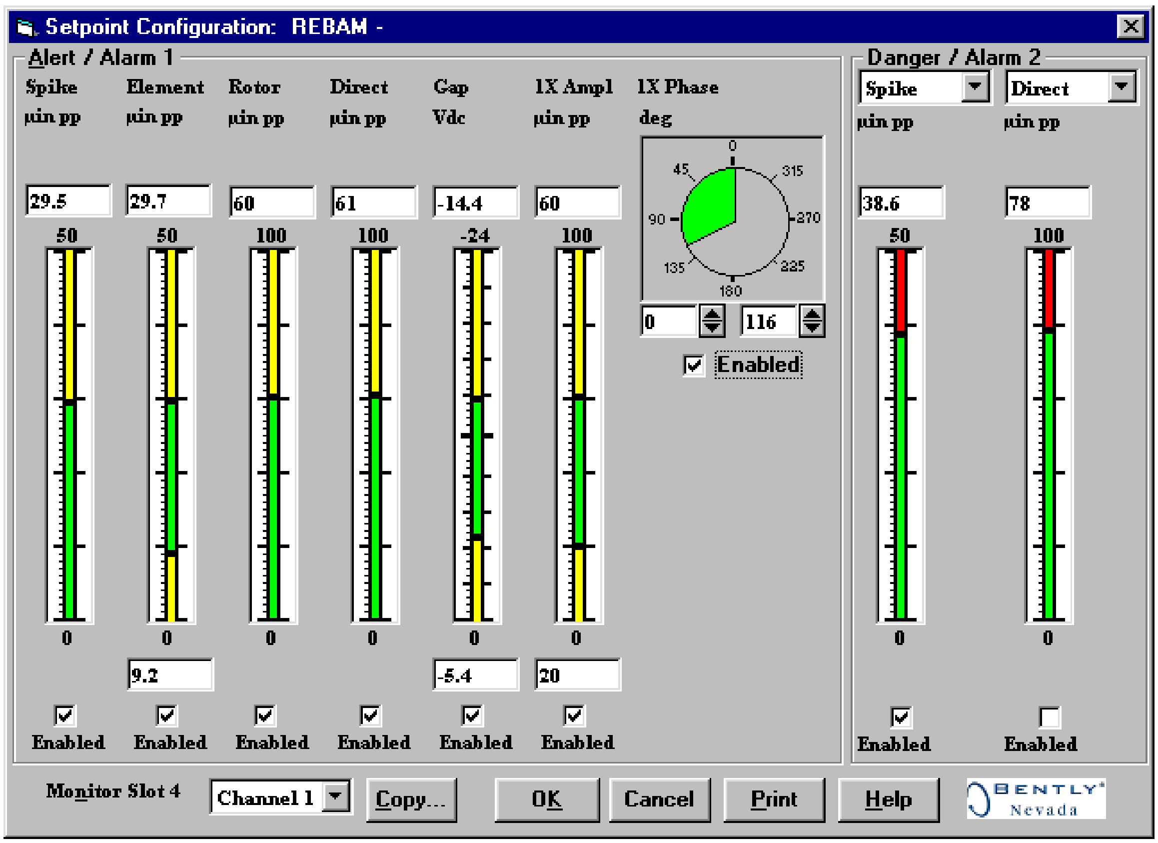
This screen summarizes the filters that will be implemented by the current configuration. This information will be very useful when verifying the operation of the monitor. In order to change the information displayed on this screen, the information on the previous screens will have to be manipulated.

19.8 Alarm Setpoints

This section lists the available setpoints for the REBAM channel. A setpoint is the level within the full-scale range that determines when an alarm occurs. The 3500 Monitoring System allows Alert/Alarm 1 setpoints to be set for every proportional value on each channel. The channel will drive an Alert/Alarm 1 indication if one or more of the channel proportional values exceeds its setpoints. The 3500 Monitoring System also allows up to four Danger/Alarm 2 setpoints (two over setpoints and two under setpoints) to be set for up to two of the proportional values. You may select any two of the available proportional values for the channel.

Note
The setpoint over and under limits can only be placed within the OK limits of the specified transducer.

Use the following screen in the Rack Configuration Software to adjust Alert/Alarm 1 and Danger/Alarm 2 setpoints.



19.8.1 Available Setpoints

The following tables list the Alert/Alarm 1 and Danger/Alarm 2 setpoints available for each REBAM channel pair. The setpoint number is used in the Communication Gateway and Display Interface Modules.

Setpoint Number	Radial Vibration
1	Over Spike
2	Over Element
3	Under Element
4	Over Rotor
5	Over Direct
6	Over Gap
7	Under Gap
8	Over 1X Ampl
9	Under 1X Ampl
10	Over 1X Phase Lag
11	Under 1X Phase Lag
12	Danger (configurable)
13	Danger (configurable)
14	Danger (configurable)
15	Danger (configurable)

19.8.2 Alarm Hysteresis

The alarming hysteresis for all channel configurations is 1/64 of Full Scale. When a channel exceeds an alarm setpoint, it must fall back below the setpoint less the hysteresis before it can go out of alarm.

For example, for a channel configuration with a 0–10 mils full scale and an alarm setpoint at 6 mils. The hysteresis = 10 mils/64 = 0.16 mils. The channel input, therefore, must fall below 6 mils - 0.16 mils (5.84 mils) before the channel is out of alarm.

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20. REBAM Verification

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20.1 Introduction

The following sections describe how to test alarms, verify channels, and test OK limits for channels configured as REBAM. The output values and alarm setpoints are verified by varying the input vibration signal level (both peak to peak amplitude and DC voltage bias) and observing that the correct results are reported in the Verification screen on the test computer.

20.2 Test Equipment and Software Setup

The following test equipment and software setup can be used as the initial set up needed for all the REBAM channel verification procedures (Test Alarms, Verify Channels, and Test OK Limits).

WARNING!
High voltage present. Contact could cause shock, burns, or death. Do not touch exposed wires or terminals.

Application Alert
Tests will exceed alarm setpoint levels causing alarms to activate. This could result in a relay contact state change.

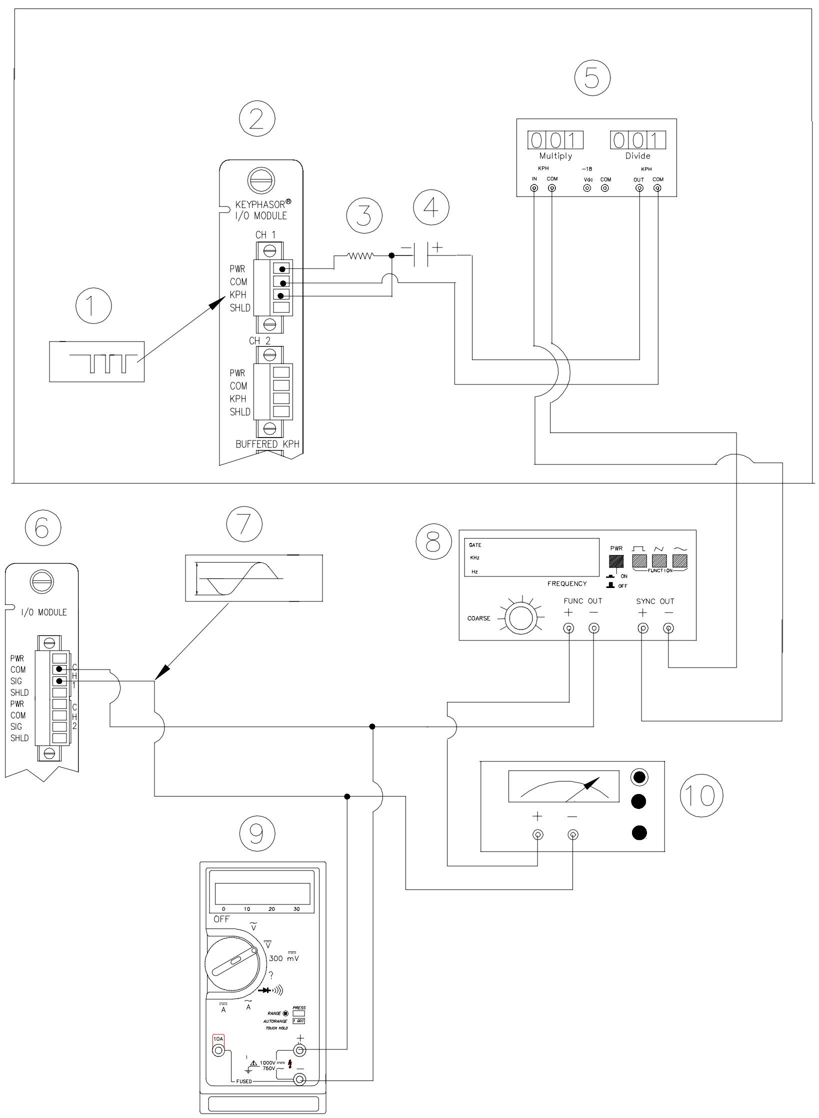
Application Alert
Disconnecting the field wiring will cause a not OK condition.

20.2.1 Test Equipment Setup

Simulate the transducer signal by connecting the power supply, function generator, and multimeter to COM and SIG of channel 1 with polarity as shown in the figure below. Set the test equipment as follows:

Power Supply	Function Generator	Keyphasor Multiplier/Divider
-7.00 Vdc	Waveform: sinewave DC Volts: 0 Vdc Frequency: 100 Hz Amplitude level: Minimum (above zero)	Multiply Switch: 001 Divide Switch: 001

The equipment shown in the dashed box is required for 1X Amplitude and Phase.



Test equipment for REBAM

(1) Keyphasor® Signal
(2) Keyphasor® I/O Module
(3) 40 kΩ
(4) 100 µF
(5) Keyphasor® Mulitplier/Divider
(6) Typical I/O module
(7) Simulated input signal
(8) Function generator
(9) Mulitmeter
(10) Power supply

20.2.2 Verification Screen Setup

Run the Rack Configuration Software on the test computer. Choose **Verification** from the Utilities menu and choose the proper Slot number and Channel number then click on the **Verify** button.

Note
Timed OK Channel Defeat is enabled for REBAM channels. If a channel goes **not OK**, the length of time it will be defeated ranges from 15 to 270 seconds before returning to the **OK** status. The time is dependent upon the configured Shaft Speed and Rotor Region Lowpass Filter. Lower values result in longer times.

20.3 Test Alarms

The general approach for testing alarm setpoints is to simulate the vibration and Keyphasor® signal with a function generator. The alarm levels are tested by varying the vibration signal (both peak to peak amplitude and DC voltage bias) and observing that the correct results are reported in the Verification screen on the test computer. It is only necessary to test those alarm parameters that are configured and being used. The general test procedure to verify current alarm operation will include simulating a transducer input signal and varying this signal:

- to exceed over Alert/Alarm 1 and Danger/Alarm 2 Setpoints, and
- to drop below any under Alert/Alarm 1 and Danger/Alarm 2 Setpoints and
- to produce a nonalarm condition.

When varying the signal from an alarm condition to a nonalarm condition, alarm hysteresis must be considered. Adjust the signal well below the alarm setpoint for the alarm to clear.

20.3.1 Spike

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the function generator frequency to approximately two times the Spike highpass corner frequency. Adjust the function generator amplitude to produce a reading that is below the Spike setpoint levels on the Spike bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Spike is green, and the Current Value field contains no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the Spike Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Spike changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Spike remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the Spike Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Spike changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Spike remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Spike changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. If you cannot verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
11. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
12. Repeat steps 1 through 11 for all configured channels.

20.3.2 Element

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the function generator frequency to approximately the mid point between the highpass and lowpass corners of the bandpass filter. Adjust the function generator amplitude to produce a reading that is between the Element over and under setpoint levels on the Element bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Element is green, and the Current Value field contains no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the Element Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Element changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Element remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the Element Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Element changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Element remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Element changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. If applicable, perform similar tasks to test the under setpoints.
11. If you cannot verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

20.3.3 Rotor

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the function generator frequency to approximately one half the corner frequency of the Rotor Lowpass Filter. Adjust the function generator amplitude to produce a reading that is below the Rotor setpoint levels on the Rotor bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Rotor is green, and the Current Value field contains no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the Rotor Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Rotor changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Rotor remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the Rotor Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Rotor changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Rotor changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. If you cannot verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
11. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
12. Repeat steps 1 through 11 for all configured channels.

20.3.4 Direct

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the function generator amplitude to produce a reading that is below the Direct setpoint levels on the Direct bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Direct is green, and the Current Value field contains no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the Direct Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the Direct Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Direct changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. If you cannot verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
11. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
12. Repeat steps 1 through 11 for all configured channels.

20.3.5 Gap

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.

2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2.
3. Adjust the power supply to produce a voltage that is within the Gap setpoint levels on the Gap bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Gap is green and that the Current Value field has no alarm indication.
5. Adjust the power supply voltage such that the signal just exceeds the Gap Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Gap changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Gap remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the power supply such that the signal just exceeds the Gap Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Gap changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Gap remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the power supply voltage such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Gap changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. Repeat steps 5 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the power supply to exceed the Under Alarm setpoint levels.
11. If you cannot verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

20.3.6 1X Amplitude (1X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the function generator amplitude to produce a reading that is within the 1X Ampl setpoint levels on the 1X Ampl bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 1X Ampl is green and that the Current Value field contains no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the 1X Ampl Over Alert/Alarm 1 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Ampl changes color from green to yellow and the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Ampl remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the 1X Ampl Over Danger/Alarm 2 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Ampl changes color from yellow to red and the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Ampl remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Ampl changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the function generator amplitude to exceed the Under Alarm setpoint levels.

11. If you cannot verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

20.3.7 1X Phase

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2.

Note
If you cannot change the phase output, change the phase alarm setpoints to activate the over and under phase alarms. The setpoints must be downloaded to the monitor to take effect.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the phase to produce a reading that is within the 1X Phase setpoint levels on the 1X Phase bar graph display of the Verification screen.
4. The 1X Amplitude needs to be a minimum of 42.7 mV to get a valid 1X Phase reading.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 1X Phase is green, and the Current Value field contains no alarm indication.
6. Adjust the phase such that the reading just exceeds the 1X Phase Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Phase changes color from green to yellow and the Current Value Field indicates an Alarm.
7. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Phase remains yellow and that the Current Value Field still indicates an Alarm.
8. Adjust the phase such that the reading just exceeds the 1X Phase Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Phase changes color from yellow to red and that the Current Value Field indicates an Alarm.

9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Phase remains red and that the Current Value Field still indicates an Alarm.
10. Adjust the phase such that the reading is below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Phase changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
11. Repeat steps 3 through 10 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the phase to exceed the Under Alarm setpoint levels.
12. If you cannot verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
13. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
14. Repeat steps 1 through 13 for all configured channels.

20.4 Verify Channel Values

The general approach for testing channel values is to simulate the vibration and Keyphasor input signal with a function generator. The output values are verified by varying the input vibration signal level (both peak to peak amplitude and DC voltage bias) and observing that the correct results are reported in the Verification screen on the test computer.

Note
These parameters have an accuracy specification of ±1 % of full scale for amplitude and ±3 degrees for phase.

20.4.1 Spike

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2.
3. Adjust the function generator frequency to approximately twice the corner frequency of the Spike Highpass Filter.

4. Calculate the full-scale voltage according to the equation and examples shown below. Adjust the amplitude of the function generator to the calculated voltage.

Application Alert
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Full Scale Voltage = Spike Meter Top Scale × Transducer Scale Factor

Example 1:
Spike Meter Top Scale = 500 uin pp
Transducer Scale Factor = 1000 mV/mil

Full Scale = (0.500 × 1.0)
= 0.500 Vpp

For Vrms input:

Vrms = (0.707/2) × (Vpp), for a sinewave input
= (0.707/2) × (0.5)
= 0.1768 Vrms

Example 2:
Spike Meter Top Scale = 10 µm pp
Transducer Scale Factor = 80 mV/um

Full Scale = (10 × 0.080)
= 0.800 Vpp

For Vrms input:
Vrms = (0.707/2) × (Vpp), for a sinewave input
= (0.707/2) × (0.800)
= 0.2828 Vrms

5. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Verify that the Spike bar graph display and Current Value Box is reading ±1 % of full scale.
6. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
7. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.

8. Repeat steps 1 through 7 for all configured channels.

20.4.2 Element

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2.
3. Adjust the function generator frequency to center frequency of the Element bandpass filter. This is calculated as the square root of the product of the highpass corner frequency times the lowpass corner frequency.
4. Calculate the full-scale voltage according to the equation and examples shown below. Adjust the amplitude of the function generator to the calculated voltage.

Application Alert
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Full Scale Voltage = Element Meter Top Scale × Transducer Scale Factor

Example 1:
Element Meter Top Scale = 500 uin pp
Transducer Scale Factor = 1000 mV/mil

Full Scale = (0.500 × 1.0)
= 0.500 Vpp

For Vrms input:

Vrms = (0.707/2) × (Vpp), for a sinewave input
= (0.707/2) × (0.5)
= 0.1768 Vrms

Example 2:
Element Meter Top Scale = 10 µm pp
Transducer Scale Factor = 80 mV/um

Full Scale = (10 × 0.080)
= 0.800 Vpp

For Vrms input:
Vrms = (0.707/2) × (Vpp), for a sinewave input
= (0.707/2) × (0.800)
= 0.2828 Vrms

5. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Verify that the Element bar graph display and Current Value Box is reading ±1 % of full scale.
6. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
7. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
8. Repeat steps 1 through 7 for all configured channels.

20.4.3 Rotor

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2.
3. Adjust the function generator frequency to approximately one half the corner frequency of the Rotor lowpass filter.
4. Calculate the full-scale voltage according to the equation and examples shown below. Adjust the amplitude of the function generator to the calculated voltage.

Application Alert
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Full Scale Voltage = Rotor Meter Top Scale × Transducer Scale Factor

Example 1:

Rotor Meter Top Scale	=	500 uin pp
Transducer Scale Factor	=	1000 mV/mil

Full Scale = (0.500×1.0)
= 0.500 Vpp

For Vrms input:

Vrms = $(0.707/2) \times (\text{Vpp})$, for a sinewave input
= $(0.707/2) \times (0.5)$
= 0.1768 Vrms

Example 2:

Rotor Meter Top Scale	=	10 µm pp
Transducer Scale Factor	=	80 mV/um

Full Scale = (10×0.080)
= 0.800 Vpp

For Vrms input:

Vrms = $(0.707/2) \times (Vpp)$, for a sinewave input
= $(0.707/2) \times (0.800)$
= 0.2828 Vrms

5. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Verify that the Rotor bar graph display and Current Value Box is reading ±1 % of full scale.
6. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
7. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
8. Repeat steps 1 through 7 for all configured channels.

20.4.4 Direct

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2.
3. Calculate the full-scale voltage according to the equation and examples shown below. Adjust the amplitude of the function generator to the calculated voltage.

Application Alert
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Full Scale Voltage = Direct Meter Top Scale $\times$ Transducer Scale Factor

Example 1:

Direct Meter Top Scale	=	500 uin pp
Transducer Scale Factor	=	1000 mV/mil

Full Scale = (0.500×1.0)
= 0.500 Vpp

For Vrms input:

Vrms = $(0.707/2) \times$ (Vpp), for a sinewave input
= $(0.707/2) \times (0.5)$
= 0.1768 Vrms

Example 2:
Direct Meter Top Scale = 10 μm pp
Transducer Scale Factor = 80 mV/um

Full Scale = (10×0.080)
= 0.800 Vpp

For Vrms input:
Vrms = $(0.707/2) \times$ (Vpp), for a sinewave input
= $(0.707/2) \times (0.800)$
= 0.2828 Vrms

4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Verify that the Direct bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

20.4.5 Gap

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2.
3. Adjust the power supply to produce a voltage equal to -18.00 Vdc on the Gap bar graph display. Verify that the Gap bar graph display and Current Value Box is reading ±1 % of -18.00 Vdc.
4. Adjust the power supply to produce a voltage equal to mid-scale on the Gap bar graph display. Verify that the Gap bar graph display and Current Value Box is reading ±1 % of the mid-scale value.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part

of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.

6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

20.4.6 1X Amplitude (1X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2.
3. Calculate the full-scale voltage according to the equation and examples shown below. Adjust the function generator amplitude to the calculated voltage.

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Full Scale Voltage = 1X Ampl Meter Top Scale × Transducer Scale Factor

Example 1:

1X Ampl Meter Top Scale	=	500 uin pp
Transducer Scale Factor	=	1000 mV/mil

Full Scale	=	(0.500 × 1.0)
	=	0.500 Vpp

For Vrms input:

Vrms =	(0.707/2) × (Vpp), for a sinewave input	
	=	(0.707/2) × (0.5)
	=	0.1768 Vrms

Example 2:

1X Ampl Meter Top Scale	=	10 µm pp
Transducer Scale Factor	=	80 mV/um

Full Scale = (10×0.080)
= 0.800 Vpp

For Vrms input:

Vrms = $(0.707/2) \times (Vpp)$, for a sinewave input
= $(0.707/2) \times (0.800)$
= 0.2828 Vrms

4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Verify that the 1X Ampl bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

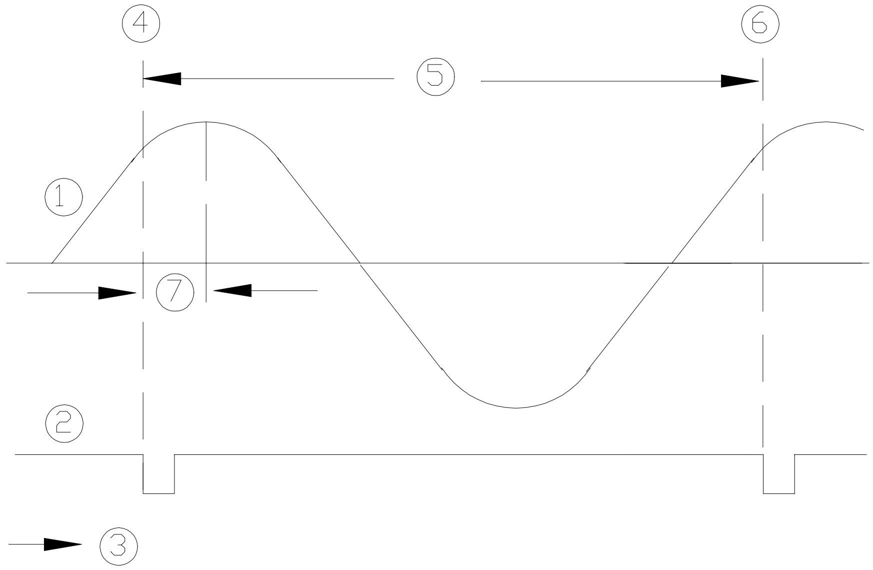
20.4.7 1X Phase

If the test equipment is not capable of changing the phase output to a known value, use the following procedure. If your test equipment can change the phase output to a known value, use the procedure "If the Test Equipment Can Change the Phase Output (1X Phase)" on page 20-20.

20.4.7.1 If the Test Equipment Cannot Change the Phase Ouput (1X Phase)

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
3. Attach one channel of a two channel oscilloscope to the vibration signal buffered output and attach the other channel to the associated Keyphasor® signal buffered output and observe the two signals simultaneously.
4. Measure the phase. 1X Phase will be measured from the leading edge of the Keyphasor® pulse to the first positive peak of the vibration signal. See the example below which illustrates a phase of 45°. Observe the 1X Phase bar graph display and Current Value Box; it should read approximately what was measured above.

Example:
1X = one cycle of vibration signal per shaft revolution



(1) 1X Vibration Signal
(2) Keyphasor Signal
(3) Time
(4) 0°
(5) One cycle
(6) 360°
(7) Phase lag = 45°

5. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
6. Repeat steps 1 through 5 for all configured channels.

20.4.7.2 If the Test Equipment Can Change the Phase Output (1X Phase)

If the test equipment has the capability to change the phase output to a known value, use the following procedures.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
3. Adjust the phase for mid-scale. Verify that the 1X Phase bar graph display and Current Value Box is reading ±1.5 % of mid-scale.

4. If the reading does not meet specifications double check the input signal to ensure it is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
5. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
6. Repeat steps 1 through 5 for all configured channels.

20.5 Test OK Limits

The general approach for testing OK limits is to input a DC voltage and adjust it above the Upper OK limit and below the Lower OK limit. This will cause a channel not OK condition and the OK Relay to change state (de-energize). The Upper and Lower OK limits are displayed in the Verification screen on the test computer.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 20-2.
3. Bypass all other configured channels.
4. Adjust the power supply voltage to -7.00 Vdc.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the monitor OK LED is on and that the Channel OK State line in the Channel Status box of the Verification screen reads **OK**.

Note
If the Danger Bypass has been activated, then the BYPASS LED will be on. All other channels in the rack must be OK or bypassed for the relay to be energized.

6. Verify that the OK relay on the Rack Interface I/O Module indicates OK (energized). See 3500/20 Rack Interface Module Operation and Maintenance Manual, part number 129768-01.
7. Increase the power supply voltage (more negative) until the OK LED just goes off (upper limit). Verify that the Channel OK State line in the Channel Status box reads **not OK** and that the OK Relay indicates not OK. Verify that the Upper OK limit voltage displayed on the Verification screen is equal to or more positive than the input voltage.
8. Decrease the power supply voltage (less negative) to -7.00 Vdc.

9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on and the OK relay energizes. Verify that the Channel OK State line in the Channel Status box reads **OK**.
10. Gradually decrease the power supply voltage (less negative) until the OK LED just goes off (lower limit). Verify that the Channel OK State line in the Channel Status box reads **not OK** and that the OK Relay indicates not OK. Verify that the Lower OK limit voltage displayed on the Verification screen is equal to or more negative than the input voltage.
11. Increase the power supply voltage (more negative) to -7.00 Vdc.
12. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on, the OK relay energizes and that the Channel OK State line in the Channel Status box reads **OK**.
13. If you cannot verify any configured OK limit, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
14. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the Monitor I/O Module. Press the RESET switch on the Rack Interface Module (RIM) and verify that the OK LED comes on and the OK relay energizes.
15. Repeat steps 1 through 14 for all configured channels.
16. Return the bypass switch for all configured channels back to their original setting.

REBAM Default OK Limits Table

Transducer	Lower OK Limit (volts)	Upper OK Limit (volts)
3300 MicroProx, 40 mV/um	-0.95 to -1.05	-16.95 to –17.05
3300 MicroProx, 80 mV/um	-0.95 to -1.05	-16.95 to –17.05
7200 MicroProx, 80 mV/um	-2.95 to -3.05	-18.95 to -19.05
Note: Assume ±50 mV accuracy for check tolerance. Limits are the same if Barriers are used.		

21. Velocity General Information

The velocity measurements from 3500 Velocity channels let you evaluate machine housing and other structural response characteristics. These channels can use signals from most seismic or inertial transducers.

The velocity channel type returns a direct measurement of the velocity of the vibration. Additionally if the monitor is an “M” series monitor (3500/42M) it is capable of returning: 1X amplitude, 1X phase, 2X amplitude, and 2X phase.

Although velocity measurements are useful for specific applications, these measurements have the following limitations:

- Electronic integration of a velocity signal yields displacement, but not position.
- Since a casing transducer normally is not able to measure steady state (dc) position and low frequency motion, the transducer cannot measure the slow roll bow of a rotor system.

Application Advisory
If housing measurements are being made for overall protection of the machine, thought should be given to the usefulness of the measurement for each application. Most common machine malfunctions (imbalance, misalignment, etc.) originate at the rotor and cause an increase (or at least a change) in rotor vibration. In order for any housing measurement alone to be effective for overall machine protection, a significant amount of rotor vibration must be faithfully transmitted to the bearing housing or machine casing, or more specifically, to the mounting location of the transducer. In addition, care should be exercised in the physical installation of the transducer. Improper installation can result in a decrease of the transducer amplitude and frequency response and/or the generation of signals which do not represent actual machine vibration. Upon request, Bently Nevada can provide engineering services to determine the appropriateness of housing measurements for the machine in question and/or to provide installation assistance.

In a 3500 Monitoring System, Velocity channels are programmed in pairs. These channels, depending on configuration, typically condition the input signals into various parameters called “proportional values”. Alert setpoints can be configured for each active proportional value and Danger setpoints can be configured for any two of the active proportional values.

There are two different channel types that support the measurement of velocity. These are Velocity and Velocity II. The Velocity channel type only supports the direct measurement and works with the 3500/42 and 3500/42M. The Velocity II channel type is an enhanced version of the Velocity channel type. It supports Direct, 1X Amplitude 1X Phase, 2X Amplitude, and 2X Phase. The Velocity II channel type is only available on the 3500/42M monitors with revision 2.1 firmware or greater, and requires version 3.2 of the 3500 Configuration software.

Application Alert
When upgrading from using a Velocity to a Velocity II channel type care must be taken regarding any DCS or PLC programming that utilizes data from the Communications Gateway. The order and the number of values for the PPL data and the alarm status data has changed for the Velocity II. This may require changes to the DCS or PLC programming. If this is undesirable then use the Velocity channel type.

22. Velocity Configuration

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22.1 Introduction

This section discusses the Configuration Considerations and the Rack Configuration Software screens associated with the Velocity Channel.

22.2 Configuration Considerations

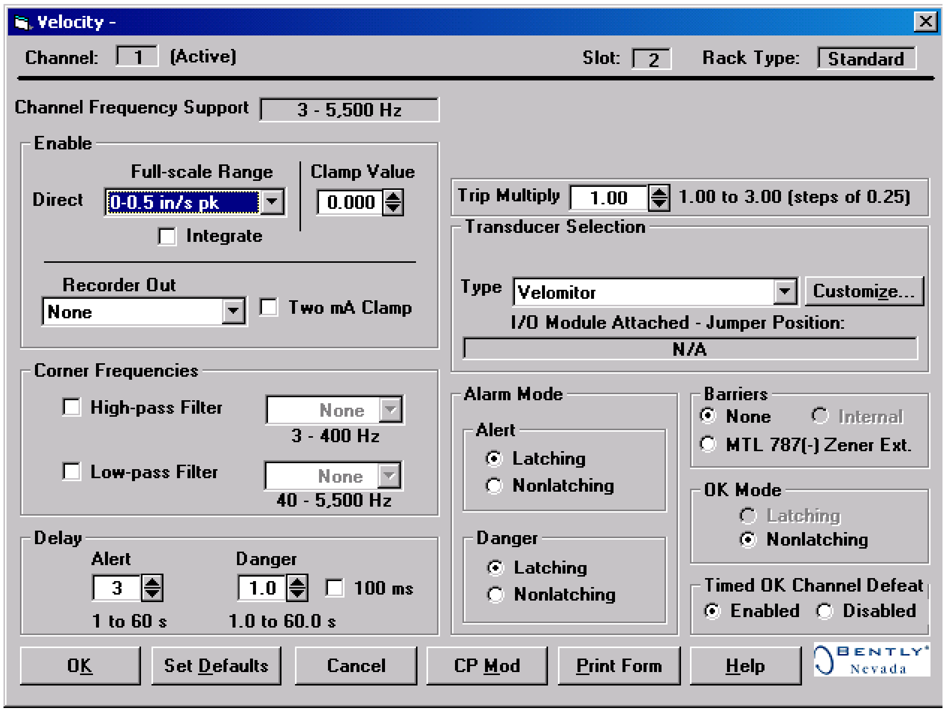
Consider the following items before configuring a Velocity Channel:

- The Velocity Direct full-scale range is dependent upon the transducer type.
- Seismoprobes are not supported with Prox/Velom I/O modules.
- The "No Keyphasor" option is automatically selected for this channel type. No Keyphasors are required.
- The Velocity Direct full-scale range is dependent upon the transducer type.
- When a full-scale range is modified, readjust the setpoints associated with this proportional value.
- Monitors must be configured in channel pairs (for example, Channels 1 and 2 may be configured as Velocity and Channels 3 and 4 may be configured as Thrust Position).
- When integration is selected, the available Direct Full-scale Ranges will change to reflect this.
- When band-pass filtering is selected, the high-pass and low-pass filters must be set a minimum of a decade apart.
- The 100ms danger alarm is only available for the Velomitor and High Temperature Velomitor options.
- When a single or dual channel of velocity is activated, the maximum channel frequency supported is as shown in “Signal Conditioning” in the specifications section.
- The Latching OK Mode and the Timed OK Channel Defeat options are not compatible.
- If a Non-Standard transducer is selected, the setpoint OK limits are set to ±1 volt from the Upper and Lower OK limits that are selected.

Application Alert
For machine protection parameters measured with Velocity or Velomitor® sensors or with Acceleration sensors a sudden mechanical impact can over-range the sensor output. If the monitor is configured with Timed OK Channel Defeat enabled and the over-range signal exceeds the OK Limits the monitor may not annunciate an alarm. This may result in a missed alarm and temporary loss of machine protection. Timed OK Channel Defeat can be disabled on velocity and acceleration channel types.
Caution
On Reciprocating Compressors mechanical impacts will occur. **DISABLE Timed OK Channel Defeat when monitoring crankcase or crosshead vibration using either Velocity, Velomitor®, or Acceleration sensors.**

22.3 Configuration Options

This section describes the options available on the Velocity Channel configuration screen.



22.3.1 General Parameters and Buttons

Trip Multiply: The value selected to temporarily increase the alarm (Alert and Danger) setpoint values. This value is normally applied by manual (operator) action during startup to allow a machine to pass through high vibration speed ranges without monitor alarm indications. Such high vibration speed ranges may include system resonances and other normal transient vibrations.

Channel Frequency Support: Supported frequency range of the selected transducer which depends upon the number of channels selected. See "Configuration Considerations" on page 22-2.

CP Mod: Selecting the CP Mod button in the Channel Options Dialog Box, allows a Custom channel configuration to be downloaded to the monitor. Custom configuration data is stored in a Custom Products Modification File. Custom Products Modification files follow the naming convention <modification #.mod>. These files must be located in the \3500\Rackcfg\Mods\ directory. When a CP Mod file is selected, a window is displayed which describes the function of the modification. CP Mod files are available through Bently Nevada's Custom Products Division. Contact your local Bently Nevada Sales Representative for details.

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. Refer to “Setting the I/O Jumper” in the "I/O Module Descriptions" section of the manual, if applicable.

22.3.2 Reference Information

These fields contain information that indicates which module you are configuring.

Channel: The number of the channel being configured (1 through 4).

Slot: The location of the monitor in the 3500 rack (2 through 15).

Rack Type: Identifies the type of Rack Interface Module installed in the rack (Standard or TMR).

22.3.3 Enable

Direct: The time rate of change of the displacement. When Integration is selected it yields a peak to peak measurement of the displacement.

The Direct values are available for all transducer types.

Direct
0-0.5 in/s pk
0-1 in/s pk
0-2 in/s pk
0 - 0.5 in/s rms
0-1 in/s rms
0-2 in/s rms
0-10 mm/s pk
0-20 mm/s pk
0-50 mm/s pk
0-10 mm/s rms
0-20 mm/s rms
0-50 mm/s rms
Custom

Integrate: When Integrate is enabled, the Direct Full-scale Range selections change to the following:

The Direct values (Integrated) are available for all transducer types.

Full-scale Range – Direct
0-5 mil pp
0-10 mil pp
0-20 mil pp
0-100 µm pp
0-200 µm pp
0-500 µm pp
Custom

Clamp Value: The value that a proportional value goes to when that channel or proportional value is bypassed or defeated (for example a problem with the monitor). The selected value can be between the minimum and maximum full-scale range values. Only the values available from the Recorder Outputs, Communication Gateway and Display Interface Module are clamped to the specified value when the proportional value is invalid.

Recorder Output: The proportional value of a channel that is sent to the 4 to 20 mA recorder. The recorder output is proportional to the measured value over the channel full-scale range. An increase in the proportional value that would be indicated as upscale on a bar graph display results in an increase in the current at the recorder output. If the channel is bypassed, the output will be clamped to the selected clamp value or to 2 mA (if the 2 mA clamp is selected).

22.3.4 Corner Frequencies

High-pass Filter: A four-pole filter that must be at least a factor of 5.7 times away from the Low-pass Filter.

HPF = High-pass Filter; LPF = Low-pass Filter

HPF ≤ (LPF / 5.7)

Low-pass Filter: A four-pole filter that must be at least a factor of 5.7 times away from the High-pass Filter.

HPF = High-pass Filter; LPF = Low-pass Filter

LPF ≥ (HPF * 5.7)

22.3.5 Delay

The time which a proportional value must remain at or above an alarm level or outside an acceptance region before an alarm is declared as active.

Alert: First level alarm that occurs when the transducer signal level exceeds the selected value. The Alert time delay is always set at one second intervals for all available proportional values.

Danger: Second level alarm that occurs when the transducer signal level exceeds the selected value.

100 ms option: The 100 ms (typical) option applies to the Danger time delay only and has the following results:

If the 100 ms option is off (☐):

- The Danger time delay can be set at one second intervals.
- The Danger time delay can be set for all available proportional values.

If the 100 ms option is on (☑):

- The Danger time delay is set to 100 ms.
- The Danger time delay can only be set for the primary proportional value.

22.3.6 Transducer Selection

Type: The following transducer types are available for the Velocity Channel (non-barrier I/O module):

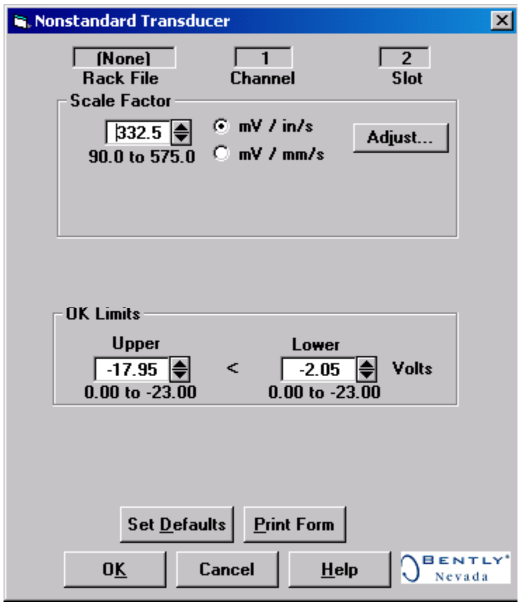
- 9200 2-wire Seismoprobe (Prox/Seis I/O only)
- 47633 2-wire Seismoprobe (Prox/Seis I/O only)
- 86205 2-wire Seismoprobe (Prox/Seis I/O only)
- Nonstandard 2-wire Seismoprobe (Prox/Seis I/O only)
- Velomitor
- High Temperature Velomitor (Prox/Velom I/O only)
- Nonstandard

The following transducer types are available for the Velocity Channel (barrier I/O module):

- Velomitor
- High Temperature Velomitor
- Nonstandard

Customize button: Used to adjust the Scale Factor for transducers. Refer to "Adjusting the Scale Factor and Zero Position" in the "Monitor Verification" section of the manual. Also, note that:

- If Non-standard is selected as the transducer type, the OK Limits can also be adjusted.
- The Non-standard transducer's scale factor must be between 90 and 575 mV/in/s.
- There must be at least 2 volts between the Upper and Lower OK Limits.



Scale Factor by Transducer Type

Transducer	Without Barriers	With BN Internal Barriers	With Barriers
9200	500 mV/(in/s)	*	500 mV/(in/s)
47633	490 mV/(in/s)	*	490 mV/(in/s)
86205	477 mV/(in/s)	*	477 mV/(in/s)
Nonstandard 2 wire	145 mV/(in/s)	*	145 mV/(in/s)
Velomitor	100 mV/(in/s)	100 mV/(in/s)	100 mV/(in/s)
High Temperature Velomitor	145 mV/(in/s)	145 mV/(in/s)	145 mV/(in/s)

Note: ±15 % scale factor adjustment allowed.

* Barriers are not supported with this transducer option.

OK Limits by Transducer Type

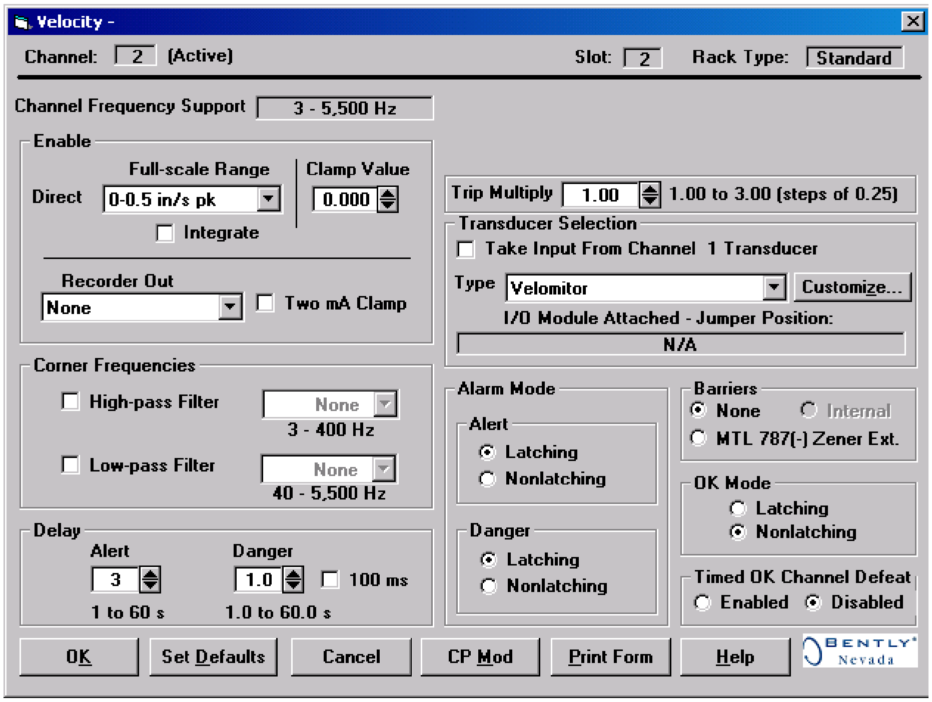
Transducer	Upper		Lower		Center Gap Voltage	
	Without Barriers (V)	With Barriers (V)	Without Barriers (V)	With Barriers (V)	Without Barriers (V)	With Barriers (V)
9200	-17.95	-17.95	-2.05	-2.05	-10.00	-10.00
47633	-17.95	-17.95	-2.05	-2.05	-10.00	-10.00
86205	-17.95	-17.95	-2.05	-2.05	-10.00	-10.00
NonStandard	-17.95	-17.95	-2.05	-2.05	-10.00	-10.00
Velomitor	-19.85	-17.95 -19.85 †	-4.15	-2.05 -4.15 †	-12.00	-10.00 -12.00 †
High Temperature Velomitor	-21.26	-21.26	-2.74	-2.74	-12.00	-12.00

* Barriers are not supported with this transducer option.

† BN Internal Barrier I/O Modules.

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the Proximitor/Seismic I/O Module. For the function of this jumper, refer to I/O Module Descriptions.

Take Input From Channel A (1 or 3) Transducer: The Channel B (2 or 4) Velocity channel options screen has an extra control that appears just above the transducer type list box (see figure below). It is the Take Input from Channel *A* Transducer checkbox. When checked (☒), the channel pair uses Dual Path Input. That is, input from the first channel (1 or 3) is used for both channels in the pair. The transducer input, barrier, OK Mode, and Timed OK Channel Defeat input from channel A will be copied to the second channel (2 or 4) in the channel pair.



Velocity Channel Options Screen for Channel B

22.3.7 Alarm Mode

Alert is the first level alarm that occurs when the transducer signal level exceeds the selected value. Danger is the second level alarm that occurs when the transducer signal level exceeds the selected value. The Alert and Danger values are set on the Setpoint screen.

Latching: Once an alarm is active it will remain active even after the proportional value is no longer in alarm. The alarm state will continue until the channel is reset using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: When an alarm is active, it will go inactive as soon as the proportional value is no longer in alarm.

22.3.8 Barriers

For Seismoprobes, select the MTL 764(-) Zener External option if external safety barriers are connected between the monitor and the transducer. For Velomitor, select the MTL 787(-) Zener External option if external safety barriers are being used. If using an Internal Barrier I/O Module for Velomitor, select the internal option. These devices are used to restrict the amount of energy that can flow into a hazardous area.

22.3.9 OK Mode

Latching: If a channel is configured for Latching OK, once the channel has gone not OK, the status stays not OK until a reset is issued using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: If a channel is configured for Nonlatching OK, the OK status of that channel will track the defined OK status of the transducer.

22.3.10 Timed OK Channel Defeat

An option that prevents a channel from returning to an OK status until that channel's transducer has remained in an OK state for the specified period of time. If the option is enabled, the time is set to 30 seconds. This option prevents false trips caused by intermittent transducers.

Application Alert

For machine protection parameters measured with Velocity or Velomitor® sensors or with Acceleration sensors a sudden mechanical impact can over-range the sensor output. If the monitor is configured with Timed OK Channel Defeat enabled and the over-range signal exceeds the OK Limits the monitor may not annunciate an alarm. This may result in a missed alarm and temporary loss of machine protection.

Timed OK Channel Defeat can be disabled on velocity and acceleration channel types.

Caution

On Reciprocating Compressors mechanical impacts will occur.

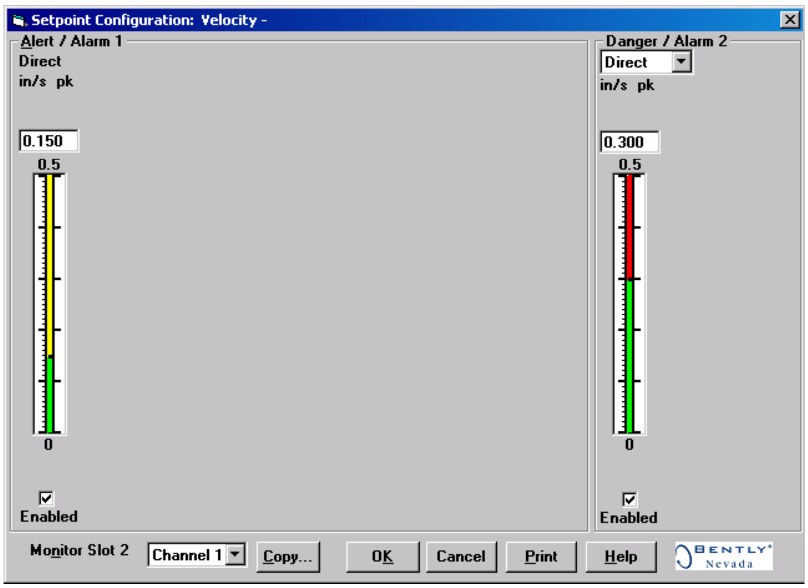
DISABLE Timed OK Channel Defeat when monitoring crankcase or crosshead vibration using either Velocity, Velomitor®, or Acceleration sensors.

22.4 Alarm Setpoints

This section specifies the available setpoints for each type of channel. A setpoint is the level within the full-scale range that determines when an alarm occurs. The 3500 Monitoring System allows Alert/Alarm 1 setpoints to be set for every proportional value on each channel. The channel will drive an Alert/Alarm 1 indication if one or more of the channel proportional values exceeds its setpoints. The 3500 Monitoring System also allows up to four Danger/Alarm 2 setpoints (two over setpoints and two under setpoints) to be set for up to two of the proportional values. You may select any two of the available proportional values for the channel.

Note
The setpoint over and under limits can only be placed within the OK limits of the specified transducer.

Use the following screen in the Rack Configuration Software to adjust Alert/Alarm 1 and Danger/Alarm 2 setpoints. This screen will vary depending upon the type of channel.



22.4.1 Available Setpoints

The following tables list the Alert/Alarm 1 and Danger/Alarm 2 setpoints available for the Velocity channel type. The setpoint number is used in the Communication Gateway and Display Interface Modules.

Setpoint Number	Velocity
1	Over Direct
2	Danger (Over Direct)
3	
4	
5	
6	
7	
8	
9	
10	
11	

22.4.2 Alarm Hysteresis

The alarming hysteresis for all channel configurations is 1/64 of Full Scale. When a channel exceeds an alarm setpoint, it must fall back the setpoint less the hysteresis before it can go out of alarm.

For example, for a channel configuration with a 0 to 10 mil full scale and an alarm setpoint of 6 mils, the hysteresis = 10 mils/64 = 0.16 mils. The channel input, therefore, must fall below 6 mils – 0.16 mils (5.84 mils) before the channel is out of alarm.

