Dual Vibration Monitor
3300/15

FM APPROVED

Reliable vibration monitoring for rotating machinery

The 3300/15 Dual Vibration Monitor provides sophisticated on-line vibration monitoring and is suitable for virtually all types of rotating and reciprocating machinery. It can continuously measure and monitor two independent channels of radial vibration, accepting inputs from two proximity probe transducer systems. The monitor is used in conjunction with the 3300 System Rack, Power Supply and System Monitor, each of which is ordered separately.

The 3300/15 Dual Vibration Monitor is designed to meet the requirements of American Petroleum Institute Standard 670, Second Edition, June 1986.

Applications

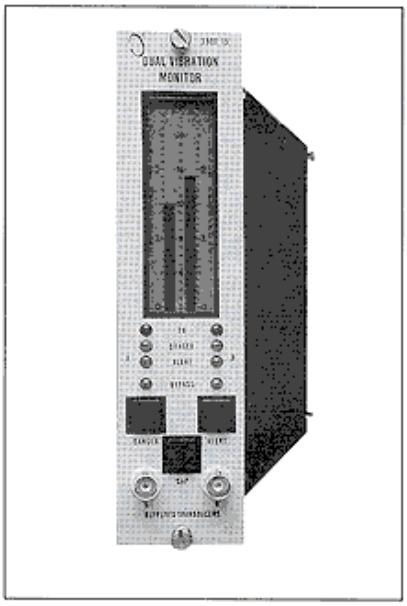
Complete on-line machinery protection to fit a wide variety of applications

Shaft radial vibration amplitude is a primary indicator of the overall mechanical condition of rotating machinery. Many machine malfunctions, including rotor imbalance, misalignment, bearing wear, shaft cracks, and rubs can be detected with vibration measurements.

The Dual Vibration Monitor measures and monitors the inputs from two proximity probe transducers. Amplitude values for both channels are continuously displayed on the LCD bargraph.

For complete vibration protection at one bearing location, two probes should be installed 90° apart (XY) at the same longitudinal location along the shaft near the journal bearing. The actual orientation, however, does not have to be true vertical and horizontal.

Since the two monitor channels operate independently, including alarm setpoint values, the two transducers do not even have to be mounted at the same bearing location. For example, one probe could be mounted at each end of the shaft or one on each of two machines. However, for shaft radial measurements, single-plane monitoring (one probe per bearing) is not satisfactory. For complete protection against excessive shaft radial vibration, XY transducers are recommended at each radial bearing location.



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Functions

The Dual Vibration Monitor is a microprocessor-based monitor which provides digitally adjustable Alert and Danger setpoints. Each channel has individual Alert and Danger alarm setpoints for radial vibration amplitude. It provides status indications (monitor and transducer OK, Alert, Danger and Bypass) and independent per channel peak to peak amplitude detection of vibration signals for continuous display and for driving recorder outputs. It provides short circuit protected power to the two transducer systems via the rear terminal strip. The OK circuit continuously monitors the operation of each transducer and associated field wiring. Both channels are ***continuously*** displayed independently on the monitor's LCD readout.

The monitor is ***ready for computer interfacing.*** No additional hardware is required to enhance the system for computerized data access, using Bently Nevada standard on-line computerized monitoring hardware and software.

Indication on the monitor display of alarm setpoint levels and gap voltages is obtained by pressing the Alert, Danger, and Gap switches. System self-test functions are standard, and any associated error codes can be read from the monitor display.

Both transducer input signals are buffered and sent to separate terminals at the Signal Input/Relay Module (which is at the rear of the monitor) and to the monitor front panel coaxial connectors. Instruments such as the Bently Nevada Digital Vector Filter 3, 108 Data Acquisition Instrument (ADRE®3), Snapshot® System, TK83 Balance Master®2 and TK81 can be connected ***directly*** to these terminals for machinery diagnostics and predictive maintenance programs, without the need for special cables or interface cards.

