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3500/50 TACHOMETER MODULE

OPERATION AND MAINTENANCE MANUAL

BENTLY
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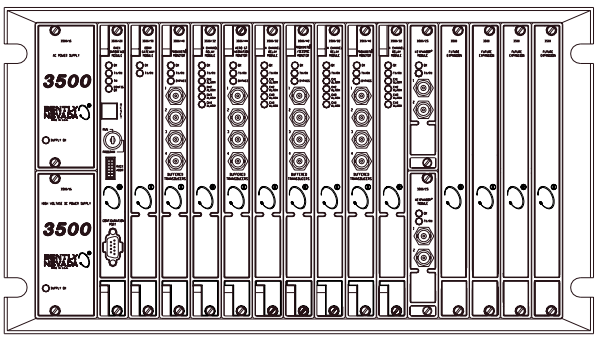

The following ways of contacting Bently Nevada are provided for those times when you cannot contact your local Bently Nevada representative:

Mailing Address	1631 Bently Parkway South Minden, NV 89423 USA
Telephone	1 775 782 3611 1 800 227 5514
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Additional Information

Notice:

This manual does not contain all the information required to operate and maintain the Tachometer Module. Refer to the following manuals for other required 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 and 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

Contents

1. Receiving and Handling Instructions

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 Corporation.

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.
- 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.

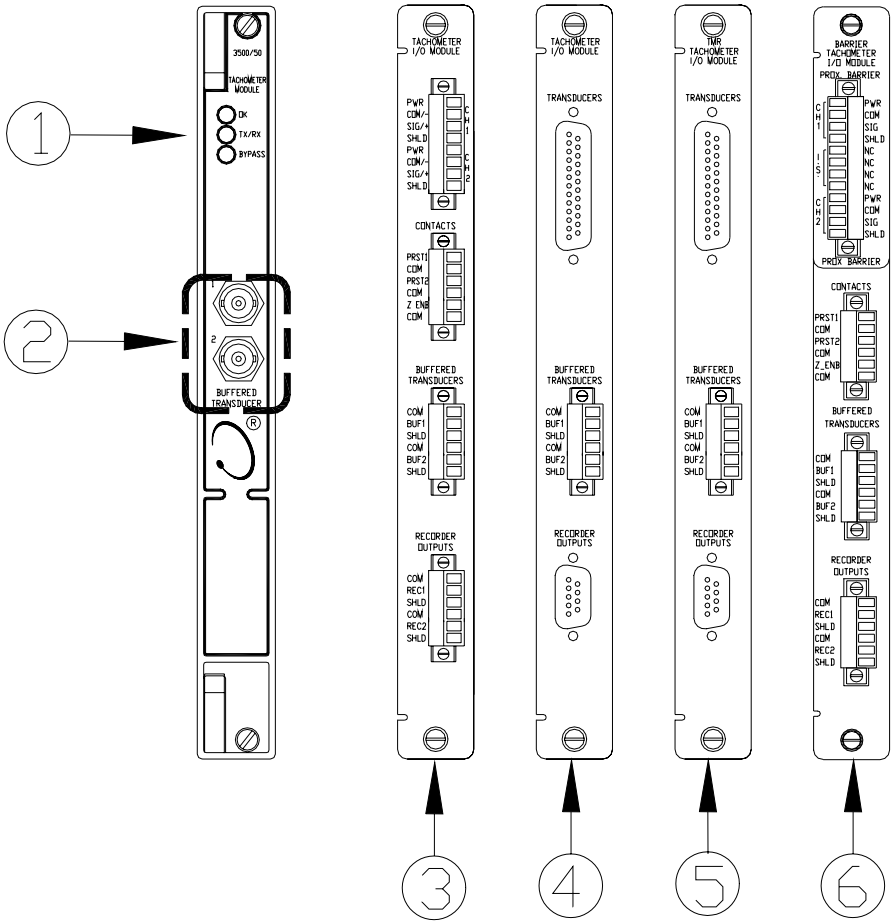
1.3 Disposal Statement

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 Corporation is not responsible for disposal of product at the end of its life or at the end of its use.

2. General Information

The 3500/50 Tachometer Module is a two-channel module that accepts a pulse input from either a proximity transducer or a magnetic pickup, and uses the input to drive alarms. In addition, the 3500/50 Tachometer Module can be configured to provide Keyphasor® signals to the monitor modules in the rack. A Keyphasor signal is a digital timing signal that is used by monitor modules and external diagnostic equipment to measure vector parameters such as 1X amplitude and phase. The Tachometer Module can be programmed, using the 3500 Rack Configuration Software, to perform any of the following functions: Rotor Speed, Rotor Acceleration, Zero Speed, and Reverse Rotation.

Front View **Rear View**



1) **Status LEDs:** Refer to Section 2.3
2) **Buffered Transducer Outputs:** Provides an unfiltered +4 mA to +20 mA output for each of the two transducers proportional to the respective full-scale range. Both outputs are short circuit protected. For reverse rotation channels, one recorder indicates forward speed and the other indicates reverse speed.
3) **I/O Module Internal Termination:** Refer to Section 4.1
4) **I/O Module External Termination:** Refer to Section 4.4
5) **TMR I/O Module, External Termination:** Refer to Section 4.4
6) **Barrier I/O Module, Internal Termination:** Refer to Section 4.4

The primary purpose of the 3500/50 Tachometer module is to provide 1) machinery protection by continuously comparing current machine speed against configured alarm setpoints to drive alarms, and 2) essential machine speed information to both operator and maintenance personnel. Alarm setpoints are configured using the 3500 Rack Configuration Software. Alert/Alarm 1 setpoints can be configured for each active proportional value and Danger/Alarm 2 setpoints can be configured for two of the active proportional values. When shipped from the factory, the 3500/50 is unconfigured. When needed, the 3500/50 can be installed into a 3500 rack and configured to perform the required monitoring function. This lets you stock a single module for use as a spare for several different speed applications.

Application Alert
The Bently Nevada 3500/50 Tachometer is not designed for use independently as, or a component of, a speed control or overspeed protection system. The Bently Nevada 3500/50 Tachometer does not provide the protective redundancy and the response speed needed for reliable operation as a speed control or overspeed protection system.

Application Alert
Where provided, the analog proportional output is suitable for data logging or chart recording purposes only. Also, where provided, speed Alert setpoints are suitable for annunciation purposes only.

 Caution
Failure to comply with these alerts constitutes a misuse of the product and may result in property damage and/or bodily injury.

2.1 Triple Modular Redundant (TMR) Description

When used in a TMR configuration, 3500/50 Modules and corresponding TMR I/O Modules must be installed adjacent to each other in groups of three. When the modules are 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 modules are compared in a 2 out of 3 method. Two modules must agree before the relay is driven. Refer to the 3500/32 & 3500/34 4 Channel Relay Module Operation and Maintenance Manual (129771-01) 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 module in the group are compared with each other. If the output of one module differs from the output of the other modules in the group by a specified amount, that module 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 module group that is used to determine how far apart the values of the three modules can be from 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 modules in a TMR group and the individual values of each module.

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 three 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.

2.2 Available Data

The Tachometer Module returns speed proportional values to the Communications Gateway Module, Display Module, and to the host software via the Rack Interface Module. The Tachometer Module also returns both module and channel statuses.

2.2.1 Statuses

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

Module Status

OK

This indicates if the module 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 (except trigger not OK)

If the Module 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 module has entered Alert/Alarm 1. A module will enter the Alert/Alarm 1 state when any speed proportional value provided by the module exceeds its configured Alert/Alarm 1 setpoint.

Danger/Alarm 2

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

Bypass

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

Configuration Fault

This indicates if the monitor configuration is valid.

Zero Speed Enable

This indicates that the alarming function for zero speed, reverse rotation, and peak reverse speed has been enabled. This status is active when:

The Zero Speed Enable contact on the Tachometer I/O Module is closed (active).

or

The module Zero Speed Enable Software Switch is enabled.

Channel Status

OK

This indicates whether a fault has been detected by the associated module channel. A not OK status is returned under any of the following conditions:

Transducer Failure

Probe Gap OK Check Fault

Channel Specific Hardware Failure

Trigger Not OK Condition - Including:

- Input signal frequency greater than 20 kHz
- Input signal frequency less than minimum for specified transducer
- Input speed greater than 99,999 rpm
- Input signal has 50 % or greater change in a period
- % Comparison check fault for Zero Speed and Reverse Rotation channel type.
- Probe positioning fault - The angular separation between the probes is incorrect.

Alert/Alarm 1

This indicates whether the associated module 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 module 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:

Tachometer Module has never been configured

Tachometer Module is in configuration mode

Tachometer Channel has an invalid configuration

Tachometer Module is in power up self-test

Fatal error found during self-test

Channel is configured for Zero Speed or Reverse Rotation, but the Zero Speed enable contact is open (inactive)

Alarming is bypassed via a software switch

Rack Alarm Inhibit 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.

The following table shows where the statuses can be found.

Statuses	Communication Gateway Module	Rack Configuration Software	Operator Display Software
Module OK	X	X	
Module Alert/Alarm 1	X	X	
Module Danger/Alarm 2	X	X	
Module Bypass		X	
Module Configuration Fault		X	
Zero Speed Enable		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 Off	X	X	

2.2.2 Proportional Values

Proportional values are speed measurements used to monitor the machine. The Tachometer Module returns the following proportional values depending on how it is configured:

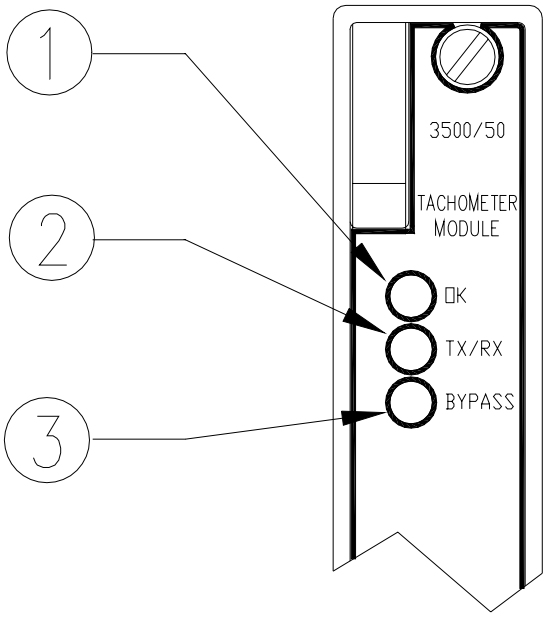
Rotor Speed	Rotor Acceleration	Zero Speed	Reverse Rotation
Speed	Rotor Acceleration	Zero Speed	Reverse Speed
Speed Band	Speed	Speed	GAP
Peak Speed	Peak Speed		Speed (Forward)
			Peak Reverse
			# Reverse Rotations

Note - Alarming is not provided for peak speed except when configured for Reverse Rotation. It is provided as a proportional value for display purposes only. For the Reverse Rotation channel type, alarming is provided on all

proportional values except GAP. The reverse speed proportional value uses a fixed danger over alarm setpoint with a value of zero.

2.3 LED Descriptions

The LEDs on the front panel of the Tachometer Module indicate the operating status of the module as shown in the following figure. Refer to Section 6.2 for all of the available LED conditions.



1) OK: Indicates that the Tachometer module and the Tachometer 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 module functions are temporarily suppressed.

3. Configuration Information

The 3500/50 Tachometer Module must have a valid configuration to operate properly. This section lists the monitor options (Section 3.2), channel options (Section 3.3), available setpoints (Section 3.4), and software switches (Section 3.5) for the Tachometer Module.

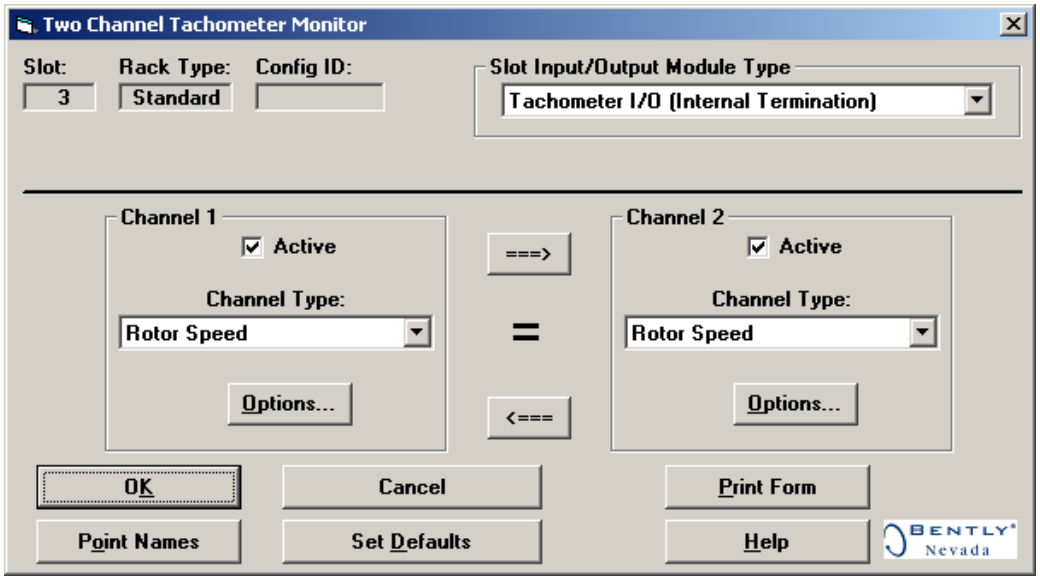
To configure the Tachometer Module, use this section to gather the configuration information and then use the Rack Configuration Software to set options and download the configuration to the module. The 3500 Monitoring System Rack Configuration and Utilities Guide (part number 129777-01) show how to install and operate the Rack Configuration Software.

3.1 Hardware Considerations

The slots in the rack are numbered from 0 to 15, counting from left to right. The power supplies go into slot 0 and the Rack Interface module (3500/20) or Transient Data Interface module (3500/22) go into slot 1. Slots 2 through 15 are called “monitoring positions”. The 3500/50 module can be installed into any of the monitoring positions. However, if the 3500/20 Rack Interface Module and Data Manager I/O are to be used to interface to DDIX, TDIX, or TDXnet, refer to the manual on the 3500/20 for slot restrictions this may place on your configuration.

3.2 Monitor Options

This section describes the options available on the Tachometer Monitor configuration screens and discusses configuration considerations.



Reference Information

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

Slot

The location of the Tachometer Module 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, which is entered when a configuration is downloaded to the 3500 rack.

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 the Tachometer Module and Tachometer Discrete I/O Module are installed for a standard or nonredundant application.

Discrete Internal I/O and Discrete Internal Barrier I/O

The transducer field wiring is connected directly to the I/O module.

Discrete External I/O

The transducers and recorders are connected to external termination blocks and then routed to the I/O module through a multi-conductor cable.

TMR I/O

Used when three identical, adjacent Tachometer Modules and three Tachometer TMR I/O Modules are installed for a TMR application.

TMR I/O (Discrete)

Used when redundant transducers and field wiring are required. A set of six transducers (three per channel) provides input signals to three identical, adjacent monitors. Each transducer is connected to an external termination block and then routed to the Tachometer TMR I/O Module using a multi-conductor cable. The recorder output field wiring is also connected to an external termination block and then routed to the Tachometer TMR I/O Module through a multi-conductor cable.

TMR I/O (Bussed)

Used when redundant transducers and field wiring are not required. A single set of two transducers (one per channel) provides input signals to each of three identical, adjacent monitors. Both transducers are

connected to a single Bussed External Termination Block and then routed to the Tachometer TMR I/O Modules using three separate multi-conductor cables. The recorder output field wiring is also connected to External Termination Blocks and then routed to the Tachometer TMR I/O Module through multi-conductor cables.

Channel 1

Channel 2

The fields in these boxes apply to the indicated channel.

Channel Type

The type of monitoring that is to be performed by the channel. The following channel types are available in the module:

Rotor Speed

Rotor Acceleration & Speed

Zero Speed *

Reverse Rotation**

Notes:
* The Zero Speed Tachometer requires two channels of input for the purposes of dual voting on alarms. When configured as a Zero Speed Tachometer, both channels must be Zero Speed.
** Reverse Rotation requires two channels of input.

Active

Used to 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.

Transducer OK % Comparison (Zero Speed and Reverse Rotation Only)

Used to enable an additional OK check for Zero Speed Tachometer dual transducer inputs. When enabled, this check requires that the two inputs be within a configurable percentage (1 to 10 % of full-scale range) of one another before driving an alarm. This check is disabled below 1 rpm and above 100 rpm.

When using a single event for speed monitoring and when the machine can ramp down quickly, a difference can occur in a monitored speed causing it to be outside the % compare window.

3.3 Channel Options

This section discusses the configuration considerations and lists the channel configuration options used to configure Tachometer Channel types.

3.3.1 Channel Configuration Considerations

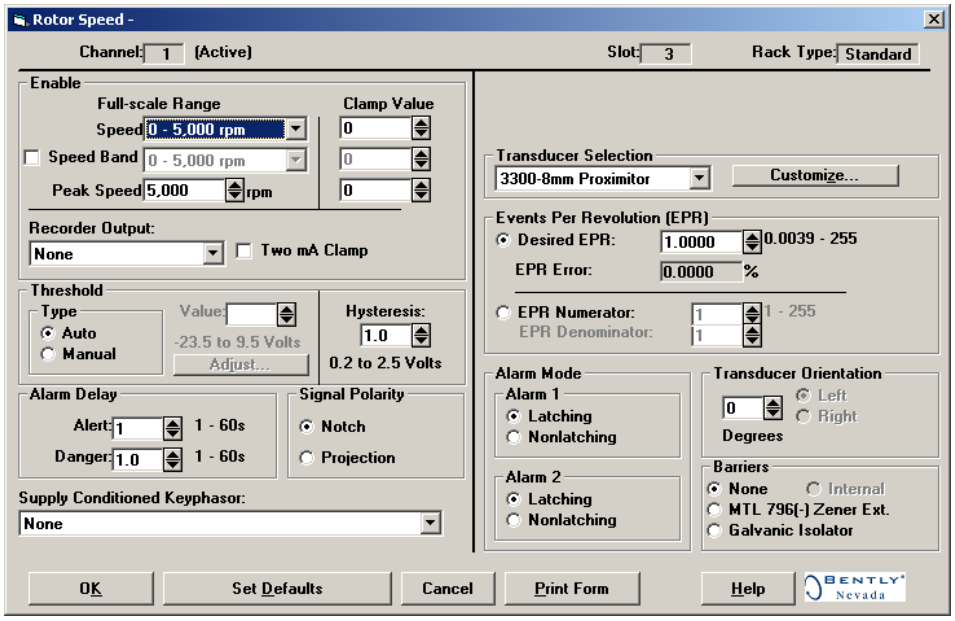
Consider the following items before configuring Tachometer channel types:

- Internal Barrier I/O Modules and External barriers are not currently supported with 7200 11mm and 14mm, 3300 16 mm HTPS, and Magnetic Pickup Proximity Transducers.
- The 3500 Tachometer does not support the 3000 Proximitor Transducer.
- Setpoints may only be set on proportional values that are enabled.
- When a full-scale range is modified, the setpoints associated with the proportional value should be re-adjusted.
- Alarming is not provided on the Peak Speed proportional value. Peak Speed is for display purposes only.
- Alarming is not provided on the Gap proportional value (where available). Gap is for display purposes only.
- Passive magnetic pickups are not recommended for monitoring at low speeds because of the small signal amplitude provided.
- Proportional value update rate and alarm response times are dependent upon input frequency. At low input frequencies, these times may be very slow.

