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Solution

Application note 009

Adding a VibroSight condition monitoring system to an existing machinery protection system

This application note provides some background information before making recommendations on how best to add a VibroSight condition monitoring system to an existing machinery protection system, including the use of an interface kit available from Meggitt Sensing Systems.

PRODUCTS AFFECTED

Applicable to existing machinery protection systems that require a VibroSight® condition monitoring system.

THE ISSUE

A large number of legacy machinery protection systems are deployed that continue to reliably monitor and protect their machinery. So, despite the known advantages of condition-based maintenance programs, many machinery operators are understandably reluctant to replace their existing systems, for reasons of disruption as well as cost. However, it can be relatively easy to add a VibroSight condition monitoring system (CMS) to an existing machinery protection system (MPS).

As required by API 670, the machinery protection system standard, most machinery protection systems make their transducer input signals available as buffered “raw” outputs that can be shared with other systems. These outputs are buffered (unfiltered) versions of the transducer input signals and are typically available on front-panel BNC connectors, but they are often available in other locations too.

Originally intended to allow electronic test equipment to be easily and quickly connected to a machinery monitoring system for testing and troubleshooting, these buffered transducer outputs also provide a way for a condition monitoring system to be easily and quickly added with minimal cost and disruption.

However, as the different machinery monitoring systems available have different approaches to combining machinery protection and condition monitoring, and signal sharing, different approaches and interfaces can be required in order to add a VibroSight condition monitoring system.

COMBINING MACHINERY MONITORING SYSTEMS AND SHARING SIGNALS

Machinery monitoring systems from Meggitt Sensing Systems take an integrated approach to machinery protection and condition monitoring systems, that includes integrated signal sharing.

VM600 system

Meggitt Sensing Systems' VM600 rack-based system allows both machinery protection cards (such as the MPC4/IOC4T and AMC8/IOC8T) and condition monitoring cards (such as the XMx16/XIO16T and CMC16/IOC16T) to be combined in the same rack.

For signal sharing:

- Externally – The MPC4/IOC4T machinery protection card pair provides buffered outputs on front-panel BNC connectors (MPC4 card) and via terminal strip connectors (IOC4T card).
- Internally – The VM600 rack's backplane supports buses that allow signals to be shared internally between cards in the rack. For example, the Raw Bus is used to share dynamic signal inputs and the Tacho Bus is used to share speed (tachometer) signal inputs. Signals can easily be shared between machinery protection and condition monitoring cards in this way.

NOTE: Signals shared internally using the Raw Bus are not buffered.
Refer to the *VM600 Machinery Protection System (MPS)* hardware manual for additional information.

For VM600 systems, different software is available: the VM600 MPSx software is required for machinery protection systems, the VM600 CMS software is required for CMC16/IOC16T condition monitoring cards and the VibroSight software is required for XMx16/XIO16T condition monitoring cards.

VibroSmart DMS (distributed monitoring system)

Meggitt Sensing Systems' VibroSmart® module-based system includes monitoring modules that can be used for both machinery protection and condition monitoring systems.

For signal sharing:

- Externally – The VSV3x0 vibration monitoring modules provide attenuated buffered outputs via screw terminal connectors (VSB300 terminal base). In addition, the VSA301 buffered output amplifier can be used with a VSV3x0 module in order to provide amplified buffered outputs on front-panel BNC connectors.
- Internally – The VibroSmart DMS supports "measurement blocks" that allow certain information, including tachometer (speed) input signals, to be shared between modules in the same measurement block.

For a VibroSmart DMS, only the VibroSight software is required.

Systems from other suppliers

Machinery monitoring systems from other suppliers can take different approaches to combining machinery protection and condition monitoring systems, and signal sharing. Although, as discussed earlier, machinery protection systems that meet the requirements of API 670 must provide individual buffered transducer output connections.

For example, the Bently Nevada® 3500 series is a rack-based system intended primarily for machinery protection applications. A 3500 rack uses different monitor modules such as the 3500/4xM Proximitor® Monitor, 3500/25 Keyphasor® Module and 3500/62 Process Variable Monitor to implement a machinery protection system.