Features/Benefits

3300 Monitors have quality, reliability and flexibility built-in

Each monitor operates independently within the system without the requirement of a separate control panel, keyboard or programming module. The Dual Vibration Monitor incorporates features which maximize long-term, reliable and highly accurate system operation. These features are extremely important, especially for installations where the monitoring system is used as an input to an automatic machine shutdown system.

It is not always possible, when placing your order, to determine the exact monitor options you will need for a particular application. The Dual Vibration Monitor provides a wide range of plug-in (user-programmable) jumpers so that the appropriate monitor options can be easily set when you receive the system. If necessary in the future, these options can be changed in the field. Programming of jumpers does not require tools or extra parts. These are plug-in jumpers that can be set by hand. The on-board microprocessor reads the jumper positions and dictates monitor operation accordingly.

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Programmable options

Following are brief descriptions of the programmable options. Refer to the 3300 System Overview for benefits and more details.

Recorder Outputs — 0 to –10 Vdc, +1 to +5 Vdc, or +4 to +20 mA.

Monitor Full-Scale Ranges — various full-scale ranges can be jumper programmed (monitor requires recalibration after changing full-scale ranges).

Meter Scales — various high quality, laser printed cut-outs are provided in the manual.

Alarm Time Delays — 0.1, 1, 3 and 6 seconds. Alarm time delay is the time interval between the point when the input signal amplitude exceeds the alarm setpoint level and when the alarm circuit causes the relay to actuate. Our research and field experience have shown that a 3 second delay is generally sufficient to minimize false alarms from either "normal" transient vibration or electrical noise sources. Therefore, the monitor is shipped from the factory with jumpers positioned for 3 second alarm delays. However, for machines which are subject to rapid failures (less than 3 seconds), shorter delays may be necessary, The original machinery manufacturer should be consulted in these cases.

Danger Relay Voting Logic — OR or AND in accordance with API 670. For dual channel monitors, AND Danger voting logic allows either channel to independently generate an Alert Alarm, but requires ***both*** channels to measure a Danger alarm condition before the Danger relay will activate. AND logic is "two out of two" voting logic. OR voting logic is "one out of two," which allows ***either*** channel to independently generate a monitor alarm (Alert or Danger).

In general, AND voting is appropriate when the two channels represent exactly the same measurement variable (transducer redundancy) and when it is likely that a transducer fault will produce a false monitor alarm. OR voting logic is appropriate when the two channels do not represent exactly the same measurement variable (transducer redundancy) and when it is likely that a transducer failure will produce a false monitor alarm.

The most common types of transducer and field wiring faults (short and open circuits) generate signals which are ***not*** likely to produce false alarms in a vibration monitor. Thus, it is generally ***not*** necessary to use AND voting logic for the purpose of transducer redundancy.

For XY applications (two probes per bearing), the radial transducers cannot actually be considered as redundant anyway. That is, they do not measure exactly the same variable. Shaft radial vibration is almost never the same in both measurement directions. In fact, our research and field experience have shown that machine damage can occur due to excessive vibration in one plane while the vibration in the orthogonal plane remains below the alarm setpoint levels. Therefore, AND voting logic for XY vibration monitors is not only unnecessary from the electrical viewpoint, it is technically inappropriate from the mechanical viewpoint.

*Note: A transducer field wiring fault which is transient and rapidly varying **may** generate a signal which will produce a false alarm in a vibration monitor. The solution to this problem is our proprietary Timed OK/Channel Defeat circuit. This circuit, incorporated in all Bently Nevada vibration monitors, can differentiate between a transient transducer fault (which is **not** allowed to produce a monitor alarm) and high vibration amplitude (which is allowed to produce an alarm). Refer to the "Timed OK/Channel Defeat" paragraph below for a more detailed description of this circuit's operation.*

For the above reason, the 3300/15 Dual Vibration Monitor is shipped from the factory with jumpers positioned for OR voting logic. Note that Quad relays ***cannot*** be selected for voting. For more information, refer to Bently Nevada Applications Note AN032, "Voting Logic - Radial Vibration and Thrust Position Monitoring."