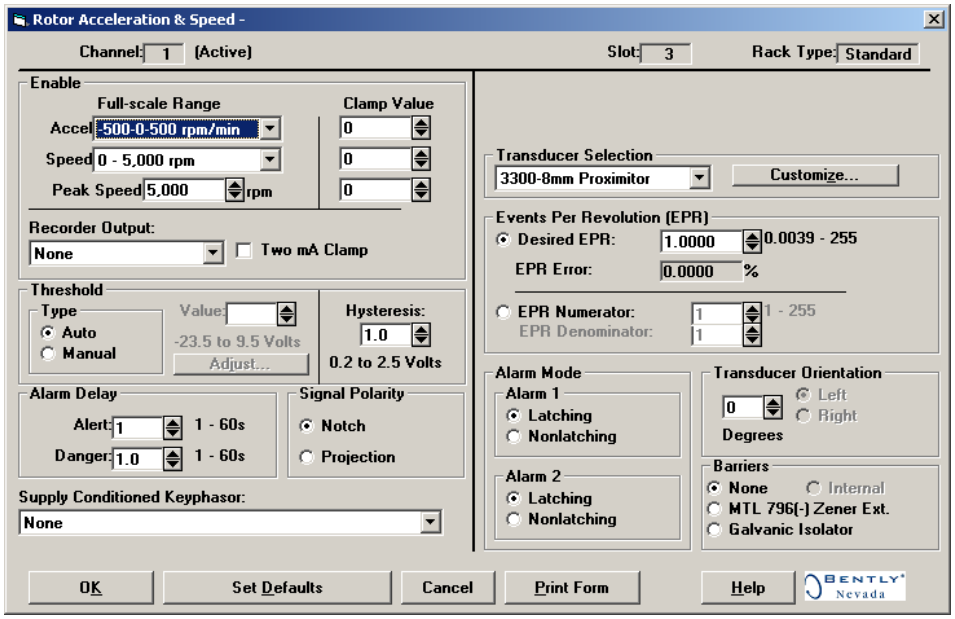
3.3.2 Channel Configuration Screens

The following screens in the 3500 Rack Configuration Software are used to configure Tachometer channel types

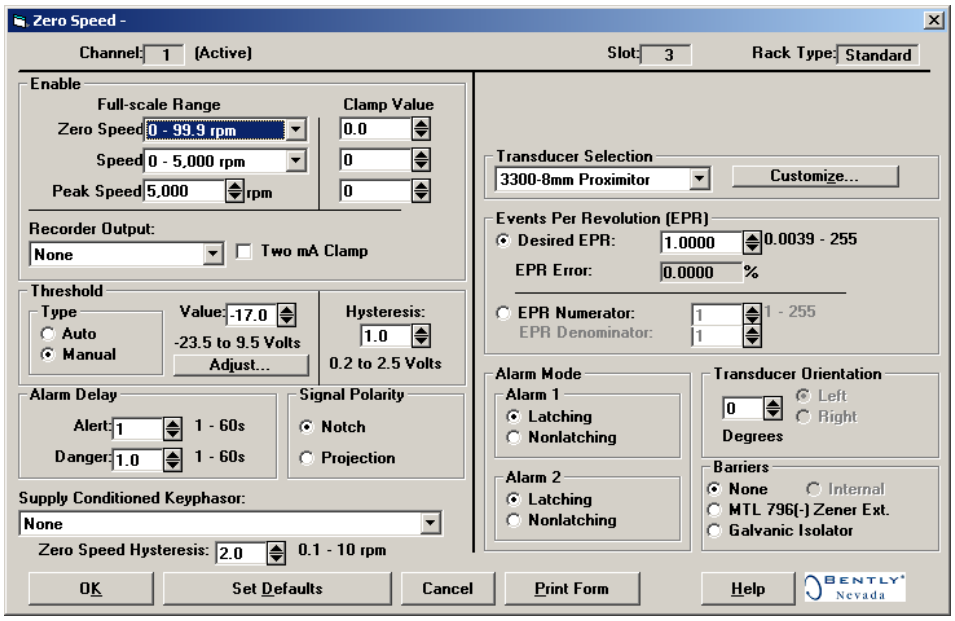
Rotor Speed



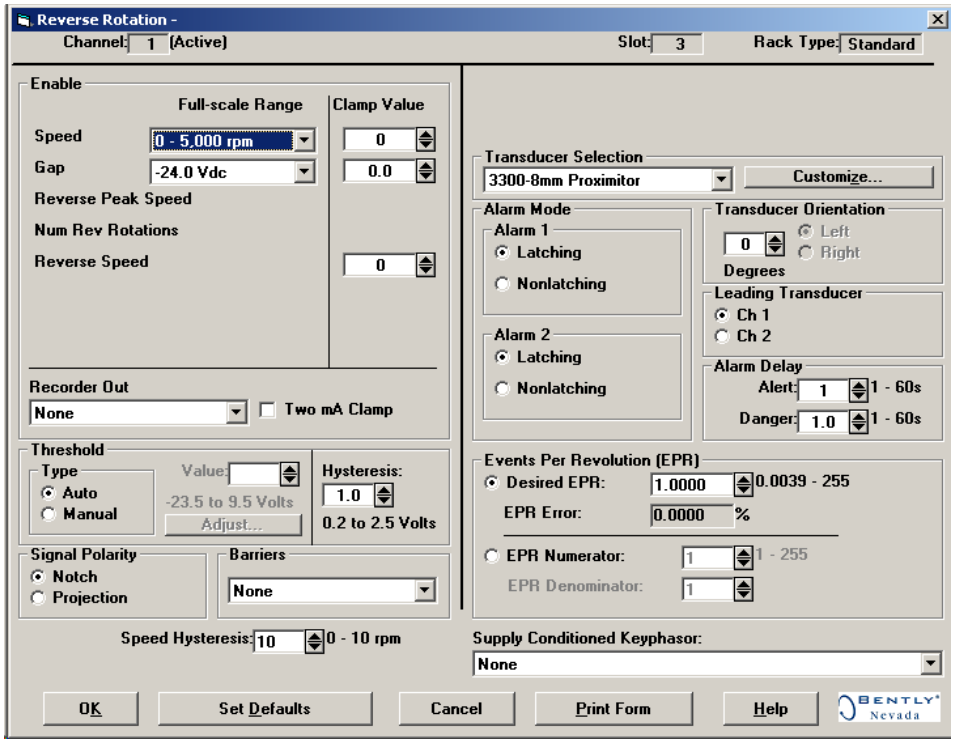
Rotor Acceleration and Speed



Zero Speed



Reverse Rotation



3.3.3 Channel Configuration Options

Reference Information

These fields indicate which channel you are configuring.

Channel
The number of the channel being configured (1 or 2).

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).

Enable

An enabled proportional value specifies that the value will be provided by the channel (✓ enabled, ✕ disabled). Proportional values that have a checkbox (✓) are always enabled.

The proportional values for the Tachometer channel types are as follows:

Channel type	Proportional Value								
	Rotor Speed	Speed band	Peak Speed	Acceleration	Zero Speed	Reverse Speed	Gap	Peak Reverse Speed	Num Rev Rotations
Rotor Speed	✓	✕	✓						
Zero Speed	✓		✓		✓				
Rotor Acceleration and Speed	✓		✓	✓					
Reverse Rotation	✓					✓	✓	✓	✓

Rotor Speed

The rotative speed of a machine shaft in revolutions per minute. For the Reverse Rotation channel type, this proportional value will only display a value when the machine is operating in the forward or normal direction.

Spd Bnd (Speed Band)

Notation for a specific speed range that is undesirable for machine operation.

Pk Spd (Peak Speed)

Notation for the maximum speed recorded by the Tachometer since the last peak hold reset occurred. The Tachometer retains the peak speed even after loss of module power.

Accel (Rotor Acceleration)

The rotative acceleration or deceleration of a machine shaft in rpm per minute.

Zero Spd (Zero Speed)

Notation for the rotative speed of a machine shaft in revolutions per minute (under 100 rpm) below which turning gear engagement can safely occur. The Zero Speed function requires inputs from two transducers. Voting logic between two transducers minimizes false zero speed indication in the event of a failed transducer. Configuration on channel two is limited to transducer options.

Gap

The physical distance between the face of the transducer tip and the observed surface. The distance is expressed in terms of voltage (Volts). Standard polarity conventions dictate that a decreasing gap results in an increasing (less negative) output signal.

Reverse Speed

The rotative speed of a machine shaft in revolutions per minute when operating in the reverse direction. The value will be zero (0) when the machine is operating in the forward direction.

Peak Reverse Speed

The maximum reverse speed recorded by the Tachometer since the last peak hold reset occurred. This value is retained even after loss of module power.

Num Reverse Rotations

The number of reverse rotations of the machine. This value is kept until a rack reset occurs. This value is retained even after loss of module power.

Full-Scale Range

The proportional values listed in the table below provide the ability to set the full-scale value. Peak Speed defaults to the full-scale range of the Speed proportional value.

The available full-scale ranges are the same for all transducer types. If the desired full-scale value is not in the drop down list, select Custom.

Rotor Speed and Speed Band	Acceleration	Zero Speed	Gap
0 to 100 rpm 0 to 200 rpm 0 to 500 rpm 0 to 1000 rpm 0 to 2000 rpm 0 to 5000 rpm 0 to 10,000 rpm 0 to 20,000 rpm 0 to 50,000 rpm 0 to 99,999 rpm Custom	-100 to 100 rpm/min -200 to 200 rpm/min -500 to 500 rpm/min -1000 to 1000 rpm/min -9999 to 9999 rpm/min Custom	0 to 99.9 rpm Custom	-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 zero and the maximum full-scale range value. Only the values available from the Recorder Outputs, Communication Gateway, and Display Module are clamped to the specified value when the proportional value is invalid.

Recorder Output

The proportional value that is sent to the 4 to 20 mA recorder. The 4 to 20 mA output is proportional to the measured value over the selected full-scale range for the proportional value. 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).

Threshold

The voltage level of the transducer signal where triggering occurs (if the Hysteresis is 0).

Auto

The trigger threshold is automatically set to a value that is midway between the most positive peak and the most negative peak of the input signal. This value tracks any changes in the input signal. Auto threshold requires a minimum signal amplitude of 1 V pp and a minimum frequency of 0.0167 Hz.

Manual

The trigger threshold is set by the user to any value in the range of +9.5 to -23.5 volts. Manual threshold requires a minimum signal amplitude of

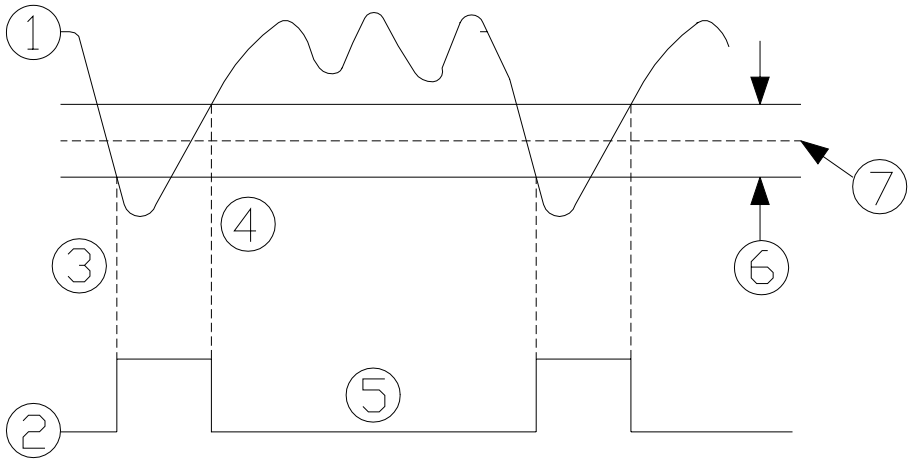
500 millivolts peak to peak. Manual threshold is the default for Zero Speed channel types.

Adjust

Available when Manual Threshold is selected. Used to display a dialog box that will aid in the setting of the Manual Threshold value.

Hysteresis

Hysteresis is the voltage level around the threshold value (½ above, ½ below) that is required to trigger. For example, when the input voltage level passes the threshold value plus ½ of the hysteresis value, a trigger occurs. The larger the hysteresis value, the greater the immunity to noise on the input signal. You can set hysteresis to any value between 0.2 and 2.5 volts.



1) Input Signal
2) Conditioned Signal
3) Trigger In
4) Trigger Out
5) Speed Pulse
6) Hysteresis
7) Threshold

Alarm Delay

The time which a proportional value must remain at or above an over alarm setpoint, at or below an under alarm setpoint, or within a speed band alarm range before an alarm is declared as active.

Alert/Alarm 1*

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

Danger/Alarm 2*

Second level alarm that occurs when the transducer signal level exceeds the selected Danger/Alarm 2 setpoint. The Danger/Alarm 2 time delay is always set at 0.1 second intervals (from 1 to 60) for all available proportional values.

* For Zero Speed alarms to occur, both transducers must observe the rotor speed fall below the setpoint for at least one second. For Reverse Rotation alarm to occur, both transducers must observe 2 events indicating reverse rotation.

Application Alert
When operating at low speeds with one event per revolution, the update rate and alarm response time can be very slow.

Signal Polarity

Notch

An output pulse, produced for use by the monitors that is triggered by the leading edge of a negative-going pulse in the input signal. This type of pulse is produced by a Keyphasor transducer looking at a notch in the shaft. If a magnetic pickup is used, set Notch/Projection setting to Notch since in most cases the positive side of the signal will be clipped at 10 volts.

Projection

An output pulse, produced for use by the monitors that is triggered by the leading edge of a positive-going pulse in the input signal. This type of pulse is produced by a Keyphasor transducer looking at a projection on the shaft.

Supply Conditioned Keyphasor

A conditioned Keyphasor signal is a digital timing signal that is used by the monitor modules and external diagnostic equipment to measure vector parameters such as 1X amplitude and phase. The 3500 Tachometer can supply conditioned Keyphasor signals to the 3500 system backplane for use by other monitors. Channel 1 of the Tachometer will drive Upper Keyphasor Channel 1. Channel 2 of the Tachometer will drive Upper Keyphasor Channel 2.

Application Alert
Signals from a Keyphasor transducer that is observing a multi-tooth gear can be used for speed measurements only and not for phase measurements.

Transducer Selection

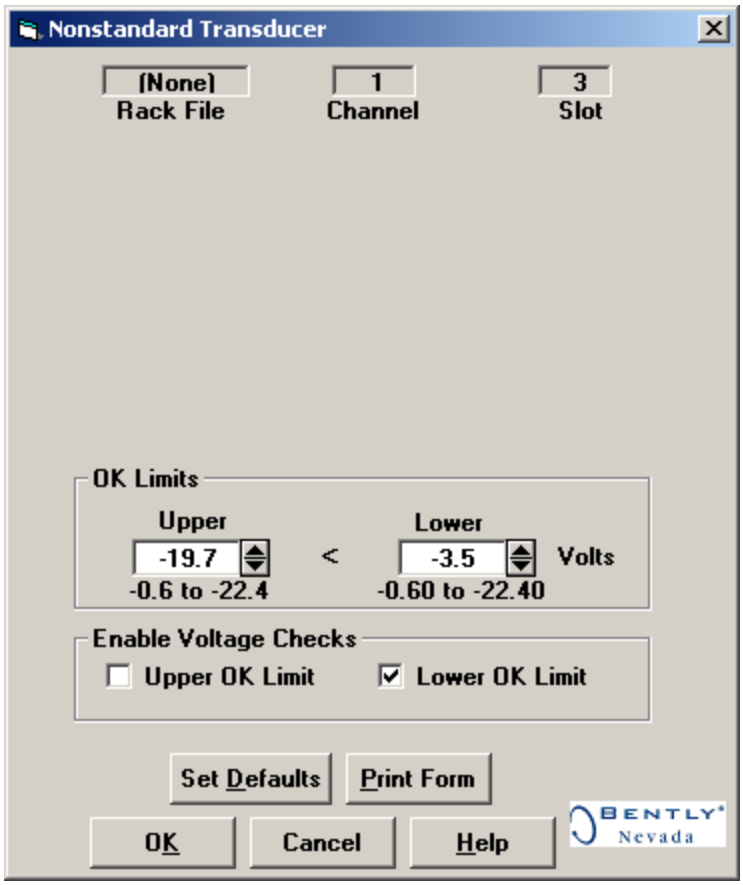
The following transducer types are available for the Tachometer channel types:

Non-barrier I/O module	Barrier I/O module
3300 - 5mm and 8mm Proximitor	3300 - 5mm and 8mm Proximitor
7200 - 5mm, 8mm, 11mm, and 14mm Proximitor	7200 - 5mm and 8mm Proximitor
3300 16mm HTPS and RAM Proximitor	3300 RAM Proximitor
Magnetic Pickup **	Nonstandard
Nonstandard	

** Magnetic Pickups are not recommended for Zero Speed applications and may not be used for Reverse Rotation applications.

Customize button

Used to enable the Voltage OK Limit check. If Nonstandard is selected as the transducer type, the OK Limits can also be adjusted. There must be at least 2 volts between the Upper and Lower OK Limits.



Enable Voltage Checks

The transducer input DC voltage level is directly proportional to the gap between the face of a proximity probe and the surface being monitored. OK Limits are the upper and lower voltages that mark the range within which a proximity transducer is defined as OK. The upper OK Limit is the more negative voltage and the lower OK Limit is the more positive voltage (closer to zero volts). OK Limits can vary depending on the transducer application.

By checking the Upper and Lower OK Limit check boxes, you cause an additional transducer check that lets the Tachometer Module distinguish between a transducer failure and a stopped machine. With these boxes checked, the Trigger OK status will remain OK when the machine is stopped and the transducer is OK.

Default OK limits are supplied for all Proximity transducers. The lower OK Limit is enabled as the default for Proximity transducers. Only the Nonstandard transducer selection lets you change the OK limits of the transducer. Enable Voltage Checks is disabled for magnetic pickups.

The Enable Voltage Check works like this:

- If the check is **disabled** and the input to the monitor is removed, the channel will immediately go Not OK and the trigger will be determined to be Not OK. If the signal is reapplied within 60 seconds, the channel will quickly regain the OK status. If the signal is reapplied after 60 seconds, the channel will also quickly regain the OK status, but a “signal too slow” system event will be logged. This message results

because the system has determined that the input signal is below the 1 RPM threshold requirement.

- If the check is **enabled** and the input to the monitor is removed, the channel will immediately go Not OK. When the signal is reapplied either within 60 seconds or after 60 seconds, the monitor will not immediately go back into OK. Since the checkbox is enabled, the trigger OK status is always OK and the trigger OK checking is disabled.

Note

A typical notch or gear tooth observed by a proximity probe will cause the transducer to be outside its upper OK Limit. Do not enable the upper OK Limit Voltage Check unless the notch or tooth is specifically designed to remain within the OK limits of the transducer.

Transducer	Upper OK Limit		Lower OK Limit		Center Gap Voltage	
	Without Barriers	With Barriers	Without Barriers	With Barriers	Without Barriers	With Barriers
3300 5 mm	-16.80 V	-16.80 V	-2.70 V	-2.70 V	-9.75 V	-9.75 V
3300 8 mm	-16.80 V	-16.80 V	-2.70 V	-2.70 V	-9.75 V	-9.75 V
3300 8mm XL						
7200 5 mm	-16.80 V	-16.80 V	-2.70 V	-2.70 V	-9.75 V	-9.75 V
7200 8 mm	-16.80 V	-16.80 V	-2.70 V	-2.70 V	-9.75 V	-9.75 V
7200 11 mm	-19.70 V	N/A	-3.50 V	N/A	-11.60 V	N/A
3300 11mm XL						
7200 14 mm	-16.80 V	N/A	-2.70 V	N/A	-9.75 V	N/A
3300 16 mm HTPS	-16.80 V	N/A	-2.70 V	N/A	-9.75 V	N/A
3300 RAM	-12.60 V	-12.60 V	-2.40 V	-2.40 V	-7.50 V	-7.50 V
3300 NSV		-12.20 V*				-7.3 V*
Magnetic Pickup	N/A	N/A	N/A	N/A	N/A	N/A

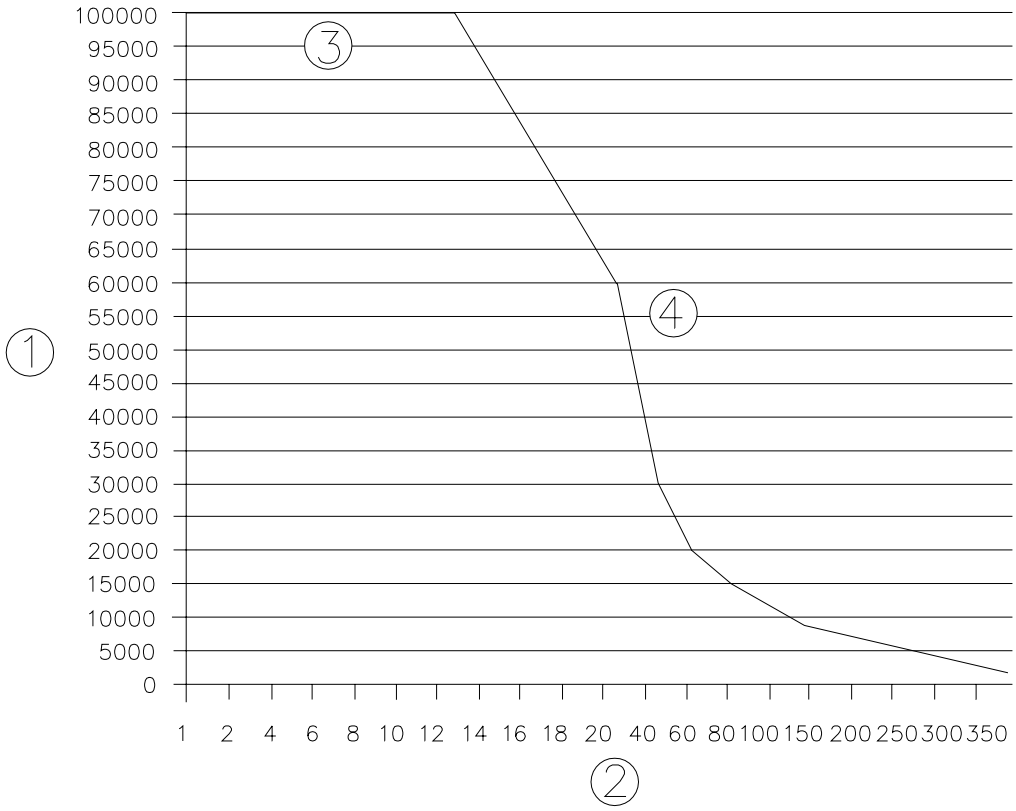
*Bently Nevada Internal Barrier Modules.

Events Per Revolution (EPR)

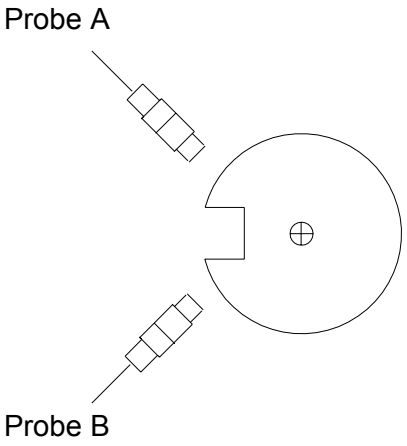
The number of pulses in a speed transducer signal for each shaft rotation. If the speed transducer is observing a multi-tooth gear, set the Events Per Revolution to the number of teeth on the gear. Enter the desired events per revolution either as a decimal value (0.0039 to 255) or as a fractional value by entering the Events Per Revolution numerator (1 to 255) and denominator (1 to 255). A fractional value is always calculated and displayed because the Tachometer uses the fractional value in its calculations. If you enter a non-integer Events Per Revolution, the software will determine which fractional value most closely approximates this value and display the associated numerator and denominator. The software will also calculate and display the

percentage of error between the desired decimal value and the approximated fractional value.