23. Velocity II Configuration

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23.1 Introduction

This section discusses the Configuration Considerations and the Rack Configuration Software screens associated with the Velocity II Channel Type.

23.2 Configuration Considerations

Consider the following items before configuring a Velocity II Channel Type:

- When "No Keyphasor" is selected, the 1X Amplitude (Ampl) and Phase Lag, 2X Amplitude (Ampl) and Phase Lag cannot be selected.
- If a Keyphasor channel is selected, a Keyphasor Module must be installed in the rack.
- The 1X and 2X Phase values can be enabled only if the selected Keyphasor channel is configured for an events per revolution equal to 1 will.
- The full-scale options allowed for each proportional value is dependent upon the transducer type.
- Seismoprobes are not supported with Prox/Velom I/O modules.
- The Prox/Seismic I/O modules do not support the High Temperature Velomitor.
- Monitors must be configured in channel pairs (for example, Channels 1 and 2 may be configured as Velocity and Channels 3 and 4 may be configured as Thrust Position). Additionally, the same family of transducers must be selected for both channels in a channel pair; both channels must be either Velomitors or seismic transducers and not one of each.
- When Dual Path operation is selected, transducer 1 is used for channels 1 & 2 and transducer 3 is used for channels 3 & 4.
- When using Dual Path both channels must be configured for the same transducer type.
- When integration is selected, the available Full-Scale ranges will change to integrated units.
- When RMS is selected, the available Full-Scale ranges will change to RMS units.
- When a full-scale is modified, readjust the setpoints associated with the proportional value.
- When band-pass filtering is selected, the high-pass and low-pass filters must be a minimum of a 5.7 times apart.
- The 100ms danger alarm is only available for the Velomitor, High Temperature Velomitor and Velomitor CT options.
- The Latching OK Mode and the Timed OK Channel Defeat options are not compatible.
- If a Non-Standard transducer is selected, the setpoint OK limits are set to ±1 volt from the upper and lower OK limits that are selected.

- The maximum frequency support varies based on transducer type and measurement units. For all transducers but Velomitor CT the maximum is 3 to 5500 Hz. For Velomitor CT the range is 2 to 5500 HZ. If RMS is selected the maximum frequency support changes to 10 to 5500 Hz.

Application Alert

For machine protection parameters measured with Velocity or Velomitor® sensors or with Acceleration sensors a sudden mechanical impact can over-range the sensor output. If the monitor is configured with Timed OK Channel Defeat enabled and the over-range signal exceeds the OK Limits the monitor may not annunciate an alarm. This may result in a missed alarm and temporary loss of machine protection.

Timed OK Channel Defeat can be disabled on velocity and acceleration channel types.

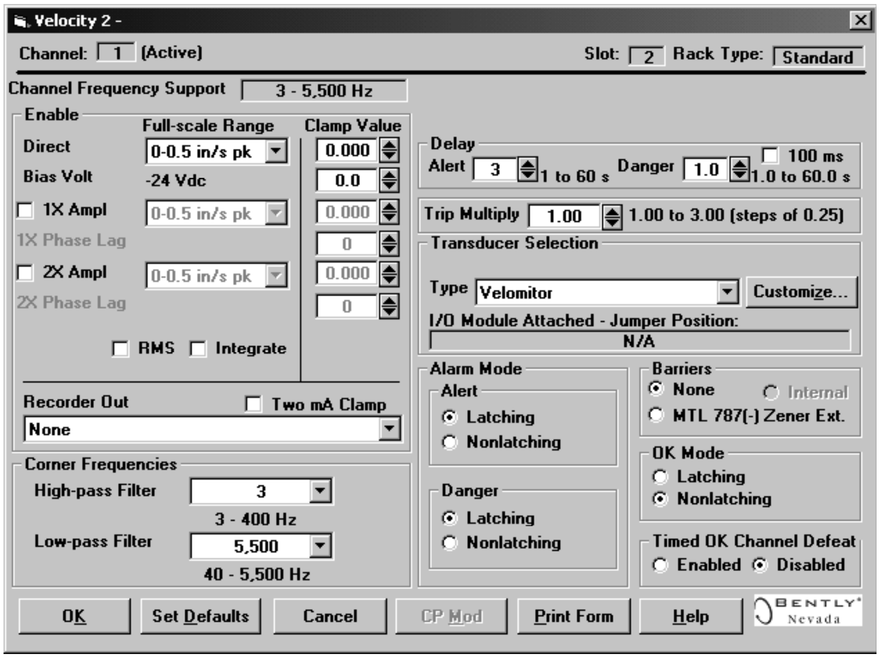
Caution

On Reciprocating Compressors mechanical impacts will occur.

DISABLE Timed OK Channel Defeat when monitoring crankcase or crosshead vibration using either Velocity, Velomitor®, or Acceleration sensors.

23.3 Configuration Options

This section describes the options available on the Velocity II Channel Type configuration screen.



23.3.1 General Parameters and Buttons

Channel Frequency Support: Supported frequency range of the selected transducer which depends upon whether RMS is selected. See "Configuration Considerations" on page 23-2.

CP Mod: Selecting the CP Mod button in the Channel Options Dialog Box, allows a Custom channel configuration to be downloaded to the monitor. Custom configuration data is stored in a Custom Products Modification File. Custom Products Modification files follow the naming convention <modification #.mod>. These files must be located in the \3500\Rackcfg\Mods\ directory. When a CP Mod file is selected, a window is displayed which describes the function of the modification. CP Mod files are available through Bently Nevada's Custom Products Division. Contact your local Bently Nevada Sales Representative for details.

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. Refer to “Setting the I/O Jumper” in the "I/O Module Descriptions" section of the manual, if applicable.

23.3.2 Reference Information

These fields contain information that indicates which module you are configuring.

Channel: The number of the channel being configured (1 through 4).

Slot: The location of the monitor in the 3500 rack (2 through 15).

Rack Type: Identifies the type of Rack Interface Module installed in the rack (Standard or TMR).

23.3.3 Enable

Direct: Direct is data that represents the overall peak measurement of the rate of change of the displacement. When Integration is selected it yields a peak-to-peak measurement of the displacement. The signal will be changed if filtering is selected (High-pass, Low-pass or High-pass and Low-pass selected).

Bias Voltage: The DC voltage used by the system as a bias for the transducer. Can be used as a diagnostic tool for evaluating system integrity. Bias voltage is not available when configured for a Velomitor and any I/O other than the Prox/Seismic I/Os.

Application Advisory
This measurement contains no information about the condition of the machinery being monitored. It has been provided only for monitoring system diagnostics.

1X Ampl: In a complex vibration signal, 1X ampl is the notation for the amplitude component that occurs at the rotative speed frequency.

1X Phase Lag: In a complex vibration signal, 1X Phase Lag is the notation for the phase lag component that occurs at the rotative speed frequency.

2X Ampl: In a complex vibration signal, 2X ampl is the notation for the amplitude component having a frequency equal to two times the shaft rotative speed.

2X Phase Lag: In a complex vibration signal, 2X Phase Lag is the notation for the phase lag component having a frequency equal to two times the shaft rotative speed. 2X phase lag is the angular measurement from the leading or trailing edge of the Keyphasor pulse to the following positive peak of the 2X vibration signal.

Note
Bias Voltage, 1X Amplitude & Phase, 2X Amplitude & Phase are only available if the monitor is a 3500/42M**.**

23.3.4 Full Scale Ranges

The full scale ranges are available for all transducer types.

Peak
0-0.5 in/s pk
0-1 in/s pk
0-2 in/s pk
0-10 mm/s pk
0-20 mm/s pk
0-50 mm/s pk
Custom

Integrate: When integration is selected, all of the proportional values for the channel will be integrated. The following full-scale ranges are available:

Integrated
0-5 mil pp
0-10 mil pp
0-20 mil pp
0-100 µm pp
0-200 µm pp
0-500 µm pp
Custom

RMS: When RMS is selected, all of the proportional values for the channel will be measured as RMS. The following full-scale ranges are available:

RMS
0 – 0.5 in/s rms
0-1 in/s rms
0-2 in/s rms
0-10 mm/s rms
0-20 mm/s rms
0-50 mm/s rms
Custom

Note
When a full-scale range is modified, readjust the setpoints associated with this proportional value.

Clamp Value: The value that a proportional value goes to when that channel or proportional value is bypassed or defeated (for example a problem with the monitor). The selected value can be between the minimum and maximum full-scale range values. Only the values available from the Recorder Outputs, Communication Gateway and Display Interface Module are clamped to the specified value when the proportional value is invalid.

Recorder Output: The proportional value of a channel that is sent to the 4 to 20 mA recorder. The recorder output is proportional to the measured value over the channel full-scale range. An increase in the proportional value that would be indicated as upscale on a bar graph display results in an increase in the current at the recorder output. If the channel is bypassed, the output will be clamped to the selected clamp value or to 2 mA (if the 2 mA clamp is selected).

If 1X Phase Lag or 2X Phase Lag are selected then the two options available are with and without Hysteresis. If the channel is Bypassed, the output will be clamped to the selected clamp value or to 2 mA (if the 2 mA clamp is selected).

The Hysteresis option helps prevent the Recorder Output from jumping from Full to Bottom Scale when the phase measurement is near 0 or 359 degrees. When the Hysteresis option is checked, the recorder signal operates as follows:

- The recorder output is scaled such that 4 mA corresponds to 0 degrees and 20 mA corresponds to 380 degrees (360 plus 20 degrees).
- The transition of a phase measurement that is increasing does not occur until the measurement has gone 20 degrees past 360 degrees. At this point, the

recorder signal switches from 20 mA to a signal that corresponds to 20 degrees or 4.842 mA.

- The transition of a phase measurement that is decreasing occurs at 0 degrees (4 mA). At this point, the recorder signal switches from 4 mA to a signal that corresponds to 360 degrees or 19.158 mA.

23.3.5 Corner Frequencies

The direct value is filtered and the corner of the filter can be adjusted. If no filtering is selected the monitor will impose filtering at its frequency response limits. The filter options do not effect the Bias Voltage, 1X or 2X measurements.

High-pass Filter: A four-pole filter that must be at least a factor of 5.7 times away from the Low-pass Filter.

HPF = High-pass Filter; LPF = Low-pass Filter

HPF ≤ (LPF / 5.7)

Low-pass Filter: A four-pole filter that must be at least a factor of 5.7 times away from the High-pass Filter.

HPF = High-pass Filter; LPF = Low-pass Filter

LPF ≥ (HPF * 5.7)

23.3.6 Delay

The time which a proportional value must remain at or above an alarm level or outside an acceptance region before an alarm is declared as active.

Alert: First level alarm that occurs when the transducer signal level exceeds the selected value. The Alert time delay is always set at one second intervals for all available proportional values.

Danger: Second level alarm that occurs when the transducer signal level exceeds the selected value.

100 ms option: The 100 ms (typical) option applies to the Danger time delay only and has the following results:

Note
The 100ms danger alarm is only available for the Velomitor, High Temperature Velomitor and Velomitor CT options.

If the 100 ms option is off (☐):

- The Danger time delay can be set at one second intervals.
- The Danger time delay can be set for all available proportional values.

If the 100 ms option is on (☑):

- The Danger time delay is set to 100 ms.
- The Danger time delay can only be set for the primary proportional value.

23.3.7 Trip Multiply

The value selected to temporarily increase the alarm (Alert and Danger) setpoint values. This value is normally applied by manual (operator) action during startup to allow a machine to pass through high vibration speed ranges without monitor alarm indications. Such high vibration speed ranges may include system resonances and other normal transient vibrations.

The increase for the setpoints is handled by defining a multiplier to apply while the rack is in trip multiply mode. The multiplier can be set from 1 to 3 times in steps of 0.25x.

23.3.8 Transducer Selection

Type: The following transducer types are available for the Velocity II Channel (non-barrier I/O module):

- 9200 2-wire Seismoprobe (Prox/Seis I/O only)
- 47633 2-wire Seismoprobe (Prox/Seis I/O only)
- 86205 2-wire Seismoprobe (Prox/Seis I/O only)
- Nonstandard 2-wire Seismoprobe (Prox/Seis I/O only)
- Velomitor
- High Temperature Velomitor (Prox/Velom I/O only)
- Velomitor CT
- Nonstandard

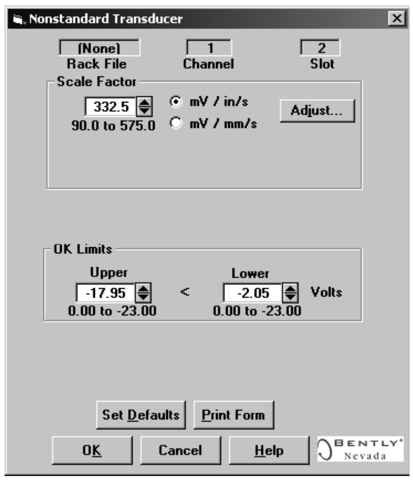
The following transducer types are available for the Velocity II Channel (barrier I/O module):

- Velomitor
- High Temperature Velomitor
- Velomitor CT
- Nonstandard

Note
If a Non-Standard transducer is selected, the setpoint OK limits are set to ±1 volt from the Upper and Lower OK limits that are selected.

Customize button: Used to adjust the Scale Factor for transducers. Refer to "Adjusting the Scale Factor and Zero Position" in the "Monitor Verification" section of the manual. Also, note that:

- If Non-standard is selected as the transducer type, the OK Limits can also be adjusted.
- The Non-standard transducer's scale factor must be between 90 and 575 mV/in/s.
- There must be at least 2 volts between the Upper and Lower OK Limits.



Scale Factor by Transducer Type

Transducer	Without Barriers	With BN Internal Barriers	With Barriers
9200	500 mV/(in/s)	*	500 mV/(in/s)
47633	490 mV/(in/s)	*	490 mV/(in/s)
86205	477 mV/(in/s)	*	477 mV/(in/s)
Nonstandard 2 wire	145 mV/(in/s)	*	145 mV/(in/s)
Velomitor	100 mV/(in/s)	100 mV/(in/s)	100 mV/(in/s)
High Temperature Velomitor	145 mV/(in/s)	145 mV/(in/s)	145 mV/(in/s)
Velomitor CT	100 mV/(in/s)	100 mV/(in/s)	100 mV/(in/s)

Note: ±15 % scale factor adjustment allowed.

* Barriers are not supported with this transducer option.

OK Limits by Transducer Type

Transducer	Upper		Lower		Bias Voltage	
	Without Barriers (V)	With Barriers (V)	Without Barriers (V)	With Barriers (V)	Without Barriers (V)	With Barriers (V)
9200	-17.95	-17.95	-2.05	-2.05	-10	-10
47633	-17.95	-17.95	-2.05	-2.05	-10	-10
86205	-17.95	-17.95	-2.05	-2.05	-10	-10
NonStandard	-17.95	-17.95	-2.05	-2.05	-10	-10
Velomitor	-19.85	-17.95 -19.85 †	-4.15	-2.05 -4.15 †	-12	-10 -12†
High Temperature Velomitor	-21.26	-21.26	-2.74	-2.74	-12	-12
Velomitor CT	-19.85	-17.95 -19.85 †	-4.15	-2.05 -4.15 †	-12	-10 -12†
* Barriers are not supported with this transducer option. † BN Internal Barrier I/O Modules.						

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the Proximitor/Seismic and the Proximitor/Velomitor I/O Modules. For the function of this jumper, refer to I/O Module Description section of the hardware manual.

Take Input From Channel A (1 or 3) Transducer: The Channel B (2 or 4) Velocity channel options screen has an extra control that appears just above the transducer type list box (see figure below). It is the Take Input from Channel *A* Transducer checkbox. When checked (☒), the channel pair uses Dual Path Input. That is, input from the first channel (1 or 3) is used for both channels in the pair. The transducer input, barrier, OK Mode, and Timed OK Channel Defeat input from channel A will be copied to the second channel (2 or 4) in the channel pair.

23.3.9 Alarm Mode

Alert is the first level alarm that occurs when the transducer signal level exceeds the selected value. Danger is the second level alarm that occurs when the transducer signal level exceeds the selected value. The Alert and Danger values are set on the Setpoint screen.

Latching: Once an alarm is active it will remain active even after the proportional value is no longer in alarm. The alarm state will continue until the channel is reset using one of the following methods:

- the reset switch on the front of the Rack Interface Module

- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: When an alarm is active, it will go inactive as soon as the proportional value is no longer in alarm.

23.3.10 Barriers

For Seismic probes, select the MTL 764(-) Zener External option if external safety barriers are connected between the monitor and the transducer. For Velomitors, select the MTL 787(-) Zener External option if external safety barriers are being used. If using an Internal Barrier I/O Module for Velomitor, select the internal option. These devices are used to restrict the amount of energy that can flow into a hazardous area.

23.3.11 OK Mode

Latching: If a channel is configured for Latching OK, once the channel has gone not OK, the status stays not OK until a reset is issued using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: If a channel is configured for Nonlatching OK, the OK status of that channel will track the defined OK status of the transducer.

Note
The Latching OK Mode and the Timed OK Channel Defeat options are not compatible.

23.3.12 Timed OK Channel Defeat

An option that prevents a channel from returning to an OK status until that channel's transducer has remained in an OK state for the specified period of time. If the option is enabled, the time is set to 30 seconds. This option prevents false trips caused by intermittent transducers.

Application Alert

For machine protection parameters measured with Velocity or Velomitor® sensors or with Acceleration sensors a sudden mechanical impact can over-range the sensor output. If the monitor is configured with Timed OK Channel Defeat enabled and the over-range signal exceeds the OK Limits the monitor may not annunciate an alarm. This may result in a missed alarm and temporary loss of machine protection.

Timed OK Channel Defeat can be disabled on velocity and acceleration channel types.

Caution

On Reciprocating Compressors mechanical impacts will occur.

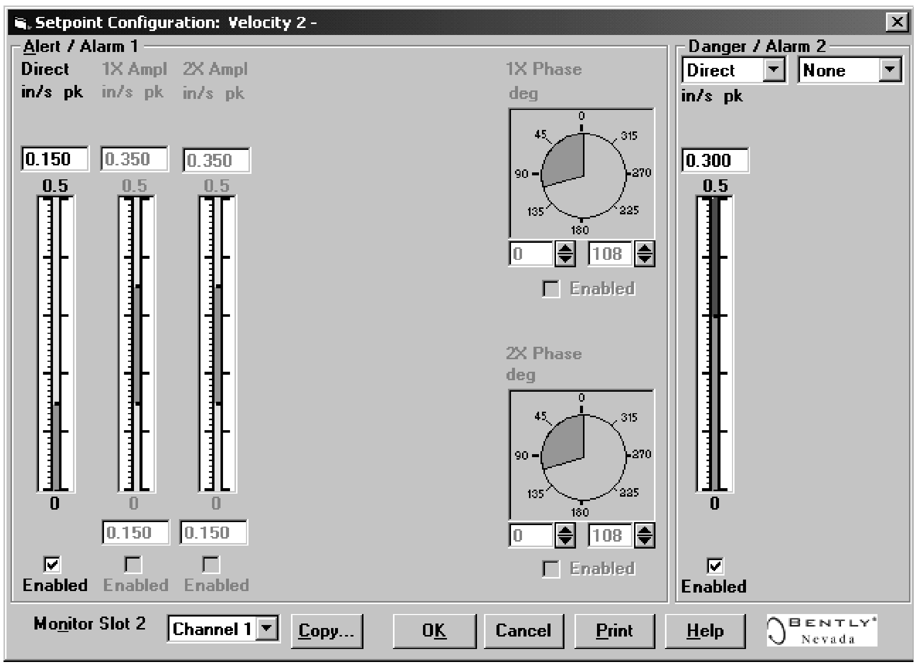
DISABLE Timed OK Channel Defeat when monitoring crankcase or crosshead vibration using either Velocity, Velomitor®, or Acceleration sensors.

23.4 Alarm Setpoints

This section specifies the available setpoints for each type of channel. A setpoint is the level within the full-scale range that determines when an alarm occurs. The 3500 Monitoring System allows Alert/Alarm 1 setpoints to be set for every proportional value on each channel. The channel will drive an Alert/Alarm 1 indication if one or more of the channel proportional values exceeds its setpoints. The 3500 Monitoring System also allows up to four Danger/Alarm 2 setpoints (two over setpoints and two under setpoints) to be set for up to two of the proportional values. You may select any two of the available proportional values for the channel.

Note
The setpoint over and under limits can only be placed within the OK limits of the specified transducer.

Use the following screen in the Rack Configuration Software to adjust Alert/Alarm 1 and Danger/Alarm 2 setpoints. This screen will vary depending upon the type of channel.



23.4.1 Available Setpoints

The following tables list the Alert/Alarm 1 and Danger/Alarm 2 setpoints available for the Velocity II channel type. The setpoint number is used in the Communication Gateway and Display Interface Modules.

Setpoint Number	Velocity II
1	Over Direct
2	Over 1X Ampl
3	Under 1X Ampl
4	Over 1X Phase Lag
5	Under 1X Phase Lag
6	Over 2X Ampl
7	Under 2X Ampl
8	Over 2X Phase Lag
9	Under 2X Phase Lag
10	Reserved
11	Danger (configurable)
12	Danger (configurable)
13	Danger (configurable)
14	Danger (configurable)

Application Advisory
The standard velocity channel type has only two setpoints and setpoint number 2 was the danger setpoint the equivalent setpoint is now number 11.

23.4.2 Alarm Hysteresis

The alarming hysteresis for all channel configurations is 1/64 of Full Scale. When a channel exceeds an alarm setpoint, it must fall back below the setpoint less the hysteresis before it can go out of alarm.

For example, for a channel configuration with a 0 to 10 mil full scale and an alarm setpoint of 6 mils, the hysteresis = 10 mils/64 = 0.16 mils. The channel input, therefore, must fall below 6 mils – 0.16 mils (5.84 mils) before the channel is out of alarm.

23.5 Proportional Value Numbers

3500/42M Velocity II Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
1	2	Bias Voltage
1	3	1X Amplitude
1	4	1X Phase
1	5	2X Amplitude
1	6	2X Phase
1	7	Reserved
2	8	Direct
2	9	Bias Voltage
2	10	1X Amplitude
2	11	1X Phase
2	12	2X Amplitude
2	13	2X Phase
2	14	Reserved

24. Velocity Verification

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24.1 Introduction

The following sections will describe how to test alarms, verify channels, verify filter corner frequencies, and test OK limits for channels configured as Velocity or Velocity II. The output values and alarm setpoints are verified by varying the input signal level and observing that the correct results are reported in the Verification screen on the test computer.

The Velocity channels can be configured for the following channel values and alarms:

Channel Values	Alarms	
	Over	Under
Direct	X	
1X Amplitude and Phase	X	X
2X Amplitude and Phase	X	X

24.2 Test Equipment and Software Setup

The following test equipment and software setup can be used as the initial set up needed for all the verification procedures (Test Alarms, Verify Channels, Verify Filter Corner Frequencies, and Test OK Limits).

WARNING!

High voltage present. Contact could cause shock, burns, or death. Do not touch exposed wires or terminals.

Application Alert

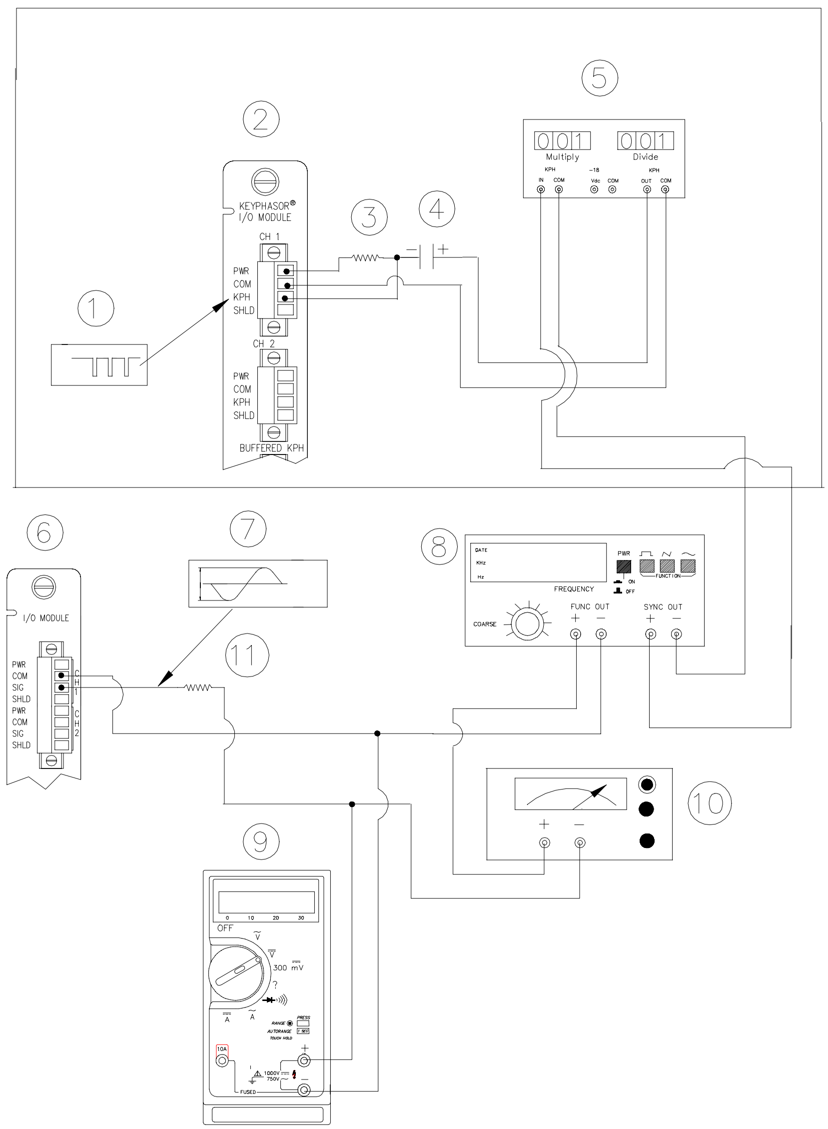
Tests will exceed alarm setpoint levels causing alarms to activate. This could result in a relay contact state change.

Application Alert

Disconnecting the field wiring will cause a not OK condition.

24.2.1 Test Equipment Setup - Seismoprobe

Simulate the transducer signal by connecting the power supply, function generator, and multimeter to COM and SIG / A of channel 1 with polarity as shown below.



Seismoprobe Test

(1) Keyphasor® Signal
(2) Keyphasor® I/O Module
(3) 40 kΩ
(4) 100 μF
(5) Keyphasor® Mulitplier/Divider
(6) Typical I/O module
(7) Simulated input signal
(8) Function generator

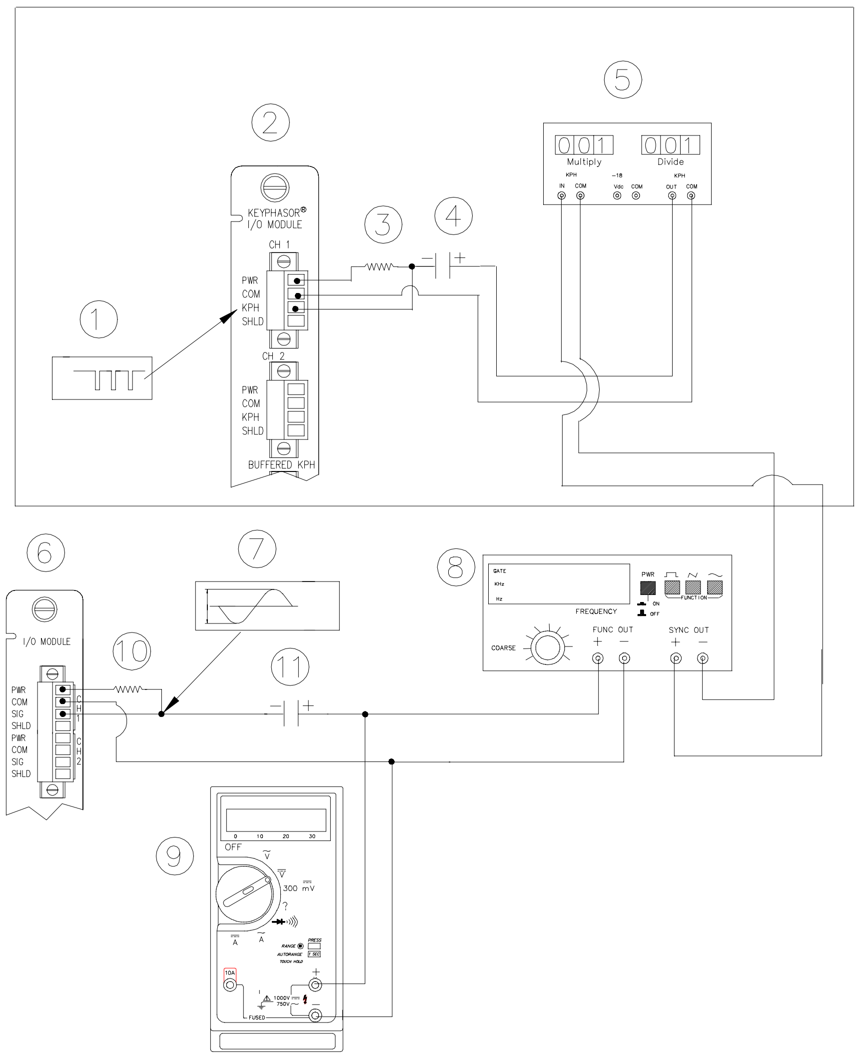
(9) Mulitmeter
(10) DC Power Supply
(11) 2.49 kΩ

Set the test equipment as specified below:

Power Supply	Keyphasor Multiplier / Divider	Function Generator
-6.50 Vdc	Multiply Switch: 001 Divide Switch: 001	Waveform: sinewave DC Volts: 0 Vdc Frequency: 100 Hz Amplitude level: Minimum (above zero)

24.2.2 Test Equipment Setup - Velomitor (Proximitor/Seismic I/O)

Simulate the transducer signal by connecting the power supply, function generator, and multimeter to COM and SIG / A of channel 1 with polarity as shown below.



Velomitor® Test Setup with Proximitor/Siesmic I/O

(1) Keyphasor® Signal
(2) Keyphasor® I/O Module
(3) 40 kΩ
(4) 100 μF
(5) Keyphasor® Mulitplier/Divider
(6) Typical I/O module
(7) Simulated input signal
(8) Function generator

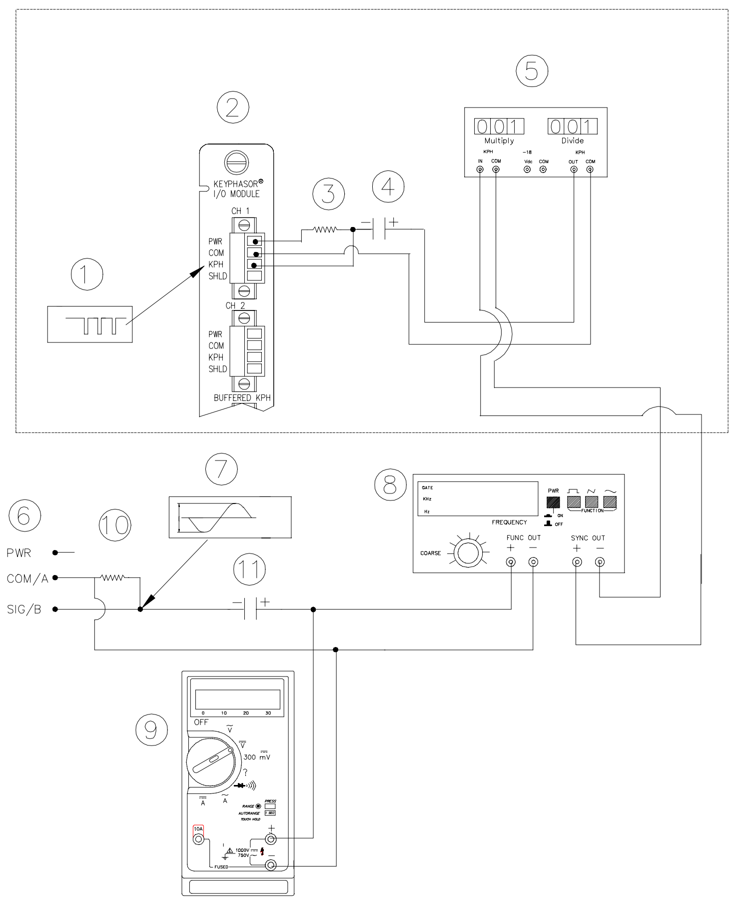
(9) Mulitmeter
(10) 4 kΩ
(11) 10μF

Set the test equipment as specified below.

Keyphasor Multiplier / Divider	Function Generator
Multiply Switch: 001 Divide Switch: 001	Waveform: sinewave DC Volts: 0 Vdc Frequency: 100 Hz Amplitude level: Minimum (above zero)

24.2.3 Test Equipment Setup - Velomitor (Prox/Velom, Internal Barrier or TMR I/O)

Simulate the transducer signal by connecting the power supply, function generator, and multimeter to COM / A and SIG / B of channel 1 with polarity as shown below.



Velomitor Test Setup With Prox/Velom, Internal Barrier or TMR I/O

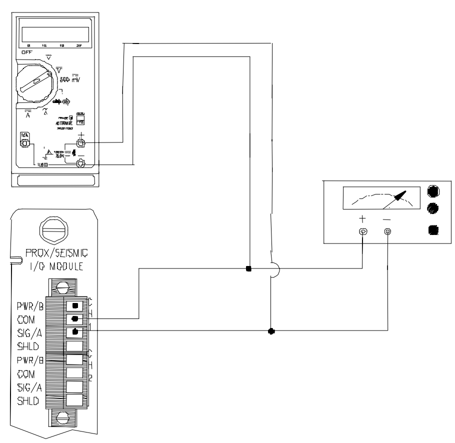
(1) Keyphasor® Signal
(2) Keyphasor® I/O Module
(3) 40 kΩ
(4) 100 µF
(5) Keyphasor® Mulitplier/Divider
(6) I/O Terminals (either External or Internal)
(7) Simulated input signal
(8) Function generator
(9) Mulitmeter
(10) 2.74 kΩ
(11) 10µF

Set the test equipment as specified below.

Keyphasor Multiplier / Divider	Function Generator
Multiply Switch: 001 Divide Switch: 001	Waveform: sinewave DC Volts: 0 Vdc Frequency: 100 Hz Amplitude level: Minimum (above zero)

The Test Equipment outputs should be floating relative to earth ground.

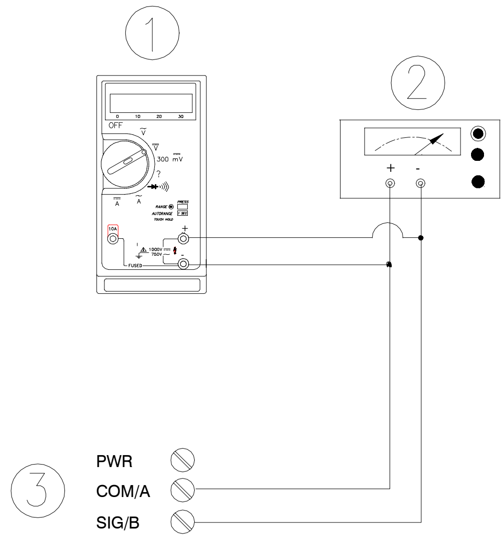
24.2.4 Test Equipment Setup – OK Limits of a Velomitor® Sensor with a Proximitor®/Siesmic I/O



Test Setup for Verifying the OK Limits of a Velomitor With Proximitor/Seismic I/O.

The Test Equipment outputs should be floating relative to earth ground.

24.2.5 Test Equipment Setup – OK Limits With a Prox/Velom, Internal Barrier or TMR I/O



Test Setup for Verifying the OK Limits of a Velomitor® with a Prox/Velom, Internal Barrier or TMR I/O

(1) Multimeter
(2) Power Supply
(3) I/O terminals (either External or Internal)

The Test Equipment outputs should be floating relative to earth ground.

24.3 Verification Screen Setup

Run the Rack Configuration Software on the test computer. Choose **Verification** from the Utilities menu and choose the proper Slot number and Channel number then click on the **Verify** button.

Note
If the Timed OK Channel Defeat is enabled, it will take 30 seconds for a channel to return to the **OK** status from **not OK**. If OK MODE is configured for latching, press the RESET button on the Rack Interface Module (RIM) to return to **OK** status.

24.4 Test Alarms

The general approach for testing alarm setpoints is to simulate the Velocity signal with a function generator and power supply. The alarm levels are tested by varying the output from the test equipment and observing that the correct results are reported in the Verification screen on the test computer. It is only necessary to test those alarm parameters that are configured and being used. The general test procedure to verify current alarm operation will include simulating a transducer input signal and varying this signal:

- to exceed over Alert/Alarm 1 and Danger/Alarm2 Setpoints, and
- to drop below any under Alert/Alarm 1 and Danger/Alarm 2 Setpoints, and
- to produce a nonalarm condition.

When varying the signal from an alarm condition to a nonalarm condition, alarm hysteresis must be considered. Adjust the signal well below the alarm setpoint for the alarm to clear.

24.4.1 Direct

1. Disconnect PWR / B, COM, and SIG / A (PWR, COM / A, and SIG / B for Proximitor/Velomitor or TMR I/O) field wiring from the channel terminals on the I/O module.
2. Connect test equipment:

   For Seismoprobe: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Seismoprobe".

   For Velomitor: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Velomitor (Proximitor/Seismic I/O)"or "Test Equipment Setup - Velomitor (Prox/Velom, Internal Barrier or TMR I/O)" for Proximitor/Velomitor and TMR I/O.
3. Calculate the verification frequency using the method in Calculating Verification Frequency. Adjust the function generator frequency to the calculated value.
4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
5. Adjust the function generator amplitude to produce a reading that is below the Direct setpoint levels on the Direct bar graph display of the Verification screen.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Direct is green, and the Current Value field contains no alarm indication.
7. Adjust the function generator amplitude such that the signal just exceeds the Direct Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from green to yellow and the Current Value Field indicates an Alarm.

8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains yellow and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal just exceeds the Direct Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from yellow to red and that the Current Value Field indicates an Alarm.
10. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains red and that the Current Value Field still indicates an Alarm.
11. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Direct changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
12. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
13. Disconnect the test equipment and reconnect the PWR / B, COM, and SIG / A (PWR, COM / A, and SIG / B for Proximitor/Velomitor or TMR I/O) field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
14. Repeat steps 1 through 13 for all configured channels.

24.4.2 1X Amplitude (1X Amp)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment:

   For Seismoprobe: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Seismoprobe".

   For Velomitor: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Velomitor (Proximitor/Seismic I/O)" or "Test

Equipment Setup - Velomitor (Prox/Velom, Internal Barrier or TMR I/O)" for Proximitor/Velomitor and TMR I/O.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
4. Adjust the function generator amplitude to produce a reading that is within the 1X Ampl setpoint levels on the 1X Ampl bar graph display of the Verification screen.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 1X Ampl is green and that the Current Value field contains no alarm indication.
6. Adjust the function generator amplitude such that the signal just exceeds the 1X Ampl Over Alert/Alarm 1 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Ampl changes color from green to yellow and the Current Value Field indicates an Alarm.
7. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Ampl remains yellow and that the Current Value Field still indicates an Alarm.
8. Adjust the function generator amplitude such that the signal just exceeds the 1X Ampl Over Danger/Alarm 2 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Ampl changes color from yellow to red and the Current Value Field indicates an Alarm.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Ampl remains red and that the Current Value Field still indicates an Alarm.
10. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Ampl changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
11. Repeat steps 3 through 11 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the function generator amplitude to exceed the Under Alarm setpoint levels.
12. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
13. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
14. Repeat steps 1 through 13 for all configured channels.

24.4.3 1X Phase

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment:

   For Seismoprobe: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Seismoprobe".

   For Velomitor: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Velomitor (Proximitor/Seismic I/O)" or "Test Equipment Setup - Velomitor (Prox/Velom, Internal Barrier or TMR I/O)" for Proximitor/Velomitor and TMR I/O.

Note
If you can not change the phase output, change the phase alarm setpoints to activate the over and under phase alarms. The setpoints must be downloaded to the monitor to take effect.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
4. Adjust the phase to produce a reading that is within the 1X Phase setpoint levels on the 1X Phase bar graph display of the Verification screen.
5. Adjust the 1X Amplitude to a minimum of 42.7 mV to get a valid 1X Phase reading.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 1X Phase is green, and the Current Value field contains no alarm indication.
7. Adjust the phase such that the reading just exceeds the 1X Phase Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Phase changes color from green to yellow and the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Phase remains yellow and that the Current Value Field still indicates an Alarm.
9. Adjust the phase such that the reading just exceeds the 1X Phase Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Phase changes color from yellow to red and that the Current Value Field indicates an Alarm.
10. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Phase remains red and that the Current Value Field still indicates an Alarm.

11. Adjust the phase such that the reading is below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Phase changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
12. Repeat steps 3 through 11 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the phase to exceed the Under Alarm setpoint levels.
13. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
14. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
15. Repeat steps 1 through 14 for all configured channels.

24.4.4 2X Amplitude (2X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment:

   For Seismoprobe: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Seismoprobe".

   For Velomitor: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Velomitor (Proximitor/Seismic I/O)" or "Test Equipment Setup - Velomitor (Prox/Velom, Internal Barrier or TMR I/O)" for Proximitor/Velomitor and TMR I/O.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two.
4. Adjust the function generator amplitude to produce a reading that is within the 2X Ampl setpoint levels on the 2X Ampl bar graph display of the Verification screen.

5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 2X Ampl is green, and the Current Value field has no alarm indication.
6. Adjust the function generator amplitude such that the signal just exceeds the 2X Ampl Over Alert/Alarm 1 setpoint level. Wait 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 2X Ampl changes color from green to yellow and that the Current Value Field indicates an Alarm.
7. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Ampl remains yellow and that the Current Value Field still indicates an Alarm.
8. Adjust the function generator amplitude such that the signal just exceeds the 2X Ampl Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 2X Ampl changes color from yellow to red and that the Current Value Field indicates an Alarm.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Ampl remains red and that the Current Value Field still indicates an Alarm.
10. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 2X Ampl changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
11. Repeat steps 3 through 10 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the function generator amplitude to exceed the Under Alarm setpoint levels.
12. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
13. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
14. Repeat steps 1 through 13 for all configured channels.

24.4.5 2X Phase

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment:

   For Seismoprobe: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Seismoprobe".

   For Velomitor: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in

"Test Equipment Setup - Velomitor (Proximitor/Seismic I/O)" or "Test Equipment Setup - Velomitor (Prox/Velom, Internal Barrier or TMR I/O)" for Proximitor/Velomitor and TMR I/O.

Note
If you can not change the phase output, change the phase alarm setpoints to activate the over and under phase alarms. The setpoints must be downloaded to the monitor to take effect.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two.
4. Adjust the phase to produce a reading that is within the 2X Phase setpoint levels on the 2X Phase bar graph display of the Verification screen.
5. Adjust the 2X Amplitude to a minimum of 42.7 mV to get a valid 2X Phase reading.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 2X Phase is green, and the Current Value field has no alarm indication.
7. Adjust the phase such that the reading just exceeds the 2X Phase Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay and verify that the bar graph indicator for 2X Phase changes color from green to yellow and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Phase remains yellow and that the Current Value Field still indicates an Alarm.
9. Adjust the phase such that the reading just exceeds the 2X Phase Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 2X Phase changes color from yellow to red and that the Current Value Field indicates an Alarm.
10. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Phase remains red and that the Current Value Field still indicates an Alarm.
11. Adjust the phase such that the reading is below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 2X Phase changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
12. Repeat steps 3 through 11 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the phase to exceed the Under Alarm setpoint levels.
13. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.

14. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
15. Repeat steps 1 through 14 for all configured channels.

24.5 Verify Channel Values

The general approach for testing these parameters is to simulate the velocity signal with a function generator and power supply. The channel values are verified by varying the output from the test equipment and observing that the correct results are reported in the Verification screen on the test computer.

Note
These parameters have an accuracy specification of ±1 % of full-scale.

24.5.1 Direct

1. Disconnect PWR / B, COM, and SIG / A (PWR, COM / A, and SIG / B for Proximitor/Velomitor or TMR I/O) field wiring from the channel terminals on the I/O module.
2. Connect test equipment:

   For Seismoprobe: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Seismoprobe".

   For Velomitor: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Velomitor (Proximitor/Seismic I/O)" or "Test Equipment Setup - Velomitor (Prox/Velom, Internal Barrier or TMR I/O)" for Proximitor/Velomitor and TMR I/O.
3. Calculate the verification frequency using the formulas in Verify Filter Corner Frequencies. Adjust the function generator frequency to the calculated value.
4. Calculate the full-scale voltage using the procedure in Calculating the Input Voltage for Full Scale. Adjust the function generator (sinewave) amplitude to the calculated value.
5. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Verify that the 1X Ampl bar graph display and Current Value Box is reading ±1 % of full scale.
6. Verify that the Direct bar graph display and the Current Value Box is reading ±1 % of full-scale.

7. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
8. Disconnect the test equipment and reconnect the PWR / B, COM, and SIG / A (PWR, COM / A, and SIG / B for Proximitor/Velomitor or TMR I/O) field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
9. Repeat steps 1 through 8 for all configured channels.

24.5.2 1X Amplitude (1X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment:

   For Seismoprobe: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Seismoprobe".

   For Velomitor: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Velomitor (Proximitor/Seismic I/O)" or "Test Equipment Setup - Velomitor (Prox/Velom, Internal Barrier or TMR I/O)" for Proximitor/Velomitor and TMR I/O.
3. Calculate the full-scale voltage using the formulas in Calculating the Input Voltage for Full-scale. Adjust the function generator (sine wave) amplitude to the calculated value.
4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Verify that the 1X Ampl bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.

7. Repeat steps 1 through 6 for all configured channels.

24.5.3 1X Phase

If the test equipment is not capable of changing the phase output to a known value, use the following procedure. If your test equipment can change the phase output to a known value, use the procedure "If the Test Equipment Can Change the Phase Output (1X Phase)".

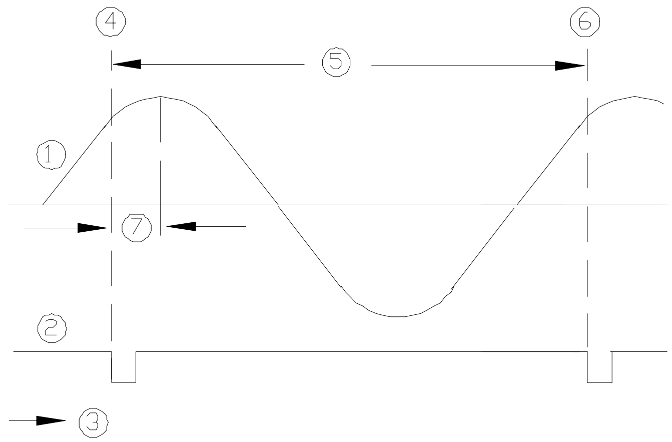
24.5.3.1 If the Test Equipment Cannot Change the Phase Ouput (1X Phase)

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment:

   For Seismoprobe: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Seismoprobe".

   For Velomitor: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Velomitor (Proximitor/Seismic I/O)" or "Test Equipment Setup - Velomitor (Prox/Velom, Internal Barrier or TMR I/O)" for Proximitor/Velomitor and TMR I/O.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
4. Attach one channel of a two channel oscilloscope to the vibration signal buffered output and attach the other channel to the associated Keyphasor® signal buffered output and observe the two signals simultaneously.
5. Measure the phase. 1X Phase will be measured from the leading edge of the Keyphasor® pulse to the first positive peak of the vibration signal. See the example below which illustrates a phase of 45°. Observe the 1X Phase bar graph display and Current Value Box; it should read approximately what was measured above. If integration is enabled then add 90 degrees to the measured value to obtain the correct reading from the monitor.

Example:
1X = one cycle of vibration signal per shaft revolution



(1) 1X Vibration Signal
(2) Keyphasor Signal
(3) Time
(4) 0°
(5) One cycle
(6) 360°
(7) Phase lag = 45°

6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

24.5.3.2 If the Test Equipment Can Change the Phase Output (1X Phase)

If the test equipment has the capability to change the phase output to a known value, use the following procedures.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment:

   For Seismoprobe: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Seismoprobe".