Timed OK/Channel Defeat — This special proprietary circuit minimizes the possibility of false alarms caused by a defective transducer, its associated interconnect wiring, or transducer power supply. When the OK limit is exceeded, the channel is defeated and the OK LED is turned OFF. The microprocessor then checks for proper transducer operation to be (re)established. When the fault clears, the channel is put back into normal operation (typically after 30 seconds delay) and the green OK LED on the monitor front panel flashes until a user-initiated reset. If the transducer problem persists, the offending monitor channel can be defeated via the internal Channel Bypass switch. A red LED on the monitor front panel will indicate the Bypass condition.

Alarm Reset Mode — latching or nonlatching, independent for Alert and Danger.

Alarm Relay Mode — Alert and Danger relay mode, normally energized or normally de-energized, is jumper-programmable (per relay) on the Signal Input/Relay Module.

First Out — indicated the first alarm to occur in the rack since the last power-up or Reset.

Frequency Response — 4 to 4,000 Hz (240 to 240,000 cpm) or 1 to 600 Hz (60 to 36,000 cpm).

Note: The 1 to 600 Hz (60 to 36,000 cpm) option is not recommended for machine applications with rapid startup and coastdown rates where acceleration/deceleration exceeds 1,000 rpm per second. Because of the extended low frequency range to 60 cpm, the monitor circuitry will retain vibration transients normally experienced during fast start-ups (such as with motor driven equipment). This can hold vibration levels above alarm setpoints beyond alarm time delays. This may result in Danger relay actuation after the internal time delay has lapsed, even if the actual vibration has decreased below the Danger alarm setpoint level. If, based on this explanation, the 240 cpm low frequency limit is not satisfactory for your application, contact your local Bently Nevada sales representative. The low frequency option is recommended for applications where shaft rotative speed is less than 1000 rpm.

The following outstanding features also are standard:

Danger Bypass — The Danger relay may be bypassed in accordance with API 670. The red bypass LED on the front panel will be ON whenever the monitor is in this condition. A jumper on the monitor circuit board can be programmed to prevent unauthorized

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use of the Danger Bypass function by disabling the Danger Bypass switch.

Channel Bypass — a channel's LCD, recorder output and relay drives may be bypassed. The red bypass LED will be ON whenever the channel is in this condition.

Trip Multiply — this factory installed option requires an external contact closure to be activated (see System Monitor Product Data Sheet). It multiplies the setpoints by the specified value (2X or 3X).

Power-up Inhibit — minimizes false alarms due to transient power surge or loss and subsequent (re)application of power. This function inhibits alarms for 2 seconds after power has stabilized, then Timed OK/Channel Defeat becomes active.

Reliable microprocessor technology includes self-test routines

Power-up, cyclic, and user-invoked self-tests are included to insure proper operation of the monitor and to increase operator confidence in the system. Errors in the monitor are indicated by rapidly flashing OK LEDs. Error codes are stored in memory and can be recalled on the LCD upon request to assist in troubleshooting. This insures that the monitor is on-line for continuous machine protection.

Convenient maintenance

System Manuals provide all the required schematics to assemble, disassemble, and service the monitor.

The monitor side covers provide tamperproof protection for the programmable jumpers and protect circuitry from damage during transport and storage. The side covers also show the locations and options for these jumpers.

Special electronic design allows for monitor insertion and removal without powering down the rack, which makes interchanging of (spare) monitor a simple, convenient task.

The monitor front panel slides away to allow easy access to internal monitor switches and testpoints without interrupting monitor operation. In the normal position, the front panel provides tamperproof protection for these functions.

Display, layout and switches are designed to provide operator convenience

The precise readout is a large 3.25 inch (83 mm) direct drive, non-multiplexing Liquid Crystal Display (LCD) in bargraph format. It combines high contrast and a wide viewing angle with a resolution of ±1.6% of full-scale. The display provides a fast, convenient, accurate readout of the measured parameters in user-selected engineering units.