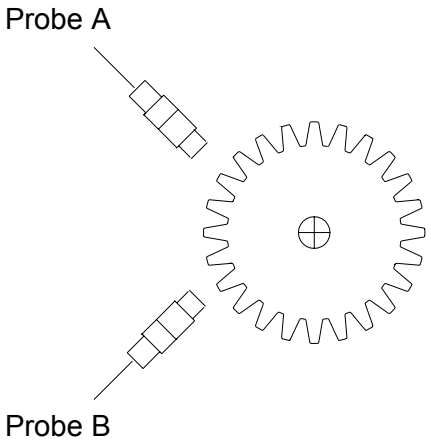
Maximum Events Per Revolution



1) RPM
2) Events Per Revolution
3) Upper RPM limit is 99,999
4) Upper Frequency limit is 20kHz



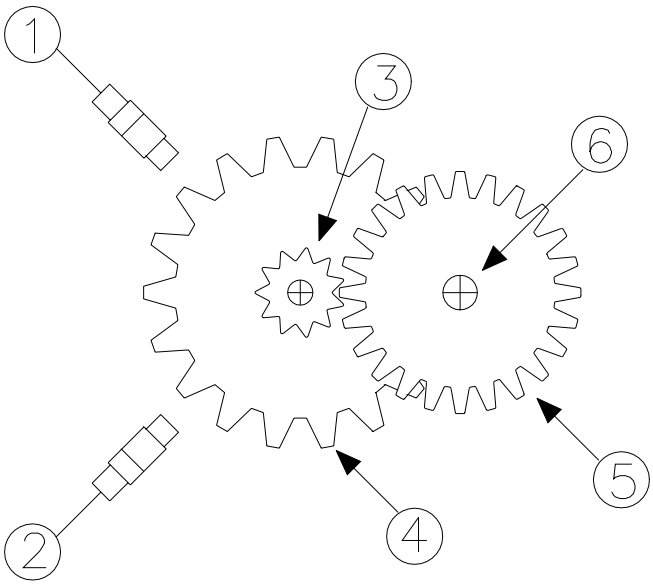
Shaft with notch
Events Per Revolution
set to 1 event



24 tooth gear
Events Per Revolution
set to 24 events

In this example, both probes are observing an 18-tooth gear on the same shaft with an 11-tooth gear. The 11-tooth gear is driven from a 24-tooth gear. The Tachometer is to indicate the speed of the shaft on the 24-tooth gear. In this case, the events per revolution must be calculated:

EPR = (24 / 11) x 18 = 39.2727



1) Probe A

2) Probe B

3) 11 tooth gear

4) 18 tooth gear

5) 24 tooth gear

6) Tachometer is to indicate the speed of this shaft.

To set the Tachometer to proper EPR, enter the decimal value into the **Desired EPR** box. The software calculates the closest fraction found which is EPR = 157/4 = 39.25. Since 157/4 = 39.25 and not 39.2727, a slight error will result. In this particular example, the error is 0.0578 % or 2 rpm at 3600 rpm.

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 by using one of the following methods:

Pressing the reset switch on the front of the Rack Interface Module

Closing the reset contact on the Rack Interface I/O Module

Selecting the Rack Reset command in the Rack Configuration or Operator Display Software

Issuing the reset command through the Communication Gateway or Display Module.

Non-latching

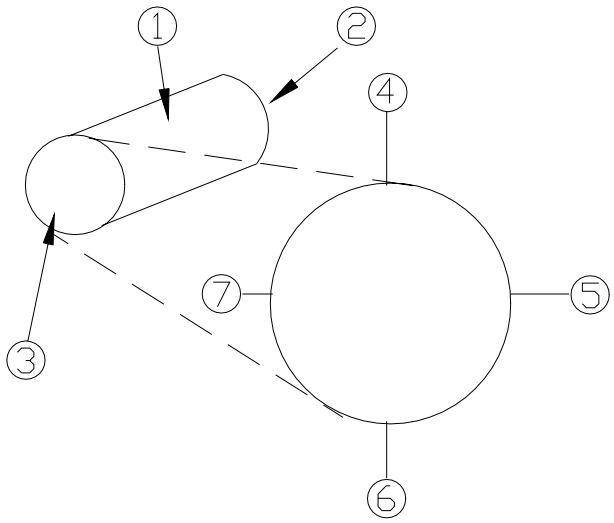
When an alarm is active, it will go inactive as soon as the proportional value drops below the configured setpoint level.

Alert/Alarm 1 should be the first level alarm that occurs when the transducer signal level exceeds the selected value. Danger/Alarm 2 should be the second level alarm that occurs when the transducer signal level exceeds the selected value. The Alert/Alarm 1 and Danger/Alarm 2 values are set on the Setpoint screen.

The Zero Speed function requires inputs from two transducers. Voting logic between the two transducers minimizes false Zero Speed indication in the event of a transducer failure. To meet the Zero Speed alarming requirement, both transducers must have a valid input below 100 rpm, both transducers must observe the rotor speed fall below the Zero Speed setpoint for three consecutive readings, and the Zero Speed Enable switch must be enabled. If both transducers read zero rpm input for one minute and Zero Speed alarming is enabled, a Zero Speed alarm will occur.

Transducer Orientation

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:



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

Barriers

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

3.4 Available Setpoints

This section specifies the available setpoints for each type of Tachometer channel. A setpoint is the level within the full-scale range that determines when an alarm occurs.

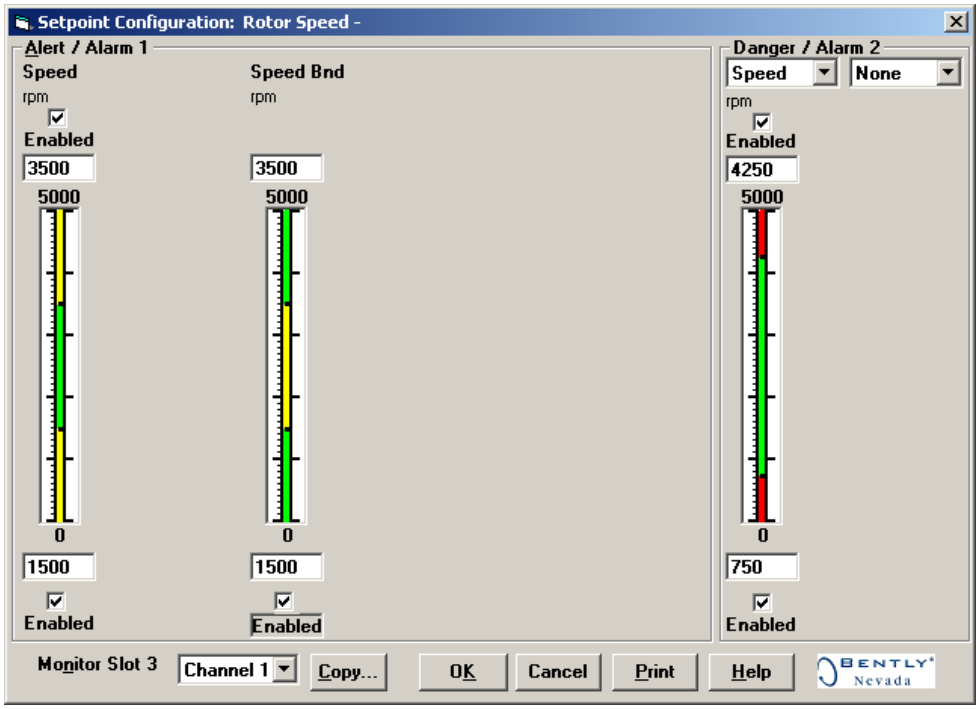
The 3500 Monitoring System allows Alert/Alarm 1 setpoints to be set for every proportional value (except peak speed) on each channel. The channel will drive an Alert/Alarm 1 indication if one or more of the channel proportional values exceeds its setpoints.

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 for Rotor Speed and Rotor Acceleration Channel types. The Zero Speed Channel type allows only one Danger/Alarm 2 setpoint (Zero Speed under).

With the Reverse Rotation channel type, one Danger/Alarm 2 setpoint is fixed at zero to facilitate alarming when a reverse rotation condition is detected. The other Danger/Alarm2 setpoint is configurable.

Application Alert
Alert/Alarm setpoints are for annunciation purposes only.

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 channel type.



Application Alert
Having alert setpoints set for both Speed and Zero speed proportional values will allow an alarm condition for either event and this may be undesirable for a zero speed indication.

The following table lists the Alert/Alarm 1 and Danger/Alarm 2 setpoints for each Tachometer channel type. The setpoint number is used in the Communication Gateway and Display Module.

Setpoint number	Rotor Speed	Rotor Acceleration	Zero Speed	Reverse Rotation
1	Over Speed	Over Speed	Zero Speed - Under	Over Forward RPM (selectable)
2	Under Speed	Under Speed	Over Speed	Under Forward RPM (selectable)
3	Over Speed Band	Over Acceleration	Under Speed	Over Reverse Peak
4	Under Speed Band	Under Acceleration	Danger (Zero Speed)	Over Number of Reverse Rotations
5	Danger (configurable)	Danger (configurable)		Over Peak Reverse Speed
6	Danger (configurable)	Danger (configurable)		Danger (configurable)
7	Danger (configurable)	Danger (configurable)		Danger (configurable)
8	Danger (configurable)	Danger (configurable)		Danger, Over Reverse Speed

All the Alert/Alarm 1 setpoints are provided first, followed by the configured Danger/Alarm 2 setpoints.

Example 1:

A Tachometer configured for Rotor Speed with the Danger/Alarm 2 Over Speed and the Danger/Alarm 2 Under Speed setpoints selected.

Alert/Alarm 1 setpoints: setpoints 1 through 4

Danger/Alarm 2 setpoints: setpoint 5 is Over Speed (Danger/Alarm 2)

setpoint 6 is Under Speed (Danger/Alarm 2)

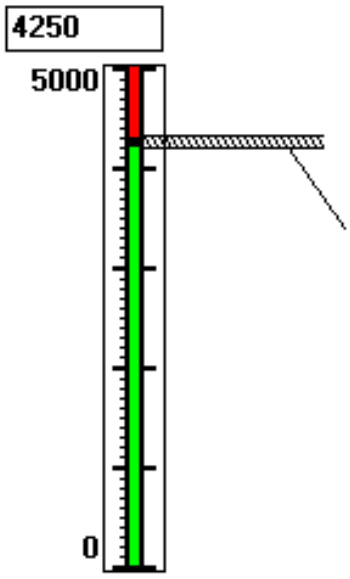
Example 2:

A Tachometer configured for Zero Speed with the Danger/Alarm 2 Zero Speed Under setpoint selected.

Alert/Alarm 1 setpoints: setpoints 1 through 3

Danger/Alarm 2 setpoint: setpoint 4 is Zero Speed Under (Danger)

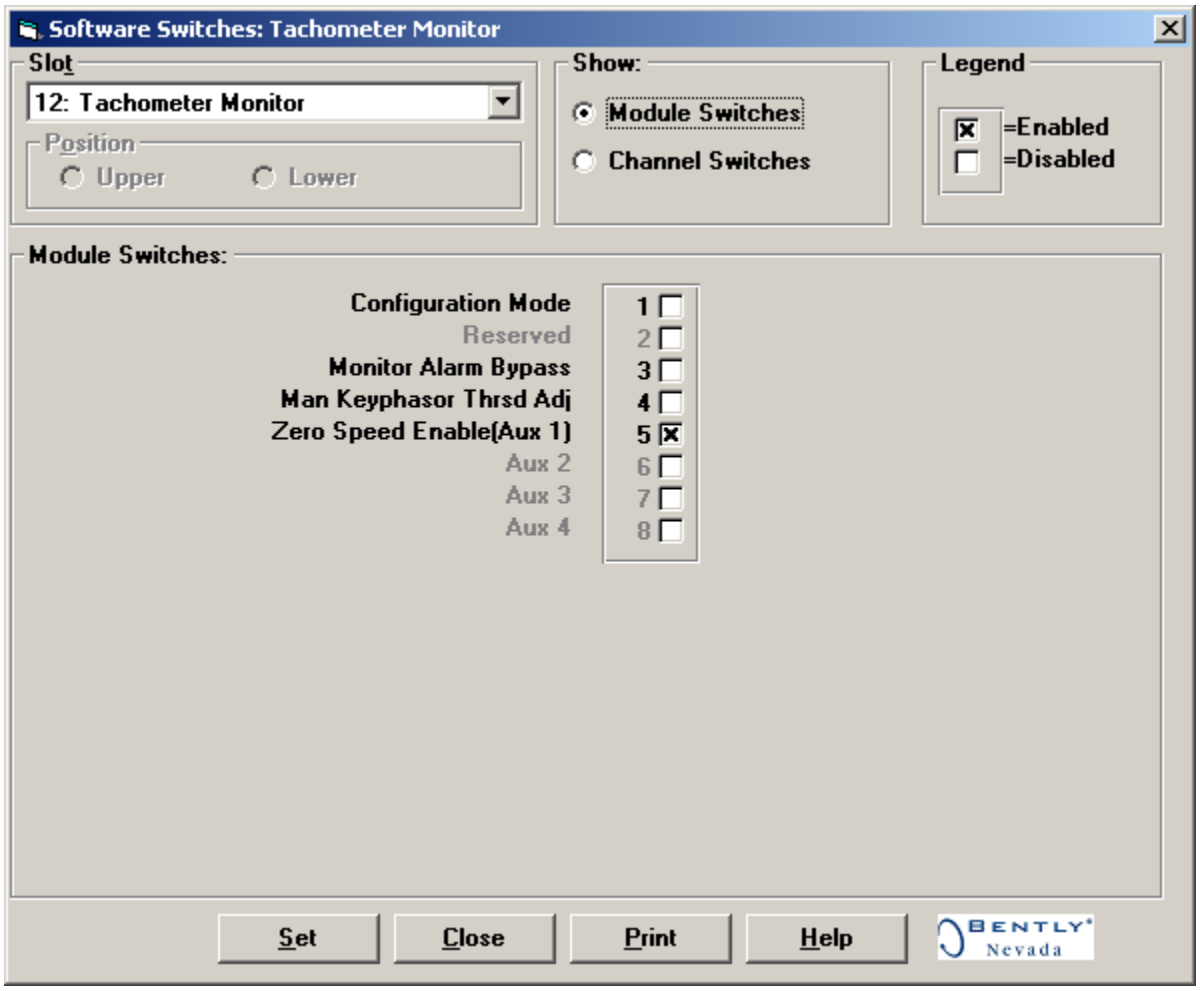
Alarm Hysteresis



The alarming hysteresis for all setpoints is 10 RPM (with the exception of Zero Speed which is configurable). 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, consider a channel with an alarm setpoint at 4250 RPM as illustrated. The channel input must fall below 4240 RPM (4250 – 10) before the channel is out of alarm.

3.5 Software Switches

The Tachometer Monitor supports four module software switches and four channel software switches. These switches let you temporarily bypass, inhibit, or invoke 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.

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 this switch is enabled, the monitor does not perform alarming functions. All proportional values are still provided.

Manual Keyphasor Threshold Adjust

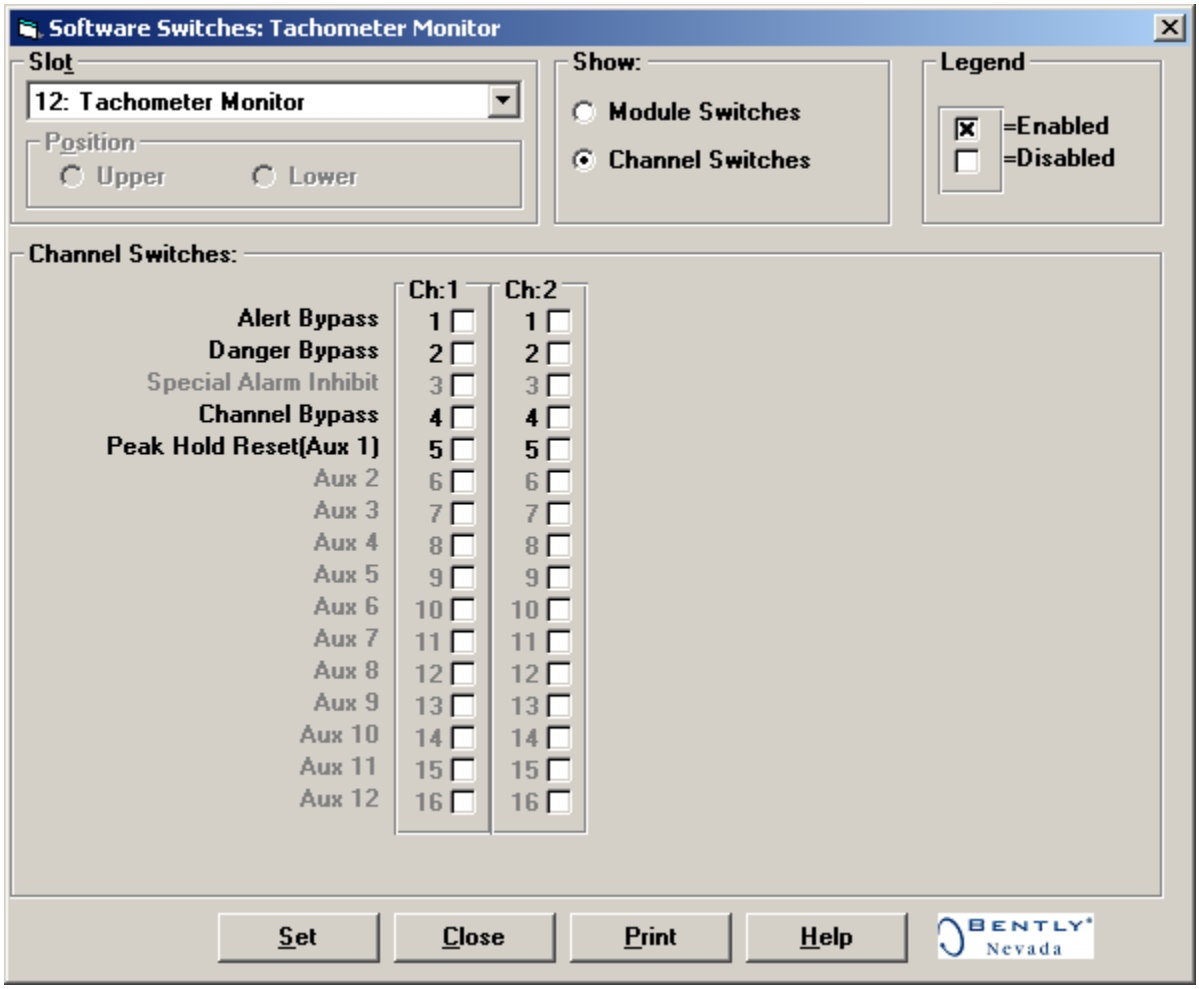
Used when adjusting the manual threshold. This switch will automatically be enabled and disabled when the **Adjust** button on the Tachometer Monitor Options screen is pressed. When in this mode the Tachometer Module will operate with a temporary Manual Threshold supplied by the Rack Configuration Software. Proportional values may go invalid, alarming will be bypassed, and Conditioned Keyphasor will not be supplied while the Manual Threshold is being adjusted.

Zero Speed Enable

The Zero Speed Enable switch is a permissive switch that allows alarms to occur for Zero Speed and Reverse Rotation. When the switch is enabled, these alarms will occur when the alarm condition is present. If the switch is not enabled, the alarms will be bypassed even when the alarm condition is present.

The monitor switch number is used in the Communication Gateway and Display Interface Module.

Monitor Switch Number	Switch Name
1	Configuration Mode
3	Monitor Alarm Bypass
4	Manual Keyphasor Threshold Adjust
5	Zero Speed Enable



Channel Switches

Alert Bypass

When this switch is enabled, the channel does not perform Alert-alarming functions.

Danger Bypass

When this switch is enabled, the channel does not perform Danger alarming functions.

Bypass

When this switch is enabled, the channel provides no alarming functions and supplies no proportional values.

Peak Hold Reset

When this switch is enabled, the current reading for peak speed, peak reverse speed, and number of reverse rotations for the channel is cleared from memory. For peak speed, both Peak Hold Reset switches must be enabled to clear the peak speed reading for a Zero Speed channel type. For peak reverse speed and number of reverse rotations, the channel 1 Peak Hold Reset switch must be disabled to clear the reading.

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

Channel Switch Number	Switch Name
1	Alert Bypass
2	Danger Bypass
4	Bypass
5	Peak Hold Reset

4. I/O Module Descriptions

The Tachometer I/O Module receives signals from the transducers and routes the signals to the Tachometer Module. The I/O module also supplies power to the transducers and provides 4 to 20 mA recorder and buffered transducer outputs for each of the transducer input channels. Install one I/O module for each monitor. Install the I/O module behind the monitor in a rack mount or panel mount rack or above the monitor in a bulkhead rack.

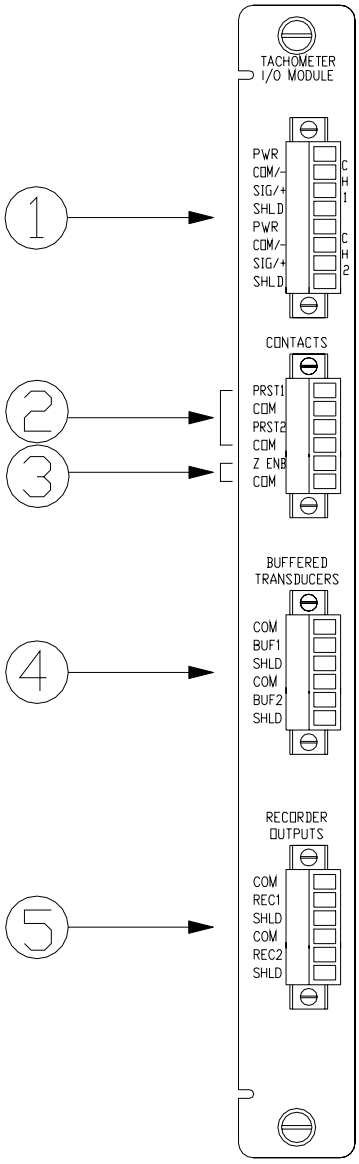
The 3500/50 Tachometer Module can operate with the following types of I/O Modules:

Internal Termination	External Termination	External Termination Block
Tachometer I/O module Tachometer Internal Barrier I/O module	Tachometer I/O module Tachometer TMR I/O module	Terminal strip connectors Euro Style connectors

This section describes how to use the connectors on the I/O modules, lists which cables to use, and shows the pin outs of the cables. The 3500 Field Wiring Diagram Package (part number 130432-01) shows how to connect transducers, system contacts, and recorder outputs to the I/O module or the External Termination Block.