   For Velomitor: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Velomitor (Proximitor/Seismic I/O)" or "Test Equipment Setup - Velomitor (Prox/Velom, Internal Barrier or TMR I/O)" for Proximitor/Velomitor and TMR I/O.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
4. Adjust the phase for mid-scale. Verify that the 1X Phase bar graph display and Current Value Box is reading ±1.5 % of mid-scale.
5. If the reading does not meet specifications double check the input signal to ensure it is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

24.5.4 2X Amplitude (2X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment:

   For Seismoprobe: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Seismoprobe".

   For Velomitor: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Velomitor (Proximitor/Seismic I/O)" or "Test Equipment Setup - Velomitor (Prox/Velom, Internal Barrier or TMR I/O)" for Proximitor/Velomitor and TMR I/O.
3. Calculate the full-scale voltage using the formulas in Calculating the Input Voltage for Full-scale. Adjust the function generator (sine wave) amplitude to the calculated value.
4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two. Verify that the 2X Ampl bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.

6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

24.5.5 2X Phase

If the test equipment is not capable of changing the phase output to a known value, use the following procedure. If your test equipment can change the phase output to a known value, use the procedure "If the Test Equipment can Change the Phase Output (2X Phase)".

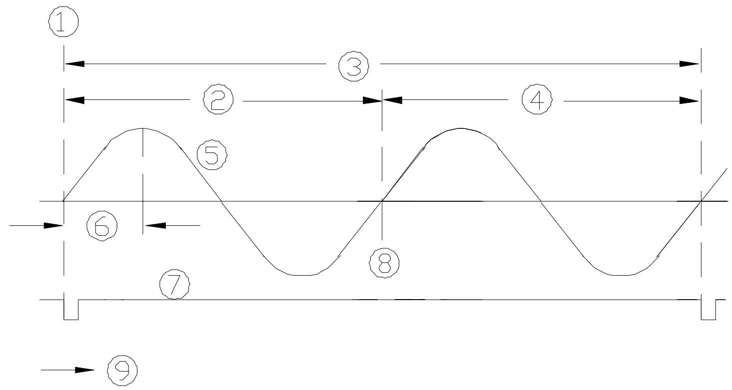
24.5.5.1 If the Test Equipment Cannot Change the Phase Output (2X Phase)

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment:

   For Seismoprobe: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Seismoprobe".

   For Velomitor: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Velomitor (Proximitor/Seismic I/O)" or "Test Equipment Setup - Velomitor (Prox/Velom, Internal Barrier or TMR I/O)" for Proximitor/Velomitor and TMR I/O.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two.
4. Attach one channel of the two channel oscilloscope to the vibration signal buffered output and attach the other channel to the associated Keyphasor® signal buffered output and observe the two signals simultaneously.
5. Measure the phase. 2X Phase will be measured from the leading edge of the Keyphasor® pulse to the first positive peak of the vibration signal. See the example below which illustrates a phase of 90°. Observe the 2X Phase bar graph display and Current Value Box; it should read approximately what was measured above. If integration is enabled then add 90 degrees to the measured value to obtain the correct reading from the monitor.

Example:
2X = two cycles of vibration signal per shaft revolution



(1) 0°
(2) First Cycle
(3) One shaft revolution
(4) Second cycle
(5) 2X Vibration Signal
(6) Phase lag = 90°
(7) Keyphasor® signal
(8) 360°
(9) Time

6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 5 for all configured channels.

24.5.5.2 If the Test Equipment can Change the Phase Output (2X Phase)

If the test equipment has the capability to change the phase output to a known value, use the following procedure.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment:

   For Seismoprobe: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Seismoprobe".

   For Velomitor: Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2. Use the setup shown in "Test Equipment Setup - Velomitor (Proximitor/Seismic I/O)" or "Test Equipment Setup - Velomitor (Prox/Velom, Internal Barrier or TMR I/O)" for Proximitor/Velomitor and TMR I/O.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two.
4. Adjust the phase for mid-scale. Verify that the 2X Phase bar graph display and Current Value Box is reading ±1.5 % of mid-scale.
5. If the reading does not meet specifications, double check the input signal to ensure it is correct. If the monitor still does not meet specifications and/or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

24.6 Verify Filter Corner Frequencies

The general approach for testing these parameters is to simulate the Velocity signal with a function generator and power supply. The corner frequencies are verified by varying the output from the test equipment and observing that the correct results are reported in the Verification screen on the test computer.

Note
If the channel units are integrated, change the channel configuration to a non-integrated scale for this test. When the test is complete, return the channel to its original configuration.

1. Disconnect PWR / B, COM, and SIG / A (PWR, COM / A, and SIG / B for Proximitor/Velomitor or TMR I/O) field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2.
3. Calculate the verification frequency using the formulas in "Calculating Verification Frequency" on page 24-25. Adjust the function generator frequency to the calculated value.
4. Calculate the full-scale voltage using the procedure in "Calculating the Input Voltage for Full-scale" on page 24-25. Adjust the function generator (sinewave) amplitude to the calculated value.
5. Verify that the Direct bar graph display and the Current Value Box is reading full-scale.
6. Adjust the function generator frequency to the low-pass filter corner frequency. Verify that the Direct bar graph display and the Current Value Box is reading between 65 % and 75 % of full-scale.

7. Adjust the function generator frequency to the high-pass filter corner frequency. Verify that the Direct bar graph display and the Current Value Box is reading between 65 % and 75 % of full-scale.
8. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
9. Disconnect the test equipment and reconnect the PWR / B, COM, and SIG / A (PWR, COM / A, and SIG / B for Proximitor/Velomitor or TMR I/O) field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
10. Repeat steps 1 through 9 for all configured channels.

24.6.1 Calculating Verification Frequency

The procedures for verifying channel values and corner frequencies require that you use the following formulas to calculate the verification frequency:

Find the geometric center of the Band-pass frequency range. Input the configured High-pass Filter Corner Frequency and the Low-pass Filter Corner Frequency into the formula below:

$$\text{Verification Frequency} = \sqrt{\text{HPF} * \text{LPF}}$$

HPF = High-pass Filter Corner Frequency

LPF = Low-pass Filter Corner Frequency

- If no filtering is configured, use a verification frequency of 100 Hz.
- If a Low-pass Filter is configured and no High-pass Filter is configured, use the following to determine the HPF to use in the formula:
- If the units are RMS, use a HPF of 10 Hz. For any other configuration, use a HPF of 3 Hz.
- If a High-pass Filter is configured and no Low-pass Filter is configured, use a LPF of 5,500 Hz.

24.6.2 Calculating the Input Voltage for Full-scale

The procedures for verifying channel values and corner frequencies require that you use the following formulas to calculate the input voltage for Full-scale. To find the Full-scale input voltage, use appropriate table or formula for integrated or non-integrated units.

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification screen.

Full Scale Formulas - No Integration

Units	To Input RMS Volts	To Input Peak to Peak Volts
in/s pk	(T.S.F x Full-scale) x 0.707	(T.S.F x Full-scale) x 2
mm/s pk	(T.S.F x Full-scale) x 0.707	(T.S.F x Full-scale) x 2
in/s rms	(T.S.F x Full-scale)	(T.S.F x Full-scale) x 2.82
mm/s rms	(T.S.F x Full-scale)	(T.S.F x Full-scale) x 2.82
To use the formulas, the T.S.F. should be in volts and the T.S.F and full-scale values should both be of the same unit system (metric or English). The transducer Scale Factor will always be specified as volts per inch/second pk or volts per millimetre/second pk.		

Example 1:
Transducer Scale Factor = 500 mV/(in/s)
Full Scale = 0.5 in/s pk

For Peak to Peak input:
$(0.500 \times 0.5) \times 2$ = 0.5 Vpp

For Vrms input:
$(0.500 \times 0.5) \times 0.707$ = 0.1767 Vrms

Example 2:
Transducer Scale Factor = 19.69 mV/(mm/s)
Full Scale = 20 mm/s pk

For Peak to Peak input:
$(0.01969 \times 20) \times 2$ = 0.7876 Vpp

For RMS input:
$(0.01969 \times 20) \times 0.707$ = 0.2784 Vrms

24.6.3 Full Scale Formulas - Integration

(For the following units: mil pp and µm pp)

$$\text{Input Voltage (V rms)} = \frac{\text{Full - Scale (English units)}}{\left[\left(\dfrac{31.831}{\text{Scale Factor (English units)}}\right) / \text{Verification Frequency}\right]} * 0.07071$$

$$\text{Input Voltage (V pp)} = \frac{\text{Full - Scale (English units)}}{\left[\left(\dfrac{31.831}{\text{Scale Factor (English units)}}\right) / \text{Verification Frequency}\right]} * 0.2$$

To use the formulas, the Velocity Scale Factor should be in volts, and the Full-scale value and Velocity Scale Factor should be in English units. Use the following conversion formulas to convert Metric units to English units:

Scale Factor

$$\text{Velocity Scale Factor (inch/s)} = \text{Velocity Scale Factor (mm/s)} * 25.4$$

Full scale:

$$\text{Full - Scale (mil)} = \frac{\text{Full - Scale } (\mu\mu\ )}{25.4}$$

Example:
To calculate the input voltage for a channel with the following configuration:

Transducer Scale Factor	=	19.69 mV/(mm/s)
Full Scale	=	100 µm pp
HPF	=	3 Hz
LPF	=	3000 Hz

Convert Metric units to English units.

Scale Factor:

$$19.69\ \text{mV(mm/s)} * 25.4 = 500\ \text{mV(in/s)}$$

Full-scale:

$$\frac{100\ \mu\text{m}}{25.4} = 3.9370\ \text{mil}$$

Calculate the input voltage.

$$\text{Verification Frequency} = \sqrt{3\ \text{Hz} * 3000\ \text{Hz}} = 94.8683\ \text{Hz}$$

$$\text{Input Voltage (V rms)} = \frac{3.9370\ \text{mil}}{\left[\left(\dfrac{31.831}{0.500\ \text{V/(in/s)}}\right) / 94.8683\ \text{Hz}\right]} * 0.07071 = 0.4148\ \text{(V rms)}$$

or

$$\text{Input Voltage (V pp)} = \frac{3.9370\ \text{mil}}{\left[\left(\dfrac{31.831}{0.500\ \text{V/(in/s)}}\right) / 94.8683\ \text{Hz}\right]} * 0.2 = 1.173\ \text{(V pp)}$$

Note
The accuracy of the reading will be affected by frequency values less than 20 Hz and setting LPF 5.7 times away from the HPF.

24.7 Test OK Limits

Note
If the Danger Bypass has been activated, then the BYPASS LED will be on. All other channels in the rack must be OK or bypassed for the OK relay to be energized.

24.7.1 For Seismoprobes:

The general approach for testing OK limit is to disconnect the input. This will cause a not OK condition and the OK Relay to change state (de-energize).

1. Run the Verification Software as described in "Test Equipment and Software Setup" on page 24-2.
2. Disconnect the SIG / A field wiring from the channel terminals on the Proximitor / Seismic Monitor I/O Module.
3. Verify that the OK relay changes state (de-energized).
4. Verify that the Channel OK State line on the Verification screen reads **not OK**.
5. Reconnect the SIG / A field wiring to the channel terminals on the Monitor I/O Module. Press the RESET switch on the Rack Interface Module (RIM) and verify that the OK LED comes on and the OK relay energizes.
6. Verify that the Channel OK State line on the Verification screen reads **OK**.
7. If you can not verify any configured OK limit, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
8. Repeat steps 1 through 7 for all configured channels.

24.7.2 For Velomitors

There are two methods for testing OK limits if the transducer being used is a Velomitor. Use method 1 if either following conditions are true, otherwise use method 2:

- The I/O module is a Proximitor/Seismic; or
- The Velocity II Channel Type is selected.

24.7.2.1 Method 1

The general approach for testing OK limits is to input a DC voltage and adjust it above the Upper OK limit and below the Lower OK limit. This will cause a not OK condition and the OK Relay to change state (de-energize). The Upper and Lower OK limits are displayed in the Verification screen on the test computer.

1. Disconnect PWR / B, COM, and SIG / A field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described "Test Equipment and Software Setup" on page 24-2.
3. Bypass all other configured channels.
4. Adjust the power supply voltage to -7.00 Vdc.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the monitor OK LED is on and that the Channel OK State line in the Channel Status section of the Verification screen reads **OK**.
6. Verify that the OK relay on the Rack Interface I/O Module indicates OK (energized). See the 3500/20 Rack Interface Module Operation and Maintenance Manual, part number 129768-01.
7. Increase the power supply voltage (more negative) until the OK LED just goes off (upper limit). Verify that the Channel OK State line on the Verification screen reads **not OK** and that the OK Relay indicates not OK. Verify that the Upper OK limit voltage displayed on the Verification screen is equal to or more positive than the input voltage.
8. Decrease the power supply voltage (less negative) to -7.00 Vdc.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on and the OK relay energizes. Verify that the Channel OK State line in the Channel Status section reads **OK**.
10. Gradually decrease the power supply voltage (less negative) until the OK LED just goes off (lower limit). Verify that the Channel OK State line in the Channel Status section reads **not OK** and that the OK Relay indicates not OK. Verify that the Lower OK limit voltage displayed on the Verification screen is equal to or more negative than the input voltage.
11. Increase the power supply voltage (more negative) to -7.00 Vdc.
12. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on, the OK relay energizes, and the Channel OK State line in the Channel Status section reads **OK**.
13. If you can not verify any configured OK limit, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.

14. Disconnect the power supply and multimeter and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the Monitor I/O Module. Press the RESET switch on the Rack Interface Module (RIM) and verify that the OK LED comes on and the OK relay energizes.
15. Repeat steps 1 through 14 for all configured channels.
16. Return the bypass switch for all configured channels back to their original setting.

24.7.2.2 Method 2

Due to the requirements for increased robustness in the TMR system, the TMR I/O Module has a Velomitor interface that is different from the Prox/Seis I/O Module's Velomitor interface. The Proximitor/Velomitor I/O Module shares this feature with the TMR I/O. The effect of this difference is that the Velomitor signal input to the I/O Module is 180 degrees out of phase from the correct Velomitor signal. This inversion is compensated for in the TMR and Proximitor/Velomitor I/O Module. This means that when you input a test signal using a signal generator or DC power supply the buffered outputs on the front panel will be inverted in phase and will have a different DC voltage than the input. This will not affect the actual vibration readings in the Monitor.

The general approach for testing OK limits is to input a DC voltage and adjust it above the Upper OK limit and below the Lower OK limit. This will cause a not OK condition and the OK Relay to change state (de-energize). The Upper and Lower OK limits are displayed in the Verification screen on the test computer.

1. Disconnect PWR, COM / A, and SIG / B field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 24-2.
3. Bypass all other configured channels.
4. Adjust the power supply voltage to -7.00 Vdc.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the monitor OK LED is on and that the Channel OK State line in the Channel Status section of the Verification screen reads **OK**.
6. Verify that the OK relay on the Rack Interface I/O Module indicates OK (energized). See the 3500/20 Rack Interface Module Operation and Maintenance Manual, part number 129768-01.
7. Increase the power supply voltage (more negative) until the OK LED just goes off (lower limit due to the inversion on the I/O Module). Verify that the Channel OK State line on the Verification screen reads **not OK** and that the OK Relay indicates not OK. Verify that the Lower OK limit voltage displayed on the Verification screen is equal to or more negative than the following value.

   For the TMR I/O Module:

   Lower OK limit voltage ≤ -20.84 - Vinput

   For the Proximitor/Velomitor I/O Module:

   Lower OK limit voltage ≤ -23.16 - Vinput

8. Decrease the power supply voltage (less negative) to -7.00 Vdc.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on and the OK relay energizes. Verify that the Channel OK State line in the Channel Status section reads **OK**.
10. Gradually decrease the power supply voltage (less negative) until the OK LED just goes off (upper limit due to the inversion on the I/O Card). Verify that the Channel OK State line in the Channel Status section reads **not OK** and that the OK Relay indicates not OK. Verify that the Upper OK limit voltage displayed on the Verification screen is equal to or more positive than the following value.

    For the TMR I/O Module:

    Upper OK limit voltage ≥ -22.02 - Vinput

    For the Proximitor/Velomitor I/O Module:

    Upper OK limit voltage ≥ -24.33 - Vinput

11. Increase the power supply voltage (more negative) to -7.00 Vdc.
12. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on, the OK relay energizes, and the Channel OK State line in the Channel Status section reads **OK**.
13. If you can not verify any configured OK limit, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
14. Disconnect the power supply and multimeter and reconnect the PWR, COM / A, and SIG / B field wiring to the channel terminals on the Monitor I/O Module. Press the RESET switch on the Rack Interface Module (RIM) and verify that the OK LED comes on and the OK relay energizes.
15. Repeat steps 1 through 14 for all configured channels.
16. Return the bypass switch for all configured channels back to their original setting.

Velocity Default OK Limits Table

Transducer	Lower Ok Limit (Volts)	Upper Ok Limit (Volts)
9200 w/ &w/o barriers	-2.0 to -2.1	-17.9 to -18.0
86205 w/ & w/o barriers	-2.0 to -2.1	-17.9 to -18.0
47633 w/ & w/o barriers	-2.0 to -2.1	-17.9 to -18.0
non std w/ &w/o barriers	-2.0 to -2.1	-17.9 to -18.0
Velomitor (standard with Internal Barrier, Prox/Seis, or Prox/Velom I/O Module)	-4.1 to -4.2	-19.8 to -19.9
Velomitor (high temp with Internal Barrier, Prox/Seis, or Prox/Velom I/O Module)	-2.69 to -2.79	-21.21 to -21.31
Velomitor (standard with TMR I/O Module)	-4.1 to -4.2	-19.8 to -19.9
Velomitor (high temp with TMR I/O Module)	-4.1 to -4.2	-19.8 to -19.9
Note: Assume ±50 mV accuracy for check tolerance.		

25. Acceleration General Information

Acceleration measurements are generally made with an Accelerometer and are typically used to evaluate high frequency vibration of a machine casing or bearing housing due to blade passing, gear mesh, cavitation, rolling element bearing defects, etc.. For harmonic motion, acceleration is often expressed as g or a. Typical units for acceleration are feet per second per second (ft/s^2) pk, meters per second per second (m/s^2) pk, or more commonly g pk (= acceleration of gravity = 386.1 in/s^2 = 32.17 ft/s^2 = 9.81 m/s^2).

Note
Acceleration, as well as velocity, are zero to peak measurements (Notation = pk).

In a 3500 Monitoring System, Acceleration channels are programmed in pairs. These channels, depending on configuration, typically condition the input signals into various parameters called “proportional values”. Alert setpoints can be configured for each active proportional value and Danger setpoints can be configured for any two of the active proportional values.

Application Advisory
If housing measurements are being made for overall protection of the machine, thought should be given to the usefulness of the measurement for each application. Most common machine malfunctions (imbalance, misalignment, etc.) originate at the rotor and cause an increase (or at least a change) in rotor vibration. In order for any housing measurement alone to be effective for overall machine protection, a significant amount of rotor vibration must be faithfully transmitted to the bearing housing or machine casing, or more specifically, to the mounting location of the transducer. In addition, care should be exercised in the physical installation of the transducer. Improper installation can result in a decrease of the transducer amplitude and frequency response and/or the generation of signals which do not represent actual machine vibration. Upon request, Bently Nevada can provide engineering services to determine the appropriateness of housing measurements for the machine in question and/or to provide installation assistance.

There are two different channel types that support the measurement of acceleration. These are Acceleration and Acceleration II. The Acceleration channel type only supports the direct measurement and works with the 3500/42 and 3500/42M. The Acceleration II channel type is an enhanced version of the Acceleration channel type. It supports Direct, 1X Amplitude 1X Phase, 2X Amplitude, and 2X Phase. The Acceleration II channel type is only available on the 3500/42M monitors with revision 2.1 firmware or greater, and requires version 3.2 of the 3500 Configuration software.

Application Alert

When upgrading from using a Acceleration to a Acceleration II channel type care must be taken regarding any DCS or PLC programming that utilizes data from the Communications Gateway. The order and the number of values for the PPL data and the alarm status data has changed for the Acceleration II. This may require changes to the DCS or PLC programming. If this is undesirable then use the Acceleration channel type.

Application Alert

For machine protection parameters measured with Velocity or Velomitor® sensors or with Acceleration sensors a sudden mechanical impact can over-range the sensor output. If the monitor is configured with Timed OK Channel Defeat enabled and the over-range signal exceeds the OK Limits the monitor may not annunciate an alarm. This may result in a missed alarm and temporary loss of machine protection.

Timed OK Channel Defeat can be disabled on velocity and acceleration channel types.

Caution

On Reciprocating Compressors mechanical impacts will occur.

DISABLE Timed OK Channel Defeat when monitoring crankcase or crosshead vibration using either Velocity, Velomitor®, or Acceleration sensors.

26. Acceleration Configuration

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26.1 Introduction

This section discusses the Configuration Considerations and the Rack Configuration Software screens associated with the Acceleration Channel.

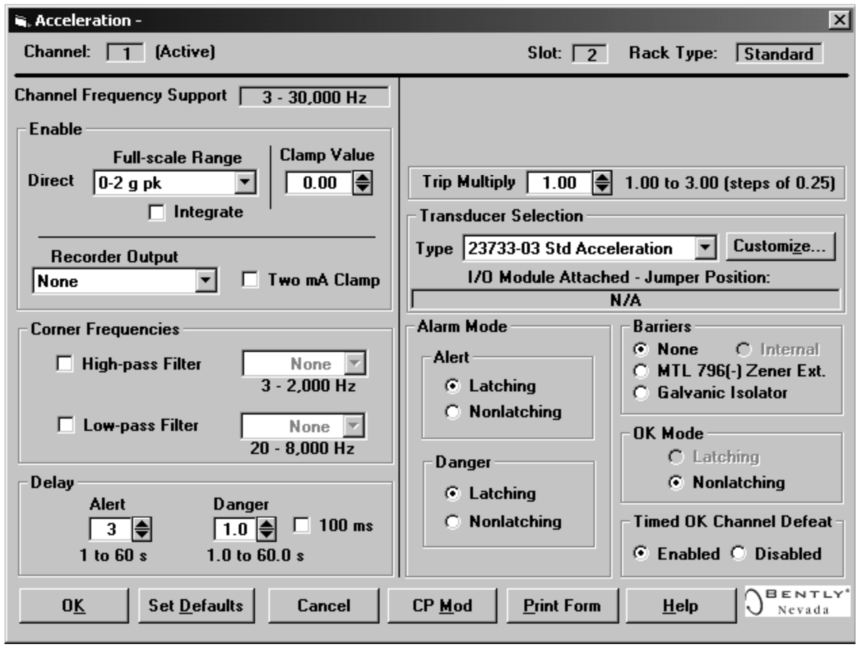
26.2 Configuration Considerations

Consider the following items before configuring an Acceleration Channel:

- The "No Keyphasor" option is automatically selected for this channel type. No Keyphasors are required.
- The Acceleration Direct full-scale range is dependent upon the transducer type.
- Monitors must be configured in channel pairs (for example, Channels 1 and 2 may be configured as Acceleration and Channels 3 and 4 may be configured as Radial Vibration).
- When a full-scale range is modified, the setpoints associated with this proportional value should be readjusted.
- If a Non-Standard transducer is selected, the setpoint OK limits are set to ±1 volt from the Upper and Lower OK limits that are selected.
- When integration is selected, the available Direct Full-scale ranges will change to reflect this.
- When band-pass filtering is selected, the high-pass and low-pass filters must be set a minimum of two octaves apart.
- When two channels of acceleration are activated, the maximum channel frequency supported is as shown in << Table reference to “Maximum Channel Frequency when two Acceleration Channels are Activated” in AccelSpecs.doc >>:
- When a single channel of acceleration is activated, the maximum channel frequency supported is as shown in << Table reference to “Maximum Channel Frequency when a single Acceleration Channel is Activated” in AccelSpecs.doc >>:
- The Latching OK Mode and the Timed OK Channel Defeat options are not compatible.
- Internal Barrier I/O Modules and External Barriers are not supported with high frequency accelerometer transducers.
- Only 18 high frequency accelerometer transducers can be installed along with a full rack of standard transducers. This is due to the fact that the rack can only power 18 high frequency Accelerometer transducers.

26.3 Configuration Options

This section describes the options available on the Acceleration Channel configuration screen.



26.3.1 General Parameters and Buttons

CP Mod: Selecting the CP Mod button in the Channel Options Dialog Box, allows a Custom channel configuration to be downloaded to the monitor. Custom configuration data is stored in a Custom Products Modification File. Custom Products Modification files follow the naming convention <modification #.mod>. These files must be located in the \3500\Rackcfg\Mods\ directory. When a CP Mod file is selected, a window is displayed which describes the function of the modification. CP Mod files are available through Bently Nevada's Custom Products Division. Contact your local Bently Nevada Sales Representative for details.

Trip Multiply: The value selected to temporarily increase the alarm (Alert and Danger) setpoint values. This value is normally applied by manual (operator) action during startup to allow a machine to pass through high vibration speed ranges without monitor alarm indications. Such high vibration speed ranges may include system resonances and other normal transient vibrations.

Timed OK Channel Defeat: An option that prevents a channel from returning to an OK status until that channel's transducer has remained in an OK state for the specified period of time. If the option is enabled, the time is set to 30 seconds. This option prevents false trips caused by intermittent transducers.

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. Refer to “Setting the I/O Jumper” in the "I/O Module Descriptions" section of the manual, if applicable.

26.3.2 Reference Information

These fields contain information that indicates which module you are configuring.

Channel: The number of the channel being configured (1 through 4).

Slot: The location of the monitor in the 3500 rack (2 through 15).

Rack Type: Identifies the type of Rack Interface Module installed in the rack (Standard or TMR).

Channel Frequency Support: Supported frequency range of the selected transducer depends upon the number of channels selected. See Configuration Considerations.

26.3.3 Enable

Direct: Machine data using accelerometers for the transducer inputs and generally used for high frequency measurements. The signal will be changed if filtering is selected (High-pass, Low-pass or High-pass and Low-pass selected).

Direct Full Scale Ranges by transducer type

23733-03 Std Acceleration Interface Module **24145-02 Hi Freq Acceleration Interface Module** **330400 Std Integral Accelerometer** **Nonstandard**	**49578-01 Std Acceleration Interface Module** **155023-01 Hi Freq Acceleration Interface Module**	**330425 Std Integral Accelerometer**
0-2 g pk	0-20 g pk (49578-01 Only)	0-20 g pk
0-5 g pk	0-25 g pk (49578-01 Only)	0-25 g pk
0-10 g pk	0-40 g pk (49578-01 Only)	0-40 g pk
0-20 g pk	0-50 g pk (49578-01 Only)	0-50 g pk
0-25 g pk (23733-03 and Nonstandard Only)	0-20 g rms	0-20 g rms
0-40 g pk (23733-03 and Nonstandard Only)	0-25 g rms	0-25 g rms
0-45 g pk (23733-03 and Nonstandard Only)	0-40 g rms	0-40 g rms
0-2 g rms	0-50 g rms	0-50 g rms
0-5 g rms	0-20 m/s^2 rms (49578-01 Only)	0-20 m/s^2 pk
0-10 g rms	0-50 m/s^2 rms (49578-01 Only)	0-50 m/s^2 pk
0-20 g rms (Not 24145-02)	0-100 m/s^2 rms (49578-01 Only)	0-100 m/s^2 pk
0-20 m/s^2 pk	0-200 m/s^2 rms	0-200 m/s^2 pk
0-50 m/s^2 pk	0-250 m/s^2 rms	0-250 m/s^2 pk
0-100 m/s^2 pk	0-400 m/s^2 rms	0-400 m/s^2 pk
0-200 m/s^2 pk	0-500 m/s^2 rms	0-500 m/s^2 pk
0-250 m/s^2 pk (23733-03 and Nonstandard Only)	0-20 m/s^2 pk (49578-01 Only)	0-20 m/s^2 rms
0-400 m/s^2 pk (23733-03 and Nonstandard Only)	0-50 m/s^2 pk (49578-01 Only)	0-50 m/s^2 rms
0-450 m/s^2 pk (Nonstandard Only)	0-100 m/s^2 pk (49578-01 Only)	0-100 m/s^2 rms
0-20 m/s^2 rms	0-200 m/s^2 pk (49578-01 Only)	0-200 m/s^2 rms
0-50 m/s^2 rms	0-250 m/s^2 pk (49578-01 Only)	0-250 m/s^2 rms
0-100 m/s^2 rms	0-400 m/s^2 pk (49578-01 Only)	0-400 m/s^2 rms
0-200 m/s^2 rms (Not 24145-02)	0-500 m/s^2 pk (49578-01 Only)	Custom
Custom	Custom	

Integrate: When Integrate is enabled, the Direct Full-scale range selections change to the following:

Direct values (Integrated) by transducer types

23733-02 Std Acceleration Interface Module **24145-02 Hi Freq Acceleration Interface Module** **330400 Std Integral Accelerometer** **Nonstandard**	**49578-01 Std Acceleration Interface Module** **155023-01 Hi Freq Acceleration Interface Module** **330425 Std Integral Accelerometer**
0-1 in/s pk 0-2 in/s pk 0-1 in/s rms 0-2 in/s rms 0-25 mm/s pk 0-50 mm/s pk 0-100 mm/s pk (Not 330400) 0-25 mm/s rms 0-50 mm/s rms Custom	0-2 in/s pk (Not 155023-01) 0-2 in/s rms (Not 155023-01) 0-100 mm/s pk (Not 155023-01) 0-100 mm/s rms

Clamp Value: The value that a proportional value goes to when that channel or proportional value is bypassed or defeated (for example when a problem occurs with the transducer). The selected value can be between the minimum and maximum full-scale range values. Only the values available from the Recorder Outputs, Communication Gateway and Display Interface Module are clamped to the specified value when the proportional value is invalid.

Recorder Output: The proportional value of a channel that is sent to the 4 to 20 mA recorder. The recorder output is proportional to the measured value over the channel full-scale range. An increase in the proportional value that would be indicated as upscale on a bar graph display results in an increase in the current at the recorder output. If the channel is Bypassed, the output will be clamped to the current proportional to the selected clamp value or to 2 mA (if the 2 mA clamp is selected).

26.3.4 Corner Frequencies

High-pass Filter: A four-pole filter that must be at least two octaves away from the Low-pass Filter.

HPF = High-pass Filter; LPF = Low-pass Filter

HPF ≤ (LPF / 4)

Low-pass Filter: A four-pole filter that must be at least two octaves away from the High-pass Filter.

HPF = High-pass Filter; LPF = Low-pass Filter

LPF ≥ (HPF * 4)

26.3.5 Delay

The time which a proportional value must remain at or above an alarm level or outside an acceptance region before an alarm is declared as active.

Alert: First level alarm that occurs when the transducer signal level exceeds the selected value. The Alert time delay is always set at one second intervals for all available proportional values.

Danger: Second level alarm that occurs when the transducer signal level exceeds the selected value.

100 ms option: The 100 ms (typical) option applies to the Danger time delay only and has the following results:

If the 100 ms option is off (☐):

- The Danger time delay can be set at one second intervals.
- The Danger time delay can be set for all available proportional values.

If the 100 ms option is on (☑):

- The Danger time delay is set to 100 ms.
- The Danger time delay can only be set for the primary proportional value.

26.3.6 Transducer Selection

Type: The following transducer types are available for the Acceleration Channel (non-barrier I/O module):

- 23733-03 Std Acceleration Interface Module
- 24145-02 Hi Freq Acceleration Interface Module
- 330400 Std Integral Accelerometer
- 330425 Std Integral Accelerometer
- 49578-01 Std Acceleration Interface Module
- 155023-01 Hi Freq Acceleration Interface Module
- Nonstandard

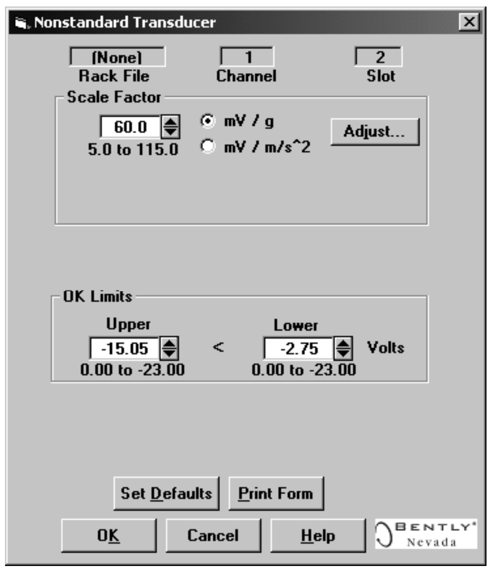
The following transducer types are available for the Acceleration Channel (barrier I/O module):

- 23733-03 Std Acceleration Interface Module
- 330400 Std Integral Accelerometer
- 330425 Std Integral Accelerometer
- 49578-01 Std Acceleration Interface Module

- Nonstandard

Customize button: Used to adjust the Scale Factor for transducers. Refer to "Adjusting the Scale Factor and Zero Position" in the "Monitor Verification" section of the manual. Also, note that:

- If Non-standard is selected as the transducer type, the OK Limits can also be adjusted.
- The Non-standard transducer's scale factor must be between 21.2 and 115 mV/g.
- There must be at least 2 volts between the Upper and Lower OK Limits.



Scale Factor by Transducer Type

Transducer	Scale Factor				
	Without Barriers	**With Bently Nevada Internal Barriers**	**Standard I/O With Barriers**	**Discrete TMR I/O With Barriers**	**Bussed TMR I/O With Barriers**
23733-03	100 mV/g	100 mV/g	95.6mV/g	100 mV/g	99.4 mV/g
24145-02	100 mV/g	*	*	*	*
330400	100 mV/g	100 mV/g	95.6mV/g	95.6 mV/g	95.6 mV/g
330425	25 mV/g	25 mV/g	23.9mV/g	23.9 mV/g	23.9 mV/g
49578-01	25 mV/g	25 mV/g	23.9mV/g	25 mV/g	24.9 mV/g
155023-01	25 mV/g	*	*	*	*

Note: ±15 % scale factor adjustment allowed.

* Barriers are not supported with this transducer option.

OK Limits by Transducer Type

	Upper		Lower		Center Gap Voltage	
Transducer	**Without Barriers (V)**	**With Barriers (V)**	**Without Barriers (V)**	**With Barriers (V)**	**Without Barriers (V)**	**With Barriers (V)**
23733-03	-15.05	-13.85 -15.05 †	-2.75	-3.10 -2.75 †	-8.90	-8.475 -8.90 †
24145-02	-15.05	*	-2.75	*	-8.90	*
330400	-15.05	-13.85 -15.05 †	-2.75	-3.10 -2.75 †	-8.90	-8.475 -8.90 †
330425	-11.37	-10.86 -11.37 †	-5.63	-5.34 -5.63 †	-8.50	-8.10 -8.50 †
49578-01	-11.37	-10.86 -11.37 †	-5.63	-5.34 -5.63 †	-8.50	-8.10 -8.50 †
155023-01	-11.37	*	-5.63	*	-8.50	*

* Barriers are not supported with this transducer option.

† BN Internal Barrier I/O Modules.

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. For the function of this jumper, refer to "Setting the I/O Jumper" in the manual of the monitor that contains this channel.

26.3.7 Alarm Mode

Alert is the first level alarm that occurs when the transducer signal level exceeds the selected value. Danger is the second level alarm that occurs when the transducer signal level exceeds the selected value. The Alert and Danger values are set on the Setpoint screen.

Latching: Once an alarm is active, it will remain active even after the proportional value is no longer in alarm. The alarm state will continue until the channel is reset using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: When an alarm is active, it will go inactive as soon as the proportional value is no longer in alarm.

26.3.8 Barriers

Select the MTL 796(-) Zener External option, or Galvanic Isolators if external safety barriers are connected between the monitor and the transducer. If using an Internal Barrier I/O Module, select the internal option. These devices are used to restrict the amount of energy that can flow into a hazardous area.

26.3.9 OK Mode

Latching: If a channel is configured for Latching OK, once the channel has gone not OK the status stays not OK until a reset is issued using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: If a channel is configured for Nonlatching OK, the OK status of that channel will track the defined OK status of the transducer.

26.3.10 Timed OK Channel Defeat

An option that prevents a channel from returning to an OK status until that channel's transducer has remained in an OK state for the specified period of time. If the option is enabled, the time is set to 30 seconds. This option prevents false trips caused by intermittent transducers.

Application Alert

For machine protection parameters measured with Velocity or Velomitor® sensors or with Acceleration sensors a sudden mechanical impact can over-range the sensor output. If the monitor is configured with Timed OK Channel Defeat enabled and the over-range signal exceeds the OK Limits the monitor may not annunciate an alarm. This may result in a missed alarm and temporary loss of machine protection.

Timed OK Channel Defeat can be disabled on velocity and acceleration channel types.

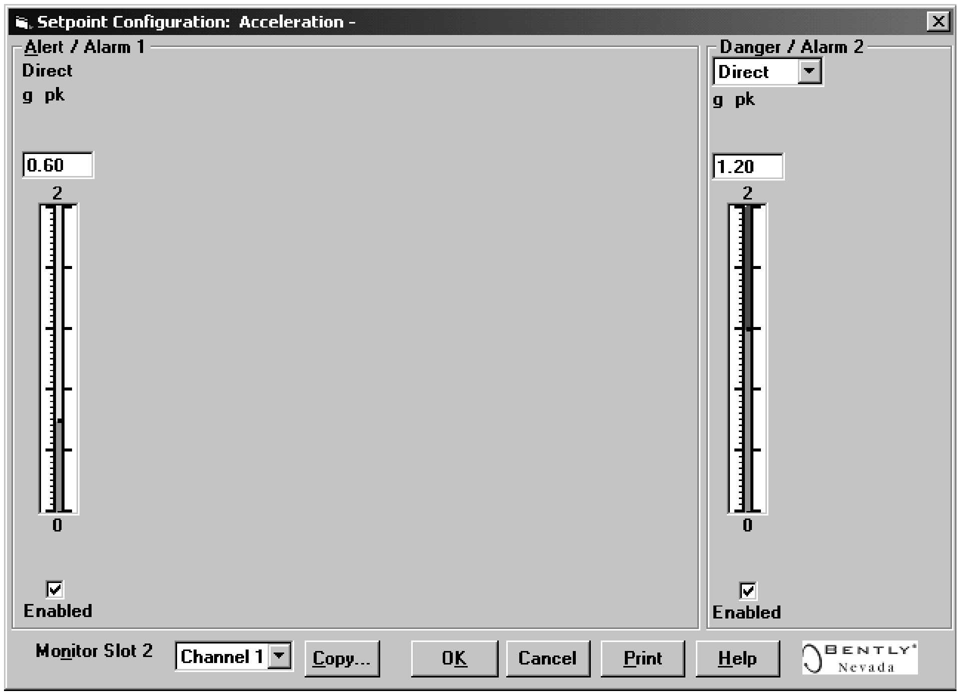
Caution
On Reciprocating Compressors mechanical impacts will occur. **DISABLE Timed OK Channel Defeat when monitoring crankcase or crosshead vibration using either Velocity, Velomitor®, or Acceleration sensors.**

26.4 Alarm Setpoints

This section specifies the available setpoints for each type of channel. A setpoint is the level within the full-scale range that determines when an alarm occurs. The 3500 Monitoring System allows Alert/Alarm 1 setpoints to be set for every proportional value on each channel. The channel will drive an Alert/Alarm 1 indication if one or more of the channel proportional values exceeds its setpoints. The 3500 Monitoring System also allows up to four Danger/Alarm 2 setpoints (two over setpoints and two under setpoints) to be set for up to two of the proportional values. You may select any two of the available proportional values for the channel.

Note
The setpoint over and under limits can only be placed within the OK limits of the specified transducer.

Use the following screen in the Rack Configuration Software to adjust Alert/Alarm 1 and Danger/Alarm 2 setpoints.



26.4.1 Available Setpoints

The following tables list the Alert/Alarm 1 and Danger/Alarm 2 setpoints available for each channel pair type. The setpoint number is used in the Communication Gateway and Display Interface Modules.

Setpoint Number	Acceleration
1	Over Direct
2	Danger (Over Direct)
3	
4	
5	
6	
7	
8	
9	
10	
11	

26.4.2 Alarm Hysteresis

The alarming hysteresis for all channel configurations is 1/64 of Full Scale. When a channel exceeds an alarm setpoint, it must fall back the setpoint less the hysteresis before it can go out of alarm.

For example, for a channel configuration with a 0 to 10 mil full scale and an alarm setpoint of 6 mils, the hysteresis = 10 mils/64 = 0.16 mils. The channel input, therefore, must fall below 6 mils – 0.16 mils (5.84 mils) before the channel is out of alarm.

27. Acceleration II Configuration

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27.1 Introduction

This section discusses the Configuration Considerations and the Rack Configuration Software screens associated with the Acceleration 2 Channel Type.

27.2 Configuration Considerations

Consider the following items before configuring an Acceleration II Channel:

- When "No Keyphasor" is selected, the 1X Amplitude (Ampl) and Phase Lag, 2X Amplitude (Ampl) and Phase Lag cannot be selected.
- If a Keyphasor channel is selected, a Keyphasor Module must be installed in the rack.
- The 1X and 2X Phase values can be enabled only if the selected Keyphasor channel is configured for an events per revolution equal to 1 will.
- The full-scale options allowed for each proportional value is dependent upon the transducer type.
- Monitors must be configured in channel pairs (for example, Channels 1 and 2 may be configured as Acceleration and Channels 3 and 4 may be configured as Radial Vibration).
- When integration is selected, the available Full-scale ranges will change to reflect this. Additionally, the frequency support will be limited to 20kHz.
- When integration is selected, the high pass filter will be set to 10Hz if it is not set to a higher frequency and the vector parameters will be inactive below 10Hz.
- When band-pass filtering is selected, the high-pass and low-pass filters must be set a minimum of two octaves apart.
- When RMS is selected, all of the proportional values for the channel will be in RMS units.
- When the Acceleration Dual Path channel type is selected, transducer 1 is used for channels 1 & 2 and transducer 3 is used for channels 3 & 4.
- When using Dual Path both channels must be configured for the same transducer type.
- Internal Barrier I/O Modules and External Barriers are not supported with high frequency accelerometer transducers.
- Only 18 high frequency accelerometer transducers can be installed along with a full rack of standard transducers. This is due to the fact that the rack can only power 18 high frequency Accelerometer transducers.
- When a full-scale is modified, readjust the setpoints associated with the proportional value.

Application Alert

For machine protection parameters measured with Velocity or Velomitor® sensors or with Acceleration sensors a sudden mechanical impact can over-range the sensor output. If the monitor is configured with Timed OK Channel Defeat enabled and the over-range signal exceeds the OK Limits the monitor may not annunciate an alarm. This may result in a missed alarm and temporary loss of machine protection.

Timed OK Channel Defeat can be disabled on velocity and acceleration channel types.

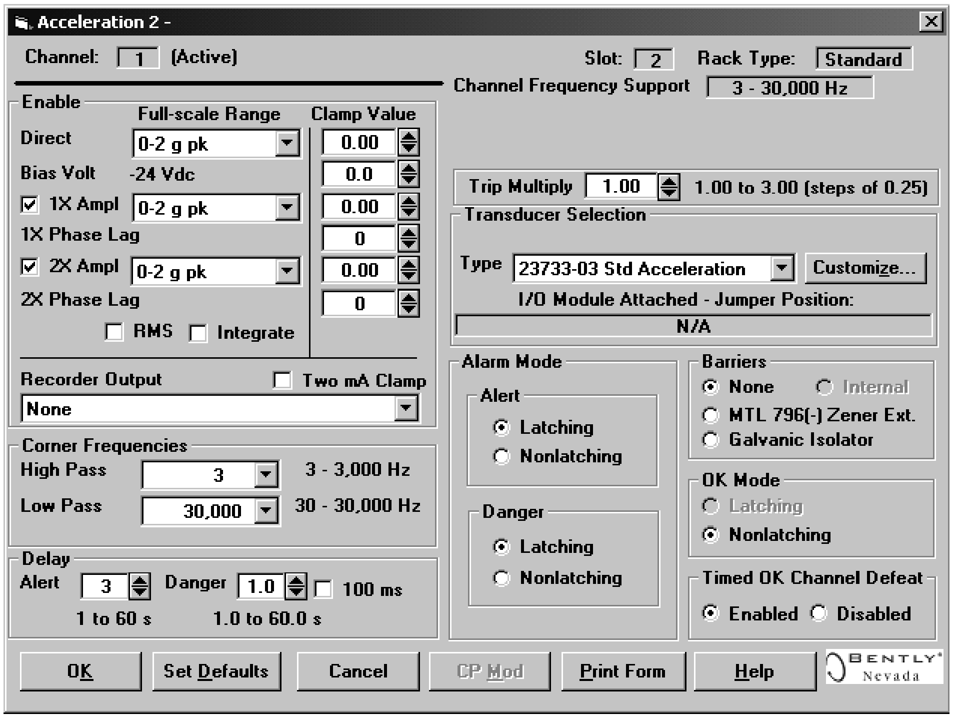
Caution

On Reciprocating Compressors mechanical impacts will occur.

DISABLE Timed OK Channel Defeat when monitoring crankcase or crosshead vibration using either Velocity, Velomitor®, or Acceleration sensors.

27.3 Configuration Options

This section describes the options available on the Acceleration II Channel Type configuration screen.



27.3.1 General Parameters and Buttons

CP Mod: Selecting the CP Mod button in the Channel Options Dialog Box, allows a Custom channel configuration to be downloaded to the monitor. Custom configuration data is stored in a Custom Products Modification File. Custom Products Modification files follow the naming convention <modification #.mod>. These files must be located in the \3500\Rackcfg\Mods\ directory. When a CP Mod file is selected, a window is displayed which describes the function of the modification. CP Mod files are available through Bently Nevada's Custom Products Division. Contact your local Bently Nevada Sales Representative for details.

Timed OK Channel Defeat: An option that prevents a channel from returning to an OK status until that channel's transducer has remained in an OK state for the specified period of time. If the option is enabled, the time is set to 30 seconds. This option prevents false trips caused by intermittent transducers.

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. Refer to “Setting the I/O Jumper” in the "I/O Module Descriptions" section of the manual, if applicable.

27.3.2 Reference Information

These fields contain information that indicates which module you are configuring.

Channel: The number of the channel being configured (1 through 4).

Slot: The location of the monitor in the 3500 rack (2 through 15).

Rack Type: Identifies the type of Rack Interface Module installed in the rack (Standard or TMR).

Channel Frequency Support: Supported frequency range of the selected transducer depends upon whether integration is enabled.

27.3.3 Enable

Direct: Direct is data that represents the overall peak-to-peak vibration. Machine data using accelerometers for the transducer inputs and generally used for high frequency measurements. The signal will be changed if filtering is selected (High-pass, Low-pass or High-pass and Low-pass selected).

Bias Voltage: The DC voltage used by the system as a bias for the transducer. Can be used as a diagnostic tool for evaluating system integrity.

Application Advisory
This measurement contains no information about the condition of the machinery being monitored. It has been provided only for monitoring system diagnostics.

1X Ampl: In a complex vibration signal, 1X ampl is the notation for the amplitude component that occurs at the rotative speed frequency.

1X Phase Lag: In a complex vibration signal, 1X Phase Lag is the notation for the phase lag component that occurs at the rotative speed frequency.

2X Ampl: In a complex vibration signal, 2X ampl is the notation for the amplitude component having a frequency equal to two times the shaft rotative speed.

2X Phase Lag: In a complex vibration signal, 2X Phase Lag is the notation for the phase lag component having a frequency equal to two times the shaft rotative speed. 2X phase lag is the angular measurement from the leading or trailing edge of the Keyphasor pulse to the following positive peak of the 2X vibration signal.

Note
Bias Voltage, 1X Amplitude & Phase, 2X Amplitude & Phase are only available if the monitor is a 3500/42M**.**

Integrate: Integration applies to all values returned from the monitor. When integration is selected, the available Full-scale ranges will change to reflect this. Additionally, the frequency support will be limited to 20kHz.