In addition, each 3500 rack requires that either a 3500/20 Rack Interface Module (RIM) or a 3500/22M Transient Data Interface (TDI) is installed (see Figure 1 and Figure 2). These modules act as the primary interface to the rack and one of them must be installed in order to communicate with the system for configuration and the retrieval of machinery information.

Earlier 3500 systems with a 3500/20 Rack Interface Module (RIM) are typically used for machinery protection only. (In order to be used for condition monitoring, an optional Data Manager I/O Module must be used in order to allow the dynamic signals to be shared with a Communications Processor such as a TDIX or a TDXnet™.)

Later 3500 systems with a 3500/22M Transient Data Interface (TDI) are typically used for machinery protection and/or condition monitoring. (The TDI combines the capability of a RIM with the data collection capability of a Communications Processor such as a TDXnet. The TDI also includes an Ethernet connection and is directly compatible with the System 1® condition monitoring software from Bently Nevada.)

For signal sharing externally:

- The 3500 monitor modules typically provide buffered transducer outputs on front-panel BNC connectors. For example, a 3500/4xM Proximitor Monitor and associated I/O Module provide buffered outputs on front-panel BNC connectors, and a 3500/25 Keyphasor Module and associated I/O Module provide buffered outputs on front-panel BNC connectors (Keyphasor Module) and via terminal strip connectors (I/O Module).
- The 3500 rack can also provide buffered transducer outputs via optional rack I/O modules that depend on the rack's primary interface module:
  - Racks with a 3500/20 Rack Interface Module (RIM) can use the optional Data Manager I/O Module (PNR: 125760-01) in order to provide access to the buffered transducer outputs from selected monitor modules via the rear of the rack (see Figure 1 and Bently Nevada 3500 system with a 3500/20 Rack Interface Module (RIM), on page 5).
  - Racks with a 3500/22M Transient Data Interface (TDI) can use the optional Buffered Signal Output Module (PNR: 147364-01) in order to provide access to the buffered transducer outputs from all monitor modules via the rear of the rack (see Figure 2 and Bently Nevada 3500 system with a 3500/22M Transient Data Interface (TDI), on page 10).

NOTE: Refer to Bently Nevada 3500 system manuals for additional information.

For 3500 systems in machinery protection applications, different software is available: the 3500 Rack Configuration software is required to configure all modules, the 3500 Data Acquisition/DDE Server software is required to collect and store static data for subsequent data export, and the 3500 Operator Display software is required to display the information collected by the 3500 Data Acquisition software.

For 3500 systems in condition monitoring applications, the System 1 software is required (which also requires a 3500/22M Transient Data Interface (TDI) or a 3500/20 Rack Interface Module (RIM) with a Communications Processor such as a TDXnet).

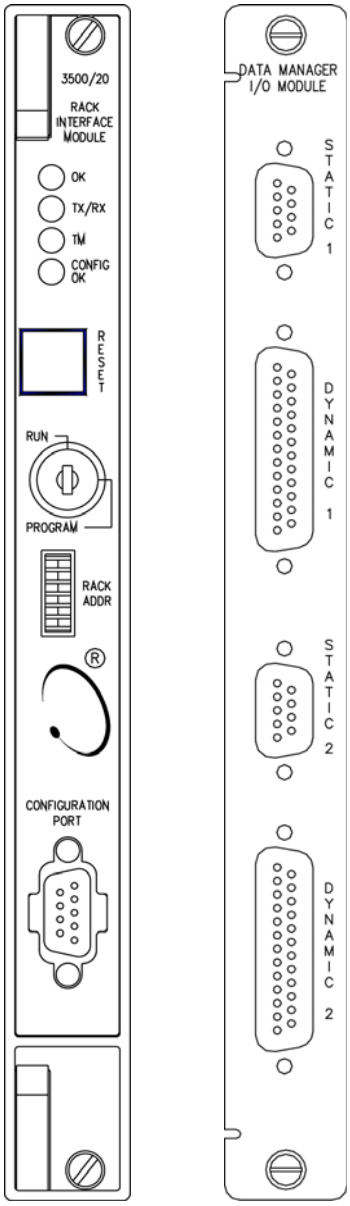

Figure 1: 3500/20 Rack Interface Module (RIM) and Data Manager I/O Module front panels