4.1 Tachometer I/O Module (Internal Termination)

Internal Termination I/O modules require you to wire each transducer and recorder to the I/O module directly. This section shows what the Internal Termination I/O module looks like and shows how to connect the wires to the Euro Style connector.



1) Connect the wires from the transducers associated with Channels 1 and 2 of the Tachometer I/O Module.

2) PRST1/COM & PRST2/COM: Connect to an external switch. Used to reset the following parameters:

- recorded peak speed
- number of reverse rotations (PRST1 only)
- peak reverse speed (PRST1 only)

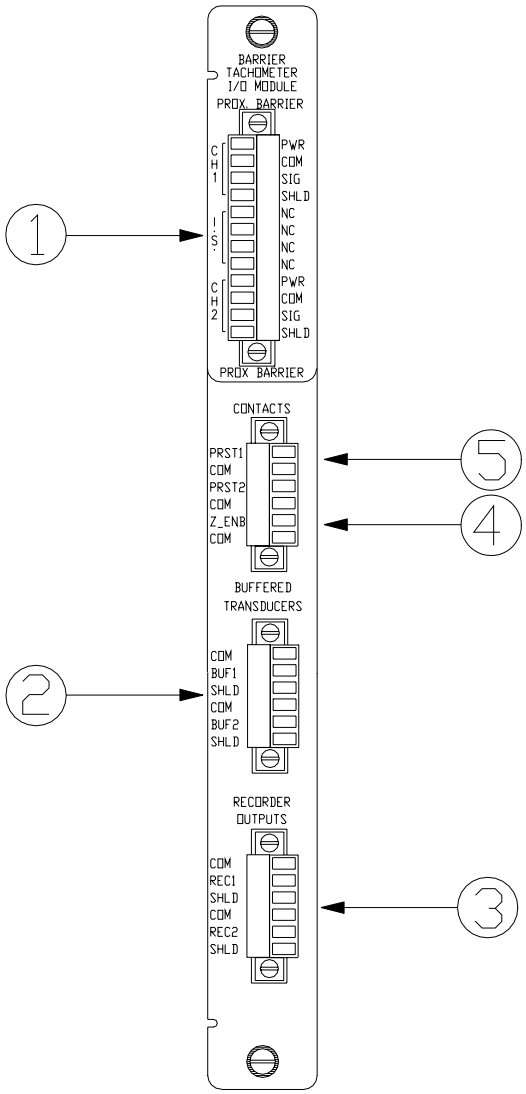
3) Z ENB/COM: Connect to an external switch. Used to enable alarming for the zero speed and reverse rotation.

4) Connect the Channel 1 and 2 Buffered Transducer Signals to external equipment, such as TDXnet.

5) COM/REC: Connect the 4 to 20 mA recorder output for each channel to a chart recorder or other data-logging device.

4.2 Tachometer Internal Barrier I/O Module (Internal Termination)

The Internal Barrier I/O modules require that each transducer be connected to the Barrier I/O module individually. This module provides two channels of intrinsically safe signal conditioning for transducers and has one internally mounted sneer barrier module. A 3500 Earthling 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.



1) Connect the wires from the transducers associated with Channels 1 and 2 of the Tachometer Internal Barrier I/O Module.

2) Connect the Channel 1 and 2 Buffered Transducer Signals to external equipment, such as TDXnet.

3) COM/REC: Connect the 4 to 20 mA recorder output for each channel to a chart recorder or other data-logging device.

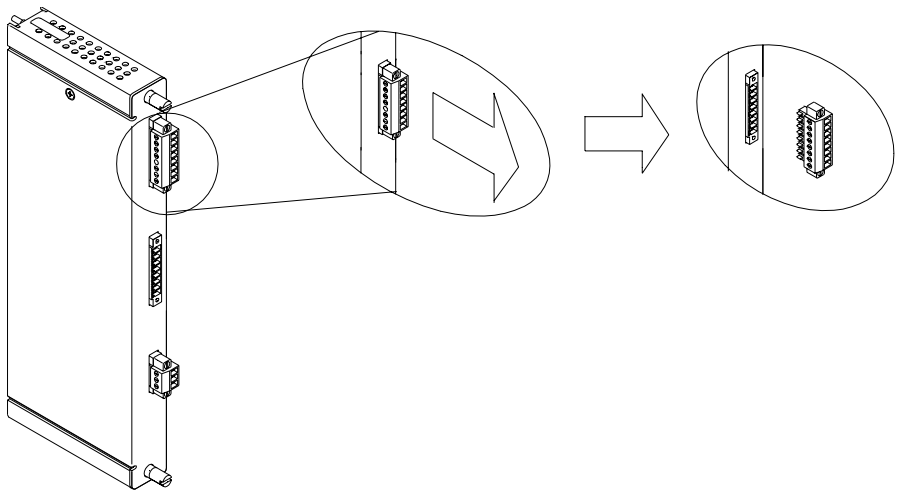
4) Z ENB/COM: Connect to an external switch. Used to enable Reverse Rotation monitoring and to enable alarming for the zero speed and reverse speed.

5) PRST1/COM & PRST2/COM
Connect to an external switch. Used to reset the following parameters:

- recorded peak speed
- number of reverse rotations (PRST1 only)
- peak reverse speed (PRST1 only)

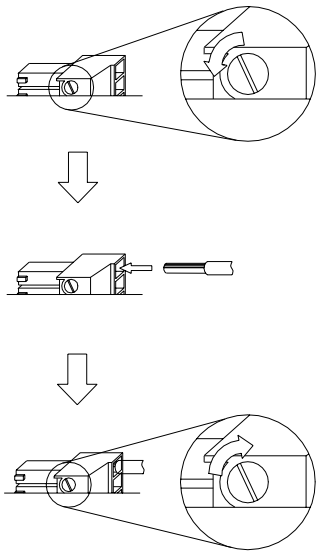
4.3 Wiring Euro Style Connectors

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.

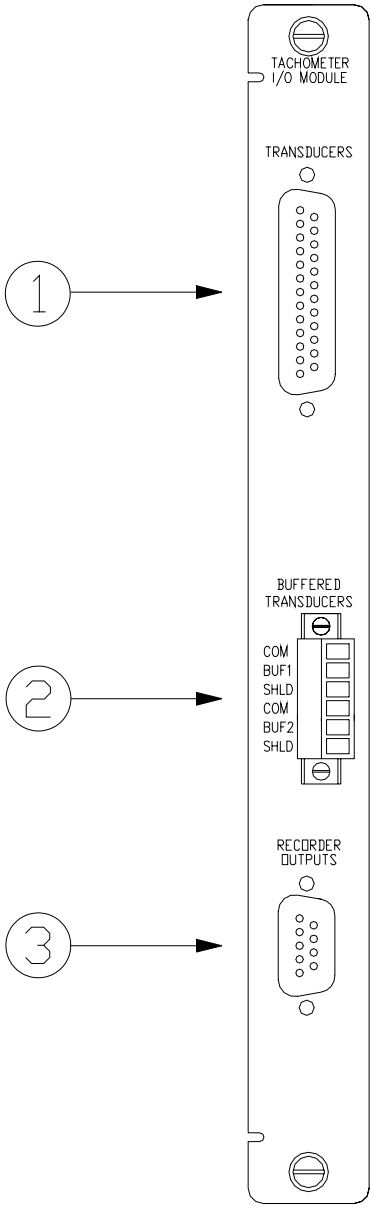


4.4 External Termination I/O Modules

External Termination I/O modules let you simplify the wiring to the I/O modules in a 3500 rack by using multi-conductor cables to route the signals to and from the transducers and recorders to the I/O module. This section describes the External Termination I/O modules available for use with the Tachometer Module. It also shows what the External Termination Blocks look like and the pin outs of the cables that go between the External Termination I/O modules and the External Termination Blocks.

4.4.1 Tachometer I/O Module (External Termination)

This section discusses the features of the Tachometer I/O Module.



1) Connect the I/O module to the External Termination Block using cable 135101-XXXX-XX.

2) Connect the Channel 1 and 2 Buffered Transducer Signals to external equipment, such as TDXnet.

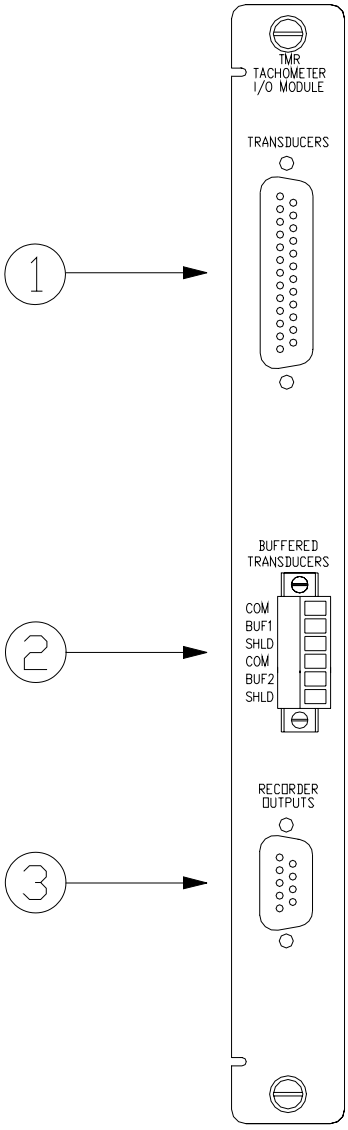
3) Connect the I/O module to the Recorder External Termination Block using cable 129529-XXXX-XX.

4.4.2 Tachometer TMR I/O Module (External Termination)

The Tachometer TMR I/O Module is used in a TMR rack and can be configured as TMR I/O Discrete or TMR I/O Bussed.

When configured as TMR I/O Discrete, six transducers (three per channel) send input signals to three Tachometer Modules so that each transducer signal of each channel is connected to a separate channel. Six External Termination Blocks are required: three for the transducers and three for the recorders.

When configured as TMR I/O Bussed, two transducers (one per channel) are bussed to all three Tachometer Modules so that each transducer is shared by three channels, one channel from each monitor. Four External Termination Blocks are required: one for the transducers and three for the recorders.



1) Connect the I/O module to the External Termination Block using cable 135101-XXXX-XX.

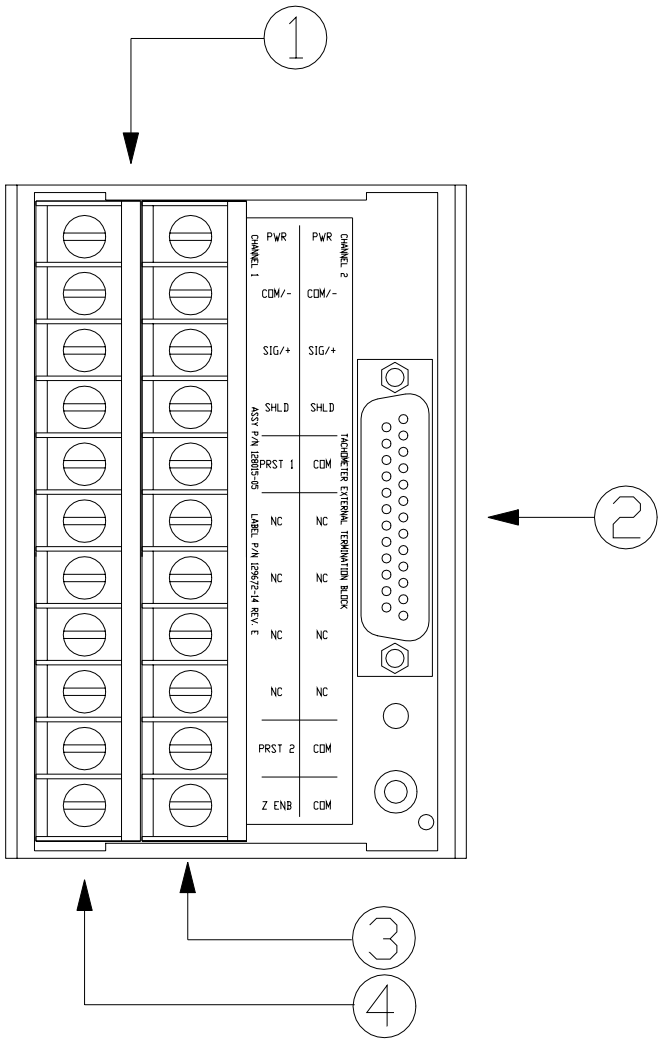
2) Connect the Channel 1 and 2 Buffered Transducer Signals to external equipment, such as TDXnet.

3) Connect the I/O module to the Recorder External Termination Block using cable 129529-XXXX-XX.

4.5 External Termination Blocks

The three types of External Termination Blocks used with a Tachometer I/O Module are the Tachometer External Termination Block, the Bussed Tachometer External Termination Block, and the Recorder External Termination Block. Each type is available with either Terminal Strip or Euro Style connectors.

4.5.1 Tachometer External Termination Block (Terminal Strip connectors)



1) Connect the wires from the transducers associated with Channels 1 and 2 to the External Termination Block

(PRST1/COM & PRST2/COM: Connect to an external switch. Used to reset the following parameters:

- recorded peak speed
- number of reverse rotations (PRST1 only)
- peak reverse speed (PRST1 only))

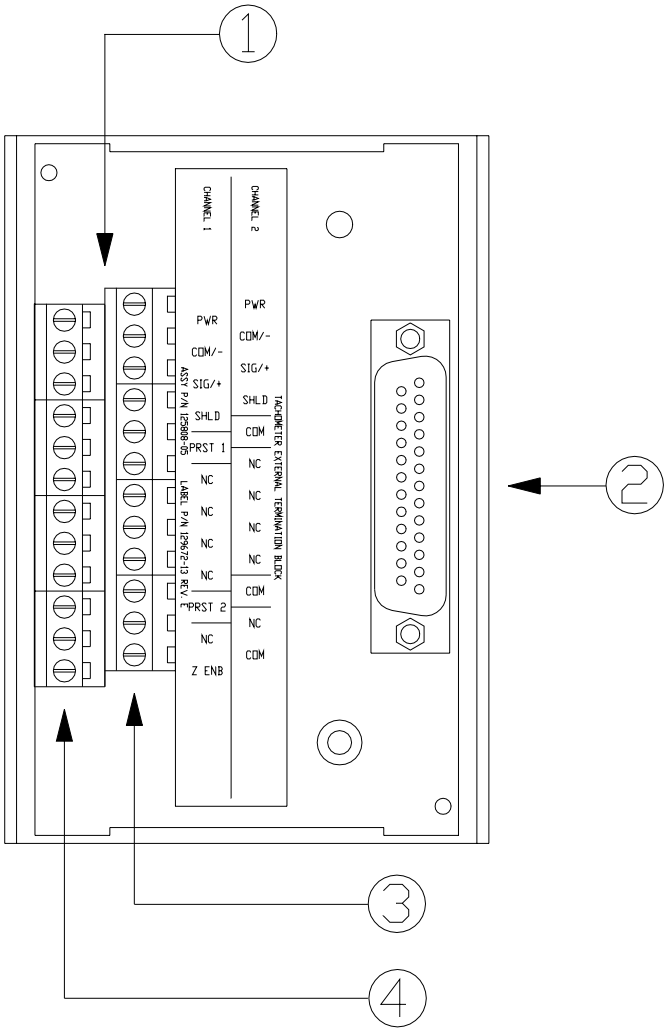
(Z ENB/COM: Connect to an external switch. Used to enable Reverse Rotation monitoring and to enable alarming for the zero speed and reverse speed.)

2) Connect the I/O module to the External Termination Block using cable 135101-XXXX-XX

3) Channel 2

4) Channel 1

4.5.2 Tachometer External Termination Block (Euro Style connectors)



1) Connect the wires from the transducers associated with Channels 1 and 2 to the External Termination Block

(PRST1/COM & PRST2/COM: Connect to an external switch. Used to reset the following parameters:

- recorded peak speed
- number of reverse rotations (PRST1 only)
- peak reverse speed (PRST1 only).)

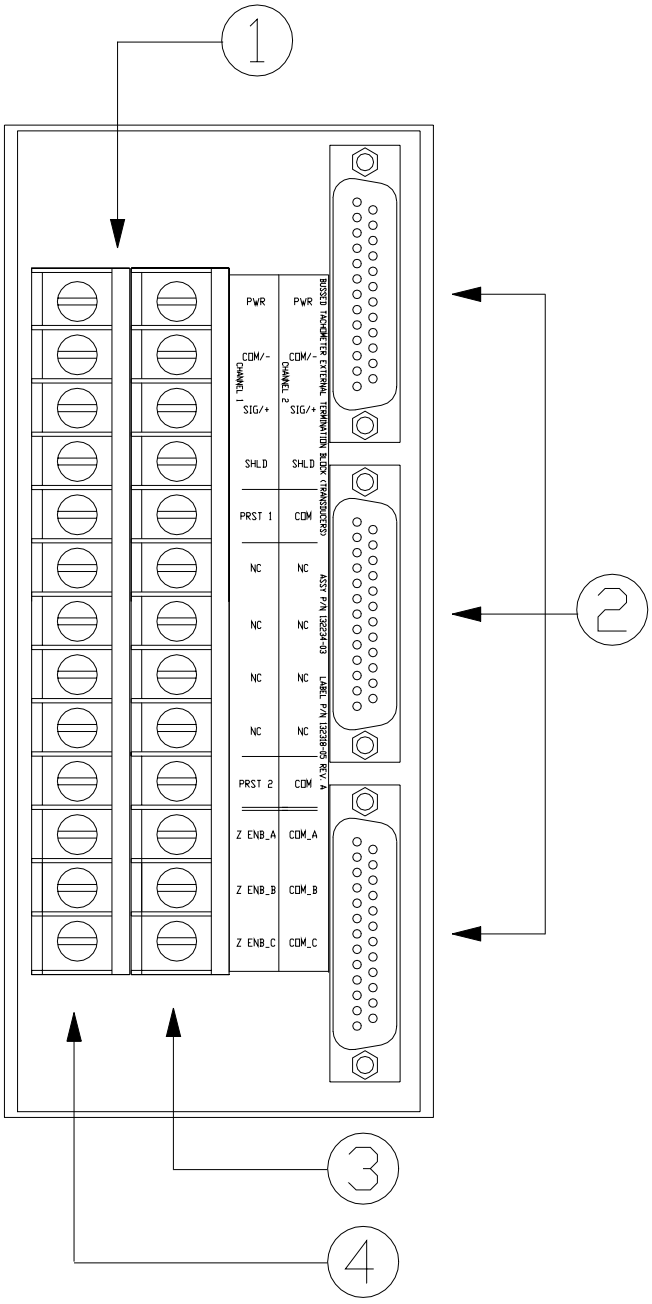
(Z ENB/COM: Connect to an external switch. Used to enable Reverse Rotation monitoring and to enable alarming for the zero speed and reverse speed.)

2) Connect the I/O module to the External Termination Block using cable 135101-XXXX-XX

3) Channel 2

4) Channel 1

4.5.3 Bussed Tachometer External Termination Block (Terminal Strip connectors)



1) Connect the wires from the transducers associated with Channels 1 and 2 to the External Termination Block.

(PRST1/COM & PRST2/COM: Connect to an external switch. Used to reset the following parameters:

- recorded peak speed
- number of reverse rotations (PRST1 only)
- peak reverse speed (PRST1 only).

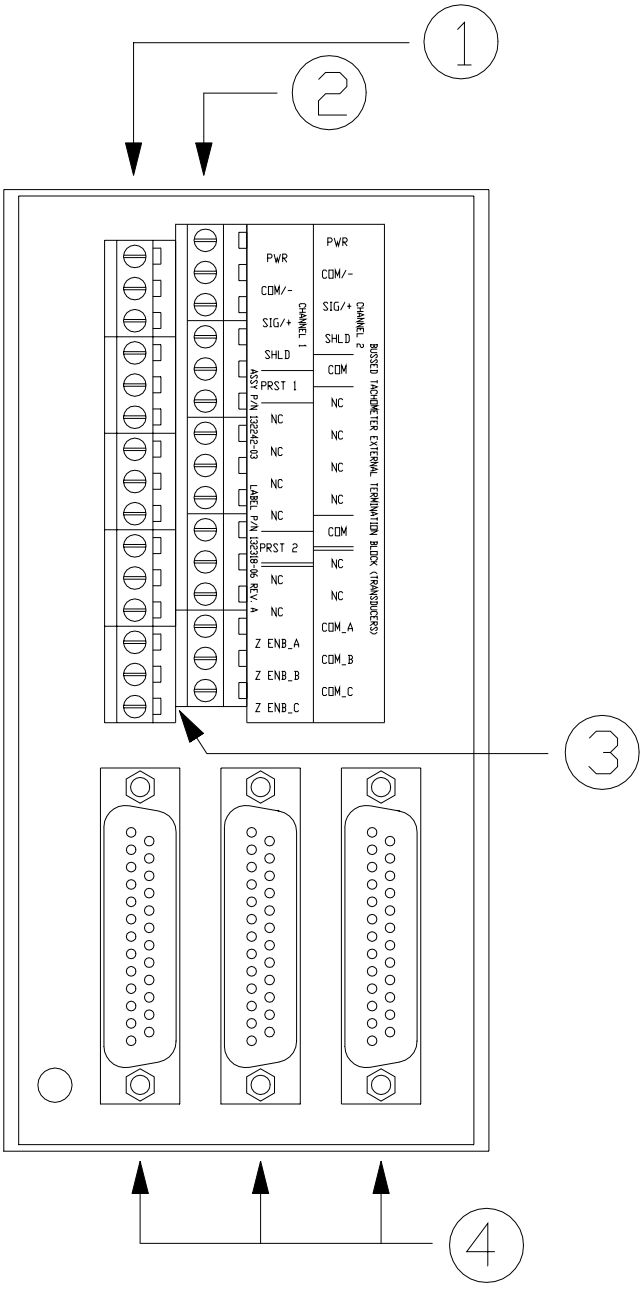
(Z ENB_A/COM_A, Z ENB_B/COM_B, and Z ENB_C/COM_C: Connect to a common switch or individual switches. Used to enable Reverse Rotation monitoring and to enable alarming for the zero speed and reverse speed.)