RMS: When RMS is selected, all of the proportional values for the channel will be measured as RMS. The following full-scale ranges are available:

27.3.4 Full Scale Ranges by Transducer Type

23733-03 Standard Acceleration Interface Module

Non Integrated Peak	Non-Integrated RMS	Integrated Peak	Integrated RMS
0-2 g pk	0-2 g rms	0-1 in/s pk	0-1 in/s rms
0-5 g pk	0-5 g rms	0-2 in/s pk	0-2 in/s rms
0-10 g pk	0-10 g rms	0-4 in/s pk	0-25 mm/s rms
0-20 g pk	0-20 g rms	0-25 mm/s pk	0-50 mm/s rms
0-25 g pk	0-20 m/s^2 rms	0-50 mm/s pk	Custom
0-40 g pk	0-50 m/s^2 rms	0-100 mm/s pk	
0-45 g pk	0-100 m/s^2 rms	Custom	
0-20 m/s^2 pk	0-200 m/s^2 rms		
0-50 m/s^2 pk	Custom		
0-100 m/s^2 pk			
0-200 m/s^2 pk			
0-250 m/s^2 pk			
0-400 m/s^2 pk			
Custom			

24145-02 High Frequency Acceleration Interface Module

Non Integrated Peak	Non-Integrated RMS	Integrated Peak	Integrated RMS
0-2 g pk	0-2 g rms	0-1 in/s pk	0-1 in/s rms
0-5 g pk	0-5 g rms	0-2 in/s pk	0-2 in/s rms
0-10 g pk	0-10 g rms	0-4 in/s pk	0-25 mm/s rms
0-20 g pk	0-20 m/s^2 rms	0-25 mm/s pk	0-50 mm/s rms
0-20 m/s^2 pk	0-50 m/s^2 rms	0-50 mm/s pk	Custom
0-50 m/s^2 pk	0-100 m/s^2 rms	0-100 mm/s pk	
0-100 m/s^2 pk	Custom	Custom	
0-200 m/s^2 pk			
Custom			

330400 Standard Acceleration Interface Module

Non Integrated Peak	Non-Integrated RMS	Integrated Peak	Integrated RMS
0-2 g pk	0-2 g rms	0-1 in/s pk	0-1 in/s rms
0-5 g pk	0-5 g rms	0-2 in/s pk	0-2 in/s rms
0-10 g pk	0-10 g rms	0-25 mm/s pk	0-25 mm/s rms
0-20 g pk	0-20 g rms	0-50 mm/s pk	0-50 mm/s rms
0-20 m/s^2 pk	0-20 m/s^2 rms	Custom	Custom
0-50 m/s^2 pk	0-50 m/s^2 rms		
0-100 m/s^2 pk	0-100 m/s^2 rms		
0-200 m/s^2 pk	0-200 m/s^2 rms		
Custom	Custom		

49578-01 Standard Acceleration Interface Module

Non Integrated Peak	Non-Integrated RMS	Integrated Peak	Integrated RMS
0-20 g pk	0-20 g rms	0-2 in/s pk	0-2 in/s rms
0-25 g pk	0-25 g rms	0-4 in/s pk	0-4 in/s rms
0-40 g pk	0-40 g rms	0-50 mm/s pk	0-50 mm/s rms
0-50 g pk	0-50 g rms	0-100 mm/s pk	0-100 mm/s rms
0-20 m/s^2 pk	0-20 m/s^2 rms	Custom	Custom
0-50 m/s^2 pk	0-50 m/s^2 rms		
0-100 m/s^2 pk	0-100 m/s^2 rms		
0-200 m/s^2 pk	0-200 m/s^2 rms		
0-250 m/s^2 pk	0-250 m/s^2 rms		
0-400 m/s^2 pk	0-400 m/s^2 rms		
0-500 m/s^2 pk	0-500 m/s^2 rms		
Custom	Custom		

330425 Standard Acceleration Interface Module

Non Integrated Peak	**Non-Integrated RMS**	**Integrated Peak**	**Integrated RMS**
0-20 g pk	0-20 g rms	0-2 in/s pk	0-2 in/s rms
0-25 g pk	0-25 g rms	0-4 in/s pk	0-4 in/s rms
0-40 g pk	0-40 g rms	0-50 mm/s pk	0-50 mm/s rms
0-50 g pk	0-50 g rms	0-100 mm/s pk	0-100 mm/s rms
0-20 m/s^2 pk	0-20 m/s^2 rms	Custom	Custom
0-50 m/s^2 pk	0-50 m/s^2 rms		
0-100 m/s^2 pk	0-100 m/s^2 rms		
0-200 m/s^2 pk	0-200 m/s^2 rms		
0-250 m/s^2 pk	0-250 m/s^2 rms		
0-400 m/s^2 pk	0-400 m/s^2 rms		
0-500 m/s^2 pk	Custom		
Custom			

155023-01 High Frequency Acceleration Interface Module

Non Integrated Peak	Non-Integrated RMS	Integrated Peak	Integrated RMS
N/A	0-20 g rms	N/A	0-4 in/s rms
	0-25 g rms		0-100 mm/s rms
	0-40 g rms		Custom
	0-50 g rms		
	0-200 m/s^2 rms		
	0-250 m/s^2 rms		
	0-400 m/s^2 rms		
	0-500 m/s^2 rms		
	Custom		

Note
When a full-scale range is modified, the setpoints associated with this proportional value should be readjusted.

Clamp Value: The Clamp value is the value that a proportional value goes to when that channel or proportional value is bypassed or defeated (For example when a problem occurs with the transducer). The selected value can be between the minimum and maximum full-scale range values. (1X and 2X Phase Lag have available values of 0 to 359 degrees.) Only the values available from the Recorder Outputs, Communication Gateway and Display Interface Module are clamped to the specified value when the proportional value is invalid.

Recorder Output: This field selects which proportional value of a channel is sent to the 4 to 20 mA recorder. The recorder output is proportional to the measured value over the channel full-scale range. An increase in the proportional value that would be indicated as upscale on a bar graph display results in an increase in the current at the recorder output.

If 1X Phase Lag or 2X Phase Lag are selected then the two options available are with and without Hysteresis. If the channel is bypassed, the output will be clamped to the selected clamp value or to 2 mA (if the 2 mA clamp is selected).

The Hysteresis option helps prevent the Recorder Output from jumping from Full to Bottom Scale when the phase measurement is near 0 or 359 degrees. When the Hysteresis option is checked, the recorder signal operates as follows:

- The recorder output is scaled such that 4 mA corresponds to 0 degrees and 20 mA corresponds to 380 degrees (360 plus 20 degrees).
- The transition of a phase measurement that is increasing does not occur until the measurement has gone 20 degrees past 360 degrees. At this point, the recorder signal switches from 20 mA to a signal that corresponds to 20 degrees or 4.842 mA.
- The transition of a phase measurement that is decreasing occurs at 0 degrees (4 mA). At this point, the recorder signal switches from 4 mA to a signal that corresponds to 360 degrees or 19.158 mA.

27.3.5 Corner Frequencies

If no filters are selected then the monitor will be configured with a 3Hz HPF and a 30kHz LPF if integration is disabled. If integration is enabled the monitor is configured with a 10Hz HPF and a 20kHz LPF.

High-pass Filter: A four-pole filter that must be set at least two octaves away from the Low-pass Filter.

HPF = High-pass Filter; LPF = Low-pass Filter

HPF ≤ (LPF / 4)

Low-pass Filter: A four-pole filter that must be set at least two octaves away from the High-pass Filter.

HPF = High-pass Filter; LPF = Low-pass Filter

LPF ≥ (HPF * 4)

Note
When band-pass filtering is selected, the high-pass and low-pass filters must be set a minimum of two octaves apart.

27.3.6 Delay

The time that a proportional value must remain at or above an alarm level or outside an acceptance region before an alarm is declared as active.

Alert: First level alarm that occurs when the transducer signal level exceeds the selected value. The Alert time delay is always set at one second intervals for all available proportional values.

Danger: Second level alarm that occurs when the transducer signal level exceeds the selected value.

100 ms option: The 100 ms (typical) option applies to the Danger time delay only and has the following results:

If the 100 ms option is off (☐):

- The Danger time delay can be set at one second intervals.
- The Danger time delay can be set for all available proportional values.

If the 100 ms option is on (☑):

- The Danger time delay is set to 100 ms.
- The Danger time delay can only be set for the primary proportional value.

27.3.7 Take Input From Channel A (1 or 3) Transducer

The Channel B (2 or 4) Acceleration channel options screen has an extra control that appears just above the transducer type list box. It is the “Take Input From Channel A Transducer” checkbox. When checked (☑), the channel pair is configured for a Dual Path mode of operation. That is, the input from the first transducer (1 or 3) is used for the input for both channels of the pair. The transducer selection, barrier option, OK mode and Timed OK Channel Defeat setting from channel A will be copied to the second channel (2 or 4) of the pair.

27.3.8 Transducer Selection

Type: The following transducer types are available for the Acceleration Channel (non-barrier I/O module):

- 23733-03 Std Acceleration Interface Module
- 24145-02 Hi Freq Acceleration Interface Module
- 330400 Std Integral Accelerometer

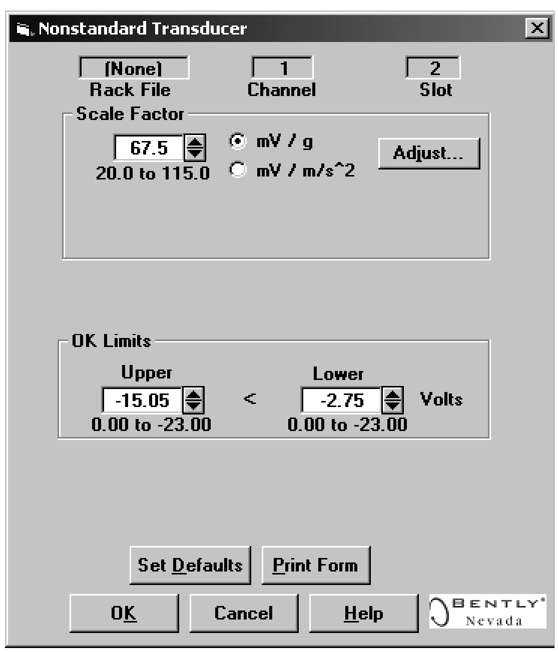
- 330425 Std Integral Accelerometer
- 49578-01 Std Acceleration Interface Module
- 155023-01 Hi Freq Acceleration Interface Module
- Nonstandard

The following transducer types are available for the Acceleration Channel (barrier I/O module):

- 23733-03 Std Acceleration Interface Module
- 330400 Std Integral Accelerometer
- 330425 Std Integral Accelerometer
- 49578-01 Std Acceleration Interface Module
- Nonstandard

Customize button: Used to adjust the Scale Factor for transducers. Refer to "Adjusting the Scale Factor and Zero Position" in the "Monitor Verification" section of the manual. Also, note that:

- If Non-standard is selected as the transducer type, the OK Limits can also be adjusted.
- The Non-standard transducer's scale factor must be between 20 and 115 mV/g.
- There must be at least 2 volts between the Upper and Lower OK Limits.
- If a Non-Standard transducer is selected, the setpoint OK limits are set to ±1 volt from the Upper and Lower OK limits that are selected.



Scale Factor by Transducer Type

Transducer	Scale Factor				
	Without Barriers	**With Bently Nevada Internal Barriers**	**Standard I/O With Barriers**	**Discrete TMR I/O With Barriers**	**Bussed TMR I/O With Barriers**
23733-03	100 mV/g	100 mV/g	95.6mV/g	100 mV/g	99.4 mV/g
24145-02	100 mV/g	*	*	*	*
330400	100 mV/g	100 mV/g	95.6mV/g	95.6 mV/g	95.6 mV/g
330425	25 mV/g	25 mV/g	23.9mV/g	23.9 mV/g	23.9 mV/g
49578-01	25 mV/g	25 mV/g	23.9mV/g	25 mV/g	24.9 mV/g
155023-01	25 mV/g	*	*	*	*

Note: ±15 % scale factor adjustment allowed.

* Barriers are not supported with this transducer option.

OK Limits by Transducer Type

Transducer	Upper		Lower		Center Bias Voltage	
	Without Barriers (V)	**With Barriers (V)**	**Without Barriers (V)**	**With Barriers (V)**	**Without Barriers (V)**	**With Barriers (V)**
23733-03	-15.05	-13.85 -15.05 †	-2.75	-3.10 -2.75 †	-8.90	-8.475 -8.90 †
24145-02	-15.05	*	-2.75	*	-8.90	*
330400	-15.05	-13.85 -15.05 †	-2.75	-3.10 -2.75 †	-8.90	-8.475 -8.90 †
330425	-11.37	-10.86 -11.37 †	-5.63	-5.34 -5.63 †	-8.50	-8.10 -8.50 †
49578-01	-11.37	-10.86 -11.37 †	-5.63	-5.34 -5.63 †	-8.50	-8.10 -8.50 †
155023-01	-11.37	*	-5.63	*	-8.50	*

* Barriers are not supported with this transducer option.

† BN Internal Barrier I/O Modules.

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. For the function of this jumper, refer to "Setting the I/O Jumper" in the manual of the monitor that contains this channel.

27.3.9 Alarm Mode

Alert is the first level alarm that occurs when the transducer signal level exceeds the selected value. Danger is the second level alarm that occurs when the transducer signal level exceeds the selected value. The Alert and Danger values are set on the Setpoint screen.

Latching: Once an alarm is active, it will remain active even after the proportional value is no longer in alarm. The alarm state will continue until the channel is reset using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: When an alarm is active, it will go inactive as soon as the proportional value is no longer in alarm.

27.3.10 Barriers

Select the MTL 796(-) Zener External option, or Galvanic Isolators if external safety barriers are connected between the monitor and the transducer. If using an Internal Barrier I/O Module, select the internal option. These devices are used to restrict the amount of energy that can flow into a hazardous area.

27.3.11 OK Mode

Latching: If a channel is configured for Latching OK, once the channel has gone not OK the status stays not OK until a reset is issued using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: If a channel is configured for Nonlatching OK, the OK status of that channel will track the defined OK status of the transducer.

Note
The Latching OK Mode and the Timed OK Channel Defeat options are not compatible.

27.3.12 Timed OK Channel Defeat

An option that prevents a channel from returning to an OK status until that channel's transducer has remained in an OK state for the specified period of time. If the option is enabled, the time is set to 30 seconds. This option prevents false trips caused by intermittent transducers.

Application Alert

For machine protection parameters measured with Velocity or Velomitor® sensors or with Acceleration sensors a sudden mechanical impact can over-range the sensor output. If the monitor is configured with Timed OK Channel Defeat enabled and the over-range signal exceeds the OK Limits the monitor may not annunciate an alarm. This may result in a missed alarm and temporary loss of machine protection.

Timed OK Channel Defeat can be disabled on velocity and acceleration channel types.

Caution

On Reciprocating Compressors mechanical impacts will occur.

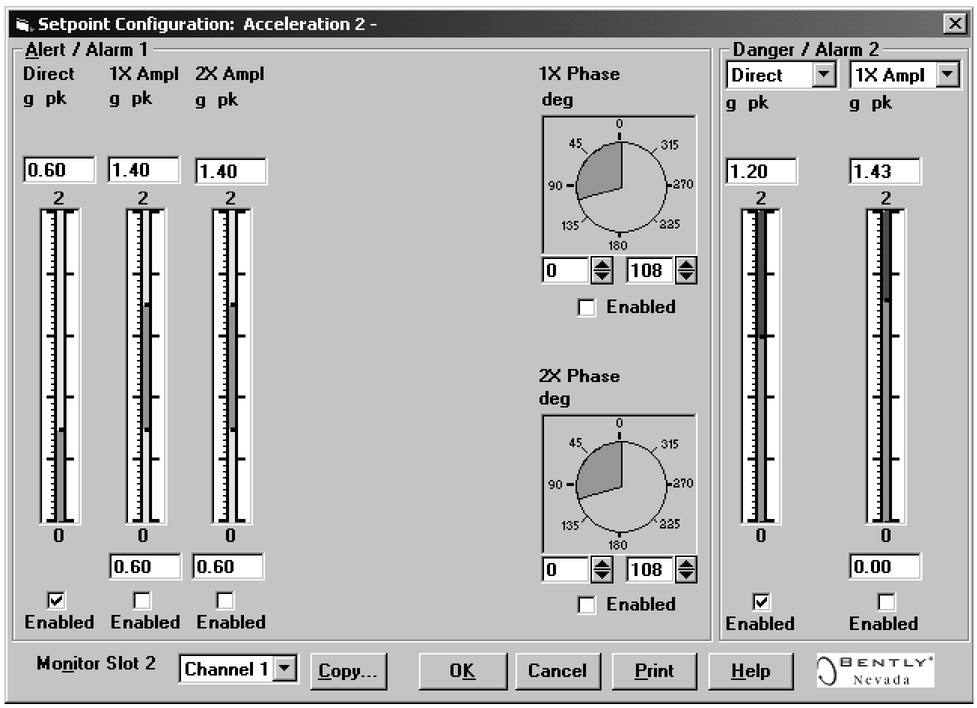
DISABLE Timed OK Channel Defeat when monitoring crankcase or crosshead vibration using either Velocity, Velomitor®, or Acceleration sensors.

27.4 Alarm Setpoints

This section specifies the available setpoints for each type of channel. A setpoint is the level within the full-scale range that determines when an alarm occurs. The 3500 Monitoring System allows Alert/Alarm 1 setpoints to be set for every proportional value on each channel. The channel will drive an Alert/Alarm 1 indication if one or more of the channel proportional values exceeds its setpoints. The 3500 Monitoring System also allows up to four Danger/Alarm 2 setpoints (two over setpoints and two under setpoints) to be set for up to two of the proportional values. You may select any two of the available proportional values for the channel.

Note
The setpoint over and under limits can only be placed within the OK limits of the specified transducer.

Use the following screen in the Rack Configuration Software to adjust Alert/Alarm 1 and Danger/Alarm 2 setpoints. This screen will vary depending upon the type of channel.



27.4.1 Available Setpoints

The following tables list the Alert/Alarm 1 and Danger/Alarm 2 setpoints available for each channel pair type. The setpoint number is used in the Communication Gateway and Display Interface Modules. Bias Voltage is not available as an alarming parameter.

Setpoint Number	Acceleration
1	Over Direct
2	Over 1X Ampl
3	Under 1X Ampl
4	Over 1X Phase Lag
5	Under 1X Phase Lag
6	Over 2X Ampl
7	Under 2X Ampl
8	Over 2X Phase Lag
9	Under 2X Phase Lag
10	Reserved
11	Danger (configurable)
12	Danger (configurable)
13	Danger (configurable)
14	Danger (configurable)

Application Advisory
The standard velocity channel type has only two setpoints and setpoint number 2 was the danger setpoint the equivalent setpoint is now number 11.

27.4.2 Alarm Hysteresis

The alarming hysteresis for all channel configurations is 1/64 of Full Scale. When a channel exceeds an alarm setpoint, it must fall back the setpoint less the hysteresis before it can go out of alarm.

For example, for a channel configuration with a 0 to 10 g full scale and an alarm setpoint of 6 g, the hysteresis = 10 g/64 = 0.16 g. The channel input, therefore, must fall below 6 g – 0.6 g (5.84 g) before the channel is out of alarm.

27.5 Proportional Value Numbers

3500/42M Acceleration II Channels		
Channel	**Proportional Value Number**	**Proportional Value Name**
1	1	Direct
1	2	Bias Voltage
1	3	1X Amplitude
1	4	1X Phase
1	5	2X Amplitude
1	6	2X Phase
1	7	Reserved
2	8	Direct
2	9	Bias Voltage
2	10	1X Amplitude
2	11	1X Phase
2	12	2X Amplitude
2	13	2X Phase
2	14	Reserved

28. Acceleration Verification

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28.1 Introduction

The following sections will describe how to test alarms, verify channels, verify filter corner Frequencies, and test OK limits for channels configured as Acceleration or Acceleration II. The output values and alarm setpoints are verified by varying the input signal level and observing that the correct results are reported in the Verification screen on the test computer.

Acceleration channels can be configured for the following channel values and alarms:

Channel Values	Alarms	
	Over	**Under**
Direct	X	
1X Amplitude and Phase	X	X
2X Amplitude and Phase	X	X

28.2 Test Equipment and Software Setup

The following test equipment and software setup can be used as the initial setup needed for all the verification procedures (Test Alarms, Verify Channels, Verify Filter Corner Frequencies, and Test OK limits).

WARNING!
High voltage present. Contact could cause shock, burns, or death. Do not touch exposed wires or terminals.

Application Alert
Tests will exceed alarm setpoint levels causing alarms to activate. This could result in a relay contact state change.

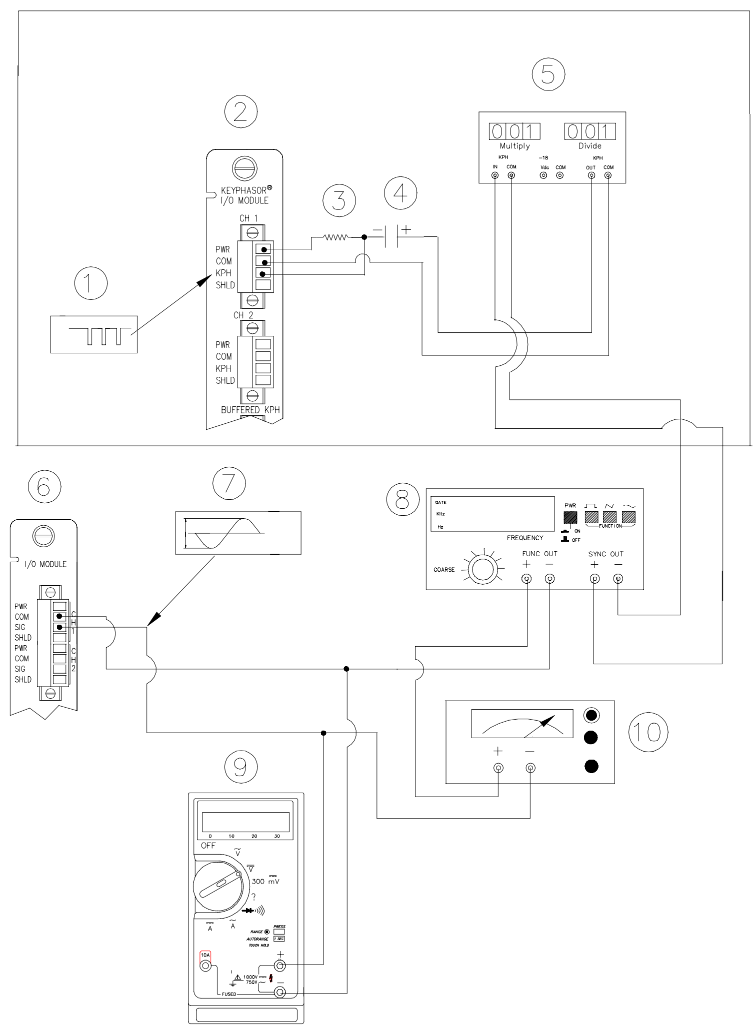
Application Alert
Disconnecting the field wiring will cause a not OK condition.

28.2.1 Test Equipment Setup

Simulate the transducer signal by connecting the power supply, function generator, and multimeter to COM and SIG of channel 1 with polarity as shown in the figure below. Set the test equipment as specified below.

Power Supply	Function Generator	Keyphasor Multiplier/Divider
-7.00 Vdc	Waveform: sinewave DC Volts: 0 Vdc Frequency: 100 Hz Amplitude level: Minimum (above zero)	Multiply Switch: 001 Divide Switch: 001

The equipment shown in the box is required for 1X Amplitude and Phase, 2X Amplitude and Phase.



Acceleration Test Setup

(1) Keyphasor® Signal
(2) Keyphasor® I/O Module
(3) 40 kΩ
(4) 100 µF
(5) Keyphasor® Mulitplier/Divider
(6) Typical I/O module
(7) Simulated input signal
(8) Function generator
(9) Mulitmeter
(10) DC Power Supply

The Test Equipment outputs should be floating relative to earth ground.

28.2.2 Verification Screen Setup

Run the Rack Configuration Software on the test computer. Choose **Verification** from the Utilities menu and choose the proper Slot number and Channel number then click on the **Verify** button.

Note
If the Timed OK Channel Defeat is enabled, it will take 30 seconds for a channel to return to the **OK** status from **not OK**. If OK MODE is configured for latching, press the RESET button on the Rack Interface Module (RIM) to return to the **OK** status.

28.3 Test Alarms

The general approach for testing alarm setpoints is to simulate the Acceleration and Keyphasor® signals with a function generator and power supply. The alarm levels are tested by varying the output from the test equipment and observing that the correct results are reported in the Verification screen on the test computer. It is only necessary to test those alarm parameters that are configured and being used. The general test procedure to verify current alarm operation will include simulating a transducer input signal and varying this signal:

- to exceed over Alert/Alarm 1 and Danger/Alarm 2 Setpoints, and
- to drop below any under Alert/Alarm 1 and Danger/Alarm 2 Setpoints, and
- to produce a nonalarm condition.

When varying the signal from an alarm condition to a nonalarm condition, alarm hysteresis must be considered. Adjust the signal well below the alarm setpoint for the alarm to clear.

28.3.1 Direct

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 28-2.
3. Calculate the verification frequency using the method in "Calculating Verification Frequency" on page 28-16. Adjust the function generator frequency to the calculated value.
4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
5. Adjust the function generator amplitude to produce a reading that is below the Direct setpoint levels on the Direct bar graph display of the Verification screen.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Direct is green, and the Current Value field contains no alarm indication.
7. Adjust the function generator amplitude such that the signal just exceeds the Direct Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from green to yellow and the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains yellow and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal just exceeds the Direct Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from yellow to red and that the Current Value Field indicates an Alarm.
10. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains red and that the Current Value Field still indicates an Alarm.
11. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Direct changes color to green. The Current Value Box should contain no indication of Alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
12. If you cannot verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
13. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
14. Repeat steps 1 through 13 for all configured channels.

28.3.2 1X Amplitude (1X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 28-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
4. Adjust the function generator amplitude to produce a reading that is within the 1X Ampl setpoint levels on the 1X Ampl bar graph display of the Verification screen.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 1X Ampl is green and that the Current Value field contains no alarm indication.
6. Adjust the function generator amplitude such that the signal just exceeds the 1X Ampl Over Alert/Alarm 1 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Ampl changes color from green to yellow and the Current Value Field indicates an Alarm.
7. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Ampl remains yellow and that the Current Value Field still indicates an Alarm.
8. Adjust the function generator amplitude such that the signal just exceeds the 1X Ampl Over Danger/Alarm 2 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Ampl changes color from yellow to red and the Current Value Field indicates an Alarm.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Ampl remains red and that the Current Value Field still indicates an Alarm.
10. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Ampl changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
11. Repeat steps 3 through 10 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the function generator amplitude to exceed the Under Alarm setpoint levels.

12. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
13. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
14. Repeat steps 1 through 13 for all configured channels.

28.3.3 1X Phase

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 28-2.
3. If you can not change the phase output, change the phase alarm setpoints to activate the over and under phase alarms. The setpoints must be downloaded to the monitor to take effect.
4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
5. Adjust the phase to produce a reading that is within the 1X Phase setpoint levels on the 1X Phase bar graph display of the Verification screen.
6. The 1X Amplitude needs to be a minimum of 42.7 mV to get a valid 1X Phase reading.
7. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 1X Phase is green, and the Current Value field contains no alarm indication.
8. Adjust the phase such that the reading just exceeds the 1X Phase Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Phase changes color from green to yellow and the Current Value Field indicates an Alarm.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Phase remains yellow and that the Current Value Field still indicates an Alarm.
10. Adjust the phase such that the reading just exceeds the 1X Phase Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Phase changes color from yellow to red and that the Current Value Field indicates an Alarm.
11. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Phase remains red and that the Current Value Field still indicates an Alarm.
12. Adjust the phase such that the reading is below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Phase changes color to green and that the Current Value Box

contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.

13. Repeat steps 3 through 12 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the phase to exceed the Under Alarm setpoint levels.
14. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
15. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
16. Repeat steps 1 through 15 for all configured channels.

28.3.4 2X Amplitude (2X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 28-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two.
4. Adjust the function generator amplitude to produce a reading that is within the 2X Ampl setpoint levels on the 2X Ampl bar graph display of the Verification screen.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 2X Ampl is green, and the Current Value field has no alarm indication.
6. Adjust the function generator amplitude such that the signal just exceeds the 2X Ampl Over Alert/Alarm 1 setpoint level. Wait 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 2X Ampl changes color from green to yellow and that the Current Value Field indicates an Alarm.
7. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Ampl remains yellow and that the Current Value Field still indicates an Alarm.

8. Adjust the function generator amplitude such that the signal just exceeds the 2X Ampl Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 2X Ampl changes color from yellow to red and that the Current Value Field indicates an Alarm.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Ampl remains red and that the Current Value Field still indicates an Alarm.
10. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 2X Ampl changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
11. Repeat steps 3 through 10 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the function generator amplitude to exceed the Under Alarm setpoint levels.
12. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
13. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
14. Repeat steps 1 through 13 for all configured channels.

28.3.5 2X Phase

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 28-2.

Note
If you can not change the phase output, change the phase alarm setpoints to activate the over and under phase alarms. The setpoints must be downloaded to the monitor to take effect.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two.
4. Adjust the phase to produce a reading that is within the 2X Phase setpoint levels on the 2X Phase bar graph display of the Verification screen.

5. The 2X Amplitude needs to be a minimum of 42.7 mV to get a valid 2X Phase reading.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 2X Phase is green, and the Current Value field has no alarm indication.
7. Adjust the phase such that the reading just exceeds the 2X Phase Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay and verify that the bar graph indicator for 2X Phase changes color from green to yellow and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Phase remains yellow and that the Current Value Field still indicates an Alarm.
9. Adjust the phase such that the reading just exceeds the 2X Phase Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 2X Phase changes color from yellow to red and that the Current Value Field indicates an Alarm.
10. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Phase remains red and that the Current Value Field still indicates an Alarm.
11. Adjust the phase such that the reading is below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 2X Phase changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
12. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the phase to exceed the Under Alarm setpoint levels.
13. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
14. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
15. Repeat steps 1 through 14 for all configured channels.

28.4 Verify Channel Values

The general approach for testing these parameters is to simulate the Acceleration and Keyphasor® signals with a function generator and power supply. The channel values are verified by varying the output from the test equipment and observing that the correct results are reported in the Verification screen on the test computer.

Note
These parameters have an accuracy specification of ±1 % of full scale.

28.4.1 Direct

1. Disconnect PWR / B, COM, and SIG / A field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 28-2.
3. Calculate the verification frequency using the method in "Calculating Verification Frequency" on page 28-16. Adjust the function generator frequency to the calculated value.
4. Calculate the full-scale voltage using the formulas in "Calculating the Input Voltage for Full-scale" on page 28-17. Adjust the function generator (sine wave) amplitude to the calculated value.
5. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
6. Verify that the Direct bar graph display and the Current Value Box is reading ±1 % of full scale.
7. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
8. Disconnect the test equipment and reconnect the PWR / B, COM, and SIG / A field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
9. Repeat steps 1 through 8 for all configured channels.

28.4.2 1X Amplitude (1X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 28-2.
3. Calculate the full-scale voltage using the formulas in "Calculating the Input Voltage for Full-scale" on page 28-17. Adjust the function generator (sine wave) amplitude to the calculated value.
4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Verify that the 1X Ampl bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

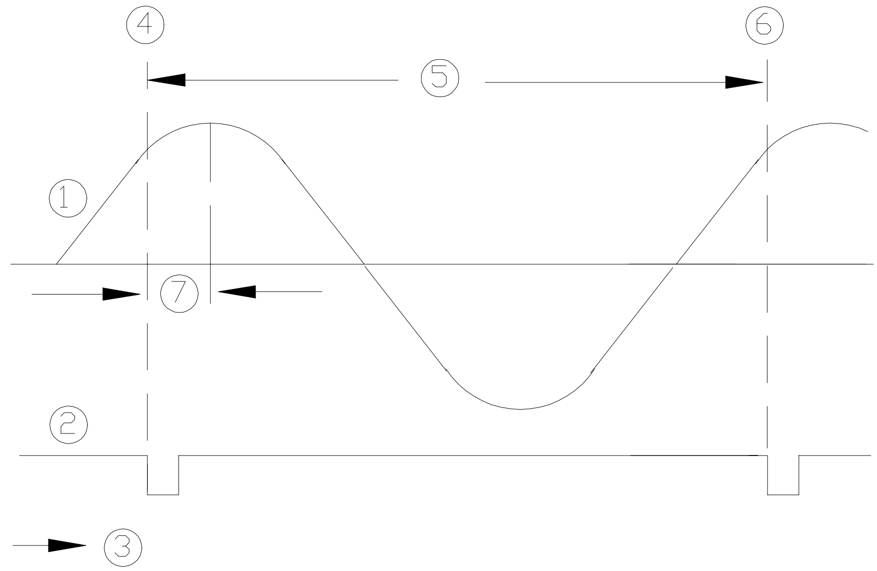
28.4.3 1X Phase

If the test equipment is not capable of changing the phase output to a known value, use the following procedure. If your test equipment can change the phase output to a known value, use the procedure "If the Test Equipment Can Change the Phase Output (1X Phase)".

28.4.3.1 If the Test Equipment Cannot Change the Phase Ouput (1X Phase)

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 28-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
3. Attach one channel of a two channel oscilloscope to the vibration signal buffered output and attach the other channel to the associated Keyphasor® signal buffered output and observe the two signals simultaneously.
4. Measure the phase. 1X Phase will be measured from the leading edge of the Keyphasor® pulse to the first positive peak of the vibration signal. See the example below which illustrates a phase of 45°. Observe the 1X Phase bar graph display and Current Value Box; it should read approximately what was measured above. If integration is enabled then add 90 degrees to the measured value.

Example:
1X = one cycle of vibration signal per shaft revolution



(1) 1X Vibration Signal
(2) Keyphasor Signal
(3) Time
(4) 0°
(5) One cycle
(6) 360°
(7) Phase lag = 45°

5. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
6. Repeat steps 1 through 5 for all configured channels.

28.4.3.2 If the Test Equipment Can Change the Phase Output (1X Phase)

If the test equipment has the capability to change the phase output to a known value, use the following procedures.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 28-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
3. Adjust the phase for mid-scale. Verify that the 1X Phase bar graph display and Current Value Box is reading ±1.5 % of mid-scale.

4. If the reading does not meet specifications double check the input signal to ensure it is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
5. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
6. Repeat steps 1 through 5 for all configured channels.

28.4.4 2X Amplitude (2X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 28-2.
3. Calculate the full-scale voltage using the formulas in "Calculating the Input Voltage for Full-scale" on page 28-17. Adjust the function generator (sine wave) amplitude to the calculated value.
4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two. Verify that the 2X Ampl bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

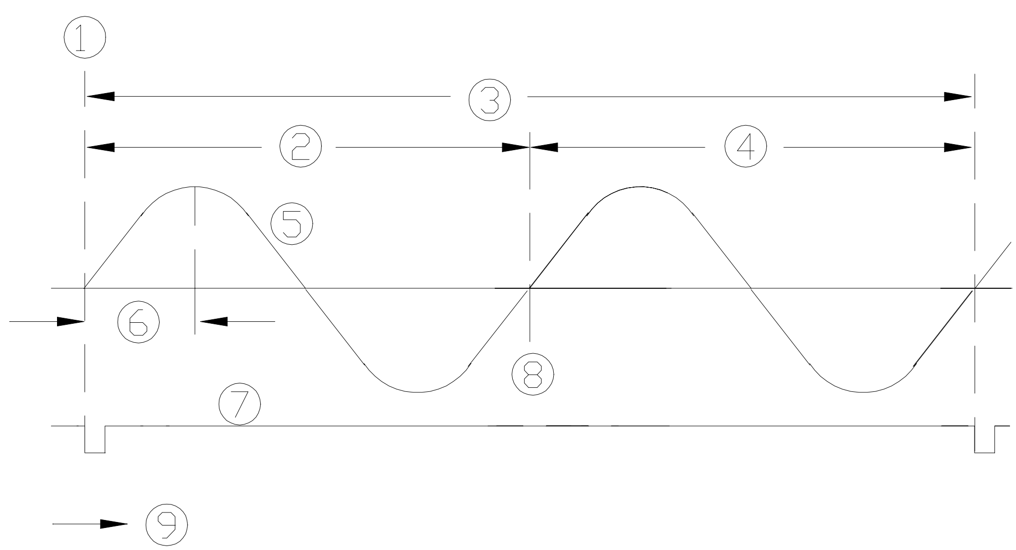
28.4.5 2X Phase

If the test equipment is not capable of changing the phase output to a known value, use the following procedure. If your test equipment can change the phase output to a known value, use the procedure "If the Test Equipment can Change the Phase Output (2X Phase)".

28.4.5.1 If the Test Equipment Cannot Change the Phase Output (2X Phase)

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 28-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two.
4. Attach one channel of the two channel oscilloscope to the vibration signal buffered output and attach the other channel to the associated Keyphasor® signal buffered output and observe the two signals simultaneously.
5. Measure the phase. 2X Phase will be measured from the leading edge of the Keyphasor® pulse to the first positive peak of the vibration signal. See the example below, which illustrates a phase of 90°. Observe the 2X Phase bar graph display and Current Value Box; it should read approximately what was measured above. If integration is enabled then add 90 degrees to the measured value.

Example:
2X = two cycles of vibration signal per shaft revolution



1. 0°
2. First Cycle
3. One shaft revolution
4. Second cycle
5. 2X Vibration Signal
6. Phase lag = 90°
7. Keyphasor® signal
8. 360°
9. Time

6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

28.4.5.2 If the Test Equipment can Change the Phase Output (2X Phase)

If the test equipment has the capability to change the phase output to a known value, use the following procedure.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 28-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two.
3. Adjust the phase for mid-scale. Verify that the 2X Phase bar graph display and Current Value Box is reading ±1.5 % of mid-scale.
4. If the reading does not meet specifications, double check the input signal to ensure it is correct. If the monitor still does not meet specifications and/or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
5. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
6. Repeat steps 1 through 5 for all configured channels.

28.4.6 Calculating Verification Frequency

The procedures for verifying channel values and corner frequencies require that you use the following formulas to calculate the verification frequency.

Find the geometric center of the Band-pass frequency range. Input the configured high-pass filter corner frequency and the low-pass filter corner frequency into the formula below:

$$\text{Verification Frequency} = \sqrt{\text{HPF} * \text{LPF}}$$

HPF = High-pass Filter Corner Frequency
LPF = Low-pass Filter Corner Frequency

- If no filtering is configured, use a verification frequency of 100 Hz.
- If a low-pass filter is configured and no high-pass filter is configured, use the following to determine the HPF to use in the formula:
- If the units are integrated or rms, use a HPF of 10 Hz. For any other configuration, use a HPF of 3 Hz.
- If a high-pass filter is configured and no low-pass filter is configured, use the following to determine the LPF to use in the formula:
- If the configuration is with **no** integration, use a LPF of 30 kHz.

- If the configuration is **with** integration, use a LPF of 14.5 kHz.

28.4.7 Calculating the Input Voltage for Full-scale

The procedures for verifying channel values and corner frequencies required that you use the following formulas to calculate the input voltage for full-scale. To find the full-scale input voltage, use appropriate table for integrated or non-integrated units.

Note
Use the transducer scale factor displayed in the Scale Factor Box on the Verification screen.

Full Scale Formulas - No Integration

Units	**To Input RMS Volts**	**To Input Peak to Peak Volts**
g peak	(T.S.F. x Full-scale) x 0.707	(T.S.F. x Full-scale) x 2
g rms	(T.S.F x Full-scale)	(T.S.F. x Full-scale) x 2.82
m/s^2 peak	(T.S.F. x Full-scale) x 0.707	(T.S.F. x Full-scale) x 2
m/s^2 rms	(T.S.F x Full-scale)	(T.S.F. x Full-scale) x 2.82
T.S.F = Transducer Scale Factor. To use the formulas, the T.S.F. should be in volts and the T.S.F. and full-scale values should both be of the same unit system (metric or English). The transducer Scale Factor will always be specified as volts per g pk or volts per m/s^2 pk.		

Example 1:
Transducer Scale Factor = 100 mV/g
Full Scale = 2 g peak

For Peak to Peak input:
$(0.100 \times 2) \times 2 = 0.4$ Vpp

For Vrms input:
$(0.100 \times 2) \times 0.707 = 0.1414$ Vrms

Example 2:
Transducer Scale Factor = 10.19 mV/(m/s^2)
Full Scale = 20 m/s^2 pk

For Peak to Peak input:

$(0.01019 \times 20) \times 2 = 0.4076$ Vpp

For RMS input:
$(0.01019 \times 20) \times 0.707 = 0.1440$ Vrms

28.4.8 Full Scale Formulas - Integration

(For the Following units: in/s pk, in/s rms, mm/s pk, mm/s rms)

To input rms volts for peak full scale units:

$$\text{Input Voltage (V rms)} = \frac{\text{Full - Scale (English units)}}{\left[\left(\frac{30.72}{\text{Scale Factor (English units)}}\right) / \text{Verification Frequency}\right]} * 0.3535$$

To input rms volts for rms full scale units:

$$\text{Input Voltage (V rms)} = \frac{\text{Full - Scale (English units)}}{\left[\left(\frac{30.72}{\text{Scale Factor (English units)}}\right) / \text{Verification Frequency}\right]} * 0.5$$

To input peak to peak volts for peak full scale units:

$$\text{Input Voltage (V pp)} = \frac{\text{Full - Scale (English units)}}{\left[\left(\frac{30.72}{\text{Scale Factor (English units)}}\right) / \text{Verification Frequency}\right]}$$

To input peak to peak volts for RMS full scale units:

$$\text{Input Voltage (V pp)} = \frac{\text{Full - Scale (English units)}}{\left[\left(\frac{30.72}{\text{Scale Factor (English units)}}\right) / \text{Verification Frequency}\right]} * 1.414$$

To use the formulas, the acceleration full-scale value and scale factor should be in English units. Use the following conversion formulas to convert metric units to English units:

Scale Factor:

$$\text{Accel Scale Factor (mV/g)} = \text{Accel Scale Factor (mV/(m/}s^2\text{)} * 9.8135$$

Full-scale:

$$\text{Full - Scale (mm/s)} = \text{Full - Scale (in/s)} * 0.39372$$

Example:
Transducer Scale Factor = 10.19 mV/(m/s^2)
Full Scale = 25 m/s^2 pk
HPF = 10 Hz
LPF = 8000 Hz

1. Convert metric units to English units.

   Scale Factor:

   $$10.19\,(\text{mV}/(\text{m}/\text{s}^2) * 9.8135 = 100\,(\text{mV/g})$$

   Full-scale:

   $$25\,(\text{mm/s}) * 0.39372 = 1.0\,(\text{in/s})$$

2. Calculate the input voltage.

   $$\text{Verification Frequency} = \sqrt{10\text{ Hz} * 8000\text{ Hz}} = 282.84\text{ Hz}$$

To Input RMS Volts for Peak Units

$$\text{Input Voltage (V rms)} = \frac{1.0\text{ in/s}}{\left[\left(\frac{30.72}{0.1\,(\text{V/g})}\right) / 282.84\text{ Hz}\right]} * 0.3535 = 0.3254\text{ (V rms)}$$

To Input Peak to Peak Volts for Peak Units

$$\text{Input Voltage (V pp)} = \frac{1.0\text{ in/s}}{\left[\left(\frac{30.72}{0.1\,(\text{V/g})}\right) / 282.84\text{ Hz}\right]} = 0.9207\text{ (V pp)}$$

28.5 Test OK Limits

Note
If the Danger Bypass has been activated, then the BYPASS LED will be on. All other channels in the rack must be OK or bypassed for the OK relay to be energized.

The general approach for testing OK limits is to input a DC voltage and adjust it above the Upper OK limit and below the Lower OK limit. This should cause a not OK condition and cause the OK Relay to change state. The Upper and Lower OK limits are displayed in the Verification screen on the test computer.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 28-2.
3. Bypass all other configured channels.
4. Adjust the power supply voltage to -7.00 Vdc.

5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the monitor OK LED is on and that the Channel OK State line in the Channel Status section of the Verification Display screen reads **OK**.
6. Verify that the OK relay on the Rack Interface I/O Module indicates OK (energized). See 3500/20 Rack Interface Module manual, part #129768-01.
7. Increase the power supply voltage (more negative) until the OK LED just goes off (upper limit). Verify that the Channel OK State line on the Verification screen reads **not OK** and that the OK Relay indicates not OK. Verify that the Upper OK limit voltage displayed on the Verification screen is equal to or more positive than the input voltage.
8. Decrease the power supply voltage (less negative) to -7.00 Vdc.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on and the OK relay energizes. Verify that the Channel OK State line in the Channel Status section reads **OK**.
10. Gradually decrease the power supply voltage (less negative) until the OK LED just goes off (lower limit). Verify that the Channel OK State line in the Channel Status section reads **not OK** and that the OK Relay indicates not OK. Verify that the Lower OK limit voltage displayed on the Verification screen is equal to or more negative than the input voltage.
11. Increase the power supply voltage (more negative) to -7.00 Vdc.
12. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on, the OK relay energizes, and the Channel OK State line in the Channel Status section reads **OK**.
13. If you can't verify any configured OK limit, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
14. Disconnect the power supply and multimeter and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O Module. Press the RESET switch on the Rack Interface Module (RIM) and verify that the OK LED comes on and the OK relay energizes.
15. Repeat steps 1 through 14 for all configured channels.
16. Return the bypass switch for all configured channels back to their original setting.

Acceleration Default OK Limits Table

Transducer	Lower Ok Limit (Volts)	Upper Ok Limit (Volts)
23733-03 w/o barriers	-2.7 to -2.8	-15.0 to -15.1
23733-03 w/ barriers	-3.05 to -3.15 -2.7 to -2.8 *	-13.8 to -13.9 -15.0 to -15.1 *
49578-01 w/o barriers	-5.58 to -5.68	-11.32 to -11.42
49578-01 w/ barriers	-5.29 to -5.39 -5.58 to -5.68 *	-10.81 to -10.91 -11.32 to -11.42 *
24145-02 w/o barriers	-2.7 to -2.8	-15.0 to -15.1
155023-01 w/o barriers	-5.58 to -5.68	
330400 w/ barriers	-3.05 to -3.15 -2.7 to -2.8 *	-13.8 to -13.9 -15.0 to -15.10 *
330400 w/o barriers	-2.7 to -2.8	-15.0 to -15.10
330425 w/ barriers	-5.29 to -5.39 -5.58 to -5.68 *	-10.81 to -10.91 -11.32 to -11.42 *
330425 w/o barriers	-5.58 to -5.68	-11.32 to -11.42
Note: Assume ±50 mV accuracy for check tolerance. * = BN Internal Barrier I/O Modules.		

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29. Shaft Absolute General Information

Shaft absolute vibration is the vibration of a shaft relative to an inertial (fixed point in free space) reference frame. A shaft absolute measurement uses two signals – one from a proximity probe and one from velocity transducer. These transducers operate in groups with a proximity probe and velocity transducer installed radially at the same point, usually in a common junction box on the machine bearing.

These two transducers provide the following four separate measurements:

1. shaft relative radial position within the bearing clearance,
2. shaft dynamic motion relative to the bearing,
3. machine casing absolute vibration measured by the velocity transducer, and
4. shaft absolute motion represented by the summation of the velocity signal integrated to displacement and added to the shaft relative signal.

The 3500 Monitoring System uses one 4-channel monitor for shaft absolute vibration measurements in both the X and Y planes. These monitors have two channels configured as Shaft Absolute Radial Vibration and two as Shaft Absolute Velocity. The channels are configured and verified as channel pairs – one pair as Radial Vibration and the other as Velocity. These channels are then associated into functional groups with a Radial Vibration and a Velocity channel in each group. For example, in a 3500 monitor that is measuring shaft absolute vibration, Group 1 contains channels 1 and 3 and Group 2 contains channels 2 and 4.