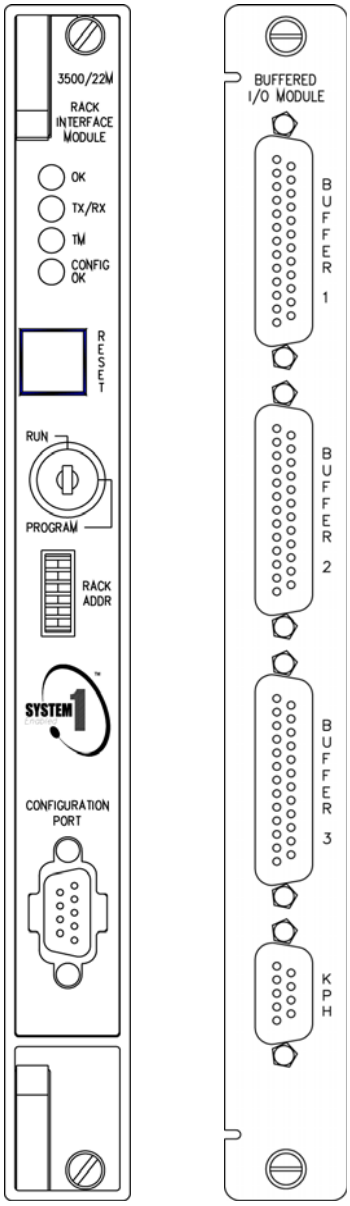

Figure 2: 3500/22M Transient Data Interface (TDI) and Buffered Signal Output Module front panels

ADDING A VIBROSIGHT CMS TO AN EXISTING MPS

VM600 system

As VM600 racks allow both machinery protection systems and condition monitoring systems to be combined in the same rack, adding a VibroSight CMS to an existing VM600 rack-based MPS can be as simple as:

- Adding one or more XMx16/XIO16T condition monitoring cards to the existing VM600 rack.
- Sharing the buffered outputs in one of the following ways:
  - Externally – by wiring the buffered output signals from either the rear of the rack (for example, IOC4T card terminal strip connectors) or from the front of the rack (for example, MPC4 card front-panel BNC connectors) to the rear of the same VM600 rack (XIO16T card plug-in connectors).
  - Internally – by modifying the card's configurations to put the signals to share on the appropriate bus of the VM600 rack's backplane. For example, MPC4/IOC4T machinery protection card pairs typically put signals on the Raw Bus and the Tacho Bus, and XMx16/XIO16T condition monitoring card pairs take these signals from the buses.

VibroSmart DMS

As the VibroSmart DMS (distributed monitoring system) includes vibration monitoring modules that can be used for both machinery protection and condition monitoring functions, adding a VibroSight CMS to an existing VibroSmart module-based MPS can be as simple as:

- Modifying the modules configuration to add condition monitoring functionality to the existing machinery protection functionality.

NOTE: The VSV300 vibration monitoring module uses the same VSB300 terminal base as the less powerful VSV310 module, which allows a VSV310 to be replaced by a VSV300 in a VibroSmart DMS (or vice versa). This quick upgrade requires only configuration changes in VibroSight in order to take advantage of the more powerful features available in the VSV300.

Bently Nevada 3500 system with a 3500/20 Rack Interface Module (RIM)

As earlier 3500 racks with a 3500/20 Rack Interface Module (RIM) are typically used for machinery protection only, adding a VibroSight CMS to such systems requires the following steps:

- Adding one or more XMx16/XIO16T condition monitoring cards in a VM600 rack.

  If only one XMx16/XIO16T card pair is required, a slimline VM600 rack (1U rack height) can be used.