2) Connect the TMR I/O module to the External Termination Block using cable 135101-XXXX-XX

3) Channel 2

4) Channel 1

4.5.4 Bussed Tachometer External Termination Block (Euro Style connectors)



1) Channel 1

2) Channel 2

3) Connect the wires from the transducers associated with Channels 1 and 2 to the External Termination Block.

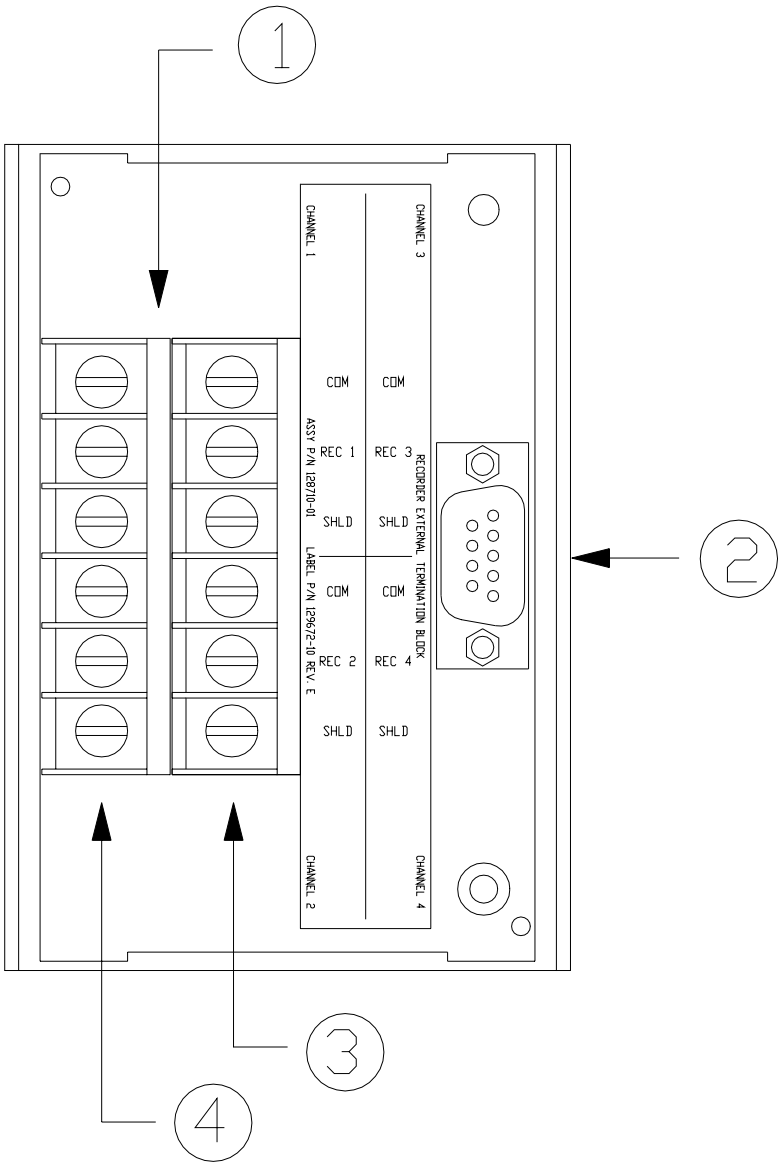
(PRST1/COM & PRST2/COM: Connect to an external switch. Used to reset the following parameters:

- recorded peak speed
- number of reverse rotations (PRST1 only)
- peak reverse speed (PRST1 only).

(Z ENB_A/COM_A, Z ENB_B/COM_B, and Z ENB_C/COM_C: Connect to a common switch or individual switches. Used to enable Reverse Rotation monitoring and to enable alarming for the zero speed and reverse speed.)

4) Connect the TMR I/O Module to the External Termination Block using cable 135101-XXXX-XX

4.5.5 Recorder External Termination Block (Terminal Strip connectors)



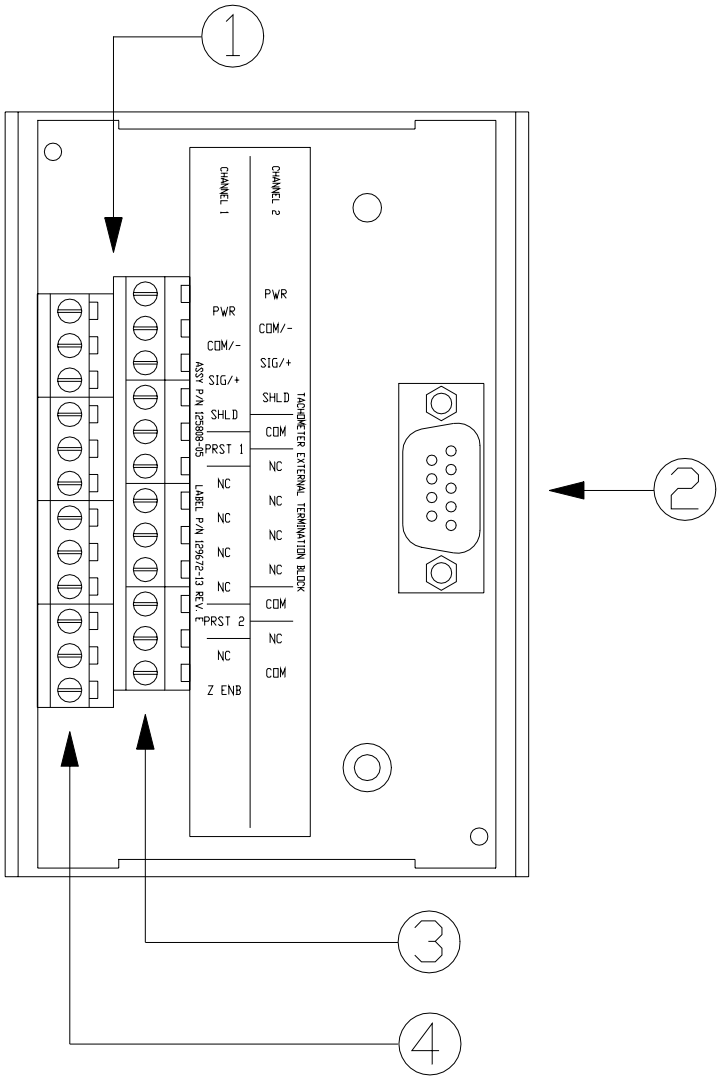
1) Connect the recorders associated with Channel 1 and 2 to the Recorder External Termination Block.

2) Connect the I/O module to the Recorder External Termination Block using cable 129529-XXXX-XX

3) Channel 3 and Channel 4 are not required for Tachometer.

4) Channel 1 and Channel 2

4.5.6 Recorder External Termination Block (Euro Style connectors)



1) Connect the recorders associated with Channel 1 and 2 to the Recorder External Termination Block.

2) Connect the I/O module to the Recorder External Termination Block using cable 129529-XXXX-XX

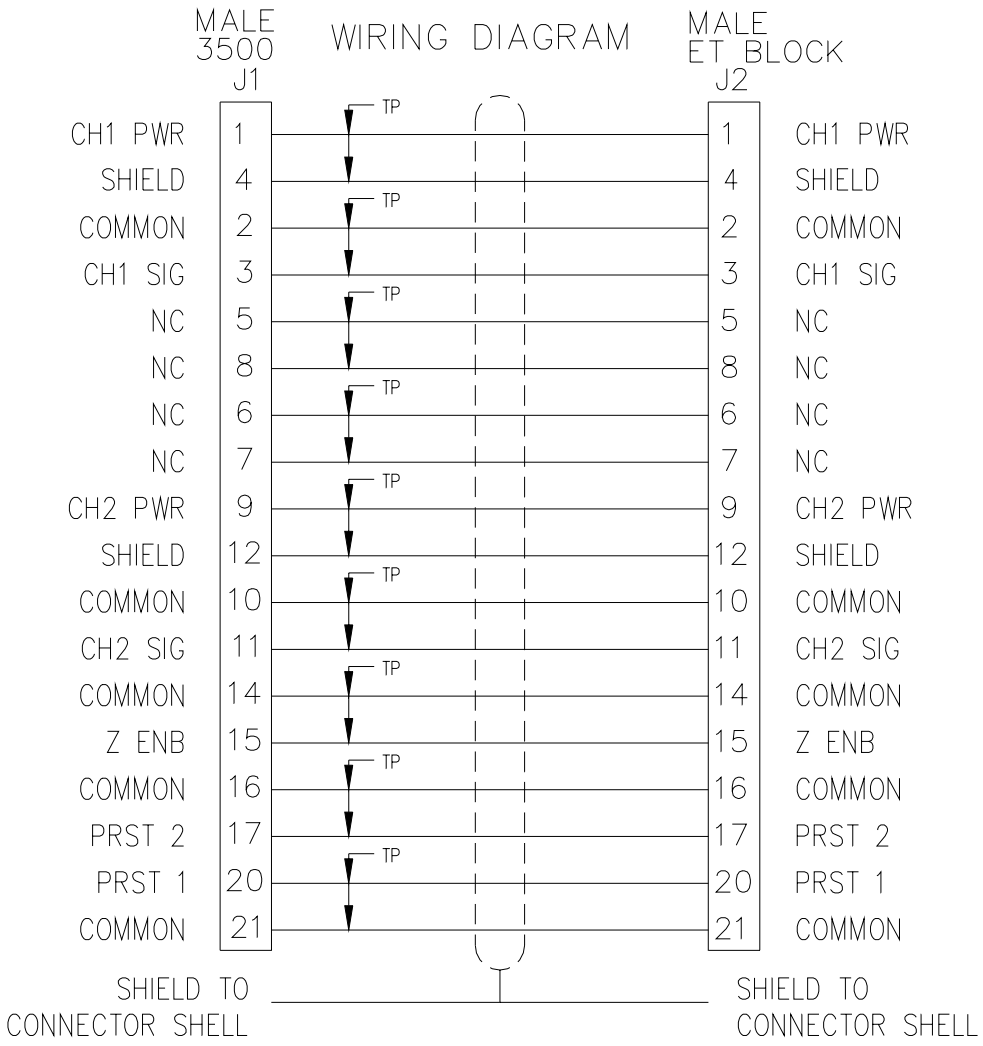
3) Channel 3 and Channel 4 are not required for Tachometer.

4) Channel 1 and Channel 2

4.5.7 Cable Pin Outs

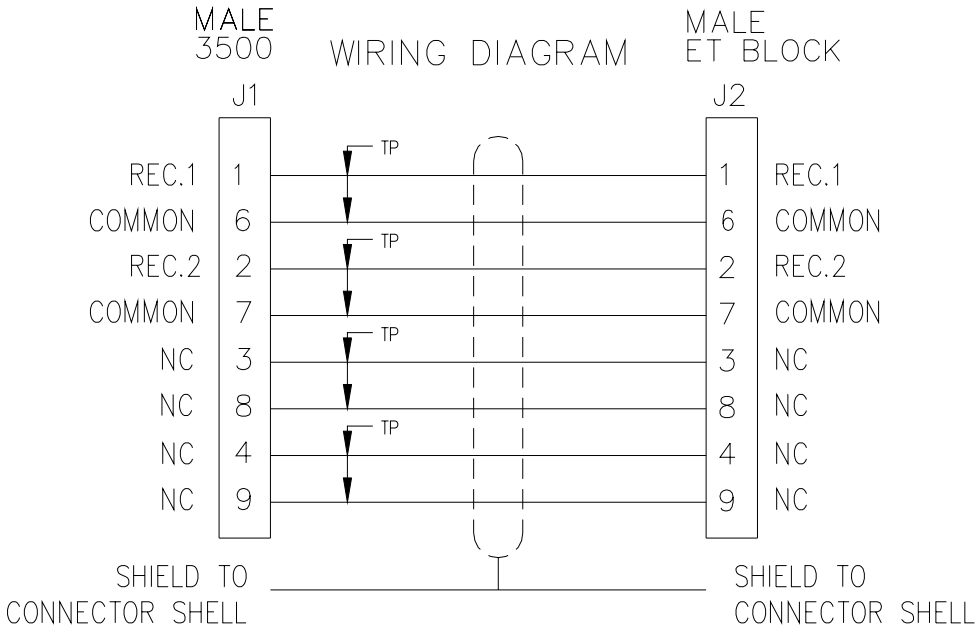
135101-XXXX-XX

3500 Transducer Signal to ET Block Cable



129529-XXXX-XX

3500 Recorder Output to ET Block Cable



5. Maintenance

The boards and components inside the 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.

This section shows how to verify the operation of channels in a Tachometer Monitor.

5.1 Verifying a 3500 Rack - Tachometer Monitor

The 3500 Monitoring System is a high precision instrument that requires no calibration. The functions of monitor channels, however, must be verified at regular intervals. At each maintenance interval, we recommend that you use the procedures in this section to verify the operation of all active channels in the monitor. It is only necessary to verify the alarms and accuracy of channel proportional values that are active.

5.1.1 Choosing a Maintenance Interval

Use the following approach to choose a maintenance interval:
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

At each interval, use the results of the previous verifications and ISO Procedure 10012-1 to adjust the interval.

5.1.2 Required Test Equipment

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

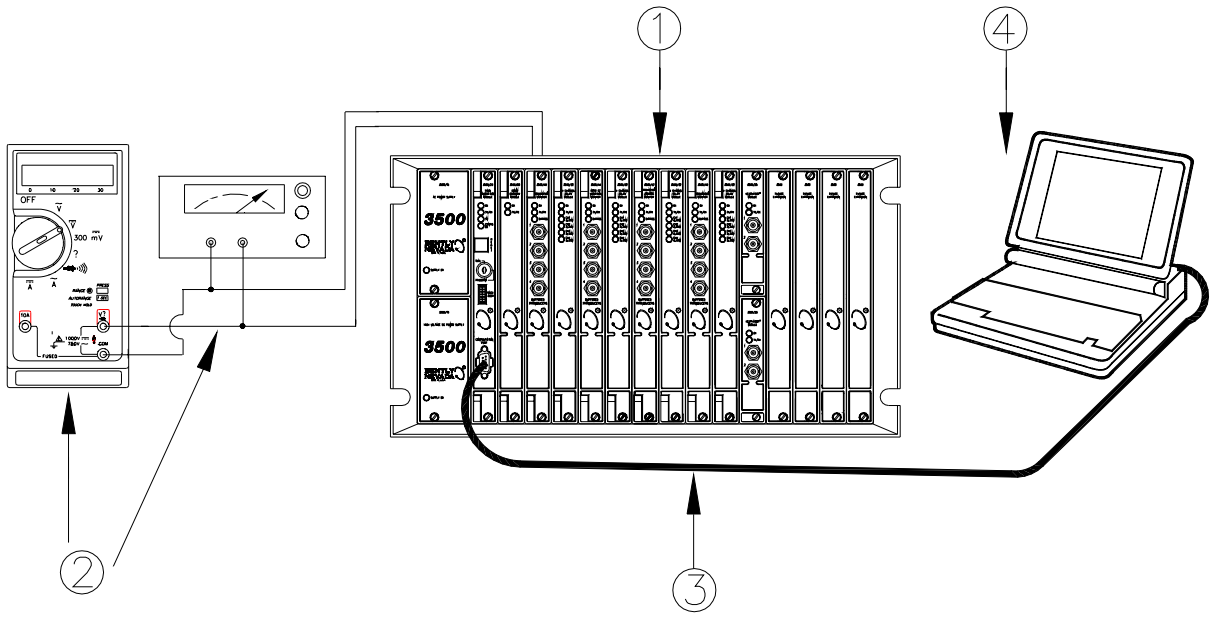
- Power Supply (single channel)
- Multimeter (4.5 digits)
- Function Generator (with Sync Output)

The Reverse Rotation channel type requires the following additional test equipment.

- Power Supply (dual channel or two power supplies)
- Function generator with adjustable phase (dual channel or two function generators)
- Oscilloscope (2 channel)

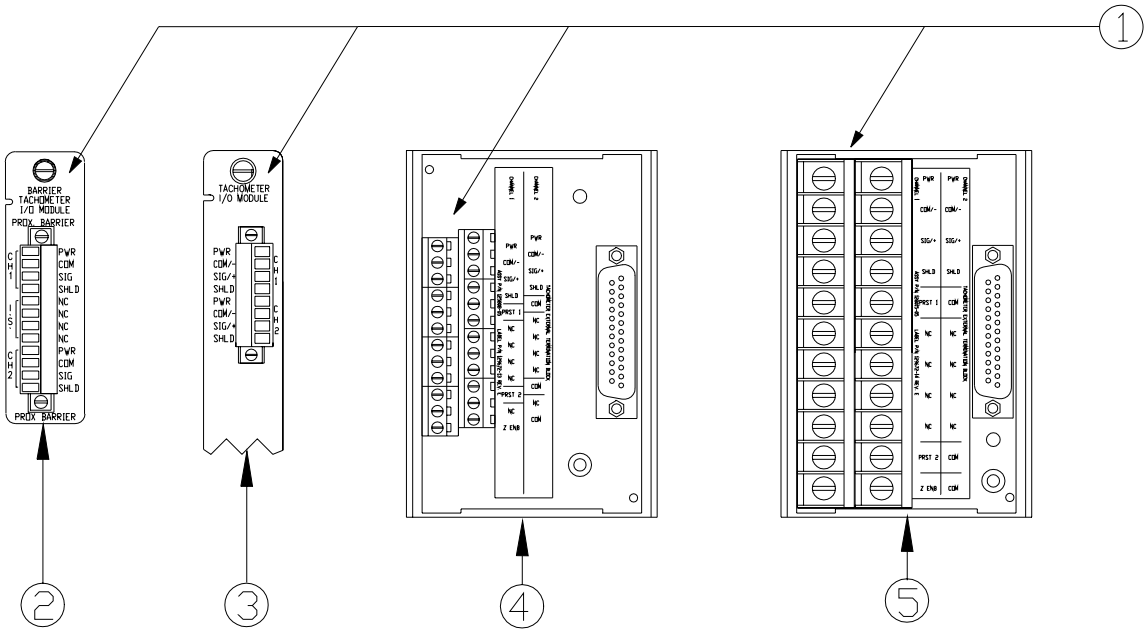
5.1.3 Typical Verification Test Setup

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



1) 3500 Rack
2) Test Equipment
3) RS-232 Communications
4) Laptop Computer

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) Tachometer Internal Barrier I/O Module (Internal Termination)
3) Tachometer I/O (Internal Termination)
4) External Termination Block (Euro Style Connectors)
5) External Termination Block (Terminal Strip Connectors)

5.1.4 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.

1) Upload, Download, and Save configuration files

2) Enable and disable channels and alarms

3) Bypass channels and alarms

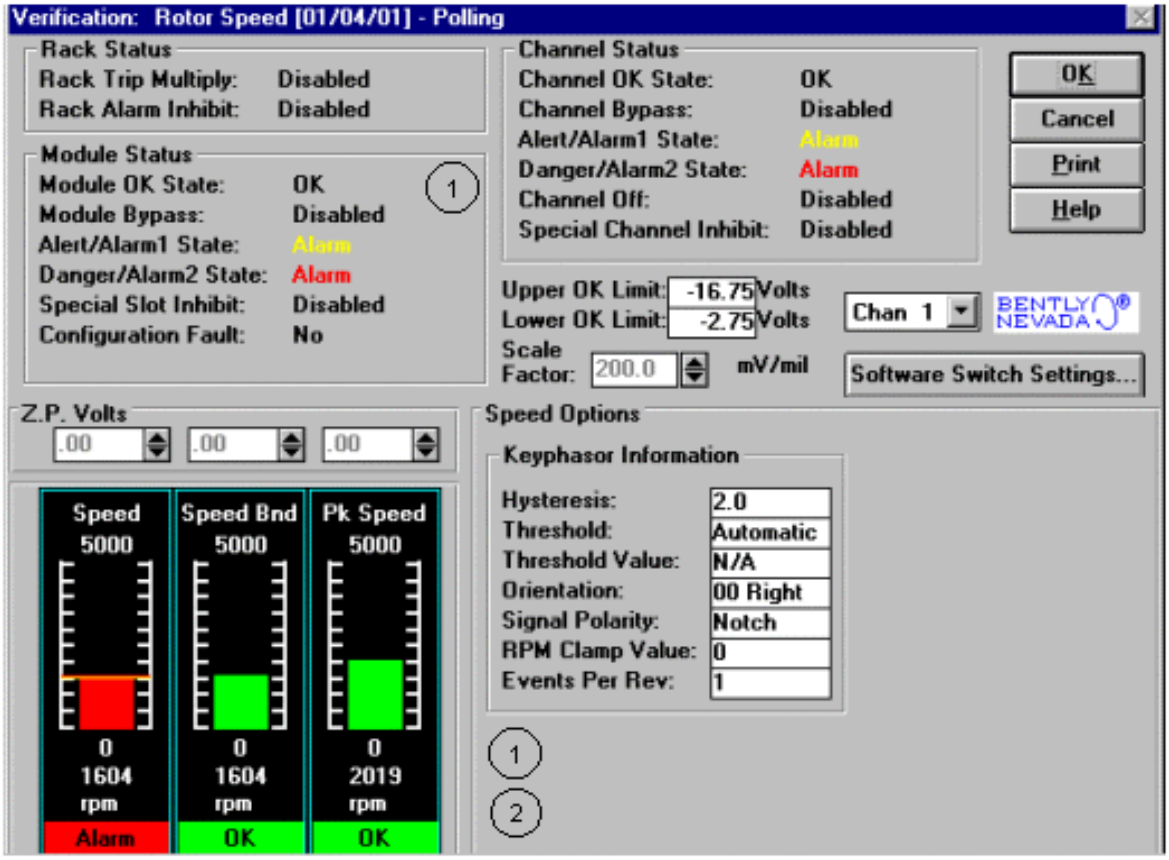
4) Display the Verification screen

The Rack Configuration and Utilities Guide (part number 129777-01) explain 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 some configuration settings, 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) Alarm Verification Fields:
These fields display output for verifying channel alarms. Alert/Alarm 1 alarms are displayed in yellow. Danger/Alarm 2 alarms are displayed in red.