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30. Shaft Absolute Configuration

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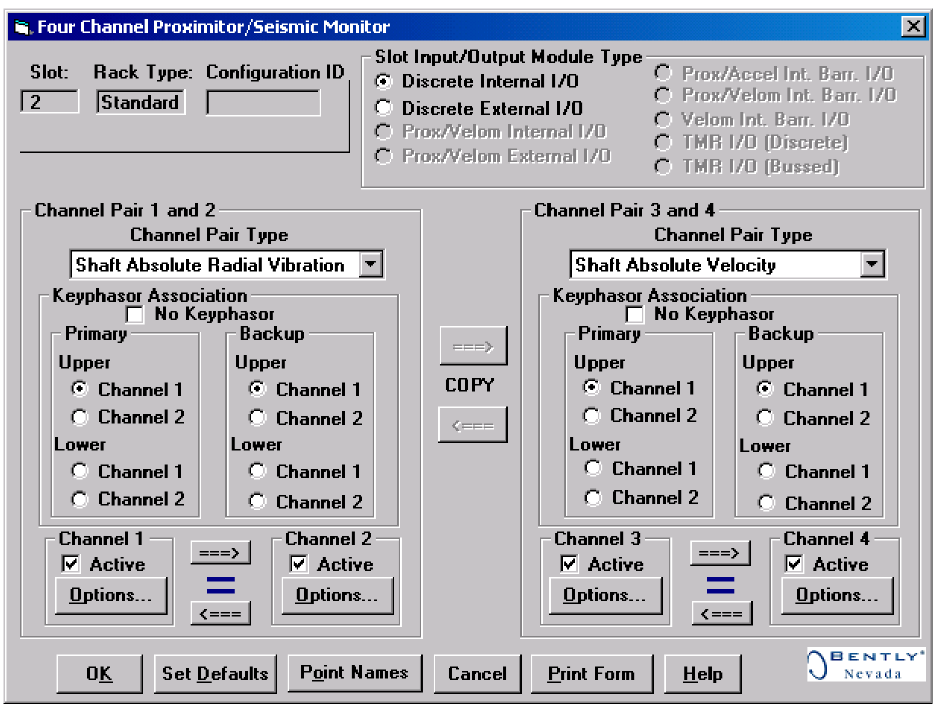
30.1 Introduction

This section describes the configuration considerations that apply to all Shaft Absolute channels.

30.2 About Shaft Absolute Channel Types

In the 3500 Monitoring System, all four channels of a Proximitor®/Seismic monitor are required for shaft absolute measurements. One channel pair must be configured as Shaft Absolute Radial Vibration and the other as Shaft Absolute Velocity. This configuration is shown in the following figure.

After they are configured, these channels are associated in two functional groups. Each group contains a Shaft Absolute Radial Vibration channel and a Shaft Absolute Velocity channel. Group 1 consists of channels 1 and 3 and Group 2 of channels 2 and 4. The shaft absolute proportional values are derived from both channels in a functional group.



30.3 Configuration Considerations

The following configuration considerations apply to all Shaft Absolute channels:

- The Shaft Absolute Velocity channel type and the Shaft Absolute Radial Vibration channel type are configured in channel pairs, but the association of the particular shaft absolute proximity and velocity transducers is according to Group 1 (channels 1 and 3) and Group 2 (channels 2 and 4).

- Monitors must be configured in channel pairs (for example, when channels 1 and 2 are configured as Shaft Absolute Radial Vibration, channels 3 and 4 must be configured as Shaft Absolute Velocity).
- The Shaft Absolute Direct proportional value will become invalid when either of the associated radial vibration or velocity transducers become not-OK.
- The Shaft Absolute Direct proportional value is the vector summation the Shaft Absolute Velocity Direct and the Shaft Absolute Radial Vibration Direct signals.
- The Shaft Absolute Direct proportional value will operate on the combined Timed OK Channel Defeat options of the radial vibration and velocity channels.

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31. Shaft Absolute Radial Vibration Options

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31.1 Introduction

This section discusses the Configuration Considerations and the Rack Configuration Software screens associated with the Shaft Absolute Radial Vibration Channel.

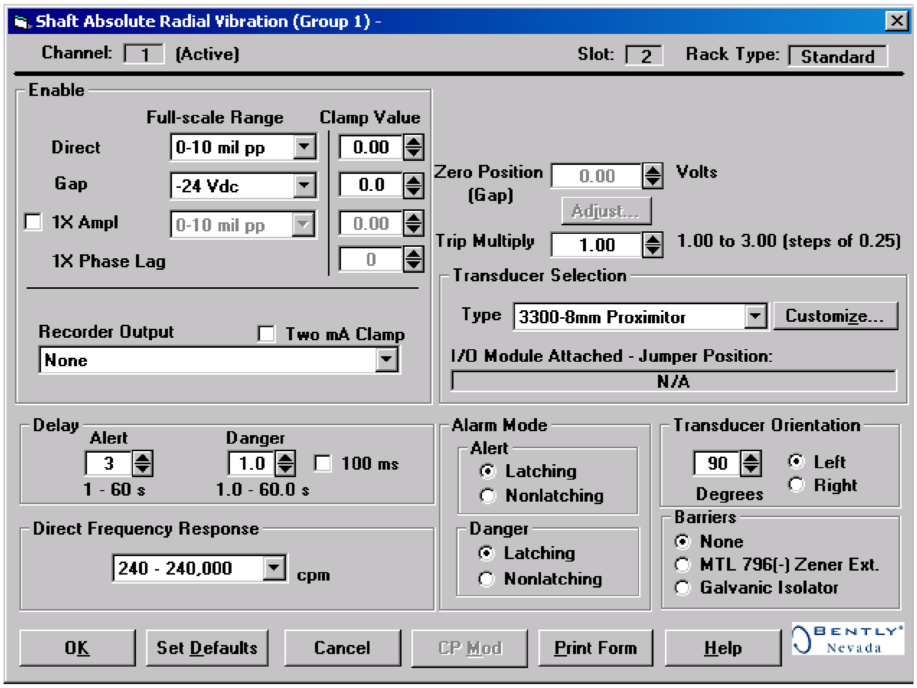
31.2 Configuration Considerations

Consider the following items before configuring a Shaft Absolute Radial Vibration Channel:

- The Shaft Absolute Velocity channel type and the Shaft Absolute Radial Vibration channel type are configured in channel pairs, but the association of the particular shaft absolute proximity and velocity transducers is according to Group 1 (channels 1 and 3) and Group 2 (channels 2 and 4).
- When "No Keyphasor" is selected, the 1X Amplitude (Ampl) and Phase Lag can not be selected.
- If a Keyphasor channel is selected, a Keyphasor Module must be installed in the rack.
- The 1X Phase value can be enabled only if the selected Keyphasor channel is configured for an events per revolution equal to 1 will.
- The full scale options allowed for each proportional value is dependent upon the transducer type.
- If a Non-Standard transducer is selected, the setpoint OK limits are set to ±1 volt from the Upper and Lower OK limits that are selected.
- Setpoints may only be set on proportional values which are enabled.
- When a full-scale range is modified, the setpoints associated with this proportional value should be readjusted.
- It is best to set the Scale Factor value and the Trip Multiply value before the Zero Position value.

31.3 Configuration Options

This section describes the options available on the Shaft Absolute Radial Vibration Channel configuration screen.



31.3.1 General Parameters and Buttons

Timed OK Channel Defeat: This prevents a channel from returning to an OK status until that channel's transducer has remained in an OK state for 30 seconds. This feature is always enabled in the Radial Vibration Channels. The option protects against false trips caused by intermittent transducers.

CP Mod: Selecting the CP Mod button Channel Options Dialog Box allows a Custom channel configuration to be downloaded to the monitor. Custom configuration data is stored in a Custom Products Modification File. Custom Products Modification files follow the naming convention <modification #.mod>. These files must be located in the \3500\Rackcfg\Mods\ directory. When a CP Mod file is selected, a window is displayed which describes the function of the modification. CP Mod files are available through Bently Nevada's Custom Products Division. Contact your local Bently Nevada Sales Representative for details.

Zero Position (Gap): Represents the zero position (in volts) when the gap scale is to read the engineering units of displacement. To ensure maximum amount of zero adjustment, the probe should be gapped as close as possible to the center gap voltage specified in the OK Limit table. This field is not available for Voltage Gap Scale.

Adjust Button: Adjust the Zero Position voltage. When this button is clicked, a utility starts that helps you set the gap zero position voltage. Since this utility provides active feedback from the 3500 rack, a connection with the rack is required. Refer to “Adjusting the Scale Factor and Zero Position” in the "Monitor Verification" section of the manual.

Trip Multiply: The value selected to temporarily increase the alarm (Alert and Danger) setpoint values. This value is normally applied by manual (operator) action during startup to allow a machine to pass through high vibration speed ranges without monitor alarm indications. Such high vibration speed ranges may include system resonances and other normal transient vibrations.

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. Refer to “Setting the I/O Jumper” in the "I/O Module Descriptions" section of the manual, if applicable.

31.3.2 Reference Information

These fields contain information that indicates which module you are configuring.

Channel: The number of the channel being configured (1 or 2).

Group: The association of channels which derive the shaft absolute signal. Group 1 consists of channels 1 and 3, Group 2 consists of channels 2 and 4.

Slot: The location of the monitor in the 3500 rack (2 through 15).

Rack Type: Identifies the type of Rack Interface Module installed in the rack (Standard or TMR).

31.3.3 Enable

An enabled proportional value specifies that the value will be provided by the channel (☑ enabled, ☐ disabled).

Direct: Data which represents the overall peak to peak vibration. All frequencies within the selected Direct Frequency Response are included in this proportional value.

Gap: The physical distance between the face of a proximity probe tip and the observed surface. The distance can be expressed in terms of displacement (mils, micrometres) or in terms of voltage. Standard polarity convention dictates that a decreasing gap results in an increasing (less negative) output signal.

1X Ampl: In a complex vibration signal, notation for the amplitude component that occurs at the rotative speed frequency.

1X Phase Lag: In a complex vibration signal, notation for the phase lag component that occurs at the rotative speed frequency.

Full Scale Range: Each selectable proportional value provides the ability to set a full scale value. If the desired full scale value is not in the pull down list, then the custom selection can be chosen.

The values in the following table are the same for all transducer types.

Direct 1X Ampl
0-5 mil pp
0-10 mil pp
0-15 mil pp
0-20 mil pp
0-100 µm pp
0-150 µm pp
0-200 µm pp
0-400 µm pp
0-500 µm pp
Custom

Gap Full Scale Ranges by transducer type

3300 XL 8mm Proximitor 3300–5 mm Proximitor 3300–8 mm Proximitor 7200–5 mm Proximitor 7200–8 mm Proximitor	3300 XL 11mm Proximitor 7200–11 mm Proximitor 7200–14 mm Proximitor Nonstandard
-24 Vdc	-24 Vdc
15-0-15 mil	15-0-15 mil
25-0-25 mil	25-0-25 mil
300-0-300 µm	50-0-50 mil
600-0-600 µm	300-0-300 µm
Custom	600-0-600 µm
	1000-0-1000 µm
	Custom

Clamp Value: The value that a proportional value goes to when that channel or proportional value is bypassed or defeated (For example when a problem occurs with the transducer). The selected value can be between the minimum and maximum full-scale range values. (1X Phase Lag has available values of 0 to 359 degrees.) Only the values available from the Recorder Outputs, Communication Gateway and Display Interface Module are clamped to the specified value when the proportional value is invalid.

Recorder Output: The proportional value of a channel that is sent to the 4 to 20 mA recorder. The recorder output is proportional to the measured value over the channel full scale range. An increase in the proportional value that would be indicated as upscale on a bar graph display results in an increase in the current at the recorder output.

If 1X Phase Lag is selected then the two options available are with and without Hysteresis. If the channel is Bypassed, the output will be clamped to the selected clamp value or to 2 mA (if the 2 mA clamp is selected).

The Hysteresis option helps prevent the Recorder Output from jumping from Full to Bottom Scale when the phase measurement is near 0 or 359 degrees. When the Hysteresis option is checked, the recorder signal operates as follows:

- The recorder output is scaled such that 4 mA corresponds to 0 degrees and 20 mA corresponds to 380 degrees (360 plus 20 degrees).
- The transition of a phase measurement that is increasing does not occur until the measurement has gone 20 degrees past 360 degrees. At this point, the recorder signal switches from 20 mA to a signal that corresponds to 20 degrees or 4.842 mA.
- The transition of a phase measurement that is decreasing occurs at 0 degrees (4 mA). At this point, the recorder signal switches from 4 mA to a signal that corresponds to 360 degrees or 19.158 mA.

31.3.4 Delay

The time which a proportional value must remain at or above an over alarm level or below an under alarm level before an alarm is declared as active.

Alert: First level alarm that occurs when the transducer signal level exceeds the selected Alert/Alarm 1 setpoint. This setpoint can be set on the Setpoint screen. The Alert time delay is always set at one second intervals (from 1 to 60) for all available proportional values.

Danger: Second level alarm that occurs when the transducer signal level exceeds the selected Danger/Alarm 2 setpoint. This setpoint can be set on the Setpoint screen.

100 ms option: The 100 ms (typical) option applies to the Danger time delay only and has the following results:

If the 100 ms option is off (☐):

- The Danger time delay can be set at one second intervals (from 1 to 60).
- The Danger time delay can be set for up to two available proportional values.

If the 100 ms option is on (☑):

- The Danger time delay is set to 100 ms.
- The Danger time delay can only be set for the primary proportional value.

31.3.5 Direct Frequency Response

The upper and lower corners for the band-pass filter used with direct vibration measurements. The available ranges are 240 to 240,000 cpm and 60 to 36,000 cpm.

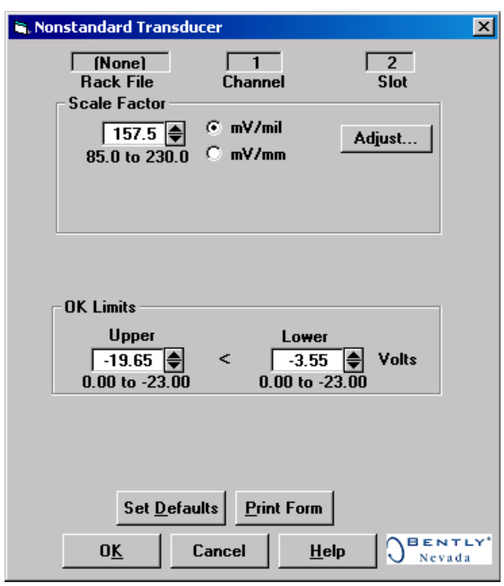
31.3.6 Transducer Selection

Type: The following transducer types are available for the Shaft Absolute Radial Vibration Channel:

- 3300 XL 8 mm Proximitor
- 3300 XL 11mm Proximitor
- 3300 – 5 mm Proximitor
- 3300 – 8 mm Proximitor
- 7200 – 5 mm Proximitor
- 7200 – 8 mm Proximitor
- 7200 – 11 mm Proximitor
- 7200 – 14 mm Proximitor
- Nonstandard

Customize button: Used to adjust the Scale Factor for transducers. Refer to "Adjusting the Scale Factor and Zero Position" in the "Monitor Verification" section of the manual. Also, note that:

- If Non-standard is selected as the transducer type, the OK Limits can also be adjusted.
- The Non-standard transducer's scale factor must be between 85 and 230 mV/mil.
- There must be at least 2 volts between the Upper and Lower OK Limits.



Scale Factor by Transducer Type

Transducer	Scale Factor
3300 5 and 8 mm 3300 XL 8 mm 7200 5 and 8 mm	200 mV/mil 200 mV/mil 200 mV/mil
3300 XL 11 mm 7200 11 mm	100 mV/mil
7200 14 mm	100 mV/mil
Note: ±15 % scale factor adjustment allowed. * Barriers are not supported with this transducer option.	

Shaft Absolute Radial Vibration OK Limits by Transducer Type

Transducer	Upper (V)	Lower (V)	Center Gap Voltage (V)
3300 XL 8 mm	-16.75	-2.75	-9.75
3300 XL 11 mm	-16.75	-2.75	-9.75
3300 8 mm	-16.75	-2.75	-9.75
3300 5 mm	-16.75	-2.75	-9.75
7200 5 mm 7200 8 mm	-16.75	-2.75	-9.75
7200 11 mm	-19.65	-3.55	-11.6
7200 14 mm	-16.75	-2.75	-9.75

Transducer Jumper Status (on I/O Module): The jumper position on the Shaft Absolute I/O module applies to the Shaft Absolute Velocity channel pair with channels 3 and 4. For Shaft Absolute Radial Vibration the jumper status does not apply. Refer to “Setting the I/O Jumper” in the manual of the monitor that contains this channel.

31.3.7 Alarm Mode

Alert should be the first level alarm that occurs when the transducer signal level exceeds the selected value. Danger should be the second level alarm that occurs when the transducer signal level exceeds the selected value. The Alert and Danger values are set on the Setpoint screen.

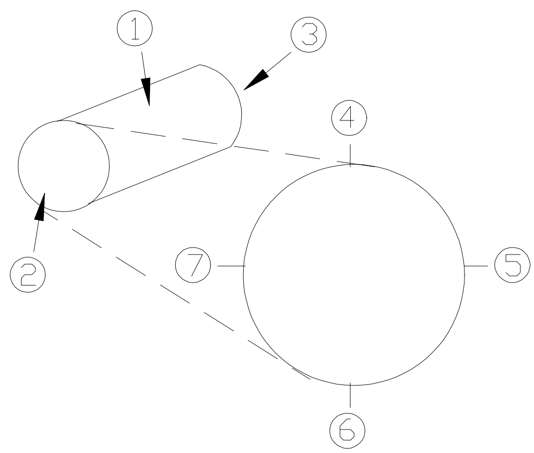
Latching: Once an alarm is active it will remain active even after the proportional value drops below the configured setpoint level. The channel will remain in alarm until it is reset using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: When an alarm is active it will go inactive as soon as the proportional value drops below the configured setpoint level.

31.3.8 Transducer Orientation

Degrees: The location of the transducer on the machine. The range for orientation angle is 0 to 180 degrees left or right as observed from the driver to the driven end of the machine train. Refer to the following figure:



This drawing is for horizontal shafts.

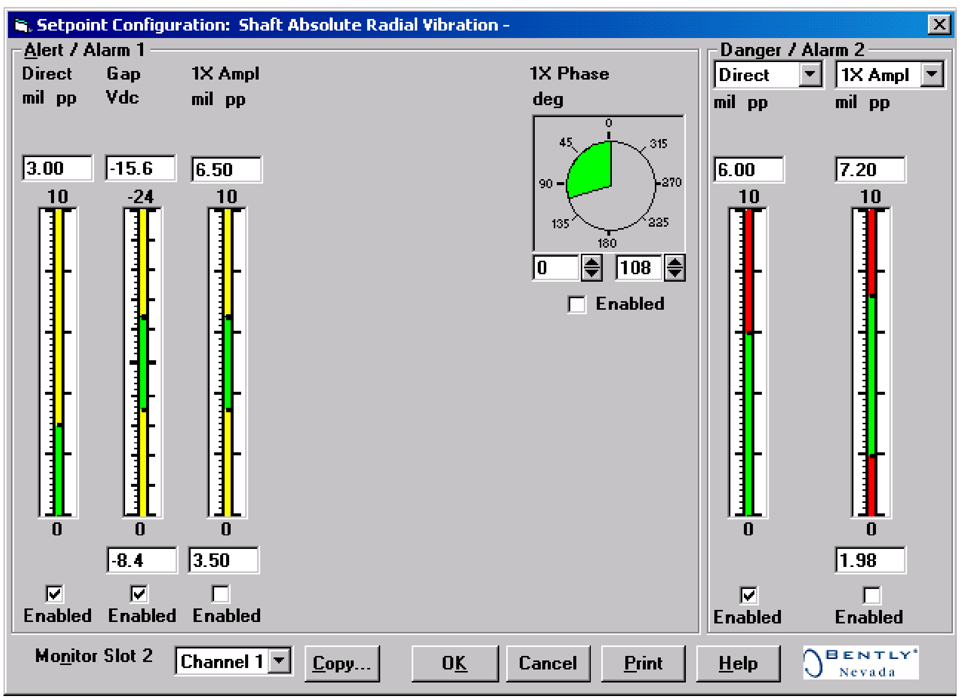
(1) Shaft
(2) Driver end
(3) Driven end
(4) 0°
(5) 90° right
(6) 180°
(7) 90° left

31.4 Alarm Setpoints

This section specifies the available setpoints for Shaft Absolute Radial Vibration channel type. A setpoint is the level within the full-scale range that determines when an alarm occurs. The 3500 Monitoring System allows Alert/Alarm 1 setpoints to be set for every proportional value on each channel. The channel will drive an Alert/Alarm 1 indication if one or more of the channel proportional values exceeds its setpoints. The 3500 Monitoring System also allows up to four Danger/Alarm 2 setpoints (two over setpoints and two under setpoints) to be set for up to two of the proportional values. You may select any two of the available proportional values for the channel.

Note
The setpoint over and under limits can only be placed within the OK limits of the specified transducer.

Use the following screen in the Rack Configuration Software to adjust Alert/Alarm 1 and Danger/Alarm 2 setpoints for the Shaft Absolute Radial Vibration channel type.



31.4.1 Available Setpoints

The following table lists the Alert/Alarm 1 and Danger/Alarm 2 setpoints available for the Shaft Absolute Radial Vibration channel type. The setpoint number is used in the Communication Gateway and Display Interface Modules.

Setpoint Number	Shaft Absolute Radial Vibration
1	Over Direct
2	Over Gap
3	Under Gap
4	Over 1X Ampl
5	Under 1X Ampl
6	Over 1X Phase Lag
7	Under 1X Phase Lag
8	Danger (configurable)
9	Danger (configurable)
10	Danger (configurable)
11	Danger (configurable)
12	
13	
14	

31.4.2 Alarm Hysteresis

The alarming hysteresis for all channel configurations is 1/64 of Full Scale. When a channel exceeds an alarm setpoint, it must fall back the setpoint less the hysteresis before it can go out of alarm.

For example, for a channel configuration with a 0 to 10 mil full scale and an alarm setpoint of 6 mils, the hysteresis = 10 mils/64 = 0.16 mils. The channel input, therefore, must fall below 6 mils – 0.16 mils (5.84 mils) before the channel is out of alarm.

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32. Shaft Absolute Radial Vibration Verification

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32.1 Introduction

The following sections describe how to test alarms, verify channels, and test OK limits for channels configured as Shaft Absolute Radial Vibration. The output values and alarm setpoints are verified by varying the input vibration signal level (both peak to peak amplitude and DC voltage bias) and observing that the correct results are reported in the Verification screen on the test computer.

Shaft Absolute Radial Vibration channels can be configured for the following channel values and alarms:

Channel Values	Alarms	
	Over	Under
Direct	X	
Gap	X	X
1X Amplitude and Phase	X	X

32.2 Test Equipment and Software Setup

The following test equipment and software setup can be used as the initial set up needed for all the Shaft Absolute Radial Vibration channel verification procedures (Test Alarms, Verify Channels, and Test OK Limits).

WARNING!

High voltage present. Contact could cause shock, burns, or death. Do not touch exposed wires or terminals.

Application Alert

Tests will exceed alarm setpoint levels causing alarms to activate. This could result in a relay contact state change.

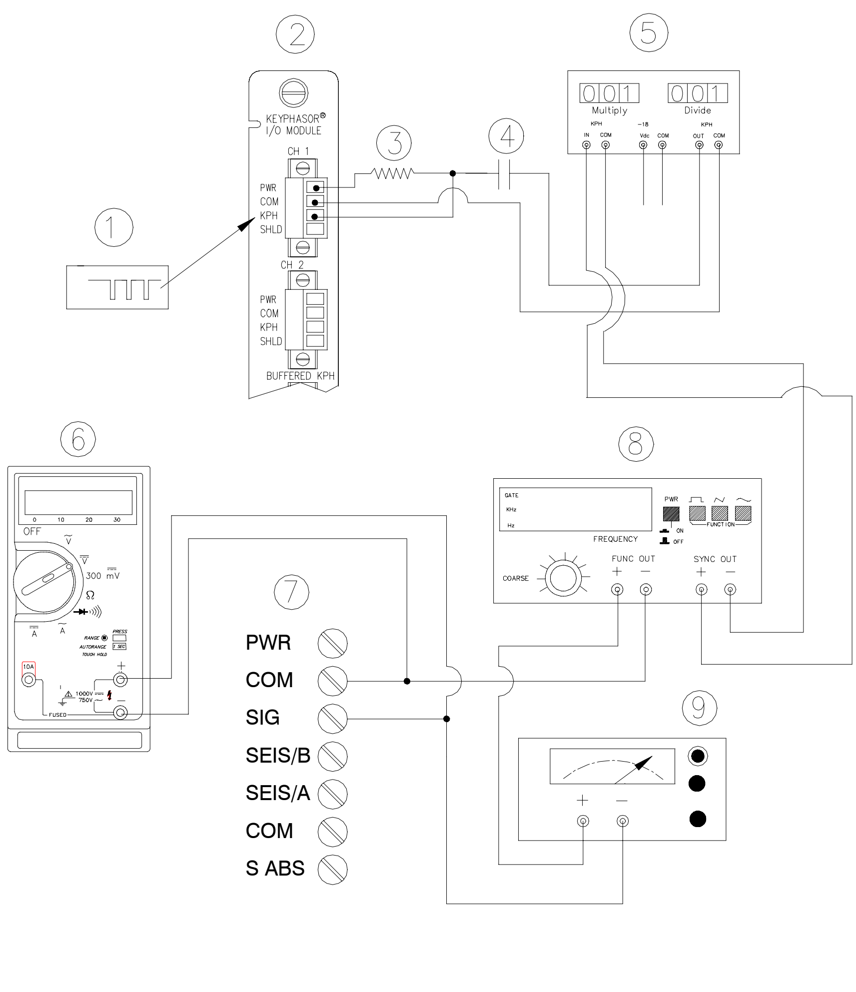
Application Alert

Disconnecting the field wiring will cause a not OK condition.

32.2.1 Test Equipment Setup

Simulate the transducer signal by connecting the power supply, function generator, and multimeter to COM and SIG of channel 1 with polarity as shown in the figure below (Shaft Absolute Radial Vibration Test Setup). Set the test equipment as specified below.

Power Supply	Function Generator	Keyphasor Multiplier/Divider
-7.00 Vdc	Waveform: sinewave DC Volts: 0 Vdc Frequency: 100 Hz Amplitude level: Minimum (above zero)	Multiply Switch: 001 Divide Switch: 001



Shaft Absolute Radial Vibration Test Setup

(1) Keyphasor® Signal
(2) Keyphasor® I/O Module
(3) 4 kΩ
(4) 100 μF
(5) Keyphasor® Multiplier/Divider
(6) Multimeter
(7) Shaft Absolute I/O Module terminals (either External or Internal)
(8) Function Generator
(9) Power Supply

The Test Equipment outputs should be floating relative to earth ground.

32.2.2 Verification Screen Setup

Run the Rack Configuration Software on the test computer. Choose **Verification** from the Utilities menu and choose the proper Slot number and Channel number then click on the **Verify** button.

Note
Timed OK Channel Defeat is enabled for Shaft Absolute Radial Vibration channels. It will take 30 seconds for a channel to return to the **OK** status from a **not OK** condition.

The general approach for testing alarm setpoints is to simulate the vibration and Keyphasor® signal with a function generator. The alarm levels are tested by varying the vibration signal (both peak to peak amplitude and DC voltage bias) and observing that the correct results are reported in the Verification screen on the test computer. It is only necessary to test those alarm parameters that are configured and being used. The general test procedure to verify current alarm operation will include simulating a transducer input signal and varying this signal:

- to exceed over Alert/Alarm 1 and Danger/Alarm 2 Setpoints, and
- to drop below any under Alert/Alarm 1 and Danger/Alarm 2 Setpoints and
- to produce a nonalarm condition.

When varying the signal from an alarm condition to a nonalarm condition, alarm hysteresis must be considered. Adjust the signal well below the alarm setpoint for the alarm to clear.

32.3 Test Alarms

32.3.1 Direct

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.

2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 32-2.

Note
For testing Alarms on Direct and Gap, there will be no need for items 1-5 of the Shaft Absolute Radial Vibration Test Setup.

3. Adjust the function generator amplitude to produce a reading that is below the Direct setpoint levels on the Direct bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Direct is green, and the Current Value field contains no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the Direct Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the Direct Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Direct changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. If you can't verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
11. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.

12. Repeat steps 1 through 11 for all configured channels.

32.3.2 Gap

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 32-2.

Note
For testing Alarms on Direct and Gap, there will be no need for items 1-5 of the Shaft Absolute Radial Vibration Test Setup.

3. Adjust the power supply to produce a voltage that is within the Gap setpoint levels on the Gap bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Gap is green and that the Current Value field has no alarm indication.
5. Adjust the power supply voltage such that the signal just exceeds the Gap Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Gap changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Gap remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the power supply such that the signal just exceeds the Gap Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Gap changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Gap remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the power supply voltage such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Gap changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. Repeat steps 5 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the power supply to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test,

go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.

12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

32.3.3 1X Amplitude (1X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 32-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the function generator amplitude to produce a reading that is within the 1X Ampl setpoint levels on the 1X Ampl bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 1X Ampl is green and that the Current Value field contains no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the 1X Ampl Over Alert/Alarm 1 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Ampl changes color from green to yellow and the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Ampl remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the 1X Ampl Over Danger/Alarm 2 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Ampl changes color from yellow to red and the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Ampl remains red and that the Current Value Field still indicates an Alarm.

9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Ampl changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the function generator amplitude to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

32.3.4 1X Phase

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 32-2.

Note
If you can not change the phase output, change the phase alarm setpoints to activate the over and under phase alarms. The setpoints must be downloaded to the monitor to take effect.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the phase to produce a reading that is within the 1X Phase setpoint levels on the 1X Phase bar graph display of the Verification screen.

Note
The 1X Amplitude needs to be a minimum of 42.7 mV to get a valid 1X Phase reading.

4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 1X Phase is green, and the Current Value field contains no alarm indication.
5. Adjust the phase such that the reading just exceeds the 1X Phase Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Phase changes color from green to yellow and the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Phase remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the phase such that the reading just exceeds the 1X Phase Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Phase changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Phase remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the phase such that the reading is below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Phase changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the phase to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

32.4 Verify Channel Values

The general approach for testing channel values is to simulate the vibration and Keyphasor input signal with a function generator. The output values are verified by varying the input vibration signal level (both peak to peak amplitude and DC voltage bias) and observing that the correct results are reported in the Verification screen on the test computer.

Note
These parameters have an accuracy specification of ±1 % of full scale for amplitude and ±3 degrees for phase.

32.4.1 Direct

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 32-2.
3. Calculate the full-scale voltage according to the equation and examples shown below. Adjust the amplitude of the function generator to the calculated voltage.

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Full Scale Voltage = Direct Meter Top Scale × Transducer Scale Factor

Example 1:

Direct Meter Top Scale	=	10 mil
Transducer Scale Factor	=	200 mV/mil

Full Scale	=	(10 × 0.200)
	=	2.000 Vpp

Example 2:

Direct Meter Top Scale	=	200 µm
Transducer Scale Factor	=	7,874 mV/mm
	=	7.874 mV/µm

Full Scale	=	(200 × 0.007874)
	=	1.5748 Vpp

4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Verify that the Direct bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

32.4.2 Gap

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 32-2.

   If Gap is configured to read in volts, adjust the power supply to produce a voltage equal to -18.00 Vdc on the Gap bar graph display. Verify that the Gap bar graph display and Current Value Box is reading ±1 % of -18.00 Vdc.

   Adjust the power supply to produce a voltage equal to mid-scale on the Gap bar graph display. Verify that the Gap bar graph display and Current Value Box is reading ±1 % of the mid-scale value. Go to step 8.

   If Gap is configured to read in displacement units, calculate the full-scale and bottom-scale voltage using the following equation:

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Gap Full-Scale = Gap Zero Position +Volts + (Gap Meter Top Scale × Transducer Scale Factor)

Example 1:

Transducer Scale Factor	=	200 mV/mil
Gap	=	15-0-15 mil
Gap Top Scale	=	15 mil
Gap Zero Position Volts	=	-9.75 Vdc
Gap Full Scale input	=	-9.75 Vdc + (15 × 0.200)

	=	-6.75 Vdc

Example 2:

Transducer Scale Factor	=	7,874 mV/mm
	=	7.874 mV/µm
Gap	=	300-0-300 µm
Gap Top Scale	=	300 µm
Gap Zero Position Volts	=	-9.75 Vdc
Gap Full Scale input	=	-9.75 Vdc + (300 × 0.007874)
	=	-7.3878 Vdc

Gap Bottom-Scale = Gap Zero Position Volts - (Gap Meter Bottom Scale × Transducer Scale Factor)

Example 1:

Transducer Scale Factor	=	200 mV/mil
Gap	=	15-0-15 mil
Gap Bottom Scale	=	15 mil
Gap Zero Position Volts	=	-9.75 Vdc
Gap Bottom Scale input	=	-9.75 Vdc - (15 × 0.200)
	=	-12.75 Vdc

Example 2:

Transducer Scale Factor	=	7,874 mV/mm
	=	7.874 mV/µm
Gap	=	300-0-300 µm
Gap Bottom Scale	=	300 µm
Gap Zero Position Volts	=	-9.75 Vdc
Gap Bottom Scale input	=	-9.75 Vdc - (300 × 0.007874)
	=	-12.1122 Vdc

3. Adjust the power supply voltage to match the voltage displayed in the Gap Zero Position Volts Box. The Gap bar graph display and Current Value Box should read 0 mil (0 mm) ±1 %.
4. Adjust the power supply to produce a voltage equal to top scale (from step 3) on the Gap bar graph display. Verify that the Gap bar graph display and Current Value Box is reading ±1 % of top scale.
5. Adjust the power supply to produce a voltage equal to bottom scale (from step 3) on the Gap bar graph display. Verify that the Gap bar graph display and Current Value Box is reading ±1 % of bottom scale.
6. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.

7. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
8. Repeat steps 1 through 7 for all configured channels.

32.4.3 1X Amplitude (1X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 32-2.
3. Calculate the full-scale voltage according to the equation and examples shown below. Adjust the function generator amplitude to the calculated voltage.

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Scale Voltage = 1X Ampl Meter Top Scale × Transducer Scale Factor

Example 1:

1X Ampl Meter Top Scale = 10 mil
Transducer Scale Factor = 200 mV/mil

Full Scale = (10 × 0.200)
= 2.000 Vpp

Example 2:

1X Ampl Meter Top Scale = 200 μm
Transducer Scale Factor = 7,874 mV/mm
= 7.874 mV/μm
Full Scale = (200 × 0.007874)

= 1.5748 Vpp

4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Verify that the 1X Ampl bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

32.4.4 1X Phase

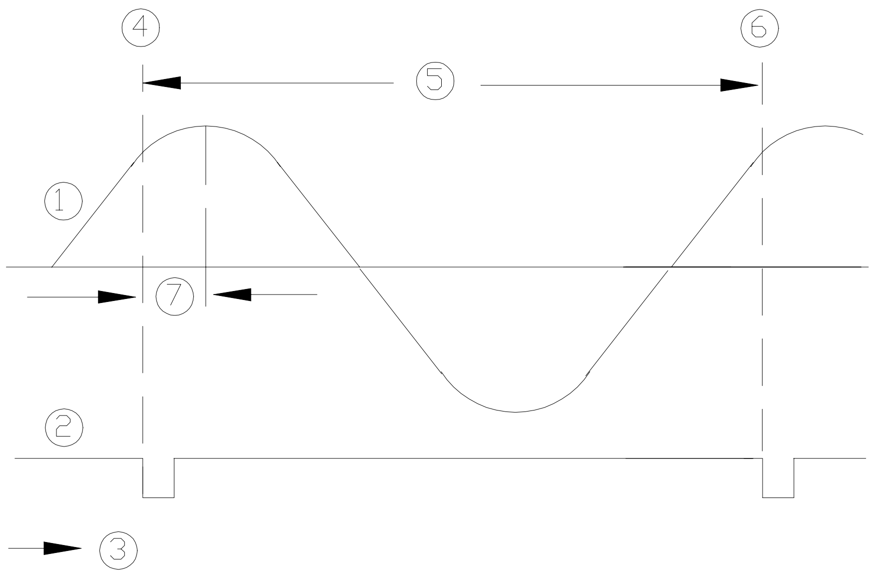
Note
If the test equipment is not capable of changing the phase output to a known value, use the following procedure. If your test equipment can change the phase output to a known value, use the procedure "If the Test Equipment Can Change the Phase Output (1X Phase)".

32.4.4.1 If the test equipment cannot change the phase output (1X phase)

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 32-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
3. Attach one channel of a two channel oscilloscope to the vibration signal buffered output and attach the other channel to the associated Keyphasor® signal buffered output and observe the two signals simultaneously.
4. Measure the phase. 1X Phase will be measured from the leading edge of the Keyphasor® pulse to the first positive peak of the vibration signal. See the example below illustrates a phase of 45°. Observe the 1X Phase bar graph display and Current Value Box; it should read approximately what was measured above.

Example:

1X = one cycle of vibration signal per shaft revolution.



(1) 1X Vibration Signal
(2) Keyphasor Signal
(3) Time
(4) 0°
(5) One cycle
(6) 360°
(7) Phase lag = 45°

5. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
6. Repeat steps 1 through 5 for all configured channels.

32.4.4.2 If the Test Equipment Can Change the Phase Output (1X Phase)

If the test equipment has the capability to change the phase output to a known value, use the following procedures.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 32-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.

3. Adjust the phase for mid-scale. Verify that the 1X Phase bar graph display and Current Value Box is reading ±1.5 % of mid-scale.
4. If the reading does not meet specifications double check the input signal to ensure it is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
5. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
6. Repeat steps 1 through 5 for all configured channels

32.5 Test OK Limits

The general approach for testing OK limits is to input a DC voltage and adjust it above the Upper OK limit and below the Lower OK limit. This will cause a channel not OK condition and the OK Relay to change state (de-energize). The Upper and Lower OK limits are displayed in the Verification screen on the test computer.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 32-2.
3. Bypass all other configured channels.
4. Adjust the power supply voltage to -7.00 Vdc.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the monitor OK LED is on and that the Channel OK State line in the Channel Status box of the Verification screen reads **OK**.

Note
If the Danger Bypass has been activated, then the BYPASS LED will be on. All other channels in the rack must be OK or bypassed for the relay to be energized.

6. Verify that the OK relay on the Rack Interface I/O Module indicates OK (energized). See 3500/20 Rack Interface Module Operation and Maintenance Manual, part number 129768-01.
7. Increase the power supply voltage (more negative) until the OK LED just goes off (upper limit). Verify that the Channel OK State line in the Channel Status box reads **not OK** and that the OK Relay indicates not OK. Verify that the Upper OK limit voltage displayed on the Verification screen is equal to or more positive than the input voltage.

8. Decrease the power supply voltage (less negative) to -7.00 Vdc.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on and the OK relay energizes. Verify that the Channel OK State line in the Channel Status box reads **OK**.
10. Gradually decrease the power supply voltage (less negative) until the OK LED just goes off (lower limit). Verify that the Channel OK State line in the Channel Status box reads **not OK** and that the OK Relay indicates not OK. Verify that the Lower OK limit voltage displayed on the Verification screen is equal to or more negative than the input voltage.
11. Increase the power supply voltage (more negative) to -7.00 Vdc.
12. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on, the OK relay energizes and that the Channel OK State line in the Channel Status box reads **OK**.
13. If you can not verify any configured OK limit, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
14. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the Monitor I/O Module. Press the RESET switch on the Rack Interface Module (RIM) and verify that the OK LED comes on and the OK relay energizes.
15. Repeat steps 1 through 14 for all configured channels.
16. Return the bypass switch for all configured channels back to their original setting.

Shaft Absolute Radial Vibration Default OK Limits Table

Transducer	Lower OK Limit (volts)	Upper OK Limit (volts)
7200 5&8 mm	-2.7 to -2.8	-16.7 to -16.8
7200 11 mm	-3.5 to -3.6	-19.6 to -19.7
7200 14 mm	-2.7 to -2.8	-16.7 to -16.8
3300 5&8 mm	-2.7 to -2.8	-16.7 to -16.8
3300XL 8&11 mm	-2.7 to -2.8	-16.7 to -16.8
Note: Assume ±50 mV accuracy for check tolerance.		

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33. Shaft Absolute Velocity Options

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33.1 Introduction

This section discusses the Configuration Considerations and the Rack Configuration Software screens associated with the Shaft Absolute Velocity Channel.

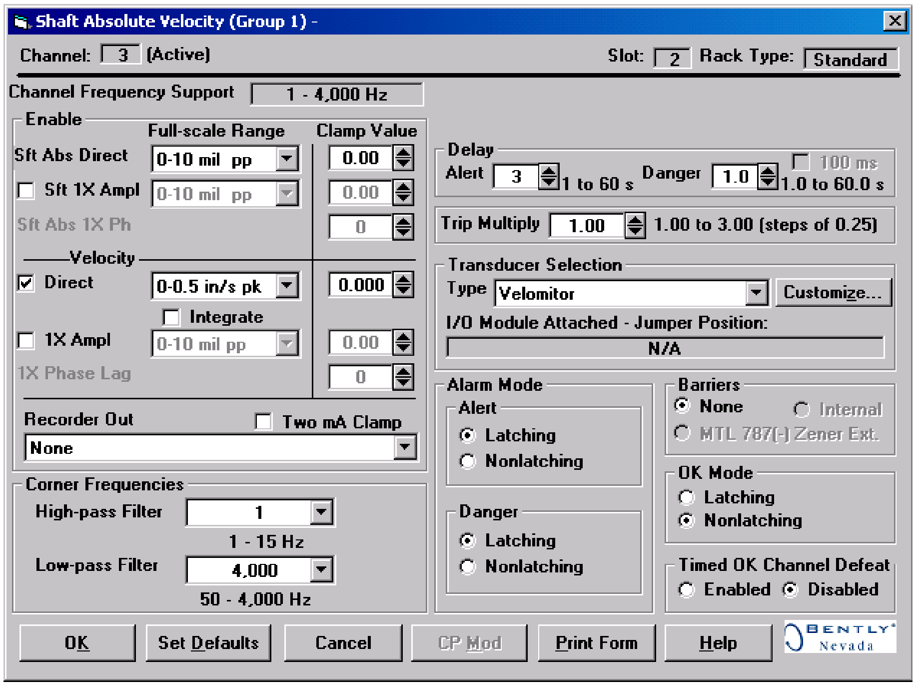
33.2 Configuration Considerations

Consider the following items before configuring a Shaft Absolute Velocity Channel:

- The Shaft Absolute Direct proportional value is the primary proportional value used in the Shaft Absolute Velocity channel.
- The Shaft Absolute Velocity channel type and the Shaft Absolute Radial Vibration channel type are configured in channel pairs, but the association of the particular shaft absolute proximity and velocity transducers is according to Group 1 (channels 1 and 3) and Group 2 (channels 2 and 4).
- The jumper selection on the I/O modules must match the velocity transducer selected in the Rack Configuration Software.
- When "No Keyphasor" is selected, the 1X Amplitude (Ampl) and Phase Lag can not be selected.
- If a Keyphasor channel is selected, a Keyphasor Module must be installed in the rack.
- The 1X Phase values can be enabled only if the selected Keyphasor channel is configured for an events per revolution equal to 1 will.
- When a full-scale range is modified, readjust the setpoints associated with this proportional value.
- When integration is selected, the available Direct Full-scale Ranges will change to reflect this. 1X Amplitude always displays in displacement units.
- The minimum machine speed supported by the 1X vector filtering is 4 Hz.
- When band-pass filtering is selected, the high-pass and low-pass filters must be set a minimum of a decade apart.
- The 100ms danger alarm is only available for the Velomitor and High Temperature Velomitor options.
- The maximum channel frequency supported is 1 Hz to 4000 Hz.
- The Latching OK Mode and the Timed OK Channel Defeat options are not compatible.
- If a Non-Standard transducer is selected, the setpoint OK limits are set to ±1 volt from the Upper and Lower OK limits that are selected.
- If the monitor is configured to alarm on high velocity conditions on a reciprocating machine, it is recommended that you disable the Timed OK/Channel Defeat option.

33.3 Configuration Options

This section describes the options available on the Shaft Absolute Velocity Channel configuration screen.



33.3.1 General Parameters and Buttons

Timed OK Channel Defeat: An option that prevents a channel from returning to an OK status until that channel's transducer has remained in an OK state for the specified period of time. If the option is enabled, the time is set to 30 seconds. This option prevents false trips caused by intermittent transducers.

CP Mod: Selecting the CP Mod button in the Channel Options Dialog Box, allows a Custom channel configuration to be downloaded to the monitor. Custom configuration data is stored in a Custom Products Modification File. Custom Products Modification files follow the naming convention <modification #.mod>. These files must be located in the \3500\Rackcfg\Mods\ directory. When a CP Mod file is selected, a window is displayed which describes the function of the modification. CP Mod files are available through Bently Nevada's Custom Products Division. Contact your local Bently Nevada Sales Representative for details.

Trip Multiply: The value selected to temporarily increase the alarm (Alert and Danger) setpoint values. This value is normally applied by manual (operator) action during startup to allow a machine to pass through high vibration speed ranges without monitor alarm indications. Such high vibration speed ranges may include system resonances and other normal transient vibrations.

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. Refer to "Setting the I/O Jumper" in the "I/O Module Descriptions" section of the manual, if applicable.

33.3.2 Reference Information

These fields contain information that indicates which module you are configuring.

Channel: The number of the channel being configured (3 or 4).

Group: The association of channels which derive the shaft absolute signal. Group 1 consists of channels 1 and 3, Group 2 consists of channels 2 and 4.

Slot: The location of the monitor in the 3500 rack (2 through 15).

Rack Type: Identifies the type of Rack Interface Module installed in the rack (Standard or TMR).

Channel Frequency Support: Supported frequency range of the selected transducer.

33.3.3 Enable

Shaft Absolute Direct: Data which represents the overall peak to peak vibration of the Shaft Absolute signal. The Shaft Absolute signal is the vector summation of the corresponding shaft relative proximitor (channel 1 or 2) and the bearing absolute integrated velocity (channel 3 or 4) signals. All frequencies within the selected Shaft Absolute Direct Frequency Response are included in this proportional value.

1X Ampl: In a complex vibration signal, notation for the amplitude component that occurs at the rotative speed frequency.

1X Phase Lag: In a complex vibration signal, notation for the phase lag component that occurs at the rotative speed frequency.

Full Scale Range: Each selectable proportional value provides the ability to set a full scale value. If the desired full scale value is not in the pull down list, then the custom selection can be chosen.

The values in the following table are the same for all transducer types.

Shaft Absolute Direct Shaft Absolute 1X Ampl 1X Ampl
0-5 mil pp
0-10 mil pp
0-15 mil pp
0-20 mil pp
0-150 µm pp
0-250 µm pp
0-400 µm pp
0-500 µm pp
Custom

Direct (Velocity): The time rate of change of the displacement. When Integration is selected it yields a peak to peak measurement of the displacement.

The Direct values are available for all transducer types.

Direct
0-0.5 in/s pk
0-1 in/s pk
0-2 in/s pk
0-10 mm/s pk
0-20 mm/s pk
0-50 mm/s pk
Custom

Integrate: When Integrate is enabled, the Direct Full-scale Range selections change to the following:

The Direct values (Integrated) are available for all transducer types.

Full-scale Range – Direct
0-5 mil pp
0-10 mil pp
0-20 mil pp
0-100 µm pp
0-200 µm pp
0-500 µm pp
Custom

Clamp Value: The value that a proportional value goes to when that channel or proportional value is bypassed or defeated (for example a problem with the monitor). The selected value can be between the minimum and maximum full-scale range values. Only the values available from the Recorder Outputs, Communication Gateway and Display Interface Module are clamped to the specified value when the proportional value is invalid.

Recorder Output: The proportional value of a channel that is sent to the 4 to 20 mA recorder. The recorder output is proportional to the measured value over the channel full-scale range. An increase in the proportional value that would be indicated as upscale on a bar graph display results in an increase in the current at the recorder output. If the channel is bypassed, the output will be clamped to the selected clamp value or to 2 mA (if the 2 mA clamp is selected).

If 1X Phase Lag is selected then the two options available are with and without Hysteresis. If the channel is Bypassed, the output will be clamped to the selected clamp value or to 2 mA (if the 2 mA clamp is selected).