  If more than one XMx16/XIO16T card pair is required, a standard VM600 rack (6U rack height) can be used.
- Sharing the buffered outputs in one of the following ways:
  - If the optional Data Manager I/O Module is not installed in the 3500 rack – by wiring the buffered output signals from the front of the rack (monitor module front-panel BNC connectors) to the rear of the VM600 rack (XIO16T card plug-in connectors).
  - If the optional Data Manager I/O Module is installed in the 3500 rack – by wiring the buffered output signals from either the rear of the 3500 rack (Data Manager

I/O Module) or from the front of the rack (monitor module front-panel BNC connectors) to the rear of the VM600 rack (XIO16T card plug-in connectors).

- If the optional Data Manager I/O Module is used to share the buffered outputs:
  - The 3500 Rack Configuration software must be used to select which monitor modules have their buffered outputs signals routed to the Data Manager I/O Module.
  - The Interface kit for buffered outputs, from Meggitt Sensing Systems' Vibro-Meter product line, can be used to simplify the wiring required to connect the Data Manager I/O Module to the XIO16T card (see Interface kit for buffered outputs, on page 12).

To use the 3500 Rack Configuration Software to configure the buffered output signals routed to the Data Manager I/O Module:

1- In the 3500 Rack Configuration Software, right click the 3500/20 Rack Interface Module (RIM) module, then click **Options** to display its configuration options window.

2- In the configuration options window, use the **Dynamic Signal Option** control to select which monitor module outputs to route which Data Manager I/O Module DYNAMIC x connectors. That is, the monitor modules in either **Slots 2-7**, **Slots 2,4,6,8,10,12**, **Slots 2,5,8,11** or **Slots 2,6,10** (see Tables 1 and 2).

The buffered transducer outputs allocated to the DYNAMIC 1 connector pins on the Data Manager I/O Module depend on the Dynamic Signal Option selected in the 3500 Rack Configuration software, as shown in Table 1.

Table 1: Pinouts for DYNAMIC 1 connector on the Data Manager I/O Module

Pin number	Dynamic Signal Option in 3500 Rack Configuration software			
	Slots 2-7	Slots 2,4,6,8,10,12	Slots 2,5,8,11	Slots 2,6,10
1	None	None	None	None
7	2, 1	2, 1	2, 1	2, 1
14	2, 2	2, 2	2, 2	2, 2
18	2, 3	2, 3	2, 3	2, 3
16	2, 4	2, 4	2, 4	2, 4
11	3, 1	4, 1	5, 1	6, 1
21	3, 2	4, 2	5, 2	6, 2
25	3, 3	4, 3	5, 3	6, 3
23	3, 4	4, 4	5, 4	6, 4
2	4, 1	6, 1	8, 1	10, 1
9	4, 2	6, 2	8, 2	10, 2
4	4, 3	6, 3	8, 3	10, 3
6	4, 4	6, 4	8, 4	10, 4
20	5, 1	8, 1	11, 1	None
3	5, 2	8, 2	11, 2	None
19	5, 3	8, 3	11, 3	None
5	5, 4	8, 4	11, 4	None

24	6, 1	10, 1	None	None
10	6, 2	10, 2	None	None
13	6, 3	10, 3	None	None
12	6, 4	10, 4	None	None
15	7, 1	12, 1	None	None
22	7, 2	12, 2	None	None
17	7, 3	12, 3	None	None
8	7, 4	12, 4	None	None

Note: The buffered transducer output allocated to a DYNAMIC x connector pin is given in 3500 rack slot number, monitor channel number format. For example, **2, 1** indicates rack slot 2 and monitor channel 1.

The buffered transducer outputs allocated to the DYNAMIC 2 connector pins on the Data Manager I/O Module are always assigned to 3500 rack slot numbers 8-13, as shown in Table 2.