2) Current Value Fields:
The current proportional values are displayed in this box. These fields are used for verifying channel output.

Alarm Setpoints are indicated on the bar graph as follows:

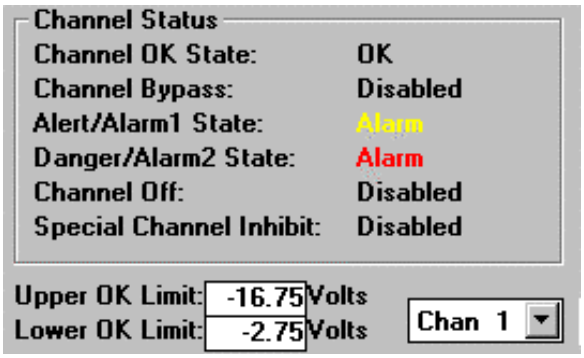
Danger/Alarm 2 Over - Solid Red Line

Alert/Alarm 1 Over - Solid Yellow Line

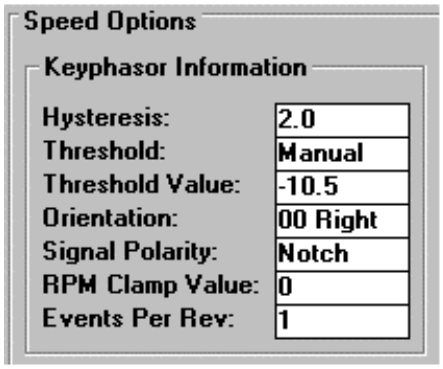
Alert/Alarm 1 Under - Dashed Yellow Line

Danger/Alarm 2 Under - Dashed Red Line

The Alarm Setpoint value can be determined by selecting the line for the setpoint with the mouse cursor. 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.



OK Limit Verification Fields:
These fields display output for verifying OK Limits.



Keyphasor Information Fields:
These fields display information used in the verification procedure.

5.1.5 Tachometer Channels

The following sections describe how to verify threshold, test alarms, verify rpm values, verify OK status, and test OK limits for channels configured as Rotor Speed, Rotor Acceleration, Reverse Rotation, or Zero Speed. The output values and alarm setpoints are verified by varying the speed input signal frequency and DC voltage and observing that the correct results are reported in the Verification screen on the test computer.

5.1.5.1 Test Equipment and Software Setup - Tachometer

The following test equipment and software setup can be used as the initial set up needed for all the verification procedures (verify threshold, test alarms, verify rpm values, verify OK status, and test OK limits).

CAUTION
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.

Test Equipment Setup - Tachometer

Simulate the transducer signal by connecting the power supply, function generator, and multimeter to the Tachometer I/O Module as shown in the figure on page 54 (Tachometer Test Setup). Set the test equipment as specified below.

Equipment	Setting
Power Supply	-10.00 Vdc
Function Generator	Waveform: sinewave DC Volts: 0 Vdc Frequency: 100 Hz Amplitude level: 8 Vpp

For the Reverse Rotation channel type, both channels of the function generator should be configured as described above. Note: for a 100 Hz frequency either set the events per revolution (EPR) to a value greater than one (1), set the speed range to 0 – 10,000,

or use a frequency less than 80Hz. Additionally, adjust the phase difference to about 60 degrees between the two channels.

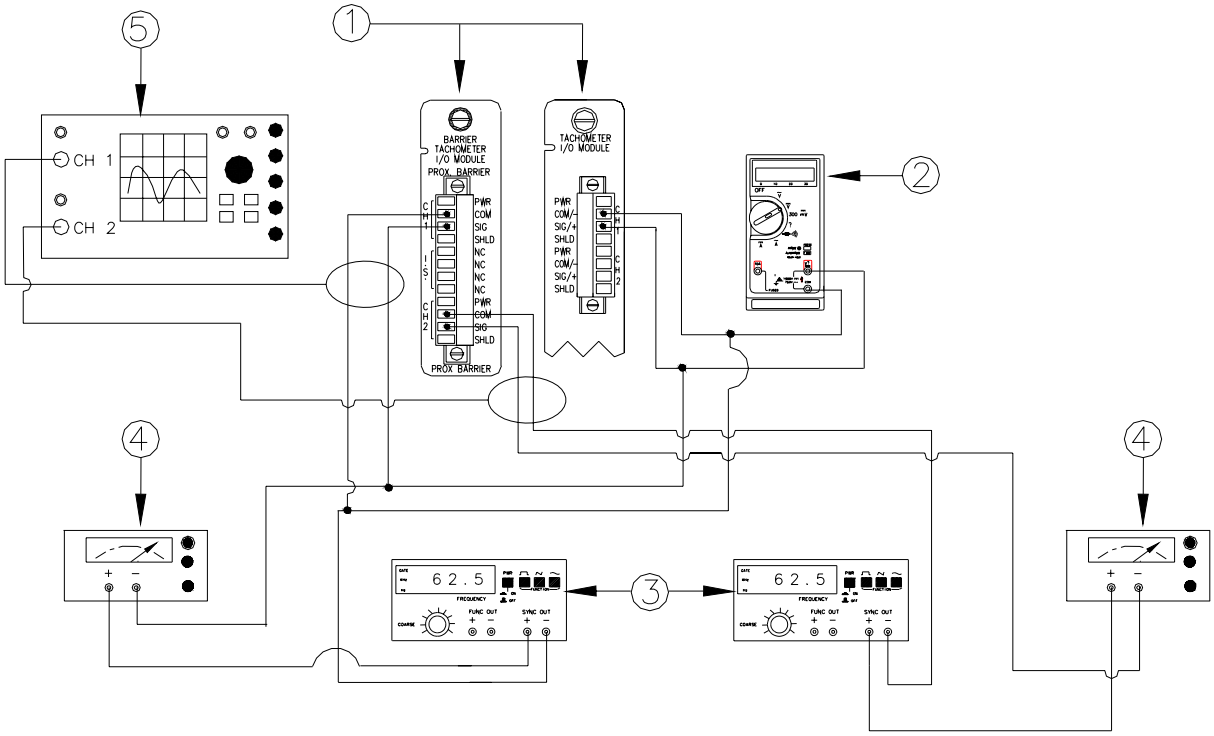


Figure 5-1. Tachometer Test Setup

1) Tachometer I/O Module OR Tachometer Internal Barrier I/O Module
2) Multimeter
3) Function Generator
4) Power Supply
5) Oscilloscope

The Test Equipment outputs should be floating relative to earth ground. For external termination I/O modules, the test setup is identical except that the test equipment outputs connect to the external termination blocks.

Verification Screen Setup - Tachometer

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.

The following table directs you to the starting page of each maintenance section associated with the Tachometer Channels.

5.1.5.2 Verify Threshold

The Threshold value is the voltage level of the transducer signal where triggering occurs. This value can be set automatically or manually. Use the following procedure to verify that the Tachometer Threshold is working correctly.

1) Disconnect PWR, COM/-, and SIG/+ wiring from the channel 1 terminals on the Tachometer I/O Module.

2) Connect test equipment and run software as described in Section 5.1.5.1 (Test Equipment and Software Setup - Tachometer).

3) Observe the Keyphasor Information Field on the Tachometer Verification Screen:

If the channel is configured for Auto Threshold:

Verify that the Channel OK State Line reads **OK**

Verify that the Current Value Fields display an rpm value.

If the channel is configured for Manual Threshold:

Adjust the Power Supply voltage to equal the displayed Threshold value voltage level

Verify that the Channel OK State line reads **OK**

Verify that the Current Value Fields display an rpm value.

4) If the Tachometer channel will not produce an rpm reading, double check the input signal to ensure it is correct. If the module still does not meet specifications or fails any other part of this test, go to Section 5.1.7 (If a Channel Fails a Verification Test).

5) Repeat steps 1 through 4 for all configured channels.

5.1.5.3 Test Alarms - Tachometer

The general approach for testing alarm setpoints is to simulate the Tachometer input 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 under Alert/Alarm 1 and Danger/Alarm 2 setpoints,

to produce a non-alarm condition.

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

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

Channel Values	Alarms	
	Over	Under
Rotor Speed	✓	✓
Speed Band	✓	✓
Rotor Acceleration	✓	✓
Zero Speed		✓
GAP		
Reverse Peak Speed	✓	
# Reverse Rotations	✓	
Reverse Speed *	✓	✓

* Note: Reverse speed has fixed over alarm setpoint at zero (0) RPM.

Rotor Speed / Speed (for Reverse Rotation)

1) Disconnect PWR, COM/-, and SIG/+ field wiring from the channel terminals on the Tachometer I/O Module.

2) Connect test equipment and run software as described in Section 5.1.5.1 (Test Equipment and Software Setup - Tachometer).

3) Adjust the function generator frequency to provide an rpm level that is below the Rotor Speed Over setpoints and above the Rotor Speed Under setpoints.

4) Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Speed is green, and the Current Value Field has no alarm indication.

5) Adjust the function generator frequency such that the rpm level just exceeds the Speed 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 Speed 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 Speed remains yellow and that the Current Value Field still indicates an alarm.

7) Adjust the function generator frequency such that the rpm level just exceeds the Speed 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 Speed 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 Speed remains red and that the Current Value Field indicates an alarm.

9) Adjust the function generator frequency such that the rpm level reads below the Over Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Speed changes color to green and that the Current Value Field 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 frequency to drop below 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 Section 5.1.7 (If a Channel Fails a Verification Test).

12) Disconnect the test equipment and reconnect the PWR , COM/-, and SIG/+ field wiring to the channel terminals on the Tachometer I/O Module. Verify that the OK LED comes on. 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.

Speed Band

1) Disconnect PWR, COM/-, and SIG/+ field wiring from the channel terminals on the Tachometer I/O Module.

2) Connect test equipment and run software as described in Section 5.1.5.1 (Test Equipment and Software Setup - Tachometer).

3) Adjust the function generator frequency to provide an rpm level that is outside the Speed Band Alarm rpm range.

4) Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED on the Tachometer is on, the bar graph indicator for Speed Band is green, and the Current Value Field has no alarm indication.

5) Adjust the function generator frequency such that the rpm level enters the Speed Band Alarm range. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Speed 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 Speed Band remains yellow and that the Current Value Field still indicates an alarm.

7) Adjust the function generator frequency such that the signal enters the Speed Band Danger/Alarm 2 rpm range. Wait for 2 or 3 seconds after the alarm time delay expires and verify that the bar graph indicator for Speed Band 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 Speed Band remains red and that the Current Value Field indicates an alarm.

9) Adjust the function generator frequency such that the rpm level reads outside the Speed Band Alarm rpm range. If the nonlatching option is configured, observe that the bar graph indicator for Speed Band changes color to green and that the Current Value Field 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 Section 5.1.7 (If a Channel Fails a Verification Test).

11) Disconnect the test equipment and reconnect the PWR , COM/-, and SIG/+ field wiring to the channel terminals on the Tachometer I/O Module. Verify that the OK LED comes on. 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.

Rotor Acceleration

1) Disconnect PWR, COM/-, and SIG/+ field wiring from the channel terminals on the Tachometer I/O Module.

2) Connect test equipment and run software as described in Section 5.1.5.1 (Test Equipment and Software Setup - Tachometer).

3) Adjust the function generator frequency to provide an rpm level that is below the Rotor Speed Over Setpoint and above the Rotor Speed Under Setpoint. Leave the function generator at this frequency long enough for the Acceleration to settle back to zero rpm/min.

4) Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED on the Tachometer is on, the bar graph indicator for Acceleration is green, and the Current Value Field has no alarm indication.

5) Adjust the function generator frequency such that the rpm/min reading just exceeds the Acceleration 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 Acceleration changes color from green to yellow and that the Current Value Field indicates an alarm. Note - Rotor Acceleration (rpm/min) is the rate of change of Rotor Speed (rpm). Therefore, the acceleration increases as the function generator frequency is increased. The Rotor Acceleration returns to zero if the function generator frequency remains constant.

6) Adjust the function generator frequency such that the rpm/min reading just exceeds the Acceleration 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 Acceleration changes color from yellow to red and that the Current Value Field indicates an alarm.

7) Adjust the function generator frequency such that the rpm level reads below the Over Alarm setpoint levels. Leave the frequency generator at

this frequency long enough for the acceleration to settle back to zero rpm/min. If the nonlatching option is configured, observe that the bar graph indicator for Acceleration changes color to green and that the Current Value Field contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.

8) Repeat steps 3 through 7 to test the Acceleration Under Alert/Alarm 1 and Under Danger/Alarm 2 setpoints by adjusting the function generator frequency to provide an rpm/min reading below the Under Alarm setpoint levels.

9) 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 Section 5.1.7 (If a Channel Fails a Verification Test).

10) Disconnect the test equipment and reconnect the PWR , COM/-, and SIG/+ field wiring to the channel terminals on the Tachometer I/O Module. Verify that the OK LED comes on. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.

11) Repeat steps 1 through 10 for all configured channels.

Zero Speed

1) Disconnect PWR, COM/-, and SIG/+ field wiring from the channel terminals on the Tachometer I/O Module.

2) Connect test equipment and run software as described in Section 5.1.5.1 (Test Equipment and Software Setup - Tachometer). The test equipment must be connected to both channel inputs on the Tachometer I/O module for testing Zero Speed. The Verification screen will show only channel 1.

3) Adjust the function generator frequency to provide an rpm level that is below the Rotor Speed Over Setpoint and above the Rotor Speed Under Setpoint and above the Zero Speed Under setpoint.

4) Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Zero Speed is green, and the Current Value Field has no alarm indication.

5) Enable Zero Speed Alarming by shorting the Zero Speed Enable contacts on the Tachometer I/O Module or enabling the Zero Speed Enable software switch.

6) Slowly adjust the function generator frequency such that the rpm level drops just below the Zero Speed Under 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 Zero Speed 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 Zero Speed remains yellow and that the Current Value Field still indicates an alarm.

8) Slowly adjust the function generator frequency such that the rpm level just drops below the Zero Speed Under 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 Zero Speed 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 Zero Speed remains red and that the Current Value Field indicates an alarm.

10) Adjust the function generator frequency such that the rpm level reads above the Zero Speed Under Alarm setpoint levels. If the nonlatching option is configured, observe that the bar graph indicator for Zero Speed changes color to green and that the Current Value Field contains no indication of alarms. Press the RESET switch on the Rack Interface Module (RIM) to reset latching alarms.

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 Section 5.1.7 (If a Channel Fails a Verification Test).

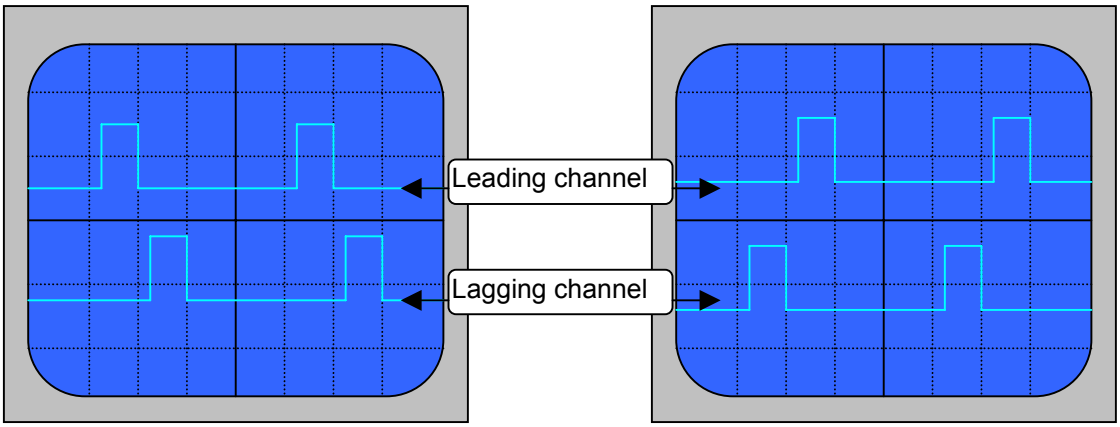
12) Disconnect the test equipment and reconnect the PWR , COM/-, and SIG/+ field wiring to the channel terminals on the Tachometer I/O Module. Verify that the OK LED comes on. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.

Reverse Peak Speed

1) Disconnect PWR, COM/-, and SIG/+ field wiring from the channel terminals on the Tachometer I/O Module.

2) Connect test equipment and run software as described in Section 5.1.5.1 (*Test Equipment and Software Setup - Tachometer*). Each of the channels of the function generator should be connected to each of the channels of the tachometer. The tachometer requires inputs on both the channels

3) Adjust the function generator frequency to provide a speed level that is well below the configured setpoint. Adjust the relative phase between the channels such that the leading channel leads by 90 degrees (verify this using the oscilloscope).



Leading channel leads by 90 degrees

Leading channel lags by 90 degrees

4) Close the PRST1 contact momentarily (or use the Peak Hold Reset software switch), Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED is on, the bar graph indicator for Reverse Peak Speed and Number of Reverse Rotations is green, the Current Value Field has a value of zero (0), and there is no alarm indication.
5) Enable Reverse Rotation Alarming by completing the contact for the Zero Speed Enable contacts on the Tachometer I/O Module or by enabling the Zero Speed Enable software switch.
6) Now adjust the phase such that the leading channel lags by about 90 degrees (verify this by using the oscilloscope).
7) Increasing the speed until the speed crosses the alert level (note that both channels should be in sync), once the speed crosses the alert level; verify that the bar graph becomes yellow and that the Current Value Field indicates an alarm.
8) Lower the speed such that it is well below the alert setpoint, verify that the Reverse Peak Speed maintains its value, the bar graph is shown in yellow, and the Current Value Field indicates an alarm.
9) Momentarily close the PRST1 contact (or use the Peak Hold Reset software switch) to reset the Reverse Peak speed value. Verify that when the setpoint is non-latching that the bar graph is drawn in green. If the setpoint is latching, press the RESET switch on the RIM, verify that the bar graph color returns to green and that the Current Value Field does not indicate an alarm.
10) Repeat steps 7 to 9 for the danger setpoint. When the value crosses the danger setpoint, the bar graph should be shown in red.
11) If you cannot verify any configured alarms, verify that the setpoints are configured correctly. If the monitor still does not alarm properly or fails any other part of this test, go to Section 5.1.7 (*If a Channel Fails a Verification Test*).
12) Disconnect the test equipment and reconnect the PWR, COM/-, and SIG/+ field wiring to the channel terminals on the Tachometer I/O Module. Verify that the OK LED comes on. Press the RESET switch on the RIM to reset the OK LED.

Number of Reverse Rotations

Before starting this test, repeat steps 1 through 6 from the previous test (*Reverse Peak Speed* test) then continue with step 1 below. The systems should be in reverse rotation at this point.

1) Verify that the value shown for the Number of Reverse Rotations continuously changes corresponding to the increase or decrease of the input speed.
2) Wait until the Number of Reverse Rotations value crosses the alert setpoint; verify that the bar graph is shown in yellow and the current values indicates an alarm.

3) Adjust the speed to a very low value (in reverse rotation) below the alert setpoint.

4) Momentarily close the PRST1 contact and verify that the Number of Reverse Rotations value resets, counting from zero. Verify that the bar graph is drawn in green (if the alarms were latching press the RESET switch on the RIM) and that the current values do not show any indications of alarm.

5) Repeat steps 2 through 4 for the danger setpoint. When the value crosses the danger setpoint the bar graph will be drawn in red.

6) If you cannot verify any configured alarm level, recheck the setpoints configuration. If the monitor still does not alarm properly or fails any other part of this test, go to Section 5.1.7 (*If a Channel Fails a Verification Test*).

7) Disconnect the test equipment and reconnect the PWR, COM/-, and SIG/+ field wiring to the channel terminals on the Tachometer I/O Module. Verify that the OK LED comes on. Press the RESET switch on the RIM to reset the OK LED.

Reverse Speed

Before starting this test, repeat steps 1 through 5 from the previous test (*Reverse Peak Speed* test) then continue with step 1 below.

1) Verify that the Reverse Speed bar graph is drawn in green and current value does not indicate an alarm.

2) Now adjust the phase such that the leading channel lags by about 90 degrees (verify this using the oscilloscope).

3) Verify that the Reverse Speed bar graph is drawn in red and the current value indicates an alarm.

4) Adjust the phase such that the leading channel leads by about 90 degrees.

5) If the alarms are latching press the RESET switch on the RIM.

6) Verify that the bar graph is drawn in green and the current values do not indicate an alarm.

7) Now adjust the phase such that the leading channel lags by about 90 degrees, increase the speed such that it exceeds the alert setpoint, verify that the bar graph is drawn in RED and the channel status is shown as alert (the danger status will also be shown).

8) Now reduce the speed so that it is below the alert setpoint (it should be below the alert setpoint minus the hysteresis)

9) If the alarms are latching, press the RESET switch on the RIM.