Monitor status (OK, Alert, Danger and Bypass) per channel can be observed ***at a glance,*** without operator action (i.e., no pressing of switches, no controller panel, etc. is required). The display provides ***continuous indication*** per channel.

Meter scale design allows the user to color code Alert and Danger levels (or normal operating range) on the scale, for better understanding and greater visibility. Unlike numerical segment LCDs or LEDs, the "analog" bargraph LCD provides operators the ability to observe percentage of full-scale and rate of change.

Relays

The Dual Vibration Monitor can be ordered with ***built-in*** relays; no external wiring between relays and rack, and no extra housing to mount the relays, are required.

Relays (optionally epoxy- or hermetically-sealed) have arc suppressors installed. The relays can be programmed for normally energized or de-energized as well as latching or nonlatching operation. Refer to the 3300 Relays Product Data Sheet for more information.

Intrinsic Safety Barriers

The 3300/15 Dual Vibration Monitor can be ordered with built-in intrinsic safety barriers. No external wiring between the monitor and the barriers is required. Refer to the 3300 Intrinsic Safety Barriers Product Data Sheet for more information.

Specifications

INPUTS

Signal: Accepts one or two proximity probe signals.

Input Impedance: 10 kΩ.

Sensitivity: 200 mV/mil (8 V/mm) peak to peak.

Power: Accepts regulated dc voltages from rack Power Supply. Nominal consumption of 2 watts.

Power-Up Inhibit: Responds to Power-up Inhibit signal from System Monitor.

Trip Multiply: Responds to Trip Multiply signal from System Monitor.

Reset: Responds to Alarm Reset signals from System Monitor.

Alarm Setpoint Adjustments: Responds to Up/Down signals from System Monitor.

SIGNAL CONDITIONING

Monitor Range: Monitor full-scale operating range is selected by the user upon ordering. Full-scale range can be subsequently (re)programmed by the user in the field.

Meter Scales: Several extra, high quality, laser-printed scales with various full-scale ranges are provided.

Frequency Response: User-programmable for 4 to 4,000 Hz (240 to 240,000 cpm), or 1 to 600 Hz (60 to 36,000 cpm); –3dB. (Refer to Features/Benefits section under Frequency Response).

OUTPUTS

Recorder: User-programmable for +4 to +20 mA, 0 to –10 Vdc, or +1 to +5 Vdc. Voltage or current outputs are proportional to programmed monitor full-scale. Individual recorder outputs are provided for each channel. Monitor operation is unaffected by short circuits on recorder outputs.

Output Impedance (voltage outputs): 100 Ω.

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Output Impedance (voltage outputs): 100 Ω.

Voltage Compliance (current outputs): 0 to +12 Vdc range across load. Load resistance is 0 to 600 Ω when using +4 to +20 mA option.

Accuracy: Within ±0.33% of full-scale typical, ±1% maximum. Accuracy is rated from signal input to proportional output, which drives display, computer interface and recorder output circuitry. Ambient temperature is specified at +77°F (+25°C).

Buffered Transducer Outputs: There is one coaxial connector per channel on the front panel and one terminal connection per channel on the rear panel. All are short circuit protected.

Output Impedance: 100 Ω.

Transducer Supply Voltage: User-programmable in Power Supply for –24 Vdc, or –18 Vdc, current limited on individual monitor circuit board.

ALARMS

Alarm Setpoints: Both alarms (Alert and Danger) are digitally adjustable from 0 to 100% of full-scale and can be set within LCD accuracy (±1.6%) to desired level. Once set, alarms are repeatable within ±0.39% of full-scale. The alarm setpoints are stored in a nonvolatile memory and are adjusted using tamperproof switches on the monitor circuit board and up/down switches on the System Monitor front panel.

Alarms and OK Relay Drives: Two alarm relay drive signals (Alert and Danger) and one OK relay drive signal.

Monitor Alarm Functions: User-programmable for latching or non-latching operation, individually for Alert and Danger.

Alarm Time Delay: User-programmable for 0.1, 1, 3, or 6 seconds.