Table 2: Pinouts for DYNAMIC 2 connector on the Data Manager I/O Module

Pin number	Dynamic Signal Option in 3500 Rack Configuration software			
	Slots 2-7	**Slots 2,4,6,8,10,12**	**Slots 2,5,8,11**	**Slots 2,6,10**
1	None	None	None	None
7	8, 1	None	None	None
14	8, 2	None	None	None
18	8, 3	None	None	None
16	8, 4	None	None	None
11	9, 1	None	None	None
21	9, 2	None	None	None
25	9, 3	None	None	None
23	9, 4	None	None	None
2	10, 1	None	None	None
9	10, 2	None	None	None
4	10, 3	None	None	None
6	10, 4	None	None	None
20	11, 1	None	None	None
3	11, 2	None	None	None
19	11, 3	None	None	None
5	11, 4	None	None	None
24	12, 1	None	None	None
10	12, 2	None	None	None
13	12, 3	None	None	None
12	12, 4	None	None	None
15	13, 1	None	None	None
22	13, 2	None	None	None
17	13, 3	None	None	None
8	13, 4	None	None	None

Note: The buffered transducer output allocated to a DYNAMIC x connector pin is given in a 3500 rack slot number, monitor channel number format. For example, **2, 1** indicates rack slot 2 and monitor channel 1.

Testing a 3500 machinery protection system with a 3500/20 Rack Interface Module (RIM) in order to compare the buffered transducer output signals available from both the monitor module front-panel BNC connectors and from the Data Manager I/O Module connectors has shown that the transfer function (gain and phase) of the buffered transducer outputs remains the same, no matter which buffered output connection is used.

Typical gain and phase against frequency curves measured at buffered transducer outputs are shown in Figures 3, 4 and 5 for the different types of transducer and monitor module.

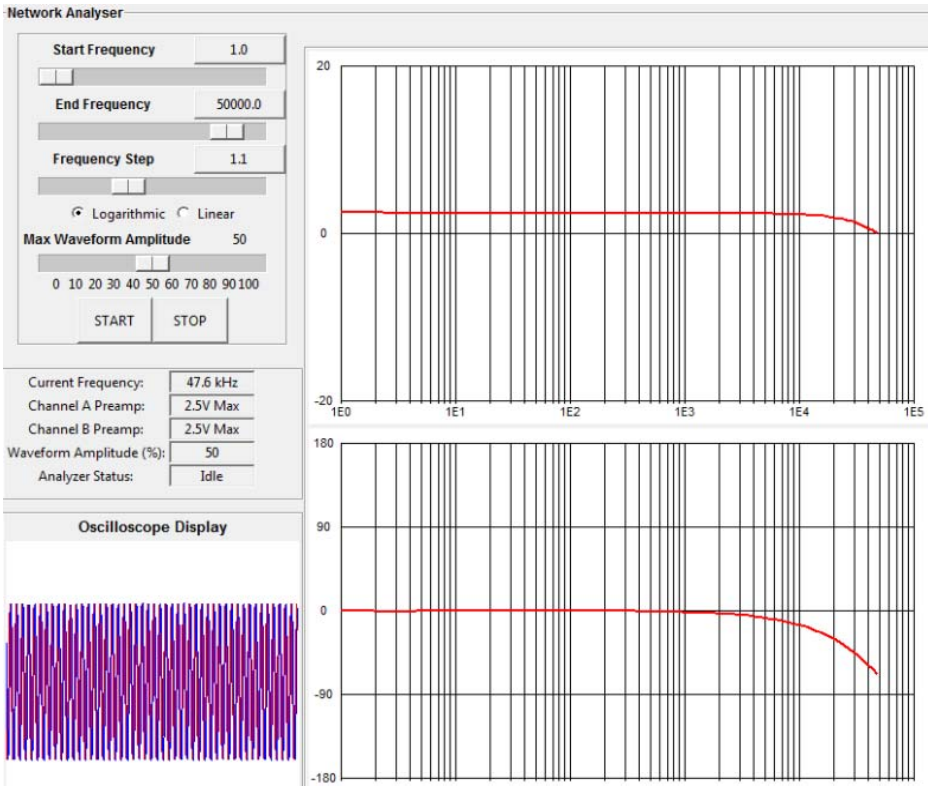

Figure 3: Gain and phase against frequency curves for an accelerometer input (3500/42M Proximitor/Seismic Monitor)

As shown in Figures 3, 4 and 5, the bandwidth for all channels is 10 kHz. There is a gain of 2.4 dB (voltage gain of x1.32) for an accelerometer input and a gain of 0 dB (voltage gain of x1) for proximity probe and tachometer inputs.