10) Verify that the bar graph is drawn in red and the alert alarm indication is no longer shown in the channel status.

11) If you cannot verify any configured alarm, recheck the setpoint configuration. If the monitor still does not alarm properly or fails any other

part of this test, go to Section 5.1.7 (*If a Channel Fails a Verification Test*).

12) Disconnect the test equipment and reconnect the PWR, COM/-, and SIG/+ field wiring to the channel terminals on the Tachometer I/O Module. Verify that the OK LED comes on. Press the RESET switch on the RIM to reset the OK LED.

5.1.5.4 Verify Channel Values - Tachometer

The general approach for testing these parameters is to simulate the Tachometer speed input 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

Before using this procedure, check that the Threshold is set correctly and the channel is OK.

Rotor Speed / Speed (for Reverse Rotation)

1) Disconnect PWR, COM/-, and SIG/+ field wiring from the channel terminals on the Tachometer I/O Module.

2) Connect test equipment and run software as described in Section 5.1.5.1 (Test Equipment and Software Setup - Tachometer).

3) Adjust the function generator frequency to 100 Hz. Observe the Keyphasor Information field on the Tachometer Verification screen to determine the configured number of Events Per Revolution. Use the following equation to determine what the displayed rpm value should be:

   Displayed Tachometer rpm = (Frequency (Hz) x 60) / Events Per Revolution

   Example:

   Frequency = 100 Hz; Events Per Revolution = 10

   Displayed Tachometer rpm = (100 x 60) / Events Per Revolution

   = 6000 / 10 = 600 rpm

4) Verify that the Speed bar graph display and Current Value fields are reading within the specified tolerance. If the recorder output is configured, refer to Section 5.1.6 (Verify Recorder Outputs) for steps to verify the recorder output.

RPM Range	Accuracy
Less than 100 rpm	±0.1 rpm
100 to 10,000 rpm	±1 rpm
10,000 to 99,999 rpm	±0.01 % of current 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 Section 5.1.7 (If a Channel Fails a Verification Test).

6) Disconnect the test equipment and reconnect the PWR , COM/-, and SIG/+ field wiring to the channel terminals on the Tachometer I/O Module. Verify that the OK LED comes on. 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.

Note

Before using this procedure, check that the Threshold is set correctly and that the channel is OK.

Rotor Acceleration

1) Disconnect PWR, COM/-, and SIG/+ field wiring from the channel terminals on the Tachometer I/O Module.

2) Connect test equipment and run software as described in Section 5.1.5.1 (Test Equipment and Software Setup - Tachometer).

3) Adjust the function generator to provide a constant acceleration of 100 rpm/min.

4) Verify that the Speed bar graph display and Current Value fields are reading within the specified tolerance. If the recorder output is configured, refer to Section 5.1.6 (Verify Recorder Outputs) for steps to verify the recorder output.

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 Section 5.1.7 (If a Channel Fails a Verification Test).

6) Disconnect the test equipment and reconnect the PWR , COM/-, and SIG/+ field wiring to the channel terminals on the Tachometer I/O Module. Verify that the OK LED comes on. 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.

Reverse Speed

The verification procedure is identical to the Speed verification procedure give in section 5.1.5.3 for *Reverse Speed,* except that both channels of the function generator are connected to the tachometer and the leading channel lags by 90 degrees.

Peak Reverse Speed

1) Disconnect PWR, COM/-, and SIG/+ field wiring from the channel terminals on the Tachometer I/O Module.

2) Connect test equipment and run software as described in Section 5.1.5.1. Ensure that both channels of the function generator are connected to the each of the tachometer channels.
3) Reset the Peak Speed value by momentarily closing the PRST1 contact.
4) Adjust the function generator such that the leading channel lags by about 90 degrees.
5) Slowly increase the frequency on the function generator (both channels should have the same frequency at any given time) and verify that the Peak Speed matches the Reverse Speed.
6) Now slowly decrease the frequency, verify that Peak Speed maintains the highest value that it had displayed.
7) Reset the Peak Speed value by momentarily closing the PRST1 contact.
8) Verify the Peak Speed value is same as the Reverse Speed value and that it matches the input frequency.
9) 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 Section 5.1.7 (*If a Channel Fails a Verification Test*).
10) Disconnect the test equipment and reconnect the PWR, COM/-, and SIG/+ field wiring to the channel terminals on the Tachometer I/O Module. Verify that the OK LED comes on. Press the RESET switch on the RIM to reset the OK LED.

Number of Reverse Rotations

1) Disconnect PWR, COM/-, and SIG/+ field wiring from the channel terminals on the Tachometer I/O Module.
2) Connect test equipment and run software as described in Section 5.1.5.1. Ensure that both channels of the function generator are connected to the each of the tachometer channels
3) Adjust the function generator such that the leading channel lags by about 90 degrees.
4) Adjust the frequency on the function generator (both channels should have the same frequency at any given time) such that the speed is 30 RPM or less.
5) Verify that the Num Rev PPL value is increasing one value at a time (e.g. 1, 2, 3, 4…).
6) Reset the Num Rev PPL value by momentarily closing the PRST1 contact. Start a timer at the time PRST1 is closed.
7) Wait for ‘n’ minutes, and note the value of Number of Reverse Rotations exactly at the ‘n’th minute from the time PRST1 was closed.
8) Verify that the value of the Number of Reverse Rotations is equal to ‘n’ * RPM.

9) 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 Section 5.1.7 (*If a Channel Fails a Verification Test*).

10) Disconnect the test equipment and reconnect the PWR, COM/-, and SIG/+ field wiring to the channel terminals on the Tachometer I/O Module. Verify that the OK LED comes on. Press the RESET switch on the RIM to reset the OK LED.

5.1.5.5 Verify OK Status - Tachometer

The general approach for testing this parameter is to cause a not OK condition and observe that the correct results are reported in the Verification screen on the test computer.

1) Disconnect the wire from the test equipment to the SIG/+ input of the Tachometer I/O module. The OK LED on the Tachometer Module should go off. With low RPMs and one event per revolution, it may take up to several minutes for the OK LED and the software to indicate a not OK condition.

2) 2) Observe the Tachometer Verification screen:

   Verify that the Channel OK State line reads **not OK**

   Verify that the Tachometer Current Value field reads **Invalid**

3) 3) If the above results do not occur, verify that there is not an input signal to the monitor. If the monitor still does not meet specifications or fails any other part of this test, go to Section 5.1.7 (If a Channel Fails a Verification Test).

4) 4) Disconnect the test equipment and reconnect the PWR , COM/-, and SIG/+ field wiring to the channel terminals on the Tachometer I/O Module. Verify that the OK LED comes on. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.

5) 5) Repeat steps 1 through 4 for all configured channels.

5.1.5.6 Test OK Limits - Tachometer

Note

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 voltage 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/-, and SIG/+ field wiring from the channel terminals on the Tachometer I/O Module.

2) Connect test equipment and run software as described in Section 5.1.5.1 (Test Equipment and Software Setup - Tachometer).

3) Bypass all other configured channels.

4) Adjust the power supply voltage to -10.00 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 3500/20 Rack Interface Module Operation and Maintenance Manual, part number 129768-01 or 3500/22M TDI Operation and Maintenance Manual, part number 161580-01.

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 section 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. This check is valid only if the Upper OK Limit Voltage Check is enabled under **Customize** in the Tachometer **Options** screen of the configuration software.

8) Decrease the power supply voltage (less negative) to -10.00 Vdc.

9) Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on and that the OK relay energizes. Verify that the Channel OK State line in the Channel Status group 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 group 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. This check is valid only if the Lower OK Limit Voltage Check is enabled under **Customize** in the Tachometer **Options** screen of the configuration software.

11) Increase the power supply voltage (more negative) to -10.00 Vdc.

12) Press the RESET switch on the Rack Interface Module (RIM). Verify that the OK LED comes back on and that the OK Relay energizes. Verify that the Channel OK State line in the Channel Status group reads **OK**.

13) Disconnect the test equipment and reconnect the PWR, COM/-, and SIG/+ field wiring to the channel terminals on the Tachometer I/O Module. Verify that the OK LED comes on. Press the RESET switch on the Rack Interface Module (RIM) to reset the OK LED.

14) If you cannot verify any configured OK limit, go to Section 5.1.7 (If a Channel Fails a Verification Test).

15) Repeat steps 1 through 14 for all configured channels.

16) Return the bypass switch for all configured channels back to their original setting.

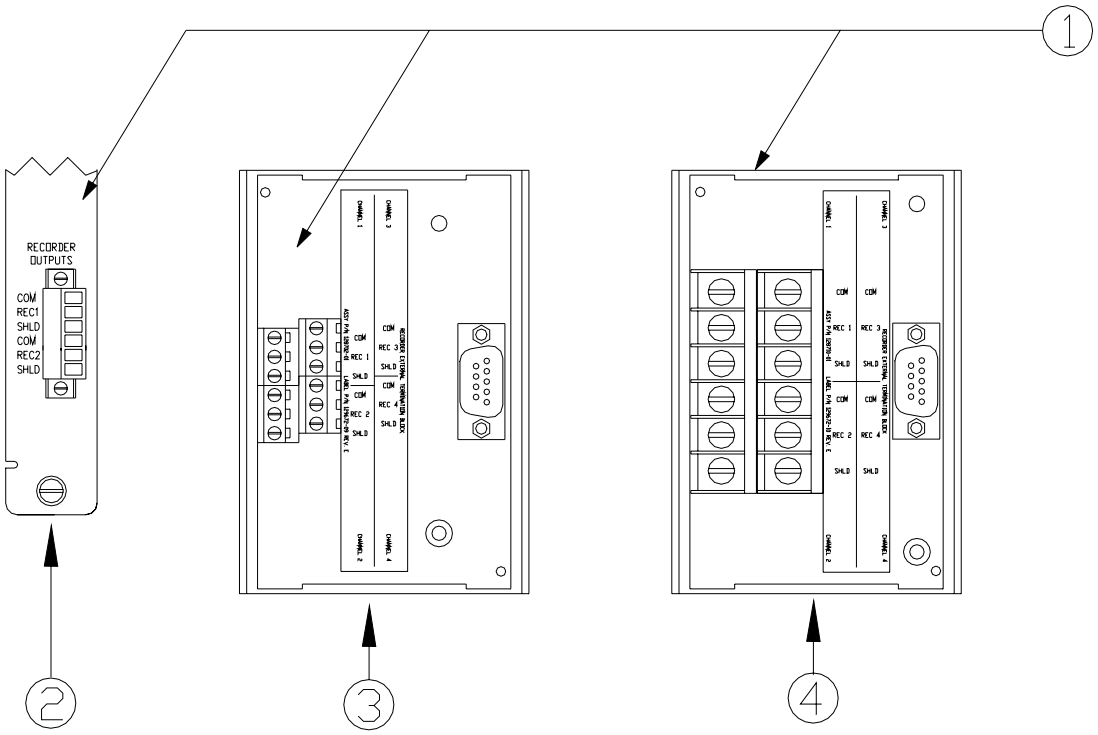
Tachometer Default OK Limits

Transducer	Upper OK Limit		Lower OK Limit		Center Gap Voltage	
	Without Barriers	With Barriers	Without Barriers	With Barriers	Without Barriers	With Barriers
3300 5 mm	-16.80 V	-16.80 V	-2.70 V	-2.70 V	-9.75 V	-9.75 V
3300 8 mm	-16.80 V	-16.80 V	-2.70 V	-2.70 V	-9.75 V	-9.75 V
3300 8mm XL						
7200 5 mm	-16.80 V	-16.80 V	-2.70 V	-2.70 V	-9.75 V	-9.75 V
7200 8 mm	-16.80 V	-16.80 V	-2.70 V	-2.70 V	-9.75 V	-9.75 V
7200 11 mm	-19.70 V	N/A	-3.50 V	N/A	-11.60 V	N/A
3300 11mm XL						
7200 14 mm	-16.80 V	N/A	-2.70 V	N/A	-9.75 V	N/A
3300 16 mm HTPS	-16.80 V	N/A	-2.70 V	N/A	-9.75 V	N/A
3300 RAM	-12.60 V	-12.60 V	-2.40 V	-2.40 V	-7.50 V	-7.50 V
3300 NSV		-12.20 V *				-7.30 V *
Magnetic Pickup	N/A	N/A	N/A	N/A	N/A	N/A

Note: Assume ±50 mV accuracy for check tolerance.
* Bently Nevada Internal Barrier I/O Modules

5.1.6 Verify Recorder Outputs

Use the following test equipment and procedure to verify the recorder outputs. Recorder outputs for the 3500/50 Tachometer Monitor are 4 to 20 mA.



1) Connect Test Equipment here.
2) Tachometer I/O Module OR Tachometer Internal Barrier I/O Module (Internal Termination)

3) Recorder External Termination Block (Euro Style Connectors)
4) Recorder External Termination Block (Terminal Strip Connectors)

1) Disconnect the COM and REC field wiring from the recorder output terminals on the Tachometer I/O Module.

2) Connect test equipment and run software as described in Section 5.1.5.1 (Test Equipment and Software Setup - Tachometer).

3) Connect a multimeter to the COM and REC outputs of the Tachometer I/O Module. The multimeter should have the capability to measure 4 to 20 mA.

4) Set the proportional value that the recorder is configured for to full-scale. Verify that the recorder output is reading 20 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) Remove input and verify that the recorder goes to the Clamp value.

7) If you cannot verify the recorder output, check the recorder configuration and connections. If the monitor recorder output still does not verify properly, go to Section 5.1.7 (If a Channel Fails a Verification Test).

8) Disconnect the multimeter, reconnect the COM and REC field wiring to the recorder output terminals on the Tachometer I/O Module.

9) Repeat steps 1 through 8 for all configured recorder channels.

5.1.7 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 module to Bently Nevada Corporation for repair.

4) Download the configuration for the spare module using the Rack Configuration Software.

5) Verify the operation of the spare.

5.2 Performing Firmware Upgrades

CAUTION

To prevent electrostatic damage to sensitive electronic components, use a grounding wrist strap such as that listed in the spares section of this manual.

Occasionally it may be necessary to replace the original firmware that is shipped with the 3500/50 Tachometer Module. The following instructions describe how to remove the existing firmware and replace it with upgrade firmware. The monitor will need to be reconfigured using the 3500 Rack Configuration software after having its firmware upgraded.

The following items will be required to perform a firmware upgrade to the monitor:

Large Flathead Screwdriver.

Grounding Wrist Strap.*

IC Removal Tool.*

Upgrade Firmware IC.*

*Refer to Section 7 (Ordering Information) for part numbers. Users may use their own grounding wrist strap or IC removal tool.

5.2.1 Installation Procedure

The following steps will need to be followed to complete the monitor firmware upgrade:

Ensure that the monitor's configuration is saved using the 3500 Rack Configuration software.

Refer to Section 1.2 (Handling and Storing Considerations) before handling the monitor or the upgrade firmware IC.

Remove the monitor from the 3500 rack.

Remove the Top Shield from the monitor.

Remove the original firmware IC from the monitor PWA.

Install the upgrade firmware IC into the socket on the monitor PWA.

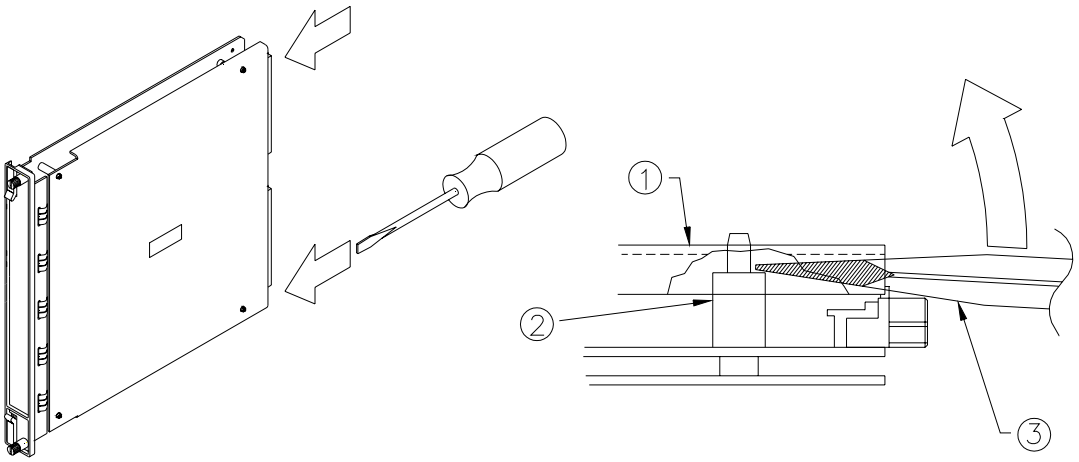
Replace the monitor Top Shield.

Replace the monitor into the 3500 system.

Reconfigure the monitor using the 3500 Rack Configuration software.

Detailed instructions for some of the steps listed above are provided on the following pages. Please review completely before proceeding.

Top Shield Removal



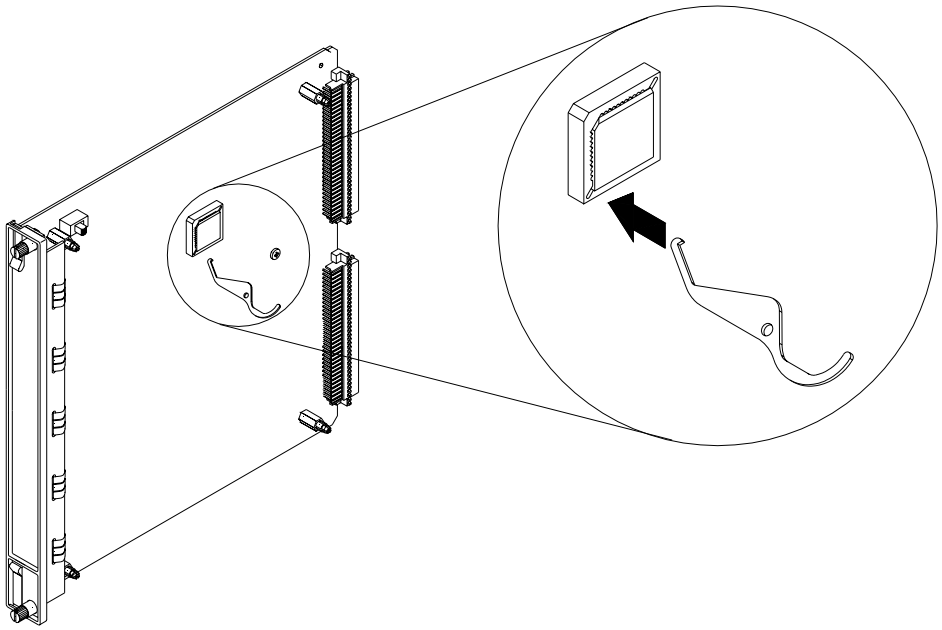
1) Top Shield
2) Standoff
3) Screwdriver

Step 1. Place the large flathead screwdriver under the top shield and on the ridge of the rear standoffs and lift upward on the screwdriver to pop the cover loose from the rear standoffs.

Step 2. Move the top shield up and down to work it loose from the two front standoffs.

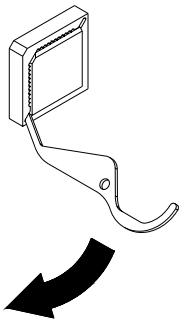
Original Firmware IC Removal

> **⚠ CAUTION**
>
> **Using excessive force to remove the firmware IC may damage the socket. Use care when removing the chip from the socket.**

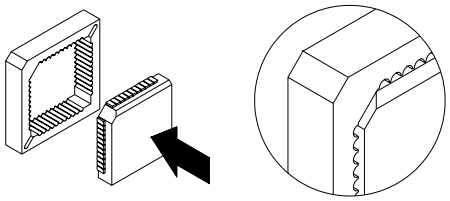


Step 1. Insert the removal tool in one of the two slots at the corner of the socket on the PWA. The diagram shows the approximate location of the chip to be removed, but not necessarily its orientation.

Step 2. Slightly lift the corner of the chip by gently pulling back on the tool. Move to the other slotted corner and repeat. Continue this process until the chip comes loose from the socket.



Upgrade Firmware IC Installation



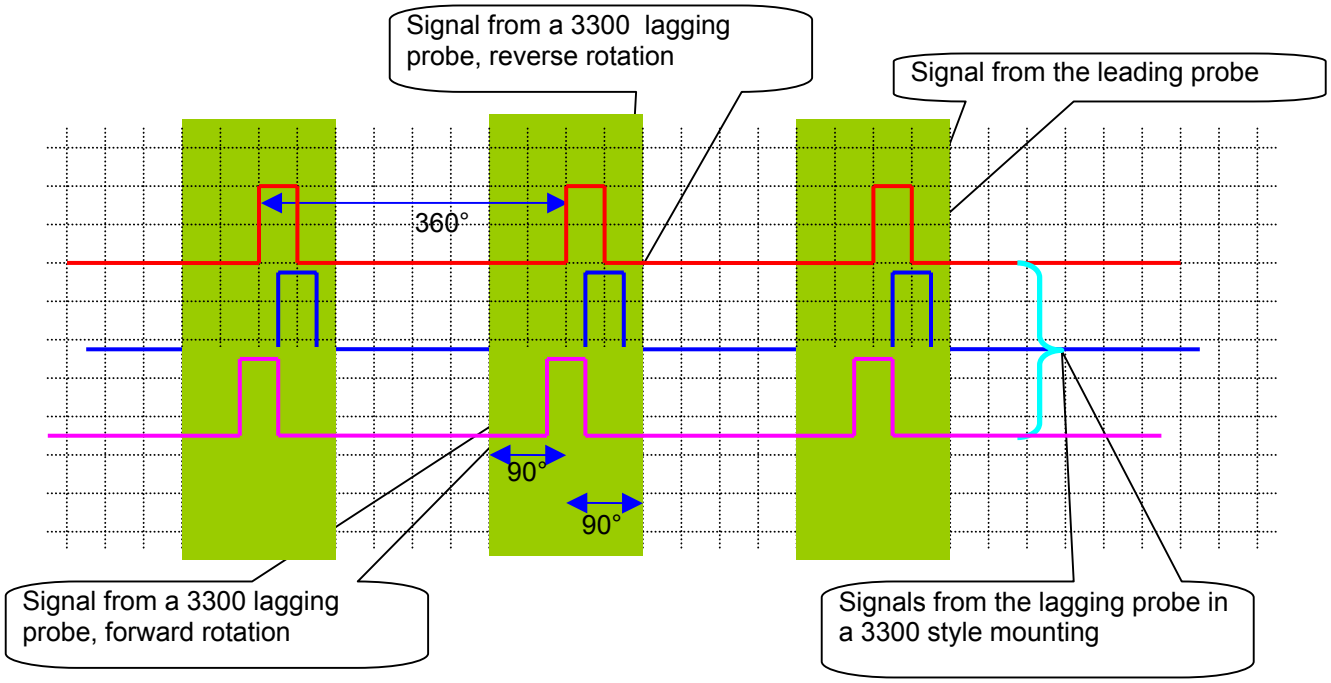
Install the upgrade firmware IC into the PWA. Be sure that the keyed corner on the IC is matched to the keyed corner of the socket. Ensure that the IC is firmly seated in the socket.