RELAY MODULES

Location: One alarm relay module can be installed behind each monitor. At least one relay module must be ordered with each 3300 System. Refer to the 3300 Relay Product Data Sheet for more information.

DISPLAYS

Meter: Nonmultiplexing vertical bar-graph type Liquid Crystal Display (LCD). Individual 63 segment LCD per channel. Probe Gap indicated on a third, center scale. LCD also displays error codes and monitor ADJUST mode.

Accuracy: Within ±1.6% of monitor full-scale.

Size: 3.25 inches, 83 mm (vertical dimension).

LED Indicators:

OK: One constant ON green LED per channel indicates OK condition of monitor, transducers and field wiring. Constant OFF indicates NOT OK condition or Channel Bypassed (red Bypass LED will be ON). OK LED flashing at 1 Hz indicates channel ***has been*** NOT OK, but ***is now*** OK. OK LED flashing at 5 Hz indicates error code(s) stored in memory.

Alarm: Two red LEDs per channel indicate alarm status (individually for Alert and Danger). Flashing alarm LED indicates First Out (independent for Alert and Danger).

Bypass: Two red LEDs indicate the status of Danger Bypass and Channel Bypass functions (individually per channel). LEDs flash when monitor is in Trip Multiply mode.

CONTROLS

Front Panel: Three switches (Alert, Danger and Gap) control meter display. LCD normally indicates vibration amplitude individually for each channel. Switch actuation allows LCD to indicate Alert setpoint level, Danger setpoint level or Gap Voltage for both channels. Switch actuation does not interrupt other monitoring functions. Flashing LCD indicates channel in ADJUST mode or presence of stored error codes.

Internal: Five switches control Danger Bypass, Channel A Bypass, Channel B Bypass, Channel A alarm setpoint adjust, and Channel B alarm setpoint adjust. Two terminal pins are provided to execute user-invoked self-test. Two potentiometers are provided for full-scale calibration. Adjustments are made from the front of the monitor, behind the slide-away front panel without powering down the monitor or rack.

ENVIRONMENTAL LIMITS

Temperature Range:

Operation: +32°F to +149°F (0°C to +65°C).

Storage: –40°F to +185°F (–40°C to +85°C).

Relative Humidity: To 95% noncondensing.

PHYSICAL

Space Requirements: One rack position (any position except 1 and 2, which are reserved for Power Supply and System Monitor, respectively).

Weight: 2 lbs. (1 kg).

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Ordering Information

Dual Vibration Monitor

	A	B	C	D	E	F
3300/15 -	□□	- □□	- □□	- □□	- □□	- □□

Option Descriptions

A □□ Full-Scale Range Option
- 01 0-3 mils peak to peak (pp)
- 02 0-5 mils pp
- 03 0-10 mils pp
- 04 0-15 mils pp
- 05 0-20 mils pp
- 11 0-100 μm pp
- 12 0-150 μm pp
- 13 0-200 μm pp
- 14 0-400 μm pp
- 15 0-500 μm pp

B □□ Transducer Input Option
- 01 3300 or 7200 Proximitor®, 200 mV/mil
- 02 3000 Proximitor, 200 mV/mil (Power Supply must be programmed for –18 Vdc.)

C □□ Alarm Relay Option
- 00 None ①
- 01 Epoxy-Sealed
- 02 Hermetically-Sealed ②
- 03 Quad Relay (Epoxy-Sealed only)

D □□ Agency Approval Option
- 00 Not required
- 01 CSA
- 02 Pending British Approval ②
- 03 Factory Mutual

E □□ Safety Barriers
- 00 None
- 01 External
- 02 Internal

F □□ Trip Multiply Option
- 00 None
- 01 2X
- 02 3X

Field-Programmable Options

These options are field-programmable via plug-in jumpers. Solid squares indicate options as shipped from the factory.