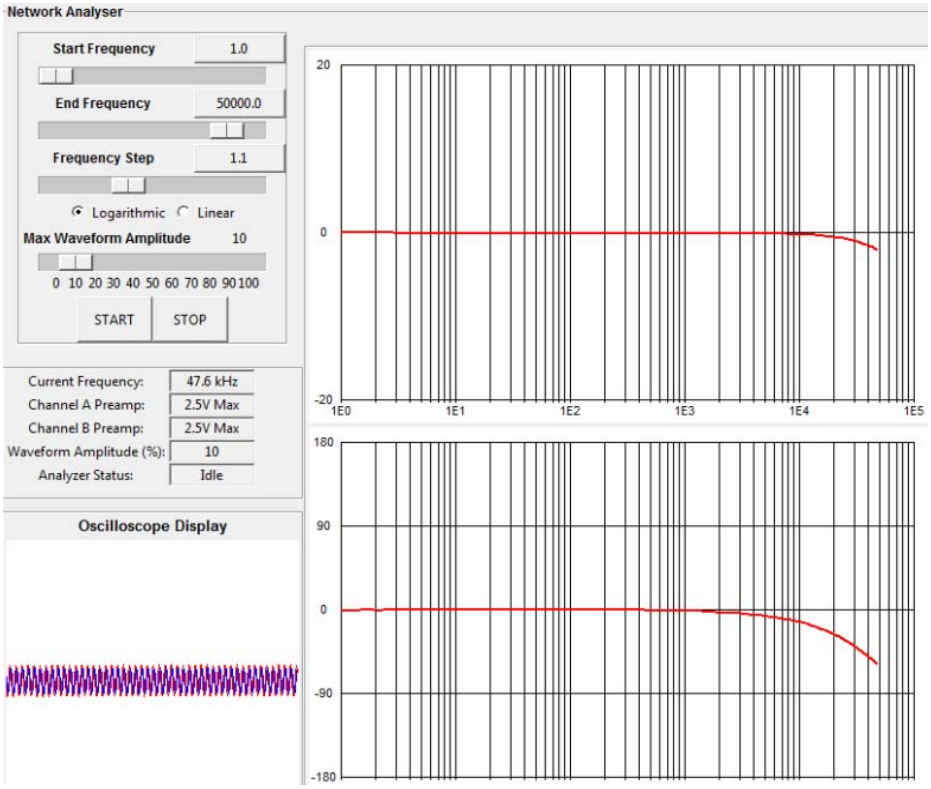

Figure 4: Gain and phase against frequency curves for a proximity probe input (3500/42M Proximitor/Seismic Monitor)