Top Shield Replacement

Replace the top shield. Be sure that the notch on the top shield is positioned at the top left corner of the module as shown in the diagram under “Top Shield Removal”. Align the holes in the top shield with the standoffs and press down around each standoff until they snap in place.

5.3 Reverse Rotation Probe Mounting

The reverse rotation channel type determines the direction of rotation, based on the relationship between the signals received from the two probes. The relation is depicted in the figure below.



If the signal from the leading probe is as shown in the figure, then the rising edge of the lagging probe must fall in the shaded region to properly detect a reverse rotation condition. The signals from a 3300/52-style probe mounting meet the requirements of a 3500 reverse rotation channel type and thus the 3500/50 reverse rotation channel type supports 3300/52 style mounting.

The 3500 reverse rotation channel is flexible in its mounting requirements as compared to the 3300. It can support an events per revolution (EPR) of greater than 2 and has multiple mounting positions possible. Given an EPR we need to have a specific angle between the leading and the lagging probes. To determine the angle use the following formula

Given an EPR of 'n' and the angle between the probes is denoted as 'X'

The limits on X are $\left(\frac{360}{n}\right) * m < X < \left(\frac{90 + 360 * m}{n}\right)$ for m = 0,1,2,…

If for some position 'm' $X \geq 360 \; then \; X = X \bmod 360$

Thus for an EPR of 2, we have two possible ranges for the angle between the probes, from 0 to 45 and from 180 to 225 (for the first range substitute 'n' by 2 and 'm' by 0, for the next range substitute 'n' by 2 and 'm' by 1, in the above formula).

For best results, the angle should be center value of the range with a tolerance of 25% of the range on either side, which means in our example we should place the probe at either 22.5 degrees or 202.5 degrees with a tolerance of ±11.25.

Given below is a table for a few selected values of 'n, and 'm'.

m	0	1	2	3	4	5	6	7	8	Tolerance
n # events	Probe ∟	Probe ∟	Probe ∟	Probe ∟	Probe ∟	Probe ∟	Probe ∟	Probe ∟	Probe ∟	
1	45.00									±22.5
2	22.50	202.50								±11.25
4	11.25	101.25	191.25	281.25						±5.625
8	5.63	50.63	95.63	140.63	185.63	230.63	275.63	320.63		±2.8125
16	2.81	25.32	47.82	70.32	92.82	115.32	137.82	160.32	182.82	±1.4075
32	1.41	12.66	23.91	35.16	46.41	57.66	68.91	80.16	91.41	±0.7025
64	0.70	6.34	11.96	17.59	23.21	28.84	34.46	40.09	45.71	±0.3525
128	0.35	3.16	5.98	8.79	11.60	14.41	17.23	20.04	22.85	±0.175
255	0.18	1.59	3.00	4.42	5.83	7.24	8.65	10.06	11.47	±0.0875

6. Troubleshooting

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

6.1 Self Test

To perform the Tachometer Monitor self-test:

Connect a computer running the Rack Configuration Software to the 3500 rack (if needed).

Select **Utilities** from the main screen of the Rack Configuration Software.

Select **System Events/Module Self-test** from the Utilities menu.

Press the **Module Self-test** button on the System Events screen.

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

Select the slot that contains the Tachometer 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.

Wait 30 seconds for the module to run a full self-test.

Press the **Latest Events** button. The System Events screen will be updated to include the results of the self-test.

Verify if the monitor passed the self-test. If the monitor failed the self-test, refer to Section 6.3.

6.2 LED Fault Descriptions

The following table shows how to use the LEDs to diagnose and correct problems.

OK	TX/RX	BYPASS	Scenario	Action
1 Hz	1 Hz		Monitor is not configured, is in Configuration Mode, or in Calibration Mode.	Reconfigure the Monitor or exit Configuration or Calibration Mode.
5 Hz			Monitor error	Check the System Event List for severity.
ON	Flashing		Monitor is operating correctly.	No action required.
OFF			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.
	Not Flashing		Monitor is not operating correctly.	Monitor is not executing alarming functions. Replace immediately.
		OFF	Alarming Enabled	No action required.
		ON	Some or all Alarming Disabled.	No action required.

= Behavior of the LED is not related to the condition.

6.3 System Event List Messages

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

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 Communicating	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: 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: Provides additional information for the events that use this field.

Slot: Indicates 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 of slot 5 would be 5L.

The following System Event List Messages may be placed in the list by the Tachometer 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 Corporation office.

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

Event Number: 126
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 +5VA-AB (Pass Main Board Analog +5V - upper and lower Power Supplies)

Event Number: 127
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-AB** (Fail Main Board -15V - upper and lower Power Supplies)

Event Number: 144
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: 145
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 OK Limit Volt Check**

Event Number: 146
Event Classification: Severe/Fatal Event
Action: Verify that the transducer is properly gapped. If the gap is OK, check to see if one of the following components is faulty:
- the Transducer
- the Tachometer I/O Module
- the Monitor Module

Monitor Module will stop alarming.

Pass OK Limit Volt Check

Event Number: 147
Event Classification: Severe/Fatal Event
Action: Verify that the transducer is properly gapped. If the gap is OK, check to see if one of the following components is faulty:
- the Transducer
- the Tachometer I/O Module
- the Monitor Module

*** Fail Transducer Power**

Event Number: 148
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 Transducer Power

Event Number: 149
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 I/O Board +2.5V-AB** (Fail I/O Board +2.5V - upper and lower Power Supplies)

Event Number: 150
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 I/O Board +2.5V-AB (Pass I/O Board +2.5V - upper and lower Power Supplies)

Event Number: 151
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: Potential Problem or 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.

*** 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.

Monitor TMR PPL Failed (Monitor TMR Proportional Value Failed)

Event Number: 310
Event Classification: Potential Problem
Action: Verify that the transducer is properly installed. If the transducer is properly installed, check to see if one of the following components is faulty:
- the Transducer
- the Tachometer I/O Module
- the Monitor Module

Monitor TMR PPL Passed (Monitor TMR Proportional Value Passed)

Event Number: 311
Event Classification: Potential Problem
Action: Verify that the transducer is properly installed. If the transducer is properly installed, check to see if one of the following components is faulty:
- the Transducer
- the Tachometer I/O Module
- 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.

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 Threshold Adj** (Enabled Threshold Adjustment)

Event Number: 418
Event Classification: Typical logged event
Action: No action required.
Monitor Module will stop alarming.

Disabled Threshold Adj (Disabled Threshold Adjustment)

Event Number: 419
Event Classification: Typical logged event
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.

*** Enable Mon Alarm Byp**

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

Disable Mon Alarm Byp

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

SW Peak Reset (Software Peak Reset)

Event Number: 433
Event Classification: Typical logged event
Event Specific: Ch x
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

*** Fail Comm Id Mismatch**

Event Number: 463
Event Classification: Potential Problem
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 Comm Id Mismatch

Event Number: 464
Event Classification: Potential Problem
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

*** Fail DAC Test** (Fail Digital to Analog Converter Test)

Event Number: 471
Event Classification: Severe/Fatal Event
Event Specific: Ch x
Action: Replace the Tachometer Module immediately.
Monitor Module will stop alarming.

Pass DAC Test (Pass Digital to Analog Converter Test)

Event Number: 472
Event Classification: Severe/Fatal Event
Event Specific: Ch x
Action: Replace the Tachometer Module immediately.

*** 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.

Setpoint Updated

Event Number: 511
Event Classification: Typical logged event
Action: No action required.

Group Setting Reset

Event Number: 521
Event Classification: Typical logged event
Action: No action required.

*** I/O Module Removed**

Event Number: 550
Event Classification: Severe/Fatal Event
Action: Re-install I/O Module.
Monitor Module will stop alarming.

*** Fail Channel Pair Check**

Event Number: 578
Event Classification: Potential Problem
Action: Verify both channels are configured as a Zero Speed or Reverse Rotation monitor type. If not, download a new configuration to the Monitor Module. If the problem still exists, replace the Monitor Module immediately.
Monitor Module will stop alarming.

Pass Channel Pair Check

Event Number: 579
Event Classification: Potential Problem
Action: Verify both channels are configured as a Zero Speed or Reverse Rotation monitor type. If not, download a new configuration to the Monitor Module. If the problem still exists, replace the Monitor Module immediately.

Enabled HW Peak Reset (Enabled Hardware Peak Reset)

Event Number: 580
Event Classification: Typical logged event
Event Specific: Ch x
Action: No action required.

Disabled HW Peak Reset (Disabled HW Peak Reset)

Event Number: 581
Event Classification: Typical logged event
Event Specific: Ch x
Action: No action required.

Enabled Zero Spd Alarm (Enabled Zero Speed or Reverse Rotation Alarm)

Event Number: 582
Event Classification: Typical logged event
Action: No action required.

*** Disabled Zero Spd Alarm** (Disabled Zero Speed or Reverse Rotation Alarm)

Event Number: 583
Event Classification: Typical logged event
Action: No action required.
Alarming will be inhibited by this action.

Supply Cond Kph Enabled (Supply Conditioned Keyphasor Enabled)

Event Number: 584
Event Classification: Typical logged event
Event Specific: Ch x
Action: No action required.

Supply Cond Kph Disabled (Supply Conditioned Keyphasor Disabled)

Event Number: 585
Event Classification: Typical logged event
Event Specific: Ch x
Action: No action required.

XDCR Signal Too Slow (Transducer Signal Too Slow)

Event Number: 590
Event Classification: Potential Problem
Action: This may be due to a machine-stopped condition. Verify that the transducer is functioning properly.

XDCR Signal Too Fast (Transducer Signal Too Fast)

Event Number: 591
Event Classification: Potential Problem
Action: This may be due to an input frequency above 20 kHz. Verify that the transducer is functioning properly.

XDCR Fifty Percent Error (Transducer Fifty Percent Error)

Event Number: 592
Event Classification: Potential Problem
Action: Verify that the transducer is functioning properly.

RPM Reading Too Low

Event Number: 593
Event Classification: Potential Problem
Action: This may be due to a machine-stopped condition. Verify that the transducer is functioning properly.

RPM Reading Too High

Event Number: 594
Event Classification: Potential Problem
Action: This may be due to a speed input above the configured full-scale range for the monitor. Verify that the transducer is functioning properly.

Accel Reading Too Low

Event Number: 595
Event Classification: Potential Problem
Action: This may be due to an acceleration input below the configured full-scale range for the monitor. Verify that the transducer is functioning properly.

Accel Reading Too High

Event Number: 596
Event Classification: Potential Problem
Action: This may be due to an acceleration input above the configured full-scale range for the monitor. Verify that the transducer is functioning properly.

XDCR Signal Now Valid (Transducer Signal Now Valid)

Event Number: 597
Event Classification: Typical logged event
Action: No action required.

Pass Direction check

Event Number: 598
Event Classification: Potential problem
Action: No action required

Fail Direction check

Event Number: 599
Event Classification: Potential problem
Action: Verify that the transducers are mounted correctly, and the phase relationship between the signal is as expected.

6.4 Alarm Event Messages

The following Alarm Event List Messages are returned by the Tachometer Monitor.

Alarm Event 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 left 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

7. Ordering Information

Part number 3500/50 - A - B - C

A **I/O Module Type**

01	Discrete I/O Module with Internal Terminations
02	Discrete I/O Module with External Terminations
03	TMR I/O Module with External Terminations
04	I/O Module with Internal Barriers

B **Agency Approval Option**

00	None
01	CSA-NRTL/C

C **Monitor Use**

01	Speed Measurement
02	Reverse Rotation

Note

If the 3500/50 Tachometer Module is added to an existing 3500 Monitoring System, the following (or later) firmware and software versions are required:

- 3500/20 RIM Firmware - Revision G (1.07)
- 3500 Rack Configuration Software - Version 2.0
- 3500 Data Acquisition Software - Version 2.0
- 3500 Operator Display Software - Version 1.10

If the Reverse Rotation channel type for the 3500/50 is to be used, the following (or later) firmware and software versions are required:

- 3500/01 Configuration Software - Version 3.50
- 3500/02 Data Acquisition Software -Version 2.40
- 3500/03 Display Software - Version 1.40
- 3500/50 Firmware - Revision J (1.22)

If the Tachometer Internal Barrier I/O Module with Internal Terminations is to be used with the 3500/50 Tachometer Module, then the following (or later) firmware and software versions are required:

- 3500/50 Tachometer Module Firmware – Revision F (1.06)
- 3500 Rack Configuration Software - Version 2.30

7.1 Spares

3500/50 Module	133388-02
Discrete I/O Module with Internal Terminations *	133442-01
Discrete Internal Barrier I/O Module with Internal Terminations	136703-01
Discrete I/O Module with External Terminations	133434-01
TMR I/O Module with External Terminations **	133450-01
External Termination Block (Euro Style connectors) *	125808-05
External Termination Block (Terminal Strip connectors) *	128015-05
Recorder External Termination Block (Euro Style connectors)	128702-01
Recorder External Termination Block (Terminal Strip connectors)	128710-01
Bussed External Termination Block *,** (Euro Style connectors)	132242-03
Bussed External Termination Block *,** (Terminal Strip connectors)	132234-03
3500/50 Module Manual	134938-01
Firmware IC	134130-01
Grounding Wrist Strap(single use only)	04425545
IC Removal Tool	04400037
Connector Header, Internal Termination	
6-position, Green	00580436
8-position, Green	00580434
12-position, Green	00502133

Note

* External Termination Blocks cannot be used with the Discrete I/O Module with Internal Terminations (133442-01).

** Use the two Bussed External Termination Blocks with the TMR I/O Module only (133450-01).

When ordering I/O Modules with External Terminations, the External Termination Blocks and Cables must be ordered separately.

7.2 3500/50 Transducer Signal to External Termination (ET) Block Cable

Part number 135101 - [A][A][A][A] - [B][B]

A **Cable Length**

0005	5 feet (1.5 meters)
0007	7 feet (2.1 meters)
0010	10 feet (3 meters)
0025	25 feet (7.5 meters)
0050	50 feet (15 meters)
0100	100 feet (30.5 meters)

B **Assembly Instructions**

01	Not Assembled
02	Assembled

7.3 3500 Recorder Output to Recorder External Termination (ET) Block Cable

Part number 129529 - [A][A][A][A] - [B][B]

A **Cable Length**

0005	5 feet (1.5 meters)
0007	7 feet (2.1 meters)
0010	10 feet (3 meters)
0025	25 feet (7.5 meters)
0050	50 feet (15 meters)
0100	100 feet (30.5 meters)

B **Assembly Instructions**

01	Not Assembled
02	Assembled

8. Specifications

INPUTS

Signal:	Each Tachometer Module accepts up to two transducer signals from proximity probe transducers or magnetic pickups. The input signal range is +10.0 V to -24.0 V. Signals exceeding this range are limited internally by the module.
Input Impedance:	20 kΩ (standard); 40 kΩ (TMR); 7.15 kΩ (Internal Barrier)
Power:	Typical consumption of 5.8 watts

OUTPUTS

OK LED:	Indicates when the 3500/50 is operating properly.
TX/RX LED:	Indicates when the 3500/50 is communicating with other modules in the 3500 rack.
Bypass LED:	Indicates when the 3500/50 is in Bypass Mode.
Buffered Transducer Outputs:	The front of each module has one coaxial connector for each channel buffered output. Each connector is short circuit and ESD protected. Buffered outputs are also available on the I/O Module via Euro Style connectors. The following specifications assume a load impedance of 100 KOhms +/- 1%. Output Impedance: 550 Ω DC Offset: 35 mV maximum. DC or AC Gain: 0.98 to 1.01
Transducer Supply Values:	-21.5 to -24.7 Vdc, 40 mA maximum per channel
Recorder:	+4 to +20 mA. Values are proportional to module full-scale range (rpm or rpm/min). Individual recorder values are provided for each channel. Operation is unaffected by short circuits on recorder outputs.

Voltage Compliance (current output):	0 to +12 Vdc range across load. Load resistance is 0 to 600 Ω.
Resolution:	0.3662 μA per bit, ±0.25 % error at room temperature, ±0.70 % error over temperature range. Update rate approximately 100 ms.

SIGNAL CONDITIONING

Specified at +25° C (77° F)

Speed Input:	The 3500 Tachometer will support 0.0039 to 255 events per revolution with a maximum full-scale range of 99,999 rpm and a maximum input frequency of 20 kHz. Minimum input frequency for proximity transducers is 0.0167 Hz (1 rpm for 1 event/revolution) and for passive magnetic pickups is 3.3 Hz.
RPM Accuracy:	Less than 100 rpm = ±0.1 rpm 100 to 10,000 rpm = ±1 rpm 10,000 to 99,999 rpm = ±0.01 % of the true shaft speed
RPM/MIN Accuracy:	±20 rpm/min

TRANSDUCER CONDITIONING

Auto Threshold:	Use for any input above 0.0167 Hz (1 rpm for 1 event/revolution). Minimum signal amplitude for triggering is 1 volt peak to peak.
Manual Threshold:	User selectable from +9.5 to -23.5 Vdc. Minimum signal amplitude for triggering is 500 millivolts peak to peak.
Hysteresis:	User selectable from 0.2 to 2.5 volts.

ALARMS

Alarm Setpoints	Alarm 1 levels (setpoints) can be set for various speed proportional values measured by the Tachometer, depending on channel type. In addition, Alarm 2 setpoints can be set for any two of the speed proportional values measured by the Tachometer. All alarm setpoints are set using software configuration. Alarms are adjustable and can be set from 0 to 100 % of full-scale for each proportional value. **Note:** For the Reverse Rotation channel type, alarming is provided on all proportional values except GAP. The reverse speed proportional value uses a fixed over alarm setpoint with a value of zero.
Alarm time Delays:	Alarm delays can be programmed using software, and can be set as follows:
Alarm 1:	From 1 to 60 seconds in 1 second intervals
Alarm 2:	From 1 to 60 seconds in 0.1 second intervals

PROPORTIONAL VALUES

Proportional values are speed measurements used to monitor a machine. The Tachometer Module returns the following proportional values:

Rotor Speed	Rotor Acceleration	Zero Speed	Reverse Rotation
Speed *	Rotor Acceleration *	Zero Speed *	Reverse Speed *
Speed Band	Speed	Speed	GAP
Peak Speed **	Peak Speed **	Peak Speed **	Speed (forward)
			Reverse Peak Speed
			Num Reverse Rotations

* The primary value for the channel. This value can be included in contiguous registers in the Communications Gateway Module or Display Interface Module.

** Peak Speed proportional values are for display purposes only. No alarming is provided for Peak Speed.

ENVIRONMENTAL LIMITS

Temperature:	-30° C to 65° C (-22° F to 150° F) operating, when used with Internal/External Termination Tachometer I/O Module. 0° C to 65° C (32° F to 150° F) operating, when used with Tachometer Internal Barrier I/O Module (Internal Termination). -40° C to 85° C (-40° F to 185° F) storage
Humidity:	95 % non-condensing

BARRIER PARAMETERS

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

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

CE MARK DIRECTIVES:

EMC Directives:

EN50081-2:

Radiated Emissions:	EN 55011, Class A
Conducted Emissions:	EN 55011, Class A

EN50082-2:

Electrostatic Discharge:	EN 61000-4-2, Criteria B
Radiated Susceptibility:	ENV 50140, Criteria A
Conducted Susceptibility:	ENV 50141, Criteria A
Electrical Fast Transient:	EN 61000-4-4, Criteria B
Surge Capability:	EN 61000-4-5, Criteria B
Magnetic Field:	EN 61000-4-8, Criteria A
Power Supply Dip:	EN 61000-4-11, Criteria B
Radio Telephone:	ENV 50204, Criteria B

Low Voltage Directives:

Safety Requirements:	EN 61010-01

HAZARDOUS APPROVALS

CSA-NRTL/C:	
When used with Internal/External Termination I/O Module	Class I, Division 2, Groups A through D
When used with Internal Barrier I/O Module (Internal Termination)	Class I, Division 1, Groups A through D Class I, Division 2, Groups A through D [Ex ia] IIC, Class I, Zone 0
CENELEC:	
When used with Internal Barrier I/O Module (Internal Termination)	[EEx ia] IIC

PHYSICAL

Main Board:	
Dimensions (Height x Width x Depth)	241.3 mm x 24.4 mm x 241.8 mm (9.50 in x 0.96 in x 9.52 in)
Weight:	0.82 kg (1.8 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)
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:	0.20 kg (0.44 lbs), non-barrier 0.46 kg (1.01 lbs), barrier

RACK SPACE REQUIREMENTS

Main Board:	1 full-height front slot
I/O Modules:	1 full-height rear slot