The Hysteresis option helps prevent the Recorder Output from jumping from Full to Bottom Scale when the phase measurement is near 0 or 359 degrees. When the Hysteresis option is checked, the recorder signal operates as follows:

- The recorder output is scaled such that 4 mA corresponds to 0 degrees and 20 mA corresponds to 380 degrees (360 plus 20 degrees).
- The transition of a phase measurement that is increasing does not occur until the measurement has gone 20 degrees past 360 degrees. At this point, the recorder signal switches from 20 mA to a signal that corresponds to 20 degrees or 4.842 mA.
- The transition of a phase measurement that is decreasing occurs at 0 degrees (4 mA). At this point, the recorder signal switches from 4 mA to a signal that corresponds to 360 degrees or 19.158 mA.

33.3.4 Corner Frequencies

High-pass Filter: A two-pole filter that must be at least a factor of 5.7 times away from the Low-pass Filter.

HPF = High-pass Filter; LPF = Low-pass Filter

LPF ≤ (LPF / 5.7)

Recommended high-pass filter setting: A minimum of two octaves below the typical machine speed. For example: Machine speed = 3600 RPM = 60 Hz

HPF ≤ ((60 / 2) /2) = 15 Hz

Low-pass Filter: A four-pole filter that must be at least a factor of 5.7 times away from the High-pass Filter.

HPF = High-pass Filter; LPF = Low-pass Filter

LPF ≥ (HPF * 5.7)

33.3.5 Delay

The time which a proportional value must remain at or above an alarm level or outside an acceptance region before an alarm is declared as active.

Alert: First level alarm that occurs when the transducer signal level exceeds the selected value. The Alert time delay is always set at one second intervals for all available proportional values.

Danger: Second level alarm that occurs when the transducer signal level exceeds the selected value.

100 ms option: The 100 ms (typical) option applies to the Danger time delay only and has the following results:

If the 100 ms option is off (☐):

- The Danger time delay can be set at one second intervals.
- The Danger time delay can be set for all available proportional values.

If the 100 ms option is on (☑):

- The Danger time delay is set to 100 ms.
- The Danger time delay can only be set for the primary proportional value.

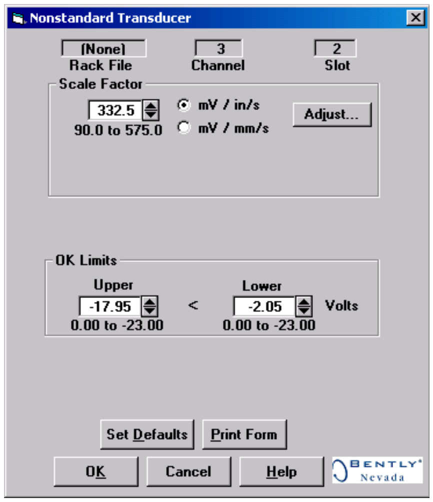
33.3.6 Transducer Selection

Type: The following transducer types are available for the Shaft Absolute Velocity Channel:

- 9200 2-wire Seismoprobe
- 74712 High Temperature 2-wire Seismoprobe
- Nonstandard 2-wire Seismoprobe
- Velomitor
- High Temperature Velomitor
- Nonstandar

Customize button: Used to adjust the Scale Factor for transducers. Refer to "Adjusting the Scale Factor and Zero Position" in the "Monitor Verification" section of the manual. Also, note that:

- If Non-standard is selected as the transducer type, the OK Limits can also be adjusted.
- The Non-standard transducer's scale factor must be between 90 and 575 mV/in/s.
- There must be at least 2 volts between the Upper and Lower OK Limits.



Scale Factor by Transducer Type

Transducer	Scale Factor
9200	500 mV/(in/s)
74712	500 mV/(in/s)
Nonstandard 2 wire	145 mV/(in/s)
Velomitor	100 mV/(in/s)
High Temperature Velomitor	145 mV/(in/s)
Note: ±15 % scale factor adjustment allowed.	

OK Limits by Transducer Type

Transducer	OK Limits		
	Upper	Lower	Center Gap Voltage
9200	-17.95	-2.05	-10.00
74712	-17.95	-2.05	-10.00
NonStandard	-17.95	-2.05	-10.00
Velomitor	-19.85	-4.15	-12.00
High Temperature Velomitor	-21.26	-2.74	-12.00

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the Shaft Absolute I/O Module. Refer to "Setting the I/O Jumper" in the manual of the monitor that contains this channel for the function of this jumper.

33.3.7 Alarm Mode

Alert is the first level alarm that occurs when the transducer signal level exceeds the selected value. Danger is the second level alarm that occurs when the transducer signal level exceeds the selected value. The Alert and Danger values are set on the Setpoint screen.

Latching: Once an alarm is active it will remain active even after the proportional value is no longer in alarm. The alarm state will continue until the channel is reset using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: When an alarm is active, it will go inactive as soon as the proportional value is no longer in alarm.

33.3.8 OK Mode

Latching: If a channel is configured for Latching OK, once the channel has gone not OK, the status stays not OK until a reset is issued using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

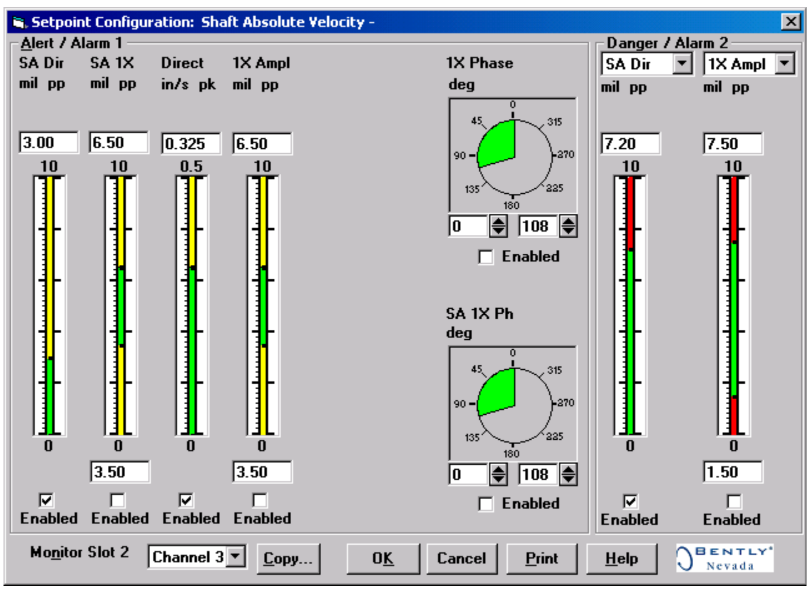
Nonlatching: If a channel is configured for Nonlatching OK, the OK status of that channel will track the defined OK status of the transducer.

33.4 Alarm Setpoints

This section specifies the available setpoints for the Shaft Absolute Velocity channel type. A setpoint is the level within the full-scale range that determines when an alarm occurs. The 3500 Monitoring System allows Alert/Alarm 1 setpoints to be set for every proportional value on each channel. The channel will drive an Alert/Alarm 1 indication if one or more of the channel proportional values exceeds its setpoints. The 3500 Monitoring System also allows up to four Danger/Alarm 2 setpoints (two over setpoints and two under setpoints) to be set for up to two of the proportional values. You may select any two of the available proportional values for the channel.

Note
The setpoint over and under limits can only be placed within the OK limits of the specified transducer.

Use the following screen in the Rack Configuration Software to adjust Alert/Alarm 1 and Danger/Alarm 2 setpoints for a Shaft Absolute Velocity channel.



33.4.1 Available Setpoints

The following table lists the Alert/Alarm 1 and Danger/Alarm 2 setpoints available for the Shaft Absolute Velocity channel type. The setpoint number is used in the Communication Gateway and Display Interface Modules.

Setpoint Number	Shaft Absolute Velocity
1	Over Shaft Absolute Direct
2	Over Shaft Absolute 1X Ampl
3	Under Shaft Absolute 1X Ampl
4	Over Shaft Absolute 1X Phase Lag
5	Under Shaft Absolute 1X Phase Lag
6	Over Direct
7	Over 1X Ampl
8	Under 1X Ampl
9	Over 1X Phase Lag
10	Under 1X Phase Lag
11	Danger (configurable)
12	Danger (configurable)
13	Danger (configurable)
14	Danger (configurable)

33.4.2 Alarm Hysteresis

The alarming hysteresis for all channel configurations is 1/64 of Full Scale. When a channel exceeds an alarm setpoint, it must fall back the setpoint less the hysteresis before it can go out of alarm.

For example, for a channel configuration with a 0 to 10 mil full scale and an alarm setpoint of 6 mils, the hysteresis = 10 mils/64 = 0.16 mils. The channel input, therefore, must fall below 6 mils – 0.16 mils (5.84 mils) before the channel is out of alarm.

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34. Shaft Absolute Velocity Verification

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34.1 Introduction

The following sections will describe how to test alarms, verify channels, verify filter corner frequencies, and test OK limits for channels configured as Shaft Absolute Velocity. The output values and alarm setpoints are verified by varying the input signal level and observing that the correct results are reported in the Verification screen on the test computer.

Shaft Absolute Velocity channels can be configured for the following channel values and alarms:

Channel Values	Alarms	
	Over	Under
Shaft Absolute Direct	X	
Shaft Absolute 1X Ampl	X	X
Shaft Absolute 1X Phase	X	X
Direct	X	
1X Amplitude	X	X
1X Phase	X	X

34.2 Test Equipment and Software Setup

The following test equipment and software setup can be used as the initial set up needed for all the verification procedures (Test Alarms, Verify Channels, Verify Filter Corner Frequencies, and Test OK Limits).

WARNING
High voltage present. Contact could cause shock, burns, or death. Do not touch exposed wires or terminals.

Application Alert
Tests will exceed alarm setpoint levels causing alarms to activate. This could result in a relay contact state change.

Application Alert
Disconnecting the field wiring will cause a not OK condition.

34.2.1 Test Equipment Setup - Seismoprobe

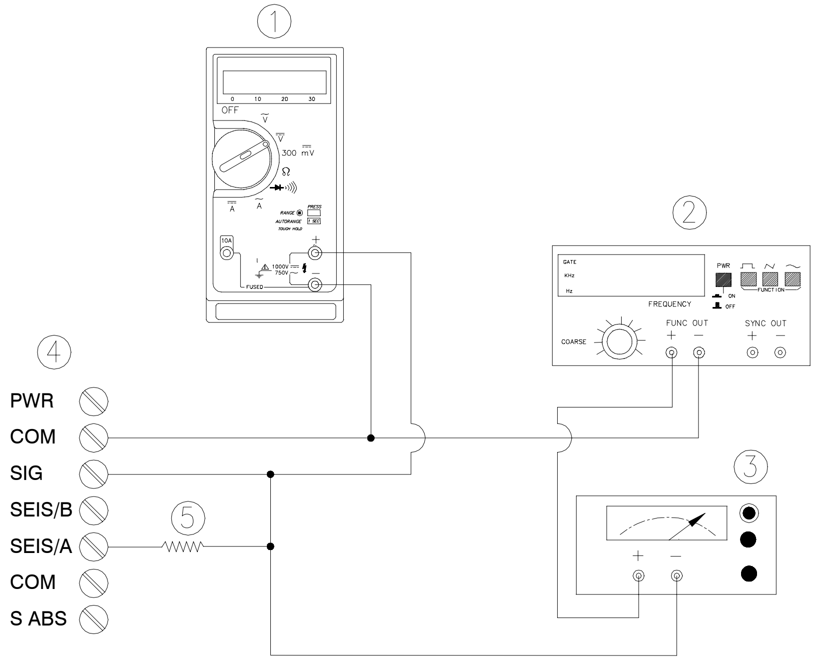
Simulate the transducer signal by connecting the power supply, function generator, and multimeter to the channel group terminals of channel 3 with polarity as shown in the corresponding figures for either Alarm Testing, Channel Verification, or 1X Amplitude and Phase Testing. Set the test equipment as specified below:

Power Supply	Function Generator
-6.50 Vdc	Waveform: sinewave DC Volts: 0 Vdc Frequency: 100 Hz Amplitude level: Minimum (above zero)

34.2.2 Test Equipment Setup - Velomitor (Shaft Absolute I/O)

Simulate the transducer signal by connecting the power supply, function generator, and multimeter to the channel group terminals of channel 3 with polarity as shown in the corresponding figures for either Alarm Testing, Channel Verification, 1X Amplitude and Phase Testing, or Velomitor OK Limit Testing. Set the test equipment as specified below:

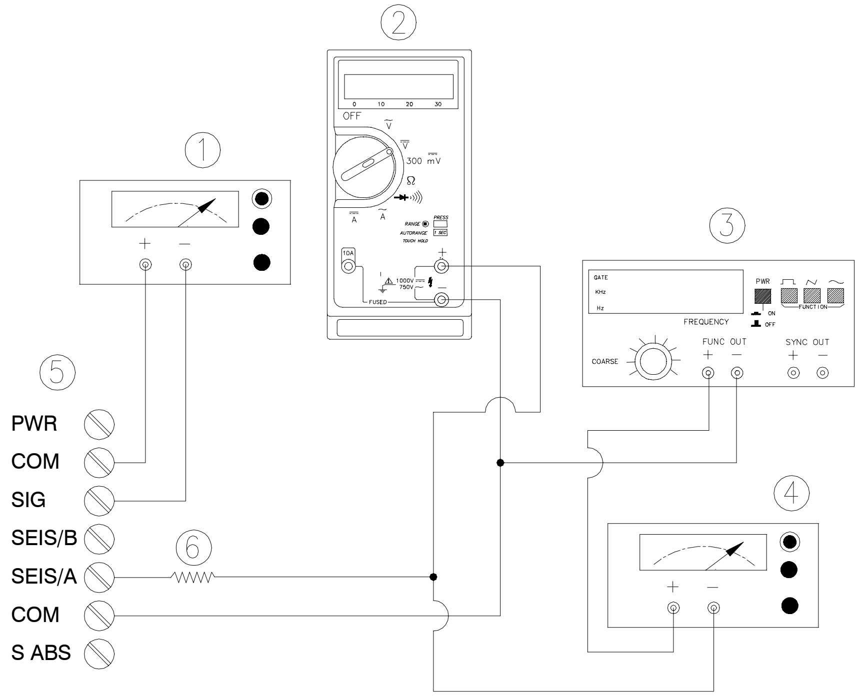
Function Generator
Waveform: sinewave DC Volts: 0 Vdc Frequency: 100 Hz Amplitude level: Minimum (above zero)



Seismoprobe Alarm Test Setup

(1) Multimeter
(2) Function Generator
(3) Power Supply
(4) Shaft Absolute I/O Module terminals (either External or Internal)
(5) 2.49 kΩ

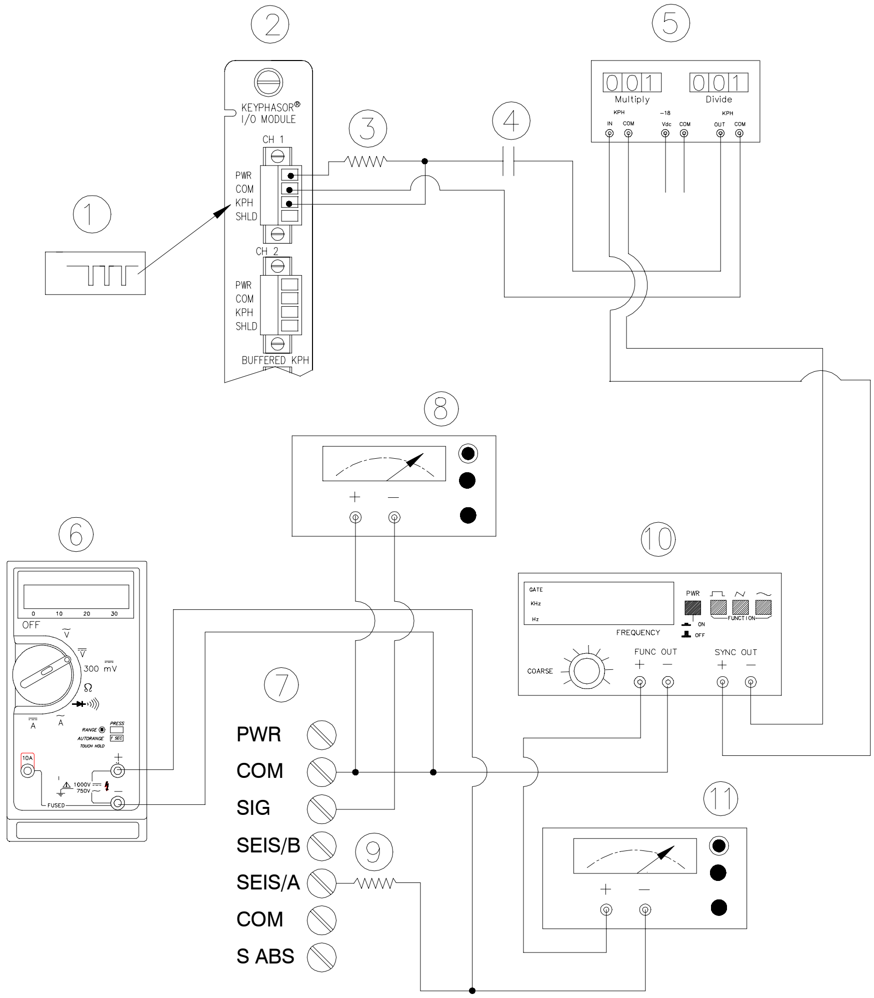
The Test Equipment outputs should be floating relative to earth ground.



Seismoprobe Channel Verification Test Setup

(1) Power Supply
(2) Multimeter
(3) Function Generator
(4) Power Supply
(5) Shaft Absolute I/O Module terminals (either External or Internal)
(6) 2.49 kΩ

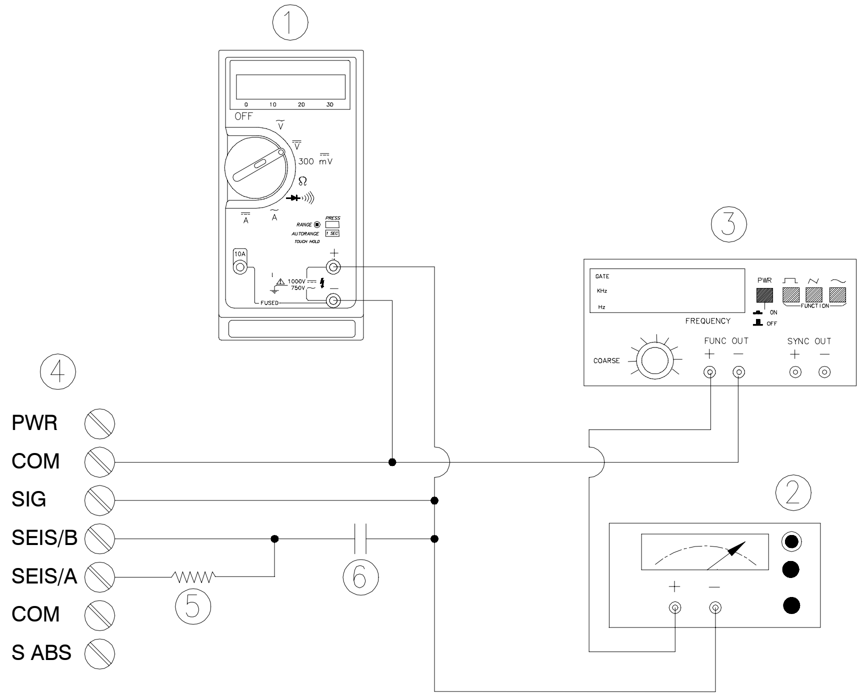
The Test Equipment outputs should be floating relative to earth ground.



Seismoprobe 1X Amplitude and Phase Test Setup

(1) Keyphasor® Signal
(2) Keyphasor® I/O Module
(3) 40 kΩ
(4) 100 μF
(5) Keyphasor® Multiplier/Divider
(6) Function Generator
(7) Shaft Absolute I/O Module terminals (either External or Internal)
(8) Power Supply
(9) 2.49 kΩ
(10) Multimeter
(11) Power Supply

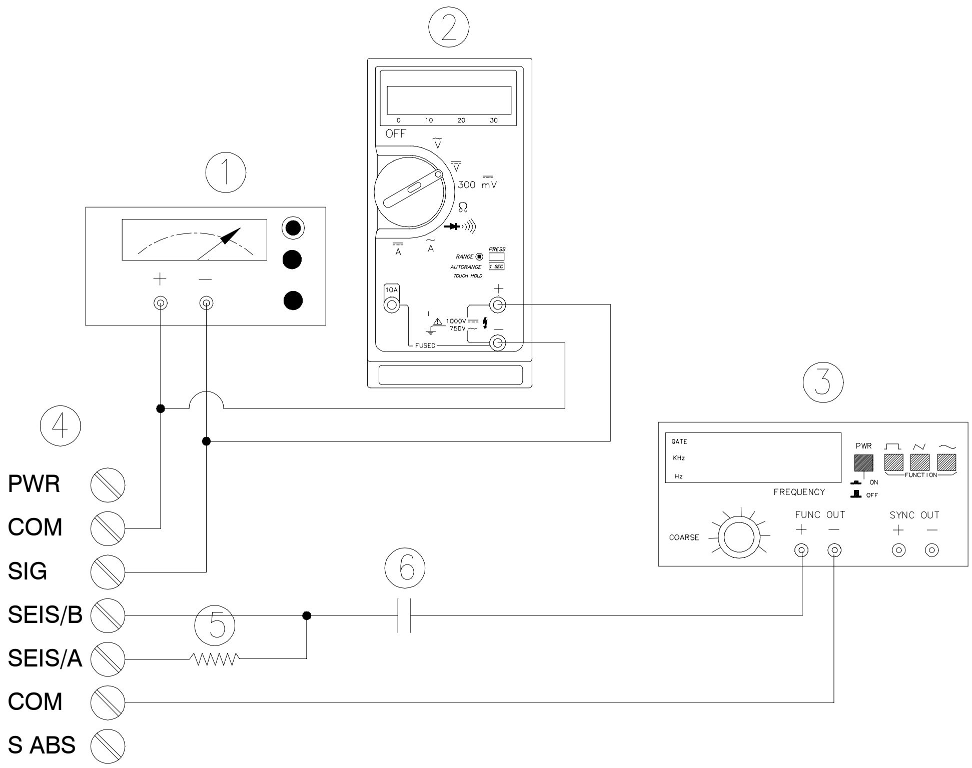
The Test Equipment outputs should be floating relative to earth ground.



Velomitor® Alarm Test Setuo

(1) Multimeter
(2) Power Supply
(3) Function Generator
(4) Shaft Absolute I/O Module terminals (either External or Internal)
(5) 4 kΩ
(6) 10 μF

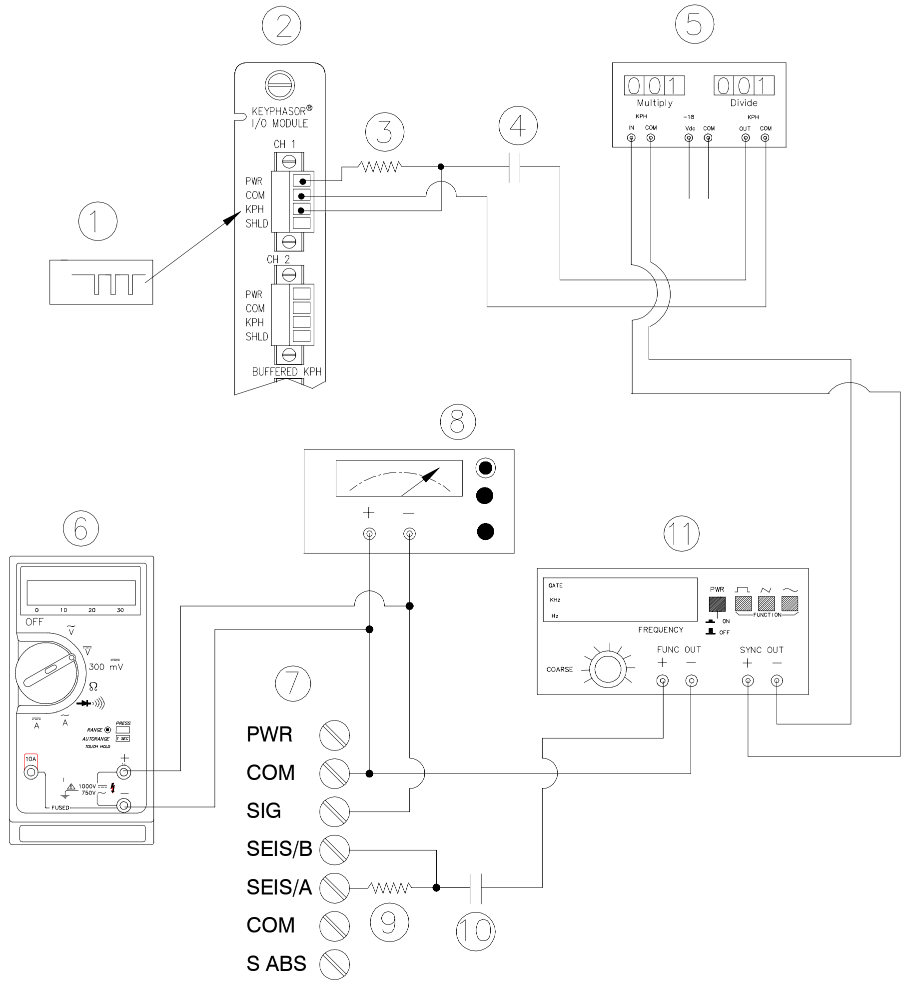
The Test Equipment outputs should be floating relative to earth ground.



Velomitor® Channel Verification Test Setup

(1) Power Supply
(2) Multimeter
(3) Function Generator
(4) Shaft Absolute I/O Module terminals (either External or Internal)
(5) 4 kΩ
(6) 10 μF

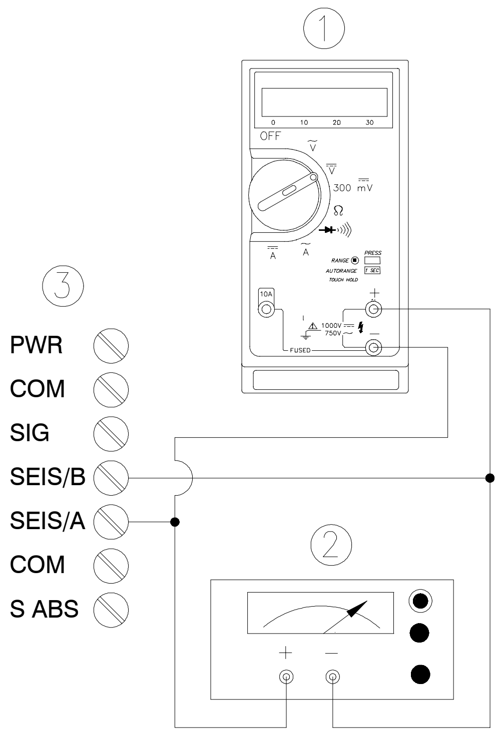
The Test Equipment outputs should be floating relative to earth ground.



Velomitor® 1X Amplitude and Phase Test Setup

(1) Keyphasor® Signal
(2) Keyphasor® I/O Module
(3) 40 kΩ
(4) 100 μF
(5) Keyphasor Mutiplier/Divider
(6) Multimeter
(7) Shaft Absolute I/O Module terminals (either External or Internal)
(8) Power Supply
(9) 4 kΩ
(10) 10 μF
(11) Function Generator

The Test Equipment outputs should be floating relative to earth ground.



Velomitor® OK Limit Test Setup

(1) Multimeter
(2) Power Supply
(3) Shaft Absolute I/O Module terminals (either External or Internal)

The Test Equipment outputs should be floating relative to earth ground.

34.2.3 Verification Screen Setup

Run the Rack Configuration Software on the test computer. Choose **Verification** from the Utilities menu and choose the proper Slot number and Channel number then click on the **Verify** button.

Note
If the Timed OK Channel Defeat is enabled, it will take 30 seconds for a channel to return to the **OK** status from **not OK**. If OK MODE is configured for latching, press the RESET button on the Rack Interface Module (RIM) to return to **OK** status.

34.3 Test Alarms

The general approach for testing alarm setpoints is to simulate the Shaft Absolute and Velocity signals with a function generator and power supply. The alarm levels are tested by varying the output from the test equipment and observing that the correct results are reported in the Verification screen on the test computer. It is only necessary to test those alarm parameters that are configured and being used. The general test procedure to verify current alarm operation will include simulating a transducer input signal and varying this signal:

- to exceed over Alert/Alarm 1 and Danger/Alarm2 Setpoints, and
- to drop below any under Alert/Alarm 1 and Danger/Alarm 2 Setpoints, and
- to produce a nonalarm condition.

When varying the signal from an alarm condition to a nonalarm condition, alarm hysteresis must be considered. Adjust the signal well below the alarm setpoint for the alarm to clear.

34.3.1 Shaft Absolute Direct (SA DIR)

1. Disconnect PWR, COM, SIG, SIES/B, and SEIS/A field wiring from the channel group terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 34-2:

   For Seismoprobe: Use the setup shown in ""Seismoprobe Alarm Test Setup on page 34-4.

   For Velomitor: Use the setup shown in Velomitor Alarm Test Setup on page 34-7.
3. Calculate the verification frequency using the method in "Calculating Verification Frequency" on page 34-26. Adjust the function generator frequency to the calculated value..
4. Adjust the function generator amplitude to produce a reading that is below the Shaft Absolute Direct setpoint levels on the Shaft Absolute Direct bar graph display of the Verification screen.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Direct is green, and the Current Value field contains no alarm indication.
6. Adjust the function generator amplitude such that the signal just exceeds the Shaft Absolute Direct Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Shaft Absolute Direct changes color from green to yellow and the Current Value Field indicates an Alarm.
7. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Shaft Absolute Direct remains yellow and that the Current Value Field still indicates an Alarm.
8. Adjust the function generator amplitude such that the signal just exceeds the Shaft Absolute Direct Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph

indicator for Shaft Absolute Direct changes color from yellow to red and that the Current Value Field indicates an Alarm.

9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Shaft Absolute Direct remains red and that the Current Value Field still indicates an Alarm.
10. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Shaft Absolute Direct changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, SIG, SEIS/A, and SEIS/B field wiring to the channel group terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

34.3.2 Shaft Absolute 1X Amplitude (SA 1X)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, SIG, SEIS/A, and SEIS/B field wiring from the channel group terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 34-2. Use the appropriate test setup in either Seismoprobe 1X amplitude and Phase Test Setup (page 34-6) or Velomitor 1X Amplitude and Phase Test Setup (page 34-9).
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the function generator amplitude to produce a reading that is within the Shaft Absolute 1X Ampl setpoint levels on the Shaft Absolute 1X Ampl bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Shaft Absolute 1X Ampl is green and that the Current Value field contains no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the Shaft Absolute 1X Ampl Over Alert/Alarm 1 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph

indicator for Shaft Absolute 1X Ampl changes color from green to yellow and the Current Value Field indicates an Alarm.

6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Shaft Absolute 1X Ampl remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the Shaft Absolute 1X Ampl Over Danger/Alarm 2 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Shaft Absolute 1X Ampl changes color from yellow to red and the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Shaft Absolute 1X Ampl remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Shaft Absolute 1X Ampl changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the function generator amplitude to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, SIG, SEIS/A, and SEIS/B field wiring to the channel group terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

34.3.3 Shaft Absolute 1X Phase (SA 1X Ph)

1. Disconnect PWR, COM, SIG, SEIS/A, and SEIS/B field wiring from the channel group terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 34-2. Use the appropriate test setup in Seismoprobe 1X amplitude and Phase Test Setup (page 34-6) or Velomitor 1X Amplitude and Phase Test Setup (page 34-9).

Note
If you can not change the phase output, change the phase alarm setpoints to activate the over and under phase alarms. The setpoints must be downloaded to the monitor to take effect.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the phase to produce a reading that is within the Shaft Absolute 1X Phase setpoint levels on the Shaft Absolute 1X Phase bar graph display of the Verification screen.

Note
The 1X Amplitude needs to be a minimum of 42.7 mV to get a valid 1X Phase reading.

4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Shaft Absolute 1X Phase is green, and the Current Value field contains no alarm indication.
5. Adjust the phase such that the reading just exceeds the Shaft Absolute 1X Phase Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Shaft Absolute 1X Phase changes color from green to yellow and the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Shaft Absolute 1X Phase remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the phase such that the reading just exceeds the Shaft Absolute 1X Phase Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Shaft Absolute 1X Phase changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Shaft Absolute 1X Phase remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the phase such that the reading is below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Shaft Absolute 1X Phase changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.

10. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the phase to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, SIG, SEIS/A, and SEIS/B field wiring to the channel group terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

34.3.4 Direct

1. Disconnect PWR, COM, SIG, SIES/B, and SEIS/A field wiring from the channel group terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 34-2:

   For Seismoprobe: Use the setup shown in Seismoprobe Alarm Test Setup on page 34-4.

   For Velomitor: Use the setup shown in Velomitor Alarm Test Setup on page 34-7.
3. Calculate the verification frequency using the method in "Calculating Verification Frequency" on page 34-26. Adjust the function generator frequency to the calculated value.
4. Adjust the function generator amplitude to produce a reading that is below the Direct setpoint levels on the Direct bar graph display of the Verification screen.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Direct is green, and the Current Value field contains no alarm indication.
6. Adjust the function generator amplitude such that the signal just exceeds the Direct Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from green to yellow and the Current Value Field indicates an Alarm.
7. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains yellow and that the Current Value Field still indicates an Alarm.
8. Adjust the function generator amplitude such that the signal just exceeds the Direct Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from yellow to red and that the Current Value Field indicates an Alarm.

9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains red and that the Current Value Field still indicates an Alarm.
10. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Direct changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, SIG, SEIS / A, and SEIS/B field wiring to the channel group terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

34.3.5 1X Amplitude (1X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, SIG, SEIS/A, and SEIS/B field wiring from the channel group terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 34-2. Use the appropriate test setup in Seismoprobe 1X Amplitude and Phase Test Setup (page 34-6) or Velomitor 1X Amplitude and Phase Test Setup (page 34-9).
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the function generator amplitude to produce a reading that is within the 1X Ampl setpoint levels on the 1X Ampl bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 1X Ampl is green and that the Current Value field contains no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the 1X Ampl Over Alert/Alarm 1 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Ampl

changes color from green to yellow and the Current Value Field indicates an Alarm.

6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Ampl remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the 1X Ampl Over Danger/Alarm 2 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Ampl changes color from yellow to red and the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Ampl remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Ampl changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the function generator amplitude to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, SIG, SEIS/A, SEIS/B field wiring to the channel group terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

34.3.6 1X Phase

1. Disconnect PWR, COM, SIG, SEIS/A, SEIS/B field wiring from the channel group terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 34-2. Use the appropriate test setup in either Seismoprobe 1X Amplitude and Phase Test Setup (page 34-6) or Velomitor 1X Amplitude and Phase Test Setup (page 34-9).

Note
If you can not change the phase output, change the phase alarm setpoints to activate the over and under phase alarms. The setpoints must be downloaded to the monitor to take effect.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the phase to produce a reading that is within the 1X Phase setpoint levels on the 1X Phase bar graph display of the Verification screen.

Note
The 1X Amplitude needs to be a minimum of 42.7 mV to get a valid 1X Phase reading.

4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 1X Phase is green, and the Current Value field contains no alarm indication.
5. Adjust the phase such that the reading just exceeds the 1X Phase Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Phase changes color from green to yellow and the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Phase remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the phase such that the reading just exceeds the 1X Phase Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Phase changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Phase remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the phase such that the reading is below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Phase changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.

10. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the phase to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, SIG, SEIS/A, SEIS/B field wiring to the channel group terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

34.4 Verify Channel Values

The general approach for testing these parameters is to simulate the velocity signal with a function generator and power supply. The Shaft Absolute Radial Vibration signal (channels 1 or 2) will be zero, making the shaft absolute signal equal to the integrated velocity signal. The channel values are verified by varying the output from the test equipment and observing that the correct results are reported in the Verification screen on the test computer.

34.4.1 Shaft Absolute Direct (SA DIR)

1. Disconnect PWR, COM, SIG, SIES/B, and SEIS/A field wiring from the channel group terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 34-2:

   For Seismoprobe: Use the setup shown in Seismoprobe Channel Verification Test Setup on page 34-5.

   For Velomitor: Use the setup shown in Velomitor® Channel Verification Test Setup on page 34-8.
3. Calculate the verification frequency using the method in "Calculating Verification Frequency" on page 34-26. Adjust the function generator frequency to the calculated value.
4. Calculate the full-scale voltage using the procedure in "Full Scale Formulas - Integration" on page 34-27. Adjust the function generator (sinewave) amplitude to the calculated value.
5. Verify that the Direct bar graph display and the Current Value Box is reading ±1 % of full-scale.
6. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
7. Disconnect the test equipment and reconnect the PWR, COM, SIG, SEIS / A, and SEIS/B field wiring to the channel group terminals on the I/O module.

Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.

8. Repeat steps 1 through 7 for all configured channels.

34.4.2 Shaft Absolute 1X Amplitude (SA 1X)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, SIG, SEIS / A, and SEIS/B field wiring from the channel group terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 34-2. Use the appropriate test setup in either Seismoprobe 1X Amplitude and Phase Test Setup (page 34-6) or Velomitor 1X Amplitude and Phase Test Setup (page 34-9).
3. Calculate the verification frequency using the method in "Calculating Verification Frequency" on page 34-26. Adjust the function generator frequency to the calculated value.
4. Calculate the full-scale voltage using the procedure in "Full Scale Formulas - Integration" on page 34-27. Adjust the function generator (sinewave) amplitude to the calculated value.
5. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Verify that the 1X Ampl bar graph display and Current Value Box is reading ±1 % of full scale.
6. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
7. Disconnect the test equipment and reconnect the PWR, COM, SIG, SEIS / A, and SEIS/B field wiring to the channel group terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
8. Repeat steps 1 through 7 for all configured channels.

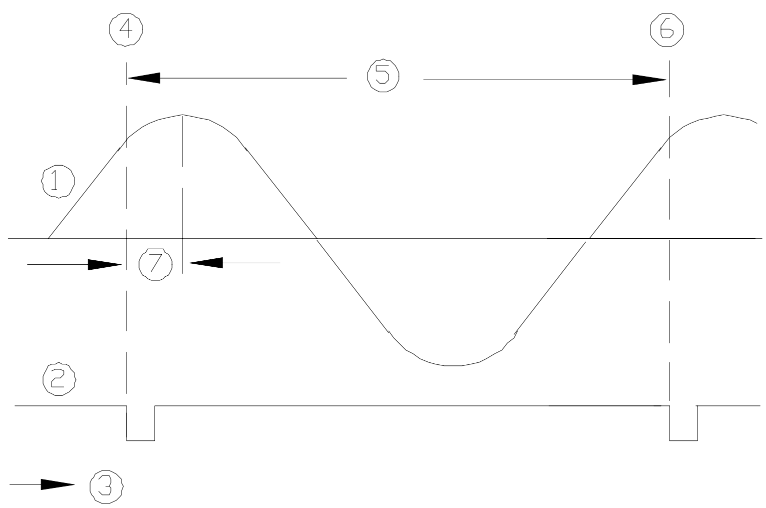
34.4.3 Shaft Absolute 1X Phase (SA 1X Ph)

1. Disconnect PWR, COM, SIG, SEIS / A, and SEIS/B field wiring from the channel group terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 34-2. Use the appropriate test setup in either

Seismoprobe 1X Amplitude and Phase Test Setup (page 34-6) or Velomitor 1X Amplitude and Phase Test Setup (page 34-9).

3. Calculate the verification frequency using the method in "Calculating Verification Frequency" on page 34-26. Adjust the function generator frequency to the calculated value.
4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
5. Attach one channel of a two channel oscilloscope to the vibration signal buffered output and attach the other channel to the associated Keyphasor® signal buffered output and observe the two signals simultaneously.
6. Measure the phase. 1X Phase will be measured from the leading edge of the Keyphasor® pulse to the first positive peak of the vibration signal. Since the Shaft Absolute 1X signal is determined after integration of the velocity signal, you must add 90° from the phase measured with the input signal. See the example below which illustrates a phase of 45°. After adding 90°, the phase will be 45° + 90° = 135°. Observe the 1X Phase bar graph display and Current Value Box; it should read approximately what was measured above, plus 90°.

   Example:
   1X = one cycle of vibration signal per shaft revolution



   1. 1X Vibration Signal
   2. Keyphasor Signal
   3. Time
   4. 0°
   5. One cycle
   6. 360°
   7. Phase lag = 45°

7. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED

comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.

8. Repeat steps 1 through 7 for all configured channels.

34.4.4 Direct

1. Disconnect PWR, COM, SIG, SIES/B, and SEIS/A field wiring from the channel group terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 34-2:

   For Seismoprobe: Use the setup shown in Seismoprobe Channel Verification Test Setup on page 34-5.

   For Velomitor: Use the setup shown in Velomitor® Channel Verification Test Setup on page 34-8.
3. Calculate the verification frequency using the method in "Calculating Verification Frequency" on page 34-26. Adjust the function generator frequency to the calculated value.
4. Calculate the full-scale voltage using the procedure in "Calculating the Input Voltage for Full-scale" on page 34-26. Adjust the function generator (sinewave) amplitude to the calculated value.
5. Verify that the Direct bar graph display and the Current Value Box is reading ±1 % of full-scale.
6. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
7. Disconnect the test equipment and reconnect the PWR, COM, SIG, SEIS / A, and SEIS/B field wiring to the channel group terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
8. Repeat steps 1 through 7 for all configured channels.

34.4.5 1X Amplitude (1X Ampl)

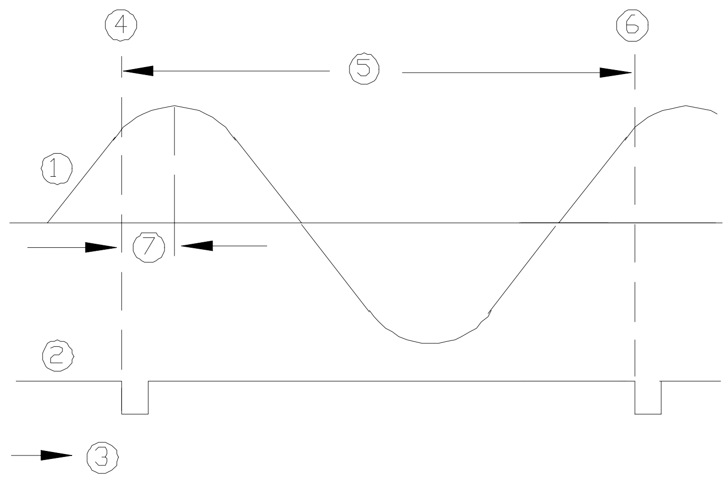
1. Disconnect PWR, COM, SIG, SIES/B, and SEIS/A field wiring from the channel group terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 34-2. Use the appropriate test setup in Seismoprobe 1X Amplitude and Phase Test Setup (page 34-6) or Velomitor 1X Amplitude and Phase Test Setup (page 34-9).
3. Calculate the verification frequency using the method in "Calculating Verification Frequency" on page 34-26. Adjust the function generator frequency to the calculated value.
4. Calculate the full-scale voltage using the procedure in "Full Scale Formulas - Integration" on page 34-27. Adjust the function generator (sinewave) amplitude to the calculated value.

5. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
6. Verify that the 1X Ampl bar graph display and Current Value Box is reading ±1 % of full scale.
7. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
8. Disconnect the test equipment and reconnect the PWR, COM, SIG, SEIS / A, and SEIS/B field wiring to the channel group terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
9. Repeat steps 1 through 8 for all configured channels.

34.4.6 1X Phase

1. Disconnect PWR, COM, SIG, SIES/B, and SEIS/A field wiring from the channel group terminals on the I/O module
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 34-2. Use the appropriate test setup in Seismoprobe 1X Amplitude and Phase Test Setup (page 34-6) or Velomitor 1X Amplitude and Phase Test Setup (page 34-9).
3. Calculate the verification frequency using the method in "Calculating Verification Frequency" on page 34-26. Adjust the function generator frequency to the calculated value.
4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
5. Attach one channel of a two channel oscilloscope to the vibration signal buffered output and attach the other channel to the associated Keyphasor® signal buffered output and observe the two signals simultaneously.
6. Measure the phase. 1X Phase will be measured from the leading edge of the Keyphasor® pulse to the first positive peak of the vibration signal. Since the Shaft Absolute 1X signal is determined after integration of the velocity signal, you must add 90° from the phase measured with the input signal. See the example below which illustrates a phase of 45°. After adding 90°, the phase will be 45° + 90° = 135°. Observe the 1X Phase bar graph display and Current Value Box; it should read approximately what was measured above, plus 90°.

Example:
1X = one cycle of vibration signal per shaft revolution



(1) 1X Vibration Signal
(2) Keyphasor Signal
(3) Time
(4) 0°
(5) One cycle
(6) 360°
(7) Phase lag = 45°

7. Disconnect the test equipment and reconnect the PWR, COM, SIG, SEIS / A, and SEIS/B field wiring to the channel group terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
8. Repeat steps 1 through 7 for all configured channels.

34.5 Verify Filter Corner Frequencies

The general approach for testing these parameters is to simulate the Velocity signal with a function generator and power supply. The corner frequencies are verified by varying the output from the test equipment and observing that the correct results are reported in the Verification screen on the test computer.

Note
If the channel units are integrated, change the channel configuration to a non-integrated scale for this test. This test cannot be performed on the Shaft Absolute Direct, Shaft Absolute 1X, or 1X PPLs. When the test is complete, return the channel to its original configuration.

1. Disconnect PWR, COM, SIG, SIES/B, and SEIS/A field wiring from the channel group terminals on the I/O module
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 34-2:

   For Seismoprobe: Use the setup shown in Seismoprobe Channel Verification Test Setup (page 34-5).

   For Velomitor: Use the setup shown in Velomitor® Channel Verification Test Setup (page 34-8).
3. Calculate the verification frequency using the formulas in "Calculating Verification Frequency" on page 34-26. Adjust the function generator frequency to the calculated value.
4. Calculate the full-scale voltage using the procedure in "Calculating the Input Voltage for Full-scale" on page 34-26. Adjust the function generator (sinewave) amplitude to the calculated value.
5. Verify that the Direct bar graph display and the Current Value Box is reading full-scale.
6. Adjust the function generator frequency to the low-pass filter corner frequency. Verify that the Direct bar graph display and the Current Value Box is reading between 65 % and 75 % of full-scale.
7. Adjust the function generator frequency to the high-pass filter corner frequency. Verify that the Direct bar graph display and the Current Value Box is reading between 65 % and 75 % of full-scale.
8. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
9. Disconnect the test equipment and reconnect the PWR, COM, SIG, SEIS / A, and SEIS/B field wiring to the channel group terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
10. Repeat steps 1 through 9 for all configured channels.

34.5.1 Calculating Verification Frequency

The procedures for verifying channel values and corner frequencies require that you use the following formulas to calculate the verification frequency:

Find the geometric center of the Band-pass frequency range. Input the configured High-pass Filter Corner Frequency and the Low-pass Filter Corner Frequency into the formula below:

$$\text{Verification Frequency} = \sqrt{\text{HPF} * \text{LPF}}$$

HPF = High-pass Filter Corner Frequency

LPF = Low-pass Filter Corner Frequency

- If no filtering is configured, use a verification frequency of 100 Hz.
- If a Low-pass Filter is configured and no High-pass Filter is configured, use a HPF of 1 Hz.
- If a High-pass Filter is configured and no Low-pass Filter is configured, use a LPF of 4,000 Hz.

34.5.2 Calculating the Input Voltage for Full-scale

The procedures for verifying channel values and corner frequencies require that you use the following formulas to calculate the input voltage for Full-scale. To find the Full-scale input voltage, use appropriate table or formula for integrated or non-integrated units.

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification screen.

Full Scale Formulas - No Integration

Units	**To Input RMS Volts**	**To Input Peak to Peak Volts**
in/s pk	(T.S.F x Full-scale) x 0.707	(T.S.F x Full-scale) x 2
mm/s pk	(T.S.F x Full-scale) x 0.707	(T.S.F x Full-scale) x 2
To use the formulas, the T.S.F. should be in volts and the T.S.F and full-scale values should both be of the same unit system (metric or English). The transducer Scale Factor will always be specified as volts per inch/second pk or volts per millimetre/second pk.		