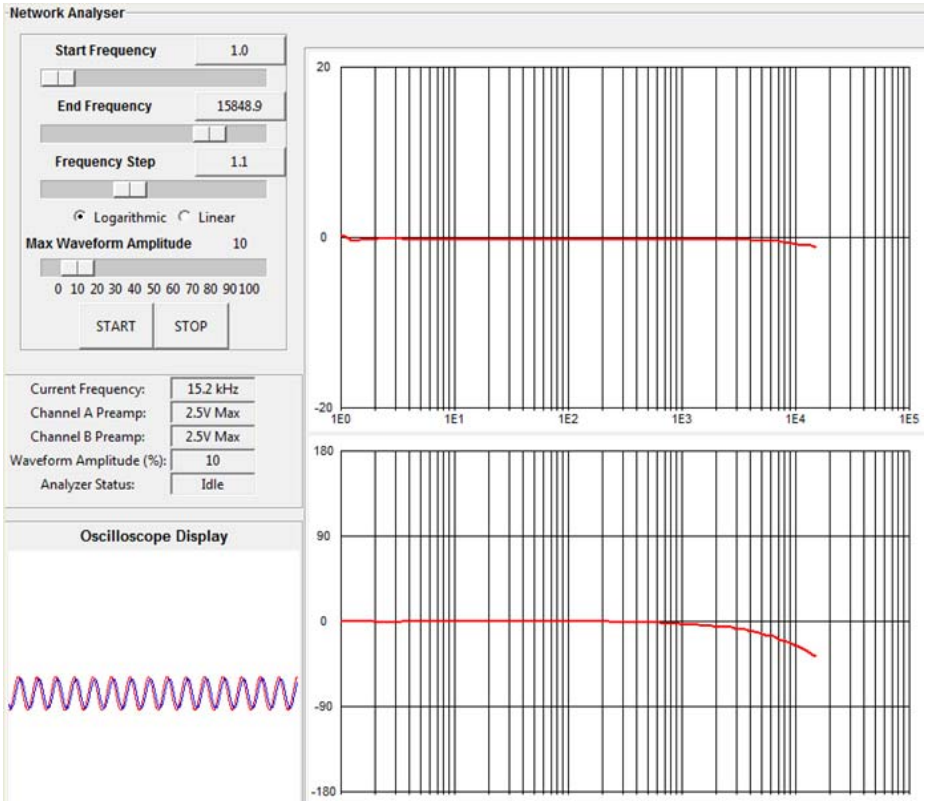

Figure 5: Gain and phase against frequency curves for a tachometer input (3500/25 Keyphasor Module)

Bently Nevada 3500 system with a 3500/22M Transient Data Interface (TDI)

As later 3500 racks with a 3500/22M Transient Data Interface (TDI) are typically used for machinery protection and/or condition monitoring, adding a VibroSight CMS to such systems requires the following steps:

- Adding one or more XMx16/XIO16T condition monitoring cards in a VM600 rack.

  If only one XMx16/XIO16T card pair is required, a slimline VM600 rack (1U rack height) can be used.

  If more than one XMx16/XIO16T card pair is required, a standard VM600 rack (6U rack height) can be used.
- Sharing the buffered outputs in one of the following ways:
  - If the optional Buffered Signal Output Module is not installed in the 3500 rack – by wiring the buffered output signals from the front of the rack (monitor module front-panel BNC connectors) to the rear of the VM600 rack (XIO16T card plug-in connectors).
  - If the optional Buffered Signal Output Module is installed in the 3500 rack – by wiring the buffered output signals from either the rear of the 3500 rack (Buffered Signal Output Module) or from the front of the rack (monitor module front-panel BNC connectors) to the rear of the VM600 rack (XIO16T card plug-in connectors).
- If the optional Buffered Signal Output Module is used to share the buffered outputs:
  - The Interface kit for buffered outputs, from Meggitt Sensing Systems' Vibro-Meter product line, can be used to simplify the wiring required to connect the Data Manager I/O Module to the XIO16T card (see Interface kit for buffered outputs, on page 12).

NOTE: The Buffered Signal Output Module allows access to all of the buffered outputs from all monitor modules (so no configuration/selection is required using the 3500 Rack Configuration software.)

The buffered transducer outputs allocated to the BUFFER 1 connector pins on the Buffered Signal Output Module are fixed, as shown in Table 3.

Table 3: Pinouts for BUFFER 1 connector on the Buffered Signal Output Module

Pin number	3500 rack slot number	Monitor channel number
1	Common (Ground)	
7	2	1
14	2	2
18	2	3
16	2	4
11	3	1
21	3	2
25	3	3
23	3	4
2	4	1
9	4	2
4	4	3
6	4	4

20	5	1
3	5	2
19	5	3
5	5	4
24	6	1
10	6	2
13	6	3
12	6	4
15	7	1
22	7	2
17	7	3
8	7	4

The buffered transducer outputs allocated to the BUFFER 2 connector pins on the Buffered Signal Output Module are fixed, as shown in Table 4.