First Out Option
- ■ Enabled
- □ Disabled

Alarm Time Delay Option ③
- ■ 3 seconds
- □ .1 second
- □ 1 second
- □ 6 seconds

Frequency Response Option ④
- ■ 240-240,000 rpm
- □ 60-36,000 rpm

Alert Reset Option
- ■ Latching
- □ Nonlatching

Danger Reset Option
- ■ Latching
- □ Nonlatching

Recorder Outputs Option
- ■ +4 to +20 mA
- □ +1 to + 5 Vdc
- □ 0 to –10 Vdc

Danger Relay Voting Option ⑤
- ■ OR voting for relay drive
- □ AND voting for relay drive

Alert Relay Mode Option
- ■ Normally de-energized
- □ Normally energized

Danger Relay Mode Option
- ■ Normally de-energized
- □ Normally energized

① *At least one relay module must be ordered with each 3300 System. If one common relay module per system has been ordered, all other monitor relay drive signals will be jumper programmed at the factory to activate relay bus one.*

② *Agency Approval Option 02 requires Alarm Relay Option 02 (Hermetically-Sealed)*

③ *Refer to Features/Benefits section under Alarm Time Delays.*

④ *Refer to Features/Benefits section under Frequency Response.*

⑤ *Refer to Features/Benefits section under Danger Relay Voting Logic.*

ACCESSORIES

Computer Interfaces

3300 Systems are ready to be used with Bently Nevada on-line computerized monitoring systems, such as Dynamic Data Manager®, Transient Data Manager®, or System 64. A Serial Interface is available with the 3300/01 System Monitor for communication with Programmable Logic Controllers, Process Control Computers, and Distributed Control Systems. Contact your local Bently Nevada sales representative for further information.

Monitor Modifications

Certain options, not listed above, are available as monitor modifications. Contact your local Bently Nevada sales representative for further information.

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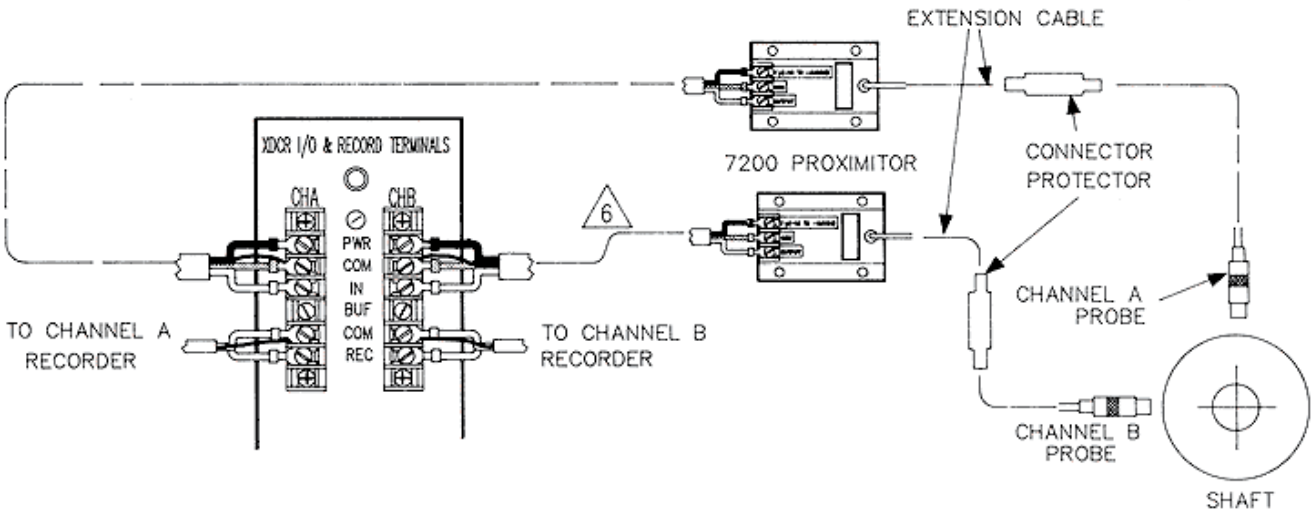

Field wiring diagram for the 3300/15 Dual Vibration Monitor