Example 1:
Transducer Scale Factor = 500 mV/(in/s)
Full Scale = 0.5 in/s pk

For Peak to Peak input:
$(0.500 \times 0.5) \times 2$ = 0.5 Vpp

Example 2:
Transducer Scale Factor = 19.69 mV/(mm/s)
Full Scale = 20 mm/s pk

For Peak to Peak input:
$(0.01969 \times 20) \times 2$ = 0.7876 Vpp

34.5.3 Full Scale Formulas - Integration

(For the following units: mil pp and µm pp)

$$\text{Input Voltage (V rms)} = \frac{\text{Full - Scale (English units)}}{\left[\left(\frac{31.831}{\text{Scale Factor (English units)}}\right) / \text{Verification Frequency}\right]} * 0.07071$$

$$\text{Input Voltage (V pp)} = \frac{\text{Full - Scale (English units)}}{\left[\left(\frac{31.831}{\text{Scale Factor (English units)}}\right) / \text{Verification Frequency}\right]} * 0.2$$

To use the formulas, the Velocity Scale Factor should be in volts, and the Full-scale value and Velocity Scale Factor should be in English units. Use the following conversion formulas to convert Metric units to English units:

Scale Factor

$$\text{Velocity Scale Factor (inch/s)} = \text{Velocity Scale Factor (mm/s)} * 25.4$$

Full scale:

$$\text{Full - Scale (mil)} = \frac{\text{Full - Scale } (\mu\mu\ )}{25.4}$$

Example:
To calculate the input voltage for a channel with the following configuration:

Transducer Scale Factor = 19.69 mV/(mm/s)
Full Scale = 100 µm pp
HPF = 3 Hz
LPF = 3000 Hz

1. Convert Metric units to English units.

   Scale Factor:

   $$19.69 \text{ mV(mm/s)} * 25.4 = 500 \text{ mV(in/s)}$$

   Full-scale:

   $$\frac{100\ \mu\text{m}}{25.4} = 3.9370 \text{ mil}$$

2. Calculate the input voltage.

$$\text{Verification Frequency} = \sqrt{3\ \text{Hz} * 3000\ \text{Hz}} = 94.8683\ \text{Hz}$$

$$\text{Input Voltage (V rms)} = \frac{3.9370\ \text{mil}}{\left[\left(\dfrac{31.831}{0.500\ \text{V/(in/s)}}\right)/\,94.8683\ \text{Hz}\right]} * 0.07071 = 0.4148\ \text{(V rms)}$$

or

$$\text{Input Voltage (V pp)} = \frac{3.9370\ \text{mil}}{\left[\left(\dfrac{31.831}{0.500\ \text{V/(in/s)}}\right)/\,94.8683\ \text{Hz}\right]} * 0.2 = 1.173\ \text{(V pp)}$$

Note
The accuracy of the reading will be affected by frequency values less than 20 Hz and setting LPF 5.7 times away from the HPF.

34.6 Test OK Limits

Note
If the Danger Bypass has been activated, then the BYPASS LED will be on. All other channels in the rack must be OK or bypassed for the OK relay to be energized.

34.6.1 For Seismoprobes:

The general approach for testing OK limit is to disconnect the input. This will cause a not OK condition and the OK Relay to change state (de-energize).

1. Disconnect the SIG / A field wiring from the channel terminals on the Shaft Absolute Monitor I/O Module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 34-2.
3. Verify that the OK relay changes state (de-energized).
4. Verify that the Channel OK State line on the Verification screen reads **not OK**.

5. Reconnect the SIG / A field wiring to the channel terminals on the Monitor I/O Module. Press the RESET switch on the Rack Interface Module (RIM) and verify that the OK LED comes on and the OK relay energizes.
6. Verify that the Channel OK State line on the Verification screen reads **OK**.
7. If you can not verify any configured OK limit, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
8. Repeat steps 1 through 7 for all configured channels.

34.6.2 For Velomitors

Due to the requirements for increased robustness in the Shaft Absolute system, the Shaft Absolute I/O Module has a Velomitor interface that is different from the Prox/Seis I/O Module's Velomitor interface. The effect of this difference is that the Velomitor signal input to the I/O Module is 180 degrees out of phase from the correct Velomitor signal. This means that when you input a test signal using a signal generator or DC power supply the buffered outputs on the front panel will be inverted in phase and will have a different DC voltage than the input. This will not affect the actual vibration readings in the Monitor.

The general approach for testing OK limits is to input a DC voltage and adjust it above the Upper OK limit and below the Lower OK limit. This will cause a not OK condition and the OK Relay to change state (de-energize). The Upper and Lower OK limits are displayed in the Verification screen on the test computer.

1. Disconnect PWR, COM / A, and SIG / B field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 34-2.
3. Bypass all other configured channels.
4. Adjust the power supply voltage to -7.00 Vdc.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the monitor OK LED is on and that the Channel OK State line in the Channel Status section of the Verification screen reads **OK**.
6. Verify that the OK relay on the Rack Interface I/O Module indicates OK (energized). See the 3500/20 Rack Interface Module Operation and Maintenance Manual, part number 129768-01.
7. Increase the power supply voltage (more negative) until the OK LED just goes off (lower limit due to the inversion on the I/O Module). Verify that the Channel OK State line on the Verification screen reads **not OK** and that the OK Relay indicates not OK. Verify that the Lower OK limit voltage displayed on the Verification screen is equal to or more negative than the following value.

   Lower OK limit voltage $\leq$ -16.90 - Vinput
8. Decrease the power supply voltage (less negative) to -7.00 Vdc.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on and the OK relay energizes. Verify that the Channel OK State line in the Channel Status section reads **OK**.

10. Gradually decrease the power supply voltage (less negative) until the OK LED just goes off (upper limit due to the inversion on the I/O Card). Verify that the Channel OK State line in the Channel Status section reads **not OK** and that the OK Relay indicates not OK. Verify that the Upper OK limit voltage displayed on the Verification screen is equal to or more positive than the following value.

    Upper OK limit voltage ≥ -23.10 - Vinput
11. Increase the power supply voltage (more negative) to -7.00 Vdc.
12. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on, the OK relay energizes, and the Channel OK State line in the Channel Status section reads **OK**.
13. If you can not verify any configured OK limit, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
14. Disconnect the power supply and multimeter and reconnect the PWR, COM / A, and SIG / B field wiring to the channel terminals on the Monitor I/O Module. Press the RESET switch on the Rack Interface Module (RIM) and verify that the OK LED comes on and the OK relay energizes.
15. Repeat steps 1 through 14 for all configured channels.
16. Return the bypass switch for all configured channels back to their original setting.

Velocity Default OK Limits Table

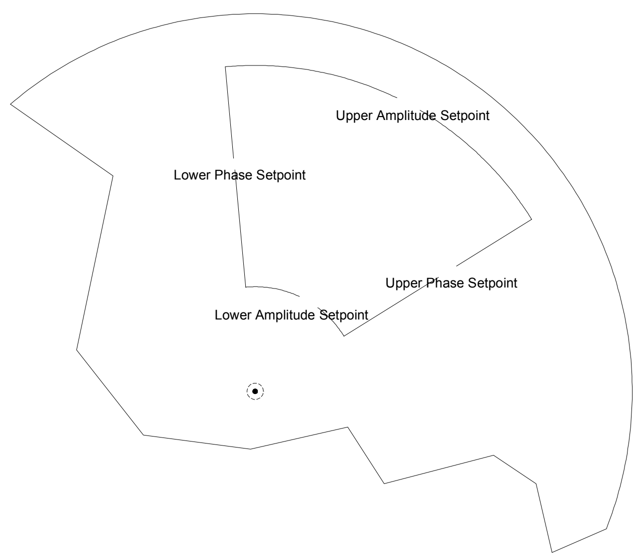
Transducer	Lower Ok Limit (volts)	Upper Ok Limit (volts)
9200	-2.0 to -2.1	-17.9 to -18.0
74172	-2.0 to -2.1	-17.9 to -18.0
non std 2-wire Seismoprobe	-2.0 to -2.1	-17.9 to -18.0
Velomitor (standard)	-4.1 to -4.2	-19.8 to -19.9
Velomitor (high temp)	-2.69 to -2.79	-21.21 to -21.31
non std	-2.0 to -2.1	-17.9 to -18.0
Note: Assume ±50 mV accuracy for check tolerance.		

35. Circular Acceptance Region General Information

Radial vibration is the dynamic motion of a shaft or casing in a direction perpendicular to the shaft axis. 3500 Radial Vibration channels measure this motion by using input signals from proximity probes. These channels condition the input signals into various parameters called “proportional values”. A Radial Vibration channel typically provides proportional values such as Direct, Gap, 1X amplitude and phase lag angle (when used in conjunction with a Keyphasor® signal), and 2X amplitude and phase lag angle. Each channel also provides setpoints that can be used for alarming. Alert setpoints can be configured for each active proportional value and Danger setpoints can be configured for any two of the active proportional values.

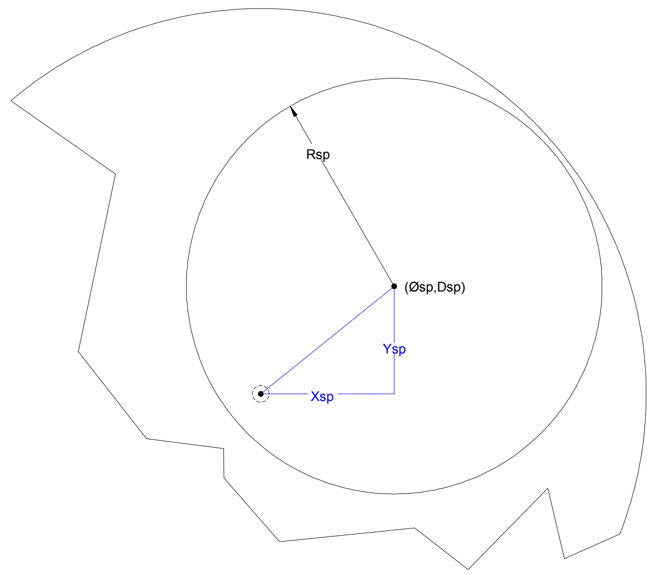
Setpoints can be used to define an Acceptance Region for the 1X or 2X vibration vectors. The user typically defines the normal Acceptance Region for each shaft radial vibration measurement on the machine, based on historical data for the machine under all normal operating conditions.

With a standard Radial Vibration Channel, alarm setpoints are set independently for maximum and minimum values of both amplitude and phase. When represented in polar format, these four setpoints define a “pie shaped” acceptance region (see figure below).



Radial Vibration Acceptance Region

Using the Circular Acceptance Region channel type, a circular acceptance region can be defined. When represented in polar format, the Circular Acceptance Region is defined by a reference vector (D_{sp}, $\varnothing_{sp}$) from the origin and a radius (R_{sp}) which functions as the alarm setpoint (see figure below).



Circular Acceptance Region

36. Circular Acceptance Region Configuration

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36.1 Introduction

This section discusses the Configuration Considerations and the Rack Configuration Software screens associated with the Circular Acceptance Channel.

36.2 Configuration Considerations

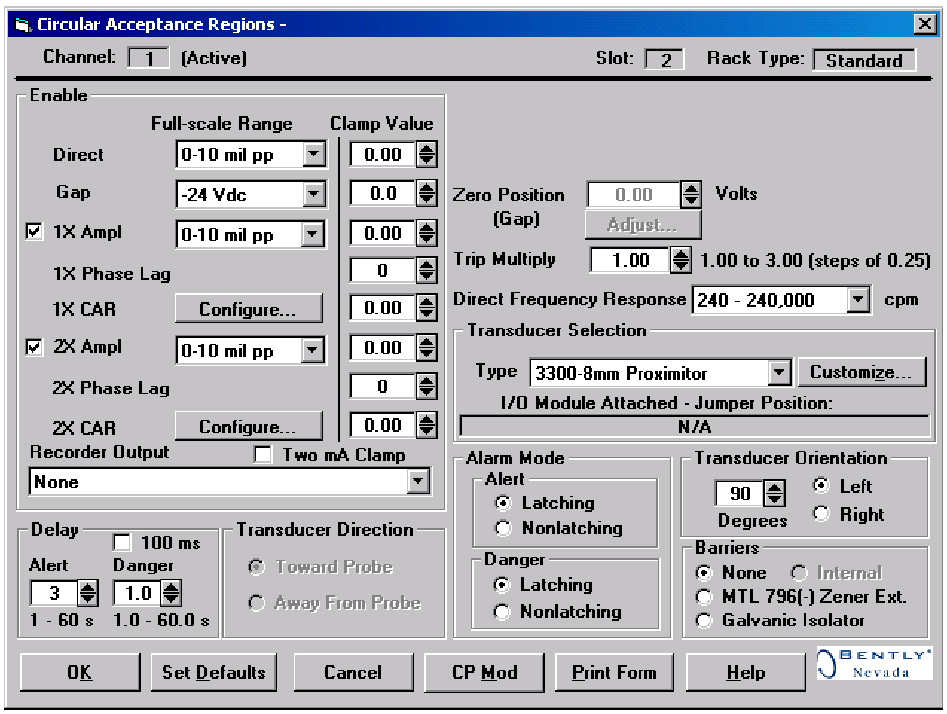
Consider the following items before configuring a Circular Acceptance Region Channel:

- Internal Barrier I/O Modules and External barriers are not currently supported with 7200 11 mm or 14 mm, or 3000 Proximitors, or the 3300 16 mm HTPS.
- When "No Keyphasor" is selected, the 1X Amplitude (Ampl) and Phase Lag, 2X Amplitude (Ampl) and Phase Lag, 1X Circular Acceptance (CAR), and 2X Circular Acceptance (CAR) can not be selected.
- If a Keyphasor channel is selected, a Keyphasor Module must be installed in the rack.
- The 1X and 2X Phase values can be enabled only if the selected Keyphasor channel is configured for an events per revolution equal to 1 will.
- The full scale options allowed for each proportional value is dependent upon the transducer type.
- If a Non-Standard transducer is selected, the setpoint OK limits are set to ±1 volt from the Upper and Lower OK limits that are selected.
- There are two selections for 3000 Series transducers:
    - **3000(-24V) Proximitor** Select this option when connecting a 3000 Series proximitor directly to a 3500 monitor. A default scale factor of 285 mV/mil will be selected. This may be adjusted ±15 %. Note that the buffered transducers on the front of the monitors and to the Data Manager are not compensated and should be interpreted at 285 mV/mil.
    - **3000(-18V) Proximitor** Select this option when connecting a 3000 Series proximitor directly to a 3500 monitor, but supplying proximitor power from an external 18 volt source. A default scale factor of 200 mV/mil will be selected. This may be adjusted ±15 %. Note that the buffered transducers on the front of the monitors and to the Data Manager are not compensated and should be interpreted at 200 mV/mil.
- Setpoints may only be set on proportional values which are enabled.
- Monitors must be configured in channel pairs (for example, Channels 1 and 2 may be configured as Radial Vibration and Channels 3 and 4 may be configured as Circular Acceptance).
- When a full-scale range is modified, the setpoints associated with this proportional value should be readjusted.
- It is best to set the Scale Factor value and the Trip Multiply value before the Zero Position value.

- 3000 (-18V), 3000 (-24V), and 3300 RAM Proximitors have limited linear ranges. Therefore, you should use caution when selecting the Full-scale range of the Direct, 1X Amplitude (Ampl), 2X Amplitude (Ampl), 1X Circular Acceptance (CAR) and 2X Circular Acceptance (CAR) PPLs. Full-scale value x Trip Multiply should not exceed the linear range of the transducer.

36.3 Configuration Options

This section describes the options available on the Circular Acceptance Channel configuration screen.



36.3.1 General Parameters and Buttons

Timed OK Channel Defeat: This prevents a channel from returning to an OK status until that channel's transducer has remained in an OK state for 30 seconds. This feature is always enabled in the Circular Acceptance Channels. The option protects against false trips caused by intermittent transducers.

CP Mod: Selecting the CP Mod button Channel Options Dialog Box, allows a Custom channel configuration to be downloaded to the monitor. Custom configuration data is stored in a Custom Products Modification File. Custom Products Modification files follow the naming convention <modification #.mod>. These files must be located in the \3500\Rackcfg\Mods\ directory. When a CP Mod file is selected, a window is displayed which describes the function of the modification. CP Mod files are available through Bently Nevada's Custom Products Division. Contact your local Bently Nevada Sales Representative for details.

Zero Position (Gap): Represents the zero position (in volts) when the gap scale is to read the engineering units of displacement. To ensure maximum amount of zero adjustment, the probe should be gapped as close as possible to the center gap voltage specified in the OK Limit table. This field is not available for Voltage Gap Scale.

Adjust Button: Adjust the Zero Position voltage. When this button is clicked, a utility starts that helps you set the gap zero position voltage. Since this utility provides active feedback from the 3500 rack, a connection with the rack is required. Refer to "Adjusting the Scale Factor and Zero Position" in the "Monitor Verification" section of the manual.

Trip Multiply: The value selected to temporarily increase the alarm (Alert and Danger) setpoint values. This value is normally applied by manual (operator) action during startup to allow a machine to pass through high vibration speed ranges without monitor alarm indications. Such high vibration speed ranges may include system resonances and other normal transient vibrations.

Direct Frequency Response: The upper and lower corners for the band-pass filter used with direct vibration measurements. The available ranges are 240 to 240,000 cpm and 60 to 36,000 cpm.

Transducer Jumper Status (on I/O Module): Returns the position of the Transducer Jumper on the I/O Module. Refer to "Setting the I/O Jumper" in the "I/O Module Descriptions" section of the manual, if applicable.

36.3.2 Reference Information

These fields contain information that indicates which module you are configuring.

Channel: The number of the channel being configured (1 through 4).

Slot: The location of the monitor in the 3500 rack (2 through 15).

Rack Type: Identifies the type of Rack Interface Module installed in the rack (Standard or TMR).

36.3.3 Enable

An enabled proportional value specifies that the value will be provided by the channel (☑ enabled, ☐ disabled).

Direct: Data which represents the overall peak to peak vibration. All frequencies within the selected Direct Frequency Response are included in this proportional value.

Gap: The physical distance between the face of a proximity probe tip and the observed surface. The distance can be expressed in terms of displacement (mils, micrometres) or in terms of voltage. Standard polarity convention dictates that a decreasing gap results in an increasing (less negative) output signal.

1X Ampl: In a complex vibration signal, notation for the amplitude component that occurs at the rotative speed frequency.

1X Phase Lag: In a complex vibration signal, notation for the phase lag component that occurs at the rotative speed frequency.

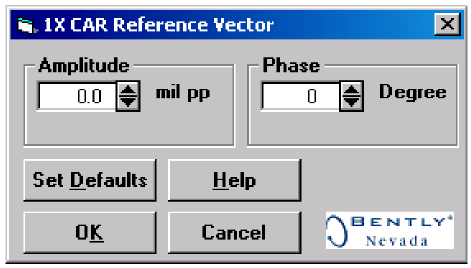
1X CAR: Circular Acceptance Region, where a reference angle and magnitude are specified and the magnitude of rotative speed frequency vibration component is reported relative to this reference.

2X Ampl: In a complex vibration signal, notation for the amplitude component having a frequency equal to two times the shaft rotative speed.

2X Phase Lag: In a complex vibration signal, notation for the phase lag component having a frequency equal to two times the shaft rotative speed. 2X phase lag is the angular measurement from the leading or trailing edge of the Keyphasor pulse to the following positive peak of the 2X vibration signal.

2X CAR: Circular Acceptance Region, where a reference angle and magnitude are specified and the magnitude of two times rotative speed frequency vibration component is reported relative to this reference.

Configure buttons: Used to adjust the Reference Vector for 1X and 2X CAR calculations. The Reference Vector amplitude must be between 0 and 10 mil. Also, vector phase must be between 0 and 359 degrees



Full Scale Range: Each selectable proportional value provides the ability to set a full scale value. If the desired full scale value is not in the pull down list, then the custom selection can be chosen.

The values in the following table are the same for all transducer types.

Direct 1X Ampl 2X Ampl
0-3 mil pp
0-5 mil pp
0-10 mil pp
0-15 mil pp
0-20 mil pp
0-100 µm pp
0-150 µm pp
0-200 µm pp
0-400 µm pp
0-500 µm pp
Custom

Gap Full-scale Ranges by Transducer Type

3300–5 mm Proximitor **3300 XL 8 mm Proximitor** **3300–8 mm Proximitor** **7200–5 mm Proximitor** **7200–8 mm Proximitor**	**3300 XL 11 mm Proximitor** **7200–11 mm Proximitor** **7200–14 mm Proximitor** **3300–16 mm HTPS** **Nonstandard**	**3000 (-18V) Proximitor** **3000 (-24V) Proximitor** **3300 RAM Proximitor**
-24 Vdc 15-0-15 mil 25-0-25 mil 300-0-300 μm 600-0-600 μm Custom	-24 Vdc 15-0-15 mil 25-0-25 mil 50-0-50 mil 300-0-300 μm 600-0-600 μm 1000-0-1000 μm Custom	-24 Vdc 15-0-15 mil 300-0-300 μm

Clamp Value: The value that a proportional value goes to when that channel or proportional value is bypassed or defeated (For example when a problem occurs with the transducer). The selected value can be between the minimum and maximum full-scale range values. (1X and 2X Phase Lag have available values of 0 to 359 degrees.) Only the values available from the Recorder Outputs, Communication Gateway and Display Interface Module are clamped to the specified value when the proportional value is invalid.

Recorder Output: The proportional value of a channel that is sent to the 4 to 20 mA recorder. The recorder output is proportional to the measured value over the channel full scale range. An increase in the proportional value that would be indicated as upscale on a bar graph display results in an increase in the current at the recorder output.

If 1X Phase Lag or 2X Phase Lag are selected then the two options available are with and without Hysteresis. If the channel is Bypassed, the output will be clamped to the selected clamp value or to 2 mA (if the 2 mA clamp is selected).

The Hysteresis option helps prevent the Recorder Output from jumping from Full to Bottom Scale when the phase measurement is near 0 or 359 degrees. When the Hysteresis option is checked, the recorder signal operates as follows:

- The recorder output is scaled such that 4 mA corresponds to 0 degrees and 20 mA corresponds to 380 degrees (360 plus 20 degrees).
- The transition of a phase measurement that is increasing does not occur until the measurement has gone 20 degrees past 360 degrees. At this point, the recorder signal switches from 20 mA to a signal that corresponds to 20 degrees or 4.842 mA.

- The transition of a phase measurement that is decreasing occurs at 0 degrees (4 mA). At this point, the recorder signal switches from 4 mA to a signal that corresponds to 360 degrees or 19.158 mA.

36.3.4 Delay

The time which a proportional value must remain at or above an over alarm level or below an under alarm level before an alarm is declared as active.

Alert: First level alarm that occurs when the transducer signal level exceeds the selected Alert/Alarm 1 setpoint. This setpoint can be set on the Setpoint screen. The Alert time delay is always set at one second intervals (from 1 to 60) for all available proportional values.

Danger: Second level alarm that occurs when the transducer signal level exceeds the selected Danger/Alarm 2 setpoint. This setpoint can be set on the Setpoint screen.

100 ms option: The 100 ms (typical) option applies to the Danger time delay only and has the following results:

If the 100 ms option is off (☐):

- The Danger time delay can be set at one second intervals (from 1 to 60).
- The Danger time delay can be set for up to two available proportional values.

If the 100 ms option is on (☑):

- The Danger time delay is set to 100 ms.
- The Danger time delay can only be set for the primary proportional value.

36.3.5 Transducer Selection

Type: The following transducer types are available for the Circular Acceptance Channel (non-barrier I/O module):

3300 Transducers

- 3300 XL 8 mm Proximitor
- 3300 XL 11 mm Proximitor
- 3300 – 5 mm Proximitor
- 3300 – 8 mm Proximitor
- 3300 RAM Proximitor
- 3300 – 16 mm HTPS

7200 Transducers

- 7200 – 5 mm Proximitor
- 7200 – 8 mm Proximitor
- 7200 – 11 mm Proximitor
- 7200 – 14 mm Proximitor

3000 Transducers

- 3000 (-18 V) Proximitor
- 3000 (-24 V) Proximitor

Nonstandard

The following transducer types are available for the Circular Acceptance Channel (barrier I/O module):

3300 Transducers

- 3300 XL 8 mm Proximitor
- 3300 XL 11 mm Proximitor
- 3300 – 5 mm Proximitor
- 3300 – 8 mm Proximitor
- 3300 RAM Proximitor

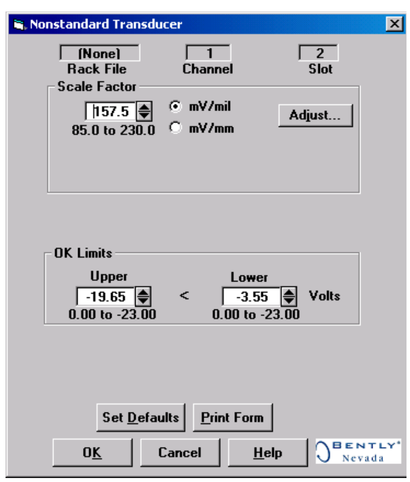
7200 Transducers

- 7200 – 5 mm Proximitor
- 7200 – 8 mm Proximitor

Nonstandard

Customize button: Used to adjust the Scale Factor for transducers. Refer to "Adjusting the Scale Factor and Zero Position" in the "Monitor Verification" section of the manual. Also, note that:

- If Non-standard is selected as the transducer type, the OK Limits can also be adjusted.
- The Non-standard transducer's scale factor must be between 85 and 230 mV/mil.
- There must be at least 2 volts between the Upper and Lower OK Limits.



Scale Factor by Transducer Type

Transducer	Scale Factor				
	Without Barriers	**With Bently Nevada Internal Barriers**	**Standard I/O With Barriers**	**Discrete TMR I/O With Barriers**	**Bussed TMR I/O With Barriers**
3300 XL 8 mm 3300 5 and 8 mm 7200 5 and 8 mm	200 mV/mil	200 mV/mil	192 mV/mil	200 mV/mil	199 mV/mil
3300 XL 11 mm	100 mV/mil	100 mV/mil	96 mV/mil	100 mV/mil	100 mV/mil
7200 11 mm	*100 mV/mil	*	*	*	*
7200 14 mm	*100 mV/mil	*	*	*	*
3000 (-18 V)	*200 mV/mil	*	*	*	*
3000 (-24 V)	*285 mV/mil	*	*	*	*
3300 RAM	200 mV/mil	200 mV/mil	192 mV/mil	200 mV/mil	199 mV/mil
3300 16 mm HTPS	100 mV/mil	*	*	*	*
Note: ±15 % scale factor adjustment allowed * Barriers are not supported with this transducer option.					

OK Limits by Transducer Type

Transducer	Upper		Lower		Center Gap Voltage	
	Without Barriers (V)	With Barriers (V)	Without Barriers (V)	With Barriers (V)	Without Barriers (V)	With Barriers (V)
3300 XL 8 mm 3300 XL 11 mm 3300 5 mm 3300 8 mm 7200 5 mm 7200 8 mm	-16.75	-16.75	-2.75	-2.75	-9.75	-9.75
7200 11 mm	-19.65	*	-3.55	*	-11.6	*
7200 14 mm	-16.75	*	-2.75	*	-9.75	*
3000 (-18 V)	-12.05	*	-2.45	*	-7.25	*
3000 (-24 V)	-15.75	*	-3.25	*	-9.5	*
3300 RAM	-12.55	-12.15	-2.45	-2.45	-7.5	-7.3
3300 16 mm HTPS	-16.75	*	-2.75	*	-9.75	*

* Barriers are not supported with this transducer option.

Note: With Barriers includes BN Internal Barrier I/O Modules.

36.3.6 Alarm Mode

Alert should be the first level alarm that occurs when the transducer signal level exceeds the selected value. Danger should be the second level alarm that occurs when the transducer signal level exceeds the selected value. The Alert and Danger values are set on the Setpoint screen.

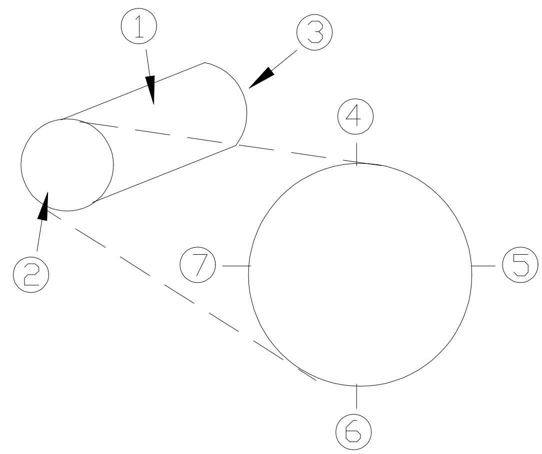
Latching: Once an alarm is active it will remain active even after the proportional value drops below the configured setpoint level. The channel will remain in alarm until it is reset using one of the following methods:

- the reset switch on the front of the Rack Interface Module
- the contact on the Rack Interface I/O Module
- the Reset button in the Operator Display Software
- the reset command through the Communication Gateway Module
- the reset command through the Display Interface Module
- the reset command in the Rack Configuration Software

Nonlatching: When an alarm is active it will go inactive as soon as the proportional value drops below the configured setpoint level.

36.3.7 Transducer Orientation

Degrees: The location of the transducer on the machine. The range for orientation angle is 0 to 180 degrees left or right as observed from the driver to the driven end of the machine train. Refer to the following figure:



This drawing is for horizontal shafts

(1) Shaft
(2) Driver end
(3) Driven end
(4) 0°
(5) 90° right
(6) 180°
(7) 90° left

36.3.8 Barriers

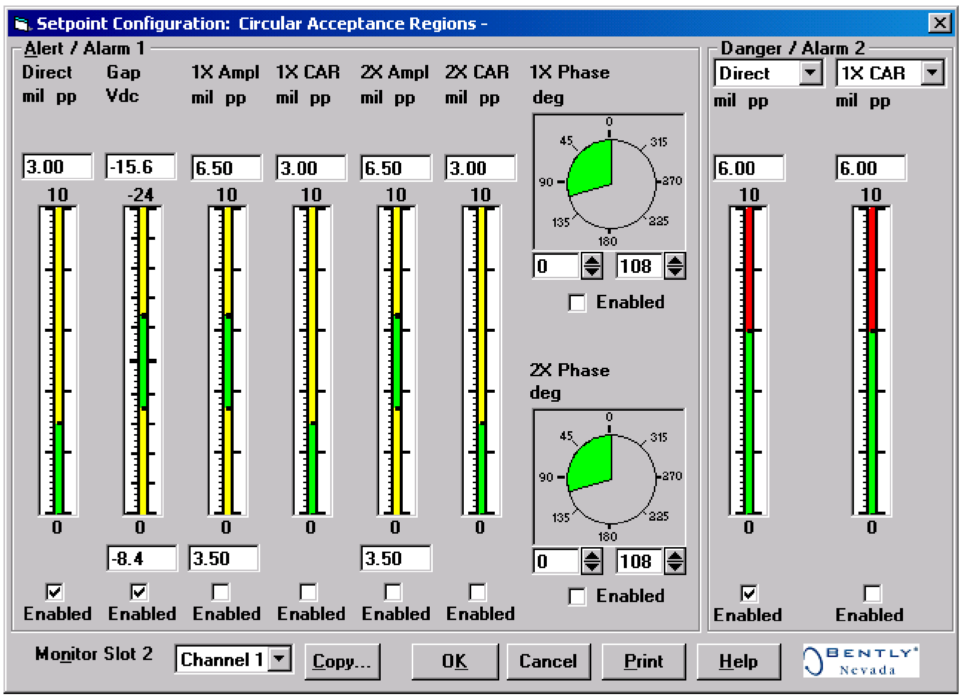
Select the MTL 796(-) Zener External option, or Galvanic Isolators if external safety barriers are connected between the monitor and the transducer. If using an Internal Barrier I/O Module, select the internal option. These devices are used to restrict the amount of energy that can flow into a hazardous area.

36.4 Alarm Setpoints

This section lists the available setpoints for the Circular Acceptance channel. A setpoint is the level within the full-scale range that determines when an alarm occurs. The 3500 Monitoring System allows Alert/Alarm 1 setpoints to be set for every proportional value on each channel. The channel will drive an Alert/Alarm 1 indication if one or more of the channel proportional values exceeds its setpoints. The 3500 Monitoring System also allows up to four Danger/Alarm 2 setpoints (two over setpoints and two under setpoints) to be set for up to two of the proportional values. You may select any two of the available proportional values for the channel.

Note
The setpoint over and under limits can only be placed within the OK limits of the specified transducer.

Use the following screen in the Rack Configuration Software to adjust Alert/Alarm 1 and Danger/Alarm 2 setpoints for Circular Acceptance channels.



36.4.1 Available Setpoints

The following tables list the Alert/Alarm 1 and Danger/Alarm 2 setpoints available for each Circular Acceptance channel pair. The setpoint number is used in the Communication Gateway and Display Interface Modules.

Setpoint Number	Circular Acceptance
1	Over Direct
2	Over Gap
3	Under Gap
4	Over 1X Ampl
5	Under 1X Ampl
6	Over 1X Phase Lag
7	Under 1X Phase Lag
8	Over 1X Circular Acceptance Radius
9	Over 2X Ampl
10	Under 2X Ampl
11	Over 2X Phase Lag
12	Under 2X Phase Lag
13	Over 2X Circular Acceptance Radius
14	Danger (configurable)
15	Danger (configurable)
16	Danger (configurable)
17	Danger (configurable)

36.4.2 Alarm Hysteresis

The alarming hysteresis for all channel configurations is 1/64 of Full Scale. When a channel exceeds an alarm setpoint, it must fall back below the setpoint less the hysteresis before it can go out of alarm.

For example, for a channel configuration with a 0–10 mils full scale and an alarm setpoint at 6 mils. The hysteresis = 10 mils/64 = 0.16 mils. The channel input, therefore, must fall below 6 mils - 0.16 mils (5.84 mils) before the channel is out of alarm.

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37. Circular Acceptance Region Verification

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37.1 Introduction

The following sections describe how to test alarms, verify channels, and test OK limits for channels configured as Circular Acceptance. The output values and alarm setpoints are verified by varying the input vibration signal level (both peak to peak amplitude and DC voltage bias) and observing that the correct results are reported in the Verification screen on the test computer.

Circular Acceptance channels can be configured for the following channel values and alarms:

Channel Values	Alarms	
	Over	Under
Direct	X	
Gap	X	X
1X Amplitude and Phase	X	X
1X Circular Acceptance	X	
2X Amplitude and Phase	X	X
2X Circular Acceptance	X	

37.2 Test Equipment and Software Setup

The following test equipment and software setup can be used as the initial set up needed for all the Circular Acceptance channel verification procedures (Test Alarms, Verify Channels, and Test OK Limits).

WARNING!
High voltage present. Contact could cause shock, burns, or death. Do not touch exposed wires or terminals.

Application Alert
Tests will exceed alarm setpoint levels causing alarms to activate. This could result in a relay contact state change.

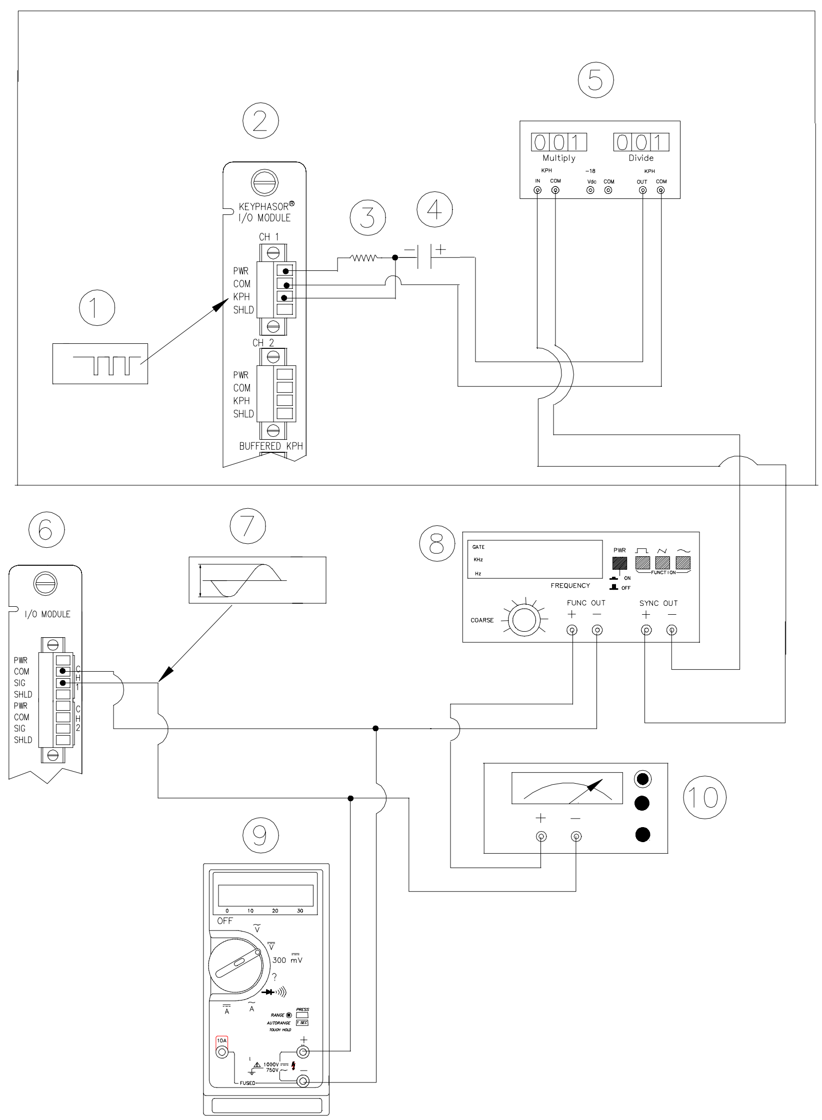
Application Alert
Disconnecting the field wiring will cause a not OK condition.

37.2.1 Test Equipment Setup

Simulate the transducer signal by connecting the power supply, function generator, and multimeter to COM and SIG of channel 1 with polarity as shown in the figure below (Circular Acceptance Test Setup). Set the test equipment as specified below.

Power Supply	Function Generator	Keyphasor Multiplier/Divider
-7.00 Vdc	Waveform: sinewave DC Volts: 0 Vdc Frequency: 100 Hz Amplitude level: Minimum (above zero)	Multiply Switch: 001 Divide Switch: 001

The equipment shown in the dashed box is required for 1X Amplitude, 1X Phase, 1X Circular Acceptance, 2X Amplitude, 2X Phase, and 2X Circular Acceptance tests.



Test equipment for Circular Acceptance

(1) Keyphasor® Signal
(2) Keyphasor® I/O Module
(3) 40 kΩ
(4) 100 μF
(5) Keyphasor® Mulitplier/Divider
(6) Typical I/O module
(7) Simulated input signal
(8) Function generator
(9) Mulitmeter
(10) Power supply

37.2.2 Verification Screen Setup

Run the Rack Configuration Software on the test computer. Choose **Verification** from the Utilities menu and choose the proper Slot number and Channel number then click on the **Verify** button.

Note
Timed OK Channel Defeat is enabled for Circular Acceptance channels. It will take 30 seconds for a channel to return to the **OK** status from a **not OK** condition.

37.3 Test Alarms

The general approach for testing alarm setpoints is to simulate the vibration and Keyphasor® signal with a function generator. The alarm levels are tested by varying the vibration signal (both peak to peak amplitude and DC voltage bias) and observing that the correct results are reported in the Verification screen on the test computer. It is only necessary to test those alarm parameters that are configured and being used. The general test procedure to verify current alarm operation will include simulating a transducer input signal and varying this signal:

- to exceed over Alert/Alarm 1 and Danger/Alarm 2 Setpoints, and
- to drop below any under Alert/Alarm 1 and Danger/Alarm 2 Setpoints and
- to produce a nonalarm condition.

When varying the signal from an alarm condition to a nonalarm condition, alarm hysteresis must be considered. Adjust the signal well below the alarm setpoint for the alarm to clear.

37.3.1 Direct

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the function generator amplitude to produce a reading that is below the Direct setpoint levels on the Direct bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Direct is green, and the Current Value field contains no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the Direct Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct

changes color from green to yellow and that the Current Value Field indicates an Alarm.

6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the Direct Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Direct changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Direct remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Direct changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. If you can't verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
11. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
12. Repeat steps 1 through 11 for all configured channels.

37.3.2 Gap

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2.
3. Adjust the power supply to produce a voltage that is within the Gap setpoint levels on the Gap bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Gap is green and that the Current Value field has no alarm indication.
5. Adjust the power supply voltage such that the signal just exceeds the Gap Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Gap changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Gap remains yellow and that the Current Value Field still indicates an Alarm.

7. Adjust the power supply such that the signal just exceeds the Gap Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Gap changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for Gap remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the power supply voltage such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Gap changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. Repeat steps 5 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the power supply to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

37.3.3 1X Amplitude (1X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the function generator amplitude to produce a reading that is within the 1X Ampl setpoint levels on the 1X Ampl bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 1X Ampl is green and that the Current Value field contains no alarm indication.

5. Adjust the function generator amplitude such that the signal just exceeds the 1X Ampl Over Alert/Alarm 1 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Ampl changes color from green to yellow and the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Ampl remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the 1X Ampl Over Danger/Alarm 2 setpoint level. Wait for 2 to 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Ampl changes color from yellow to red and the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Ampl remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Ampl changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the function generator amplitude to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

37.3.4 1X Phase

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.

2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2.

Note
If you can not change the phase output, change the phase alarm setpoints to activate the over and under phase alarms. The setpoints must be downloaded to the monitor to take effect.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the phase to produce a reading that is within the 1X Phase setpoint levels on the 1X Phase bar graph display of the Verification screen.
4. The 1X Amplitude needs to be a minimum of 10 mV to get a valid 1X Phase reading.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 1X Phase is green, and the Current Value field contains no alarm indication.
6. Adjust the phase such that the reading just exceeds the 1X Phase Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Phase changes color from green to yellow and the Current Value Field indicates an Alarm.
7. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Phase remains yellow and that the Current Value Field still indicates an Alarm.
8. Adjust the phase such that the reading just exceeds the 1X Phase Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Phase changes color from yellow to red and that the Current Value Field indicates an Alarm.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Phase remains red and that the Current Value Field still indicates an Alarm.
10. Adjust the phase such that the reading is below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Phase changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
11. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the phase to exceed the Under Alarm setpoint levels.
12. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.

13. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
14. Repeat steps 1 through 12 for all configured channels.

37.3.5 1X Circular Acceptance

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2.

Note
If you can not change the phase output, change the phase alarm setpoints to activate the over and under phase alarms. The setpoints must be downloaded to the monitor to take effect.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Adjust the function generator amplitude to produce a reading that is below the Not 1X setpoint levels on the Not 1X bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 1X Circular Acceptance is green, and the Current Value field has no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the 1X Circular Acceptance Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Circular Acceptance changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Circular Acceptance remains yellow and that the Current Value Field still indicates an Alarm.

7. Adjust the function generator amplitude such that the signal just exceeds the 1X Circular Acceptance Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Circular Acceptance changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Circular Acceptance remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Circular Acceptance changes color to green and the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. Adjust the phase such that the reading just exceeds the 1X Circular Acceptance Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Phase changes color from green to yellow and the Current Value Field indicates an Alarm.
11. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Circular Acceptance remains yellow and that the Current Value Field still indicates an Alarm.
12. Adjust the phase such that the reading just exceeds the 1X Circular Acceptance Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 1X Circular Acceptance changes color from yellow to red and that the Current Value Field indicates an Alarm.
13. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 1X Circular Acceptance remains red and that the Current Value Field still indicates an Alarm.
14. Adjust the phase such that the reading is below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 1X Circular Acceptance changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
15. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
16. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
17. Repeat steps 1 through 16 for all configured channels.

37.3.6 2X Amplitude (2X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2.
3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two. Adjust the function generator amplitude to produce a reading that is within the 2X Ampl setpoint levels on the 2X Ampl bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 2X Ampl is green, and the Current Value field has no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the 2X Ampl Over Alert/Alarm 1 setpoint level. Wait 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 2X Ampl changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Ampl remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the 2X Ampl Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 2X Ampl changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Ampl remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 2X Ampl changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.

10. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the function generator amplitude to exceed the Under Alarm setpoint levels.
11. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
12. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
13. Repeat steps 1 through 12 for all configured channels.

37.3.7 2X Phase

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in Test Equipment Setup.

Note
If you can not change the phase output, change the phase alarm setpoints to activate the over and under phase alarms. The setpoints must be downloaded to the monitor to take effect.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two. Adjust the phase to produce a reading that is within the 2X Phase setpoint levels on the 2X Phase bar graph display of the Verification screen.
4. The 2X Amplitude needs to be a minimum of 10 mV to get a valid 2X Phase reading.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 2X Phase is green, and the Current Value field has no alarm indication.

6. Adjust the phase such that the reading just exceeds the 2X Phase Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay and verify that the bar graph indicator for 2X Phase changes color from green to yellow and that the Current Value Field indicates an Alarm.
7. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Phase remains yellow and that the Current Value Field still indicates an Alarm.
8. Adjust the phase such that the reading just exceeds the 2X Phase Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 2X Phase changes color from yellow to red and that the Current Value Field indicates an Alarm.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Phase remains red and that the Current Value Field still indicates an Alarm.
10. Adjust the phase such that the reading is below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 2X Phase changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
11. Repeat steps 3 through 9 to test the Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the phase to exceed the Under Alarm setpoint levels.
12. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
13. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
14. Repeat steps 1 through 13 for all configured channels.

37.3.8 2X Circular Acceptance

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in Test Equipment Setup.

Note
If you can not change the phase output, change the phase alarm setpoints to activate the over and under phase alarms. The setpoints must be downloaded to the monitor to take effect.

3. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two. Adjust the phase to produce a reading that is within the 2X Phase setpoint levels on the 2X Phase bar graph display of the Verification screen.
4. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for 2X Circular Acceptance is green, and the Current Value field has no alarm indication.
5. Adjust the function generator amplitude such that the signal just exceeds the 2X Circular Acceptance Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 2X Circular Acceptance changes color from green to yellow and that the Current Value Field indicates an Alarm.
6. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Circular Acceptance remains yellow and that the Current Value Field still indicates an Alarm.
7. Adjust the function generator amplitude such that the signal just exceeds the 2X Circular Acceptance Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 2X Circular Acceptance changes color from yellow to red and that the Current Value Field indicates an Alarm.
8. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Circular Acceptance remains red and that the Current Value Field still indicates an Alarm.
9. Adjust the function generator amplitude such that the signal reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 2X Circular Acceptance changes color to green and the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
10. Adjust the phase such that the reading just exceeds the 1X Circular Acceptance Over Alert/Alarm 1 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 2X Circular Acceptance changes color from green to yellow and the Current Value Field indicates an Alarm.
11. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Circular Acceptance remains yellow and that the Current Value Field still indicates an Alarm.

12. Adjust the phase such that the reading just exceeds the 1X Circular Acceptance Over Danger/Alarm 2 setpoint level. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for 2X Circular Acceptance changes color from yellow to red and that the Current Value Field indicates an Alarm.
13. Press the RESET switch on the Rack Interface Module (RIM). Verify that the bar graph indicator for 2X Circular Acceptance remains red and that the Current Value Field still indicates an Alarm.
14. Adjust the phase such that the reading is below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for 2X Circular Acceptance changes color to green and that the Current Value Box contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.
15. If you can not verify any configured alarm, recheck the configured setpoints. If the monitor still does not alarm properly or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
16. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel pair terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
17. Repeat steps 1 through 16 for all configured channels.

37.4 Verify Channel Values

The general approach for testing channel values is to simulate the vibration and Keyphasor input signal with a function generator. The output values are verified by varying the input vibration signal level (both peak to peak amplitude and DC voltage bias) and observing that the correct results are reported in the Verification screen on the test computer.

Note
These parameters have an accuracy specification of ±1 % of full scale for amplitude and ±3 degrees for phase.

37.4.1 Direct

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in Test Equipment.

3. Calculate the full-scale voltage according to the equation and examples shown below. Adjust the amplitude of the function generator to the calculated voltage.