Table 4: Pinouts for BUFFER 2 connector on the Buffered Signal Output Module

Pin number	3500 rack slot number	Monitor channel number
1	Common (Ground)	
7	8	1
14	8	2
18	8	3
16	8	4
11	9	1
21	9	2
25	9	3
23	9	4
2	10	1
9	10	2
4	10	3
6	10	4
20	11	1
3	11	2
19	11	3
5	11	4
24	12	1
10	12	2
13	12	3
12	12	4
15	13	1
22	13	2
17	13	3
8	13	4

The buffered transducer outputs allocated to the BUFFER 3 connector pins on the Buffered Signal Output Module are fixed, as shown in Table 5.

Table 5: Pinouts for BUFFER 3 connector on the Buffered Signal Output Module

Pin number	3500 rack slot number	Monitor channel number
1	Common (Ground)	
2	14	1
16	14	2
4	14	3
14	14	4
3	15	1
17	15	2
5	15	3
15	15	4

The conditioned keyphasor outputs allocated to the KPH connector pins on the Buffered Signal Output Module are fixed, as shown in Table 6.

Table 6: Pinouts for KPH connector on the Buffered Signal Output Module

Pin number	3500 rack slot	Monitor channel number
9	Common (Ground)	
6	Upper keyphasor	1 (Upper keyphasor 1)
7	Upper keyphasor	2 (Upper keyphasor 2)
8	Lower keyphasor	3 (Lower keyphasor 1)
5	Lower keyphasor	4 (Lower keyphasor 2)

Interface kit for buffered outputs

The Interface kit for buffered outputs from Meggitt Sensing Systems was developed to simplify the expansion of existing machinery monitoring systems that make their transducer input signals available as buffered “raw” outputs that can be shared with other systems.

In particular, the Interface kit can be used to reduce the field wiring required when adding a VibroSight condition monitoring system using VM600 XMx16/XIO16T card pairs and/or VibroSmart VSV3x0 modules to a machinery protection system where the transducer input signals are available as buffered transducer outputs on 25-pin D-sub connectors. For example, as on a 3500 rack with a Data Manager I/O Module (PNR: 125760-01) or a Buffered Signal Output Module (PNR: 147364-01).

As shown in Figure 6, this interface kit consists of an DIN-rail mounting interface module with a 25-pin D-sub connector input and screw terminal outputs, and an associated interface cable with 25-pin D-sub connectors.

Figure 6: Interface kit for buffered outputs (module and cable)

NOTE: Refer to the *Interface kit for buffered outputs* data sheet for additional information.

THE SOLUTION

A VibroSight condition monitoring system can be added to practically any existing machinery protection system and if the existing system meets the requirements of API 670, then individual buffered transducer output connections will be available to make this task easier.

As different machinery monitoring system suppliers have different approaches to combining machinery protection and condition monitoring, and signal sharing, different signal interfaces can be required in order to share the existing transducer signals with the VibroSight condition monitoring system. A dedicated Interface kit for buffered outputs is available from Meggitt Sensing systems to facilitate efficient and reliable signal sharing with a VibroSight condition monitoring system.

It is important to understand the availability of the buffered transducer outputs in order to implement a reliable signal interface for sharing signals between the machinery protection and condition monitoring systems, while minimizing cost and the downtime (unavailability) of the machinery protection system.

It is equally important to understand the characteristics (transfer functions) of the buffered transducer outputs in order to configure the VibroSight condition monitoring system correctly for the transducer signals available.

TRADEMARKS

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Meggitt Sensing Systems is the operating division of Meggitt specializing in sensing and monitoring systems, which has operated through its antecedents since 1927 under the names of ECET, Endevco, Ferroperm Piezoceramics, Lodge Ignition, Sensorex, Vibro-Meter and Wilcoxon Research. Today, these operations are integrated under one strategic business unit called Meggitt Sensing Systems, headquartered in Switzerland and providing complete systems, using these renowned brands, from a single supply base.
The Meggitt Sensing Systems facility in Fribourg, Switzerland was formerly known as Vibro-Meter SA, but is now Meggitt SA. This site produces a wide range of vibration and dynamic pressure sensors capable of operation in extreme environments, leading-edge microwave sensors, electronics monitoring systems and innovative software for aerospace and land-based turbo-machinery.

In this publication, a dot (.) is used as the decimal separator and thousands are separated by thin spaces. Example: 12345.67890.

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