Application Alert
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Full Scale Voltage = Direct Meter Top Scale × Transducer Scale Factor

Example 1:

Direct Meter Top Scale	=	10 mil
Transducer Scale Factor	=	200 mV/mil

Full Scale	=	(10 × 0.200)
	=	2.000 Vpp

For Vrms input:

Vrms	=	(0.707/2) × (Vpp), for a sinewave input
	=	(0.707/2) × (2)
	=	0.707 Vrms

Example 2:

Direct Meter Top Scale	=	200 μm
Transducer Scale Factor	=	7,874 mV/mm
	=	7.874 mV/μm

Full Scale	=	(200 × 0.007874)
	=	1.5748 Vpp

For Vrms input:

Vrms	=	(0.707/2) × (Vpp), for a sinewave input
	=	(0.707/2) × (1.574)
	=	0.5566 Vrms

4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Verify that the Direct bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED

comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.

7. Repeat steps 1 through 6 for all configured channels.

37.4.2 Gap

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2.
3. **If Gap is configured to read in volts**, adjust the power supply to produce a voltage equal to -18.00 Vdc on the Gap bar graph display. Verify that the Gap bar graph display and Current Value Box is reading ±1 % of -18.00 Vdc.
4. Adjust the power supply to produce a voltage equal to mid-scale on the Gap bar graph display. Verify that the Gap bar graph display and Current Value Box is reading ±1 % of the mid-scale value. Go to step 8.

If Gap is configured to read in displacement units, calculate the full-scale and bottom-scale voltage using the following equation:

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Gap Full-Scale = Gap Zero Position Volts + (Gap Meter Top Scale × Transducer Scale Factor)

Example 1:

Transducer Scale Factor	=	200 mV/mil
Gap	=	15-0-15 mil
Gap Top Scale	=	15 mil
Gap Zero Position Volts	=	-9.75 Vdc
Gap Full Scale input	=	-9.75 Vdc + (15 × 0.200)
	=	-6.75 Vdc

Example 2:

Transducer Scale Factor	=	7,874 mV/mm
	=	7.874 mV/μm
Gap	=	300-0-300 μm
Gap Top Scale	=	300 μm
Gap Zero Position Volts	=	-9.75 Vdc
Gap Full Scale input	=	-9.75 Vdc + (300 × 0.007874)
	=	-7.3878 Vdc

Gap Bottom-Scale = Gap Zero Position Volts - (Gap Meter Bottom Scale × Transducer Scale Factor)

Example 1:

Transducer Scale Factor	=	200 mV/mil
Gap	=	15-0-15 mil
Gap Bottom Scale	=	15 mil
Gap Zero Position Volts	=	-9.75 Vdc
Gap Bottom Scale input	=	-9.75 Vdc - (15 × 0.200)
	=	-12.75 Vdc

Example 2:

Transducer Scale Factor	=	7,874 mV/mm
	=	7.874 mV/µm
Gap	=	300-0-300 µm
Gap Bottom Scale	=	300 µm
Gap Zero Position Volts	=	-9.75 Vdc
Gap Bottom Scale input	=	-9.75 Vdc - (300 × 0.007874)
	=	-12.1122 Vdc

5. Adjust the power supply voltage to match the voltage displayed in the Gap Zero Position Volts Box. The Gap bar graph display and Current Value Box should read 0 mil (0 mm) ±1 %.
6. Adjust the power supply to produce a voltage equal to top scale (from step 3) on the Gap bar graph display. Verify that the Gap bar graph display and Current Value Box is reading ±1 % of top scale.
7. Adjust the power supply to produce a voltage equal to bottom scale (from step 3) on the Gap bar graph display. Verify that the Gap bar graph display and Current Value Box is reading ±1 % of bottom scale.
8. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
9. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
10. Repeat steps 1 through 9 for all configured channels.

37.4.3 1X Amplitude (1X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2.
3. Calculate the full-scale voltage according to the equation and examples shown below. Adjust the function generator amplitude to the calculated voltage.

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Full Scale Voltage = 1X Ampl Meter Top Scale X Transducer Scale Factor

Example 1:
1X Ampl Meter Top Scale = 10 mil
Transducer Scale Factor = 200 mV/mil

Full Scale = (10×0.200)
= 2.000 Vpp

For V rms input:

V rms = $(0.707/2) \times$ (Vpp), for a sinewave input
= $(0.707/2) \times (2)$
= 0.707 Vrms

Example 2:
1X Ampl Meter Top Scale = 200 µm
Transducer Scale Factor = 7,874 mV/mm
= 7.874 mV/µm
Full Scale = (200×0.007874)
= 1.5748 Vpp

For V rms input:

$$V\ rms = (0.707/2) \times (Vpp), \text{ for a sinewave input}$$
$$= (0.707/2) \times (1.574)$$
$$= 0.5566\ Vrms$$

4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one. Verify that the 1X Ampl bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

37.4.4 1X Phase

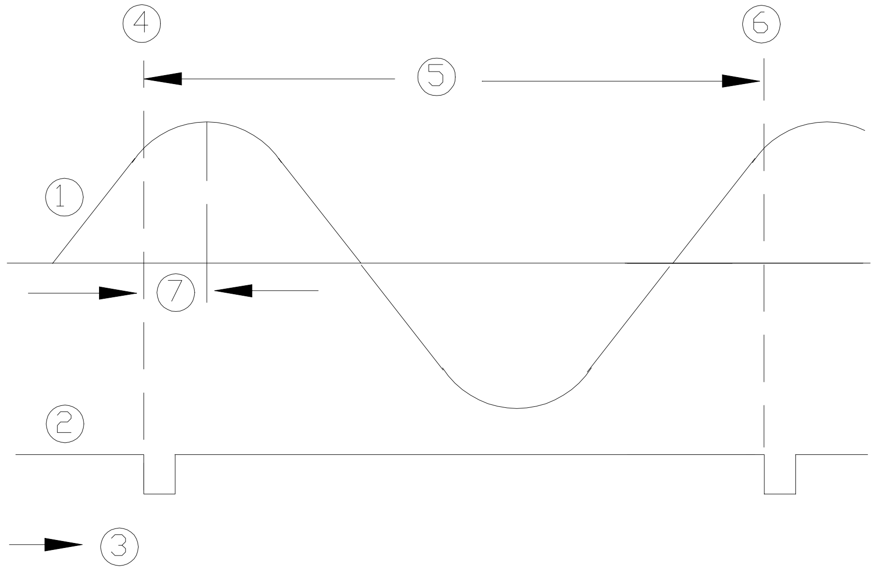
If the test equipment is not capable of changing the phase output to a known value, use the following procedure. If your test equipment can change the phase output to a known value, use the procedure "If the Test Equipment Can Change the Phase Output (1X Phase)".

37.4.4.1 If the Test Equipment Cannot Change the Phase Ouput (1X Phase)

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
3. Attach one channel of a two channel oscilloscope to the vibration signal buffered output and attach the other channel to the associated Keyphasor® signal buffered output and observe the two signals simultaneously.
4. Measure the phase. 1X Phase will be measured from the leading edge of the Keyphasor® pulse to the first positive peak of the vibration signal. See the example below which illustrates a phase of 45°. Observe the 1X Phase bar graph display and Current Value Box; it should read approximately what was measured above.

Example:

1X = one cycle of vibration signal per shaft revolution



(1) 1X Vibration Signal
(2) Keyphasor Signal
(3) Time
(4) 0°
(5) One cycle
(6) 360°
(7) Phase lag = 45°

5. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
6. Repeat steps 1 through 5 for all configured channels.

37.4.4.2 If the Test Equipment Can Change the Phase Output (1X Phase)

If the test equipment has the capability to change the phase output to a known value, use the following procedures.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
3. Adjust the phase for mid-scale. Verify that the 1X Phase bar graph display and Current Value Box is reading ±1.5 % of mid-scale.
4. If the reading does not meet specifications double check the input signal to ensure it is correct. If the monitor still does not meet specifications or fails

any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.

5. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
6. Repeat steps 1 through 5 for all configured channels.

37.4.5 1X Circular Acceptance

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is one.
3. Attach one channel of a two channel oscilloscope to the vibration signal buffered output and attach the other channel to the associated Keyphasor® signal buffered output and observe the two signals simultaneously.
4. Measure the phase. Phase will be measured from the leading edge of the Keyphasor® pulse to the first positive peak of the vibration signal. See the example in 1X Phase that illustrates a phase of 45°.

Note
If the test equipment is capable of changing the phase, set output to a known value.

5. Calculate the full-scale voltage according to the equation and examples shown in "1X Amplitude (1X Ampl)" on page 37-20. Adjust the function generator amplitude to the calculated voltage.
6. Calculate the 1X Circular Acceptance Radius according to the equations and example shown below.

   Formulas - Circular Acceptance Radius

   X and Y Vibration Components:

$$X \text{ component } (X) = \text{Vibration } (D) * \text{Cos (Input Voltage phase } (\varnothing))$$

$$Y \text{ component } (Y) = \text{Vibration } (D) * \text{Sin (Input Voltage phase } (\varnothing))$$

X and Y Setpoint Components:

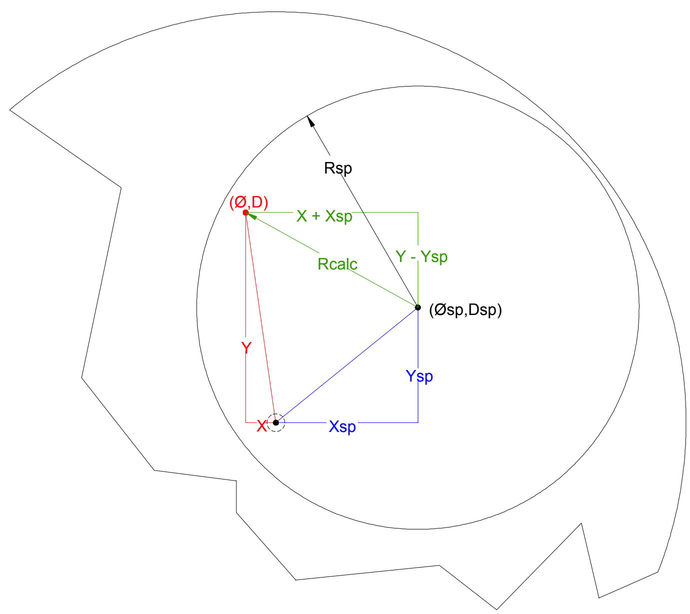
$$\text{Xsp component (Xsp)} = \text{Vibration (Dsp)} * \text{Cos (Input Voltage phase } (\varnothing sp))$$

$$\text{Ysp component (Ysp)} = \text{Vibration (Dsp)} * \text{Cos (Input Voltage phase } (\varnothing sp))$$

Radius from Setpoint:

$$\text{CalculatedRadus (Rcalc)} = \sqrt{(\text{Xsp component (Xsp) - X component (X)})^2 + (\text{Xsp component (Xsp) - X component (X)})^2}$$

Example:



Reference Vector Amplitude (Dsp)	=	1 mil
Reference Vector Phase (∅sp)	=	45 degrees
Vrms Input	=	0.707 Vrms
Input Voltage phase (∅)	=	100 degrees
Transducer Scale Factor	=	200mV/mill

Calculate Vibration (D):

Vpp = (2/0.707) x (Vrms), for sinewave only
= (2/0.707) x (0.707)
= 2.000 Vpp

Vibration (D) = (Vpp) x (1/Transducer Scale Factor)
= 2.00 x (1/0.2)
= 10 mill

Calculate X and Y Vibration Components:

$$X \text{ component } (X) = 10 \text{ mil} * \text{Cos } (100°) = -1.736 \text{ mil}$$

$$\text{Y component (Y)} = 10 \text{ mil} * \text{Sin } (100°) = 9.848 \text{ mil}$$

Calculate Xsp and Ysp Reference Vector Components:

$$\text{Xsp component (Xsp)} = 1 \text{ mil} * \text{Cos } (45°) = 0.707 \text{ mil}$$

$$\text{Ysp component (Ysp)} = 1 \text{ mil} * \text{Sin } (45°) = 0.707 \text{ mil}$$

Calculate Circular Acceptance Radius (Rcalc):

$$\text{CalculatedRadus (Rcalc)} = \sqrt{(0.707 \text{ mil} - -1.736 \text{ mil})^2 + (0.707 \text{ mi} - 9.848 \text{ mil})^2} = 9.462 \text{ mil}$$

7. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
8. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
9. Repeat steps 1 through 8 for all configured channels.

37.4.6 2X Amplitude (2X Ampl)

Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2.
3. Calculate the full-scale voltage according to the equation and examples shown below. Adjust the function generator amplitude to the calculated voltage.

Note
Use the Transducer Scale Factor displayed in the Scale Factor Box on the Verification Screen.

Full Scale Voltage = 2X Ampl Meter Top Scale $\times$ Transducer Scale Factor

Example 1:
2X Ampl Meter Top Scale = 10 mil
Transducer Scale Factor = 200 mV/mil

Full Scale = (10×0.200)
= 2.000 Vpp

For V rms input:
V rms = $(0.707/2) \times$ (Vpp), for a sinewave input
= $(0.707/2) \times (2)$
= 0.707 Vrms

Example 2:
2X Ampl Meter Top Scale = 200 µm
Transducer Scale Factor = 7,874 mV/mm
= 7.874 mV/µm

Full Scale = (200×0.007874)
= 1.5748 Vpp

For V rms input:
V rms = $(0.707/2) \times$ (Vpp), for a sinewave input
= $(0.707/2) \times (1.574)$
= 0.5566 Vrms

4. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two. Verify that the 2X Ampl bar graph display and Current Value Box is reading ±1 % of full scale.
5. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
6. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
7. Repeat steps 1 through 6 for all configured channels.

37.4.7 2X Phase

If the test equipment is not capable of changing the phase output to a known value, use the following procedure. If your test equipment can change the phase output to a known value, use the procedure "If the Test Equipment Can Change the Phase Output (2X Phase)".

37.4.7.1 If the Test Equipment Cannot Change the Phase Output (2X Phase)

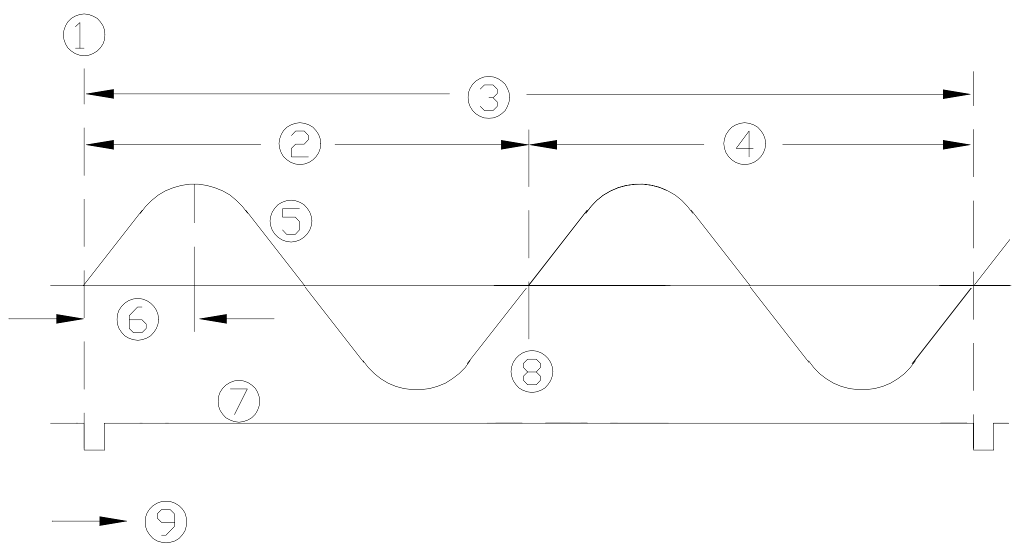
1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.

2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two.

3. Attach one channel of the two channel oscilloscope to the vibration signal buffered output and attach the other channel to the associated Keyphasor® signal buffered output and observe the two signals simultaneously.

4. Measure the phase. 2X Phase will be measured from the leading edge of the Keyphasor® pulse to the first positive peak of the vibration signal. See the example below, which illustrates a phase of 90°. Observe the 2X Phase bar graph display and Current Value Box; it should read approximately what was measured above.

   Example:
   2X = two cycles of vibration signal per shaft revolution



(1) 0°
(2) First Cycle
(3) One shaft revolution
(4) Second cycle
(5) 2X Vibration Signal
(6) Phase lag = 90°
(7) Keyphasor® signal
(8) 360°
(9) Time

5. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.

6. Repeat steps 1 through 5 for all configured channels.

37.4.7.2 If the Test Equipment Can Change the Phase Output (2X Phase)

If the test equipment has the capability to change the phase output to a known value, use the following procedure.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two.
3. Adjust the phase for mid-scale. Verify that the 2X Phase bar graph display and Current Value Box is reading ±1.5 % of mid-scale.
4. If the reading does not meet specifications, double check the input signal to ensure it is correct. If the monitor still does not meet specifications and/or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
5. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
6. Repeat steps 1 through 5 for all configured channels.

37.4.8 2X Circular Acceptance

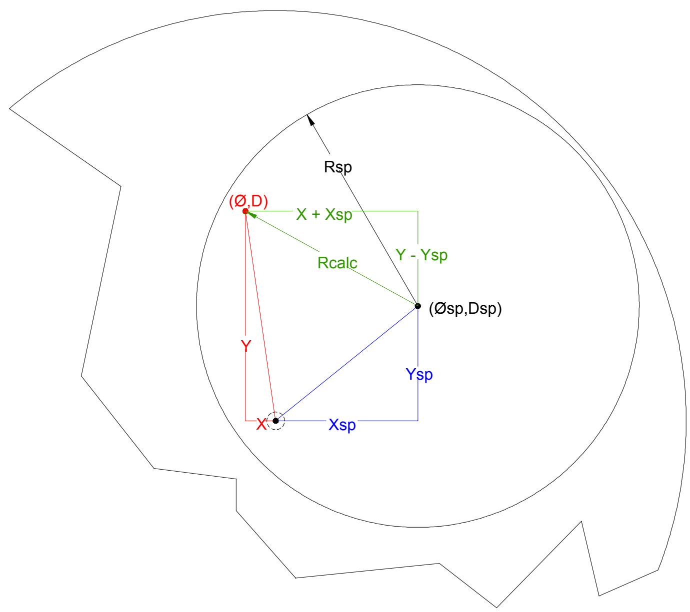
Note
The Keyphasor must be triggering and have a valid rpm value to check this parameter.

1. Disconnect PWR, COM, and SIG field wiring from the channel pair terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2. Set the Keyphasor multiplier/divider so that the multiply setting is one and the divide setting is two.
3. Attach one channel of a two channel oscilloscope to the vibration signal buffered output and attach the other channel to the associated Keyphasor® signal buffered output and observe the two signals simultaneously.
4. Measure the phase. Phase will be measured from the leading edge of the Keyphasor® pulse to the first positive peak of the vibration signal. See the example in "2X Phase" on page 37-26 that illustrates a phase of 45°.

Note
If the test equipment is capable of changing the phase, set output to a known value.

5. Calculate the full-scale voltage according to the equation and examples shown in "2X Amplitude (2X Ampl)" on page 37-25. Adjust the function generator amplitude to the calculated voltage.
6. Calculate the 2X Circular Acceptance Radius according to the equations in "1X Circular Acceptance" on page 37-23 and example shown below.

   Example:



Reference Vector Amplitude (Dsp)	=	1 mil
Reference Vector Phase (∅sp)	=	45 degrees
Vrms Input	=	0.707 Vrms
Input Voltage phase (∅)	=	100 degrees
Transducer Scale Factor	=	200mV/mill

For Vibration (D):

Vpp	=	(2/0.707) x (Vrms), for sinewave only
	=	(2/0.707) x (0.707)
	=	2.000 Vpp

Vibration (D) = (Vpp) x (1/Transducer Scale Factor)
= 2.00 x (1/0.2)
= 10 mill

Calculate X and Y Vibration Components:

$$\text{X component (X)} = 10\text{ mil} * \text{Cos}\,(100°) = -1.736\text{ mil}$$
$$\text{Y component (Y)} = 10\text{ mil} * \text{Sin}\,(100°) = 9.848\text{ mil}$$

Calculate Xsp and Ysp Reference Vector Components:

$$\text{Xsp component (Xsp)} = 1\text{ mil} * \text{Cos}\,(45°) = 0.707\text{ mil}$$
$$\text{Ysp component (Ysp)} = 1\text{ mil} * \text{Sin}\,(45°) = 0.707\text{ mil}$$

Calculate Circular Acceptance Radius (Rcalc):

$$\text{CalculatedRadus (Rcalc)} = \sqrt{(0.707\text{ mil} - -1.736\text{ mil})^2 + (0.707\text{ mi} - 9.848\text{ mil})^2} = 9.462\text{ mil}$$

7. If the reading does not meet specifications, check that the input signal is correct. If the monitor still does not meet specifications or fails any other part of this test, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
8. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel pair terminals on the I/O module. Verify that the OK LED comes on and the OK relay energizes. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.
9. Repeat steps 1 through 8 for all configured channels.

37.4.9 Test OK Limits

The general approach for testing OK limits is to input a DC voltage and adjust it above the Upper OK limit and below the Lower OK limit. This will cause a channel not OK condition and the OK Relay to change state (de-energize). The Upper and Lower OK limits are displayed in the Verification screen on the test computer.

1. Disconnect PWR, COM, and SIG field wiring from the channel terminals on the I/O module.
2. Connect test equipment and run software as described in "Test Equipment and Software Setup" on page 37-2.
3. Bypass all other configured channels.
4. Adjust the power supply voltage to -7.00 Vdc.
5. Press the RESET switch on the Rack Interface Module (RIM). Verify that the monitor OK LED is on and that the Channel OK State line in the Channel Status box of the Verification screen reads **OK**.

Note
If the Danger Bypass has been activated, then the BYPASS LED will be on. All other channels in the rack must be OK or bypassed for the relay to be energized.

6. Verify that the OK relay on the Rack Interface I/O Module indicates OK (energized). See 3500/20 Rack Interface Module Operation and Maintenance Manual, part number 129768-01.
7. Increase the power supply voltage (more negative) until the OK LED just goes off (upper limit). Verify that the Channel OK State line in the Channel Status box reads **not OK** and that the OK Relay indicates not OK. Verify that the Upper OK limit voltage displayed on the Verification screen is equal to or more positive than the input voltage.
8. Decrease the power supply voltage (less negative) to -7.00 Vdc.
9. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on and the OK relay energizes. Verify that the Channel OK State line in the Channel Status box reads **OK**.
10. Gradually decrease the power supply voltage (less negative) until the OK LED just goes off (lower limit). Verify that the Channel OK State line in the Channel Status box reads **not OK** and that the OK Relay indicates not OK. Verify that the Lower OK limit voltage displayed on the Verification screen is equal to or more negative than the input voltage.
11. Increase the power supply voltage (more negative) to -7.00 Vdc.
12. Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on, the OK relay energizes and that the Channel OK State line in the Channel Status box reads **OK**.
13. If you can not verify any configured OK limit, go to "If a Channel Fails a Verification Test" found in the "Monitor Verification" section of the manual.
14. Disconnect the test equipment and reconnect the PWR, COM, and SIG field wiring to the channel terminals on the Monitor I/O Module. Press the RESET switch on the Rack Interface Module (RIM) and verify that the OK LED comes on and the OK relay energizes.
15. Repeat steps 1 through 14 for all configured channels.
16. Return the bypass switch for all configured channels back to their original setting.

Circular Acceptance Default OK Limits Table

Transducer	Lower OK Limit (volts)	Upper OK Limit (volts)
7200 5&8 mm w/ barriers	-2.7 to -2.8	-16.7 to –16.8
7200 5&8 mm w/o barriers	-2.7 to -2.8	-16.7 to -16.8
7200 11 mm w/o barriers	-3.5 to -3.6	-19.6 to -19.7
7200 14 mm w/o barriers	-2.7 to -2.8	-16.7 to -16.8
3300 5&8 mm w/ barriers	-2.7 to -2.8	-16.7 to -16.8
3300 XL 8 mm w/ barriers	-2.7 to -2.8	-16.7 to -16.8
3300 5&8 mm w/o barriers	-2.7 to -2.8	-16.7 to -16.8
3300 XL 8 mm w/o barriers	-2.7 to -2.8	-16.7 to -16.8
3000 (-18 V) w/o barriers	-2.4 to -2.5	-12.0 to -12.1
3000 (-24 V) w/o barriers	-3.2 to -3.3	-15.7 to -15.8
3300 RAM w/o barriers	-2.4 to -2.5	-12.5 to -12.6
3300 RAM w/ barriers	-2.4 to -2.5	-12.1 to -12.2
3300 16 mm HTPS w/o barriers	-2.7 to -2.8	-16.7 to -16.8
Note: Assume ±50 mV accuracy for check tolerance.		

38. Specifications

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38.1 Inputs

Signal: Accepts from 1 to 4 proximity, velocity or acceleration transducer signals.

Input Impedance

- Standard I/O: 10 kΩ. (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 kΩ.

Power Consumption: 7.7 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).
- Acceleration & Acceleration II: 10 mV/(m/s2) (100 mV/g).
- Velocity & Velocity II: 20 mV/(mm/s) pk (500 mV/(in/s) pk) or 5.8 mV/(mm/s) pk (145 mV/(in/s) pk) or 4 mV/(mm/s) pk (100 mV/(in/s) pk).
- Shaft Absolute
  - Radial Vibration: 3.94 mV/µm (100 mV/mil) or 7.87 mV/µm (200 mV/mil).
  - Direct: 3.94 mV/µm (100 mV/mil) or 7.87 mV/µm (200 mV/mil).
  - Velocity: 20 mV/(mm/s) pk (500 mV/(in/s) pk) or 5.8 mV/(mm/s) pk (145 mV/(in/s) pk) or 4 mV/(mm/s) pk (100 mV/(in/s) pk)
- REBAM: 1000 mV/mil (40 mV/um) or 2000 mV/mil (80 mV/um).
- Circular Acceptance Region: see Radial Vibration.

38.2 Outputs

Front Panel LEDs

- OK LED: Indicates when the 3500/42M is operating properly.
- TX/RX LED: Indicates when the 3500/42M is communicating with other modules in the 3500 rack.
- Bypass LED: Indicates when the 3500/42M 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.

Recorder Outputs

- +4 to +20 mA:. Values are proportional to monitor full-scale. Individual recorder values are 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
- Error: ±0.25% error at room temperature ±0.7% error over temperature range.
- Update rate: 100 ms or less.

Shaft Absolute Buffered Outputs

- The Shaft Absolute I/O modules have one output for each channel group. Each output is short-circuit protected.
- Output Impedance: 300 Ω.

38.3 Signal Conditioning

Specified at +25°C (+77° F).

38.3.1 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.
- Smax: 0.125 to 15.8 times running speed.
- 1X & 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.

Accuracy

- Direct and Gap: Within ± 0.33% of full scale typical, ±1% maximum.
- 1X & 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.

38.3.2 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.

38.3.3 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.

38.3.4 Acceleration

Frequency Response:

- Bias Voltage: Low-Pass: -3 dB at 0.01 Hz
- 1X & 2X Vector Filter: Constant Q Filter. Minimum rejection in stopband of –51.0 dB.

Note
1X & 2X Vector parameters are valid for machine speeds of 60 cpm to 60,000 cpm.

- The following table represents the frequency ranges for the 3500/42M under different options using the Acceleration II Channel Type. Resources used for processing data are assigned based on channel pairs. It is possible to select different options for the two channels of a channel pair. However, the frequency response for both channels will be limited to the worst case frequency response of the individual channels.

Output Type	Non Integrated	Integration
RMS	10 Hz to 20 kHz	10 Hz to 20 kHz
Peak	3 Hz to 30 kHz	10 Hz to 20 kHz

The next two tables represent the frequency ranges if the Acceleration Channel type is selected instead of the Acceleration II. The following table shows the frequency ranges if both channels of a channel pair are enabled

Output Type	Without Filter	Low Pass Filter, High Pass Filter	Integration after filters
RMS	10 Hz to 30 kHz	10 Hz to 9.155 kHz	10 Hz to 9.155 kHz
Peak	3 Hz to 30 kHz	3 Hz to 9.155 kHz	10 Hz to 9.155 kHz

The next table shows the frequency response range if a single channel is enabled for a channel pair when using the Acceleration channel type.

Output Type	Without Filter, Low Pass Filter, High Pass Filter	With Integration
RMS	10 Hz to 30 kHz	10 Hz to 14.5 kHz
Peak	3 Hz to 30 kHz	10 Hz to 14.5 kHz

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).

Accuracy

- Within ± 0.33% of full scale typical, ± 1% maximum. Exclusive of filters.
- 1X & 2X: Within ±0.33% of full-scale typical, ±1% maximum.

38.3.5 Velocity

Frequency Response

- Bias Voltage: Low-Pass: -3 dB at 0.01 Hz
- RMS: 10 to 5,500 Hz, -3 dB.
- Peak or Peak-to-Peak: 3 to 5,500 Hz, -3 dB.
- 1X & 2X Vector Filter: Constant Q Filter. Minimum rejection in stopband of –51.0 dB.

Note
1X & 2X Vector parameters are valid for machine speeds of 60 cpm to 60,000 cpm.

Filter Quality

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

- o Low-Pass: 4-pole (80 dB per decade, 24 dB per octave).

Accuracy

- o Within ± 0.33% of full scale typical, ± 1% maximum. Exclusive of filters.
- o Velomitor
  - Full Scale 0-0.5: ±3% Typical
  - Full Scale 0-1.0: ±2% Typical
  - Full Scale 0-2.0: ±1% Typical
- o 1X & 2X: Within ±0.33% of full-scale typical, ±1% maximum.

38.3.6 Shaft Absolute, Radial Vibration

Frequency Response

- o Direct Filter: User-programmable, 4 Hz to 4000 Hz or 1 Hz to 600 Hz.
- o Gap Filter: -3 dB at 0.09 Hz.
- o 1X Vector Filter: Constant Q Filter. Minimum rejection in stopband of -57.7 dB.

Note
1X Vector parameters are valid for machine speeds of 240 cpm to 60,000 cpm.

Accuracy

- o Direct and Gap: Within ± 0.33% of full scale typical, ±1% maximum.
- o 1X: Within ±0.33% of full-scale typical, ±1% maximum.

38.3.7 Shaft Absolute, Velocity

Frequency Response:

- o Peak or Peak-to-Peak: User-programmable, 1 to 4,000 Hz, -3 dB.

Filter Quality

- o High-Pass: 2-pole (40 dB per decade, 12 dB per octave).
- o Low-Pass: 2-pole (40 dB per decade, 12 dB per octave).

Accuracy

- o Within ± 0.33% of full scale typical, ± 1% maximum. Exclusive of filters.
- o Shaft Absolute Buffered Output: ± 6.0% @ 25 C

38.3.8 Circular Acceptance Region:

See Radial Vibration.

38.3.9 REBAM:

Frequency Response

- Spike: Highpass filter that is user programmable from 0.152 to 8678 Hz.
- Element: Bandpass filter that is user programmable for BPFO ranging from 0.139 to 3836 Hz. Highpass corner is 0.8x BPFO. Lowpass corner is 2.2x BPFO.
- Rotor: Lowpass filter that is user programmable from 0.108 to 2221 Hz.
- Direct: Highpass filter that is programmable from 3.906 to 14.2 Hz. Selection is determined by Spike and Rotor filters.
- Gap: Lowpass filter that is programmable from 0.002 to 1.0 Hz. Selection is determined by the Rotor filter.
- 1X Vector Filter: Constant Q Filter. The range of shaft speeds for which the value is valid is dependent upon the nominal Shaft Speed the channel is configured for. 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 the speed input is generated from a multi-event gear or speed wheel, 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 Band Pass: 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.

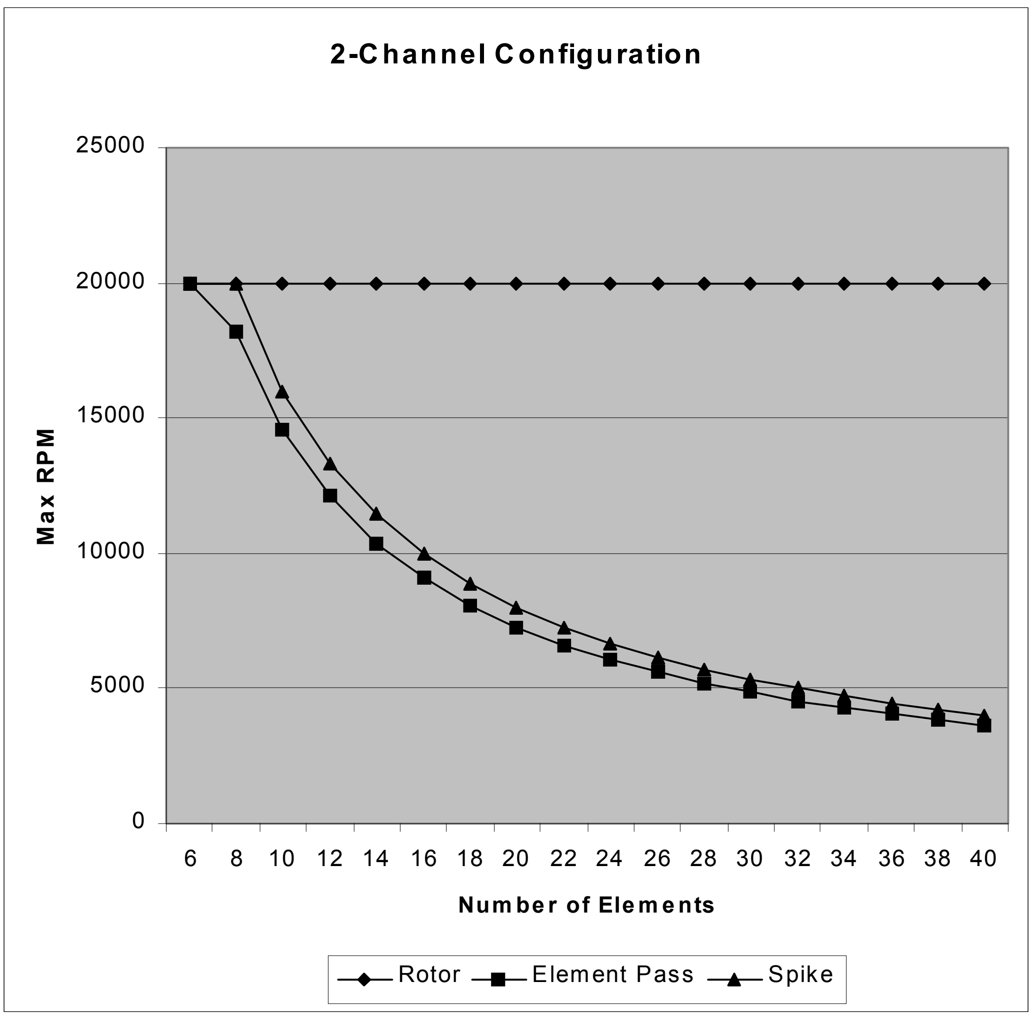
- 1X Amplitude: Constant Q of 16.67. Stopband frequencies are 0.91 and 1.09 times the running speed. Stopband attenuation is -51 dB minimum.

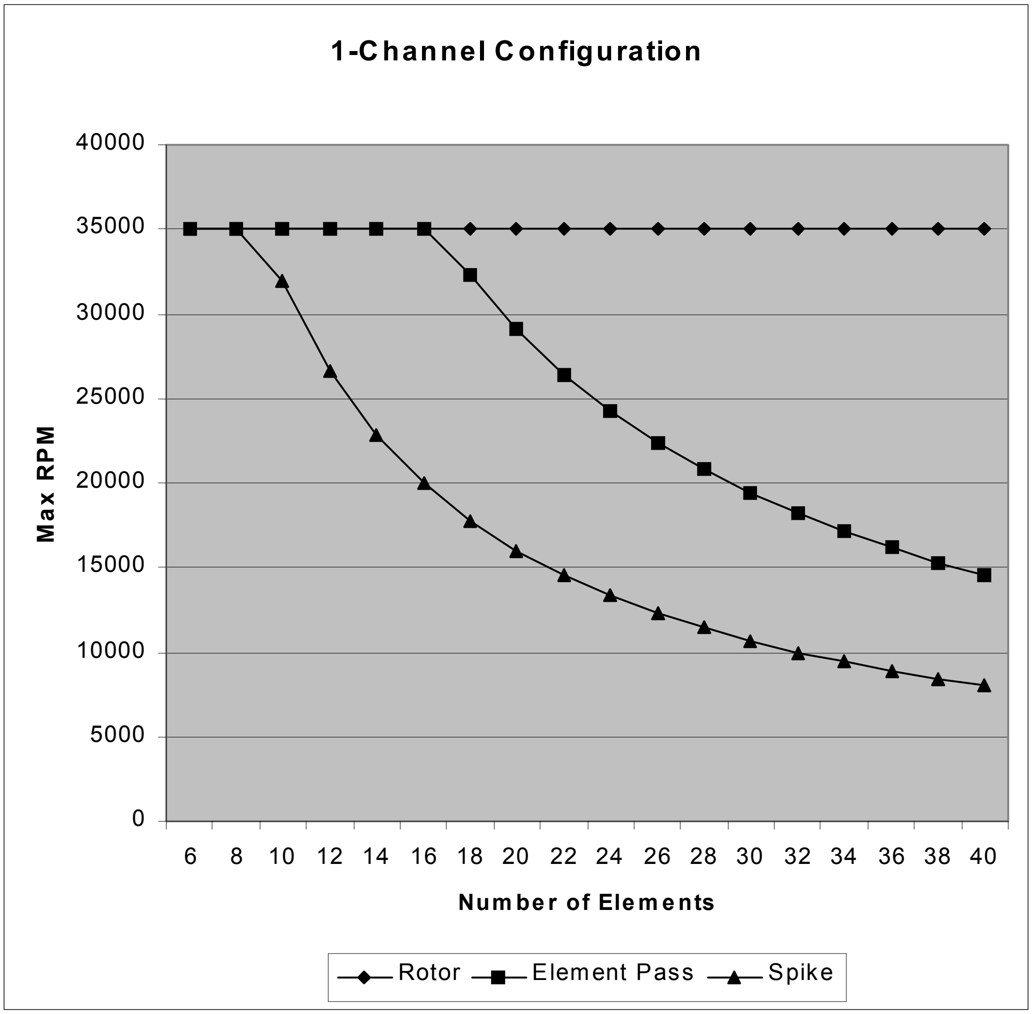
Accuracy

- Amplitudes: 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, generally those for higher speed machines, will only allow one channel of a channel pair to be enabled. The following graphs show, for both 1-channel and 2-channel configurations, the approximate maximum shaft speed for the Spike, Element and Rotor filters for a bearing with a given number of rolling elements. The graph assumes that the rotor lowpass filter corner is set at 3.2X the shaft speed and the spike highpass filter corner is set at 4X the element pass frequency for the outer race (BPFO).





Filter Tracking/Stepping

A valid speed signal input is required for this feature. The following summarizes how the tracking feature works:

- 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.

38.4 Alarms

Alarm Setpoints: Alert levels can be set for each value measured by the monitor. In addition, Danger setpoints can be set for any two of the values measured by the monitor. All alarm setpoints are set using software configuration. 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 setpoint will be limited to the range of the transducer. Accuracy of alarms are to within 0.13% of the desired value.

Alarm Time Delays: Alarm delays can be programmed using software, and can be set as follows:

- Radial Vibration, Thrust, Differential Expansion, Eccentricity, Acceleration, Velocity, Acceleration 2, Velocity 2, Circular Acceptance Regions, Shaft Absolute Radial Vibration,

  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.
- Shaft Absolute Velocity

  Alert: From 1 to 60 seconds in 1 second intervals.

  Danger: From 1 to 60 seconds in 0.5 second intervals.
- REBAM

  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.

38.5 Static Values

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

Acceleration: Direct, define as one of the following: RMS Acceleration **or**, peak Acceleration **or**, RMS Velocity **or**, peak Velocity **or**, Band-pass peak Acceleration **or**, Band-pass peak Velocity.

Acceleration II: Direct, 1X Amplitude, & 2X Amplitude; define as one of the following: RMS Acceleration **or**, peak Acceleration **or**, RMS Velocity **or**, peak Velocity **or**, Band-pass peak Acceleration **or**, Band-pass peak Velocity. Additionally, 1X Phase, 2X Phase and Bias Voltage

Velocity: Direct, define as one of the following: RMS Velocity **or**, peak Velocity, peak-to-peak Displacement **or**, Band-pass peak Velocity **or**, Band-pass **or** peak-to-peak Displacement.

Velocity II: Direct, 1X Amplitude, & 2X Amplitude: define as one of the following: RMS Velocity **or**, peak Velocity, peak-to-peak Displacement **or**, Band-pass peak Velocity **or**, Band-pass **or** peak-to-peak Displacement. Additionally, 1X Phase, 2X Phase and Bias Voltage

Shaft Absolute Radial Vibration: Direct, Gap, 1X Amplitude, 1X Phase Lag

Shaft Absolute, Velocity: Shaft Absolute Direct, Shaft Absolute 1X Amplitude, Shaft Absolute 1X Phase Lag, Velocity Direct, Velocity 1X Amplitude, Velocity 1X Phase Lag

Circular Acceptance Region: Direct, Gap, 1X Amplitude, 1X Phase Lag, 1X Circular Acceptance Radius, 2X Amplitude, 2X Phase Lag, 2X Circular Acceptance Radius

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

38.6 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 (B) = 27.25 V

Imax (B) = 91.8 mA

Rmin (B) = 297 Ω

Channel Parameters (Entity)

Vmax = 27.25 V

Imax = 91.8 mA

Rmin = 297 Ω

38.7 Environmental Limits

Operating Temperature:

- o -30°C to +65°C (-22°F to +150°F) when used with Internal/External Termination Proximitor®/Seismic I/O Module.
- o 0°C to +65°C (32°F to +150°F) when used with Proximitor®/Seismic Internal Barrier I/O Module (Internal Termination).

Storage Temperature: -40°C to +85°C (-40°F to +185°F).

Humidity: 95%, noncondensing.

38.8 CE Mark Directives

38.8.1 EMC Directives

Certificate of Conformity: 136669

EN50081-2

- o Radiated Emissions: EN 55011, Class A
- o Conducted Emissions: EN 55011, Class A

EN50082-2

- o Electrostatic Discharge: EN 61000-4-2, Criteria B
- o Radiated Susceptibility: ENV 50140, Criteria A
- o Conducted Susceptibility: ENV 50141, Criteria A
- o Electrical Fast Transient: EN 61000-4-4, Criteria B
- o Surge Capability: EN 61000-4-5, Criteria B
- o Magnetic Field: EN 61000-4-8, Criteria A
- o Power Supply Dip: EN 61000-4-11, Criteria A
- o Radio Telephone: ENV 50204, Criteria A

38.8.2 CE Mark Low Voltage Directives

Certificate of Conformity: 134036

EN 61010-1: Safety Requirements

38.9 Hazardous Area Approvals

CSA/NRTL/C:

- o When used with Internal/External Termination I/O Module: Class I, Division 2, Groups A through D, T4@ Ta=65°.
- o Certification Number BN26744C-18
- o When used with Internal Barrier I/O Module, refer to specification sheet 141495-01 for approvals information.

38.10 Physical

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 lbs.).

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 lbs.).

Rack Space Requirements

Monitor Module: 1 full-height front slot.

I/O Modules: 1 full-height rear slot.

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39. Ordering Information

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39.1 Ordering Considerations

39.1.1 General

The 3500/42M Module requires the following (or later) firmware, and software revisions:

- o 3500/01 Software – Version 2.50
- o 3500/02 Software – Version 2.20
- o 3500/03 Software – Version 1.21

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.

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

39.1.2 Internal Barrier I/O Module

The 3500 Internal Barrier specification sheet (part number 141495-01) should be consulted if the Internal Barrier Option is selected.

39.1.3 Shaft Absolute

The Shaft Absolute Channel Type requires the following (or later) firmware and software revisions:

- o 3500/42M Module Firmware – Revision 2.02
- o 3500/01 Software – Version 2.61
- o DM2000 Software - Version 3.10.

Requires the M version of the 3500 Proximitor/Seismic Monitor.

39.1.4 Acceleration II

The Acceleration II Channel Type requires the following (or later) firmware and software revisions:

- o 3500/42M Module Firmware – Revision 2.10
- o 3500/01 Software – Version 3.20
- o DM2000 Software - Version 3.30

Requires the M version of the 3500 Proximitor/Seismic Monitor.

39.1.5 Velocity II

See Acceleration II.

39.1.6 Circular Acceptance Regions

See Acceleration II.

39.1.7 REBAM

The REBAM Channel Type requires the following (or later) firmware and software revisions:

- 3500/42M Module Firmware – Revision 2.1
- 3500/01 Software – Version 3.30
- 3500/02 Software – Version 2.32
- 3500/03 Software – Version 1.32
- DM2000 Software - Version 3.40

Requires the M version of the 3500 Proximitor/Seismic Monitor.

39.2 List of Options and Part Numbers

39.2.1 Proximitor® Seismic Monitor

3500/42-AXX-BXX

A: I/O Module Type

0 1 Prox/Seis I/O Module with Internal Terminations

0 2 Prox/Seis I/O Module with External Terminations

0 3 TMR I/O Module with External Terminations.

0 4 I/O Module with Internal Barriers (4 x prox./accel. ch's) and Internal Terminations

0 5 I/O Module with Internal Barriers (2 x prox./accl. + 2 x Velomitor channels) and Internal Terminations

0 6 I/O Module with Internal Barriers (4 x Velomitor channels) and Internal Terminations

0 7 Shaft Absolute I/O Module with Internal Terminations

0 8 Shaft Absolute I/O Module with External Terminations

0 9 Prox/Velom I/O Module with Internal Terminations

1 0 Prox/Velom I/O Module with External Terminations

Note
1. The following table shows the ordering option and supported transducer types.

Ordering Option	Prox/Accel	Velom	Seismo-probe
A01 & A02	See Note 4		X
A03	X	X	
A04, A05, & A06	See Note 2		
A07 & A08	X	X	X
A09 & A10	X	X	

Note
2. The following table shows the ordering options that are available for Internal Barriers with this monitor.

Ordering Option	Channel 1 & 2	Channel 3 & 4
A04	Prox/Accel	Prox/Accel
A05	Prox/Accel	Velomitor
A06	Velomitor	Velomitor

Note
3. HTVS transducer is supported in A 09 and A 10 I/O module type options.

Note
4. Prox/Accel and Velomitor are supported with the A01 & A02 options. However, unless Seismoprobes will be used the appropriate choice is the A09 and A10 options.

B: Agency Approval Option

0 0 None

0 1 CSA/NRTL/C

39.2.2 External Termination Blocks

125808-02: Prox/Seismic External Termination Block (Euro Style connectors).

128015-02: Prox/Seismic External Termination Block (Terminal Strip connectors).

132242-01: Prox/Seismic Bussed TMR External Termination Block (Euro Style connectors).

132234-01: Prox Seismic Bussed TMR External Termination Block (Terminal Strip connectors).

128702-01: Recorder External Termination Block (Euro Style connectors).

128710-01: Recorder External Termination Block (Terminal Strip connectors).

140993-01: Shaft Absolute External Termination Block (Euro Style connectors).

141001-01: Shaft Absolute 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).

39.2.3 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

39.2.4 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

39.2.5 Spares

140734-02: 3500/42M Proximitor/Seismic Monitor.

128229-01: Prox/Seismic I/O Module with Internal Terminations.

128240-01: Prox/Seismic I/O Module with External Terminations.

126632-01: Prox/Seismic TMR I/O Module with External Terminations.

00530843: 3500/42M Prox/Seismic I/O Module four-pin connector shunt.

143489-01: 3500/42M 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).

138708-01: Shaft Absolute I/O Module with Internal Terminations.

138700-01: Shaft Absolute I/O Module with External Terminations.

00517018: 3500/42M Shaft Absolute I/O Module eight-pin connector shunt.

140471-01: Prox/Velom I/O Module with Internal Terminations.

140482-01: Prox/Velom I/O Module with External Terminations.

00561941: 3500/42M Prox/Velom I/O Module ten-pin connector shunt.

00580434: Internal Termination I/O Module connector header, Euro Style, 8 pin. Used on I/O modules 128229-01 and 138708-01.

00580432: Internal Termination I/O Module connector header, Euro Style, 10 pin. Used on I/O modules 128229-01, 138708-01.

00502133: Internal Barrier I/O Module connector header, Euro Style, 12 pin